ABSTRACT

CLARK, TIMOTHY P. The Sea is Empty. Fisheries and the Global Seafood Sector in the Age of Capital. A Socio-Historical Analysis. (Under the Direction of Dr. Stefano Longo).

Within the broader sub-discipline of environmental sociology, more scholars have begun to focus on the socioecological dynamics of marine systems, coastal communities, and the seafood industry. Environmental sociologists refer to this waxing scholarship as marine sociology, or an area within environmental sociology that examines non-terrestrial socioecological problems (Longo and Clark 2016; Hannigan 2017). Increased attention towards marine issues and seafood systems is necessary because, for example, the ocean sustains food production, environmental stability, and economic security.

Over the course of the 20th century, global fisheries underwent historic change due to substantive human driven withdrawals. Prior to the 20th century, many viewed the ocean as a limitless bounty of resources (Bolster 2012). However, within a period of a few decades following the Second World War, overfishing and biodiversity loss have occurred at levels that now threaten global ocean system stability (Clausen and Clark 2005). Indeed, while not all fish populations are overfished, few are what the United Nations Food and Agriculture Association (FAO) would call under-fished, or fished at a level that signals good prospects for long-term sustainability (FAO 2018). As writer and journalist Anna Badkhen (2018: 3) explains in her account of Senegalese fishers:

"Entire trips go by during which the captain stares at the limp arms of his crew. The sea is broken, fishermen say. The sea is empty."

It is likely that Atlantic menhaden fishers across the United States' Eastern seaboard issued similar frustrations as their catch rates plummeted in the late 19th century and, once-again and more damningly, in the mid-20th century. Similarly, fishers and boat captains in the Gulf of

Thailand now, in more contemporary times, spend roughly 10 times as much effort to catch the same quantity of fish as they did a generation ago.

This dissertation addresses these developmental trends in global fisheries, and unpacks their consequences for communities, labor relations, and ecologies. Three research articles comprise the empirical portions of the dissertation. The first piece utilizes time series regression techniques to analyze a panel data set for most of the world's nations over time, between 1961 and 2010. Here, the goal was to assess the effects of capitalist-oriented, economic development on fishery footprint in greater empirical and theoretical detail than in prior studies. The second article utilizes methods in historical comparative analysis to assess the mechanisms and processes of development in a global North fishery known as the Atlantic menhaden fishery. The time span of the study begins in the 1850's—around the industrialization of the fishery—and concludes in contemporary times. The fishery's developmental history is organized into time periods based on the dominant, market usage of the fish: oil, fertilizer, livestock feed, and aquaculture feed.

The conclusions of this study serve as a telling segue into the third and final dissertation article on labor abuses in Thai fisheries. The third article consists of a historical case study of the political economy and ecology of Thai fisheries since the onset of the neoliberal food regime. This study uses two political-economic analytical approaches, the tragedy of the commodity and global labor value chain, to uncover the implications of Thailand's socioecologically precarious position in the global seafood value chain.

The dissertation will conclude with a theoretical synthesis chapter that explicates the importance of my dissertation's empirical and theoretical advancements for sociological studies of sustainability and marine issues.

The Sea is Empty. Fisheries and the Global Seafood Sector in the Age of Capital. A Socio-Historical Analysis.

by
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DEDICATION

I dedicate this dissertation to the late Murray Bookchin, whose essay “What is Social Ecology?” forever changed my outlook on the environment and our place within it.

BIOGRAPHY

Timothy P. Clark is an environmental sociologist with expertise in political economy, sustainability, and food system development.

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CHAPTER 1: INTRODUCTION

As a whole, this dissertation provides important commentary and data driven analysis on obstacles to sustainable development, in the context of marine ecosystems, fisheries, and coastal communities. As I will highlight below, influential literature on sustainable development often naturalizes capitalist social relations. Thus, oftentimes, sustainable development discourse posits mechanisms to advance sustainability that prioritize capitalist development over socioecological sustainability.

In this introduction chapter, I will begin with an outline of my empirical chapters. While each of these chapters explored their own, unique research questions, and used different analytic approaches and data, I reason that what ties them together in a logically cogent fashion is their advancement of critical marine sociology and a critique of pre-analytic sustainability (Longo and Clark 2016; Longo et al. 2016). As I will illustrate in this chapter in further detail, both these perspectives critique underlying assumptions in sustainable development discourse. Specifically, sustainable development discourse tends to subtly prioritize the sustainment of a capitalist social order. As a consequence, this discourse often overlooks antagonisms between capital and nature, and downplays concerns of socioecological justice. I will explore these shortcomings in more detail and relate them to the dissertation chapters during this introductory section. First, though, it is necessary to outline my dissertation chapters.

Dissertation Chapters: Advancing Marine Sociology

For my dissertation, I conducted three separate research studies, in journal article form, in order to systematically explore sustainable development as it pertains to marine sustainability. The chapters complement one another methodologically. Chapter 2 provides a quantitative, cross-national regression analysis on marine ecological sustainability over time. This study elucidates

the socio-structural, macro drivers of national-level fishery impact. This large-scale, quantitative analysis reveals important developmental differences between affluent and less affluent nations. Thus, the subsequent chapters provide case studies of development and change in a global North fishery (Chapter 3) and the fishery system of a global South fishery (chapter 4). Chapter 3 relies on methods and data suitable to a more qualitative oriented, narrative historical analysis and within-case comparison. Chapter 4 unpacks economic and ecological data using two critical approaches in environmental and economic sociology.

Thus, as a whole, this dissertation provides idiographic and nomothetic insight that advances our knowledge of how socio-structural tendencies lead to unsustainable outcomes in marine socioecological systems. Specifically, each chapter provides important lessons for sustainable development; particularly in relation to assumptions about economic growth, technological efficiency, and trade. These mechanisms of sustainable development assume that capitalist development is trans-historical and conforms to human nature—e.g., terms like "economic growth" are assumed to mean the expansion of capitalist markets and the expansion of gross domestic product (GDP). In line with marine sociological thinking, this dissertation stresses that marine ecosystem degradation is not accounted for by essentialist characterizations of human behavior, and that scholarship must challenge the underlying assumptions and workings of social systems (Longo and Clark 2016). In short, to properly understand the obstacles to marine sustainable development, a thorough and critical analysis of the dynamic social factors that structure socioecological relations is needed.

Indeed, a great deal of research and development literature still relies on what Longo et al. (2016) refer to as a pre-analytic vision of sustainability. This pre-analytic vision conceives of capitalist development as a trans-historical social system that closely conforms with the most

prevalent aspects of human nature; particularly, greed and the "natural" desire to accumulate more and more monetary wealth. Thus, any approach to sustainability, according to this vision, must still maintain what Foster (2005) referred to as the treadmill of capital accumulation. Further, this discourse posits that ecological vitality and resilience can be promoted through the proliferation of growth-friendly strategies that rely on technological innovation, market liberalization (i.e., global trade), and rational governance (Watts 2015). Such mechanisms are often posited as ways to promote capital accumulation and market expansion in a more ecologically benign manner. All of the articles in this dissertation address these potential mechanisms of sustainability in relation to marine socioecological systems, and thus provide empirical evidence for whether or not sustainable development can be achieved without disrupting the circuit of global capital.

In order to properly understand the importance of this task, it is necessary to review how sustainable development is conceptualized and applied in developmental literature, often authored by influential international organizations. The following subsection provides a critical overview of this discourse and literature.

Summary and Analysis of Sustainable Development

In the mid-1980's, the United Nations established the Brundtland Commission to assess the growing threat of natural resource depletion, and to rally concerned actors around the cause of environmental protection. The Commission, named after its Chairperson and former Norwegian Prime Minister Gro Harlem Brundtland, is now most known for its popularization of the term "sustainable development," which the Commission defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs," (Brundtland 1987: 17). Importantly, the Commission also emphasized that "technology and

social organization can be both managed and improved to make way for a new era of economic growth," (Brundtland 1987: 17).

The Commission's definition emphasized that sustainable development included continued economic growth. However, the report made no comment on the social significance of a capitalist political economy. Indeed, the Commission's 300-page report—entitled "Our Common Future"—made no reference to capitalism and, also, included no comments about the logic of capital accumulation or the exploitative social relations that capital accumulation requires. Thus, this highly influential document subtly reified the present social order of capital. As Lukacs argued in *History and Class Consciousness,* evidence of widespread reification is apparent when social problems "that cannot be ignored must be shown to be purely surface phenomenon, unrelated to this [capitalist] mode of production," (Lukacs 1968: 11). The Commission's notion that mild reforms in management and technological change could solve a problem—environmental unsustainability—that challenged the very viability of human society points to this surface level treatment of a deeply rooted issue.

What was particularly revealing about the Commission's treatment of capital, though, was that the authors felt no need to directly defend it or discuss the system's implications for effective change. This omission is thus a pertinent example of what social theorist Mark Fisher (2009) refers to as "capitalist realism," or the widespread notion that not only is capitalism the best or most viable socioeconomic system, but it is the *only possible* socioeconomic system. This subtle form of ideological determinism produces a tendency to conflate the sustainability of capitalism with the sustainability of human society, generally. As Jameson (1994) remarked, it is now easier to imagine the end of the world than a world without capitalism. Therefore, to Fisher, environmental catastrophe confronts capitalist realist ideology as a kind of simulacrum, where

the true implications of the problem are too damning to consider. This provides us some clue as to why the Brundtland Commission failed to critically examine, or even mention, capitalism. Put simply, the report "works" because it does not have to explain vague phrases like development, economic growth, value, technological innovation, etc. From this lens, the purpose of the report is not to explain what human society, generally, needs to sustain itself. Instead, the report provides a theoretical framework that naturalizes capitalist social relations and, thus, posits solutions meant to sustain forms of social organization amenable to capital accumulation on an ecologically stressed planet.

The Commission's report had profound impact on sustainable policy making and proposals. This impact is especially clear in contemporary approaches to marine sustainability, advanced by the Food and Agriculture Organization of the United Nations (FAO) and the World Bank. The FAO's approach to marine sustainability can best be summarized by their Blue Growth Initiative (BGI). Borrowing from the Brundtland Commission, the FAO reasons that the programs under the umbrella of the BGI will maximize economic and social benefits, but minimize environmental impact. Mechanisms, or "enabling conditions" to ensure sustainable marine development include legislation and policy frameworks, public and private partnerships, technological and financial innovations, and the promotion of knowledge / education. The FAO cites its assistance in the creation of national level policy programs, the financing of aquaculture development, and the development of monitoring tools to promote better management of aquaculture operations as evidence of successful blue growth (FAO 2017).

Similarly, the World Bank promotes what they call the "Blue Economy." The World Bank (2017) argues that there is no fundamental antagonism between economic growth and marine sustainability. Thus, the Blue Economy is a capitalist economy. To promote marine

sustainability, the World Bank argues, requires improved management, increased access to world markets for small scale fishers, the proliferation of industrial aquaculture, the economic valuation or commodification of marine resources, technological innovation—such as genetic modification— and cooperative governance between states and firms. Such measures will overcome what the World Bank (2017: ix) refers to as "current economic trends" that heavily degrade marine systems. In short, like the FAO, the World Bank views marine ecological degradation as an accidental externality caused by technological inefficiency, insufficient cooperation (amenable through increased trade relations), and not enough commodification.

Much like the Brundtland's report to the UN, it is impossible to find any critical reference to capitalism within these documents. Economic development is assumed to mean capitalist development, and it is clear that these organizations prioritize the continuation of such development. This oversight can lead to the oversimplification of complex, sometimes paradoxical social processes. For example, technological innovation that allows for more efficient production does not necessarily translate to a reduction in total productive impact on ecosystems over time. Likewise, putting a price on an ecological component or system serves to approximate its exchange value, but this valuation scheme does not capture its socioecological utility. Thus, "valuing" nature, under the logic of capital, does not necessarily lead to the protection of nature; in fact, the opposite outcome often occurs.

Finally, mechanisms of interstate and public / private cooperation may portend improved management of resources and finances. However, improved management of this sort does not necessarily lead to more sustainable outcomes, especially when dirty or ecologically intensive production can relocate to other regions of the world, where the pressure to conform to an uneven capitalist world-market structurally coerces global South nations and producers.

Furthermore, top-down regulatory approaches often have deleterious outcomes for workers and small-scale fishers.

Thankfully, research in environmental sociology and environmental political economy has advanced more critical approaches to understanding capital relations and their relationship with nature. The following section will provide important context on the foundational literature on environmental sociology and the political economy of the environment. This examination will then transition into a contemporary literature review of critical materialist scholarship in environmental sociology. This extant literature provides the theoretical and methodological foundation for my research. Thus, this review precedes an overview of the methodological approaches that I utilized in my articles. Prior to the conclusion of this introductory chapter, I will also provide a discussion that synthesizes my methodological approach.

Foundations in Environmental Sociology

Prior to the emergence of environmental sociology in the late 1970's, sociologists typically adhered to Durkheim's oft misinterpreted dictum that only social facts could explain social facts (Catton and Dunlap 1994; Rosa and Richter 2008). Importantly, in this period, social scientists regarded the social world as exempt from ecological limits and concerns. Terms like social ecology or socioecological, much less environmental sociology, would not have registered within the disciplinary framework of sociology.

This dissertation rests on three foundational, theoretical insights that are relatively new in the intellectual history of sociology. One, ecosystems can collapse. Here, collapse suggests that no amount of technological innovation or human ingenuity could save an ecological system if that system is stressed enough. Two, human activity induces environmental change, and the level or nature of this change is dependent upon historically contingent, socio-structural conditions.

Three, not only can human activity cause environmental change and ecological problems, but human activity is conditioned or structured by ecosystems. Thus, what is socially possible is often ecologically mediated. This is not to say that humans do not socially construct their realities—they certainly do. Furthermore, humans also assign meaning and cultural value to features of ecosystems. Such symbolic meaning-making can result in conflict over how to deal with toxic waste, for example (Shriver and Kennedy 2005). Nevertheless, what humans can do, whether it be for work, food, population growth, community development, etc. depends upon the resources and biotic stability that ecosystems (re)generate.

These foundations evolved from the work and theoretical arguments made by early environmental sociologists. Catton and Dunlap (1978; 1980) advanced what they called a new ecological paradigm for sociologists. This paradigm placed human beings as simply one component of biotic communities, who were vulnerable to ecological feedback, and who lived on a planet with finite resources. This logic, Catton and Dunlap (1980) argued, differed from the human exemptionalist paradigm, which removed human society from such constraints. Catton and Dunlap's work stems from trends in wider society, which at the time of their intellectual development would witness the birth of the modern-day environmental movement and important intellectual contributions from environmental activists and scholars like Rachel Carson (1962) and Barry Commoner (1971). While there was some scholastic debate on semantics and the concept of paradigms (e.g. Buttel 1978), environmental sociologists still regard this theoretical framework as foundationally important for situating environmental sociology within the discipline.

In addition to the framework provided by Catton and Dunlap, three developments within the field of environmental sociology are of critical importance to this dissertation. One, is the

emergence of environmental political economy in the 1980's. Schnaiberg's *The Environment* argued that the state, capital, and labor formed coalitions of actors that generated a growth oriented treadmill dynamic within capitalist economies (Schnaiberg 1980). This dynamic requires ever greater amounts of environmental inputs, which means more natural resource withdrawals. Schnaiberg also argued that this process generated ever-increasing levels of additions, or pollutants, to ecosystems. Because the treadmill is sustained by a growth dependent logic, state actors and labor unions often collude with capital to maintain the treadmill (Schnaiberg and Gould 1994). Treadmill scholars also emphasize that institutional behavior (e.g., public sector investment) is often geared toward accelerating treadmill dynamics (Obach 2007; Gould 2015).

The second development concerns the rise of ecological modernization. Ecological modernization scholars contested the claims made by scholars of the treadmill of production. Ecological modernization scholars argue that capitalism has advanced, and continues to advance, through certain developmental stages. In an early iteration of this logic, Huber (1985) suggested that, due to on-going technological innovation, production systems would increase their efficiency and, as a result, industrial activity would cease to require intensifying environmental withdrawals. In the 1990's ecological modernization scholars would advance Huber's technological theory to argue that marketization would advance rationalization into all aspects of social life—notably, the management of ecosystems (Mol 1996). Put differently, the commodification of resources and the intensification of a capitalist economy would lead to the proper valuation of ecosystems (Spaargaren and Mol 1992). This valuation would produce more effective management and appreciation of natural resources. The continuation of economic development, along with the promotion of a regulative state and ecologically concerned civil

society, would curve the ecologically deleterious outcomes of institutions that were once subordinate to a treadmill logic (Jänicke 1990; Grossman and Krueger 1996; Dinda 2004; Oosterveer and Spaargaren 2011).

The ecological modernization school posed a serious intellectual challenge to the treadmill of production framework. First, it suggested that the treadmill of production was somewhat ahistorical in that it did not account for changing social norms, which could shift institutional behavior. Two, ecological modernization offered a more optimistic outlook for economic development. These critiques perhaps contributed to the treadmill of production school's shift away from a direct critique of capitalism (Schnaiberg and Gould 1994). Indeed, Schnaiberg and Gould's (1994) work contained almost no direct references to capitalism itself—a stark contrast to Schnaiberg's original piece, published in 1980 (Foster, Clark, and York 2010).

Thus, between the 1980 publication of *The Environment* and the mid-1990s, critiques of the dominant assumptions of market logic and the capitalist mode of production generally waned. The third key development, which is most central to the underlying framework of my dissertation, arose from first and second wave ecosocialist scholarship: social metabolism. During this time, three works of scholarship stand out as vitally important for this critical theory of political economy and environment. One, is Foster's (2000) *Marx's Ecology.* This work reconsidered Marx as an ecological thinker, who was grounded in an Epicurean materialism that enabled a historical materialist critique of Hegel and his idealist followers. Foster (2000) also detailed how Marx utilized this perspective to critique socio-biologists of his day, like Malthus, who argued that humans were innately greedy, self-interested, and prone to over-consumption of resources. Marx critiqued Malthus' populationist argument, and instead reasoned that the impoverished masses of industrial Europe were the socio-historical product of capitalist

development; in particular, the enclosure of common lands and the creation of an industrial, wage dependent, reserve labor army (Foster 2000). In short, socioecological troubles that Malthus emphasized—famine, agricultural fertility decline—were the product of a particular social system, at a particular moment in human history—not a natural outcome of human population growth. This work of Marx, which Foster (2000) helped to rediscover and expand upon, is foundational for contemporary work in environmental political economy.

Second, Paul Burkett's *Marx and Nature* clarified the utility of a Marxist approach to understanding human-environment interactions; in doing so, it challenged the notions that Marx's analyses were deterministic, promethean, and minimized the importance of ecology. Borrowing heavily from Marx's own writings, Burkett (1999) reasons that nature possesses no inherent exchange value. Because exchange value is determined during the labor process, by costs of labor and the means of production, there is no undiscovered exchange value of, say, carbon sequestration. Governments or firms who control land or resources may put a price on the selling of certain ecological goods; however, this price is an approximation of market costs, and does not reflect the inherent utility of any ecological service.

From the perspective of capital, nature is useful only insofar as it augments the creation of exchange value. Capital's tendency to appropriate the wealth of ecosystems so as to accelerate the accumulation of exchange value impedes neoliberal mechanisms from appropriately "valuing" nature with a price or market regulatory scheme. Such efforts conflate exchange value with use value, and mistakenly assume that the market "value" of a commodity or service is concomitant to its utility. Because the wealth of ecosystems is impossible to "value" according to a capitalist logic, it is problematic to assume that ecological degradation is an externality to capital accumulation.

The third work in this category that I highlight here is Mészáros' *Beyond Capital* (1995). In this long and complex work, Mészáros stresses the importance of the antagonistic social relationship between capital-labor. Mészáros emphasized that capital relations infiltrated all forms of social life, including ecosystems, which were subjected to a logic of "universally diffused commodity production," that, by definition, could accept no limit to growth (Mészáros 1995: 133 & 146). In addition to alienating human beings from their most basic needs, such as control over food supply, land, and water rights, capital applies its logic of limitless expansion toward ecosystems and natural resources. Nature, though, has limits which capital cannot always outrun. Thus, "fatal overreaching itself is the hallmark of capital's relationship…to the elementary conditions of social metabolic reproduction," that human society depends upon (Mészáros 1995: 171). Repeated, widespread fishery collapse is just one pertinent example of this tendency. Mészáros' notion of social metabolism, or the identification of the defining, socially mediated, historically contingent productive relations that shape human/ecological interchanges is fundamental to contemporary political economy of the environment.

While this above review is not exhaustive, it does highlight the pillars of environmental political economy that later scholars elaborated on in the 21st century. I detail this new generation of scholarship in the section that follows. In the next section, I discuss the extant literature on social metabolism, which consists of the theory of metabolic rift and its applications, the tragedy of the commodity, and ecological unequal exchange. This precedes a discussion of the critical political economy of the contemporary, world-food system, which often overlaps with the social metabolic school. This discussion will then segue into the next section of the review, which will consist of a background on fisheries and marine sociology.

An Introduction to Metabolism

What makes an aquatic territory—freshwater or marine—a fishing ground? Social metabolic scholarship provides the theoretical orientation needed to answer this question. First, as Howard explains, human labor is a subjective process that unites human activity and the material, non-human environment (Howard 2017). Thus, a fishery is the unification of marine ecologies and socially mediated, human needs through the process of labor. The motives and character of labor (i.e., why we produce and how we organize productive relations) are historically contingent. Therefore, the ecological character of a fishery system is socially mediated and historically contingent as well.

The rediscovery of Marx's ecological thinking has been vital for the development of a sociological perspective that recognizes the importance of ecological systems. In Marx's (1978) essay "Critique of the Gotha Program," he decried the manifesto of the United Workers Party of Germany for its promethean approach, which over-emphasized human activity as the original generator of wealth. Wealth, to Marx (1978), originated from nature—human labor did not "create" it, so much so as labor made the wealth more realizable, or useful, to humans. Furthermore, in the aforementioned essay, Marx (1978:525) argues that human labor is "only the manifestation of a force of nature." This argument, made later in Marx's life, stems from his earlier conceptions of humanity and nature. In the *Economic and Philosophic Manuscripts of 1844*, Marx reasons "that man's physical and spiritual life" is "linked to nature," which, he argued, "means simply that nature is linked to itself," (Marx 1978: 75).

Marx also held a surprisingly advanced view of ecology that he incorporated into his research of capital. For example, in formulating his theory of ground rent for Volume III of *Capital*, Marx explained (in a letter to Engels) that he had to "wade through the new agricultural

chemistry" of German soil scientists, whose research proved more useful to him "than all the economists put together," (Marx 1979: 205). In his next letter to Engels, Marx described how plant decomposition, emissions from burning flames, and evaporation cycles were all connected to soil fertility and plant growth. Suffice to say, Marx closely followed the scientific debates of his time, especially as they pertained to the flows of matter, energy, and evolution within connected ecosystems (Foster 1999). He thus borrowed from scientific literatures in his reliance on the concept of metabolism, which denoted the "exchange of matter between man and nature," but, also, the biochemical processes that occurred within nature, independent of human activity (Marx and Engels 1975: 553). Marx referred to this on-going interchange of biochemical materials that constituted the broader, biophysical world as the "universal metabolism of nature" (Marx and Engels 1975: 56).

In both the sense that human beings were creatures of nature and that humans had to appropriate wealth from ecosystems to survive, Marx contended that humans were dependent upon this universal metabolism. This dependency is an eternal condition of human existence. Yet, the ways in which humans interact with ecosystems is not eternal, but historically mediated by social forces that, though malleable, can appear as ever-present or natural—what York and Clark (2006) refer to as the "social gravity" of a given historical epoch.

Borrowing from Marx, contemporary social metabolic scholars emphasize that each mode of production tends to produce a historically unique social metabolism, or complex set of interchanges between human beings and nature (Marx 1976: 637; Foster, Clark, and York 2010). The character of these interchanges is mediated through human labor. Thus, the purposes of human labor and the social relations that shape labor activity affect the character of the universal metabolism of nature. Marx explains this view rather succinctly in the *Poverty of Philosophy,*

when he remarked that soil fertility, though a natural quality, is "closely bound up with the social relations of the time" (Marx 1971: 162-163). As I will detail below, social metabolic scholarship explores how the dynamic social forces of capital dictate production, labor, and trade relations serve as social forces that tend to result in deleterious effects on the stability and fecundity of ecological systems.

Social Metabolic Scholarship in the 21st Century

Social metabolic scholarship has generally relied upon quantitative methods and historical case study approaches to explore socioecological change. Quantitative approaches within the social metabolic framework utilize methods in structural human ecology to parameterize and analyze how social process and social organization shape environmental impact over time. This area of study relies upon the STIRPAT approach (Stochastic Impacts by Regression on Population, Affluence, and Technology) originally formulated by Rosa and Dietz (1994) who improved upon more static and mechanistic conceptions of human impact on environmental indicators.

The STIRPAT model is theoretically based on the IPAT model (Duncan 1961), which I present here. The IPAT model was a simple and straightforward multiplicative approach to gauging the socio-structural drivers of ecological impact.

$$\text{Impact}=\text{Population}*\text{Affluence}*\text{Technology}$$

Dietz and Rosa (1994) posited that IPAT could be reformulated stochastically, with its indicators unpacked in a more deliberate fashion, so as to be empirically testable in the social sciences. SHE researchers (e.g., Rosa et al. 2004) reformulated the IPAT into stochastic form as follows:

$$I_i = aP_i^b A_i^c T_i^d e_i$$

By utilizing panel data at the nation state scale, structural human ecology research tests hypotheses in the environmental social sciences that concern economic development,

modernization, and demographic change over time (Jorgenson 2013). This research consistently demonstrates that aggregate population growth is a primary driver of environmental degradation at the nation state scale. Importantly though, when controlling for population, affluent nations consume the most resources and emit the most pollution—and, when controlling for geographic factors, developed nations see stable effects of population (Jorgenson 2013 and Longo et al. 2015). In any cross national or within nation analysis of environmental change, it is now essential to control for these effects. This is somewhat remarkable when considering that, just two decades ago, Dietz and Rosa (1994) referred to the "paucity of strong evidence regarding the effects of population and economic growth on the environment," (Dietz and Rosa 1994, 283). Today, modeling techniques are advanced enough to assess long term environmental change across and within nations, for a variety of indicators.

Research in structural human ecology suggests that the composition of a nation's population age structure, level of urbanization, technical modernization, and affluence tend to affect various measures of environmental impact (Carolan 2013; Dietz and Jorgenson 2015). Human ecology scholarship does not always explicitly critique capital in social metabolic terms, i.e. from an eco-socialist perspective. Yet, in addition to significant scholarly overlap, structural human ecology research has proven invaluable for social metabolic scholarship due to its advances in empirically modelling the effects of capitalist production on various ecological metrics. In employing time series modeling techniques, researchers test evidence to confirm or disprove the notion that capitalist development eventually leads to ecological sustainability, for various indicators, at generalizable scales. York et al. 2003 and Dietz et al. 2007 all find, for example, a lack of evidence for a levelling off effect of GDP per capita, at higher levels of affluence, for carbon footprint. Jorgenson (2014) finds that economic development increases

occur concomitantly with increased carbon intensity of well-being, suggesting that affluent nations are more dependent upon carbon development to support their social needs.

Human ecology researchers of food system impacts find similar results concerning economic growth, geography, and population structure for both animal protein consumption and pesticide consumption (York and Gossard 2004; Cole and McCoskey 2013 Longo and York 2008). Regarding aquatic food systems, human ecology researchers have demonstrated that economic growth at the national level tends to increase levels of fishery footprint and seafood consumption, but has a negative effect on marine biodiversity indicators (Clark et al. 2018; Longo et al. 2013; Clausen and York 2008).

