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What's the Catch? An Analysis of Seafood Sustainability at the University of Vermont

Sara Cleaver
Vermont

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An Analysis of Seafood Sustainability at the University of Vermont

by Sara Cleaver

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Advisors:
Stephanie Kaza
Joe Roman
Amy Seidl
Tyler Doggett

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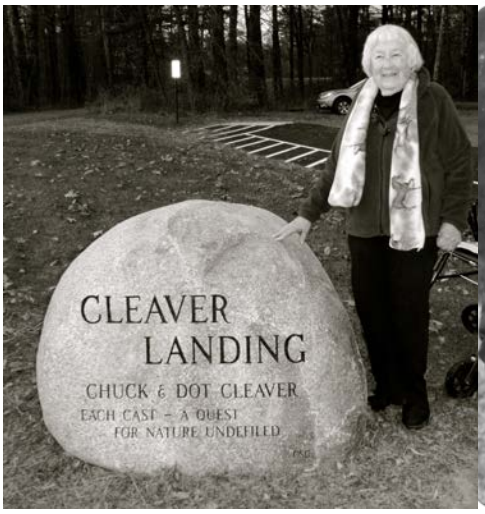
I would like to dedicate this thesis to my grandparents, Dot and Chuck Cleaver, who cultivated a desire to explore within many people, and ensured that we grew up to appreciate, care for, and be amazed by the natural world.



"Each cast a gentle quest for nature undefiled
The Call, a fly,
A strike, reply,
Pulsing fish, the heartbeat felt of God."
-CSC

Preface

For me, eating fish as a child usually meant watching Grandpa drift into the dock on the Kennebec River in his green boat, and waiting for Grammy to finish frying the whole fish on the stovetop. Sometimes, it meant the whole family returning from fishing adventures in our canoes, with trout hidden behind the gunwales, and cooking the fish over an open fire at our campsite. I would look at the fish (often times baffled that my family liked to eat those things, but always willing to try it nonetheless), while its dark, beady eyes peered back at me from the pan. I wondered about what its life had been like before its fatal temptation, my grandfather's yellow bug, hit the water near where it swam.

I witnessed from a young age, the research, skill, and wisdom needed to find the perfect fishing hole, and how catching a fish required meticulous observation; more than just casting lures arbitrarily into the water. My grandfather's six three-ring binders, each about four-inches thick and held together with duct tape (just like all good things), are authentic proof of the commitment required to truly master the art of fishing. According to one email documenting a 25-year span of fishing, Grandpa caught "14,418 fish, plus circa 1000 smelt—including 8,836 smallmouth bass, 1,194 largemouth bass, 382 brook trout, and 735 landlocked salmon. Also included was the number of fishing trips he had gone on in those years (2,271), and a challenge for any who dared to "try and beat it!" These binders, spanning the last sixty years of his life, also act as treasures, causing many Maine fishermen who knew "Chuck" to salivate at the thought of opening them and acquiring the knowledge held inside. In accordance with my grandfather's wishes, and to the dismay of eager fishermen, the contents of these binders will not become known beyond those considered family, in my grandfather's words, "for the sake of the fish".

As an avid conservationist, the backdrop of my grandfather's fishing obsession was always what was best for the fish, for the purpose of conserving their populations for those who can also learn to appreciate them in the years to come. His lures were barbless, so that when he threw fish back, their mouths wouldn't be damaged. In my cousin's words, "He nearly included the Nature Conservancy as a "sixth child" in his will and testament, before deciding that the

sentimental value of calling the Conservancy a child did not outweigh the legal complications of doing so".

My grandfather and grandmother, gifted and devoted paddlers, campers, fishermen, and more, engrained a love of the outdoors in our family. Looking in from the outside, (and this we've been told more than once), some wonder how we've managed to continue to enjoy the outdoors, after it being drilled into us through experience, that a Cleaver family reunion is not in fact, a Cleaver family reunion without being wet (or hiding under a canoe or tarp trying not to get wet), dodging mosquitoes or black flies (or believing that they are raisins in the oatmeal), and seeing scarce to no signs of civilization for the duration of the trip. My dad did not have a birthday meal that didn't come out of a dry-bag until he was in college. In-laws had to learn the hard way as well; on the West Branch of the Penobscot, the Sandy River, Pierce Pond, and Moosehead Lake. But something about my grandmother paddling upstream along beside me, shouting through the pouring rain, "Now, *isn't this fun*?!" in some way or another, persuaded me. I learned that I too, am a Cleaver. These less-than-luxurious adventures *were* fun. In fact, they are some of the memories that I keep closest, because the way my family guided me through exploring the natural world, in more ways than one, is what has lead me to strive to protect it.

These experiences etched themselves somewhere within me as memories that emerged years later as guides of my conscience and what I believe to be ethical regarding how people obtain food from the underwater world. It is the convergence of these experiences, and what I have come to learn about the earth, oceans, and sustainability in my higher education, that developed into this thesis on sustainable seafood.

Abstract

Humans are fishing the oceans at a rate much faster than marine fisheries can recover, often using methods that are damaging to the marine environment. Research has revealed the complexity of issues within how seafood travels from the seas to consumers' plates. Sustainable seafood certification programs have grown in popularity as public pressure demands certain practices of the seafood industry, and seafood guides have increased public awareness and highlighted the power of consumer choice. The University of Vermont (UVM) has taken steps to provide local and organic food that is sustainably harvested, but has not done the same for seafood. This research is an analysis of seafood at UVM, and it attempts to understand where the seafood served at UVM comes from. Additionally, through document research, interviews, and collaboration with UVM Dining Services, this thesis investigates UVM's initiation of a sustainable seafood effort on campus and proposes recommendations as alternatives to the seafood currently offered, recommendations which may align more closely with UVM's commitment to environmental sustainability and social responsibility.

Keywords: certifications, community supported fisheries, Marine Stewardship Council, sustainable fisheries, sustainable seafood, traceability

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Important Acronyms

BAP- Best Aquaculture Practices

BRP- Black River Produce

BOI- Blue Ocean Institute

CSF- Community supported fishery

EDF- Environmental Defense Fund

FAO- Food and Agriculture Organization

GAA- Global Aquaculture Alliance

MBA- Monterey Bay Aquarium

MSC- Marine Stewardship Council

MSY- Maximum sustainable yield

NAMA- Northwest Atlantic Marine Alliance

UDS- University Dining Services

UVM- University of Vermont

WWF- World Wildlife Organization

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Introduction

In the last thirty years, consumer demand for seafood has doubled, leading to a drastic increase in industrial fishing (Jacquet & Pauly, 2006). Overfishing, coastal development and pollution, invasive species, poor boating practices, damaging fishing methods, anthropogenic climate change, and ocean acidification are many of the issues that are tragically affecting the health of marine life and the functioning of marine ecosystems. Humans, as consumers, also worry about the safety of the food we eat, and when dealing with seafood, our main concerns focus on microbes that can lead to food-borne illness, and levels of toxins such as methyl-mercury. People have long sought fish as a source of food and protein. I am not recommending that we should discontinue our use of the ocean's fisheries as a source of nutrition, but rather that there are better practices that would increase the likelihood of long-term access to the benefits that fisheries provide. Not only do we derive much of our food from fisheries, but many people around the world rely on fishing as their primary form of economic livelihood. It would be wrong, even impossible, to preserve marine fisheries entirely for generations to come and exclude all human activities from the oceans' resources. But current efforts to conserve marine fisheries and make both the fishing industry and the process of obtaining our seafood more sustainable lead me to believe that sustainability and human consumption of seafood can co-exist.

As someone who cares deeply about the state of the natural world, especially the world's oceans, I have spent a great deal of time reflecting upon which marine issues are most pressing. Plastics in the ocean, ocean acidification, destruction of coral reefs, and dolphin slaughter have all motivated me to channel my frustration with our lack of commitment to caring for the oceans

and use it as motivation to change our relationship to the marine world. Though the extent of problems associated with human utilization of the oceans and their natural resources is a lengthy list, the issues that evoke the most call to action for me are those that humankind has direct and immediate control over. The idea that we have overfished many marine fisheries to the point of collapse is unacceptable. We have enough knowledge to understand that our current use of the ocean is not sustainable. There are many tools that could be utilized to work towards solutions: government action through regulations and policies, economically based market-mechanisms, or changes in human behavior. Though no one solution could cure the destruction occurring in the oceans, each lends a vital contribution to marine conservation. I believe that using purchasing power and consumer demand to increase sustainability in the seafood industry is one of these mechanisms that can be part of a global shift to address the health of the oceans and marine resources.

Consumer demand can have serious influence on which products are produced and sent to market. The University of Vermont (UVM), which prides itself on being a progressive, environmentally aware institution and a leader in sustainability, has proved to be able to provide local and organic food on campus in response to the institution and students' desires to achieve sustainability. But as of the spring of 2011, UVM did not source its seafood to fit with specific sustainability criteria. The seafood the university purchases and sells, such as shrimp or salmon, may be contributing to depletion of overfished species, or may be caught in an unsustainable manner, wreaking havoc on marine ecosystems.

However, University Dining Services (UDS) expressed a desire to switch to more sustainable sources of seafood. That is why the main goal of my thesis was to look into what seafood was served on campus, comment on any changes that are made, and to propose

alternatives to current sources of seafood. Through my research, I strove to provide clarification on how sustainable the seafood served on campus really is. One goal of this research was to analyze the seafood UVM offers to consumers and discover where this seafood comes from, and how it is caught or raised. I also researched alternative strategies to sustainable seafood that are currently taking place in the northeastern United States. These alternatives led me to suggest possibilities to UDS and the UVM Office of Sustainability to ensure that UVM includes more sustainable seafood in our dining facilities for consumers. Another aspect of this thesis was motivating UDS and the Office of Sustainability to be active in pursuing sustainable seafood at UVM. The report that I created for UDS and the Office of Sustainability highlights the benefits and challenges to each of the seafood recommendations, in hopes of attaining this goal. Though taking this project full-circle would have been ideal, implementing a sustainable seafood initiative stronger than what UVM offers currently will take more time than the duration this thesis.

Throughout this research, what I considered to be sustainable seafood was in a constant process of evolution. Ultimately, my definition of sustainable, with respect to seafood, was transformed and refined. Prior to this research, I thought that seafood could largely be categorized as sustainable or unsustainable based on how it was caught and the health of the species' populations. I now know that defining seafood as sustainable depends on what values we look at. The outcomes of this research have driven me to develop beliefs on what I now consider to be the most important factors behind any sustainable seafood effort- transparency, local procurement, and scale. This research reveals the path I took to reach this conclusion.

Safe seafood choices are important when working with those in charge of how we source our food on campus, as is making sure that our seafood is coming from sustainable sources.

Offering sustainable seafood at UVM will play a minor role in easing the pressure off of diminishing marine fisheries and strengthening the resources that humanity has overexploited, but it will allow UVM to continue to be a leader in sustainability and a model for other institutions to strive to make educated decisions about sustainable seafood on their campuses as well.

"*Many of us ask, 'what can I, as one person, do', but history shows us that everything good and bad starts because somebody does something or does not do something".*
-Sylvia Earle

Literature Review

Human beings, as a species, have depended upon the resources of the oceans for sources of protein for thousands of years. According to the Food and Agriculture Organization of the United Nations [FAO], "Globally, fish provides more than 1.5 billion people with almost 20% of their average per capita intake of animal protein" (2010, p. 2). The world eats more fish every year, collectively and per person, and most of what occurs within the seafood industry, both under the water and above, is hidden from consumers (Greenberg, 2010). The numerous issues that arise when looking at how people obtain seafood, such as overfishing and destructive fishing or aquaculture practices, make it quite difficult to ensure that what arrives on consumers' plates has been caught or raised in a way that will not deplete resources for future generations. In addition, research shows that not all seafood is safe and healthy for human consumption. Literature has conveyed a variety of arguments on how to improve the seafood industry with regard to these issues, with many arguments focused on market-based initiatives. Raising consumer awareness of the issues through tools such as pocket guides, using eco-labeling schemes, and making changes in the demands of university dining programs are some of the efforts that have begun to work towards achieving sustainability.

1) Fishing Practices and Sustainability

a) Exploitation and Overfishing

Despite the fact that humans have been fishing the oceans for thousands of years, during the past five decades technology has enabled us to catch fish from the sea at a faster rate, from deeper places, and with greater yield (Monterey Bay Aquarium [MBA], 2011). More people

inhabiting the Earth are competing for continuously less fish and the extent of the ocean crisis is increasing. Though the fisheries sector has created livelihoods and brought economic gain to many people around the world, it has also caused dire concern over fish stocks (Food and Agriculture Organization of the United Nations, 2010; World Wildlife Fund [WWF], 2011). The current status of marine fisheries is actively debated and a significant degree of uncertainty exists in regards to its health. However, most experts as well as fishermen agree that the resources of the world's oceans are under immense pressure (Ayer, Côte, Tyedmers, & Willison, 2009). We are simply catching too many fish for the dwindling numbers in marine fish populations. The drastic increase in industrial fishing driven by greater consumer demand has led many species to be directly and indirectly affected by industrial fishing (Jacquet & Pauly, 2006). Figure 1 shows the top ten species for marine capture fisheries (wild fish) in 2008.

Figure 1. Marine capture fisheries production: top ten species in 2008 (FAO, 2010, p.15).

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The general trend is that the percentage of fisheries stocks that are overexploited, depleted, or in a stage of recovery is increasing over time, and the number of stocks that are under or only moderately exploited is declining (Figure 2). If a stock is fully exploited, current catches are at or close to their maximum sustainable production levels, and no potential exists for increased production within those fisheries (FAO, 2010). Commercial fish populations, such as Atlantic halibut, bluefin tuna, and haddock, have declined to well below natural levels in the past ten years, and the entire cod fishery in the North Atlantic collapsed completely due to overfishing in

the early 1990s (MBA, 2011). As much as 90% of the ocean's large predatory fish, such as swordfish and cod, have been fished from the oceans (MBA, 2011; Myers & Worm, 2003). Smaller fish such as sardines and anchovies are flourishing in the absence of their larger predators, which is creating a serious ecological imbalance (Kaufman, 2011). With well over half of the stocks fully exploited (FAO, 2010; WWF, 2011), the consensus among the global scientific community is that a significant percentage of the world's marine fisheries face serious population challenges, possibly leading to extinction (Pauly et al., 2002; Iles, 2007).

Figure 2. Global trends in the state of world marine stocks since 1974 **(**FAO, 2010, p.38).

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In addition, other factors contribute to the problem of overfishing. Worldwide, regulation within the fishing industry is either not strong enough, non-existent, or difficult to enforce (MBA, 2011). In the United States Magnuson-Stevens Fisheries Management Act, the primary law governing marine fisheries management in the U.S., sustainable fisheries are defined as those with stock levels at or above maximum sustainable yield (Gudmundsson & Wessells, 2000). However, the concept of maximum sustainable yield (MSY), defined as the largest catch that can maintained over an indefinite period of time (The International Sustainability Unit Marine Programme, 2012), is usually misinterpreted to favor short-term economic benefits over long-term sustainability (Nixon, as cited in Gudmundsson & Wessells, 2000). The MSY model was initially developed with the assumption that fishing would stop once it became unprofitable, but governments around the world now heavily subsidize their fishing industries. In 2003, 60% of the estimated $25 billion to $29 billion fisheries subsidies went to increasing fishing capacity, thereby encouraging the overexploitation of marine resources rather than conservation efforts

(Sumaila et al., 2010). According to Sumaila et al. (2010), the 39 developed countries analyzed in their 2003 study provided 68%, or $18.4 billion, worth of subsidies to the global fishing industry, with Japan and China leading the way (see Appendix A). Additionally, the MSY model does not take an ecological approach, and thus ignores interspecies interactions and the dynamics of predator-prey relations (Roman, 2011).

Solutions to overfishing are rare on a global scale. Fishing is banned or strictly regulated in protected areas and no-take zones, allowing conservation of habitats and populations (WWF, 2011). These zones can also improve the yields of nearby fisheries, saving them from collapse (Balmford, Gravestock, Hockley, McClean, & Roberts, 2004). But few of these areas exist, though more are being developed, such as off the coast of California. Unfortunately, even when rules and regulations are present, many are broken. Illegal, unreported, and unregulated fishing has devastating impacts on global fisheries (Flothmann et al., 2010). Agnew et al. (2009) claim that the total value of current illegal and unreported fishing losses worldwide are between 10 and 23.5 billion dollars annually, which represents between 11 and 26 million tons of catch. In simple terms, illegal, unreported and unregulated (IUU) fishing activities are estimated to account for "approximately one quarter of global marine capture landings" (The International Sustainability Unit Marine Programme, 2012).

b) Fishing Methods

Commercial fishing methods vary depending on geographic location, target fish species, and the kinds of fishing regulations in place within certain jurisdictions. Certain fishing methods result in serious consequences to marine life and habitat. Within the United States, the most common method of fishing involves dragging large nets behind fishing boats (MBA, 2011)

(Figure 3).

Figure 3. Types of fishing gear used in U.S. fisheries (Monterey Bay Aquarium, 2011).

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Fishing methods have become sources of concern for a variety of reasons (National Research Council, 2002). All types of fishing gear can capture non-targeted species, but this accidental catch, "bycatch", is often more associated with certain fishing methods. Methods such as longlining and gillnetting (Figures 4 and 5) tend to catch animals such as sea turtles, sharks and seabirds by accident (MBA, 2011). Although bycatch has declined to some extent in recent years, hundreds of thousands of sea turtles, seabirds, and marine mammals still die as bycatch, many of which are endangered. Almost 20% of all shark species are threatened with extinction, primarily as a result of being caught accidentally on longlines (MBA, 2011). Longlines can have several thousand baited hooks attached to them and be over 150 kilometers long. They can be set either near the surface to catch pelagic fish such as tuna and swordfish, or on the ocean floor to catch fish such as halibut and cod (Greenpeace International, 2011). Gillnets are suspended by floats and weights at the surface or can be anchored to the sea floor, and are often used to catch sardines, salmon, and cod. Fish cannot see the nets and become 'gilled' or entangled (MBA, 2011).

Figures 4 and 5. Longlines and gillnets (Greenpeace International, 2011; Monterey Bay Aquarium, 2011).

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

The direct effects of trawl nets and dredges include high amounts of bycatch, mortality of benthic (bottom-dwelling) organisms, and destruction of the seafloor habitat (National Research Council, 2002). Fishing boats tow trawl nets, which have wide openings at the front and are shaped like funnels, to herd fish towards the back of the nets. Bottom trawls are nets equipped with rollers, chains, and doors, which weigh thousands of pounds and are dragged across the sea floor (The Ocean Conservancy, 2002). Trawls catch fish such as pollock, cod, flounder and shrimp, but species caught varies depending upon the depth the nets are towed. Dredging involves dragging a net attached to a heavy frame along the sea floor to catch shellfish such as scallops, clams, and oysters living on or in the mud or sand (MBA, 2011). Bottom trawls and dredges destroy anything on the seafloor, including ancient corals, and have been likened to "dragging a massive net across entire fields, cities and forests in the hope of catching a few cows" (Greenpeace Canada, 2008, p.1). Examples of a bottom trawl and dredge can be seen in Figures 6 and 7. Furthermore, in tropical regions, dynamite and cyanide are often used to stun fish so that reef fish can then be sold live in restaurants (Grescoe, 2008), a practice that destroys coral reefs.

Figures 6 and 7. Bottom trawl and dredge (Greenpeace International, 2011).

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But more environmentally responsible methods of fishing do exist, and there are significant disparities between large-scale and small-scale fisheries (Appendix B). Small-scale fisheries tend to employ far more people, consume much less fuel oil, and discard way less fish and other animals at sea than large-scale fisheries, and small-scale fisheries still manage to reap approximately the same annual catch as large-scale fisheries (Jacquet & Pauly, 2008). Hook-

and-line fishing, also known as pole-caught or hand-line-caught, has a very low impact, as does troll fishing (a type of hook-and-line method that tows fishing lines behind a boat at varying depths) because undesired species that are caught can be quickly thrown back and survive (Grescoe, 2008). But some methods only work for some species. Trollers catch fish such as salmon, mahi-mahi and albacore tuna that are attracted to moving lures or bait (Monterey Bay Aquarium, 2011). Hook-and-line fishing is used to capture fish that school on the surface, such as skipjack and albacore tuna (Greenpeace International, 2011). Traps and pots, often used to catch bottom-dwelling fish or crustaceans such as lobsters and crabs, are associated with fewer problems than other methods of fishing (Greenpeace International, 2011). Using harpoons and scuba diving to catch fish are methods quite unlikely to catch untargeted species as bycatch (MBA, 2011).

