GLOBAL SUSHI: A SOCIO-ECOLOGICAL ANALYSIS OF THE SICILIAN BLUEFIN TUNA FISHERY

by

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This dissertation is a sociological study of the Sicilian bluefin tuna fishery. It will examine the social and ecological transformation of this fishery during the modern era. This will be analyzed utilizing a sociological framework that draws on theory from environmental sociology. The Sicilian fishery has been exploited for its abundant tuna for over a millennium, providing a major source of protein for Mediterranean civilizations. However, within the last half century there has been exponential expansion of industrialized methods of production and increasing capture efforts. This has culminated in the development of bluefin tuna "ranches," which have become a highly controversial method for supplying global markets. Escalating pressure on the fishery has contributed to a host of environmental and social concerns, including pushing this important fishery to the brink of collapse. Using a combination of primary and secondary source data such as interviews with local fishers and those in the tuna ranching sector, data compiled by

international agencies such as the International Commission for the Conservation of Atlantic Tunas (ICCAT) as well as archival data on the Sicilian bluefin tuna fishery, I will employ sociological methods and analyze the recent changes in social life and the environment in Sicilian fishing communities. Subsequently, this project will shed light on the globalized and industrialized nature of the modern agri-food system and lead to a better understanding of its social and environmental impacts.

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Per la bellissima Antonina Sofia

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CHAPTER I

INTRODUCTION

Background of the Problem

This dissertation will examine the eco-social transformations in the Sicilian bluefin tuna fishery over its long history. The Atlantic bluefin tuna (ABFT) has been an important economic, social, and cultural product in this region for over a thousand years. Throughout the Mediterranean, ABFT were captured using traditional traps at least since antiquity. In Sicily, the traditional trap fishery is called *la tonnara* and has historically been one of the most important and fertile of all the trap fisheries in the region.

Within the last half-century, there has been an escalating expansion of intensified efforts to capture and "ranch" ABFT in the Mediterranean, in order to supply a global commodity in increasing demand. At the same time, ABFT stocks have been depleted to levels that threaten the future of the fishery (ICCAT 2007a). Today, the eastern stock of ABFT, mostly located in the Mediterranean, is a principal source of bluefin tuna for the global market. The popularity of luxury food items, particularly sushi and sashimi, has driven higher consumption rates and market values of this vital resource and cultural symbol. These events are having a significant impact on Mediterranean ecosystems as well as fishing communities in the region. This dissertation will focus on these developments in Sicily, examining the ecological and social transformations that have occurred in this historic fishery. In doing so it will show that the structure of the modern industrial agri-food system, driven by the dictates of the capitalist competitive market system, has resulted in the decline of natural resources along with the communities and cultures that are tied to them.

Nature as a Social Issue

Examining human relations to the natural world is a relatively new area of study for sociologists. However, it is astonishing that the fundamental importance of nature in human social life has so long been neglected or treated as a simple prerequisite that, once acknowledged, can than be forgotten. The ecological and biological interrelationships between the social and the natural unveil a false dichotomy. Humans are both social and physical creatures. Humans and societies are an active part of the natural world and nature does not exclude humans or the social world. While this is surely self-evident, it is a reality that is often overlooked by much of the social sciences. As the great biologist and paleontologist Stephen Jay Gould once noted: "No biases are more insidious than those leading to the neglect of things everyone knows about in principle" (Gould 1977: 289). In this respect, these biases result in a tendency to ignore fundamentally important aspects of social life, such as its foundations in the natural world.

Recently, environmental degradation and the problems associated with it have become topics of serious discussion within the social sciences. According to the U.N.'s *Millennium Ecosystem Assessment Report* (2005) "Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history" (16). The scale and pace of human impact on the environment is clearly reaching unprecedented levels (Broswimmer 2002; Vitousek, Mooney, Lubchenko, and Melilo 1997).

Concerns over a host of environmental problems demonstrate clear links to human social structures, institutions, and organizations (Vitousek et al. 1997; York, Rosa, and Dietz 2003). Global warming, water and air pollution, decreasing biodiversity, deforestation, dwindling supplies of precious resources, species extinction, and exposure to toxic substances are just a few of the environmental problems that have become central social, political and economic issues in the modern world. As such, scientists and policy makers alike have begun to take seriously the social drivers that are at the root of these concerns.

Clearly, the increasing attention given to environmental problems is related to the basic biological and ecological reality that human systems cannot function without first meeting basic physical needs. Humans must interact with nature in order to acquire the resources necessary to live and prosper. For example, when producing basic food needs through agricultural production or fishing, human societies interact with a variety of ecological processes and these processes in turn impact human societies in countless ways.

On a broad level, this project examines a fundamental component of human societies and their relationship to their environment: the agri-food system. Food production is essential to social life and human well-being. While it is well known that human societies have always affected their local environment in the course of producing food and fiber (Mazoyer and Boudart 2006), the ecological impacts of the modern global agri-food system are unprecedented (Foster 1994; Ponting 1993). In addition, the social relations that result from the modern system of food production have several affects on social life, such as changes in labor patterns and other economic factors, as well as cultural traditions and practices related to food production and consumption.

Specifically, this research will examine the historical roots and modern developments in the Sicilian bluefin tuna fishery. This fishery has played a central role in Mediterranean life for more than a millennium, meeting the biological and social needs for many civilizations in this region. In the Mediterranean, the exploitation of bluefin tuna resources has reached a point of great ecological concern. In response to increasing global demand, ABFT stocks are being pressured to a degree many ecologists and fisheries scientists have determined to be ecologically unsustainable (ICCAT 2007c; IUCN 2007; Miyake 2004; Safina 2003; Tudela and García 2004). The ecological and social consequences that are occurring as a result of these recent developments are yet to be completely understood.

The Global Agri-Food System

The modern system of food and fiber production has developed a variety of characteristics that are of great interest to sociologists. This system brings together various social structures, institutions, technology, and power relations with basic ecological processes necessary for human life. Today's global capitalist agri-food system has transformed the way human societies produce and consume agri-food products

(Goodman and Redclift 1991; Mazoyer and Boudart 2006; McMichael 1995). Food systems that were once regionally based are now part of a global phenomenon that produces agri-food products in a manner unparalleled in human history. Lead by vertically and horizontally integrated trans-national corporations (Heffernan 2000), this system of production has raised a number of concerns regarding the ecological and social consequences of global capitalist agri-food production.

Agri-food production is the source of the vast majority of food and fiber consumed in the world today, and thus is vital to virtually all societies. The modern world's productivity of food and fiber is, of course, unsurpassed in all of human history. However, this productivity comes at a severe environmental cost. For example, modern agricultural production has been associated with environmental concerns such as erosion and salinization of soils; water depletion; pollution of land, water and air; and habitat and biodiversity loss due to land clearance and ecosystem disruption (Chew 2001; Diamond 2005; Foster 1994; Ponting 1993). Although many of these impacts date back to the origins of agriculture, others are particular to the modern world, where new problems have been added to the traditional ones – e.g., pollution from chemical pesticides and fertilizers and the intensive use of fossil fuel energy sources in agricultural production (Mazoyer and Boudart 2006; Ponting 1993).

Environmental concerns in the realm of food and fiber production are not limited to the sphere of agricultural production of plants and animals. Fish production, through industrial fishing and aquaculture, has its own set of ecological impacts. Over-fishing has decimated a number of fish stocks throughout the world's fisheries (Jackson et al.

2001; Jacquet 2007). The collapse of commercial fisheries that were once considered inexhaustible has become a common concern. Moreover, industrialized aquaculture production, in attempt to pick up the slack for decreasing returns from the world's oceans, has a host of immediate and potential consequences for wild stocks and the marine ecosystems (Pauly 2004; Pauly et al. 2002).

In order to develop a clearer understanding of the dynamics of the global agri-food system, its environmental impacts and social consequences, this research makes use of the theoretical lens provided by the political economic perspective developed within environmental sociology. Specifically, this analysis will help to provide insight into the processes that are taking place in the Sicilian bluefin tuna fishery. This study provides a powerful example of the parallel circumstances that are common throughout the world's fisheries and, more broadly, the global agri-food system.

Eco-Social Context: Global Marine Fisheries in Crisis

To understand the conditions within the modern Mediterranean bluefin tuna fishery, it is important to place these developments within their historical and ecological context. As stated previously, environmental degradation has become a serious issue throughout the world's ecosystems (Millennium Ecosystem Assessment 2005). The depletion, pollution, and destruction of global marine fisheries are among the many environmental challenges to be faced. Societies throughout history have impacted their marine environments, some to a greater degree than others (Jackson et al. 2001). However, the current crisis in marine fisheries is global in its scope, rapid in pace, and colossal in its scale. This unprecedented human impact on marine ecosystems requires some discussion.

Industrialized fishing efforts for marine species first emerge in the nineteenth century. However, in the post World War II era, global marine fish catches saw a marked increase. In the later half of the twentieth century there was an enormous increase in the capital, energy, and capacity put into fishing efforts (Jackson et al. 2001; Jacquet 2007; Pauly 2004). Global captures increased more than five-fold between 1950 and 2000[1] (UN FAO 2007; WWF 2008a). In fact, in the 1950s and 1960s the global fishing effort was increasing at such a rate that catches have grown faster than the rate of population growth in the same period[2] (Pauly et al. 2002). This effort was led by capital-intensive gear including large-scale purse-seines, long-liners, and factory trawlers as well as new developments in fish location technology.

Throughout much of history, the ocean was regarded as a vast resource and human efforts were thought to have little or no impact on the inexhaustible ocean life. While the ocean is a vast and seemingly limitless resource, about eighty-five percent of global fish captures occur on the continental shelves, which make up only seven percent of the ocean's area (Pauly 2004). Thus, increasing pressure on this relatively small area

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[1] This increase refers to marine fishes in marine waters. The term "marine waters" is intended to refer to oceans and seas including adjacent saltwater areas.

[2] In the 1950s landings from marine fisheries grew at an average rate of 6.8 percent per year, increasing to 7.4 percent per year in the 1960s. Global population growth rates peaked in 1963 at just over 2 percent. (Garcia and Newton 1997)

of ocean space makes these areas vulnerable to over-fishing and will have serious affects on ocean biodiversity and ecology (Jackson et al. 2001; Worm et al. 2006).

With the exponential growth in fish captures, the consequences resulting from the over-exploitation of stocks that were once thought to be infinite became all too clear. In the early 1970s, Peru's historically abundant anchoveta fishery collapsed, and in the 1980s and 1990s, the famous cod fishery off the coast of Eastern Canada and New England collapsed, both creating serious ecological and economic consequences (Pauly et al. 2002). These are some of the largest and best-known stock collapses and were regarded as indications of marine fisheries in distress, but by no means were they the only stock failures. More and more, fisheries were being exploited beyond their sustainable limits; today approximately three-quarters of marine fisheries are either fully exploited or overexploited (UN FAO 2007).

According to the UN FAO (2007), in the 1990s growth in global captures appeared to stagnate even with increased investment in gear and technology. This created some concern, as it became apparent that stocks were being over-exploited and yields in marine resources were clearly showing signs of slowing down. Yet, the problem was found to be much worse than originally thought when it was discovered that China, a major producer with significant impact, was systematically over-reporting its catches. Thus, captures were actually slowly falling since the 1980s at a rate of 0.7 million tons per year (Pauly et al. 2002; Watson and Pauly 2001). Although fishing efforts have been steadily increasing in the recent past, cumulative yields of all species in large marine ecosystems have declined by thirteen percent since 1994 (Worm et al.

2006). Recent trends in captures of global marine fisheries resources, once thought to be infinite, are clearly indicating the onset of a crisis.

A number of marine species throughout the world have been distressed primarily by over-exploitation of stocks and habitat loss due to environmental degradation. According to IUCN - World Conservation Union, at least 1,200 fish species are considered threatened (IUCN 2007). In a recent study, Worm et al. (2006) predict that if trends of increasing pressure and loss of biodiversity in marine ecosystems continue unchanged, the collapse of all taxa that are currently fished could occur by the middle of the twenty-first century. Moreover, it is estimated that all large predatory fish have seen a ninety percent decline in spawning stock biomass since pre-industrial levels (Myers and Worm 2003). Atlantic bluefin tuna, a large marine predator with a high market value, have not been spared in this onslaught of the oceans.

Sicily and the Bluefin Tuna

State of the Mediterranean Bluefin Stock

Thunnus thynnus, commonly referred to Atlantic bluefin tuna (ABFT) or Northern bluefin tuna, is a highly migratory pelagic fish species[3]. Its natural characteristics make it one of the most spectacular organisms in the ocean. In particular, the size and speed of this creature are a marvel of nature. Ranging on average from one to two meters (about three to six feet) in length and weighing an average of 400 kilograms (about 900 pounds),

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[3] Three species of bluefin tuna have been designated: Atlantic or Northern (*thunnus thynnus*, Southern (*thunnus maccoyii*) and Pacific (*thunnus orientalis*).

they sometimes grow to larger than four meters (approximately thirteen feet) and have been recorded as weighing as much as 680 kilograms (roughly 1,500 pounds) (Doumenge 1999; Fromentin and Powers 2005).

These gargantuan creatures are designed to travel far and move quickly. Tagging studies have found that ABFT can migrate long distances across the ocean, from the east coast of North America to Northern Europe (Block and Stevens 2001). During their long migration across the Atlantic, it has been estimated that ABFT commonly swim at speeds of twenty to thirty km/h[4], and can have bursts of speed between seventy and 100 km/h, making it the fastest species in the sea (Safina 1998).

ABFT are found all around the North Atlantic and the Mediterranean Sea. This range of habitat is made possible by the fact that the bluefin tuna has developed an endothermic thermoregulatory system, which allows it to maintain relatively stable body temperatures in cold and warm waters alike[5]. ABFT are opportunistic feeders and can take advantage of cool subarctic waters, such as those in the North Sea, and still return to warm waters of the Mediterranean for spawning (Safina 2001). This expansive range can make it challenging to determine the size and health of the stocks. However, through a variety of biological and stock-assessment studies including tagging, fishing records and anecdotal evidence, fisheries scientists have determined that this species is in fast decline

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[4] Km/h refers to kilometers per hour.

[5] ABFT are one of the few fish that are warm blooded. They can be found in water temperatures ranging from seven to thirty degrees Celsius and maintain a body temperature of between twenty-eight to thirty-three degrees Celsius (Safina 1998). The tuna's thermoregulatory system is highly complex and considered a wonder of evolution.

(Doumenge 1999; ICCAT 2007c; Safina 1998; 2001; WWF 2006). In fact, the rapid decline of these bluefin stocks has prompted the IUCN to categorize ABFT as endangered[6] (Safina 1996).

Within approximately the last thirty to forty years, ABFT have been severely over-fished. Western Atlantic bluefin stocks are estimated to have experienced a dramatic depletion. In 2004, spawning stock biomass (SSB) only reached nineteen percent of 1975 levels (ICCAT 2007c). Eastern Atlantic stocks are estimated to have declined to only forty-eight percent of SSB since the early 1970s (ICCAT 2007c; Safina 2001). In this area, fisheries scientists estimate that fishing pressures are such that mortality rates for the eastern socks are three times the level that would allow for the sustainability of the stock (ICCAT 2007c). Because this species exhibits certain natural characteristics such as late reproduction, large size at reproduction, long life span, and the formation of large spawning aggregations, they are extremely vulnerable to over-exploitation (Ottolenghi et al. 2004; Safina 2001).

While Western stocks have been critically depleted, and have become less commercially viable, the Eastern stock has remained a major source of ABFT for the global market. This fishery, specifically in the Mediterranean where a majority of ABFT are now caught, is experiencing even greater declines in the very recent past (ICCAT

[6] ICCAT officially recognizes two stocks in the North Atlantic, Eastern and Western, although these stocks are of the same species. Mostly, this distinction is made for managerial purposes. Eastern stocks, which include those in the Mediterranean, are considered endangered according to IUCN and Western stocks are regarded as critically endangered. Nevertheless, there is a great deal of controversy surrounding this managerial distinction of dissecting what some, mostly industry lobbyists, argue is one stock.

2007c). In the Mediterranean there is evidence that there has been increasing pressure on both pre-spawing age as well as the largest spawning age fish. (ICCAT 2007c; Safina 2001). This can have devastating long-run impacts on the stock viability. Decreases in stock biomass have directly correlated with the increased activity from large-scale tuna fishing operations within this region and the booming demand and price for bluefin tuna on the global market (Fromentin and Powers 2005; Mather, M., and C. 1995). The pressure on the Mediterranean fishery has increased in recent years to such a degree that the International Commission for the Conservation of Atlantic Tuna (ICCAT), the international body that manages the bluefin fishery in this region, has stated that a total collapse of this fishery is possible in the near future (ICCAT 2007c).

ABFT make up only a small portion of the 80 million tons or so of fish that are caught globally each year in marine fisheries. Nevertheless, the high market value for ABFT drives ever increasing fishing efforts, as they make up a disproportionate amount of the value in the sale of global marine resources (Gaski 1993). According to ICCAT (2007c), annual catches of eastern stocks reached their peak in 1994 at 50,807 tons and have declined to between 30,000 to 35,000 tons in the years since. However, including illegal, unreported, and unregulated (IUU) catches, it is likely that they have remained at levels close to 50,000 tons for the past several years. The vast majority of these captures originated from the Mediterranean region (Bregazzi 2005). Catches of western stocks are significantly less, reaching about 3,000 tons per year (ICCAT 2007c).

The potential collapse of the Mediterranean and North Atlantic ABFT fishery is of great concern. This event will have vast social, economic and ecological impacts throughout the region and beyond. As stated above, the bluefin tuna has been of enormous economic, social, and cultural importance to the Mediterranean region. Furthermore, the ecological consequences of a collapse will clearly have devastating effects on local ocean ecosystems.

ABFT are an apex predator. In the ecosystems they inhabit, their position in the trophic chain is critical. Drastic population changes of this species can result in significant changes in ecosystem dynamics and biodiversity. That is to say there is an increased chance of negative impacts on the ocean ecosystems (Harper 2004). As stated previously, ecological impacts such as these will have direct consequences for societies that interact with ocean ecosystems. In Sicily, fishing communities have depended on this fishery since early antiquity.

La Tonnara: Traditional Sicilian Fishing

Sicily has hosted a variety of civilizations. The Phoenicians, Greeks, Romans, Saracens, Normans, and Spanish, among others, all laid claim to this hospitable and prosperous island for significant periods throughout history. The bluefin tuna has been an important food source, cultural symbol, and economic resource in Sicily for all of these societies (Consolo 1986; La Mantia 1901; Lentini 1986; Martorana, Durand, and Lentini 1995; Purpura 2005; Sarà 1998). Cave paintings in this region dated thousands of years old include representations of bluefin tuna and pottery from the Greek era portray individuals preparing and distributing bluefin, indicating its historical significance (Consolo 1986; Sarà 1998).

The Mediterranean is one of two spawning grounds for ABFT. Eastern stocks spawn exclusively in this region and western stocks spawn in the Gulf of Mexico. Making their way from the open Atlantic through the Straight of Gibraltar, bluefin tuna seek the warm, clear, salty waters of the Mediterranean in order to reproduce[7] (Doumenge 1999; Mather et al. 1995). This process of returning to their birthplace to spawn brings large numbers of ABFT to this region each year, with some of the highest reproduction rates occurring in the region between Sicily and the Balearic Islands (Schaeffer 2001).

During spring and summer, ABFT inundate the waters off the coast of Sicily. Aware of the abundance of bluefin tuna during this period, early civilizations quickly began to develop methods to capture bluefin that migrate close to shorelines, including the construction of elaborate traps. In Sicily, this trapping system is called *la tonnara*[8]. Although similar types of trap systems have been employed throughout the Mediterranean, this research will focus on Sicily, as this has been a region with some of the most important and fertile trap fisheries in the area. What is more, it has been argued that the trapping system developed in Northwest Sicily served as the model for many of the later trap fisheries throughout the Mediterranean (Consolo 1986; Fodera 1961; La Mantia 1901).

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[7] It should be noted that still relatively little is understood about the biological mechanisms that draw bluefin to the Mediterranean.

[8] *Tonnara* translates roughly to "tuna trap"; *tonnare* is the plural form.

The *tonnare* in Northwest Sicily are significant for a number of reasons. These are some of the oldest and historically the most famous traps in Sicily and the greater Mediterranean (Consolo 1986). From the eighteenth through the twentieth centuries, the *tonnara* in Favignana, the largest in this region, was known as the "queen" of the Mediterranean trap fisheries. Traditionally, the Sicilian *tonnare* were not only providers of nourishment, but also major sources of economic activity and employment. Moreover, the *tonnara* is an important cultural tradition and symbol for many communities in Sicily. Today, the *tonnara* in Favignana is the last operating traditional trap fishery in Sicily. All others have ceased to operate due to decreasing fish stocks. Favignana continues to use traditional trapping methods that date back to the Arab period beginning about 800 C.E. and possibly even further (Mather et al. 1995). In recent years, catches have dropped considerably at this site and it has become clear that the *tonnara* and the tradition and culture that are intrinsically intertwined with it, have all but come to an end in this region.

Catches in the traditional fishery began showing signs of distress in the 1960s, precisely at the time when purse-seine technology and long-liners entered the central Mediterranean ABFT fishery. By the 1970s, traditional trap catches were falling catastrophically while purse-seines were increasing catch and capacity. At the same time exports for Japan's sushi and sashimi market began a period of expansion (Bestor 2001; Issenberg 2007). While up until the middle of the twentieth century there were about twenty-one *tonnare* in Sicily, by 1973 there were just seven (Mather et al. 1995). Today there remains only one, and its future is highly in doubt.

These conditions have drastically changed the social and economic life for people of this region, particularly for coastal communities. Bluefin fishing has been a mainstay in Sicilian life. The loss of this resource, combined with a lack of industrial development in Southern Italy, has resulted in a rapid transition for many in traditional tuna fishing communities. Generally, in the twentieth century, Sicily has experienced high rates of unemployment and emigration to Northern Italy, Europe, and the United States due to poor economic conditions (Ginsborg 2003). In many of these fishing communities today, individuals attempt to make a living in what remains of the bluefin fishery, fish for other species, retire, or often seek employment in tourism and related service industries.

Global Production: Expansion of the Sicilian Fishery

The traditional Sicilian bluefin tuna fishery had a long history of abundant captures, supplying an important food source and economic foundation for coastal communities. Catches fluctuated from year to year, but generally this fishery was a dependable resource for local communities possibly for millennia, and in many years this marine resource was preserved and exported. However much exporting was a part of this fishery, local consumption was always the fundamental component of its economy (Lentini 1986). Today, local consumption is no longer an important factor in the fishery. Bluefin tuna originating from the Mediterranean have become, first and foremost, a global commodity, and global demand is the main driver of its capture/production (Bestor 2001; Issenberg 2007).

The major markets for the bluefin tuna are Japan, Europe and the United States. Japan, with its enormous appetite for marine products, far surpasses any other nation in its level of imports of all tuna, including ABFT, consuming about half the global catch (Gaski 1993). Strong demand for high and medium quality sushi and sashimi are the main drivers of this appetite. Bluefin tuna is regarded as the premier fish for sushi and sashimi, and it fetches, depending on the market conditions, among the highest prices of any fish commodity on the global market (Bestor 2001; Ellis 2008b).

High global demand and market price resulted in a frenzy of fishing effort to capture bluefin wherever they were prolific. As discussed before, the Mediterranean is one of the last abundant areas for bluefin tuna. Investment in capacity and technology to expand fishing effort increased greatly in Mediterranean fleets along with the global demand. As a result, purse-seines and long-liners began to increase their presence and size in the Mediterranean. These fleets use energy- and capital-intensive methods to capture large quantities of bluefin throughout the Sea. As the price for fresh bluefin escalated, tuna "ranching" became an economically viable method of producing bluefin for the global market. This method is highly controversial in that it has severe impacts on wild stocks and has been charged with a variety of environmental impacts on local ocean ecosystems (Tudela and García 2004).

The growth and globalization of the Sicilian tuna fishery has a variety of environmental, social, and economic impacts. This fishery, which was once a stable resource for local communities, is now looking at the real possibility of social and ecological collapse. Already, small-scale fishers have been deeply affected by the changes in catch effort and the historical *tonnara*; its economy and its culture have collapsed. The ecological transformations that are occurring due to social, mostly economic, drivers, have been significant in this part of the world. As discussed, these ecological consequences in turn affect and interact with the social transformations. This dissertation is a study of these transformations and interactions.

Research Methods

On a broader scale, this research is an investigation into the changing nature of food production systems, and specifically the globalized, industrialized and commodified form that has emerged in the modern world-system. The central question of this research is: " How does the modern system of agri-food production impact communities and their environment?" This question will be examined using theory from environmental sociology and political economy outlined in the next chapter. Specific questions that this research will address include:

Question 1: How have recent changes in agri-food production impacted the ABFT fishery in the Mediterranean?

Question 2: How have these changes influenced political-economic and technological transformations in Sicily?

Question 3: How has this impacted traditional fishing communities and the fishery's ecology?

Question 4: Are technological advances, such as farming ABFT, helping to curb depletion of stocks in the Sicilian bluefin tuna fishery?

Question 5: Are technological advances, such as farming ABFT, providing social, cultural and economic development in fishing communities?

Historical Analysis

In order to answer these questions, multiple methods will be combined to develop a comprehensive sociological case study of the Sicilian bluefin tuna fishery comparing two historical periods: the traditional and the modern fishery. I will employ a historical methodology, which includes fieldwork, observation, and in-depth interviews. The long history of the Sicilian bluefin tuna fishery permits an expansive study of the social relations and ecological conditions that are present within this process of food production. As such it allows for the perspective of what Braudel (1979) calls *la longue durèe* (the long term), and for a systematic comparison of historically specific periods of production. Thus, this fishery is an ideal case for a historical analysis.

Historical analysis has a long tradition in sociology. Arguably, the classical sociologists employed historical analysis to develop some of the discipline's foundational works including, for example, Marx's *Eighteenth Brumaire* (1954), Weber'*s Protestant Ethic* (1956) and Durkheim's *Suicide* (1951). Furthermore, the best known contemporary historical analyses have been developed around comparative case studies such as Moore's (1966) and Skocpol's (1979) work on social revolutions. This approach seeks to address theoretical questions using historical data and examines a single or small number of cases rather than large data sets (Goldstone 2003). Such a historical analysis allows me to investigate the fishery in significant detail so as to develop in depth knowledge of the socio-ecological transformations and locate important social mechanisms that are central components in these transformations (Mahoney and Rueschemeyer 2003).

According to Yin (1993), case studies are best utilized when a study investigates broad issues, requires the analysis of contextual conditions, and relies on multiple sources. Also, historical case studies are amenable to both quantitative and/or qualitative examination (Yin 1993). Sociological research using historical methods is methodologically eclectic, and attempts to utilize the tools that are best enabled at answering the questions at hand (Mahoney and Rueschemeyer 2003). Using multiple sources of data, this research will hone in on the environmental and social impacts of the modern global agri-food system on a specific region, a process that is often referred to as "triangulation" (Singleton and Straits 1999). In addition, this allows for a more comprehensive understanding of the social dynamics at play within this fishery, the drivers of ecological change, and the prospects for the future (Yin 1993).

Field Research

This research required obviously required fieldwork in Sicily. During three visits, I spent a total of about five months collecting data for this research project. The first exploratory visit occurred in the summer of 2006. The latter two visits occurred from May through June of 2007 and 2008. The data collected consisted of site visits, observations, in-depth interviews, historical documents, as well as other secondary texts and available data on the Sicilian fishery that were accessible locally.

While in Sicily, I accessed materials that provided ecological and historical information. Through my affiliations with the Università degli Studi, Messina and the

CNR-IAMC[9], Italy's National Research Commission, located in the Sicilian port town of Castellammare del Golfo, Sicily, I was able to access scientific sources and establish a research base. Additionally, through access to a number of public resources in Sicily, including the Biblioteca Centrale della Regione Siciliana, Biblioteca Comunale del Castellammare del Golfo, Museo del Mare in Castellammare del Golfo, Biblioteca Fardellina di Trapani, and Comune di Castellammare del Golfo[10], I collected archival material and other valuable primary and secondary historical documents on the Sicilian fishery. At the Università degli Studi, located in Palermo and Trapani, I studied scientific papers and academic theses on the history of the *tonnara* as well as tuna farming/ranching. I also attended two conferences on the Sicilian bluefin tuna fishery in Favignana and Bonagia.

Furthermore, I visited the sites of many *tonnare* in Northwest Sicily, including the *tonnare* of Castellammare del Golfo, Magazinazzi, Scopello, Bonagia, and Favignana. In each of these locations I spent time in the community, observed active or inactive fishing operations in the tuna or other fishing sectors, and met with a number of local inhabitants such as shopkeepers, political figures, tuna fisherman and/or those that worked in the ranching sector. As Favignana is the last remaining working tonnara in Sicily and one of the largest and historically most productive tonnare in the Mediterranean region, I visited

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[9] IAMC-CNR is the Consiglio Nazionale delle Ricerche: Instituto per l'Ambiente Marino Costiero (National Research Commission: Institute for the Coastal Marine Environment)

[10] These are a combination of libraries, museums, and local government offices.

this site many times during my research in Sicily. While there I observed the fishing activities at this *tonnara*, as well as the harvest of bluefin, locally know as *la mattanza*.

Interviews

As a result of my life-long experience in this region, I have a number of local contacts that I was able to draw upon for interviews and as liaisons to others in the fishing and tuna ranching sector. In-depth interviews with local residents and experts gave important insight into social phenomenon that only those close to the fishery could communicate. In addition, these interviews provided important history, context, and technical knowledge that inform this research on the whole.

The sampling method for this study is a combination of purposive sampling, selecting the subjects based on previous knowledge, and snowball sampling, in which subjects suggested additional individuals for interviewing (Babbie 2005). I conducted a total of forty-one in-depth interviews in communities throughout Northwestern Sicily that have been historically associated with the fishery[11]. Interviews were conducted in Italian and recorded using a digital voice recorder. Upon return from the field, the interviews were translated and transcribed to text.

The participants were chosen for their experience and knowledge in relation to the bluefin tuna fishery in Sicily. These included traditional fisherman, individuals working in the tuna ranching sector, fisheries scientists, and politicians as well as community

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[11] This fieldwork was approved by the Department for Protection of Human Subjects, University of Oregon, protocol #E485-07.

members that have a great deal of knowledge regarding the fishery and its relation to the communities in which they reside. These individuals represent a variety of perspectives, and thus enhance this study's ability to recognize and comprehend the complex reality occurring in this region (Rubin and Rubin 2005) (Table 1).

Category	Number Interviewed	Follow-up interviews
Tonnara	10	4
Tuna Ranches	8	3
Scientists and Academics	6	2
Community Members and Others	8	1
Total	31[12]	10
Total Interviews Conducted	41	

Table 1: Number of Interviews and Affiliated Categories or Sectors.

I focused on Northwest Sicily for a number of reasons. First, this part of Sicily was one of the most important regions in the development of the traditional *tonnara* fishery in Sicily. Second, this is the region of Sicily that contains the last active tonnara, on the island of Favignana. Third, since 2001 this region has an active tuna ranch in the Golfo di Castellammare. Last, in a practical sense, I have very close personal ties to the communities in this area as I have been visiting this region since I was a child and resided in this part of Sicily for almost one year in 2002.

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[12] Total number interviewed does not equal sum of category columns as one participant was affiliated with two categories.

The interviews were semi-structured following a design that allowed the subjects to elicit their experiences over their life course as it pertains to the history and changing nature of the industry, environmental conditions and future prospects. Each interview lasted for about thirty-minutes to one hour. The descriptions, narratives and detailed accounts provided discursive data that identify important social and historical events, and discussed important issues which have impacted the fishery and the communities. In addition, the interviews provided knowledge and information regarding the history of the fishery and technical knowledge of the workings of the traditional, as well as modern, fishery.

The addition of interviews broadens the methodological approach of this research, expanding the potential for qualitative insight. There are a variety of approaches for conducting qualitative interviews that range from focusing on individual meanings and constructions of reality, to a more broadly focused approach that seeks to better understand processes and social developments. This study utilizes that latter approach, as it can be best described as a case study. Elaborated case studies work well with a broadly focused scope that concentrates mainly on events or processes (Weiss 1994).

Utilizing interview data facilitates knowledge regarding historical circumstances, their context, how they unfold and what it means for larger processes and social structures. The intention is to "generalize to broader processes, to discover causes and to explain or understand phenomenon" (Weiss 1994 :7). This approach provides detailed descriptions of events and issues, integrates multiple perspectives, and describes processes, such as how events occur as well as their affects on communities. It encourages the development a holistic description of complex events or systems (Babbie 2005; Weiss 1994).

Interviews were conducted in the subjects' native language, unless the subject preferred otherwise. As I am fluent in Italian as well as the Sicilian dialect, the regional dialect was used when appropriate. Subjects were recorded using a digital voice recorder and, upon return, the interviews were translated and transcribed to text. The text provided important data for substantiating sociologically significant phenomena occurring in relation to the ecological conditions in the bluefin tuna fishery, adding crucial insight and a historical foundation. In addition, the interviews functioned as an important complement to the historical data, offering insight into the relationship between daily practices and socio-structural conditions.

It is important to add that, even with my long experience, personal contacts in this region and my ability to speak both Italian and Sicilian, it was sometimes challenging to find eager participants. This is a result of a few important cultural and historical realities that exist in this part of the world. Those associated with the traditional *tonnara* were often suspicious of outsiders, particularly early on. I imagine that this cultural reality exists often enough in many traditional fishing communities. However, in Sicily this is magnified due to historical events related to organized crime, violence, and oppression.

In addition, those still employed in the tuna ranching sector were often guarded and would only speak with me once given authorization from management. This was due to the environmental campaigns and the resulting negative press for the bluefin tuna ranches and growing community concerns. As a result, I was informed that management communicated to employees that they were not to speak to journalists. My role as an academic researcher was sometimes mistaken for that of a journalist.

While all of these aspects did make the task of finding participants somewhat challenging at times, I found that once participants generally understood my research goals and my sincere desire to learn more about their lives, history, and work experiences, they were more than willing to share openly. As a result, I was able to learn a great deal more than expected, as well as develop some genuine friendships.

Although sometimes challenged by my position as an "outsider," my cultural ties and relations in this region often gave me the privileged position of "insider." This dual role, insider/outsider, provided me with a great deal of access, but enough distance that I could engage with the research process as an observer. In addition, it is important to note that my gender allowed me easier access into a male dominated profession. The fishing industry in traditional and modern times is made of an almost exclusively male labor-force and management. Without a doubt, my entry into the fishing sector was facilitated both by some insider status, as well as the fact that I am a male. While a gendered analysis is not undertaken here, this social reality has implications for a variety of aspects of social life in Sicilian communities.

Quantitative Data

Data collected by the International Commission for the Conservation of Atlantic Tuna (ICCAT) was employed in this study as well. ICCAT has collected over fifty years of quantitative catch data on tuna and billfish throughout the North Atlantic and the

Mediterranean. These descriptive statistics are publicly available through ICCAT's website. They provide valuable data for understanding the trends in bluefin tuna catches including the productivity of the fishery, the location of the catches, and the technology used. In addition, the Food and Agriculture Program of the United Nations (UNFAO) provided useful trade data and a variety of Internet databases where valuable sources of economic and historical data.

In summary, data collected for this research included primary and secondary sources. These incorporated quantitative data, historical resources and records, field observations and qualitative interviews. Together, these data offer essential information for understanding the global dynamics at play within the Sicilian fishery.

Contribution

This dissertation will contribute to the discussions in environmental sociology regarding the impacts of human societies on environmental resources. Specifically, it will add to the debate surrounding the potential benefits of ecological modernization, as proposed by many economists and some sociologists, in contrast to theories that describe the inherent tendencies of capitalist social relations toward unrelenting expansion, and increasing environmental and social problems. These debates have been central within environmental sociology. As such, this work adds an important piece to this dialogue.

As of late, the Sicilian bluefin tuna fishery and, to a greater extent, the Mediterranean fishery, have become popular topics covered by journalists in the mainstream media such as *Time Magazine*, *National Geographic*, *Scientific American*, and others. While very informative, these pieces have been somewhat superficial and generally brief. This work provides the depth not possible in the journalistic realm. Also, to my knowledge, there has been very little publication on the history of the Sicilian fishery in the English language. There have been a small number of books and articles published on the subject, but they have for the most part been either memoirs or technical pieces. The greatest collection of writing on the subject is published in Italian. This work is greatly indebted to those Italian publications, and provides a comprehensive explanation of the social history of the fishery in English, where little exists.

This dissertation also presents an original analysis of the transformation of the Sicilian bluefin tuna fishery. Fisheries scientists and biologists have written a great deal on bluefin tuna and the state of the stock throughout the world, however a social scientific analysis has been, up to this point, absent. Moreover, there has been no examination of the fishery by sociologists. This analysis utilizes current environmental sociology theory and offers original explanation and discussion on the conditions within a contemporary topic that has been the subject of much social interest, controversy and debate.

Overview of the Chapters

The following chapter will lay the theoretical foundation for this research. The long history of the traditional fishery and global nature of the modern bluefin tuna fishery demands a theoretical approach that can examine the material conditions and the ecological and social transformations from a historical perspective. This is accomplished by utilizing theory within environmental sociology that is materialist in its ontology, but also takes into consideration the historically specific social relations and constructions. As such, the chapter examines theories within environmental sociology that utilize a radical political economic perspective and gives some detail on the historical foundations of these theoretical approaches.

In doing so, Chapter II outlines the historical development of classical political economy and explores how it diverges and develops into the field of neoclassical economics. Chapter II also provides a radical critique rooted in Marxian theory. This will be followed by a discussion of the modern political economic theories on the environment including environmental economics, ecological modernization theory, world-systems theory, second contradiction, treadmill of production, and metabolic rift, highlighting the significance for understanding current environmental problems. The development of the chapter will examine the importance for developing a radical political economic perspective. The metabolic rift theory will be highlighted as it provides crucial insight for this study.

Chapter III provides a historical discussion of the traditional bluefin trap fishery in Sicily, *la tonnara*. Beginning in antiquity, it provides a brief sketch of Sicily's long history, together with the evolution of bluefin tuna fishing in the region. In doing so, the chapter discusses the various civilizations that dominated this celebrated island in the center of the Mediterranean Sea, and the various practices and contributions made to Sicilian bluefin tuna fishery. In Chapter IV, I will explain the technical workings of the tonnara and touch on the history of the social relations that develop within this system of capture. More, this chapter explains the close ties with the natural world and deep knowledge of ecological processes, as well as the kind of labor, that are crucial when organizing and operating this method of fishing.

Chapter V examines the modern Mediterranean bluefin tuna fishery and the industrialized fishing practices that dominate the Sicilian fishery in the twentieth and twenty-first centuries. In this chapter, I will examine the growth of the bluefin tuna industry and its emergence as a global commodity. This chapter will also discuss the production process and its impacts on bluefin populations in the Mediterranean as well as local ecosystems. Much of the focus of this chapter will be on the tuna "ranching" sector. Within the past decade, this method of production has been expanding rapidly throughout the Mediterranean, including Sicily. As such, this chapter will discuss this modern method of producing tuna for global markets in some detail.

Chapter VI, will consider the events that have occurred in the fishery from opposing theoretical perspectives, modernization theory and radical political economy (RPE). This chapter will consider the view of modernization theory, described in Chapter II, in regard to the events that are occurring in this fishery. In doing so, I will highlight the perspective offered by this theory for understanding the contemporary concerns in the Mediterranean bluefin fishery and its shortcomings.

Chapter VII, serves as a sociological analysis of the eco-social transformations that are occurring in this fishery. After a historical sketch of the Sicilian tuna fishery, its ecology, technology and social relations described in previous chapters, the traditional and the modern industrial methods of production will be examined using a socio-ecological lens. With a solid understanding of the different periods and methods of production, I will apply a theoretical approach that draws on the literature within environmental sociology with a focus on the metabolic rift. This chapter will concentrate on the sustainable nature of the traditional trap fishery and discuss this in relation to the current bluefin crisis. I will make use of data collected during field research, particularly interviews, to discuss the changing socio-ecological conditions in the Sicilian fishery as well as the implications of these changes. The final chapter, Chapter VIII, contains a summary of findings, some concluding comments and future considerations.

CHAPTER II

THEORETICAL LENS: ENVIRONMENTAL SOCIOLOGY AND RADICAL POLITICAL ECONOMY

Introduction

The production and consumption of food constitutes a basic link in human relations to nature. In examining of this relationship, it is necessary to utilize a theoretical framework that allows for far-reaching insight into the social processes that are central components of the food production and distribution system. In this chapter, I will develop a theoretical approach that will allow me to illuminate human relations to nature, specifically the food production system, and in doing so, create a framework that gives specific insights into the processes occurring in the Sicilian bluefin tuna fishery.

The approach employed in this dissertation will make use of political economic theory and its development within environmental sociology. The elaboration of this approach will begin with a historical discussion of classical political economic and neoclassical economic theory, both important in the establishment of this tradition. Moreover, many of the key assumptions that make up this foundation will be examined and critiqued, primarily by using the works of Marx. This chapter will conclude with a discussion of current environmental sociological theory which has benefited from the theory advanced by the radical political economic perspective and draw on its insights.

A Radical Political Economic Approach

Incorporating the many disciplines within the social sciences including history, economics, political science, sociology, anthropology, and philosophy, among others, political economic studies allow a broad point of view when analyzing the social world. At the same time, this perspective offers a distinct approach for addressing a variety of specific social problems (Dréze and Sen 1995). This viewpoint attempts to understand and identify the crucial forces in the social world that are at the basis of social organization and, more generally, social life. In doing so, it endeavors to discover the political, cultural and economic factors that are manifestations of social life, with a particular interest in the access and distribution of important resources (Balaam and Veseth 2001). This area of study has contributed greatly to the theoretical development within the sub-discipline of environmental sociology. As such, these schools of thought come together to form an effective approach for analyzing the society and nature relationship.

While these aspects of the political economic approach are central to my analysis, it is necessary to discuss the history of the tradition and clarify exactly how this tradition is employed in this work. Through a historical discussion of the discipline, valuable insight is revealed. That is, the orthodox and uncritical nature of much of modern (political) economic theory differs greatly from the radical approach. This will be discussed in detail shortly. Briefly, over time, the political economic approach has transformed philosophically from a revolutionary standpoint to a conservative view

(Lippit 1996). Therefore, it is more accurate to consider the theoretical perspective employed in this analysis as a *radical* political economic analysis. It draws on the theory presented by thinkers, particularly Karl Marx, that develop a critical perspective, or what is sometimes considered a "heterodox" political economic analysis[13] (Stilwell 2006).

The political economic approach has become increasingly important in the development of sociological theory, particularly in the area of environmental sociology (Burkett 1999; Buttel, Dickens, Dunlap, and Gijswijt 2002; Clark 2007; Foster 1999a; b; O'Connor 1991; Schnaiberg 1980; Schnaiberg and Gould 1994). Political economic theories on the environment offer an eco-structural perspective when analyzing social relations, together with the social factors that contribute to environmental issues, such as the degradation of natural resources. They draw on the works of political economic thinkers and advance a radical analysis [14] of social relations and their relationship to ecological issues. These theoretical views have provided environmental sociologists with a critical lens for examining a wide variety of ecological concerns.

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[13] Unfortunately, the distinction between the orthodox and heterodox views is rarely made. This may be due to the fact that Marxian analysis is frequently referred to as a political economic approach. However, it is worth remembering that the subtitle to Marx's *magnum opus* is *A Critique of Political Economy.*

[14] In this context, it is important to note the etymology of the word radical. It derives from the Latin word "radix" or "root," and is defined as "arising from or going to the root or the source" (American Hertiage Dictionary 1982).

Environmental Sociology and Political Economy

In this chapter, I will review the theoretical perspectives that inform my work, giving an overview of the political economic tradition and follow this through to its role in the development of the radical theories within environmental sociology. In order to do so, it is necessary to discuss the foundations of these theories and the classical study of political economy that date back to at least the eighteenth century. As such, I will briefly discuss some of the relevant theoretical views within classical political economy, using the ideas of Smith and Ricardo as exemplary of this school of thought, and further this discussion by examining the main ideas within neoclassical economics, its modern derivative.

I will follow this with a discussion of major theoretical perspectives in environmental economics and environmental sociology. This will begin with what I refer to as modernization theories and move to a radical political economic perspective including world-systems theory, the second contradiction of capitalism, and the treadmill of production. I will conclude this section with a discussion of Marx's theory of metabolic rift.

Classical Foundations of Political Economy

The philosophical foundations of classical political economy are arguably best represented by the works of Adam Smith (1723-1790), often referred to as the founding father of the discipline[15]. As such, his influence is visible throughout all of the traditions of economic thought. Smith's most famous work, *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776) is a classic work in political economic thought. As a student of the Enlightenment, as were many of his revolutionary contemporaries in the United States and France, his work reflects several of the popular philosophical views that were developing during this period, such as individual liberty. Underlying Smith's work is the philosophy of possessive individualism, which is closely related to the Enlightenment notion of personal liberty, in which the interests of the individual are paramount. In his attempt at ascertain the "laws of the market," Smith's philosophical view focused on the importance of the individual over the collective, and highlighted the pursuit of self-interest as a central driver of social progress (Heilbroner 1986a).

This notion of social progress is based on the idea that competitive self-interest results in behaviors with beneficial consequences. That is, the conflicting interests of individuals can create the conditions that allow a society to prosper and bring about social harmony (Heilbroner 1986b; Yates 2003). This viewpoint is most famously declared in his statement that "It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard for their own interest" (Bowditch and Ramsland 1961: 18). Thus, the pursuit of individual satisfaction can generate the conditions that allow for social prosperity.

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[15] In fact, three classical thinkers, Smith, Tomas Malthus, and David Ricardo, are often called the "founding fathers." This is an appropriate title since women were excluded from this debate until the 20th century.

Smith's well known notion of laissez-faire capitalism, which he called "the obvious and simple system of natural liberty" (Smith 1937: 651), is buttressed by this philosophy of possessive individualism. For Smith, the social harmony of the capitalist market system was part of a natural, even evolutionary, process that allowed society to move and progress toward perfection (Heilbroner 1986a). Markets, he argued, would create the most benefit for the most people when they are left alone, without undo interference from government management[16]. In his view, market mechanisms allow for the natural levels of prices, wages, production levels and profits to develop, or what would later be termed "market equilibrium" (Hunt 1979; Yates 2003). This naturalizing of the market is a key theme that is picked up by later neoclassical economists and is central to this theoretical discussion.

Smith was the first to unravel the class system that he observed during his lifetime. He differentiated between three principle social classes – capitalists, workers, and landlords – and explained that these classes corresponded to three categories of income: profits, wages, and rents. In addition, Smith was the first economist to distinguish between profits that accrued from industrial capital and wages, rents, and profits on merchant capital (Hunt 1979).

This class based analysis led him to a theory of value in which labor was the creator of value or wealth. "Labor," Smith notes, "was the first price, the original

[16] This reading of Smith has often been taken too far as he did call for more government management than is commonly acknowledged. In addition, he was acutely aware of the power that owners had over workers, as well as the potential degradation of workers caused by the extreme division of labor (Arrighi 2007; Heilbroner 1986a).

purchase-money that was paid for all things" (Heilbroner 1986b :176-6). Nevertheless, Smith never developed a coherent labor theory of value. This would be left to other thinkers, namely Ricardo and Marx. In terms of price or exchange value, he explained this as emerging from the "adding up" of the components of incomes: wages, rents, and profits. In this context, profits came from those that "hazard their stock" in the "adventure" of investment and re-investment (Bowditch and Ramsland 1961). Again, it was not until Marx developed the concept of surplus value that this would be explained in a more sophisticated manner, in which profit is not simply an equal component of the price that is added onto it (Hunt 1979).

Ricardo (1772-1823) built on many of Smith's concepts, and developed a more thorough explanation of the labor theory of value. As a wealthy industrialist, Ricardo was contemptuous of the landowners that controlled Britain's Parliament in his day. He clearly recognized the importance of class conflict saying "the interests of the landlords is always opposed to the interest of every other class in the community" (in Hunt 1979: 117). His ongoing dispute with Thomas Malthus (1766-1834) concerning the Corn Laws revolved around these concerns, as Ricardo was strongly in favor of removing these laws that used tariffs to protect domestic production of English grain. Removing the tariffs would allow cheap grain to enter England, thus providing cheaper food for laborers in urban centers. Ricardo appreciated that the price of labor was the main impediment to profit. Cheaper food would bring down the cost of labor, as labor prices were determined by the average cost of social reproduction[17].

Ricardo and Smith agreed that, in a market system, all commodities have a use-value; that is, real world utility. However, a use-value does not determine its market value or exchange value. This was made clear using the "water-diamond paradox." Water has a high use-value, but little or no exchange value (at least in Smith's and Ricardo's time), but diamonds have very little utility, and a very high market value. While all items that have exchange value must have some use value, as Smith stated: "The things that have the greatest value in use, have frequently little or no value in exchange; and, on the contrary, those which have the greatest value in exchange, have little or no value in use" (Heilbroner 1986a:174).

Ricardo affirmed that "possessing utility, commodities derive their exchangeable value from two sources: from their scarcity and from the quality of labor required to obtain them" (in Hunt 1979: 121). As scarcity is not usually a significant factor for most commodities – only in rare or a one of a kind item such as artwork – labor is the chief source of value. The prices of commodities are strictly proportional to the labor embodied in them in the production process. In addition, Ricardo made clear that tools and machinery were the products of labor. Production is a process in which the application of labor transforms natural resources into value (Hunt 1979). However, for Ricardo and other classical political economists, natural resources were free goods or

[17] Interestingly, while Ricardo and Malthus did not agree on the application of the Corn Laws, they did agree on Malthus' theory on population and thus both fell on the same side against the Poor Laws that offered social assistance to the poor.

"gifts of nature." While it is often overlooked, Karl Marx (1818-1883) corrected this error in his development of a more sophisticated labor theory of value. This will be discussed further momentarily.

Neoclassical Economic Theory

Neoclassical economists developed a theoretical approach that was greatly influenced by the classical founders. Yet, this approach takes on a number of new assumptions that cause it to veer away from its classical foundations. While accepting many of the central concepts originating from the classical political economic view, such as the philosophical importance of possessive individualism, neoclassical economics took these concepts into new territory.