Finally, researchers utilizing a human ecology framework have found empirical support for the generalizability of unequal ecological exchange. Unequal ecological exchange suggests that poorer nations' ecological wealth is drained in service of profit accumulation in the global North (Bunker 1984; Frey et al. 2018). Utilizing cross-national panel methods, researchers find that indicators of unsustainable development are driven by inequitable trade relations with global North nations and uneven patterns of economic and social development (Jorgenson 2016; Noble 2017; Givens 2018; Huang 2018). This research suggests that trade relations and the material flows of resources are vastly uneven across an unequal, and arguably imperialistic, world economy. Moreover, they suggest that economic development, as a socioecological process, must be assessed at different levels of affluence across nations to account for inequities endemic to a capitalist world-economy.

Case study approaches that explore the workings of a capitalist social metabolism emphasize the socioecological dynamics of commodification, unequal economic and ecological exchange, and labor relations. Longo, Clausen, and Clark (2015) explain that commodification

subjects ecological systems to the logic of the capitalist value form—exchange value—and thus tends to overextend the regenerative capacities of ecosystems. In case studies of North Atlantic salmon and Mediterranean blue fin tuna, these authors demonstrate how the drive to accumulate ever-increasing levels of exchange value antagonized ecosystems, revolutionized labor relations, and generated inadequate technocratic responses from policy makers and environmental managers (Longo, Clausen and Clark 2015; Clausen and Longo 2012).

Ecologically unequal exchange emphasizes that the flow of ecological wealth across nations and regions occurs in the context of a stratified world system in which some nations, regions, and communities profit while others are exploited for the service of capital flows. For example, social metabolic scholars have characterized Appalachia as an internal (i.e., within the borders of a wealthy, core capitalist nation) periphery where non-local firms siphoned out wealth via the exploitation of workers and application of hyper-efficient, destructive technologies on coal-rich Appalachian ecosystems (Fox 1999; Austin and Clark 2012; Wishart 2012).

In sectors of the world food system, including the seafood sector, these uneven socioecological development patterns are important to understand. Case studies of the metabolic flows of the world-food system indicate that trade agreements and economic relations across rich and poor states result in uneven flows of agro-ecological value (Holt-Gimenez 2017; Otero et al. 2013; McMichael 2012). In global fisheries, specifically, global North fleets and retailers have sought out the less-regulated waters of the global South to maximize ecological withdrawals, and these efforts are often stimulated by increased regulations in global North nations aimed at protecting aesthetic values (i.e., tourism) of global North coastal communities (Havice and Campling 2010; McCauley et al. 2018).

Political Economy and Labor Relations

Finally, in parallel fashion to this development of unequal ecological exchange, scholars also emphasize the labor relations that characterize global capitalist development in a stratified, imperialistic world-system. In terms of fishery development, labor in the global North has become more scarce and specialized, with many generational fisheries losing viability due to external socioeconomic trends (Howard 2017). As such, today, roughly 98 percent of all people who work in fisheries are employed in global South nations (World Bank 2012; FAO 2018). Overall, global supply chains within the seafood sector are thus subjected to what Smith (2015) and Suwandi (2019) refer to as the global labor arbitrage. Social metabolic scholarship emphasizes the global labor value chain as a key conceptual tool for assessing the complex and nebulous pattern of globalization. This is an especially useful framework in the context of the corporate or neoliberal food regime, where global food supply networks are A: sourced in the global South, where labor intensive food production typically occurs and B: dominated by global North firms, especially retail and food distributors, who determine the market for food commodities (McMichael 2009; 2012a and Lawrence 2017).

The GLVC perspective emphasizes how global North firms have horizontally integrated their supply chains through arms-length contracting in order to push production to more easily exploited workers in the global South (Smith 2015; Suwandi 2019). The reduction of unit labor costs (high productivity, low wages) becomes the primary driver of product sourcing. This perspective emphasizes that value is created during production, not (chiefly, as orthodox development theory suggests) during value added activities that occur at more downstream points in the chain. Thus, this perspective emphasizes that value capture is the driving impetus behind the global labor arbitrage and, thus, globalization itself.

Research Methods

Each chapter utilizes different methods and data. Each article provides an in-depth overview of their methodological approach, as well as the data used for analyses. In what follows, I will provide a brief overview of all approaches taken in this dissertation, and emphasize how the data and analytical approaches complement one another epistemologically.

In chapter 2, I utilize quantitative methods in structural human ecology to develop a multivariate regression analysis. This analysis aims to explore the socio-structural drivers of change in nations' ecological footprint of fisheries. I collected data from the World Bank, International Monetary Fund, Food and Agriculture Organization of the United Nations, and the Global Footprint Network. I then organized this data into a panel data set. It is organized annually, at the nation state level, for years 1961-2010.

The purpose of this article was to provide a more in-depth understanding of the complex nature of the known effect of economic development on fishery ecological footprint. I delineated the sample according to level of national affluence to approximate world system dynamics. I utilized per capita Gross Domestic Product (GDP) as my measure of capitalist development. This operationalization is standard in the environmental and political economic literature, as it represents the amount of profit (i.e., market value) seized by a nation state over a given year. I then interacted the effect of GDP / Capita with time period (decade) and region of the world. Thus, this article explores how the effect of economic development varies over time, across different regions, and at different levels of national affluence.

Chapter 3 provides a historical comparative, within case study of development and socioecological change pertinent to the Atlantic menhaden fishery. Common to approaches in single case comparative analyses, I organized this case according to time period. I then process

traced through key junctures of development, or events, which were exogenous and endogenous to the fishery's history. Along the way, I answer the following research question: what factors drove the menhaden to change to new periods of market use? The final analytical section of this chapter then answers the following question: what unique factors of the most recent period drove the socioeconomic collapse of the fishery? This process of deduction is inspired from Mill's thinking on comparative analysis and methods of difference.

To answer these questions and form my analysis, I collected primary historical data from the NC State Archives, the UNC and NC State Special Collections Libraries, the Reedville Fishermen's Museum in Reedville, VA, the Mariners' Museum in Norfolk, VA, and the Core Sound Waterfowl Museum in Harkers Island, NC. Here, primary documents refer to 27 archived interviews and hundreds of pages of government and industry documents, including correspondence, log-books, and empirical data on fishery statistics. I also relied heavily on secondary data, published (and unpublished) from scholars, media, government, and community historians.

Chapter 4 examines global South fishery dynamics; specifically, the intermingling of ecological exploitation and human exploitation in Thai fisheries—a problem that has become increasingly severe in more recent years. In deductive fashion, I applied two neo-Marxist theoretical frameworks in order to provide needed structural context for how scholars can make sense of the growing demand for forced and severely exploited migrant labor. The first perspective, detailed above and in the research article, is the tragedy of the commodity. The tragedy of the commodity provides an analysis of the ecology of Thai fisheries, and the changing social metabolic relations, that gave way to a new era of fishing in the Gulf of Thailand. The second perspective I apply is the global labor value chain perspective. This perspective borrows

from Marx's labor theory of value, but applied to analyze the growing concerns of global commodity chain or global value chain researchers.

For this chapter, I gathered data from several international organizations to conduct my analysis. Most of this data comes from the Harvard Atlas of Complexity. Utilizing UN Comtrade data, the Harvard Atlas of Economic Complexity is a free, publicly available, interactive metadata tool that allows the user to compile and share longitudinal data on trade and economic valuation. I focused my data collection, from this source, on the Thai seafood sector. I compared its valuation, production levels, and export levels to itself (over time) and to other nations. The global labor value chain and tragedy of the commodity framework were useful to interpret this data without falling into neoclassical assumptions. Thus, this research article provides structural context to a growing social problem and serves to build theory in environmental sociology and globalization.

Taken together, these approaches I utilize in the chapters provide idiographic and nomothetic insight into global development in fisheries, food systems, and the world economy. Using multiple methodological approaches, I am able to demonstrate how capitalist development has had uneven effects at multiple scales. For example, I show how the expansion of a growth dependent, capitalist economy has shifted ecological burden to global South nations over time. Yet, I also show how this process was a painful one for many in the global North, who were never justly compensated for their hard, physical labor, and were ultimately left with a community that was not sustainably enriched. That story has, as my fourth chapter suggests, been accelerated and made more brutal in the modern world seafood system, off the coasts of Thailand.

Overarching Argument

In his work *How Europe Underdeveloped Africa,* Rodney (2018) reasons that scholars of global change mistakenly characterize development in strictly economistic terms. On top of that, such economistic characterizations are themselves quite limited because they tend to omit exploitation, neglect the importance of the social relations of production, and naturalize capitalist social relations as trans-historical or as the most natural way to organize society (Rodney 2018). Rodney (2018) also critiqued development scholars for disregarding underdevelopment, which he reasoned was an outcome of global capitalist imperialism. While it is impossible to cover all aspects of social development and fisheries in a single dissertation, all the chapters in this dissertation heed Rodney's advice for critical scholarship.

Indeed, while each chapter applies different methods to different cases, each piece provides complimentary evidence for why sustainable development must consider the long-term effects of class inequity and social exploitation as they pertain to marine sustainability, within the socio-historic context of a capitalist social metabolic order. For example, we cannot fully make sense of the findings in chapter 2 without discussing capital's on-going, structural imperative to lower the price paid to labor. Chapter 2 demonstrates how, over time, the ecologically deleterious effects of economic development shifted to the waters of the global South. As Chapter 3 and 4 illustrate, global North buyers shifted their markets toward the marine environments of the global South. This pattern largely stemmed from capital's quest for profit, which remains dependent upon the exploited labor of its workforce. Thus, capitalist development is driven by a socio-structural pressure to increase rates of exploitation in order to accumulate capital and satisfy short term investment or share-holder demands.

This socio-structural imperative, again based on exploitative class dynamics, serves as an obstacle to ecological sustainability that those interested in sustainable development must confront. Each chapter reveals, in various ways, why such reckoning is necessary. Contrary to developmental discourse I outlined above, Chapter 2 reveals that economic growth is not a panacea for marine environmental protection. Chapter 3 demonstrates that technological innovation repeatedly led to increased withdrawals of menhaden fish from the ecosystem, not balance or efficiency. These withdrawals did not occur because of sheer human greed or consumptive demand, but instead stemmed from the social-structural requirements of generalized commodity production. Indeed, as I note in this chapter, many fishers and captains lamented and protested the on-going commodification of the fishery. Chapter 4 contains similar insights about growth and technological innovation, but adds that liberal notions of trade or global cooperation are marred by systemic trade inequity and value chain injustice. This speaks to Rodney's (2018) notion that imperialism—not cooperation or some force that could spur rational ecological management—is often the more accurate characterization of the logic of capitalist globalization.

These three mechanisms—economic growth, technological innovation, and international trade—are repeatedly advanced by major international organizations as ways to promote sustainable development. However, as I outlined above, and as my dissertation expands upon in great detail, these mechanisms often falter. In Chapter 5, the concluding chapter, I reflect on the persistence of these approaches in spite of contrary evidence. I argue that the evidence presented in each empirical chapter should compel environmental sociological scholarship to challenge what Fisher (2009) referred to as capitalist realism or, or the naturalization of a capitalist social order that precludes alternative developmental paths. Capitalist realism expresses itself in

sustainability discourse as a pre-analytic sustainability, which produces a tendency to avoid confronting the socio-structural obstacles to truly sustainable development (Longo et al. 2016). For reasons I describe in the conclusion, I argue that critical scholarship is necessary if environmental sociology is to advance thought and practice that promotes sustainability.

CHAPTER 2: STUDY ONE—EXAMINING THE EFFECT OF ECONOMIC DEVELOPMENT, REGION, AND TIME PERIOD ON THE FISHERIES FOOTPRINTS OF NATIONS (1961-2010)

(Clark, Timothy P. and Stefano B. Longo. 2019. "Examining the Effect of Economic Development, Region, and Time Period on the Fisheries Footprints of Nations (1961-2010)." *International Journal of Comparative Sociology* 60(4): 225-248.)

Introduction

Marine and other aquatic systems provide an essential source of sustenance and economic livelihood for populations throughout the world. Seafood is a valuable source of protein and nutrients, expected to help meet the growing global demand for food over the next several decades (Kharas 2015; UN 2015b). Indeed, aquaculture production already outpaces beef production, and the United Nations positions fisheries as especially important for the economic security of poor and, particularly, coastal populations (UNFAO 2014; Jennings et al. 2016). Accordingly, development organizations consider sustaining coastal and marine environments as essential for the future of economic and food security (World Bank 2017; United Nations 2015a).

Over the last several decades, anthropogenic activities pressured marine systems to the point that future sustainability of many fisheries is in serious question. Overfishing and pollution, for example, reduced predator biomass in the ocean, contributed to drastic declines in sustainable fishing yields, and generally curtailed the ecological resilience of marine systems (Pauly et al. 1998; Smith et al. 2011). There exists a tension at the center of marine sustainability, seafood consumption, and economic production in the marine realm. This tension stems from social organization, social action, and the material demands of human society. As such, marine problems are social problems which require continued sociological examination (Longo and Clark 2016).

This study draws on prior research in environmental sociology and food systems to further examine the effects of economic development on the ecological impact of fisheries production and consumption in the modern world food system. I build upon previous studies of fishery footprint and seafood consumption (e.g. Clark et al. 2018; York and Clausen 2008; Jorgenson, Rice, and Crowe 2005) to explore how the effect of economic development varies across levels of national economic affluence, region, and time period. In this study, I emphasize these effects in relation to the fisheries footprint of less-affluent nations, as this is a critical area of both social and ecological concern.

This study begins with a brief background on contemporary issues in modern fisheries. I follow that with a review of relevant theory and literature. Subsequently, I detail the methods and data, present the findings, and conclude with a substantive discussion of key findings and suggestions for future research. For further clarification, I often use the shorthand term seafood to refer to all aquatic food, including marine-or freshwater-based organisms consumed by humans. I also use the terms fish and fisheries to include fish and non-fish aquatic species, such as crustacean and mollusks, and their capture.

Background

With more than 55 percent of ocean territory currently experiencing industrial fishing, the world ocean has been broadly subjected to intensive fishing practices (Kroodsma et al. 2018). As a result, roughly 31 percent of all fish stocks suffer from overfishing and about 58 percent of fish stocks are fully exploited, meaning that increased fishing yields would result in the transgression of maximum sustainable yields (FAO 2016). However, many estimates lack completeness, and international agencies such as the Food and Agriculture Organization of the United Nations (FAO) likely understate the effects of fishing on aquatic organisms and marine environments

(Pauly and Zeller 2016; Watson and Pauly 2001). When including the reverberating effects of overfishing and pollution, human activity leaves no area of the ocean system unaffected (Halpern et al. 2008).

Despite these concerns, the demand for seafood increased substantially over recent decades (FAO 2010). Accordingly, global institutions began to promote programs aimed at incentivizing growth and productivity in seafood production while reducing ecological impact largely through increasing the efficiency of production (FAO 2014). This strategy, commonly dubbed "blue growth," generally coalesces with broader assumptions about the benefits of economic growth on human well-being (Barbesgaard 2018; World Bank 2014). Put differently, leading developmental organizations consider growth in fisheries production and consumption as key components to increasing economic opportunities, providing nutrition, and, thus, advancing human welfare in less affluent nations (World Bank 2017b). The normative policy prescription for improving access to "blue resources" in a sustainable fashion is to advance policies, programs, and techniques that are compatible with the broader aims of economic expansion, including increasing commodification and novel technologies, and intensifying trade of certain food commodities (Barbesgaard 2018; McMichael 2009).

This study seeks to further examine the effect of economic growth on the ecological footprint of fisheries across different socio-structural factors, as little is known about how political economic indicators interact with geography, time period, and level of development (Jorgenson, Rice, and Crowe 2005). Recent research in sociology indicates that population, economic development, and the structure of food consumption within nations corresponds with increasing fisheries footprints (Clark et al. 2018). As economic growth often marks a central goal in the development of fisheries policies, this study aims to shed further light on how policies and

programs that promote growth-centered production and consumption may affect the conditions of marine and aquatic ecosystems. The following section explores how past literature theoretically situates and empirically investigates questions and concerns pertinent to our present study.

Environmental Sociology, Food Systems, and Fisheries

Like other species, humans exist within a greater ecological complex, characterized by reciprocal interactions between human institutions and ecosystems (Catton 1994; Duncan 1961). In recent years, environmental sociologists accomplished much towards explicating the primary, socio-structural drivers of ecological impacts by making use of diverse measures, such as deforestation, threatened species, and emissions (Ergas and York 2012; Jorgenson 2006; Jorgenson 2008; Shandra et. al 2009). Generally speaking, research utilizing a structural human ecology perspective demonstrates that factors related to economic affluence, technological advancement, and population dynamics contribute to ecological impacts (Rosa, York, and Dietz 2004; Dietz and Jorgenson 2013). Researchers often break down these metrics to explore the effect of gross domestic product (GDP) per capita in relation to, for example, carbon emissions, or how household size relates to air quality, (e.g., Jorgenson and Clark 2012; Cramer 1998). Also, scholars commonly examine the specific effects of per capita GDP on the measure of environmental impact, such as whether it increases, plateaus, or declines at higher levels affluence (Dinda 2004; Dietz, Rosa, and York 2007). Overall, research in structural human ecology repeatedly demonstrates that a society's population dynamics, level of material affluence, and technical development drive ecological change (Carolan 2011; Dietz, Kalof, and Frisch 1996; Dietz and Jorgenson 2013; Stern et al. 1997; York, Rosa, and Dietz 2003).

Scholars of food systems also utilize a human ecology framework to account for changes in consumption and production dynamics. For example, York and Gossard (2004) demonstrated that geographic factors such as climate and latitude, along with factors such as economic growth, are associated with nations' levels of meat consumption. Regarding aquatic food systems, past research that draws from the human ecology framework indicates positive associations between economic growth and declines in aquatic biodiversity and increases in fishery footprint (Clausen and York 2008; Clark et al. 2018). Similarly, Longo, Clark, and York (2013) demonstrate that economic growth and incorporation into the global food system are positively associated with increases in ecologically intensive aquaculture.

Researchers in the human ecology tradition try to incorporate ecological indicators into their models. For example, extending upon studies that utilize more strict measures of human food consumption, Clark et al. (2018) employed the fisheries footprint metric from the Global Footprint Network in order to more effectively include the ecological impacts associated with seafood consumption at the national level. The Global Footprint Network provides ecological footprints for five forms of consumption, as well as the aggregate ecological footprint score for nations, annually and over a period of several decades (Global Footprint Network 2017).

Conceptually, an ecological footprint represents the amount of productive, ecological territory needed to provide for the consumption of a particular environmental resource. Extending upon Clark et al.'s (2018) analysis, we apply the fisheries footprint measure as our dependent variable in this study. Prior sociological research employed similar frameworks to model the socio-structural drivers of other footprint indicators (Jorgenson and Clark 2009 2011; York, Rosa, and Dietz 2003). This measure is discussed in detail within the methods and data section.

The tools of structural human ecology prove useful for gaining a better understanding of changing environmental impacts within food systems. In addition, though, this study emphasizes that nations' food systems exist within a larger political-economic context associated with the dynamics of the capitalist world-system. The world-systems approach conceptualizes the global economic order as characterized by a division of labor and power, resulting in a tripartite order classified as core, periphery, and semi-periphery nations (Wallerstein 1974). In the modern world-system, wealth and power tends to concentrate in the core nations, or the global North. The implications of this global economic order are vast. In relation to the issues we examine here, world-systems theory provides a lens for considering the dynamics of global systems of commodity production in relation to ecological impacts and food production (Hornborg, McNeill, and Martínez Alier 2007; Longo 2011; McMichael 2008). Scholars of environmental resource consumption and the world-system emphasize that, over the long-history of capitalist development, poorer nations often export environmental resources to wealthy, or core, nations (Bunker 1984). The body of extant literature on unequal ecological exchange in the world-system supports the notion that as global capital proliferates and strengthens capitalist relations between nations, environmental degradation expands in a way that uniquely, and often adversely, affects poorer nations (Jorgenson and Kick 2003).

The inequitable distribution of environmental goods and external costs exists in relation to inequitable power relations between nations within the capitalist world-system (Hornborg 2009). Richer nations tend to increase their aggregate consumption of environmental space by, for example, procuring favorable trade relations with less powerful, export-oriented nations (Jorgenson 2009). Periphery regions and nations also, oftentimes, become sinks for various forms of pollution (Frey 2003; Jorgenson and Rice 2012).

Thus, when considering the effect of economic development, I posit that level of affluence of nations likely matters greatly in order to grasp the effect of economic development and to interpret this effect. McMichael (2012b) emphasizes that, along with the globalization of industry and textiles, capitalist globalization expanded into the agri-food systems of less affluent nations over the last several decades. In regard to food systems operating within the structural parameters of capital accumulation, what I call the capitalist world food system, capitalist development is often ecologically intensive (York and Gossard 2004; Longo, Clark, and York 2014). As highlighted by treadmill of production scholars, capitalist development requires ever-increasing environmental withdrawals in order to keep up with the on-going, structural requirement for profit maximization (Schnaiberg 1980; Gould, Pellow, and Schnaiberg 2004). Social metabolic scholars extend upon this to argue that social developments associated with capitalist production tend to disrupt ecological systems and cycles, with serious consequences for terrestrial and aquatic food systems (Foster 1999; Foster, Clark, and York 2010; Longo, Clausen, and Clark 2015; Holleman 2018).

This incongruence likely stems from the contradictory demands that the food system places on less affluent nations. For example, less-affluent nations within the capitalist world food system often experienced concomitant increases in internal demand for animal protein consumption and external pressures to increase their export-oriented production of agri-food commodities. As European super market chains targeted poorer nations for export-oriented livestock production, two-thirds of recent increases in global meat consumption occurred in the global South (McMichael 2009). Incorporation into the world capitalist food system may therefore result in dual increases in domestic consumption and export-oriented production of particular types of food commodities, such as animal products. Broadly speaking, the expansion

of the capitalist world food system resulted in nations in the global South becoming more dependent upon imports for feeding their own population (McMichael 2009b). Yet, at the same time, the structural imperatives of the world capitalist food system pressured many poorer nations to modernize and increasingly commodify their food production systems in order to better integrate into the global food system that large multi-national firms dictate (Holt-Giménez 2017). Research suggests that the resulting dynamics indicate that poorer nations typically import basic food provisions, while core nations increasingly import higher value or luxury food items (Otero, Pechlaner, and Gürcan 2013). Overall, within the dynamics of this global food order, increases in protein production, consumption, and trade with core nations characterizes less-affluent nation incorporation into the world capitalist food system (McMichael 2012a).

Seafood is among the highest traded of all food commodities. Combining insights from human ecology and world-systems theory, we can better analyze the processes of the global economic order in relation to fisheries footprints. Like many food commodities, biophysical conditions shape and limit fish production. For example, ocean up-welling—a process where cold nutrient rich water rises and displaces surface waters—characterizes some of the most productive fisheries in the world, such as those off the coasts of Chile and Peru. Biophysical conditions and political-economic processes such as economic production and consumption dynamics, national-level fisheries policies, and national access agreements, resulted in significant fishing efforts by fleets in productive waters of the global South, including by fleets from the North (Havice and Campling 2010; McCauley et al. 2018). For example, depletion of fisheries, changes in quotas, and limits on access have been shown to shift fishing to areas of the global South, like coastal regions of Africa (Berkes et al. 2006; Worm et al. 2009) Fisheries management regulations, agreements, and associated capture quotas sometimes drive captures by

ships flying flags of convenience, that is registering ships to particular nations in a way to skirt capture quotas. These and other efforts that result in increased levels of so-called illegal, unregulated, and unrecorded captures tend to increase exploitation of fisheries in the global South. These practices, which can obfuscate the social sources of ecological degradation, conceal that the "successes" of fishery management in the global North coincide with ecologically intensive fishing practices in the global South (Hilborn, Oresanz, and Parma 2005).

The seafood economy of the modern world-system, including patterns of production and consumption outlined above, trade dynamics, and associated economic and political power, interact in marine spaces. Like other natural resources that are largely place-based, fishing fleets from wealthy and less affluent nations develop fishing grounds in the global South. Wealthy nations of the global North possess more autonomy over their associated fishing grounds through greater management, regulation, and monitoring, which in recent years led to limits on fishing, while those in the global South often continued to suffer exploitation in both legal and illegal manners (Worm et al. 2009). Wealthy nations dominate fishing all over the world through heavily subsidized distant water fleets. Recent research tracking industrial fishing practices identified that 97 percent "of all industrial fishing effort detected," originate from wealthy nations, and "Eighty-four percent of the industrial fishing effort in lower-income EEZs [exclusive economic zones] was conducted by foreign countries" (McCauley et al. 2018: 3).

With this in mind, it is worthwhile to examine fisheries footprints of nations over time, along with the regional patterns of change. Further, it is useful to analyze this with a focus on the fisheries footprint in the global South. As discussed, the dynamics of the modern world-system are an important force in shaping the ways in which fisheries exploit marine systems. Thus, it is

sensible that this analysis emphasizes whether and to what degree fisheries footprint is associated with economic development in less affluent countries in contrast to affluent ones.

Data and Methods

In this analysis of the dynamic relationships between economic growth and fisheries footprints, I employ a modelling approach commonly used in cross-national environmental sociological research. I analyze national-level data using a multi-variate regression approach consistent with the STIRPAT analysis (York, Rosa, Dietz 2003). I drew the explanatory and control variables for this study from the World Bank and Food and Agriculture Organization of the United Nations (World Bank 2018; FAO 2018a). I obtained the dependent variable, fisheries footprint, from the Global Footprint Network (Global Footprint Network 2018). I constructed several time-series models, five of which I present in this study.

The first three models include no interaction terms, but enable comparisons across nations in the sample. The first model groups all nations together, to explore the main effects of our explanatory variables across the whole world-system. I then delineated nations according to their level of income, according to World Bank measures. Following Jorgenson and Clark (2012) wealthy nations fall into the World Bank's high-income category, which I determined according to a nation's per capita gross national income. In order to maintain a consistent and conservative approach, I only grouped nations into this category if the nation maintained this designation over the entire course of time (i.e., each year) that the World Bank utilized this classification. I grouped all other nations together as less-affluent nations, signifying countries that could be designated as periphery and semi-periphery nations. In total, I analyzed 132 less-affluent nations, which are listed in Table 2.1. Table 2.2 contains affluent nations utilized in this sample.

Table 2.1. Less Affluent Nations Included in the Study, Grouped by Region.

Asia	Central and South America	Middle East	Africa	Europe and North America
Armenia	Argentina	Afghanistan	Angola	Albania
Azerbaijan	Belize	Algeria	Benin	Antigua and Barbuda
Bangladesh	Bolivia	Cyprus	Botswana	Barbados
Cambodia	Brazil	Egypt Arab Rep	Burkina Faso	Belarus
China	Chile	Iran Islamic Rep	Cameroon	Bosnia and Herzegovina
Fiji	Colombia	Iraq	Central African	Bulgaria
Georgia	Costa Rica	Jordan	Republic	Cabo Verde
India	Cuba	Lebanon	Chad	Croatia
Indonesia	Ecuador	Morocco	Congo Dem Rep	Dominican Republic
Kazakhstan	El Salvador	Oman	Congo Rep	Estonia
Kenya	Guatemala	Saudi Arabia	Ethiopia	Greece
Kiribati	Guyana	Tunisia	Gabon	Grenada
Korea Rep	Honduras	Turkey	Gambia The	Haiti
Kyrgyz Republic	Nicaragua	Yemen Rep	Ghana	Hungary
Lao PDR	Panama		Guinea	Jamaica
Malaysia	Paraguay		Guinea-Bissau	Latvia
Maldives	Peru		Lesotho	Lithuania
Myanmar	Suriname		Liberia	Macedonia FYR
Nepal	Trinidad and Tobago		Madagascar	Malta
Pakistan	Uruguay		Malawi	Mexico
Philippines	Venezuela RB		Mali	Montenegro
Russian Federation			Mauritania	Poland
Samoa			Mauritius	Portugal
Solomon Islands			Mozambique	Serbia
Sri Lanka			Namibia	St Lucia
Tajikistan			Niger	St Vincent and the
Thailand			Nigeria	Grenadines
Timor-Leste			Rwanda	
Turkmenistan			Sao Tome and Principe	
Ukraine			Senegal	
Uzbekistan			Sierra Leone	
Vanuatu			South Africa	
Vietnam			Sudan	
			Swaziland	
			Tanzania	
			Togo	
			Zambia	
			Zimbabwe	

Table 2.2. Affluent Nations Included in the Study.