Most types of fishing gear continue to be altered, yielding new developments that have begun to ease collateral costs to marine life (Dean, 2011). Researchers and engineers have been working on noisemakers that can be installed on boats to keep bycatch species away, specifically designed nets with "Turtle Exclusion Devices", and varying mesh sizes to catch only targeted species. They have also experimented with certain types of hooks that are not strong enough for larger species to get caught on, and circle hooks that are more difficult for some bycatch species to swallow (Dean, 2011).

However, there are exceptions and tradeoffs with all fishing methods. Purse seines (Figure 8), considered one of the most ecologically-sound industrial fishing techniques, use large nets to encircle schools of fish, but can catch other animals depending on which kind is used (Grescoe, 2008). In the Eastern Tropical Pacific fishery, yellowfin tuna school near or under dolphins, and purse seiners can maximize their catches of yellowfin tuna by chasing and setting their nets on

the dolphins. After many years, and millions of dolphins' lives lost in that time, fishing regulations and certifications for "Dolphin-Safe Tuna" in the 1990s reduced dolphin bycatch (Greenpeace International, 2011). Pots, traps, gillnets, and trawls have all been linked to ghostfishing, where stray gear continues to unintentionally catch organisms and cause damage to the seafloor (Chuenpagdee, Morgan, Maxwell, Norse, & Pauly, 2003). In addition, whalers in the 19th century industrialized harpooning, leading to complete exploitation of whales. Also, scuba divers have more recently had serious impacts on lobster and invertebrate populations in bays (Grescoe, 2008).

Figure 8. Purse seine used to encircle large schools of fish (Greenpeace International, 2011).

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c) Aquaculture

In his book, *Four Fish,* Paul Greenberg claims that our population simply cannot meet the global demand for fish by looking to wild sources. He quotes one marine ecologist saying that if we did, "we would need 'four or five oceans' to support current human population" (Greenberg, 2010). Aquaculture (domesticated fish production, or fish farming) is the fastest-growing form of global food production (National Oceanic and Atmospheric Administration [NOAA], 2011a), and it makes up over 50% of the world's seafood supply (The Ocean Conservancy, 2011).

Mariculture refers to raising marine species. It can take place in natural or artificial environments, such as in coastal waters, or in tanks and ponds. Types of fish farming and species farmed differ greatly between regions around the world. Asia dominates aquaculture production, contributing 89% of global production in terms of quantity (FAO, 2011). Many marine fish are farmed in East Asia, mainly China. In 2008, China led aquaculture production with 32,736,000

tons, whereas the United States only produced 500,000 tons (Table 1). Norway and Chile are the leaders in salmon production, but Canada also contributes to farmed Pacific and Atlantic salmon (FAO, 2011). Turbot, halibut, and sole are three commonly farmed marine species of flatfish (fish that swim on their sides and have both eyes on the same side of the head in adults), and oysters are the single most harvested marine species (FAO, 2011). Global production of farmed salmon exceeded wild harvests by more than one million metric tons in 2004 (Knapp, Roheim, & Anderson, 2007). As is the case with salmon, for many species, farmed production yields substantially more than the highest catch ever recorded from wild fisheries (FAO, 2010).

Table 1. Top 15 aquaculture producers by quantity in 2008 and growth (FAO, 2010, p.21)

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In the United States, only 5% of the country's seafood supply is domestic mariculture (NOAA, 2011b). About two-thirds of this supply is from mollusk cultures such as oysters, clams, and mussels, 25% comes from salmon farming, and farmed shrimp constitute around 10% (NOAA, 2011a). Fifty percent of global aquaculture (including freshwater species) is dedicated to finfish (fish with fins), 25% percent is crustaceans (lobsters, shrimp) and mollusks (clams, oysters) and the other quarter is farmed aquatic plants (FAO, 2011).

The practice of aquaculture has been both praised and criticized. It has potential to take pressure off of wild stocks as a food source for the world, but fish farming practices pose risks (Naylor et al., 2000; Taylor 2009). Numerous problems are generated with the farming of aquatic species (Lucas & Southgate, 2003). Most include potential risks to human health and the environment (Schlag, 2010). Wild fish are often used in aquaculture to feed the farmed stock (Naylor et al., 2000; Taylor, 2009), which counters one of the major benefits of fish farming.

Many aquaculture operations even stock wild-caught fish, creating a false alternative to wild harvests (Naylor et al., 2000).

Aquaculture can also negatively impact surrounding aquatic ecosystems, depending on the methods and structures used. Open net pens or cages (Figure 9), forms of high-impact aquaculture, allow waste, diseases, and parasites from the farmed fish to pass into the surrounding environment, which can pollute and harm the wild habitat (Monterey Bay Aquarium, 2011). Infestations of pests such as sea lice can flourish in dense farm populations and spread to surrounding waters, and become a threat to wild fish populations (Taylor, 2009). In addition, the high risk of escape in open systems can lead to interbreeding with the wild population and competition for natural resources with wild fish (The International Bank for Reconstruction and Development, 2007). Hundreds of thousands of hectares of mangroves and coastal wetlands have been transformed into aquaculture sites, contributing to the loss of essential ecosystem services generated by mangroves (Naylor et al., 2000). Many marine species use mangroves as nursery grounds, and mangroves serve as coastal protection and flood control zones, prevent erosion, and filter water (Naylor et al., 2000; Rönnbäck, 1999).

Figure 9. Open net pen/cage for fish farming (Monterey Bay Aquarium, 2011).

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Semi-closed aquaculture systems, such as ponds or raceways (Figures 10 and 11), can contain or treat wastewater. But if water is untreated and then discharged, it can accelerate nutrient pollution (MBA, 2011; Naylor et al., 2000), and raceways still leave the health of the wild population at risk if farmed fish escape and exchange pathogens (Monterey Bay Aquarium, 2011).

Figures 10 and 11. Ponds and raceways for aquaculture (Monterey Bay Aquarium, 2011).

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Closed or recirculating aquaculture (Figures 12 and 13) systems have been seen as a solution to the issues posed by open-system aquaculture (Taylor, 2009). The environmental impacts of these systems are minimal, but these systems can be very expensive and require a lot of electricity to operate (Lucas & Southgate, 2003; Greenberg, 2010). Also, as depicted in Figure 13, these systems can take up a lot of land for their operations.

Figures 12 and 13. Recirculating aquaculture systems (Monterey Bay Aquarium, 2011; Auburn University Department of Fisheries & Allied Aquacultures, 2011).

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

In terms of aquaculture and human health, the idea of applying organic standards to farm-raised fish has started a movement that again has its benefits but does not go without critique (Nestle, 2006; Taylor, 2009). One common argument is that organic standards generally oppose all use of antibiotics, and in terms of aquaculture, the environmental impact of not using any antibiotics has the potential to endanger wild fish populations through exposure to unhealthy farmed fish that may escape into the wild (Taylor, 2009). Despite the challenges, many scientists believe that if done appropriately, fish farming could prove to be the solution to the world's search for sources of protein (Greenberg, 2010).

d) Human Health, Contamination, and Mercury

Fish are a crucial component to a nutritional diet as they are an excellent source of protein, vitamins, and minerals (Nestle, 2006). In the new dietary guidelines for Americans set forth by First Lady Michelle Obama and the Departments of Agriculture and Health and Human Services, fish are identified as the best source of omega-3 fatty acids (USDA & USDHHS, 2010). Omega-3s can reduce the risk of heart disease, stroke, and cancer and are especially important for pregnant and nursing women and young children (Monterey Bay Aquarium, 2010). But controversy has long shadowed the human health benefits of eating fish because of the risks that have caught the public eye (Mergler et al, 2007; USDA, 2010).

Consumer concerns are focused on microbes that can lead to food-borne illness as well as contamination levels of toxins and substances such as methyl-mercury. In the early nineties, in response to investigations into the safety of fish and shellfish sold in American supermarkets, the Food and Drug Administration developed safety plans for seafood, similar to those for other kinds of meat (Nestle, 2006). Since 1997, Hazard Analysis and Critical Control Point (HACCP) for seafood has required all processors of seafood sold in the United States to monitor temperature and cleanliness of water, facilities, and surfaces, and health of employees (Nestle, 2006). But regardless of government-issued regulations, seafood still poses serious health risks (Sobel, Painter, & Angulo, 2005). Toxins that originate on land, mercury for example, as well as chemicals such as polychlorinated biphenyls (PCBs) and dioxins, and pesticides such as dichlorodiphenyl-trichloroethane (DDT), can contaminate seafood (Monterey Bay Aquarium, 2011).

Human activities such as pesticide use and coal burning introduce these harmful substances into the environment. Contaminants then become a part of the ocean food web, and

as larger species eat smaller species farther down the food chain, contaminants are concentrated in fatty tissues of fish and other animals through a process called bioaccumulation. Before DDT was banned in the 1970s, one 1967 study in the Long Island Estuary found that DDT concentrations magnified 800 times from the levels in the water to the levels in zooplankton. Concentrations then magnified another 31 times to the fish that ate the zooplankton, and by the time the DDT reached seagulls, it had magnified more then 200,000 times (Woodwell, Wurster, & Isaacson, 1967). Once they reach high trophic levels, biomagnified contaminants can lead to decreased birth rates, increased death rates, and ultimately, declining populations (Russell, 2012). Mercury is a heavy metal that is emitted in large part from coal-burning power plants, and when it gets into waterways, mercury is converted into methylmercury by microorganisms (Nestle, 2006). Large predatory fish that consumers generally have a preference for, such as swordfish and tuna, end up with the most toxins (Mergler et al., 2007; Selin et al., 2010). Exposure to these toxins increases potential for cancers, reproductive and neurologic problems, and other health effects (Longnecker, Rogan, & Lucier, 1997).

Methylmercury can interfere with brain function and prenatal development (Selin, Sunderland, Knightes, & Mason, 2010; Taylor, 2009). A mother's consumption of fish and shellfish that contain methylmercury can expose a fetus to this harmful substance in the womb (U.S. Environmental Protection Agency, 2010). Prenatal and infant mercury exposure has the potential to cause deafness, blindness, cerebral palsy, and mental retardation (National Resource Defense Council [NRDC], n.d). Children who have been exposed to methylmercury in the womb have also experienced impacts on cognitive thinking, memory, attention, language, and fine motor and visual spatial skills (U.S. EPA, 2010). Therefore, women of childbearing age are warned to minimize their consumption of fish with high mercury levels (Environmental Defense

Fund [EDF], 2011b). In adults, mercury poisoning can adversely affect fertility and blood pressure regulation and can cause memory loss, tremors, vision loss and numbness of the fingers and toes, and exposure to mercury may also lead to heart disease (NRDC, n.d). The Environmental Protection Agency considers 0.1 micrograms of mercury per kilogram of body weight per day to be the maximum intake that is safe. According to Natural Resources Defense Council Mercury (n.d), this means that even just six ounces of canned white albacore tuna per week could be unsafe, though this calculation is only an estimate (NRDC, n.d).

All of the evidence regarding seafood and human health does not go without varying opinions and exceptions, and much is left up to the individual to how one will balance benefits and risks. Jeff Silverstein, leader of the aquaculture program for the USDA Agricultural Research Service, states, "fear of contaminants in fish is real, but not necessarily balanced with the actual risks," (Taylor, 2009). All seafood contains some level of mercury, but thankfully, not all fish contain the same amounts of mercury (Mergler et al, 2007; Nestle, 2006). Table 2 shows mercury levels for a variety of fish, but does not distinguish between various fisheries or farmed versus wild species. Research has been conducted on levels of mercury within farmed species compared to wild fish species. Consumption of farmed fish can also lead to exposure to methylmercury because the toxin can be present in the feed given to the fish (Taylor, 2009). But because farmed fish are usually smaller species and have relatively shorter life spans in which to accumulate contaminants, toxins are more of a problem in large farmed fish that live longer (Mergler et al., 2007; Taylor, 2009), just as with wild fish. One exception to this, however, is wild Alaskan salmon, which has some of the lowest levels of mercury of any fish.

Table 2. Mercury Levels in Seafood Species (United States Food and Drug Administration, 2001)

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

e) Models for Sustainability

Despite the challenges that human beings are creating for the health and functioning of marine fisheries, and the slow progress being made towards providing sustainable seafood to consumers, some sources do provide more sustainable seafood. Author of *Four Fish,* Paul Greenberg (2010), traveled to Alaska and documented the Kwik'Pak Fishing Company- the only fair-trade certified fishing company in the world. Kwik'Pak earned recognition for a few reasons. The small community reaps the profits of their labor, rather than it going to wealthy businessmen who are largely removed from the fishery itself. Yupik Eskimo natives own, and for the most part run, the fishery themselves. In addition, instead of ruining the fishery (as has occurred elsewhere, such as salmon in Turner Falls, Massachusetts by means of dams), the fish are sustainably harvested to ensure the salmon will maintain acceptable levels for the community to continue to earn a profit (Greenberg, 2010). Kwik'Pak Fisheries can also assure consumers that the salmon they are buying is authentic Yukon River salmon, by collaborating with Trace Register, a global food traceability company. Kwik'Pak says it is the only wild salmon company in Alaska that offers entirely traceable salmon (Kwikpak Fisheries, 2011).

Recently, NOAA proposed aquaculture guidelines that will serve as standards that regional fishery councils must meet when new fish farms are proposed. Even though the stringency of the guidelines is still uncertain, these guidelines are a step in the right direction. Among other recommendations, the guidelines suggest further research on alternate feeds, rather than wild fish (Dean, 2011). Many aquaculturalists have adopted more sustainable practices even prior to the policy measures, including using little or no fish meal in feed, increased farming of lower trophic levels of fish, and integrating farming systems (Naylor et al., 2000).

2) A Shift Towards Sustainability in the Market

Seafood consumers, retailers and seafood processors have begun to demand transparency in the seafood industry, an industry that is full of complexity and confusion. Even a simplified supply chain for seafood portrays how following seafood as it moves from harvest to the consumer is difficult (see Appendix C). Once a vessel brings fish to port, the fish can follow any number of paths. They may be sold whole to restaurants and fish markets, to either foreign or domestic primary processors, and then to secondary processors back in the country where they were first hauled into port. Fish could be caught in another country to begin with, and meander through a chain of processors in that country until being imported back into the country of origin. Processors may carry out a variety of processes such as freezing, canning, filleting, breading, and packaging, before sending the product off to other distributors. A distributor may then ship seafood to other distributors, or sell it to food service providers or retailers, where it finally reaches the consumer. Along each of these steps of the chain, other middlemen may be present, further complicating the supply chain (Roheim, 2008).

Once retailers started to develop seafood purchasing-policies centered on sustainability, they requested more accountability from distributors and producers (Greenpeace International, 2011). More and more of the general public now asks for sustainable seafood that has not been caught with destructive fishing techniques and does not come from overfished stocks. The success of attempts that are aimed at providing consumers with access to knowledge about sustainable sources of seafood, such as certification programs, marketing schemes and educational tools, are widely controversial. Researchers have studied how effective these programs have been in terms of reaching consumers, raising awareness, and restoring marine fisheries (Gudmundsson, 2000; Kemmerly & Macfarlane, 2009).

Seafood Watch, a consumer-based initiative started by the Monterey Bay Aquarium, offers consumers tips on buying environmentally friendly seafood. This effort has been shown to increase environmental awareness, contributing to a marketplace change in favor of what the aquarium defines as sustainable seafood, which ultimately has the potential to bring about environmental improvement (Kemmerly & Macfarlane, 2009). Monterey Bay Aquarium, among other environmental groups such as the Environmental Defense Fund and the Blue Ocean Institute have created easy-to-carry pocket guides, intended to help consumers make informed decisions about what seafood they purchase (see Appendix D for an example of a national Seafood Watch pocket guide). Monterey Bay Aquarium defines sustainable seafood as "seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems" (Monterey Bay Aquarium, 2011). Each organization's guide separates certain kinds of fish into categories such as "Eco-Best", "Eco-Okay", or "Eco-Worst" or assigns each species of fish a numerical value representing its sustainability on a scale from zero to four. They also provide health alerts to indicate species high in heart-healthy omega-3 fatty acids or low in environmental contaminants (Environmental Defense Fund, 2011). Monterey Bay Aquarium's Dr. Randy Kochevar claims, "It's been a staggeringly popular program… We just passed the five million mark of people downloading the guides, and studies show that people do carry and use them" (PBS-Nature, 2010). However, Florence Fabricant (2008), writer for the New York Times, raises a common question about the guides: Who along the chain of seafood supply will be able to answer the questions consumers are supposed to pose about the seafood they eat?

Complementing these seafood awareness guides, proposed programs for eco-labeling seafood products have emerged in efforts to provide incentives to fisheries managers to create

sustainable fisheries (Gudmundsson, 2000). The Marine Stewardship Council, founded in 1997 with the goal of certifying fisheries as sustainable, created an eco-label for all of its certified products in order to provide economic incentives to improve ecological sustainability of fish stocks (Marine Stewardship Council, 2010) (Figure 14). The MSC standard has three principles that certified fisheries must meet: They must maintain sustainable fish stocks, that is, the fishing activity must operate at a level so that fishing can continue indefinitely and is not overexploiting the fish population. Second, environmental impact must be minimized and fishing operations should "maintain the structure, productivity, function and diversity of the ecosystem on which the fishery depends" (MSC, 2010). Third, the fishery must meet all local, national and international laws and must have an effective management system in place. The MSC also has a Chain of Custody certification for businesses. Businesses must show they have storage and record-keeping systems in place that prove that only seafood from a certified fishery carries the MSC eco-label, so that deliveries of MSC certified fish can be traced to a Chain of Custody certified supplier (MSC, 2010).

Figure 14. Marine Stewardship Council certification label (MSC, 2010).
*Image removed from digital version; available in hard copy version housed in the Environmental Program office

The idea behind MSC certification was that the fishery itself or anyone along the chain of custody who purchases fisheries products from one of the certified fisheries could purchase rights to an eco-label for their products, which would let consumers know that the product had been harvested from a sustainable source (Gudmundsson, 2000). The assumption behind this is that if there is a demand for environmental improvement, the response from consumers will be to purchase more eco-labeled products, driving the demand for unlabeled products down. In due

course, this would put pressure on fisheries managers to manage fisheries sustainably and become certified, allowing their prices to rise (Gudmundsson, 2000).

There are also certification schemes for farmed seafood, such as the Global Aquaculture Alliance. The Global Aquaculture Alliance (GAA) develops Best Aquaculture Practices (BAP) certification standards for hatcheries, farms, processing facilities and feed mills. Not unlike certifications for capture fisheries, aquaculture certifications have been met with both acceptance and criticism (Grescoe, 2008). The GAA states that their standards “assure healthful foods produced through environmentally and socially responsible means" (David Suzuki Foundation, 2011). But salmon farming standards proposed by the GAA are criticized for being too weak to address critical environmental and social threats resulting from current open net/pen salmon farming (David Suzuki Foundation, 2011).

