Sensemaking at Sea: How Alaskan Fishing Captains Interrelate with Natural Systems

by

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The Tables Turned
by William Wordsworth[1]

Up! Up! my Friend, and quit your books;
Or surely you'll grow double:
Up! up! my Friend, and clear your looks;
Why all this toil and trouble?

The sun above the mountain's head,
A freshening lustre mellow
Through all the long green fields has spread,
His first sweet evening yellow.

Books! 'tis a dull and endless strife:
Come, hear the woodland linnet,
How sweet his music! On my life,
There's more of wisdom in it.

And hark! how blithe the throstle sings!
He, too, is no mean preacher:
Come forth into the light of things,
Let Nature be your teacher.

She has a world of ready wealth,
Our minds and hearts to bless--
Spontaneous wisdom breathed by health,
Truth breathed by cheerfulness.

One impulse from a vernal wood
May teach you more of man,
Of moral evil and of good,
Than all the sages can.

Sweet is the lore which nature brings;
Our meddling intellect
Mis-shapes the beauteous forms of things –
We murder to dissect.

Enough of Science and of Art;
Close up those barren leaves;
Come forth, and bring with you a heart
That watches and receives.

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[1] Wordsworth, W., & Gill, S. (1984). *William Wordsworth: The major works*. Oxford: Oxford University Press.

Dedication

This dissertation is dedicated to my father.
Thanks Pop for you steadfast support and positivity. This would not have been possible without your help.

Acknowledgements

Although a dissertation is an isolating endeavor, I could not have done this on my own. Thankfully, I did not have to. I want to acknowledge the following people for their contribution to this study and to making the attainment of my degree possible.

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I decided to study sensemaking in commercial fisheries after taking Karl Weick's course on sensemaking. His initial support was also instrumental in getting my PhD program out of a state of drift. Karl embodies an attitude of wisdom, in which he both offers knowledge to and seeks knowledge from the same person. He often made me feel like I was teaching him, but in doing so he was teaching me how to be a wise scholar. I am immensely thankful for his excitement about my research, his encouragement to keep working, and his keenly insightful feedback. His influence on my own approach to scholarship, as well as to life in general, has been immense.

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Chapter One
Introduction

"Here I am, heading out to sea free, and I have this abstract thing controlling me."
—Kodiak trawl captain

1. Introduction

The practice of commercial fishing involves the processes through which vessel captains convert the potential catch embedded in natural systems into actual catch, under the terms defined by "controlling" and "abstract" regulations. In the face of hidden, submerged, or otherwise indeterminate natural systems, captains must make sense of how to most efficiently, safely, and legally produce desired material outputs. The practice of making sense, or "sensemaking," is "the process through which people work to understand issues or events that are novel, ambiguous, confusing, or in some other way violate expectations" (Maitlis & Christianson, 2014: 57). No research has been conducted, however, on the processes through which commercial fishing captains make sense of the natural systems upon which they depend for their livelihood, or on how regulatory systems impact that sensemaking. By investigating sensemaking as a key component of the practice of commercial fishing, this study aims to fill that gap.

The practice of commercial fisheries scholarship, due to in part to its pervasive reliance on rational decision-making theory (e.g., Acheson, 2006; Branch et. al, 2006; Carlsson & Berkes, 2005; Grafton et. al, 2006; Hilborn, Orensanz, & Parma 2005; Plummer & Fitzgibbons 2004), has largely overlooked how fishing captains make sense of indeterminate natural systems in order to make key decisions about how to extract material resources from them. Fisheries management scholar Daniel Holland speaks to this void in the following:

> When modeling fishing decisions, there should be more explicit consideration given to how fishermen incorporate information into complex decisions, and how they actually make decisions. . . If our goal is to understand and predict fishing behavior and design more effective fishery management tools, it is critical to

> understand how fishermen actually make decisions, not how economic theory suggests they should make them. (2008: 342)

Svein Jentoft, another fisheries management scholar, suggests some of what is needed to fill this void: "We should not only be looking for causal factors external to the individual actors involved, but also to the motivations that guide their behaviour and the interpretations and meanings they attribute to the particular circumstances that they find themselves in and the choices they make" (2006: 678). This dissertation employs a sensemaking perspective, while also drawing on other concepts used in the organizational theory literature (e.g., materiality, recurring action patterns, abduction), to understand the interrelated interpretations, meanings, choices, and actions that captains enact in the practice of commercial fishing.

Sensemaking's key role in commercial fishing is captured by an axiom used by the Kodiak, Alaska-based trawl captains studied for this dissertation: 'You never know until you tow.' This axiom depicts the aspect of trawl fishing in which captains, due to the dynamic and obscured nature of ecological systems at sea, cannot know which species of fish they are catching, as well as how much of each species they are catching, until after they have caught it. This aspect of knowing in commercial trawl fishing aligns with a fundamental assumption of the sensemaking literature: "An individual cannot know what he is facing until he faces it and then looks back over the episode to sort out what happened" (Weick, 1988: 305-306).

The retrospective nature of sensemaking points to an important difference between a sensemaking perspective and a rational decision-making perspective of experience. This difference is the relationship between cognition and action. From a sensemaking perspective, "cognition lies in the path of action" (Weick, 1988: 308), but from a rational decision-making perspective, cognition precedes action, as Elster (1989: 22) implies in the following: "When faced with several courses of action, people usually do what they believe is likely to have the best overall outcome." The captains' axiom, 'you never know until you tow,' emphasizes cognition lying in the path of towing rather than towing lying in the path of cognition. A sensemaking perspective of the practice of commercial trawl fishing, therefore, requires the researcher to examine how captains, in the face of the indeterminacy of natural systems, act their way into understanding, rather than how they simply understand and then act.

Yet, captains must know something before they tow. They must, as it is commonly stated in the sensemaking literature, have "a workable level of certainty" (Weick, 1969: 40). Sensemaking scholarship concerns events that are occasioned by equivocality and ambiguity, and focuses on the ensuing processes through which actors create the certainty they need by answering the questions, ‘what’s happening here?’ and, ‘now what do we do?’ (Blatt et al., 2006; Cunliffe & Coupland, 2012; Weick, Sutcliffe, & Obstfeld, 2005). Sensemaking scholarship also emphasizes that in answering these questions, actors help enact the conditions that occasion future sensemaking (Weick, 1995; Smircich & Stubbart, 1985). In its emphasis on the enacted nature of experience, a sensemaking perspective alerts researchers to the fact that “key organizational events happen long before people even suspect that there may be some kind of decision they have to make” (Weick, 2003: 186). Thus, a sensemaking perspective expands one’s focus beyond decisions to the processual and reciprocal nature of experience.

There are, however, situations that call for a rational decision-making analysis. Rational decision-making analyses are appropriate when studying situations in which actors know their constraints and opportunities, have selected an exhaustive set of alternative actions, and can conduct a comparative assessment of alternatives prior to acting. Such analyses assume that actors conduct this assessment in the interest of selecting an action that will allow them to maximize their utility (Elster, 1989). Yet, as Masten (1993: 127) notes, "Rules of behavior prescribed by economic models, however logical, cannot be normative if managers are incapable of implementing them or the assumptions upon which the models are built do not apply.” As the Kodiak trawl captains’ axiom suggests, the constraints and opportunities they face at sea in terms of the species they are attempting to catch are always at least somewhat indeterminate. A sensemaking analysis, in not being bound by the oversimplified focus on decisions and utility maximizing behavior, requires the researcher to examine individual and social processes that are enacted in the face of unexpected and unknown constraints and opportunities, and which are conducted in the interest of understanding and coherence of experience rather than mere maximal utility (Daft & Weick, 1984; Weick, 1995).

In a context in which managers must act in the face indeterminacy, a sensemaking perspective offers an expanded and more nuanced perspective through which to see and understand what at-sea fishing operations *are* rather than what rational choice scholars think they *should* be. In this study I demonstrate that the indeterminacy of Kodiak trawl captains’ future imposes a sensemaking demand on their present, and I construct a model of what that sensemaking looks like. Sensemaking scholarship was developed to “break the stranglehold that decision making and rational models have had on organizational theory” (Weick, 2003: 186), and this dissertation aims to break the stranglehold that rational choice models have had on fisheries management, both its scholarship and practice. Understanding the sensemaking processes through which commercial fisheries are enacted can inform the creation of more appropriate management and regulatory processes, from which a more sustainable system can be constructed.

While I employ organizational theory to extend our understanding of commercial fishing practice and management, I also employ commercial fishing practice to extend our understanding of organizational theory. Although the natural world has long been considered a crucial part of understanding human organization (Bansal & Gao, 2006; Hoffman & Bansal, 2012), the connection between natural processes and human organization remains underspecified (Whiteman & Cooper, 2011). There is a robust literature examining distal relationships between corporate processes and structures and the natural environment (e.g., Bansal & Roth, 2000; Flammer, 2013; Hoffman, 1999; Russo & Fouts, 1997), and several studies of organizational processes and structures within natural resource extraction industries (Bansal, 2005; Holm, 1995; Sharma & Henriques, 2005; Weber, Heinze, & DeSoucey, 2008; Zeitsma & Lawrence, 2010). Yet, few organizational studies have examined proximate connections between human and natural processes (e.g., Keyes, 2004; Weick, 1993; Whiteman & Cooper, 2011). As Bansal and Knox-Hayes (2013: 63) state, “The discussion of the physical materiality [of the natural environment] has only minimally permeated organizational theory.” The current literature relies on intermediate relationships, characterized by “action at a distance,” while proximate relationships, characterized by “action by contact” (Cooper & Law, 1995), remain under-researched. There is a vibrant body of work in the natural sciences on the proximate human dimensions of natural processes, yet within organization studies there is minimal work on the proximate natural dimensions of human organization. Examining sensemaking at the frontline of commercial fishing offers a way to understand the proximate natural dimensions of human organization, and will further expand organizational theory into the realm of natural systems.

In section 4 of this chapter I discuss in greater detail the gaps in the organizational theory literature that this study addresses. These gaps lie in the sensemaking literature and in the broader organizational theory literature that relates to materiality. Prior to that, however, in section 2 I describe the empirical problem I aim to address, namely fisheries bycatch. In section 3 I state my overarching research question and break it into its constituent parts. In the next section, section 5, I describe the context in which this study was conducted, namely the Kodiak commercial trawl fleet in terms of ten common, yet not exhaustive, characteristics. The following section concerns my qualitative methodology and analytical processes, and finally in section 7 I provide a roadmap to the subsequent four chapters of this dissertation

2. Problem Statement: Fisheries Bycatch

While commercial fishing industries deserve attention for the rich context they offer for developing rigorous theory about the natural dimensions of organizational theory, these industries also deserve the attention of organizational researchers because of their relevance to worldwide economies. The worldwide catch in marine fisheries fluctuates around 80 million tons, with the Northwest Pacific (e.g., South China Sea, Yellow Sea, Sea of Japan) contributing the largest amount at 25%, the Southeast Pacific (western coast of South America) second at 16%, and the Western Central Pacific (e.g., Sulu-Celebes Sea, Arafura Timor Sea, the Gulf of Thailand) third at 14% (FAO, 2011). In 2008, commercial fisheries directly employed over 34 million people worldwide, while in turn supplying over three billion people with at least 15% of their average animal protein intake (FAO, 2011: 3).