Affluent Nations
Japan
Australia
Austria
The Bahamas
Belgium
Bermuda
Canada
Czech Republic
Denmark
Finland
France
Germany
Iceland
Ireland
Italy
Luxembourg
Netherlands
New Zealand
Norway
Spain
Sweden
Switzerland
United Kingdom
United States
Israel
Kuwait
United Arab Emirates

Delineating nations by level of income is logical on both theoretical and empirical grounds. Other studies demonstrate that environmentally intensive consumption varies across level of national income, or affluence (Jorgenson 2009; York and Gossard 2004). In spite of gains in efficiency, environmental sociologists generally accept that affluent nations consume more environmental space and more luxurious food commodities than less affluent nations (York, Rosa, Dietz 2004; Otero, Pechlaner, and Gürcan 2013). Further, world-system theory suggests that production and consumption processes occur differently in nations according to world-system position.

Regarding less-affluent nations, major development institutions argue that further marketization and modernization of poorer nations will increase seafood consumption in a way

that improves food security, economic development, and ecological sustainability (UNFAO 2014b; World Bank 2017). Furthermore, substantial increases in fishery footprint occurred in less-affluent nations —especially when compared to wealthy nations—over the five-decade time period that our sample covers (Global Footprint Network, 2018). Thus, focusing on less-affluent nations allows this study to explore these claims and the drivers of ecological change in a way that grouping all nations together, regardless of economic position in the world-system, would not. I organized data into a panel data set, with observations grouped by nation and occurring annually between 1961 and 2010.

Table 2.3. Descriptive Statistics for Dependent Variable, Log of Fisheries Footprint.

Decade	Mean (All Nations)	Mean (Less Affluent Nations)	Mean (Affluent Nations)	Median (All Nations)	Median (Less Affluent Nations)	Median (Affluent Nations)	Total Missing Observations	Total N
1960's	11.78	12.14	13.99	11.55	11.04	13.98	373	1,377
1970's	12.29	11.84	14.12	12.27	11.69	14.20	310	1,430
1980's	12.56	12.15	14.26	12.66	11.99	14.21	292	1,448
1990's	12.63	12.29	14.27	12.61	12.19	14.34	68	1,672
2000's	12.97	12.72	14.13	12.84	12.51	14.19	22	1,718

Dependent Variable: Fisheries Footprint of Nations

The dependent variable described in Table 2.3, fisheries footprint, represents the total marine territory needed to sustain levels of consumption of various seafood products within a nation (Folke et al. 1998; Ewing et al. 2010). The calculation of fisheries footprint also considers the ecological conditions associated with particular species, essentially providing a weight for species that require more ecological resources/space. In this measure, for example, higher trophic-level species (i.e. higher on the food chain), require more ocean territory (Galli et al.

2012; Borucke et al. 2013). The footprint also includes aquaculture production and aquafeeds (Ewing et al. 2010; Borucke et al. 2013). Finally, the fisheries footprint (EFC) is calculated as the sum total of fisheries production (EFP) and imports (EFI), with fisheries exports (EFE) subtracted from that total (Global Footprint Network 2017). Thus, via the structure of its calculation, the fisheries footprint considers trade flows between nations. I present the equation for the fishery footprint, developed by the Global Footprint Network, as follows:

$$EFC = EFP + EFI - EFE$$

The Global Footprint Network (2017) determines the EFP from the specific trophic level of each harvested or farmed, marine fish species within a nation. Put differently, the amount of marine territory a specific species requires to reproduce itself matters greatly for determining a nation's footprint. Thus, the harvesting or farming of a certain amount of a high trophic species, like salmon or tuna, counts more towards EFP than would the same amount of a lower trophic species, like oysters or herring. The EFI and EFE measures calculate the fishery product trade balance of a nation. Similarly, these measures rely upon trophic indicators to determine their value. These trophic considerations matter greatly for the calculation of the ecological footprint of fisheries, and thus make them a distinct indicator from seafood consumption (Clark et al. 2018).

Yet, because the FAO aggregates seafood commodity trade metrics, the Global Footprint Network (2017) relies upon more general, non-species-specific trophic indicators to determine EFI and EFE. The calculation utilizes a fairly conservative approach to determine the trophic load, or footprint intensity, of nations' fishery trade balances. Specifically, it assumes that a nation's exported fish products possess the same trophic load as the nation's harvested and imported fish. Similarly, the Global Footprint Network' calculation assumes that the trophic load

of imports of a particular nation is equal to the average global harvest (Lin et al. 2018). Historical increases in a nation's fishery footprint, especially in more export oriented nations, suggest elevated levels of high trophic fishery production as this trophic level is, effectively, more directly weighted in the calculation of the metric.

Table 2.4. List of Variables Included in the Study.

Variable	**Type of Variable**	**Transformation**	**Source**	**Description**
Fisheries Footprint	Dependent Variable	Logged	Global Footprint Network	Global Hectares
Total Population	Control	Logged	World Bank	De facto, total residents
Meat Consumption, tons	Control	Logged	UN Food and Agriculture Organization	Total tons of beef, poultry, veal, pork and sheep consumed
Urban Population, percent of total population	Control	Logged	World Bank	Percent of total, i.e. number of persons in "urban" zone per 100
Per Capita GDP, Constant U.S. Dollars	Explanatory	Logged	World Bank	GDP Divided By Midyear Population
Livestock Production	Control	Logged	UN Food and Agriculture Organization	Dressed carcass weight, commercial and farm slaughter
Non-Dependent Age Population	Control	Logged	World Bank	Percent of Total Population Between Ages 15 and 64

Table 2.4. (Continued)

Period Decade*Per Capita GDP	Explanatory	Interactive effect between periods (decades) and log of per capita GDP	World Bank
Region*Per Capita GDP	Explanatory	Interactive effects between regions and log of per capita GDP	World Bank

Independent Variables

Table 2.4 (above) presents the remaining variables. Models control for de facto population size, urban population rate, non-dependent population (ages 15-64, percent of total population), and terrestrial meat consumption (measured in tons), as prior literature shows that these factors drive consumption of ecological resources and fisheries footprint (Dietz, Rosa, and York, 2007; Clark et al., 2018). Following Clark et al. 2018, I also control for livestock production, as prior studies demonstrate links between protein production and consumption (Gossard and York 2003; Jorgenson and Birkholz 2010). These variables were collected from the World Bank (2018), except for meat consumption and livestock production, which I drew from the FAO's collection of food and agricultural data (FAO 2018a). The main variable of interest, gross domestic product (GDP) per capita, operationalizes economic growth of nations and is taken from the World Bank (World Bank 2018). I utilize a constant GDP per capita, equivalent to 2010 U.S. dollars, to account for inflation over time. In the results section and onward, I report coefficients pertaining to per capita GDP as economic development. Economic development, in this analysis, signifies capitalist economic development, which is fundamentally driven by a growth imperative, including the continuous expansion of GDP.

In order to consider the effects of economic development during specific periods and major regions in the world, I construct interactions between time period (decade) and per capita GDP, and region and per capita GDP. I incorporate these interactions into the models and present them along with the main effects. I also delineate nations into five different regions: Asia, Africa, Middle East, Europe and North America, and Central and South America. For the regional categories, I borrowed from extant research in environmental sociology, which constructed regional categories to examine differences in seafood consumption and the carbon intensity of well-being (York and Gossard, 2004; Jorgenson, 2009). Extant literature also examines the effects of socio-structural drivers as they vary over periods of time (Jorgenson and Clark, 2010; Jorgenson and Given, 2015). I constructed periods as decades, and interacted them with the economic development measure. In constructing these interactions, I could then assess if the effect of economic development varied across decades.

In addition, by utilizing the average marginal effects, I am able to provide the magnitude of the effect of economic development over each decade and across different regions in our models, allowing for relatively easy comparisons. The models thus detail not only if economic development varies with time and region, but they also demonstrate the nature of these differences. Overall, these interactions allow the study to investigate the relationships between economic growth and fisheries in further detail than prior studies and, accordingly, better elaborate on economic development policies and their potential effects on fisheries footprint.

Models

In order to account for common issues with distribution and skew with cross-national studies, I log transformed all variables to construct a log-log model. This approach is consistent with the STIRPAT modelling method used to test the association between various forms of environmental

impact and variables related to social development, economic affluence, and population dynamics (York, Rosa, and Dietz 2003). When interpreting the results of the models, coefficients indicate the percentage change in the dependent variable for a 1 percent change in the corresponding independent variable. For example, a coefficient of .5 would indicate a .5 percent increase of the dependent variable for a 1 percent change in that independent variable.

I conducted several pre-model tests to help determine the appropriate modeling approach for the analysis. Specifically, I ran several diagnostic tests to explore common issues with panel data. These issues include heteroscedasticity, cross-sectional dependency, and serial correlation (Torres-Reyna 2007). After running a modified Wald test (heteroscedasticity), Woolridge test (serial correlation), and a Pesaran's test (cross-sectional dependency), I found statistically significant results for all three tests $P < .05$. I therefore needed to rely upon a modeling approach that could account for heteroscedasticity and contemporaneously correlated error terms. I thus utilized OLS models with panel corrected standard errors (xtpcse command in Stata) (Beck and Katz 1995). To deal with serial correlation, I included an autoregressive (ar1) option to account for previous responses potential lag effect on subsequent responses (Rabe-Hesketh and Skrondal 2012).

Because of the unbalanced nature of the dataset, which contain some missing observations especially in earlier periods, I also utilized a pairwise deletion (rather than casewise deletion) option to include as many observations as possible. Fixed effects regression techniques prove useful for controlling for unobserved, time invariant factors that may influence a nation's fisheries footprint, such as coastline, land territory, and climate. However, panel corrected standard errors do not allow for a fixed effects option. I thus included country specific effects

within most of our models to better account for unobserved heterogeneity across nations, effectively allowing for interpretation as a fixed effects model.

I also ran a post-estimation test for multi-collinearity after the first model, which included variables of interest across all nations in the sample. Aside from the obvious correlation between the quadratic term of economic development (GDP2) and per capita economic development (GDP), the model presents little evidence for concern in regards to multi-collinearity, as only one relationship barely exceeded a .6 correlation. In the final model which includes country specific effects and region, I did take some steps to address potential confounding effects when controlling for regional and country specific effects. I briefly describe these measures in the results section. In addition, I ran several unpresented models that explored the potential confounding effects of outliers. I estimate models that excluded China (e.g., FAO, 2018b) as well as high percentile observations for the dependent variable across the sample (e.g., Longo et al. 2019). These models yielded similar results, with no changes in statistical significance or direction of the coefficients, and very little—if any—change in their magnitude. Thus, outliers or unusual observations did not pose significant reason for concern.

I also ran a series of preliminary models to explore the nature of the main effects without the interaction terms on all nations in the sample (model 1), affluent nations (model 2), and less-affluent nations (model 3). Below, in Table 2.5 (next page), I report the total number of observations, groups (i.e., nations) in each model, and average observations per nation for the unbalanced, panel data set.

Table 2.5. Initial Model Description.

Models	Description	Time Frame	Observations	Nations	Average Observations Per Nation	R^2
Model 1	Affluent and Non-Affluent Nations	1961-2010	5,806	159	36.5	.906
Model 2	Less-Affluent Nations	1961-2010	4,680	132	35.4	.888
Model 3	Affluent Nations	1961-2010	1,126	27	41.7	.973

Results

I present the results of models 1, 2, and 3 in Table 2.6. These models do not include any interaction terms. The discussion of the coefficients is in the context of the models, and I therefore report them net of all other effects.

Table 2.6 Results for Models 1, 2, and 3.

Variables	All Nations, Model 1	Less-Affluent Nations, Model 2	Affluent Nations, Model 3
Per Capita GDP	1.14*** *SE .19*	.405*** *SE .059*	3.842*** *SE 1.45*
GDP Quadratic	-.052*** *SE .011*	_____	-.196*** *SE .070*
Total Population	1.48*** *SE .115*	1.81*** *SE .134*	.372** *SE .165*
Non-Dependent Population	.847** *SE .38*	.70* SE .407	.654 *SE .721*
Urban Population	-.242** *SE .113*	-.507* *SE .125*	.753 *SE .472*
Meat Consumption	.062 *SE .046*	.03 *SE .050*	.096 *SE .085*

Table 2.6 (Continued)

Livestock Production	.012 *SE .007*	.019* *SE .010*	-.003 *SE .011*

(*** P<.01
**P<.05
*P<.1)

For models 1, 2, and 3, I considered the potential effect of a quadratic term of economic development to explore whether the relationship to the fishery footprint takes a curvilinear form and, importantly, if the magnitude of the effect potentially declines at higher levels of economic development. The quadratic coefficient of economic development was negative for model 1, which suggests that the effect of economic development shows declines at higher levels of affluence. Based on the results for the more specified models 2 and 3, this effect of high values of economic development only occurs in nations that are historically the most affluent. The results from model 1 indicate that, when including all nations, fisheries footprint reaches a ceiling and levels off with no decline. Due to the lack of statistical significance and high collinearity between the quadratic of economic development and the log of economic development, I report model 2's results sans the insignificant quadratic coefficient.

In model 1, all controls except livestock production and meat consumption are statistically significant (p<.05). The effects of total population and non-dependent age population are positive. These results conform to expectations and with prior literature. More people in a nation typically require more food resources, and a higher percentage of working age adults suggests greater spending power. A higher percentage of urban residents corresponds with lower levels of fishery footprint.

The second model, model 2, considers less-affluent nations. Similar to model 1, meat consumption did not reach statistical significance. For less affluent nations, the GDP quadratic did not reach statistical significance, and I thus removed it from this model to avoid confounding

results or confusing explanations of the effect of per capita GDP. The positive coefficients for total population and non-dependent population do reach statistical significance and, thus, increases in total population and the percentage of the population who are of working age both positively affect fishery footprint over time, in less affluent nations. The moderate results for livestock production in less affluent nations suggest that there is some evidence that increases in animal commodity production correspond with increases in nations' fishery footprints. The magnitude of the main coefficient of interest, per capita GDP, reaches statistical significance. The coefficient of .405 suggests an approximate .4% increase in a less affluent nation's fishery footprint for every one percent increase in per capita GDP. Thus, I interpret economic development in less affluent nations as an important driver of increases in these nations' fishery footprints.

For affluent nations, model 3 suggests that for every 1% increase in a nation's population, fishery footprint will increase by a corresponding .372%. This was the only statistically significant control variable. In this model, total population within nations is the most consistent predictor of fishery footprint increases outside of per capita GDP, the main variable of interest. Per capita GDP and its quadratic both reach statistical significance. The GDP quadratic indicates that in affluent nations, higher levels of economic development appear to correspond with decreasing levels of fishery footprint. The estimated turning point is at about 19,000 USD. Thus, the marine environmental impact—measured in fishery footprint—of economic development is most consistent and deleterious for non-affluent nations over time. In order to analyze this in more detail, Models 4 and 5 therefore focus on how the effect of economic development varies across region and period of time for exclusively less-affluent nations.

Models 4 and 5 are developed based on the results of the previous models, which indicate statistically significant relationships between the dependent and independent variables. In Table 2.7, I present the results for Models 4 and 5. These include the main effects and the interaction terms for economic development and period (Model 4) and economic development and region (Model 5), net of all other controls in the models.

Table 2.7. Interaction Models.

Variables	Period*GDP for Non-Affluent Nations, Model 4	Region*GDP for Non-Affluent Nations, Model 5
Per Capita GDP	.328*** *SE .064*	.497*** *SE .097*
GDP Quadratic	_____	_____
Total Population	1.81*** *SE .142*	1.77*** *SE .142*
Non-Dependent Population	.498 *SE .398*	.112 *SE .469*
Urban Population	-.451*** *SE .127*	-.447*** *SE .141*
Meat Consumption	.038 *SE .051*	.052 *SE .058*
Livestock Production	.017* *SE .010*	.012 *SE .010*
Period 1 (1960's)	Baseline	_____
Period 2 (1970's)	-.129 *SE .178*	_____
Period 3 (1980's)	-.257 *SE .239*	_____
Period 4 (1990's)	-.704*** *SE .269*	_____
Period 5 (2000's)	-.609** *SE .294*	_____
Period 1*Per Capita GDP	Baseline	_____
Period 2*Per Capita GDP	.025 *SE .025*	_____
Period 3*Per Capita GDP	.039 *SE .032*	_____
Period 4*Per Capita GDP	.091** *SE .036*	_____

Table 2.7 (Continued)

Period 5*Per Capita GDP	.086** *SE .038*	_____
Asia	_____	Baseline
Central / South America	_____	-2.18 *SE 1.87*
Middle East	_____	-2.97** *SE 1.13*
Africa	_____	9.41*** *SE 1.12*
North America / Europe	_____	_____
Asia*Per Capita GDP	_____	Baseline
Central / South America*Per Capita GDP	_____	.349* *SE .191*
Middle East*Per Capita GDP	_____	-.275** *SE .139*
Africa*Per Capita GDP	_____	-.283*** *SE .107*
North America/Europe*GDP	_____	_____

(*** P<.01
**P<.05
*P<.1
North America / Europe omitted due to collinearity with country specific effects.)

Model 4 considers the nature of the relationship between economic development and fishery footprint in relation to different periods. Specifically, this model examines whether the effect of economic development changes with time and, if so, the character of this change. In doing so, this model explores, in greater detail, discussions and debates about the nature of economic growth and development and its effect on consumption and environmental impact of food systems (Spaargaren, Oosterveer, and Loeber, 2012). With the exception of meat consumption and non-dependent population, all controls, as well as the main effect of economic development reach statistical significance. The statistically significant interaction terms for periods 4 (1990s) and 5 (2000's) indicate that the effect of economic development on fisheries

footprint, for less-affluent nations, does vary by time period. These results signify that the effect of economic development increased relative to the baseline category of the 1960's.

Model 5 examines how the effect of economic development varies by region. This allows the study to consider economic development in a more nuanced, non-monolithic way that places nations within categories that can broadly consider some degree of cultural and/or geographic differences. All controls except nondependent population, livestock production, and meat consumption reach statistical significance when accounting for the interactions of GDP and region. In Model 5, the effect of economic development in Central/South America, the Middle East, and Africa differs from the baseline category ($p<.05$), Asia. Thus, the results suggest that the effects of economic development on fisheries footprint vary by region. I omitted less affluent nations from North America due to issues with collinearity stemming from the inclusion of country specific effects. Finally, it should be noted, that Asia (even when excluding China) has the highest levels of fisheries and aquaculture production in the world (FAO 2018b).

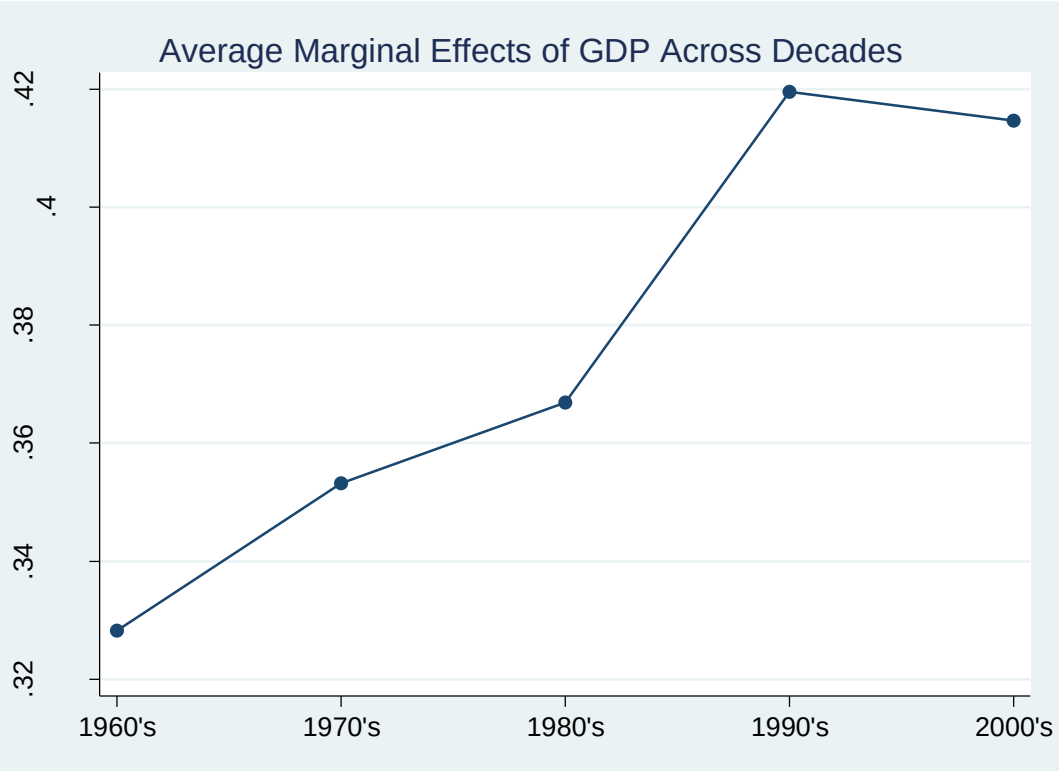
Finally, Table 2.8 (next page) presents the average marginal effects of economic development at each period and region for less affluent nations. Run after each interaction model in STATA as a post-estimation technique, the margins command allows for more direct comparisons of magnitude across period of time and region, respectively, for the effect of economic development.

Table 2.8. Average Marginal Effects of Economic Development for Time Periods and Regions.

Average Marginal Effect of GDP	Model 4		Model 5	
	Coefficient	Standard Error	Coefficient	Standard Error
1960's	.328***	.064		
1970's	.353***	.063		
1980's	.367***	.063		
1990's	.420***	.061		
2000's	.415***	.061		
Asia			.497***	.097
Central and South America			.846***	.193
Middle East			.221***	.128
Africa			.214**	.079
North America / Europe				

Average marginal effects demonstrate a clear trend in the effect of economic development over time on nations' fishery footprints in less-affluent nations. In addition to the average marginal effect of economic development reaching statistical significance (P > .01) across each period of time, the effect of economic development increases in less affluent nations over most of the periods. In the latest decade available, the effect of economic development decreases slightly relative to the 1990's, but remained at a comparatively high level. Figure 2.1 displays this trend graphically.

Figure 2.1. Average Effect of Economic Development across Decade



The average marginal effects also confirm, with greater clarity, that the presence and magnitude of the effect of economic development does vary by region. For less-affluent nations in Africa, economic development demonstrates the smallest effect on fishery footprint in comparison to other regions. Conversely, the strongest effect occurs for less-affluent nations in Central / South America followed by Asia, and then the Middle East. For example, the model predicts that, for less-affluent Central/South American nations, for every one percent increase in economic development there is a predicted .846% increase in these nations' fishery footprints. Conversely, for less-affluent nations in Africa, fishery footprint increases only .214% for every one percent increase in economic development. For less affluent nations in the Middle East, the effect is slightly higher at .221. Overall, these results suggest that region strongly modifies the effect of economic development on fisheries footprint in less-affluent nations.

Discussion

Ecological Impact or Food Security?

Modern seafood production practices are a central aspect of marine ecological change. The ecological impact associated with fishing is well-evidenced in numerous examples of overfishing, including the overall decline in the mean trophic-level of species, where fishers rely on species at lower levels of marine food webs (Pauly et al., 1998). Not only does this phenomenon imply overfishing, but increased fishing at these levels can have wider reverberating impacts on marine biodiversity and ecology (Smith et al., 2011). In relation to other food commodities, seafood and fisheries products are thus unique in that they rely upon wild stocks for a significant portion of the total, i.e. beyond aquaculture. Thus, for fisheries, metabolic cycles must continue, relatively unabated, in order to prevent the collapse of future populations (Clausen and Clark, 2005). In this context, the driving influence of economic development on increasing fisheries footprints in less affluent nations is a critical socio-ecological concern.

With this in mind, I argue that the ecological footprint of fisheries is a better indicator of a nation's marine ecosystem impact than it is the quality of dietary consumption. The footprint indicator says nothing about the distribution of fisheries products within a nation. Furthermore, as a broad measure, it reveals little about the specifics of how fisheries products are utilized within a nation. For example, a nation's fishery footprint may increase due to a small portion of a nation's population becoming wealthy and expanding their consumption of protein commodities. As suggested above, another potential source of fisheries footprint expansion is the use of fisheries products' as an input commodity for agriculture, such as animal feed or fertilizer, or

aquaculture, in the form of fish feed (Clark 2020; Longo et al., 2019). Neither of these uses suggest a widespread improvement of diet.

However, the footprint indicator does account relatively well for aggregate bio-productive area needed to support total consumption of fisheries products. As such, while it is uncertain how the increase of a fishery footprint impacts dietary quality, there is reason for greater confidence that a larger fishery footprint poses challenges for sustainability in marine systems. Thus, the findings for less-affluent nations, whose waters comprise the vast majority of the world's fishing territory, reveal that economic development within the dynamics of a capitalist world food system tends to result in increasingly deleterious effects on marine sustainability over time. The potential for metabolic disruption is especially troublesome when one considers future food security of less-affluent nations, whose position in the world-system is associated with food insecurity (Kick, McKinney, and Thompson 2011) and who rely on seafood as an important source of protein and employment (FAO 2018b).

Comparing Economic Development across Levels of Affluence

Model 1, which examined the drivers of fishery footprint for all nations, shows some consistency with similar work on fishery footprint and seafood consumption (Clark et al. 2018). The effects of economic development and total population remain positive; however, meat consumption and livestock production both fail to reach statistical significance. The inclusion of non-dependent age population, whose effect is positive, conforms to previous research on this metric as a potential driver of ecological impact (York, Rosa, Dietz, 2013; MacKellar et al., 1995). The negative effect of the GDP quadratic in model 1 indicates that, at the most affluent levels of economic development, the effect of economic development on fishery footprint reaches a

maximum. Therefore, no significant reduction in fisheries footprint associated with economic development is indicated in this model, only a levelling effect once a ceiling is reached.

There exists substantial variation in the nature of these effects when examined more closely according to nations' level of affluence. In regard to the main coefficients of interest, those that examine the effect of economic development, level of affluence matters greatly. For affluent nations only (model 3), the presence of a quadratic effect for economic development requires some elaboration. The world's wealthiest nations are increasingly importing their consumed seafood from the global South, whose waters they depend upon for continued expansions of fisheries based consumption and production. For example, wealthy nations such as the United States, Japan, and those within the European Union comprise around 12 percent of the world's population, but consume 30 percent of the world's seafood (Swartz et al. 2010). Indeed, the vast majority of seafood consumed in affluent nations, such as the United States, is imported—by some estimates more than 90 percent by value and 80 percent by volume for the United States alone (NOAA 2017; NOAA 2019).