In the neoclassical view, economics becomes a technical and "value-free" science, and therefore is considered to be isolated from social and political issues. As a consequence, neoclassical theorists began dropping class, power relations, and social structures from the study of political economy. This turn can be traced to the early nineteenth century and is associated with famous economists such as Jeremy Bentham (1748-1832), Jean-Baptiste Say (1767-1832), and Nassau Senior (1790-1864), and later Frédéric Bastiat (1801-1850) and John Stuart Mill (1806-1873), and completed in the 1870s by the economists associated with the "marginalist revolution," most notably William Stanley Jevons (1835-1882), Carl Menger (1840-1921) and Léon Walras (1834-1910) (Hunt 1979; Stilwell 2006).

Jeremy Bentham may be the earliest staunch advocate of utilitarian theory, a foundation on which neoclassical economics is based. This analysis focuses on individual agents, and is based on the idea of individual (consumer or firm) preferences as central forces for social development. From this vantage point, existing social relations, including laws of ownership and existing distribution of property rights, are assumed as a starting point for an analysis. Moreover, the process of market exchange is beneficial to all actors involved and ultimately results in "equilibrium" (Bowditch and Ramsland 1961; Hunt 1979). These assumptions suggest that individuals (and firms) will maximize their satisfaction (utility and/or profits) in their economic decisions. That is to say, individuals are fundamentally rational actors and make decisions accordingly. In a utilitarian sense, they seek to maximize pleasure/satisfaction and minimize pain. In these processes, neoclassical models assume that economic actors have equal access to high quality information, are free of other constraints, and that they are motivated by their personal satisfaction of wants and needs (Prugh 1999).

The neoclassical economists drew from the classical tradition in many ways, such as incorporating the philosophy of economic liberalism and explaining the laws of capitalism as natural laws, but snubbed many important concepts including class struggle and the labor theory of value. In addition, the neoclassical view ignores the conception of social surplus and its distribution, replacing it with a theoretical view based on individual surplus alone, thus isolating economic activity from its social and political context (Lippit 1996; Sweezy 1942).

These changes are often characterized as a progression in economic thinking. However, this is a crude explanation in which a number of important social factors are not considered. With the turbulent times and social changes that occurred over the eighteenth and nineteenth centuries, capitalism, under the stress of competing views, was transformed from a revolutionary system that pushed for the transformation of social relations into the dominant system, once established. As the capitalist mode of production emerged as the prevailing system, the revolutionary class influenced by the Enlightenment tradition developed into the conservative class, interested in maintaining the social status quo (Baran 1957). With these social transformations came parallel theoretical changes in the area of political economy, initiating the march towards what is often referred to as "the end of history." In neoclassical theory, the dominant social class of the era found the possibility for a theoretical justification and legitimation of the existing social conditions. In this view, the modern capitalist social and historical relations are natural and eternal. Therefore, this tradition works within a social vacuum and is thus absent of any real institutional, social, or historical investigation (Sherman 1987). Further, this view easily avoids any possibility of exploitation of labor or nature.

The influences of the natural sciences and its methods played an important role in neoclassical theory. Political economic analysis, with its focus on class and power, were considered value-laden theories, and therefore criticized as unscientific. Modeling themselves after the physical sciences, the neoclassical economists embraced mathematical formulations of economic phenomenon that isolated economic events from their "noisy" (i.e. complex) social setting. In today's context, econometric models are central to the academic credibility of economic research.

The neoclassical view did accept the strong liberal position of the classical liberal thinkers including the belief that "free trade" would benefit all economic actors. Building on Ricardo's concept of "comparative advantage," in which international trade benefits both nations, even when one nation could produce all of the traded commodities more efficiently than the other, neoclassical economists, and their neo-liberal allies, promote "free trade" policies and the reduction of protective barriers to trade. Ultimately the goal of these policies is to maximize the capital within a nation. Neoclassical economists contend that global inequality and global poverty are related to a nation's commitment to the capitalist system of production. Poorer nations have insufficiently adopted policies that will allow their nation to increase capital flow (Yates 2003). This is the underlying philosophy behind structural adjustment programs, developed later by the neo-liberals at the International Monetary Fund and the World Bank, as well as free trade agreements such as NAFTA and CAFTA[18].

Borrowing from Smith, Ricardo and Malthus, neoclassical economists are adamant about the limited role of government in relation to most economic activity, including trade. Global trade, it is argued, will contribute to increase the mass of commodities and enjoyment, and restriction on trade will reduce enjoyment or utility (Hunt 1979). With their focus on utility, neoclassical economists such as Milton

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[18] NAFTA – North American Free Trade Agreement. CAFTA – Central American Free Trade Agreement.

Friedman (1912-2006) have promoted this approach without reservation. For example, when considering food production, in their view, developing food for exports allows some nations to obtain foreign exchange that they can then spend on imports. Comparative advantage states that this exchange process will benefit all actors and lead to market equilibrium in which each gets fair market value and all needs will be met through market mechanisms like supply and demand. These foundations are extremely important for understanding the modern economic perspective. They lay the framework for what has come to be known as neo-liberal economics and its steadfast commitment to free trade, open markets, and the expansion of global capitalism or what is often referred to as "globalization."

Marx and the Critique of Political Economy

Each of these economic traditions has been extremely influential in academia and beyond. However, it is clear that the outlined theoretical perspective has many flaws, some of which are fatal. Nevertheless, the philosophical notions that underlie these views are likely the most influential perspectives for policy makers and analysts, as well as the general public when addressing environmental issues including food production and consumption.

While Karl Marx (1818-1883) was well acquainted with the works of the classical political economists, he found much of this body of work deficient. Arguably, his most pointed critique was that these thinkers had an *ahistorical* view of the system of production they were analyzing. As explained previously, for these classical liberal political economists, capitalism was a natural, inevitable and eternal system. This was a major point of contention for Marx and other critical political economists who followed, and the difference cannot be underestimated in its importance (Nell 1980). Marx's work always contained a historical character. As a result, his approach explains social reality as the outcome of historical processes, not the reflection of invariant natural laws (Sweezy 1942).

Unlike the liberal political economists of his era, Marx began his classic work, *Capital* (1867) with a systematic analysis of the commodity form. Marx explained that the commodity is the microcosm of the existing system of production, and thus must be unveiled. This is not a minor point in that it highlights that capitalism is a transitory system, one mode of production in a long string of production systems. The commodity form that emerges in a capitalist society is peculiar to this system of production. In contrast, the classical political economists were attempting to make claims about *all* societies for *all* times and seeking to discover "natural laws." Therefore, there was a tendency to begin their analyses with issues related to population or division of labor in general.

Marx's objective was "to lay bare the economic laws of motion of modern society," (Marx 1977: 92), not all societies for all times. Central to Marxist theory and radical political economy is the concept that the social relations that develop during capitalism are historically specific (Sherman 1987; Sweezy 1942). Moreover, Marx pointed out that class conflict was a manifestation of social forces and a driver of social change. Thus, the centrality of power relations and class conflict was essential to any theory of political economy[19]. From a Marxist perspective, leaving this aspect out of analysis of social relations, as the neoclassical economists have attempted, will surely lead toward flawed conclusions.

In addition, the classical political economists left the labor theory of value incomplete and ambiguous in that they ultimately included utility as an aspect of value, and the neoclassical economists discarded it entirely. For Marx, political economy is a science of social relations, not utility. Use values are relations between consumers and objects, and social relations, relations between people, are not reflected in an object's use value. For example, the value of a coat in its function to keep one warm, i.e. its use value or what neoclassical economists call utility, is a *qualitative* value that is not necessarily represented in its *quantitative* form or value in exchange[20]. Since, for Marx, political economy is in essence a study of society, utility may be a starting point in developing a thoroughgoing analysis of social relations, but it cannot be the focus. Neoclassical economics sees utility – and, as a result, the relations between people and things – as its central analytical concept (Sweezy 1942). Thus, Marxists critique this concentration on utility and individual actors, as it leaves substantial gaps in its potential for social analysis.

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[19] Contrary to popular belief, Marx was not attempting to reduce all of social reality into economic terms, what is often referred to as "economic determinism." Rather he was interested in exposing the "true interrelations between the economic and the non-economic factors in the totality of social existence" (Sweezy 1942: 15).

[20] Today, this is clearly evidenced in the increased exchange value that a brand logo adds to an article of clothing while not affecting its use value at all.

Additionally, Marx's concept of surplus value allowed for the more comprehensive explanation of value. The classical political economists made clear that labor was at the basis of all value, but could not explicate the origins of profit. For them, and for the neoclassical economists who follow this aspect of the tradition, profit appears (some might argue magically) from the process of exchange[21]. Here, equivalents are exchanged for equivalents, and there is no place for surplus value. Marx's "general formula for capital" (M-C-M') explained that the expansion of capital was the central aim of the capitalist, where M' included the original capital investment plus profits. Profits could not be understood through exchange or circulation, as this left many holes in the logical explanation of their origins. As a result, the source of profits must relate back to the source that creates value, and can only be uncovered in the process of production (Sweezy 1942).

This is a crucial point since, according to the labor theory of value, labor, and with it, nature, are the common characteristics of all commodities. Labor, Marx clarified, was the source of "surplus value." This conceptualization allows for a clearer picture of class relations, where socially necessary abstract labor time embodied in commodities is the starting place for a theory of exploitation and accumulation and a clearer understanding of the social relations under capitalism (Foster 1986). The capitalist system, for radical political economists, is based on the exploitation of "free" labor. Without exploitation, capital cannot accumulate, get reinvested and grow. As a scholar

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[21] Often, this process, in which profit emerges from exchange, is explained in the classical and neo-classical perspectives as a return for risking capital instead of keeping it idle.

of any of these traditions understands, the capitalist system of production is built on expansion; without growth the system will stagnate, create crisis and eventually collapse.

Thus, a radical perspective, based on the works of Marx, exposes the shortcomings of the assumptions made by classical and neoclassical economics and the associated traditions, revealing a theoretical approach that is essentially based in an ahistorical view and mistakenly perceives the current social relations as the only possible society. What is more, a radical analysis makes clear that a theoretical approach that explains social relations in terms of use value, or utility, and ignores social relations and social context, most notably power relations, is misapplied. Equipped with this knowledge, the radical political economic view opens up new theoretical avenues for understanding, which can highlight issues that reveal a more credible representation of the social world and the consequences of modern capitalism. This lens not only provides for a better understanding of the origins of value, but also reveals a system of exploitation of humans and the natural world in the name of increasing surplus value. Further, it has the potential to destroy the foundation on which the modern establishment justifies modern capitalist social relations.

Environmental Economics and Environmental Sociology

The previous discussion gives an overview of classical foundations of political economic theory and its transformation into its neoclassical form. In addition, it distinguishes radical political economy from this perspective and outlines a few important critiques. Through this critique, fatal flaws in the assumption made by the classical and neoclassical theorists are revealed.

All of these theoretical views have informed social scientists and their analyses related to modern environmental issues. Areas of study and research, including environmental economics and environmental sociology, have developed contemporary theories that try to elucidate the social relations to the natural world and the social mechanisms that drive environmental problems. They discuss approaches and methods for the potential resolution of these issues, including possible solutions for ecological and social sustainability and how best to utilize natural resources.

The following sections will begin with a discussion that explicates the view of what I refer to as modernization theory. This theoretical view is associated with the market's ability to resolve environmental problems informed by neoclassical economics as well as a free trade agenda. I include ecological modernization theory, a sociological theory, within this approach as it shares many foundational positions with environmental economics. This will be followed by a summary of other environmental sociological theories that have political economic foundations including world-systems theory, O'Connor's second contradiction, and treadmill of production. The section will conclude with a lengthy discussion of metabolic rift theory as developed by Marx and advanced by John Bellamy Foster.

Modernization Theories

The views of neoclassical economics have been very influential in the academe. The break with many of the theoretical foundations of classical political economics and its overarching approach that brought together related social issues and resulted in new disciplines that emerged to fill the gaps, such as sociology and political science. While these areas of study, along with history and the humanities, have developed in their own right, their close association and conceptual exchange with the key principles established by the classical and particularly the neoclassical traditions in economics is unmistakable.

These traditions make a variety of claims regarding all aspects of social life. Modern economics, based on the previously discussed principles of thought, becomes an essential view in the reproduction and expansion of capitalist social relations and its political economic order. As the dominant perspective within establishment political, economic, and academic circles, neoclassical economics emerges as the prevailing framework to address a variety of social concerns. This is evidenced in the deluge of academic and popular writings on the processes of capitalism that utilize the assumptions made by this view and impose them as natural laws[22]. Among the social concerns that are addressed are the issues related to the environment, including environmental degradation and sustainability. Furthermore, within this social context, modern orthodox economics becomes the only "legitimate" approach in most circles when discussing pressing environmental realities. Those who promote this view fall into a variety of theoretical

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[22] A good illustration of this is the mass of writings on globalization and its inevitability. For example see: (Friedman 2005; Irwin 2005; Lindsey 2002).

camps, including environmental economics[23] and, within sociology, ecological modernization theory. While there are some clear differences between the economic and sociological viewpoints, they share enough in common philosophically, such as the emphasis on market incentives, valuating resources and technological optimism, that I consider these various camps under the larger category of modernization theories and differentiate them from radical political economic (RPE) theories discussed later.

Environmental Economics

Environmental economists, and others, have developed theories that directly apply the assumptions of neoclassical economics to the environmental realm, providing a framework for an economic conception of environmental problems and their solutions. While there have been many debates about the increasing environmental impacts related to economic growth, many social scientists have argued that economic growth need not lead to environmental degradation. In fact, some contend that economic growth, along with expansion of trade or "globalization," is the most practical path toward sustainability (Anderson and Blackhurst 1992).

With the growth of the environmental movement in the 1960s, many critics, not the least of which was Rachel Carson (1907-1964), began to address the shortcomings of

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[23] It is important to clarify that while I consider *environmental* economists to be within the modernization thoery perspective, I do not include *ecological* economics within this viewpoint. The work of ecological economists is often at odds with environmental economics on a number of issues, such as on how to properly value natural resources and on the potential for "steady-state" economies (Booth 1998; 2004; Daly, Cobb, and Cobb 1989; Daly and Farley 2004).

economic theory in terms of the environment. Carson (1962) pointed to the destructive effects of chemicals in the environment that were brought about by agricultural pesticides, creating a spark that ignited the environmental movement. Carson focused on the industrialization of agriculture and the harmful effects on songbirds, but the notion that economic activity, particularly large-scale industrial activities, can have major environmental implications was brought to the fore (Pearce 2002).

In the realm of economics, the sub-discipline of environmental economics emerged to address these and other concerns in relation to environmental degradation. While environmental economics was developing some new approaches and assumptions, it came forward as an outgrowth of the neoclassical economic tradition and, as a result, borrowed many of its assumptions. For example, the notion that economics is a value-free approach, the concentration on maximization of utility, the focus on the individual rational actor, and supply and demand price equilibrium mechanisms are all central concepts within environmental economics.

The idea that decisions are made according to consistent and predictable rational process, is a crucial starting point for neoclassical theory and equally so for environmental economics. With equal information and access, it is assumed that actors can make choices that optimally meet their needs, i.e. bring about maximum utility. Maximizing utility (welfare) will not only have beneficial consequences on social actors, but can be employed to address environmental problems. In addition, borrowing from Bentham, it is maintained within this view that individuals, as the judges of their own welfare, will prefer greater individual welfare to less individual welfare, and that welfare can be adequately measured either in units of currency (for example dollars) or as a relative preference (Samuelson and Nordhaus 1992). That is, a quantitative value can be determined through pricing mechanisms to satisfy social and environmental needs.

Following this, the concept of market equilibrium is central. This concept states that it is the function of a market to link demand and supply through the price mechanisms. High demand for a commodity in short supply will bid the price upwards and conversely low demand or oversupply will bring prices down. It is assumed under these models that in a market system there is a tendency toward equilibrium, where price, supply and demand meet (Samuelson and Nordhaus 1992). Over time this produces maximum efficiency in the marketplace, where actors will be satisfied in relation to their buying power. This state of maximum efficiency is referred to as Pareto optimum, after the nineteenth century Italian economist Vilfredo Pareto (1848-1923). Simply stated, Pareto optimum is reached when nothing can make someone better off without making someone else worse off (Stavins 2000).

Using the basic concepts and assumptions borrowed from their neoclassical roots, environmental economists continue developing a variety of mechanisms to address such environmental issues as overuse and degradation of ecosystems and natural resources. Environmental economists consistently address these environmental issues and argue that the market must play a central role in alleviating them. Environmental problems are seen as emanating from a lack of proper market valuation and pricing that occurs when environmental "bads" are "externalized" (Turner, Pearce, and Bateman 1993).

A main feature of this theoretical perspective is the concept of economically *internalizing* the natural world, i.e. placing economic value on nature and integrating the environment into the economic system. Negative environmental externalities are those features of the economy that produce unpaid costs (Rao 2000). “A negative externality occurs whenever an agent has to bear a part of the cost of another agent’s activity without being compensated” (Rauscher 1997: 19). The failure to account for these externalities within the market is often referred to as a “market failure.” In order to resolve these market failures, it is argued that market principles, including pricing or incentives and costs mechanisms, must be implemented within the production process, for example during the pollution emitting process (Runge, Ortalo-Magné, and Vande Kamp 1994).

Developing this example, a factory using a nearby river or stream as a sink for its wastewater proceeds to pollute the waterway, which results in the devastation of the aquatic life, making it unsafe for human recreation or consumption. Theorists using the environmental economics framework argue that the costs of reduced recreation, fish catches, and other wealth producing activities of this waterway are no longer viable. In this case, the costs of pollution are not internalized by the firm/actor that is polluting or overusing a resource, but are paid for by society. In other words, the factory is not paying the price for decreases in economic activity that are related to the environmental degradation, such as less recreation and other economic activity that is related to the waterway. Consequently, market failure situations arise when firms create private profits, but in doing so impose large external costs on society. In addition to the lost revenues, included in this process of externalizing is the cost of cleaning up the degraded environment. This cost is often shifted to society in the form of taxpayer-funded cleanups (Turner et al. 1993).

Environmental economics argues that the free market takes into account the price of resources when deciding how much of that resource to use in the production of goods. Where those prices accurately reflect the true value of resources, the free market may encourage conservation when appropriate. However, the prices of many resources often do not reflect the full costs involved in their use. It is assumed that rational actors would maximize their utility by conserving resources if the costs of overusing were high enough (Turner et al. 1993).

In order to address this problem of externalizing costs, some theorists suggest incentive based approaches, such the hedonic pricing method (HPM) and the contingent valuation method (CVM) (Cropper and Oates 2000; Turner et al. 1993). While there are other methods of valuation that do not focus on demand side, they are considered to be less useful, since the absence of a demand curve renders them poor measures of welfare (Turner et al. 1993). As a result, they are not often considered in practical matters[24].

HPM is used to estimate economic values for ecosystem services that directly affect market prices and focuses on the demand side of the equation. Utilizing HPM, the price of a house or a job, for example, can be decomposed into the price attributes that make up the good, such as air quality in the price of a house, or, in the case of a job, the risk of death. Therefore, economists can value the individual characteristics of a good by looking at how the price individuals are willing to pay for it changes when the

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[24] See (Foster 2002) for a thorough discussion.

characteristics change. HPM is often used to estimate economic benefits or costs associated with air pollution, water pollution, and what are considered "environmental amenities," such as aesthetic views or recreational sites (Cropper and Oates 2000). Using this approach, the price of the environment is related to the market value of the commodities related to it. Extending the example for clarification, if we compare two homes of equal size and in generally equivalent areas, one of which is built near a pollution emitting power plant, we can assume that the difference in value for these houses will be related to the pollution produced by the power plant. The value of clean air would be computed in this difference in price. While this is a somewhat simplistic example, it illustrates the point. Rational actors will pay more for the same product if it includes cleaner air.

Using CVM, economists create surveys compiling questions that ask the consumer about the environmental commodity and their "willingness to pay" for them (Turner et al. 1993). Typically, economists ask respondents to value an output, such as a day of camping or fishing, rather than a change in pollution concentrations that would cause the location to be unusable for their purposes. The goal is to determine the maximum a person is willing to pay for an improvement in an environmental quality. This is accomplished by either asking what this amount should be or suggesting a stated amount and asking if they would pay for it (Cropper and Oates 2000). Aggregating data compiled from this research, environmental economists create demand curves and determine the values for environmental commodities. Using these and other incentive based methods, environmental economics proposes that the "invisible hand" of the market can resolve environmental challenges, so long as they are priced accordingly. It is important to note that implicit in these market based solutions is the assumption that privatization of common resources will best meet social and environmental goals.

Environmental Economics and Free Trade

For environmental economic theorists, trade liberalization is central to a variety of economic, social, and political mechanisms that will lead toward global welfare maximization, which includes environmental protection and sustainability (Copeland and Taylor 2003; Rao 2000; Rauscher 1997; Runge et al. 1994; Sampson 2005). These theorists claim that increasing assimilation into the global economic structure and trade regimes will ultimately have a beneficial impact on resource use and the environment (Copeland and Taylor 2003). That is, this approach suggests that as nations expand free markets and open trade, they will increase their integration into the global economy and, as a direct result, further the modernization process. Exporting nations will have "comparative advantage" in that they will be able to focus their production on commodities which best utilize their resources relative to the resource allocation of competitors[25] (Ingco and Winters 2004). Thus, global market mechanisms will allow (force) nations to focus on producing the commodities that they are best suited for, which

[25] Note that to have *comparative* advantage with regards to a particular commodity, a nation need not be able to produce it more efficiently than any other nation could (which would be a case of *absolute* advantage). It only need produce it more efficiently than any nation that found the commodity worthwhile to produce can produce it.

will be to the benefit of all actors.[26] Furthermore, comparative advantage is often advanced from a two-nation model to a multi-nation model developing into a "chain of comparative advantage" (Ekins, Folke, and Costanza 1994; Findlay 1970). In other words, "By specializing in the production of those goods which a State has comparative cost advantage and trading in those goods in which such advantage is relatively less, the world's resources are optimally used and maximized" (Qureshi 1996: 4).

A fundamental assumption of modernization theory, particularly in the economic realm, is that an open international trading system will benefit all nations (Ingco and Winters 2004; Rao 2000; Runge et al. 1994; Sampson 2005). This *laissaz-faire* approach endorses the removal of tariffs, price supports and subsidies and advocates a system of global "free trade." It is argued that this development will stimulate more economic growth and foreign investment along with advancements in technology and increase the welfare of all actors involved[27]. In terms of the environment, trade liberalization can lead

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[26] It is worthwhile to consider that Ricardo and Smith recognized that the advantages that could come from the global division of labor, what Ricardo labeled "comparative advantage" could be realized only when national boundaries limit capital and labor mobility. That is, a major assumption underlying this principle is the immobility of capital and labor between nations. For these theorists, only under these conditions does comparative advantage replace absolute advantage. As such, according to Ricardo's original conception of the principle of comparative advantage, in the modern globalized world where capital moves freely to, for example, take advantage of cheaper labor costs, the principle does not hold (Daly et al. 1989).

[27] It is important to note that many theorists associated with this approach often argue for a more nuanced view. They are not only advocating quantitatively more trade but a different kind of freer trade that removes "distortions" such as regulations and subsidies. In fact, contentions over agricultural subsidies have been the crucial sticking point at recent free trade negotiations leading to debates characterized as free trade vs. protectionism. This debate inevitably leads to a discussion regarding the theoretical

to the rational allocation of resources, as well as other aspects of modernization, and will have beneficial effects on the environment through increasing efficiency and decreasing pollution (Copeland and Taylor 2003; Ingco and Winters 2004; Runge et al. 1994). "Liberalization of trade and the rules that govern trade have become inextricably linked with economic development, conservation of the environment, and improving social conditions" (Sampson 2005: 2). This view argues that by implementing free market principles, natural resources will be allocated most efficiently and profitably, resulting in an improved environment. Ingco and Winters (2004: 6) state that moving production to the most efficient locations, free trade "… is more likely to promote conservation of the environment, and hence livelihood, than the opposite." More trade, fewer barriers to trade, and economic growth are the preferred methods to bring about welfare-improvement, which includes environmental protection (Runge et al. 1994).

This approach is coupled with what is sometimes referred to as "technological optimism," the belief that solutions for environmental problems will stem from increasing scientific and technological innovations that are spurred by increasing revenues from economic growth. For example, Abler and Shortle (1998) argue that economic benefits can lead to changes in environmentally beneficial technological innovation in the area of food production for four reasons. First, economic growth will encourage the diffusion of technology internationally and this technology has the potential to be "environmentally friendly." The increase in wealth generated from trade will allow for the purchase of

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possibility of genuine free trade within the current political economic system and is beyond the scope of this discussion.

capital equipment and input technology not previously available. Second, with the increases in market size, technology will be more affordable because of economies of scale in research and development. Third, as more wealth is generated there will be more resources to devote to research in areas such as environmentally friendly technology. Last, research and new technologies will reduce the costs of production, which can result in lower prices. Lower prices coupled with the availability of "greener" and lower cost technologies will reduce producers' incentive for employing potentially harmful yield-increasing technologies.

Ecological Modernization Theory

For modernization theories, economic development is considered a prerequisite for sound environmental policy. The best way to enhance environmental quality is to stimulate economic growth, since it generates the social resources necessary for addressing environmental problems (Grossman and Krueger 1995). Within sociology, ecological modernization theory (EMT) is the approach most closely allied with this perspective, although it also focuses on the institutions of modernity, rather than simply the economy (Mol and Sonnenfeld 2000; Mol and Spaargaren 2000; Spaargaren 1997; Spaargaren, Mol, and Buttel 2000). Clearly, there are differences in viewpoint from the strict economic orientation. Nevertheless, the similarities are sufficient to include this theoretical view within this discussion.

EMT initially emerged in the 1980s in Northwestern Europe. Its early advancement is often associated with the work of Joseph Huber, characterized by technological optimism and a favorable attitude toward market approaches when addressing environmental reforms (Mol and Spaargaren 2000). To some degree, EMT comes forward in environmental sociology, in response to neo-Marxist theories on the environment. The major debates it was engaged in during this time were addressing counter-productivity or deindustrialization theorists (demodernization) on the one hand, and neo-Marxists on the other.

While EMT is not economically deterministic like neoclassical economics, capitalist economic development is a central part of their definition of the modernization process[28]. A fundamental component that sets EMT apart from other environmental sociology theories is that, for EM theorists, economic growth is not a 'zero-sum game' in terms of the environment. Like many economists, these theorists argue that economic growth is not necessarily dependent on environmental exploitation and, therefore, the potential for long-term resource sustainability is not undermined by modernization through economic development (Mol and Sonnenfeld 2000; Spaargaren et al. 2000). While some environmental sociologists and, even some economists like E.F. Schumacher, have argued that growth in gross domestic product (GDP) was directly tied to increases in natural resource use, EM theorists argued that there is a "de-linking" of GDP and natural resource consumption occurring in modernized nations, such as

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[28] In EMT modernity is a process of economic, social, and political development. This process is often related to the advancement of science and technology, Western style capitalism, liberal democracy and other Enlightenment principles. Giddens (1990) offers a simple definition for modernity as the "...modes of social life or organization which emerged in Europe from about the seventeenth century onwards and which subsequently became more or less worldwide in their influence" (Giddens 1990 :1).

Germany and the Netherlands (Murphy 2000). Thus, EM theorists do not expect that the expansion of a global free market will necessarily exacerbate environmental problems (Mol 2001).

EMT maintains that with the advancement of the modern era came a variety of beneficial and harmful developments for humans and the environment. These theorists suggest that this process is rational and, as a result, it will advance the benefits while ultimately diminishing negative developments. Consequently, the environmental crisis can become a vehicle for furthering the rationalization[29] process occurring under modernity (Spaargaren 1997). The growth of modern institutions and broadening of the bureaucratization process will bring about the amelioration of ecological problems through what they term "ecological rationality" (Mol and Spaargaren 2005). As a result, the advancement of the present social, political, and economic systems are necessary components for the development of ecologically sound resource use.

EMT challenged the core ideas of the demodernization perspective especially during the "first phase" of theory in the 1980s. It is argued that in order to address environmental problems, it is necessary to move further into the modernization process, not away from it. In addition, unlike neo-Marxists, modernization theorists do not believe that a fundamental reorganization of the core institutions of modern society is essential for long-term environmental sustainability. Therefore, the theoretical discussion within EMT is based on the advancement of the *current* social relations of production and

[29] For Weber, the advancement of the rationalization process included dramatic increases in efficiency, calculability, predictability, and control throughout the social system and the elimination of traditional social relations (Weber 1956; 1961).

social structures in order to best meet humanity's needs. EMT acknowledges some transformation within the modernization project, but these transformations did not imply that core institutions must be superseded[30].

Mol and Sonnenfeld (2000) lay out five categories of social and institutional transformations under modernity that allow for the development of sustainable societies: 1) the changing role of science and technology, 2) the increasing importance of market dynamics and economic agents, 3) transformation of the role of the nation-state, 4) modifications in the position, role and ideology of social movements, and 5) changing discursive practices and emerging new ideologies. All of these changes and adjustments, they argue, are taking place in modern society, but need to move further.

Like environmental economic theories, the idea of internalizing the natural world is an important concept. It is argued that the externalization of costs is more likely to occur in nations that are not sufficiently modernized. The course of action for returning equilibrium to the system is sometimes referred to by EM theorists as the twin processes of 'ecologizing the economy' and the 'economizing of ecology' (Spaargaren 1997). Methods such as valuating resources, environmental taxes, market incentives, and re-engineering production that occur in modernized nations are seen as examples of these processes (Sonnenfeld 2000). This view is clearly tied to other modernization theories.

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[30] In this case, the term "modernization" may be a misnomer, in that there are strong ties to particular institutions, and replacing these institutions, specifically the competitive market economy, with a new set of revolutionary social relations is not seriously considered.

Moreover, EMT suggests that as nations modernize, environmental degradation and economic development will form an Environmental Kuznets Curve[31] (EKC). The EKC exhibits increasing environmental impacts during the early stages of economic development, which stabilize and decline after a turning point in national affluence is reached, forming an inverted U-shaped curve (Dinda 2004). Modernization and economic growth, it is argued, spur technological innovation, government regulations, democratic social movements, industry adaptations, and other institutional transformations, which will generally bring about decreases in environmental impact previously caused by industrial production (Mol and Sonnenfeld 2000).

Radical Political Economy and the Environment

I now turn to radical political economic (RPE) theories on the environment. These theories will offer different insights than those within the modernization approach. The relationship between capitalist production and the environment has been thoroughly examined and explicated by the sociological works of theorists working in what I refer to as the RPE tradition. These scholars have highlighted the historical roots of environmental degradation, as well as the mounting threat posed to the environment and society in the modern era, by a production system based on capitalist logic. While there

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[31] The EKC takes its name from the work of Simon Kuznets (1955), who addressed income inequality. Kuznets argued that income inequality typically increases during early stages of economic development, but that it eventually stabilizes and then decreases after a critical level of economic development is reached Thus, the EKC is an application of Kuznets's conceptualization of the relationship between economic development and income inequality to the environment.

are some similarities in these approaches as well as the processes that they emphasize in their analyses, there are some important distinctions within RPE that are crucial when understanding the causes and consequences of the society and nature dynamic within modern capitalist social relations.

The following theoretical discussion will provide a powerful framework for analyzing these relations. In doing so it will suggest shortcomings in the modernization theoretical framework. Beginning by outlining world-systems theory and moving on to what are sometimes called eco-Marxist theories on the environment – second contradiction, treadmill of production and metabolic rift – I will undertake a review of this intellectual tradition. Concluding with the metabolic rift will allow me to develop this approach in some depth, and illustrate its insight and explanatory power.

World-Systems Theory

The world-systems view claims that social forces developed under the capitalist system shape national integration into the world economy. This perspective is based on a tripartite global system of core, periphery and semi-periphery nations in which core nations benefit from unequal exchange relationships with periphery nations (Frank 1979; Wallerstein 1974). Contrary to Ricardo's theory of "comparative advantage," in which both nations are expected to benefit from trade exchanges, this view emphasizes the historical structural hierarchy that leads to the exploitation of labor and resources in the periphery, which subsidizes the core (Amin 1976; Frank 1979).

Research in world-systems theory (WST) has found that core nations have historically exploited labor and natural resources in the periphery, which has had lasting negative social as well as environmental impacts. The extraction of resources from the periphery has long been a part of capitalist development in the core (Bunker 1984). This has developed into a process of export commodity concentration in the periphery, defined as a large percentage of trade concentrated in a small number of goods, which are often agri-food products (Jorgenson 2003; Rubinson and Holtzman 1981). This concentration of exports has been shown to create a dependency relationship with the core, perpetuating underdevelopment and environmental degradation in the periphery, while promoting wealth and consumption in the core (Jorgenson and Kick 2003; Kentor and Boswell 2003). It is argued that these global trade relations bring about conditions in which periphery nations increase specialization in primary sector commodities for export while becoming more dependent upon core countries for manufactured goods and capital.

Drawing on a world-system perspective, sociologists such as McMichael (1995), Friedman (1982), and others developed a theoretical analysis of the agri-food system that emphasize the rise and fall of "food regimes." These theorists, working in the political economy of agriculture tradition, explain the development of the modern agri-food system as a globalized process that is dominated by a small group of transnational corporations (Bonanno et al. 1994). They contend that, with the help of international finance agencies, large transnational corporations gain increasing control of markets and therefore dictate the workings of the system. This often occurs to the detriment of small producers throughout the world (Buttel, Larson, and Gillespie 1990). In addition, these theorists argue that these processes have resulted in the transformation of natural systems into increasingly industrialized systems of production, which can bring about significant environmental problems (Goodman 1991).

McMichael and others argue that what has been occurring, particularly since the 1970s, and which expanded further in the 1990s, is the internationalization of the agri-food industry and global demand, as opposed to local demand, increasingly driving the food economy (Goodman 1991; McMichael 1994; 1995). Furthermore, since the 1990s, there has been an unprecedented deregulation of agriculture that is associated with the increase of export oriented neo-liberal development strategies (Goodman 1991).

The work done by world-systems theorists attempts to reveal the reality behind the free trade rhetoric promoted by the neo-liberal view. It provides a perspective that takes into consideration the long history of Western colonialism, domination, and exploitation and links this to the present global political economic structure. In doing so, this view criticizes theories of free trade and globalization, as they appear on their face as logical, but it is argued, with some scrutiny they quickly crumble. From the world-systems view, it becomes apparent that "free-trade" approaches neglect crucial historical realities and their current manifestations in global power relations.

The Second Contradiction of Capitalism

James O'Connor's work in environmental sociology is best known for his development of the second contradiction of capitalism. For O'Connor (1991), environmental degradation caused by a capitalistic system of production constitutes a "second contradiction" which builds on Marx's (1977) first contradiction of capitalism. The second contradiction focuses on capitalist exploitation of the natural environment, positing that advancement and development of this mode of production increases capital's impacts on the natural environment, furthering environmental degradation. This degradation continually increases the costs of future economic expansion and will ultimately lead to the system's demise (O'Connor 1998).

The first contradiction of capitalism expresses capital's social and political power over labor and the inherent tendency towards realization crisis, or crisis of capitalist overproduction. To elaborate, the first contradiction, related to what Marx (1977) called "the general law of capitalist accumulation," is based on capitalism's exploitation and alienation of the working class and creates a tendency for economic crisis. The manifestation of the first contradiction is found within capital's limitless drive to increase exploitation and accumulation, "…amassing wealth at one pole and relative human misery and degradation at the other" (Foster 1992:78).

This contradiction results in a crisis of overproduction (sometimes referred to as a realization or a demand crisis) when capital surpluses are continually siphoned from the working class into the hands of the capitalist class. This accumulated wealth is invested in order to increase production of goods with the goal of increasing profits and accumulating more wealth, resulting in the increasing concentration of wealth. Consequently, labor's share of the productive wealth is continually diminished.

Capital becomes its own worst enemy, threatening profitability because of what Marx called the "contradiction between social production and private appropriation"

(O'Connor 1998). The greater capital's power over labor the greater the exploitation over labor and the more potential profits will be produced. "However, precisely for this reason, the greater will be the difficulty of realizing these potential profits in the market" (O'Connor 1998: 240). Capital attempts to restore profits by increasing labor productivity via speeding up work or cutting wages. This allows for more production from fewer workers and less overhead costs. The unintended consequence of this is to reduce the purchasing power of laborers and the demand for consumer commodities thus ultimately reducing the realized profits (O'Connor 1998).

O'Connor maintains that the logic in the first contradiction is limited and one-side because it presupposes limitless supplies of what Marx called the "conditions of production." As a result, growth and expansion, which are vital to capitalism's reproduction, are constrained only on the demand side. He argues that if the costs of the conditions of production (i.e. labor, nature, infrastructure, and space) increase significantly, capital faces a possible "second contradiction." The second contradiction is a cost-side crisis, which has the potential to result in *underproduction.*

O'Connor uses Marx's conception of the "conditions of production" describing them as encompassing three aspects: 1) human labor power or the "personal conditions of production" 2) the environment or the "natural or external conditions of production" and 3) urban infrastructure or the "general communal conditions of production." Conditions of production are not produced as commodities, but are treated as "fictitious commodities" with "fictitious prices" (1998:144).

In short, the second contradiction states that "…when individual capitals attempt to defend or restore profits by cutting or externalizing costs, the unintended effect is to reduce the "productivity" of the conditions of production, hence to raise average costs" (O'Connor 1991: 108). These "limits to growth" do not appear as absolute shortages of natural resources, but as *high-costs*. The demand for raw materials and unpolluted commons increases as they become scarce, driving up what Marx called the "costs of elements of capital."

O'Connor (1994) explains that there are two sides of the cost side crisis. First, over time, in the process of defending profits, capital degrades or fails to maintain the material and social conditions of production. For example, capital may try to restore limping profits by neglecting work conditions, thus resulting in rising health care costs, degrading the soil, thus lowering the productivity of the land, or decaying the urban infrastructure, thus increasing congestion and law enforcement costs. The second aspect is related to the social reaction to the degrading conditions and the role of civil society. As conditions worsen, social movements demand that capital provide the maintenance and restoration for these conditions of life, also resulting in higher costs.

"The basic cause of the second contradiction is capitalism's economically self destructive appropriation and use of labor power, urban infrastructure and space, and external nature or environment" (O'Connor 1991:108). It is self-destructive because the costs of the conditions of production will rise when private costs are turned into social costs. As capital continually works to lower costs, they inadvertently tend to raise costs of capital as a whole. On the one hand, the first contradiction has no problem producing commodities, but it has a problem realizing surplus value. On the other hand, the second contradiction has no problem realizing surplus value, but has a problem producing it. With this explanation we can see that the two contradictions are intimately related (Foster 1992). Economic pressure can develop from the demand side or cost side or both, arising from capital's drive to accumulate profits by externalizing costs and exploiting labor.

Treadmill of Production

The treadmill of production (ToP) model was originally developed by Allan Schnaiberg and first published in *The Environment: From Surplus to Scarcity* (1980). It has since been expanded by a number of other sociologists, most notably Gould, Pellow, and Weinberg (Gould, Pellow, and Schnaiberg 2004; 2008; Gould, Schnaiberg, and Weinberg 1996; Weinberg, Pellow, and Schnaiberg 2000). It was originally formulated as an economic exchange theory, but it has direct implications for the environment, particularly natural resource sustainability and pollution (Gould et al. 2004). ToP is an analysis of social institutions involved in the creation and distribution of social surplus, asking questions such as: What social forms induce higher levels of industrialization and extraction of resources (Schnaiberg 1980)?

In short, the theory states that increasing accumulation of capital in Western economies is re-invested into economic institutions in order to increase productivity and ultimately profits. The economic need to continually increase profits is unceasing. This logic plays out in a variety of ways. For example, investment in new technology increases efficiency (i.e. "worker productivity") and profits, while reducing demand for workers. In order to stem unemployment and ultimately avoid stagnation, industry must boost production. All of this leads to increases in profits, which are accumulating and must be reinvested in production, and the cycle continues. While profits increase, the process of accumulation concentrates capital. Therefore, most individuals are not benefiting and must work harder to stay in the same place socially and financially; hence the term treadmill.

The theory has a political component as well. The economic component of ToP explains the expanding production and economic development as well as increasing consumption. The political component involves convergence of private capital, labor, and governments in promoting this goal and is based on the widespread belief that economic growth will bring about improvements in public welfare. All three of these groups tend to support policies aimed at fostering growth. The convergence of private capital, labor and state interests represents a powerful political force, promoting constant acceleration of the treadmill (Gould et al. 2004).

Because of the pressures from competition and shareholders, Western (capitalist) economies are geared toward continually increasing production (growth). This process has become highly institutionalized. However, the treadmill has negative consequences for workers, communities, and the environment while enhancing political and economic power of shareholders (investors and managers). That is, the treadmill is beneficial to shareholders, but it represents a decrease in the social efficiency of the productive system (society running in place), which leads to increased rates of ecosystem depletion and pollution that result from resource and chemical intensive processes (Gould et al. 2004). Thus, the treadmill logic creates an "enduring conflict" between the environment and society (Schnaiberg and Gould 1994).

Schnaiberg and Gould (1994) characterize the logic of ToP as a process that is continually increasing accumulation of wealth, increasing the movement of workers away from self-employment, increasing allocation of accumulated wealth to new technologies, and increasing activities of government to facilitate expanding accumulation, which result in an increasing necessity for ever greater ecological withdrawals and the likelihood of ecological disorganization. Through these processes, societies become progressively more vulnerable to socioeconomic disorganization due to the degradation of ecological conditions.

ToP emphasizes the importance of contradictions in behaviors of individuals, institutions and aslo the state (Gould et al. 2004). Schnaiberg (1980) develops what he calls the "socio-environmental dialectic," consisting of dialectical relations between production expansion and ecological limits. The syntheses of this dialectic can be resolved historically through synthesis of varying duration. They are the result of social decision making of various types and lay out possibilities for future outcomes. Schnaiberg theorizes three likely outcomes, calling them economic, planned scarcity, or ecological synthesis. None is inevitable, but neither are the choices infinite. He maintains that the only solution for ecological and social sustainability is the resolution of the dialectic in the manner of the ecological synthesis.

Schnaiberg's "treadmill of production," while originally drawing on the works of prominent neo-Marxists such as Paul Baran (1910-1964) and Paul Sweezy (1910-2004), has moved away from this tradition. His work with Gould (Schnaiberg and Gould 1994) maintained its original theory, but has currently dropped much of this influence and draws on a variety of non-Marxist sources (Foster 2005). In addition, Schnaiberg (1980) maintains that any solution to the ecological crisis must *first* deal with the treadmill, what might be termed the primacy of the treadmill. More, he does not regard the treadmill as exclusively capitalist. That is to say, for Schnaiberg the removal of capitalism (i.e. socialism) is not simply the answer. Upon examining the existing socialist states of the late twentieth century, Schnaiberg did not necessarily advocate for a movement toward socialism.

Metabolic Rift

In contrast to O'Connor's or Schnaiberg's econo-centrist theories, John Bellamy Foster, drawing from Marx, developed a theory of society-nature relations that was holistic and focused on the society and nature dialectic that Schnaiberg (1980) agreed was a central tension in the relationship. While all of these theories share a Marxist foundation, only Foster develops Marx's ecological theory along with a social analysis (Clark and York 2005). O'Connor's work can be characterized as an addition to Marx's theory, while still ignoring Marx's ecological approach. O'Connor understood Marx's contribution to the ecological problems of capitalist society in purely economic terms. Also, ToP focuses squarely on economic growth and its social and environment effects, and this conception of the society-nature dialectic is useful, yet inadequate. On the other hand, the metabolic rift theory, which draws on Marx's conception of society and nature metabolism, reveals a more sophisticated analysis, what can be considered a socio-ecological approach (Foster 1999a).

The tradition of sociology had been reluctant to address the environment as an issue for a variety of reasons, one of which was the perceived lack of relevance of the classic scholars, such as Marx, Weber, and Durkheim, in addressing issues on the environment. However, in a systematic reconstruction of Marx's theory of metabolic rift, Foster (1999a; 2000) demonstrates that many of the critiques leveled against Marx regarding the environment are unfounded. Previously sociologists have stated that Marx, among the other classic theorists in sociology, wore "blinders" in relation to issues such as the exploitation of nature, existence of natural limits, and nature's role in creating value. Additionaly, Marx was generally seen as having a Promethean attitude toward nature and the potential of capitalist technology. In this view, scholars were critical of Marx's labor theory of value, claiming that it ignores natural limits and the role of nature. Benton (1989) states that this problem "...render[s] the theory incapable of adequately conceptualizing the ecological conditions and limits of human need-meeting interaction with nature" (63). As a result, theorists working in this tradition, such as Schnaiberg, tended to distance themselves from Marxian conceptions of society and nature.

Foster makes clear that Marx, in fact, addressed these issues and characterizations such as those stated are unsubstantiated. Marx provided a powerful analysis of the main ecological crisis of his day – the problem of soil fertility in capitalist agriculture – and commented on other ecological crises (e.g. deforestation, air and water pollution). This is achieved in large measure by his application and extension of the concept of metabolism in his analysis of the interrelationship between society and nature.

Before I develop a discussion of the concept of metabolism and what Marx called the "metabolic rift" rooted in capitalist social relations, it is important to explain Marx's analytical orientation or what can be considered his starting point for an analysis of society-nature relations. This orientation offers much insight into the development of a radical political economic analysis of contemporary environmental issues. This being so, in the next section, I will briefly outline Marx's materialist conception of history and its importance to his study of society and nature.

Nature and Marx's Materialist Conception of History

In the *Manuscripts of 1844*, Marx commented on the alienation between humans and their environment, an important component later in his ecological discussions. However, at that time, Marx had not completely developed his materialist conception of history, which becomes central to his political economy. The *Manuscripts of 1844* utilized a framework that was similar to that of the German philosopher Ludwig Feuerbach (1804-1872) and can be described as materialist *philosophy*. That is to say, Marx was still in the process of redefining his analytical perspective and transitioning to a materialist conception of history, what Fracchia (1991) describes as Marx's *Aufhebung* of philosophy[32]. Therefore, the foundation of a materialist conception of history is not complete until the *German Ideology* is written in 1845.

In the *Manuscripts,* Marx acknowledges that there is a physical aspect in the human estrangement from nature saying: "Man lives from nature… nature is his body…[and] man is a part of nature"[33] (Tucker 1978: 75). However, the concept of alienation/estrangement from one's species being/essence is not adequate once Marx employs a thoroughgoing materialist analysis, what he calls a "science of history" in the *German Ideology* (Fracchia 1991). As such, Marx begins to utilize the concept of exploitation, rather than estrangement, and acknowledges that any notion of a fixed species essence, or human nature, lacks historical specificity. To correct this shortcoming, he begins to employ the notion of an "ensemble of social relations," first developed in Marx's *Thesis on Feuerbach* (Tucker 1978). This is significant because in this re-development and re-conceptualiziion of his understanding of human history, Marx also begins to make use of the concept of metabolism to better explain the processes with which human societies interact with extra-human nature. These concepts, exploitation and metabolism, fundamentally materialist in their foundation, open up new avenues for understanding human societies and human history, as well as new prospects for human freedom (Foster 2000; Fracchia 1991).

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[32] Rejection or break with the Western philosophical tradition.

[33] Marx often used the word *menschliche* in his writings, which correctly translated means human. However, this is erroneously translated to the word "man" in most of the English publications.

These concepts are central to Marx's political economy and allow Marx to construct a comprehensive materialist analysis of the human relations to the natural world (Foster 2000). Clearly, a complete analysis of human history must include the physical world, i.e. nature. As Marx states in the *German Ideology*: "the first fact to be established is the corporeal organization of human beings and their consequent relation to the rest of nature" (Tucker 1978: 149)[34]. This basic assumption must be the starting point for any materialist analysis.

It is important to note that Marx's materialism avoids the traps of mechanistic or reductionist materialism. While he is an ontological realist[35], he stresses the importance of a historical standpoint. This is clear in his adoption of the notion "ensemble of social relations," which eschews any trans-historical human essence (Fracchia 1991). Thus, his materialist analysis takes on the character of a cautious constructionism or critical realism, which recognizes that the external world is dependent on nature and matter and that there is "a level of physical reality that is independent of and prior to thought" (Foster 2000: 2).

At the same time, this approach maintains the importance of cultural constructs that underlie social mechanisms, and their role in human understanding (Dickens 2004).

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[34] Tucker's (1978) translation has been corrected by Fracchia (2005), giving a more accurate translation from the original German "köperliche Organisation der Menschen" and substitutes Tucker's "physical" with "corporeal" and "these individuals" with "human beings." This quote reflects Fracchia's translation.

[35] Ontological realism refers to the notion that the world exists independent of human observations or that there is an extra-human world independent of human existence. This is a central component of Western science (Rosa 1998).

As such, this approach is neither a mechanical nor a deterministic materialism, either of which can ignore the importance of social constructions or historical contingency. This is crucial so as to avoid any trans-historical assumptions about human nature and human societies (Fracchia 2005). Unlike the classical political economists and their neoclassical descendents discussed previously, historical specificity was crucial to Marx's analysis.

Marx made clear that a materialist framework was necessary for studying humans interacting with nature in order to satisfy their material needs, in which a philosophical perspective would be inadequate (Foster 2000; Fracchia 1991). A central focus in Marx's approach was directed at undermining idealistic and teleological philosophy that emphasizes the power of the mind over body and separation of humans from nature. Simultaneously, he emphasized the need to avoid the mechanistic reductionism that often plagues materialist thought. For Marx, it was crucial to address the flawed, and potentially dangerous, philosophical and political conclusions that can be reached by each of these misguided approaches.

Marx's materialism is also dialectical. A dialectical approach to the natural world sees humanity as enveloped in natural processes, not outside of them. It recognizes that "opposing forces lie at the base of the evolving physical and biological world" (Levins and Lewontin 1985: 280). Organisms are both subjects and objects, causes and effects of their environment. There is an interactive effect occurring that influences all aspects of the natural world including, of course, humans. Parts of a system are not mutually exclusive from the whole. One does not exist without the other, one acquires its properties from the relation to the other, and those properties develop as a result of their interpenetration (Levins and Lewontin 1985). As Engels stated in *Dialectics of Nature* (1966):

> " Thus at every step we are reminded that we by no means rule over nature like a conqueror over a foreign people, like someone standing outside nature - but that we, with flesh, blood, and brain, belong to nature, and exist in its midst" (180).

