Understanding small-scale fisheries in Thailand: Ecological change and local governance systems

By
Courtney Kehoe

A thesis submitted to the
Faculty of Graduate and Postdoctoral Studies
in fulfillment of the requirements for the
Masters of Science degree in Environmental Sustainability

Institute of the Environment
University of Ottawa

ABSTRACT

With the state of the world's marine fisheries in decline and an ever increasing global demand for seafood products, there is rising concern for the future of both our oceans and the more than 180 million people living in the developing world who depend on fisheries for their livelihood. In a country like Thailand, where approximately 3.3 million individuals are working within the fishing industry either full-time or part-time and where catch per unit effort has decreased significantly over the years, understanding ecological change (especially as perceived by fishers whose knowledge is derived and continually updated through everyday lived experience) is paramount. At the same time, recognizing management schemes that realize local realities and acknowledge not only the resource system but the actors that depend on it and the interactions therein is also of great importance. By adopting Ostrom's general framework for analyzing the sustainability of socio-economic systems the following research explores how ecological, social, and institutional factors are affecting small-scale fishers in the village of Khan Kradai, Prachuap Khiri Khan province. In doing so it contributes towards a deeper understanding of the reasons why small-scale fishers choose to either exploit local resources or use them in a more sustainable way.

ACKNOWLEDGMENTS

This research is written as part of the research programme New Directions in Environmental Governance (NDEG) and the author gratefully acknowledges the financial support provided by the NDEG project. A special thanks to fishers and their families in the village of Khan Kradai for their participation in this research and to Surawat Suwannawa, Wichitta Uttamamunee and Dr. Jawanit Kittitornkool for their assistance in translating and the general support they offered. The author would also like to thank Dr. Peter Vandergeest (York University), Dr. Dan Lane (University of Ottawa), and Dr. Scott Findlay (University of Ottawa) for their insight and encouragement, and extend genuine appreciation toward academic supervisor Dr. Melissa Marschke (University of Ottawa) for her careful guidance and continued support throughout this process.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The state of the world's marine capture fisheries is in decline. According to statistics produced by the Food and Agriculture Organization of the United Nations (FAO), total average marine capture of twenty-three major targeted species - comprising 40 percent of total marine catch - was 4.5 percent less in 2012 than in 2003 (FAO 2014). Some argue the decline in fisheries is even worse than FAO statistics suggest, claiming that capture data between 1950 and 2010 were underreported by as much as 50 percent, and catches have therefore been falling more severely than initially thought (Pauly and Zeller 2016).

Countries throughout Asia are especially vulnerable to experiencing declines in marine capture fisheries, given that the continent is responsible for producing approximately 60 percent - equivalent to more than 81 million tonnes - of the world's annual catch (Stobutzki, Silvestre, and Garces 2006). Independent assessments of coastal fisheries in South and Southeast Asia (SEA), undertaken by eight different countries, have found that demersal fisheries (which include flounders, halibuts, soles, rays and other bottom-dwellers) are being harvested at rates that exceed maximum sustainable yield (MSY) (Stobutzki, Silvestre, and Garces 2006). Thailand, the fourteenth largest fish-producing nation in the world, is one of these eight countries experiencing the effects of overfishing. Marine capture fisheries in this country declined 39.2 percent from 2,651,233 tonnes landed in 2003 to 1,610,418 tonnes in 2012 and by almost 50 percent since the early 1990s (FAO 2014; EJF 2015). Overall catch per unit effort in this region has also fallen 86 percent since 1966 (EJF 2015). In the Gulf of Thailand specifically, where approximately eighty percent of the country's catch is harvested, important pelagic fish (such as Indo-Pacific king mackerel, sardines and anchovies) are fully exploited (Ahmed et al. 2007). As fishing capacity and effort continues to grow in these regions and as domestic and global demand for seafood products increases, it is expected that marine capture fisheries will continue to be depleted; leaving the state of the world's fisheries at risk (Paterson 2013; Sutton and Rudd 2015).

Such revelations are of grave concern not only from an environmental standpoint but also from a livelihoods perspective, as much of the worlds' poor who live in coastal communities rely either directly or indirectly on fisheries-related activities to survive. Increasing pressure on already depleted coastal and inshore fisheries in SEA, stemming from greater demand for fish and seafood product, will have a direct effect on small-scale fisheries (SSF) (R. Pomeroy et al. 2016). SSF, also known as artisanal fisheries, are a subsector of the marine capture fisheries industry and contribute approximately 25 percent of global fish catch (Staples, Satia, and Gardiner 2004; Pauly and Charles 2015). Despite the relatively small amount landed by SSF, their importance to coastal communities — as a source of income, jobs, and food as well as an embodiment of cultural heritage and identity — is significant (Paterson 2013; Chuenpagdee and Jentoft 2015). SSF employ more than 90 percent of the world's capture fishers and provide direct or indirect employment to over 180 million individuals living in the developing world (Lebel, Khrutmuang, and Manuta 2006; Béné, Hersoug, and Allison 2010; Kittinger et al. 2013; Partelow 2015; Jentoft and Chuenpagdee 2015; Eriksson et al. 2016). In Thailand specifically, there are approximately 3.3 million individuals working within the fishing industry, either full-time or part-time (The World Bank 2012; Pauly and Charles 2015). A large portion of this fishing population - 87 percent - are SFF, despite the fact they account for less than 5-6 percent of Thailand's overall catch (Jones, Gray, and Umponstira 2010).

It is widely accepted that anthropological pressures are to blame for declines in global marine capture fisheries (Stobutzki, Silvestre, and Garces 2006; Béné, Hersoug, and Allison 2010; R. S. Pomeroy and Andrew 2011; Cinner et al. 2013). In the Gulf of Thailand, for instance, the FAO has identified overfishing as one of the main causes of decline in fisheries, alongside environmental degradation and the fact that since 2008 Thai vessels are no longer allowed to operate in Indonesian waters (FAO 2014). For this reason, it is believed that one way to address the problem is through sound management. However, for SSF (especially in developing countries) implementing sound management has proven

difficult because of the great diversity of ecological and social contexts (Andrew et al. 2007). As social-ecological systems (SES), SSF require a type of management that realizes local realities and acknowledges not only the resource system and its units, but also the actors that depend on them for their livelihood (and the interactions between the two). Conventional management schemes that depend on government control, therefore, are often found to be ineffective because of a mismatch between the scales at which power is being exercised, rules are made, and resources are being extracted (McConney and Charles 2010; Jentoft and Chuenpagdee 2015). For this reason, there has been growing support for devolution and the practice of co-management, whereby responsibility is shared between government institutions and the community of local fishers. It is believed that such institutions can promote more communal-driven and sustainable human-environment interactions (Brondizio, Ostrom, and Young 2009).

2. RESEARCH QUESTIONS

Using Thailand as a case study, the following research provides a more nuanced understanding of ecological change within SSF and considers the extent to which communities can actually become involved in fisheries management, and whether or not co-management of SSF is in fact a viable option. It does so by asking the following questions:

1. How has the social and ecological state of SSF in Thailand changed over the years, according to fishers?

2. What forms of local governance systems are in place in Thailand to manage SSF?

Focusing on SSF in the village of Khan Kradai in Prachuap Khiri Khan province, and approaching the above questions from a social-ecological systems perspective, this research paints a more comprehensive picture of SSF in Thailand. In asking the first question, details on both ecological determinants (species abundance, size, catch-per-unit-effort, seasonal variability) and social determinants (history of use, fishing practices, gear used, rules in use, governing institutions, etc.) are ascertained. These details are then used to better understand the reasons why certain forms of local governance, identified by the second research question, have come to exist.

3. LITERATURE REVIEW

Research on SSF in SEA is not a new phenomenon. In neighboring countries including Cambodia and Vietnam, there has been research on how SSF contribute to local livelihoods and economies, as well as the various forms of fisheries governance that exist (Béné, Hersoug, and Allison 2010; Marschke et al. 2012; Carbonetti, Pomeroy, and Richards 2014; Marschke, Lykhim, and Kim 2014). In Thailand too there has been a considerable amount of research on SSF, although focus has predominantly been on conservation efforts such as the creation of marine protected areas (Lunn and Dearden 2006b; Tan-Mullins 2007; Nasuchon and Charles 2010; Weigel et al. 2015). The following section provides a brief survey of the literature on SSF within SEA (Thailand especially) and pays close attention to: how SSF are defined, how SSF support coastal livelihoods, ecological change within SSF, and the types of local governance systems that exist.

3.1. Defining SSF

While there remains no agreed-upon definition of SSF, they are almost always described as being opposite of their large-scale, industrial counterparts. Perhaps the most notable characteristic of SSF, setting them apart from large-scale fisheries (LSF), is the use of vessels less than 15 meters in length (Lunn and Dearden 2006a). For some time, SSF vessels were also known for being engineless but this is no longer the case as many have become motorized by engines of 85 horsepower or less (Anuchiracheeva et al. 2003; Mathew 2003; Stobutzki, Silvestre, and Garces 2006; Lunn and Dearden 2006a). Limited capacity in terms of boat size means that another feature of SSF is that they tend to operate in waters nearer to shore and often utilize family members or close relatives as crew (Anuchiracheeva et al. 2003). The use of less technical gear such as gill nets, trammel nets, and hook and line is also a common trait, as is smaller catch per unit effort (Stobutzki, Silvestre, and Garces 2006; Hauck 2008).

But SSF are defined by more than just their size and scale of technology, as they differ from LSF in their social characteristics, governability, economic motivation and market linkages also (R. S. Pomeroy and Andrew 2011; Chuenpagdee and Jentoft 2015). SSF are, for instance, known to sell their catches primarily to local, domestic markets, or keep them as a means of subsistence, rather than export to regional and international markets (Lunn and Dearden 2006b; Jones, Gray, and Umponstira 2010). In many cases there is also strong social capital amongst SSF, which is often used as a means of management: encouraging cooperation and compliance (Jentoft and Chuenpagdee 2015).

In Thailand, marine capture fisheries have been categorized by the Department of Fisheries (DoF) as: small artisanal, large artisanal, semi-commercial and commercial. While there is no agreed upon definition for small and large artisanal fisheries, which for the purpose of this paper fall under the umbrella of "SSF", those engaging in these fisheries are often said to occupy fishing grounds within 5 miles from the coast and have a boat capacity less than 5 gross tons (The World Bank 2012; EJF 2015) or in some cases less than 10 gross tonnes (Department of Fisheries Thailand, 2014). Alternatively, those engaging in semi-commercial and commercial fisheries, which for the purpose of this paper fall under the umbrella of "LSF", are said to occupy waters beyond this 5-mile mark and operate boats with a capacity greater than 10 gross tonnes. In 2014, it was reported that a total of 28,876 boats were registered under the categories of small and large artisanal; this is double the amount registered as semi-commercial and commercial — 6,560 and 6,615 respectively (Department of Fisheries Thailand, 2014). A Government survey from 2011 however, suggests that two thirds of Thailand's fishing fleet (including SSF) remains unregistered (EJF 2015).

3.2 SSF contribution to coastal livelihoods

SSF are considered engines for regional rural development and poverty alleviation in much of the developing world (Staples, Satia, and Gardiner 2004; Andrew et al. 2007; Béné, Hersoug, and Allison

2010). This is because employment from SSF is not limited to harvesting, but also includes pre-harvest and post-harvest activities such as gear construction and fish processing (Mills et al. 2011). As a result of these extensive and diverse employment opportunities it has been estimated that over 180 million people in developing countries rely on SSF for at least part of their income (Béné, Hersoug, and Allison 2010; Eriksson et al. 2016). While those directly employed in SSF are not always 'the poorest of the poor' – in Thailand they often earn a higher daily wage than the national household and have a national income that is above the poverty line – there is nevertheless a heavy dependence on this occupation (Nickerson-Tietze 2000; Lunn and Dearden 2006b; Béné, Hersoug, and Allison 2010). Individuals, entire families, even whole communities rely on these labor opportunities, making SSF the backbone of coastal livelihoods (Chuenpagdee and Jentoft 2015). In addition to offering a means of livelihood, SSF also contribute greatly to human nutrition and food security, especially for those living in coastal communities (Lunn and Dearden 2006a; Andrew et al. 2007; R. Pomeroy et al. 2016). In SEA countries, SSF provide a major source of inexpensive protein (Tan-Mullins 2007) and, in the developing world more broadly, they have been found to provide the greatest share of fish for human consumption (Mills et al. 2011).

Given the important welfare functions of SSF, fishers can get locked into a way of life where their actions (in relation to the SES within which they operate) seem irrational (Blaikie 1995). This irrational behavior is what Blaikie & Brookfield (1985) described as 'desperate ecocide': fishers, in order to derive the social benefits of SSF, put increased pressure on fish stocks and coastal resources by employing more destructive gear, catching unsustainable yields, and fishing down trophic levels (Armitage and Marschke 2013; Ruddle 2014). Such unheeded pressure can leave already impoverished SSF households further marginalized (Armitage and Marschke 2013). This perceived causal relationship between fisheries and poverty has long been described using the two pillared paradigm: fishers are poor because they are fishers and they are fishers because they are poor (Béné 2003). More recently, however, there have been calls for a new paradigm that would broaden the focus from predominantly economic and biological factors (e.g. resources availability and income generated) to also include socio-institutional mechanisms (e.g. set of rules, norms, and organizations that determine access, use and control) (Béné 2003).

3.3 Ecological change and SSF

The effect of SSF on ocean ecologies and fisheries has received much attention over the years. On the one hand, some scholars have adopted the neo-populist view that "small is beautiful" (Schumacher 2010): not denying that SSF put pressure on resources and surrounding ecosystems but arguing that compared to LSF the environmental impact of SSF is far less (Campling, Havice, and McCall 2012; Chuenpagdee and Jentoft 2015). According to these proponents SSF are less threatening because they operate in multiple fisheries, use less gear, and the gear that is used is more passive and selective in nature (Mathew 2003). On the other hand, scholars have warned against a romanticized notion of SSF because it suggests that these fisheries are 'ecologically sustainable, socially just, or both' — when in fact this is not always the case (Ruddle 2014). According to these opponents, 'vessel size and the scale of production alone do not determine the social and/or environmental' outcomes of a fishery (Jones, Gray, and Umponstira 2010; Campling, Havice, and McCall 2012, 181). SSF can exploit many of the same stocks as LSF while also targeting a large number of smaller stocks (Jones 2009; McConney and Charles 2010) and are capable of exerting a high level of pressure on marine resources and ecologies that could negatively impact biomass, species abundance, and species richness as well as the individual sizes of target fish (Lunn and Dearden 2006a; Lunn and Dearden 2006b; Paterson 2013).

The coastal waters of SEA are among the most productive and biologically diverse in the world (R. Pomeroy et al. 2016). However, as a result of overfishing and overcapacity within marine capture fisheries, the quantity and quality of important habitat in this region has been reduced and certain fish populations depleted (Lunn and Dearden 2006a; R. S. Pomeroy 2012). In fact, 'it is now almost universally accepted that most of the nearshore fisheries in SEA are overfished' (R. Pomeroy et al. 2016) In Thailand, a total of 1,240,000 tonnes of marine capture fisheries were harvested from the Gulf of

Thailand and 360,000 tonnes from the Andaman Sea in 2014 alone (Department of Fisheries Thailand, 2014). The composition of landings from the Gulf of Thailand was found to be 64.7 percent demersal species, 20.9 percent pelagic species and 14.4 percent anchovy; this compared to the Andaman Sea landings that consisted of 49.2 percent demersal species, 27.5 percent pelagic, 11.7 percent anchovy and 11.7 percent other. Small-scale fisheries were responsible for harvesting 11 percent and 23 percent of these amounts from the Gulf and Andaman Sea, respectively. It should be noted however, that because "many [SSF] sell their products locally and/or consume their catches themselves, their landings are often under-represented in official statistics" (Lunn and Dearden 2006b, 61) or lumped in with industrial catches (Pauly and Charles 2015).