Indeed, according to the World Bank's Development Indicators, seafood consumption within affluent nations increased substantially across our time sample. Yet this increase does not correspond perfectly with the fishery footprint indicator, which remained comparatively stagnant for affluent nations. A likely explanation for this discrepancy lies in the methodology for the fishery footprint indicator. As discussed, the trophic level of produced (captured, farmed) species matters greatly for determining nations' footprint indicators; however, the Global Footprint Network assumes that the trophic load of imports of a particular nation is equal to the average global harvest. This assumption may obscure inequitable trade dynamics because affluent nations are known to import high trophic, high value species harvested in the waters of nations in the

global South (Deutsch et al. 2011; van Mulekom 2006). It is likely that if the Global Footprint Network adjusted for this concern that there would be important differences in the results. Specifically, it is likely that the relatively stagnant fishery footprint in affluent nations corresponds with a rise in higher trophic catches in the waters of the global South, which the current measurement approach does not include. I therefore advocate for the revision of the footprint indicator in future development of this measure.

Thus, when relying upon the fishery footprint metric, it is difficult to determine if an unequal ecological exchange relationship exists within global fisheries. However, this study does suggest that less-affluent nations generally suffer the ecologically deleterious effects of economic development worse than their affluent counterparts (often their trading partners). For example, the models present no evidence that a quadratic effect occurs within the fisheries of less-affluent nations. I posit that the global political economic conditions and legal arrangements of the modern world food system, which allow easier access and extraction to the resources in less-affluent nations, along with the biophysical conditions that form the ecological foundation of production, likely account for this disparate effect of economic development.

Economic Development, Less Affluent Nations, and Fisheries Footprint

The results suggest that the effects of economic development on fisheries footprint differ according to level of affluence. Thus, after the examination of initial models, I sought to further explore the effect of economic development within less affluent nations, which the models indicate experienced greater marine impacts associated with seafood production and consumption. I developed more refined models to examine period and region effects, along with their interactions with economic development, focusing solely on less affluent nations. The findings comparing the effects of different periods (decades) over the time of this study may

suggest some slowing of the effect of economic growth on fisheries footprint in the most recent decade (2001-2010). I interpret this moderate decline as likely due to the nature of fisheries, and the character of food production and consumption. Global fisheries captures stagnated over the last several decades, as fish populations are finite and thus bounded by natural limits. Also, food consumption tends toward a ceiling due to biological and economic factors. Thus, it is reasonable to expect that fisheries footprint cannot expand indefinitely. However, as aquaculture added significant quantities of fish, not offsetting captures, I still expect some continued expansion in future decades (Longo et al., 2019). This continuation will likely stem from increased aquaculture and intensified fishing efforts.

The results of this study indicate that region also moderates the effect of economic development for less-affluent nations. This regional variation suggests that economic development contributes to differences in these nations' use of marine ecological space associated with consumption (including imports and local production) of seafood products. Economic development demonstrated the strongest effect for less affluent nations in Central/South America. This finding makes sense given that nations within this region, in recent decades, increased their share of world aquaculture production, as well as per capita aquaculture production (FAO 2016). On the other hand, economic development demonstrated relatively small impacts for less affluent nations in Africa, despite the fact that fisheries production increased substantially (by more than 10%) for Africa (World Bank 2016). The comparatively small effect of economic development for less-affluent nations in Africa suggests that Africa's fisheries resources may witness major economic investment in the coming years, leading to increased fishery footprints across African waters. More negative fishery trade balances in African nations in comparison to less affluent nations in other regions may also account for the

relatively small effect. Previous research in fisheries science suggests that this is an important dynamic in Africa in particular (Worm et al. 2009). Thus, this study signals that future research in fisheries and the world food system should expand upon the limitations of this study to explore inequitable ecological exchange relations across levels of the world system. Such work may require other metrics beyond the fisheries footprint.

The increase of the ecological footprint of fisheries in less-affluent nations, largely driven by capitalist economic development, suggests that both the quantity of the catch and, importantly, the trophic load of these catches are unsustainable. I therefore interpret the ecological impact of economic development—which has increased with time—as a serious concern for marine sustainability, and future food and economic security for less-affluent nations. The undercutting of ecological processes can result in long-term strains on social conditions which, especially for poorer nations, is incongruent with broader aims for social and economic development (Amin 1974; Rice 2009). The prioritization of ecological processes requires special diligence for future seafood security, as fisheries production necessitates the long-term protection of species in precarious marine ecosystems.

Conclusion

The key takeaways from this study concern the impact of economic development on fishery footprint and, by close proxy, marine sustainability over the last five decades. First, only affluent nations seem to demonstrate the potential for an environmental Kuznets curve effect. Second, the more ecologically intensive effects of economic development thus appear to be occurring in the fishing grounds of poorer nations. The models that specifically examine less affluent nations make clear this uneven impact of ecologically intensive development. Third, the nature of economic development's impact on fishery footprint in less affluent nations generally intensified

over time, with some moderate flagging in the 2000's. I interpret this slowing as the result of global overfishing and the reduced potential of wild fish stocks to sustain their ecological metabolism. Finally, the nature of economic development's effect varies substantially by region, and this variation raises questions about export oriented development and future potential for fishery expansion (or lack thereof) in the global South.

The results of this study thus add more detail on the nature of economic development's effect on fishery footprint. Overall, this study provides evidence to suggest that the expansion of the world capitalist food system is fraught with contradictions for fisheries and food security. Relatedly, if these trends and dynamics persist, they risk the potential for marine sustainability. Leading developmental organizations correctly emphasize that "for billions around the world—especially the world's poorest—healthy oceans mean jobs, food, and protection," (UN 2017: 1). Yet, this study suggests that the paradigmatic, developmental assumptions of the capitalist world food system, which emphasize commodification, profit maximization, and expansion, may have serious consequences for marine sustainability. In the coming years, policies and programs must offer new prescriptions to ensure the sustainable governance of fisheries resources in such ways that fairly distribute impacts throughout nations, in different regions, and across varying levels of affluence.

CHAPTER 3: A WITHIN-CASE COMPARATIVE ANALYSIS OF THE ATLANTIC MENHADEN FISHERY IN THE AGE OF CAPITAL

(Clark, Timothy P. 2020. Mining the Sea: A Within Case Comparative Analysis of the Atlantic Menhaden Fishery in the Age of Capital." *Sociology of Development* 6(2): 222-249.)

Introduction

The Atlantic menhaden is a small, oily, and fatty fish that migrates up and down the Eastern seaboard of the United States. As a critical species in a complex Atlantic marine food web, the Atlantic menhaden are ecologically valuable in their role as food for other fish. Atlantic menhaden, via their prolific consumption and digestion of microscopic, low in the food chain marine life are, effectively, a "conduit through which the sun's energy gets passed from single celled animals to top level predators" (McKenzie 2010: 145). Also, in recent decades, marine biologists have explored the Atlantic menhaden's ecological role as a filter fish, noting that its feeding habits can potentially regulate water quality in bays and estuaries (McHugh 1967; Oviatt et al. 1972; Gottlieb 1998; Friedland, Ahrenholz, and Haas 2005). Thus, the Atlantic menhaden are a critical component within a marine ecosystem and food web that has consistently, for centuries, provided a material basis for human communities along the Eastern seaboard.

The economic development of the menhaden fishery is also of vital socio-historical importance. The Atlantic menhaden are the basis for the United States' first capitalist and, arguably, its largest and most important fishery (Franklin 2007). Today, due to contention between fishers, tourists, and environmentalists, the management of Atlantic menhaden generates a tremendous amount of controversy. In 2016, the Atlantic Marine States Fisheries Commission (AMSFC) received more public comments on Atlantic menhaden management than any fishery in its history (Nature Conservancy 2017). While such fervor over such a small and unassuming fish may seem unusual, the economic importance and controversy over managing

the fishery are nothing new, and indeed such conflict dates back centuries (Frye 1978; Franklin 2007; Bolster 2012).

In parallel fashion to other overlooked marine and coastal problems (Longo and Clark 2016), few who do not live and work in Atlantic coastal communities have ever heard of this important, but controversial little fish The explanation for the durable anonymity of the vital menhaden lies in its peculiar developmental history. While there are a number of uses for menhaden, the Atlantic menhaden have been—at least over the last 170 years—predominantly utilized as an input commodity for industries within the capitalist agri-food system. Prior to its commodification, there is some record of colonial settlers eating the fish directly (Lawson 1709; Catesby 1732). Historians debate the extent to which Native Americans utilized the menhaden (Franklin 2007; Ceci 1975), but one "pattern of veracity" across the historical record is clear: Atlantic menhaden "purpled" the waters in their abundance and were a critical component of a vibrant, pre-industrial marine food web that settlers and Natives relied upon (Frye 1978).

The subsuming of Atlantic menhaden to the logic of a capitalist market place radically changed this complex social-ecological relation. The dominant utilizations of Atlantic menhaden across the age of capital include oil, fertilizer for crops and fields, livestock feed, and aquaculture feed. To be sold as input commodities, Atlantic menhaden are captured and then processed, or "reduced," into oil, powder, and pellet forms. The ways in which menhaden have been predominantly utilized were not inevitable, though, and the developmental history of the fishery has had critical consequences for the socioecological relations of coastal communities along the Atlantic coast.

This study examines key inflection points in the history of the Atlantic menhaden fishery to explore why certain uses emerged. I also compare political economic factors across periods to

explore the lasting socio-ecological effects of the fishery on the Atlantic marine system, and account for the social drivers of the fishery's recent (1980's onward) decline. In brief, the conclusion will emphasize the following key findings. One, rather than an indicator of sustainable development, fishery decline in this case is driven by socioeconomic change in the capitalist world food system. Two, the history of the Atlantic menhaden fishery demonstrates the need to integrate studies of terrestrial and marine food systems. Ecosystem disruptions in both these sorts of socioecological systems condition one another in important ways. Finally, the racialization of the fishery's workforce allowed for the naturalization of racial inequalities, and this naturalization accelerated processes of commodification.

Theory

First, this study draws upon Longo, Clausen, and Clark's (2015) "tragedy of the commodity" approach, which underscores the importance of a capitalist political economy for understanding socioecological change. The tragedy of the commodity theory emphasizes that, under a capitalist political economy, commodities are primarily produced for exchange rather than for use. Because exchange value is valorized as money and accumulated as capital, ecosystems become subject to a logic of endless, quantitative expansion (Burkett 1999; Longo, Clausen, and Clark 2015). Capitalist production thus depends upon what Wallerstein (1983) referred to as the commodification of everything and, as such, complex socioecological processes—or what Polanyi referred to as commodity fictions—are simplified according to the reductive logic of capitalist commodity exchange (Polanyi 1957). Finally, this process is far from a natural socio-historical occurrence; rather, it typically comes about after the annihilation of social forms of production not amenable to capitalist commodity production (Marx 1976; Longo, Clausen, and Clark 2015; Foster and Clark 2018).

An important aspect of the Atlantic menhaden fishery is the composition of its workforce. Records and testimony indicate that the fishery was comprised of an 80-90% African American workforce. I thus borrow from sociological theory of intersectionality to more fully understand the interactive role of a black working class for the development of this fishery. Particularly, I utilize Davis' (1983) and Collins' (1993) writings on the racialization of black bodies and labor. In short, white dominated discourse imposes certain controlling images on Black Americans (both men and women, in unique and overlapping ways) that naturalizes black labor to a relegated status. As Davis (1983: 94) explains, white employers would often "compliment" their Black servants as "good…and faithful creatures," whose true purpose was realized as menial servants for whites. Collins (1993) notes that black workers were conceived of as "mules", and consequentially assigned more physically grueling labor at the factory, and as domestic servants for white families. As Du Bois (1999: 69) emphasized, such discourse adapts over time to repeatedly justify racial hierarchies, where those relegated to the bottom tiers perform "necessary duties and services which no real human being ought to be compelled to do," (Clark, Auerbach, and Zhang 2018).

Commodification can thus entail intersectional power struggles that tend to deepen capitalist relations amenable to commodification within certain industries and communities. As Longo, Clausen, and Clark's (2015) theory would suggest, the outcomes of this struggle are often tragic for socioecological systems. Under a capitalist mode of commodity production, ecological wealth is typically extracted until a point of systemic exhaustion or collapse. When ecosystem stresses become more and more apparent, capitalist firms and states tend to prioritize the implementation of techno-efficiency solutions or geographic fixes (e.g. moving

production/pollution elsewhere) over solutions that promote holistic ecosystem rejuvenation (Longo, Clausen, and Clark 2015).

Capitalist commodity production has always operated within the context of a world economy, delineated according to a certain division of labor based around core capitalist nations extracting economic and ecological wealth and, ultimately, value from periphery states (Bunker 1984; Wallerstein 2004). Semi-periphery nations consist of an amalgamation of core and periphery productive characteristics, and often serve as mediating forces between core centers of capital and peripheral zones of extraction (Chase-Dunn and Hall 1997; Frame 2018). In recent decades ecological degradation and productivity stagnation in core states, foreign investment in profit oriented, agricultural modernization in the global South, and the collapse of the USSR combined to generate important changes in the institutional dynamics across core, periphery, and semi-periphery nations (Chase-Dunn and Hall 1997; Chase-Dunn 2005; Amin 2015).

Changing institutional dynamics of the capitalist world system are especially apparent through the lens of food regimes. In brief, a food regime can be understood as the international relations of food consumption and production that is governed by a certain set of rules, norms, and institutions for the purpose of capital accumulation and the maintenance of a capitalist world order, or system (Friedman and McMichael 1989; Friedmann 1993; Araghi 2003). For example, the structure of food relations for production, distribution, and consumption between the United States and Great Britain resulted in opportunities for Atlantic menhaden capitalists to market and sell their products to address contradictions inherent within the capitalist food system. In recent years, once fully periphery nations like Thailand have emerged as “new agricultural countries” where production is export oriented / geared towards nations in the global North, and a substantial portion of the workforce, notably global trends in fishery employment, consists of

migrants from still more firmly periphery states like Cambodia, Myanmar, and Laos (McMichael 2012; Clark et al. 2018). Overall, then, this theoretical framework demonstrates the complementarity of several theories of political economy with intersectional approaches to understanding crosscutting inequalities—in this case, the intersection of race and class power dynamics. . This complementarity is particularly useful for building upon prior understandings of the structured, socioecological relations within a capitalist political economy, or what Marxist scholars refer to as the social metabolic order of capital (Mészáros 1995; Foster 2000).

Data and Methods

This study relies on primary and secondary data that spans the duration of the Atlantic menhaden's industrial history. For secondary data, I utilize a series of marine and environmental histories of the Atlantic region and other works that focus specifically on aspects related to the Atlantic menhaden fishery. For primary data, I utilize archived government and state agency documents and reports from the U.S. Fish Commission, Maine Board of Agriculture, Pacific Guano Company, newspaper articles, county histories, the Atlantic States Marine Fisheries Commission, the North Carolina Sea Grant program, and some unpublished local histories. Many of these sources also contain unaltered letters, interviews, and fishery records. Furthermore, I collected archived, primary data from marine history museums that include logbooks, receipts, as well as correspondence, and interviews of retired workers and owners. Overall, I examined over 250 primary and secondary source documents related to the fishery's history until I reached a point of saturation as related to my research questions. Finally, I also utilized time-series data of fishery records and fish captures, taken from UN software and reports on the fishery from regulatory agencies.

I use ideographic within case methods to explore my research questions. Ideographic insight is typically case specific, and is useful for building and testing theory, constructing historical narrative analyses, and highlighting complexities of particular cases (Lange 2012). Over the last century and a half, the majority of productive activity in the Atlantic menhaden fishery moved from Maine to as far south as North Carolina, where the migrating fish reach a stage in their life history that is large enough to justify capture. It is thus a regional fishery prone to changes in geographic concentration. Temporally, my analysis begins in the 1840's, as this is generally regarded as the point during which the industrialization of the fishery began (Bolster 2012; Franklin 2007; Frye 1978). Within this case, I pose two research questions. One, what factors contributed to the utilization of Atlantic menhaden as oil, fertilizer, livestock feed, and aquaculture feed? Two, why has the Atlantic menhaden fishery suffered severe economic decline the last several decades? In answering these questions, I will also detail the socioecological consequences of these developments and the fishery's eventual decline.

Answering these questions allows me to explore how changes in the broader capitalist agri-food system can affect local and regional outcomes within a particular fishery. At the same time, this study will detail how this fishery shaped the socioecological system of the United States' Eastern seaboard, a place where humans have made lives as fishers, farmers, and hunter gatherers for centuries (Lawson 1709; Catesby 1732; Cronon 2011). To explore and to understand why certain utilizations of the fish emerged, I first construct narrative analyses within different periods of utilization. I determine periods according to dominant, temporally specific, market uses of the Atlantic menhaden since the fishery's transition into a capitalist system of production (Table 3.1).

Table 3.1. Periodization of Fishery

Time Period	Dominant Use	Region
1840s-1870s	Oil	Northeast Atlantic
1870s-1920s	Fertilizer	Mid-Atlantic, Southern
1920s-1970s	Livestock Feed	Mid-Atlantic, Southern
1980s-Present	Aquaculture Feed	Mid-Atlantic

I define dominant as the market utilization for which the majority of Atlantic menhaden were fished. In order to answer the first research question, then, this study utilizes a holistic and ecologically grounded, political economic history of the fishery within different periods of time that provides some causal insight regarding economic development within the fishery. This analytical process involves uncovering the drivers of events, or patterned processes that can causally spark social change (Lange 2012: 44). In order to understand the pivotal workings within periods, I must consider several specific social factors within the temporally specific narrative process. Across periods within the fishery, I will describe "events", which Griffin (1993) defines as distinguishable happenings, one with some pattern or theme that sets if off from others" that affects change within a distinguished time frame (Lange 2012: 44). This study orders these events temporally, within periods, to analyze how the fishery became oriented to certain kinds of market uses. Within case methods also emphasize theory testing, or the exploration of specific observable implications and intervening processes that should be present if a theory is valid (Mahoney 2007). By incorporating intersectional and world food system considerations into my socio-historical analysis of the Atlantic menhaden fishery, I test and expand upon the tragedy of the commodity thesis.

In the utilization of internal comparison, this study generates ideographic insight across these periods of the Atlantic menhaden fishery (Lange 2012). Particularly, this methodological tool enables the study to explore why, in recent years, the fishery has failed to expand and,

instead, suffers from flagging economic growth. In comparing periods within the case, I can determine which factors were unique to the most recent utilization period and, thus, form an argument about the drivers of decline. Internal comparison thus explores and answers the second research question. The following section presents narrative analysis for each utilization of the fishery over its industrial history, beginning with oil.

Narrative Analyses of Atlantic Menhaden Utilizations

Oil

Prior to the industrialization and capitalization of the fishery, most Atlantic menhaden were caught by quasi subsistence, New England based fisher-farmers who used the fish in rudimentary ways to fertilize their crops or for direct food consumption. Farmers cooperatively shared boats and seines, or large fishing nets, which at that time were often homemade from flax grown upon their own farms (Franklin 2007). A notable few boiled the fishes, skimmed the top for oil, and sold it to local merchants (Frye 1978). Regarded today as inedible (Ellis 2003), there is some record of the Atlantic menhaden being directly eaten in the 18th century, as it was described by some to be "an excellent sweet fish," with no butter needed to fry (Lawson 1709; Catesby 1732). Yet broader socio-structural conditions channeled the fish into a wholly different utilization that demanded new forms of productive relations.

Some business minded farmers began to realize the local market potential for Atlantic menhaden oil in the late 1840's. Goode (1880) noted that around 1850 an elderly lady of Blue Hill, Maine boiled a kettle of fish for chicken feed and subsequently skimmed off and bottled the oil that had risen to the top. She then took this oil to a local merchant, who likely worked in the flagging whale oil trade. This relatively small scale demand for oil generated a local, in shore Atlantic menhaden fishery that other fishers regarded as somewhat of a sideshow (Bolster 2012).

However, the failing whaling business generated acute interest in Atlantic menhaden as a potential replacement for whale oil, and this development rapidly drove the early Atlantic menhaden fishery towards commodification. Whale oil was indeed a critically important commodity, referred to today as the plastic of its age (Davis, Gallman, and Gleiter 1997). The U.S. whaling industry in the mid-19th century depended upon capital intensive technologies, such as ships designed for long voyages, in order to chase increasingly scarce Atlantic whales. After the U.S. civil war, when many of these boats were destroyed, the U.S. whaling industry could not recover sufficiently to chase the increasingly scarce right and sperm whales of the Atlantic coast (York 2017). Thus, as the United States' globalized whale industry faltered, Atlantic menhaden fisheries entered into a world market organized according to capitalist imperatives to grow profits, outcompete rivals, and accumulate capital.

The commodification of Atlantic menhaden led to conflict between the industrializing Atlantic menhaden fleet and independent fishers. Due to the widespread recognition that Atlantic menhaden were a favorite food of larger fish, hook and line fisher-folk began to see the new Atlantic menhaden oil industry as a threat to their economic security. For example, in 1852, more than 150 fishers from a single Maine fishing village petitioned the state legislature to put an end to seine fishing of Atlantic menhaden, as they considered this practice a threat to the food supply of larger fish caught on hook and line (Bolster 2012). Bolster (2012: 132) cites a struggling fisher, Josiah Hardy, who spoke for many fishers when he argued that the use of advanced harvesting technologies, such as seines, "should be abolished in these waters," in order to preserve hook and line fishing which "good fisherman" utilized. Further, he reasoned, the use of seines required expenses and capital , which could only be spent by "a present monopoly to the

few" who could afford them. Independent Maine fishers would try and fail repeatedly to ban or limit seine fishing over the next several decades (Frye 1978).

Thus, one of the earliest developmental junctures in the history of this fishery came with the eradication of commons fishing. In his discussion of primitive accumulation, Marx described the "annihilation" of prior forms of property relations not amenable to capital accumulation (Marx 1976: 928). Such expropriation typically sets the stage for a historical phase of capitalist commodity production, or commodification (Longo, Clausen, and Clark 2015). As hook and line fishing became increasingly difficult for social and ecological reasons, the social definition of what it meant to be a fisher transformed from one of a quasi-subsistence, in shore fisher who extracted resources from a commons, to a worker on a fishing boat earning a wage to pay for consumer goods. As marine historian Matthew McKenzie notes in his environmental history of 19th century Cape Cod, "increased removals," of forage fish like menhaden "imposed upon independent hook and line fishermen a dire choice," to continue to fish in a struggling coastal environment or to "abandon their homestead" (McKenzie 2010: 150). Many chose the latter option, and between 1865 and 1895 Cape Cod fishing villages lost 20 percent of their population with fishers often moving to work in industrial fishing centers (McKenzie 2010). Ecological change thus became a mechanism of expropriation, or a vast shift in property relations (Foster and Clark 2018), where access to the sea for work became more and more untenable for those who were not waged workers.

In 1864, with the help of investment from Rhode Island based capitalists, the first factory for rendering Atlantic menhaden into oil in Maine was constructed. The cost to build the factory stood at about $12,000—or about 60 times what a typical, independent New England fisher made annually (Bolster 2012). State governments and congress thus did little to slow the tide of

industrial purse seine fishing, leaving it virtually unregulated (Smith 1895). As the fishery entered into a capitalist world market and industrialized with the infusion of capital investment, the Atlantic menhaden were further subjected to the logic of capitalist commodification. This logic prioritizes the never-ending expansion of quantitatively limitless exchange, valorized as money and accumulated as capital (Burkett 1999).

Fertilizer

Broader conditions in the capitalist agri-food system began to stimulate increased demand for a fertilizer product—guano—that justified further commodification of menhaden. Indeed, as the menhaden fishery began to solidify itself as a reliable source of oil for other industries, Great Britain and the United States desperately sought sources of nitrogen to amend their increasingly infertile soil. Unlike prior forms of agricultural production, capitalist agriculture geographically alienated systems of production, distribution, and consumption across urban and rural zones and, in doing so, dismantled processes of nutrient recycling that maintained soil fertility (Foster 1999; Marx 1976). Marx built his ecological critique of the 19th century soil crisis by reading and corresponding with the leading soil chemist of his day, Justus Von Liebig, who remarked that "certain existing relations," constituted a "robbery" of the soil that, if not aggressively dealt with, could bring about the "ruin of agriculture," (Liebig 1859).

The soil crisis of the mid-19th century generated an unsustainable and imperialistic rush for nitrogen rich bird deposits, or guano, off the coasts of Peru and Chile (Clark and Foster 2009; Magdoff 2011; Clark and Foster 2013). The 1870s collapse of the guano trade translated to high demand for new sources of fertilizer inputs to replenish degraded soil. Nitrogen rich menhaden were marketed to fill this need of the capitalist agri-food system. The technical advancement of rendering menhaden flesh helped to structure demand for the product that menhaden capitalist

referred to as fish "guano." As such, by the mid-1870s "demand for [fish] scraps" was "represented as exceeding three times the present supply" for trade with southern U.S. states alone (Maine Board of Agriculture 1875). "Guano" companies and associations began investing capital all over New England. For example, the Pacific Guano Company, which moved operations from the Peruvian Pacific coasts to a Massachusetts fishing village, declared that "the exhaustion of supplies on the Pacific islands compelled the Company to look in other directions for original sources," (Pacific Guano Company 1876: 9). U.S. farmers clamored for the relatively cheap fish scrap, and agricultural reports of the time document the fertilization of upwards of 2 million bales of cotton via Atlantic menhaden alone (Goode 1880; Titus 1885).

The institutional arrangements of the first global capitalist food regime opened up new market potential for menhaden fertilizer commodities. The first food regime, with Britain as hegemon, was geared toward enabling British dominance in an increasingly globalized capitalist world system via cheap importation of staple crops like wheat and corn from settler states such as the U.S. (Friedmann 2005). The abolition of the English Corn Laws, for example, drove the costs of food imports down and served as further means to feed and sustain) an industrial army of wage workers within Great Britain (McMichael 2013). Domestically, within the United States, grain crop production and trade soared, became highly capitalized, and governed by speculative markets (Cronon 1991). Accordingly, Atlantic menhaden were argued to be an "inexhaustible" source of cheap fertilizer for "all grass and grain crops" (Maine Board of Agriculture 1875: 45). Thus, the Atlantic menhaden became a critical component that spurred industrial methods of farming within the U.S.

Because the entirety of the menhaden, the oil and flesh, could now be utilized to satisfy the demands of capitalist markets, the Atlantic menhaden industry rapidly expanded its

technological capabilities and political clout. The Atlantic menhaden fishery was the first U.S. fishery to become reliant upon steam power and, also, became one of the earliest and most powerful agricultural lobbies in the United States—so much so that federal officials, such as U.S. commissioner of fisheries Spencer F. Baird, hesitated to critique it publicly for overfishing. (Bolster 2012). Baird's colleague and eventual successor, George Browne Goode, who led the most exhaustive review of the 19th century menhaden fishery, attributed declining menhaden stocks to changing weather patterns, aggressive non-human predation, and the natural fickleness of fish stocks—everything, in short, except the fishery (Goode 1880). Nevertheless,, independent fishers despised the "Damned pirates," of the Atlantic menhaden industry "sneakin' into our waters," who, they argued, were unchristian and "heathen" (Lippincott's Magazine 1883). Like the protests of Maine fishers in the 1850's such complaints were in vain.

As the fishery transitioned to a distinctly capitalist form of productive relations, its capitalization, productivity, and wage labor force expanded while its fleet and factories consolidated, as Table 3.2 indicates.

Table 3.2. Fishery Consolidation and Capitalization.