This dialectical materialism leads directly to a coevolutionary understanding of society and nature. Since humans cannot be separated from the extra-human natural world and interact with it, it is plain that effects on one have influence and shape the other. This conception of human-nature coevolution was promoted by Engels in *Dialectics of Nature* and later developed by noted evolutionary biologists such as Stephen Jay Gould, Richard Levins and Richard Lewontin. This view recognizes that human evolution allows for new ways of interacting with surroundings, which change the conditions of the interaction and the environment (Foster 2000). These alterations can then offer new possibilities for human development. In nature, changes in organisms lead to changing environments (Lewontin and Levins 2007). Human societies actively change their environment, and these transformations activate new consequences and responses, creating what might be considered a feedback loop. Thus, a coevolutionary analysis avoids reductionist and one-sided approaches that lead to erroneous conceptions of interrelations between nature and human society.

Social Metabolism and the Metabolic Rift

The concept of metabolism was developed in the biological and ecological sciences to describe the processes that allow material exchanges to take place between an organism and its environment, or a cell and its surroundings (Fischer-Kowalski 1997). Scholars working in the area of systems ecology have argued that it is useful to consider the concept of metabolism at the ecosystems level as well as their sub-systems (Foster 2000; Odum 1977). Metabolic processes allow living organisms to uptake necessary resources from their surroundings and convert them into the basic building blocks of life (Fischer-Kowalski 1998). For example, in the process of respiration, humans intake air from the surrounding environment, derive chemical energy from oxygen, and then release carbon dioxide and water vapor back into the air. Organisms, and the cells and tissues that make them up, need to constantly maintain and regulate themselves through the use of energy flows and nutrients, which are supplied by the environment. As such, metabolic processes are essential for life (Foster 1999a).

Marx and Engels recognized the significance of the concept of metabolism and applied it to describe society's interaction with its environment in much the same way biologists use it to understand the workings of a cell or an organism (Fischer-Kowalski 1997; Foster 1999a). Societies, as human systems, work to acquire material resources from their environment and return waste or consumed material back to the environment in order to maintain and reproduce themselves. The mechanisms that regulate these interactions are of course different, but the principle is the same. As such, Marx and Engels did not employ this concept as a simple metaphor for the interrelationship between society and nature, but as a conceptual depiction of these processes that occur in the maintenance of a society (Clark 2007). The concept of metabolism allows for a holistic, or better dialectical and materialist understanding of the relations between society and nature, as well as gain insight into the processes that were causing a "rift" in the conditions of social and ecological reproduction (Foster 1999).

Studying the soil science of chemist Justus von Liebig (1803-1873), Marx initiated a well-developed understanding of social metabolic relations. In the mid-nineteenth century, the problems related to soil fertility were a major concern for agriculture production. Liebig's work regarding the processes of plant nutrition and soil, shed light on the social and natural processes that impacted soil nutrients. Based on Liebig's work that examined the regulatory metabolic process of the soil, Marx began to develop his critique of capitalist agriculture (Foster and Magdoff 2000). Briefly stated, Marx saw that due to the separation between town and country that characterizes capitalist production, the soil and its constituent nutrients were negatively impacted. With the growth of industrial production in the cities, food and fiber produced in the country were shipped to urban centers to supply the growing pool of laborers. With this, the soil nutrients contained within the agricultural products are shipped far away from their point of origin. These nutrients would not return to the soil to complete the metabolic process, where the circulation of matter allows for the restoration of the soil. This results in the slow depletion of the soil's fertility, creating a "rift" in the metabolic interaction between society and nature. "Marx employed the concept of metabolic rift to capture the material estrangement of human beings in capitalist society from the natural conditions of their existence" (Foster 1999a: 383).

Marx understood that human beings interact with nature through the labor process. In the society-nature metabolism, labor is the "process by which man, through his own action, mediates, regulates, and controls the metabolism between himself and nature" (Marx 1977: 283). Via the labor process, humans act on their natural surroundings, extracting energy and material and depositing waste. It is their means of reproduction. Marx stated the labor process is

> "an appropriation of what exists in nature for the requirements of man. It is the universal condition for the metabolic interaction [*Stoffwechsel*] between man and nature and the everlasting nature imposed condition of human existence... and it is common to all forms of society in which human beings live" (Marx 1977 : 290).

The notion that the labor process mediates the metabolic relationship between human societies and their surroundings is a key component of this theoretical approach. Humans develop technology, i.e. tools, that allow them to act on nature to produce and procure their physical needs. Societies are organized around principles that allow humans to interact with the natural world on various levels. Human societies change their environment, both natural and social, and this altered environment opens up a number of different opportunities or consequences.

As such, the concept of metabolism employs a true socio-ecological and coevolutionary perspective. It takes into account both the fact that humans are natural beings and thus regulated by natural laws, as well as social beings which govern physical processes through social methods such as institutions, methods of production, and the division of labor, among other social factors (Foster 2000). This of course realizes that while humans interact with nature, they do so in a historical and social context. Just as humans make history, "but they do not make it just as they please", humans interact with nature, yet not as they please "but under circumstances directly found, given and transmitted from the past" (Tucker 1978: 595).

The human social organization presents societies with a variety of methods for procuring their needs throughout history. It was Marx's insight that highlighted the "rift" between society and nature created by historically specific social circumstances under capitalist production. This is not to say that other societies, and historically other modes of production, did not degrade their local environment. They certainly did impact their surroundings, and not always in a positive way (Diamond 2005; Ponting 1993). However, the nature and the scope of the processes occurring under capitalism involve a deeper more lasting impact on nature, as it has the potential to undermine "the everlasting nature imposed condition of human existence" (Marx 1977: 290).

Analytical Lens

Political economic theories on the environment allow for a comprehensive understanding of environment and society relations. Emerging from the classical studies of political economy, which bring together and historically situate multiple academic disciplines including sociology, political science, and economics, this approach is broad enough to provide insights that are glossed over with other views that simply focus on either society or nature, but ignore their interdependence. While a great deal of knowledge developed in this area is important for socio-ecological studies, it is important to highlight the flaws in classical as well as later neoclassical theory that fall into ahistorical thinking and myopic analyses.

Environmental sociology has adopted the political economic view as one of its foundational theoretical approaches. Many of the most prominent theories within this area of study have been inspired by this viewpoint when analyzing socio-ecological phenomena. Each of the aforementioned theoretical approaches provides insight into social, systemic and institutional processes and their interaction with extra-human nature. However, environmental economics and ecological modernization theory are clearly constrained by their foundation and commitments to neoclassical economic principles.

Considering this, it is useful to delineate political economy from *radical* political economy, which attempts to avoid the problematic approaches that ignore historical context. While the second contradiction, world-systems theory and treadmill of production theory are effective and important when considered global socio-ecological issues, as demonstrated above, the metabolic rift theory, developed by Marx and furthered by Foster, offers the most systematic approach for understanding human/nature relations. That is to say, utilizing metabolic rift theory allows insight that highlights fundamental socio-ecological concerns and develops a true socio-ecological analysis.

World-systems theory is powerful for understanding global political economic dynamics, yet its environmental theory is only an extension of this and offers no comprehensive ecological component per se. The second contradiction theory, as well as the treadmill theory, have a tendency to be one sided as well. These approaches focus on the processes of economic expansion and its impact on the environment or ecological processes, but fall short of Schnaiberg's (1984) intention to develop a truly dialectical approach. These frameworks do not clearly acknowledge the ecological processes and their interactive impacts on social relations, and how transformations of each directly affect each other. The focus for these approaches is on quantitative growth and the resulting degradation of the environment, the economy, and to some degree labor. However, the qualitative transformations of nature and society as well as their interactions are not addressed in any systematic way.

The concept of metabolism has both an ecological meaning and a wider social meaning. It develops a theory of society and nature that is holistic, acknowledging both social and natural processes and their interactions. What is more, this approach opens up wider discussions relating to the qualitative, as well as quantitative, transformation of social relations and nature. Marx's understanding of the labor process as intimately tied to the natural world, and his focus on this process, has larger socio-ecological implications and creates broad avenues for study. Additionally, his materialist conception of history provides a foundation for a deeper understanding of society and nature relations, without which the theory would be incomplete.

Therefore, the theoretical analysis provided in this research will discuss and utilize the beneficial concepts developed by all the radical political economic theories within environmental sociology. However, the application of the metabolic rift theory will provide many of the key insights for understanding the ecological and social transformations of the Sicilian bluefin tuna fishery. As a result, an analysis employing this theoretical lens will delve deeper and open up greater potential clarification of socio-ecological phenomena.

CHAPTER III

THE HISTORY OF THE SICILIAN *TONNARA*

Introduction

In order to understand the modern conditions in Sicily's bluefin tuna fishery, it is crucial to situate it historically. This chapter will discuss the historical development of the traditional bluefin tuna trap fishery in Sicily called *la tonnara*[36]. To do so it is necessary to provide a brief sketch of Sicilian social history as well as some of the significant contributions various civilizations made to the island's history. As such, this historical discussion will offer context for the following chapters. In addition, it is difficult, if not logically impossible, to analyze the socio-ecological transformation that this fishery has undergone without at least a basic history or starting point. With this background, Sicily's traditional fishery can serve as a historical comparator to the modern fishery.

This historical case study seeks to provide an appreciation for the remarkable history of the fishery, noting its social significance. It will highlight the central importance of the bluefin tuna fishery for Sicilian coastal communities. As a result, this

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[36] *Tonnara* translates roughly to tuna trap. Throughout this dissertation I will use the Italian term *tonnara* when referring to the tuna trap. I will use the plural form *tonnare* when referring to more than one trap.

approach will offer a useful starting point for employing a materialist conception of history, and thus for a radical political economic analysis of the social-ecological conditions and transformations. This examination of the social organization surrounding the procurement of basic needs provides an opportunity for developing important socio-ecological insights.

Tuna Fishing in Archaic and Ancient Sicily

Sicily's influence on the history of the Mediterranean region is long and noteworthy. As a central stopping point in the Mediterranean, the island of Sicily has played host to a number of civilizations that dominated the island for its geographic convenience, hospitable climate and abundant natural resources (Figure 1). It has served as fertile colony, a stopping point for travelers and merchants, a strategic military base, as well as a battleground for the multitude of civilizations that occupied the greater Mediterranean. Just two miles across the Straights of Messina to Italy and the European mainland, and approximately 100 miles from the North African coast, Sicily's geographic location offered a link between the East and West and the North and South, which all too regularly attracted those with power to exploit its people and its natural resources (Finley 1968). In addition, Sicily and the string of islands that lead to Africa were not only a link, but also a partition between these civilizations. Consequently, throughout history it was often at the center of feuding neighbors (Braudel, Ayala, and Braudel 2001).

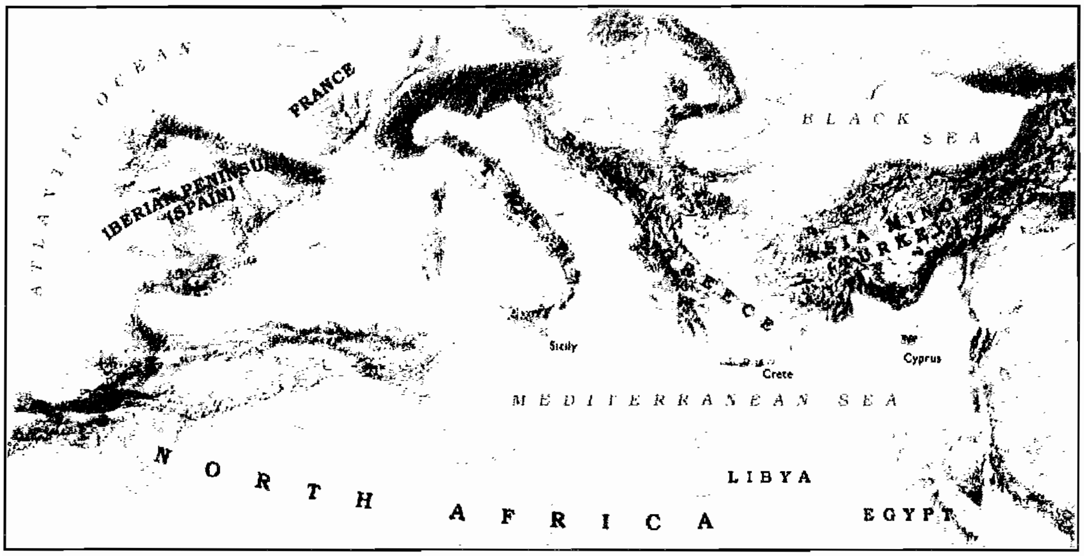

Figure 1: Map of the Mediterranean Basin (IAM 1998)

Up until the latter half of the first millennium BCE, three groups of peoples are known to have inhabited Sicily during the Neolithic era: the Sicels, Sicani, and Elymi. While it is difficult to determine which of these groups are "indigenous" to the region, it is generally accepted that the colonization of Sicily began early in antiquity (Finley 1968; Sammartino and Roberts 1992). With the arrival of the Phoenician and Greek settlers circa eighth century BCE, the long history of occupation by foreign powers began in earnest, which arguably continues to this day (Schneider 1998). As will be discussed, this history of occupation and domination has had lasting effects on the Sicilian economy and culture.

The grand remains of ancient Greek settlements are found today throughout modern Sicily and Southern Italy. From the majestically placed theater in Taormina overlooking the Ionian Sea, to the well-preserved temples of Agrigento and Segesta the

Greek influence on this region is readily apparent through the vast amount of art, architecture and artifacts found there. Its importance in the Greek empire is exhibited through these crumbling remains.

For the early Greek settlers, Sicily offered opportunities for the cultivation of its abundant land. Although there is some debate about the original motivations that urged Greeks to settle in Sicily, it is speculated that land and resources were growing scarce in Greece, due mostly to population growth together with traditional inheritance patterns, leaving many without land to cultivate (Braudel et al. 2001; Sammartino and Roberts 1992). Greek "explorers," more likely merchants and pirates, sailed throughout the Aegean Sea on to the Western Mediterranean by about 800 BCE. Early contacts allowed for the development of settlements in Sicily, the first of which was likely *Naxos* (757 BCE) on the east coast near Mount Etna. The Greeks later established a number of major settlements, most notably *Megera Hyblaea, Siracusae* (present day Siracusa), *Zancle or Messena* (Messina), and *Akragas* (Agrigento) (Benjamin 2006; Braudel et al. 2001) (see Figure 2). These settlements in Sicily, along with the southern mainland of Italy, would later become known as *Magna Graecia* and play a key role in Greek civilization and Mediterranean history.

While the Greeks traveled to Sicily in search of land, the Phoenicians were attracted to Sicily's excellent western harbors and its ocean resources. These maritime people settled in Northwest Sicily and developed important trading posts that functioned as a midpoint between settlements in the East and West, between *Gades* (Cadiz) and *Canaan* (Palestine). Additionally, its geographic proximity to Carthage in North Africa made for easy access to this principal settlement. Notable Sicilian settlements developed by the Phoenicians include *Motya* (present day Mozia), the first Phoenician settlement dating around 700 BCE, *Ziz* or *Panoramus* (Palermo), *Solus* (Solunte) and *Drepena* (Trapani) (Benjamin 2006; Finley 1968).

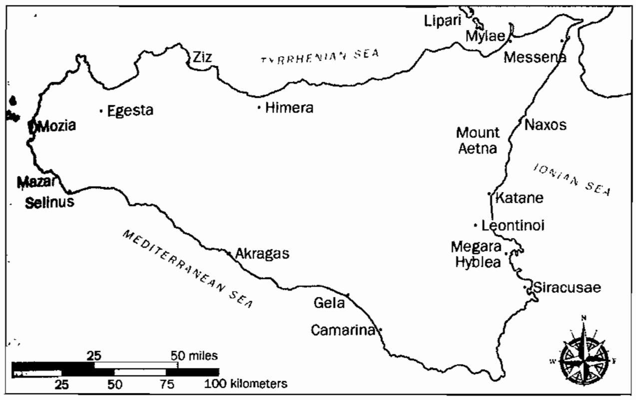

Figure 2: Early Greek and Phoenician Settlements in Sicily (Benjamin 2006)

Early Mediterranean civilizations exploited Sicily's waters and relatively fertile soils. Since the earliest recorded history, the bluefin tuna fishery has been a major food source and economic mainstay for local populations (Consolo 1986; D'Amico 1816; La Mantia 1901; Martorana et al. 1995; Ravazza 2005; Roesti 1966; Sarà 1998; Vivona 2000). Bluefin tuna has been systematically fished in the Mediterranean for thousands of years. One of the earliest known incidences of tuna consumption is evidenced in the skeletal remains and drawings of tuna found in the Grotta del Uzzo, in Northwest Sicily, which are dated to the late Neolithic period (Sarà 1998; Vivona 2000). In the Grotta del Genovese on the Sicilian island of Levanzo, cave paintings that date to at least the third millennium BCE depict a variety of human and animal figures including those of large tuna that have been identified as bluefins (see Figure 3) (Durand 1995; Sarà 1998). At the Scoglio del Tonno in Taranto, Puglia, artifacts dating from 3,600 years ago (y/a) (seventeenth century BCE), as well as Mycenaean ceramics from twelfth century BCE, can be found depicting tuna, thus displaying a long and consistent effort of capturing and consuming tuna in one location (Sarà 1998; Vivona 2000). Another notable verification of tuna fishing's long history in the region is found in a flat Cycladic vase (third millennium BCE) that is decorated with an oared vessel, surrounded by waves, which includes the outline of a large fish with a clear likeness of a bluefin tuna on its mast (see Figure 4).

Figure 3: Grotta delle Genovese (third mil. BCE) (Sarà 1998)

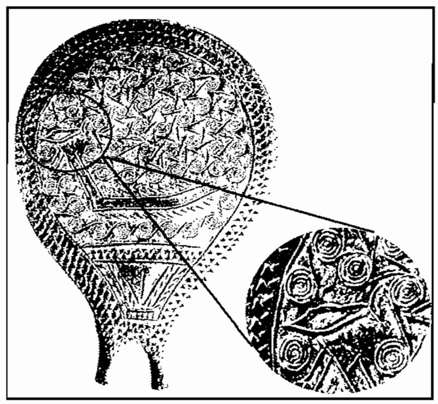

Figure 4: Cycladic Vase with Detail (third mil. BCE) (Braudel et al. 2001)

The Canaanites, considered the ancestors of the Phoenicians (Braudel et al. 2001), were likely the first to fish systematically for bluefin tuna. Settling the coastal areas throughout Southern Italy, North Africa, the Iberian Peninsula and the French

Mediterranean, they devoted their energies to fishing more than agriculture or pasturing and their lives where intimately connected to the sea and its resources. These seasoned navigators spent significant time on the open seas and likely used the migration routes of bluefin tuna or sea birds, among other natural indicators, to navigate the seas and develop trade routes (Doumenge 1999; Sarà 1998).

It is argued that the Phoenicians initiated activities that progressed into the Mediterranean traditional trap fishery, called the *tonnara* in Italy, *madrague* in France, *almadraba* in Spain, and *armacoa* in Portugal (Mather et al. 1995). In doing so, they laid the foundation in Sicily for what was to become one of the largest and, historically, most active bluefin tuna fishery in the Mediterranean (Brown 1995; Consolo 1986; Maggio 2000; Sarà 1998; Vivona 2000). Utilizing the salty Mediterranean Sea and the long sunny days, these settlers are said to have established the Sicilian saltpans as well, which are a key factor in the historic growth of the fishery. Salt became the preservative for the abundant tuna that were caught during the seasonal migration to the Mediterranean coastal areas, thus allowing for the conservation and trade in salted tuna products by Phoenician merchants. Salt collection and tuna preservation was a central feature of Phoenician culture and life (Sarà 1998). Its importance is highlighted by the fact that the local priests presided over the production and distribution of salt (Benjamin 2006). The famous saltpans of Western Sicily, developed thousands of years ago, have been utilized by numerous civilizations in this region and beyond up through the present day.

In antiquity, tuna had enormous cultural and economic importance throughout the Mediterranean (Benjamin 2006; Brown 1995; Consolo 1986; Durand 1995; Sarà 1998;

Vivona 2000). This is exemplified in the ubiquity of depictions of tuna on coins, art, literature, and religious structures. Images of tuna are used throughout the ancient Mediterranean in art and architecture, appearing alongside the principle deities such as Apollo, Athena, Zeus, and Helios.

The representation of tuna on coins throughout the ancient Mediterranean is an indicator of its foundational significance in the economies of the Ancients. In the fifth and sixth century BCE, cities and regions in which tuna fishing was an essential activity had images of tuna on their coins, similar to agricultural cities that placed grain or grapes on their's (Sarà 1998). The stamped coins provide support for the notion that the commerce in tuna was valuable for the Mediterranean region in antiquity, and in some regions possibly the principal commercial activity. In *Abdera* (Adra, Spain), one of the earliest coins[37] from this region depicts a temple with columns, which are shaped in the form of large vertically placed bluefin tuna (Roesti 1966; Sarà 1998). As such the tuna are central pillars of the structure. The symbolic significance of the tuna holding up the temple also demonstrate their central role in the social and cultural development of major cities in antiquity. Today, this image can be still be found in the city of Adra's coat of arms.

In Sicily, coins from many of the Greek coastal settlements contained images of tuna as well. For example, a coin from *Solus* (Solunto) (Figure 5a) that dates to the third century BCE displays the fundamental role of tuna fishing in this region. On one side the

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[37] Likely the oldest example of coins depicted tuna are from Gades circa 300 BCE.

head of Herakles is depicted and on the other a bluefin tuna. Pairing the tuna with the Gods demonstrates a high regard and value for this resource for the Ancients in Sicily.

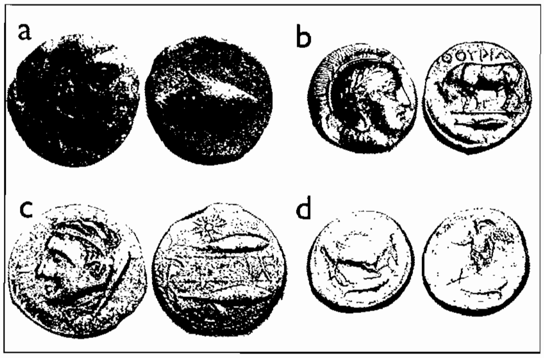

Figure 5: Tuna Depicted on the Coins of the Ancients. a) Bronze coin, *Solus* Ca. 3rd century BCE.b) Silver Nomos, with Head of Athena, *Lucania*. Ca. fifth century BCE. c) Phoenician, *Sexi*, Ca. second century BCE. d) Silver Tetradrachm, *Catana*, Ca. fifth century BCE (images retrieved from www.coinarchives.com; March 26, 2008.)

Other artifacts, particularly ceramics, also display depictions of tuna in the ancient Mediterranean world. Likely the most famous of these images found in Sicily is the Classical Greek vase (2,300 y/a) *The Tuna Merchant* (Figure 6a) that depicts the slicing and distribution of bluefin tuna on a *chianca*, or a three-legged block (Consolo 1986; Vivona 2000). Another noteworthy artifact is a Black Figure olpe, a vessel used for pouring wine, from the Greek era (fifth century BCE, Figure 6b), that clearly depicts the ritualized sacrifice of a bluefin tuna and locates the species among a particular group of non-human animals that were vital to the community, such as domesticated animals (Durand 1995).

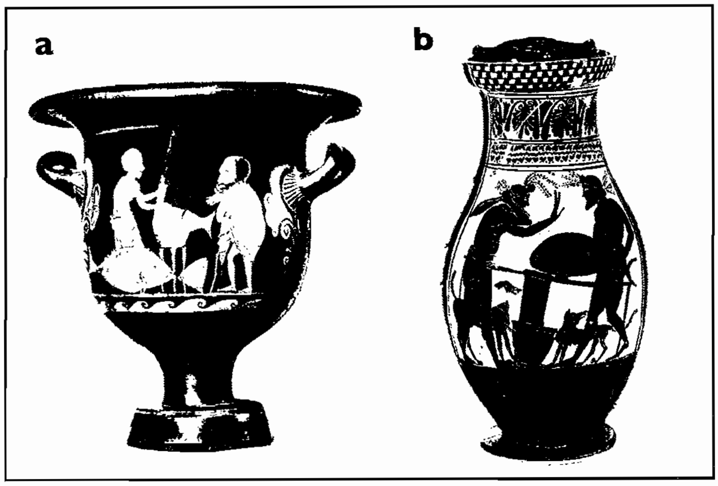

Figure 6: a) Greek Vase: "The Tuna Merchant," third century BCE. (Thompson 1947) b) Black Figure Olpe, fifth century BCE (Martorana et al. 1995).

Moreover, the writings of the Ancients represent the continuous participation in fishing for ABFT back to the ancient period, as well as its significance to the population of antiquity. In Book X of *The Odyssey*, Homer (ninth century BCE) makes reference to "men harpooned like tuna" (translated from Martorana et al. 1995: 14), Aeschylus (sixth century BCE) comments on a systematic capturing of fish in nets, and in the fourth century BCE, Aristotle (2002) highlights the importance of tuna to this region in his ten volume biological treatise *On the History of Animals*, in which he comments on the bluefin's behavior, and the areas where it can found and fished. (Consolo 1986; Martorana et al. 1995).

The earliest known detailed discussion of systematic bluefin fishing was written by the second century Greek poet, Oppian of Cilicia. In his major work on fishing and hunting *Halieutica*, he describes techniques that reveal a system of fishing very similar to what is employed two millennia later in the *tonnara.* He records that fish enter "nets like a city" with "gates" which fill "the closing net with copious pray" (Oppian 1722: Book III p 146). While at this time in history the tuna fishing techniques might be considered crude in comparison to later developments, these methods developed along with a growing understanding about bluefin biology and the local ecosystem. Even during this early period, communities constructed intimate knowledge of the timing and patterns of tuna migration and created methods of capture that took advantage of this knowledge.

Some of the accounts of bluefin biology and behavior developed by classic thinkers may have been erroneous, such as the Aristotle's account that tuna hibernate during winter and only emerge in the spring, or the notion that bluefins cannot see well out of their left eye[38] (Aristotle et al. 2002). However, the material knowledge that emerges from these hypotheses, that is, the behavior and migration patterns of bluefin tuna, is significant. In many regions, such as the waters off of Northern Sicily, bluefin tuna migrate east to west during spawning periods and move in a clockwise fashion once they reach shallow waters. Surely this is place specific, but this knowledge was foundational for developing new methods of capture and constructing more sophisticated traps. Up until the modern period, this ancient knowledge played a role in the decisions and practices within the *tonnara.*

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[38] "The tunnies, as they enter, swim with their right side to the shore, and leave with the left side to the shore; and some persons say that they do this because they see better with their right eye, and their sight is naturally dim" (Aristotle et al. 2002: 212)

Roman Sicily and Bluefin Fishing

While Greek colonizers pushed out local settlers to some degree, political control of the island was generally left to local populations with only minimal ties to the polis in Greece. However, under Roman rule, Sicily was completely dominated in an imperial relationship. Beginning in the third century BCE, Sicily functioned primarily as the granary of the Roman Empire, as it was forced to pay tribute mostly in wheat and corn. Additionally, it served as a strategic area to defend and attack the Empire's greatest adversary in the region: Carthage (Aymard and Giarrizzo 1987; Finley 1968). The Roman philosopher Cicero said that Roman control of Sicily was "the first to teach our ancestors what a fine thing it is to rule over foreign nations" (in Sammartino and Roberts 1992: 31).

Governed by a prefect, high taxes were imposed on Sicilians to the benefit of the Roman elite and bureaucrats (Aymard and Giarrizzo 1987). In addition, the Romans imposed a *latifundium* system in Sicily. Worked mostly by slaves, these vast estates owned by affluent Romans, and later Sicilians, had long lasting and deep effects on Sicilian history into the twentieth century, the remnants of which are still experienced today (Ginsborg 2003). The system of *latifundium* would later become a central aspect of Sicilian feudal and capitalist life, imposing enduring class dynamics in the region (Blok 1975).

In the third century CE, the Roman thinker Claudius Aelianus described Italian and Sicilian fishing practices in his treatise *On the Nature of Animals* (Aelian and Scholfield 1958). He described tuna fishing that utilized natural geography and observation structures built along the coast, which allowed lookouts to signal the position of schools of bluefin moving toward the shore (Martorana et al. 1995). Early Mediterranean tuna fishers took advantage of the fact that large schools of bluefins were easily visible in the clear waters off the coast. Individuals positioned at high points on land communicated sightings to waiting boats and to those on shore allowed fisherman to close their nets and capture migrating tuna. As long ago as the sixth century BCE, similar methods were described in Càdiz (Spain), where enormous systems of capture called *sciabica* or *shabaka* were used to fish for bluefin tuna (Sarà 1998).

As large urban centers began to take shape, mostly at the center of the Empire, demand for protein increased. A major source of supply for this growing demand was provided by the Mediterranean Sea, including locations near Sicily's coast. Doumenge (1999) maintains that a "real fishing industry" began to take shape in the Mediterranean during this period. Large amounts of fish products such as *garum*, a liquid fish condiment, and many other products, including salted bluefin tuna, were shipped from Sicily to Rome. Exploiting a subjugated slave labor class, Rome was able to provide nourishment for its large military and urban populations.

Later in this period, the Byzantine Empire controlled Sicily. The Roman and Byzantine domination of Sicily had a modest effect on the bluefin fishing techniques and technology. Claudius Aelianus' description of the Roman tuna fishing in Sicily demonstrates a system that drew on the knowledge of the ancient Greeks. However, during this era, particularly during the Christian era, the fishery continued to have high levels of productivity. What is more, efforts to conserve surplus catches expanded and lasted until the third and fourth centuries CE. (Mather et al. 1995; Sarà 1998). While it has been suggested that many of the modern methods began to take form during the Roman Christian era, most scholars agree that it was not until Saracen control of Sicily in the ninth through the eleventh centuries CE that the methods and techniques used in what we now call the *tonnara* began to be clearly established (Ahmad 1975; Doumenge 1999; Sarà 1998; Vivona 2000). In fact, much of the terminology used to this day dates back to the Arab period. A good example of this is the title used for the central authority figure and leader of the tonnara at sea, *Rais,* which originates in the Arabic for "leader" or "head." While the specific date is uncertain, it is speculated that during the Arab period key features of the Sicilian trap emerged, creating a distinct method of capture and established the technology that still influences the region.

The Emergence of the *Tonnara* - Arab and Norman Sicily

It was not only in the realm of fishing that Arab Sicily experienced a great deal of economic and social development. Particularly following the Roman exploitation of the island, the Arab conquest of Sicily is considered to be a very prosperous period for the region. Under Arab control, Sicily experienced advancements in science, art, architecture and agriculture (Ahmad 1975; Amari 2002; Consolo, Bouchard, and Lollini 2006). In addition, while it cannot be credibly argued that Sicilians were wholly without repression during this time, generally, there was a fair amount of religious tolerance during this period and cities such as Palermo experienced great prosperity as well as religious diversity (Ahmad 1975; Finley 1968). Palermo emerged as a thriving metropolis and one of the largest in region, including Europe. Non-Muslims were given the right to practice their religion, but often paid higher taxes. In addition, they were required to regularly wear markings to distinguish themselves and were required to adhere to a number of social rules, which made their lower social status apparent (Mack Smith 1968a). The religious and social openness allowed for expansion in a variety of realms. After the long and often harsh rule of the Romans and Byzantines, along with the concentrated power of the Church, the Arabs gained control of a land that was heavily exploited and denuded (Consolo et al. 2006). Nevertheless, utilizing the rich resources of the island and introducing new agricultural practices such as irrigation systems and varieties of cultivatable plants[39], and of course fishing techniques particularly in the tuna fishery, Sicily thrived under Arab rule from the ninth to the eleventh centuries (Consolo et al. 2006).

It is during the Arab control of Sicily that the *tonnara*, as it is known today, began to take shape. The most distinctive "modern" features, including separate holding pens or rooms and other details described below, were likely perfected throughout this era. Under Norman rule, the technical development of the fishery was furthered with the solid foundation of technology and knowledge developed in Arab Sicily. There is great debate regarding the exact period when the evolution of the *tonnara* was completed, and the modern system of trapping emerged. Whether it occurred during the Arab or the Norman period is not entirely clear. However, it is has been established that the methods

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[39] Arabs introduced some of the most important crops to Sicily during this period including olives, lemons, and grapes. These agricultural products became fundamental to the Sicilian agricultural economy for centuries.

and practices of the Sicilian *tonnara* were fully developed by the eleventh century. And more, it has been generally accepted that during Norman control, some of the major contributions offered during Sicily's Arab era were perfected (La Duca 1988; La Mantia 1901; Sarà 1998; Vivona 2000).

As mentioned earlier, Sicily's strategic position and abundant resources made it a region of contention for vying powers. The powerful Norman kingdom of Medieval Europe had an interest in expansion and repeatedly battled with Arab powers for control of Sicily and Southern Italy. Wresting control from the Saracens, the Normans conquered Sicily in the eleventh century CE and established a clear feudal order. Not only was there a new authority in Sicily, but a new system of control and distribution of resources and property. Originating from Northern Europe, where feudal social relations were already existing, the Normans under Roger I imposed a social system that drastically changed Sicilian life. With the introduction of a feudal system, the *tonnara* experienced radical economic and social changes in areas such as in ownership, property and access rights. A system of *regalia* was enforced, wherein rights and privileges to such things as local resources were reserved exclusively for the sovereign, a crucial development for the establishment of the feudal regime.

On the beaches of Sicily, the rights of the *tonnara* were reserved for the royal authority and fishing was banned without the concessions of royals. Royal power held proprietorship of the *tonnara* and concessions were sometimes offered in return for loyalty, wealth and service. The establishment of fishery control and regulation began with decrees that determined points along the shore where bluefin fishing could be carried out, the number of boats, and even fisherman who would have access to the fishery (Avolio 1805). Moreover, the amounts of captures due to the king, as well as to diocese and their churches, was predetermined and enforced (Mack Smith 1968a).

The abundant tuna fishing in Sicily was seen as a great source of wealth for the Norman sovereign and feudal nobility. Because of its strategic location, under Roger II Sicily flourished as an important component in the Mediterranean trading network. Al Idrissi, the twelfth century Arab geographer and aid to the Roger II, described a relatively significant scale of bluefin tuna fishing and trading activities throughout coastal Sicily (La Mantia 1901), and salted bluefin tuna and biscuits made from Sicilian wheat became a staple for sailors traveling throughout the Mediterranean region (Benjamin 2006; Mack Smith 1968a). This was a period of great economic expansion in Sicily. Roger II encouraged the development of fishing and agriculture as well as several other areas, including mining and salt production. As a result, he may have had the largest revenue of any king in Europe, and Palermo was considered a leading metropolis in the region (Mack Smith 1968a; Sammartino and Roberts 1992).

With the exception of some material substitutions and the introduction of motorization, the *tonnare* in Sicily in the twentieth and twenty-first centuries were very much the same as those used in Norman Sicily in the eleventh and twelfth centuries. The technical specifications, methods, practices and many customs associated with the fishery changed little over the next 900 or so years. Thus, likely sometime around the turn of the first millennium CE, the tonnara was born and perfected in Sicily. This technology and its lasting effects will be discussed shortly.

Expansion of the *Tonnara* - Spanish Sicily up to the Modern Era

Sicily continued to experience foreign domination up through its unification with mainland Italy in the 1860s, known as the *Risorgimento*. While a number of European royal dynasties ruled over Sicily at different periods from the thirteenth to the nineteenth century, the most significant and longest lasting of these powers were the Spanish. During the Spanish period, which lasted for about four centuries, a Viceroy appointed by the Spanish Kingdom administered Sicily. Much like the Normans before them, the Spanish Kings benefited from Sicily's natural resources, not the least of which was the bluefin fishery. Through the collection of taxes and royalties, the tuna fishery became an important source of revenue (Mack Smith 1968a). At this time, the *tonnare* in Sicily were quite productive, and salted bluefin became an increasingly valuable product for local use and export (Cancila 1972).

This period of Sicilian history, beginning in the fifteenth century, is marked by some of the worst exploitation of the Sicilian people and its resources. While Sicilian peasants worked the land and seas, the local aristocracy maintained positive relations with the crown and was given a good deal of autonomy. Consequently, the feudal character of Sicily was modified from the Norman period in that aristocratic power increased significantly.

Throughout Northwestern Europe, feudal relations were deteriorating as new class relations based on individual private property and wage labor emerged. While this social transition was late to reach Sicily, aspects of these class relations filtered into Sicilian social life. Due to the strength of the Sicilian aristocracy throughout this period, the bourgeoisie only began to expand its influence during the nineteenth century. The aristocracy and the system of *latifundium* were the prevalent form of property ownership and, with it, the dominant social institution. *Latifundistas* had the legal right to bind peasants to work "*di suli in suli*," from sunup to sundown. Nobles and bishops appointed civic officials and controlled taxation and markets (Sammartino and Roberts 1992). This long era of Spanish domination reinforced the subordinate social position of the Sicilian peasantry.

The Sicilian tuna fishery was very active during the Spanish era. This period marked an increase in the concessions and control by private individuals (La Mantia 1901). Increasing concessions of *tonnare* to private individuals developed into a period of early capitalism, or better termed, rent capitalism (Bobek 1962). Concessions to fish, carried forward from the Norman rule, were offered to barons as well as the local diocese. This was often used as a way for the crown to raise funds, but was quite different from the system of agricultural *latifondo,* in which the aristocracy was made up of absentee landlords and had little knowledge or interest in the activities on the estate. During this era of social transformation, the proprietors of the *tonnara* began to take an active role in the commercial prosperity of the *tonnara*. The *tonnare* were experiencing abundant catches and, beyond the proprietors, the royal authorities benefited from a tax levied on the surplus tuna exported from Sicily.

In technical terms, this period could be considered the classic period for the Sicilian *tonnara.* Its development is clearly recorded by a number of historians and, while the Arabs and Normans had formed the technical and social foundations, this period marks a consistent and mature cultivation of tuna fishing using well-established methods, as well as clear cultural attributes that lasted for centuries. This will be discussed further in the following chapter.

In the eighteenth and nineteenth centuries, Sicily was ruled by four different dynasties: Spanish Bourbons, the House of Savoy, the Austrian Hapsburgs, and the Neapolitan Bourbons. This tumultuous period ended with the *Risorgimento* and the unification of modern Italy. It is important to note that although the *Risorgimento* is often regarded as the period in which Sicily is freed from foreign imperial powers, many Sicilians saw the unification with the north of Italy as just another form of colonial control (Schneider 1998).

In 1860, under the military leadership of Giuseppe Garibaldi, Sicily was united with mainland Italy under the Savoy rule of King Victor Emmanuel II. This movement was stirred by the liberal politics of the bourgeois revolutions that had taken hold in Northern Europe. Under the pretext of ridding Sicily and the Italian peninsula of foreign rule and exploitation, Sicilians fought for a new social and political system that offered hope to common Sicilians. While most were ignorant of the political dealings of the North, they anticipated the prospect of land reform and increased access to basic needs. However, the new government would not interfere with the long established power of the aristocracy and land holdings of the barons, but rather protected them from the landless. While power relations were transformed, many aspects of class relations were maintained[40] (Benjamin 2006). Northerners spoke a different language and had quite a different culture than the Southerners, specifically the Sicilians. Soon these newly adopted Italians began to become critical of the Piedmontese and their agenda in the South. The bourgeois revolution that united Italy brought greater power to a small class of landowners and, while less tyrannical than a monarchy, was not nearly as democratic as it declared itself to be. Northerners were equally disheartened by what they considered to be racially inferior Sicilians. While the Piedmontese came to spread their enlightened forms of political, economic and social systems, many from the North felt that this would prove impossible in such a backwards region (Mack Smith 1968b).

Sicily remained subjugated even after unification. By the twentieth century, in attempt to increase political control, Sicily gained regional autonomy but remained a relatively poor region of Italy, with high levels of unemployment and emigration. During World War II, Mussolini adopted a policy of autarky and, in his attempt to bring Italy back to the grandeur of the Roman period, turned Sicily into a granary and supplier of raw materials for the North. Plagued by corruption and the Mafia, the *Mezzogiorno*, that includes Southern Italy Sicily, did not begin to experience all of the benefits of modern economic development and First World status until the latter half of the twentieth century.

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[40] This brings to mind the famous quote from Giuseppe di Lampadusa's celebrated novel based on Sicilian society during this period, *Il Gattopardo*. In the film based on the book, young "revolutionary" Tancredi says to his uncle, the Prince of Salina, "Se vogliamo che tutto rimanga com'è, bisogna che tutto cambi." That is, "If we want things to stay as they are, it is necessary that everything changes."

In the post World War II era, particularly starting in the late 1960s, the Italian government began to invest in infrastructure in Sicily. In addition, private interests like automobile maker FIAT and energy giant ENI begin to invest in factories in Sicily. However, the economic benefits were relatively small for the region and in most agricultural areas large numbers of Sicilians were still emigrating in large numbers (see Figure 7). Government programs did little to help the agriculture and fishing regions, channeling most of the spending towards large-scale capitalist farms and firms (Ginsborg 2003). In the mid 1950s, Italy was still by many measures analogous to an underdeveloped country and, in Sicily in 1970s, according to Charles Tilley, this was still apparent. In the Forward to Blok's (1975) famous work *The Mafia in a Sicilian Village*, he writes of Sicily's poverty and corruption:

> "On hearing of such a place we are likely to call it "backward" or "feudal" or "underdeveloped," one more proof that Sicily is actually part of the Third World. Certainly most Sicilians are very poor and are trapped in a web of exploitation...[yet] we have to explain, not an eternal backwardness, but a decline from greatness" (xv).

The second half of the twentieth century was also the period of decline for the Sicilian *tonnare*. Small-scale farmers and fishers in Sicily began to feel the effects of the modern global agri-food system geared towards large-scale commodity production. Surely, since recorded history Sicily has always competed and traded with other regions. International trade in goods was not a new phenomenon. However, in the past Sicily's economic sphere stayed mainly within and around the Mediterranean. As large

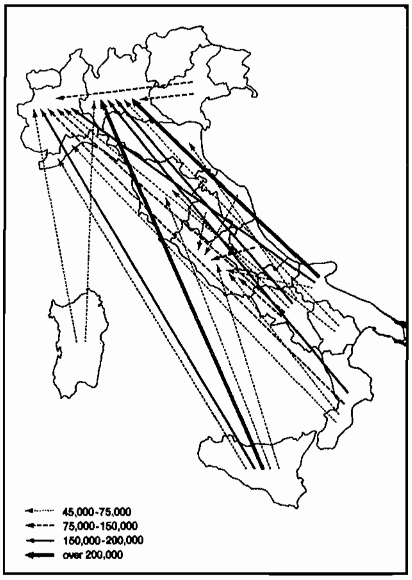

Figure 7: Migration Flows within Italy 1955-1981 (Ginsborg 2003)

industrial fishing vessels began to enter the Mediterranean flying flags from all over the world, and bluefin tuna was transformed into a global commodity with a very high price-tag, the traditional bluefin tuna fishery in Sicily began its rapid decline. This will be discussed in detail in Chapter V, which covers the state of the modern fishery.

As such, the decline of the Sicilian *tonnara* must been seen in this social and historical light. The transformations to new class relations, and later the economic potential of modern industrial development, offers little benefit for the Island and its people. Those who work the *tonnara* maintain their close ties to traditional methods of production that have supplied them with vital resources for centuries. But this changed considerably with the expansion of industrialized global food production. The *tonnara* became a quaint relic of the past.

A Brief Note on the "Southern Question"

It would be remiss to discuss Sicilian history and leave out a discussion on the long standing debates regarding the poverty and exploitation in this region, or what has be called the 'Southern Question' (Gramsci 1992; Schneider 1998; Schneider and Schneider 1976). Throughout this chapter it has been made clear that the Sicilian people, like many of the peoples from southern regions around the world, have been dominated and exploited for centuries. In post unification Italy, the split between the industrial North and the agricultural South led to deep social, cultural and economic divides. Many Northerners regarded the *Mezzogiorno* as a backwater region that was a drag on the Italian economy and a scar on the cultural character of Italy[41].

The renowned Italian thinker Antonio Gramsci (1992) addressed this in his unfinished essay "Some Aspects of the Southern Question." In his attempt to discuss the geographic, economic, and cultural divides, Gramsci described the "ideology propagated" throughout Italy by a system of propaganda and the hegemony of dominant cultural institutions. As Gramsci (1992) explains, this divisive ideology describes the South and its people as a "lead weight which impedes a more rapid development of Italy; southerners are biologically inferior beings, semi-barbarians or complete barbarians by natural destiny" (31). This was drawn on by the ruling class to drive a wedge between a unified Italian labor movement by pitting the Northern working class and Southern

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[41] In fact, this ideology has reemerged in modern Italian politics with the growth of *La Lega Nord* (The Northern League) a political party that has advocated for a succession of the North from southern and central Italy.

peasantry against one another. Regarded as culturally and racially inferior, Southerners were also considered to be themselves at fault for their destitution.

In the post World War II era, as the North grew into an industrialized zone, many parts of the South were mired in poverty and misery. It is important to note that the lingering system of *latifundium* played no small role in this phenomenon. These large estates based on absentee landlords, middle-class managers, bullies, and the mass exploitation of peasant labor and the land, perpetuated a large, essentially landless peasantry that was stuck in continuous debt (Blok 1975; Ginsborg 2003). Thus, for some of the Sicilian population, the conditions in modern times were characterized by economic uncertainty, fear, and abject poverty. As Italy emerged as a First World economic power in the modern era, the social relations in this nation were such that Schneider and Schneider have gone so far as to label it "orientalism in one country" (Schneider 1998) or colonial oppression of the South by the North.

While causes for the emergence and growth of organized crime are difficult to pinpoint, they are surely related to a social system that lacked basic rights for a majority of the population and was based on domination and exploitation. The long-standing presence of organized crime, the Mafia or *Cosa Nostra*, made Sicily infamous for its lawless nature and brutishness. Popularized through Hollywood films such as *The Godfather* and *The Sicilian*, Sicily is often regarded as a culture that is based on bloodshed and brutality. While these characterizations are exaggerations, they are not completely baseless. There has been a great deal of resistance to organized crime in the recent past, particularly after the 1992 assassinations of popular magistrates Giovanni

Falcone and Paolo Borsellino, yet Mafia violence and corruption have been a fact of life in many parts of Southern Italy, especially Sicily, for more than a century. Nevertheless, it is simplistic to examine this reality without a sound understanding of the social history of this region and the modern social context that creates the modern unified Italy.

A discussion of the "Southern Question" is only touched on here, but it is important to remember the modern social circumstances that emerged, especially in the nineteenth and the twentieth centuries, and the influence this had on Sicilian life. There is no doubt that these social realities (poverty, exploitation, violence, corruption, and a general despair) impacted the traditional and the modern bluefin tuna fishery. While this may be hinted at in this study, the scope of this project does not allow me to analyze this in detail at this time. However, it is an implicit part of many aspects of Sicilian social life, and should be recognized as such. Without a doubt, these social realities played a role in the modern history of Sicily and my experience as a researcher in this region.

CHAPTER IV

TONNARE AND *TONNAROTI*

La Tonnara Siciliana

In this chapter, I will give a brief technical description of the *tonnara*, its structure, design and basic practices. This description will give important clarification for this method of fishing and assist in offering a human ecology of the fishery or to situate the significance of the *tonnara* in the society and nature relationship. Furthermore, I will discuss in more detail the role of the *tonnaroto*[42], the fisherman who worked in the *tonnara*, and the social relations within the Sicilian fishery.

The Sicilian tuna trap, *la tonnara*, evolved into a complex form based on the simple devices developed during early antiquity around the Mediterranean region. These traps took advantage of the bluefin tuna's reproductive biology, which brought these large pelagic species close to the shore for spawning. During their reproductive migration, Atlantic bluefin travel in large schools throughout the Atlantic and Mediterranean and converge on two locations, the Gulf of Mexico and the Mediterranean Sea. In the eastern zone it is maintained that the bluefin tuna seek the clear, warm, salty waters of the Mediterranean in order to reproduce (La Duca 1988; Ravazza 2005; Sarà 1998).

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[42] *Tonnaroto* is the singular form and *tonnaroti* is the plural form.

Likely, the earliest bluefin tuna fishing entailed casting nets from the shore and small vessels and dragging them in to shore. This developed into the system of fishing called *sciabica* in which nets were cast in a more systematic fashion from the shoreline, trapping tuna and herding them in. The *tonnara* is a more elaborate fixed trap fishing system in the open sea. While nets reach back to the shore and may be moored to rocks, the main structure of the trap is usually a significant distance from the shoreline, anchored in the open sea.

There are two different types of *tonnare*, *tonnara di andata* and *tonnara di ritorno*. This translates roughly to approaching traps and departing traps and relates to the migration routes of bluefin in the region. In the early part of the season, May through June, bluefin enter the region close to the shore to deposit their eggs and semen. Once they complete the reproduction process, they leave the region heading to deeper waters of the Mediterranean and out to the North Atlantic. Those traps that capture the first wave of tuna before and during reproduction, are the *tonnare di andata.* Those that capture tuna after reproduction, on their way out to sea, are the *tonnare di ritorno.* The distinction is relevant as the traps in northern Sicily are *tonnare di andata*[43]. As such, they capture the largest, and potentially most valuable tuna. After spawning, bluefin tuna are leaner due to a long reproduction period in which they generally do not feed. Moreover, *tonnara di ritorno* are active in the late summer, July and August, and are of slightly different design and they are usually much smaller.

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[43] The *tonnare* detailed throughout this chapter are *tonnare di andata.*

Design of the *Tonnara*

A *tonnara* consist of two essential structural elements: *la coda* and *la isola.* The *coda*[44], or the tail, is a long series of nets that are placed perpendicular to coast with the purpose of blocking the course of reproducing bluefin, guiding them towards the trap. These long barrier nets are run out to the location of the trap and, depending on the location of the *tonnara*, can extend from hundreds of meters to several kilometers in length and reach a height of about forty to fifty meters. The blockade net is formed of thirty-meter length sections of fishing nets that are stitched together on land and then place out to sea. These processes are done using small wooden boats designed specifically for this method of capture called *vascelli, varcazze, parascarmi,* and *bastarde*[45] (Terranova 1986).

In the following, I will describe the structure of the classic tonnara that has historically been used in Sicily as illustrated by Bova (1761) and by Terranova (1986) (see figures 8 and 9). Most of the *tonnare* in Sicily use a form that is similar to these illustrations.

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[44] *Coda* is also sometimes referred to as *pedale.*

[45] These are the names designated to different size boats of the *tonnara*. The name *bastarde* is used for a number of different boats which inlcude *la muciara Rais*, or the *Rais'* boat (Terranova 1986).