Some of the experts who have analyzed eco-labels have shared their support of the programs, claiming that eco-labels may have the ability to restore previously exploited stocks if fisheries are managed properly and held to high standards (Gudmundsson & Wessells, 2000; Hilborn & Cowan, 2010; Kaiser & Edwards-Jones, 2006). Even large companies have agreed to these marketing approaches. Two of the largest food service companies in the United States, ARAMARK and Compass Group North America, are now committed to sourcing seafood that meets Monterey Bay Aquarium’s “Best Choice” or “Good Alternative” rankings (Packard & Monterey Bay Aquarium, 2011). Whole Foods Market was the first nationwide retailer to sell MSC products, and the company has just declared they would “no longer sell wild-caught seafood that is "red-rated" by the Blue Ocean Institute and the Monterey Bay Aquarium” for seafood from fisheries not covered by the MSC (Associated Press, 2012, p.1). In January 2006, Wal-Mart, the world’s biggest retailer, agreed to source all seafood supplies in North America

from MSC sources within five years, catalyzing other retailers to follow in its path (Gulbrandsen, 2006). Target, the second largest discount retailer in the United States, currently sells fifty brands of either MSC or BAP certified fish, though they have just committed to sourcing 100% sustainable, traceable seafood by 2015, not necessarily through MSC or GAA-certified fisheries (Carpenter, 2011). Costco has also said that they will hold off on selling several types of fish until they can find MSC certified options (Environmental Leader, 2011). Even some of MSC's hardest critics acknowledge its presence as a tool for change, and note that the MSC is the certification "taken most seriously by scientists" (Jacquet et al., 2010, p. 28) despite its shortcomings. The MSC is also praised in Jared Diamond's *Collapse: How Societies Choose to Fail or Succeed* (2005), and is featured as a solution to declining fish stocks in the 2009 film *The End of the Line* (Jacquet et al, 2010).

But debate over seafood certification and eco-labeling has been active. Critics have argued that MSC certification is being awarded to fisheries whose stocks are not being managed properly and where ecosystems are being damaged (Pope, 2009; Smith, 2011), and that market incentives have led the MSC certification scheme "away from its original goal, towards promoting the certification of ever-larger capital-intensive operations" (Jacquet et al., 2010, p.29). Froese & Proelss' very recent study published in *Marine Policy* showed that for fish stocks where there was sufficient information, "31% of MSC-certified stocks were overfished and subject to continuing overfishing" (as cited in Eilperin, 2012, p. 2). Concerns have arisen over the recent MSC certification of Canada's Atlantic longline fishery for swordfish, a fishery that kills about 35,000 blue sharks and catches over 1,000 endangered loggerhead turtles every year (Wallace, 2011). Because MSC certifications tend to go by precedent, granting unsustainable fisheries certification could have serious consequences (Wallace, 2011). Some

studies have concluded that certifying fisheries will not help increase stock size (Gudmundsson, 2000), and in some cases declines in biomass can actually be found among MSC certified fisheries (Jacquet et al., 2010). Along similar lines, Iles (2007) raises a point that these market-based approaches rely upon increased consumption in order to reward the industry, and until that issue is confronted, they are not likely to be successful in increasing sustainability. He argues that increasing consumption of sustainable seafood actually contributes to the demand for wild seafood in general, leading to overexploitation. Because of this, Iles claims, an improvement in sustainability will likely only be possible by expanding aquaculture (2007, p. 588). Greenberg has a similar argument that both wild and farmed fish need to be part of a common future (2010).

Critics also worry about MSC lowering its standards of certification because of conflicts of interest and economic incentives (Grescoe, 2008; Jacquet et al, 2010). Some experts believe that eco-labels will not necessarily represent the most desirable aspects of specific seafood to consumers (Goyert, Sagarin, & Annala, 2010), and that consumer demand for eco-labeled products, as well as willingness to pay price premiums for labeled products, have been low (Gulbrandsen, 2006). Considering half of the seafood in the international market was exported by developing nations and 80% (if not more) of seafood in the United States is imported (Yasuda & Bowen, 2006), MSC has been accused for not taking a particularly global perspective (Iles, 2007). Small fisheries in the developing world that are often very sustainable make up a very small portion of MSC-certified fisheries (Jacquet et al., 2010). A vast amount of literature shows that the Marine Stewardship Council certification scheme attempts to help fisheries take a step in the right direction towards sustainability, but a significant number of credible critics agree that MSC must undergo major reform before marine fisheries are managed properly enough to ensure long-term sustainability. A thorough analysis of the Marine Stewardship Council states,

"Although there are several noteworthy criticisms of the organization…In eight years they have made amazing headway in addressing the international fisheries crisis through a market based approach of ecolabeling sustainable seafood products" (Owens, 2008, p. 26).

3) Collegiate Approaches to Sustainable Seafood

Literature on seafood sustainability efforts at the university-wide level is lacking, but the movement towards getting sustainably sourced seafood on some university campuses has begun. As issues related to sustainable seafood are also increasingly making the news (Figure 15), the sustainable seafood movement is one that is becoming evermore important. Offering sustainable seafood on university campuses will gradually become a crucial component of the movement to green college campuses, a movement which began in the 1990s and has gained momentum over the past 20 years (UVM Office of Sustainability, 2011b).

Figure 15. Number of times "sustainable seafood" has appeared in headlines or leads. Media categories as defined by Lexis Nexis.

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

Of the efforts to increase sustainable seafood on university campuses, the ones that are apparent all tend to follow similar strategies. Generally, universities either partner with a marine conservation organization, agreeing to distribute educational materials, purchase and sell seafood that is deemed as sustainable on certain seafood lists, or the university will form an agreement with a certification company, and purchase the rights to their eco-labeled seafood products. According to the University of Notre Dame Office of Sustainability (2008), Notre Dame became the first major U.S. college to earn the Marine Stewardship Council Chain-of-Custody certification. Now other schools, the University of Wisconsin among them, get 100% of their

seafood certified by the MSC. Stanford University held a "Sustainable Seafood Week" in November 2008, showcasing sustainable seafood and bringing experts to dining halls with the purpose of educating students about the state of the oceans and fisheries (Sustainable Stanford, 2008). Northeastern University, New York University, Pomona College, and Columbia University have committed to purchasing all seafood in accordance with the Monterey Bay Aquarium's Seafood Watch guidelines, as have a number of other schools (Go Green, 2010; The Association for the Advancement of Sustainability in Higher Education, 2011). The Association for the Advancement of Sustainability in Higher Education (AASHE), held a conference in 2011 called, "Seafood Sustainability on Campus: Making it a Reality". This conference was specifically focused on MSC certifications (AASHE, 2011). Though these efforts are bringing attention to the issue of ocean sustainability, there is not much variety in the way universities have gone about developing sustainable seafood initiatives on their campuses.

According to the University of Vermont's *Vision, Mission, and Goals,* UVM aims to **"**model the highest standard of ethical conduct, accountability and best practice", and maintain a "comprehensive commitment to liberal education, environment, health, and public service" (The University of Vermont Office of the President, 2012). UVM has demonstrated these goals in numerous ways. In December 2010, UVM committed to climate neutrality by 2025, with specific emissions targets every five years (UVM Office of Sustainability, 2011a; American College & University Presidents' Climate Commitment, 2012). The University also holds claim to the nation's first Gold-rated LEED certified student center, and has several student-run groups dedicated to environmental sustainability.

UVM has also showcased its commitment to the environment in the food industry. Sodexo is currently contracted as UVM's food service provider. University Dining Services

(UDS) (the name given to the relationship between Sodexo and UVM) sources the majority of its food from Sysco, "one of the world's largest food service distributors," but is increasingly sourcing more food from Black River Produce and other small vendors (Cameron, 2011, p. 27). UDS has developed many initiatives to increase sustainability on campus. UVM has been identified as a key partner in the Keep Local Farms effort, which gives ten cents from the sale of each single-serve Hood milk to support New England dairy farmers. Since the launch of this initiative in November 2009 to December 2010, $8,300 had been raised (University Dining Services, n.d). University Dining Services is also a member of the Vermont Fresh Network, meaning that they purchase "from at least three Vermont Fresh Network member farmers and/or food producers and agree to source from them on a regular basis" (University Dining Services, n.d). Furthermore, the University of Vermont has recently made another significant advancement following through with its environmental reputation. UVM has committed to being one of the first institutions nationwide to end the sale of bottled water on campus. "As of July 1, the university will no longer have a beverage contract with corporate sponsorship", as UVM ends its ten-year contract with Coca-Cola (Reidel, 2012, p. 1), which was led by a strong student activism movement (Baron, 2011). Another example of UVM's commitment to the environment is UDS' hiring of one student to act as the Sustainability Intern. The intern determines the percentage of "real food"- defined as food that is "locally grown, fair trade, of low environmental impact and/or humanely produced" (UVM Office of Sustainability, 2011b). This assessment includes baked goods, meat, poultry, dairy, eggs, seafood, coffee, beverages, produce, and staple food purchased at each dining location (University Dining Services, n.d).

Despite the numerous efforts the University of Vermont has taken to increase its environmental sustainability, UVM does not appear to have focused efforts in the realm of

sustainable seafood, and any information on UVM's seafood guidelines is not apparent to students. The results of the Sustainability Intern's real food calculation from Fall 2010 showed that none of the seafood at UVM was considered "real food", meaning it did not meet any of the local, organic, humane, or fair trade criteria (Nord, 2011). During the four months from September to December 2010, UDS purchased $8,554 worth of seafood. This is only approximately 1% of the $850,434 spent on all foods on campus including baked goods, meat, dairy, beverages, produce, staples, and more during this period (Nord, 2011). Although this is a minimal proportion, sourcing sustainable seafood on campus can still help UVM achieve its goal of serving 20% of "real food" at all of its campus dining locations by 2020 (UVM Office of Sustainability, 2011b).

In terms of documents that can be accessed without talking to administrators, the extent of sustainable seafood literature at UVM comes in the form of what was reported in the survey responses that put UVM in fourth place on Sierra Magazine's "10 Coolest Schools" list for commitment to the environment (Sierra Club, 2009). One of the questions posed by the Sierra Club surveys was, "Do your cafeterias source seafood that is considered "sustainable" by the Marine Stewardship Council, the Monterey Bay Aquarium's Seafood Watch Program, or a similar organization?" UVM's response: "The local distributors of most of the campus seafood state that they try to source only sustainable seafood backed up by any one of these organizations" (Sierra Club, 2009, p.3). This response is not extensive, nor does it provide much detail on what UVM is doing along the lines of sourcing its seafood. It also creates confusion when comparing it to the finding of the sustainability intern that 0% of UVM's seafood is "real food". But news announcing Sodexo's recent commitment to sourcing MSC products

(Environmental Leader, 2011) may lead to apparent change and clear results in UVM dining facilities and the seafood the university agrees to buy.

Other students have utilized methods similar to the ones used in this research for their theses relating to increasing sustainability on campus, though they explored more popular issues such as local produce and bottled water. Efforts by students, faculty, or staff, to investigate seafood at UVM, however, have been nearly nonexistent, leaving no foundation of school-wide activism or initiatives upon which this research could build. For this reason, this thesis represents preliminary documentation of sustainable seafood at UVM.

4) Summary

Attempts at working towards sustainability in the way people obtain seafood, in hopes of preventing the collapse of marine fisheries, have taken various paths. Better fishing practices, and even the domestication of fish, as well as market approaches such as consumer awareness schemes and sustainable seafood certification programs, have been evaluated, commended, and critiqued in various forms of literature. The complexity of the issues and the variety of possible solutions working from different perspectives makes any one theory no more dominant than another, and what can be done to solve the dire state of marine fisheries, while providing seafood to a demanding and growing population, is largely inconclusive. Certifications for fisheries with sustainable practices, increased reliance on aquaculture in order to feed human populations, and consumer education schemes are all possible solutions. Meanwhile, on university campuses, a shift in awareness has begun, but is fairly undocumented and inaccessible to the average student or consumer. At UVM, little information on the university's seafood purchases is available to consumers, and UDS expresses no clear or specific plan for seafood sustainability. Considering

the lack of information available on UVM's seafood, research on sustainable seafood at UVM was necessary to possess a baseline of what UVM offers for seafood and what the possibilities are for improvement in seafood sustainability in the future.

Methods

The overall purpose of this thesis was to assess baseline data of seafood at UVM and find more sustainable alternatives of seafood to offer at UVM. The goal of this research was to explore a variety of factors involved in seafood sustainability efforts (sustainability goals, health and safety concerns, supporting small-scale fisheries) through a combination of document research and interviews. Another part of this research involved creating a report for UDS and the UVM Office of Sustainability containing recommendations as to how UVM can provide seafood from more sustainable sources. These recommendations include steps on how to go about obtaining seafood from credible, sustainable sources. I hope this research positively influences the level of sustainability that the university is held to in terms of its seafood purchases and offerings to its consumers.

1) Approach and Objectives

This thesis was conducted using a mixed methods approach, in which qualitative and quantitative approaches are combined into the research methodology of a single study (Tashakkori & Teddlie, 1998, p. 17). Additionally, this research derives some of its methodology from Grounded Theory, in which a theory is generated while a researcher is in the process of conducting research. This method allowed for my conclusions to be formulated as a direct result of exploring the data, rather than forcing research-driven hypotheses and assumptions (Strauss & Corbin, 1990). The explicit goal of Grounded Theory is to "develop theory derived from, and grounded in, the data" (Morse & Richards, 2002, p. 56). The parts of this thesis that have been borrowed from Grounded Theory are: 1) Identifying a topic area, 2)

collecting various pertinent data types, 3) writing memos throughout the entire process, and 4) developing a theory based on the data collected (Scott, 2009). I used the first two steps of Grounded Theory by choosing to look into seafood sustainability at UVM and gathering relevant data on UVM's current seafood and data on current sustainable seafood initiatives elsewhere. By continuously noting areas to further explore and themes that emerged throughout the process, I implemented the third part of the Grounded Theory model. I analyzed these data to develop more general theories about sustainable seafood initiatives and in doing so, applied the fourth step of the process to my research. The major part of Grounded Theory not included in this research was coding of the data.

Additionally, this research methodology is largely driven by the foundations of action research, which strives to address concerns and search for solutions that will in turn change the practices of the institution or individual. "Action research is change oriented and seeks to bring about change that has positive social value" (Allen, 2001, p. 1). Action research is a cycle of posing questions, gathering data, reflection, and deciding on a course of action. Ferrance (2000) states that action research is a:

> …quest for knowledge about how to improve. Action research is not about doing research on or about people, or finding all available information on a topic looking for the correct answers. It involves people working to improve their skills, techniques, and strategies (p. 2-3).

Action research methodology applies to this research because the cycle is similar to what this thesis entails. The first four components of the action research cycle will be used in this research. They are shown Figure 16 and are: Identification of problem area, collection and organization of data, interpretation of data, and action based on data. The last two steps of the

action research cycle will not be in this research, and would require further time to evaluate the results of any action that occurs out of this research (Ferrance, 2000).

Figure 16. Action Research Cycle (Ferrance, 2000).

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

It is difficult to put an exact name on this methodology because the later methods were so dependent upon the results found from the earlier steps in these methods. As more information was uncovered, the direction in which the research was headed was made clearer. The following objectives were used to direct these data collection and analysis:

- Analyze current seafood offered in three campus facilities in terms of species, quantity, and general sustainability trends (including exploitation of fish stocks, fishing/farming methods, and human consumption advisories).
- Conduct an examination of alternatives and best practices for seafood sustainability provided by experts in the field of sustainable seafood.
- Report findings on the seafood the University has been purchasing, as well as recommendations for the future, to University Dining Services and the Office of Sustainability.

2) Data Collection & Analysis

Communication with several people was necessary to carry out this thesis, and the information they provided me with was essential. Additionally, any further progress with sustainable seafood at UVM will most likely involve the people in Table 3.

Table 3. Seafood Contacts Fall 2011-Spring 2012

Name	Position/Location	Mode of Contact	Information/ Documents Provided
Thomas Oliver	University Dining Services, Operations Director	In-person meetings, email Spring 2011-Spring 2012	Preliminary info on UVM seafood, contacts for invoices
Brian Roper	University Dining Services, District Chef	In-person meetings, email Spring 2011-Spring 2012	Resource for any questions relating to UDS and sustainable seafood
John Brandes	University Dining Services, Chef Manager	In-person meetings, email Spring 2011-Spring 2012	Resource for any questions relating to UDS and sustainable seafood
Scott Sparks	Black River Produce, Sales Executive	Email communication Fall 2011- Spring 2012	Invoices from BRP & Sysco, Sodexo Seafood Sustainability Initiative Document
Gioia Thompson	UVM Office of Sustainability, Director	Email communication Spring 2012	Contacts to meet with about future plans for seafood at UVM.

a) Assessing Current Seafood

Through an invoice analysis, current seafood served on campus over the past academic year was identified. At the suggestion of UDS, I researched three different types of dining facilities at UVM, to make sure I included types of seafood that may get served only at certain facilities. The three locations I examined seafood at were Harris-Millis, a residential dining hall (Figure 17), the Davis Center Marketplace, a catering and retail location (Figure 18), and the Marche, a retail location (Figure 19). In this research, I used invoices provided by Black River Produce and Sysco, as well as personal contacts within UDS. This compilation I created included species and quantities, and calculations in order to obtain totals for each month for each type of seafood. I observed trends in the data to see if UDS buys the same amounts and kinds of seafood during each month.

Figure 17. Entrance to Harris-Millis Dining Hall. Photo by Sara Cleaver, 2012.

Using the identified current types of seafood on campus, the next step was investigating the "general" sustainability and safety (both to be defined below) of each type of fish served on campus. I examined overlaps in the information gained from the invoice analysis and the data on websites of three leading sustainable ocean conservation groups, Monterey Bay Aquarium Seafood Watch (MBA), Environmental Defense Fund (EF), and Blue Ocean Institute (BOI). Each of these organizations has criteria for identifying species as sustainable, which are for the most part very similar. Scientists develop these recommendations based on government reports and scholarly journal articles, and by contacting fishery and aquaculture experts. All of the organizations have criteria for wild fisheries that focus mainly on the health of the fish stocks, impacts of fishing methods on other species, management, and effects on habitat. Criteria for sustainability for aquaculture focus on access to accurate and up-to-date information on fish farming operations, pollution and chemical use, effects on habitat, the type of feed, escapes, diseases, parasites, and pathogens, and the source of the stock- whether or not it is independent of wild stocks (BOI, n.d.; EDF, 2011; MBA, 2011).

I investigated trends in sustainability and safety by choosing a few broad categories as criteria for each type of fish identified:

1) Caught using unsustainable fishing practices.
2) From overexploited/diminishing fisheries.

3) Farmed using poor aquaculture practices/ unsustainable fish farming systems.
4) Associated with health warnings (from EDF) of contaminants such as mercury, lead, PCBs, or pesticides.

I organized the data I obtained first in separate categories, showing which organization provided what data about each type of seafood. A detailed legend of how I developed the table with pertinent information (Table 8) and how to read it is included with it in the results section.

My intention behind the general sustainability table was to determine which fish were, in general, less sustainable and less safe for human consumption. But as with any research design, some methodological limitations must be noted, because this greatly oversimplified the complexity involved in figuring out whether seafood is sustainable. I was still able to focus on general or overall sustainability and safety of certain species of fish, but unable to specifically quantify the sustainability of each seafood. This is because the sustainability and health issues are often dependent upon the fishery. As transparency in the seafood industry is rare, especially on an international level, access to information of which fishery seafood comes from is very limited and hard to come by. While conducting this portion of my research, I had contact with UVM's supplier at Black River Produce (BRP) who told me they have a specific person who chooses which fish at the Boston Fish Market will be sent up to BRP. He also conveyed that there was no real way to figure out where the fish had come from long after the purchase, and that the yield in results may not be worth the effort required to figure this information out. Thus, rather than meandering down the seafood distribution chain trying to reveal exactly where UVM's seafood came from, if detailed information on a product UVM offered was not available, I more thoroughly explained the sustainability factors that would be involved in determining each species' sustainability. The other main limitation to this portion of my data is that with time, these ratings may change because of the evolving statuses of certain populations or new

management strategies. Therefore, this data may become outdated at some point in the future as the seafood industry changes.