	1873	1875	1877
Factories in operation	62	60	56
Sail vessels employed	383	304	270
Steam vessels employed	20	39	63
Total Employees	2306	2633	2631
Capital Invested	$2,388,000	$2,650,000	$2,047,612
Fish Taken	397,700,00	563,327,000	587,624,125
Gallons of oil	2,214,800	2,681,487	2,426,589
Tons of guano	36,299	53,625	55,444

Table 3.2. (Continued)

Total Value of Manufactured Products	$1,218, 675	$1,582, 015	$1, 607,722

(Goode 1880)

The fishery again expanded as it moved southward in the 1880's but, by the end of the 19th century, the fishery had all but disappeared in the North Atlantic due in part to collapsed stocks in the Gulf of Maine. Collapse is indeed no understatement—records indicate that menhaden stocks virtually disappeared, as catches in the Gulf fell from 140,000 pounds in 1877 to miniscule, near zero, levels in 1880 and beyond (Association of the Menhaden Oil and Guano Manufacturers of Maine 1878; Vaughn and Smith 2009). The fishery subsequently consolidated to 55 plants across the Mid-Atlantic, Chesapeake Bay, and North Carolina (Goode 1887; Smith 1895; Garrity-Blake 1994). In an effort to reduce competition, companies utilized strategies of vertical integration, or the firm driven practice to own as many links in the commodity chain as possible. This included acquiring the failing fishery businesses and buying out commercial fishers in an effort to integrate supply chains (Gabriel 1920). An 1897 article in the Long Island Trader described this process:

"On the twenty-fifth of the latter month all the important concerns yielded to the inevitable, and, on that day, was consummated the final transfer of their properties to the American Fisheries Company. Together with those of Long Island went practically all the factories of the Atlantic coast."

With the boon of fertilizer, the menhaden fishery exploded economically (Greer 1912) and entrenched itself as an important component of the nascent capitalist world food system. Moreover, the declines of fish stocks in the Gulf of Maine and elsewhere in the northern regions (Goode 1880; 1887) signified a need to both be mobile and technologically capable of making longer voyages. This ecological change favored financially endowed capitalists who could out compete smaller scale ventures. Economic power translated to social and political power, as the

highly capitalized menhaden lobby effectively prevented the U.S. Congress from imposing regulations in spite of scientists, small scale fishers, and politicians voicing support for limits (Bolster 2012).

Yet the growth of the menhaden fishery was not without obstacles. Arguably the most important industrial innovation of the 20th century, the Haber-Bosch process, made possible the mechanical production of nitrogen fertilizer (Schrock 2006). This innovation, along with the rise of relatively inexpensive and abundant fossil fuel, severely challenged the market viability of Atlantic menhaden. External market pressures thus placed the fishery at a critical juncture in its history.

Livestock Feed

However, other conditions within the capitalist world food system presented some opportunity for the protein rich and fatty Atlantic menhaden. Along with the importation of grains discussed in the previous section, a characteristic of the first capitalist food regime was the increase of food flows of meat from settler states such as the United States (McMichael 2009). Integration of agriculture and industry strengthened in the late 19th and early 20th centuries. As such, the industrial production of meat proliferated and virtually wiped out local butchers and meat packers in the U.S.' major cities (Friedmann and McMichael 1989; Cronon 1991). Moreover, meat consumption in the form of beef, pork and, increasingly, chicken came to signify an affluent, modern diet, as crystallized by Herbert Hoover's 1928 campaign promise for widespread prosperity in the form of a "chicken in every pot," (Smith 2017).

As previous research in the social drivers of seafood consumption demonstrates, the consumption of terrestrial and aquatic protein consumption show some positive relation over time (Clark et al. 2018). This protein consumption treadmill occurs for nuanced and often

unexpected reasons, as this particular case demonstrates. Indeed, the Atlantic menhaden became integral for supporting the growing, terrestrial meat industry within the United States. By 1918, the Federal Bureau of Fisheries had already begun funding and conducting research to explore how fish scrap could be produced for utilization as a feed for hogs and other livestock (New York Times 1918). Less than a decade later, the Bureau confidently explained that "very fine poultry and pig foods are easily prepared" with feeds augmented by menhaden scrap (Ellis 1927: 2).

In the 1920's and 1930's, menhaden capitalists expressed optimism over the new market. In a letter to menhaden factory owners, supply chain brokers noted the healthy demand for menhaden scrap for feeding livestock (Jett 1927). This demand was so intense that one menhaden distributer chastised factory managers for the "carelessly handled" scrap shipments "owing to the heavy production and the need to move it quickly," (H.S. Baker and Bro. Correspondence 1933). When one considers that the vast majority of menhaden were utilized for fertilizer purposes as late as 1912, the shift towards scrap based livestock feed in less than two decades is especially impressive (Greer 1912). Moreover, the date of this letter suggests that the demand for menhaden scrap was healthy enough to remain strong during the peak of the Great Depression, and this resilience is confirmed by local histories (McKenney ca. 1959).

However, market demand for scrap within the capitalist agri-food regime was not the only factor driving a durable and growing fishery. By the mid-1920's, more than 80 percent of the factories and vessels in the fishery were located in southern or mid-Atlantic states, across the Chesapeake Bay and North Carolina (Franklin 2007). The fishery thus geographically transitioned to the south, with a southern and predominantly African American labor force. Many of the fishers were former slaves or their immediate descendants. Black workers

comprised the crew and rarely ascended to positions of authority—such as captains or mates—and were relegated to lower wage, physically intensive labor (Garrity-Blake 1994; Frye 1978). These racialized class dynamics confirm Du Bois' (2003) intersectional writings on race and class at the turn of the 20th century, where Black agriculture workers lacked direct access to the means of production and simultaneously did not possess leverage to improve their social standing. One former captain (a white man), now around 90 years old, described the pay scale of this period:

"Everybody [worked on commission]…When I started fishing they paid the captains 80 cent a thousand. They paid the mate and pilot 20 cent a thousand. The chief engineer, then they paid a second engineer about 18 cents a thousand... Then they got out to the crew and paid them 3 and a half cents a thousand."

Thus, the strict racial hierarchy ensured a plentiful portion of the labor army would earn pennies on the dollar. While there were key differences, the fall of the racialized guano trade of the 19th century, where Chinese workers quite literally enslaved to provide fertilizer for British and American farms (Clark, Auerbach, and Zhang 2017), preceded another racialized work structure meant to supply the input needs of the capitalist world food system.

The crew's labor required extreme physical exertion. One Black fisherman described how he and his fellow crewmen lifted seven hundred thousand pounds of fish into the boat in a single day, with no mechanical assistance (Curry Interview with Frye 1989). Fishers also endured difficult physical conditions, such as sleeping in cramped and often dirty quarters and dangerous working conditions where pain, injury, and fatal accidents ranged from constant, to common, to not unheard of, respectively (Garrity-Blake 1994). Fishers utilized coordinated songs, commonly called chanteys, to synchronize their pulling of the nets to avoid injury and improve efficiency as they manually drew in the haul (Frye 1978). Along with the coordinated muscle movement, the fishers sang chanteys to cope with the emotional and psychological difficulties of the job, such as

sleepless nights, stress over finances, tensions with bosses and, as this example shows, leaving behind loved ones for a fishing season:

Chanteyman: I left my baby standin' in the back doory cryin' , Honey, don't go!
Fishers' (response): Lawd, lawd, don't go!
Chanteyman: I'd go home but ain't got no money!
Fishers' (response): Lawd, lawd, ain't got no money (UNC Sea Grant 1988).

Such hardship lacked just compensation due to a racialized system of control, where black workers' physical and psychological stress was obscured. Citing an archived Princeton dissertation (Ligouri 1968), Garrity-Blake (1994) stressed that white fishers' attitudes strongly encouraged black fishers to remain in "their place," which typically meant working in more undesirable and dangerous positions. Similarly, according to testimony of former captains, black workers were recruited to perform the more physically grueling tasks of the job due to their supposed superior physical strength and natural inclinations to hard labor (Garrity-Blake 2010). Meanwhile, the white captain's work was "cerebral," and "thought to be the brains of the operation" (Garrity-Blake 1994: 53). A 1957 New York Times' piece captures the effects of this racialization quite well. Black fishers were a "happy, hardworking lot…with little labor to perform," outside of hauling in the catch, who "fare like kings" and prefer to sing their chanteys "in the major key," (Wharton 1957). Subjugation, servitude, and physical labor was the most natural and thus most pleasant, even easy-going, state of being for African American men in the fishery.

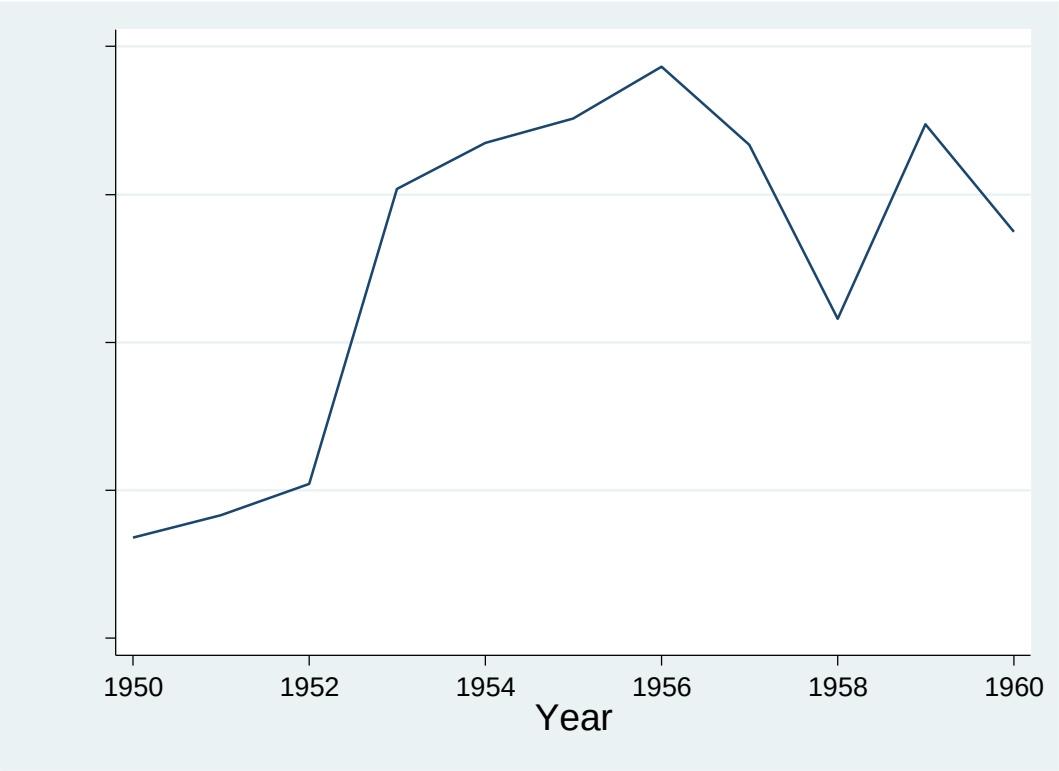
As evidenced by a bounty of testimony from black fishers, the exhausting work imposed upon them was far from natural. Further, in the early 1950's, black menhaden fishers across coastal communities organized more radically, framing their fight against class exploitation as a civil rights issue (Cecelski 2018). Yet efficiency gains in the late 1950's curbed the power of an increasingly agitated black working class, many of whom had unionized and attempted a failed

strike in the early 1950's. During this time, industry firms acquired discounted military surplus such as diesel powered steel boats and spotter planes to find fish more easily (Franklin 2007). Innovations like fish solubles intensified the efficiency of fish meal, and mechanized inventions like the power block—a device that mechanically pulled in the nets—reduced the need for human labor and boosted catch rates (Frye 1997; Garrity-Blake 1994). As in other cases of fisheries, gains in efficiency did not lead to decreased effort to procure sustained yields, but instead further subjected natural cycles of fish reproduction to the limitless, exchange oriented logic of capital (York 2017).

Indicative of commodification, innovation in the fishery centered around mechanizing technology for more efficient capture and utilization of menhaden, regardless of the fish's natural cycles of reproduction; in parallel fashion, this technology enabled the fishery to further cut labor costs (Longo, Clausen, and Clark 2015). Gains in productive efficiency under a system of generalized commodity production, typically lead to expansions of the scale of productive operations (Clausen and Longo 2012; Longo and Clausen 2011). These factors, along with abundant reproductive years of menhaden (Henry 1971), created a perfect storm for catch rate growth. The capture rate, in metric tons, over the 1950s, is displayed in Figure 3.1.[1]

[1] All capture data comes from Fish StatJ software.

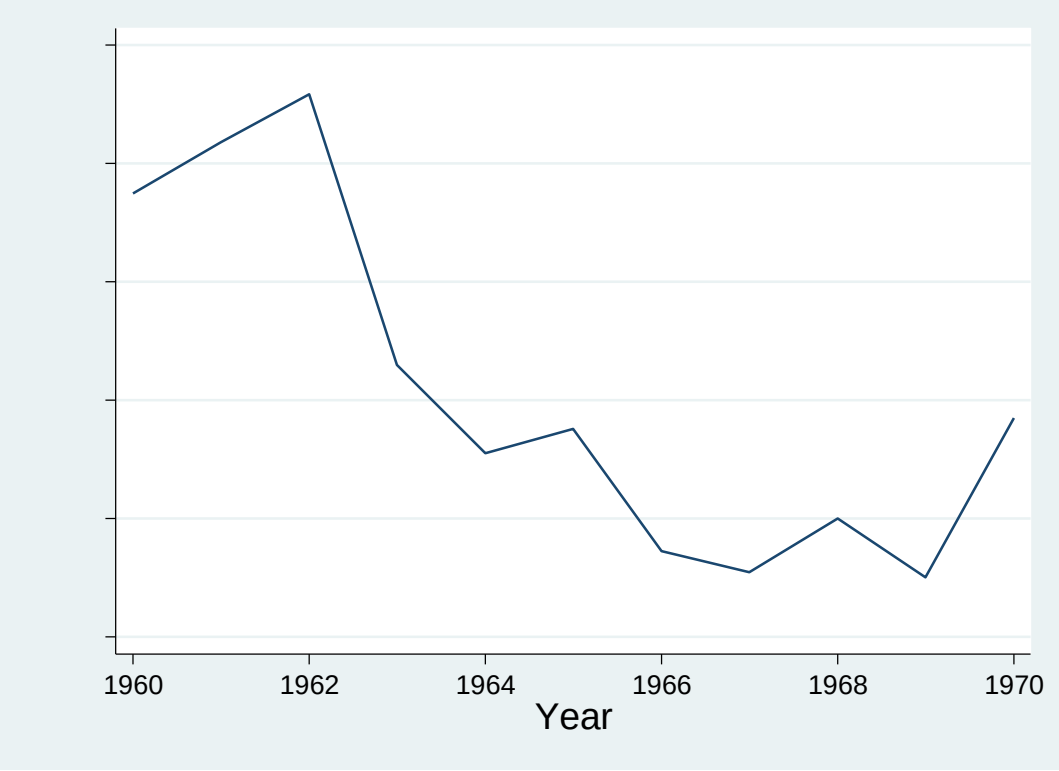
Figure 3.1. Atlantic Menhaden Catch, 1950-1960.



In their interview of a 1950's menhaden captain, the Saturday Evening Post—which described the fishery as "fiercely competitive"—detailed how the captain was attempting an unusual early night run to perhaps trick other captains, and how other captains would bend an "elastic" code of ethics in order to deliberately mislead others about fish location (Saturday Evening Post 1959). Thus, gains in techno-efficiency did not necessarily make the lives of fishers easier. Certainly, for black fishers, the mechanization of labor coincided with even less political leverage. Furthermore, the expectation to expand catch rates became untenable for many companies unable to sustain the capital required to catch more fish and boost profit. For example, in their written explanation for the 1961 sale of the American Fishing Company, retired executives explained that on boat installation of power blocks cost $250,000 per boat which was simply too expensive and risky given the nature of the capital intensive, competitive industry (Colonna and Colonna 1993).

Their sale was likely a wise decision. The 1960's capture rates plummeted (Figure 3.2), meaning that smaller scale menhaden boat and factory owners would have an increasingly difficult time competing with more sufficiently capitalized companies.

Figure 3.2. Atlantic Menhaden Catch, 1960-1970.



Aquaculture Feed

Parallel to broader socio-structural conditions in the mid-20th century, competitive capital gave way to a more monopolistic structure controlled by a handful of powerful firms (Baran and Sweezy 1966). Put differently, as Figures 3.3 and 3.4 illustrate, between 1960 and 1980, the Atlantic menhaden fishery experienced severe consolidation (ASFMC 2011).

Figure 3.3. Total Vessels, 1960-1980.

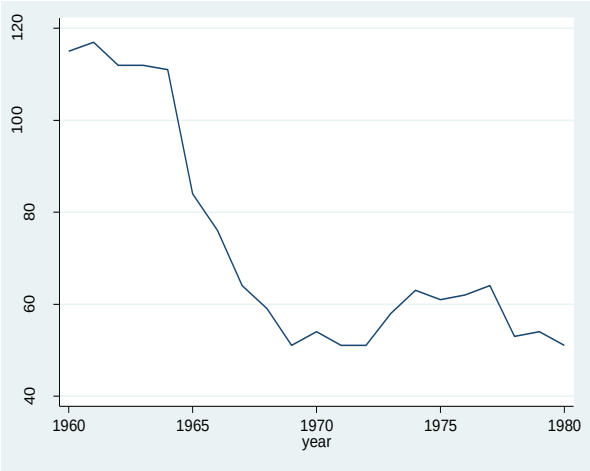
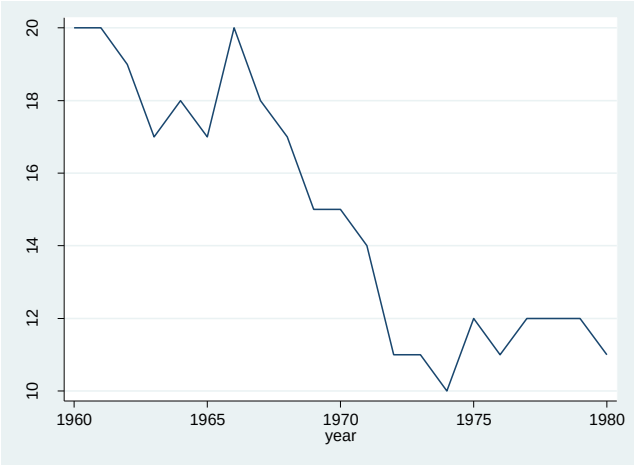


Figure 3.4. Total Factories, 1960-1980.



These declines in vessels and factories do not correlate well with fish captures, which actually made some modest recoveries in the 1970's. On boat refrigeration appeared in frequent use by the early 1970's and enabled longer voyages but, due to its cost, further squeezed out smaller competitors (Dudley 2012). By 1980, the fishery had experienced two decades of consolidation but had failed to recover to its 1950s' levels of catches. These factors, along with amplified competition from an increasingly globalized food system, created a rush to market the menhaden for new utilizations—specifically, aquaculture feeds.

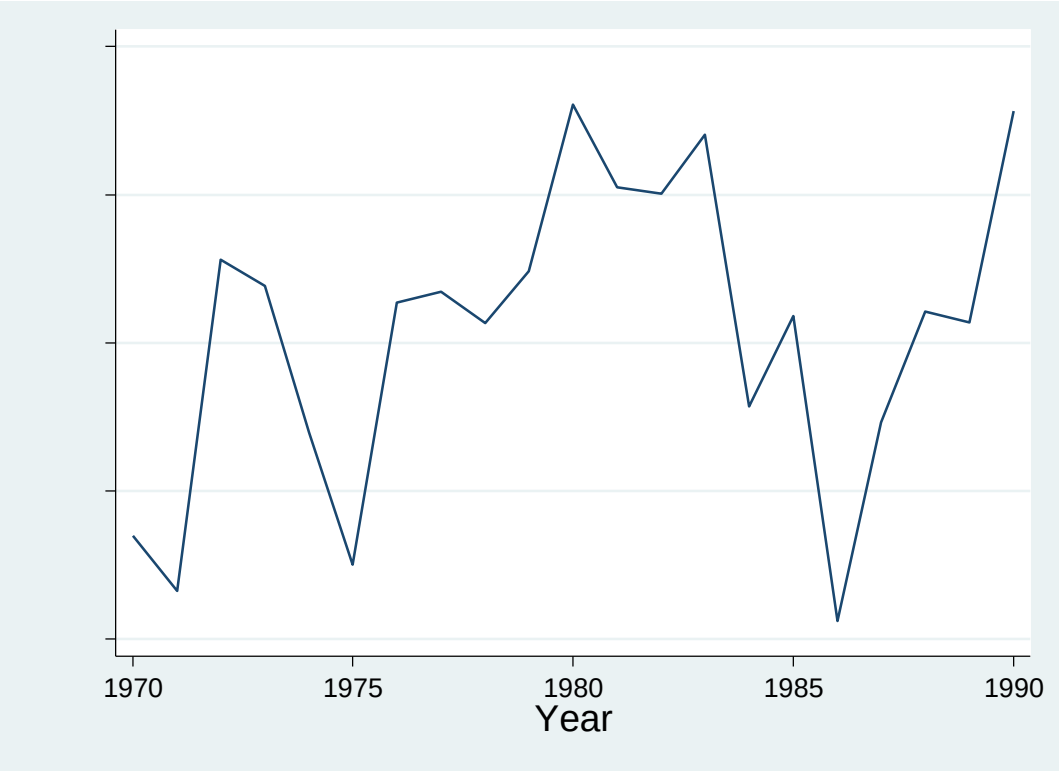
Aquaculture is the controlled rearing of marine and aquatic species. The cultivation of high value, carnivorous species requires fish meal and fish oil products such as feed to ensure fish growth. In the late 1970's, industrial aquaculture production emerged as a technique for maintaining increased consumption of seafood across nations (Clark et al. 2018). In the United States, the U.S. Fish and Wildlife Service provided financial and organizational support for expanding aquaculture production within the United States as a means to provide for domestic seafood consumption, which had soared by 20% (per capita) between 1975 and 1985 , in the context of declining wild captures of seafood, (Parker 1989).

Despite stagnating rates of wild caught fish, global consumption of seafood has also increased measurably over the last several decades (FAO 2016; Longo, Clark, and York 2013). Thus, much of the growth in global seafood consumption has been sustained by the rising aquaculture industry. In 2014, for the first time at a global scale, aquaculture systems surpassed capture fisheries as the primary source of fish directly consumed by humans (FAO 2016). The most economically prolific segment within aquaculture production consists of species like salmon and shrimp that require meal and oil products derived from fish such as Atlantic menhaden (Longo, Clausen, and Clark 2015).

Equally important is the globalized nature of the emergent neoliberal or corporate food regime (McMichael 2005) within which aquaculture production and trade are key elements (Longo, York, and Clark 2013). In large part as a response to indebtedness to financiers centered in the global North and structural adjustment programs, many nations in the global South reconstituted their agricultural production systems and food trade relations (Friedmann 1991). Fish meal and fish oil are both globally traded products, and according to Dudley (2012) these dynamics limit the "market power" of the contemporary, U.S. fishery because the consumers of fish meal within the U.S. could buy cheaper, similar products from external suppliers rather easily if needed. For example, Thailand, which has revolutionized its agricultural production and trade in recent decades, now produces more fish meal annually than the United States (McMichael 2012).

Aquaculture production began to influence demand for Atlantic menhaden in the 1980's (ASMFC 1992). The economic possibility of aquaculture feed was a potentially welcome development after an ecologically volatile and economically precarious two decades (Hale et al. 1991). This volatility is reflected in terms of a rather unpredictable rate of capture over the course of the 1970's and 1980's (Figure 3.5).

Figure 3.5. Atlantic Menhaden Captures, 1970-1990.



In the 1970's, soy emerged as a strong competitor to fish meal in livestock and poultry feeds (ASFMC 1981). As the market for cheap soy expanded, the price of menhaden declined throughout the 1980's and, as such, fell to its lowest levels in 35 years (ASFMC 1992). Thus, while menhaden products are still utilized to feed terrestrial livestock animals, they no longer dominate the market due to an inability to compete with soy, which can be reliably and industrially produced, and—unlike Atlantic menhaden—is not dependent upon relatively mercurial population fluctuations. These economic conditions led, as one menhaden boat owner explained, to dire conditions within the fishery in the mid 1980's:

"At that time it cost about $300 a ton to produce fish meal. And I got a call from Holly Farms, they'd been offered fish meal at that time from Zapata-Haney at $125 a ton. That's losing $175 (per ton), so the more fish you caught the more money you lost."

The owner went on to explain that soy and other feed products, like corn, received government subsidies that menhaden fisheries did not (Garrity-Blake 2010). Again, these dynamics speak to

the broader institutional patterns of the emergent, corporate food regime, which solidified northern grain producers via favorable World Trade Organization rules (McMichael 2013).

As a utilization, aquaculture feed using menhaden oil possesses one advantage that soy and corn do not: carnivorous, high value species require high amounts of protein and fat that fish meal and oil are more effective at providing for farmed species (Longo, Clark, and York 2013). Regarded as a superior ingredient, fish reduction products are even used as a compound feed for omnivorous and herbivorous species (Asche and Tveterås 2004). Thus, since the 1990's, Atlantic menhaden are rendered in greater and greater quantities for utilization as aquaculture feed (ASMFC 2017). Contemporary Atlantic menhaden capitalists therefore cite the growth of global aquaculture as a primary driver of demand for menhaden commodities (Whitehead and Harrison 2017).

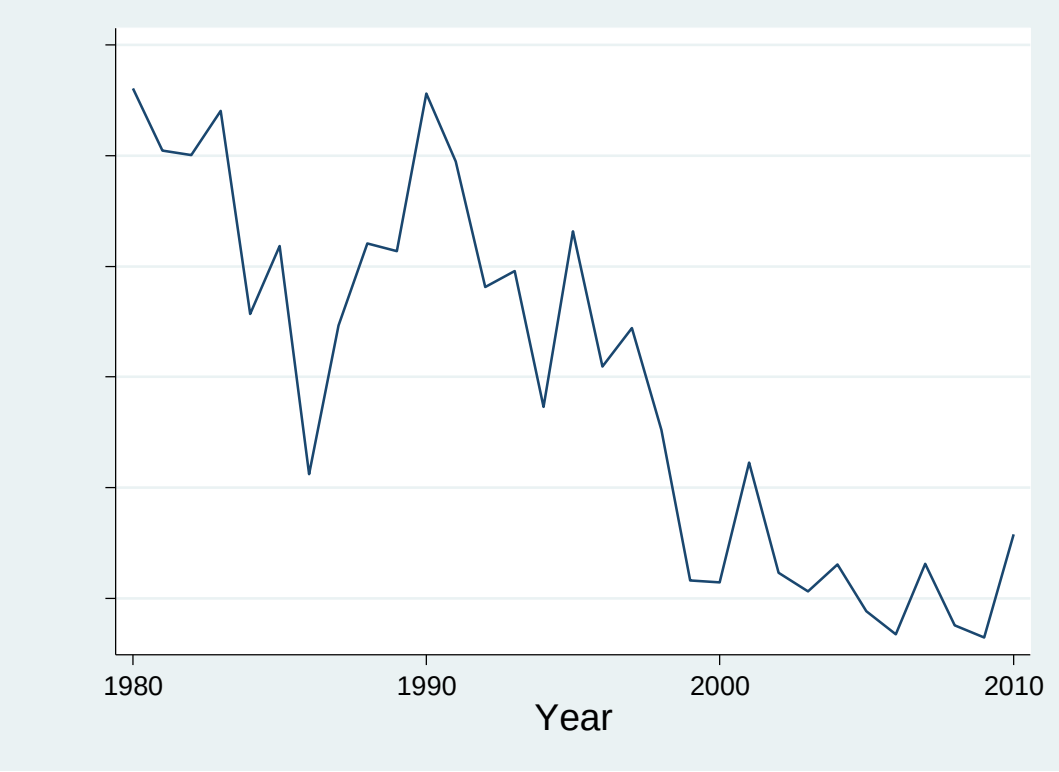
In sum, several key events within each period drove the Atlantic menhaden to new dominant uses. These events set several social occurrences in motion, such as technological innovation, the role of the state, and shifts in labor relations, all of which had specific socio-ecological outcomes within the fishery, as this study has described. The events are summarized in Table 3.3.