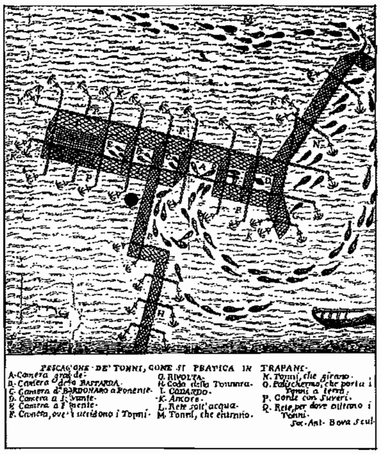

Figure 8: Sketch of a Classic *Tonnara* by Antonio Bova (1761)

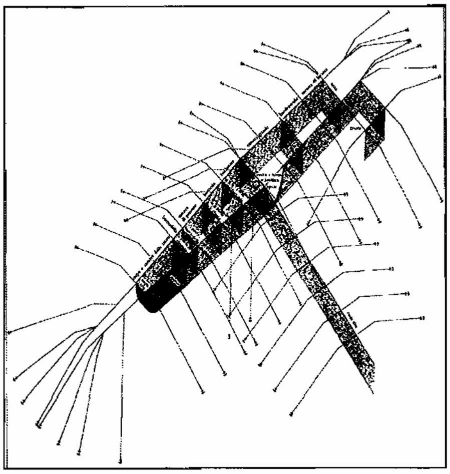

Figure 9: Design of the *Tonnara* of Favignana (Terranova 1986)

The *isola*, or island, is formed by an elaborate construction of nets that become an elongated rectangular structure. This main component of the trap is made up of many *camere*[46] or "rooms/chambers" that divide the large structure to capture, hold and move fish toward final harvesting. This design commonly consists of seven or eight *camere* averaging approximately forty to fifty meters in length including, from east to west: *camera levante* (eastern chamber), *camera bordonaro di levante* (eastern *bordonaro* chamber), *camera grande* (large chamber), *camera bordonaro* (*bordonaro* chamber), *camera bastardo* (bastard chamber), *camera piccolo* (little room) (sometimes referred to as *ponente* (west)), *camera bastardello*[47](little bastard chamber), *camera della*

[46] *Camere* is the plural form, *camera* is the singular form. *Camere* are sometimes referred to as *vasi.*

[47] This *camera* is of smaller size, generally twelve to fifteen meters in length.

morte[48](chamber of death). Tuna enter into the center of the trap (*camera grande*) and they are corralled into rooms east or west. As these rooms fill, or upon the decision of the *Rais* (head or director of the *tonnara*), tuna are moved west toward the *camera della morte* where they are harvested.

Most of the *camere* have *porte di rete,* or "doors," that allow the *tonnaroti* to open and close parts of the trap and facilitate the movement of the captured fish. These *porte* divide the *camera*. When the *Rais* orders that the tuna should be transferred to another *camera*, the *porte,* which are designed through a pulley system to drop open and allow fish to move, are opened and then are pulled closed (Figure 10). This is a process that requires great timing, skill, and experience.

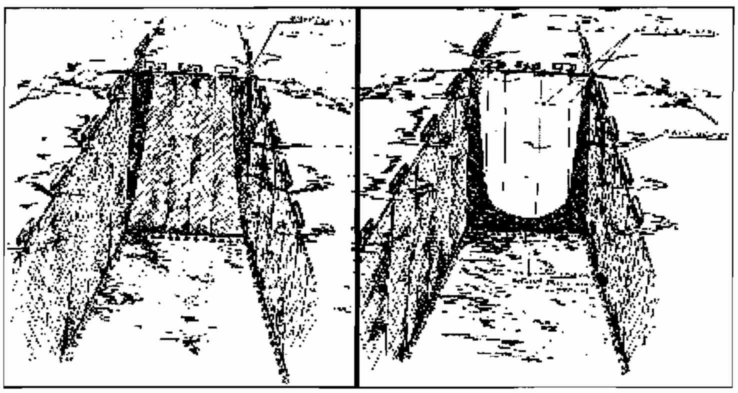

Figure 10: Inside the *Tonnara*, *Porte di Rete* (Doors made of nets). The image shows a *camera* with *porte* in closed position (left), and opened to allow tuna to move (right) (Fodera 1961).

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[48] The label of the rooms can vary slightly from location to location. As such, these labels are those decribed by D'Amico (1816). *Camera della morte* is approximately double the length of other average sized *camere*.

The length of the *isola* in the largest Sicilian *tonnare,* like those that were found in Favignana and Bonagia, is approximately 1,000 meters. The width of the structure varies in relation to its function. At the eastern most point[49] called *Testa di levante* the width is about 45 meters and on the western most point the nets narrow to 30 meters. The opening where tuna enter, the *bocca* (mouth/entrance), is about seventy meters wide[50]. To reach the ocean floor, the nets range from about fifty meters in depth, giving a total area of approximately 20,000 sq meters and a volume of approximately 900,000 cubic meters (Ravazza 2005). Easier to visualize, the size of a single *tonnara* is approximately equivalent to lining up ten full-sized soccer fields back to back.

At its center, where the *isola* meets the *coda,* the trap has a maximum width of 60 meters. This meeting point is called the *spicu* and is an important aspect of the trap as it is the origination point for the construction of the *tonnara.* Forming the *spicu* are the first surface ropes/cables, which are laid out to sea during the construction of the skeletal structure of the *tonnara.* Two sets of ropes are pulled out, forming the *crucciatu* (a cross), which is the foundation of the *tonnara.* This point has cultural and ceremonial significance as well. All the bluefin must pass this point to enter the trap and the crossed nets are thought to symbolize a crucifix. As such, the *Rais* and the *tonnaroti* ritualistically

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[49] This discussion describes the Sicilian *tonnare di andata* in Northern Sicily. Although the features of all the Sicilian tonnara are similar, the geographical positioning of these tonnare are different than those on the southern or eastern coast and therefore spatial positioning and facing direction are different.

[50] The opening is usual wide open, unless there is the *bocca a nassa (*or in dialect *'ucca a 'nnassa)* a system of netting adapted from Spanish and Portuguese tuna traps that are designed, using angled nets, to prevent escape once tuna enter.

pray here and ask Jesus or the Roman Catholic Saints to aid them by bringing the bluefin for an abundant catch.

This is also the location of *la palma*, or the palm. The *palma* is a device that serves both cultural and technical functions as well. Erected at the point where the tuna enter the trap, it is a wooden structure standing approximately ten feet tall made in the shape of a cross. The cross is decorated with palms and, usually, images of Roman Catholic Saints. For the *tonnaroti* this religious symbol brings good fortune for a healthy catch. However, it also serves technical functions. As boats move away from the *tonnara*, the nets and buoys are no longer visible due to the arc of the horizon. The *palma* is used to guide the *tonnaroto* to the *tonnara* or, more simply, as a reference point. It also helps them gauge the ocean currents and ocean conditions. By examining the movement of the *palma*, the *tonnaroto* can make an assessment of the conditions from a distance. For example, the *palma* can be pulled under the surface by rough seas, resulting in the saying "*puro i Santi avemu 'nfunno,*"[51] referring to poor conditions (Ravazza 2005: 82).

When the bluefin are enclosed into the final room, *camera della morte*[52], they are slaughtered in an exciting and climactic practice called *la mattanza*. Originating from the Spanish *matar*, *mattanza* translates into "the slaughter" or "the killing." The *camera della morte* is the only chamber that includes a net along the underside of the chamber. The *mattanza* is a much celebrated harvest during which the *tonnaroti* line the edges of

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[51] "Even the Saints have been dunked."

[52] *Camera della morte* is sometimes referred to as *il coppu* by the *tonnaroti.*

the *camera della morte* with their specialized boats built specifically to fit within the structure, and gradually pull up the heavy nets, starting on the east side of the chamber moving west. Pulling the nets onto the largest vessel, *il vascello,* or in Sicilian *vasceddu,* requires the coordination of a large group of fishermen that must heave in relative unison in order to reduce the area within the chamber. Traditionally, during this process, *tonnaroti* took part in work songs called *cialome* to help to maintain a synchronous effort and also communicate important cultural symbols. Closing the rectangular area (called *la chiusura del quatrattu)* until the bluefin have little area left to move and are forced to come to the surface, results in a passionate display as the tuna quiver and thrash their powerful tails, attempting to break free from the crowded conditions on the surface. At this final stage, *tonnaroti* gaff the violently thrashing tuna using harpoons and maneuver them aboard the *vasceddu* in a ritual that transforms the azure waters within the *camera della morte* into a crimson sea. Teams of eight or more fishermen, *rimiggi*, are often required to pull aboard giant bluefins that can reach up to 600 kilograms (figure 11).

Figure 11: *Mattanza.* Scopello, 1980. Photo courtesy of Baldo Sabella, Comune di Castellammare del Golfo.

Social Relations in the *Tonnara*

After examining a bit of the history and development of the *tonnara* as well as the methods of capture, this section will discuss the social relations in the *tonnara*. Here I will discuss the different positions within this method of production, the system of wages, ownership and property rights and the division of labor. This discussion will generally examine the conditions that developed after the Norman conquest and into the modern era.

As discussed previously, the fishermen who take part in the *tonnara* are called *tonnaroti*. Generally a crew, or *ciurma*, of fifty or more was needed to complete the sea-going operations in a *tonnara*. Besides the *ciurma*, there was also a group of individuals hired to work on land in the barracks, during the fishing season and beyond[53]. In the largest *tonnare* the total seasonal labor force would reach about one hundred men.

The *tonnara* always contained two fundamental structural elements: one at sea, already discussed in detail, and one on land referred to as *il malfaraggio*. As the tuna fishing season lasted for many months, in earlier times *tonnaroti* and other workers stayed on site for long periods of time, some for the entire season, which could run up to four months. The work done on land included mending, assembling and storing nets, maintaining and storing boats, loading boats, organizing daily operations, and sometimes

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[53] These were usually townspeople who held trades such as barbers, carpenters and cooks. Women were generally absent from the *tonnara*, in fact sometimes they were completely banned from the site. However, women were commonly employed in the production and/or repairing of the nets used in the *tonnara*.

processing fish. The *malfaraggio* contained a number of different elements, including the structure and courtyard the *tonnaroti* used when engaging in work activity.

Social relations within the *tonnara* were hierarchical, with a head fisherman called the *Rais*, who served as the leader of the fishing operations[54]. In the *tonnara*, the *Rais'* authority over ocean-based activity was supreme. This position was held in very high esteem, and the local *Rais* often had a prestigious position in the community. These individuals were very experienced fisherman and tended to be reclusive. This may have been related to customs and rituals, but also the enigmatic nature of the position and process. Usually, this position was handed down patrilineally.

The *sotto-rais,* or *vice-rice*, was the second in command and oversaw a great deal of the process as well as acted as counselor to the *Rais*. There were a number of positions that follow including the *capo muciara*, head of the *Rais'* boat, and *capiguardia*, heads of other boats. The *faratici*, or "simple" *tonnaroto*, were the fisherman who had no leadership position, and have a variety of marine responsibilities in order to carry out most fishing duties (Fodera 1961). Some *tonnare* would distinguish between *faratici* and *marinai* or mariners, where the *marinai* were more capable and experienced. In addition, there were a number of other individuals including *fachini* and *portinai* (gofers and porters), tuna processors, such as *tagliatori (*cutter/butcher*), salatori* (salter)*, cuocatori* (cooks), as well as *botai* and *calfati* (bottlers and barrel makers) and

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[54] Frequently there was a *Rais di mare* (*Rais* of the sea) and *Rais di terra or costa* (*Rais* on land or coast), each charged with overseeing the operations in their respective locations. Unless specified, the term *Rais* generally refers to the *Rais di mare*.

garzoni , who were general laborers or shop boys, among others[55] (Cancila 1972; Consolo et al. 2006).

Traditionally, all *tonnaroti* were paid in both currency and kind. The compensation was also hierarchical. Those with greater authority and responsibility earned higher pay as well as a higher percentage of the catch. As the *tonnara* entered into the modern period, the *tonnaroti* earned meager wages, yet most peasants still sought work in the *tonnara.* If chosen to work in the *tonnara* individuals were, for the most part, guaranteed a wage or payment in kind as long as the season was not a failure. This provided some stability, during a time in which peasant life had little guarantees. According to Rosario Lentini, an economic historian and expert on the Sicilian *tonnare*, in the 1800s *tonnaroti* could earn a great deal more than what they could earn working in the fields. Generally the earnings were distributed in three parts: *parti*, *prestamo*, and *soldo morto*. *Parti,* referring to the parts of the capture, or payment in kind, *prestamo* and *soldo morto*, were a predetermined seasonal wage, the first given up front, and the latter at the end. The *parti* and *soldo morto* were given at the end of the season as they were dependent on captures and thus varied annually (Lentini 1986). Laborers were usually given what was called *panatica*, income in the form of daily rations such as bread and wine, but this form of payment could also be deducted from for other supplies and rations (Cancila 1972). What is more, individual *tonnaroti* were sometimes given a bonus, in the form of added payment in kind, for superior performances.

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[55] Different tonnare sometimes used different terminology to refer to individuals or activities/duties. As a result, there were other titles and positions within the *tonnara* that are not discussed here.

In an 1887 letter written by Gaetano Caruso, the administrator of Favignana's and Formica's *tonnare*, he described the expenses in the *tonnare,* including a breakdown of payment in kind and salaries of *tonnaroti.* In these *tonnare*, a *faratico* could earn about 115 lira[56] in a season, not including other payments in kind or rations. But this was often based on the amount of captures for the season. Payment in kind, which is called *il migghiaratu* or sometimes *la ghiotta*, was distributed in such a way so that the *tonnaroti* only earn about sixteen percent of the season's tuna catch, which Caruso (1887) reports as equaling an average of thirty-one liras over the period between 1878-1887. Also, *tonnaroti* could also earn about twenty-seven percent of the added incidental catch, such as the odd swordfish that enters the trap and a *panatica* of sixty cents a day.

In these *tonnare*, payment in kind was distributed in eighty parts, with the largest portion going to the *Rais* (five parts) and a much smaller part to the "simple *tonnaroto*" receiving about one-half of one part (Caruso 1887). This distribution usually occurred at the end of the season, but also, depending on the location, distributions could be made during the season when certain agreed upon captures were reached. For example, in Bonagia, the *ciurma* would receive one tuna to be split amongst them for every three hundred captured[57].

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[56] According to Daniele Castrizio, a leading expert on numismatics of the Mediterranean region, in the late nineteenth century100 lira was equivalent to about twenty-nine grams of gold. Another guide is the measure developed by Malanima (2003) who estimates Italian per capita GDP in 1860 at between 262 to 350 lira.

[57] In the late twentieth century, this payment was converted into the value of the largest bluefin and was distributed as a cash bonus rather than payment in kind.

The bluefin tuna fishing season was historically an important part of the earnings of the peasant laborer in coastal Sicily. This not only provided annual seasonal wages, but payment in kind offered a food source for the year that could be consumed or, when provisions were more than a family needed, *tonnaroti* could sell or barter some of their earned portions. Due to the nature of the seasonal work in the *tonnara*, the *tonnaroto* was often also a farmer/peasant, or independent fisherman. At least since the 15th century, a part of the *tonnaroti* community finished the season at the *tonnara* and then was reabsorbed into the agricultural community for the late summer and fall grain harvesting (Consolo 1986). Others continued fishing for different species of seasonally available fish. The latter remained a common occurrence into the modern era.

Consolo (1986) discusses the compensation and conditions for the *tonnaroto* as the fishery entered into new eras defined by colonial control, and feudal relations, and beyond as capitalist social relations were emerging. In reference to the changes that occurred in the nineteenth century and the evolution of the working conditions into the modern era he states: "The *tonnaroto*, who we imagine was free and autonomous during the Arab reign, is now relegated to the margins, to be content with meager compensation in kind or in cash for his work" (translated from original Italian, 26).

It would be an exaggeration to assume that the working conditions in the *tonnara* were idyllic in earlier times. Surely, this was always hard and dangerous work. However, there were transformations in the social location of the *tonnaroto* along with the social relations of production that occurred over the long period in which the *tonnara* was productive that made the dangerous work less beneficial to the workers. Most recently, these transformations reflect the growing attention to expansion of wealth and power and later accumulation of capital by the proprietors and owners.

Division of Labor

It is clear that a very high level of competence in maritime affairs was required when organizing, setting, and maintaining the *tonnara*. In addition, the work required to carry out the daily operations was very labor intensive, but also necessitated a broad knowledge of the workings of the *tonnara,* and the sea in general. This may be best exemplified in the *Rais*, as his position of authority put a great deal of the decision making in his hands. However, it would be wrong to assume that his authority translated into a one-man operation, with others simply carrying out hard labor at his command. That is to say, the "simple" *tonnaroto* was a highly skilled mariner with a great deal of experience and knowledge, including an understanding of the climatic and ecological conditions. In fact, the *Rais* might often seek the opinion of experienced *tonnaroti* when making important decisions such as when to carry out the crucial construction operations. The *Rais,* would usually make the final decision on when and where to carry out operations, but commonly some technical decisions and most of the work were done by a combination of *tonnaroti* who knew well how to complete these tasks.

The division of labor is present within the *tonnara* throughout the historical record, but there was also a considerable amount of overlap in the work that the peasant/fishermen engaged in. It may be better described as the social division of labor rather than the detailed division of labor known to modern capitalist factories (Braverman

1975). What is more, there was a process of apprenticeship that took place in which *tonnaroti* learned skills through guided practice.

In the *tonnara*, some held responsibilities that defined their role, but this did not necessarily limit their interaction within other activities. Surely the *faratici* carried out much of the demanding work, such as lifting and moving anchors, transporting nets, etc., but it was common for all the *tonnaroti* to have a hand in most of the activities. For example, *capiguardi* did not oversee or direct operations from afar. These individuals were involved with every step of the process, regularly engaging in backbreaking work. This could be said for all members of the *ciurma*. Regardless of the division of labor and the hierarchy within the *tonnara*, there was a great deal of camaraderie among the *ciurma* that may be a result of the distinct character of the work, the long periods of time these individuals spent together, and the dangers present in the absence of cooperation and shared effort (Consolo 1986).

Ownership and Property Rights

A description of the *tonnara* and its social relations provide important insight for understanding this system of production. The social relations occurring within this system of labor were quite different than what exists today. Yet, it is important not to perceive this system in a romantic fashion. It is clear that as broader historical social relations change, the *tonnara* is always part of larger social processes and is impacted in various ways. From what is known about the social history of this system from the Norman era forward, there is little doubt that the social relations of production of the period influenced power relations and affected such things as access to resources and labor. For example, the *tonnara* system was unmistakably patriarchal. This was true to such a degree that traditionally at some *tonnara* women could not even step foot in the fishing grounds during the bluefin season.

There was certainly some degree of exploitation, as is evidenced in original records that display salaries, expenses, and sales (La Duca 1988; Lentini 1986). A simple *tonnaroti's* wage was typically much lower than other participants, and it is likely that his labor was not adequately compensated in this wage. Also, throughout history and depending on who was in power, kings, nobles, clergy and capitalists had their hands in the pot, but did not engage in day-to-day labor.

During the Norman period, the King granted concessions that contracted fishing rights. While many of the prime fishing sites remained in the demesne of the King, concession was granted to vassals, that is local barons, as well as the local clergy, monasteries, bishops, and churches. The earliest recorded concessions were offered to the Church, regional monasteries, bishops, etc. For example, in the year 1097, Roger I conceded the *tonnara* of Scopello to the monastery of Santa Maria di Boico (La Duca 1988), in 1132 the Bishop of Cefalù, is granted the rights to the local *tonnara* (Sarà 1998), and in 1176 William "The Good" offered the concession to the *tonnara* at Fimi (Isola delle Femmine) to the Benedictines of Monreale (Avolio 1805; La Mantia 1901). These are followed by many more concessions in Sicily including those in 1210, 1215, 1221, all of which where made to monasteries in the area of Messina (La Mantia 1901).

By the 13th century, King Frederick II increased the number concessions, offering most to local barons. This period introduced the *gabelloto*[58] to the *tonnara.* The *gabelloto* is often associated with agricultural *latifondo* estates. In the *latifondo*, however, the noble class did not take an interest in any aspects of the operations of these feudal estates. Utilizing similar social relations that exist within the system of *latifundium*, the aristocracy hired *gabelloti* to manage the *tonnara* in their name. Others, such as *credenziere* and *exercitores delle tonnare*, were appointed to manage and oversee tuna fishing operations and prevented others without royal authorization from fishing (La Mantia 1901).

While *gabelloti* took on the same title as those that managed the *latifondo* for the local aristocracy in feudal Sicily, they are described as having quite a different role and character in the *tonnara.* That is to say, while the agricultural *gabelloto* who supervised the massive estates for the wealthy Sicilian aristocrats were purely salaried managers, and frequently brutal in their ways (Blok 1975), the *gabelloto* in the *tonnara* was often known to invest some funds in the maintenance of the *tonnara* and could have suffered gains and losses along with the fluctuating returns (Sarà 1998). This group may be fairly characterized as a proto-capitalist bourgeoisie, as most of these individuals were not aristocrats, however much they aspired to be, nor were they peasants. Nevertheless, it

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[58] *Gabelloto* originates from the Italian ward *gabella* or tax. These individuals usually paid a fee for the right to manage the fishery. However, they did not own the means of production. Equipment, nets, and boats used in the *tonnara* were owned by the sovereign or later possibly by a member of the aristocracy who was granted the concession. The right to fish granted through the concession by the King did not change hands, usually a *gabelloto* signed on for a period of years, until much later in Sicilian history when the *tonnare* were eventually sold to private individuals.

would not be accurate to consider this a classical capitalist endeavor, as one might expect. Firstly, any returns or "profits" that were obtained were not reinvested in production or technological expansion with the intention of growing and accumulating capital. Secondly, *gabelloti* did not own the means of production, they merely rented them along with the right to fish, paying a tax to the royal authorities. Finally, the *gabelloto* were also confined to offer a part of the capture to individuals and institutions such as the sovereign, his representatives, and the local diocese[59]. While it may seem a short step from *gabelloto* to capitalist, this would take a few centuries to occur.

The *tonnara* during the Norman period was class stratified, functioning within what can be considered a feudal system. As such, it maintained a class structure and exploitative characteristics that are an inherent part of a feudal system. Taxes or tribute in kind were offered to the sovereign, lord, and/or diocese on any extracted resources that were part of the royal estate. The emergence of feudal social relations with the Norman conquest rearranged Sicilian society and created conditions in which fishing communities no longer had direct access to the fishery without legal rights to fish granted by powerful authorities. (Consolo 1986; D'Amico 1816; La Duca 1988; La Mantia 1901; Lentini 1986). Centuries later, as social relations in Sicily transformed, capitalist relations begin to dictate within this institution as well (Mack Smith 1968a).

The Norman concession might be considered an early form of capitalist private property. However, this is debatable. In truth, the estate was always under the power of

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[59] This part was often called *decima*, referring to the fact that it generally was made up of ten percent of the annual captures (Lentini 1986)

royal authority, and usually a *tonnara* was conceded only for periods of six years and could be renewed. Nevertheless, most individuals were excluded from the fishery and strict limits were set on where a *tonnare* could be placed along the coast. It is difficult to find any indication of this type of arrangement preceding this period. La Mantia (1901) states that in this era "the *tonnara* form an exception to the communal right to liberal fishing of the sea" (translated from original Italian: 49).

However, as McCay and Acheson (1987) and St Martin (2005) explain, communal rights, common property, and open access to resources takes on different characteristics in different places and times. Looking further back in history, the third century Roman jurist Ulpian (*Domitius Ulpianus*), argued that preventing anyone from fishing would essentially prevent the use of the sea at all (La Mantia 1901: 3). In addition, what was considered the earliest form of international law of the sea, Rome's *Mare Liberum*, developed from the belief that, while Rome had jurisdiction over parts of the sea, no one had *dominium* over it. In Rome, civil law, which applied to land based activities, did not apply to the sea (Steinberg 2001). Roman rights recognized the liberty of the ocean and considered it a resource essentially held in common. Therefore, the right to fish was not constrained. The Roman notion of *Mare Liberum* was adopted from common practices of the Ancients that preceding them (La Mantia 1901; Purpura 2005).

Throughout the feudal period, the fishing was regulated and controlled in a variety of methods. Some methods restricted access to the *tonnara*, others restricted net size and fishing for other species as well. Other periods had little restrictions other than rights to fish by concessions (Avolio 1805; La Mantia 1901; Molinari 1912).

There is little known of the earliest form of the trap fishing that existed in Roman and pre-Roman times or the system of fishing that existed in Arab Sicily and likely took a similar physical form to the modern *tonnara.* However, it is clear that the *tonnara* under Arab rule functioned under fundamentally different social relations, including property rights and access. Bluefin tuna fishing was unmistakably active and important during this period and there is no indication that access to the *tonnara* was reserved for any individual or religious institutions (Amari 2002). As the social relations that existed during the Arab control of Sicily have been documented as less authoritarian than other ruling powers, many have argued that the *tonnara* during this period was organized in a communal manner with joint control and distribution of its resources by local communities (Consolo 1986; Sarà 1998).

While it is difficult to determine the specific details regarding the social relations in the *tonnara* of earlier periods, Raimondo Sarà (1998), a marine biologist and expert on the Sicilian *tonnare*, states that

> "The tonnara from its beginnings could not but have been of collective property to serve and sustain all of the community (they could not have been simply familial, neither individually owned). Men, women, or children worked together throughout the year. The sole motivation was sustentation, gratification and social elevation of the population" (translated from original Italian: 50).

This early form of trap fishery was an important part of the social fabric. Others have argued that in the early period of the *tonnara*, the massive materials needed to organize and operate such a system including nets, ropes and moorings, necessitated that all those in the village, or even nearby villages, participate in a cooperative and creative effort, working in a communitarian enterprise. This work affected a variety of aspects of social life including economic, social and religious aspects (Consolo 1986).

Over time, as the power of the Kings of Sicily diminished and the social changes that overtook Europe began to emerge on the Island, the acquisition of *tonnare* by private individuals became a common occurrence. Eventually, all fell into private hands. Merchant capitalists began to control the bluefin fishery and later wealthy Genovese bankers began to invest in it. The most famous sale was the purchase of the Egadi Islands in 1637, including the *tonnara* of Favignana and Formica, by the Genovese merchant Camillo Pallavicino for 63,000 *onze*[60] (La Mantia 1901). By the middle seventeenth century, the Kingdom no longer held control of any *tonnare*. All were sold to private individuals or controlled by the Church (Marrone 1986). With the formation of the new Republic of Italy in the 1860s, *tonnare* that were owned by the Church were resold to privatize citizens. Often the new owners developed familial consortiums and began to accumulate multiple *tonnare*, concentrating their wealth and control of this method of production and distributing the risks. In this period, the modern era of the *tonnara*, prominent Italian families, such as Pallavicini, Parodi, Florio, and Foderà, owned many of the *tonnare* in Sicily (Pavesi 1889; Sarà 1998). It is important to note that just about all of the early owners of the *tonnare*, and also some *gabelloti,* were not

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[60] *Onze* was a traditional Sicilian currency. One *onza* equaled thirty *tari* and one *tari* equaled 20 *grani.* To give an idea of the value of an *onza*, in the seventeenth century, a Sicilian *bracciante* (farm worker) could earn about one to two *tari* per day (Cancilla 1972).

Sicilians, but merchants and bankers who originated from mainland Italy, principally from Genoa, a major center of banking activity.

With the transfer of the *tonnare* to private hands, another stage in the history of this system of capture was initiated. As private property became the law of the land and individual financiers sought to invest and accumulate profits, the production methods within the *tonnara* were affected as well. Owners sought to establish more efficient systems of production. New industrial materials began to substitute for traditional materials used for centuries[61].

A good example of this is the aforementioned purchase of the *tonnare* in Favignana and Formica by Pallavicini in the seventeenth century. The Genovese merchant bankers were determined to increase their returns from the *tonnare*. Calleri (2006) reproduces original documents from the Pallavicini Archives in Genoa. The June 1723 Archive describes the intentions to reform the crew in Formica in order to reduce costs:

> "1[mo] Devesi riformare la ciurma d'ambe le tonnare a minor quantita di quella al presente, è per esser superflua in tempo scarsa pesca e poi, se la divina providenza manderà abbondanza di tonni, come si spera, in questo caso non manca in Trapani buona gente di mare e di terra… con pagarsi a giornata come al solito. É questa per sparmia per la spesa solita." (Calleri 2006: 113)
>
> Translation:
>
> "1[st] we need to reform the crew in order to reduce it from the present size, from being superfluous in times of poor fishing and then, if the divine providence sends an abundance of tuna, like we hope, in this case there is

[61] Changes regarding materials will be discussed in the next section.

no shortage of good men in Trapani…which we can pay by the day as usual. This will reduce the usual operating costs”

Additionally, there are these calculations (Table 2) that described the potential savings allowed by reducing the crew, comparing the “old” crew (left) to the smaller “reformed” (right), their numbers and the *parti,* or payment, as well as the savings (*sparmio*):

	Ciurma Antica di Mare	
		Parti
Rais	1	2.5
Rais di Costa	1	1
Marinari	18	18
Faratici	27	27
Mosciara	8	4
	55	52.5

	Ciurma Rifirmata di Mare	
		Parti
Rais	1	2.5
Rais di Costa	1	1
Marinari	15	15
Faratici	19	19
Mosciara	6	3
	42	40.5
Sparmio	**13**	**12**

Table 2: Formica Crew Reforms and Potential Savings. Reproduced from the Pallavicini Archives (1723) in (Calleri 2006).

The Florio family, known throughout Sicily as one of the wealthiest capitalist dynasties in the Island’s history, owned or leased many of the *tonnare* in northwest Sicily, and notably, purchased these famous *tonnara* in Favignana along with Formica in 1874 for 2,750,000 lira[62] (Lentini 1981). The Florio family, at this time lead by Iganzio Florio, also had ownership in the *tonnare* in Virgine Maria, Arenella, Isola delle Femmine, and Scopello, all in the vicinity of Palermo or the Golfo di Castellammare. Originating from the mainland in Calabria, the Florio’s would become the most

[62] This is a very large sum of money for the time considering that Italian economist Paolo Malanima (2003) estimates Italian GDP per capita in the mid-nineteenth century at close to 300 lira (see footnote above).

influential family in Western Sicily during the era following unification, with major interests in wine production and banking, as well as trade and navigation (Lentini 1986; 1995).

Nevertheless, the *tonnara* was not always a solid investment for the emerging capitalists. A great problem for capitalist owners such as the Florios, was the inconsistent returns from the *tonnara* (Lentini 1995). Some years would result in large captures, while in other years captures would not meet expectations or return predictable profits. Throughout history most *tonnare* had "better" and "worse" years, but on average (over time) produced consistently and abundantly. The reasons for higher and lower captures are diverse, likely ranging from the bluefin's annual biological variations to environmental conditions such as ocean temperatures or salt concentrations (Fromentin and Powers 2005). Nevertheless, this began to pose a problem, as new capitalist ventures sought growth and capital accumulation. In the late nineteenth century, Ignazio Florio expanded the production in Favignana to include the first cannery in Sicily and likely the largest in Europe. Preserving and canning bluefin under oil initiated a new level of industrial production and mechanization not seen before in the Sicilian fishery. This also created as new possibilities for export. However, this did not completely resolve the problem stemming from inconsistent captures (Lentini 1995).

There were continued efforts to reduce labor and to address production concerns. One example of these attempts to increase efficiency and reduce the number of laborers needed to run the *tonnara*, occurs in the late twentieth century, as owners begin to push for changes in the design of the *tonnara* to a system referred to by locals as "*la tonnara* *alla Spagnola*" (in the Spanish style). These new layouts would reduce the need for labor significantly, and were pushed by owners often over the protests of the *Rais* and crew. In fact, there have been cases when a *Rais* refused and resigned when owners forced these changes. However, these solutions could not entirely resolve the problems of inconsistent returns in the *tonnara.* As Doumenge (1999) states:

> "It is this congenital defect of irregular captures that condemns the *tonnara* to extinction, they could not furnish guarantees and stability indispensable to an economic organization with the consistent demand of a market in expansion" (translated from original Italian: 32).

This problem would remain for bluefin tuna production in the Mediterranean until the late the twentieth century, when new methods of capture and production directly address these and other issues. This discussion will be taken up in Chapter V.

Technology, Labor and Nature in the *Tonnara*

As stated previously, the process of building and operating the *tonnara* was a highly labor and time intensive process. Producing and mending nets, maintaining the boats, laying out the framework of the structure and anchoring it, setting the nets, daily fishing operations and maintenance, capturing the tuna, and then retrieving the nets and equipment for storage all required a large group of fisherman as well as a support staff. Simply laying out the framework for the trap often took several days or weeks. Once everything is in place, setting the nets can require several more days to weeks depending on the weather conditions. In most cases, setting the trap started in early April with the intention of completing the trap by the end of the month (Fodera 1961).

The process of constructing a *tonnara* each year (*calare la tonnara*) occurs at sea. While the nets are pieced together on shore, they are brought out to sea and placed in position on a structure of several kilometers of ropes and cables that make up the frame of the *tonnara*. This process requires hundreds of anchors weighing from 200 to 600 kilograms, which must be placed in position with precision, potentially the most dangerous process in the construction. While modern anchors are made of iron, traditionally large rocks were used to anchor the structure. Once the construction of the frame of the *tonnara* is complete, nets measuring many kilometers in length are brought out to sea and hung from the cables that are lined with hundreds of floats or buoys.

The exact position of the *tonnara* is specific to its geographic location. This is determined by a variety of factors, including the historic patterns of migrating bluefin, ocean currents and winds, among other environmental, historic and social factors. All of these decisions are made each year by the *Rais*. While he may seek advice from his assistants, traditionally the decision and the responsibility are completely under his authority. Each step of the process requires careful calculation and placing of the nets. While the *Rais* made tactical decisions, the process had to be carried out by a team of fisherman working in concert. It was crucial that these decisions were made with accuracy. There was the potential of a failed season if the location or construction of the *tonnara* was incorrect.

Each year these large and elaborate traps were assembled (*calatu*) and disassembled (*salpatu*). While the bluefin migration only lasts a few weeks, the process of preparing, maintaining, constructing, disassembling and storage continues for four, sometimes close to five months, beginning in late March or April and lasting until July.

The labor and skill of the *tonnaroti* was crucial to the smooth functioning of the *tonnara*. While those with limited experience could complete some aspects of the work done in the *tonnara*, the bulk of the work was either impossible or very dangerous in the hands of inexperienced or unskilled laborers. The importance of the *tonnaroto's* labor in the *tonnara* is made clear by the Sicilian decree of *Feriae tonnitiarum,* ordered in 1524, in which individuals who were skilled at work in the *tonnara* were banned from arrest for debts, and those that worked in the *tonnara* who were already incarcerated were allowed temporary freedom during the bluefin tuna season with the agreement to return to incarceration after the period that ran from April 10 to June 20 (La Mantia 1901). In the 1590s, the Viceroy Duke of Monteleone established that *tonnaroti* could not be ill-treated by creditors during the bluefin season. More, during this period they were immune from incarceration (Cancila 1972: 145).

The technology used in the *tonnara* in the modern era is very much the same as it has been for centuries. However, beginning in the mid-twentieth century, there were a number of modern substitutions made for various materials. The nets in the *tonnara* were made from natural fibers such as hemp, or coconut fiber, but traditionally made from a Mediterranean grass called *ddisa* (*Ampelodesmos mauritanicus*)[63]. In the modern era, natural fiber nets were substituted with nylon nets. The surface ropes (*sommo*), used to

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[63] *Ddisa* is sometimes called mauritania grass or rope grass.

form the top of the structure, were also made of the same natural fibers and were substituted with steel cables. The nylon and steel have the advantage of great strength over the natural fiber, as well as longer life span and less maintenance. Buoys were once made from native Sicilian cork trees. In the modern era, colorful plastic buoys are utilized. In addition, rocks, large and small, were used to keep vertical nets in place. Later, with the exception of Favignana that continues to use the local *tufa*, lead or other heavy metals are often used as net weights. Boats were always made of wood. Recently, one fleet of boats produced for a modern *tonnara* was made of steel. These much heavier boats were more durable, but more difficult to maneuver manually. However, with the addition of diesel-powered tug-boats used in transport, the additional weight was less of a concern. These boats are harder to maneuver in the open sea, and they were still maneuvered using hand oars before and after attaching to the tug-boats. As stated, modern anchors were made of steel and traditionally, large rocks were used as the principle anchors in the *tonnara*. While many of these new materials had some advantages, many of them were no longer locally produced, but purchased and imported from distant facilities[64]. As such, they did not employ local artisans in their production, thus slowly reducing the economic importance of the *tonnara* in some areas. In addition, the processes of producing and moving new heavier materials were often more energy intensive and benefited from some mechanization and fossil fuel powered boats.

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[64] According to local fisherman in Sicily, nets were often reused by hand spinning them into rope. Nylon nets made particularly strong ropes. But in the modern era, there has been an increasing tendency to discard old nets after a certain level of wear and tear.

While some materials changed, the general technology, many of the tools, and the techniques for fishing remained the same for centuries. Those that worked in the *tonnara* developed a keen understanding of the fishery, learning the particulars and nuances of the location's ecology, geography, climate, and weather. Determining where to place the trap was a decision that had to be made with a deep understanding of the local currents and winds. What is more, the *tonnaroti*, from the earliest of times, learned the habits and behaviors of the bluefin and adapted their methods of capture and placement accordingly. These individuals gained an acute perception of the ocean conditions and the ecology of their location in order to make decisions for the proper functioning of the *tonnara*, developing skills only possible through direct observation, experience, and learning.

Tonnara and *Tonnaroto*: Intimate Relations to Nature

It is clear that in the *tonnara* trap system the *Rais*, due to his responsibility as leader of the sea operations, required in-depth knowledge of the maritime ecosystem. However, many of the *tonnaroti*, and particularly the *sotto-rais*, *capiguardia*, and even many *faratici*, had years of fishing experience and knowledge and were an integral part of the functioning of the *tonnara*. This is demonstrated in a variety of examples of daily activities.

One such notable example of this close ecological connection with the local ocean environment is the way in which *tonnaroti* kept track of the tuna that entered the trap. This was done using simple tools and extensive knowledge. Once the tuna enter into *la* *boca,* they are watched over by *la ciurma*[65] (the crew), or specifically *guardiani* (lookouts). *Tonnaroti* often observed the bluefin under a tent (*cabana*) erected overhead for shade utilizing a looking glass called *lo specchio*[66].

Along with this method, expert fisherman kept tabs on the tuna using lines dropped into the trap with a rock or weight tied to one end. Holding the line while the fish moved around or into a different *camera* (rooms), the *tonnaroti* kept tabs on the tuna by feeling the vibrations on the line, as the rock often acted as an object of curiosity to the tuna. While these counts were obviously estimations, it was usually a very good conservative estimate. As Antonio Oliva, the descendent of three generations of *Rais,* commented on the estimates of *tonnaroti*:

> "When I was a boy, I used to stay on site with my father and observe the *tonnaroti*… If they [the *tonnaroti*] said there were a *ventina* (about twenty) there were at least twenty five or thirty. If the said there were a *trentina* (about thirty), you could count on forty or so."

These methods were used in order for the fishermen to determine the quantity of bluefin that had entered the trap, whether the trap was consistently fishing, or if a problem had arisen.

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[65] *Ciurma* is the title given to the crew made up of tuna fisherman called *tonnaroti.* Thus, these two terms may be used interchangeably when discussing the fisherman.

[66] The *specchio* looks like a stainless steel bucket with a clear glass bottom. The fisherman submerge the *specchio* into the water just deep enough so it does not allow water to enter into the cavity and, leaning over from the side of the boat, place their head inside of it. The glass bottom allows for a clearer view of the tuna under water. Another method utilizes olive oil drizzled on the surface of the water to remove the distortions and allow for better observation.

Tonnaroti had developed a sharp sense of understanding regarding the bluefin and its behavior. For example, these expert fishermen could describe the "mood" of the captured tuna. That is, they would report whether the tuna were "calm and content" or "nervous." With this information, the *Rais* would determine how and when to proceed with the activities leading to the *mattanza* (harvesting). Nino, a *tonnaroto* at the *tonnara* in Scopello (Northwestern Sicily) during its final years, recounted an interesting anecdote that discusses the response of the *Rais* when they found a shark in the *tonnara*, which highlights the fisherman's finely honed knowledge regarding the fishery. He recalled:

> "The *pescatore bravisimme* (most talented fisherman) could tell you how many tuna were in the *tonnara*... The *gaurdiane* (lookouts) were so talented that, not only did they understand how many tuna there could be, but they understood when the tuna were nervous, and this was a concern for them. It was a concern because... they knew that there was a shark nearby, and the tuna were nervous. A shark in the *tonnara* could ruin the season... They saw that the tuna were nervous and called the *Rais*... The *Rais* came closer and asked, "What is the situation" ...and they would respond, "The tuna are nervous," and this was a displeasure because they knew that there was a shark "*uu' malupisce*"...The *Rais* sent for the *facchinaggio* (porter) to purchase a lamb, because the lamb was to be offered to the shark... They tied up the lamb and lowered it... I experienced this... once it was submerged and they felt the shark starting to bite at the lamb, they began to move away with the boat, slowly, and the shark followed, out away from the *tonnara*. These were techniques that always worked, since ancient times."

This is an excellent account of the *tonnaroti's* intimate familiarity with the ecological conditions and profound understanding of the bluefin's behavior. These fishermen had inherited knowledge and techniques developed over centuries, that enabled them to sense the conditions within the trap and resolve problems with relatively good success.

The *tonnaroti* observed a number of natural indicators that allowed them to better predict the arrival and movement of the tuna into the traps. Specifically, through years of practical experience, the *tonnaroti* understood that certain sea organisms and birds were signs of bluefin moving into or towards the trap. As Salvatore Accardi, former *capobarca* from Bonagia, explained:

> "Before reaching the location of the *tonnara* we may notice sea birds. First the *Rais*, because first he explains, and then others learn. And even you yourself learn, and then make contributions, "*Talia, le cedde di mare ci sunnu*!" ["Look, the sea birds have arrived!"] We fished last night. Or maybe we are fishing right now."

Thus the *tonnaroti,* as one participant in this study stated, "read the signals of nature." This quote also provides insight into the process of knowledge transfer and the contributions made by many members of the crew as they gain experience. Furthermore, these methods date back for many generations and the *tonnaroti* often see this as a direct link to their ancestors and even the Ancients. Another example of *tonnaroti* reading signals of nature is their practice of observing the presence of *vellela velella*, an invertebrate marine organism they call "*la barchetta di San Pietro*" (Saint Peter's Little Boat). Ninni Ravazza explained:

> "For hundreds of years when the *tonnaroti* see *la barchetta di San Pietro*, they realize that it anticipates the arrival of tuna. It is a positive symbol for the *tonnaroti*. This is their interpretation of nature…it signals favorable weather conditions, currents and winds"

As discussed earlier, the *tonnaroto* had to have a strong understanding of the natural conditions in order to set and maintain a working trap. This was built on years of experience and a deep understanding of the local environment. For example, some locations were known for strong currents, which must be avoided when setting the trap, others for the constant presence of sharks that needed to be lured away or caught. This was a labor process that was fully engaged with natural ecosystems and as a result the fisherman developed close relationship with these processes. Gioacchino Cataldo, *Rais* in Favignana from 1997-2007, compares the work of the *tonnaroto* to a farmer saying:

> "Like a cultivator plants a tree, helps it to grow, and waits for it to bear fruit, the *Rais* [and *tonnaroto*] do the same thing with the *tonnara*. He has to set up the nets in the right way to capture the tuna. And then he waits for the tuna... It is a very emotional process. When you initiate and prepare, you try and avoid making errors, there are many measures, there are many meters of nets, you need to avoid the destructive currents and set it along with the habits of the tuna."

Beyond their deep understanding of the local environment and the ecology of the bluefin, the *tonnaroto* had great respect for the bluefin. This was an organism that supplied not only nourishment, but an economy and a way of life for many families. Their strong ties to this species, created a culture of reverence for its existence and appreciation for the benefits that it brought to the communities. Old time *tonnaroti* expressed to me that they had "tuna blood in their veins." In fact, the *tonnaroti* gave different names to the bluefin depending on its condition. They called the bluefin *tunnina* only after it was killed and brought aboard ship and *tonno* (tuna) while it still lives and swims. This distinction, while seemingly trivial, has some significance for this discussion. *Tunnina* is food, and *tonno* is a living being. In the culture of the *tonnara*, it was improper for a *tonnaroto* to call a bluefin *tunnina* while it was still living. They had great reverence and admiration for the magnificent creature that brought food and employment to their communities, and in its living form it should not be demeaned. As Ninni Ravazza clarified: "Tuna we must respect, but *tunnina* we can eat."

A Collective Identity and Culture

The *tonnara* and its history linger in many of the coastal regions of Sicily, even decades after closure. During the many years that I have frequented this region, particularly Northwestern Sicily, the *tonnara*, along with the Greek temples and Roman villas, has remained a central cultural icon of the historical achievements and greatness of this island's culture. In the fishing communities that historically contained working *tonnare*, such as Favignana, Bonagia, Scopello, and Castellammare del Golfo, it would hardly be a stretch to argue that there is not a single individual of previous generations, who is not either familiar or closely associated with this fishery. As stated before, it was a central economic and social force in these communities. These forces created a culture tied to the *tonnara* that is nearly impossible to describe short of its own full-length volume. However, I will briefly discuss it here to provide some sense of its significance to these communities, and what was lost when the Sicilian *tonnara* fishery collapsed.

As I spoke to individuals in places like Favignana and Bonagia, they described a great joy that came from a successful *tonnara*. This sentiment was common throughout these communities. They detailed the celebrations that occurred upon the capture of the season's first tuna. In some locales, church bells were rung and the large bluefin was ceremonially carted through the streets. They talked about a sense of "harmony and festivity" that engulfed the entire community when this occurred as it signaled good fortune. Giuseppe Solina from Bonagia described the feeling when the news came that the *tonnara* captured its first bluefins saying: "It is like when you get married and you find out your wife is pregnant." Gender issues aside, I presume that this was his way of describing pure joy. Signor Solina explains:

> "When you finished building the *tonnara* (*calare la tonnara*) and everything came out fine with the work… you were left with a sense of satisfaction. You thanked God, you thanked the Saints. You made many compliments to the *Rais* and the other commanders and you were very satisfied and even more so when the first tuna arrived … You had a certain happiness for the *Rais* since he was the commander, but also for the workers. You thought, we have done all this work together with him, … We rang the [church] bell, said many prayers, and celebrated."

Each *tonnaroto* that I interviewed expressed a great passion for this type of work. Many of them were fisherman and fished for other species during other times of year, but the *tonnara* held a special place for them. They expressed the importance of this work for the community, the satisfaction of capturing these incredible creatures, and the camaraderie of working in this capacity with a group of skilled mariners and friends. They described the work songs (*cialome*) that helped them work together and pass the long days, and their devotion to this work. For example, Salvatore Spataro, *Rais* in Favignana from 1986-1996 and later in Bonagia, stated:

> "I was born here [in Favignana] and I did it [worked in the *tonnara*] always with passion. I always wanted to work in the *tonnara* from when I was child. I went to watch my father and his friends working in the *tonnara* so I always had this passion [for it]."

To be sure, *tonnaroti* also expressed the hard work required and challenging conditions, which were, to say the least, not always comfortable. Cold wet mornings or long hot days at sea could be trying. The labor and lifting was heavy and often very dangerous, and they sometimes spent long periods away from families, particularly in earlier times. But it was very rare to find a *tonnaroto* who did not express pride and fulfillment in their work. The *mattanza*, which is one of the most fatiguing and dangerous parts of the *tonnara*, was typically identified as the most satisfying aspect of the work as they saw their labor come to fruition. There was a strong sense of dignity and gratification that went along with learning the skills of this honored tradition. Nino Paradiso noted:

> "The *tonnara* was all manual labor. It was hard work, very hard (*durrisimo*). But in the end we were satisfied, because we were doing the work of mariners."

There was a collective character of the work in the *tonnara* as this was work that required great cooperation. It was very common for family members to work together and there was a kinship (even brotherhood) expressed regarding the relationships between *tonnaroti*. There is no doubt that setting, maintaining, and fishing the *tonnara* required a great deal of cooperation and focus. Human labor was the main source of energy and the organization of that labor was crucial to success. For example a *tonnaroto* explained:

> "In the mattanza… we had to be together and in unison when we were pulling the nets and without mistakes because if we made mistakes it could be dangerous."

This was a process that occurred at sea and involved powerful tuna weighing several hundred pounds and using harpoons to pull them aboard. *Tonnaroti* relied on each other for safety and success and developed strong bonds.

Decline of the *Tonnara*

The earliest comprehensive record of bluefin tuna fishing using the *tonnara* began with the Normans. Norman concessions and legal procedures surrounding the fishery provided clear records of their activity. Circa the end of the first millennium CE, there were likely forty *tonnare* around Sicily. At the onset of the sixteenth century, thirty-five *tonnare* were active in Sicily (Marrone 1986). In the period from 1700-1900, there were periods of time when 100 *tonnare* were active in Sicily, but of these, less than half had continuous activity throughout the entire period. Some of these 100 *tonnare* were attempting to develop new traps in areas where traditionally none had existed. As a result, many were misplaced, stretching the limits of the fishery's productivity (Sarà 1998). Thus, in the eighteenth century, the Marquis di Villabianca (1986) describes seventy *tonnare* around the Island. By the end of the century there were fifty-eight and about twenty years later, D'Amico (1816) observed that fifty-three tonnare were functioning throughout Sicily.

From the historical record we know that Sicily consistently maintained from thirty to forty tonnare around the island for many centuries, and likely almost a thousand years (Sarà 1998). This drastically changed in the second half of the twentieth century. In

1950 there were about eighteen active *tonnare* around the island of Sicily. By 1995 this dropped to only two, those in Favignana and Bonagia.

As of this writing, there is only one "active" *tonnara* in Sicily, located in Favignana. But most who are close to this method of production would argue that this has ended as well, and calling it active is a stretch. Though functioning in the first decade of the twenty-first century, Favignana's *tonnara* is no longer economically viable. It operates owing to subsidies from the Sicilian regional government, without which this *tonnara* would no longer exist. In 2002 and 2003, the *tonnara* in Favignana did not capture any bluefin tuna (Ravazza 2005). In 2006 and 2007, they captured a few hundred bluefin, almost all less than one hundred kilos. Most recently in 2008, once again the *tonnara* did not capture any bluefin.