Focusing on Alaska, commercial fishing is one of the state's largest industries, employing more than 30 thousand people a year from 2001 to 2011 (BLS, 2013). In relation to the broader US, Alaskan fishing ports, specifically Dutch Harbor and Kodiak, are typically listed as the 1st and either the 4th, 5th, or 6th largest fishing ports in terms of the amount of catch that crosses the dock, respectively. For instance, in 2011 Alaskan fisheries landings accounted for 1.9 billion of the 5.3 billion pounds of fish landed in the US (Whitney, 2012). Commercial fishing industries in Alaska and around the world rely on the organizing processes that we collectively know as natural resource management for their economic sustainability, embedded in which is ecological sustainability. These contexts, however important they are to worldwide economies, have been effectively overlooked by organizational researchers.

For commercial fisheries to sustain their positive economic benefits, two overarching problems within these industries must be continually addressed both at-sea by captains and on-land by regulators and managers: overfishing and bycatch. These issues, however, emerge from different organizational processes. Overfishing tends to occur when a fleet catches too much of a species they are fishing for. Thus, captains know that they are catching a certain species, and choose to continue catching it. The issue is whether captains have the information they need regarding overfishing limits to choose to stop fishing, and then whether they make that decision or not, and which factors influenced their decision. The overfishing problem tends to be characterized by issues of information, decision making, and incentives, and appropriate for a rational decision making analysis (e.g., Abbott & Wilen, 2011; Acheson, 1998; Fehr & Leibbrandt, 2011; Gatewood, 1984). The fact that rational choice tools and frameworks have been cemented into the foundation, and continue to guide the ongoing construction, of fisheries management literature is related to the long-standing, inveterate problem of overfishing.[2]

Bycatch involves catching or impacting animals incidental to the species one is targeting. Bycatch, defined as "fish that are captured in a fishery but not retained for sale or personal use" (Patrick & Benaka, 2013: 470), is a relatively more recent concern among fisheries scholars and managers (e.g., Caruthers & Neis, 2011; Lewison, et. al, 2011; Pauley & Christianson, 1995). Nonetheless, bycatch is widely considered a major threat to marine ecosystems and the human economies that rely on them (Abbott & Wilen, 2009; Patrick & Benaka, 2013). The bycatch issue, however, is quite different from overfishing in that it is characterized by multiple species co-occurring in time and space (Heery & Cope, 2014), rather than one species that is fished over and over. Rather than merely a decision-making problem, bycatch tends to be a sensemaking problem in that the co-occurring species are ambiguous in relation to fishing practices. Due to this ambiguity, captains do not know what other species, and how much of those other species, they will catch while fishing for a target species, until after they have already fished. In other words, captains cannot know until they tow. Being a sensemaking issue, understanding bycatch requires different interpretive frameworks, research methodologies, and analytical procedures than those typically employed in research grounded in rational choice theory (Scott & Davis, 2007; Weick, 1995, 2003).

At sea, captains attempt to efficiently catch what they can sell, and, to the extent it is profitable to do so, avoid catching what they cannot sell. Captains turn potential catch into actual catch, but their actual catch may turn out to be something other than what they thought it would be. Captains in fishing industries around the world face increasing pressure to be more selective

[2] In 1883, the British held the National Fisheries Exhibition, during which Thomas Henry Huxley, who was a member of the Great Britain Parliament Royal Commission on trawling, proclaimed that, due to the laws of evolution, most of the great sea was inexhaustible. This proclamation had profound effects on fisheries governance (Kurlansky, 1997). However, as early as 1946, the journal *Nature* had a brief report on an International Conference on Overfishing (*Nature*, 1946)

in terms of what they extract from natural systems (Kelleher, 2005; Patrick & Benaka, 2013), while also saddled with increasing economic pressure, due to surging fuel costs, to increase the efficiency of their fishing practice (Priour, 2009; Cheilari, Guillen, Damalas, & Barbas, 2013). Although trawl captains 'never know until they tow,' they face increasing pressure to make sense of the composition of hidden systems prior to extracting from them, and to be quick about it. Attempting to extract certain natural resources while not extracting certain other natural resources that have the same behavioral traits requires sensemaking. Yet, we know little of the sensemaking processes captains undergo at sea. This dissertation elucidates how captains make sense of the indeterminate natural systems from which they attempt make their living.

3. Research Question

The empirical problem that trawl captains cannot know until they tow, but are increasingly pressured to know before they tow, suggests the following research question: *How do frontline commercial fishing managers make sense of indeterminate natural systems as they attempt to extract material resources from them?* In what follows, I address the six elements of this question. First, the frontline is the place where systems of different character collide. In the commercial fishing context, the frontline is the interaction of natural and social systems. Second, the frontline manager is housed proximate to such points of interaction, and is in charge of the day-to-day activities aimed at interrelating with natural systems. In commercial fisheries, this person is the vessel captain. Third, 'indeterminate' means "not known in advance" (Merriam Webster, 2014). The concept describes a relational characteristic in which perceptual cues of some entity are ambiguous, equivocal, hidden, or missing. At sea, a defining feature of being a commercial fishing captain is constructing fishing operations in relation to indeterminate natural systems. Key parts of natural systems in this context are submerged under water, hidden from view, making its species-level composition only fully determinable after part of it has been extracted and hauled on board.

Fourth, sensemaking occurs when people are thrown into the middle of things and forced to act without the benefit of a stable sense of what is happening. The process is constrained not only by past events, but also be the speed with which current events flow into the past and interpretations become outdated (Weick, 2001: 462). The essential sensemaking task of the frontline manager is to "create a coherent and plausible account of what is going on without ever really seeking a one true and final picture of how the world actually is" (O'Leary & Chia, 2007:

392-393). Put simply, through sensemaking the frontline manager continually attempts to create determinacy out of indeterminacy. Fifth, a system is an entity that is emergent from the organization of other entities, which become its parts. When “the whole is more than the sum of its parts,” the organization of the parts produces that which is “more than,” while the “sum” is simply the unorganized aggregation of parts (Buckley, 1967: 42). And sixth, systems are natural, as opposed to human, to the extent that they can “exist outside of society” (Bansal & Knox-Hayes, 2013: 75). Natural systems are distally impacted by, but not proximately created by, human processes. I use the terms ‘natural systems’ or ‘natural process’ to refer to that which exists outside of society and is not yet integrated with human operations. Humans interrelate with natural systems and processes in the interest of extracting natural materiality from them.

To answer my research question, I apply sensemaking primarily, and other interpretive concepts secondarily (i.e., materiality, recurring action patterns), to ethnographic data of a commercial trawl fishing fleet based in Kodiak, Alaska. My focus is on the day-to-day fishing practices through which captains determine where to fish, what to fish from, and where to fish next, including how fisheries regulations structure those determinations. To gather data on this frontline fishing practice I conducted observations, participant observations, and interviews of fishing captains and both industry and agency managers, and I gathered archival data of regulations and regulatory processes. After doing so, I used grounded theory-based analytical procedures to generate theory about the interpretive and behavioral processes captains undertake to make sense of natural systems.

4. Theoretical Orientation

This study of at-sea commercial fisheries management focuses on how captains make sense of indeterminate natural systems in order to extract material resources from them. The following elaboration of the theoretical framework used in this study focuses on two assumptions upon which I conduct my subsequent analyses. First, entities (i.e., actors, processes) that are constituted by both human and material components must have been constructed, at some point, by the interrelation and integration of distinct human and natural entities. The organizational theory literature, however, has overlooked interrelational processes aimed at the integration of distinct human and natural entities. Second, humans must make sense of natural systems in order to create integrated human and natural entities. While sensemaking scholars have investigated the interrelationship of human and natural systems, they have overlooked the sensemaking processes through which humans intend to extract materiality from natural systems in order to create material artifacts. This dissertation takes a materiality and sensemaking-based look at how commercial fishing captains interrelate with natural systems to create the material artifacts that millions depend on for basic nutrition. The following elaborates this theoretical orientation.

a. Sensemaking

A fishing captain's primary duty is determining where to fish (Gatewood, 1984; Gezelius, 2007; Orth, 1987), what to fish from, and where to fish next, whether it is the next set, the next trip, or the next season. What is "perhaps the fundamental problem of ordering and organizing" is a salient issue in the practice of commercial fishing: "the problem about what will come next" (Cooper & Law, 1995: 242). In contexts characterized by indeterminacy, determining what comes next is the province of sensemaking, which encompasses the activities through which actors answer the questions, "what's the story here?" and "now what should I do?" (Weick et al., 2005: 410). To answer these questions is to create a "workable level of certainty" (Weick 1969: 40) about what is happening and what might, could, or should happen next. Workable levels of certainty "suggest plausible acts of managing, coordinating, and distributing" (Weick et al., 2005: 411). Acts of managing, coordinating, and distributing are the organizing processes that, taken together, are the organization (Chia, 2003; Czarniawska, 2004; Law, 1994), which, in this context, is a fishing vessel (the fishing vessel as an organization is further discussed in section 5, part d.). Thus, the relationship between sensemaking and organizing is straightforward: "People organize to make sense of equivocal inputs and then enact this sense back into the world to make it more orderly" (Weick et al., 2005: 410). In other words, the relationship is recursive in that people organize to engage in processes collectively known as sensemaking, yet it is only through such sensemaking processes that they are able to organize.

I use sensemaking to understand how frontline managers in the commercial fishing context construct their operations in relation to natural systems. Thus, in this study sensemaking is a process that interrelates qualitatively different systems. To define sensemaking as a process that spans social and natural systems, alter the following definition given by Maitlis and Sonenshein (2010: 551): "Sensemaking is the process of social construction that occurs when discrepant cues interrupt individuals' ongoing activity, and involves retrospective development of plausible meanings that rationalize what people are doing" (citing Weick, 1995 and Weick et al., 2005). "Discrepant cues" in this study emerge when social and natural systems collide, which potentially, or actually, leads to interruptions to ongoing activity. And if we replace “people” with “entities,” thereby noting that people attempt to make sense of both social (e.g. Gioia & Chittipeddi, 1991; Maitlis, 2005) and material (e.g., Weick, 1993; Whiteman & Cooper, 2011) entities, we have a more inclusive start to a study of sensemaking as the process that interrelates social and natural systems.