Table 3.3. Summary of Key Events within Periods.

Market Use of Atlantic Menhaden	Period of Time	Key Event(s)
Oil	1840s-1870's	Flagging U.S. Whaling Trade
Fertilizer	1870's-1920's	Soil Crisis, fertilizer trade
Livestock Feed	1920's-1970's	Industrialization of meat production
Aquaculture Feed	1980's-Present	Rise of aquaculture and fish farming

The question remains, though: why, in recent decades, has the Atlantic menhaden fishery suffered profound economic decline? Indeed, the once mighty Atlantic menhaden fishery now consists of a single factory on the entire Eastern seaboard, and the industrial fishery is virtually extinct in all states that do not border the Chesapeake Bay (Whitehead and Harrison 2017). Perhaps most telling, capture rates over the last three decades trended negatively, as recoveries in captures were generally not sustained and followed by worse years (Figure 3.6).

Figure 3.6. Atlantic Menhaden Captures, 1980-2010.



The difficulty for companies to sustain growing profits (Franklin 2007), the declining catch rates of Atlantic menhaden, and the deterioration of economic competition due to consolidation combined, in the words of natural resource economist Jane Harrison, to make the contemporary Atlantic menhaden fishery a “shadow of its former itself” (Harrison 2016).

Internal Comparison: Explaining Decline

Social Drivers of Decline

The narrative analysis reveals several, unique social drivers that contributed to the fishery's decline during the aquaculture period. First, the trend toward monopolization and the historical under-valuing of the black working class eroded political and community support. Second, the Atlantic menhaden fishery cannot compete at a global scale with other, similar fisheries elsewhere across the world food system. Thai fisheries, for example, can extract value from a super-exploited migrant labor force and a stressed marine ecological system (Clark et al. 2018). These social drivers and their outcomes correspond to the most recent, aquaculture period, and are thus critical for a full understanding of why the United States' largest fishery suffered substantial decline.

Combined with a within-case comparative method, these considerations dispel more common and simplistic explanations for decline. For example, lack of fish is not a sufficient condition for accounting for such sustained decline. Indeed, capped at around 170,000 metric tons, contemporary low rates of catch are, in fact, mandated by the ASFMC (SEDAR 2014). Also, local fishers and historians both consistently document the frequent sightings of Atlantic menhaden, indicating that recent year classes were rather abundant (Garrity-Blake 2010). Finally, if the long term history of the fishery is any indication, the Atlantic menhaden is an extremely resilient population due to its well documented, prolific breeding habits (Lewis, Ahrenholtz, and Epperly 1987). While the fish is most certainly less abundant than pre-industrial times, the plain truth is that Atlantic menhaden fishers could be catching a great deal more fish, or at least planning to catch more in the future as stocks recover. In addition, as discussed in the narrative analyses, concerns regarding overfishing, scarcity, or declines in capture are nothing

new in this fishery or in fisheries, generally, along the Atlantic coast (Bolster 2012; McKenzie 2010).

Another common answer for decline is the level of political conflict in the contemporary fishery. This conflict stems from environmentalists and sport fishers who see the Atlantic menhaden fishery as a threat to water quality and the marine food web (Franklin 2007). This makes for an interesting, anti-menhaden coalition composed of Greenpeace and the American Sport Fishing Association, both of whom claim Atlantic menhaden as the "most important fish in the sea" and engage in direct action and political lobbying against the industry (Greenpeace 2010; ASFA 2018). Furthermore, retired fishing captains consistently attributed the sports fishing lobby as responsible for successfully spreading misinformation about the Atlantic menhaden fishery. As one former captain, in a 2010 interview, explained:

"[Sport-Fishers say] The striped bass ain't got nothing to eat…Which is a lie. But that's what they want--, it's just another weapon to get the menhaden industry, to shut you down." (Garrity-Blake 2010).

Still, in other periods, there was political conflict. As discussed in the narrative analyses, hook and line fishers protested the Atlantic menhaden fishery throughout the 1850's, 1860's, 1870's, and beyond with little to no avail. Moreover, protests against the Atlantic menhaden fishery from sport fishers themselves are not a new phenomenon. Based on government reports of the fishery from the U.S. Fish Commission, the federal government was aware of sport fishers' opposition to the fishery as early as 1895 (Smith 1895). Thus, like over-fishing or fish scarcity, political conflict is not a sufficient condition to account for sustained decline.

A more adequate explanation for decline stems from how community economic decline and competition across the world food system amplified the once surmountable obstacles of over-fishing and political controversy. These consequences came to the fore during the aquaculture

period, and diminished the resiliency of the fishery and coastal communities. First, because the Atlantic menhaden fishery no longer supported a large workforce, its community economic importance declined. Accordingly, activists against the fishery could target their ire towards a single, non-locally owned company: Omega Protein, whose offices were located in Houston, Texas.[2] It is no longer a "jobs vs. the environment" debate, as the lone menhaden factory on the Atlantic coast now only supports an estimated 250 families. This outcome should not be a surprise, though, given that the historical tendency within the fishery to devalue the labor contributions of the vast majority of its black workforce.

Further, the Atlantic menhaden fishery struggles to compete within the institutional dynamics of the emergent corporate food regime Due to the growing regulatory ambiguity and dominance of transnational corporations within fisheries, competitors in some regions are able to slash labor costs and avoid state regulations by registering their vessels where they please (Osterblom et al. 2010). In Thailand, for example, migrant fishers are, in documented instances, coerced into years of labor and chained to boats while making brief stops in port (Clark, Longo, and Clausen 2018). These practices are typically unregulated and unreported (Osterblom et al. 2010).

Theoretical Implications of Decline

First, the tragedy of the commodity framework, especially when bolstered through intersectional considerations, demonstrates how capitalist development hollowed out its workforce, trended towards monopolization, and degraded the overall productivity of the marine ecosystem. In the short and medium run, this historical process drove extraction and profit accumulation. Yet in the long run, this process eroded the potential for community support of the fishery in the face of

[2] It is now Cooke Inc., as of 2017.

political controversy. Perhaps if menhaden capitalists supported the employment security of black workers at critical, historical junctures—such as during the 1950's labor conflicts—contemporary menhaden communities would possess the social and political capital needed to overcome controversy. However, such support would have contradicted the socio-structural demands of capitalist commodification to accumulate profit and outcompete smaller firms.

In the contemporary, corporate food regime, the Atlantic menhaden fishery has little ability to expand its market share when competing against semi-periphery suppliers who can offer a cheaper product by relying on forced labor, unregulated fishing, and other unsavory practices. The rise of semi-periphery agricultural competition, such as Thai fisheries, as a mediator in global seafood commodity trade is thus of paramount importance for fully understanding the Atlantic menhaden fishery's socioeconomic decline. Ambiguity in global seafood commodity chains favors the multi-national corporation, as these entities can seize control and structure the rules in such ways that squeeze value from production (McMichael 2009).. Semi-periphery states like Thailand may therefore act as mediating forces in food-commodity chains, a kind of middle man between global North buyers and the upstream, periphery sources of value: exploited workers and ecosystems.

Conclusion

This case contributes to the fields of marine sociology, development, and food systems in several important ways. First, this study's consideration of world system dynamics in relation to the emergent corporate food regime allows for a critical evaluation of sustainable development. Second, the study's findings illustrate several key ecological implications that transcend geographic and epistemic barriers. Finally, in incorporating intersectional considerations, this study expands upon the tragedy of the commodity theoretical framework. Regarding the first key

finding, some environmentalists see the decline of the fishery as a triumph, or a win for the ocean system. Such views risk oversimplification. It is difficult to tell if state agencies are becoming more concerned with marine ecology or, instead, are simply becoming more amenable to another, more lucrative form of capital. In the years since the 2005 closure of Beaufort Fisheries in Beaufort, North Carolina, new construction for a recreational marina has already occurred. Soon, to be completed by the same developer, a multi-story waterfront condominium will occupy the shoreline. In this former fishing hub, locals express concern over rising costs of living. These concerns parallel lamentations over the loss of fishing jobs, the consequences of which were most severely felt by a rural, black working class. Also, as discussed, the decline of the fishery also coincides with the rise of unsustainable fishing practices elsewhere, particularly in the capitalist periphery and semi-periphery. In short, the tourist industry and the global North, firm driven demands for upstream cost-cutting measures across the capitalist world food system likely carry more weight than the need to restore the Atlantic marine ecosystem.

What is clear is that the ecology of the Atlantic marine system has been undervalued over the last several centuries. Ecological decline is especially evident when one takes a long view of the Atlantic marine ecosystem. Prior to white colonization, explorers and colonial boosters consistently described the Atlantic marine environment as remarkably fertile, with rich biodiversity (Smith 1609; Catesby 1731; Cabot 1947). Such marine life also helped to support coastal, Native communities (Lawson 1709; Cronon 2011). Like the fishery itself, the greater Atlantic marine system is a shadow of its former self—pre-capitalist fishers would likely not recognize the marine environment today, as much of the world's once most productive fishing grounds are now ecological dead zones (Ellis 2003). Such ecological degradation is bound up with industrial fishing generally, but marine historians consistently argue that the historic decline of

Atlantic menhaden—a species at the heart of the food web, with the potential to regulate water quality—deserves special attention (Ellis 2003; Franklin 2007; McKenzie 2010; Bolster 2012).

The ecological ramifications of this case extend beyond the sea, though. As Clark and Longo (2018) argue, ecological troubles in coastal and marine systems are often a result of terrestrial agriculture problems, such as nitrogen run-off and soil erosion. This case also demonstrates that the reverse can ring true, in mutually reciprocated fashion. Capitalist agriculture has, historically, exhausted soil systems and driven animal protein production and consumption towards greater and greater ecological intensity (Foster 1999; York and Gossard 2004; Longo, Clark, and York 2013). Input commodities like Atlantic menhaden are essential to allow for the continuous ecological and physiological boundary transgressions endemic to capitalist agriculture. Without ample fertilizer and supplemental protein products, capitalist agriculture could simply not overcome the metabolic disruptions it tends to induce. Thus, environmental change in marine ecosystems and terrestrial agri-food systems cannot be disentangled or understood separately.

Finally, this case demonstrates the utility for incorporating intersectional theory into political economic analysis. The general tendencies of capitalist commodity production—expropriation, expansion of profit, and ecological tragedy—that Longo, Clausen, and Clark (2015) emphasize require socio-political dominance. Thus these tendencies are not processes per se, but struggles. In considering how the racialization of the workforce naturalized a racialized hierarchy, this case demonstrates how systems and discourses of racial control can accelerate tragedy of the commodity dynamics. Future analyses can expand on this study in a comparative fashion, by exploring how other intersectional considerations, including gendered power dynamics, may play important roles in the interwoven commodification of fisheries and terrestrial agriculture systems across the world food system.

CHAPTER 4: GLOBAL LABOR VALUE CHAINS, COMMODIFICATION, AND THE SOCIOECOLOGICAL STRUCTURE OF SEVERE EXPLOITATION. A CASE STUDY OF THE THAI SEAFOOD SECTOR.

(Forthcoming in *Journal of Peasant Studies*)

Introduction

Seafood markets in the global North depend upon a highly complex and nebulous series of seafood commodity, or value, chains. In the modern capitalist world food system, capture fisheries and farmed fisheries (aquaculture) are global operations. Accordingly, increases in production and consumption of seafood products depend upon high levels of trade in global commodities, both farmed and captured, supplied by regional firms who operate in the waters and factories of the global South. These socio-structural conditions shape processes of production—including the labor process—and are ecologically significant.

Here, I develop an analysis of the interaction between labor processes, global political-economic dynamics, and changing ecological conditions in Thailand's seafood sector. The study emphasizes concerns around severe exploitation of migrant fishers who work in Thailand. The analysis of this case provides insights on the ongoing socio-ecological contradictions and tensions in the capitalist world food system, particularly in the seafood sector.

Thailand's economy and, specifically, its agricultural sector have received special attention for prolific growth and productivity. Accordingly, the World Bank touts Thailand as one of the world's "great development success stories," (World Bank 2017). McMichael (1993; 2012b) refers to Thailand as a model NAC or "new agricultural country" where the state has successfully promoted agro-industrialization for urban and export markets often centered in affluent nations, the core of the capitalist world-system. Thailand's seafood sector plays an important part in this narrative of economic success.

On the other side of this developmental narrative lies a poorly kept secret. As numerous nongovernmental and international governmental organizations (NGO and IGO) and journalistic reports demonstrate—including the Environmental Justice Foundation, Human Rights Watch, the International Labour Organization, The New York Times, and The Guardian—Thai fisheries rely upon extremely exploitative labor practices to capture and process fish for sale in global markets (EJF 2015; HRW 2018; The Guardian 2014; ILO 2013). Sometimes called "unfree labour," these practices use "coercion or compulsion to extract labour from workers…[and] often involves deception at the point of entry into work, as well as coercion that precludes workers from exiting labour relationships that are highly exploitative" (LeBaron and Phillips 2019: 1). This is no small matter for the Thai economy, as the market value for seafood exports for Thailand reaches nearly $6 billion US and accounts for roughly 20 percent of Thai product exports (USDA 2018). This case is particularly important to consider in light of broader developments in the world food system. Indeed, exporting luxury or perceived high-quality seafood products is somewhat typical in the global seafood trade, where richer nations often import perceived high-quality fish protein from poorer nations (Asche et al. 2015).

The aim of this study is to provide needed structural, political economic and ecological, context to this social problem. As I elucidate in the discussion section, the analysis indicates that the Thai seafood sector is ecologically and economically stressed, and that severe labor exploitation of impoverished migrants is a limited attempt to maintain market viability in a crowded, unequal, and global seafood industry. Prior to this analysis, I provide needed background on the issue of labor, particularly forms of severe exploitation including forced labor, in the Thai seafood sector. This background predominantly focuses on recent reforms and their effects, and illustrates the persistent nature of severe exploitation in the Thai seafood

sector—especially in its capture fisheries, which now fish mostly for low-trophic level so-called "trash-fish." I then clarify the study's theoretical frameworks. This clarification is followed by an analysis of changing economic and socioecological conditions in the Thai seafood sector and discussion of the findings and implications of this research.

The discussion emphasizes the limitations of conceptualizing the material basis of seafood commodity chains as inherently low-value, especially in the empirical context that this case presents on fishing labor and marine ecosystems. I reason that the prioritization of capitalist exchange or market value results in false conceptions of labor as a low-value social process. In addition, I argue that systemic failures to recognize or appreciate the inherent worth of ecological utility and capacity for sustaining life—i.e., ecological wealth—are, similarly, products of a social system that prioritizes commodity exchange value above all else. Thus, I reason that reforms and development strategies that attempt to sidestep such structural tensions by emphasizing efficiency gains, state management, and corporate social responsibility will encounter obstacles that stem from commodification, a central component in the social metabolic order of the capital system (Mészaros 2000).

Analytical Approach

The study deductively arranges the analytical framework based on two critical theoretical frameworks in political economy and environmental sociological theory: global labor value chains (GLVC) and the tragedy of the commodity. I analyze pertinent data on economic valuation, trade, labor, and fisheries ecology from leading international organizations. These data are drawn primarily from the Harvard Atlas of Economic Complexity, an interactive software program that is publicly available and useful for building data visualizations according to economic sectors within nations. From this data set, economic valuation of fisheries products is

at an aggregated scale. Thus, fisheries export value includes non-fish species, like shrimp, as well as seafood products that are processed or preserved. I also analyze fisheries production and export data taken from the Food and Agriculture Organization of the United Nations, utilizing similarly aggregated fisheries data, as well as data on labor and fishing taken from the Thai Department of Fisheries. For the purpose of this analysis, I will utilize the broader phrase "seafood sector" to include captured fish, reared aquaculture, and processed seafood commodities.

I organize the analysis section into two sub-sections situated according to the theoretical frameworks. First, I highlight empirical data pertinent to commodification; particularly, changes in labor relations, fishing technology, and marine ecosystem stress. I chose to begin the analysis with this, as the industrialization and subsequent ecological intensification of the Thai seafood sector predates its contemporary political economic positionality in global labor value chains. This placement provides materialist, historical context that enables a more effective understanding of the contemporary, socioecologically precarious state of the Thai seafood sector.

The data presented within the global labor value chain subsection primarily examines market valuation within the Thai seafood sector. In doing so, I emphasize that the valuation of Thai seafood sector products is a reflection of abstract exchange value, operationalized as price or market value. Thus, I consider these relatively abstract economic data in the context of severely exploited migrant fishing labor and increasingly degraded marine systems.

In the discussion section, I elucidate a socioecologically informed description of the political economic context under which severe exploitation, within the Thai seafood sector, occurs. While processing plant labor abuses are a concern within the seafood sector, the analysis chiefly considers the socio-structural and ecological drivers of deteriorating labor conditions at

sea, in Thai capture fisheries. However, a sizeable portion (approximately 60 per cent) of this catch fuels aquaculture production as feed inputs (EJF 2015). Thus, the analysis necessarily includes discussions on the socioecological importance of aquaculture. Overall, the analytical approach follows the methodological principles of contemporary, historical materialist studies of environment and society (Holleman 2015). Thus, when considering value, this study recognizes the central importance of capitalist social relations of production in these determinations (Burkett 2005). Accordingly, the analysis engages social and ecological conditions through a critique of capital's class relations. An analysis based off this supposition aims to uncover how exploitation and conflict are often hidden in data that, if not evaluated through a critical, historical materialist lens, may appear somewhat removed from the antagonistic class relations central to capital accumulation (Holleman 2015).

Background: Labor Exploitation in the Thai Seafood Sector

Between 2013 and 2015, a number of journalistic reports from major news outlets documented extremely troubling conditions suffered by migrant fishers in Thailand. While NGOs and IGOs had already been conducting studies on the matter (Solidarity Center 2009; ILO 2013; EJF 2015), media coverage brought international attention. Relatedly, as a result of ongoing discussions regarding illegal, unreported, and unregulated (IUU) fishing in Thai fisheries, in 2015 the European Union issued a (now lifted) "yellow card" for the Kingdom of Thailand, which served as a final warning before a full ban on Thai seafood imports (White 2016). For its part, the United States downgraded Thailand to its lowest score on their Trafficking in Persons report (Reed 2018). Major food distributors like Costco, Walmart, and Tesco also reacted to brand pressure and bad press by investigating their supply chains further, providing more

information to customers, and pressuring their major suppliers, such as Thai Union Group, to upgrade their chains (Reed 2018; Nakamura et al. 2018; Gold et al. 2015).

In response, the Thai government, which took power through a military backed coup in 2014, enacted regulations that registered migrant workers, extended health care coverage, and made contracts (which included some worker protections, such as mandatory rest) a requirement (Vandergeest et al. 2017). The Thai government also extended the minimum wage to fishers in 2014 (ILO 2018). Thai Union Group, whose officials expressed shock over the reports, also took steps to ensure control over its shrimp supply chain and voided all contracts with shrimp processors and vertically integrated their processing operations (Reed 2018).

However, a series of recent reports document persistent and new problems. Many workers still do not receive the minimum wage (ILO 2018; Issara 2017). According to Human Rights Watch (2018), nearly 60% of interviews with escaped or current fishers reveal some degree of coerced labor. Other studies, such as Chantavanich et al. (2016) detail that violence against workers is common, and more likely suffered by Burmese workers who do not speak Thai. Abuse, maltreatment, and exploitation are typically found to be more severe in long-haul voyages—especially ones where transshipping occurs (Issara 2017). However, workers on long-haul voyages are often underrepresented in survey and interview research due to their extended time—sometimes years—out at sea.

State regulatory practices sometimes directly or indirectly facilitate conditions that result in extreme exploitation and "unfree labor" (LeBaron and Phillips 2019). Indeed, new regulations—while often helpful—can lead to unintended consequences. The Issara Institute (2017) documents how captains and net bosses control migrant fishers' movements by restricting access to the fishers' pink cards, which fishers need to avoid arrest and possible deportation.

Other survey research confirms that migrant workers frequently lack access to at least one form of government identification (CSO Coalition 2018). Moreover, the ILO discovered a patterned increase in fees and pay reductions implemented by captains, many of which are arbitrary, thinly veiled attempts to recoup minimum wage earnings paid to migrant fishers (ILO 2013; ILO 2018).

The persistence of these troubles points to potentially intractable contradictions endemic to the political economy of fisheries and seafood. Producers must compete in a global market, across stressed ecosystems, to create value (Campling et al. 2012). A fishery, as Campling (2012) notes, must compete both horizontally (across similar scale actors) and vertically, between capital and the environmental conditions in which the fishery operates. Accordingly, even so-called successful management programs often overlook or misunderstand labor and sociological dynamics within fisheries (Simmons and Stringer 2014; Song et al. 2017).

This complexity allows Thai Union group, a company whose market value exceeds $1.5 billion, to refer to illegal fishing and labor rights violations as "inherent risks" within the seafood sector (Thai Union Group 2017: 68). Perhaps accordingly, the Thai seafood sector is still dependent upon exploited migrant labor to catch fish in spite of reforms. Today, the overwhelming majority of fishers in Thailand are working-age men who migrate from Myanmar (Burma) and Cambodia. The majority of these fishers report sending remittances home (70%, according to CSO 2018), and 98% express that the potential to send remittances drive their desire to work in fishing (Issara 2017). It is thus unsurprising that many cite a "deteriorating rural livelihood" as motivation to migrate to find work at sea, in Thailand (Vandergeest 2019: 329).

While migrant labor is commonplace across the Thai seafood sector, an increasing amount of attention points toward the disturbing irony that a great deal of severely exploited

fishing labor goes toward the capture of low-priced "trash-fish," a term used to characterize species deemed unfit for human consumption, which are instead often processed into cat food and aquaculture feed (Fischmann 2017; EJF 2015; 2019). Much of this effort supports Thailand's aquaculture industry, which requires trash fish inputs (ILO 2016)

Theoretical Framework

Labor Value Commodity Chains

Hopkins and Wallerstein (1986:159) initially formulated the concept of global commodity chains (GCC) to describe the geographically extensive "network of labor and production processes whose end result is a finished commodity." Social scientists advanced such conceptions to emphasize value. Sturgeon (2008) notes the concept of value aligned better with the structure of the chain, across which actors engage in "value added" procedures beyond the initial, most upstream node of "low value" production.

Key global value chain (GVC) scholarship identifies the transnational corporation as the primary actor in the structuring and governance of value chains (Gereffi 2005). Gereffi (1994) argues that GVCs are increasingly buyer (as opposed to producer) driven, and that this organizational dominance allows firms to establish value added nodes downstream, away from initial, upstream production sites. Value chains within the global food system are typically described as buyer driven, dominated by food distribution or grocery firms (e.g. Walmart, Tesco, Mars, etc.) centered in the global North, who can set prices and profit more from value added production (Busch and Bain 2004; Burch and Lawrence 2009; Pechlaner and Otero 2008).

Some researchers critique shortcomings of GVC scholarship; particularly, the tendency to de-historicize the role of capital in favor of meso-level firm studies and the questionable acceptance of neoclassical market assumptions concerning value and valuation (Carr, Chen, and

Tate 2000; Bair 2004; 2005; Bair and Werner 2011). As a consequence of these shortcomings, scholarship that probes issues of labor relations and class struggle tend to "occupy a marginal position," in food studies (Marsden et al. 2014: xiii). This theoretical relegation is evident in GVC literature, which often posits that export oriented industrialization failed to lift less-affluent nations out of poverty not because of systemic labor exploitation and downstream value capture, but rather, such issues stem from failures to successfully engage in so-called economic upgrading where countries "can 'climb the value chain' from basic assembly activities using low-cost and unskilled labor to more advanced forms," of production (Gereffi 2015: 18). From this perspective, production activity that requires higher degrees of technology, knowledge, and "skill" (i.e., less labor intensive) are the mechanisms for creating value in the modern economy (Hernández et al. 2014).

The consequence of this marginalization extends beyond the scholarly realm. For example, a recent ILO (2016) study of Thai seafood value chains does not assign a price to the inputs caught for shrimp farms, effectively suggesting that this contribution is worthless to the aggregate value accumulated throughout the chain. The most lucrative, high priced node of the shrimp supply chain is instead the distribution and retail component, where half of all Thai shrimp production "is sold and transported to international markets, mainly to big retailers," (ILO 2016: 15). Here, the labor that went into feeding, growing, and harvesting the shrimp constitutes the least valuable portions of the shrimp value chain. While the ILO (2016) does not disregard the procurement of feed for aquaculture entirely, it assumes that its material composition as a "low-value added species…unfit for human consumption," accounts for its minimal capacity to generate earnings within the chain.

Thus, it is necessary to extend upon scholarship that is critical of neoclassical assumptions of economic valuation. Suwandi (2019) emphasizes the "labor value commodity chain" as the driving force behind the global labor arbitrage, or the effort of global North firms to engage in arms-length contracting to source productive, cost-efficient labor in the global South. As opposed to mainstream GVC theory, which commonly stresses technology, skill, and knowledge as the creators of value, Suwandi (2019) emphasizes productive relations, or the social processes that result in the material procurement of the commodity. These processes depend on the living labor of vulnerable low paid workers, who toil in the factories, farms, and oceans of the global South. From this perspective, capitalistic exchange value reflects socio-historical conditions between people (Burkett 2005; Foster and Clark 2019). Thus, attempts to explain some forms of labor as inherently low-value due to their level of skill, knowledge, technicality (etc.) risk obscuring social relations of production and reifying exchange value as a true indicator of a commodity's usefulness or inherent worth (Burkett 2005).

The primary aim of globalization of production and consumption, from this perspective, is to appropriate as much value as possible from the labor process. Global North firms achieve this goal via the maintenance of low unit labor costs, which require a highly productive workforce with paltry wage compensation (Suwandi 2019). Unit labor costs remain low through the proliferation of the global labor arbitrage, essentially the worldwide "race to the bottom," where global South nations compete for global North capital investment via, in part, weak regulatory protections for labor that maintain low wages. Global North firms increasingly rely upon arms-length contracting, where they negotiate extremely profitable, non-equity relationships with global South producers (Suwandi 2019). This form of contracting characterizes the norm of buyer-driven commodity chains within the global agri-food system.

Because global labor value chains (GLVC) analysis centers on labor and the susceptibility of exploitation, it avoids common pitfalls in conceptualizing the labor process and value production endemic to NGO's, media outlets, and journalistic sources. These sources often make slavery, forced labor, and all forms of extreme exploitation seem outside the norm within a market system (Vandergeest and Marschke 2019). This not only results in shortsighted, top down policy prescriptions that ignore what workers want (Vandergeest, Tran, and Marschke 2017; Vandergeest 2019), but also risks overlooking the significance of labor exploitation for the accumulation of capital—regardless of whether or not fishers are paid a minimum wage. Because GLVC centers the focus of analysis on unit labor costs, it addresses such shortcomings. I thus use the inclusive term "severe exploitation" to characterize migrant labor in Thai fisheries.