With these ratings and the percentages I calculated for each type of seafood UVM purchased, I compared these data and created another table showing the rankings of each species of seafood organized by the proportion of UVM's seafood that each species made up (Table 9). This enabled me to see whether or not the least sustainable species were ones that UVM ordered more of than other species, or if their amounts were less significant.

b) Best Practices for Sustainability- Recommended Strategies for UVM

There are many potential solutions that could guide UVM in the direction of seafood sustainability. Considering the complexity of marine and freshwater ecosystems and the numerous issues that play into seafood sustainability, choosing just one solution or plan for UVM would be difficult. Solutions for how UVM can increase its seafood sustainability were found by investigating current sustainable seafood initiatives occurring elsewhere, using scientific data on sustainable seafood, and conducting semi-structured interviews with people who have implemented different types of sustainable seafood programs. All interviewers provided their informed consent, which was obtained through email prior to the meetings through, stating what the purpose of the interview and the intentions of my research were. The consent was voluntary and implied by the interviewees' willingness to be interviewed. Interview questions can be found in Appendix E. Interviewees included the following people:

Consuming Invasive Species- Asian carp-Richard O'Donohue, the Proctor Dining Hall chef at Middlebury College who played a large role in the initiative to include Asian carp (an invasive species) on the menu at Middlebury College. I interviewed Chef O'Donohue in-

person at Proctor Dining Hall at Middlebury College on September 22, 2011 and recorded the interview. After communication with Chef O'Donohue, I used the snowball sampling method. This method entails having current subjects (in this case, Richard O'Donohue, the interviewee) recommend further personal contacts that may be useful in the research. I then contacted the representative from Schafer Fisheries (in Illinois) that O'Donohue suggested, in regards to the potential for UVM to purchase Asian carp from them.

Selecting species of most concern- Diane Imrie, Director of Nutrition Services, Fletcher Allen Health Care. I interviewed Imrie over the phone on March 26, 2012. Imrie organized a visit to Gloucester, Massachusetts that was intended to expose health care providers to and teach them about a more sustainable fishing methodology. The desired outcome of this visit was for hospitals to initiate a more local, seasonal fish and seafood menu for their organizations, and since then, Fletcher Allen has taken many steps to increase their seafood sustainability.

Community Supported Fisheries- Niaz Dorry, Coordinating Director for the Northwest Atlantic Marine Alliance who was recommended as a source of information by Joe Roman. I conducted this interview in person at Harvest Café in the Fletcher Allen Hospital (Burlington, VT) on February 11, 2012, and recorded it. Dorry is an expert in small-scale, traditional fisheries as a means of marine biodiversity conservation, and has been central to many sustainable seafood efforts on the East Coast of the U.S.

I listened to the recorded interviews, noted segments related to my research in the results, and wrote up notes from the phone interview with Diane Imrie. If topics needed clarity or further information, I researched them using appropriate websites, or followed up with interviewees through email, and included this information in the results as well. I organized the data by observing similarities and differences between the approaches (Table 10). I documented

benefits and reasons why each method would be plausible for UVM, as well as challenges to each approach (see "Analysis of Best Practices- Recommended Strategies for UVM").

c) Satisfying UVM's Sustainable Seafood Needs

The final component to this research was creating a report for University Dining Services and the UVM Office of Sustainability. I initiated arrangements for a meeting with UDS and the Office of Sustainability to discuss possibilities for the future of UVM seafood, which will hopefully occur after the completion of this thesis. The report (Appendix J) includes a brief summary of why Sodexo's new Sustainable Seafood Initiative (explained later in further detail) is only one step in the direction towards seafood sustainability, and recommendations that University Dining Services include the proposed alternatives in future dining plans.

d) Timeline

To gain a better understanding of the timeframe of my research, I have included the following timeline, which includes some of the major events beginning in the fall of 2011 spanning until the majority of my results had been collected. This is not a comprehensive list documenting this entire process, but it provides a clearer context of the timing of my research. Although steps that occurred before September 2011 are not included because they may not have specific places in my methods, a significant amount of preliminary background research and planning took place during the spring of 2011.

Table 4. Timeline of Research

Date	Aggregated Activities
September 2011	• Conducted research with individuals involved in purchasing outside of UVM • Collection information from UDS on current seafood

October 2011	• Continued research with those involved in purchasing both in UDS and BRP • UDS plans on switching to a brand of seafood called CleanFish*
November-December 2011	• Further investigated sustainable seafood alternatives • Continued working with current seafood data • Maintained communication with UDS on sustainable seafood effort
January 2012	• Sodexo was no longer partnering with CleanFish* • Met with UDS representatives and introduced the idea of eating Asian carp • Further investigation of alternatives
February 2012	• Collected necessary remaining information on sustainable alternatives • Began email correspondence with Gioia Thompson
March-April 2012	• Met with UDS to learn more about Sodexo's new Sustainable Seafood Initiative and Sustainable Seafood nights • Began formal analysis of data

*CleanFish is a company whose mission it is to connect artisan fishermen and fish farmers and market their products under traceable, transparent brands. UDS initially mentioned that they would begin sourcing CleanFish products through Black River Produce at the beginning of my research, but Sodexo and CleanFish did not end up maintaining ties.

Results

1) Assessing Current Seafood

When I began my research, the first information UDS reported was that they served several types of seafood including: Lobster, mahi-mahi, salmon, shrimp, sole, cod, tilapia, scallops, mussels, and clams (T. Oliver, J. Brandes, & B. Roper, personal communication, March 23, 2011). The following is from information I received after that from Black River Produce. Using the information in the invoices, I organized it into the following tables and performed the necessary calculations for the totals and percentages of the assessed seafood.

Species & Quantities

Table 5. Species of seafood served in three dining facilities at UVM: Commodity Report from Black River Produce Sept 2010- Aug 2011

	Marketplace	**Harris-Millis**	**Marche**
Sept 2010	Winter Harbor smoked salmon		
October 2010	China Bay scallops		
November 2010	Shrimp		Catfish
December 2010	Scallops		Shrimp
January 2011	Halibut		
February 2011		Swordfish tails	
March 2011	Crawfish	Mahi-mahi	Catfish Pollock
April 2011	Shrimp	Shrimp	Ducktrap smoked trout Haddock (scrod) Hake Shrimp Spruce Point smoked salmon Tilapia
May 2011	Scallops Scrod cod		Farmed steelhead salmon
June 2011	Canadian salmon (farmed) Grey sole Spruce Pt smoked salmon	*	*
July 2011	Flounder	*	*
August 2011	Chilean salmon (farmed)		Chilean salmon (farmed)

*No data- Dining facilities not open

Twenty-one different types of seafood were ordered during this time. The Marketplace (Figure 18) placed the most orders, but the largest variety of species in a month was during April, in the Marche. The Marketplace offered seafood 14 times, Harris-Millis 3, and the Marche 12, over this duration. Shrimp was the most frequently ordered, 4 times during the year (Table 5).

Figure 18. Windows looking into the Davis Student Center Marketplace. Photo by Sara Cleaver, 2012.

Table 6. Monthly quantities (weight in pounds) of seafood in three dining facilities at UVM from Sept 2010 to Aug 2011

	Marketplace	**Harris-Millis**	**Marche**	**TOTAL**
September 2010	5.24	0	0	5.24
October 2010	1.00	0	0	1.00
November 2010	10.00	0	20.21	30.21
December 2010	10.00	0	130	140
January 2011	2.75	0	0	2.75
February 2011	0	5.84	0	5.84
March 2011	2.00	66.32	200.00	268.32
April 2011	10.00	2.00	97.74	109.74
May 2011	41.73	0	21.08	62.81
June 2011	175.63	0	0	175.63
July 2011	5.43	0	0	5.43
August 2011	86.20	0	34.70	120.90
TOTAL	**349.98**	**74.16**	**503.73**	**927.87**

Out of the three dining locations, by weight the Marche (Figure 19) purchased the most seafood over the course of the year, 507.73 pounds. Harris-Millis purchased the least, 74.16

pounds. The most seafood purchased in one month was 268.32 pounds in the month of March, while the least purchased in one month was one pound in October (Table 6).

Figure 19. The "Euro Bar" inside the Marche. Photo by Sara Cleaver, 2012.

Shrimp made up the largest amount of seafood purchased, 204.50 pounds, approximately 22% of all seafood purchased for these three dining locations. Farmed Canadian salmon, catfish, and farmed Chilean salmon also made up significant amounts of seafood purchased, with 155.86, 125.21, and 120.90 pounds, respectively. These four seafood products made up about 65% of the seafood purchased out of 21 different products (Table 7).

Some of this seafood was purchased by UVM without the intention offering it to those who frequent the Marketplace for daily meals. This is because the Marketplace is a catering facility, and customers can request certain types of seafood for specific functions held at the university through the Marketplace (B. Roper, personal communication, March 13, 2012). At the Marketplace, most orders for seafood that are not going towards a catered function will be above 15 pounds, unless they are added to something such as stew. So the small amounts, such as one pound of China Bay scallops in October, are probably for a catered order (J. Brandes, personal communication, March 13, 2012).

Table 7. Amount of each type of seafood (in pounds) from the Marketplace, Harris-Millis, and the Marche dining facilities at UVM from Sept 2010 to Aug 2011		
Seafood	**Quantity (lbs)**	**Approximate Percentage of Total Seafood Assessed**
Shrimp	204.50	22.0%
Salmon, Canadian- farmed	155.86	16.8%
Catfish	125.21	13.5%
Salmon, Chilean- farmed	120.90	13.0%
Pollock	80.00	8.6%
Mahi-Mahi	66.32	7.1%
Scallops	39.00	4.2%
Salmon, Steelhead- farmed	21.08	2.3%
Hake	20.00	2.2%
Salmon- Sprucepoint	19.80	2.1%
Sole	15.21	1.6%
Cod	12.73	1.4%
Haddock	10.00	1.1%
Tilapia	10.00	1.1%
Swordfish	5.84	0.6%
Flounder	5.43	0.6%
Salmon, Winter Harbor-farmed	5.24	0.6%
Trout, Ducktrap- farmed	5.00	0.5%
Halibut	2.75	0.3%
Crawfish- farmed	2.00	0.2%
Scallops, China Bay- farmed	1.00	0.1%

General sustainability ratings

In creating Table 8, if I could not find the exact name of the seafood identified in the invoices on the three websites (Monterey Bay Aquarium Seafood Watch, Environmental Defense

Fund, and Blue Ocean Institute), or if there were a few options of which fish it could, I used the whole range of options for which type of fish it could be (for it was not possible to determine which was most commonly caught and sold for all types of fish). For example, on Blue Ocean Institute's website, there is no category for plain "scallops". So I used the ratings for all of the possible options of different kinds of scallops, which included Bay, Mexican Bay, Peruvian Calico, Weathervane, Scottish, Icelandic, and Sea scallops. However, there were some cases in which it did make sense to use the most common data, such as for swordfish, in which I made the assumption that UVM does not get harpoon-caught swordfish.

For Monterey Bay Aquarium (MBA) and Environmental Defense Fund (EDF), I inserted the possibilities ranging from "Avoid" to "Best Choice" and "Eco-Worst" to "Eco-Best", into the appropriate categories. Best Choice or Eco-Best fish are well managed, abundant, caught or farmed in environmentally friendly ways, and generally low in contaminants. When buying Good Alternative or Eco-Ok species (in yellow on the websites), consumers should be aware there are some concerns with how these species are caught or farmed. These species have mixed reviews and may have moderate levels of contaminants. Avoid or Eco-Worst species are overfished or caught or farmed in ways that harm other marine life or the environment. These fish may also have high levels of contaminants (EDF, 2011; MBA, 2011).

Blue Ocean Institute's system is more quantitative than the other two, generating a number rating as well as a color to represent a certain level of sustainability. Initially, each species of fish begins with "core points" based on criteria such as species' life history strategies, (how fast the fish grow and how quickly they reproduce), abundance, impacts of fishing methods on habitat and other animals, and management of the species. For farmed species, these criteria are focused on inherent operational risks- whether waste, pollution, or fish can get into the

surrounding environment, the feed of the fish, and the ecological sensitivity of the area surrounding the fish farm. "Points of adjustment", or additional questions upon which to judge each species or populations, are then used to refine the scores. The final scores from zero (worst) to four (best) match up with colors from red to green, similar to the red-yellow-green lists of MBA and EDF, but also including some in-between colors; orange and light green (BOI, n.d).

For the Blue Ocean Institute column, I took the range of the "Final Scores" of each fish. For example, for catfish, the final score of the fish on BOI's website depends upon whether or not the catfish is farmed domestically or imported. Therefore, I used a range that included both the farmed and wild fish in the "BOI" category, since this information could not be determined. If there is only one number in the BOI column for a species of fish, there was only one option of fish on their website. If there are two numbers spread out from one another vertically, there were more than two options, and displayed is the range of all the numbers. If there are two numbers with one right below the other with no space in between, then there were only two options of fish, and BOI's "Final Scores" of those two are shown.

I analyzed the data by looking at the most common issues that arise for each kind of fish, and those issues were placed in the "Main concerns/variables" category. Throughout the table and analysis, I used the following color scheme for sustainability ratings: Red=Eco-worst species, avoid. Blue= eco-ok, good alternatives. Green= Eco-best, best choice. I coded each piece of information in the "Main concerns/variables" category with the color of the type of fish it fit with- whether the fish were rated "Avoid", "Best Choice", and so on.

The "Health Concerns" category I developed based on whether any of the organizations listed health concerns for a fish species. If the health concerns are in red, the specific type of fish

identified is associated with contamination. If the health concerns are in orange, a definitive answer could not be determined. There could be a range of the severity of the health concern, depending on certain variables such as which population of fish it is. Depending on how much contamination there is in a species of fish, it could be okay for adults to eat a fair amount, but children should limit their consumption of a type of fish to no more than four meals per month.

Asterisks were placed in categories that were too difficult to determine without the specifics of the fish. The discussions of these fish are included below the general sustainability table in the "Analysis of Current Seafood at UVM" section.

Table 8. General sustainability ratings of seafood in the Marketplace, Harris-Millis, and the Marche dining facilities at UVM, Sept 2010- Aug 2011

Note: More than one rating in the MBA, EDF, and BOI columns indicates that more than one possibility for each species, depending on other variables such as the abundance of populations in certain geographic locations, or fishing/farming methods used.

Key:
Best Choice or Eco-Best- well managed, abundant, caught/ farmed in environmentally friendly ways.
Good Alternatives or Eco-Ok- may be associated with fishing/farming methods that have some concerns
Avoid or Eco-Worst overfished or caught or farmed in ways that harm other marine life or the environment. These fish may also have high levels of contaminants

	Species	MBA	EDF	BOI	Main concerns/variables	Health concerns	Rating
1.	Catfish-farmed	Good Alt Best Choice	Eco-OK Eco-Best	2.10-2.35	Imported- poor regulations. Domestic		Okay to keep on list
2.	Cod	Avoid Good Alt Best Choice	Eco-Worst Eco-OK Eco-Best	1.35- 2.25	*		*
3.	Crawfish-farmed	Avoid Best Choice	Eco-Worst Eco-Best	 2.90	Imported Over 90% are domestic		Okay to keep on list.
4.	Flounder	Avoid Good Alt	Eco-Worst Eco-OK	1.55-2.20	Atlantic Pacific	PCBs	*
5.	Haddock	Good Alt Best Choice	Eco-OK Eco-Best	1.90	Canadian, Icelandic Atlantic U.S. Atlantic trawl U.S. Atlantic hook + line		Okay to keep on list
6.	Hake	Avoid Good Alt	Eco-Worst Eco-OK	 2.10	White Hake Offshore, Red, Silver Hake.	Mercury	*
7.	Halibut	Avoid Good Alt Best Choice	Eco-Worst Eco-OK Eco-Best	1.10- 2.20	Atlantic California Pacific/Alaskan	Mercury PCBs	*

8.	Mahi-mahi	Avoid Good Alt Best Choice	Eco-Worst Eco-OK Eco-Best	2.15- 2.9	Imported longline U.S Pacific longline, troll, pole-and-line U.S. Atlantic	Mercury	*
9.	Pollock	Avoid Good Alt Best Choice	Eco-Worst Eco-OK Eco-Best	 2.60- 2.70	*		*
10.	Salmon, Canadian-farmed	Avoid	Eco-Worst	0.85	Require a lot of feed Poor open farming systems	PCBs	Take off list
11.	Salmon, Chilean-farmed	Avoid	Eco-Worst	0.85	Require a lot of feed Poor open farming systems	PCBs	Take off list
12.	Salmon, Spruce Point-farmed	Avoid	Eco-Worst	0.85	*	PCBs*	*
13.	Salmon, Steelhead, farmed	Avoid Best Choice	Eco-Worst Eco-Best	1.60- 2.10	Imported salmon A lot of feed Pollution Rainbow trout	PCBs	*
14.	Salmon, Winter Harbor, farmed	Avoid	Eco-Worst	0.85	*	PCBs*	*
15.	Scallops	Good Alt Best Choice	Eco-OK Eco-Best	1.85- 2.75	Wild- dredging, bycatch Farmed		Okay to keep on list
16.	Scallops, China Bay-farmed	Best Choice	Eco-Best	2.75	Dredging if farmed on bottom		Okay to keep on list
17.	Shrimp-farmed	Avoid	Eco-Worst	1.55- 1.30	Trawling Bycatch Open systems 90% from SE Asia & Latin America= lax regulations		Take off list
18.	Grey Sole (witch flounder)	Avoid	Eco-Worst	1.55- 2.00	Overfished Bycatch Trawling	PCBs	Take off list
19.	Swordfish	Avoid Good Alt	Eco-Worst Eco-OK	2.10- 2.45	Imported- overfished, bycatch Domestic	Mercury	Take off list
20.	Tilapia-farmed	Avoid Good Alt Best Choice	Eco-Worst Eco-OK Eco-Best	1.75- 2.85	China & Taiwan- Poorly managed Other countries- some management Domestic- (less than 10%)		*
21.	Trout, Ducktrap-farmed	Best Choice	Eco-Best	2.10	Most are farmed in US. Some pollution	PCBs	Okay to keep on list

*see “Analysis of Current Seafood at UVM” section

Of the 21 types of seafood purchased by Sodexo in this time, 6 were rated "Okay to keep on list". Five, including two species of farmed salmon, shrimp, swordfish, and grey sole or "witch flounder" were rated "Take off list", and ten did not have enough information to make a well-informed rating, and require further examination. Those requiring more information are discussed in the following analysis.

Taking the quantitative data from Table 7 and comparing it to the qualitative data from Table 8, Table 9 was generated to demonstrate the sustainability ratings of the species that make up certain proportions of the seafood UVM purchases.

Table 9. Percentages and Ratings of Assessed UVM Seafood

Seafood	**Approximate Percentage of Total Seafood Assessed**	**General Sustainability Rating from Table 8.**
Shrimp	22.0%	Take off list
Salmon, Canadian- farmed	16.8%	Take off list
Catfish	13.5%	Okay to keep on list
Salmon, Chilean- farmed	13.0%	Take off list
Pollock	8.6%	* Not enough information
Mahi-Mahi	7.1%	* Not enough information
Scallops	4.2%	Okay to keep on list
Salmon, Steelhead- farmed	2.3%	* Not enough information
Hake	2.2%	* Not enough information
Salmon- Sprucepoint	2.1%	* Not enough information
Sole	1.6%	Take off list
Cod	1.4%	* Not enough information
Haddock	1.1%	Okay to keep on list
Tilapia	1.1%	* Not enough information

Swordfish	0.6%	Take off list
Flounder	0.6%	* Not enough information
Salmon, Winter Harbor-farmed	0.6%	* Not enough information
Trout, Ducktrap- farmed	0.5%	Okay to keep on list
Halibut	0.3%	* Not enough information
Crawfish- farmed	0.2%	Okay to keep on list
Scallops, China Bay- farmed	0.1%	Okay to keep on list

Analysis of Current Seafood at UVM

According to the general sustainability ratings for UVM seafood (Table 8), shrimp is the most abundant item, and it is a "take off list" species. The second and fourth largest amounts purchased were farmed Canadian salmon and farmed Chilean salmon which are also "take off list" species. Grey sole was another species to avoid, which UDS purchased 15.21 pounds of. Only 5.84 pounds of swordfish, the last "take off list" species, was purchased. Prior to conducting this research, I had hoped the information that would be included in this table would be more consistent across species, and organizing each type of seafood according to ranking would be possible. The realization that this data does not fit nicely into the listed categories, and that the data is complicated by many factors such as fishing and farming practices and health of specific populations, is important to understanding the complexity of seafood sustainability.

All of the fish included in Table 8 are included in this analysis, but those that had an asterisk in the rating column of Table 8 are the focus of this analysis, because they highlight the most complex species for which a rating could not be determined. Those fish are examined first. Monterey Bay Aquarium Seafood Watch (2011), Blue Ocean Institute (n.d.), and Environmental Defense Fund (2011) were all used in this analysis.