There are seven resources that actors draw from to make sense: sensemaking is *social*, informed by *identities*, *retrospective* in orientation, focused on *extracted cues*, always *ongoing*, beholden to a relative standard of *plausibility*, and shaped by, and dependent upon, *enactments* (Weick 1995, 2001). The following linear outline of a sensemaking process depicts the relationships among these properties: “Once people begin to act (enactment), they generate tangible outcomes (cues) in some context (social), and this helps them discover (retrospect) what is occurring (ongoing), what needs to be explained (plausibility), and what should be done next (identity enhancement)” (Weick, 1995: 55). Because thorough discussions of these sensemaking resources can be found elsewhere (e.g., Miller, 2003; Weick, 1995, 2001), I focus the remainder of this discussion of my theoretical orientation on a component of the organizational theory and sensemaking literatures that is most germane to my research question and context: materiality.

b. Making sense of natural materiality

In examining how fishing captains make sense of natural systems, this study focuses on the role of materiality in sensemaking generally, and the role of materiality specifically. While unqualified ‘materiality’ is rarely defined, Orlikowski, in her important work on ‘sociomateriality,’ provides multiple examples: “bodies, clothes, rooms, desks, chairs, tables, buildings, vehicles, phones, computers, books, documents, pens, utensils, data and voice networks, water and sewage infrastructures, electricity, and air systems” (2007: 1436). Although materiality-based concepts such as ‘sociomateriality’ becoming increasingly popular in organizational theory (Leonardi & Barley, 2010; Orlikowski & Scott, 2008), organizational scholars in general have long included material entities in their studies of social systems (e.g., Barley, 1986; Tushman & Anderson, 1986; Orlikowski, 1992; Weick & Roberts, 1993). Sensemaking researchers in particular have also included materiality in their work, focusing on processes that are instigated by and aimed at understanding materiality that is ambiguous, equivocal, or in some way disruptive to organizing processes. Such materiality includes a nuclear power plant (Mills, 2003), an automotive assembly line (Patriotta, 2003), airplanes (Weick, 1990), the NASA Columbia Shuttle (Dunbar & Garud, 2009), a heat wave (Boudes & Laroche, 2009), an aircraft carrier (Weick & Roberts, 1993), and a complex of ecological processes (Whiteman & Cooper, 2011).

Materiality is neither new to organizational research in general, nor sensemaking in particular. Yet, in a recent review of the sensemaking literature, Maitlis and Christianson (2014: 101) state, "We are only just starting to understand sensemaking as [a process] in which sociomateriality plays a much greater role than we have to date recognized. We strongly encourage further scholarship in this area." The overarching principle of sociomaterial research, drawn from the literature on the sociology of translation (e.g., Callon, 1986; Latour, 2007; Law, 1994), is that researchers should not privilege one type of entity over another (Orlikowski, 2007; Orlikowski & Scott, 2008). Under this approach to scholarship, entities that are not wholly human are 'material,' and entities that are wholly human are 'social.' The corrective advanced by sociomaterial scholars is that social and material entities should not be assumed to be "distinct" or "pre-formed" but instead should be viewed as "constitutively entangled" (Orlikowski, 2007). These entanglements form entities such as "sociomaterial ensembles" (Pentland, Hrem, & Hillson, 2011), "agencements" (D'Adderio, 2008), and "silent artifacts" (Cacciatori, 2012).

Yet, because the materiality studied in this domain of research is almost always some form of artifact (e.g., Mazmanian, Orlikowski, & Yates, 2013; Nicolini, Mengis & Swan, 2012; Oborn, Barrett, & Dawson, 2013), it is, by definition, already a product of social processes. Thus, this materiality has been constitutively entangled with social processes prior to being studied as part of a sociomaterial process. In their commitment to investigating the role of sociomateriality in organizational processes, scholars have overlooked the processes through which non-social materiality is interrelated with social processes, from which artifacts emerge. By primarily investigating artifactual materiality that is further integrated into social processes, the materiality in this domain of research is doubly social, muddling the prescription to not privilege one type of entity over another.

There is, however, organizational scholarship that involves materiality that is not born of social processes. This type of materiality includes what Bansal and Knox-Hayes (2013) call, emphasizing its temporal and spatial attributes, "physical materiality," and what Whiteman and Cooper (2000, 2011) call, emphasizing its ecological and biological attributes, "ecological materiality." Taken together, I call this materiality 'natural,' a label that encompasses all non-social, non-artifactual actors, objects, and processes. As noted above, what is natural can exist apart from what is social (Bansal & Knox-Hayes, 2013). Thus, this materiality is not part of a sociomaterial process, though it may be a target of social processes aimed at its constitutive entanglement into material artifacts.

Studies that have included natural materiality in their analyses tend to focus on reactionary social processes characterized by crises born of unexpected interactions with natural systems. The social goal in these events is to interrelate with, but physically separate from, natural systems. For example, Weick (1993) examined the crisis-oriented sensemaking practices enacted by wildland firefighters facing natural systems characterized by dangerous indeterminacy, and focused on the social processes they enacted in order to interact with, but eventually escape from, the natural system. Whiteman and Cooper (2011), also studying a crisis event, brought social and natural systems closer together in arguing that an actor's quality of "ecological sensemaking" is influenced by their prior extent of embeddedness in the local ecological materiality. Whiteman and Cooper were interested in the extent to which the social entity knows the natural system, and examined how depth of knowledge influences how well the social entity can save itself from succumbing to the potentially pernicious natural system. Taken together, scholars in this area of material research have not elucidated the mundane, day-to-day mechanics of the processes through which social entities interrelate with indeterminate natural systems in order to extract material resources from them in a sustained, continual manner.

The result of these two domains of material research is either an over-socialized understanding of interrelationships between social and material entities - characteristic of the artifact-based material literature - or an omission of contexts and processes in which social systems interrelate with natural systems on a daily, mundane basis with the intention of creating material artifacts - characteristic of the domain that incorporates natural materiality. What is missing is an understanding of the processes through which frontline managers interrelate with "distinct" and "pre-formed" materiality in order to extract and integrate them into social systems. Such processes are characteristic of natural resource extraction contexts.

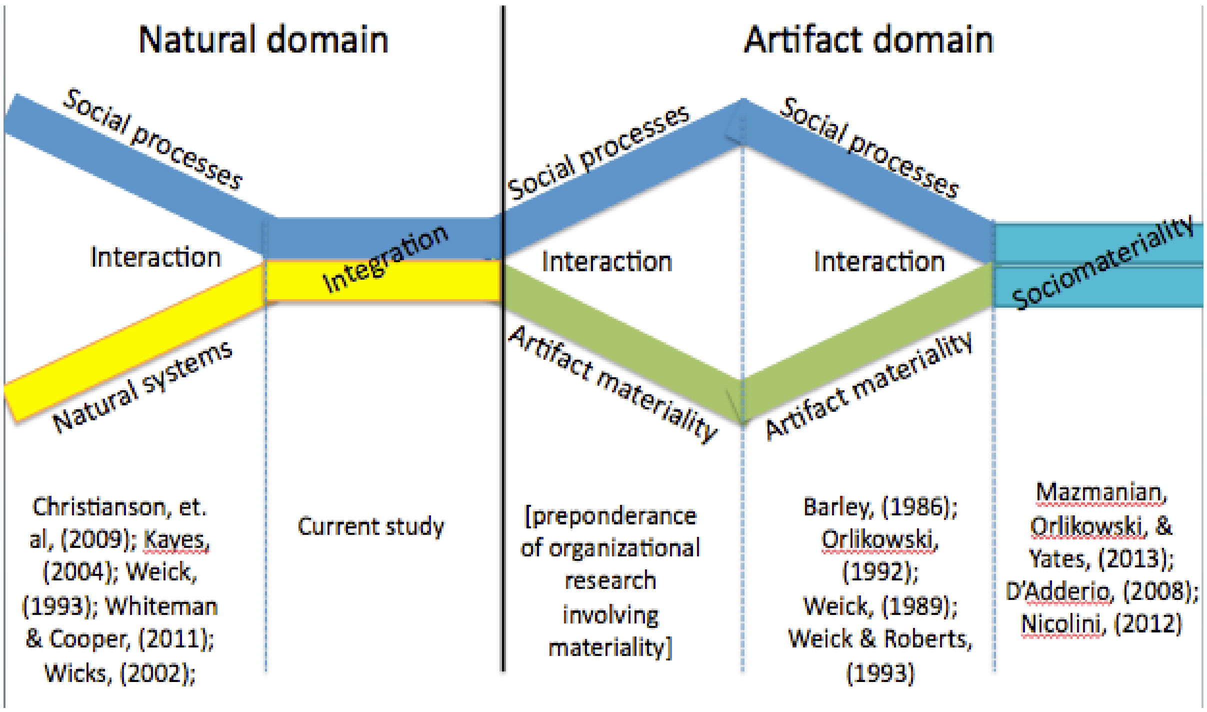

Figure 1: Depiction of the current (and future) state of the organizational theory literature that involves materiality

Figure 1 depicts the current structure of the organizational theory literature involving materiality, as well as this study's place in it. Moving from left to right, research in which natural materiality interacts with, but is studied as distinct from, social processes, falls in the first segment of the natural domain (e.g., Christianson et al., 2009; Keyes, 2004; Weick, 1993; Whiteman & Cooper, 2011; Wicks, 2002). The relationship between social and natural systems depicted in these studies, perhaps due to their tendency to focus on crises, is one of interaction only; thus, the social processes studied in this segment are not ongoing interrelational processes aimed at extracting and integrating natural materiality into their own operations, as is the case in natural resource extraction contexts. Natural resource extraction contexts are characteristic of the next part of the diagram, which is the segment that this study occupies. Studies that would occupy this segment elucidate ongoing, repeated interrelational processes between natural and social systems, which are intended to, or actually accomplish, integration of natural and social systems. Moving further to the right, the solid black line indicates the point at which natural materiality is irreversibly integrated into a social system, and becomes artifactual. Thus, all the materiality that is included in research to the right of the black line stems from interrelational processes that could be the subject of research to the left of the line.

Further to the right in the diagram is the preponderance of organizational research that includes materiality. What is characteristic about this research is that it separates materiality from social processes and focuses primarily on social processes, as Orlikowski (2007) convincingly argued (e.g., Boje, 1991; Maitlis, 2005; Rao, Monin, & Durand, 2002). Moving on to the next segment, as noted above, there have long been studies in organizational theory that examine interactions between artifacts and social processes, and in which the materiality is acknowledged as part of organizational processes (e.g., Barley, 1986; Tushman & Anderson, 1986; Orlikowski, 1992; Weick & Roberts, 1993). And finally, to the far right is the sociomateriality segment, which portrays artifactual materiality as integrated with social processes, forming sociomaterial ensembles (e.g., D'Adderio, 2008; Mazmanian, Orlikowski, & Yates, 2013; Nicolini, 2012).

In examining interrelational processes aimed at integration, rather than mere interaction, this study clears more of the trail that was first mapped by Weick's (1993) examination of sensemaking in the frontline context of wildland firefighting, and later blazed by Whiteman and Cooper's (2011) examination of sensemaking in the front-line context of subsistence hunting. In doing so, this study also expands our horizon beyond cases selected for their actual or potentially extreme outcomes; this study examines day-to-day sensemaking processes through which managers pursue basic goals, such as economic sustainability, and do so by interrelating with natural systems in the interest of extracting and integrating natural materiality into their operational processes.