The GLVC perspective is also effective for avoiding reifying or uncritically interpreting data on economic development and valuation (Burkett 2015). For example, Smith (2016) elucidates why scholars should not interpret gross domestic product (GDP) as the value procured from domestic production. Rather, GDP is a more accurate reflection of surplus value seized from production, a process that arms-length contracting helps to obfuscate (Smith 2016). Smith (2016) demonstrates how the global labor arbitrage and false conflation of *value* with *price* leads to fallacious interpretations of trade relations and economic growth across unequal nations and firms.

As an example, if Thai seafood firms seek to attract global North buyers (which they certainly do), they must offer as competitive a price as possible to compete in a global market. This pressure has reverberating effects throughout the chain, but notably for the producers of material inputs (trash fish), who are also pressured to find ways to lower their sale price. As export-oriented Thai shrimp firms manage to cut production costs by slashing the prices paid to

these fishers for their inputs, they attempt to maintain competitiveness as global North suppliers. However, the compensation returned to Thailand decreases in at least a relative fashion, as their unit value added must necessarily decline.

Nevertheless, from a neoclassical interpretation of export valuation, it would therefore appear that Thai shrimp production *itself* is a less economically valuable endeavor. Smith's (2016) writing on the global labor value chains thus forces us to ask an important question: how can the value of commodity production be inversely related to the sale and profits of the same commodity in global North markets? Similar to the above example on labor compensation, conceptions of the value chain as comprised of nodes within which value is added, often through increasingly skilled and specialized production processes, risk overlooking that pricing and the valuation process are enmeshed within social relations. Thus, much like the cost paid to afford labor power, price paid to suppliers of commodities is indicative more of socio-political contestations than it is a concrete reflection of commodity value, much less a measure of the worth of the labor time or ecological wealth that the commodity represents (Smith 2016).

The Tragedy of the Commodity

To understand the forces that drive change in productive relations, I must also consider ecological dynamics. To that end, environmental sociologists have forwarded the tragedy of the commodity approach in order to unpack the broad socioecological effects of capitalist fisheries production across the globe (Clark and Longo 2019; Clark et al. 2018; Longo, Clausen, and Clark 2015). From this perspective, capitalist commodity production, particularly at the material bases of food systems, necessitates intensified ecological withdrawals and production of waste in order to satisfy the demands of commodity production. Contrary to the well-known tragedy of the commons thesis, pressures on ecosystems stem from the social logic of capital, which

demands the growth of abstract, limitless exchange value. The expansion of exchange value is therefore a pre-requisite of investment that tends to supersede human need or the regenerative requirements for ecosystem sustainability.

Under capitalist commodity production, exchange value "is the fundamental sign for producers with regard to what they should produce," and, as such, material conditions become modified to accommodate the demands of an economic system governed by a quantitatively limitless, alienated value form (Saito 2019: 109). Often, as has been noted in social metabolic research on fisheries, this involves processes of biological speed up, where the life cycles of aquatic species are shortened in order to accelerate turn-around on investment (Longo, Clausen and Clark 2014).

Longo et al. (2015) note that institutional responses to ecological disruption prefer to rely upon techno-solutions or geographic fixes in order to maintain the circuit of capital accumulation in the face of ecosystem degradation. Efficiency mechanisms or spatial shifts in extraction do not address the underlying antagonism between the regenerative demands of ecosystems and the limitless quest for exchange value expansion necessitated by generalized commodity production. Across the seafood sector, there exist multiple examples of such superficial "fixes" to ecological degradation, including fishing for species with briefer life cycles, expanding into new marine frontier(s), and placing hopes in intensive aquaculture development (Longo et al. 2019; Tickler et al. 2018; Pauly and Palomares 2005).

The tragedy of the commodity perspective also emphasizes the inequitable distribution of socioecological tragedy across nations, identities, and classes (Clark 2020; Longo et al. 2015). As labor value commodity chain theory suggests, capital accumulation in global fisheries favors the interests of global North firms and markets (Barbesgaard 2018; McCall-Howard 2017;

Hannigan 2017; Longo and Clark 2019). Uneven development across fisheries has involved massive shifts in labor systems and marine ecologies, towards socioecological relations more amenable to commodity production, and ultimately capital accumulation (Longo et al. 2015; McCall-Howard 2017).

Inequitable structuring of global labor value chains across an unequal world system also tends to obscure the most deleterious ecosystemic effects of commodification. In short, modern labor value chains outsource more ecologically intensive forms of production into impoverished and less affluent nations (Jorgenson 2005; Rice 2007; Roberts and Parks 2009; Clark and Longo 2019). These regions' ecologies are then, often quite ruthlessly, subjected to the demands commodity exchange in order to (primarily) benefit global North firms (Foster and Holleman 2015). Capital relates to complex ecologies (and the social utility, or wealth, they generate) in a one-sided manner, or "only insofar as they facilitate the production of (exchange) value," (Foster and Clark 2019: 236).

Recent work (Frame 2019; Longo et al. 2019) characterizes the capitalist semi-periphery, or middle-income, economically "emergent" nations, as especially important as mediators in this expropriation of ecological wealth. . These nations, in short, often possess the geographic proximity and techno-political capacity to exploit their peripheral neighbors in service of northward capital flows. Yet, because global North firms determine the market for the commodities procured from food producers, semi periphery firms and nations, such as the Thai seafood sector, remain subordinate to the governance and economic demands of core nations and core-centered firms (Gereffi 1994; Wang 2017).

Analysis

The Tragedy of the Commodity in Thai Fisheries

Decades before Thailand came to occupy its current position in the political economy of the global seafood system, its fisheries industrialized and shifted toward producing commodities for the capitalist world-market. In the 1960's, Thai fishing fleets began to rely increasingly upon trawling methods to capture fish. As such, Marr et al. (1976) described the Gulf of Thailand as overexploited, with future fishery growth dependent upon long-distant hauls (Marr et al. 1976; Pauly 1979). In the 1980's, following a period of national development, Thailand transitioned to an export-oriented and specialty food-commodity producing nation. This transition was fueled by capital investment from global North nations, which stimulated intensified intra-regional corporate investment supported by a cooperative Thai state (Onuki 2008). By 1980, Japanese and U.S. backed capital accounted for about half of total capital investment, and much of this was focused in the agricultural sector, in conjunction with structural adjustment programs (Goss and Pacheco 1999). Foreign capital investment in more technically intensive forms of production fostered vertical integration in key seafood sectors, as well as contract farming, which characterized the agro-modernist turn in Thailand during this time (Goss and Burch 2001). As Table 4.1 illustrates, this period of investment and global commodification corresponded with the intensified industrialization of the Thai fleet, and a decline of smaller scale fishing methods.

Table 4.1. Thai Fishing Methods (SEAFDEC) and Developmental Investment Flows (FAO).

Country	Year	Agricultural Developmental Flows in Hundreds of Millions of Dollars (Current USD)	Trawl (Metric Tons)	Hook and Line (Metric Tons)
Thailand	1980	530.75	1,055,150	8,760
Thailand	1985	198.06	1,002,392	8,413
Thailand	1990	112.81	1,268,319	6,884

Table 4.1 (Continued)

Thailand	1995	51.99	1,597,292	5,788
Thailand	2000	26.93	1,620,642	5,424
Thailand	2005	9.47	1,607,383	3,856
Thailand	2010 / 2011	10.66 (2010)	1,459,518 (2011)	2,989 (2011)

Over the same period of time, the social organization of Thai fisheries changed drastically as well. In Table 4.2, artisanal fishing implies that fishers catch all or a majority of their haul with the intent of selling it to market, whereas subsistence fisheries utilize their catch for barter, domestic consumption, and rely on two or fewer employees (Teh, Zeller, and Pauly 2015). As Table 4.2 demonstrates, subsistence yields decreased by nearly 50% over a 30-year period, while market-oriented production and industrial fishing both increased substantially. Also, during this time, small scale shrimp farmers became more dependent upon regional, transnational firms for extension services and financial support, which effectively fostered dependence on capital intensive, transnational corporations (Goss et al. 2001; Onuki 2008).

Table 4.2. Thai Fishery Yields Grouped by Sector (Measured in Tons).

	Industrial Yields	Artisanal Yields	Subsistence Yields
1980	591,100	317,000	430,000
1985	603,200	412,000	427,000
1990	1,043,300	490,000	387,000
1995	1,695,100	574,000	343,000
2000	1,392,400	554,000	230,000
2005	1,308,100	612,000	194,000
2010	1,039,300	642,000	161,000

There are two telling indicators of the ecological effects of commodification in Thai fisheries over these decades. One, increased technological efficiency (marked by development of more intensive production methods) did not correspond with a leveling off of ecological withdrawal. A common, neoclassical assumption in fisheries development is that modernization, marketization of the economy, and increased technological efficiency will effectively meet consumer demand—ideally with less ecological impact. As a general example, the FAO (2015)

emphasizes efficiency more than 20 times in a 28-page report on blue growth, placing it as a central component of increased sustainable development in multiple arenas of the seafood sector. Yet, Thai fisheries exhausted significantly more effort to maintain and expand catch rates in spite of more efficient technological capacity and increased commodification. According to a survey of its cumulative fishing effort over several decades, the Thai Department of Fisheries found that their catch per unit effort declined by nearly 90% between 1960 and 1990, and has reached historic lows in more recent years (Thai DoF 2015).

Table 4.3 confirms the present reality of decades of intensive fishing, both within and beyond Thailand's immediate waters, as it displays the extent to which Thai fisheries exceeded maximum sustainable yield rates and so-called optimal efforts. Notably, only catch efforts for anchovies caught in the Andaman Sea remained under the "optimal fishing effort," measured in days (DoF 2015). Optimal level of fishing effort quantifies the amount of time needed to reach the maximum sustainable yield, given the technical capacity of the Thai fishing fleet. The FAO (2019) defines maximum sustainable yield as the highest theoretical level of harvest that can be extracted from a wild-fish population without potentially affecting the population's viability in future years. Regardless of the ecological validity of these concepts, which have been challenged, surpassing the optimal level of fishing effort suggests that the Thai fishing fleet has been engaged in greater amounts of time and energy to capture particular yield levels and thus continues to surpass already stressed bioecological boundaries.

Table 4.3. Maximum Sustainable Yield and Effort in Thai Fisheries.

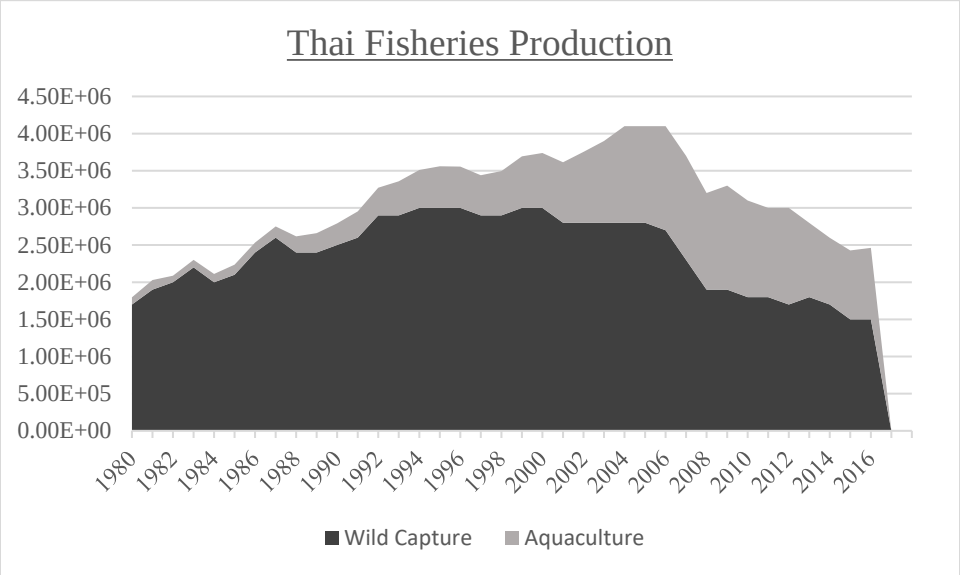
Location	MSY (Tonnes)	Optimal Fishing Effort	2015 Catch (Tonnes)	Actual Fishing Effort	Time Exceeded (+) or Not Exceeded (-)
Demersal Fish					
Gulf of Thailand	794,771	24.33mh**	503,276	36.20mh	11.87mh(+)
Andaman Sea	240,519	4.81mh	177,684	5.09mh	.28mh(+)
Anchovies					
Gulf of Thailand	191,785	114,588 days	183,216	115,600 days	1,012 days(+)
Andaman Sea	32,944	52,014 days	33,903	51, 520 days	494 days(-)
Other Pelagic Fish					
Gulf of Thailand	248,176	130,493 days	245,986	178,709 days	48, 216 days(+)
Andaman Sea	118,477	54,238 days	99,039	64, 925 days	10, 687 days(+)

(**mh= Million Hours) (Thai DoF 2015)

To maintain fisheries export production, in this struggling, marine ecological system, Thai fisheries have also relied upon increased aquaculture effort (Figure 4.1). Despite the fact that aquaculture production methods can be quite effective at producing massive amounts of seafood, evidence suggests that it does not likely offset the fishing impacts of wild-caught, capture fisheries (Longo et al. 2019). This is further demonstrated in Thailand's growing rate of

capture of small feed fish, whose flesh and oil are often processed into feed for aquaculture farms. In contemporary industrial Thai fishing, roughly 60 percent of fishery captures in the Gulf of Thailand consist of so-called "trash-fish," or low-trophic level fish with a variety of uses, such as fish feed in aquaculture (EJF 2013).

Figure 4.1. Thai Seafood Sector Production Sources, Metric Tons (World Bank).



This shift in the emphasis of Thai fishery catch has noteworthy implications. As Pauly et al. (1998) explain, the tendency to fish at lower trophic levels indicates a pattern of unsustainable fishing where smaller, lower trophic species come to replace catches of larger, piscivorous fish, as they become scarce. Not only does this phenomenon imply overfishing, but increased fishing at low trophic levels have particular, reverberating impacts on marine biodiversity and ecology (Smith et al. 2011). Pauly and Chuenpagdee (2003) confirm that, over a period of 20 years (1977 to 1997), the mean trophic level of catches in Thai fisheries declined rapidly, and thus "profoundly modified the ecosystem" of the Gulf of Thailand (347).

Finally, Thai fisheries have utilized their regional political economic power to exploit fishery resources beyond their own waters. This effort constitutes a geo-spatial fix to the ecological effects of global commodification. After the creation of marine EEZ's, Thailand

continued to fish in Burmese, Indonesian, and other nearby and neighboring nations' waters either illegally or with negotiated permission—often because nations' with less industrialized fishing fleets used the EEZ's as a bargaining chip for other, non-fishing related matters (Butcher 2004). Marine scientists note that, when adjusting for catches beyond the EEZ of Thailand, rates of Thai fishery captures triple (Derrick et al. 2017).

Thus, increasing commodification in Thai fisheries was a significant driver of historic overfishing in Southeast Asian waters. After decades of intensive and expansive fishing practices, the region is, ecologically speaking, a shell of its former self. Over 60 percent of Southeast Asian fisheries' resource is estimated to be at medium to high risk of overfishing—and risk is higher in the waters of poorer nations, such as Cambodia (DeRidder and Nindang 2018). When including waters of the Andaman Sea, catch per unit effort declined 86 percent since the late 1960's (EJF 2015).

Understanding Thailand's Position in Global Labor Value Chains

In 1993, the World Bank announced that they considered Thailand a high performing Asian economy—indeed, a central component of their "East Asian Miracle" report (World Bank 1993). This report came at the zenith of a decade long period of significant economic growth rates. That growth followed the Thai government's relaxation of non-tariff trade barriers (and other mechanisms) designed to stimulate export-oriented development (Bumgarner and Prime 2001). Following the Asian Financial Crisis in the mid 1990's, Thailand continued to grow rather strongly through the millennium and is, according to some recent assessments, turning a corner and moving out from a recent and short-lived economic malaise (World Bank 2018).

However, Thailand's prospects for continued economic expansion, beyond a middle income or semi-periphery nation, appear uncertain. As an emergent economy, Thailand is a

victim of its own success. Foreign capital investors increasingly consider Thailand at a disadvantage, caught in the tellingly named "middle income trap," for the simple reason that cheaper labor is obtainable in poorer and more firmly peripheral states (Nikomborirak 2017). Put differently, Thailand's "middle income trap" suggests that it is caught between "the competitive edge of low wages among developing countries and the high value-added market of more developed countries," and that this positionality serves to limit economic growth and capital investment (Tipayalai 2015: 2). This quagmire has resulted in Thai economists calling for a fourth stage of development known as "Thailand 4.0" that emphasizes the promotion of a value-based economy, fueled by biotech, the promotion of "knowledge intensive" industries, and the creation of export processing zones (Louangrath 2017; Royal Thai Embassy).

The implications behind Thailand's "middle income trap" must be understood. Thai labor costs are, in the manufacturing sector, relatively expensive for the region (Fisher 2017). Indeed, they more than doubled in a ten-year period in spite of growth in unit labor productivity, or output per unit of time worked, of the workforce (Table 4). From the standpoint of capital, this rising unit labor cost suggests that the Thai economy is trending in a less competitive and less profitable direction.

Table 4.4. Thailand Labor Data, Manufacturing Sector.

Year	Unit Labor Cost	Unit Wage Cost	Unit Labor Productivity
2003	4.68	0.45	0.031
2013	10.85	1.65	.111
Percent Increase	+231%	+366%	+358%

(Adapted from Rukumnauykit and Pholphirul 2016).

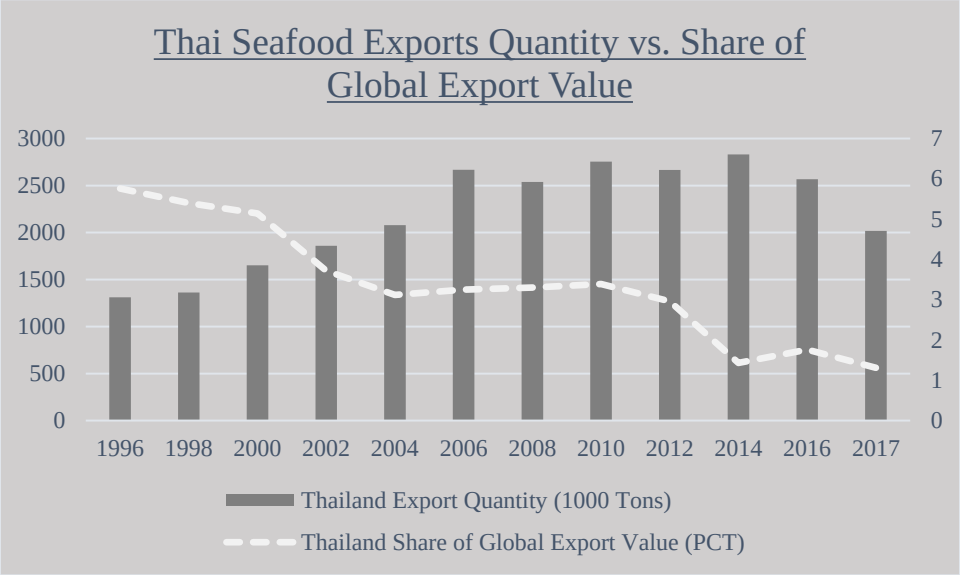
The steadily rising unit labor cost for domestic, Thai workers within the manufacturing sector in part explains what scholars refer to as a persistent labor shortage in Thai fisheries (Fischmann 2017). Extant research on Thai capture fisheries reveals that Thai nationals make up a paltry percentage, between 0-9%, of Thai fishing vessels and also occupy more well-paid positions like captain or net-boss (Issara 2017; HRW 2018; CSO 2018). However, such positions of authority on board fishing vessels are few. Low paid migrants from Cambodia and Myanmar perform most of the work on Thai fishing vessels. This steady reserve of replaceable, impoverished workers from poorer states deflates the price for labor within Thai fisheries. While this influx of migrant labor surely reduces unit labor costs in Thai fisheries, it does little to attract domestic workers who can make better wages in manufacturing or other sectors.

Furthermore, the structure of the buyer-driven, agri-food labor value chain reduces the political power of vulnerable workers in the seafood sector. If labor activists, states, or organizations raise awareness of severe fisher exploitation at the base of supply chains, the buying-firm may simply relocate their supply to chains with weaker oversight, where similar problems either do not exist or, more pessimistically, have yet to be exposed (Carstensen and McGrath 2012). Labor scholarship also emphasizes the difficulty in organizing agricultural workers in agri-food commodity chains due to, for example, geographic and social isolation of agricultural workers (Ford 2015), and such difficulties are all the more apparent in the seafood sector.

These socio-structural forces help the migrant-dependent, Thai seafood sector in efforts to sidestep the "middle income trap" that the Thai manufacturing sector occupies. However, the Thai seafood sector's reliance on severely exploited, migrant labor has not resulted in improved prosperity within the global seafood supply chain. Rather, it appears to be a tactic of economic

survival. Figure 4.2 (Harvard Growth Lab 2020; FAO Food Balance 2020) displays how, over time, Thailand's share of global, seafood sector export value has consistently declined. Figure 4.2 also details how this rate of decrease in share of global export value declined in spite of increases in quantity of seafood exported, up and until the most recent years for which data is available. This suggests that Thai fisheries products have been devalued, or cheapened, in recent decades.

Figure 4.2. Fish Exports vs. Share of Global Seafood Sector Value.



(Harvard Growth Lab 2020; FAO Food Balance Data 2020)

Indeed, Table 4.5 confirms that Thai fisheries exports have lost unit value over time. Again, in spite of an overall growth in gross exports of seafood products, Thailand's net export valuation deteriorated substantially. Thus, the decline of Thai seafood export value is not simply the result of other fisheries capturing more of the market—Thai seafood commodities are becoming less economically valuable, from a market perspective. Moreover, Thai gains in seafood sector productivity (as indicated by export production rates) were not able to offset this loss of market value. The value per ton of Thai seafood exports decreased measurably during this time period. Overall, in ten years, the value of Thai seafood exports declined by nearly 350% per

ton. This decline has occurred in spite of the fact that Thailand is re-orienting much of its seafood sector to incorporate so-called value added production of re-export commodities and technical processing (USDA 2018).

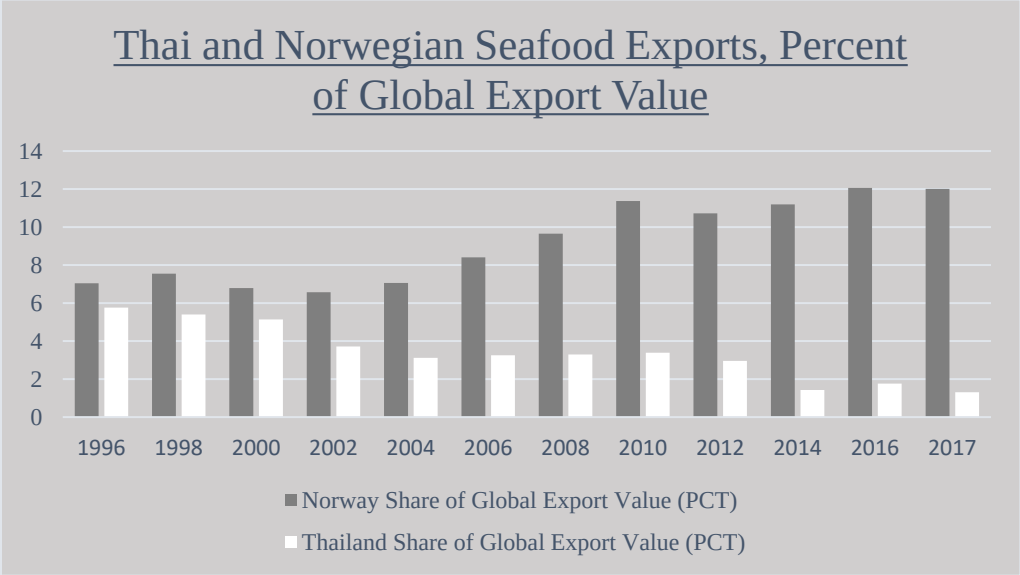
Table 4.5 Seafood Export Quantity and Valuation Over Time, Thailand.

Year	Tons Exported	Export Valuation (Constant USD)	Value Per Ton	Percent Change from last Observation
1996	1,311,000	3.55 Billion	2707.9	
2000	1,651,000	3.35 Billion	2029.1	↓25%
2004	2,079,000	2.25 Billion	1082.2	↓46.7%
2008	2,538,000	2.9 Billion	1142.6	↑5%
2012	2,666,000	2.75 Billion	1031.5	↓10%
2016	2,567,000	2 Billion	779.1	↓24.5%

(Harvard Growth Lab, FAO Food Balance Data 2020)

The global marketplace for seafood products also constrains Thai seafood sector development. Over the last two decades, European seafood sectors of comparable size to Thailand have successfully promoted their own high-priced seafood, like farmed salmon. Notably, salmon also comprises a substantial portion of Thai Union Group's aquaculture effort (Thai Union Group 2017). Yet, Figure 4.3 (Harvard Growth Lab) demonstrates how Norway—Europe's largest seafood exporter—has followed a radically different path in its seafood sector development.

Figure 4.3 Comparison of Seafood Sector Valuation, Share of Global Export Value, Norway vs Thailand.

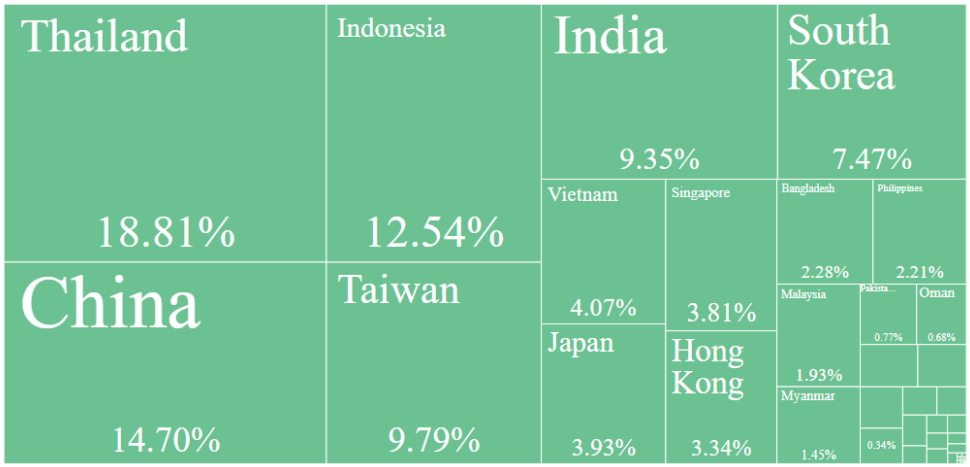


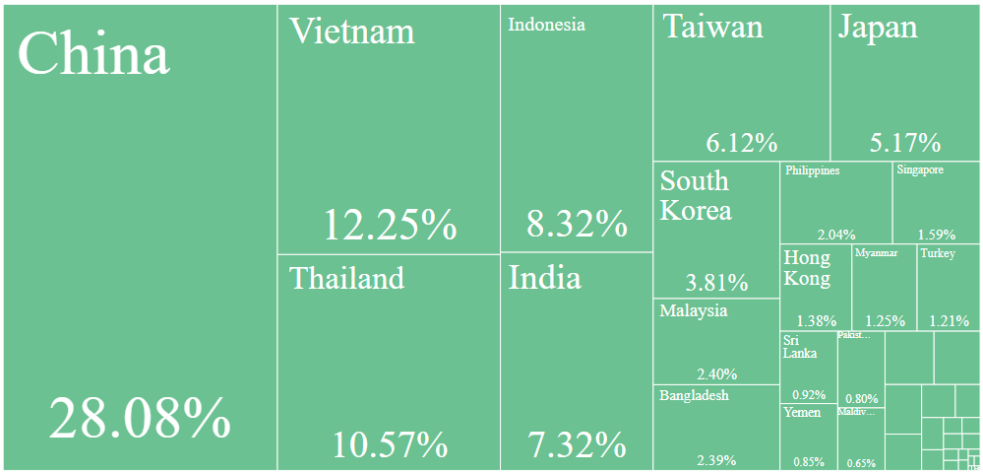
(Harvard Growth Lab 2020)

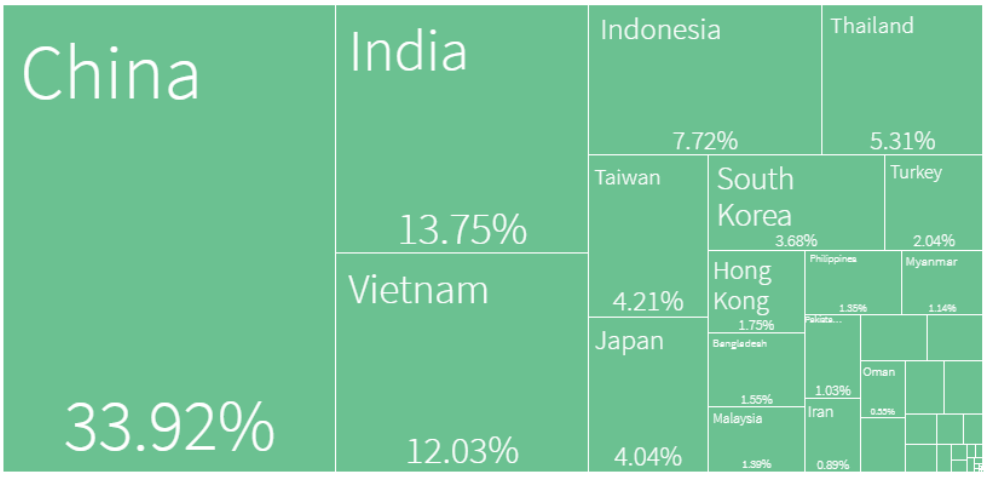
While Norway has an exceptionally lucrative seafood sector, other export-oriented European seafood sectors bear similar trends. Spanish seafood exports, for example, captured nearly double the level of economic valuation in 2017 than Thai seafood, despite being less productive in terms of quantity of seafood exported.