The rating that was used in the last column of Table 8 is objective to my best ability as a researcher. For instance, many people would argue that farmed fish should not be on our menu at all. However, I used my best judgment according to only the information provided on these three websites. Although it would have been more beneficial to not generalize and to be able to actually determine the sustainability of each fish UVM purchased, for the purpose of this portion of my research, generalizing sustainability issues down to the species of fish proved to be an adequate baseline for the rest of my research.

Cod, like many of the fish identified in this research, has been listed as both a sustainable species as well as a species to avoid by the various organizations. This is because the sustainability of cod is so dependent upon where it is from (Atlantic or Pacific), and how it is caught. Severely depleted populations are a result of overfishing, and trawling for cod is not uncommon. However, cod in Iceland and the northeast Arctic are more abundant (MBA, 2011) and some of those fisheries use hook-and-line gear. Pacific cod is caught with bottom longlines, trawls, traps or hook-and-line, and the method used can largely determine the amount of both damage to the seafloor and bycatch. Imported cod from Japan and Russia is rated as a species to avoid because those fisheries remain largely unregulated. Population levels for these fisheries have not been assessed and bycatch reduction measures have not been implemented.

Flounder are overfished in the Atlantic, but have less depleted populations in the Pacific. However, bottom trawling for flounder increases the amount of bycatch and damages the seafloor, but it is not as much of a problem for sandy or muddy habitats, where flounder tend to live. According to EDF (2011), summer flounder from the Atlantic have elevated PCB levels, so it is recommended that adults eat no more than one meal per month and kids under 12 years old should eat no more than half a meal per month.

Hake is caught in the U.S. Atlantic, but there are several kinds of hake that vary in population vulnerability. White (southern) hake has been very overfished and is usually caught with trawls that damage the seafloor and/or gillnets, which also catch many non-targeted species. Most red and silver hake populations have recovered, and are caught using modified trawl gear that limits bycatch. Because of moderate mercury levels, EDF (2011) recommends limiting children up to 6 years old to four meals of hake per month.

Halibut can be caught in the U.S. Atlantic and Pacific, as well as in the Canadian Pacific. Atlantic populations are depleted and are usually caught with trawls. California halibut, from the Pacific, is vulnerable to overfishing because of its limited range and loss of habitat. California halibut caught with gillnets should be avoided because of marine mammals and seabirds are often caught in the nets, however California halibut caught using hook-and-line methods is a better alternative. The populations of Pacific halibut in Alaska, British Columbia, and Washington are well managed and healthy, and these fisheries are mostly restricted to bottom longlining methods, decreasing both bycatch and damage to the seafloor. Some halibut have elevated mercury levels, and EDF (2011) advises men and non-child bearing women to eat no more than three meals per month. Children from 6 to 12 years old should eat no more than two per month, and children younger than 6 years old to eat no more than one meal per month.

Mahi mahi may be resilient to fishing since they grow quickly, spawn frequently, and have large ranges, however, little is known about overall population size. Imported mahi are usually caught using longlines, leading to high amounts of bycatch. Troll-caught mahi are a better alternative. Because the mahi mahi fishery in the southeastern United States has strict management, hook-and-line caught mahi mahi from that region is more sustainable. Mahi has a

health warning for moderate mercury levels, so children younger than 6 years old should eat no more than three meals of mahi mahi per month.

Pollock can be caught in many fisheries throughout the Atlantic or Pacific. Pollock is a fast growing and maturing fish, causing it to be less vulnerable to overfishing. However, populations in Alaska are declining. In recent years, there have been increased levels of Chinook salmon bycatch associated with the Alaskan pollock fishery. Even though midwater trawl gear is used, it has caused damage to the seafloor and benthic organisms. The endangered Steller sea lion and northern fur seal also rely heavily on Alaskan pollock for food. Despite these concerns, the Alaskan Pollock fishery is a well-managed catch-share system (MBA, 2011; EDF, 2011, BOI, n.d.).

Atlantic pollock is much harder to categorize. It can come from Norway, Iceland, the U.S & Canada, and MBA, EDF, and BOI all differ somewhat in their assessment of these fisheries. In Iceland, overfishing of Atlantic pollock continues, and pollock caught with Danish seines and trawls should be avoided because of the damage they cause to the oceans floor and benthos, and the high bycatch associated with these methods (MBA, 2011; EDF, 2011). However, smaller pollock fisheries in Iceland use gillnets, which are a good alternative, and these fisheries are more abundant (MBA, 2011; EDF, 2011).

According to MBA (2011), in the U.S. and Norway, Atlantic pollock populations are healthy and abundant, and the fisheries are well managed. EDF (2011) on the other hand, claims that the Atlantic populations of pollock are less abundant than those in Alaska. BOI (n.d.) states that pollock are more numerous in European waters than American waters. In European waters they are caught primarily with bottom trawls, Danish seines and bottom gillnets, which all have high environmental impacts (MBA, 2011). Atlantic pollock from Norway, however, caught with

purse seines or gillnets, are less destructive (MBA, 2011; EDF, 2011). Additionally, EDF and MBA add that the bottom trawl and Danish seine fisheries in Norway are smaller and healthy, and are a good alternative to the Icelandic fishery that uses Danish seines or trawls.

Tilapia is farmed in freshwater habitats all over the world. As tilapia require little feed, they can provide more protein than they use (BOI, n.d). The sustainability of tilapia depends upon where it is farmed, because of differing aquaculture regulations worldwide. Tilapia farming methods vary widely within any given country (MBA, 2011), but the three sustainable seafood organizations generalize tilapia sustainability. Less than 10% of tilapia consumed in the U.S. market is farmed domestically (MBA, 2011), where farms are generally low-risk recirculating systems, and produce less pollution (BOI, n.d.). Most tilapia consumed in the U.S. are imported from Latin America and Southeast Asia, where farming practices are generally less eco-friendly than in the U.S (MBA, 2011; EDF, 2011; BOI, n.d.). Most Tilapia farmed in Asia and Latin America are farmed in systems that allow fish to escape, which contribute to the decline of wild freshwater fish populations (BOI, n.d).

Sprucepoint and **Winter Harbor farmed Atlantic salmon** are farmed in the open ocean off the coasts of Scotland, Norway, and Chile. In general, farmed Atlantic salmon is a species to avoid. However, a representative at Ducktrap River/Winter Harbor provided the information that farming standards for these fish are available at marineharvest.com. According to the website, Marine Harvest does focus a lot of attention on sustainability, however it is still difficult to tell whether they practice stricter sustainability standards than typical Atlantic salmon farms worldwide.

Steelhead Salmon are members of the rainbow trout species, raised in the U.S. and an Eco-Best species. However, a small amount of farmed trout is imported into the U.S. and

marketed as steelhead, which are raised in open-water pens and are associated with problems similar to farmed Atlantic salmon, such as pollution and exchange of diseases and parasites. For that reason, if imported, steelhead is considered an Eco-Worst species.

Catfish is farmed, but can be either domestic or imported. The channel catfish is now one of the most commonly farmed fish in the United States. Domestic catfish are raised in closed, recirculating freshwater farms in the Southeastern U.S, where they are native. They are fed a vegetarian diet, thus taking pressure of off wild fish for feed, but catfish farms sometimes contribute to water pollution. Imported catfish, on the other hand, come from Vietnam, Thailand, and China, are usually raised in open cages or nets in rivers. There is little to no government regulation of fish farming operations in these countries, and there may be a high amount of effluent associated with these operations, leading imported catfish to be only a Good Alternative or Eco-Ok species, rather than Best Choice like domestic catfish.

Crawfish are usually farmed, and can also be domestic or imported. They are sometimes farmed in rotation with rice. Similar to catfish, crawfish also eat a vegetarian diet. However, when crawfish escape they can be invasive. In Louisiana, where more than 90% of all U.S. crawfish production occurs, they are native, but in China, where they are not native, escapes are reason for serious concern, and farming practices there are not well documented.

Haddock can be caught in the U.S., Canadian, and Icelandic Atlantic. Because haddock is generally caught with bottom trawls, longlines, or gillnets, it is usually a Good Alternative species, but when caught with hook-and-line, it is a Best Choice, because this method is associated with less bycatch. Haddock populations have rebounded from a crash in the 1990s, and are now heavily regulated.

Farmed Canadian & Chilean Salmon are Avoid species for a number of reasons. They require a lot of feed in order to raise- it generally takes three pounds of wild fish to grow one pound of farmed salmon. Additionally, waste, parasites, and diseases from open pens can spread to wild populations, and escapes are not uncommon. Farmed salmon also contain high levels of PCBs. Regulations for salmon farming vary greatly between countries, but are in some cases non-existent.

Scallops can be either wild-caught or farmed. Wild-caught scallops (the majority of scallops consumed in the U.S.) are caught with trawls and are associated with bycatch, but sea scallop populations in both the North Atlantic and the Mid-Atlantic are now considered healthy and abundant, allowing them to be categorized as a Good Alternative species. Because scallops help improve water quality, don't rely on fishmeal, and usually don't require antibiotics or chemicals, farmed scallops are a Best Choice. Farmed scallops raised "on-bottom" are harvested using a dredge that damages the seafloor, but most scallops that are imported into the U.S. are farmed "off-bottom" and harvested by hand. One other concern is that Peruvian Calico scallops are often labeled as regular scallops, and are a severely depleted species.

China Bay Scallops, also known as the blue-eyed Scallop, Cape Cod Scallop, China Bay, Long Island Scallop, and Peconic Scallop, are farm-raised, and therefore follow the same sustainability criteria as other farmed scallops. Again, depleted Calico scallops may be mislabeled as Bay Scallops and should avoid being eaten.

Shrimp, with a few exceptions, is usually farmed in coastal areas of Asia and South/Central America where farming operations destroy wetlands, introduce chemical pollution and disease, and may foster poor treatment of laborers. Most shrimp consumed in the U.S. is

farm-raised and imported, but wild-caught shrimp or shrimp farmed in the U.S. can be Best Choices or Good Alternatives.

Grey sole, a flatfish that was determined to be witch flounder, is found in the Atlantic Ocean and is very overfished. Grey sole is caught using bottom trawls, damaging the seafloor and catching non-targeted benthic species. This species also may have elevated PCB levels.

Swordfish caught in California or the U.S. Atlantic, with gillnets or longlines, are Good Alternative Species because bycatch is managed in those fisheries. But imported swordfish caught with longlines are listed as fish to avoid, because of high levels of bycatch. Additionally, elevated levels of mercury in swordfish lead it to be a species to take off the list for UVM.

Ducktrap River Trout is a brand of rainbow trout that is farmed in the U.S., Chile, Argentina, or Columbia. Trout are relatively efficient at converting their feed into protein, especially with recent improvements in their feed. In the U.S., escape and pollution problems are generally well controlled, allowing domestic rainbow trout to be a Best Choice. But some farms discharge partially treated water into nearby waters, which can increase pollution**.** This trout may have moderate PCB levels as well.

2) Best Practices- Recommendations for UVM

My proposed ideas for more sustainable seafood options at UVM focus on consuming invasive species, increasing transparency along the seafood supply chain and getting rid of species of most concern, as well as sourcing more local seafood. These ideas arose from interviews with people involved in three different sustainable seafood efforts. The first effort I researched was Middlebury College offering invasive Asian Carp. Fletcher Allen Hospital's strategy involved pinpointing their values and sourcing seafood to match those values as well as

selecting certain species they wanted off their menu or that they wanted from more sustainable sources. The third sustainable seafood effort I included in my research was that of Northwest Atlantic Marine Alliance, which tries to establish bonds between local fishermen and nearby communities. Each strategy possesses an array of benefits as well as some challenges. Although Table 10 provides basic data on each of these strategies, it shows some key variations in different approaches to sustainable seafood. Much of the data in this table, however, is dependent upon many details within each approach, and some approaches offer flexibility as well if we were to apply them to a sustainable seafood initiative at UVM.

Table 10. Data from Personal Contacts for Best Practices for Sustainability- Recommended Strategies for UVM

Identified Approaches / **Factors for Choosing Best Practices**	**Consuming Asian Carp- Middlebury College**	**Species of Most Concern-Fletcher Allen Hospital**	**NAMA- CSFs and/or local procurement**
Where Seafood Comes From	Schafer Fisheries- Illinois	North America	Northeast U.S.- choose closest CSF or distributor
Farmed/wild	Wild	Farmed and/or wild	Wild
Fresh/frozen	Fresh and frozen	Fresh	Fresh
Economic	-Estimated $0.14- $2.35 per lb. -Seasonal- not available during harsh winters	-Varies depending on product, but well under $7.00/lb -Choose fish based on availability	-Varies depending on product -Choose fish based on availability
Environmental*	-Eradication of invasive species - Fairly local -Avoid consuming vulnerable populations	-Avoid consuming vulnerable populations -Match seafood choices with values	-Holistic ecosystem management, not focused on vulnerable species
Social Responsibility*	-Keeps inland fisheries in business	n/a	Benefits to local fishing community

*The above data is based on data from self-reports of either the contact person(s) or the appropriate organization. The environmental and social benefits represent the information provided by each entity, and reflect their perspective.

a) Consuming Invasive Species- Asian Carp

In the winter of 2010-2011, Proctor Dining Hall at Middlebury College (known by some as "the kitchen with a cause" (Keren, 2011, p.1) began offering Asian carp on the menu. One of the chefs brought the problem of invasive Asian carp (Figures 20 and 21) to the attention of the other chefs and dining services, and Middlebury decided to focus purchasing efforts on this specific issue. The following is what was gained from the interview with Chef Richard O'Donohue and purchasing agent Charlie Sargent, along with some extended research where necessary.

Figures 20 and 21. Asian carp. (Asian carp Regional Coordinating Committee, 2008).

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

Asian carp can weigh anywhere from fifteen to one hundred pounds (R. O'Donohue, personal communication, 2011; Schaper, 2006). Asian carp are not native to the United States, but were introduced in the 1970s and ever since have been making their way up the Mississippi River and its tributaries, including the Illinois River. They are now just south of the entrance to Lake Michigan, through the Chicago Canal (R. O'Donohue, personal communication, September 22, 2011), although Asian carp DNA has already been found in Lake Michigan (Environmental News Service, 2010). Eventually they could make their way to Lake Champlain, devastating the lake just as other invasive species such as the zebra mussel have already done.

Prior to buying Asian carp to add to their menu in Proctor Dining Hall, Middlebury had taken a few other steps to offer sustainable seafood on campus. They had incorporated wild Alaskan salmon on the menu, switching entirely from farmed salmon. This choice complemented Middlebury's values because of its fair trade, environmental sustainability, and

nutritional benefits (Middlebury College News Room, 2004; Hites et al., 2003). Middlebury has also faced challenges when sustainability goals conflict with one another. One instance of this is offering frozen Alaskan cod on the menu because it is a fishery certified as sustainable by MSC, however it is not local, even for seafood, which usually travels great distances.

Middlebury bought 1,500-1,600 pounds of Asian carp in total last year, from Schafer Fisheries in Illinois. They started with a couple hundred pounds, and it can be shipped fresh or frozen. The cooks experimented with it; frying it with different seasonings and dipping sauces. "It's like the tofu of the water, because it took on any flavor we gave it" (R. O'Donohue, personal communication, September 22, 2011). They had to find a new name for it, which is one thing anyone attempting to sell Asian carp is trying to do. They have marketed it to students at Middlebury under names such as "Schaferfish" and "Rock Island Sole"(Keren, 2011). Naming schemes such as this one have been extremely successful with many types of fish, such as renaming the Patagonia Toothfish to "Chilean Seabass" (Vettel, 2010).

While Proctor Dining Hall served Asian carp, they still offered other seafood on their menu. They were mainly offering it for a period of time when the idea of eating invasive species was emerging, in order to bring attention to the issue. The chefs at Proctor Dining Hall may continue to serve Asian carp occasionally, but as they are "going to give it a rest for a while" and continue serving a variety of protein options, it will not be a regular offering (R. O'Donohue, personal communication, September 22, 2011).

b) Selecting Species of Most Concern

In 2009, a federal grant was provided to educate hospitals and promote environmentally sound practices that would protect the health and safety of patients and health care workers (D. Imrie, personal communication, September 27, 2011). The desired outcome was for hospitals to

initiate more local, seasonal fish and seafood menus (Fletcher Allen Center for Nutrition and Healthy Food Systems, 2012). Because of this, Diane Imrie, the Director of Nutrition Services at Fletcher Allen Hospital, began working with Health Care Without Harm to support sustainable fisheries and local fishing communities. One of the first steps of this process was going on a trip to Gloucester, Massachusetts, organized by Niaz Dorry from the Northwest Atlantic Marine Alliance. During this trip, Imrie, Executive Chef Richard Jarmusz, and other representatives from Fletcher Allen (such as procurement officers) heard from the fisherman and the organizations working with them about their efforts to promote sustainable fisheries and best practices (D. Imrie, personal communication, September 27, 2011). The trip also included a sustainable seafood lunch prepared by the Fisherman's Wives Association, and a boat ride out in Gloucester Harbor (O'Leary, 2010). The visit significantly changed their thinking about how they source seafood, and now, all of the seafood products Fletcher Allen purchases are sourced to match their new set of values (N. Dorry, personal communication, February 11, 2012), highlighted in the following section.

Since then, Fletcher Allen has begun to offer seasonal fish (Appendix F) through Black River Produce in its dining locations three times per week. They decide weekly, based on what is available, what they will offer to patients in the hospital and customers in retail locations. They have served local (by seafood standards, meaning not from the other side of the world) bluefish, redfish, and ocean perch, as well as trout from Idaho, wild sockeye salmon from Alaska, and are working on getting sustainably-harvested wild Northern shrimp from Maine on the menu. Fletcher Allen has also purchased seafood from a fisherman (a woman, actually) in New Hampshire, and often times will label the location where the fish being served was caught, the name of the boat that caught it, and the Captain of the boat (Figure 22).

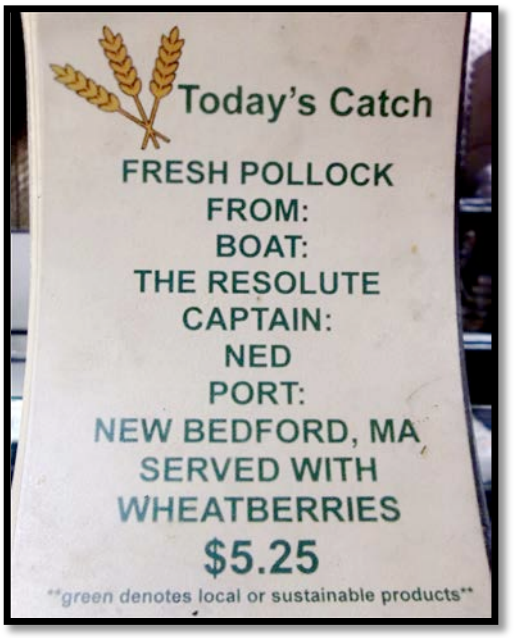

Figure 22. Seafood label in Fletcher Allen's Harvest Café, indicating the details of where the fish was caught. Photo by Sara Cleaver, 2012.

Imrie expressed how Fletcher Allen was working on getting rid of non-North American seafood, and trying to get more local, sustainable, and healthy seafood on the menu. She shared how the assessment of current seafood must come first, and focused her efforts on the top five fish served at Fletcher Allen (by poundage and dollar value). This, she said, made sense because beginning to make changes in the items that were big volume purchases would hold the most significance (personal communication, September 27, 2011). Fletcher Allen began their assessment using the following considerations/values in their fish and seafood assessment:

- Mercury levels
- From North America
- Whether or not it is shipped to process
- Population sustainability
- Monterey Bay Aquarium standards
- Hannaford's sustainable seafood policy, which requires traceability, data on stock sizes and harvest practices, and focuses on decreasing food miles

From there, the Fletcher Allen Center for Nutrition and Healthy Food Systems, under both Imrie and Jarmusz, worked with Black River Produce to achieve the sustainability goals they desired. Imrie recalled from her experience that the most successful way to go about offering more sustainable seafood on their menu was to choose the top three to five fish that were currently being offered that concerned them most in terms of sustainability, and hand-select replacements for them that aligned with their values. According to Imrie, in comparison to what

Fletcher Allen paid for seafood before they began this sustainable seafood program, "The fish in general has not been much more expensive – the team is careful to try stay well under $7.00 per pound" (personal communication, March 26, 2012).