3.4 Governance systems for SSF

Fisheries governance, broadly speaking, is considered a wicked problem: it is interpreted in moral terms, operative at different scales, and distant or unique in terms of time and space (Jentoft and Chuenpagdee 2009). Traditionally, it has been approached by way of top-down methods that lack diversity, are primarily science driven, and are concerned with achieving only biological or ecological goals (Berkes 2003). Such centralized forms of management however, are not well-suited for SSF and have been found to be unsuccessful in the past (Andrew et al. 2007; McClanahan et al. 2009). What is needed instead are formal or informal institutions that can effectively protect ocean ecologies and conserve fish stock whilst promoting the socio-economic objectives of fisheries through policies and practices that are context specific and in harmony with local perceptions (Mathew 2003; Fernández and L 2008; Armitage and Marschke 2013). For this reason there is growing support for more bottom-up approaches to fisheries governance that are capable of integrating management with social systems (e.g. political jurisdictions, use patterns, culture) and social issues (e.g. livelihoods and food security) (Hauck 2008; McClanahan et al. 2009).

Co-management, also referred to as community-based fisheries management (CBFM), is considered to be the bottom-up approach best suited to SSF (Jentoft and Chuenpagdee 2015; Sutton and Rudd 2015). As a form of co-governance, CBFM is dependent on the cooperation and sharing of responsibility and power among governing institutions as well as interactive communication and learning among stakeholders (Jentoft and Chuenpagdee 2009; Jentoft and Chuenpagdee 2015). By providing opportunity for government institutions to collaborate with communities of fishers in order to protect natural resources, CBFM allows resource users (who have the local knowledge on ecological and environmental change derived and continually updated through everyday lived experiences) to influence rules and/or create social incentives for responsible behaviour in fishing (Anuchiracheeva et al. 2003; Jentoft and Chuenpagdee 2009; McConney and Charles 2010; FAO 2014). Active participation of community-based groups in the management process is important because it ensures a deeper understanding of the diagnosis and remedy of problems within SSF; it also creates a greater sense of ownership and thus increases legitimacy around rules and regulations among fishers (Andrew et al. 2007; Sutton and Rudd 2015). When local SSF management is not seen as legitimate by resource users it cannot be effective (Kosamu 2015) as became evident when the Department of Fisheries (DoF) tried to implement a fishing rights system in the province of Prachuap Khiri Khan in 1995 (Anuchiracheeva et al., 2003). The concept of fishing rights, which was new to the communities, was not fully explained at the onset of the project and the title – 'fishing in front of the village' - did not capture the social/cultural norms (whereby fishing grounds of villages often overlap). Thus, feeling that such a program would limit their access to important fishing grounds, the target group of fishers stood in opposition, and as a result the program did not move forward. CBFM could reduce such misunderstandings by allowing policy and practices to be more context specific and in harmony with local perceptions (Armitage & Marschke, 2013).

Upon recognizing the benefits of allowing community-based groups to be at the heart of the management process, many governments began decentralizing power over natural resource management (Klain, Beveridge, and Bennett 2014; Sutton and Rudd 2015). In Thailand, this process of decentralization came in 1992 when the Constitution ceded power to local-level institutions such as the Tambon Administrative

Organization (TAO) (Nasuchon and Charles 2010). However, as Anuchiracheeva et al. (2003) found during their research in the Bang Saphan Bay District of Prachuap Khiri Khan, this shift in responsibility did not devolve power to the lowest level and, as a result, fisher groups are not always seen as legitimate. This is cause for concern given that provincial, district, or sub-district level institutions sometimes lack the necessary resources (financial and human) to be effective (Tan-Mullins 2007; McClanahan et al. 2009; Jentoft and Chuenpagdee 2015) (Tan-Mullins, 2007; McClanahan 2009; Jentoft and Chuenpagdee 2015). In situations where capital is scarce it has been argued that it may be easier for local groups to have the power to: identify fishers and then limit entry to newcomers; demarcate no-fish zones; or, put in place seasonal closed areas (McClanahan et al. 2009). These local groups might also seek to identify appropriate, sustainable, fishing methods and attempt to ban certain types of gear; for example, bottom trawls could be prohibited as they are considered more destructive than upper or mid-water trawls (Salayo et al. 2008). To enforce these rules, groups will often create social stigma against individuals who break them (Jones 2009).

3.5 Understanding SFF as SES

SSF are increasingly conceptualized as SES due to the dynamic and complex relationship that exists between the social and the ecological systems (Berkes 2010; Basurto, Gelcich, and Ostrom 2013; Binder et al. 2013; Partelow 2015). These two systems – the social and ecological – are inextricably linked: human activity (e.g. harvesting) has a direct impact on nature (e.g. drawing down the stock of fish), and all the while nature (e.g. depleted stock) is impacting human activity (e.g. conservation efforts). For this reason, in order to understand SES like SSF one must have comprehensive knowledge of the social-institutional context, ecological dynamics, and potential external drivers (Partelow 2015). A number of frameworks have been designed with this purpose in mind; each having its strengths and weaknesses in terms of considered content and structure (see Binder et al. 2013 for a comparison of ten frameworks).

Ostrom's general framework for analyzing sustainability of SES (2009) is one framework that has been used to examine common-pool resources like forests, pastures, and fisheries. It provides a common language for exploring SES by establishing a set of variables, from which a subset of components can be chosen in order to analyze a particular case (Hinkel et al. 2015). What differentiates this framework from others is that it 'provides the option to treat the social and ecological systems in almost equal depth' (Binder et al. 2013). This balance is important given that the relationship between these two systems is often overlooked. Alternative frameworks either take a purely anthropogenic perspective, whereby the 'ecological system is seen only as provider of services that increase human well-being' and the social system is conceptualized by 'considering the macro to micro relationship' but not the interaction between (e.g. Sustainable Livelihoods Approach), or a purely ecocentric perspective, whereby the ecological system is examined irrespective of its utility for humans and the social system is conceptualized only at a macro level (e.g. Ecosystem Services framework) (Binder et al. 2013, 8). Ostrom's framework is unique in that it pays close attention to the interconnectedness and feedback loops between these two systems and allows for a micro and macro level analysis of the system in question through its multi-tiered approach (Binder et al. 2013; Cinner et al. 2013).

3.6 Summary

Research on SSF in SEA might not be a new phenomenon, but there remains a number of knowledge gaps (Kolding and Zweiten 2011; Ruddle 2014). While researchers have focused on the ecological and social aspects of SSF, as well as the various forms of governance and management schemes in place to protect the system as a whole, few have adopted the SES framework to examine change within the ecological system and study under what conditions the users of the resource develop rules for a sustainable management of the resource (Binder et al. 2013).

5. METHODS

5.1 Study Site

This study was conducted in the village (or *ban*) of Khan Kradai, in Prachuap Khiri Khan province, Thailand. Centrally located, the province of Prachuap Khiri Khan stretches approximately two hundred kilometres between the Gulf of Thailand (on the east) and the country of Myanmar (on the west), and at its narrowest point is only thirteen kilometres wide[1]. The province is comprised of eight districts, which are further divided into forty-eight sub-districts and three-hundred and eighty-eight villages – Khan Kradai is one of these villages, located in the sub-district of Ao Noi.

5.2 Data Collection

Data for this study were collected by way of key informant interviews, focus groups, and participant observation over a four-month period (June - September 2015) (Table 1). Face-to-face, semi-structured key informant interviews (*n*=30) were conducted with fishers (*n*=26), local middlepersons (*n*=2), and local government officials (*n*=2). Key informant interviews with fishers focused on three key areas: history of use; target species, fishing effort and market access; as well as, local management and governance systems. Towards the end of each interview, participants were also asked to provide an oral history detailing ecological, technological and governance changes within the SSF over their lifetime. Two different focus groups, concentrating on two areas of interest -- ecological change and local governance systems, were also conducted with five to seven fishers or two fishers. Each focus group, which included participatory rural appraisal activities, was run twice: once with each of the community-based fisher groups operating in the area so as not to cause conflict between the groups. The focus group on ecological change sought to: identify the resource system by having participants map out spatial boundaries and discuss the clarity of these boundaries; determine the (targeted) resource units, the approximate number of units, the economic value, and the seasonal/temporal distribution via a seasonal calendar and ranking activity; and, identify variations over time through a transect activity in which participants graphed perceived changes (in species, abundance, technology, governance, etc.) over time. The objectives of the focus group on governance systems were to unpack the history and structure of each community-based organization, and identify other actors engaged in the management or governance process and determine their influence through a stakeholder activity. Participant observation consisted of: accompanying fishers on day trips to haul fishing gear; working with the community and local Fisherfolk Shop to process and package local species caught; travelling with fishers to meetings and protests in provincial capital, neighboring villages, and Bangkok. Weekends were also spent teaching English to the children in the community.

Table 1: Qualitative research methods

Description of method	Timeframe
Key informant interviews (*n*=30)	June 2015 – September 2015
Focus groups (*n*=4)	August – September 2015
Participant observation	June 2015 – September 2015

[1] http://www.tourismthailand.org/About-Thailand/Destination/Prachuap-Khiri-Khan

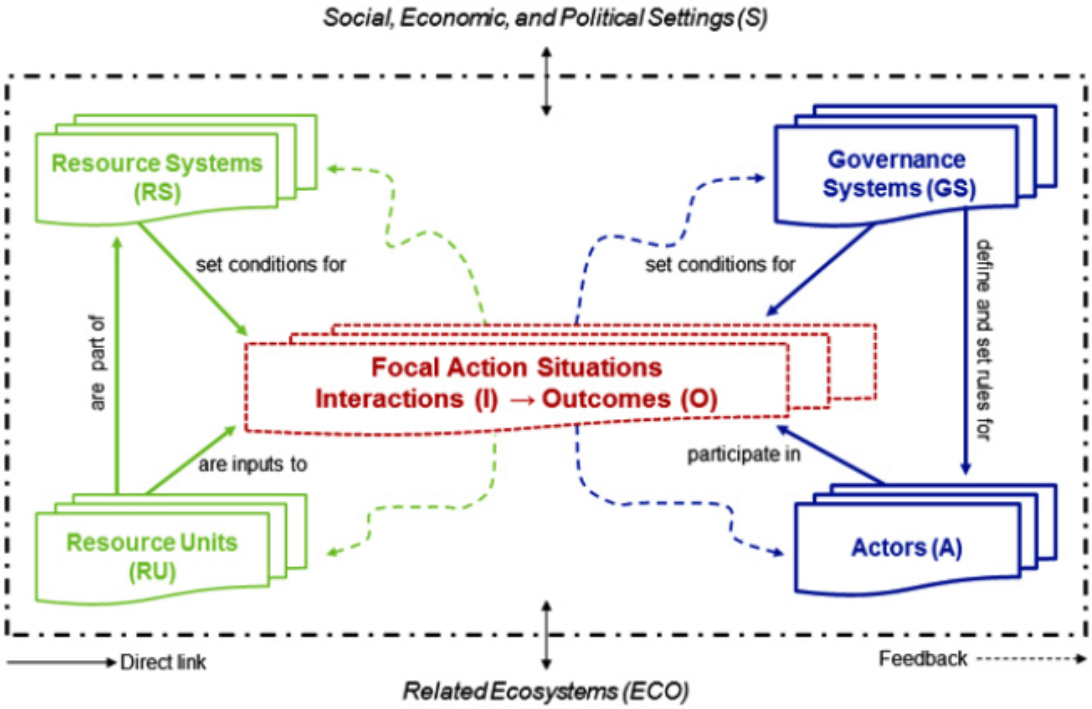
Key informant interview and focus group participants were recruited by way of convenience sampling and snowball sampling. Initial participants were identified by a Thai counterpart who had already established contacts in the village. These participants were then asked at the end of their interview if they could provide the names of one or two other fishers from the village, and this was continued over the course of the study. As much time was spent in the village, close rapport was established and participants were also identified and approached through mere daily interactions.

All data collected during key informant interviews were translated and transcribed in real-time, while data collected during focus groups were translated and transcribed immediately following the session so as not to disrupt the exchange of dialogue among participants. Transcribed data were then entered into NVivo 10 - a software program for qualitative analysis, and coded using a selection of variables from Ostrom's general framework for analyzing social-ecological systems (Figure 2 below).

5.3 Framework for analysis

As Figure 1 shows, Ostrom's framework begins by identifying four top-level variables that are common among all SES. These include: the resource systems, the resource units, actors and governance systems.

Figure 1: Ostrom's SES framework

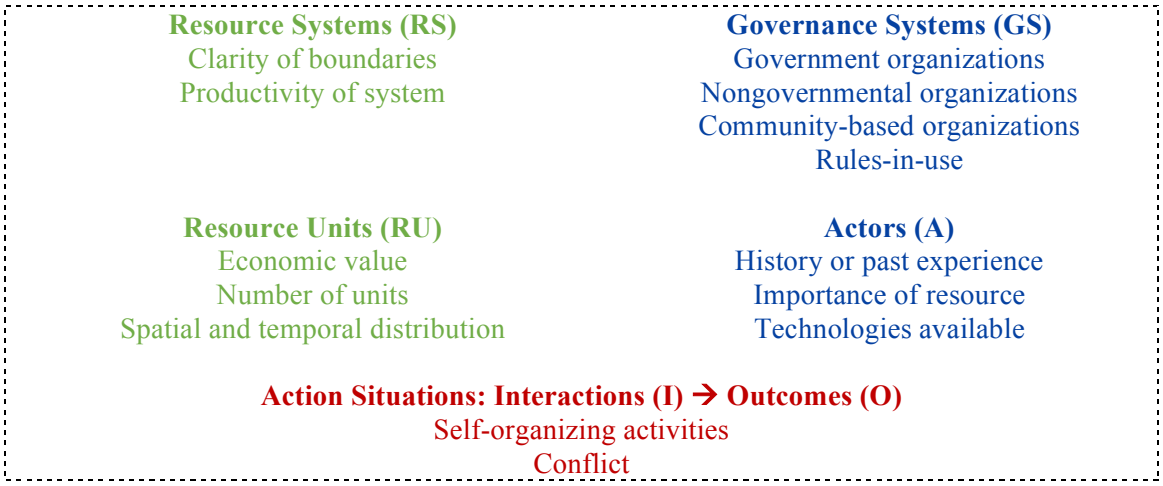


Source: McGinnis and Ostrom (2014)

Each of these four variables are then broken down into second-level variables, which can again be unpacked further to identify third-level, fourth-level or fifth-level variables. For example, governance systems can be broken down and analyzed according to property-rights systems, rules-in-use or rule-making organizations. These variables can then be unpacked in order to examine, for instance, whether the rule-making organizations are public sector, private sector, non-governmental, or community-based (McGinnis and Ostrom 2014). Variables are meant to be seen as part of the system as a whole and interpreted in accordance with their role in explaining outcomes (Hinkel et al. 2015). These outcomes, or "action situations" as they are referred to in the framework, effect the variables directly and indirectly

through feedback loops (depicted as dashed arrows in Figure 1). The SES framework also takes into account exogenous factors such as related ecosystems and/or the social, economic and political setting.