The traditional bluefin tuna trap fishery in Sicily, *la tonnara*, has collapsed. What exists today is merely a shadow of its sustainable past. Gone with it are the sources of work and cultural life. Villages that once based their livelihoods around fishing and, in particular the *tonnara*, are today mostly tourist attractions. Young people no longer consider work in this sector, but often hope to find government jobs or work in the tourist industry. Others seriously consider leaving Sicily altogether, as they watch relations and friends leave. Today, traditional *tonnara* sites, boats and equipment are often found crumbling in decay, or, on the rare occasion, a site is transformed into a quaint hotel for wealthy guests. How can a sustainable fishery that was a crucial part of a culture and economy for centuries, if not millennia, collapse? In the next chapter, I will discuss the modern bluefin tuna fishery in Sicily and the greater Mediterranean. This discussion will explore and detail the changing nature of production in the middle to late twentieth century, from a traditional fishery into an industrial fishery.

CHAPTER V

THE INDUSTRIALIZATION OF THE MEDITERRANEAN BLUEFIN TUNA FISHERY

Introduction

As the previous chapters discussed, the bluefin tuna fishery has been a vital resource for the Mediterranean region dating back at least to antiquity and likely beyond. As a principal breeding ground for bluefin, this area continues to be a crucial habitat and abundant producer of this species. However, there has been a massive transformation of this fishery within the past half-century. Traditional fishing and its technology have been replaced by modern methods. These technological transformations did not occur in isolation, but alongside major social and ecological transformations. This chapter will examine the modern bluefin tuna fishery in the Mediterranean and specifically in Sicily. In doing so, it will offer a necessary discussion on the new processes of production and provide a historical view of the changing nature of this famous fishery that has been celebrated by Mediterranean societies throughout history.

Industrialization of Global Fish Production and Expansion of Consumption

During the twentieth century, and particularly in the post World War II era, food production in many parts of the industrialized world began to take on the characteristics of the modern factory. Producing food became an industrialized process that generated mass commodities for a growing global market. In agriculture, the mass production of food and fiber became possible with the widespread use of synthetic fertilizers and pesticides, the development of new hybrid plant varieties, increasing application of mechanization of production, and the expansion of irrigation, resulting in an era known as the "green revolution."

Mirroring the industrialization of agriculture, the fishing industry adopted capital and hi-technology intensive methods in order to increase catch capacity and exports (Garcia and Newton 1997; Jackson et al. 2001; Montaigne 2007; Pauly 2004; Safina 1998). Fishing has developed into a rationalized[67] system of food production, which is characterized by mechanization, the application of science and technology, increasing productivity with a focus on efficiency of production, high levels of capital investment, large-scale production, high division of labor and specialization of production. With the expansion of shipping and transport technologies, marine products increasingly became heavily traded global commodities. Thus, this process provides global populations, typically in the developed world, with better access to a variety of marine food resources at any time of year; consumption of marine resources has increased dramatically over the last few decades (UN FAO 2007; World Bank 2006a).

Between 1950 and the late 1980s, the exploitation of global marine resources expanded exponentially, from a total of about 20 million tons per year to over 80 million

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[67] Rationalization is used in the Weberian sense of the term or what is commonly referred to as instrumental rationality.

tons per year (UN FAO 2007). With the growing affluence of wealthy consumers from core nations, fish production and consumption expanded in a variety of traditional as well as non-traditional markets. Literature on this matter largely points to demographic changes, in particular population growth, and consumption trends and patterns during this period as a chief drivers of increasing fish consumption (UN FAO 2007; World Bank 2004). However, it is important to note that during the 1950s and 1960s and again since the start of the twenty-first century, fish production increased so quickly that it outpaced population growth[68] (Pauly et al. 2002; UN FAO 2007). Also, global consumption of fish grew from nine kilograms per capita in 1961 to almost seventeen kilograms per capita in 2003 (UN FAO 2007). Most of the expansion in fish consumption occurred in developed nations that have the lowest levels of population growth in the post World War II era. For example, in industrialized nations, between 1961 and 2003 fish consumption grew faster than population growth (UN FAO 2007; World Bank 2006b).

To fuel the expanding demand for marine products, global fishing efforts have intensified greatly. More capital investments were made into improving and increasing capture technology. Larger and more heavily capitalized fishing fleets began to roam the world in search for abundant fish stocks. With advanced location technology, increased size and speed of boats, and better overall capture apparatus, many ocean species have

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[68] During the twenty-first century this growth in production is mostly due to the mass expansion of aquaculture.

been exploited to levels never seen before and beyond sustainable limits (Myers and Worm 2003; Pauly 2004).

Expansion of the Bluefin Market

The Mediterranean fishery for ABFT has been widely exploited in recent years to provide fresh, frozen, and processed tuna for core nations, particularly Japan, followed by Europe and the United States. The expansion of production and industrialization of the bluefin tuna fishery in the Mediterranean is a relatively recent phenomenon. This process was in large part set off by the growth of global markets for fresh bluefin tuna, almost entirely for the large sushi and sashimi market in the developed world. As the primary market for bluefin tuna, Japan has been the driving force behind this expanding market.

After the horrific destruction that occurred during World War II, Japan's economy was reconstructed with the aid of the Allied powers. By the 1950s, Japan's economy was growing at an impressive rate of ten percent per year (Brooks 2008). The rapidly expanding economy propelled Japan back into a leadership position in the global capitalist economic hierarchy. In the 1970s and 1980s, Japan became a world leader in producing and exporting many hi-tech consumer goods, such as electronics and automobiles. As a result, Japan played a major role in the expanding global economy of the post World War II era and driving global demand in commodities that have become highly desirable to wealthy consumers.

Marine products have been a long-time staple in traditional Japan cuisine. As a nation of North Pacific islands, fish provided a great deal of calories and protein for a population with relatively little arable land. Japan's appetite for fish is enormous, a large percentage of which is imported. In 2001, Japan imported 3.8 billion kilos of fresh, frozen, processed, and live marine products (Bestor 2004). This total was more than fifty percent of the 6.1 billion kilos of domestic production[69]. Total imports were valued at $14 billion in 2001 led by shrimp ($2.5 billion) and tuna ($1.8 billion) (Bestor 2004).

The Japanese market far exceeds any other market in terms of consumption and imports of bluefin tuna. In 2005, Japan imported fifty-five percent of the entire global imports in ABFT. Together with Spain, France, United States, and Italy the imports of ABFT made up almost ninety-five percent of the global market. In terms of dollar values, Japan's imports made up almost seventy-five percent of the total value of global imports of bluefin tuna (Di Trapani 2007). This difference between quantity and value of Japanese imports is an indicator of the high value and "quality" of bluefin tuna that is imported to Japan, as well as the strength of the Japanese market.

The principle market for ABFT is the Japanese sushi and sashimi market. With the growth of the Japanese economy, the demand for bluefin in the form of sashimi and sushi increased dramatically and enormous price escalation followed this swelling demand (Safina 1998; WWF 2002). Specific cuts of bluefin are highly prized and sold in a variety of forms. In Japan, the fatty belly, sold as *toro*, became a delicacy that began to command the highest prices (Bestor 2004). Bluefin tuna is likely the most valuable fish on the international market. Wholesale prices for the highest quality tuna have reached

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[69] Domestic production includes Japanese distant water fishing, not merely vessels in Japanese waters.

several hundred dollars per kilo and entire bluefins regularly sell for $20,000 to $30,000 on the Japanese Tsukiji market (Miyake et al. 2003). In 2001, a single bluefin sold for more than $170,000 and market prices have reached historic highs of $900 a kilo (Bestor 2004; Ellis 2008b; Miyake et al. 2003). At Tsukiji's first auction of 2009, a 128 kg bluefin was auctioned for $105,000, or $820 per kg (Wright 2009). These are relatively rare occurrences. Nevertheless, these examples display the incredible global demand and transformation of an item that once sold for five to ten cents a pound in the United States market (Ellis 2008a; Gaski 1993; Issenberg 2007).

Although, Japanese have consumed sushi for centuries, the earliest forms of this item were salted and fermented fish with rice. In fact, our common modern notion of sushi and sashimi (raw fish with or without rice) is a relatively new culinary concept that emerges with the access to modern refrigeration technology. The Japanese began consuming sushi rolls at the turn of the 20th century, and raw sushi as we commonly know it, only developed in the post war period (Ellis 2008b; Issenberg 2007). Eating *toro,* the fatty belly of bluefin, as sashimi only emerged in Japan in the 1960s (Ellis 2008a). Thus, along with changes in technology and a growing economy and expanding global trade, came changes in culinary practices and consumer tastes. Traditional cuts of preserved or fermented tuna, gave way to new patterns in production, distribution and consumption. Later, in the 1970s and 1980s, modern sushi/sashimi was transformed from a local "traditional" cuisine into the latest cultural status symbol to represent a new wealthy cosmopolitan class in Japan, and later the world (Issenberg 2007).

Bluefin Tuna: From Cat Food to High Class Cuisine

Before the current boom in demand for bluefin tuna, Atlantic bluefin was a species that was of little interest to most fishing operations. Atlantic bluefin tuna had a low market value and was minimally exploited, particularly in comparison to other tuna species. In the West Atlantic, bluefin tuna were hunted mostly for sport, as their large size and great strength and speed offered a considerable challenge to recreational fisherman (Whynott 1995). Most commercial fishing operations regarded bluefin as a nuisance, as tuna are voracious eaters and would frequently consume the commercially viable target prey (Safina 1998). The bluefin had little value in Western consumers and was typically destined for pet food plants. Even in Japan, when bluefin was consumed, fatty parts of the tuna were considered undesirable or even inedible[70]. In fact, the fatty/oily belly, now highly praised, was often given to cats (Issenberg 2007). In the post war period, particularly by the 1970s and 1980s, with a new appreciation for its high fat content, the bluefin's fatty belly, *toro*, began to be considered a high status item in Japan. As a result, bluefin tuna, called *maguro*, was transformed from cat food to fine Japanese cuisine. In a short time, its value on the Japanese market jumped an astonishing 10,000 percent, with similar spikes throughout the world (Issenberg 2007).

In Japan, bluefin tuna, and particularly *toro*, is now the king of sushi/sashimi. While other species are utilized in the production and consumption of sushi and sashimi, bluefin tuna is generally regarded as the highest quality and most desirable species for

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[70] Of course the bluefin consumed in Japan was traditionally Pacific bluefin (*thunnus orientalis*) not Atlantic bluefin (*thunnus thynnus*).

this type of consumption (Bestor 2001). Fueled by the growing prosperity of Japanese consumers, high-end restaurants and elite sushi bars began offering this highly esteemed dish, which is regularly consumed by business elites and upper class consumers.

Within a short time, the growing trend in Japan was transported to other wealthy nations, and in the 1990s sushi was the latest food craze in core nations such as the United States and Europe. Bluefin tuna became the most demanded and expensive tuna species on the world market (Ottolenghi 2008). High demand for this newly acquired taste marked a drastic change in the biology of the bluefin, and the societies that were traditionally tied to this species. With such a high price on its head, fishing effort for bluefin tuna was expanded throughout the world's oceans.

As a result of these trends, including the skyrocketing price of bluefin, there was exponential growth in the size of the bluefin market, particularly the fresh market. By the 1990s, fresh bluefin tuna destined for the sushi and sashimi market surpassed imports of frozen bluefin on the global market (Di Trapani 2007). According to Infofish, a fishing industry technical and trade database, the estimated export market for bluefin tuna in January 2007 was worth about $400 million a year, with the Japanese import market making up about $350 million of this total (Infofish 2007). However, this estimate is low considering that thousands of tons of fish are captured and sold, and go unreported each year[71] (Bregazzi 2005; Volpe 2005; WWF 2008a).

NOAA's Southwest Regional Office reports that between the years 2004 through 2007, Japan imported an average of about 25,700 tons of ABFT each year (NOAA 2008). These imports had a four-year average value of $516 million of ABFT imports (Table 3). The discrepancy between Infofish's and NOAA's estimates may be an indication of illegal, unregulated, and unreported (IUU) captures that are not considered by Infofish. Bregazzi[72] (2006) reports that Japanese imports are likely higher than even the NOAA

	2004	2005	2006	2007
Fresh	9,966	9,882	7395	5114
Frozen	6,624	4,220	5355	6283
Frozen Fillet	8,841	10,466	15542	13451
Total (Tons)	25,431	24,568	28,292	24,848
Millions of Yen	53,175	52,527	64664	63267
Millions of Dollars[73]	492.36	477.52	557.45	536.16

Table 3: Japanese Imports of ABFT in tons and values (2004-2007) (NOAA 2008)

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[71] Another indicator that this estimate is low is that the same organization reports that EU imports make up 47 million Euros a year, which, together with Japan, accounts for the total estimate.

[72] Roberto Mielgo Bregazzi, the director of Advance Tuna Ranching Technologies (ATRT), located in Madrid, Spain, has compiled a great deal of data on bluefin tuna in the Mediterranean using a wide variety of official and industry sources. Due to the high level of IUU activities in the bluefin tuna fishery, precise data is often difficult to come by. His estimates are likely some of the best that are available.

[73] Values were estimated using the annual average exchange rate for the year considered.

data suggests. Thus, the global market for bluefin tuna is actually much bigger than most official sources report.

The values in Table 3 account for Japan's imports of ABFT, but the total global export market value is clearly much higher. What is more, these estimates do not consider domestic production. Japan has a large fleet that makes a significant contribution to the global market total. Thus, while there is no precise estimate, we can safely assume that the value of global trade in bluefin is much greater than $500 million. According to Bregazzi's (2006) estimates, the export value of Mediterranean bluefin alone in the years 2004 and 2005 were approximately 300 to 350 million euros each year (Table 4). Once on the consumer market, the value of bluefin sales is likely in the billions of dollars.

As can be seen in Table 4 and Graph 1, Mediterranean bluefin account for the largest share of the total ABFT market, as well as the market for all species of bluefin at almost $300 million in 2004 and more than $240 million in 2005. As catches of Pacific and Southern bluefin dropped, the Northern bluefin (ABFT) has became the main target species and the Mediterranean has been the principal fishing zone, remaining one of the few zones where bluefin were still relatively abundant (see Graph 1 and Graph 2).

Export Nation	2004		2005	
	Value in Dollars[74]	Tons	Value in Dollars	Tons
Croatia	37,223,934	3762	28,062,605	2569
Cyprus	113,222	1375	11,152,538	674
France	34,031,871	8055	29,990,490	6101
Greece	600,456	3184	290,981	778
Italy	25,309,235	5047	36,417,172	6890
Libya	5,012,289	703	2,499,409	415
Malta	32,840,654	2286	38,657,006	3940
Morocco	2,863,632	415	11,299,554	1057
Spain	103,157,850	10799	21,675,531	7981
Tunisia	12,198,901	1191	20,017,367	1683
Turkey	39,532,015	4045	40,876,170	2935
Total	292,884,059	40863	240,938,822	35023

Table 4: Mediterranean Bluefin Tuna Exports. Estimated Values and Quantity in Tons with Nation of Origin (2004-2005) (Bregazzi 2006).

Transformations in the Global Bluefin Market

Fresh caught bluefin demands a high price on the global fish market, periodically the highest of all fish. At its peak, one slice of high quality sushi could easily sell for fifty dollars or more in prestigious restaurants (Bestor 2001). At the Tsujiki wholesale market, at its highest price, a kilogram of bluefin *toro* could sell for 175 dollars (Ellis 2008b). For the Japanese upper class, there was no substitute for fresh bluefin as a status

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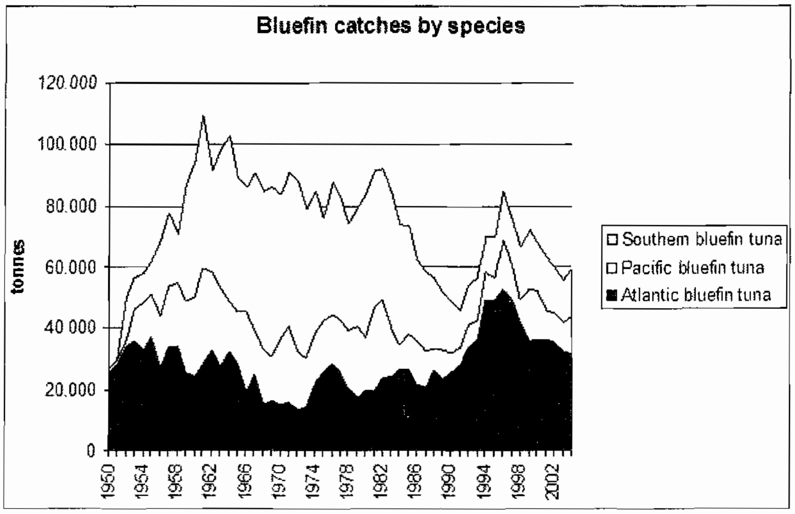
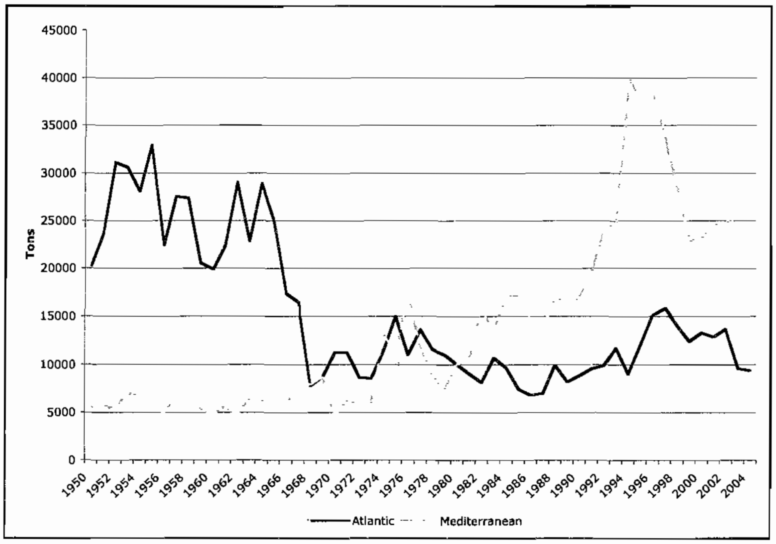
[74] Original values were in euros. Values were estimated using the annual average exchange rate for the year considered.



Graph 1: Bluefin Tuna Captures by Species (1950-2004) (Infofish 2007).



Graph 2: East Atlantic and Mediterranean Bluefin Captures (1950-2004) (ICCAT 2007a)

symbol. However, due to the increasing market demands, locally caught Pacific bluefin (*thunnus orientalis*) were increasingly pressured and overfished in the Pacific Ocean. Consequently, Japanese fishing operations and suppliers had to look elsewhere in order to satisfy and expand this new consumer market.

The growing value of bluefin tuna on the global market brought about a number of important social phenomena that are crucial to understanding the expansion of bluefin tuna catches and the impact on ABFT. First, because of the high price of bluefin, it became viable to transport freshly caught, individual bluefin via airplanes to high value markets. Japan Airlines (JAL) saw fish as an ideal commodity for air travel, and was the first operation to attempt the air transport of bluefin tuna (Issenberg 2007). A bluefin caught off the coast of Maine or Sicily could be delivered to Japanese consumers within twenty-four hours of its capture. For example, in 1991 the United States exported almost $16 million in bluefin tuna to Japan via air alone (Gaski 1993). Even though Pacific bluefin has been the preferred species in Japan, now, as a result of high-speed transport, tuna from distant waters became a luxury food commodity for elite Japanese consumers as well.

Second, new technology in food storage, including cooling and freezing technology, allowed for the conservation of tuna in a way that maintained much of its perceived quality. Methods were developed that preserve freshness of tuna by maintaining constant proper temperatures without freezing. Superior freezing and thawing technologies were advanced that allowed the fast freezing of tuna down to very low temperatures of negative forty-five degrees Celsius (UN FAO 2004). Also, new technologies in production became viable, namely tuna ranching, which created a novel way to add value to bluefin tuna and maintain sushi grade tuna. While frozen bluefin, and some ranched tuna, are not always as highly praised for the quality characteristics that are determined by expert sushi graders, these methods certainly allowed for a medium-quality sushi grade tuna market to expand greatly.

Third, the expansion of the middle-range market spurred a new boom in consumption of bluefin tuna (Tudela and García 2004). The burgeoning Japanese middle class could now occasionally consume this luxury food item that was mostly reserved for the upper class and business elites. Bluefin tuna began to show up on the menus of middle range sushi bars and later "fast food" style conveyer belt sushi bars (Bestor 2001). Together, all of these processes contributed to the expansion of a larger global market. Restaurants from Los Angeles to London to Seoul were offering bluefin tuna sushi and sashimi on their menus and tuna ranches were striving to push into new and growing Asian markets. Bluefin tuna was now a global food commodity for those with a taste for luxury (Issenberg 2007).

Industrialization of the Mediterranean Sea

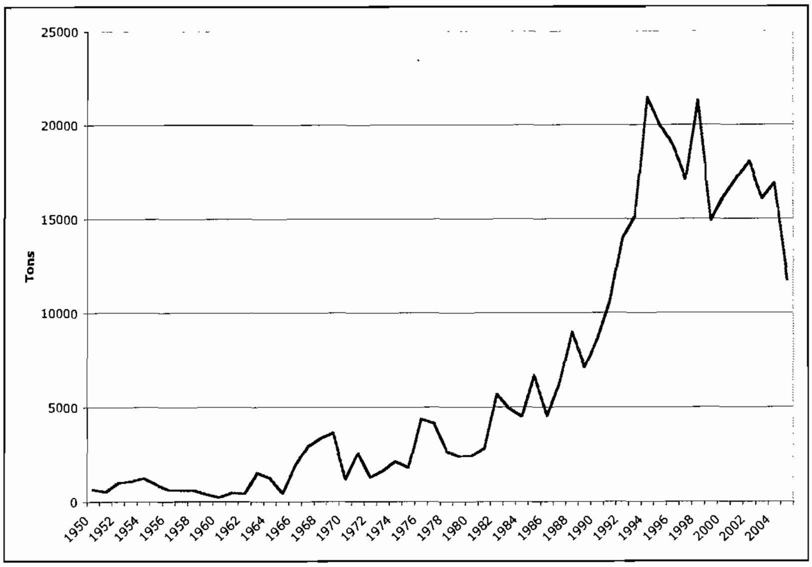
This large global market for bluefin tuna required mass production. Industrialized fishing, already active in most fisheries, became the *modus operandi* within bluefin tuna fisheries. The Mediterranean fishery, one the oldest and most productive bluefin fisheries in the world, became the target of industrial fishing operations in an attempt to capture large quantities of this high-value commodity to feed the expanding market.

Two of the most common methods of industrialized fishing used in tuna fisheries are long-lines and purse-seines. Long-lines are fishing lines baited with hooks ranging from a few miles up to eighty miles in length. These lines contain hundreds or even thousands of baited hooks (Ellis 2003b). Japanese long-lines began steadily fishing in the Mediterranean in 1972 and quickly found an abundant source of bluefin tuna for their market. In that year, long-liners from Japan captured about 70 tons of bluefin in Mediterranean waters. Just two years later they captured 835 tons, an increase of over 1,000 percent. Most of these captures occurred off the coasts of Sicily (Mather et al. 1995). Japanese long-line vessels were banned from the Mediterranean in 1975 by an agreement made between Japan and ICCAT. But this method of capture is still in use by vessels flying flags of convenience (from other nations) as well as in other areas of the North Atlantic fishery. In 2000, over one billion hooks were set throughout the ABFT fishery (Duncan and Woolford 2006). Long-lines do not distinguish between old and young fish, or necessarily specific species of sea life. As a result, they commonly hook species such as sea turtles, marine mammals, and a variety of sea birds (Safina 1998).

Purse seining involves large nets, some of which are large enough to encircle a football stadium. Purse-seine fishing for bluefin in the Mediterranean usually takes place during the spawning period. These nets are deployed into the oceans vertically in a cylinder like fashion, with a float line at the top and a leadline at the bottom, which encircle schools of fish. A purse line runs through purse-rings along the bottom of the nets. Once the tuna have been encircled, the bottom of the seine is drawn closed using the purse line, trapping any sea-life inside the large area surrounded by nets. After the bottom is cinched the nets are lifted out of the ocean with the use of powerful net cranes, hydraulic power-blocks and purse-winches. The large nets filled with bluefin are brought aboard the vessel. Auxiliary vessels such as skiffs or speed-boats, and sometimes helicopters, are also utilized during this process (UN FAO 2008). Purse-seines are also used to capture live "seed" stock for bluefin ranches (Ottolenghi et al. 2004). Under these circumstances, they are not hauled aboard the vessel, but kept alive awaiting transfer.

Along with these large-scale capital-intensive fleets, high technology has been incorporated into fishing for bluefin. New technologies have been used to detect and capture fish stocks moving throughout the ocean and pinpoint their location for fishing vessels. These include innovations such as Doppler radar, spotter planes, bird locating radar, omni-scan sonar, fish aggregating devices (FAD), satellite-derived sea surface temperature information, and radio buoys (Safina 1998; UN FAO 2008). In addition, larger nets, more powerful deck machinery, and generally bigger vessels to transport and store larger catches were implemented, particularly by the 1980s (Safina 1998). Today the capacity of the Mediterranean purse-seine fleet has expanded tremendously, far beyond the regulated capture quota for the region (ATRT 2008b).

The earliest use of purse-seines in the North Atlantic fishery was in Norway in the 1940s. By the 1950s, purse-seines were capturing over 10,000 tons of bluefin in this fishery and by 1972 this North Atlantic fishery collapsed to a capture of only 100 tons (Mather et al. 1995). In the Mediterranean, purse seining became a major method of capture by the 1970s, expanding rapidly thereafter (Graph 3).



Graph 3: Total Mediterranean Purse-seine Captures (1950-2005) (ICCAT 2007c).

Today's Mediterranean purse-seine fleet has begun to focus on speed, due to the interest in live transfer for tuna ranches. Accordingly, fishing operations have increased the speeds of many of their vessels to almost twenty knots (Bregazzi 2005). In effort to create greater efficiency in live capture for ranching, purse-seine fleets have increased investment into a number of areas of the fishing process, including better detection and communication technology, increasing the number of skiffs, employing faster auxiliary vessels, implementing new technology to lift and move skiffs, as well as using larger and faster sinking nets (Bregazzi 2005; WWF 2006). This is done in order to locate, reach, and secure bigger schools of bluefin before competing purse-seines reach the migrating school, as well as reducing the potential for speedy bluefin to escape capture.

This is a highly competitive industry with large investments made into capture technology. The "modernization" of the purse-seine fleet has resulted in increasing investment where the newest boats fitted with the latest technology can cost almost six million dollars[75] (Ottolenghi 2008). The Mediterranean purse-seine (PS) fleet is characterized by

> "high initial and revolving capital investment, stringent amortisation and financial costs, as well as ever-growing operational overheads (fuel, fishing licenses, tuna spotting airplanes, labour, maintenance and repairs, insurances, etc…The entire Mediterranean BFT PS is therefore faced with a minimal yearly BFT catch, necessary to at least cover for expenses and amortisation of such ships….every single one of these fishing units is operated, either as an autonomous business profit-centre or as forming part of a fishing fleet operated [by] the same business parameters" (ATRT 2008b: 87).

As a result, purse-seine operations are under heavy economic pressure to locate and capture bluefin in order to meet operating costs and increase profits, which can be used to stay ahead of the competition through investments in technology and capacity.

The Sicilian Bluefin Tuna Fishery Goes Global

While the Sicilian *tonnare* have a long history of supplying food resources for the Island and even in good years exporting tuna to other areas of in the Mediterranean region (Consolo 1986; La Mantia 1901; Lentini 1986), in the post World War II era this fishery began primarily to serve the global market (Bestor 2001; Dalton 2004; Mather et al. 1995). Today, most of the ABFT caught and raised in this part of the world are destined for the Japanese sushi and sashimi markets (Bestor 2001; 2004; Ellis 2003a) (Graph 4).

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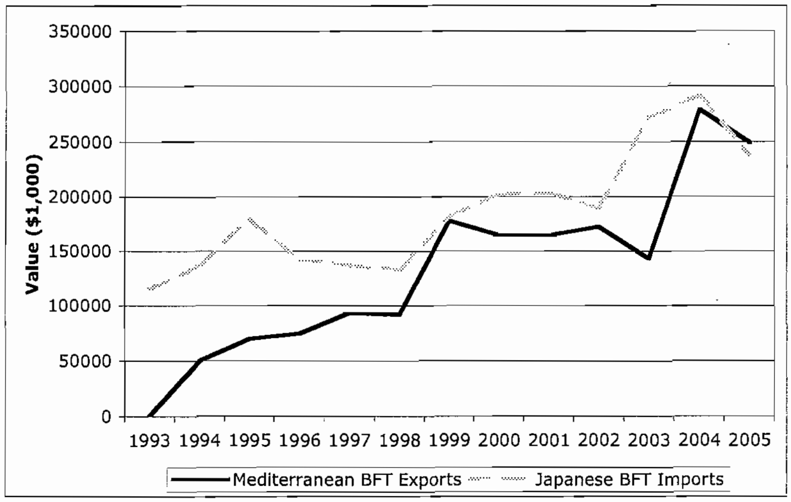
[75] Tudeal and Garcia (2004) point out that a large portion of the "modernization" of the European purse-seine fleet was subsidized by public funds.



Graph 4: Value of Mediterranean Bluefin Tuna Exports and Japanese Imports (1993-2005) (UNFAO 2007)

As the price of tuna on the world market was increasing exponentially, traditional methods in the Mediterranean were being replaced by industrial methods. New technologies in the fishing sector were applied to increase catches and exports. Purse-seine technology became the dominant fishing method in the Mediterranean beginning in the 1970s and 1980s while other modes of harvesting were experiencing decline[76] (Mather et al. 1995; Ottolenghi et al. 2004). The Mediterranean fleet continued growing in size and capacity and advanced technology was implemented to find and capture bluefin tuna, as the Mediterranean became a major source of ABFT for the world market.

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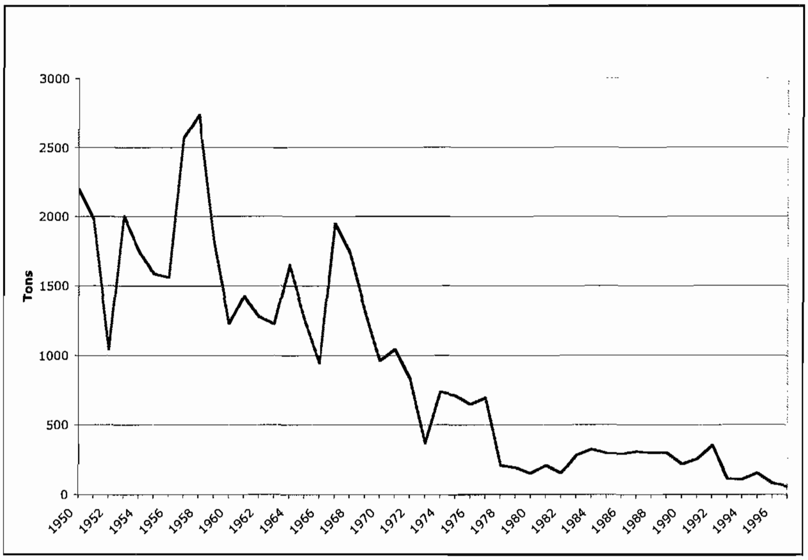
[76] Other capture technology continue to be utilized in this region including, as discussed, trapping, but also harpooning, hand lines, and possibly some drift netting, although this method is banned for tuna fishing.

During this era, the Sicilian trap fishery experienced a collapse in captures (Graph 5). While early in the expansion these traps were a major source of the global bluefin market, they were quickly replaced by an expanded fleet of industrial vessels that were adept at capturing bluefin tuna before they reached traps set close to the coastline. Bluefin were intercepted before or sometimes after they reached their spawning areas. In addition, purse-seines capture large quantities of bluefin, many of which are not spawning age. ABFT are believed to reach spawning age relatively late, after five years of age (Schaeffer 2001). Over time, capturing pre-spawning age fish can have devastating impacts on stocks (Safina 2001).



Graph 5: Sicilian Trap Captures (1950-1997)

Due to the market developments that began in the 1970s, more and more fishing operations were chasing after finite stocks of Mediterranean bluefin. Competition became fierce and the stocks began to show signs of distress. In Sicily, as well as other parts of the Mediterranean, the trap fisheries collapsed one by one. In some of the regions where trap fisheries were located, a new technology replaced the traditional method: bluefin tuna ranching.

Tuna Farming: Bluefin Ranching

In the late twentieth century, global fish consumption expanded with the help of aquaculture production. As global marine captures could not keep pace with the expanding consumer markets found mostly in core nations, industrial aquaculture emerged as the strategic method to augment production (UN FAO 2007). Inspired by the growing market in industrial aquaculture products and its production methods, bluefin tuna "farming" was adopted as a way to expand and control the production of bluefin in the Mediterranean.

Tuna farming, sometimes referred to as "capture-based aquaculture" (Ottolenghi 2008; Ottolenghi et al. 2004) or bluefin tuna ranching, is a form of intensive tuna production that in many ways parallels feedlots used for livestock production on land. Bluefin are captured and placed in feeding cages to rapidly increase weight, and specifically, their fat content until they are ready for slaughter. Unlike conventional industrial aquaculture systems, such as those used in salmon, sea bass, tilapia, etc., there has been little success spawning tuna in controlled environments[77]. The "domestication"

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[77] There have however been some recent breakthroughs in domesticating Pacific bluefin (*thynnus orientalis*) and the completion of the life cycle (Ellis 2008b).

of tuna for commercial mass production has been a process that has thus far eluded the scientists and the industry (Sawada et al. 2005).

As closing the bluefin tuna life cycle in captivity for commercial production has proved problematic, purse-seines capture wild "seed" stocks that are transported to fattening facilities located throughout the world, many of which are in the Mediterranean. As of this writing there are almost seventy registered bluefin tuna ranching facilities throughout the Mediterranean in eleven countries, with a potential capacity of over 63,000 tons[78] (ICCAT 2008). Schools of bluefin have often been located using spotter planes that are contracted to roam the Mediterranean searching for groups of tuna moving through the sea. Just about every fishing firm that exploits the Mediterranean bluefin tuna stocks either owns or charters small planes used for locating tuna (Bregazzi 2005). These spotter planes will relay to purse-seines the bluefin school's specific geographical coordinates and direction. Purse-seines, equipped with geographic positioning systems, move to the location with great speed thanks to larger engines and faster boats, which have been newly "modernized." Recently, spotter planes have been regulated and banned during certain seasons by ICCAT (ICCAT 2007b).

Once at the location, purse-seines capture the schools of bluefin by encircling them with their nets, as described previously. Rather than pull the capture on board, purse-seines that provide tuna ranches hold ABFT in their seine at sea. Once an

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[78] Currently there are tuna ranches in Spain, Italy, Croatia, Malta, Libya, Turkey, Tunisia, Cyprus, Greece, Morocco and, recently, Portugal. In addition, firms have expressed interest in establishing ranches in Lebanon, Syria and Israel (Miyake 2004).

agreement has been made with a ranching operation, a tugboat pulling tuna cages is deployed. In addition, a freezer vessel and other auxiliary vessels will accompany the tugboat. As many of these operations are vertically integrated, often the same organization that owns the ranching operation owns the purse-seine and/or the tugboats. Otherwise, tugs are rented for transport. These tasks are all easily coordinated to carry out this mammoth undertaking. Deals are sometimes made on the high seas in the transfer from purse-seine to ranching operation. This is based on a first come first served basis, thus speed is of essence. Bluefin must be transferred to the cages with the help of scuba divers, who also estimate count and weight sometimes with the help of underwater video photography[79].

Once transferred from purse-seine nets to sea cages, the cages are transported across the sea to the location of the ranching facility. Tugboats and accompanying vessels move at the careful pace of on average about one to one-and-a-half knots so as to avoid harming the valuable cargo. This transport can take many days, weeks or even more than a month. As more and more captures are occurring in the Eastern Mediterranean, a tug pulling cages to Sicily, for example, will often require from thirty to forty days to arrive at its location. All the while, the bluefin are carefully observed to assure their safe arrival, since stressful conditions can prove fatal to the bluefin. Bluefin tuna that perish during transport are retrieved by scuba divers and processed on board

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[79] As will be discussed later, this process is one of the major holes in the regulation of bluefin captures in the Mediterranean. While it has been regulated that close records are to be kept on captures and transfers, it is extremely unlikely that accurate biometric information is gathered at this time in the capture process (Ottolenghi 2008).

accompanying freezer vessels. In addition, large bluefin that appear to have high potential for market may be captured. If it is determined that they are of high quality, they may be transported to market quickly via air.

After the bluefin reach the ranch facility, the cages are moored and the operation begins feeding. Cages normally measure in diameter between thirty to fifty meters and range in depth according to the site; sites can have anywhere from three cages to nine or more (Ottolenghi 2008). In the wild, bluefin tuna are opportunistic feeders preying on an array of small and large species. However, in captivity, bluefins are fed a diet of frozen fish selected for the high oil or fat content to produce bluefin that meet the quality demands of the relatively new sushi and sashimi markets. The feed is usually made up of some combination of herring, sardines, mackerels, anchovies, and squid. These feed fish are sometimes procured locally, but the majority is imported from outside the region, including from the Americas (Ottolenghi 2008).

Large quantities of frozen feed fish are defrosted and distributed to the tuna daily during multiple feedings. Starting slowly so that the wild tuna will become accustomed to consuming dead prey, the ranches attempt to increase the quantity of feed to levels that approach seven to ten percent of the tuna's weight, with an average of five to six percent per day. A bluefin tuna ranch with a capacity of 1,000 tons consumes an average of fifty to sixty tons of feed fish per day. ABFT are kept in ranches from anywhere from four months and up to two years.

Most ranches prefer to keep the bluefin for shorter periods, as this is usually the most profitable approach. Thus, ABFT are captured in May and June and shipped to the ranch location and fattened until October, or as late as December. After this period, tuna begin to reduce their food consumption, thus slow down weight gain, and more specifically, reduce fat content. As the process is essentially done to add value to the bluefin, the bluefin's feeding behavior is carefully monitored. Bluefin generally reduce feeding in the winter months and therefore do not add sufficient weight to justify the costs of keeping them in cages. The winter weather also adds other risky elements, such as the potential for die offs and damage to cages that can result in escapes[80]. Thus, it often no longer remians cost effective for ranches to keep tuna for longer than six months. Finally, this period corresponds with the period of high market demand in Japan during the New Year holiday festivities, which usually brings the highest price for bluefin for the year.

Tuna may be harvested throughout the season, depending on the market price, demand, and quality. Scuba divers using underwater rifles may capture individual bluefin, and if it meets quality expectations, quickly transport them via air. The majority of ABFT are harvested at the end of the season in a process that resembles the *mattanza*[81], but has some distinctive features. When fully harvested, ABFT are corralled by scuba divers into a smaller pen where they are forced up to the surface. Once on the surface,

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[80] On Christmas Day 2003, thousands of tuna escaped from the tuna ranching cages owned by New Eurofish s.r.l. in Castellammare del Golfo, Sicily. ABFT that are kept in cages and fattened lose their orientation and upon escape tend to beach themselves. Thus, on this day the *spiaggia* (beach) in Castellammare was covered in fattened bluefin tuna.

[81] In fact, ranchers call the process of harvesting tuna in these ranches a "*mattanza*" after the method developed by the traditional trap fishery.

staff members armed with rifles shoot each of the large tuna, aiming for their heads[82]. Divers kill smaller tuna by entering the nets and individually driving a small spike into their brains. In this process, ranchers try to limit the amount of stress that the bluefin experience. This is important to these firms as stress produces lactic acid that can affect the color and firmness of the bluefin's meat, qualities that are examined by professional sushi graders, and will lower the market value of the tuna.

As soon as all bluefin have been harvested, hydraulic winches are employed to bring them onboard processing vessels owned and operated by Japanese traders who purchase the fresh tuna. Here tuna will be cleaned, bled, gutted, beheaded (using chain saws), tails removed, sliced into filets and cooled or frozen, all on board the vessel. In Sicily, all of this tuna is destined for foreign markets, usually to Japan.

This technology was first employed in Canada in the 1960s by a Japanese firm. The objective was to take lean, post-spawning bluefins and transform them into fatty valuable commodities. Lean tuna fetches a lower price on the Japanese market, and thus fattening for the growing sushi/sashimi market could add value to the price of the captured fish. In addition, capturing and fattening allowed the firm to release the tuna on the market when most lucrative. When bluefin are captured and hauled aboard, they must be sold or frozen immediately. Naturally, frozen ABFT returns a lower value. In the 1970s, this technology was first employed in the Mediterranean for in Ceuta, Spain.

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[82] Shooting bluefin in the head is done for two principle reasons. One is to kill them quickly, and the other, related objective, is to avoid damaging their precious meat.

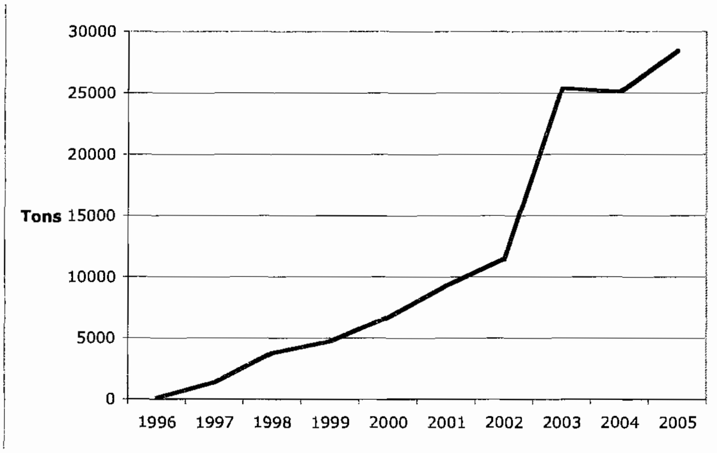
Again, this ranch captured and fattened "lean" post-spawning tuna, as a way to increase added value (Miyake et al. 2003).

Soon new technology in tuna ranching was developed in Australia. These were no longer the lean tuna returning from spawning but the spawning fish themselves that were to be further fattened. These novel and more "efficient" methods of fattening were brought to the Mediterranean region with the establishment in 1996 of tuna ranches off the coasts of Croatia and Murcia, Spain (Miyake et al. 2003). As the price of tuna skyrocketed, the tremendous profit potential of this method of production made it an attractive venture for those in the Mediterranean fishing industry. Additionally, bluefin from the Mediterranean was highly valued on the Japanese market (Tudela and García 2004). As a result, beginning in the mid 1990s, ranching in the Mediterranean Sea expanded quickly.

The first bluefin fed in cages in Sicily occurred in 1978 in Scopello, the same location in which a traditional *tonnara* was active. However, this endeavor was done for "research purposes," not for market production (Sarà 1998). In 1999, 100 tuna were "farmed" in Sicily, and in 2001 the first government concession was granted to a commercial Sicilian tuna ranch (Crociata 2007).

The global supply of bluefin tuna produced using this method reached over 20,000 tons by the year 2000, about half of which came from the Mediterranean. Within the next four years, from 2000 through 2004, tuna ranching production in the Mediterranean would triple (Graph 6). This growth has continued into the present and today's capacity in the Mediterranean has doubled again since 2005, and is currently over

63,000 tons[83]. Furthermore, up to eighty percent of Mediterranean exports of bluefin tuna to Japan originate from tuna ranches (Ottolenghi et al. 2004; Tudela and García 2004). As a result, tuna ranches have become the main supplier of ABFT for the global market.



Graph 6: Mediterranean Tuna Ranch Production (1996-2005) (Bregazzi 2005; Miyake et al. 2003).

Bluefin Tuna Ranches and Global Capital

Tuna ranching firms are vertically integrated joint ventures dominated by Japanese, Spanish, Korean, and French trans-national corporations (TNC), including companies such as Mitsubishi, Maruha, Mitsui, Takayama, Torei-Toyo Reizo, Kali, Fuentes Group and Sons, Sud-Marèe, Intermarchè, and Hijos de Albaladejo. The leading players in the Mediterranean are the Japanese firms Mitsui and Co. Ltd. and Mitsubishi

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[83] As will be noted later, this increase in capacity has been occurring at the same time that ICCAT has been decreasing the total allowable catch in the Mediterranean to numbers that are a third of the ranching capacity in the region (WWF 2008a).

Corporation and the Spanish firm Ricardo Fuentes e Hijos S.A. The Japanese firms are giant trans-national corporations that have operations in a number of sectors. The Spanish firm is the largest producer, processor and distributor of tuna products in the Mediterranean.

To give an idea of the size and scope of these firms, in the fiscal year 2006-2007 Mitsubishi earned nearly $10 billion in gross profits (Mitsubishi Corporation 2007b). This TNC has operations in agricultural products, food and beverages, textiles, construction materials, metals, machinery, energy, chemicals (petrochemicals, fertilizers, plastics), software, telecommunications, and consumer electronics, among others (Mitsubishi Corporation 2007a). Mitsui's gross profits in the same period were more than $7.5 billion, with production in food and retail, mining, petrochemicals, shipbuilding, construction, aerospace engineering, chemicals, and iron and steel production to name a few (Mitsui and Company Ltd. 2007)[84]. Interestingly, both of these TNCs also produce military weaponry. Therefore, the same companies that bring global consumers fresh tuna are also bringing them the Ball Defense AH-1Z Viper attack helicopter and the Mitsubishi F-2 fighter plane. Besides the unusual juxtaposition of these commodities under one corporate umbrella, this demonstrates the very large size of these firms, the great amounts of capital and technology available to them, as well as

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[84] Values of profits were determined using an exchange rate of 118 yen equal to one U.S. dollar. This exchange rate is an annual average based on the monthly rate for the year 2007. The original values are ¥1,148.1 billion for Mitsubishi, and ¥903 billion for Mitsui.

their ability to expand their scope of operation as far as necessary to produce and expand profits.

The Japanese TNCs are often the major financers of tuna ranching operations in the Mediterranean. These are truly trans-national operations. Commonly, the Japanese firms work together with others who have expertise in the logistics of tuna ranching, such as the Spanish firm Fuentes Group. This firm was founded in the 1960s as a seafood purchaser, processor and distributor. Today it specializes in fresh and frozen bluefin tuna production and distribution, but also produce and distribute other tuna (such as skipjack, yellow fin and big eye) as well as other species such as sea bass, swordfish, and sardines. However, the firm emphasizes that bluefin tuna is the "star" product (Fuentes Group 2007). The Group is made up of over 25 companies working within the seafood industry, including bluefin tuna "aquaculture," sea bass and sea bream aquaculture, salting and processing, extractive fishing, storage and freezing, sales and distribution and transport (Fuentes Group 2007). Their vertically integrated structure allows them play a role in a number of tuna ranching operations throughout the Mediterranean Sea.

In the 1980s, the Fuentes Group began to collaborate with large Japanese multinationals including Mitsui, Mitsubishi, and the next biggest Japanese firm in the sector, Maruha, and initiated its bluefin export business to Japan. In 1996, they established joint venture operations with these major corporations to, according to their web site, "increase efficiency of bluefin production and export" (Fuentes Group 2007). That is, they began to develop tuna ranches in the Mediterranean with the help of Japanese capital. Some examples of these tuna ranching operations include: Viveratùn

Cartagena S.A. (with Maruha Corporation and Tafco) their first ranch in Europe, established in 1996 off the southern coast of Spain; Tuna Graso S.A., off the coast of Cartegena (with Mitsui & Company Ltd., Kanetomo Compnay. Ltd.); Atunes de Levante S.A. (with Mitsubishi Corporation), also off the southern coast of Spain.

Fuentes' bluefin tuna ranching operations are located throughout the Mediterranean, including Sicily, and their latest ventures include ranches in Libyan and Tunisian waters. Bluefin tuna ranching and fishing in Libya offers a great potential for growth in this industry as there is little oversight of operations, and little to no regulatory pressure from the Libyan government, which has developed close ties to the ranching industry. Fuentes Group has created a partnership with the wealthy Libyan financier Seif al-Islam, the son of Libya's leader Muammar Gaddafi, as well as Tunisian President Ben Ali's brother-in-law, Maroud Trabelsi, who have been key in creating an exclusive Libyan and Tunisian fishing zone (Bregazzi 2005). This strategic move has also given Fuentes Group access to Libyan and Tunisian waters for bluefin capture. Utilizing purse-seines through Fuentes' relationship with the French firm Avallone, captures are made against Libya's capture quotas (Bregazzi 2005) [85].

As demonstrated here, tuna ranching in the Mediterranean Sea is a major industry that has the potential to be very lucrative for large trans-national firms. This is not a venture for small or medium-scale operations. Large amounts of capital must be available to drive this truly global industry. Start-up costs are very high and the risks of losses are great. Thus, as one industry executive communicated to me, it is necessary to

[85] That is, if the captures are recorded at all (Bregazzi 2005).

have enough capital available to absorb potential losses, particularly early on in the venture.

Tuna Ranching in Sicily

Ranching technology has recently become an important part of the Sicilian fishery. According to Italian government documents, Italy has ten facilities that have been given concessions to practice tuna "fattening." In Sicily, there are four facilities that have such concessions, but only two are currently operational. The other concessions are located on the Italian mainland (Table 5).

National Registration Number	Operator Name	Operator Location	Capacity
ITA-FAR016	Ittica Offshore del Tirreno S.p.a.	Pozzuoili (NA)	300
ITA-FAR017	De.Mo. Pesca di Pasquale della Monica & C. s.a.s.	Cetara (SA)	600
ITA-FAR015	La Favorita snc	Ercolano (NA)	500
ITA-FAR008	(1) Jonica Pesca s.r.l; (2) New Paganpesca s.r.l.; (3) Tuna Farms of Mediterraneo s.l.	Corigliano Calabro (CS)	2000
ITA-FAR009	Procida Tuna Farm s.r.l.	Procida (NA)	300
ITA-FAR007*	Soc. Ittica Trappeto a.r.l.	Trappeto (PA)	600
ITA-FAR011	Iorio Gennaro	Acquappesa (CS)	600
ITA-FAR013	IORIOMAR s.r.l.	Cetraro (CS)	500
ITA-FAR014	Akua Italia srl	Procida (NA)	800
ITA-FAR001*	New Eurofish s.r.l.	Castellammare del Golfo (TP)	1500
ITA-FAR002	Ora Ora Maricultura s.r.l.	Ex Sir - Lamezia Terme	800
ITA-FAR003	Soc. Coop. Pescatori S. Francesco di Paola	Bivona (VV)	800
ITA-FAR004*	Tuna Fish s.r.l.	S. NICOLA (PA)	700
ITA-FAR005*	Pescazzurra s.r.l.	Milazzo (ME)	1500

Table 5: Tuna Ranch Concession in Italy (2007-2008). An asterisk (*) indicates Sicilian concession (De Castro 2007; ICCAT 2008).