There are a few key things to note about the seafood that Fletcher Allen offers. Imrie stated that because of the many issues associated with tuna, no tuna is being served, at least for now. Fletcher Allen also looked to Northwest Atlantic Marine Alliance's "Green Seafood Guidelines", which is expanded upon later in this research. Fletcher Allen shifted to fresh fish, and now always cut the fish the day they are serving it. The trout that they serve is from the West Coast, specifically Idaho, and is apparently "very popular for patients" (D. Imrie, personal communication, September 27, 2011).

However, hospital food services face many challenges that must be overcome; obstacles that universities or other institutions do not have to handle. In hospitals, even chefs need to be aware of the healing process. Comfort is a necessary element in healing, and for many people, comfort food is an important ingredient of comfort. So, Imrie also had to consider the question of what hospitals replace comfort foods such as tuna fish salad with, in her quest for sustainable seafood. Also to be considered, farmed fish is easier to swallow for patients who have throat issues (N. Dorry, personal communication, February 11, 2012). In light of these obstacles, Fletcher Allen continues to work towards solutions in sustainable seafood, and Fletcher Allen's sustainable seafood program is always evolving.

c) Community Supported Fisheries and Buying Local- NAMA

I held an in-person interview with Niaz Dorry on February 11, 2012. When Niaz Dorry first began her work in fisheries, she read that the primary problem was that fishermen were catching too many fish. She knew this was occurring, but she also heard that the secondary

problem was that there were too many fishing boats. Dorry realized that having too many boats does not necessarily equate to catching too many fish. However, the environmental community was concentrated primarily on how many boats were catching fish. Dorry explained how she quickly discovered that this was a false claim:

> If you look at what we're learning with rest of food system, it's like saying we have too many farmers growing [food] … You actually might need a lot of boats to fish at the right scale. So the more we got rid of boats, the most industrialized the fishery became because the effort that was put in by the small boats didn't get retired; it ended up being consolidated. And so suddenly you had an industrial boat taking the place of twenty small-scale boats. So you got this perception that you got rid of overfishing because you got rid of capacity, but you really didn't.

Since Niaz had this realization, NAMA has been focusing on the issue of scale, with a mission of restoring and enhancing "an enduring marine system supporting a healthy diversity and an abundance of marine life and human uses through a self-organizing and self-governing organization" (Northwest Atlantic Marine Alliance, 2012a). NAMA has not only worked on influencing fisheries policy but has also developed programs in the New England region to direct the seafood market towards local, small-scale fishing communities.

One of the areas in which NAMA has focused its market efforts is in community-supported fisheries, as well as farm to cafeteria strategies, chef and restaurant involvement, and hospitals. Community-supported fisheries (CSFs) are tailored after the community supported agriculture (CSA) model. Community Supported Agriculture programs have seen tremendous growth in popularity since the concept of CSAs was brought to Massachusetts from Japan in the 1980s. At present, over 1,000 examples of CSA operations have been documented in the U.S. (Northeast

Organic Farming Association of Vermont [NOFA], 2012). However, only 19 community-supported fisheries currently operate in the coastal United States (NAMA, 2012b).

Through CSFs, NAMA seeks to achieve its mission by considering environmental stewardship, local economies, and social improvements. CSFs allow consumers to purchase a share of locally caught seafood in the beginning of the season, and in return, receive a weekly delivery of the catch during the season. This early financial support helps fishermen with pre-season expenses until they can begin generating an income during the season. Shareholders also have the benefit of knowing exactly where their seafood comes from, and fishermen's profits can be improved while fishing less, because rather than throwing unwanted fish back, they are able to sell all of their catch (NAMA, 2012b).

Even with the CSF model, usually consumers cannot buy directly from fishermen. Federal law requires reported landings, which are the total quantity of all marine species captured, brought to shore, and sold or transferred to another person or party (Maine Department of Marine Resources, 2006). Reporting landings is a process that most fishermen choose to leave to the primary buyers. Instead of having their own federal license to sell seafood to consumers, fishermen sell their landings to a seafood dealer who then takes on the responsibility of reporting the landings. But successful CSFs ensure that these seafood dealers can tell you where the fish are from. These dealers that buy on a first-purchase basis (directly from the fishermen) are crucial to a successful CSF by creating a chain of local procurement and distribution, buying from day boats that work at a smaller scale of operations than industrial fishing vessels (N. Dorry, personal communication, February 11, 2012). Rather than there being many steps (distributors, processors) in the supply chain, CSFs eliminate most of the middlemen. Because of the more direct relationship created between fishermen and consumers, concerns about the

seafood being purchased are more likely to be addressed, and questions that consumers have can be answered. According to NAMA (2012b), the seafood-market transformation can occur through CSFs based on environmental stewardship, local economies, social improvements, and healthy regional food systems. CSFs promote marine conservation while cultivating economic opportunities in coastal communities. They also establish relationships between coastal and inshore communities while supporting natural resource-based livelihoods, and provide fresh, local seafood to those who participate.

However, the CSF model is driven by different motivations than the species-focused seafood guides. One of the goals of the CSF model is to have fishermen bring home 100% of what they catch, confident that they will be able to sell it. The alternative to this is tossing back already-dead fish that have no market value, so that fishermen can reach their quotas with species that hold high market value (N. Dorry, personal communication, February 11, 2012). Each species costs the same amount of money for fishermen to catch, and all species hold ecological value. The more selective consumers become, however, the more fishermen must focus on volume of the fish there is demand for. This is one reason a shift from species-centered red-yellow-green lists is necessary. Dorry explained that although these lists are "a good start, we need to go beyond them". These lists do not embody the role of each species within the marine ecosystem, and their usefulness as a consumer tool depends upon access to information and transparency within the seafood industry that does not currently exist. Just knowing the species does not allow consumers to make informed decisions about purchasing sustainable seafood. Dorry noted the pattern that develops when species are on the green list: they tend to migrate over to the red list as consumers focus on eating only "best choice" species.

Comparable to similar criticisms that MSC certifications are not presenting the assumed benefits to marine conservation (Jacquet et al., 2010; Pope, 2009; Smith, 2011), Dorry believes MSC labeling is a "feel good label for the purchaser…we are not seeing the ecological benefits of it". Aligned with much of the criticism about MSC, Dorry considers MSC to be a form of greenwashing, because of the lack of good it does for marine conservation (personal communication, February 11, 2012). But NAMA does have its own set of "Green Seafood Guidelines" (Figure 22), however they are mainly value-based, just like CSFs, rather than single-species based. NAMA's values encompass local procurement, small-scale fisheries, and framing seafood sustainability issues within a holistic ecosystem approach. Focusing on avoiding one species at a time does not reflect the natural interconnectedness of marine ecosystems. As one CSF acknowledged, "What gets delivered in a [CSF] share on any given day is up to Mother Nature" (Gloucester Fishermens' Wives Association, 2012, p.1).

Figure 23. NAMA's Green Seafood Guidelines (NAMA, 2012d).

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

One issue in seafood distribution is that the price consumers generally pay for seafood does not cover the costs of operation for the fishermen. The high cost gets distributed to those involved in packing, freezing, distributing, and transporting seafood at least hundreds of miles from where it is caught, and the fishermen never see most of this money (NAMA, 2012c). One project undertaken in Gloucester, Massachusetts used fishermen's tax returns to understand how much they were getting paid for their catches versus their business costs. Dorry described that on average across species, fishermen were earning about 64 cents per pound less than what they needed to be paid just to break even with their business costs. Though first and foremost a social

justice issue, from an environmental standpoint, this deficit again must be made up in volume, which means fishing for more fish. However, this would not occur if sellers along the distribution chain did not mark up seafood as much. “A lot of margin can be shaved in fishermen’s favor without the consumer having to pay extra” (N. Dorry, personal communication, February 11, 2012).

This margin can be “shaved” buying seafood closer to the source, where the consumer doesn’t pay for high costs of transportation and distribution, and more of the price goes directly to the fishermen. Another method calls for distributors paying the fishermen a higher price for their products, while keeping the cost of seafood high, but this does increase the cost to the consumer. Though NAMA works through both of these methods, community-supported fisheries are concentrated on providing fishermen with better prices for their catch. CSFs also enable communities to hold discussions on the seafood supply chain and to attempt to make the process of how fish end up on our plates less complicated (NAMA, 2012c).

Throughout the interview, Dorry explained her viewpoints of why seafood has not, as of yet, followed in step with the local food movement. She explained the emotional aspect involved in individuals and societies making this transition, and how we haven’t quite made this attachment to resources from the ocean. “We’ve had an animal protection element in it for chicken and beef, and many people have decided that it is okay to eat chicken and beef and other animals as long as we know they are not in CAFOs” (N. Dorry, personal communication, February 11, 2012). Most of the ocean-related campaigns have been concentrated on the charismatic megafauna, such as whales and dolphins. These are all also “very rightly placed values”, but, as Dorry put it:

> There is a way to not harm the whole marine ecosystem and still have access to seafood, and it is by applying the same principles we have applied to our chickens. And to then decide we are only going to get seafood from places that are not factory farmed seafood, that are not industrial-scale caught, that are appropriate for the marine ecosystem. (Personal communication, February 11, 2012).

Analysis of Best Practices- Recommended Strategies for UVM

a) Consuming Invasive Species- Asian Carp

Eating Asian carp as an approach to sustainable seafood possesses many benefits. There are also a number of reasons why UVM can and should utilize this approach. Eating invasive species aids in any remediation efforts to get rid of them. As Asian carp have the potential to be a serious threat to Lake Champlain, efforts to eradicate them are something that UVM should strongly consider participating in. Asian carp in Lake Champlain would directly affect anyone who uses the lake as some sort of resource, such as for recreation or as an educational resource for groups that enter the field. This includes the UVM population. Initiating an effort to remove this species would also educate consumers about the impacts that people can have on dynamic ecosystems, and how actions in one location (such as a lack of or ineffective action on the part of the federal or state governments dealing with Asian carp currently) can effect environments and communities far away. Rather than creating a demand for species whose populations may be declining, consumers would be eating a species that is abundant and not at risk of declining populations anytime soon (without our help).

Another environmental benefit of eating Asian carp is that coming from Illinois, it is very local in comparison to where most seafood we eat comes from. Other seafood usually travels around the world to reach our dining facilities, and eating more local fish would reduce

transportation costs and carbon dioxide emissions, as well as support the local food movement in a new way that has yet to really catch on.

In terms of social responsibility, the fishermen of the Mississippi and Illinois Rivers are always catching Asian carp, even when they are targeting other fish. Keeping those fisheries in business will require processors and consumers purchasing their catch, even if it is Asian carp. "No matter what the fishermen catch, there are Asian carp among the fish," said Steve McNitt, sales manager at Schafer Fisheries. "We have to buy what they catch to keep them going" (Wang, 2012, p. 1).

There are also economic benefits to purchasing Asian carp. At $0.14 (Schaper, 2006) to $2.35 per pound (R. O'Donohue, personal communication, September 22, 2011), Asian carp are vastly cheaper than other seafood. Additionally, the yield when cooking it can be very high, because grinding it (what chefs at Middlebury College found to be effective) reduces loss. Schafer Fisheries can fill large orders, so purchasing enough for seafood consumers at UVM would not be a problem. It only took Schafer Fisheries two days to fill a 175,000-pound order because of how plentiful Asian carp are along the Mississippi River. Smoked Asian carp products are also available from other processors. One company called Big River Fish sells several million pounds of carp meat annually (Wang, 2012).

As far as knowing how to prepare Asian carp and making it appetizing to consumers, chefs at Middlebury College have provided some simple ideas and the ingredients they used for how to prepare Asian carp (included in Appendix G). When asked if they had any suggestions for trying to offer Asian carp at UVM, Chef O'Donohue's response regarded how the staff can come up with their own ideas on how to serve it. "It almost boosted moral, because [the cooks] were able to do something themselves instead of take the recipe off the computer system. I think

that was a benefit of it." According to Michael Schafer of Schafer Fisheries, "the fish can be used for many different dishes with very favorable responses. Most people cannot tell it's fish because of its very mild flavor and it adapts to seasoning very well" (personal communication, January 26, 2011).

However, there are some challenges of this approach that will need to be considered if UDS decides to take on this sustainable seafood strategy. Chefs will need to work with the amount of bones in the carp, and experiment with ideas on how to prepare it. The ideas from Middlebury College chefs will be useful tools, but will still require some experimentation with ingredient proportions. One more consideration is that availability of Asian carp does fluctuate with the seasons. Schafer stated, "Some seasons are better than others depending on the cold of the winter". Mild winters yield a lot of fish, and river flooding usually causes a slow down, so seasonality is a bit unpredictable (personal communication, January 26, 2011). Because of this, any purchasing of Asian carp would need to be flexible, but UDS already purchases fish according to what is available. They do not choose seafood items for the menu far in advance because it is difficult to do so with any kind of fish, since availability, as well as price, is so unpredictable.

Purchasing Asian carp to serve at UVM would not be difficult, and the benefits outweigh the obstacles of doing so. The United States is the only country that doesn't eat carp (Martens, 2010), which goes to show that plenty of people around the world have developed preferences for it. UVM could play a part in the shift towards the consumption of Asian carp in the United States by offering it in dining facilities on campus.

b) Selecting Species of Most Concern

Offering carefully selected sustainable seafood holds a variety of benefits, depending upon the set of values an institution chooses as the criteria for the products it purchases. The benefits for this approach could vary depending on how much value is placed on certain objectives, such as offering more local seafood. At Fletcher Allen Hospital, because they focused on species for which sustainability was of most concern, they have avoided purchasing types of fish from populations that are at risk of being overexploited. By replacing the highest volumes and least sustainable fish, Fletcher Allen attempted to make a large positive change, rather than focusing on fish that they did not order all that often.

In this approach, it is advantageous for the institution to choose its own criteria for sustainability because the approach is designed based on the benefits that the people designing it, or the consumers, care about. If buying seafood from within North America were a goal, then one of the implied benefits would be reduced transportation costs compared to those of seafood from far away, as well as again reducing carbon emissions from transport. Moreover, as most institutions are largely focused on price, species can be selected based on their costs. Fletcher Allen chose to purchase species that are all well under seven dollars per pound.

If this approach were to be applied to the seafood that I assessed, the five species rated as "take off list" in Table 8 would need to be addressed first and foremost. UDS could either avoid these species entirely, or look into specific cases in which these fish are being caught or farmed in ways that would reflect the institution's values of sustainability. This approach would also call for looking into the species that UDS purchases the most of (by weight) to make sure they are coming from sustainable sources. This way, the species UDS purchases the most of, and therefore has the greatest impact upon, will be coming from credible, sustainable sources.

The barriers to this approach are few, since it is designed with the institutions' own criteria in mind. This approach would require UVM to take the time to decide upon a clear set of criteria to choose seafood by, including environmental and social responsibility, consumer preference, and cost. One possible barrier may be that the fish that were previously offered in the highest quantities may be the kinds that are most favored by customers, and therefore chefs may be reluctant to substitute these fish with something else.

c) Community Supported Fisheries and Buying Local- NAMA

After the interview with Dorry, I determined that the CSF model would not be best for UVM, but the idea of local procurement with input from NAMA is still a viable option. Therefore, the benefits/challenges analysis will be based on local procurement using NAMA's approach.

Dorry provided her point of view on response to the other ideas evolving in this research. Concerning consuming Asian carp, Dorry shared her belief that we should eat invasives as part of an eradication strategy, but to be aware of any larger marketing schemes. "Once people develop a taste for something, if there is demand for it, then fishermen and the market want to perpetuate [the species'] existence (personal communication, February 11, 2012). This would counteract any eradication goals in place, and those involved in commercial sale of those species would oppose strategies for completely eliminating the invasive species. Dorry does not support aquaculture, so marketing and eco-labeling schemes such as Global Aquaculture Alliance best be avoided, and UVM should look to other alternatives.

Noteworthy efforts that NAMA has been involved in could act as models for UVM and will be important to look to in terms of trying to achieve UVM's own sustainability goals for

seafood. One effort that some schools and hospitals have adopted is getting seafood locally, not necessarily through a CSF. At one university in New England, a woman sells out her fishing boat and is able to provide one hundred pounds at a time to the school, so the price is affordable. However, this only occurred through the university's conscious choice to add more values to their sustainability criteria and to embrace local and small-scale fisheries (N. Dorry, personal communication, February 11, 2012). Dorry suggests that institutions work through the already-existing distribution mechanisms (such as Black River Produce) and put pressure on them to ask questions of the source regarding where the seafood they purchase comes from. NAMA is working on mechanisms to send a large proportion of locally caught seafood to the region's universities.

This approach has numerous benefits. It promotes ecological stewardship that results in creative, community-based approaches to marine conservation. Because 100% of the catch that fisherman bring to port gets sold, nothing is thrown back as waste, and choosing to purchase more local seafood reduces carbon emissions from transportation. Social responsibility benefits include fostering economic opportunities that support natural resource-based livelihoods in local communities, and buying closer to the fishermen can establish a relationship between communities by providing fresh seafood. Additionally, the consumer benefits by having closer contact with the fishermen, which allows consumers to know more about their food.

This approach to sustainable seafood would be a plausible option for UVM, just as the other approaches are. The Northwest Atlantic Marine Alliance would set up an opportunity for the university to meet fishermen in Gloucester and hear about what it means to them to have seafood sourced locally and be paid a fair price. As it is important for chefs to be a part of this process because they are the ones answering consumers' questions, the executive chef(s),

procurement officer(s), and representative(s) from the Office of Sustainability at UVM could all participate in this opportunity to go to Gloucester.

The steps involved and the relationships required to begin using this approach would not be difficult to accomplish. There is someone in New Hampshire who wants to deliver fresh seafood to Vermont, and Niaz Dorry has offered to set UVM up with this contact. Additionally, the very first step taken could be as simple as taking shrimp off the menu, which parallels the "Selecting Species of Most Concern" approach. Other universities in New England are already leading the way in "Fish-to-school" programs, such as the University of New Hampshire, providing UVM with models to follow. If other universities in New England have taken further steps in sourcing sustainable seafood, UVM can make steps towards achieving seafood sustainability as well.

The only challenges to this approach include finalizing ties between UVM and seafood providers and determining the cost of seafood from local fishermen or distributors. NAMA would play a large part in assessing how to provide local seafood to institutions, but Niaz Dorry has claimed that it is certainly possible. As with any of the approaches, seasonality is a factor, but UVM could choose seafood based on local or regional availability, and there are a number of options to work with at any time during the year (Appendix F). Connecting to local fishermen through the Northwest Atlantic Marine Alliance is a viable approach to seafood sustainability for UVM.

3) Satisfying UVM's Sustainable Seafood Needs

The report developed for University Dining Services and the UVM Office of Sustainability can be found in Appendix J. The report explains how we are currently at an ideal time for UVM to take advantage of this opportunity to switch to an original sustainable seafood

movement, beyond the MSC and BAP program recently implemented as the university's method for sourcing sustainable seafood. Included in this report is how Sodexo's current sustainable seafood initiative is an improvement from having no specific criteria by which to choose seafood, as well as reasons why this method does not go far enough to ensure the seafood being offered is sustainable. Furthermore, I have described the three recommended approaches to sustainable seafood that UVM should consider. These recommendations consist of: 1) sourcing Asian carp, 2) removing the most concerning species (from sustainability and/or health and contamination standpoints) from UVM's menu or finding more reliable sustainable sources for these fish, and 3) sourcing seafood from relatively local, small-scale fisheries with the help of Northwest Atlantic Marine Alliance. I have also identified benefits & challenges of each approach within the report, and listed general objectives that should guide further action at UVM. Lastly, I proposed preliminary tasks that I believe are manageable and achievable ways for UVM to begin a new sustainable seafood effort; tasks that should be expanded upon in the future to create a comprehensive sustainable seafood initiative, comparable to the three that I have studied in my research.