Figure 2: A selection of first- and second-level tier variables in Ostrom's SES framework



Source: Adapted from Cinner et al. (2013)

It should be noted, that Ostrom's original framework is not exhaustive and, therefore, not all lower-tiered variables are identified. Instead, as researchers continue to operationalize the framework they identify and test new concepts and ideas, which are then included in these modified versions of this framework (see Basurto, Gelcich, and Ostrom 2013; Cinner et al. 2013; McGinnis and Ostrom 2014; Delgado-Serrano and Ramos 2015).

6. RESULTS

Field data were analyzed using a subset of first and second-tier variables from Ostrom's general framework for analyzing social-ecological systems (Figure 2). The following section presents the results of this analysis beginning with the **resource system** (i.e. the small-scale fishery sector), which is explored using the second-level variables **clarity of boundaries** and **productivity of system**. It then moves to discuss the **resource units** (i.e. those species harvested by small-scale fishers) according to the **number of units**, **spatial/temporal distribution**, and **economic value**. Once the ecological system has been examined, the section then turns toward the social system beginning with the **actors** operating within in this system (i.e. local and non-local fishers). These resource users are examined using the variables: **history or past experiences**, **importance of resource**, and **technologies available.** Following this discussion, the local **governance systems** are explored through **organizations (government, non-government and community-based)** and **rules-in-use**. The section concludes with a brief look at the **interactions and outcomes** – specifically **self-organizing activities** and **conflict**, before highlighting a few components of the **social, economic and political setting** in Thailand that effect SSF.

6.1. Resource system

6.1.1 Clarity of boundaries

As a common-pool resource, SSF in Thailand are known for difficult excludability (Ghorbani and Bravo 2016). This notion of non-exclusion, which is a result of fisheries being "open access" (anyone can enter into the sector at any time), makes identifying boundaries, or telling individuals where they are and are not allowed to operate, a challenge. While there are laws in place to limit the area where certain vessels can operate (e.g. large-scale trawlers and push netters are restricted from fishing in the national non-commercial fishing zone – within 3 kilometers from shore), for small-scale fishers there are no such boundaries. Many SSF tend to stay within 3 kilometers of shore due to limited capacity and their territory therefore remains relatively consistent through time (Lunn & Dearden, 2006). However, there are some who travel outside of the non-commercial fishing zone (beyond 5 miles) to target certain species (e.g. Indo-Pacific king mackerel) and catch fish of a suitable size (Jones et al. 2010).

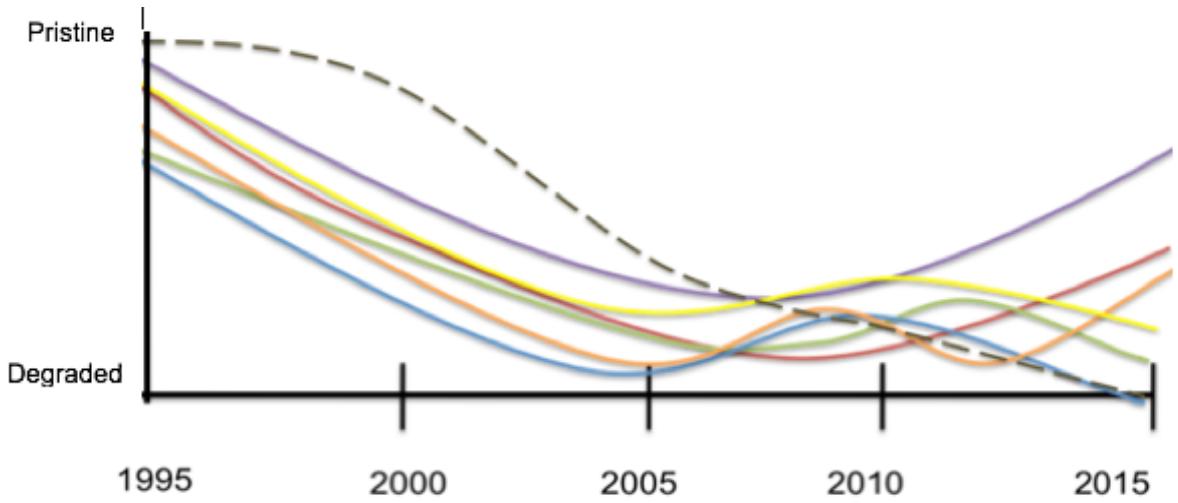
Fishers in Khan Kradai identified their resources' boundaries as extending 3.7 to 5 miles along the coast and 2 miles out to sea (n=2). Fishers make use of artificial reefs (a conservation project discussed in greater detail below) as boundary markers to identify this area. These reefs are said to "serve as a way of protecting the area from LSF and certain fishing practices, because the SSF can say that it is a conservation area" (001). For this reason, fishers replace the reefs in February during the closed season when "trawlers and purse seiners using gear with mesh size smaller than 4.7 cm are prohibited from fishing in the upper southern area of the Gulf of Thailand" and many outside fishers are said to try and move onto the grounds (FAO 2009). This boundary, which has been identified by fishers from the community, is not meant to exclude others from entering into the area (nor would it likely be successful in doing so); in fact, fishers from neighbouring villages often come to fish in Khan Kradai, especially when splendid squid come into the bay: there is said to be many boats and "a lot of competition" in the area (005). Instead, these boundaries are meant to assist in the monitoring and enforcement of community norms. Although, as one fisher noted, the area for artificial reefs is normally 3 miles out but because local fishers lack the means to protect such a large area they have set them out at 2 miles (009).

6.1.2 Productivity of system

It has been argued that 'using simple resource or ecological reference points or indicators' identified by tapping into traditional ecological knowledge can help us to better understand 'where the resource and ecosystem is along the use continuum from pristine to mature to degraded' (McClanahan et al. 2009,

43). With this in mind, fishers in Khan Kradai were asked during focus group sessions to identify and explain ecological reference points beginning in 1995 up until the current day in 2015. What participants in both focus groups identified was a significant change in the use continuum in terms of both volume and diversity of aquatic resources as well as ocean ecology in the past twenty years. As Figure 3 shows, fishers in Focus Group A perceived the resource have declined: slowly at first, with only a 10 percent drop from 1995-2000, and then at a much more rapid rate from 2000-2005. Individuals in Focus Group B also identified a downward trend but noted a much steadier decline over the 10-year period from 1995-2005.

Figure 3: Changes in productivity over past twenty years according to fishers



Focus group A (single dashed line reflects all participants' views)
Focus group B (each solid, colored line reflects the views of a single participant)

Source: Focus groups (September 2015)

Despite the differences in rate of decline, there was general agreement between the two focus groups: compared to 1995 levels, by 2005 there was as little as 10-20 percent of the resource remaining. In addition to much lower catch volumes of targeted species like short-bodied mackerel (*rastrelliger brachysoma*), goldstripe sardinella (*sardinella gibbosa*) and splendid squid (*loligo formosana*), focus group participants also reported a number of species that "disappeared" during this ten-year period from 1995-2005. These species include: scalloped hammerhead shark (*sphyrna lewini*), white spotted guitarfish (*rhynchobatus australiae)*, milkfish (c*hanos chanos)*, longfin bannerfish (*heniochus acuminatus),* spiny seahorse (*hippocampus histrix)*, Hawksbill turtles (*eretmochelys imbricata),* sea cucumber (*holothuroidea*), and sea anemone (*actiniaria*). In explaining the disappearance of these species, fishers in both focus groups noted how in the past, hawksbill turtles would come to lay their eggs on the shores of Khan Kradai, but since 2005 they no longer see them doing so. One fisher suggested that the changing shoreline due to weathering and coastal erosion could be partially to blame for this. Fishers also went on to explain the disappearance of sea cucumber, which they claimed were once plentiful at the bottom of the mountain, as having occurred at the same time as the sea anemone, sometime in the late 1990s. The reason for the loss of these species could not be fully explained by Focus Group A, although they suggested that the species might have been caught in fishers' nets as the number of operators and gear used in the area increased; on the other hand, Focus Group B on the other hand, attributed the loss to increased demand for sea cucumber from China and the high price (800 Baht/kilo) at which they could be sold. This theory was confirmed during a key informant interview where the participant also spoke of demand from Chinese markets and the high price offered, adding that these market factors attracted people from other villages to come and harvest the resource (024).

Along with these perceived declines in resources during the period from 1995-2005, focus group participants also spoke of changes to the ecosystem itself, notably the near disappearance of sea grass. In Thailand these aquatic plant species are crucially important ecosystems as they provide nursery habitats as well as feeding grounds for some 149 fish species (EJF 2015). Their disappearance therefore, might also explain the perceived loss of sea turtles and other species that would depend on these beds. One focus group claimed that before the motorization of fishing boats in 1995 there was much sea grass in the bay; however, after only two years, there remained only two small patches. Fishers believed that pollution in the water (from hotels and factories) was also to blame for this disappearance, in addition to the sea grass getting caught in boat engines. What is interesting to note is that the other focus group said they had never seen sea grass in the bay in the past, and only began to see the two to three patches (referred to above) in 2012-2013; a sign that their conservation efforts (described below) are working to improve the ecosystem.

With few resources left in the area in 2005, focus group participants spoke of how fishers began to leave the area in search of fish elsewhere: Bang Saphan (some 90 kilometres away) was one of the areas fishers migrated to. Upon fishers' return to Khan Kradai, and following the implementation of conservation projects (discussed below) in 2008, fishers in Focus Group B argued the resource began to rebound. They claimed that the amount of resources went from near zero in 2005 to 20 percent in 2009 and 40-50 percent in 2010 with there being a "very good number of fish" by 2012. One individual argued that between 2010 and 2012 there was a 70-80 percent return of resources, though there was much disagreement over this: other participants argued this could not be true because they were looking for alternative work in Bangkok at the time. Presently, fishers still believe marine capture fisheries in Khan Kradai to be in trouble and when asked whether or not they think it will recover in the future they were only mildly optimistic. Focus Group A claimed that the revised Fisheries Act may be able to help with the restoration of stocks, whereas Focus Group B believed that a change in the mentality of fishers would be the determining factor: one participant noting how he "thinks in the future the resource will get better because, unlike the past when fishers would just catch the fish and not care for the environment, they are now focused on conservation".

In explaining perceived reasons for change (Table 2), many fishers acknowledged that SSF have played a role in the degradation of local ocean ecology and fisheries, although the degree of destruction from SSF was argued to be less than that of LSF; the LSF use of otter trawls and the targeting of anchovy are seen as especially damaging.

Table 2: Individual fishers' perceived reasons for change

Participant	Reflection
015	"There are no scaly whipray this year because of a problem with the bottom of sea and because gill nets used to catch herring have a mesh size of 2.9cm and this is small. The government needs to stop the LSF from catching anchovy and otter trawling"
018	"There are more SSF boats now and so there has been an impact on resources because more fishers. More boats means you must share the splendid squid and so there is not a lot, and when there are a lot of boats fishing the squid cannot have babies"
019	"The water is not good, it is polluted from otter trawling because when these boat fish near the shore the mud from the ground of the sea comes in the water"

021	"Resources declined not only because of the LSF, we the SSF destroyed it too…the amount of how much destroyed is less than LSF though"
023	"Only the local boats in here before but now there are a lot of boats that come fish here from other villages"
024	"The top and middle only have a few resources and so people are starting to fish the ground of the sea"
025	"Resource has declined because there are more LSF now…they catch baby fish and so they can't grow up for me to catch"
030	"No fish because the water is hot"

Source: Key informant interviews (June – September 2015)

6.2 Resource units

6.2.1 Species targeted

Among the most common species reportedly targeted by SSF in Thailand are those belonging to the families Carangidae and Scombridae, Lethrinidae, Lutjanidae and Serranidae (Jones et al, 2010). These families include the jacks and scads, mackerels, breams, snappers, and groupers, respectively. Many SSF operate in more than one - sometimes upward to four - fisheries throughout the year and are known to catch a 'high diversity of "non-target" species' as bycatch (Barbier 2003; Lunn and Dearden 2006a; McClanahan 2009).

Fishers in Khan Kradai operate in up to seven different fisheries (Table 3). Those fishers who focus on just one or two fisheries were found to target either splendid squid (n=6), blue swimming crab (n=1), or both (n=4): the exception being one fisher who targets short-bodied mackerel and goldstripe sardinella. Splendid squid is the most commonly targeted species in Khan Kradai, with half of the participants operating in this fishery. According to one participant, the squid fishery is attractive to local fishers and to individuals who are considering making SSF their livelihood because it is "easy and comfortable": it requires no additional labor and therefore has a reduced overhead cost and fishers can decide when they want to go out and come back in (024). After splendid squid, short-bodied mackerel, goldstripe sardinella, blue swimming crab, Indo-Pacific king mackerel and banana shrimp were among the top species targeted by fishers in Khan Kradai. However, as Table 3 shows, some participants target more unique species such as black pomfret, dollfus octopus, and scaly whipray. While only one fisher spoke of harvesting green mussels, participant observation confirmed that there are in fact a number of fishers engaging in this activity.

Table 3: Targeted species & bycatch

Targeted species	Scientific name	# of fishers operating in fishery	Bycatch

Banana shrimp	*Penaeus merguiensis*	6	barracuda, blue spotted sea urchin, blue swimming crab, common knobby spindle shell, common ponyfish, fivespot herring, flathead lobster, fourfinger threadfin, goldstripe sardinella, largescale tongue sole, leatherfinned yellow jacket, long-finger fiddler crab, mantis shrimp, rainbow cuttlefish, scaly whipray, short-bodied mackerel, sift cuttlefish, splendid squid, striped sea catfish, tiger-toothed croaker
Black pomfret	Parastromateus niger	1	Information not available (N/A)
Blue swimming crab	*Portunus pelagicus*	11	banded whip-tail stingray, blue spotted sea urchin, brick-red box crab, Chinese-silver pomfret, comb pen shell, common knobby spindle shell, flathead lobster, fourfinger threadfin, grey large-eye bream, largescale tongue sole, lined silver grunt, musk crab, oriental flathead lobster, painted sweetlip, rainbow cuttlefish; scaly whipray, serrated mud crab, sharptooth snapper, short-bodied mackerel, silver pomfret, silver sillago, spider crab, squid egg, stout-spine murex, three-spot swimming crab, triangular-tail, horseshoe crab
Bracyuran crab	Lupocyclus Sanguinolentus	1	N/A
Dollfus octopus	*Octopus dollfusi*	1	N/A
Four-finger threadfin	*tetradactylum*	1	N/A
Goldstripe sardinella	*Sarinella gibbosa*	13	fivespot herring, gizzard shad, oxeye herring, silver sillago
Green mussel	Perna viridis	1	N/A
Indo-Pacific king mackerel	*Scomberomorus guttatus*	7	barracuda, dolphin fish, emperor red snapper, giant seaperch, grouper, Indo-Pacific sailfish, Jenkin's whipray, Russell's snapper, scaly whipray, spottail shark
Reeves croaker	Chrysochir aureus	1	N/A
Scaly whipray	*Himantura imbricatus*	2	N/A

Short-bodied mackerel	*Rastrelliger brachysoma*	14	banana shrimp, barebreast jack, barracuda, barred garfish, black-spot long toes, blue swimming crab, cockatoo righteye flounder, crescent perch, fourfinger threadfin, goldenstripped sardinella, Indo-Pacific king mackerel, largehead hairtail, largescale tongue sole, mullet, ornate threadfin bream, painted sweetlips, red cornetfish, Reeve's croaker, roundbelly sardinella, silver sillago, starry emperor, tiger-toothed croaker, toli shad, wolfherring, yellow-strip scad
Silver sillago	Sillago sihama	1	N/A
Splendid squid	*Loligo formosana*	18	blacktail tripodfish, cockatoo righteye flounder, fivespot herring, goldstripe sardinella, largehead hairtail, moonfish, oriental-sole, rainbow cuttlefish, sift cuttlefish, toothed ponyfish, wolf-herring
Spotted sardinella	Amblygaster sirm	1	N/A
Three-spot swimming crab	Portunus sanguinolentus	1	N/A
Tiger-toothed croaker	*Otolithes ruber*	1	N/A
White pomfret	Pampus argenteus	2	N/A

Source: Key informant interviews and focus groups (June – September 2015)

Although fishers in Khan Kradai set out to target the above mentioned species, their catch often contains an array of non-target species — or bycatch. The type of bycatch reported by fishers depends on the species targeted and gear used, although common non-target species include snappers, croakers, herrings, sweetlips, jacks and shads.