5. Context

This study expands fisheries management to incorporate organizational theory as one of its tools for managing frontline fishing practices, while also expanding organizational theory by incorporating fisheries management within its fold. My findings, recommendations for practice, and future research, all aimed at these dual goals, are derived from an ethnographic study of the Kodiak, Alaska trawl fleet. While the commercial fishing industry "has long been the primary economic activity of Kodiak" (Kodiak Chamber of Commerce, 2013: 33), the trawl feet is a primary component of that activity. For example, in 2011, 350 million pounds of fish was delivered to Kodiak's docks, worth $178 million. Of these fish, 264 milling pounds (77% of the total) was "groundfish," which includes pollock, rockfish, flatfish, Pacific cod, sablefish, and lingcod, which was worth $78.4 million directly off the vessel. Groundfish is fished by the trawl fleet, as well as the pot and longline fleets, making it difficult to determine how much of this fish

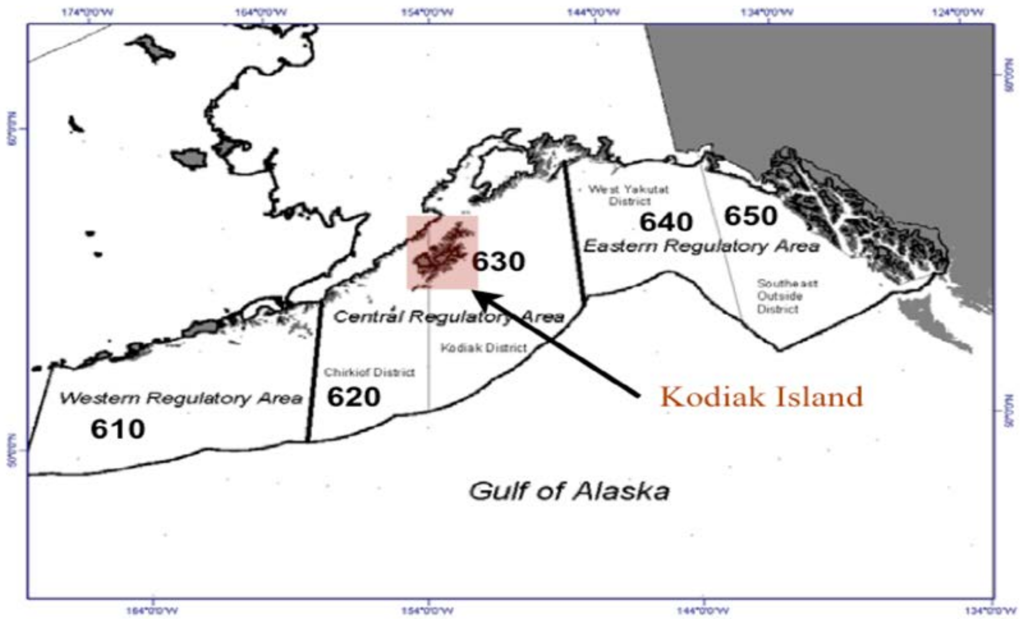

Figure 2: Regulatory fishing areas in the Gulf of Alaska (NPFMC, 2011)

was delivered by trawlers. Yet, we do know that only the trawl fleet fishes for pollock and rockfish, which accounted for 50% of the groundfish delivered to Kodiak in 2011, worth $23 million in ex-vessel value (Kodiak Chamber of Commerce, 2013). And we can safely assume the trawl fleet delivered a large portion of the remaining 49%.

I focused my research efforts on how trawl captains interrelate at sea with indeterminate natural processes to produce the catch that helps drive Kodiak's economy. Embedded in at-sea operations are regulatory structures and agency management processes, both of which are primarily aimed at ensuring the fleet overfishes neither their target quotas nor their bycatch limits. Thus, a description of the at-sea context of commercial fishing requires, in addition to a description of fishing operations, a description of the regulations constructed and the in-season fishery management conducted on-land.

This section discusses ten common, yet not exhaustive, elements of the Kodiak trawl fleet, which are depicted in Figure 3. The Kodiak trawl fleet fishes under the same regulatory authority, with the same type of gear, using the same type of vessel, with the same organization structure, under the same quota allocation regimes (race vs. privatized), in mostly in the same fisheries, for the same species, within the same in-season agency management processes, and often under their own management structures.

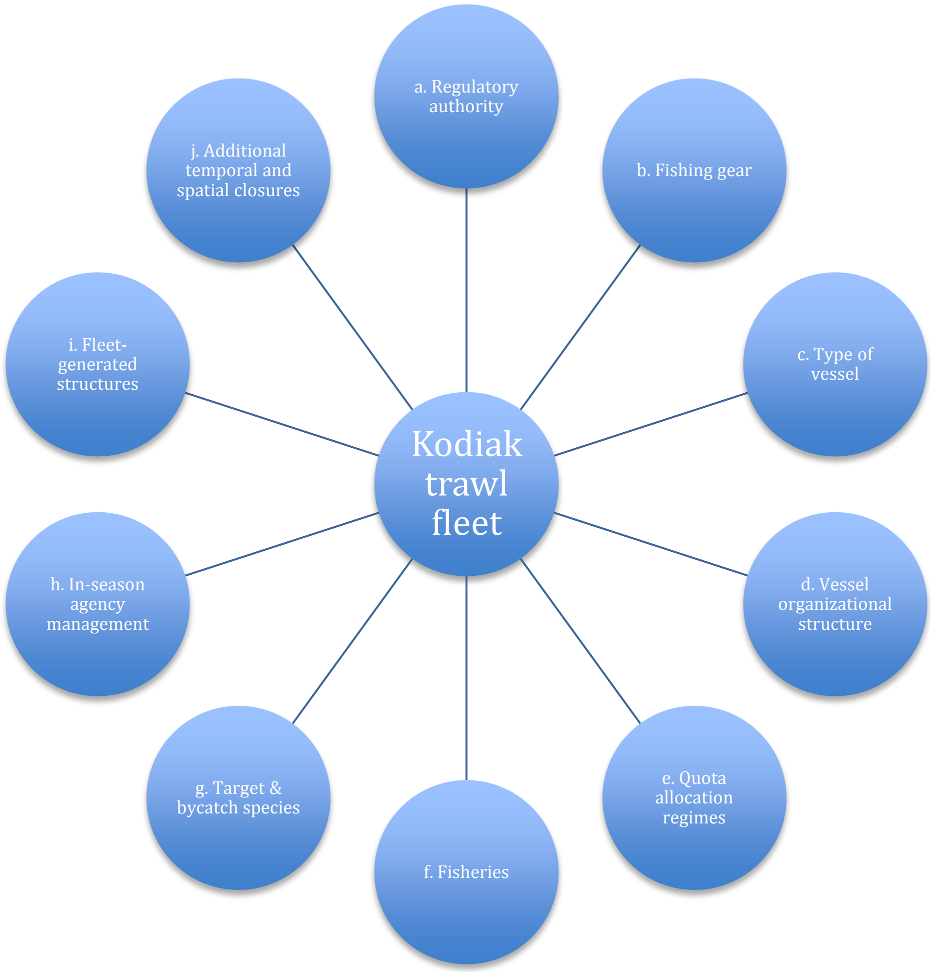

Figure 3: The elements of the Kodiak trawl fleet discussed in this section

a. Fishing under the same regulatory authority

The regulatory portion of the at-sea fishing processes studied in this dissertation is enacted by a federal government organization known as the North Pacific Fishery Management Council (Council). There are eight Regional Fishery Management Councils in the US, each regulating fisheries within the federal waters that surround the US (Figure 4). Although the Council regulates fisheries solely off the coast of Alaska, it is constituted by political appointees representing Alaska, Washington, and Oregon, and, at the same time, various fishery stakeholders. With input from scientific and industry advisory groups, as well as and the public, the Council creates fishery management plans (FMP). FMPs are designed to structure fishing effort to comply with federal laws, primarily the Magnuson-Stevens Act (MSA), and secondarily other laws such as the Marine Mammal Protection Act and the Endangered Species Act. The Council has created, and continually amends, FMPs for the major fishing areas within Alaskan

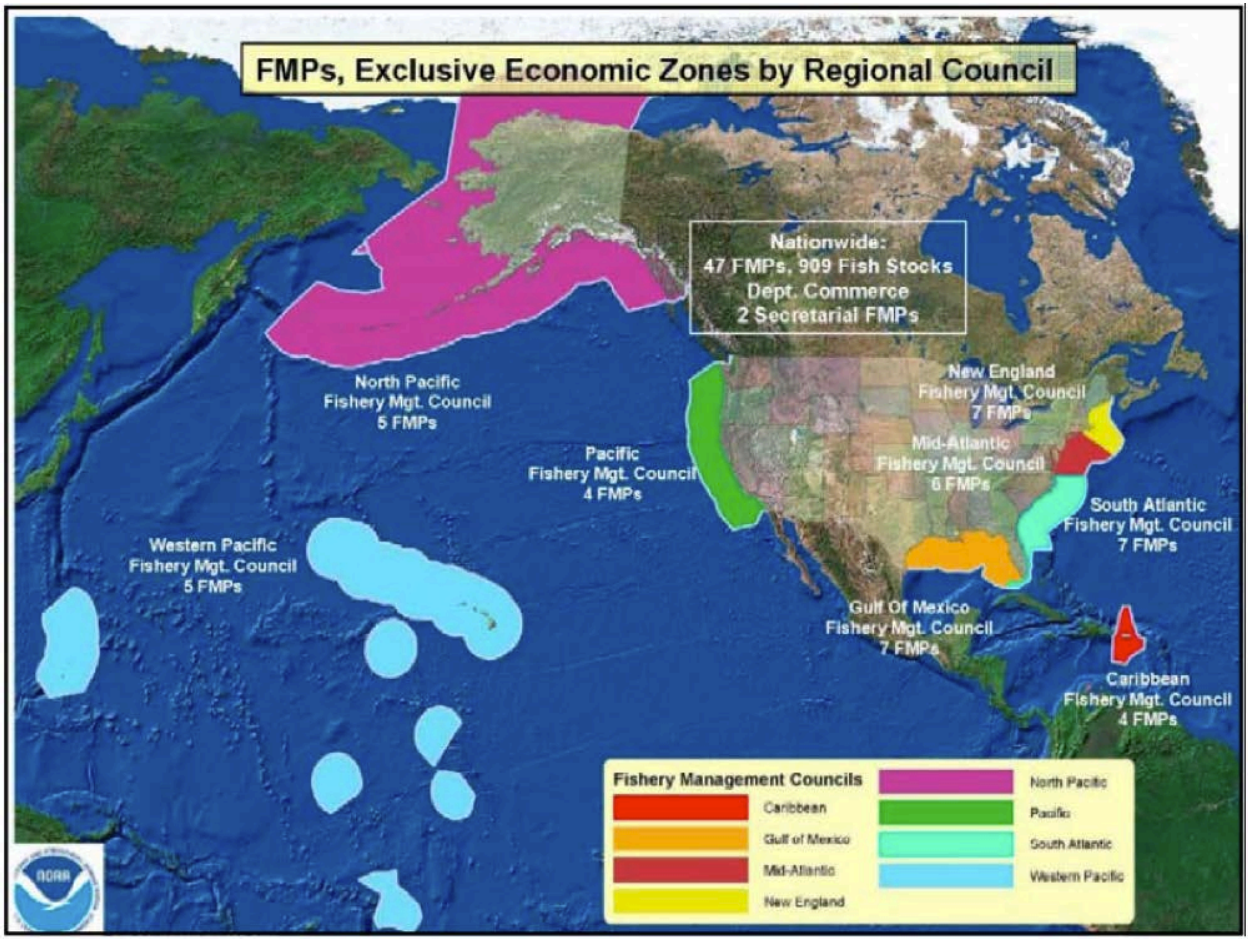

Figure 4: The 8 Regional Fishery Management Councils created by the Magnusson-Stevens Act in 1976 (From North Pacific Fishery Management Council website, http://www.npfmc.org/wp-content/PDFdocuments/meetings/IntrotoProcess.pdf)

waters: The Bering Sea and Aleutian Islands, the Gulf of Alaska, and the Arctic Ocean. The Council has also constructed different FMPs for species with widely differing morphological and behavioral characteristics, such as ‘groundfish’ (e.g., pollock, cod, flatfish, rockfish), shellfish (crab, scallops), and salmon.