4) Analysis of Outcomes

Through the Grounded Theory approach, I allowed the results of this research to formulate my theories about UVM's seafood. However, I did find some of the beliefs that I had formulated surrounding the seafood industry in general (based on prior experience trying to purchase sustainable seafood myself) to be proven true during this thesis. I had thought that unless the investigator has the ability and professional expertise to physically travel and trace seafood to the exact fishery and fisherman that caught it, often times the best we can do to

achieve seafood sustainability is rely upon third-party certification programs or distributors to assure us that our fish come from a sustainable source, even though some of these certifications are under much criticism. I found this to be largely true under the current model for the seafood industry. However, I did uncover other models that strove for more sustainable seafood and greater transparency in sourcing seafood, which would allow an increased knowledge of where our seafood comes from and how it was obtained.

This investigation into both the seafood that UVM offers as well as alternative seafood sustainability initiatives demonstrates how being well informed about the sustainability of the seafood we eat requires more than knowledge of which species we consume. It calls for an in-depth understanding of specific populations, fishing and farming practices, and ecological interactions between species. It also compels us to consider the scale at which fish are harvested, how the fishing community is supported, and how far fish travel from sea to plate.

UVM underwent changes (though it cannot be determined what the changes meant for seafood sustainability as of yet) in the seafood it offered on campus in the spring of 2011 to now, the spring of 2012. Though Sodexo initially thought they would be buying CleanFish products (CleanFish is one company that UDS expressed they would be sourcing seafood from), UVM now offers increasing amounts of MSC and BAP certified seafood, which is one clear outcome of this research. However, because of the criticisms surrounding these certifiers, it is unclear to what extent UVM's seafood is more sustainable than it was previously. It may be seafood that is in some ways more sustainable than the seafood UVM offered before, but a specific quantitative finding of what this switch to MSC and BAP certified seafood does for ocean sustainability is undetermined.

This research demonstrated that better alternatives to sustainable seafood exist and have succeeded elsewhere. The alternatives I investigated may or may not make sense from a convenience, consumer preference, economic, or commercial standpoint if they were to be implemented as a part of UVM's sustainable seafood program. Because many factors such as those mentioned still remain to be investigated, the final verdict on any sustainable seafood effort at UVM is forthcoming.

My definition of "sustainable" in terms of seafood and fisheries was significantly modified through this research. The concept of sustainability, when concentrating on seafood, must encompass an incredible array of ideas, beyond what is indicated on the red-yellow-green lists. Transparency, first and foremost, is required in order to move forward with a sustainable seafood initiative. Without having access to accurate information on the products being purchased and sold, we cannot explore their sustainability or identify what needs improvement. Additionally, the distance seafood travels to the consumer was another theme that emerged from this research. In a place like Vermont, no seafood would be considered local if we applied the same standards for local that we do to other products such as produce. "Local" seafood may really be what most would consider regional. Seafood from the northwestern Atlantic (the northeast coast of the United States) would be the most comparable to local standards. Seafood from the east coast of the United States, or the Midwest freshwater fisheries, such as Asian carp in the Illinois River, seem to be in the next zone- still the same region of the world, but more than 1,000 miles away. Even Fletcher Allen's standard of purchasing seafood from only North America is of closer proximity than purchasing seafood from all over the world. The occurrence of which "local" seafood was mentioned during my research led to the realization that

procurement of relatively local or regional seafood was another major aspect of developing an effective sustainable seafood initiative.

The other significant factor of seafood sustainability that came out of this research was the issue of scale. Though the idea of scale was not as apparent or frequent as those of transparency or proximity, it was highlighted as a crucial characteristic of the Northwest Atlantic Marine Alliance's approach, and was important in Fletcher Allen's sustainable seafood initiative as well, as they now obtain seafood from some of the small-scale fishermen NAMA works with. Fisheries will not last if we continue to exploit them on an industrial scale. Furthermore, we will only be able to sustain economic stability for more people if small-scale fisheries are supported, because of the many more people that are employed by small-scale fisheries than industrial fisheries (Appendix B). Through this research it has become evident that seafood sustainability requires a considerable degree of attention on transparency within the seafood industry, proximity to the source, and the scale of fishing that occurs.

Discussion

1) Limitations to the Data

As with any type of research, this thesis held several limitations. The limitations highlighted are necessary to gain a full understanding of what could and could not be controlled for within this study.

A few limitations are products of my knowledge and position as a student. I have not had any formal education in food systems, which may have proved to be helpful in this area of research. Looking back, I would have worked more with the UVM Office of Sustainability in addition to UDS. The possible gaps in my knowledge combined with the changing statuses of fisheries health and fishing practices restrict my ability to navigate the complex seafood industry with complete certainty. Moreover, this thesis represents research conducted over the course of about one academic year or so, and UVM data does not reflect information from all dining facilities. Trends in the data are short term, and a lengthier period of time would lend a clearer picture of UVM's seafood sustainability. I was also unable to consider most economic factors, which are vital to the development of any initiative at an institution such as UVM. Analysis of the economics behind sustainable seafood would require much more research and would depend heavily on future data, such as what kind of seafood UVM decides to purchase in the future, and what upcoming fish prices will be.

As a student I can also only access certain information. Because of this, I had to do my research based on what UDS provided me. Occasionally, many questions or inquiries I had for UDS or my other information sources were not addressed for one reason or another. For this reason, I had to put faith in my sources that they were providing me with credible, honest, and accurate information.

Similarly, throughout this research looms the overarching caveat that we do not always know that the seafood we have on our plates is necessarily the type of fish that we expect. Seafood fraud is a huge problem, but for the purposes of this research, I assumed that the types of seafood listed were indeed what they say they were. Since genetic testing was not a part of this research methodology, there was no way to be sure (see part 2, "State in Flux", for more on genetic testing in fish).

2) State in Flux

Just as marine ecosystems and fisheries are constantly changing, the issues and solutions related to them are in a constant state of flux. Recent events concerning seafood sustainability include specific changes at UVM, issues with seafood fraud, and new tools for tracing where the fish we eat come from.

Prior to the spring of 2012, UDS did not have any sustainable seafood program in place (T. Oliver, personal communication, March 23, 2011). Head chefs of each dining facility made the decisions about which kinds of seafood to purchase, and sustainability was not a priority. The seafood offered at UVM was decided by what kind of fish chefs wanted for a particular meal, the availability, and price of the fish (J. Brandes, personal communication, March 13, 2012). The sustainability, nutrition, and contamination concerns were either left up to those selecting the seafood further down the distribution chain, or ignored entirely. Although the way these decisions have been made is still much the same, changes in seafood at UVM have recently come about.

As of the spring of 2012, UDS began implementing Sodexo's Sustainable Seafood Initiative as part of Sodexo's *Better Tomorrow Plan*, the company's global roadmap for

sustainability. This involves having all Sodexo seafood certified as sustainable by the MSC or GAA by 2015 (Sodexo, 2011). The seafood will be both wild and farm-raised fish, but it will all be frozen. One outcome of this initiative is that more of UVM's seafood is now coming from Sysco, rather than Black River Produce. However, just as prior to this initiative, concerns regarding sustainability, nutrition, and contamination are left to the providers of what is now MSC or BAP certified seafood. UDS leaves such matters to those who are doing the certifications, and puts faith in those organizations that they are doing an acceptable and accurate job of certification to ensure sustainability. Another new initiative that emerged is Sustainable Seafood Night, which occurs weekly throughout dining facilities on campus. This entails serving MSC or BAP certified seafood (Figure 24), and providing some educational materials on Sodexo's sustainable seafood initiative to customers (J. Brandes, personal communication, March 13, 2012). In spite of these new occurrences, it is still not possible for the average consumer to figure out where the seafood served on the UVM campus comes from (see Appendix H for Sysco products form). But even if it were easy for a consumer to know where the seafood on their plate is supposed to be from, seafood fraud makes the already-convoluted issue of seafood sustainability even more complicated.

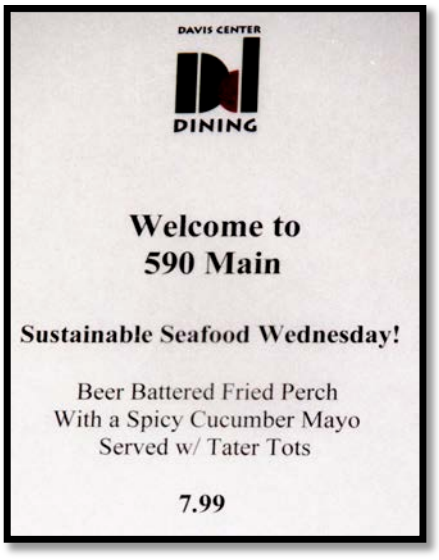

Figure 24. Menu for one sustainable seafood night at the Davis Center Marketplace.
Photo by Sara Cleaver, 2012.

In the fall of 2011, the Boston Globe published a five-month investigation on the mislabeling of fish, confirming that "Massachusetts consumers routinely and unwittingly overpay for less desirable, sometimes undesirable, species - or buy seafood that is simply not what it is advertised to be" (Abelson & Daley, 2011, p.1). DNA analyses conducted by a lab in Canada showed that 87 of 183 samples from the Boston area were misidentified when sold to consumers – approximately 48%. In addition, another 2011 study conducted by the Washington, D.C.-based nonprofit Oceana discovered mislabeling when it conducted DNA tests of fresh and frozen fish at 15 Boston area supermarkets (Abelson & Daley, 2011, p.1). Often times, the fish were advertised as local catch, but were actually caught thousands of miles away. Fox's 2008 study found 6 out of 8 fish labeled as wild salmon were actually farm-raised (as cited in Gibbon, Hastings, Hirsch, Hislop, & Stevens, 2010). Even endangered species showed up in some samples, meaning that consumers may be unknowingly buying fish from unsustainable fisheries while believing otherwise. Jacquet & Pauly's 2008 study found that over one-third of all fish are mislabeled, and this number may have increased over the past few years.

Renaming and mislabeling fish has proven to have some beneficial outcomes for sellers, preventing 'eco-aware' consumers from making effective purchasing decisions on behalf of conservation. Farm-raised Thai shrimp (accounting for nearly 30% of global production) are often exported and labeled as 'wild- caught' which are more eco-friendly. Sellers are able to do this because of the lack of traceability (Jacquet & Pauly, 2008). Some fish are often mislabeled to avoid high tariffs when exported to the United States (Abelson & Daley, 2011). If not even for environmental, ethical, or economic reasons, seafood fraud should be addressed on the basis of consumer health and nutrition. Worldwide, there have been numerous instances of seafood consumers being hospitalized or falling ill due to toxins, or oils that cause gastrointestinal

problems- all due to mislabeled fish that shouldn't have been eaten (Abelson & Daley, 2011). Seafood fraud is clearly an issue that stretches far beyond depletion of species of fish whose very existence may be in jeopardy.

It is not surprising that those who sell seafood can get away with rampant seafood fraud, as just 2% of the seafood eaten in the United States is inspected, according to Oceana (Carpenter, 2011). The Food and Agriculture Organization claims that the United States has mandatory traceability requirements (2010), but this existing government regulation is not complete for fish imports and does not require sellers to label or trace seafood in a way that creates a clear chain of custody (Gibbon et al., 2010). No standardized method exists for seafood buyers to easily follow the seafood chain of custody (Gibbon et al., 2010). But even though seafood fraud is a serious setback for seafood sustainability efforts, ideas to respond to this corruption are constantly developing. One proposed idea is that of seafood tracing. Tracing, or traceability is "a policy designed to increase consumer confidence in the food supply" (Thompson, Sylvia, & Morrissey, 2005). Some tracing programs in their beginning stages have emerged from private organizations, such as Trace Register and FishSource, which attempt to trace products from their place of origin to the consumer, or monitor fisheries for sustainability. Certification programs, such as MSC, are types of tracing schemes, using third-party verification rather than online reporting or product tagging with barcodes. But these are voluntarily programs and tools that distributors must pay for. Though one widespread tracing mechanism is not yet in place for seafood, traceability systems are increasingly being used. Traceability will continue to be a crucial part of the evolving seafood industry, and will be vital to remedying the failures in the seafood supply chain (FAO, 2010).

3) Activist Account- Future Research and Next Steps

Action research can "contribute to people realizing their values – envisioning a preferred future and organizing effectively to achieve it" (Elden & Chisholm, 1993, p.127). This research on sustainable seafood can enlighten us as to what our "preferred future" of sustainable seafood at UVM might be. I delved into this research initially assuming I had three distinct ways to go about overcoming the challenge of sourcing more sustainable seafood. After interviews and analyzing these three cases, I discovered the following overarching results:

- The approach that Fletcher Allen has taken is not all that different from NAMA's approach. They both require focusing on the individual/group/institution's values and acting on those values.
- I found that applying any of these approaches would mean UVM buying more local seafood, and effective change would require small steps at first, like making substitutions for certain seafood or just trying one new kind of fish.
- All of these approaches are being implemented elsewhere, with seemingly successful responses, reactions, and results. They are not far-off, unlikely, or unauthentic solutions. In fact, they are tangible, potential solutions to real problems that affect more than just the state of the oceans.

Though important findings came out of this "action research", this study was not completed without difficulties that often times impeded progress. Changing circumstances of Dining Service's plans for sustainable seafood caused the methods to be altered, and awaiting peoples' responses that were critical to this research frequently slowed the progression of this thesis. Constant frustration with the way things are in the seafood industry often blocked my optimism for the future of this industry as well. Creating change within a system that has been developing over many years is not easy. Especially in America, our rigid thinking about eating what we are familiar with, what is most convenient, and what is least costly, prevents us from questioning norms and transforming the status quo, even if a transition is more logical and ultimately benefits society. If we can focus on our values and not be quick to judge original, unique ideas for sustainable seafood, these ideas may catch on and generate practices that are

actually very worth-while. Creating a demand for seafood that encourages sustainable fishing practices, supports local fishing communities, and increases transparency in the supply chain is a multi-step process. It is one that will require substantial effort and partnership beyond the completion of this thesis.

Though the research for this thesis may be finished, the task of offering more sustainable seafood at UVM is in its nascent stage. A lot must still be addressed, but the research that has been conducted can bring clarity to the process of obtaining more sustainable seafood at UVM. The following is a list of steps that will be necessary to carrying out this project. I believe these steps to be necessary, but possibly not sufficient on their own, to a new sustainable seafood initiative at UVM.

1. **Meet with UDS and UVM Office of Sustainability to share findings**– I have contacted Gioia Thompson (Appendix I) in regards to setting up a meeting with her and UDS in which we can discuss which of the three pathways that I have researched UVM can pursue further. It would also be a way to make the necessary introductions between UVM and contacts such as Schafer Fisheries or Niaz Dorry, who may be crucial in latter steps of the process.

2. **Gain momentum behind the movement, educate consumers-** In the past, the student body of UVM has been successful at putting pressure on Sodexo/UDS to change their practices and purchases. To offer more sustainable seafood on campus, consumers must make it clear to Dining Services that they want to see this change occur. Until the university communicates that it values transparency in our seafood supply chain, and that we want to know where our food comes from, UVM's seafood suppliers will not change their practices. We want our behaviors as a university to reflect our values. The ultimate goal would be that chefs should be able to tell the customers where the fish being served was caught, and how. Smaller steps to achieve this goal:

a. Assess the desire of the UVM community to have more sustainable seafood on campus, beyond what the university currently offers. Surveys of consumer beliefs and requests for changes must be analyzed.
b. Get already active environmental/animal rights groups involved and motivated to act. Outreach emails can be sent to the Vermont Student Environmental Program (VSTEP), who just recently achieved the bottled water ban, Students for True Animal Rights (STAR), the Environmental Program, the Rubenstein School of Environment and Natural Resources, and other pertinent student groups or specific classes.

3. **Establish a relationship between UVM and Schafer Fisheries (Michael Schafer)**, **and/or NAMA**, depending on approach chosen. Niaz Dorry has offered to make the introductions necessary to set up a trip to Gloucester for UVM representatives to meet with fishermen. This would be an opportunity to strengthen ties between UVM and the coastal fishing communities, hopefully resulting in a connection between UVM Dining Services and a seafood distributor that is focused on supporting local communities and sustainable fishing efforts.

4. **Take more steps to ensure we really know where our food is coming from-**

GreenPeace suggests the following for a sustainable seafood procurement policy, stating that the minimum information required to judge the sustainability of a seafood product is:
- The common and scientific name of the species
- The fishing technique, or the aquaculture method used
- The fishing area (to stock level), or country of aquaculture (to farm level).

Although this would be just a starting point, I encourage UVM at the very least to require our seafood supplier to provide us with this information. This would leave UVM with accurate information to expand upon in attempts to create a more sustainable seafood initiative on campus.

Epilogue

"There is a way to fish, and then there is extraction of seafood. We need to support the people who fish." –Niaz Dorry, personal communication, February 11, 2012.

Upon diving into the field of sustainable fisheries and the seafood industry, I had an understanding of my passion for the subject, but did not know how absorbed I would become in many of the documents that I had a chance to read. I quickly realized that every new article or piece of information I gained was in some way relevant to this thesis, because of its relevance to sustainable fisheries. This presented a challenge in writing my thesis, especially my review of literature and the state in flux. The interconnectedness of the issues called for an extension of the span of the topics I wrote about in order to encompass many of these elements of ocean sustainability. Even so, including all of those elements would reach far beyond the boundaries of an undergraduate thesis.

Despite the various challenges I encountered, this thesis became a meaningful, personal journey. It started to evoke questions about ethics, morality, and spiritual attachments to the natural world. It also awakened memories of my Grandfather and what fishing was to him; a science and an art interwoven into one, and how most of the commercial fishing industry today is something he would hardly recognize as fishing. I assume that my grandfather would share this same sense of betrayal of the natural world that I feel when witnessing the commercial fishing industry today. The work I accomplished in my research, combined with perfectly-timed, articulate works surrounding my grandfather's life as a fishermen, explorer, scientist, and artist, activated the meanings some of his lessons (or at least what I have interpreted them to mean) that I had not yet entirely understood. Though I intended this thesis as a methodological synthesis, analysis, and interpretation of data, it undeniably turned out to be a lot more.

Conclusion

> We believe the more we know about what happens to the fish that end up on our plates the more likely we are to get involved in the policy level changes that need to take place to ensure that the oceans are healthy enough to continue feeding us – and all the other creatures that feed on the seas – for generations to come.
>
> -Northwest Atlantic Marine Alliance, 2012d

As the growing human population continues to depend upon a finite supply of food, managing ecosystems (marine ecosystems among them) will remain a daunting task. According to Daniel Pauly, a leading expert in marine fisheries, small-scale fisheries "may be our best hope for the sustainable management of coastal marine resources" (Packard & Monterey Bay Aquarium, 2011). We also know that transparency in the seafood industry is vital to ocean sustainability, and supporting local fishing communities through purchasing power can promote their survival. My desire is that these values will become key aspects of how UVM sources sustainable seafood in the future.

It is my hope that the culmination of this thesis represents what is really the beginning of a new way of thinking about where the University of Vermont's seafood comes from. Since I gained a great deal of my knowledge about the environment while attending UVM, it is my wish that this thesis and any of its future outcomes leave a lasting impression at the University of Vermont, in the form of enhancing the university's environmental sustainability. Though it may take time and collaboration, the outcomes of moving forth with opportunities for seafood sustainability will offer the University of Vermont a chance to once more be a model institution in the realms of environmental and social sustainability.

As this project is still in an emerging phase, questions are left to be answered pertaining to the future of sustainable seafood at UVM. Whether or not UDS follows through with the university's commitment to the environment will depend upon consumer behaviors. We must

pay attention to the source and scale. Among us are consumers, students, educators, environmentalists, animal rights activists, and thoughtful, ethical people who understand the ideas and benefits of local food, and the importance of knowing where what we eat comes from. Not applying what we know about sustainability to the seafood offered at UVM generates dissonance between our beliefs and our actions. It is in our hands to reach a level of seafood sustainability that is in harmony with our values.

Seafood sustainability requires not only taking into account the condition of certain fish populations, how they are caught, and contaminants that affect human health, but also how much we really know about the seafood we consume, how far it travels to reach us, and how we sustain small-scale fishing communities. A truly sustainable seafood program will embrace all of these critical ingredients. Current limitations in the seafood industry leave room for many possibilities for seafood sustainability. We must use our consumer power carefully and consider the ramifications of our actions if we want fish to remain one of the last wild foods. Not much else compares to a wild fish to symbolize the perpetual magnificence of nature, and as such, wild fish are worth conserving.