6.2.2 Number of units

The amount of aquatic species caught by SSF varies from day to day and has much to do with the biological parameters of the species targeted (e.g. population dynamics and predation) and the technical interactions of harvesters (e.g. the amount of bycatch and degree of competition among users) (Murawski 2000).

In Khan Kradai, average daily catch of the seven main targeted species was found to range between 5-10 kilograms for species like banana shrimp or blue swimming crab and 300-500 kilograms for goldstripe sardinella (Table 4). However, fishers reported catches on some days to be as little as 2-3 kilos for species like splendid squid and as much as 1500 kilograms for short-bodied mackerel: these larger amounts were said to be caught no more than 10 times a year.

Table 4: Average catch of main targeted species

Species	Average catch (kg/boat/trip)	Bycatch (percentage of catch)
Banana shrimp	5-10 (n=3)	20-30 % (up to 80%)
Blue swimming crab	5-10 (n=7)	10% (up to 50% if windy)
Dollfus octopus	40-50 (n=1)	N/A
Goldstripe sardinella	300-500 (n=11)	10%
Indo-Pacific king mackerel	10-30 (n=5)	1-10 %
Short-bodied mackerel	100-300 (n=10)	10-40 %
Splendid squid	10-20 (n=14)	1-10 %

Source: Key informant interviews and focus groups (June – September 2015)

According to fishers, the percentage of daily catch that is made up of non-targeted species varies depending on the species targeted and the weather. Bycatch from banana shrimp, for instance, was reported to be the highest of all targeted species; one focus group claimed it makes up 20-30 percent of the catch and the other suggested it was closer to 80 percent. Bycatch from short-bodied mackerel was also found to be significant: at 40% according to one focus group. Gear used to target goldstripe sardinella and blue swimming crab caught a number of non-target species as well (approximately 10 percent of total catch); when it is windy, this percentage for blue swimming crab increases to as much as 50 percent. Bycatch from the fishing of Indo-Pacific king mackerel and splendid squid was reported to be the least significant compared to all other targeted species comprising as little as 1-10 percent of catch.

6.2.1 Temporal and spatial distribution

Species richness and abundance within SSF are also determined by temporal distribution (at seasonal, annual, or decadal scales) and spatial processes such as geographical range and catchability (Murawski 2000). In Thailand, for instance, the wet season has been found to correspond with greater species richness and abundance when compared to the dry season (Ikejima et al. 2003).

In Khan Kradai, participants operate in many fisheries throughout the entire year but identify certain months – or seasons – as being better (in terms of catchability) than others for certain types of species (Table 5). Individuals operating in the splendid squid fishery, for instance, identified September through November as the best months of the year to target this particular species; although August and December were also considered to be good months. According to fishers, what makes these times of year ideal for fishing splendid squid is that it is prior to monsoon season and therefore the water is clear due to lack of

waves. Short-bodied mackerel was reported to have two distinct seasons: one season before the "*Lom Wow"* winds (which blow from North to South) in September and October and one season after these winds from January to March. According to fishers, during these times of year the heavy rains bring fish from the Northern part of the Gulf. Indo-Pacific king mackerel similarly have two seasons – September through November and February through April. Blue swimming crab were said to be most abundant during the monsoons, as were banana shrimp: the best times of year for these species being October to January and November to January (although February to June were also considered to be good times), respectively. For banana shrimp, fishers claimed the reason these times are the best is because the species prefer rough waters: Northeast winds blow in November and December, Southeast winds blow from January to March, and then in April and June the winds blow offshore.

Table 5: Seasonality for main targeted species according to fishers

Species	Seasonal
Banana shrimp	November – January
Blue swimming crab	October – January
Goldstripe sardinella	September – November
Indo-Pacific king mackerel	September – November
Short-bodied mackerel	January – March, September – October
Splendid squid	September – November

Note: Monsoon season: October – December; Dry season March – June; Wet season September – December

Source: Key informant interviews (June – September 2015)

6.2.2 Economic value

The economic value of marine capture fisheries is known to influence fishers' choice of targeted species: 'when resources of economic importance are reduced in abundance by overfishing' for instance and 'there are other more abundance stocks available' fishers have the tendency to switch targeted species (Murawski 2000). Resources of economic importance, in this case, are most often defined by their commercial value. However, in assessing the economic value of a species local fishers also take into consideration the catchability or abundance of the targeted species. Within SSF, resources of economic importance have been found to include shrimps, demersal fish, rays, crabs and other invertebrates (Weigel et al. 2015).

In Khan Kradai, fishers identified short-bodied mackerel, goldstripe sardinella and blue swimming crab as the most valuable targeted species; banana shrimp and Indo-Pacific king mackerel were also found to be economically important. Fishers explained that the reason why short-bodied mackerel and goldstripe sardinella are considered the most valuable, despite the low price paid by local middlepersons (on average 40 and 8 THB per kilogram [1.20 and 0.24 USD] respectively), is because they are able to catch greater volumes of these species. This compares to the reasoning behind fishers' choice to list Indo-Pacific king mackerel as economically valuable, in which case it was not a matter of catch (which is low) but rather of the high price paid (on average 190 THB per kilogram [5.70 USD]). Despite the number of fishers operating in the splendid squid fishery, few consider splendid squid to be of great economic value due to high capital costs and a high degree of competition. While the price for splendid squid is relatively high (115 THB per kilogram [3.45 USD]), fishers noted that catches are low and the season is short – only two to three months long. Even those who considered squid to be among the most valuable species mentioned that the season is short, capital is more expensive, and you must book a spot/compete against other fishers. Fishers will consider these economic factors before deciding which

species they will set out from shore to target. As an example, one fisher told of how income earned over a 15-day period could be as much as 100,000 THB [3000 USD] if he was targeting short-bodied mackerel, whereas, in the same period, this one fisher targeting banana shrimp instead might make only 30,000 THB [900 USD], or worse just 7,000 THB [210 USD] if targeting another species like Indo-Pacific king mackerel.

According to fishers, the economic value of bycatch is low and therefore non-target species are often kept for food rather than sold to local middlepersons. Markets for bycatch do exist, however, and in cases where non-target species are sold they are first separated out from the main catch. These markets do not have a direct influence on fishers' choice of targeted species, but they do determine whether bycatch is kept or returned to the sea. To take a case in point, one fisher explained that in the past there was no market for mantis shrimp (bycatch from banana shrimp) and so he would throw it back over, but three years ago there started to be demand from consumers and now he gets 30 THB per kilogram [1.00 USD] for this species.

6.3 Actors

6.3.1 History of use or past experience

SSF have long been a way of life for people living in the village of Khan Kradai. The majority of participants (n=24) claimed to have started fishing at a very young age (between seven and seventeen years old). As participants ranged in age from 31-65 this means that a number of them have between ten and thirty years of experience on the water, the exception being those few (n=4) who only took up this livelihood three to six years ago. Many fishers started locally with their immediate family or relatives (n=12) whereas others worked in the short-haul LSF in Southern Thailand (n=10). Others came to work in SSF because they wanted a change of occupation (n=3) or in one case because there were no other occupations available to them.

Fishers' experience working within the LSF, and reasons for returning to SSF, varied from participant to participant (Table 6). Common factors pushing fishers out of the LSF however, included: having to be away from family, the (hard) nature of work, unfair pay, an influx of foreign labor, and a general lack of freedom. Two participants told of how they saved money earned while working in the LSF in order to come back and invest in a small boat of their own.

Table 6: Individual fishers' reflections on experience in the LSF

Respondent	Reflection
Participant 017	"When fishing with the LSF I had to work as an employee – just got the money, no time to relax. With the SSF it is my own business"
Participant 021	"My pay was up to the amount of fish caught and it would be more than 20 days before getting paid…there was a lot of fish at the time and the ownership got a lot but workers only a little. In SSF to make money it is up to myself – whether I am lazy or not."
Participant 024	"When [the foreign laborers] wanted to stop work or do anything, they could because the group was bigger."
Participant 027	"The system in the LSF is not fair because the little money for the labor in the boat must be share but the head man of the boat…gets a lot of money."

Participant 030	"I left because it was hard work and the salary was only a little compared to the owner of the boat."

Source: Key informant interviews (June – September 2015)

6.3.2 Importance of resources

The importance of SSF extends beyond the above mentioned cultural and generational components to also include economic functions. For the people of Khan Kradai, economic dependence on SSF stems from the fact that, for nearly all participants (n=25), it is their only means of livelihood; the exception being one individual, for whom SSF is a secondary occupation/leisure activity. According to fishers, the time and effort required to tend to fishing gear does not allow for a secondary occupation to be taken up, especially when operating in more than one fishery. Moreover, they consider themselves knowledgeable in this one area of work, and feel as though they do not have the skills necessary to succeed in another occupation. Even if fishers have the expertise to move into alternative livelihoods, many still lack the necessary capital (e.g. land for agriculture). Fishers admitted to trying other occupations (e.g. motorcycle driver, factory or construction worker) before taking up fishing as a livelihood: some were employed (part-time or full-time) in the agricultural sector for instance, and as in Thai tradition were also enlisted in the military for a two-year term at the age of twenty. What drew many of these individuals to - or back into - SSF was the ability to "get money fast": as one fisher explained, in agriculture you must work all year and you only get money one time, but when fishing you can make money every 15 days (023). SSF is also an occupation where individuals can be nearer to their family, and are free to decide for themselves the extent to which they want to work.

6.3.3 Technologies available

Through participant observation it was determined that there are approximately 80 boats operating out of Khan Kradai, but far fewer fishers. According to key informant interviews, the reason for this is that while the majority of fishers in Khan Kradai own just one boat (n=22), there are some fishers who own two (n=2), three (n=1) or even five (n=1) boats. As one fisher explained, the purpose of having multiple boats is so that each can be equipped with a different set of gear, that way a fisher is always prepared to target a number of different species and there is no need to come ashore and spend time switching gear. The average size of these boats is 8 meters in length and 3 meters in width; some are as small as 4.5 meters by 1.5 meters and as large as 10 meters by 3 meters. Each boat is motorized by an engine between 9 and 90 horsepower (HP) and almost half (n=11) are equipped with a small 5HP diesel hauler. Fishers using boats with an engine power of 20 HP or less were found to target just one (n=8) or two (n=4) species, whereas those using a boat with an engine greater than 20HP target multiple species. Some fishers have a sounder (n=7) and/or GPS (n=10) to assist them in their fishing activities; those who do not make use of these technologies often do not travel far from shore (i.e. no further than 3 miles) to target species. While a number of fishers hire one (n=7), two (n=5), three (n=2), or four (n=1) persons to labor on the boat, (n=9) do not hire additional labor to help with the tasks at hand. If these laborers are not spouses and/or family members, they are certainly persons from within the community.

As suggested above, SSF in Khan Kradai make use of a variety of gear types. The main gear used by fishers includes: bottom-gill nets with 10 centimeters and 4.5 centimeters mesh to catch blue swimming crab and short-bodied mackerel, respectively; floating gill nets with 4.5 centimeters and 2.9 centimeters mesh to catch short-bodied mackerel and goldstripe sardinella, respectively; trammel nets with an outer mesh of 10 centimeters and inner mesh of 4.5 centimeters to catch banana shrimp; hook and line to catch Indo-Pacific king mackerel; hand jigs as well as cast nets to catch splendid squid; and, long strings of gastropod shells (approximately 3000-4000 shells, each separated by two meters of rope) to trap dollfus octopus. According to fishers, the gear used to target Indo-Pacific king mackerel and dollfus octopus are

new to the village; presently only one fisher makes use of the latter gear, which is said to have originated in Vietnam and was then adopted in Thailand's Trat province.

According to fishers, in the past there were only 5 to 10 boats operating in Khan Kradai. These boats were said to have had little capacity: they were not motorized and were not equipped with a hauler or other electronics. Gear used by SSF also differed, with those in the splendid squid fishery for example, having used lamps in place of lights which are used nowadays. Fishers also made use of a single gill net with 1.7 – 2 centimeter mesh that could be function as a floating gill net or bottom net gill net.

6.4 Governance systems

6.4.1 Organizations

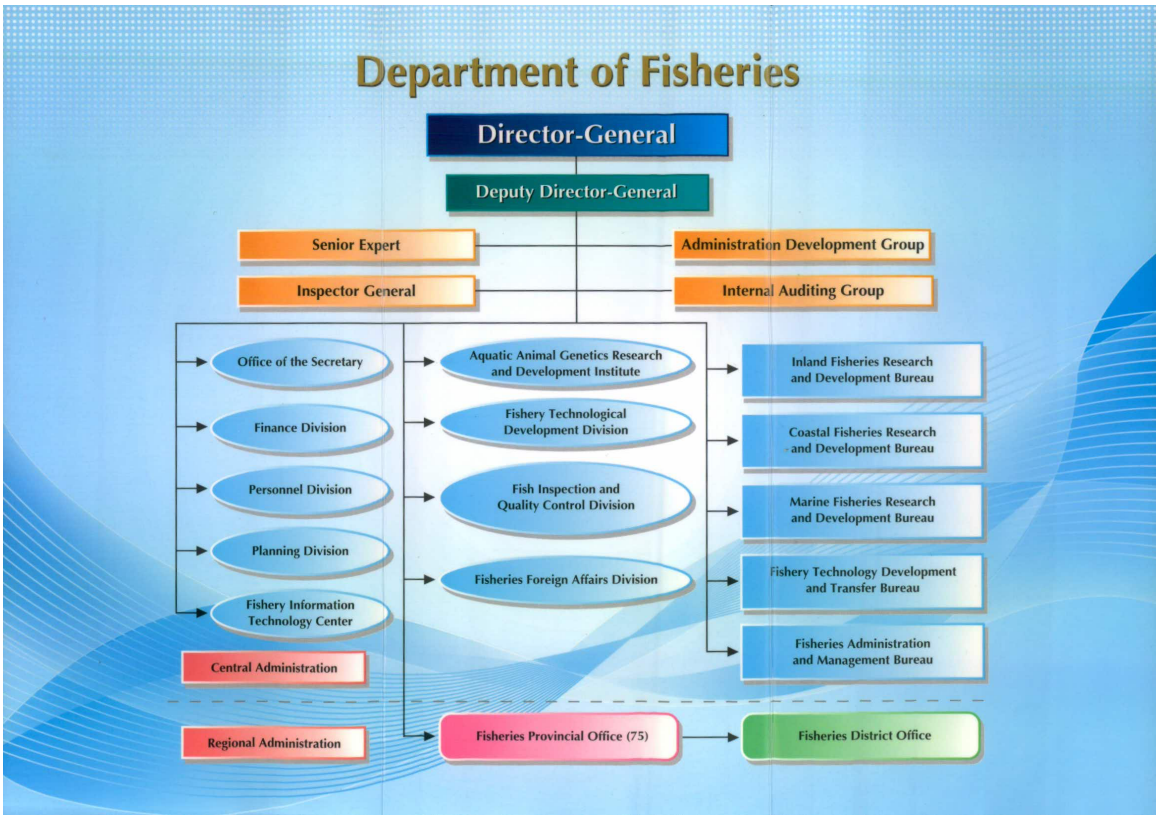
6.4.1.1 Government organizations

There are three sectoral ministries responsible for fisheries management in Thailand: the Ministry of Agriculture and Cooperatives' Department of Fisheries, the Ministry of the Interior, and the Ministry of Natural Resources' Department of Coastal and Marine Resources (Tan-Mullins, 2007). Since the government's move to decentralize power in 1995, however, the responsibility of these ministries – at least the implementing of policies and plans -- has fallen into the hands of provincial offices. The decentralization of authority also positioned district and village level government organizations, such as the Tambon Administrative Organization (TAO) and village head in a steward position (Tan-Mullins 2007). The following section explores the roles and responsibilities of some of these institutions, considers how they are received by local fishers, and identifies some of the challenges they face.