Thailand must also, increasingly, compete with so-called developing nations' seafood sectors across Asia. Over the last two decades, China, India, Vietnam, and Indonesia have ramped up their seafood export production, and have overtaken Thailand in terms of economic value procured from seafood exports. The following three figures (Harvard Growth Lab 2020), display how drastically the market for Asian seafood exports has shifted over the last two decades. Asian nations such as China, India, and Vietnam have flooded the global seafood market with massive amounts of seafood production, both farmed and captured.

Figures 4.4a, 4.4b, and 4.4c. Treemaps of Seafood Export Valuation for Asian Nations. 1996, 2006, 2016.







Thus, Thai seafood exports are both less valuable, from a neoclassical perspective on value chains, and less competitive in a crowded market, where many nations in the region

engage in high-volume export-oriented production of similar commodities, at similarly low prices. As the subsequent section argues, it is necessary to consider the increased reliance on severe exploitation of migrant workers in Thai capture fisheries, in this context. Severe exploitation helps to maintain the economic viability of Thai seafood, but in a highly limited, unjust, and unsustainable fashion.

Discussion

This case connects parallel, neo-Marxist interpretations of globalization and development with environmental sociology and critical studies of commodification and ecology. Through the application of these perspectives, I collected and analyzed relevant data on economic valuation, work and labor, and fisheries ecology to assess the socioecological conditions under which severely exploited, migrant labor came to be a "management practice" for much of the Thai seafood sector (Crane 2013).

This study indicates how GLVC can be enriched by engaging this perspective with the socioecological concerns emphasized by the tragedy of the commodity. Chiefly, GLVC analyses have focused on the manufacturing and textiles sectors. Applying the labor theory of value to the global commodity chain, Smith (2016) and Suwandi (2019) reinvigorate commodity chain research by emphasizing labor exploitation and value capture as the driving impetuses behind economic globalization. While this work has thus far been limited in its application toward labor and valuation in food systems, I argue that it is quite useful for understanding why the cost of agri-food system labor is systematically devalued and how this is closely linked to ecological conditions.

When one considers the metabolic obstacles to capital accumulation that the agri-food system poses, the pressure to engage in severe exploitation of the labor force becomes more

apparent. Generalized commodity production is dependent upon the ongoing turnover of the capital circuit. Value, formed in production, must be realized through continuing processes of distribution and consumption (Marx 1985). The nature of capital accumulation thus suggests that firms must constantly work to reduce time and costs associated with production and circulation, or risk disrupting the required turnover of capital needed to keep the circuit moving (Mann and Dickinson 1978, Smith 2016).

Commodified fisheries require intensified forms of production that trend away from methods that are more in line with the naturally existing metabolic flows of marine-based ecologies. From the standpoint of capital, ecological systems rely too heavily on slower and less predictable biological cycles that cannot fuel the capital circuit quickly enough. Thus, as I detailed in Table 1 and 2, global commodification in fisheries tends to undermine smaller scale and less-intensive fishing approaches. Unlike a technological- and capital-intensive fishing fleet, these methods are unable to engage in geographically expansive voyages or trawl the depths of the ocean floor. Intensive methods become all the more necessary as ecosystems are degraded, because declining ecological fecundity typically requires increased investment in fixed capital to overcome physiological limits presented by stressed ecosystems (Bunker and Ciccantell 2004). This socioecological reality makes cutting costs for labor all the more important.

Some INGO's have linked over-fishing to exploitative labor conditions in Thai fisheries (e.g. Oxfam 2014; EJF 2015b). Yet, these studies and reviews often do not link over-fishing to capital accumulation and the structure of an inequitable, commodified world food system. Further, explanations for sustained over-fishing typically grant agency to technology itself. In the Oxfam (2014) report, such problems are said to be driven by "a rapidly expanding fishing fleet," bolstered by "destructive fishing gear," which led to a "Malthusian extraction of marine

resources" (Oxfam 2014: 42). From this perspective, these are essentially outcomes of the tragedy of the commons, where human nature, interacting with enough technological capacity, will invariably degrade marine systems beyond recognition. The consequences of overlooking capital's social metabolic relations are also evident when the EJF (2015b) argues that the Thai seafood sector has over-valued trash fish and failed to recognize the economic potential of fishery conservation. As is evident in Thai fishery valuation data, the problem is not simply that Thai fishery commodities are over-valued. This view also suggests that improved management of the fleet is "the best route to maximizing revenue capture" (EJF 2015b). While better management and regulation might improve some indicators, as the tragedy of the commodity approach suggests, such methods tend to run counter to the immediate, self-valorizing logic of capital. Moreover, improved nation-state level regulation would do little to address unsustainable practices in other locations, especially in the waters of the global South, where retailers can continue to seek untapped and less-regulated markets to purchase seafood.

Dynamics specific to Thailand interact in important ways with these structural dynamics. Unlike regional competitors such as Vietnam, whose supply chains are more vertically integrated, Thailand's fishery sector is characterized by highly commodified, arms-length contracting, where smaller scale fishers and fish farmers possess weak bargaining power in relation to the buyers of their products (ILO 2016). This relation—which also exacerbates traceability difficulties—is made economically feasible via Thailand's close proximity to comparatively poorer nations, whose rural reserve labor army supplies Thailand with its fishers. Furthermore, while the Vietnamese seafood sector is changing rapidly, around 80% of Vietnam's catch is harvested in shallow water, on smaller boats (Pomeroy et al. 2009; Pham et al. 2014). In addition, Vietnam's primary seafood export—shrimp—are still produced by small-scale farmers,

whose usage and access to input (i.e., feeds) is limited (Tran et al. 2013). Thus, Thailand's longer and more systemic history of commodification and integration with the capitalist world system clearly matter to a strong extent.

These structural dynamics of commodification, and the tragedy of the commodity, further intersect with more meso-level processes specific to Thailand's fisheries. Thailand's responses to reports of forced labor are not insignificant at the firm or state level. Yet, problems of labor abuses and severe exploitation persist because, even in a more regulated context, the structural pressures of commodification bear down on actors working within the system. Thus, in spite of a "B" response from the Global Slavery Index, Thailand still rates roughly 7 points higher than the regional average on the index's vulnerability score, a measure of slavery risk (Global Slavery Index 2016). This stems in part from Thailand's geo-spatial fix to its overextended marine ecosystem, which have included subsidies to support long-haul voyages needed to catch increasingly scarce fish (Global Slavery Index 2020). These long-haul voyages are difficult to regulate, and widely known to contain higher risk for labor abuse.

As the tragedy of the commodity presents, states and international organizations have preferred techno-solutions to serious reforms that challenge the demands of capital accumulation. In large part to meet structural demands and contend with ecological change, intensive aquaculture production has been characterized as a potential win-win, where species can be reared in controlled environments, and fed supplements sourced from low-trophic and "inedible" fish. This practice, though, has altered the metabolic structure of marine systems, and induced mass biological speed-up. In this case, fishing down food webs represents an attempt to overcome the metabolic obstacles of marine systems that tend to impede the turnover of capital. In these examples, the dominance of the logic of commodity exchange—to modify ecological

systems towards processes more amenable to the expansion of exchange value—is apparent, and clearly alters the stability of marine socioecological systems.

Indeed, efficiency—under a logic of on-going commodification and capital accumulation—does not seek to strike a balance with ecosystems. Commodified fisheries must constantly struggle against the biological limits presented by marine systems and the metabolic demands of fish species, caught or farmed. Capital accumulation in the fisheries sector (and elsewhere in the world capitalist food system) is thus more directly subjected to the limitations of metabolic cycles of nature than in many other sectors. Furthermore, in spite of the increased technological capacities of an industrial fleet and capital-intensive aquaculture, seafood production remains extremely dependent upon human labor. Aquaculture farming may be more controlled and economically efficient, but it is not dematerialized. Rather, industrial scale aquaculture requires massive amounts of labor-intensive inputs, typically from other capture fisheries that increasingly focus on catching trash-fish. Thus, the capitalist seafood sector is not only costly—it is one that is fundamentally difficult to automate. These socioecological circumstances contribute to producing the conditions for severe exploitation of labor in fisheries; particularly in fisheries like those in Thailand, which have been extensively commodified.

To be sure, Thailand faces serious challenges to remain competitive in a crowded global seafood sector. Its "middle-income trap," characterized by rising unit labor costs in its growing manufacturing sector, helps to generate a domestic labor shortage within an industry whose labor costs must be systematically reduced to an extreme degree. Thus, in the Thai seafood sector, efforts to remain competitive have been associated with importing its seafood labor-force from the poorer, and more firmly peripheral states it borders. This reliance on severe exploitation points to the geo-political significance of semi-periphery nations in global labor value chains,

particularly in the buyer-driven global food system. Expansive and extra-legal fishing measures that exploit nearby, more firmly peripheral workers and marine ecosystems are required in order to maintain some degree of economic viability in a highly competitive labor value chain where global North retailers and distributors can control the price of commodities, set the market, and push risk and competition upstream.

This relation also points to the limits of dominant development paradigms and narratives of modernization that emanate from mainstream developmental organizations. Indeed, sustaining the viability of Thai fisheries within the context of the world capitalist food system and ecological decline demands a steady supply of impoverished workers from poorer regions of periphery nations. Thailand, and the global North firms it supplies with low-cost seafood, thus have an economic stake in maintaining the social conditions that characterize severe migrant labor exploitation in fisheries. This reality suggests that NGO reports that characterize the Thai state's mismanagement of its fisheries as the primary driver of the persistence of forced labor may shift the focus away from corporate buyers in the global North, who continue to plead ignorance about what goes on at the most upstream nodes of their supply chains.

Finally, as I demonstrated, the devaluation of Thai fish products via the reliance on severe exploitation has not led to relative prosperity for the Thai seafood sector. Thus, this case sheds light on how unsustainable development occurs over time in an important geographic center of the world food system. Severe labor exploitation has enabled a precarious industry to survive and extract relatively meager levels of value in the context of a highly competitive global seafood market, one in which more and more of the value is captured by firms in the global North. Thus, I reason, the biggest "winners" of Thailand's political economic positionality are

the global North firms and retailers who have benefited from the buyer-driven, global labor arbitrage that has pushed competition upstream, towards producers in the global South.

Conclusion

This study advances theory in the political economy of globalization and the environment and provides socioecological context to a social problem, from a critical, structural perspective. I advanced the theory of the global labor value chain by applying it to a case of severe labor exploitation in an important sector of the world capitalist food system, seafood production. Labor in agri-food systems is, too often, naturalized as being unskilled, undesirable, and of low value. Such connotations are especially apparent with descriptions of "trash-fish" as nearly economically worthless. This reification of capitalist valuation obscures the exploitation that fuels profits emanating from global South fishery operations, as well as in other sectors of the labor-dependent agri-food system, generally. In a world market dictated by global North firms (buyers), producers must compete to offer relatively inexpensive products to distributors. This case thus complicates the narrative that the agri-food sector is definitively a "low value" industry.

Rather, in this case I demonstrate that declining rates of market valuation signal value capture from Thai fisheries. This points to Thailand's precarious political economic position in the global seafood commodity chain. The Thai seafood sector must compete, i.e. reduce production costs, against other firms across different nations that can offer similar commodities to global North markets. However, the Thai seafood sector must maintain its foothold in global seafood commodity chains within an increasingly stressed marine ecological system. As the tragedy of the commodity perspective suggests, severe labor exploitation amounts to a fairly

limited management approach—the underlying antagonisms between capital and ecology remain, which work to undercut the potential of future fishery development in the region.

Furthermore, this case study should be useful for future analyses of seafood value chains and unequal ecological exchange across the world food system. For example, future studies can explore the extent to which seafood supply chain managers reify conceptions of value, and thereby naturalize labor exploitation in seafood supply chains. Indeed, because firms govern and manage their supply chains, and because seafood supply chains are difficult for governments to regulate, some argue that the solution to forced labor at upstream nodes of production must come from firm governance strategies or corporate social responsibility (Busch and Bain 2004; Gereffi and Lee 2016; Seafood Slavery Risk Tool 2018). This has resulted in a nascent industry of seafood ethics and supply chain risk consulting, marketed to the private sector. However, corporate social responsibility risks naturalizing trends in neoliberal re-regulation where states have, with intentionality, abdicated responsibility for enforcing labor and environmental regulations (LeBaron and Phillips 2019). Further, continued monopolization and financialization prioritize short term profit for shareholders whose interests and concerns limit meaningful, voluntary action taken by multi-national firms (LeBaron 2020). Future research on corporate social responsibility should keep these considerations in mind.

It is also crucial that further work recognize another important matter that this case highlights: the global dynamic of environmental injustice as it pertains to unsustainable development. The extraction of natural resources and the destruction of ecological wealth typically benefit firms in the global North, and thus reinforce a globalized system of white, capitalist hegemony (Pellow 2007; Holleman 2018). It is impossible to ignore the social reality that firms in the global North, dominated by mostly white men, and affluent nations in the world-

system enjoy and profit from the “luxury” or “specialty” commodities caught and processed by impoverished, Brown-skinned fishers, in many cases working against their will and in brutal conditions, in the global South.

It is likely that severe exploitation will continue to be a major concern in global fisheries as long as the commodification of seafood intensifies and is the primary mechanism by which food is produced and distributed. In this case study, I examined the combined and interacting tragedies of severe exploitation and marine degradation that are socially driven to a significant degree by global commodity systems. Thus, I contend that the de-commodification of food becomes a central means for addressing concerns associated with social equity and ecological sustainability.

CHAPTER 5: CONCLUSION

This dissertation furthers the study of food systems and environmental sociology in a number of ways. Broadly speaking, this dissertation provides context and commentary on the socio-structural, political economic obstacles to sustainable development in fisheries and socioecological marine systems. Scholars of sustainability generally agree with the notions that sustainable development should prioritize the ecological needs of future generations while promoting goals consistent with socioeconomic justice or equity (Harris 2000; Purvis et al. 2019). However, as discussed in the introductory chapter of this dissertation, developmental literature often overlooks the sociological significance of capitalist social relations for actually achieving these goals. This dissertation sought to remedy such oversight through a series of socio-historical queries that highlight the importance of the capital-labor relation in conjunction with the ceaseless, structural impediment to accumulate capital. To conclude, I will briefly restate the main findings of each article. Then, I will provide the overarching, interrelated takeaways that these articles emphasize in concomitant fashion.

Major Findings of Each Study

Chapter 2 revealed the nature of the positive relationship between per capita GDP and the ecological footprint of fisheries in less affluent nations. Using comparative models and interactions, I determined that the decoupling of economic growth and fishery footprint occurred only in the world's most affluent nations over time. Again, my measure of economic growth was operationalized in the GDP/Capita indicator, which reflects the amount of market value accumulated within a nation at a per capita level. In less affluent nations, the effect of this measure of capitalist economic expansion was positive, and the Period x GDP interactions revealed that this effect tended to increase in magnitude over time, for less affluent nations. The

effect of capitalist economic growth, i.e. per capita GDP, is also more pronounced for less-affluent nations in Central and South America and Asia. This study illustrates that less-affluent nations shoulder the burden of the capitalist economy's ecologically deleterious, growth-oriented dynamics. Further, these results call into the question the ability of a market oriented "blue economy" to equitably promote sustainability, both spatially and from a socioeconomic perspective.

Chapter 3 uncovered two historical interplays that scholars, without proper socio-historical context, can easily overlook. The first noteworthy relationship I emphasize is the connection between terrestrial agriculture decline and marine system degradation. A major social force that pushed the Atlantic menhaden fishery into more unsustainable productive cycles arose from systemic ecological rifts within capitalist terrestrial agricultural systems. The 19th century soil fertility crisis that occurred in commodified agricultural systems within the United States and Great Britain stimulated a global rush for nitrogen inputs, which eventually led to the shores of the Eastern Seaboard where early menhaden capitalists began to market so-called "fish guano" for exhausted soils. Subsequently, in the 20th century, the logic of capitalist agriculture extended beyond the soil to the flesh and lives of animals—livestock and aquatic. As a protein and fat supplement, processed menhaden served (and continues to serve, to a lesser extent) as a means to accelerate growth of animals before their eventual slaughter.

Chapter 3 also reveals the interplay between commodification and racial subjugation. Specifically, the naturalization of a strict racial hierarchy at work helped maintain a generational cycle of extreme exploitation. Black fishers comprised the overwhelming majority of workers in this fishery. Yet, their compensation (based on catch shares, with little guarantees or benefits) allowed white menhaden capitalists to avoid financial risk and disproportionately benefit from

the economic reward of good hauls. This study thus demonstrated that commodification, as a process or cycle, is abetted by systemic social inequity.

Chapter 4 details a contemporary, and notably severe, case of such dynamics at sea. Global fisheries are now extremely trade dependent, with most labor occurring in the waters of the global South. As my case study illustrates, the complex global seafood value chain obscures problematic productive relations that can occur at sea, in export-oriented fisheries. Utilizing political economic theory of valuation, I explore the interplay between the rise of intensified labor exploitation in Thai fisheries and Thailand's place in the global seafood sector. I demonstrate how, in the 21st century, a rise of migrant labor exploitation corresponds with increasing economic precarity in the global seafood value chain, for Thai fisheries. This developmental trajectory demonstrates a core irrationality of the capitalist value chain, from the perspective of a semi-periphery nation: continuously appease the global North market in order to maintain an increasingly exploitative buyer/seller relationship. Indeed, it is difficult to tell who benefits from this value chain structure besides large-scale buyers of Thai seafood products and, to a lesser but important extent, the executives of Thai Union Group.

The following subsections provide commentary on the key takeaways from this dissertation as whole. I conclude with brief remarks and reflections on how to approach sustainable development from a sociological perspective.

Overarching Findings

Marine Sustainability

Each study demonstrates how the priorities and structural demands of a capitalist social metabolic order lead to systemic environmental degradation. At a world scale, the Global Footprint Network's fishery footprint indicator illustrates the amount of marine territory needed

to sustain consumption of marine space. It is, as I explained in Chapter 2, an ecologically weighted measure of seafood consumption. Further, given the nature of the calculation, it is an apt metric of marine ecological impact over time. In the study presented in Chapter 2, the relationship between capitalist economic expansion and increased fishery footprints is clear. In most of the world's nations, and thus most of the world's marine territory, capitalist economic development has increased nations' fisheries footprints over the last half century.

I explored ecological sustainability with my case studies as well. In the Atlantic menhaden fishery, I describe how the ecology of the marine food web and fecundity of the marine ecological system became degraded over time. As I discuss, Indigenous people and early, white settlers and colonizers would likely not recognize the marine environment today due to systemic over-fishing and environmental pollution. The commodification of Atlantic menhaden and subsequent intensification of menhaden fishing led to ecological decline at every stage of historical development. This decline is illustrative going back even to the 19th century, when in-shore, small-scale fishers attempted to politically resist menhaden capitalists' plundering of the ecosystem.

In the Gulf of Thailand, I analyzed a similar process of ecological plundering at what appears to be a compressed and accelerated scale. I discuss how the ecological fecundity across the Gulf of Thailand has sustained prolonged decline over a period of export oriented, capitalist fishery development. Thai fisheries have resorted to practices that evidence systemic over-fishing, including relying on longer and more expensive voyages, illegal fishing in neighboring nations' waters (thus expanding their own footprint), and engaging in what marine scientists call fishing down the food web for smaller and oftentimes less biologically mature fish species.

Much, if not the vast majority, of this unsustainable fishing effort goes to support global North consumption and global North capital.

Pre-Analytic Sustainability vs. Socioecological Justice

This dissertation challenges pre-analytic conceptions of sustainable development. In addition to prioritizing economic growth, i.e. capitalist growth, as the most necessary feature of sustainable development, pre-analytic sustainability tends to isolate social concerns from environmental and economic concerns (Longo et al. 2016). This so-called "three pillar" or "triple bottom line" approach tends to relegate social justice as a tertiary concern, and thus fails to understand that "societies that are more equitable have greater potential for socio-ecological sustainability," (Longo et al. 2016: 13). As I detailed in Chapter 3, we should avoid conceptions of fishery failure, collapse, or decline as sustainable. Pre-analytic conceptions of the Atlantic menhaden fishery as sustainably managed overlook how development has favored more wealthy and powerful people and entities. As I discuss in Chapter 3, fishery economies across much of the Eastern Seaboard have been replaced by non-locally owned, economically precarious tourist development—much of which, ironically, includes recreational / tourist fishing. A local historian of Beaufort fishing communities put it best when lamenting on the rise of high-dollar, recreational marinas, lodging, and restaurants at the sites of now gone fish houses: "capital just gets what it wants."

The Atlantic menhaden's historical trajectory is not unique for Global North fisheries. Indeed, similar patterns of development likely account for the environmental Kuznets curve that I uncovered for affluent nations in Chapter 2. I thus reason that it is questionable to even assert that this decoupling effect evidences sustainable development in affluent nations. Rather, as I uncovered in Chapter 3, the Atlantic menhaden's historical journey to modern "sustainable

fishery" is one fraught with ecological degradation, social inequity, and economic decline. However, from an abstracted and ahistorical pre-analytic view, declines in fishing impact, corporate viability (e.g., Omega Protein), and the growth of a service sector economy (tourist development) can appear "sustainable." This dissertation, which centered concerns of justice and socio-historic analysis to critically understand socioecological change, provides an alternative assessment.

Efforts to analytically place justice as central to socioecological sustainability are important because inequities endemic to capital accumulation are often overlooked by the pre-analytic perspective (Longo et al. 2016). Indeed, this oversight is also systemic within blue growth and blue economy literature, which often prioritizes growing the economy and commodifying new marine spaces over the well-being of people and social equity (Bennett et al. 2020). A critical view is therefore needed, especially as the seafood value chain becomes more nebulous and obfuscating with each passing decade. As the 4th chapter reveals, the complex nature of the global seafood value chain conceals systemic labor and ecological abuses. Indeed, even corporate executives in the global North and in Thailand maintain that the disaggregated nature of the value chain presents fundamental obstacles to oversight and management.

Thus, when confronted with reports of slavery in seafood value chains, global North retailers and global South sellers plausibly plead ignorance. Scholars of sustainability must peer through the veil of the value chain to uncover the interconnected nature of historical development. The decline of the Atlantic menhaden fishery and the rise of "trash-fishing," where debt-slaves in the Gulf of Thailand catch menhaden-like input commodities, are historically interconnected. I thus argue that global North fishery "sustainability" arose out of an unequal exchange relationship, where ecological extraction and social exploitation occur at greater levels

in the global South. This process suggests that sustainability or sustainable governance, to the extent that they do exist in richer nations, are socioecological luxuries—the product of systemic, global socioecological injustice. Again, to uncover such historical processes—many of which are specific to globalized capital accumulation—requires theoretical orientations that are capable of transcending pre-analytic conceptions of sustainability.

Environmental Sociology and Sustainable Development

Many disciplines offer varied suggestions to combat unsustainable socioecological processes and outcomes. Often, these involve specific policies, management strategies, and appeals to improve consumer-citizen education. As discussed in this dissertation, such programs often include blue growth or blue economy initiatives put forward by international organizations, or corporate and consumer responsibility tools meant to educate buyers about risk of slavery, overfishing, or related problems. Sociologists can offer their methodological and theoretical skills to improve these measures in numerous ways, and many sociologists dedicate their lives to work for and within these institutions in order to advance constructive, reform-oriented proposals.

A strength of sociology in these matters also lies in the discipline's willingness to forward radical, foundational critique of existing structures and institutional processes. As discussed in Chapter 1, a serious oversight in scholarship and NGO/INGO literature arises in its failure to directly challenge, or even attempt to understand, the limitations posed by a capitalist social metabolic order to actually achieve sustainability. This failure to challenge capital is, as Fisher (2009) noted, not uncommon in a neoliberal, post-cold war era of capitalist realism. Alternative realities, including alternative conceptions of development and sustainability, appear difficult to realize or imagine. Inevitably, this neglect leads to confounding outcomes—many of which I presented throughout this dissertation.

To a certain extent, we should expect a particular degree of naturalization of the social world; indeed, ideological reproductions of the status quo are a foundational component of a stable society. Nevertheless, to achieve real sustainability and meet the rising challenges of an ecologically stressed life-world, scholarship concerning the sociology of sustainability should challenge logics that suggest—implicitly or explicitly—there is no alternative. This requires envisioning a world without the constraints and injustices mandated by capital. Scholarship aimed at promoting these goals would do well to heed Rodney's (2018) call to recognize exploitation as a central component of capital accumulation and development. Indeed, a central thread of this dissertation can be understood as follows: over the course of the last 150 years, capitalist fisheries have sought out increasingly exploited labor and fertile marine ecologies from which to appropriate wealth. This quest eventually led to the decline of global North capture fisheries and the rise of ecologically intensive fishery development in export oriented, global South fisheries where there remains a surplus of severely exploited fishing workers.

Perspectives that explore alternative forms of social organization, where production and social relations are organized around cooperatively and equitably meeting human need, are of paramount importance at this time. This is a critically important theoretical concern, especially in food system sustainability, as food is an essential commodity for the sustainment of human life. Production oriented around profit and the accumulation of abstract exchange value will necessarily involve human exploitation and ecological degradation. Thankfully, there are other values and motives for production and social regulation besides profit and capital accumulation. While pre-analytic conceptions of sustainability obscure this possibility, environmental sociology should continue to elucidate critiques of the present social metabolic order, while keeping in mind that another world is possible. At a fundamental level, the discipline of

sociology offers even its introductory students the most important tools to envision these alternatives: we just have to use our imagination.

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