At the heart of the MSA, and each FMP, are 10 National Standards. The Standards that most heavily influence at-sea fishing processes are the following:

> 1. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery.
>
> 9. Conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. (US Department of Commerce, 2007: 58-59)

One of the primary duties of the Council is balancing the competing demands of Standards 1 and 9: encouraging the “optimum yield” of target species, while also minimizing the bycatch that is caught along with target species. ‘Target species’ are “those species primarily sought by the fishermen in a particular fishery” (NOAA, 2006: 53), and bycatch is, as described in the previous section, species caught incidental to target species, but which is not retained for personal use nor for sale. “Optimum yield” is “The harvest of a species that achieves the greatest overall benefits, including economic, social, an biological, considerations” (NOAA, 2006: 34). The need to balance optimum yield and bycatch minimization is grounded in the common circumstance in which species besides those being targeted display similar temporal and spatial patterns of behavior at certain times of the year to those being targeted. This overlap of behavioral patterns fosters catching both when only targeting one. The need to minimize bycatch is heightened by circumstances in which target and bycatch species that are caught together also tend to display different spatial and temporal behavioral patterns at other times of the year. These different behavioral patterns foster the formation of distinct fisheries for these species. Thus, at one period the species co-occur and are caught together, and at other times of the year they are caught in distinct locations. For instance, Chinook salmon is often bycaught in pollock fisheries far out in the ocean, yet this bycatch becomes especially salient when it is perceived to impact the optimum yield of Chinook fisheries that occur at the mouths of rivers.

b. Fishing with the same gear

The Kodiak trawl fleet is foremost defined by the type of gear they deploy to catch fish and the type of vessel they use to deploy it. Trawling involves using a large net to catch fish that are located either on the bottom or in the water column. The largest of these nets approaches a mile around, typically with an opening of around 80 ft. high by 240 ft. wide, mesh as big as 120 feet at the front, “large enough to drive a car through,” tapering to about five inches at the back of the net, in a section called the ‘codend’ (see Figure 5). The codend is where caught fish collect as the

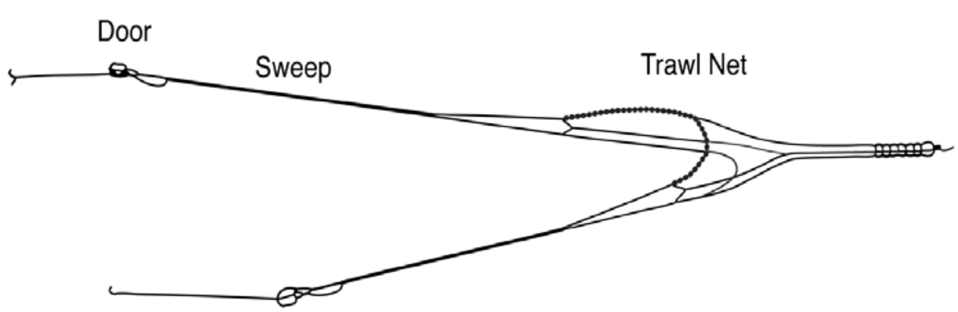

Figure 5: Trawl net diagram (Rose et al., 2010: 1)

Figure 6: An 80 to 100 ton codend of rockfish (photo courtesy of Alaska Whitefish Trawlers Association)

captain tows. Codends are typically 120 feet around and anywhere from 60 feet to over 1200 feet long, varying with the type of fish targeted. The larger codends in the Kodiak fleet hold as much as 100 tons of catch (see Figure 6).

To trawl, a captain must locate schools of fish and overtake them with a net, in contrast to more static gear that uses an attractant, such as bait, to draw fish to it (e.g., hook and line, pots). Once the captain set the gear behind the vessel, he steams forward at two to three knots, pulling two large rectangular and concave metal 'doors' that are connected to either side of the front opening of the net. Each door has about 60 square feet of surface area and weighs around 1500 to 3000 lbs in the water. When the vessel steams forward, the concavity of the doors pushes against the density of the seawater, creating hydrologic resistance that opens the mouth of the net. At this point the net is fishing, and the captain will work to maintain it at a depth that aligns with the fish he is attempting to catch, and, depending on how rocky the bottom is, also at a depth that also avoids hitting the bottom and tearing the net. To know where to trawl, captains rely on a sonar to 'see' the bottom and things in the water column as they move under the vessel. Depending on the variability of the bottom topography and the location of schools of fish, trawling may require ongoing adjustment of the net's location in the water column.

To fish with a trawl net is to conduct a tow, which is the basic event of a trawl fishing operation. The tow starts with setting the net and ends when the captain hauls the net up and the deck crew dumps the codend either straight into the fish hold or onto the trawl deck for sorting. Individual tows constitute a fishing trip, which is the period from when a vessel leaves the dock, heads out to the fishing grounds, fishes either until its fish holds are full or it catches its pre-determined amount of fish, and returns to the dock to unload its catch. Individual trips are conducted within fishing seasons, which last either as long as the fleet or individual has quota to fish (discussed below), a prohibited species bycatch limit has not been reached (also discussed below), or simply for a regulatorily-defined period of time. The length of a fishing season tends to be a factor of the size of the quota, the extent of vessel capacity aimed at catching it, and the nature of natural systems in which vessels are fishing - primarily the extent to which target fish are aggregated and how amenable the weather is to fishing. If the natural conditions are ripe for trawling, then fishing will likely be "fast," and the season will be relatively short.

While tows add up to a trip and trips add up to a season, the information garnered from tows informs subsequent tows in the same trip, subsequent tows in subsequent trips, and subsequent tows in subsequent trips in subsequent seasons. Running a fishing operation is a

Figure 7: Examples of Kodiak trawl vessels (photo courtesy of Alaska Whitefish Trawlers Association)

concatenated process in which knowledge from one clearly demarcated event is imported into subsequent events. This is the reason that a determination of where to fish is always a determination of where to fish next. The only difference is the proximate or distal relationship of the previous fishing event to the next fishing event.

c. Fishing with the same types of vessels

All commercial fishing fleets in Alaska are defined by whether they deliver their catch from a fishing trip to a shoreside processing plant or instead process the fish onboard. The Kodiak trawl fleet is constituted almost entirely by catcher-vessels (CVs), which are vessels that deliver their catch to a shoreside fish processing plant. The alternative to the CV is the CP (catcher-processors), which houses its own processing plant on board. CV and CP fleets, even if they use the same type of gear and fish for the same species, tend to be regulated differently. For example, CPs are not allowed to fish for pollock in the Gulf of Alaska, while they are allowed in the Bering Sea.[3]

Figure 8: Deckhands dumping a codend of cod (photo courtesy of Alaska Whitefish Trawlers Association)

The Kodiak fleet consists of a stable core of CVs that primarily fish in the Central Regulatory Area of the Gulf of Alaska, as well as a group of more transient vessels that move from the Gulf to the Bering Sea to the coasts of Washington and Oregon. The size of the fleet fluctuates with how lucrative local fisheries are compared to fisheries in other areas. Nonetheless, the fleet is typically around 35 vessels. About 25 vessels homeport in Kodiak, and the remainder homeport primarily in Washington or Oregon. Approximately 15 vessels are owner-operated, which means the owner runs the vessel part of the year, while several owners own multiple boats. In addition, corporations that own fish processing plants also own a few boats in the Kodiak fleet, and the number of “corporate boats” appears to be increasing every year.

Vessels in the Kodiak fleet range in length from around 58ft to around 125ft, with an average length of around 80ft feet (See Figure 6 for examples of Kodiak trawl vessels). While vessels vary in how much fish they can carry in their fish holds, about half of the fleet meets or exceeds their regulatory fishing trip limit of 300,000 pounds, while the other half holds anywhere from 150,000 to 280,000 pounds (this trip limit is one of the Steller sea lion protection measures, which are further described below). The Gulf-wide trip limit means that even though a vessel may hold more than 300,000 pounds of fish, it can only bring that amount to port in a 24-hour period. The fleet as a whole, based on trip limits, can hold about 3,800 tons of fish at once.

[3] There is one trawl CP that is allowed to fish for pollock and cod in the Gulf.

d. Fishing with the same organization structure

Each Kodiak vessel is an organization in that each is constituted by "social structures created by individuals to support collaborative pursuit of specified goals" (Scott & Davis, 2007: 11). All Kodiak vessels have the same goals - to fish profitably, safely, and legally. And all Kodiak vessels have the same general organizational structure constituted by a captain, first mate, engineer, and one or two deckhands. Each of these roles comes with its own generic rules, procedures, and contributions to the overarching operation. Thus, a vessel is also an organization in that it has "generic subjectivity" (Wiley, 1988). The first mate usually works on deck with the deckhands, helping with and managing their work as they conduct the hundreds of interlinked maneuvers, adjustments, and connections required to set a trawl net into the water, haul it back on board, and dump its contents (see Figure 7 a picture taken during a haulback). The engineer is responsible for all vessel mechanics, from maintaining the one or two diesel engines employing anywhere from 500 to 1200 horsepower (most of the fleet operating at around 900 horsepower, which is twice the average horsepower of a semi truck), to operating the hydraulics as they pull the net on board, to fixing a malfunctioning head. The captain oversees the first mate, deckhands and the engineer, while also determining where to fish, and, once he finds a place to fish, determining how to catch them. Vessels usually have two captains who alternate running the boat throughout the year, and most crew alternate as well.