<u>Department of Fisheries</u>

According to an interview with a high-ranking DoF officer in Prachuap Khiri Khan, when it comes to addressing issues within SSF the authority of provincial-level officers is derived directly from Thailand's Fisheries Act (1947). At the time of this research the roles and responsibilities of the provincial DoF were undergoing change due to the fact that revisions were being made to the Fisheries Act (1947) following the European Union's issuance of a yellow card (discussed below). That said, as Figure 4 shows, even if changes come to the Fisheries Act (1947), power is clearly concentrated at the national level in the hands of the Director-General. As a result, provincial officers only have the authority to make provincial notices that are then passed on to Cabinet for approval: they do not themselves have the power to make rules and regulations such as the banning of certain types of equipment.

Figure 4: Administrative structure for Department of Fisheries, Thailand



Source: Department of Fisheries Thailand (2015)

When it comes to fulfilling its responsibilities, and exercising what power it does have, one of the greatest challenges facing the provincial DoF is inadequate funding. According to the officer interviewed, the costs of monitoring the ocean (e.g. petro and maintenance of patrol boats), given its size, are too great; the financial support is just not there despite the fact that these costs have been highlighted in numerous proposed budgets submitted to the government. A second challenge identified was conflict between community groups, or within them, which is said to make the job of the DoF more difficult. It was the opinion of this one officer that community organizations should be created so that knowledge about conservation and the importance of ecological health can be passed among fishers. He believes, however, that sometimes these community organizations do not themselves follow the rules and regulations; noting how "if [fishers] want to point the finger at someone else then they must also point [it] back at themselves".

Fishers in Khan Kradai mainly interact with district officials, who are found at the lowest level of the DoF administrative hierarchy, and spoke of the DoF with mixed emotions. On the one hand, there were those who criticize the DoF claiming that officers only come to provide fishers with knowledge on the registration of boats and proper licensing (n=2), and that they lack general knowledge of SSF (n=4). It was argued that the DoF fail to enforce rules – notably the closed season for LSF referred to earlier (n=2); it was even said that some officers within the DoF are corrupt (n=2). Some individuals were also angered by the fact that the DoF did not provide the financial support identified in a letter from the government: a budget of 700,000 THB [21,000 USD] was never received. On the other hand, there are those who speak of the DoF in a more positive way, claiming that officers help provide knowledge: taking fishers to other villages to learn about conservation and eco-tourism ventures and to seminars aimed at educating fishers on taking care of species. These fishers also witnessed DoF officers verifying

the size of species caught and checking boats reported to be using illegal gear. One fisher noted how the DoF provides financial support for conservation activities, giving the example of the artificial reef.

Tambon Administrative Organization

In Thailand, the sub-district level government (also known as the Tambon Administrative Organization (TAO)) was created nearly two decades ago in 1997 in an attempt by the Thai government to decentralize powers in each of the provinces (Tan-Mullins, 2007). When it comes to SSF, part 2 section 23 of the Tambon Council and Tambon Administrative Act, B.E. 2537 (1994) bestows powers upon the TAO to "protect, look after and maintain natural resources and the environment". For this reason, it is believed that the TAO 'plays an important role in building successful community-based fisheries management initiatives' (Nasuchon and Charles 2010).

According to an interview with a representative of the TAO in the the sub-district of Ao Noi, which encompasses the village of Khan Kradai, management of SSF falls not under the jurisdiction of the TAO but under provincial and national entities – specifically, the Department of Fisheries. According to this one individual, the TAO is only tasked with providing a "public service, by giving knowledge on laws and regulations to people so as to ensure there is good governance"; it does not have the responsibility or capacity to provide adequate support for the SSF. That said, in the village of Khan Kradai the TAO is not completely free from influence as it has provided "a budget for activities that work to preserve and increase the health of the resources" for the last four years. It has also been responsible for providing financial support to unregistered boats that are damaged during the monsoon season (registered boats are dealt with by the DoF).

Village head

Village heads also plays an important role when it comes to SSF management given their position in the local sociopolitical structure (Tan-Mullins 2007). Considered to be the 'main bridge between the government and villagers', the village head is thought to be well-positioned to deal with fishery conflicts (Tan-Mullins 2007, 357).

In Khan Kradai, the village head is well received by fishers and said to be more accessible than the Chief Executive Officer of the TAO. Fishers claim they are able to personally phone the village head when an issue arises and he will respond by sending someone to deal with the situation. In cases where fishers from other villages try to break community rules for instance, the village head from Khan Kradai can reach out to these fishers' village head(s) in an attempt to resolve the conflict.

6.4.1.2 Non-governmental organizations

Non-governmental organizations also play an important role when it comes to SSF governance by providing advice, ideas, expertise, and technical assistance to fishers; helping to initiate community-based fisheries management; and providing funding to support already existing community-based groups (Sutton and Rudd 2015).

Thai Sea Watch Association

Thai Sea Watch Association (TSWA) is one non-governmental organization (NGO) that has been operating in the community of Khan Kradai since 2008. It is looked on favorably by fishers in the community as it has been instrumental in organizing community-based groups and helping identify and implement projects that aim to restore and conserve local resources. TSWA has also provided fishers with knowledge on fisheries law (e.g. the Fisheries Act); some fishers admit to not knowing about the Fisheries Act before TSWA came to the village (002) and claim to feel a greater sense of empowerment since partnering with the Association.

TSWA has also played an active and important role in helping fishers in the province of Prachuap Khiri Khan create an alternative market for sustainable seafood caught by local fishers (including fishers from Kradai) via the Fisherfolk Shop (see Kehoe et al. 2016).

Greenpeace Southeast Asia and Oxfam Great Britain

Greenpeace and Oxfam are other NGOs working with fishers in the community of Khan Kradai. Compared to TSWA these organizations were said to be less influential; nevertheless, they offered support by offering some knowledge on conservation and by providing financial support for CBFM projects.

6.4.1.3 Community-based organizations

Two community-based fisheries groups operate in the village of Khan Kradai. The following section provides details on their structure, purpose, main activities, and the relationships each have with other formal and informal governance institutions (Table 7) according to group members.

The first of these two community-based groups, known as *Small-scale Fisheries Khan Kradai*, began in 2008 when a few fishers came together over coffee to talk about problems within their community. According to focus group participants, it was only after this small group of individuals travelled to the neighboring village of Mong Lai (where local NGO TSWA was working with local fishers) and began attending meetings with a community-based fisheries group there, that they decided to focus more on conservation and management of fisheries. The group became registered as an organization in 2011 and is currently comprised of approximately sixty members -- including fishers and their families. Membership, which is open to all fishers in Khan Kradai, was said to fluctuate: there were once one hundred members, but as a result of disagreements and differences in opinion some individuals left. Member meetings are held twice a month to discuss any issues that might exist within the community (the group is active in a number of other community-related activities such as a petro station and mutual fund), with special attention given to fisheries-related problems. The *Small-scale Fisheries Khan Kradai* group continues to work closely with TSWA and, under the NGO's guidance, has implemented a number of conservation projects (described below); the group is also part of a greater network of fishers from villages throughout the province. Through these relationships and continued experience interacting with various stakeholders (e.g. government), the group believes it has grown in strength: in the beginning, few members would attend meetings with the Provincial office and other stakeholders – fewer would speak. Over time however, fishers became more interested in participating in these activities and were less afraid to speak out at these meetings.

The second community-based group operating in Khan Kradai, known as *Three Bays Small-scale Fisheries,* began in 2011 and was in part also initiated by TSWA as a number of its founding members were first part of the group in Mong Lai village (referred to above). However, once these individuals became aware of TSWA's strong sense of social activism (e.g. lobbying and protesting) they no longer wanted to be associated with the organization; instead, they moved to create their own independent group. Membership is open to all fishers from the three villages of Khan Kradai, Aow Noi, and Mong Lai (this is where the group gets the name "Three Bays") whose boat is registered or is willing to have it registered in a timely manner (with the help of the group). Currently, there are between fifty and sixty fishers (not including family members) associated with this group -- approximately half are from Khan Kradai. These individuals meet two or three times a month to discuss whatever activities have gone on since they last met, as well as any progress made on the group's ecotourism venture: 'Amazing Three Bays', which is currently in the works. While the *Three Bays Small-scale Fisheries* group is not yet registered, it is nevertheless recognized by government organizations like the provincial Department of Fisheries, whom the group works closely with.

Table 7: Details of community-based groups operating in Khan Kradai

	Small-scale Fisheries Khan Kradai	Three Bays Small-scale Fisheries
When was the group formed?	2008	2011
Is the group registered?	Yes	No
Number of members?	60 Includes family members (i.e. spouses and children)	50-60 Does not include family members, but only half of the members are from Khan Kradai
Does the number of members fluctuate?	Yes, it has decreased over the years	Yes
How often does the group meet?	Twice a month (on 'big Buddhist' days)	Two-three times a month
What is the group's main purpose?	To fight for all issues that happen in/on the sea.	Concerned about conservation, but also interested in developing ecotourism
What organizations does the group work with?	NGO Thai Sea Watch Association, Greenpeace and Oxfam	Department of Fisheries and Department of Tourism
How has the group progressed over time according to members?	Strong; have learned from experience and grown.	Not strong, but also not weak.

Source: Focus groups (September 2015)

6.4.2 Rules-in-use

Rules, as they apply to SSF, often go beyond broad-reaching, formal regulations such as those identified under a national Fisheries Act to also include more place specific, informal rules such as those designed by local resource users. As such, mechanisms to monitor and enforce rules-in-use also go beyond the typical provisions and penalties (as applied by government organizations like the Department of Fisheries) to include the use of social capital.

In Khan Kradai while fishers must follow a distinct set of rules identified under Thailand's Fisheries Act, they are also expected to respect those rules created by the two community-based fisheries groups operating in the village: *Small-scale Fisheries Khan Kradai* and *Three Bays Small-scale Fisheries*. During key informant interviews, participants identified a number of these formal and informal rules.

The formal rules recognized by fishers included: the registration of boats with the DoF (n=2); the prohibiting of LSF activity within 5 miles from shore (n=3); and, the prohibiting of LSF activity in the upper Gulf of Thailand during the closed spawning season (February to May) (n=2). Informal rules acknowledged by fishers included: no fishing of anchovy within 5 miles of shore or during the day and no using anchovy lights (n=4); no catching juvenile species (n=5); no using crab traps (n=9); no using gill nets with mesh smaller than 2.5cm (n=6); bottom gill nets used to target blue swimming crab must not have mesh smaller than 10 cm (n=3); no pursing around the artificial reefs (n=7); and, berried female blue swimming crab must be released back into the ocean or brought to shore and deposited in crab bank (n=3).

While there are no penalties attached to the informal community rules governing SSF in Khan Kradai they are nevertheless found to be quite effective. For example, one fisher who was interviewed said: "I used a 9cm net [to target blue swimming crab] and could catch a lot. The fishers here [in Khan Kradai] wondered why I could catch so much and when they came to see I was using a smaller net [than was allowed under community rules] they had a meeting to tell me to change. In the fishery law you can use nets with 7 or 8 cm mesh...but I was not angry because I was an outsider and I knew I had to follow community rule". As this statement suggests, the community of fishers in Khan Kradai uses verbal communication in order to relay rules: coming together as a group to have a conversation with the violator - explaining the reasons why their actions are not acceptable in the area. They then depend on shared norms, values and understandings that exist among family, friends and the fishing community more broadly as a means of enforcement. This sense of responsibility towards monitoring and enforcing these rules was said to come from the fact that fishers depend on SSF for their livelihood, and therefore "must be a security guard of the sea" (021). Although, this same participant admitted that "fishers do not have the [legal] power to say to another fisher not to do something" (021). In cases where fishers find themselves unable to simply reason with those fishers who refuse to obey the rules (especially formal rules) they will often go to the Department of Fisheries for assistance.

6.5. Interactions and outcomes

6.*5.1 Self-organizing activities*

With varying degrees of support from the above mentioned governance institutions, the two community-based groups in Khan Kradai have implemented the following conservation projects:

Artificial reefs

While an artificial reef (built by the provincial Department of Fisheries) already exists 5 miles offshore, SSF in the village of Khan Kradai argue that they derive little if any benefit from it. For this reason, and in an effort to rebuild depleted fish stocks in the area, the *Small-scale fisheries Khan Kradai* group started the artificial reef project in 2008. The group learned how to construct the reefs (using concrete for the base, coconut branches for the trunk and banana leaves for the top) and gained better understanding of their function and potential impacts from sources outside of the community – notably from observing their use in LSF. Each of the twelve reefs that were set out initially (2 miles from shore) cost an estimated 5,550 Baht (166.50 USD) to build and, due to decomposition of the coconut branches and banana leafs used to construct them, must be replaced three times a year. Financial support for this project comes from TSWA, the TAO, the Coastal Resource Department, the Government Savings Bank of Prachuap, Greenpeace, and others. The group sees the impact of this project as being positive thus far: one fisher claimed that "there are not many resources except for around the artificial reef" (027).

Crab bank

In 2008, in an attempt to rebuild the stock of blue swimming crab in the area, the *Small-scale fisheries Khan Kradai* group created a crab bank a few hundred meters from shore. This conservation project, which similarly received financial support from the above mentioned institutions, requires that female

berried blue swimming crab caught in fishers' nets, are taken out, taken ashore, and deposited in the bank. Once the female crab drops its eggs it is then taken out of the bank and sold by children in the community; the monies earned going toward their schooling. Much the same as the artificial reef project, many see this initiative as already having had a positive impact on the resource: one fisher claimed that the "crab bank has made a lot of crab when before there wasn't any" (012). However, there remain some who are critical of the crab bank - primarily because it is located in the water rather than on land. These individuals argue that if the crab bank were located on land (as is the case in the neighboring village of Mong Lai) it could be easily run using oxygen; this way, the structure would not need to be taken ashore during the monsoon season, which is disruptive and problematic. It would also eliminate concerns that once eggs are dropped from the female berried crab and are hatched into zoea, they can be easily eaten by predators.