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Appendices

Appendix A- Beneficial, capacity-enhancing and ambiguous subsidies for developed and developing countries

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

Sumaila, U.R., Khan, A. S., Dyck, A. J., Watson, R., Munro, G., Tydemers, P., & Pauly, D. (2010). A bottomup re-estimation of global fisheries subsidies. *Journal of Bioeconomics, 12*. 201-225.

Appendix B. Schematic illustration of the duality of large and small-scale fisheries prevailing in most countries of the world (statistics are global).

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

Jacquet, J., & Pauly, D. (2008). Funding priorities: Big barriers to small-scale fisheries. *Conservation Biology, 22*(4), 832-835.

Appendix C. A Simplified Seafood Supply Chain

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

Roheim, C.A. (2008). Seafood supply chain management: Methods to prevent illegally caught product entry into the marketplace. Retrieved from cmsdata.iucn.org/downloads/supply_chain_management_roheim.pdf

Appendix D. National Seafood Watch Pocket Guide

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

Monterey Bay Aquarium Foundation. (2011). Select a Seafood Watch pocket guide. Retrieved May 1, 2011, from http://www.montereybayaquarium.org/cr/cr_seafoodwatch/download.aspx

Appendix E. Interview Questions

Questions used to structure interview with Chef Richard O'Donohue, Middlebury College:

1. How did Middlebury choose Asian carp/ how did this initiative come about?
2. When did this shift occur?
3. Did Asian carp replace another type of fish on their menu?
4. Does Asian carp seem to be successful on the menu for students (do they seem to enjoy it as much as other fish)?
5. How does the price of Asian carp compare to that of previously (or currently) purchased fish?
6. Is there specific seasonal availability of Asian carp? What do you do when there is less supply to make up for it? In other words, what changes in the menu are seen when Asian carp are not in season?
7. How did your dining services go about locating a specific fishery to supply Asian carp?
8. Have other fairly local species been recommended to you?
9. Do you believe that having Asian carp on the menu is something that may only be possible for smaller schools, because they have to feed fewer students, or would it work at an institution as large as UVM, thoughts on this?
10. What other seafood is on Middlebury's menu, where is it sourced from, do they know it is sustainable and if so, how?
11. Is there anything in particular that you would suggest to try to get an initiative such as this at UVM?

Questions used to structure interview with Diane Imrie, Director of Nutrition Services, Fletcher Allen Health Care:

1. What seafood is on the menu at Fletcher Allen?
2. Where is it from (distributor, fishery, any amount of information on where it is from that she has, or who I could talk to- also known as snowball sampling)?
3. How do you know it is a sustainable source?
4. Would you recommend similar fish and distributors for UVM Dining Services?

Questions used to structure interview with Niaz Dorry, Coordinating Director of Northwest Atlantic Marine Alliance:

1. First, I'm curious as to how and why you got involved in this work- I understand you started working on toxic pollution issues. I'm curious about your background in general.
2. Can you tell me a little more about your work and the CSF approach? How did this idea come about?
    a. So you worked with Fletcher Allen to help them get fish from Gloucester twice a week. Can you tell me about this?
    b. Do they still get some fish from other places, or only through your CSF and NAMA?

- Do you have any suggestions regarding how to work through the sustainability of a distributor's fish, what is an effective way of purchasing fish from a truly sustainable source? Would we do this through BRP? If not, how would this work? I want to propose something to UVM Dining Services.
- So if UVM were to do this, would the CSF be Gloucester- is that the closest one that is open year-round?
- Have you seen decent models for large institutions (such as UVM) to achieve highly or at least acceptable levels of sustainability in regards to seafood? Contracts are difficult to sever!!
- What are your thoughts about MSC?
- What do you think of the consumer-education focused efforts such as Seafood Watch?
- What about eating invasive species, even if they are not local (such as Lionfish and Asian carp)? Do you think there will be a demand for this, do you think it is a good demand even if it is non-local?
- What would be the most important things for me to keep in mind for this project?
- Do you think that in Vermont we should even be eating seafood?
- How do you on an individual/personal level, make your seafood choices?

Appendix F. Seasonal Availability Chart for New England Seafood

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

New Hampshire Seafood- Fresh and Local. (n.d.) NHSeafood.com. Retrieved from www.nhseafood.com.

Appendix G. Recipes for Asian carp from Middlebury College

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

Appendix H. Sample Sysco Invoice, Spring 2012

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

Appendix I. Email to Gioia Thompson, UVM Office of Sustainability, February 22, 2012

Dear Gioia,

I am working on an Honors College thesis with Stephanie Kaza and Joe Roman on sustainable seafood at UVM. I have been working a little bit with Dining Services trying to get more sustainable seafood on campus, and as an end result of my thesis, am going to propose a few possibilities for UVM in terms of from where the university obtains its seafood. Now I know that we have contracts with Sodexo, but I know that buying local produce from Vermont farmers apart from those contracts has occurred to a great extent on campus, and I am looking to do this type of thing with seafood. Even if we can just begin to source some of our seafood from other places, this would be a huge step.

Recently I had an interview with Niaz Dorry, the coordinating director of Northwest Atlantic Marine Alliance (NAMA), who specializes in connecting local fishermen with consumers. You may be familiar with the efforts that Fletcher Allen has taken with their seafood, and some of this effort has been through collaboration with NAMA. A chef, the sustainability coordinator Diane Imrie, and a procurement officer all visited fishermen in Gloucester alongside Niaz, and found a way to set up a connection (through Black River Produce) with small-scale fishermen in the Northeast.

I was hoping to talk to you about the possibility of making this happen, seeing as UVM's values are reflected in our actions as an institution in many ways, such as the water bottle ban and buying local produce, but ocean sustainability seems to have been left out of our decisions as consumers, until now. Other large universities in New England have begun to take similar steps, and I know we could do our part to do so as well. Please let me know how we could get this going, because I believe it is a crucial part of maintaining UVM's excellent reputation of environmental stewardship.

Appendix J

Report on Sustainable Seafood at UVM
for University Dining Services & UVM Office of Sustainability

An Analysis of Sustainable Seafood at UVM

May 2012

Prepared for: University Dining Services & UVM Office of Sustainability

By Sara Cleaver
College of Arts & Sciences
The University of Vermont
Environmental Studies Senior Thesis

"It is ever more apparent that the health of individuals and societies alike is inextricably linked to the health of food sources, including the ocean. Consumers are beginning to demand food that not only tastes good but also is better for the environment".

-Johnson, H., Redman, P., & Seafood Choices Alliance, 2004

To University of Vermont Dining Services and the UVM Office of Sustainability:

The following is a brief report of the sustainable seafood possibilities I looked into for my undergraduate Environmental Studies thesis during the year of 2011-2012. UVM's values are reflected in our actions as an institution in many ways, such as the water bottle ban and the increasing proportions of local produce offered, but ocean sustainability seems to have been left out of our decisions as consumers, until now. Other large universities in New England have begun to tackle the issue of sustainable seafood, initiating "fish-to-school" programs, and this would be an excellent opportunity for UVM to participate in something similar. I believe further addressing the issue of seafood sustainability is a crucial part of maintaining UVM's excellent reputation of environmental stewardship. The shift to caring more about where our food comes from, for environmental, social, health, and economic reasons, has occurred for land-based foods, and UVM has followed, but now we must apply this same ethic to foods derived from the sea.

Sodexo's recent commitment to source 100% Marine Stewardship Council or Best Aquaculture Practices-certified seafood by 2015 is a step in the direction towards seafood sustainability. However, the range of issues involved in determining whether seafood is "sustainable" is incredibly complex. We cannot assume that a label is going to match the values of the student body, or UVM's values as an institution. Considering the many criticisms regarding Marine Stewardship Council, other certification schemes, and even seafood guides, after a year's worth of research it is my hope that UVM will also consider the recommendations for sustainable seafood that I have investigated, in order to ensure that UVM lives up to its title as "The Environmental University".

A vast amount of literature shows that the Marine Stewardship Council certification scheme attempts to help fisheries a step in the right direction towards sustainability, but a significant number of credible critics agree that MSC must undergo major reform before marine fisheries are managed properly enough to ensure long-term sustainability.

A few main criticisms of MSC:

- Some fisheries have been granted certifications that studies have concluded are not sustainable (Wallace, 2011).
- Certifying fisheries will not help increase stock size (Gudmundsson, 2000), and in some cases declines in biomass can actually be found among MSC certified fisheries (Jacquet et al., 2010)
- MSC may lower its standards of certification because of conflicts of interest and economic incentives (Grescoe, 2008; Jacquet et al, 2010).

Additionally, UDS should have a set of criteria by which to source its seafood. These criteria should reflect the University of Vermont's commitment to the environment:

1. Reduce harm to the environment by using purchasing power to choose species from sources that have been thoroughly investigated by credible experts, rather seafood products with certifications or labels that may be under criticism.
2. Support small-scale fisheries and relatively local fishing communities when possible.
3. Maintain economic vitality despite changes to UVM's seafood sources.

The following are recommendations of ways to obtain seafood from sustainable sources according to these criteria, as well as the benefits and possible challenges of each approach. These recommendations are not mutually exclusive, and can (and should) be combined to create an even more successful, wide-ranging sustainable seafood initiative at UVM.

Recommendations

Recommendation 1: Selecting Species of Most Concern

Diane Imrie, the Director of Nutrition Services at Fletcher Allen Hospital, began working with Health Care Without Harm to support sustainable fisheries and local fishing communities. One of the first steps of this process was going on a trip to Gloucester, organized by Niaz Dorry from the Northwest Atlantic Marine Alliance (NAMA). During this trip, Imrie, Executive Chef Richard Jarmusz, and other representatives from Fletcher Allen (such as procurement officers) heard from the fisherman and the organizations working with them about their efforts to promote sustainable fisheries and best practices. The trip also included a sustainable seafood lunch prepared by the Fisherman's Wives Association, and a boat ride out in Gloucester Harbor (O'Leary, 2010). The visit significantly changed their how they source seafood (N. Dorry, personal communication, February 11, 2012).

Since then, Fletcher Allen has begun to offer seasonal fish from Gloucester through Black River Produce in its dining locations twice a week. They have served bluefish, redfish, ocean perch, trout from Idaho, wild sockeye salmon from Alaska, and are working on getting sustainably-harvested wild Northern shrimp (from Maine) on the menu. They are working on getting rid of non-North American seafood, and trying to get more local seafood on the menu. These options, in comparison to the long distances most seafood travels from sea to plate, is much more local. Imrie recalled from her experience that the most successful way to go about offering more sustainable seafood on their menu was to choose the top three to five fish that were currently being offered that concerned them most, and select replacements for them that aligned with their values. This made sense because beginning to make changes in the items that were big volume purchases would hold the most significance (personal communication, September 27, 2011). Additionally, Fletcher Allen has overcome an extra layer of challenges that come with offering certain foods in hospitals, that as a university, we do not have to encounter, making this approach even more plausible for UDS to achieve.

Benefits for this approach depend upon the values and criteria the institution chooses:

- Because the institution can choose its own criteria for sustainability, the benefits for this approach could vary depending on how much value is placed on certain objectives, such as buying local.

- Species to purchase can be selected based on costs

- If the university focuses on a few species that are of most concern, benefit is that UDS replaces highest volume, least sustainable fish with more sustainable fish.
    - After investigating seafood offered in three UVM dining halls from September 2010-August 2011, there are five types of seafood that should be avoided entirely or UDS should seek out more transparent sustainable sources for. These are:
        - **Shrimp** (which was the most abundant item, and should therefore be focused on first according to this approach)
        - **Farmed Canadian salmon** and **farmed Chilean salmon** (the second and fourth most abundant)
        - **Witch flounder marketed as Grey sole**
        - **Swordfish** (especially for mercury contamination reasons)

Challenges of this approach:

- UVM would need to have a clear set of criteria to choose seafood by.

- One possible barrier may be that the fish that were previously offered in the highest quantities may be the kinds that are most favored by customers, therefore chefs may be reluctant to substitute them with something else.

Recommendation 2: Buying Local- NAMA

One effort that some schools and hospitals have adopted is getting seafood locally, through a more direct relationship with fishermen. The Northwest Atlantic Marine Alliance focuses on connecting fishermen to seafood purchasers, and they are working on developing this connection for institutions in New England. Choosing this approach must occur through the university's conscious choice to add more values to its sustainability criteria and to embrace more local and small-scale fisheries. NAMA would be happy to set up an opportunity for representatives from UVM such as Executive chef(s), procurement officer(s), representative(s) from Office of Sustainability to meet the local fishermen and hear about what it means to them to have seafood sourced locally and be paid a fair price. Meeting the fishermen engrains these ideas. However, even if this trip does not happen, UVM should seek out a distributor such as Black River Produce that supplies seafood from these fishermen. Pressuring distributors to ask questions from the source can accomplish a lot in sourcing more sustainable seafood. Additionally, NAMA is working on mechanisms to send a big chunk of locally caught seafood to the region's universities, and there is someone in NH who wants to deliver to Vermont. UDS should begin by ordering even just one fish from Gloucester, through Black River Produce, after speaking with Northwest Atlantic Marine Alliance. Because UDS has existing ties with BRP, this would not be difficult. I strongly consider taking this approach if it falls under University Dining Services economic criteria.

- **Environmental benefits**:
  - Ecological stewardship that results in creative, community-based approaches to marine conservation.
  - 100% of the catch gets sold, nothing thrown back as waste.
  - More local than other fish (reduces transportation costs and carbon emissions)

- **Social responsibility benefits:**
  - Can foster economic opportunities that support natural resource-based livelihoods
  - Purchasing more directly from fishermen can establish a relationship between communities by providing fresh seafood.
  - Closer contact with the fishermen allows consumers to know more about their food.

- **Economic Benefits:**
  - Vary depending on product

- **Challenges of this approach:**
  - NAMA may still need to do some assessing on their part of how to provide to institutions, but it is possible.
  - Seasonality
  - Unsure of price

*see Northwest Atlantic Marine Alliance information sheets (attached) for more information on environmental and social benefits of buying local seafood, the benefits of small scale fisheries, and seasonal availability of New England seafood.

Recommendation 3: Consuming Invasive Species- Asian Carp

In the winter of 2010-2011, Proctor Dining Hall at Middlebury College (known by some as "the kitchen with a cause" (Keren, 2011, p.1) began offering Asian carp. Asian carp are not native to the United States, but were introduced in the 1970s, and have ever since been making their way up the Mississippi River and its tributaries. They are now just south of the entrance to Lake Michigan, through the Chicago Canal (R. O'Donohue, personal communication, September 22, 2011). Eventually they could make their way to Lake Champlain, devastating the lake just as other invasive species such as the zebra mussel have already done.

Middlebury bought 1,500-1,600 pounds in total last year, from Schafer Fisheries in Illinois. They started with a couple hundred pounds. The cooks experimented with it, and found that it is "like the tofu of the water, because it took on any flavor we gave it" (R. O'Donohue, personal communication, September 22, 2011). According to Michael Schafer of Schafer Fisheries, "the fish can be used for many different dishes with very favorable responses. Most people cannot tell it's fish because it's very mild flavor and adapts to seasoning very well" (personal communication, January 26, 2011). They have marketed it to students at Middlebury under names such as "Schaferfish" and "Rock Island Sole"(*Keren, 2011). Additionally, there are multiple processors of Asian carp, and they can all fill large orders and offer some different products. The chefs at Middlebury College have some ideas on preparing Asian carp that they are willing to share. UDS could even do a taste trial with Asian carp to start with. The moment is here. "We might as well seize it. In other words, Carpe carp!" (Vettel, 2010, p.1).

- **Environmental benefits:**
  - Eating invasive species, rather than vulnerable populations
  - More local than other fish (reduces transportation costs and carbon emissions)

- **Social responsibility benefit**:
  - Keeps fisheries in businesses. "No matter what the fishermen catch, there are Asian carp among the fish," said Steve McNitt, sales manager at Schafer Fisheries. "We have to buy what they catch to keep them going" (Wang, 2012, p. 1).

- **Economic benefit**:
  - $2.35 (R. O'Donohue, personal communication, September 22, 2011) to $0.14 per pound (Schaper, 2006). Additionally, the yield can be very high because grinding it reduces loss.

- **Educational benefits**:
  - Educates students about human impacts on ecosystems and invasive species
  - Chef O'Donohue at Middlebury College felt that this effort "boosted moral, because [the cooks] were able to do something themselves instead of take the recipe off the computer system. I think that was a benefit of it".

- **Challenges of this approach:**
  - Need to work with bones
  - Deciding how to prepare it; ideas from Middlebury College still require experimentation with ingredient proportions.
  - Seasonality- "Some seasons are better than others depending on the cold of the winter…River flooding usually causes a slow-down" (M. Schafer, personal communication, January 26, 2011).

*See Keren's article (attached) for more information on Asian carp at Middlebury College.

Objectives to Guide Further Action for University Dining Services and the Office of Sustainability:

1) Set up clear criteria for selecting sustainable seafood options, focused on values. Can use the ones proposed, or develop similar criteria of their own with the input of the student body.
2) Reevaluate current seafood purchasing choices based on new criteria.
3) Take into account the proposed suggestions for sustainable seafood and get a local, sustainable option on the menu regularly.
4) Work on making the new sustainable seafood products appealing to consumers' tastes, if necessary.
5) Market the new sustainable fish/seafood option by labeling and information of seafood sources in the dining facilities.
6) Set up a monitoring position/ internship to check on updates to the sustainability of seafood sources and student food preferences, similar to the current Sustainability Intern at UDS.

Food for More than Thought: Activist Strategies

1. **Meet with UDS and UVM Office of Sustainability to share findings**– set up a meeting to discuss which of these three recommendations UVM will pursue further. Additionally, introductions between UVM and contacts such as Schafer Fisheries or Niaz Dorry, who may be crucial in latter steps of the process, can be made.

2. **Gain more momentum behind the movement, educate consumers-** To offer more sustainable seafood on campus (even if it is just a few times a month, for example), consumers must make it clear to Dining Services that they want to see the university's values (representing the values of the student body) reflected in its purchasing behaviors. Until the university communicates that it values transparency in our seafood supply chain, and that we want to know where our food comes from, UVM's seafood suppliers will not change their practices. The ultimate goal would be that chefs should be able to tell the customers where the fish being served was caught, and how. Smaller steps to achieve this goal:
    a. Assess the desire of the UVM community to have more sustainable seafood on campus, beyond what the university currently offers. Surveys of consumer beliefs and requests for changes must be analyzed.

    b. Get active related groups on campus involved, such as Vermont Students for Environment Protection (VSTEP), Students for True Animal Rights (STAR), the Environmental Program, and the Rubenstein School of Environment and Natural Resources.

3. **Establish a relationship between UVM and Schafer Fisheries (Michael Schafer)**, **and/or NAMA**, depending on approach chosen. Niaz Dorry has offered to make the introductions necessary to set up a trip to Gloucester for UVM representatives to meet with fishermen. This would be an opportunity to strengthen ties between UVM and the coastal fishing communities, hopefully resulting in a connection between UVM Dining Services and a seafood distributor that is focused on supporting local communities and sustainable fishing efforts.

4. **Take more steps to ensure we really know where our food is coming from**:
    a. GreenPeace suggests the following for a sustainable seafood procurement policy, stating that the minimum information required to judge the sustainability of a seafood product is:
        - The common and scientific name of the species
        - The fishing technique, or the aquaculture method used
        - The fishing area (to stock level), or country of aquaculture (to farm level).

    I encourage UVM, at the very least, to require our seafood supplier to provide us with this information, so we can have accurate information to use as a starting point to take this sustainable seafood initiative further.

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Appendix A- Northwest Atlantic Marine Alliance information

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

Appendix B. Schematic illustration of the duality of large and small-scale fisheries prevailing in most countries of the world (statistics are global).

*Image removed from digital version; available in hard copy version housed in the Environmental Program office

From Jacquet, J., & Pauly, D. (2008). Funding priorities: Big barriers to small-scale fisheries. *Conservation Biology, 22*(4), 832-835.

Appendix C. Article from Middlebury College on Asian carp

*Image removed from digital version; available in hard copy version housed in the Environmental Program office