In Northwest Sicily, one such operation was developed in the Gulf of Castellammare, near the site of an obsolete *tonnara*. Like many of these facilities, New Eurofish s.r.l. in Castellammare provides ABFT for the global market and is owned by the Fuentes Group of Spain and Mitsui of Japan, together with a local firm. This was the first bluefin ranching facility developed in Italy in 2001. Currently New Eurofish operates about six cages of fifty meters in diameter with a capacity of about 1,200 to 1,500 tons of tuna fattened during the bluefin season. This operation begins capturing in late May to early June and transports the bluefin to the facility to begin feeding. ABFT normally reach New Eurofish's ranch in late June, where they are fattened for four to six months. Recently, most of the bluefin caught for this ranch have been captured in Libyan waters or off the coast of Malta.

In addition to New Eurofish, there are two other tuna ranching facilities in Sicily. Pesca Azzura s.r.l. is located near Millazzo (Messina) in Northeast Sicily. This facility has been given a concession to operate ten cages and has, according to ICCAT (2008), a capacity of roughly 1,500 tons. A consultant for Pesca Azzura stated that the capacity is closer to 1,000 tons, and that the facility has only produced about 500 tons in recent years. This firm began as a joint venture with Ricardo Fuentes e Hijos as well, but, according to the same consultant, they no longer maintain this partnership.

In the southeast Tuna Fish S.p.A, a joint venture exists between an Italian company Coalma S.p.A. based in Palermo, Sicily and Ricardo Fuentes e Hijos, and likely one of the major Japanese firms. This tuna ranch is located near the small community of

Pozzallo (RG) with a capacity of 700 tons. Tuna Fish S.p.A. stopped operations due to technical problems. According to employees of this firm, the ranch was only in operation for one year and experienced great financial losses caused by environmental conditions that were not ideal for tuna ranching. It is unknown whether they will resume operations in the future, but according to the Director of Commercial Affairs, it is unlikely that they will restart this venture in this capacity because of the huge risks involved with re-entering the market again at this time.

The Sociata Ittica Trappeto a.r.l. has been given a concession to operate tuna ranches as well, according to Italian government documents. However, as of yet, this firm has not established tuna cages in Sicily. This firm operates aquaculture facilities in Trappeto, in the Gulf of Castellammare, where they raise sea bass, sea bream, and John Dory.

Aquaculture or Ranching?

The bluefin tuna fishery in the Mediterranean has been subsidized by public funds in order to "modernize" the fishery. The ranching industry has been a major actor in this fishery for the last decade and has therefore been a major beneficiary of the policy. Through the Financial Instrument for Fishing Guidance (FIFG), the European Union (EU) has funneled funds to this industry under the banner of expanding aquaculture and all that this implies for expanding food production and economic activity (Tudela and García 2004).

There is great controversy surrounding the subsidies granted by the EU to ranching operations. At the heart of the issue is the question of whether the designation of tuna farming/ranching as "aquaculture" is appropriate. Coming from wild stocks, bluefin tuna produced in this manner bear little resemblance to most fish, mollusk, or crustacean aquaculture operations. Nevertheless, tuna ranches have been granted millions of euros in grants in order to promote "aquaculture" in the EU in the name of producing more food for growing global consumers. It has been estimated that over twenty million euros have been dispersed to the tuna farming/ranching industry between the years 1997-2004 (WWF 2007). Tudela and Garcìa (2004) claim that some ranches in Europe have received public funding from national and regional administrations, which has covered up to seventy-five percent of the start-up costs.

According to the European Commision's Common Fisheries Policy (CFP), aquaculture is defined as

> "the rearing or culture of aquatic organisms using techniques designed to increase the production of the organisms in question beyond the natural capacity of the environment; the organisms remain the property of a natural or legal person throughout the rearing or culture stage, up to and including harvesting" (Commission of the European Communities 2002: 3)

This definition is very similar to that of the UN FAO's which states that "aquaculture" is "farming of aquatic organisms" which, they imply, enhances production and private ownership (UN FAO 1997). According to these criteria, tuna ranching fits loosely into this category.

However, typically aquaculture is considered the rearing of fish through the organism's entire life-cycle. The common use of the term implies that fish are bred and raised from the egg to capture. The employment of this loose definition allows tuna ranching to fall under the subsidies available to aquaculture. In fact, advocates of tuna ranching have made similar claims as those in the industrial aquaculture sector that tuna ranching will help to feed the world's growing population. However, since ABFT are not bred, or "domesticated" under controlled conditions, this process of production yields no real increase in potential food sources.

Bluefin Ranching and Environmental Concerns

Tuna farming/ranching has come under a great deal of scrutiny from environmentalist and environmental organizations, particularly in Europe. This has been mainly due to the increasing fishing pressure that has been put on the Atlantic bluefin since the emergence of tuna ranches in the Mediterranean. It has been argued that this method of production is directly responsible for the increases in capacity of purse-seines in the region (ATRT 2008b; ICCAT 2007c; WWF 2007). There is little doubt that ABFT are under mounting pressure and that this has become a serious concern for the future viability of the stocks. As is clear from data presented by ICCAT (2007a) as well as other research groups (ATRT 2006; 2008b), purse-seine captures, most of which are destined for ranching facilities, have clearly been on the rise. As stated, a major avenue for exploiting Mediterranean stocks has been the growing global sushi and sashimi market that, in recent years, has been related to bluefin tuna, which are high in fat content and the specialization of tuna ranches.

Tuna ranching has also been associated with a number of other environmental concerns, including the accumulation and concentration of unconsumed feed and waste resulting from intensive feeding operations, increasing pressure on feed species in other fisheries, and inefficient use of energy resources. In addition, health organizations are recommending that individuals, particularly pregnant women and children, limit their intake of tuna due to high levels of mercury (Burros 2008). It is not known whether tuna ranches intensify this problem. However, if the results from industrial aquaculture of other species, such as salmon, are any clue, the indications do not portend well (Naylor et al. 1998; Naylor et al. 2000). A more detailed discussion of environmental concerns regarding industrialized ABFT fishing and ranching will be taken up in Chapter VI.

ICCAT: Management of the Mediterranean Fishery

Undeniably, rational management of the Mediterranean fishery is vital if the bluefin stocks are to remain abundant and also provide a marine food source to communities and society as a whole. However, the management regime in this region has had little success in addressing the problems in this fishery thus far. In the Mediterranean, the bluefin fishery is regulated by the International Commission for Conservation of Atlantic Tuna (ICCAT). ICCAT is considered a Regional Fisheries Body (RFB) and manages the fisheries for a variety of species of tuna and billfish, which include swordfish and marlin, in the North Atlantic and it adjacent seas such as the Mediterranean (ICCAT 2007a) (Figure 12). There are a variety of RFB that manage the global tuna species called Tuna Regional Fishery Management Organizations, including the Indian Ocean Tuna Commission (IOTC), the Inter-American Tropical Tuna Commission (IATTC), Western and Central Pacific Fisheries Commission (WCPFC) and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT).

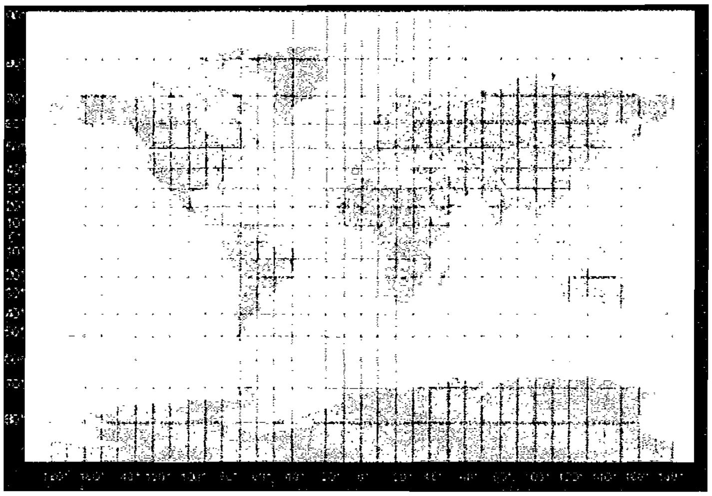


Figure 12: Map of Area Under ICCAT's Management (ICCAT 2007a)

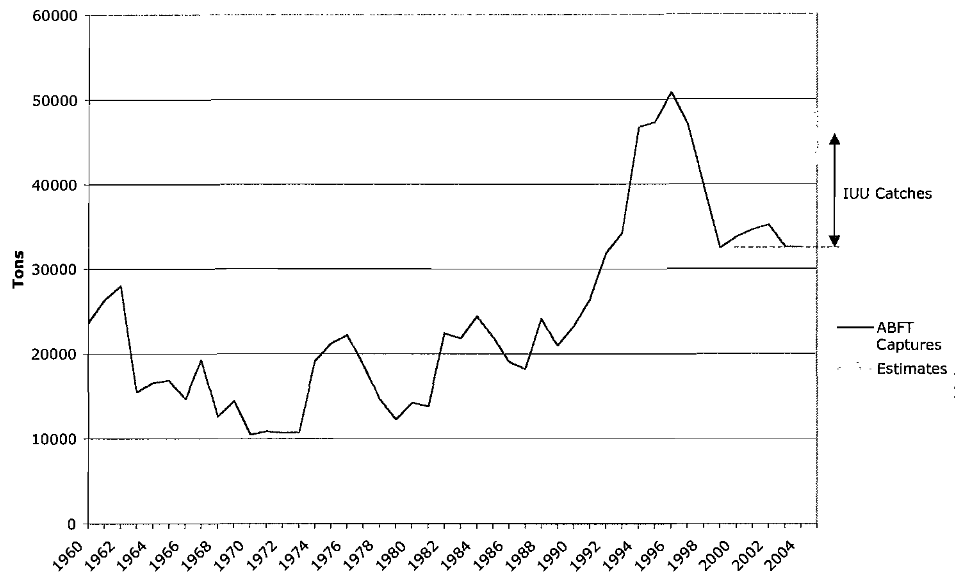
ICCAT is an inter-governmental organization that was founded in the 1960s after the collapse of bluefin stocks off the coast of Brazil and in the North Sea. In 1966, seventeen nations came together and signed an International Convention for the Conservation of Atlantic Tuna, in order to begin to address the concerns related to increased fishing pressure in an attempt to manage the stocks in this region. This was the precursor to the Commission (ICCAT), which today is made up of forty-five member nations, including North Atlantic and Mediterranean rim nations as well as Japan, a nation particularly relevant to ABFT fishing, as well as other nations who are associated with this fishery. ICCAT compiles statistics and, through the Standing Committee on Research and Statistics (SCRS), analyzes and publishes research on the health of the fishery as well as makes scientific recommendations to the member nations on how to best manage the fishery.

ICCAT manages the Mediterranean bluefin fishery by determining the maximum sustainable yield (MSY) and allocating a quota or a total allowable catch (TAC) in tons to each member nation. Member nations are expected to enforce their own TACs. This is done mainly by allocating a quota for the fishing season to each vessel in a nation's fleet. Fishing vessels must keep accurate records and report their captures, and once the boat's quota is reached it must cease capturing bluefin for the rest of the year. Minimum capture size and weight are determined by ICCAT and fishing operations are prohibited from capturing tuna below the minimums. For 2008, these minimums where increased from ten kilograms to thirty kilograms (ICCAT 2007b). In addition, ICCAT manages the fishery by closing the bluefin fishing to specific gear technology during selected periods, and establishes rules for the use of other technology such as the use of spotter planes (ICCAT 2007b).

There has been a great deal of controversy surrounding ICCAT's management of the ABFT fishery. One of the major concerns is the high degree of illegal, unregulated, and unreported (IUU) catches. Captures have regularly exceeded the legal allowable catch. While ICCAT has been collecting and compiling statistics, it has become widely accepted that these statistics are unreliable due to the IUU catches (ATRT 2006; Bregazzi 2005; ICCAT 2007c). Enforcement of catch quotas has been flimsy at best, and false accounting has plagued the records of captures and sales. As a result, on paper, nations and fishing enterprises meet ICCAT quotas, but catches are actually much higher than those reported (ICCAT 2007b).

There is consensus among fisheries scientists that Mediterranean bluefin tuna stocks are on the decline and that, on its current path, this reduction in stocks will eventually lead to a collapse of this fishery. However, the current state of the stock is to some degree debatable, due to the poor data available. That is, following the current trajectory, when a collapse will occur is debatable. With inaccurate data, it is difficult to accurately predict the long-term viability of the fishery. As discussed, the increasing IUU captures have created a situation where there is little certainty and a great deal of concern. Nevertheless, as described in previous chapters, the effects of the stock depletion are already observable in traditional trap fisheries in Sicily, as well as other locations in the Mediterranean.

Graph 7 displays the captures of Eastern Atlantic and Mediterranean ABFT from 1960 through 2004. In the 1960s and 1970s this fishery began its expansion and experienced exponential growth by the 1990s. However, in the late 1990s the data show a considerable drop in captures from over 50,000 tons down to around 32,000 tons. The drop shows compliance with ICCAT's quota for this fishery, set during this period at exactly 32,000 tons. Nevertheless, as displayed in the graph, IUU fishing continues and it has been estimated that captures are actually in the range of 42,000 to 49,000 tons in the past few years. In fact, many experts believe that the captures are on the high end of this range, and close to 50,000 tons a year, with captures in the Mediterranean alone around 43,000 tons (ATRT 2006; ICCAT 2007c).



Graph 7: ABFT Captures North Atlantic and Mediterranean (1960-2004 with Estimates for 2004 and 2005) (ICCAT 2007, Bregazzi 2005).

Another concern with the management regime surrounds the establishment of TAC in the Mediterranean and East Atlantic region, which are far higher than scientific estimates of MSY. Due to the influence of powerful interests in this sector, ICCAT has historically overlooked catch recommendations made by their own scientists. This has resulted in catch quotas that are higher than most fisheries scientists feel the stocks can sustain (Safina 2001; Tudela and García 2004) (Table 6). Between 2003 and 2006 the SCRS studies suggested that captures of ABFT above 26,000 tons per year would not be sustainable in the Mediterranean and East Atlantic fishery. Nevertheless, the TAC was set at 32,000 tons each of these years, and as stated, because of IUU activity the captures, captures were actually much higher. In 2007, with the increasing pressures on spawning stock biomass (SSB), particularly in the Mediterranean Sea, ICCAT SCRS determined that ABFT captures should not exceed 15,000 tons per year, in order to maintain healthy stocks for the long-term. ICCAT's policy compromise was to set the TAC at 27,500 tons, creating an uproar from environmental and conservation groups, as the future of this stock has recently become an even greater concern.

Year	ICCAT - SCRS Recommendation	Total Allowable Catch (TAC)	Estimated Actual Captures
1998	< 25,000	32,000	
1999	< 25,000	32,000	
2000-2001	< 25,000	29,500	
2002	< 25,000	32,500	
2003-2004	< 26,000	32,000	~45,000-50,000
2005	< 26,000	32,000	~45,000-50,000
2006	< 26,000	32,000	~50,000
2007	15,000-26,000	29,500	~61,000
2008	8,500-15,000	22,000	

Table 6: Annual ICCAT TACs , SCRS Recommendations, and Estimated Captures in North Atlantic and Mediterranean Fishery (1998-2008) in Tons (Bregazzi 2005; 2006; ICCAT 2007b; c).

ICCAT's (2007c) SCRS report clearly states that "a collapse in the near future is a possibility" (66). In 2008, ICCAT scientists recommended that in order for the fishery to remain viable and avoid collapse, captures should be between 7,500 and 15,000 tons in the Eastern Atlantic and Mediterranean. In October of 2008, the IUCN recommended that the Mediterranean fishery be closed and spawning grounds protected. At the ICCAT meeting in November of the same year, an agreement was made to decrease the TAC in this region to 22,000 tons, still far higher than scientific recommendations. Furthermore, a recommendation to close the Mediterranean fishery in May and June, the bluefin spawning season, was overlooked (WWF 2008b).

Even with these dire predictions about stock collapse and strong scientific consensus that the pressure on the fishery was seriously threatening the species, the political economic pressures were such that the scientific suggestions went unheeded. Delegates from European Community, particularly Spain, Italy, and France along with Japan and Morocco, have been the key players in negotiating the higher TAC, as well as compromising other SCRS recommendations such as closing the fishery to large industrial vessels for an extended a period, at least during key spawning periods, and increasing minimum landing size. According to an Italian scientist that I interviewed, economic concerns and scientific uncertainty are cited as the justification for maintaining TAC above scientific recommendations.

Even ICCAT's compromised regulations are regularly flouted, either directly or by flying flags of convenience[86]. By and large, the ICCAT regulatory scheme lacks effective enforcement. Enforcement of regulations is left up to member countries, and member nations' efforts have often been, to say the least, inadequate and ineffectual (Bregazzi 2005; Tudela and García 2004; WWF 2006). Frequently, regulations are agreed upon that many fisheries scientists consider weak to begin with, but are nevertheless summarily ignored by large industrial fleets. The Italian and French fleets are notorious for their violation of ICCAT regulations, but are by no means the lone

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[86] Some fleets will attempt to skirt regulations by fishing under the quota of another nation, or under the guise of a nation that is not part of the agreement, so as to avoid limitations on captures.

culprits (Bregazzi 2005; 2006). This lack of enforcement was one of the important reasons that the IUCN suggested closing the fishery until information could be better ascertained on the state of the stock.

Under the current regulatory scheme, captures for bluefin ranches have been difficult to regulate and are regarded as a major impediment to proper record keeping (Tudela and García 2004). As ranching is the major producer of bluefin in the region, they have been at the center of the management controversies. Ranching facilities receive seed stock from different purse-seine operations, potentially from different nations. A central issue is that bluefin are captured alive and sold alive to ranchers. The ICCAT quota system is nation-state based. Quotas are checked against sales or export of bluefin, and each fish in the export market is required to carry along with it records of its origins, the ICCAT Bluefin Tuna Statistical Document (BFTSD), a method designed to reduce IUU. However, there are often poor records of where the catch originated, since the policies and oversight are weak. Also, there have been methods used to skirt this requirement as well.

With ranches, the nation that exports a bluefin is often different than the nation that captured it. The transfers that occur at sea becomes a “black box” where estimates are made by fishing boats and ranchers to complete transactions, and, as mentioned, records are poor. Since fishing boats do not come to shore, they can avoid declaring the captures. Often it is likely that the vessel that captured the fish is unknown by the importer/purchaser. What is more, ICCAT BFTSD are not employed between EU countries; fishing and ranching enterprises may work with other member or non-member nations to avoid recording against their nation's quota. Members may send product through various ICCAT member or non-member countries to avoid proper record keeping.

Ranches are not designated quotas by the member nation in which they are located. They are granted a concession that allows them to operate a specific number of cages, of a specific size. Indirectly this is a limit on their capacity since cage size directly dictates the amount of tuna than can be fattened. For example, a cage of fifty meters in diameter is considered effective for ranching up to 200 tons of bluefin tuna a year. Exceeding this amount in a cage this size can cause extreme stress on the bluefin. However, there is evidence that ranches have often exceeded capacities (Bregazzi 2006; Tudela 2002).

Interestingly, the concessions granted for tuna ranches in the Mediterranean far exceed the TAC for the region. Table 7 depicts the tuna ranching capacity of each nation in the Mediterranean. The total capacity is far beyond what ICCAT's scientific advisory council suggests is sustainable. If ranches have been adhering to ICCAT regulations, then we would have to assume that they have been working at a very low level of capacity[87].

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[87] Some concessions may not be operational thus lowering the total capacity to some degree.

Country	Capacity
Croatia	7880
Cyprus	3000
Greece	2100
Italy	13000
Libya	1000
Malta	11150
Morocco	1000
Portugal	300
Spain	11852
Tunisia	2400
Turkey	9460
Total	63142

Table 7: Tuna Ranching Capacity in the Mediterranean in tons (ICCAT 2008).

There are additional complications in the regulation of tuna ranching. Fish that perish in transport or are harvested before reaching the ranch facility may not be recorded. Also, the weight of the fish is usually given before fattening, thus underestimating the actually tonnage produced. Because of the high level of IUU in this fishery, there is always room for doubt regarding the true state of the Mediterranean stocks. With the lack of tight oversight and strong regulations it has become very difficult to accurately assess impacts on wild stocks, and thus rationally manage the stocks.

Conclusion

The modern system of tuna production is an industrialized process that uses high levels of new technology, capital, and energy to produce a global commodity for luxury food markets. Bluefin tuna hailing from the Mediterranean have become a status symbol in developed nations, particularly Japan, where relatively recent social phenomenon have created a high exchange value for a species that was in many parts of the world previously little regarded and valued. Transnational corporations have developed methods to provide this valuable commodity to upper and middle class consumers using new methods of production that intensified capture efforts. The market has become increasingly lucrative such that efforts were made to control production and add value to bluefin by fattening them in cages, what is commonly called ranching.

While this has been lucrative for TNCs, there is a great deal of concern regarding the environmental and social impacts related to these industrial fishing and rearing operations. Other resource users, particularly small-scale traditional trap fishing, have been seriously affected by industrial operations. In Sicily, these methods are all but extinct. Furthermore, the environmental impacts associated with tuna ranching have caused great alarm. Overfishing and other environmental concerns related to bluefin tuna ranches creates conditions that have serious consequences on ocean ecosystems. ICCAT, the regulatory regime that oversees the bluefin fishery, has been largely ineffective at controlling over-exploitation of the fishery.

In the following two chapters, I will elaborate my analysis and describe the social and ecological transformations in the Sicilian bluefin tuna fishery discussed up to this point. In doing so, I will apply the theoretical lens outlined in Chapter II. This analysis will provide important insight into the drivers of the many environmental and social concerns that are threatening the future of a historic fishery. Additionally, it will provide a deeper understanding of the social relations that are central to these modern developments.

CHAPTER VI

THE MEDITERRANEAN BLUEFIN FISHERY: A CASE OF ECOLOGICAL MODERNIZATION OR METABOLIC RIFT?

A Theoretical Assessment

This dissertation has provided a history of the Sicilian bluefin tuna fishery and discussed the social and ecological transformations that occurred in the fishery in the late twentieth century. In doing so, it has highlighted the very real concerns about the future of this historic fishery. There has been an exponential expansion of fishing effort in the Mediterranean ABFT fishery, which has corresponded with the surge in the value of bluefin tuna on the global market. The exploding market for sushi and sashimi grade bluefin has provided increased incentive to seek out and expand captures of bluefin tuna wherever they are available and when possible, produce bluefin in capture-based farming facilities, or bluefin tuna ranches. These factors have impacted a number of bluefin fisheries throughout the world, including the Mediterranean fishery off the Italian island of Sicily.

It is important to consider this issue from opposing perspectives to avoid one-sidedness, myopia, or simple bias. Considering differing analytical approaches, modernization and radical political economic approaches, allows for important insight regarding social relations and the state of the Mediterranean fishery. In this chapter, I will consider the view of modernization theory, described in Chapter II, in regard to the events that are occurring in this fishery. In doing so, I will highlight the perspective offered by ecological modernization theory (EMT) to understand the contemporary concerns in the Mediterranean bluefin fishery.

Mol and Sonnenfeld (2000) lay out five categories of social and institutional transformations that are central to scholarship in EMT and can essentially promote sustainable societies: 1) the changing role of science and technology, 2) the increasing importance of market dynamics and economic agents, 3) transformation of the role of the nation-state, 4) modifications in the position, role and ideology of social movements, and 5) changing discursive practices and emerging new ideologies. In order to better assess the theoretical understanding offered by EMT, each of these categories will be examined, first by looking at the ICCAT management regime, then the role of the state, or in this case the European Union (EU), and finally by the potential impacts of market mechanisms, new technology and consumer movements on the ecological conditions in the fishery.

The Failure of ICCAT

ICCAT has been criticized strongly by conservation groups and some scientists for its mismanagement of the ABFT fishery[88]. Currently, scientists maintain that there is little reliability regarding the data on Mediterranean bluefin stocks due to IUU captures

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[88] The ICCAT management regime was discussed in detail in Chapter V.

and sales. Clearly, a thorough account of the state of the bluefin stocks is a valuable tool in developing proper policies that will be compatible with social and environmental sustainability. Nevertheless, scientific findings and reports prepared by fisheries scientists, the foremost experts on the conditions of the stock, predict the likelihood of collapse, and the potential impacts on the future conditions of Mediterranean ecosystems is regularly overruled by the policy makers for ICCAT.

While this modern management regime is organized on democratic principles and is ostensibly regulating and controlling the exploitation of this fishery according to scientific principles, in fact, it has done very little to address its foremost problems. Major actors in this fishery openly skirt ICCAT regulations, which results in unreliable data. In addition, many nations regularly avoid submitting data in a timely manner. These issues have been made easy by lax enforcement. As such, ICCAT undermines itself by depending on unreliable data to manage the fishery, yet creates the conditions in which it is highly unlikely that they can collect accurate information.

Those who seek to minimize any regulation over their activities in the fishery exploit this environment of uncertainty. Thus, the delegates of nations that are major economic players in the fishery lobby for looser regulations such as higher TAC, smaller minimum capture sizes, and a longer fishing season. Delegates, including industry representatives and some scientists, often emphasize the considerations of industry as opposed to flimsy data and unreliable science. This has been evidenced by the fact that ICCAT has consistently regulated TAC at levels much higher than suggested (see Table 6 in Chapter V), avoided the closure of the fishery for extended periods during spawning season, or refused to adopt a complete moratorium on fishing in order to allow stocks to rebound, policies that have been suggested by many fisheries scientists (Tudela and García 2004).

Thus, ICCAT is fully immersed in a battle between capital and a rational scientific management of the fishery. While science can be very important in developing any sensible management of the fishery and ICCAT has established that “technical and scientific” information will guide management (ICCAT 2007a), science has been generally undermined and influenced by the social conditions that emphasize economic expansion as a path to social progress. The notion that rational resource management, a hallmark of modernization theory, will occur with the establishment of democratic regulatory/management regimes ignores that fact that the broader social relations that provide the context of this management will continually manipulate and sway the process in favor of the dominant social class.

The European Union: Subsidizing Collapse

In the current system of production, the interests of transnational agri-food capital are paramount. The outcome of the November 2008 ICCAT meeting in Marrakech, Morocco was a typical example of the results of powerful political economic forces shaping management decisions. As noted, scientists had been ringing alarms regarding the degraded state of the fishery. In 2008, fisheries scientists recommended the significant reduction of captures to levels below15,000 tons, and even as low as 8,500 tons for the following seasons, as well as closing the fishery for up to nine months of the year (WWF 2008b). The conditions in the Mediterranean had deteriorated such that scientists were making very strong claims about the potential danger of maintaining business as usual.

Led by the European Commission (EC) and with backing from North African nations that are heavily invested in ranching, ICCAT adopted higher TAC (as noted in Table 6) that created grave concerns among many scientists and conservation groups about the viability of the bluefin stocks in the region. The EC was said to have pressured developing nations that had voted for reduced TAC and fishery closures by threatening the breakdown of bi-lateral trade agreements (Abend 2008). For example, early signers such as Belize, Panama and Guatemala mysteriously withdrew support for tougher regulation after trade discussions with the EC (Abend 2008; Walt 2008).

As discussed earlier, the EU has played an important role in stimulating the expansion of the fishing sector through subsidizing the "modernization" of the fishing sector and supporting bluefin tuna "farming." EU subsidies have been dispensed to the Mediterranean fishing sector in order to update their boats and gear, which has resulted in increased technology and capacity in the Mediterranean purse-seine fleet. Additionally, the tuna ranching sector has benefited from the notion that this method is a form of "aquaculture" and should be subsidized. The EU considers aquaculture as a means to increase the available food supply to the growing global populations and support a large fishing sector that is economically challenged due to over-exploited stocks. As such, industrial aquaculture is supported by public funds, ostensibly for the broad social benefit it offers.

The EU has created a Common Fisheries Policy (CFP), much like their Common Agriculture Policy (CAP), which develops the region's fisheries rules and procedures. The CFP, initiated in 1983, is the official regulatory policy that overseas the fishing activity in EU waters, and is concerned with the exploitation of the fishery in terms of economic and environmental sustainability. Nevertheless, policy decisions regularly put the interests of industry over those of the environment.

The tuna fishing sector, including bluefin tuna ranches, has been a growing industry for the EU. Ranching has been the largest producer of the most valuable marine species in the region. This has resulted in increasing tax revenues and, of course, increasing benefits to important constituents in the fishing sector. After subsidizing the expansion of the fleet and capacity of ranches, it would be politically risky to endorse the decreases in TAC as proposed by ICCAT's SCRS. Instead, the policies have been established in a manner that questions the precautionary approach offered by most fisheries scientists, for one that primarily supports industry expansion. The ecological costs of these decisions are predicted to be dire.

Furthering Modernization: Technology, Privatization and Consumer Movements

For modernization theories, the expansion of new technologies is a central force in addressing environmental problems[89]. Open markets and privatization will facilitate the conservation of private environmental space and natural resources by providing

[89] This approach was referred to earlier as technological optimism.

incentives for research and development, as well individual private interests. This approach claims that the capitalist competitive market system is neither an essential precondition for, nor the key obstruction to stringent or radical environmental reform. The focus is on redirecting and transforming competitive markets in such a way that the market obstructs less and contributes more towards sustainability. This approach has been very influential in the social processes taking place in the ABFT fishery in the recent past and present.

The expansion of technology has been a common theme in this fishery with the growth of new more powerful methods of capture, location devices, and most recently bluefin ranching. Up to this point, these technologies have arguably been at the center of the problem of overfishing. Yet, these technologies have been supported by government subsidies as part of a push to modernize the Mediterranean fleet and advance "aquaculture." According to those who espouse this view, a further push in technology will reverse the damaging impacts of the past and (re)create the possibility for a sustainable fishery. This approach is best exemplified in the increasing attention and research invested in the domestication of *thunnus thynnus*, and the project REPRO-DOTT[90] that has emerged with this goal.

As has been discussed, bluefin tuna farming/ranching cannot be considered true aquaculture in the sense that bluefin tuna are captured from the wild. Aquaculture is generally understood as a controlled breeding and rearing process that domesticates the species, so to speak. Marine life produced by aquaculture is, as a rule, managed for the

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[90] DOTT is the acronym for Domestication of *Thunnus Thynnus*.

organism's entire life cycle. In this light, bluefin ranching has received a great deal of criticism. To address this, there has been a concerted effort to close the bluefin's life-cycle in captivity. This has been the main ambition of the project REPRO-DOTT, and is regarded by some as the way to save the bluefin tuna from its path towards extinction (Ellis 2008a). Ostensibly, this will be done by providing sustainable industrial aquaculture and "enhancing" wild stocks.

REPRO-DOTT is a research program funded mainly by the EU, together with public research institutions and private industry, and is designed to "improve the knowledge of the reproductive biology of the species in captivity and compare this with wild populations, in order to develop an aquaculture farming technology for the bluefin tuna" (European Commission 2008: accessed September 26, 2008). A number of marine biology and biotech institutes are taking part in this research project, including Universidad de Cadiz, Spain; Università di Bari, Italy; Institut Français de Recherche pour l'Exploitation de la Mer, France; Oceanographic and Limnological Reasearch: National Center for Mariculture, Israel, among others, as well as industry giant Ricardo Fuentes' Tuna Grasso.

The coming together of the state, industry and academia with the goal of furthering technology in this area of bluefin production is telling. This venture can be compared to the many hi-tech projects in the realm of agriculture, including the work done developing synthetic inputs, hybrid seeds, and most recently biotechnology (Kloppenburg 1988; Lewontin and Berlan 1986). In agricultural production, these technologies had the effect of creating more potential for private profits, while increasing the capital-intensity of farming practices. Generally, this has increased the role and scope of global agri-business in food production and hurt small-scale traditional farmers, particularly in the periphery (Bonanno et al. 1994; Kloppenburg 1999; Shiva 2000). The underlying ideology in regard to this expansion of technology, privatization, and expansion of production is firmly based in the theoretical view provided by modernization theories.

However, what needs to be considered is whether this approach towards food production will further drive a wedge between society and nature or resolve some of the growing problems in this fishery. That is, if we examine this issue using a radical political economic approach, what will this tell us about the potential for this type of solution? Will these proposed technological solutions offer hope for reversing the crisis in the Mediterranean bluefin tuna fishery and will they benefit fishing communities?

Examining existing industrial aquaculture systems of other carnivorous species, such as salmon, provides some insight into what a future bluefin aquaculture system might look like. Generally speaking, salmon aquaculture has been environmentally disastrous. It has had tremendous impacts on local ecosystems, been inefficient in terms of energy and resource use, impacted wild stocks in a negative fashion, and provided a food product that has been shown to contain higher levels of toxins than wild caught species (Clausen and Clark 2005; Naylor et al. 1998; Naylor et al. 2000). What is more, Clausen's (2008) study of salmon fisheries in British Columbia and Alaska has shown that small- or medium-scale and traditional fishers have not experienced benefits from the development of industrialized salmon aquaculture in the region.

It is quite clear that a bluefin tuna aquaculture system in the Mediterranean would have the same types of problems, only magnified. Bluefin are a larger, more energy intensive species and the food conversion ratio (FCR) for bluefin is far higher than salmon. Also, long-term farming would increase the impacts on the local environment where these systems are located. In the current ranching system, bluefin tuna are fed for a short period, usually about six months. Domestication and full scale industrial aquaculture would amplify the effects of waste and feed concentration due to the longer rearing periods required. In addition, wild bluefin have been known to contain high levels of methyl mercury, a toxin dangerous to human health, which would in all likelihood be increased by an aquaculture system, as it has for salmon (Hites et al. 2004). Indeed, the notion of developing bluefin tuna within an industrial aquaculture system emerges from neo-liberal market logic, not from any scientific or ecological logic.

As has been indicated by this research, the growth of hi-technology and capital-intensive systems has not benefited local fishing communities in the Sicilian bluefin tuna fishery. TNC have profited from the privatization of local resources and the exploitation of bluefin stocks that were once central to the economies of coastal communities. Small- and medium-scale resource users have been dispossessed by these large-scale industrial systems.

Project REPRO-DOTT also serves as an important public relations tool. This project creates the impression to the general public that tuna ranching is moving towards a “sustainable” system of aquaculture. This provides an opportunity for research scientists to gain public support, and more importantly, public funding for this project

(Tudela and García 2004). In this view, tuna ranches are regarded as cutting edge technology that facilitate the growth of sustainable agri-food production. This imperative increases tuna ranches prospects for public funding. However, as Tudela and Garcìa (2004) have stated, and previously noted in this work, the notion that this method can commercially mass-produce bluefin tuna to provide a marine food source in a sustainable manner is a myth.

Consumer Movements

Social movements and increased awareness/dialogue regarding environmental problems are also regarded as a driver of ecological modernization. That is to say, democratic social action by, for example, individuals and non-governmental organizations, is regarded as an important step in this process. Indeed, there has been an increasing awareness of the plight of ABFT and the concerns about its path toward extinction. This has resulted in the growth of conservation programs to address these concerns by major organizations, including the World Wildlife Fund (WWF) and Greenpeace.

The WWF's program, which seeks to halt the bluefin crisis in the Mediterranean, hinges on consumer boycotts of ABFT. Their website states:

> "As more and more major European retailers boycott Mediterranean bluefin tuna, WWF is calling on other supermarket chains - and chefs, restaurants, consumers - to follow suit, until the imperiled species is out of the danger zone" (WWF 2008a) accessed October 2, 2008.

In addition, in the section entitled "What you can do," the organization suggests:

> "So until ICCAT has agreed to a satisfactory recovery plan, WWF strongly advises that you avoid Atlantic bluefin tuna... Ask your fishmonger, fish market or sushi restaurant to switch to other species – or other stocks that are sustainably managed" (WWF 2008a) accessed October 2, 2008.

Consumer choice and demand is regarded as a major driver of bluefin tuna overfishing. Activists from the Slow Food Movement have also made similar statements and developed education programs for consumers, particularly young people. The logic within this approach is that if consumers are educated they will make ecologically rational choices. By making their preferences known, the market will respond and produce sustainably managed ABFT. Greenpeace's approach is quite different. This organization advocates for the implementation of marine reserves in order to save the ecosystem and allow the bluefin to thrive (Greenpeace International 2008). Greenpeace has staged demonstrations around tuna ranching and documented illegal fishing practices.

While each of these approaches has value, neither movement gets to the social roots of the problems that drive over-exploitation in the Mediterranean bluefin fishery. In particular, the consumer boycott approach has been popular among social movements, but its success at challenging global political economic processes has been limited. In the Mediterranean bluefin fishery, this approach has been largely ineffective. A major part of this ineffectiveness is likely due to the fact that consumers can hardly be expected to know whether bluefin have been harvested sustainably when even the regulatory body, ICCAT, does not have accurate information regarding captures and production.

The notion that the fishery can be reformed without any radical social change, but through consumer choices or individual policy ideas, does not develop a broad enough picture of the circumstances in the fishery. Any social movement addressing this issue must include aspects that highlight social and environmental justice. That is to say, the dispossession of traditional resource users, the extracting of value by TNC, the "externalities" that are left behind, the unequal distribution of the a regional Mediterranean resource (consumed mostly by the global elite), and a broad critique of the modern agri-food system in which food is simply another commodity on the global market must be the central thrust for aligning social movements that have the potential to have long lasting impacts.

Modernization Theories: Theory without History

The circumstances in the ABFT fishery provide a strong example for determining the efficacy of modernization approaches towards understanding and addressing environmental problems. According to EMT, crucial aspects of what is considered "ecological modernization" are developing within the Mediterranean bluefin tuna fishery. There has been an increase in science and technology and expansion of market principles, both of which are occurring within the development of bluefin tuna ranches as well as project REPRO-DOTT. In addition, the development of a regional democratic regulatory regime in ICCAT, in which member nations vote on regulatory schemes and non-governmental organizations have a voice, and the expansion of social movements and social discourse surrounding this issue have been established and are widespread, particularly in Europe.

However, the conditions within the Mediterranean have not improved, and in fact, are severely deteriorating. By examining the Sicilian case, it is clear that the conditions have declined rapidly over the last half-century. This has been made clear by the collapse of the traditional fishery, and the real possibility that the entire Mediterranean fishery could collapse within a short period of time (ICCAT 2007a).

The solutions called for under this model are generally targeted at managers, consumers and science and technology. With different approaches and varying emphasis, it has been argued that in order for progress to be made on this issue, regulation and enforcement must be enhanced and consumers must make more informed choices about the foods they decide to purchase. Others argue that scientific progress and a new infusion of technology will provide solutions to pressing concerns about the bluefin stocks, as well as other social and environmental concerns. Each of these measures appears logical and should not be disregarded. However, a crucial element is overlooked, i.e. the historical conditions that shape social context and relations.

While modernization theories have wide mainstream appeal, these approaches are lacking in their capacity to provide a deep and thorough understanding of the conditions surrounding the existing relations between society and nature. Therefore, it is necessary to provide an alternative view that reveals these shortcomings. Like its foundations in neoclassical economics, most modernization theories propose that the current social relations are natural, inevitable and fixed, or at least the best possible. Therefore, any progress that is to be made in addressing the collapse of the bluefin fishery must begin within this current social framework. In this sense, the “modernization” approach is ahistorical. Regarding the current relations of production in this way leads to conclusions that offer limited insight, knowledge and solutions.

For example, environmental economics attempts to place a price on all ecosystem functions. This view argues that this process can resolve "market failures." Market equilibrium and all of its implications are regarded as natural mechanisms that will work out environmental problems once properly internalized. Ecological modernization theory has borrowed many of these principles and transformed them into a theory that promotes "modernization." However, these approaches are reifying capitalist ideology into what Lukács (1968) calls "supra-historical essences." Hiding behind the veil of a system of generalized commodity production, "reification requires that a society should learn to satisfy all its need in terms of commodity exchange" (Lukács 1968: 91). As a result, economic "laws" are conceived that mask and distort existing social relations. The knowledge that is constructed from this process does not offer a clearer understanding of the social or ecological environment, but simply reproduces and expands the ruling ideology.

These theoretical frameworks are also reductionist in their approach (Foster 2002). Economists regard the market as the universal process that will regulate natural systems. However, nature is not a commodity produced for markets, nor does nature reproduce itself according to the "laws" of markets. Environmental economists consistently fail to understand the complexity of nature and disregard the dialectical relations between society and nature, reducing nature to a source of "raw material" to be subjected to the cash nexus of the market (Levins and Lewontin 1985). This approach, rather than resolving environmental problems, generally further exacerbates them. Costing or pricing nature ignores that economic processes function within the biosphere and its processes (what we call nature). Nature is not a subsystem of the economy (Daly and Farley 2004). Additionally, reducing all social phenomena to individual (consumer or firm) actions ignores the power of the social and institutional frameworks within which individual action occurs. As a result, it is typical for this approach to ultimately miss important aspects of any social issue such as culture, exploitation, power, oppression, and alienation, all of which are important for understanding the modern society and nature relationship.

EMT, as a sociological tradition, has not ignored the role of social institutions. In fact, this view regards them as crucial to the ecological modernization process. However, EMT implicitly shares the eternal and fixed notion of capitalist social relations with economic theory. This perspective relies to a great degree upon market mechanisms and the pricing of nature in order to address environmental concerns. Thus, private property relations are taken for granted and expanded into natural systems. Moreover, this view privileges Western European culture as the model for modern society.

EMT has been criticized for erroneously focusing on efficiency of production, without taking into consideration aggregate expansion of production, what some refer to as the Jevons Paradox (Clark and Foster 2001). They have also been criticized for improperly generalizing their findings (York and Rosa 2003). EMT does not address the fundamental problems associated with the processes of unlimited accumulation that drive capitalist development and have, in aggregate, resulted in further depletion of resources and increased waste and pollution. These theorists have often overlooked the practices resulting in the distancing of environmental "bads" offshore that have been occurring at least since the colonial period[91] (Bunker 1984; Moore 2000; York and Rosa 2003). Further, the focus on technological fixes and institutional transformation is overly optimistic regarding the speed of technological solutions and the flexibility of capitalist institutions. These institutions' driving forces cannot veer from expansion of capital and the accumulation of surplus value without resulting in systemic crisis.

If, as modernization theorists posit, these processes of modernization will eventually create more sustainable markets, this is shaping up to be a long process. In this case, entrenched interests resist regulation and diminish the potential benefits of fishery management that may restrict potential profits and growth. These very powerful corporate interests have undue influence on the regulation process. Thus, the speed of destruction of this resource is outpacing any possibility for rational management under the current social and institutional frameworks.

EMT clearly builds on the assumptions of neoclassical economic theory. The reliance on market mechanisms as a solution for addressing environmental problems is an unmistakable indicator of this foundation. However, this rationalization of the modernization process as closely tied to the expansion of competitive capitalist markets is problematic. Many of these processes that EMT regards as solutions can be understood as root problems. Consequently, this view increases the potential to deepen the

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[91] This process of distancing is often referred to as the "Netherlands Fallacy."

developing rift between society and nature. Rather than moving toward progress, this path could easily lead to social and environmental decay (Foster and Clark 2004).

This chapter has shown that modernization theory is inadequate for understanding the socio-ecological transformations that have developed in the Mediterranean bluefin fishery. Therefore, the following chapter will develop an analysis that utilizes a radical political economic perspective and that focuses on the theory of metabolic rift to better explain these transformations and their socio-ecological consequences.

CHAPTER VII

SOCIO-ECOLOGICAL TRANSFORMATIONS AND RIFTS IN THE SICILIAN BLUEFIN FISHERY

I lavoratori con offerte spontanee
il municipio con ufficiale concorso
levarano questo monumento
al benefattori di Favignana
addiminstrando que puo
non esser discordia fra il
capitale e il lavoro
tra richezze e la inopia
dove presiedano
la giustizia la pietà l'amore

Monument to Ignazio Florio, Favignana (1896)

Introduction

The words above are inscribed on the monument erected to Ignazio Florio in the center of the Piazza Europa on the island of Favignana, Sicily. The *tonnara* in Favignana was one of the largest and most productive in the entire Mediterranean, and it became known as "*la regina*" (the queen) of the *tonnare* (D'Amico 1816). The Florio family owned the *tonnare* in Favignana in the nineteenth century, and it was Ignazio Florio who invested in the construction of the famous cannery and tuna processing plant on the island in the middle part of the same century. In doing so, the Florio family established one of the largest industrial canneries and fish processing plants in nineteenth century Europe (Lentini 1981). Between the *tonnara* and cannery *(Stabilimento Florio)*, tuna fishing, processing, and canning employed a majority of the residents of this small island off the northwest coast of Sicily (Lentini 1986; 1995). The processing and canning establishment is beloved among natives to Favignana. Known for its immense size and capacity, once adorned with beautiful décor and magnificent plants and trees, it is usually the first landmark one sees when arriving to Favignana.

The monument to Ignazio Florio, which includes a larger than life statue of the patron from this wealthy southern Italian family, declares the community's appreciation for the family's capital investments into the Favignanese tuna industry and the jobs it provided. It proclaims that the workers of Favignana, in a "spontaneous offering," erected the monument to their benefactor, demonstrating that the "discord between capital and labor, between wealth and poverty" need not exist where "justice, mercy, and love" preside. More than a century later, the processing plant, the once vibrant economic center of the community, is under reconstruction to be converted into a museum. After its closure in 1981, the plant fell into decay and disrepair. Even more significant, the *tonnara*, the source of bluefin tuna for the cannery and principle source of economic activity on this small island community, collapsed and was transformed into a tourist attraction, kept active only through the subsidies provided by the Sicilian regional government.

After centuries of activity, the discord between capital and labor, in the context of the global market place, has taken its toll on this small Sicilian fishing island. Like all the *tonnare* in Sicily, the Favignanese have seen the slow collapse of their fishery occurring before their eyes. Their *tonnara*, which was once the pride of the Mediterranean, no longer brings in the hundreds of large bluefin each year that provided a major source of economic activity. Today, the *tonnara* is a quaint system of fishing for the history books, and an interesting attraction for tourists.

What interest remains in the *tonnara* of Favignana is one of nostalgia for days when fisherman battled large animals, virtually with their bare hands. To be sure, many Northern Italians and Europeans visit Favignana with this romanticized conception and the hope that they will catch a glimpse of a local ritual, *la mattanza*, and the famous *tonnaroti* that haul in the tuna. All along the Sicilian coastline, crumbling structures and boats indicate locations that were once central to economic and social life in these communities, and now serve as dramatic backdrops for sunbathers and swimmers. At least one *tonnara*, in Bonagia, has been converted into a four star hotel.

Analytical Framework

Many journalists, fisheries scientists, and popular writers have discussed the historical transformations that have occurred in the *tonnara*. These examinations often touch on the economic importance of bluefin tuna as a global commodity, but fall short of a thorough discussion of the processes that drive the "discord between capital and labor," which have been central to the social and ecological transformations that have occurred in this fishery, particularly over the last half-century. While these studies and accounts are informative and useful in their own right, and I am greatly indebted to many of them, it is clear that a socio-ecological analysis that examines the collapse of this traditional fishery, along with its economy and culture, and the growth of modern industrial methods of capture and production, is required to better understand the forces that have depleted a vital resource in this region. Such an approach promises a deeper understanding of the importance of social relations on natural resource depletion, which has implications for comprehending these processes as they occur throughout the world's fisheries.

As discussed in Chapter I, this study seeks to answer some fundamental questions pertaining to the collapse of the traditional Sicilian bluefin tuna fishery, the growth of bluefin tuna production, and the implications for the future. In doing so, this analysis will help explain how global processes have become central aspects of the modern agri-food system and have affected small communities and the natural resources that have sustained them for centuries. A more thorough analysis will create opportunity for developing solutions to environmental concerns such as resource depletion that other superficial analyses often overlook.

Utilizing theory described in detail in Chapter II, this chapter will provide a study of the aforementioned developments. Drawing on a relatively brief account of the long history of this important fishery in Chapters III and IV, and the modern industrial fishery in Chapter V, I will develop my analysis so as to offer new insight into the social relations that are central to the historical changes that have occurred, which include the loss of a sustainable resource that provided nourishment, economic activity, and a cultural foundation for communities in this part of the world. As Chapter VI showed, modernization theory is inadequate for understanding the conditions that have developed within the Mediterranean bluefin fishery, as well as the way these transformations have impacted Sicilian communities. Therefore, this chapter will utilize a radical political economic perspective to analyze these issues an approach that will illuminate the social relations that are central to the transformations in the Sicilian traditional ABFT fishery, and, inextricably linked to this phenomenon, the wider collapse of the Mediterranean fishery.

This analysis is informed by data collected through in-depth interviews conducted in Sicily during the spring of 2007 and the spring of 2008, as well as primary and secondary historical texts and quantitative data described previously. Throughout this analysis, I draw on the information provided by these data. Using interviews and discussions, I was able to learn a great deal about the technical workings, history, cultural significance, economic role, and environmental conditions of the fishery. The underlying source for much of the analysis is provided by individuals who have had direct experiences with the fishery either by working in it, living amongst it, or studying it. This information has provided the foundation for my understanding, which has been supplemented, complemented, and corroborated by documents, texts, and quantitative data. In this chapter, I will provide some extended quotations derived from interviews to support or clarify the analysis, when deemed beneficial to the broader analysis.

My analysis will focus on a discussion of the ecological conditions in the modern fishery in contrast to those of the traditional trap fishery. The modern methods of producing Mediterranean bluefin tuna have had serious ecological consequences, which have both transformed and been transformed by the social relations that dominate the global production of agri-food commodities. The Sicilian *tonnara* has collapsed. This significant event has occurred over the last fifty years or so; all the major fishing locations throughout Sicily have been closed[92].

After having examined its long history, the collapse of this traditional fishery becomes even more shocking. Plainly speaking, the Sicilian *tonnara* was what today's fisheries managers and policy makers would consider a sustainable fishery. The fishery was in operation for centuries. Moreover, communities were built on the economies provided by the *tonnara.*

The main cause of stock depletion in the Mediterranean ABFT fishery has clearly been overfishing. Nevertheless, pollution and increased use of coastal areas for recreation, tourism, transportation and shipping have played a role in this process as well. Each of these impacts has a variety of underlying causes. As the principle driver of stock depletion, the primary focus in this analysis will be on the processes that impel overfishing in this fishery. Within academia and the popular press, there are a number of explanations for this decline, ranging from population growth, to greedy fisherman, to poor management decisions or the lack of privatization of common property resources.