Release of Aquatic Species

The provincial Department of Fisheries has allocated approximately 700,000 - 800,000 fingerlings and juvenile crab to the *Three Bays Small-scale Fisheries* group. These species are released either at sea or from shore. It was said that this activity occurred at least ten times already.

6.5.2 Conflict

Conflict among fishers is a common phenomenon, especially in Southeast Asia where resources are suffering from significant declines due to environmental degradation, overfishing and overcapacity (Salayo et al. 2008). While conflict is most often said to exist between SSF and LSF, it is also known to arise *within* SSF and LSF and has even been found to occur between native fishers and migratory fishers (Silva and Lopes 2015). In Khan Kradai, there exists similar conflict dynamics, as LSF try to encroach on SSF grounds or as other SSF attempt to use gear that is deemed unacceptable. Over the course of this study, however, the main conflict fishers were having to deal with was the fishing of comb pen shell along the coast of Prachuap Khiri Khan by (mostly) migratory fishers.

Comb pen shell fishing

According to local fishers, the targeting of comb pen shells is not a practice that originated in the province of Prachuap Khiri Khan; rather, fishers from the South of Thailand have slowly travelled up the coast, harvesting the species along the way. While the majority of those individuals fishing comb pen shells are therefore migratory fishers (not native to Prachuap), there is nevertheless an increasing number of locals who are moving into the fishery; not surprisingly, given it is a highly lucrative business. In 2013 fishers in one village claimed they were receiving 12 THB per kilogram [0.36 USD] for the whole species (shell + meat). When a MOU was signed in July 2014 banning the fishing of this species in one village, resulting in fewer boats, the price went up to 17 THB per kilogram [0.51 USD]. Today, fishers receive up to 100 THB per kilogram of meat [3 USD].

The conflict that exists between local fishers and these individuals who target comb pen shells is a result of differing perceptions when it comes to the ecological implications of the activity. On the one hand, local fishers believe these shells offer a place for squid and other aquatic species to lay their eggs and argue that their extraction disrupts this habitat and also increases sediment in the water, which ultimately affects fish migration. These individuals also argue that the disposal of the species shells (as some fishers will shuck aboard their ship and throw discards overboard) is also destructive to certain types of gear - notably bottom gill nets. On the other hand, those fishing comb pen shells claim that the activity causes no harm to the environment for they do not use dredging to harvest the species; rather, they expose these shells by using equipment to blow away the surrounding sand; something they say happens naturally throughout the year. These fishers also argue that "comb pen shells are an aquatic species in public waters so nobody owns them, and there is no law or right that prevents [them] from fishing" and believe "the villagers simply want to control the area for themselves and not share with others". While

local fishers focused much of their attention on the ecological implications of fishing comb pen shells, the underlying social issues surrounding this practice were largely ignored – primarily, the reported use of foreign labor and the nature of work that these individuals are subject to. Crew are, reportedly, expected to dive down and recover these species using only a weighted belt and an air compressor run off the boat's engine. Off the coast of Pranburi (another district in Prachuap Khiri Khan province) reports of one drowning have already surfaced (Thairath News, 2015), and there have been numerous allegations of others.

In an attempt to resolve the conflict, both parties met with the Provincial governor, district officers, representatives from the Department of Fisheries and Royal Thai Navy, and other prominent figures on numerous occasions. At these meetings, district officers and Navy officials admitted that they do not have the equipment (e.g. boats) or funding (e.g. for petro) necessary to properly monitor the activities of fishers. Jurisdictional reach was also unclear: one Deputy Officer reported that "the budget and broken equipment are really secondary problems, her major problem is that she doesn't know what power she has to go out and arrest these fishers". What is more, it was said that before any decision could be made on the matter, scientific evidence would be needed to prove that this fishing is actually harmful to the environment; local fishers claimed to be "experts on this issue because [they] are the ones who fish every day and are on the sea" and said they were unable to wait for science.

After numerous meetings a temporary solution was reached and a Provincial notice for the creation of a conservation area was issued on August 10, 2015. This solution however, came with a number of concerns. Firstly, this conservation area of 3 kilometers follows longitude and latitude rather than the physical landscape. Local fishers and even district officers argued that in some cases (i.e. where there the landscape protrudes) comb pen shell fishers would be favored by such demarcation. Secondly, once on the water officers would not know exactly where this area begins and ends as there would be no clear boundary markers; local fishers and district officers had requested that buoys be put out to identify the area. Thirdly, as there are no penalties attached to Provincial notices, and because the practice of comb pen shell fishing is not found in the Fisheries Act the Department of Fisheries, officers cannot inflict any form of punishment making it more or less ineffective.

6.6. Social, economic and political setting

SSF cannot be studied as an isolated sector: there is a need to consider the role of external influences, including the social and political context in which communities of fishers operate (Marschke et al 2012). The following section considers three external factors that impact SSF in Khan Kradai.

Rabob Keaw

During key informant interviews, fishers (n=12) spoke of having *Rabob Keaw* - a system ("rabob") whereby fishers borrow money from a local middleperson, often to invest in fishing-related materials (e.g. boat, engine, gear, etc.) or repairs but sometimes also to support household needs. Those fishers (n=3) who sell to a middleperson who is also a relative were also borrowed money from them as well at some point in time. There were fishers (n=3) who had *Keaw* with middlepersons in the past but were able to pay off their debt; although, two of these fishers admitted to falling back into the system of borrowing again: for one of these individuals the *Keaw* system became a cycle of borrowing money, paying the money off, and borrowing money again. Of those other fishers (n=9) who claimed to never have *Keaw* one does not sell to a middleperson at all but instead developed his own market for the blue swimming crab he catches. When fishers enter into the *Keaw* system they are tied to middlepersons until their debt is repaid and as a result are often unable to access alternative markets. In the case of Khan Kradai, this means some fishers miss out on the opportunity to sell their catch to their local Fisherfolk Shop, which buys sustainably sourced seafood at a premium price to sell to affluent consumers in Bangkok (Kehoe et al. 2016).

Thai Constitution

Section 66 and 67 of Thailand's Constitution (the supreme law) make reference to community rights – specifically, "*the right to conserve…and participate in the management, maintenance and exploitation of natural resources*". These sections also state that "*any project or activity which may seriously affect the quality of the environment, natural resources and biological diversity shall not be permitted, unless its impacts on the quality of the environment and on health of the people in the communities have been studied and evaluated and consultation with the public and interested parties have been organized*". When fishers in Khan Kradai are unable to enforce community rules they will often make reference to the Constitution.

IUU Fishing

In April 2015 the European Commission issued Thailand with a yellow card, insisting that the country efficiently and effectively reform its fishing sector to comply with EU standards or risk having trade sanctions imposed on all fisheries product (The EU IUU Regulation, February 2016). In an effort to lift this yellow card (and ultimately avoid receiving a red card, which would see sanctions enforced) the military government in Thailand implemented sweeping regulations. One of these was the Royal Ordinance on Fisheries B.E. 2558, an emergency decree which was approved and received royal assent November 14, 2015, amending the Fisheries Act of 1947.

The revised Fisheries Act, while meant to improve Thailand's fishing industry by addressing the problem IUU fishing as well as other social and ecological issues within the LSF such as slave labor (see Marschke and Vandergeest 2016) will also have both positive and negative impacts on SSF. The Act, for instance, does well to facilitate increased participation of SSF in the governance process by calling for the setting up of a Provincial Fishery Committee (part 3) – a committee which must include representatives of the local fishing community. At the same time, however, Article 34 of this new legislation hinders SSF by limiting their operations within three nautical miles of the coastline. According to the Act, "an artisanal fishing license holder shall not engage in a fishing operation in offshore seas", whereby offshore seas are defined as "the seas located in the Kingdom beyond the coastal seas" and coastal seas are those "lying within the Kingdom extending up to three nautical miles from the baselines". Fishers see such restrictions as detrimental to their livelihood for, as noted earlier, some fishers go much further out to sea (up to 12 nautical miles) in search of fish. It is also a practice that many fishers believe "could lead to the ruin of coastal natural resources" and increased conflict among fishers (The Nation, 2016).

7. DISCUSSION

7.1 Ecological dimensions of SSF in Thailand

When it comes to common-pool resources like SSF, it has been said that no one fisher has the rational incentive to limit the amount he or she harvests and, as a result, resources are easily exploited and ecosystems are frequently degraded (Bailey 1988; Andrew et al. 2007; Ghorbani and Bravo 2016). Indeed, such was found to be the case in the Thai village of Khan Kradai where fishers made use of unsustainable fishing gear and put significant pressure on local stocks for years without considering the effects such practices could have on the social-ecological system.

As is often the case within SSF, these fishers targeted multiple species rather than exploiting one specific stock (McConney and Charles 2010). The main species caught were identified as pelagic vertebrates like short-bodied mackerel, indo-Pacific king mackerel, and goldstripe sardinella and demersal invertebrates like banana shrimp, blue swimming crab and splendid squid. These small, fast-growing species are known to be capable of withstanding higher levels of fishing effort when compared to species with longer life spans and slower growth rates, and are therefore generally seen as the optimal fish to target from a sustainability perspective (Jennings, Greenstreet, and Reynolds 1999; Lunn and Dearden 2006b). While targeting these lower-level species allowed fishers in Khan Kradai to avoid fishing *down* trophic levels – a practice whereby higher-level species (that have been economically depleted) are replaced by lower-level species – it is likely that fishers did fish *through* trophic levels by substituting lower-level species with other species that occupy the same level (Essington, Beaudreau, and Wiedenmann 2006). The expansion of the splendid squid fishery in the region, as landings of other fishers like short-bodied mackerel decrease (as a result of anthropogenic and climatic factors) is one example of substitution or addition. Another example is the recent entry into the indo-Pacific king mackerel fishery by local fishers. Much like fishing *down* trophic levels, fishing *through* trophic levels can result in a decrease in mean trophic level – a key indicator of the sustainability of fisheries and ecosystem integrity – because of conflicting demand for ecosystem services among species and loss of biodiversity (Essington, Beaudreau, and Wiedenmann 2006). This problem is undoubtedly exacerbated by the increasing amount of diverse non-target species caught (as bycatch) by fishers in Khan Kradai; the increased economic value of once valueless species in recent years has prompted fewer discards (McClanahan et al. 2009).

Over the last twenty years, fishers in Khan Kradai have witnessed ecological change – notably greater variability in abundance of main targeted species and reductions in diversity of species, that could well be attributed to unsustainable fishing practices and fishing *through* trophic levels (Murawski 2000). While it is difficult to determine the extent to which the stock of species in the area have actually decreased over time (given that catch data for SSF in the region is scant), fishers whose knowledge is derived and continually updated through everyday lived experience spoke of significant reductions in catch-per-unit-effort since 1995 - particularly, throughout the early 2000s (as also noted by Anuchiracheeva, 2003). The loss of seagrass beds in the waters nearshore (as identified by fishers) is indicative of a changing ecosystem and can be attributed to the motorization of boats, intensification of gear used, or, as mentioned above, the systematic removal of fish and disrupting of important components of the food web (Reynolds, Duffy, and Knowlton 2013).

While fishers in Khan Kradai do not rely on SSF as a "safety net" or a livelihood of last resort in the same way that fishers in many other regions of Southeast Asia do, they are nevertheless dependent on them. While some individuals have had the opportunity to engage in other types of employment (e.g. construction, factory work or agriculture) and simply chose fishing as their preferred livelihood, many others lack the capital (e.g. land) and skills necessary to provide an enabling environmental for these alternative occupations. Ecological change in the past, as perceived by fishers, therefore threatens the ability of SSF to provide economic and social benefits for this coastal community into the future (Jones 2009; Eriksson et al. 2016).

7.2 Socio-institutional dimensions of SSF in Thailand

7.2.1 Community-based fisheries management

Ecological change has been the main catalyst for CBFM in Khan Kradai, as fishers (who are otherwise known to be risk averse) recognized that they were faced with an undeniable crisis and collectively tempered their behavior (Carbonetti et al. 2014; Hinkel et al. 2015). Behavior was tempered through a kind of self-imposed quota, whereby the community of fishers placed restrictions on gear used and species size. With no prior experience in resource management, fishers depended on external actors for the knowledge and capabilities necessary to operationalize this management scheme (Sutton and Rudd 2015). The most prominent of these external actor was NGO TSWA, as it was the first institution to reach out and encourage fishers to come together as a group to manage local resources. The DoF was another external actor that provided support, although to just one of the two CBFM groups in the village of Khan Kradai that chose to distance itself from NGOs due to differences in opinion. Under the guidance of these external actors, CBFM groups in Khan Kradai created informal community rules and designed and implemented projects aimed at marine preservation and conservation. As has been found elsewhere with community-based endeavors (Armitage, Marschke, and van Tuyen 2011), stakeholders perceive a positive correlation between the enactment of these rules/projects and the state of SSF in the area even though there is no empirical evidence to prove this perceived correlation.

While the initial formation of CBFM groups in Khan Kradai is owing to partnerships forged with external actors, the perceived progress and success of each group over time is undoubtedly a result of their small size, active show of leadership, and robust social capital (Gutiérrez, Hilborn, and Defeo 2011; Kosamu 2015). The group *Small-scale Fisheries Khan Kradai* for instance, is led by a handful of individuals who are highly motivated and well-respected within the community and by networks of SSF across the province (Gutiérrez, Hilborn, and Defeo 2011). Both groups are also grounded in the social capital principles of proactivity, shared norms, trust and reciprocity. These attributes, in combination with small group size, facilitate cooperation among members and increase participation in group activities (Berkes 2010; Sutton and Rudd 2015). Increased participation and strong social capital among fishers can help with institution-building vis-à-vis the creation of broad-reaching networks, which increase opportunities for learning. In Khan Kradai, the linking of the *Small-scale Fisheries Khan Kradai* group with the Prachuap Khiri Khan branch of the Federation of Small-scale Fisherfolk (made up of CBFM groups from villages throughout the province) is one example of this. The formation of such networks is instrumental in fostering a greater sense of agency among fishers and helps to strengthen their voice to ensure that their opinions and local knowledge of the resource is brought into play in the management process; an important factor given that local "government is not always aware of the real problems in the community" (Allison and Ellis 2001; Nasuchon and Charles 2010, 168). When it comes to protesting certain activities (e.g. comb pen shell fishing) and promoting particular community practices (e.g. the use of more sustainable gear types) local knowledge and a strong group voice is important.

Despite the many advantages, CBFM alone is not an adequate system of governance as outsiders are not always guided by collective interests or subjected to the peer pressure that helps ensure fishers' compliance with community-rules. Thus, what is required instead is a cooperation and sharing of responsibility between CBFM groups and other local and/or regional governance bodies (Dietz, Ostrom, and Stern 2003; Armitage 2007; Aswani et al. 2013; Silva and Lopes 2015).

7.2.2 Decentralization

Decentralization, as a process designed to gradually transfer rights, resources, responsibility and decision-making powers from central institutions to their lower-level branches, is one way to bring about cooperation amongst governing institutions (Chardchawarn 2010). A second, more preferred way of

bringing about successful and sustainable co-management, however, is devolution – a process that transfers these same powers and resources to local-level governments and organizations (Berkes 2010). In Thailand, decentralization remains a flawed process despite the fact it began nearly two decades ago (with the promulgation of the Constitution of the Kingdom of Thailand of 1997 and the Decentralization Act of 1999). Moreover, a complete devolution of powers has yet to transpire.