The captain is also responsible for everyone's safety and overall compliance with the numerous regulations a vessel has to follow while at sea. These regulations include which fish can be sorted from the catch once it is dumped on the deck, what type of trash can be tossed at sea, which areas the vessel can fish in, or even 'transit' in, and so on. Two captains, while interviewing them in their wheelhouse, waved a thick book of regulations at me, emphasizing the complexity and magnitude of regulations they have to abide by at sea. This book is issued by NMFS. The local NMFS manager charged with enforcing those regulations also waved this book at me in his office, also emphasizing it size and complexity.

e. Fishing under the same quota allocation regimes

Captains, mates, and deck crew use catcher vessels and its trawl gear to fish for species that they have been allocated quota to catch. In the Gulf, quotas are allocated either at the fleet or the vessel levels. When quotas are allocated at the fleet-level, all the vessels in that fleet fish for the same quota. This type of management structure is known as a 'race,' 'derby,' or 'Olympic-style' fishery. For example, 100% of the pollock quota is allocated to the catcher-vessel fleet. Any vessel that belongs to the catcher-vessel fleet and has a permit to fish for pollock in a regulatory area (e.g., 610, 620, 630) can fish for the pollock quota allocated to that fleet and to that area.

The length of a race fishery varies greatly. They may last only a day or they may last weeks depending on the size of the quota, the extent of fishing effort, how aggregated the species is, how plentiful those aggregations are, and how amenable the weather is to catching those aggregations. If we assume amenable weather and plentiful target fish, when a fleet fishes under the same quota and its collective capacity to catch the target fish is high in relation to the size of the quota, the result is typically competition. This means that the amount of fish one captain catches may detract from the amount of fish another captain has the potential to catch. Captains race one another to catch as much as they can before they collectively reach the quota. For example, from 2002 to 2008 a winter pollock race fishery in area 630 was open for as few as two days and as many as 26 days, with an average of 10 days. This extreme range is due to varying levels of effort, which is shaped by a variety of factors, one of which is that this fishery tends to sit open while the fleet fishes for cod. When the fleet turns its attention to this fishery, however, it is typically over in a few days. In conditions of plentifully aggregated pollock, vessels usually get in one to two trips before the fishery closes. Yet, if a vessel is faster than other vessels, it may get in three trips in this fishery. The race fisheries the Kodiak fleet engages in are pollock, cod, and flatfish.

Alternatively, when percentages of a quota are allocated to individual entities, such as a community, cooperative, or vessel, captains fish for predetermined amounts of fish. Assuming that all conditions of plentifully aggregated target species, this means that the amount that one entity catches does not detract from the amount another has the potential to catch. These types of management structures are known as ‘privatized’ or ‘rationalized’ fisheries, and include catch shares and individual fishing quotas. Another benefit of the privatized nature of this quota allocation structure is that the length of a fishery typically aligns with regulatorily-defined dates, and captains can fish at their leisure within those dates. For example, the Central Gulf rockfish fisheries, the only rationalized trawl fisheries in the Gulf, have been ‘rationalized’ since 2007. From 2000 to 2006, this fishery opened around July 1 and tended to close around July 10. Since 2007, vessels have had their own rockfish quotas that captains can catch any time between May 1 and November 15. Taken together, the Kodiak trawl fleet has experience fishing in both rationalized and race fisheries, both across and within years in which they move from one to the other.

f. Fishing in the same fisheries

A fishery is the merging of a quota for a target species, whether it is a race or privatized quota, a management structure defining the timing and location of fishing effort for that target species, as well as the types of vessels that can fish in that area and for that species, “one or more stocks of fish which can be treated as a unit” (MSA, 2007: 7), and fishing effort. Thus, a fishery is the integration of relatively abstract structures and relatively concrete fishing activity. The spatial and temporal structuring of fisheries is discussed below.

The spatial structuring of fisheries in the Gulf is a factor of three regulatory demarcations. First, with the passage of the MSA came the Exclusive Economic Zone (EEZ). For the preponderance of the resource management era prior to the MSA, the US’s territorial waters extended three miles offshore. Then in 1966 Congress added a nine-mile contiguous fishery zone adjacent to its territorial waters. This act relegated the three-mile zone to state control, and the adjacent nine miles to federal control. The MSA expanded the US’s federal waters, now the EEZ, to 200 miles offshore. While trawling is allowed in the EEZ, most state waters are closed to bottom trawling year-round, with a small number open to pelagic (mid-water) trawling (e.g., Prince William Sound, Middleton Island winter fisheries). Second, federal waters are further divided into the Arctic Sea, the Bering Sea, the Aleutian Islands, and the Gulf of Alaska. And third, the Gulf is divided into regulatory areas (610, 620, 630, 640) (see Figure 2). Each of these areas has its own fisheries. The Kodiak trawl fleet primarily operates in the Central Gulf, which encompasses areas 620 and 630, and sometimes crosses into areas the Western Gulf (610) and the Eastern Gulf (640). The neighboring Sand Point CV trawl fleet, however, primarily operates in the Western Gulf, while sometimes crossing into the Central Gulf.

Fisheries are further temporally structured into seasons. The creation of seasons in the Gulf trawl fisheries is largely a product of the 1990 listing of the Steller Sea Lion (SSL) under the Endangered Species Act. Since its listing, NMFS has enacted multiple structures, known as the SSL protection measures (PM), designed to distribute fishing effort across time in order to limit the extent to which fishing activity impacts the life history patterns of SSLs. As stated in the ESA Biological Opinion, the seasonal structure is “intended to temporally disperse pollock catches in the [Gulf]” (NMFS, 2010: 62). Starting in 2001, the PMs required that trawl fishing start each year on January 20th rather than January 1st, which is when non-trawl Gulf groundfish fisheries begin. The PMs also require the annual pollock TAC to be split equally among four seasons: two winter seasons (A, B), and two fall seasons (C, D). Each season occurs in each regulatory area (610, 620, 630), resulting in 12 pollock fisheries in the Gulf every year. Regulators allocate each season's 25% of the pollock quota among the three areas based on the predicted spatial distribution of the pollock biomass in the winter and in the fall. The cod fisheries are treated similarly, with an A season that occurs in the winter, and a B season that occurs in the fall.

Despite these seasonal structures, trawl fisheries overlap in time and space. The flatfish fisheries, temporally unaffected by the PMs, last all year; the rockfish fisheries, also not included in the PMs, last from May 1 to November 15. At particular times of the year, all trawl fisheries overlap, while at other times of the year just cod, pollock, and flatfish seasons overlap. Thus, the Kodiak fleet can engage in multiple overlapping fisheries. Due to the overlapping seasonal structure, and based on quota allocation structures, how relatively large target quotas are (each December the Council announces the quotas for all fisheries in the next year, while also setting preliminary quotas for the following year), and the value of individual species, vessel owners tend to construct annual fishing plans. Fishing plans outline which season a vessel will be fishing in at any given period throughout the year. These plans are based on the overarching trawl business model, which is to always be fishing, and to do so in the most profitable manner possible. Kodiak owners structure their fishing plans around the regulatory start dates for the most lucrative Central Gulf fisheries - pollock, cod, and rockfish, as well as other fisheries in other areas, depending on where their vessel is permitted to fish.

Thus, the Kodiak fleet tends to fish in the same fisheries at the same time, collectively moving from one fishery to another, with some individual variation. This fleet-level movement is based on an attempt to organize fishing operations to align with certain action patterns of target species, but under the constraints imposed by seasonal structures, as well as other regulation. For instance, the structure that divides pollock and cod fisheries into winter and fall fisheries forces captains to fish for these species in the fall, when they tend to be relatively less aggregated. When captains tow on thinly aggregated fish, they tend to catch more bycatch. Captains uniformly lament having to fish for cod and pollock in the fall seasons.

In the remainder of this study, I use "fishery" to refer to either a fishery or a season, as is typically the case in both management and industry. In all but the cod and pollock fisheries, “fishery” and “season” are interchangeable, for in the flatfish and rockfish fisheries, there is but one season. However, I will use “season” when it is necessary to distinguish one season from another, or when it is necessary to point out that I am discussing phenomena at the more specific season-level rather than the more general fishery level.

g. Fishing for the same target species, bycatching the same non-target species

The Kodiak fleet is a multi-target species fleet. Unlike the CV trawl fleet in the Bering Sea, which fishes almost solely for pollock, Kodiak vessels target pollock, cod, several species of flatfish, and several species of rockfish. A target species is created when regulators assign a quota to a species, the amount of which is derived from on a combination of scientific recommendation and regulator opinion, and allow fishing to occur for that species. All non-target species that are not retained are labeled ‘bycatch’ (NOAA, 2006), but not all bycatch is created equally. Some species are rendered bycatch because there is no market for them or because captains or processing plants do not retain them for technical reasons (e.g., too big to bring on board, too small to be processed), while others are rendered bycatch by regulatory prohibition. Although captains cannot retain certain bycaught animals due to other laws (e.g., marine mammals, birds), a certain group of fish species has been regulated as ‘prohibited species’ in Gulf trawl fisheries. Prohibited species can neither be targeted by trawl captains nor retained if caught while targeting other species; thus, they cannot be sold by trawlers even if there is a market for them - and the species that are prohibited in the Gulf trawl fisheries are some of the most valuable in Alaska. Prohibited species in the Gulf trawl fisheries consist of tanner (‘snow’) crab, king crab, Pacific herring, Pacific Halibut, steelhead trout, and Pacific salmon, which, in terms of the Gulf, refers to Chinook and chum salmon.

Two prohibited species have a profound impact on how Gulf trawl fisheries unfold. This is because catch amounts of these species can determine whether a fishery opens or not, and can cause a fishery to close before its quota has been caught. In Gulf trawl fisheries, Pacific halibut and Chinook salmon have prohibited species catch limits, and can have such impact. While halibut limits have been in place since 1985, the limit for Chinook bycatch in the Gulf pollock fisheries was an outcome of the 2010 bycatch event which is the subject of Chapter Four. Prior to that event there were no in-season management limits on how much salmon could be bycaught in trawl fisheries.

The difference between a 'limit' and a 'quota' is that 'quota' is used for a target species in a specific fishery, while 'limit' is used for prohibited species, and applies to all fisheries in which that species is caught over a certain period. When a prohibited species limit is reached, all open target fisheries in which that species might be bycaught close, and they do not open until more limit becomes available. The halibut limit is divided and released several times a year, while the full Chinook limit is released at the beginning of the year. A trawl fishery in which halibut is caught as bycatch will close when the halibut limit is reached - even if there is target species quota remaining. And all target fisheries in which halibut might be caught will not open until more halibut limit becomes available. To use an analogy, prohibited species catch limits function as a bank account for target quotas – they are used to fund fishing for target species. Once prohibited species catch funds are spent, NMFS managers will close whichever fisheries the prohibited species is typically bycaught in. Pacific halibut prohibited species catch tends to impact cod and flatfish fisheries, and Chinook salmon prohibited species catch can impact pollock fisheries.