As discussed, large-scale fishing fleets with unprecedented capture capacity were unleashed in this fishery in earnest in the by the 1970s. The expansion of the global ABFT market created conditions that allowed for new methods of production to become viable, notably tuna farming or "ranching," and its scale is such that it supplies the

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[92] As explained earlier, only the *tonnara* of Favignana remains in this region. However, this is all but finished as well. It is kept afloat by government contributions in order to promote tourism and provide some economic stimulation.

faraway demands of the global sushi/sashimi market. Today, ranching has become the principle method of bluefin tuna production in the Mediterranean Sea. As explained previously, bluefin tuna ranching has seen exponential growth in production since its inception in this region in the mid 1990s.

There are unquestionable ecological impacts that result from the modern methods of capture and production, which I refer to in Chapter V and will detail in this chapter. These impacts have transformed an ecologically sustainable fishery into one on the verge of economic and ecological collapse. These changes are borne from the methods of production common within the modern global agri-food system and the social relations that provide the larger framework for its activities.

Within this social context, the modern agri-food system provides commodities for global consumers. This system is buttressed on the expansion of profits, which can be characterized as motored by a "treadmill of production." Accordingly, the most basic of human needs, in this case food, becomes a commodity like all other products and goods. Available to the highest bidder, commodities in a capitalist market system are exchanged based on a logic that primarily considers economic exchange value and neglects its value in use. This logic has the tendency to establish social conditions that provoke and magnify the alienation between humans and nature, as the natural processes that are necessary for their production is separated and distanced from social life. That is to say, the social and ecological systems are disrupted and disorganized, the long-term effect of which can be best described as a rift in the metabolic relations between human societies and nature.

The theoretical views developed within environmental sociology provide the most far-reaching and fruitful analysis. When examining the modern agri-food system, it is necessary to consider the dialectic between social context and ecological conditions. It will become clear in the remaining text of this dissertation that the radical political economic perspective within environmental sociology allows for a socio-ecological analysis and provides powerful social insight in relation to the concerns in this fishery and beyond.

Treadmill of Tuna Production

In the broader discussion surrounding the expansion of fishing, as well as industrial aquaculture, there have been several arguments made regarding drivers of resource depletion. Commonly, population growth is seen as a key element in this process. For example the UN FAO states in their *State of the World Fisheries and Aquaculture* (2006):

> "In recent years, both fish consumption and overall food consumption have been influenced by complex interactions involving several demographic and economic transformations such as population growth; rising incomes and economic growth; rapid urbanization; increased female participation in the workforce; increased international trade; international agreements on trade, rules, tariffs and quality standards; and improvements in transportation, marketing, and food science and technology… Population and income growth, together with urbanization and dietary diversification, are expected to create additional demand and to continue to shift the composition of food consumption towards a growing share of animal products in developing countries." (40-41)

Certainly, the argument is not limited to consumption by growing populations, but this is regarded as a central agent in the demographic processes and their relation to fish consumption.

A common argument is that population growth is the central driver of resource depletion[93]. The famous political economist, Tomas Malthus, built his theories on this principle. This view has had a long history and recently Pimentel and Pimentel (1999) state that:

> "Because the world population continues to expand, more pressure than ever before is being placed on the basic resources that are essential for food production. Unfortunately, the human population is growing exponentially, whereas food production can only increase linearly" (35).

Malthusian arguments have been popular in the explanation of expanding food resources and there are obvious reasons to consider the effects of growing populations. Oftentimes this analytical approach, either directly or indirectly, points a finger in the direction of the developing world, as these are the areas that are continuing to see expansion of population, while the developed world has generally seen population growth level off. What is more, other demographic transitions, such as those mentioned before, imply growing resource use emanating from the developing world as they "transition" to developed status. These demographic shifts have already occurred in the developed world, and thus, these views tend to impugn the global South. While pointing a finger of

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[93] Obviously population does play a major role in resource depletion and environmental concerns. However, the environmental impacts of populations can vary greatly depending on the level of affluence associated with it.

blame at the developing world, this approach neglects the fundamental role of the developed world in driving the process.

Many in the industrial bluefin fishing industry explain the bluefin crisis in these or similar terms. As Giuseppe Stabile, technical coordinator at New Eurofish explains:

> "In my opinion the future is surely in the development of farming. I say this because if you want to do two things, on one hand protect the ocean and on the other hand provide food resources for human populations. It is not possible to continue to fish; that is to exploit the ocean. We need to transform to fish farming the way it happened in agriculture. People had to transfer from hunting to agriculture. The choices are either starvation, not having enough resources for the growing population, or transform from hunter to farmer. This has not completely transpired in the ocean, but I believe it is our destiny. Because the ocean cannot continue to supply food for the growing population of about six billion people."

The Commercial Director of Coalma, a large Italian producer of marine products, regarded the problem in a way that can be described as a "tragedy of the commons" dilemma. The "tragedy of the commons"[94] theory, developed by Garret Hardin (1968), is inspired, for one, by Malthus, and is related to concerns regarding access to common resources, overpopulation, and environmental degradation[95].

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[94] Hardin's "tragedy of the commons" argument is based on the notion that common land will be slowly destroyed due to the competing individual interests of the users in the absence of regulation. For example, in a situation of common grazing land, Hardin argues that farmers will try to individually reap the benefits, while socializing the costs to other farmers. As each farmer has the same general view of individual maximization of benefit, this will lead to the tragic despoliation of the land.

[95] Hardin's view has been associated with a eugenicist philosophy that saw environmental problems tied to overpopulation and driven by the lack of control over "breeding" (Ross 1998). For example, Hardin states: "To couple the concept of freedom to breed with the belief that everyone has an equal right to the commons is to lock the world into a tragic course of action" (Hardin 1968: 1246).

Realizing that bluefin stocks were heavily depleted and would have negative long-term consequences for stocks and ultimately for business, the Commercial Director of Coalma informed me the that this was a problem in and among fishing communities. He described a lack of understanding of resource problems as well as, what basically amounted to, greedy fisherman, stating: "The problem is related to a common way of thinking among fisherman. They want to catch today and do not think about tomorrow."

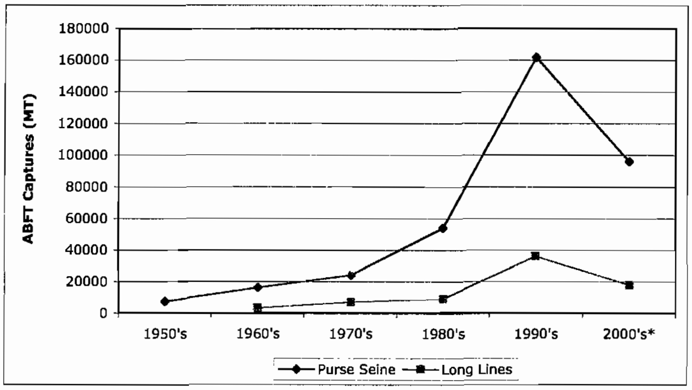
When analyzing complex resource concerns, such as those occurring in the Sicilian bluefin tuna fishery, Malthusian approaches, and with this tragedy of the commons, approaches are somewhat simplistic. Surely, it is widely accepted that larger populations have the potential to have a greater impact on their environments. However, these views can often ignore the broader socio-structural and historical realities that are important when analyzing these issues (Ross 1998; St. Martin 2005). Problems are formulated largely as relations between humans and nature and neglect how this is mediated through social relations of production. The historically specific social relations impact the ways in which communities access common resources such as the oceans (Berkes, Feeny, McCay, and Acheson 1989; McCay and Acheson 1987) as well as they ways in which demographic trends develop and how they are understood (Foster 1994; 1998; Ross 1998).

Applying Schnaiberg's theory of the treadmill of production (ToP) to these concerns can begin to broaden the analysis and provide helpful insight. As the Sicilian tuna fishery enters the modern era, new methods of production are sought to ensure increases in production. The Sicilian *tonnara*, along with other trap fisheries throughout the Mediterranean, formed a bluefin tuna fishery in this region that was ecologically sustainable. This was in no small part due to the fact that captures from individual traps and even entire regions, were inconsistent from year to year. Some years had abundant captures while others had relatively smaller ones. This inconsistency created a great challenge for the new capitalist owners, particularly in the modern era.

According to the treadmill logic, capital is invested in order to expand and create surpluses that are re-invested. Due to the dynamic of the modern market economy, expansion is necessary to keep capital competitive. A system of perpetual growth encompasses the entire social structure through various social institutions including the state, business firms, and labor. Once this logic dominates social institutions, the expansion of production becomes a central strategy for growing economic returns and, it is argued, social progress. Other methods of "efficiency" are also introduced, which lower costs of production while expanding output and returns on investments.

By the late twentieth century, there was little doubt that a system of production based on infinite expansion governed production methods in the global agri-food system. While Schnaiberg did not characterize the treadmill as purely a capitalist process (he also recognized the process in the existing socialist states in the late twentieth century), this logic of economic growth at all costs is essential to capitalist production systems in part due to a real, or perceived, competitive structure and the dictates of capital accumulation within the capitalist logic. While many social and natural scientists point to population growth as the chief driver of the deterioration of ecological systems throughout the world, the ToP model emphasizes the system of production as a fundamental force in this process. From this perspective it is not simply population growth, but a particular economic logic requiring never-ending economic expansion, and affluence in the developed world, which have been central drivers of increasing ecological problems (Jorgenson 2003; York et al. 2003).

In the Sicilian bluefin tuna fishery, the impacts of the ToP logic are most readily observed in the post World War II era, detailed in Chapter IV. The expansion of investment into more technologically intensive fishing efforts with the intention of increasing production developed at an unprecedented rate. In the Mediterranean, bluefin tuna captures increase from about 5,000 tons in 1950 to about 40,000 tons in 1994 (ICCAT 2007). During this time, there was tremendous growth in capital-intensive capture technology. In particular, purse-seines captures grew at an exponential rate (Graph 7). At the same time, as has been shown in Chapter IV, labor intensive trap technology was on the decline and heading towards collapse. With the expansion of purse-seines and their on-board technology, the demand for labor significantly declined in the fishery (Safina 2001).



Graph 8: Purse-Seine and Long-Line Mediterranean ABFT Captures by Decade (1950s – 2000s)*[96] in Metric Tons (ICCAT 2007).

Increased fish consumption is certainly tied to growing populations, but it is also related to economic and cultural factors (York 2004). When considering food consumption and populations, the distinction between staples and luxury food items needs to be made. Population growth does parallel the increasing consumption of staple food resources, but the relationship between population and luxury food items, such as ABFT, is not comparable.

While those that promote bluefin tuna ranching make claims that this is a process that is simply responding to the needs of a growing population, this argument is misguided. When we examine the conditions and facts that have historically emerged in the Mediterranean bluefin tuna fishery, this mythology is shattered. Firstly, the rate of expansion of production of ABFT far exceeds the rate of population growth over the last fifty years. Annual catches of Mediterranean ABFT saw an eight-fold expansion in the

[96] Data for the captures during the 2000s is only recorded up to 2005.

span of forty years (ICCAT 2007). This was largely driven by an attempt to capture new, large distant markets. The nations with the highest imports and consumption of bluefin tuna are Japan, Spain, France, and the United States, which together make up close to ninety percent of the world's consumption (Crescimanno and Di Trapani 2007). These nations have relatively lower levels of population growth, particularly in recent years. Lastly, hungry populations are also poor. Due to its status as a high prestige food, bluefin's value on the global market increased enormously, resulting in greater effort and captures. It can only be a false logic that holds that growing hungry populations are responsible for the growing global demand for bluefin tuna or that production has been expanded to meet their needs.

As I documented, bluefin tuna emerged as a luxury food product. Its value as a food source stems not from its nutritive capacity, but by its market value and cultural status. While other food products, such as beef, have been historically tied to high status, the socio-cultural phenomenon surrounding bluefin tuna is unique. Little physical sustenance is garnered from ten to twenty grams of fatty tuna in the form of sashimi, the largest global market for ABFT. This is a symbol for the global elite (and later the middle class), not a food source for growing hungry populations.

The expansion of the industry and fishing capacity stemmed from the high market value of this global food commodity, and the potential returns on investment. Opportunities for growth and expansion drove the industry to increase capacity. Socially constructed notions of prestige that display one's position in the social hierarchy created market demand in wealthy nations, which were pushed by marketing and other powerful media sources. In the process, industry invested in new technologies, including better locating equipment, larger capacity, and faster boats to expand production and continue the cycle of the treadmill.

Furthermore, as the ToP theory suggests, government organizations and industry groups have pushed for expansion of capacity and technology in the name of food security and jobs. This has resulted in massive subsidies entering into the fishery offered by regional governments and the European Union. The subsidies have been used to "modernize" the fleet, that is, purchase larger, faster boats equipped with advanced technology, as well as developing tuna "ranching" facilities (Bregazzi 2005; Doumenge 1999; Tudela and García 2004)

As Schnaiberg's analysis makes clear, there are a variety of consequences related to the treadmill of production, including what he terms environmental "disorganization," or degradation. In Sicily, the *tonnara* is dually impacted. First it has a limited capacity for expansion and secondly investors slowly abandon it, as new technologies are faster and able to locate tuna before they reach the traps. Over time overfishing by industrial fleets diminish the technology's captures, due to the heavy impact on bluefin and overall decrease in bluefin population in the Mediterranean. The levels of captures in the Sicilian *tonnara* showed significant declines in the last decades of the twentieth century and were wiped out. Large-scale industrial captures in the broader Mediterranean have leveled off even with increasing effort. This phenomenon is often indicative of the pre-collapse stage of a fishery.

In addition, in the Sicilian fishery, the historical record shows a concern for the impacts that certain technologies and increasing capture effort might have on the bluefin populations. The idea of applying intensified effort to increase captures, was understood to have negative potential consequences in the long-run of the fishery. La Mantia (1901) described a long history of contestation over the amount, location and technology used in fishing for bluefin, as well as other species during the bluefin season. The earliest know disputes and challenges were in the sixteenth century. La Mantia described the actions in the region of Palermo regarding the *tonnare* of Mondello and Arinella, in which there were concerns that the location of the *tonnara* in Arinella was too close to that in Mondello. This dispute began proceedings to enact minimum distances between active bluefin fishing. Bans were also put in place regarding the types of nets that could be used in the vicinity of the *tonnara* and the capture of small tuna was prohibited by a number of decrees in 1784, 1785, and 1794 in Sicily (La Mantia 1901). Moreover, D'Amico (1816) discussed the damage done to the bluefin fishery by practices that resulted in overfishing and the capture of juvenile and small fish, stating that these practices "sterilized" the fishery. Thus, the logic of ever increasing captures in the Sicilian fishery was contested even during these relatively recent periods. It is only in the modern era, i.e. post World War II, that this logic of the treadmill of production became dominant.

Use Value and Exchange Value: Food as Commodity

Central to this study is the contradiction brought about by the triumph of the commodity form and exchange value over use-value, which has become a central component of the global agri-food system. Within this social process lies the key to understanding the exploitation of nature and labor and environmental degradation. In the simplest terms, the tendency to focus on, or better to obsess over, exchange value ignores an item's fundamental, real world usefulness that is realized in its use or consumption. As Marx (1977) explains in Vol. I of *Capital*, "The usefulness of a thing makes it a use-value" (126). An exchange value is a commodity's quantitative market value that is determined by the existing social relations, i.e. it is socially constructed/determined and historically specific.

In Sicily and the greater Mediterranean, bluefin tuna has historically been a central source of protein and its value in the local Sicilian and foreign market reflected this. Under historically specific social conditions, a significant source of nourishment, sustaining populations in this region for millennia, has been transformed into a luxury food item for wealthy populations in the industrialized/developed world. In the modern capitalist era, its use-value as a source of calories and nourishment is, at best, secondary to its value in exchange, which is a reflection of socially constructed status and prestige related to the consumption of sushi and sashimi.

In this form, purchasing and consuming bluefin in many of the major global metropolitan centers of Japan, Europe, the United States, and a few semi-peripheral nations, becomes a way to communicate one's taste for fine cuisine, or better, one's ability to afford it. Its inflated value on the market is a modern phenomenon that reveals the nature of a system of food production that is not based on providing basic sustenance to human populations, but for expanding profits. In the logic of neoclassical economic theory, this quest for profits can and will provide for social well-being. As demonstrated in the case of the ABFT fishery however, it is resulting in the relentless exploitation of nature and the destruction of a species. This has had profound social and ecological consequences, not the least of which has been the collapse of the traditional Sicilian *tonnara*.

In the quest for profits, all capital expenses or costs are to be avoided, or at least reduced to the lowest levels possible. The logic of capital accumulation calls for "efficiency." However, efficiency is defined in monetary terms, not in social or ecological terms. As a result, methods are sought that increase the returns on investment through means such as expanding capture technology and reducing labor costs; as the fundamental sources of value, labor and nature are exploited to the benefit of investors.

The potential to increase exchange value of agri-food commodities by adding value through processing food products is also an important trend. This has been occurring in the industrial agri-food system for decades, as agricultural products are transformed into a number of industrial inputs for the mass production of processed or fast foods (Friedman 1993; Goodman 1991). As fresh fish was generally considered a commodity where little value could be added through processing, expanding captures was usually the easiest way to expand returns. However, with the onset of tuna ranches, the process of fattening adds value to the captured live tuna, thus providing an opportunity to increase the exchange value of the bluefin without any meaningful impact on the use value of the resource.

It should also be considered that, in the process of creating profits, agri-food business attempts to pass off as much of the possible costs of production to society at large, a practice that economists call "externalizing" costs. Thus, the costs of ecosystem disruptions that are caused by overfishing are not paid for by TNCs that are profiting from a production system that has over-exploited the stocks. The ecosystem services that are provided by nature and the benefits to human societies are, to use Schnaiberg's (1980) term, disorganized by these commodity production processes and are paid for by society. The long-term ecological problems that result have a variety of implications and costs for human populations and must be addressed in one form or another.

It is not surprising then, as Foster (2000) states, that Marx considered "the contradiction between use-value and exchange value engendered by capitalism… to be one of the foremost contradictions of the entire dialectic of capital" (168). Understanding the profound nature of this contradiction is crucial for developing any lasting analysis of the modern global agri-food system, as well as any possible alternatives or solutions. Exchange values are not, as neoclassical economists and other like-minded theorists would like to believe, derived from nature. As established earlier, bluefin tuna went from a staple in the diets of early Mediterranean civilizations, to a generally poorly regarded global commodity in the Western world, and then to the king of sushi for the global elite under late-modern capitalism. Surely, the physical characteristics of the tuna remained the same throughout this time. However, its market value was transformed by a phenomenon that can only be social in character.

The exchange value of the commodity form in capitalist societies is shaped by socio-historical conditions that have little or nothing to do with the natural quality of the item, in this case the food source. The quantitative value takes precedent over the qualitative value, much the same way that quantitative economic growth overshadows qualitative aspects of society and nature. Anything that falls outside the cash nexus is essentially valueless in economic terms. This contradiction has profound implications, which will be developed further as I turn towards framing the analysis utilizing Marx's conception of social metabolism and the metabolic rift.

Metabolic Relations

Most of the remainder of this chapter will focus on the developments in the Sicilian bluefin tuna fishery using the concept of metabolism and the metabolic rift. This theoretical perspective will highlight crucial aspects of the nature and society relationship in the Sicilian bluefin tuna fishery, underscoring the contradictions that develop in the modern era. This approach will, in true radical tradition, attempt to get at the root of the socio-ecological issues and concerns in this fishery.

Marx utilized the concept of socio-ecological metabolism to better comprehend the relationship between society and nature, recognizing that humans were both natural and social creatures. These metabolic relations are regulated by nature on the one side, and society on the other (Foster 1999a). As Marx described, through the labor process, human societies mediate and regulate the metabolism between humans and nature. The ways in which human labor is socially determined provides the social conditions for human-nature metabolism.

By examining the production process, and specifically labor, we can gain insight into the human relations to nature. Humans have been accessing ocean resources for millennia. For example, coral reef fishing by Aboriginal communities in the western Pacific has been occurring for about 40,000 years (Jackson et al. 2001). However, the ways in which human societies have accessed and utilized these resources have been transformed significantly. More than the level of available technological capability, human interactions with nature, in this case with the oceans, is mediated by a variety of social factors. Also, science and technological development are very much shaped by these social factors, which today include the dominant frameworks within economic, political, and educational institutions.

Focusing on the processes as a metabolic exchange provides a dialectical approach for examining these issues. Humans interact with the oceans when extracting resources for nourishment. I provided some insight into the social relations and labor in the *tonnara* in Chapter III and IV. In these chapters, I described a kind of labor that spans many modes of production, and provided an example of the ways in which social relations transform the natural conditions and the labor process. I will develop this further first by an examination of the system of production utilizing the conception of coevolution that is central to the Marxist framework, and then through a discussion of the transitions to the modern capitalist fishery and the emergence of a rift in metabolic relations. I will then elaborate on the furthering of the rift by tuna ranching, and detail the environmental transformations and their implications. The chapter will conclude with a discussion of the impacts of the socio-ecological transformations on communities and culture in Sicily, and the collective importance of the *tonnara* in these fishing communities.

The approach developed in this chapter brings to light the metabolic rift created by social relations, which are governed by processes that are central to the advancement of the capitalist competitive market system. This approach enters into terrain that other theoretical approaches, such as neoclassical economics and ecological modernization theory, avoid. Thus, it allows for a study that brings out key aspects of this issue that would be left out of other analyses.

Clausen and Clark (2005) have done much to explicate the ocean crisis within capitalist production using the metabolic rift approach. Extending the metabolic rift to marine ecosystems, they described how the processes of modern industrialized methods of production, which are adopted in order to serve the needs of capital, are disrupting a number of the ocean's ecological cycles, such as the reproduction rate of fish and the energy transfer through trophic levels. In addition, the works of Clausen and York (2008a; b) have provided the insight that a sociological approach can provide for understanding concerns related to marine environments. Building on these works, this research examines the specific disruptions have been developing in the modern Sicilian ABFT fishery.

Applying the metabolic rift as an analytical framework, clarifies that environmental concerns are not necessarily located in problems related to population growth, a particular technology, or personal attitude, but in the social relations that provide the context for production and, more broadly, social life. In addition, this approach informs us that the decay of the *tonnara* in Sicily is not the result of a self-propelled scientific process meeting existing or impending social needs, the selfish attitudes of fishermen, or the inevitable "tragedy of the commons," but the search for a specific way to increase the added value of bluefin tuna, and to expand the global market for a luxury food item.

La Tonnara: The Coevolution of a Sustainable Fishery

Through this examination of the history of the Sicilian *tonnara* it becomes apparent that this method of fishing developed through a long process of society and nature coevolution. As societies began to gain knowledge of the biology of the bluefin, particularly the timing of its reproductive period and its behavior during this period, they developed simple trapping systems. As a result, these trapping systems allowed earlier societies to enhance their understanding of bluefin behavior and processes, and expand their food source. This leads to further adaptations in the trapping systems until the *tonnara* developed, probably between the ninth and eleventh centuries (Consolo 1986; Sarà 1998).

Bluefin tuna seek warm, limpid waters in order to reproduce, and venture close to the coastline during their reproductive period. The *tonnara* system of trapping historically developed in harmony with the biological processes and the environmental conditions that allow bluefin to reproduce in this region. Benefiting from these processes, societies were able to capture large bluefin tuna that provided a significant part of the nutritional needs for local communities and even allowed for a surplus to be traded with other communities and nearby regions (Lentini 1986).

As described in detail in Chapter III, the *tonnara* system of trapping captures migrating tuna and corrals them into a system of nets. This large apparatus is divided into multiple "chambers," where tuna circle until they are escorted to the *camera della morte* and harvested in the famous practice called *la mattanza*. The entire process is finely balanced with the bluefin's behavior such that the bluefin is hardly affected by the process until its conclusion. While it is impossible to know the bluefin's specific response, many who have first hand experience have commented on the "contentment" of the tuna once trapped in the tonnara. As Giuseppe Solina, a *tonnaroto, sotto-rais,* and later *Rais,* who worked in the tonnara in Trapani and Libya for more than fifty years explained:

> "Tuna can stay in the room for a month. They keep moving in circles. Once they get established, they continue to turn. They are not bothered; they are in love.... They get habituated. Sometimes, even when you want them to, they do not want to move out of the room, they continue moving in circles."

The bluefin adapt easily to the environment of the trap. Noting that "they are in love" may sound patently anthropomorphic. However, we should consider that the bluefin is a highly sensitive creature that requires specific conditions in order to reproduce. The ocean conditions described previously are essential, but more, its reproduction may be affected by a variety of other external circumstances, for example crowded conditions, excessive noise, pollution or other stress provoking conditions.

Inside the *tonnara*, the bluefin behaves in a way similar to its behavior outside of the structure. That is, the structure is designed in such a way, and is large enough, that bluefin tuna continue their reproductive behavior inside the trap. Ninni Ravazza, a scuba diver for the tonnara in Bonagia from 1984 until its closure in 2003, described the reproductive conditions in the tonnara. In his capacity as a scuba diver, he had first-hand view of the bluefin's behavior on a daily basis. He explains that bluefin tuna reproduce:

> "...until the final moment, until they are harpooned by *tonnaroti*. The tuna are not under stress. During the period of May through June they are fully in their period of sexual reproduction ...[in the *tonnara*] they are not stressed. They are *tranquillissimi* (very calm). There is not even an attempt to escape. They are in the nets, and during this period they do not eat, they do not look to escape since they are not chasing prey. The tuna in the *tonnara* does not have a great interest in searching for food ... in this moment [it] is a serene tuna, a tuna that tranquilly continues to reproduce. In the middle of June after they have finished their reproductive season, they again to feel the pangs of hunger and begin to search for prey. That is why the *mattanza* must be held usually by the 15th or 20th of June. If you wait too long the tuna will try to escape, they will look for an exit above or below, and many will escape."

In his memoirs on the years he spent working in the tonnara, *Diario di Tonnara*, Ravazza (2005) states:

> "I have seen tunas make love, and I was touched to tears by this miracle of nature. I have seen them *surriare* (rub along their underbellies) and then return to their circular path" (translated from the original Italian, 151).

That bluefin tuna continued to reproduce inside the traditional trap "until they are harpooned by the *tonnaroti*" is no small matter. This fact is undoubtedly one of the key features that allowed the *tonnara* to function as a viable method of capture for centuries. Large tuna of reproductive age entered the trap and proceeded to engage in the instinctual reproductive activity that had drawn them to this part of the ocean.

The trap's large size was also crucial for allowing the tuna to maintain its reproductive behavior. Since tuna are ram ventilators, they must swim constantly to allow water to flow through their mouths and gills in order to extract oxygen. The large traps allow them to move freely and maintain the constant motion necessary for life. It must have been clear to early fishers that the tuna will suffocate quickly if they are not able to move about and that they tend to react negatively to crowded conditions. Why else would they have constructed such massive traps with very large "rooms?"

This leads to another simple yet significant question: Why did early fishers transform their simple net capture technology into the large and elaborate *tonnara*? That is, why was the technology transformed from the Phoenician and Greek system that captured bluefin tuna in nets and immediately hauled them to boats or to shore? While it may impossible to definitively answer these questions, it is fair to say that there must have been some real material benefit that the *tonnara* system had over the older technology. My analysis concludes that this benefit emerged with a system that was more efficient and productive in that it could continue to trap bluefin at the same time that others were harvested. Once the *tonnara* was constructed, the bluefin could be moved and harvested, while the structure stayed in place ready to capture more that same day.

Interestingly, and quite importantly, early fishers began to understand that bluefin tuna could stay in these large "rooms" quite comfortably for many days or weeks at a time. These *tonnaroti* recognized that the *camere* must be large enough to allow this, and that the tuna could be corralled and moved, as more than one *tonnaroto* communicated to me, "like sheep" throughout the trap. Thus, the trap does not harm or upset the tuna behavior, and as a result, is developed to work almost seamlessly with bluefin ecology. The trap, adapted over long periods of intimate interaction with the bluefin, was designed in such a way that it functioned closely within its reproductive biology. Ecologically speaking, this is a vital part of creating a sustainable fishery.

There were many other factors that allowed this method to sustain captures and maintain bluefin populations, which should also be clarified. It is significant that the *tonnara* was a selective fishery. Unlike modern industrial methods of capture that utilize high-technology to locate and capture tuna, due to its design and fixed nature, the *tonnara* could not, and did not, capture fish indiscriminately *en masse*. The *tonnara* was constructed to trap bluefin as they reach coastal areas in locations that had been determined to be strategic sites for the trap. In doing so, the traps captured spawning age fish as they embarked on their annual reproductive journey.

Small ABFT of non-reproducing age were rarely, if ever, captured in the *tonnara.* This was in no small part due to the mesh size of nets in traditional traps, which were relatively large. I have directly observed these nets and many of them were large enough to provide an escape for smaller, young bluefin tuna. Thus, very small tuna, as well as small fish of other species, could easily avoid the confines of the trap. Only the *coppo* (bottom net) in the *camera della morte* contained a reasonably small mesh size to assure the capture of all fish that entered into it and still maintain strength. But fish of smaller dimension would rarely reach this part of the mammoth trap[97].

In addition, the *tonnara* was selective in that bluefin tuna that did not come near enough to the coast and stayed outside the area of the trap remained free. Due to its fixed nature, a bluefin that did not enter in its area could avoid the trap. Indeed, many tuna would avoid capture each year and continue on their migration paths unaffected.

The fixed trap was limited to the number of bluefin tuna that entered into its strategic positioning. But, no matter how strategic and knowledgeable the *Rais* and *tonnaroti*, captures in the *tonnara* would always contain a random element. This is clearly represented in Graph 9 derived from data compiled by Cancilla (1972). It displays captures of bluefin tuna in Favignana and Formica, off the western coast of Sicily from 1738 through 1813. These two very productive *tonnare* could not avoid the inconsistent nature of production associated with the traps. As is displayed in the graph, there were some general trends toward increases or decreases in captures over time. However, there was a large degree of variation in captures from year to year. In this

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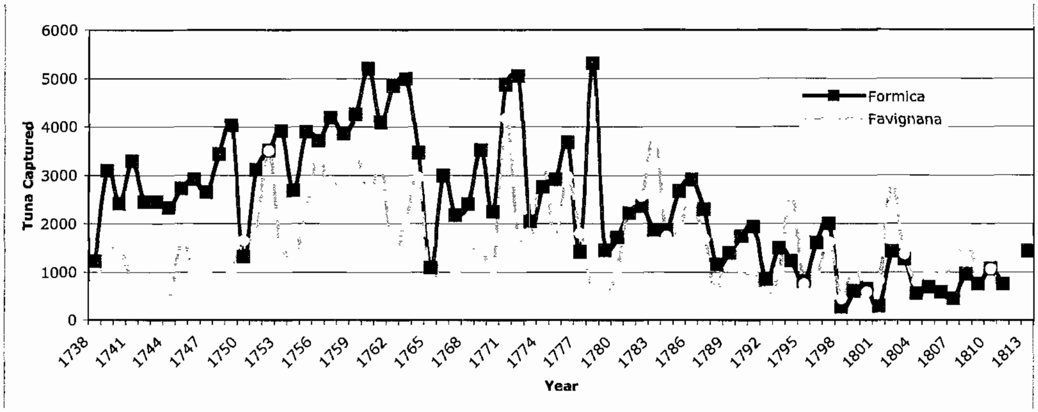
[97] Practically, smaller mesh sizes were more difficult to handle in the ocean and, particularly in early years when nets were made of natural fiber, became very heavy and labor intensive as they became water logged. The natural fiber also played a role in the trap's selectivity in that a large tuna could break the nets if they attempted escape. Breaks or openings deeper than fifteen meters or so were difficult to see from the surface, and the odd tuna that found any openings could escape. This changed with the adoption of nylon nets in the modern *tonnara* and required the addition of scuba divers to the list of crewmembers to, among other things, remove dead or dying tangled tuna from nets.

example the most drastic were in Formica from the years 1776-1779, which recorded captures of 3,673, 1,416, 5,314, 1,455 bluefins for each respective year.



Graph 9: Tuna Captures in Favignana and Formica (1738-1813) (Cancilla 1972).

Inconsistencies are inherent in this form of capture. Fisheries scientists and marine biologists have posited that year to year variability in environmental factors and seasonal processes such as climate, currents, ocean temperatures, and salinity can affect the bluefin's behavior and may make them more or less vulnerable to certain types of capture (Fromentin and Powers 2005; Sharp 2001).

From the historical record, it is apparent that fluctuating captures were quite normal and likely expected to some degree. However, in the modern era of the *tonnara* that corresponds with private ownership and emerging capitalist relations, owners attempted to increase the efficiency and consistency of captures. In the latter half of the twentieth century, many of the attributes that made this system sustainable were impediments to expanding capital returns. Eventually, when it could no longer meet the needs of global agri-food conglomerates, it was abandoned for more efficient, technology intensive methods that could locate tuna before they approached coastal areas.

The *tonnara* in Bonagia is an interesting example. Many of the participants that I spoke with were confident that the *tonnara* could have continued in this location after its closure in the first years of the twenty-first century. The *tonnaroti* saw the decision to close, as by and large a business decision made by the owners of the *tonnara* Nino Castiglioni S.a.s. Participants stated variations on the theme that it was no longer in the owner's interest to finance the activity of the *tonnara.* Giuseppe Trapani *tonnaroto* in Bonagia in its last years stated:

> "What has changed is the system of interests, they have interests and they want to speculate in other areas. In my opinion, this is what has changed.

Giussppe Solina adds:

> "Part of it was the diminishing catches… we used to catch many fish of 150-300 kilos and the difference in recent captures was significant…part was the Japanese had certain demands, the other was that the new owners were importing tuna from, I think America, so that they could process and can them… There is much money to make and they would say "Why should I invest in the *tonnara* unsure if I will get the return." The ocean is not secure."

There are many aspects of the decision to shut down Bonagia's *tonnara.* But the global trade in tuna became the source of one of Sicily's largest tuna processing companies. This was a more secure investment.

As demand for sushi increased dramatically, industrial fishing operations began to enter the fishery and provide larger, more consistent captures using computer technology to locate and capture bluefin in the Mediterranean. This was even more pronounced as

Pacific bluefin were overfished by Japanese fleets and industrial fishing operations needed new sources of bluefin for a growing market. Very different from the *tonnara* system, industrial fishing tended to maintain or increase captures every year. The natural fluctuations that were always part of this fishery were not a great obstacle for methods that had at their disposal locating technology and high-powered boats.

That trap fishing in the region was able to maintain captures over such a long period of time was directly related to the way in which it evolved along with the collective knowledge. *Tonnara* traps were capturing significant amounts of large bluefin, but there was no way to be sure how successful captures would be each season. Nevertheless, throughout Sicilian history, bluefin were captured annually and usually of sufficient quantity, which had direct material benefits on the small communities that captured them (Consolo 1986).

For example, according to the eighteenth century Pallavicini Archives (Calleri 2006) for the year 1759, seventeen of Sicily's *tonnare* captured a combined total that exceeded 21,000 bluefin tuna. Using a conservative estimate, this would tell us that about 2,700 tons of bluefin were caught in these seventeen Sicilian *tonnare* alone in that year, and thus provides an indication of the fishery's productivity[98]. Considering that today's management regime regulates that a maximum of 26,500 metric tons can be captured in the entire Mediterranean each year, it is quite likely that the trap system throughout this region, including Europe and North Africa, often captured roughly at this

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[98] Chapter I cited scientific studies that determined an average size ABFT is about 300 to 400 kilograms. I use a conservative average of 250 kilograms to make this estimate.

level. In fact, according to Antonio DiNatale, fisheries scientist and Italian delegate to ICCAT, in some years traditional Mediterranean tuna traps likely exceeded this amount of total annual captures.

One major difference in this respect is that, due to the dictates of capital expansion, the modern fishery increased effort in order to capture more bluefin each year. Bluefin populations, while relatively abundant, had to withstand an onslaught of capture technology year after year for a series of decades. This consistent pressure, tied to the break in the reproductive cycle, has impacted the stocks to such a degree, that today, even with increased efforts, captures have leveled off and are dropping (ICCAT 2007). As many *tonnaroti* informed me from first hand experience, captures have been diminishing in quantity and weight of bluefin.

The downfall of the *tonnara* was not necessarily related to inadequate technology for supplying marine products to regional populations. Rather, it was not easily amenable to the needs of an expanding agri-food business capital. Additionally, new systems of production were eventually developed (i.e. ranches), that created a level of control over bluefin production that was not possible before. The *tonnare* was a productive fishery that was selective, and importantly, did not interfere with the bluefin's reproductive behaviors. The historical record shows that captures were inconsistent, yet I find no indication that lower captures impacted local communities in any significant manner. I find no record of hunger and deprivation in these communities related to lower captures. More likely, it affected surplus product available for export.

Finally, the *tonnara* was a seasonal fishery. Bluefin tuna were fished only during the spawning season. While the reasons for seasonal fishing for bluefin are obvious, due to the fact that the bluefin inundate the area during this part of the year, this seasonality had beneficial consequences for the region's other fisheries as well.[99] As discussed elsewhere, in these fishing communities, fisherman would turn to the *tonnara* as a source of employment during the spring and summer. As a result, during this period, fisherman would, as one participant in my study noted, "give the ocean a rest." That is, there was very little other fishing activity occurring at this time, as most people in the fishing sector were in someway working in the *tonnara*. In fact, fisherman discussed the importance of seasonal fishing with me on many occasions. They had a clear understanding that these customs, practiced for centuries, had benefits for sustaining the stocks of many species in the region's fishery, including the bluefin.

Capitalist Transitioning: The Emergence of a Rift

The characteristics described in the previous section were important aspect in developing a sustainable fishery for bluefin in this region. Some may argue that this sustainability can be regarded or explained as a function of limited technological capability of the *tonnara* system. It is important to remember, however, that increasing captures, that is making the trap less selective, could have been addressed to some degree even with the limited technology of earlier periods. For one, traps could have been

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[99] Mediterranean bluefin are still fished during this season. However, as mentioned, purse-seines capture them before they reach the coastlines, somewhat earlier than the trap system.

moved further out to sea to increase captures. This is exactly what occurred in the late years of the tonnara in Bonagia and Favignana. As purse-seine fishing impacted populations and captures fell in the existing *tonnare*, the traps are moved out as far as 3,000 meters from shore. Also, the mesh size of nets could have been reduced to diminish the loss of smaller bluefin. This likely would have made the work of pulling nets arduous, but would have had little impact on the decision making of owners attempting to maximize profits. This too was adopted in the later *tonnare* as industrial fishing impacted stocks.

These decisions to change aspects of the traps were not driven by diminishing catches alone. They began in earnest in the late nineteenth century and were, for one, initiated by the Florios, the owners of the largest *tonnare* in Western Sicily, discussed already. By and large, capitalist social relations were set in motion and began to dominate in Sicily after the *Risorgimento*. As discussed in Chapter IV, the ownership patterns shifted towards privatization, as individual families begin to purchase and own *tonnare* throughout the region beginning in the seventeenth century and continue until all *tonnare* were privately owned. This had lasting effects on the practices in the *tonnara,* including the decisions to alter methods discussed here, as well as others to make the system of capture more "efficient," by requiring less labor, making captures more consistent, and reducing operating costs. Many of these alterations could have been easily adopted in earlier (pre-capitalist) periods, but they were not. As shown in Chapter IV, these practices do not transpire until the emergence of the capitalist era.

Before the onset of modern capitalist relations, the idea of increasing "efficiency" was not present in the sense described here. This began to change as private owners sought greater returns on their investments and growth in production, notions that were foreign to earlier social forms. Indeed, in the earliest periods of the *tonnara*, particularly back to the Arab period in the ninth through eleventh centuries, the idea of investing in the *tonnara* for growth in capital returns was nonexistent. Even with the transition to Norman control in the twelfth century and the emergence of feudal relations, this conception of increasing wealth and reinvestment for growth is absent. Feudal kings extracted surplus wealth from the *tonnara*, for example through rent and taxes, but did not invest capital and expect it to expand. Instead they provided the social organization for production, mostly through protection or force. Surely markets existed, but in a much different form than they exist today. As discussed, all aspects of life were not dependent on market transactions. In fact, most basic needs were met outside the market (Meiksins-Wood 2000).

Furthermore, feudal *gabelloti*, managers of the tonnare and leaseholders, did not seek accumulation, growth on investment for reinvestment, or new methods of "efficient" production. This slowly comes about when the Genovese bankers began to invest in the *tonnare* of Sicily in the seventeenth century, precisely as capitalist social relations were expanding throughout Europe. Nevertheless, the logic of expanding capital at all costs is not a governing principle until much later. By the middle-late twentieth century, the capitalist commodity form dominated, and market exchange value became a central focus of production.

The consequences for the Sicilian bluefin tuna fishery were disastrous. While many adaptations were made to the *tonnara's* technology, it is never truly amenable to the imperatives on the new global market. In order to address this, new technologies were adopted in this fishery in order to capture increasing amounts of bluefin and extract increasing profits from the oceans, that is, industrial fishing and later ranching. The new systems of capture were implemented with quantitative expansion in mind, and had little regard for the ecological or social consequences.

In the modern era, large purse-seines hunt down bluefin in the deep sea, and the relations that sever the bluefin's reproductive process emerge. Oftentimes, bluefin are captured before they reach their spawning grounds or are captured at pre-spawning age. Purse-seine technology, the preferred method of industrial tuna capture, does not necessarily distinguish between younger or older bluefin. As detailed in Chapter V, capital and technology intensive methods are used to expand the capture effort, including faster boats, sonar and spotter planes. This has had dreadful impacts on bluefin stocks in the Mediterranean. Nevertheless, these technologies are much more effective at providing for increasing global demand and expanding profits. In particular, new methods are developed for providing bluefin for the fattening process, which creates an important opportunity to add value to the global commodity.

These industrialized methods create a rift in the metabolic relations in this fishery. Just as Marx described a rift caused by the decreasing fertility of the soil in his era, as capitalist agriculture was exploiting (robbing) the future productivity of the land, capitalist fishing creates the conditions to exploit the fishery and rob it of its future viability. Industrialized food production has created conditions on land and sea that disrupt the multitude of ecological systems and cycles. Marx highlighted the earliest crisis of capitalist agriculture and the slow depletion of the soil that it brought about. This rift has been exacerbated by the industrialization of agriculture that occurred in the twentieth century, and the technologies that this approach promoted, including the mass consumption of synthetic fertilizers, pesticides, the expansion of irrigation systems, and hybridized seeds. These industrial methods of production serve the needs of agri-business capital, but in the long run, undermine themselves as they degrade the soil ecology and, generally, other natural systems.

In the oceans, a parallel process has taken place. Industrial methods to produce fish for global seafood markets have expanded in recent decades. Mirroring the green revolution, the "blue revolution" [100] has been promoted to address the challenges of increasing food production for increasing populations. This method has been implemented for the production of a variety of high-value marine products including salmon, shrimp and sea bass. However, it is well known that these methods of production have high ecological impacts due to their large-scale intensified methods (Clausen and Clark 2005; Naylor et al. 1998; Naylor et al. 2000; Pauly 2004).

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[100] The "blue revolution" is the moniker adopted by industry for the production of seafood under industrialized "farming" conditions.

Furthering the Rift: Tuna Ranches

A promotional video for New Eurofish (2007) states:

> "Today there is a new tonnara… where the ocean is the same… the tuna is the same… and man is the same…but what has changed is the technology!"

Business interests frame tuna ranching in Sicily as the new and modern *tonnara*. The implication is that innovative modernized technology is improving on the old trapping system. This is very appealing to many in this region, particularly those interested in economic development and promoting business growth. The *tonnara* and its very labor-intensive methods are regarded as quaint, but backwards. Their representative, a participant in this study, echoed the sentiment:

> "The technology has changed and the market has changed, but the profound rapport that ties Mediterranean people with the tuna is unaltered."

Unlike the traditional *tonnara*, the modern industrialized practices associated with bluefin tuna captures in the Mediterranean are based in a technology and capital intensive approach that developed over a relatively short period of time. These methods focus on maximum output and control while utilizing minimal labor power, and have a utilitarian regard for the conditions that are involved in the bluefin's ecology, or the broader ecological conditions.

Today, the central goal in this fishery is to expand the global market and increase added value and returns on capital investments. The social imperatives of expansion and competition, structured by the institutions of modern capitalism, create an irresistible drive to increase captures and supply this global commodity, whose market value has increased dramatically. In doing so, new technologies have been developed in order to enhance the opportunities and prospects for those investing in the marine products sector in the Mediterranean.

The most recent phenomenon that has taken hold on this fishery is the initiation and growth of tuna farming or "ranching."[101] Beyond this method's ability to increase the added value of the marine food commodity, this technology has allowed producers and suppliers of ABFT in the Mediterranean to increase their control over the processes of bluefin tuna production. It has gone a long way towards eliminating many of the challenges regarding inconsistencies and so-called inefficiencies that were inherent in the *tonnara* system. This method has increased the potential for the industrial production of bluefin tuna for expanding capital returns, allowing producers to directly manage and manipulate the quality of the product they offer for the market. This is done by developing feeding regimes that increase the fat content of the tuna to levels that will fetch higher prices on the global sushi/sashimi market, increasing the added value of the product and establishing a level of management of the captured species not possible with earlier systems. Thus, ecological cycles become subject to the whims of the economic cycles of capitalist production (Clark and York 2008).

This process increases production and value of a high-value global market commodity. This has often been regarded, in the neo-classical economic view, as having potential benefits for both the environment and society through increasing economic activity and expanding wealth. While this growing industry has created wealth, it is not

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[101] This was discussed in detail in Chapter V.

tied to the local communities that are the sites of the production process. In addition, there have been numerous concerns resulting from this industrial activity, including overfishing, impacts on local ecosystems, energy inefficiency, pressure on global fish stocks, a severing of the bluefin's life cycle, and the loss of a cultural heritage and knowledge central to Sicilian fishing communities.

Overfishing

As returns on investments increase and market opportunities open up for a variety of actors in the ABFT market, specifically the largest TNC, the metabolic rift that emerges as a result of industrialized efforts is furthered, rather than mended. The ecology of the bluefin is additionally disrupted and the energy expenditures intensify dramatically. These effects have put the future of the Mediterranean bluefin stocks in serious doubt.

Bluefin tuna "ranching" has become the standard industrial method in the Mediterranean for producing this species for the global market. This follows decades of large-scale long-line and purse-seine fishing that expanded the capacity of the fishery enormously. As industrial aquaculture of large predatory fish becomes more popular around the world, this system of production is transferred to bluefin tuna. However, because tuna are highly sensitive creatures and have not thrived under conventional farming conditions, it is not a seamless transition.

Although there have been great investments and effort put into developing industrial tuna aquaculture, in which the entire life cycle of the bluefin tuna are controlled and reproduced, this has not yet come to fruition in any practical way[102]. As previously mentioned, "seed" fish or wild captured bluefin are contained for fattening in tuna ranches. Unlike most forms of industrial aquaculture, all ABFT traded on the world market reared in ranches come from wild stocks. While other types of industrial aquaculture have had serious environmental impacts, tuna ranching is in a class by itself in that these bluefin are not reproduced in captivity.

This is of great concern to the viability of stocks, as there is great pressure on ABFT from over-fishing, pollution, increased ocean traffic, and other environmental pressures (Tudela 2002). Tuna ranching cannot make the claim that they are reducing impacts on wild stocks, commonly made by advocates of other types of industrial aquaculture. In fact, this method of production is likely worsening the conditions for the Mediterranean ABFT fishery, creating the potential for collapse. ICCAT (2007) states that:

> "The decline in SSB [spawning stock biomass] appears to be more pronounced during the more recent four or five years ... The increase in mortality estimated with the age-structured model for large bluefin is consistent with a shift in targeting towards larger individuals *destined for fattening/farming*....A collapse in the near future is a possibility given the 2006 stock assessment estimations of the SCRS of the fishing capacity of all fleets combined and current fishing mortality rates, unless adequate management measures are implemented and enforced" (emphasis added, 66).

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[102] There have been some strides made in this process and an Australian firm claims that it has had some success with rearing Southern bluefin and Pacific bluefin in captivity. As of yet, this is still not a production process that is ready for large scale activity (Ellis 2008a; Sawada et al. 2005).

As ICCAT has emphasized, ABFT spawning stock biomass (SSB) has been seriously depleted in recent decades. This is a result of the increasing captures of spawning age fish, but has been exacerbated by the capture of pre-spawning fish as well, since these small fish never make it to spawning age to replace older fish. In the modern industrial fishery there has been little or no selectivity regarding size and weight. While in recent years management policies have regulated minimum size and weight of captures, tuna smaller than the regulated minimum weight have typically been caught with great frequency. In fact, ICCAT (2006) has estimated that up to fifty percent of captures in recent years have come from pre-spawning age bluefin. In 1998, small non-reproducing age fish constituted about half the overall catches of east Atlantic and Mediterranean stocks. Additionally, in the Mediterranean, fish at age zero are frequently captured (Safina 2001). As the bluefin tuna's age of reproductive maturation has been estimated at between five to ten years, when reaching weight of about thirty kilograms, capturing small and young bluefin can have devastating effects on stocks (Block and Stevens 2001).

Tuna reproductive behavior, called repetitive broadcast spawning, requires that tuna have high lifetime fecundity in order to be successful (Schaeffer 2001). Also, larger bluefin spawners tend to have higher levels of recruitment success and their numbers have been diminished greatly (ICCAT 2007). In the current production context, the bluefin tuna's opportunity to reproduce has been significantly diminished. In the Mediterranean, the areas around Sicily and the Balearic Islands are regions that have historically been important breeding grounds with high levels of bluefin tuna reproduction (Schaeffer 2001). These areas have been heavily fished and expanding industrial production has diminished ABFT reproductive success.

In addition, the capacity of the fishing fleet, particularly purse-seines, as registered by ICCAT, far exceeds the total allowable catch (TAC) regulated for the Mediterranean (ATRT 2008b). The bluefin tuna fleet captures are much higher than what the Mediterranean fleet is reporting. Fleets would have to work at very low capacity in order to fall within recorded catches and the designated TAC. At present, most of this fleet is operating to capture live ABFT for the tuna ranches (ICCAT 2007c). As a result, tuna ranches have been central to the expansion of investment driving this growing fishing capacity. As Bregazzi explains:

> "Indeed, should an average observer concede that 100% of all BFT PS [purse-seine] catches between 2003 and 2005 were unlikely but effectively transferred live into tuna ranching cages, [he or she] would then have to conclude that the entire Mediterranean Sea tuna ranching sector worked at 65,25% of its maximum ranching capacity in 2003, 36,18% of its maximum ranching capacity in 2004, 34,96% of its maximum ranching capacity in 2005 and is expected to work at 31,85% of its maximum ranching capacity in 2006" (Bregazzi 2006).