When it comes to SSF in Khan Kradai, the transfer of rights and responsibilities from central branches of Thailand's DoF for example has been inefficient: provincials offices not receiving the resources commensurate with their responsibilities (Dietz, Ostrom, and Stern 2003). Regional and provincial level actors who are meant to play the role of steward lack the administrative, political and fiscal capacity necessary to effectively manage the fisheries (Tan-Mullins 2007; Nasuchon and Charles 2010; Carbonetti, Pomeroy, and Richards 2014). Thus, even if these actors have the political will to 'initiate or actively support participatory governance practices, seek to understand underlying problems and issues in the sector, [or] support citizen proposed initiatives' they lack the political capacity: proper management requires both political will and political capacity (Carbonetti et al. 2014: 297). Similarly, fishers and their local-level organizations have not been afforded the opportunity to join in the design, implementation, and enforcement of local practices but rather are only consulted in the management process (Sutton and Rudd 2015).

7.2.3 Conflict and co-management

In SEA, the majority of conflict within marine capture fisheries is directly related to declining resources and degrading ocean ecologies (Salayo et al. 2008). And although this conflict often occurs between SSF and LSF, the case of comb pen shell fishing along the coast of Prachuap Khiri Khan province goes to show it can also manifest among SSF – notably between resident and migratory fishers – owing to increasing competition for remaining fishery (Nickerson-Tietze 2000; Anuchiracheeva et al. 2003; Silva and Lopes 2015; EJF 2015; R. Pomeroy et al. 2016).

There is growing interest among scholars to use conflict as a way of testing various management schemes by considering their ability to deal with it effectively (Nickerson-Tietze 2000; McConney and Charles 2010)10/4/16 9:11:00 AM. It is already known that, on the one hand, conventional management schemes are often unsuccessful in resolving conflict because they lack nuance and take a prescriptive approach that fails to consider important power dynamics among stakeholders (McConney and Charles 2010). Alternative forms of management such as CBFM or co-management on the other hand, however, are more apt to offer solutions to conflict because of the number of actors involved in the process: nongovernmental organizations, while not always part of the process, have been found to play a key role in helping fishers resolve their conflicts (Tan-Mullins 2007). As demonstrated by the comb pen shell fishing case in Khan Kradai, bringing all stakeholders to the management table allows for the various perceptions of the problem and the solution to be brought forward (Jentoft and Chuenpagdee 2009). When it comes to conflicts of interest, such as fishing of comb pen shells, by considering all sides of the problem it is more likely that an egalitarian resolution will be reached.

7.3 External dimensions of SSF

Issues of ecological change and the emergence and effectiveness of local systems of governance within SSF cannot be discussed in a vacuum, as they are almost always effected by broader political, institutional and economic drivers (Anuchiracheeva et al. 2003a; Silva and Lopes 2015; EJF 2015a; R. Pomeroy et al. 2016). Changes to Thailand's Fisheries Law for instance, in the wake of the EUs threat to impose sanctions, has led to the setting up of a provincial committee which might lead to greater success of co-management by encouraging partnerships between government and local organizations.

8. CONCLUSIONS

It is clear that social and ecological elements of SSF in Khan Kradai have changed greatly over the years. Local fishers spoke of an increase in fishing effort and the introduction of new technologies and gear types in the last 20 years. These changes have put significant pressure on SSF and resulted in a perceived decline in fish stocks and changes to the coastal ecosystem. Aware of the dire situation they were facing – one that threatened their livelihood – fishers in the village self-organized with the help of external actors (notably nongovernmental organization Thai Sea Watch Association) in an effort to better manage the resources. However, even with the implementation of local conservation projects, fishers' willingness to come together in collective action, and national legislation that promotes decentralization, a lack of administrative, political and financial capacity has been found to undermine the success of co-management in Khan Kradai. That said, in seeing how recent conflicts over resource use in the area have been dealt with, it is clear that there is space for local fishers to participate in the management of resources and, given the right tools, CBFM is a viable option for addressing social and ecological change within SSF in Thailand. By adopting Ostrom's general framework for analyzing the sustainability of SES, it becomes possible to explore and better understand the ecological, social, and institutional factors that provide fishers with the incentive to either exploit the resource or, alternatively, use them in a sustainable manner (Kittenger et al. 2013).

BIBLIOGRAPHY

Ahmed, Mahfuzuddin, Pongpat Boonchuwongse, Waraporn Dechboon, and Dale Squires. 2007. "Overfishing in the Gulf of Thailand: Policy Challenges and Bioeconomic Analysis." *Environment and Development Economics* 12 (01): 145. doi:10.1017/S1355770X06003433.

Allison, Edward H, and Frank Ellis. 2001. "The Livelihoods Approach and Management of Small-Scale Fisheries." *Marine Policy* 25 (5): 377–88. doi:10.1016/S0308-597X(01)00023-9.

Andrew, Neil L., Christophe Béné, Stephen J. Hall, Edward H. Allison, Simon Heck, and Blake D. Ratner. 2007. "Diagnosis and Management of Small-Scale Fisheries in Developing Countries." *Fish and Fisheries* 8 (3): 227–40.

Anuchiracheeva, Supaporn, Harvey Demaine, Ganesh P Shivakoti, and Kenneth Ruddle. 2003. "Systematizing Local Knowledge Using GIS: Fisheries Management in Bang Saphan Bay, Thailand." *Ocean & Coastal Management* 46 (11-12): 1049–68. doi:10.1016/j.ocecoaman.2004.01.001.

Armitage, Derek. 2007. "Governance and the Commons in a Multi-Level World." *International Journal of the Commons* 2 (1): 7–32.

Armitage, Derek, and Melissa Marschke. 2013. "Assessing the Future of Small-Scale Fishery Systems in Coastal Vietnam and the Implications for Policy." *Environmental Science & Policy* 27 (February): 184–94. doi:http://dx.doi.org/10.1016/j.envsci.2012.12.015.

Armitage, Derek, Melissa Marschke, and Truong van Tuyen. 2011. "Early-Stage Transformation of Coastal Marine Governance in Vietnam?" *Marine Policy* 35 (5): 703–11. doi:10.1016/j.marpol.2011.02.011.

Aswani, Shankar, Georgina G. Gurney, Sara Mulville, Jaime Matera, and Michael Gurven. 2013. "Insights from Experimental Economics on Local Cooperation in a Small-Scale Fishery Management System." *Global Environmental Change* 23 (6): 1402–9. doi:10.1016/j.gloenvcha.2013.08.003.

Bailey, Conner. 1988. "The Political Economy of Fisheries Development in the Third World." *Agriculture and Human Values* 5 (1-2): 35–48. doi:10.1007/BF02217175.

Basurto, Xavier, Stefan Gelcich, and Elinor Ostrom. 2013. "The Social–ecological System Framework as a Knowledge Classificatory System for Benthic Small-Scale Fisheries." *Global Environmental Change* 23 (6): 1366–80. doi:10.1016/j.gloenvcha.2013.08.001.

Béné, Christophe. 2003. "When Fishery Rhymes with Poverty: A First Step Beyond the Old Paradigm on Poverty in Small-Scale Fisheries." *World Development* 31 (6): 949–75. doi:10.1016/S0305-750X(03)00045-7.

Béné, Christophe, Bjørn Hersoug, and Edward H. Allison. 2010. "Not by Rent Alone: Analysing the Pro-Poor Functions of Small-Scale Fisheries in Developing Countries." *Development Policy Review* 28 (3): 325–58.

Berkes, Fikret. 2003. "Alternatives to Conventional Management: Lessons from Small-Scale Fisheries." *Environments* 31 (1).

———. 2010. "Devolution of Environment and Resources Governance: Trends and Future." *Environmental Conservation* 37 (04): 489–500. doi:10.1017/S037689291000072X.

Binder, Claudia R., Jochen Hinkel, Pieter W. G. Bots, and Claudia Pahl-Wostl. 2013. "Comparison of Frameworks for Analyzing Social-Ecological Systems." *Ecology and Society* 18 (4). doi:10.5751/ES-05551-180426.

Blaikie, Piers. 1995. "Changing Environments or Changing Views? A Political Ecology for Developing Countries." *Geography* 80 (3): 203–14.

Brondizio, Eduardo S., Elinor Ostrom, and Oran R. Young. 2009. "Connectivity and the Governance of Multilevel Social-Ecological Systems: The Role of Social Capital." *Annual Review of Environment and Resources* 34 (1): 253–78. doi:10.1146/annurev.environ.020708.100707.

Campling, Liam, Elizabeth Havice, and Howard McCall. 2012. "The Political Economy and Ecology of Capture Fisheries: Market Dynamics, Resource Access and Relations of Exploitation and Resistance." *Journal of Agrarian Change* 12 (2-3): 177–203.

Carbonetti, Benjamin, Robert Pomeroy, and David L. Richards. 2014. "Overcoming the Lack of Political Will in Small Scale Fisheries." *Marine Policy* 44 (February): 295–301. doi:10.1016/j.marpol.2013.09.020.

Chardchawarn, Supasawad. 2010. "Decentralization and the Roles of Bureaucrats, Politicians, and the People." 459. V.R.F. Institute of Developing Economies, JETRO.

Chuenpagdee, Ratana, and Svein Jentoft. 2015. "Exploring Challenges in Small-Scale Fisheries Governance." In *Interactive Governance for Small-Scale Fisheries*, edited by Svein Jentoft and Ratana Chuenpagdee, 13:3–16. Cham: Springer International Publishing. http://link.springer.com/10.1007/978-3-319-17034-3_1.

Cinner, Joshua E., M. Aaron MacNeil, Xavier Basurto, and Stefan Gelcich. 2013. "Looking beyond the Fisheries Crisis: Cumulative Learning from Small-Scale Fisheries through Diagnostic Approaches." *Global Environmental Change* 23 (6): 1359–65. doi:10.1016/j.gloenvcha.2013.11.001.

Delgado-Serrano, María M., and Pablo A. Ramos. 2015. "Making Ostrom's Framework Applicable to Characterise Social Ecological Systems at the Local Level." *International Journal of the Commons* 9 (2). https://www.thecommonsjournal.org/article/view/URN%3ANBN%3ANL%3AUI%3A10-1-117255/518/.

Department of Fisheries Thailand. 2015. "Brief Background." http://www3.fisheries.go.th/en/.

Dietz, Thomas, Elinor Ostrom, and Paul C. Stern. 2003. "The Struggle to Govern the Commons." *Science* 302 (5652): 1907–12.

EJF. 2015. "Pirates and Slaves: How Overfishing in Thailand Fuels Human Trafficking and the Plundering of Our Oceans." London: Environmental Justice Foundation. http://ejfoundation.org/sites/default/files/public/EJF_Pirates_and_Slaves_2015.pdf.

Eriksson, Hampus, Dedi S. Adhuri, Luky Adrianto, Neil L. Andrew, Tenny Apriliani, Tim Daw, Louisa Evans, et al. 2016. "An Ecosystem Approach to Small-Scale Fisheries through Participatory Diagnosis in Four Tropical Countries." *Global Environmental Change* 36 (January): 56–66. doi:10.1016/j.gloenvcha.2015.11.005.

Essington, Timothy E., Anne H. Beaudreau, and John Wiedenmann. 2006. "Fishing through Marine Food Webs." *Proceedings of the National Academy of Sciences of the United States of America* 103 (9): 3171–75.

FAO. 2014. *The State of World Fisheries and Aquaculture: Opportunities and Challenges.* Rome: Food and Agriculture Organization of the United Nations. http://www.fao.org/3/a-i3720e.pdf.

Fernández, Gallardo, and Gloria L. 2008. "Chapter 2: Fishing Management and Property Rights: A Conceptual Framework." *From Seascapes of Extinction to Seascapes of Confidence* 0 (0). doi:10.3402/gallardo.v0i0.35.

Ghorbani, Amineh, and Giangiacomo Bravo. 2016. "Managing the Commons: A Simple Model of the Emergence of Institutions through Collective Action." *International Journal of the Commons* 10 (1): 200. doi:10.18352/ijc.606.

Gutiérrez, Nicolás L., Ray Hilborn, and Omar Defeo. 2011. "Leadership, Social Capital and Incentives Promote Successful Fisheries." *Nature* 470 (7334): 386–89. doi:10.1038/nature09689.

Hauck, Maria. 2008. "Rethinking Small-Scale Fisheries Compliance." *Marine Policy* 32 (4): 635–42. doi:10.1016/j.marpol.2007.11.004.

Hinkel, Jochen, Michael E. Cox, Maja Schluter, Claudia R. Binder, and Thomas Falk. 2015. "A Diagnostic Procedure for Applying the Social-Ecological Systems Framework in Diverse Cases." *Ecology and Society* 20 (1). doi:10.5751/ES-07023-200132.

Ikejima, K, P Tongnunui, T Medej, and T Taniuchi. 2003. "Juvenile and Small Fishes in a Mangrove Estuary in Trang Province, Thailand: Seasonal and Habitat Differences." *Estuarine, Coastal and Shelf Science* 56 (3-4): 447–57. doi:10.1016/S0272-7714(02)00194-4.

Jennings, Simon, Simon Greenstreet, and John Reynolds. 1999. "Structural Change in an Exploited Fish Community: A Consequence of Differential Fishing Effects on Species with Contrasting Life Histories." *Journal of Animal Ecology* 68: 617–27.

Jentoft, Svein, and Ratana Chuenpagdee. 2009. "Fisheries and Coastal Governance as a Wicked Problem." *Marine Policy* 33 (4): 553–60. doi:10.1016/j.marpol.2008.12.002.

———. 2015. "Assessing Governability of Small-Scale Fisheries." In *Interactive Governance for Small-Scale Fisheries*, edited by Svein Jentoft and Ratana Chuenpagdee, 13:17–35. Cham: Springer International Publishing. http://link.springer.com/10.1007/978-3-319-17034-3_2.

Jones, Estelle. 2009. "The Impact of Artisanal Fishing on Coral Reef Fish Health in Hat Thai Mueang, Phang-Nga Province, Southern Thailand." *Marine Policy* 33 (4): 544–52.

Jones, Estelle, Timothy Gray, and Chanin Umponstira. 2010. "Small-Scale Fishing: Perceptions and Threats to Conserving a Livelihood in the Province of Phang-Nga, Thailand." *Environment Asia* 3 (1): 1–7.

Kittinger, John N, Elena M Finkbeiner, Natalie C Ban, Kenneth Broad, Mark H Carr, Joshua E Cinner, Stefan Gelcich, et al. 2013. "Emerging Frontiers in Social-Ecological Systems Research for Sustainability of Small-Scale Fisheries." *Current Opinion in Environmental Sustainability* 5 (3-4): 352–57. doi:10.1016/j.cosust.2013.06.008.

Klain, Sarah C., Rachelle Beveridge, and Nathan J. Bennett. 2014. "Ecologically Sustainable but Unjust? Negotiating Equity and Authority in Common-Pool Marine Resource Management." *Ecology and Society* 19 (4). doi:10.5751/ES-07123-190452.

Kosamu, Ishmael B.M. 2015. "Conditions for Sustainability of Small-Scale Fisheries in Developing Countries." *Fisheries Research* 161 (January): 365–73. doi:10.1016/j.fishres.2014.09.002.