The ability for prohibited species catch limits to constrain how much target quota captains can catch is one of the primary reasons that the axiom 'You never know until you tow' raises critical issues for Kodiak trawlers. The issue is that by the time captains know what they are catching in terms of amounts of prohibited species, it may be too late - that fishery in which they are fishing, and perhaps multiple subsequent fisheries, may be closed, stranding millions of dollars. In fact, on multiple occasions a few bad tows by one or two vessels have been known to shut down fisheries due to high halibut bycatch, leaving large amounts of target quota uncaught. Kodiak trawl captains do not like to "leave quota on the table," for doing so impedes the extent to which they can enact a profitable fishing business. As the Kodiak fleet's fisheries management consultant described at a fleet meeting, fishing a target quota when there is increased potential to catch high amounts of halibut means "you are gonna shoot yourself in the head."

h. Fishing within the same in-season agency management processes

In-season management is the active control of fishing effort to meet the regulatory imperatives of preventing overfishing of target species and minimizing bycatch of prohibited species, while also fostering the ability to achieve optimum yield. In-season management is conducted by NMFS employees. At the time of this research, there were two such employees in charge of managing all federal Alaskan fisheries. They describe the inherently tensional goal of in-season management the following:

> "[We] have quotas that we make sure are not exceeded. If people want to fish they have to follow what we say. But we also want to maximize the allocations once they are set. . . If the fleet wants to do something, it's our job to make sure they don't go over their allocations. We don't like to see negative numbers on the catch reports. . . . When we make closures we know they are affecting people, that it affects their pocketbooks, and we don't close fisheries without keeping that in mind."

Fisheries open and close on noon of the dates prescribed by regulation - unless in-season managers use the tool of closing fisheries early in order to not see negative numbers on weekly catch reports (which state the percentage of quota that remains, and when a quota is exceeded a negative percentage is given). In-season managers close fisheries early for one of two reasons: they predict a fleet will catch its target quota or they predict a fleet will reach its prohibited species catch limit prior to the regulatory end date of the fishery.

The process in-season regulatory managers go through for closing a fishery early is largely the same for both a target quotas and prohibited species catch limits. First they monitor and track target species and prohibited species catch amounts. From these data, in-season managers formulate target and prohibited species catch rates, which enables them to predict when a fleet will exhaust a quota or reach a limit, accounting for predictable changes in fishing effort or weather. The data in-season managers rely on come from NMFS fisheries scientists placed on fishing vessels and in processing plants, and from the processing plants themselves. In-season managers will also contact industry managers, owners, and captains to get a less abstract understanding of fishing operations.

In-season management is still, however, somewhat abstracted from at-sea fishing processes. Managers often receive target catch data, which is collected by processing plants, one to three days after it was caught, and prohibited species catch data, which is collected by on-board or in-plant fishery scientists, a week or more after it was caught. The further behind fishing activity that in-season management process are, the further into the future they have to predict when a quota or limit will be reached, and thus the less precise such predictions may be. In-season managers discussed this predictive process, and how their detachment from fishing activity influences it, when asked to describe a typical day:

> "Fisheries are different every year, every season. You don't expect it to be the same. . . We have to re-learn how a fishery will react every season. We have to learn how the weather is going to affect things, moon phases, I mean just about

> everything affects these fisheries. But we have learned over time what to look for, but we are still learning. . . The dynamics are always changing, and our reception of fishing activity data is always behind what is actually happening, so we have to project for that. . . If we [close a fishery] a day under or a day over depending on catch rates, that can be a big deal. If we are a day under, we might then have to re-open the fishery."

Not only do inseason managers have to predict days in advance due to both delays in getting catch data and the inherent unpredictability of fishing, they also have to predict into the future because they have to post closures in the Federal Register for them to be enforceable. It takes several days to post a closure in the Federal Register, more if a weekend or holiday is approaching, as the in-season managers discuss in the following:

> "We are beholden to the Federal Register. . . .If we have to close a fishery, we will pick a closure date, send it to headquarters in DC, it gets some review there, then we send it to the Federal Register. But the Federal Register isn't open on the weekends or on holidays, so we have to project. With holidays we have more days to project to determine a closure, and if the holiday is in the middle of the week we have to project differently."

Captains operate according to the whims of the weather and the unpredictability of the ecology, on weekends and on holidays, while in-season managers operate according to predetermined bureaucratic schedules.

i. Fishing in the same fleet-generated structures

The Kodiak fleet's movement from one fishery to the next is not only shaped by ecological and weather conditions, the relative sizes of quotas and values of species, and the actions of in-season managers, it is also shaped by an industry-level logic that each vessel should have fair access to a shared quota. Thus, in race fisheries in which vessels do not have their own individual-level quota, each has access to a fleet-level quota. The actual amount a vessel catches is beholden to the vessel's effectiveness in terms of being able to find fish, and efficiency in terms of how much time it needs to fill its hold. Nonetheless, because fisheries overlap, the fleet tends to work together to structure that movement in order to maintain fair access. For example, in the winter, both pollock and cod seasons open on January 20th, enabling the fleet to contemporaneously fish for both quotas. Yet, captains are uncomfortable with the potential for situations to arise in which one group of captains, or even one captain, fishes from a quota in one fishery, such as cod, while another group of captains is fishing for pollock. When this situation occurs, the captains fishing in different fisheries at the same time diminish each other's opportunity to catch as much as they can of both quotas (e.g., the captains fishing for pollock catch the quota that the captains fishing for cod could have the opportunity to catch after they have exhausted the pollock quota). To prevent situations in which captains contemporaneously diminish one another's opportunity to have fair access to a quota, Kodiak captains organize on land to create 'fleet agreements.'

The most common fleet agreements are the 'fair start' and the 'stand down.' In these agreements, which are signed by all fleet members, captains agree to delay their fishing effort ('stand down') and start fishing on a chosen date that is after the regulatory-defined start of the season ('fair start'). These agreements structure the temporal nature of individual fishing operations in order to maintain fair access. Returning to the example above of the cod and pollock fisheries, in most years the fleet agrees to stand down in the pollock fishery when it officially begins on January 20th, and schedule a fair start in that fishery for a date after they predict they will have finished catching the cod quota. The fleet separates their fishing effort using a self-generated temporal structure, and in doing so create fair access to both the pollock and cod quotas. These agreements mean that one captain fishing for pollock cannot "catch the quota out from underneath" another captain fishing for cod.

Fleet agreements are also meant to, to the best of the fleet's ability to work within the regulatorily-prescribed timing of fishing seasons, align their fishing operations with life history traits, such as the aggregating behavior of all their target species and roe development in pollock. In the following a captain outlines this reasoning for delaying fishing for pollock in the winter seasons:

> "The longer you delay any [winter pollock] season, the better off the fleet is. The last time we had a big roe year was 2007 when B season came and we sat because of weather. It was 10 days after [the season started],when we left the dock and we had big numbers. . . There is no downturn about it. So, I think we should come up with a plan everyone likes, and go from there. The longer we postpone it the better off we all are truthfully".

When setting out to fish, captains search for a place to fish, with the time in which they go fishing being largely predetermined - either by regulation or fleet agreement. This is why sensemaking at sea, which starts at the docks, is largely focused on *where* to fish when captains set out to sea, rather than *when* to fish. And that is why this study examines processes through which captains determine where to fish, not when to fish.

Another important type of fleet agreement is the voluntary catch share. This is also aimed at allowing fair access, often in cases in which in-season managers determine that there is too little quota, in relation to potential fishing effort, to open a race fishery at all. The reason is that fisheries must be open for a 24 hour period, but the fleet will likely overfish their quota in that period. In 2010 in-season managers started working with and allowing the Kodiak fleet to self-manage certain fisheries by monitoring and controlling their own catch amounts. The basic structure of such an agreement is a predetermined amount, based on the quota and fish hold capacity, that each vessel gets to catch. With such an agreement in hand, in-season managers will open the fishery for the amount of time the fleet requests to catch the quota, taking factors such as the time it takes to steam to the grounds, weather, and probable fishing quality (i.e., extent of aggregating behavior) into consideration. The fleet then tracks their catch amounts while operating at sea and processing plant managers monitor catch amounts when captains offload. For example, since 2010 Kodiak captains have self-managed all the A and B 630 fisheries, and have caught an average of 95% of the 630 A and B quotas. From 2003 to 2009, however, captains overfished either the 630 A or B pollock quotas each year, catching an average of 128% of the fish they were allowed to catch. In two of those years, in-season managers did not open the B season at all in order to compensate for the overfishing that occurred in the A season. And in one B season the fleet caught 323% of the quota. As one in-season manager commented, "A fishermen can come in on their quota a lot better than we can project." This dissertation helps us understand the interpretive and decision-making processes captains undergo in order to enact such precision.

j. Fishing in the same regulatorily-limited areas

The fleet-level movement in which captains attempt to align their operations with the behavioral patterns of their target species is further limited, both spatially and temporally, within fishing seasons. These limitations are primarily due to the SSL PMs, yet also due to other regulatory structures. In addition to the trip limit and the seasonal structures described above, there are a "complex" and "complicated" "mosaic" of temporal and spatial closures trawl captains face, making it "impossible to easily sum these various closures and determine how much of the area is closed to fishing" (NMFS, 2010: 59 - 60). The purpose of spatial and temporal closures is to control the relationship between fishing effort and SSL rookeries and haulouts. Rookeries are "terrestrial areas used by adult Steller sea lions during the breeding season"; haulouts are "terrestrial areas used by adult Steller sea lions during times other than the breeding season and by non-breeding adults and subadults throughout the year" (NMFS, 2010: 96). There are 148 area-based closures that impact pollock fishing in Alaska, 79 of which are in the Gulf. In general, fishing for pollock is prohibited less than 10 nautical miles around haulouts and 20 nautical miles around rookeries. Yet, the absolute or temporal existence, or spatial range, of many closures depends on whether the vessel is using bottom or pelagic trawl gear.

Yet, there are additional spatial closures that structure trawl fishing activity in the Gulf. There are eight areas closed to protect red king crab rearing and breeding around Kodiak Island, some of which are closed for part of the year, others for the entire year, and others are contingent on king crab 'recruitment events.' In 2010 the Council added new tanner crab closures near Kodiak Island. Other closed areas intended to protect crab stocks include the Cook Inlet Non-Pelagic Trawl Closure Area and the Southeast Outside Trawl Closure. In addition, there are several Essential Fish Habitat closures in the Gulf (i.e., Coral Habitat Protection Area; Alaska Seamount Habitat Protection Areas; Slope Habitat Protection Area), as well as the Sitka Pinnacles Marine Reserve. Taken together, these restrictions are based on gear, time, space, and the nature of certain life history events of certain species.