This scenario is highly unlikely considering the competitive nature of this process, the high levels of capital investment associated with it, and, generally, the underlying orientation of the global food system that is geared toward expansion and accumulating capital returns for investors. While, according to official statistics, tuna ranches are only a part of the drive to increase captures, it has been widely accepted that these official records are misleading due to intentional falsification. As a result, tuna ranches are likely producing much more than is officially acknowledged (ATRT 2008a; UN FAO 2005).

Fishing for tuna ranches also increases the capture of non-target species or by-catch. It is impossible for purse-seine operations to capture only the specific species they aim to catch. As a consequence, greater efforts to locate, capture, and transport ABFT results in increase impacts on other marine species (Ottolenghi et al. 2004; Staniford 2002; Tudela 2002). There is also the high likelihood that tuna will be killed during the process of capture or transport, as ABFT are highly sensitive to stress and collisions, which can add to pressure on the species (Tudela 2002).

Local Environmental Impacts: Benthic Ecosystem

Overfishing is not the only environmental problem stemming from this method of production. As with all contained feeding facilities in the ocean, there are a number of impacts on the local ecosystem. The Sicilian coast, like many other areas of coastline in the Mediterranean, is under heavy human pressure from a variety of uses, including tourism, fishing, and shipping. This high human pressure makes for vulnerable ecosystems, as waste materials heavily pollute areas.

Tuna ranches contain a high intensity of biomass enclosed in a small area of sea. These facilities increase the potential environmental disruptions, as feeding operations create areas of condensed populations that results in waste accumulation from excess unconsumed feed and waste produced by tuna (Ottolenghi et al. 2004). Accumulation of organic matter in coastal zones can have detrimental impacts on water quality and, in particular, on organisms that inhabit the seabed (benthic communities). This creates the potential for increased spread of diseases (Staniford 2002; Tudela 2002). In general, the environmental effects of capture-based aquaculture facilities include organic pollution and eutrophication, effects of chemical use[103], algal blooms, benthos modification, and other interactions (Ottolenghi et al. 2004).

High levels of organic matter deposited into benthic communities make them highly susceptible to what is termed benthic eutrophication, or the expansion of algal blooms that can suffocate organisms (hypoxia) (Grall and Chauvaud 2002). Studies done on the tuna ranches and the local ecosystem are still trying to fully understanding the extent of these effects. Recently, Vezzulli et al. (2008) found that tuna ranches have had significant impacts on benthic communities, including higher bacterial production rates and other changes that point to "early changes in the sediment's metabolism" (369). Studies done in the Golfo di Castellammare, the location of New Eurofish, have determined that there has been an accumulation of organic sediments beneath the bluefin cages and damage to macrobenthic fauna and sediments (Santulli et al. 2003). The most intense impacts on the ocean floor were directly below the ranch location and the close proximity. Effects appear to mostly dissipate at about 250 meters from the cages (Santulli et al. 2003). Another study found a dramatic drop in bottom species across time associated with the Castellammare ranch, with generally the similar spatial effects (Vega Fernandez et al. 2003).

According to tuna ranches, the results that find impacts generally limited to 250 meters have been considered evidence of the negligible impacts of tuna ranching, as well

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[103] However, according the participants in this study from the tuna ranching sector, ranches in Sicily do not use chemicals or antibiotics to treat the bluefin.

as the sensibility of its methods. However, it is quite obvious that the most notable impacts from ranching will occur directly underneath the sea cages that house bluefin tuna, as matter drifts down to the ocean floor and some dissipates through currents. The serious ecological impact on these benthic communities, albeit limited by space, adds to the already numerous impacts caused by a host of other socially driven environmental disruptions in this heavily used region.

Another, unforeseen, effect have been the oily slicks that have emanated from the tuna ranch in Castellammare. Many participants described to me the slicks that wash up on the nearby beach, a major tourist attraction for this beach community, in late summer. Apparently, the tons of feed used to fatten tuna not only impact the ocean floor, but result in fatty oils radiating from the ranch location. While there is no indication that these oils are harmful to human health, it creates serious concerns to those who are tied to the tourist industry, as the oily slicks are repulsive to beach goers and tourists.

Energy Demands

Tuna ranching is a very energy-intensive process. The capturing and fattening of fish under controlled conditions only intensifies the energy needs of producing food for human societies. Bluefin tuna are at the top of the food chain and require large amounts of feed fish in order to increase in size. According to the second law of thermodynamics, or the Law of Entropy, all energy transformations result in the degradation of energy sources. Organisms higher in the food chain, high trophic level fish, require much more energy to produce calories for human consumption than those organisms lower in the food chain including, of course, plant life.

Raising carnivorous finfish under industrial aquaculture conditions has become common throughout the world. However, massive marine resources are required to increase the weight of carnivorous fish. With food conversion ration (FCR) at 20:1 or 30:1, bluefin tuna has likely the highest FCR of all species raised in captivity (Aguado-Gimènez and Garcìa-Garcìa 2005; Tudela 2002). Thus, twenty or thirty kilograms of feed fish, which include herring, sardines, mackerel, and sometimes squid, must be fed to ranched ABFT in order for them to increase their body weight by one kilogram.

Feeding top predators in capture-based facilities is inefficient in terms of energy utilization. As described by the high FCR ration, the energy inputs, in terms of calories used as feed, are much higher than the caloric energy available once the fattening process is complete. This is in large part due to the bluefin's high energy demands. For example bluefin tuna are ram ventilators, and thus must swim constantly. Additionally, they have elaborate thermal regulations systems to maintain body temperatures. These physiological factors create the conditions in which it is estimated that bluefin devote only around five percent of their energy towards growth (Aguado-Gimènez and Garcìa-Garcìa 2005).

Ranching is a very fossil fuel intensive process. Capturing ABFT utilizes high-powered boats, and sometimes airplanes for spotting. Once captured, tugboats must be deployed in order to transport the live tuna. These tugs pull cages at the very slow speed of one to two knots for hundreds or thousands of kilometers until they reach the ranching facility. Once on site, the tuna must be fed large quantities of frozen fish. These fish is usually captured in faraway fisheries, such as the Norwegian herring fishery, and then frozen and transported. The feed will be transported once again, via truck, to a feed facility, where they are then brought out to the cages from shore. Once captured, the bluefin are either shipped via air to provide a fresh product, or slaughtered and frozen on board vessels and then shipped across the globe, usually to Japan. It is very difficult to calculate the inputs of fossil fuels required for the production and consumption of ranched tuna. However, this process is obviously extremely energy intensive in that the majority of these modes of transport require massive amounts of fossil fuels.

This process creates a rift in society and nature metabolism, as the process of producing bluefin requires greater energy than is drawn from the caloric energy provided by species. What is more, ABFT, a regional source of food for millennia, are transported long distances, also disrupting the socio-ecological metabolism of the region. This process removes an important source of caloric energy from this region and, using fossil fuel energy (including jet planes), transports Mediterranean bluefin to markets across the globe.

The global transport of food and fiber through trade processes has become commonplace in the modern system of food production. However, these processes of export and trade in food have exacerbated the rift in the socio-ecological metabolism. Energy sources at one time provided by natural renewable energy systems, like the sun, and supplied by regional areas, have been transformed and are now supplied in large part by fossil fuel energy, a non-renewable, polluting, and oftentimes non-local source of energy. The modern Sicilian bluefin tuna fishery is a clear example of a major contradiction created by these processes of "globalization" and food production.

Threat to Global Fish Stocks

Ranching also results in increased pressure on populations of the global fish stocks that are used as feed for tuna ranches. As discussed, this process of feeding bluefin for fattening results in a net loss of energy as more resources are input than energy is returned, and thus translates into a net loss of fish resources. Many of the feed species come from other parts of the world, including the North Sea and tropical and subtropical regions of the Atlantic, thus further expanding the global energy requirements necessary to feed bluefin related to the transport of feed. These fisheries provide species that are commonly consumed by humans, and therefore place direct pressure on food resources for other regions. This is particularly problematic for many parts of the global South that rely on these lower trophic level resources for sustenance.

Additionally, there have been concerns regarding diseases that can be transported by feed fish to local species (Dalton 2004). Through the transport of feed fish from distant fisheries there is the possibility of involuntary introduction of pathogens. "Frozen allochthonous species can be vectors to pathogenic organisms as well as potential aetiological disease agents of autochthous wild populations" (UN FAO 2005: accessed online at http://www.fao.org/docrep/008/y8870e/y8870e00.HTM#Contents).

In order to supply tuna products in Sicily and Italy, Sicilian producers have increased the production of yellowfin, as well as other species of tuna, for "high-quality" markets. Yellowfin tuna is a smaller species and not as abundant in the Mediterranean region. This species tends to aggregate in tropical and subtropical waters with spawning grounds off the west coast of Africa (Figure 13). As a result, Sicilian populations regularly consume canned yellowfin imported from abroad, while most locally produced bluefin tuna (Sicilian and Mediterranean) are exported and shipped thousands of kilometers away. This globalization of production and consumption is a further example of the discussed rift and creates conditions that are ecologically unsustainable.

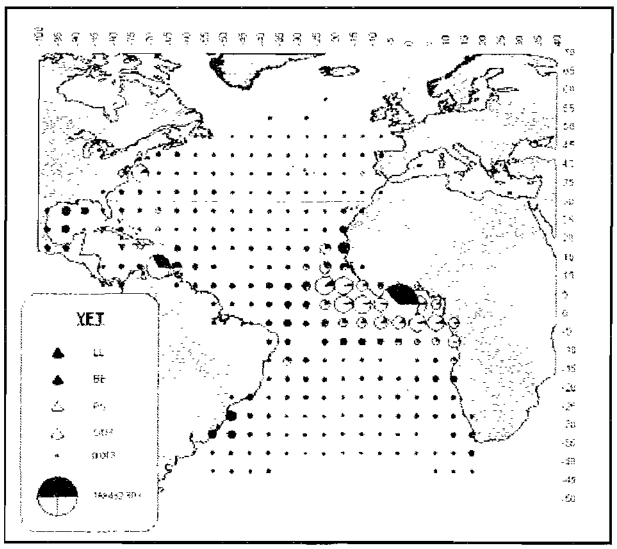

Figure 13: Geographic Distribution of Yellowfin Tuna Captures Between the years 2000-2004 (ICCAT 2007)

Interruption of the Bluefin Reproductive Cycle

Not only is the energy required to ranch bluefin tuna tremendous and the impacts on other fisheries severe, but this system of production directly effects the bluefin's ecology and thus threatens the future of the stocks. In stark contrast to the *tonnara*, the process of capturing and rearing bluefin for ranches, disrupts the life cycle of the bluefin tuna. In the previous discussion regarding sustainability and the *tonnara*, I make clear that the processes of bluefin reproduction that continues inside the *tonnara,* are likely critical factors in maintaining this fishery for so many centuries. In the industrial fishery, this natural reproductive process can no longer occur. The bluefin that are captured and hauled away to cages are regularly caught during May and June, the period when bluefin move toward their spawning areas. Once they are captured by purse-seines and transferred to a ranching facility, the reproductive cycle is broken. Most tuna never reach the spawning area as they are caught on the high seas. According to a marine animal specialist and veterinary advisor for a Sicilian tuna ranch, it is not likely that ranched bluefin will have the opportunity to reproduce because they are caught exactly during their reproductive period. Furthermore, the transport and ranching conditions are generally too stressful for bluefin making it all but impossible for them to reproduce.

Implications of the Metabolic Rift

Japan's high consumption for this luxury food item has created conditions in which the local waters of Japan can no longer supply the bluefin at the level required by industry. The expansionary nature of industrial production within a competitive market system more or less reached its limit in this region, and thus began a search for other areas to provide this valuable ocean commodity. The Mediterranean Sea has become a significant provider of bluefin for Japan and other nations. This entire process clearly creates a rift in the socio-ecological metabolism of the Mediterranean region.

Mediterranean bluefin are mostly sent to Japan, where bluefin populations have already generally deteriorated. This has the impact of not only depleting bluefin populations in the Mediterranean, but also requiring enormous amounts of energy. As stated elsewhere, this process has little to do with providing sustenance for the importing nation.

The ecological significance of this rift is enormous. In the broader ecological picture, ABFT are considered a keystone species. That is, they have key characteristics that play an important role in the health of specific ocean ecosystems. As Schmitz (2007) explains, the term derives from the role that a keystone plays in an arch, providing the structural integrity of the diverse stones that form the arch. As a top predator, their position in the trophic chain is critical. Removal of these important species from the ecosystem will result in changes in population dynamics and a decrease in biodiversity, which can diminish the stability and resilience of the ecosystems (Hooper et al. 2005). That is to say, it can increase the possibility of ecological disequilibrium within an ecosystem (Harper 2004; Pauly et al. 1998). This disequilibrium can play out in a number of ways. For example, the recent significant expansion in jellyfish populations in this region point to the ecological transformation of the Mediterranean fishery directly related to overfishing of large predators, as well as other environmental transformations such as climate change (Rosenthal 2008). Biodiversity is regarded as a centrally important ecological principle for the healthy maintenance of ecosystems.

Communities and the Culture of the *Tonnara*

As has been discussed throughout this dissertation, the Mediterranean bluefin tuna fishery is under great distress. In this chapter, I have explained the ecological consequences of industrial methods of production in this region and beyond. This transformation has had severe social and ecological consequences for the communities involved with the bluefin tuna fishery. While there have been many concurrent factors that influence social lives in the communities in Northwest Sicily, it is useful to examine this one major transformation, in the bluefin tuna fishery, and consider the ways in which this has affected communities.

This issue has had an unmistakable impact on Sicilian life. We must evaluate these changes to determine whether they are affecting the families and individuals that make up the communities in ways which are, on the whole, providing a better quality of life for its members. Additionally, we should consider the changing conditions and whether they allow for future generations to meet their needs as well. That is, do the changes that have occurred and the consequences of these changes benefit the community and are they ecologically and socially sustainable?

In the following section, I will discuss the society and nature dialectic in the bluefin fishery in the Sicilian communities where I conducted research. Undoubtedly, the material and cultural undermining of a community is problematic and can have negative consequences for its human and natural systems. As such, I will consider the effects of the social changes that have occurred in these communities in terms of the relations to the fishery. I will describe these relations, relying to a great degree on the accounts of those that live and or work in these communities.

Community Transformations

Bonagia and Favignana are two of the largest and longest lasting of the Sicilian *tonnare*. In these communities, even today there is still a great deal of interest and discussion surrounding this cultural institution. When discussing the *tonnara* with fishermen and members of these communities, an unmistakable sense of sadness, despondency, or signature Sicilian fatalism, is conjured up by the conversation.

Participants in my interviews often communicated the sense of losing the community's roots and its history. Giuseppe Trapani, a relatively young *tonnaroto* from Bonagia states it clearly saying:

> "This town and the *torre*[104] have a history, a story. And they have finished this story. Because anyone that comes to see the *torre* at this point is sad, *basta*[105]."

Giaocchino Cataldo, maybe the most recognizable *Rais* from Favignana, in his typical original fashion, stated:

> "The *tonnare* in recent years brings grief. In the recent years the smile of the *tonnara* is gone. Previously, the *tonnara* had a smile. I could not wait until sunrise to go to the *tonnara*. In the last years, I could not wait to leave."

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[104] *Torre* is a reference to the seventeenth century tower that is the most prominent landmark of the *tonnara* in Bonagia.

[105] *Basta,* in this context, can be translated as "period" or "end of conversation."

These feelings of sorrow and sadness for the loss of something so important to the community and their lives was not only expressed by those who worked in the *tonnara*, but also by many community members who gained significant, though sometimes indescribable, joy and pride from the culture and life of the *tonnara* in their communities. As we watched the *tonnaroti* prepare for what may have been the last *mattanza* in Favignana, one community member shared his sadness regarding the state of affairs in the *tonnara*:

> "There is nothing, there are no tuna… At one time, it was beautiful, happy… people worked. You felt it. My father worked in the *tonnara*, my grandfather too. I grew up here. As a little boy I used to come here. I remember it well… There was a culture and it was very much part of you. You felt it, you understand, you could feel it. Now it is being lost… You can say without a doubt that it is finished. The *tonnara* is finished, *basta*… It brings tears to my eyes"

As discussed in Chapter IV, labor in the *tonnara* required a great deal of skill and *tonnaroti* developed a keen sense of the environmental surroundings. Workers tended to have a strong desire and even passion to work in this capacity, and they generally describe it as quite satisfying. Furthermore, the work built a collective identity, as the individuals worked in conditions that required cooperation.

Many of these aspects began to fade away in the final years of the *tonnara*. Younger people saw the writing on the wall and did not imagine a future for themselves in this line of work. Watching the *tonnara* fishery collapsing before their eyes, future *tonnaroti* did not express the same interest in staying with it. The son of a family of *tonnaroti* explained that:

> "We young people, even with the passion that my father was a *Rais,* did not have the same enthusiasm as before because you could see where it was heading. You can see it was moving towards an end, and there was no future. You went to work just to work, to make a days wage. And you let it go. You did not go to learn, because it was clear that it was finished. But in the past, no, it was not like this. At one time there was a future and you went to learn and build your future. The young people had no more incentive to learn the *tonnara* anymore, because it was over."

Giuseppe Trapani adds:

> "The *tonnara* went from four months to three months to two months of work. It was no longer something we could look forward to. Rather than a year round work in maintaining and four months of the *tonnara* it was down to two months of low wages."

The *tonnara* system of fishing was more than just a seasonal job for the *tonnaroti*, it was a way of life. It was a central aspect of their community and culture. It was celebrated, and its loss has had significant impacts on the families in these communities. As I have shown, individuals expressed a feeling of loss and sadness that still hangs over the communities, as something so important to their history is gone. Fishing and the culture surrounding it were fundamental for these communities and the *tonnara* was the most celebrated of these activities.

We can see other tangible effects as well. Economically, the *tonnara* was a central source of employment either directly, by working in the *tonnara*, or in related industries including salting, canning, woodworking, and net making. The loss of this source of work was a slow process as new technologies were adopted that replaced the old, equipment began to be manufactured in other regions and countries, made from different elements, and the *tonnara* slowly reduced its captures.

Beyond the *tonnara,* there have been other drastic changes in these communities in the last half century. As discussed in Chapter III, there have been efforts to increase industrialization and service industries, typically tourism, in Sicily. These efforts have impacted small fishing and agriculture communities in numerous ways, including employment opportunities and a transition into an economy that put more emphasis on service industries.

Today, many Sicilian communities suffer from high unemployment, particularly among the younger members. It is difficult to get accurate statistics on the specific unemployment rate for small fishing communities, but in the province of Trapani, Sicily, the rate of unemployment in 2003 was thirteen percent, and for residents below the age of twenty-four it was above thirty-six percent. This is compared to an unemployment rate in Italy in the same year of almost eight and one-half percent (ISTAT 2008). Furthermore, Sicily has commonly had the highest unemployment rate of any Italian region (ISTAT 2005). In 2003, the unemployment rate throughout Sicily was over twenty percent (ISTAT 2008).

The tuna ranching system promised jobs to the local economy. Much in the form of neo-liberal rhetoric, the system was pitched to the locals as an opportunity to increase economic activity and jobs in an economically depressed region. As the Antonio Ancona, Mayor of Castellammare del Golfo (1998-2004), explained:

> "There was an accord, more verbal than legal. We were given a guarantee of a certain amount of position for mariners as well as those working on the land for Castellammare. But the firm did not maintain them. They sponsored community activities the first years. They gave 30,000 euros for the feast and some also for sport. But the real proceeds are modest. The

> first two or three years, they invested in sport and cultural activities.... It is a multinational, Spanish, Japanese, and a group from Marsala. The local participation is minimum... an international group. There are Sicilians but, proceeds to Castellammare are relatively small. There were about 40 mariners employed, but slowly [most are not employed anymore]. There is no doubt that it [tuna ranching] is a productive activity. There is a return [for the community], but even though, it is not what we expected."

Furthermore, during the twentieth century Sicily experienced periods of mass emigration to Northern Italy, Europe, particularly Germany, and the United States (Ginsborg 2003). In these small Sicilian fishing communities, it is very common to find individuals with family and friends who have emigrated. Fisherman and community members regularly shared with me the fact that they had cousins, aunts, uncles, sisters and brothers living in the United States. In fact, my own immediate and extended family is a good example of this. As Salvatore Spataro noted:

> "Favignana has little fishing left and is developing mostly towards tourism. People come and rent boats and things and this creates a little work. The *tonnara* provides little anymore. If the *tonnara* finishes, it will affect tourism some... The economy here is getting worse. Everywhere it is getting bad, but here it is worse. There is little left....People here often look to immigrate to North Italy or abroad where there is more work. I know many people who left. Some in my family have left. I have family in the United States..."

Many communities have experienced vast demographic changes. Favignana is useful to examine, as it is an island community with a major *tonnara*. According the the Comune di Favignana (2008), in 1961 the island had a population of 6,626 residents. By 2001, only 4,137 residents remained on Favignana, an almost thirty-eight percent reduction. Interestingly enough, Favignana faces a housing boom as wealthy Italians purchase or construct vacation homes on the island. Vacation homes are growing "*come* *le funghi*" (like mushrooms) all over the island. This has had the effect of increasing home values and making it quite difficult for potential first time homebuyers on the island to purchase their own homes. As Giuseppe, a young fisherman who came from a long line of Faviganese fishermen described:

> "See all that land? That used to be countryside. We would hunt there. Now it is all houses. There are people that can't pay their rent that live here and people that have big homes that come maybe once a year from Palermo, Torino, Milano, from all over. The price of homes will scare you. 250,000 Euros! How is a fisherman supposed to buy a home? If I go into a bank with my income, they will throw me out. What am I supposed to do? Those that have money come from outside and buy homes. For the residents who live here all year round, we will have to leave the island to make earnings. How can I buy a home? The prices are in the stars! How can we compete with those that are from outside?"

Individuals who used to make their living from the sea must either look to the tourist industry, look for work elsewhere with the hopes of coming back one day, or leave the island altogether.

As the ecological conditions change in these communities, that is, as fish stocks are diminished due mainly to overfishing, residents are affected in a variety of ways. Those in the fishing sector must look to other ways to make a living; young folks do not see opportunity in it any longer. Labor that is regarded as satisfying and rewarding, must be given up for more lucrative earnings and individuals and families sometimes find it necessary to leave their communities in order to do so. As these regions become tourist attractions, the cost of living, particularly the values of homes, increases, as vacation home-buyers flood the market, creating conditions in which long time residents are priced out of the market.

The culture in these communities, aspects of life that made these areas unique and supplied tangible and intangible benefits to those living among it, is slowly dying. This may have an indefinable affect on the community. However, it is very clear that there is a strong sense of loss regarding the collapse of the *tonnara* in these communities. Sicilians took great pride in the *tonnara*, and many feel a sense of sorrow at its disappearance. Beyond this, the loss of this culture is also a loss of intimate maritime knowledge that developed over centuries regarding the methods and activities surrounding bluefin tuna fishing. This collapse is significant in that this was a sustainable fishery. Losing this knowledge and methods of capture will likely have real impacts on the long-term viability of the bluefin, as well as the greater ecology of the Mediterranean.

While some may bemoan the disintegration of the local culture, others may see this as a process of economic and social development, i.e. modernization. Neoclassical economists and their supporters, including those that promote business and industrial development in Sicily, may argue that what is occurring in Sicily is the triumph of one technology over another, resulting from the inevitable progress of scientific and technological discovery that drives social progress. As such, these community changes are either welcome or necessary in order to adapt to the greater social and technological transformations that are occurring throughout the world.

However, if we begin to seriously analyze what is lost in ways that go beyond the nostalgic view of legends of old-world fishing communities, we find that modern capitalist social relations, and in particular the accumulation of capital that defines these relations, rather than inevitable technological processes is the major driver of the changes that are taking place. As I have shown, the transformation of the bluefin into a global commodity with an extremely high market value impacted the methods of production in this region. More, these methods had little to do with supplying nutrition or sustenance and everything to do with increasing added value and returns on investments.

The neoclassical ideology argues that this will bring about the maximum benefit to all actors in the fishery. But as we can see here, instead the system of production and its social relations have the tendency to roll-over anything in its path and leave behind misery and destruction. TNCs, with large reserves of capital, are the major actors and beneficiaries of this commercial activity. The benefits of these new technologies fall mainly to these corporate entities. In addition, it is argued that these theoretical and policy approaches are value-neutral. Yet, they are anything but. They value quantitative economic growth and profits over community development, cultural heritage and ecological sustainability. Growth and profits are reified as objective benefits to society at large. This view unavoidably results in a misapplication and misconception of the notions of social progress and modernization.

It is not enough to lament the identity and culture in a romantic way, but to understand the consequences of these transformations. Braverman's (1975), discussion of the growing dissatisfaction with the conditions of industrial and office labor, allows for insight on this concern. He highlights that while scientific and technical revolution requires higher levels of education and training, the deskilled character of the work leaves many without any fulfillment and is, as such, ever more exploitative and alienating. The labor process, as Braverman points out, is dominated and shaped by the accumulation of capital.

In the communities that I studied, it is clear that labor is transformed from one that allows for the development of some level of satisfaction to one that becomes dictated by the advance of profit. One of the respondents, Antonio Paradiso, had the unique view of working in both the *tonnara* and for a local tuna ranch. His perspective is enlightening:

> "There is no comparison. In the *tonnara* the work is all manual. There are large anchors of 500 kilos that take six people to lift and chains made of iron and nets carried on our shoulders. But at the end we were all satisfied with our work. We went to prepare the nets to fish for tuna and practically we put our experience as fisherman together, and we fished and caught them. What happens here [in the tuna ranch]? The large ships capture the tuna, the tugboats bring them over, and we watch them. You sit and watch the tuna. This is the work of a guard. There is no comparison. There is no marine culture of fishing. Everything is put together already… in the *tonnara* we had to build the trap and fix them… and you joked and played around too."

He continues describing his work as a guard in the ranch:

> "It [the *tonnara*] brought great satisfaction. Not like in this tuna ranch, [for instance]. Standing and watching… making sure a boat does not come and hit a cage. This is not a mariner's skills. A mariner knows how to read the weather, knows if bad weather is coming, watches the ocean and understands if the currents are strong or something is wrong or if a net is broken and if it is fixable, how to fix it. This is the skill of a mariner… You had to have an understanding of nature, slowly you learn a lot, watching… and you become a mariner or a fisherman. Like this [working in the ranches] you can't.

The tuna ranches create a qualitatively different kind of work. The labor process in the ranches does not allow for the type of learning and skill development that are created in the *tonnara*. Young *tonnaroti* learned highly valuable skills in their communities. These were skills that provided work in the *tonnara* and beyond as experienced and capable mariners. Those whom I spoke that worked in ranches did not express this notion of developing valuable and honored skills as mariners. In fact, a scuba diver for New Eurofish clarified for me that he should not be considered a fisherman:

> "The work that we do is not fishing for tuna, the fishing is done by the boats. They have their nets, the purse-seines, what we do is transfer them from their nets to our cages. From there to here."

While it was extremely difficult to discuss issues of work conditions with current employees of the ranches, former employees were more open to discuss this. Vincenzo Di Pasquale, a former scuba diver for New Eurofish for seven years, gives a detailed account:

> "When I went there I had no experience around tuna, if they were dangerous or what... My first interaction I was afraid, because there are fish that are 400 kilos. But the experience was great because they are not dangerous and it is fascinating and it is pleasing. But then when you go everyday, everyday, everyday it becomes a little heavy, at 50 years old doing this scuba work is heavy.... I left because the conditions were not ideal for work. There are days when you are not feeling well, have pains, but you have to go in the water, the tuna arrive and cages arrive. Often, in the morning you go into the cages for 3 or 4 hours and check it all in the water to make sure that the system is in order. But there are other days for example when you have to move tuna, because you want to combine the cages and you need to prepare the empty cage to go out again [to go pick up more tuna]. You need to do all of this in one day because, all the while you are working, the boats are waiting for you. And since there are high costs associated with the waiting tugboats, you are in the water until

> evening. You start at about eight in the morning and finish around five or six. All day in the water...."

He continues:

> "I liked the work, but physically I could not do it anymore, it became very stressful on my body. Maybe the Spanish have a different way of working from us ... they tend to exploit the people more. All the companies are doing it to make this [*participant rubs his fingers together making signal that represents money*]. ...We could have used more workers. They look to exploit the people to the maximum, to squeeze them. When they don't need them anymore, ffeeww [*participant signals tossing them away*].

The labor conditions in the tuna ranch are very much like most industrial processes. Laborers are reduced to numbers that provide the best conditions to generate profits, often creating conditions that increase the exploitation, including negative corporeal impacts on workers (Fracchia 2008). While those who worked in the tuna ranches were clearly happy to be working, particularly in an economy with high rates of unemployment, and sometimes enjoy the character of the work, there is a level of clearly communicated exploitation. What is more, the business side of the process is evident and prominent to workers in the ranches. They clearly think of the process supplying bluefin as a global luxury commodity as a financial endeavor, and accept the conditions of employment based on this logic. In addition, the tuna ranches provide either highly technical work, such as for scuba divers and technicians, or marine work that has been described as monotonous or simplistic, such as guards.

The work in the *tonnara* required intimate knowledge of and relations with nature, as well as a collective work environment. While capitalist social relations have become part of the *tonnara*, particularly in the twentieth century, this cannot drastically change the interrelations between laborer and nature in the traditional fishery. The characteristics of this type of capture system depend on these relations. It is a labor and knowledge intensive system, and not always easily amenable to the needs of capital. Surely, to some degree, it does transform to these needs, but this had definite limits. In order to meet the needs, a new system of production, with new relations of production, was required.

The relations between labor and nature in the ranches are linked to nature in a mostly utilitarian way and minimally to an understanding of the local ecology. The years of knowledge gained from a historical fishery are being lost to high technology methods that rely little on the intimate understanding of the bluefin's ecology. For example, tuna are located using radar or spotter planes. There is no need to understand the bluefin's specific migration routes. Also, each ranch has technical specialists and veterinarians that determine the feeding process and animal maintenance. This is highly specialized knowledge, that often reduce or eliminate traditional "folk" knowledge (Dyer and McGoodwin 1994).

The advancement of local knowledge, of natural systems and the bluefin's ecology is slowly lost to the knowledge held and controlled by powerful economic interests. This is a system of industrial fishing that is based on highly specialized technical knowledge often required to run highly technological equipment and heavy machinery. The subtleties of fishing and understanding of a local marine ecology mean little to this type of endeavor. Work becomes increasingly subdivided and more technical yet, at the same time, demands less knowledge of the marine ecosystem or the ABFT ecology.

These transformations have material consequences for ecosystems and the societies that depend on them. The transition to this type of industrial system has been central to the depletion of bluefin tuna stocks in the region. Ecologically, this causes disruptions in ocean metabolic systems mainly though the loss of biodiversity and transformation of the trophic chain. It also has a variety of impacts on the local environment.

Economically, the local resources are utilized for trans-national corporate interests and much of the wealth generated from this system of production is extracted from the community, but environmental degradation is left behind and has its own short and long-term economic costs (externalities). This type of industrial production has created conditions in which bluefin tuna fishing is no longer a viable source economic activity for the local economy except under industrial conditions. That is to say, industrial production coupled with the dynamics of the competitive market system, creates conditions in which it becomes impossible to maintain any other systems of capture, such as the *tonnara*, due to the socio-ecological conditions that it itself has created. Economically, the conditions are such that local fishing communities see little if any benefit. As one participant from Favignana astutely noted:

> "These things here, the *mattanza* and the *tonnare*, if one looks at it, this is the way things are going all over the world. The problems are occurring because of the economy, and capitalism has gone this way. The poor are getting poorer and there has been all this [environmental] change for the worse."

Culturally, communities lose a significant part of their history that is of great social importance and cohesiveness. The loss that is expressed in these communities may appear to be somewhat sentimental. However, it also represents an understanding that family histories, cultural ties and traditions, and the general social foundation has been supplanted for a system that does not provide these important and necessary aspects of social life, nor consider their inherent value.

This may be regarded by economists, neoclassical and neo-liberal alike, as a subjective, one-sided (even conservative) explanation in that it ignores the benefits of markets to the environment, economies, and culture, and may hinder constructive technological innovation. However, it is clear that any economic benefits that arise from modern industrial food production are not equally distributed. Ecologically, we have witnessed the thrashing of ecosystems all over the world, and there is little scientific doubt regarding the environmental damage brought about by these methods of production. Culturally, market mechanisms are not capable of supporting culture or providing more than a superficial culture based on commodity exchange. The focus on the individual and the pursuit of "rational welfare maximization" tend to pull people apart rather than develop more social cohesion or cooperation. What is more, from the neoclassical perspectives, in the final analysis, only the economic outcomes really matter. Economistic views are reductionist in this way and are predisposed to ignore culture and the environment, since these aspects of social well-being are often valueless on the accountant's balance sheet. Ironically, the humanistic concepts such as justice and love that the people of Favignana inscribed on the monument to its wealthy patron have been supplanted by the dictates of a global competitive market system based on the logic of capital expansion and accumulation.

CHAPTER VIII

CONCLUSION

A Systemic Crisis

In this dissertation, I developed a socio-ecological analysis of the Sicilian bluefin tuna fishery. Atlantic bluefin tuna (ABFT) has been a central product in this region for millennia. This project has discussed the major social and ecological changes that have taken place in this region in the modern era. The industrialization and globalization of the Sicilian tuna fishery has a variety of environmental, social, and economic impacts. It has become standard economic rhetoric to highlight the potential economic benefits that international trade in this high-value food resource has for communities, but, in fact, the benefits are often concentrated into the hands of elite economic players and TNCs. Multinationals have no direct ties to the communities that have utilized this important resource for generations. As such, they have no genuine stake in the community or investment in the effects of over-fishing, environmental degradation, or social decay that occurs when a major aspect of the local economy and culture are undermined. In addition, the character of the labor market is changing in ways that are regarded by modernization theories as more modern or progressive; that is, away from primary sector activity toward secondary or tertiary sector activities. Yet, a major source of natural wealth is removed from the community and region, and the long-term viability of the economy is destabilized by the collapse of resources and the environmental degradation that follows.

In serving the expansion of capital, the traditional system of capture in Sicily is slowly abandoned. This serves as a good illustration of what the conservative economist Schumpeter called "creative destruction" (Schumpeter 1987). Capital in pursuit of expanding profits must wipe out old methods of production and consumption in order to create new opportunities for growth. In the process, it leaves a wake of destruction in its path. In this case it includes ecological devastation, the loss of economic opportunities for local populations, and cultural disintegration in communities. While Schumpeter, and his acolytes, regarded this as a progressive force, it has had detrimental impacts on the Mediterranean bluefin fishery.

Oftentimes, ecological degradation is not easily reversible, and thus this kind of destruction is, in the long-run, counter productive, even for capital. This is the insight offered by O'Connor (1991) in his "second contradiction" thesis. As discussed, capital destroys from under its feet the very foundation that it builds on. The long-term consequences of resource destruction will have detrimental impacts on the capacity for capital to continue its expansion. Even business interests and trade representatives have understood this predicament (Bregazzi 2006; Miyake 2004).

Surely the "creative destruction" of the traditional fishery generated technological change and economic expansion. However, through utilizing a socio-ecological approach within a radical political economic perspective, it is clear that production processes that emphasize capital-intensive technology, intensified privatization, and global economic expansion are both socially and ecologically unsustainable and benefit an elite few. This examination brings to the fore the metabolic rift, or the socio-ecological breaks with natural systems, that has been driven by the relations of production emerging from a global agri-food system based, first and foremost, on the principles of capitalist commodity production.

In a broader sense, I argue that this crisis of the Atlantic bluefin that has been developing for the past half-century is not an isolated, atypical incident. Rather it is a manifestation of a food system that has been developed on a global scale with the principle goal of capital expansion and accumulation. At the same time, all other functions or concerns such as meeting human need, conservation of environmental resources, biodiversity, etc., are running far behind without the possibility of catching up. The depletion of bluefin stocks in the Mediterranean is a prime example of the problems that face the modern agri-food system.

This agri-food system has taken on the character of industrialized commodity production. The system's industrialized and globalized nature, commitment to commodification of food resources and the intensification of competitive "free" market oriented structures has manifested itself in a number of ways. This study reveals the modern agri-food system's signature mark: the immediate and long-term destruction of the environment, communities, and families. While this system has, without a doubt, produced benefits to some of the world's population, these benefits have neither been distributed equally, nor have the benefits been without severe social and ecological costs. The agri-food system, based on the logic that I have described, has been shown to increase environmental and social problems throughout the world, including the mass exploitation of non-human animals, which has resulted in a variety of dangerous health effects for human populations and non-human animals (Longo and Malone 2006; Mason 1990), the increasing use of potentially dangerous synthetic pesticides and fertilizers linked to export-oriented production (Longo and York 2008), the regrettable reality of want, hunger and starvation amid plenty (Magdoff 2004; Poppendieck 2000), the inefficient use of energy resources (Pimentel et al. 2005), the over-exploitation of three quarters of the ocean's fisheries (Vitousek et al. 1997), and the deterioration of farming communities throughout the world, but magnified in the global South (Amin 2003; Bonanno et al. 1994; Burbach and Flynn 1980; Kloppenburg 1988). These, among many more manifestations, display the unprecedented nature of the environmental and social concerns brought about by the modern agri-food system (Foster 1994; Mazoyer and Boudart 2006). The global crisis in fishing, which includes the crisis of the Mediterranean bluefin tuna, is unfortunately a typical expression of these problems, and cannot be solved using the same logic that brought them about.

Summary of Findings

This work has sought to address the ways in which the modern system of agri-food production impacts communities and their environment. This has been examined by presenting an analysis of the degradation of bluefin resources in the Mediterranean. Specifically, I asked the questions: How have recent changes in agri-food production impacted the ABFT fishery in the Mediterranean? How have these changes influenced political-economic and technological transformations in Sicily? How has this impacted traditional fishing communities and the fishery's ecology? Will technological advances, such as farming ABFT provide solutions for depleting stocks in the Sicilian bluefin tuna fishery as well as for social, cultural and economic development in fishing communities?

Bluefin tuna have historically been an important source of protein for Sicilian communities and the Mediterranean region at large. In addition, this fishery has been a central cultural force and source of significant economic activity for centuries. As such, this analysis begins to uncover the social drivers of overfishing in this region and discusses the social implications of the environmental changes for Sicilian communities that have interacted with this fishery for more than a thousand years.

This has been accomplished by utilizing environmental sociological theory that can be described as a radical political economic perspective. This theoretical view has allowed for an examination of the issues surrounding this fishery that are, up to this point, unique in that it analyzes the transformations using a socio-ecological point of reference. In doing so, it reveals many of the shortcoming of mainstream theoretical explanations such as those developed in the areas of economics, sociology, and the popular press, that fail to emphasize the historically specific character of modern social relations, as well as the dialectic between society and nature.

Examining the Sicilian bluefin tuna fishery utilizing a radical political economic perspective reveals the consequences and contradictions of the so-called modern system of agri-food production, which is characterized by increasing industrialization, capital and technology intensiveness, the expansion of global competitive markets and export-oriented production. The conditions that emerge create a rift in the metabolic relations between society and nature, causing breaks in the ecological processes in the fishery. This transformation has brought the entire Mediterranean BFT fishery to the brink of collapse.

The Sicilian ABFT fishery provided an important food source, economic activity, and cultural heritage for millennia, and has been decimated in less than half a century. This destruction is structured by a global agri-food system that is geared toward producing first and foremost global commodities, not food. As I have discussed, a skyrocketing market for a luxury food item destined for wealthy consumers is a driving force for ranching bluefin tuna. Therefore, high market values created the potential for high returns on investment. All other considerations, such as producing food using sustainable systems, have been ignored and potentially lost.

In terms of ecological conditions, the ranching system has a variety of negative consequences on the local ecosystem as well as the broader ecology. Due to overfishing of wild stocks, there is the potential to disrupt trophic level processes as bluefin, a keystone predator, is diminished or removed from the ecosystem food chain. Industrial methods for capturing Mediterranean BFT are disrupting the bluefin reproductive biology. These processes capture tuna during their reproductive migration and break the bluefin's life cycle. Also, ABFT, a regional source of food for many millennia, are transported long distances, which disrupts the socio-ecological metabolism of the region by removing an important source of caloric energy and using fossil fuel energy to transport bluefin to market.

Traditional fishing communities in Sicily have been impacted by a variety of socio-economic concerns that have affected social life. Sicily is a region that has been exploited by a number of civilizations for centuries, and today it is likely the most economically challenged region of Italy. While there have been a number of socio-economic problems and concerns in this region, surely the collapse of the traditional trap fishery has added greatly to the social and economic breakdown of the traditional fishing sector and the communities that have been historically tied to them. There has been a great degree of emigration in these communities and a breakdown of cultural heritage. Furthermore, deskilling or a loss of highly developed maritime knowledge, is occurring as centuries of accumulated experience on maintaining a sustainable fishery are tossed aside for increasingly capital, technology, and energy intensive systems that provide opportunity for expanding capital investments.

Clearly, the so called "modernized," that is industrialized, commodified, and globalized system of production, has been destructive to the ecology of the region, as well as the livelihoods and cultural life of many coastal communities in Sicily. There certainly exists a method to produce relatively large captures of bluefin in a sustainable manner in this region. But the *tonnara* system was no longer amenable to the needs of agri-food business capital, so it was essentially destroyed for new methods that rearranged production as well as consumption of the resource and has had socially and ecologically devastating effects.

Due to the high market value of bluefin tuna, almost overnight the Mediterranean bluefin fishery became a heavily exploited industrialized fishery. As was discussed in Chapter IV, the forces of capital began to transform the *tonnara* in the seventeenth and eighteenth centuries. However, in its traditional form, this fishery created real limitations on capital expansion. A revolution in the means of capturing and producing bluefin, what many would call modernization, was required for the fishery to become fully compliant with the dictates of capital.

What I found in this case follows many of the tendencies of the general processes of capitalist industrialization that have been exhibited throughout the global agri-food system. There is a definite movement away from manual labor and towards increasingly mechanized, capital-intensive technology, and mass production for global markets. It should be noted that the *tonnara* system was a very elaborate technology as well, but very different in the sense that it was not, for example, highly mechanized or industrialized in the modern sense.

My work also points to major changes in ownership patterns. The long history of the *tonnara* spans many modes of production, which of course affected control, access and ownership of the resource. The most recent changes occurring are from control by local private capital, which began in the traditional fishery, to transnational capital. What has occurred in the recent past was the expansion of transnational ownership, the intensified privatization of the fishery, and the dispossession of traditional resource users.

Related to these two issues, this work highlights that the transformation in technology develops primarily to serve the needs of transnational capital. That is, it develops to serve the expansionary nature of capitalist production, as well as the need to further control ecological cycles to fit into modern commodity production systems. In this case, natural processes are shaped, or rather forced, to fit into economic processes so as to increase added value. This results in a contradiction of increased production and value, while eroding the natural resource base. The level of control of the production process reaches a new height with bluefin ranching. It allows TNCs to add value to captured tuna through fattening, and includes a level of control over when and in what form (fresh or frozen) products will go to market.

Further, this work makes clear that the globalized industrial production of Mediterranean bluefin creates the conditions in which the Sicilian *tonnara* is no longer a feasible method of production. The social metabolism of the modern industrial fishery undermines sustainable fishing methods and negatively impacts the communities that have historically practiced them. As it is practiced today, the modern system of bluefin tuna fishing in this region is socially and ecologically unsustainable. Numerous fisheries scientists have confirmed this unfortunate circumstance.

This dissertation has demonstrated that the industrialization of a food producing system, coupled with the dynamics of the modern global capitalist market system, results in socially and ecologically destructive system of production. In addition, the forces of capital expansion and accumulation are central drivers of the transformation into an industrialized fishery. The narrow focus on expanding exchange value and its subjection of use-value creates an irreconcilable contradiction, degrading ecological systems and the communities that have historically relied on them.

Environmental problems, such as those that have developed within the modern global agri-food system, are rooted in social and historical processes and the productive relations that emerge from them. It is crucial to recognize that these processes and relations are driving socio-ecological transformations, i.e., changes in society and nature metabolism. These transformations can result in socially and ecologically unsustainable systems of production, such as those that have devastated the ecology and social life in the Sicilian bluefin tuna fishery.

The Way Forward

This discussion brings to mind an important potential concern regarding this analysis. The question that will surely arise from the skeptic is: Would, then, the elimination of capitalist social relations solve the ecological problems developing in the Sicilian bluefin tuna fishery? Surely, if this cannot be answered affirmatively, many mainstream economists and modernization theorists would point to this as a fatal flaw in this analysis. However, it should be made clear that the elimination of modern capitalist social relations does not guarantee resolution to this problem or, for that matter, the many ecological problems that we face in the modern world.

These concerns may or may not be solved by social transformation away from the global capitalist agri-food system based on competitive markets. The ways in which novel social relations take shape has as much to do with solving the problem as the initial action of revolutionary social change. Ecological sustainability requires that with revolutionary social change must come the acceptance and application of ecological principles in the organization and development of new social relations. This includes understanding crucial ecological matters such as the finite nature of the earth's resources, that ecological systems work together and are not isolated from social systems, and, related to this, that ecosystems are not subsystems of economic systems. Additionally, in order to persevere, a system of production that is ultimately based on the exploitation of nature and labor cannot be replaced with another system that maintains these principles under a different guise.

While there is no magic solution provided by the transcendence of capitalist social relations, it has become quite clear that without this transcendence, an ecologically sustainable society is almost certainly unattainable. Furthermore, scholars such as Foster (2008), Mészáros (2008), Magdoff (2008), Clausen (2007) and Clark and York (2008) have developed powerful arguments for why transcending capitalist social relations, as well as a movement towards socialist principles, can provide a unique opportunity to address the multitude of socio-ecological problems that face modern societies.

The strength of environmental sociology is that it highlights that social institutions work within natural systems, and are affecting them and affected by them. As shown in this dissertation, the social conditions developed in the Sicilian bluefin tuna fishery have been transformed from a sustainable fishery to one on the verge of collapse. The logic of the competitive market system shaped the social metabolism in such a way that it has created a rift in the metabolic relations. This has been structured by the expansion of market-oriented principles, resulting in industrial fishing, and more recently, extending the rift with the advent of tuna ranching.

In concluding the chapter in *Capital* on "Machinery and Large-Scale Industry" Marx (1977) states:

> "… all progress in capitalist agriculture is a progress in the art, not only of robbing the worker, but of robbing the soil; all progress in increasing the fertility of the soil for a given time is a progress toward ruining the more long-lasting sources of that fertility" (638).

So too does capitalist progress in modern industrial fishing and "aquaculture" rob the long lasting sustainability of the Sicilian bluefin tuna fishery and "disturbs the metabolic interaction" (637) between humans and the oceans. Each step that attempts to address the social and ecological problems brought about by the contradictions of the modern capitalist industrial agri-food system, further degrades rather than restores the rift between human societies and their environment.

As has been displayed here and elsewhere, modern industrial systems in food production are problematic. However, in theory, they need not be. That is to say, relatively large-scale systems that utilize mechanization and new technology are not inherently anti-ecological[106]. Nor is technology itself the problem. However, coupled with the logic and aims of the modern competitive market system, it is clear that the practice of industrializing agri-food production takes on characteristics that are ecologically and (often) socially destructive. In this social context, industrial technology serves the needs of the broader economic imperatives often at the expense of ecological sustainability.

It is no longer acceptable to assume that an agri-food system that is driven by "free" market principles with the goal of capital accumulation will provide food and associated agricultural products in a just and ecologically sustainable manner. In order to restore the rift in metabolic relations driven by the agri-food system described above, new approaches and social relations of production must be taken seriously. The current system has surpassed ecologically limits, and is functioning on ecological debt, or

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[106] The *tonnara* system is a relatively large-scale system and the technology is quite sophisticated and complex, yet is it very different from industrial fishing in the current social context.

drawing on the resources of the future. As this analysis of the Sicilian fishery has shown, our agri-food system regularly uses more energy than produces or consumes more food than it provides. This is socially and ecologically irrational. In addition, the distribution and access of food is limited by ability to pay, which has been shaped by a long-standing world-system built on exploitation, domination, and colonialism.

In order to develop a more rational and just system, the modern agri-food system must be succeeded with an approach that regards the use-value of food resource, or its real world usefulness as a source of nutrients and energy, as a principle feature of social organization and production. Furthermore, if large-scale "industrial" systems are going to be employed in the realm of agri-food production, they must first adhere to ecological principles in terms of energy and resource efficiency, as well as broader goals of social well-being. That is, it must consider the so-called "externalities" produced by the system including both environmental and social harms.

In addition, it is necessary to acknowledge that small- and medium-scale systems, decentralized systems, and labor intensive systems can be extremely productive, energy efficient, ecologically sound and socially progressive, and cannot be overlooked as future directions for agri-food production (Altieri 1995; Levins 1986; Pimentel et al. 2005; Rosset 2000). As a society, we must re-evaluate how and for what purposes we produce food. A system that, while providing abundant resources for a relatively small segment of the global population, at the same time destroys ecological systems, steamrolls communities, and leaves massive populations without food or recourse is not sustainable or just.

The *tonnara* system was not a socially ideal form of production. However, it developed a variety of characteristics that allowed it to work closely within natural systems. This was a sustainable system of production that took its form after a long process of society and nature co-evolution. As we look towards the future, the concept of sustainable development is at the forefront of many academic debates, policy decisions and business plans. Yet, approaches that attempt to find solutions without considering the issues brought to the fore in this analysis, in regard to social relations and social institutions that guide production and consumption, will neglect crucial aspects of this problem.

The *tonnara* informs us regarding the many ways that fishing can be sustainable. We should not dismiss these lessons as sentimental or obsolete "backward" knowledge for the allure of new hi-tech systems that do not address the root social problems and drivers of environmental problems. Surely, we cannot return to the days of old when the *tonnara* sustainably provided marine resources for populations. This is not sensible, nor is it wise. The approach set forth here is not a conservative or reactionary analysis that suggests the answers to ecological problems lie in reverting back to an ideal past. Nevertheless, we have much to learn from the ways in which systems such as the *tonnara* functioned in close association with natural systems, and the social factors which emerge to create a rift in society's metabolic relations with nature. Utilizing this knowledge will help to move forward towards developing socially and ecologically sustainable systems of production.

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