Lebel, Louis, Supaporn Khrutmuang, and Jesse Manuta. 2006. "Tales from the Margins: Small Fishers in Post-Tsunami Thailand." *Disaster Prevention and Management* 15 (1): 124–34. doi:10.1108/09653560610654284.

Lunn, Kristin E., and Philip Dearden. 2006a. "Monitoring Small-Scale Marine Fisheries: An Example from Thailand's Ko Chang Archipelago." *Fisheries Research* 77 (1): 60–71. doi:10.1016/j.fishres.2005.08.009.

———. 2006b. "Fishers' Needs in Marine Protected Area Zoning: A Case Study from Thailand." *Coastal Management* 34 (2): 183–98. doi:10.1080/08920750600567234.

Marschke, Melissa, Derek Armitage, Truong Van Tuyen, Hein Mallee, and others. 2012. "Do Collective Property Rights Make Sense? Insights from Central Vietnam." *International Journal of the Commons* 6 (1): 1–27.

Marschke, Melissa, Ouk Lykhim, and Nong Kim. 2014. “Can Local Institutions Help Sustain Livelihoods in an Era of Fish Declines and Persistent Environmental Change? A Cambodian Case Study.” *Sustainability* 6 (5): 2490–2505. doi:10.3390/su6052490.

Mathew, Sebastian. 2003. “Small-Scale Fisheries Perspectives on an Ecosystem-Based Approach to Fisheries Management.” *Responsible Fisheries in the Marine Ecosystem*, 47–63.

McClanahan, Timothy R., Juan Carlos Castilla, Alan T. White, and Omar Defeo. 2009. “Healing Small-Scale Fisheries by Facilitating Complex Socio-Ecological Systems.” *Reviews in Fish Biology and Fisheries* 19 (1): 33–47. doi:10.1007/s11160-008-9088-8.

McConney, Patrick, and Anthony Charles. 2010. “Managing Small-Scale Fisheries: Moving towards People-Centred Perspectives’.” *Handbook of Marine Fisheries Conservation and Managment. Oxford University Press, New York*, 532–46.

McGinnis, Michael D., and Elinor Ostrom. 2014. “Social-Ecological System Framework: Initial Changes and Continuing Challenges.” *Ecology and Society* 19 (2). doi:10.5751/ES-06387-190230.

Mills, David, Lena Weslund, Gertjan de Graaf, Yumiko Kura, Rolf Willman, and Kieran Kelleher. 2011. “Under-Reported and Undervalued: Small-Scale Fisheries in the Developing World.” In *Small-Scale Fisheries Management: Frameowrks and Approaches for the Developing World*, 1–15. CAB International.

Murawski, Steven A. 2000. “Definitions of Overfishing from an Ecosystem Perspective.” *ICES Journal of Marine Science: Journal Du Conseil* 57 (3): 649–58. doi:10.1006/jmsc.2000.0738.

Nasuchon, Nopparat, and Anthony Charles. 2010. “Community Involvement in Fisheries Management: Experiences in the Gulf of Thailand Countries.” *Marine Policy* 34 (1): 163–69. doi:10.1016/j.marpol.2009.06.005.

Nickerson-Tietze, Donna J. 2000. “Community-Based Management for Sustainable Fisheries Resources in Phang-Nga Bay, Thailand.” *Coastal Management* 28 (1): 65–74.

NVivo 10. 2010. http://www.qsrinternational.com/nvivo-product/nvivo-mac.

Ostrom, E. 2009. “A General Framework for Analyzing Sustainability of Social-Ecological Systems.” *Science* 325 (5939): 419–22. doi:10.1126/science.1172133.

Partelow, Stefan. 2015. “Key Steps for Operationalizing Social–ecological System Framework Research in Small-Scale Fisheries: A Heuristic Conceptual Approach.” *Marine Policy* 51 (January): 507–11. doi:10.1016/j.marpol.2014.09.005.

Paterson, Christopher J. 2013. “Fisheries Refugia: A Novel Approach to Integrating Fisheries and Habitat Management in the Context of Small-Scale Fishing Pressure” 85 (Part B): 214–29.

Pauly, Daniel, and Anthony Charles. 2015. “Counting on Small-Scale Fisheries.” *Science* 347 (6219): 242–43.

Pauly, Daniel, and Dirk Zeller. 2016. “Catch Reconstructions Reveal That Global Marine Fisheries Catches Are Higher than Reported and Declining.” *Nature Communications* 7 (January): 10244. doi:10.1038/ncomms10244.

Pomeroy, Robert, John Parks, Kitty Courtney, and Nives Mattich. 2016. “Improving Marine Fisheries Management in Southeast Asia: Results of a Regional Fisheries Stakeholder Analysis.” *Marine Policy* 65 (March): 20–29. doi:10.1016/j.marpol.2015.12.002.

Pomeroy, Robert S. 2012. “Managing Overcapacity in Small-Scale Fisheries in Southeast Asia.” *Marine Policy* 36 (2): 520–27. doi:10.1016/j.marpol.2011.10.002.

Pomeroy, Robert S., and Neil Andrew. 2011. *Small-Scale Fisheries Management: Frameworks and Approaches for the Developing World*. CABI.

Reynolds, Pamela, Emmett Duffy, and Nancy Knowlton. 2013. “Seagrass and Seagrass Beds.” *Smithsonian Ocean Portal*. February 27. http://ocean.si.edu/seagrass-and-seagrass-beds.

Ruddle, Kenneth. 2014. “Tropical Small-Scale Fisheries—some Interwoven Issues.” http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/TRAD/34/Trad34_36_Ruddle.pdf.

Salayo, Nerissa, Len Garces, Michael Pido, Kuperan Viswanathan, Robert Pomeroy, Mahfuzuddin Ahmed, Ida Siason, Keang Seng, and Awae Masae. 2008. “Managing Excess Capacity in Small-Scale Fisheries: Perspectives from Stakeholders in Three Southeast Asian Countries.” *Marine Policy* 32 (4): 692–700. doi:10.1016/j.marpol.2007.12.001.

Schumacher, E. F. 2010. *Small Is Beautiful: Economics as If People Mattered*. Reprint edition. New York, N.Y.: Harper Perennial.

Silva, Monalisa R.O., and Priscila F.M. Lopes. 2015. “Each Fisherman Is Different: Taking the Environmental Perception of Small-Scale Fishermen into Account to Manage Marine Protected Areas.” *Marine Policy* 51 (January): 347–55. doi:10.1016/j.marpol.2014.09.019.

Staples, D, B Satia, and Peter R. Gardiner. 2004. “A Research Agenda for Small-Scale Fisheries.” Food & Agriculture Organization.

Stobutzki, Ilona C., Geronimo T. Silvestre, and Len R. Garces. 2006. “Key Issues in Coastal Fisheries in South and Southeast Asia, Outcomes of a Regional Initiative.” *Fisheries Research* 78 (2-3): 109–18. doi:10.1016/j.fishres.2006.02.002.

Sutton, Abigail M., and Murray A. Rudd. 2015. “The Effect of Leadership and Other Contextual Conditions on the Ecological and Socio-Economic Success of Small-Scale Fisheries in Southeast Asia.” *Ocean & Coastal Management* 114 (September): 102–15. doi:10.1016/j.ocecoaman.2015.06.009.

Tan-Mullins, May. 2007. “The State and Its Agencies in Coastal Resources Management: The Political Ecology of Fisheries Management in Pattani, Southern Thailand.” *Singapore Journal of Tropical Geography* 28 (3): 348–61. doi:10.1111/j.1467-9493.2007.00314.x.

The World Bank. 2012. “Hidden Harvest: The Global Contribution of Capture Fisheries.” 66469-GLB. Washington, D.C.

Weigel, Jean-Yves, Pierre Morand, Thuntada Mawongwai, Jean-François Noël, and Ruangrai Tokrishna. 2015. “Assessing Economic Effects of a Marine Protected Area on Fishing Households. A Thai Case Study.” *Fisheries Research* 161 (January): 64–76. doi:10.1016/j.fishres.2014.06.012.

APPENDIX A

Key Informant Interview

Participant name:
Fisher organization (if belongs to one):
Age:
Interview date:
Location:
Interviewer:
Translator:
Time started:
Time completed:
Oral Consent Obtained:

Part A: Background in Fisheries

1. For how many years have you been engaged in fishing?

2. Why did you decide to fish?

3. Why do you continue to fish?

4. What is your primary role in fishing (fishing on own boat, fishing as labourer, having others fish on own boat etc).

Part B: Target Species, fishing effort, market

5. How many fisheries do you operate in?

6. Can you tell me about each fishery (length of operation, time of year, gear used, how long a fishing trip takes)?

Fishery	Length of Operation	Best time of year	Fishing Trip Details	Gear Used

7. Have you always operated in these fisheries?

8. What species do you catch? (Top 3)

9. Have these always been your top three species?

10. Is it possible to say your average daily catch? If so, how much? And, if catch varies throughout the year, can you explain how?

Fishery	**Average Daily Catch**	**Variation**

11. Who do you sell your catch to?

12. Do you have a choice?

13. What species are considered most valuable?

Part C: Local Governance Systems

14. What rules are in place to govern the fisheries you operate in?

    a) Who decides on these rules?

    b) Who enforces them?

    c) In your opinion, are they seen as legitimate/recognized by fishers?

Part D: Oral Histories

15. What changes in small-scale fisheries have you witnessed over the course of your lifetime?
    N.B. If you could, please include information on the above themes (eg gear used, species size, abundance, catch-per-effort, etc.).

16. Why do you think you observed these trends?
    N.B. If they are willing to speak about it, ask them to reflect on changes that may have occurred prior to their lifetime or predict what might occur in the future.

APPENDIX B

Focus Group 1: Species Identification & Ecological Change

Number of Participants: 5-7

Materials: Whiteboard Markers; Chart Paper; Pencils & Pens

Overall Goal: To triangulate data received during key informant interviews and learn more about ecological change within small-scale fisheries in Thailand – specifically Khan Kradai village, Prachuap Khiri Khan province.

Specific Objectives:

1. Resource System:
- Have participants map out spatial boundaries of the resource system and discuss the clarity of these boundaries.

2. Resource Units:
- Determine the units and the approximate number of units in the area (type of fish and abundance) – and how this has changed over time
- Uncover the temporal (i.e. seasonality) and spatial distribution of these units
- Find out what knowledge fishers have on the interaction among these resource units (i.e. food chain, trophic levels, etc.)

Tentative Workshop Design

Time	Objective	Activity
1:00 pm – 1:10 pm	Introduction	
1: 10 pm – 1:40 pm	To have a clear conception of spatial boundaries of the resource system in question	Map of village - Have participants draw and explain the area they deem to be 'theirs'
1:40 pm – 2:30 pm	To triangulate data received during key informant interviews	Seasonal Calendar Activity Ask participants to fill in the calendar according to species – best/worst times of year. *Ask if this has changed over time. If yes, how and why?
2:30 pm – 3:00pm	To better understand how market incentives might influence choice of targeted species	Ranking Activity Ask participants about the price of resource units and catchability and have them rank accordingly
3:00 pm – 3:50 pm	Determine what ecological changes have occurred over the past 20 + years.	Transect Activity Have participants identify variations in species abundance overtime using a data-line going back 20 years
3:50pm – 4:00pm	Conclusion	

Part A: Map of Village

Aerial view from Google

Part B: Seasonal Calendar Activity

SPECIES	MONTHS OF THE YEAR												REASON	CHANGES IN PAST 20 YEARS
	J	F	M	A	M	J	J	A	S	O	N	D		
Herring														
Short-bodied Mackerel														
Blue Swimming Crab														
Banana Shrimp														
King Mackerel														
Other Species Identified														
Other Species Identified														
Other Species Identified														
Other Species Identified														

Part C: Ranking Activity

SPECIES	MARKETING		COSTS	AVAILABILITY	
	Brings the most money	BAHT /kilo	Requires the most investment (i.e. in terms of capital -petro, gear, labor, etc.)	Easiest to catch (i.e. in terms of seasonality)	Greatest in abundance

Part D: Transect Activity

*Timeline will be presented in Thai years and begin in 1995 and participants will be asked to comment on the state of the resources over time.

|----------|----------|----------|----------|
1995 2000 2005 2010 2015

APPENDIX C

Focus Group 2: Management Practices and Resource Governance

Number of Participants: 5-7

Materials: Whiteboard markers; Flip-chart paper; Pencils & pens

Overall Goal: To understand better, the management practices and governance structures in place within small-scale fisheries in Thailand.

Specific Objectives:

1. Governance Systems:
- Understand better those community fishery-based organizations operating within the community and, by way of the stakeholder activity, other governance systems. Identify the various types of resource management.

2. Interactions:
- Have participants engage in conflict activity to identify conflict among resource users, information sharing among users; lobbying activities; and, self-organizing activities.

Tentative Workshop Design

Time	Objective	Activity
2:00 pm – 2:10 pm	Introduction	
2:10 pm – 3:00 pm	To find out more about the fisher organizations active in the community	Interview Activity - Have participants answer questions about the community organization they identify most closely with.
3:00 pm – 3:50pm	To identify if and how – as well as with whom - local fishers/community organizations come to solve problems related to resource use.	Stakeholder Activity - Ask participants to identify those government and non-government organizations engaged in resource governance/management and rank them according to influence. Have participants explain their reasoning behind the arrangement.
3:50pm – 4:50pm		Conflict Activity - Have participants break into groups of 2 or 3 and list two to three governance/management problems they have experienced in recent years. Have them explain the causes of the problem, the effects, and the coping strategies
4:50pm – 5:00pm	Conclusion	

Part A: Interview Activity

Group Formation & Dynamics

1. What is the name of your group?
2. When was this group formed?
3. By who was it formed?
4. How many people comprise the group?
5. Does this number fluctuate?
6. How is membership determined?
7. Is everyone who is interested in joining permitted to do so?
8. How often do you meet?
9. Who or what determines how often you meet?
10. What do these meeting consist of?
11. Who makes the final decision in your meetings?
12. Are non-members allowed to attend these meetings? If no, why not?

Group Purpose

13. For what reason(s) was this group formed?
14. What areas of the fishery are targeted by your group, and why?
15. Who determines this?
16. On what basis?
17. What do your responsibilities include?
18. What is your perspective of your participation in fisheries management over the group's lifetime?

Market Access

19. Does your group link with the markets in any way? I.e. Do you have any connections with middlemen/buyers that those not in the group do not?
20. Is the group involved with and/or supportive of market-oriented regulations such as eco-certification? If yes, explain.

Jurisdictional Power

21. Is your association registered/recognized by the government and its state actors (e.g. Department of Fisheries)?
22. Where or from whom does your association derive power?
23. Do you work with the Department of Fisheries, the Tambon Administrative Organization (TAO), or other committees within or outside the village?
24. If so, how do you communicate?
25. Which of these committees/organizations do you think are most important with regards to managing the fisheries?

Part B: Stakeholder Activity

*Rank influence as high, medium, low, no influence

Stakeholder		Influence	Kind Of Support Offered
Government	Non-Government		

Note: Possible Stakeholders
Department of Fisheries; Department of Agriculture & Cooperatives; Harbor Department; Provincial Governor; District Officers; Tambon Administrative Organization; Village Headman; Thai Sea Watch Association; Green Net; Greenpeace

Part C: Conflict Activity

Problem	Causes Of Problem	Effects Of Problem	Coping Strategy
1.			
2.			
3.			