6. Methodology & Analytical Approach

This dissertation is a case study of the Kodiak trawl fleet with the goal of extending organizational theory, primarily sensemaking, and secondarily recurring action patterns, to the frontline of commercial fishing. Theory extension is appropriate when existing ideas can provide the foundation for exploration of new theoretical territory (Lee, Mitchell, & Sablynski, 1999). An example of theory extension is Dutton and Dukerich's (1991) case study of the New York Port Authority. In elucidating how their subjects dealt with issues related to homelessness, the authors elaborated theory of organizational adaptability with the role of consistency in the interrelationship between identity and image. In this study, the salient dynamic among regulatory structures and processes, at-sea fishing practices, and indeterminate nature systems provides a fruitful context for extending sensemaking into the realm of natural resource management.

Case studies are appropriate when the goal is theory extension (Eisenhardt, 1989). A case study design is used when 'how' and 'why' questions are posed, rather than questions concerning 'who, what, where, how many, and where next.' The former questions seek to explain, the latter seek to predict (Yin, 2009). In addition, case studies are appropriate when the research questions necessitate a longitudinal perspective, and when the focus is on real world events that cannot be divorced from their contexts (Lee 1999; Yin, 2009). Simply stated, "The case study is a research strategy which focuses on understanding the dynamics present within single settings" (Eisenhardt, 1989: 534). The overall goals of my research are to understand rather than predict organizational phenomena, to elaborate rather than test organizational theory, and to depict dynamic and longitudinal processes rather than cross-sectional relationships, all in a discrete real-world setting. A case study approach is somewhat of a mainstay of sensemaking research (e.g., Dunbar & Garud, 2009; Gioia & Thomas, 1996; Maitlis 2005; Patriotta, 2003), and is an appropriate choice for this study.

I chose to study the commercial fishing context because of my background in the Alaskan fishing industry. I spent three years and two summers working as a fisheries observer for the National Marine Fisheries Service primarily trawlers in the Bering Sea and off the coasts of Washington and Oregon. Being a fisheries observer meant that while I lived on board with the crew, I was an outsider, a 'fish cop' as fishermen were wont to characterize. My duty was to sample the catch according to statistical protocols and monitor fishing operations for regulatory violations, and provide data that is the primary information upon which regulatory management decisions are made in Alaskan federal fisheries. In total I logged 669 days at sea on 17 different vessels, 15 of which were trawlers. This background gave me an in-depth understanding of at-sea fishing operations while also giving me the legitimacy I needed, primarily as someone who has extensive experience at sea and knowledge of trawl fisheries, to gain access to the Kodiak trawl fleet to conduct ethnographic research.

I chose the Kodiak trawl fleet for as my case practical and topical reasons. In terms of practical reasons, the fleet has a reputation for being a local, community-based fleet, while also being a large industrial fleet. I knew that many trawl captains who fished out of Kodiak also lived there. From preliminary research, I realized that there were local industry and regulatory managers, industry personnel, and community groups I could also study while the fleet was fishing. Being in the community was being at the frontline of commercial fisheries management. In terms of topical reasons, my initial interest was in fleet self-regulatory processes when engaging in a 'rationalized' catch-share fishery. The Gulf rockfish fishery had just been converted to a catch-share fishery in 2006, and my goal was to study the Kodiak fleet as they moved inter-annually from competitive fisheries, such as pollock and cod, to the non-competitive rockfish fishery. Yet when I arrived in the field in 2011, I found that the issue that was of salient concern to the Kodiak fleet and the broader community was Chinook bycatch. This concern transitioned to halibut bycatch in 2012. Thus, a few months into my fieldwork, I realized that I was no longer studying the fleet as they managed their operations in and out of a catch share fishery, but as they managed their bycatch in all fisheries. Because of the ethnographic nature of my research methods, my case shifted with shifting focal issues on the ground, whether I wanted it to or not.

I used qualitative methods to collect data due to their sensitivity to individuals' interpretations, activities, and interrelated interpretations and activity sequences, as well as contextual elements and processes (Langley, 1999, 2007; Lofland, et al., 2006). My primary fieldwork spanned a two-year period (2011, 2012). I spent January through May of each year in Kodiak, Alaska observing the Central Gulf trawl fleet as they enacted the same winter fisheries each year. In both years the fleet started fishing Pacific cod, transitioned to the A and B pollock fisheries, yet in 2012 the fleet transitioned back to cod mid-way through pollock, and then transitioned again back to pollock (all in the interest of fishing the species that was most aggregated). In both years the fleet fished flatfish and then rockfish after pollock and cod. I arrived in 2011 prior to the 2011 A season, which was the first pollock season after the 2010 D season, during which the at-sea portion of the Western Gulf bycatch event occurred (which is the subject of Chapter Four).

My data sources include semi-structured interviews, observation, participant observation, and archival documents and recordings. Interviews can be an effective tool for understanding how organizational participants come to attach meaning to events (Berg 1998). As such, interviews provide an opportunity to see how organizational members organize their world. As Czarniawska (2004: 49) explains, "what people present in the interviews is but the results of their perception, their interpretation of the world, which is of extreme value to the researcher because one may assume that it is the same perception that informs their actions." I conducted semi-structured interviews of Kodiak trawl captains (26), fish processing plant managers (4), salmon and halibut captains (7), industry managers/consultants (11), and National Marine Service managers (6). Captains had an average of 25 years of experience at the helm of a fishing vessel, ranging from 16 to 41 years. Two of these captains took part in the Western Gulf bycatch event, but all had experience targeting pollock and catching, as well as attempting not to catch, Chinook salmon bycatch. Table 1 provides examples of the questions that loosely structured interviews with captains. I recorded interviews with an electronic recorder when given permission, otherwise I took hand-written notes. Recorded interviews were transcribed verbatim, and hand-written notes were typed as soon as possible in order to merge notes and memory into as accurate a transcription as I could manage. Interviews typically lasted between one and two hours, with the longest over four hours and the shortest about half an hour.

Table 1: Example interview questions	
Fishing captains and owners who used to be captains	How long have you been fishing? How long have you been a captain?
	Is there anything that surprises you at sea?
	Please describe a normal day of fishing.
	What makes a good captain? What characteristics separate one captain from another?
	What is your approach to dealing with Chinook bycatch?
	Who do you communicate with at sea? Why do you communicate with that person? What makes another captain good to work with?
	Has communication changed at sea since the big Chinook bycatch event in the Western Gulf?
	What would you change about the current bycatch management system?

Observation and participant observation are ethnographic study techniques. Ethnography is the close, detailed, and intensive observation of, and writing about, social life (Schwartzman, 1993). Like interviews, ethnography is also suited to an emphasis on meanings and interpretations, including describing in detail how organizational actors make sense of equivocal events in work settings (Patriotta, 2003; Zilber, 2002). Zilber (2002: 237) elaborates this point in stating that ethnography "can be aimed at uncovering not only overt behavioral patterns, but also the subjective experiences of organizational reality and the ongoing negotiations between members and subgroups over the interpretations and understandings of this reality."

I conducted observation and participant observation in a variety of settings. First, I observed 15 Central Gulf trawl fleet meetings, each lasting one to three hours. Second, I observed two meetings of the local fisheries advisory group - the Kodiak Fisheries Advisory Committee (KFAC). Third, I spent one day of observation on board two vessels, each conducting non-fishing, industry-organized research trips to test devices designed to exclude salmon from the catch. Fourth, I conducted participant observation during two fishing trips, one of which targeted flatfish on the other rockfish. These two trips together lasted seven days. Thus, in total I observed operations on four fishing vessels. Fifth, I observed five to six days of three Council meetings, which last nine days, one of which was the April 2011 meeting in which the issue of Chinook salmon bycatch in the Gulf was a primarily agenda item. Sixth, I conducted seven months of participant observation in a local industry organization that helps manage the Central Gulf trawl fleet.

My data collection approach was simply to write down everything I could, in as much verbatim language as I could. This included spoken words, actions, intentions, and appearances (Hoyle, Harris, & Judd, 2008). To aid note-taking efficiency, as well as recall, I followed Berg's (1998: 147-148) suggestions of 1) recording key words and data in the field, 2) taking notes about the sequence of events, 3) limiting the time in the setting, 4) writing up the full notes immediately after leaving the setting, and 5) writing up the notes before sharing them with others. I took hand-written notes during meetings and fishing trips, while also obtaining official recordings of Council and KFAC group meetings. I transcribed notes from fleet meetings and fishing trips as soon as possible so that they were as accurate as I could manage. In terms of the local consultancy organization, I took hand-written notes when possible during my first year of fieldwork. Later in the second year I was allowed to record the time I spent in this organization.

The primary archival research I conducted was recordings of Council meetings. Council administrative staff records each meeting and uploads the files to an internet data storage service (box.net), which is accessible by the public. These recordings include Council discussions, deliberations, as well as public testimonies. Four Council meetings comprised the on-land portion of the Western Gulf bycatch event: December 2010, February 2011, April 2011, and June 2011. The Chinook salmon bycatch portion of each meeting ranged from half a day to one and a half days of Council activity. I transcribed all of the public testimony period of the Chinook salmon bycatch portion each meeting, and the entire Chinook salmon bycatch portion of three meetings (limited time being the reason a fourth meeting was not transcribed). Nonetheless, I listened to the non-transcribed meeting multiple times, each time taking notes. My focus of these meetings was their public testimony period.

Public testimony consists of stakeholders describing their involvement in an issue, stating their concerns with an issue, and telling the Council the action they should take on an issue.

Individuals are allowed three-minute statements and groups are allowed six-minute statements. Council members ask stakeholders questions in return. In the meetings of concern, some members of the public found themselves testifying for as long as half an hour, and others as short as three minutes. Often the exchanges between stakeholders and Council members are spirited and candid, and often they are systematic in which Council members ask multiple stakeholders the same questions for the stated purpose of finding commonalities. Table 2 provides the array of stakeholder testimonies analyzed for this chapter, comprised of 57 testimonies and 36 unique testifiers, which added up to 115 pages of single-spaced transcribed text.

Table 2: Archival data sources from public testimony periods of relevant Council meetings

Meeting	Salmon industry testimonies	Trawl manager testimonies	Trawl captain testimonies	Conservation group testimonies	Other testimonies	Total testimonies	Pages of transcribed text
Dec. 2010	12	2	6	0	0	20	38
Feb. 2011	1	2	1	1	0	5	14
April 2011	6	5	6	1	1	19	27
June 2011	4	5	4	0	0	13	36
Total	23	14	17	2	1	57	115
Unique testifiers	17	7	9	2	1	36	

The data derived from these methods were coded primarily with Nvivo and analyzed using grounded theory principles (Glaser & Strauss, 1965). My primary approach was constant comparison, in which I iteratively compared themes derived from the data to the organizational theory literature (Charmaz, 2006). I began the analytical process with interviews of captains. From this initial step, dominant themes began to emerge, such as "interrelating with ecological processes," "working with processing plants," and "updating to avoid Chinook." With initial dominant themes in mind, I moved to fishing trip data and added and refined themes. From there I moved to other interviewees, to fleet meetings, and then to Council meetings, each time adding and refining themes. I worked through my data and revised my themes iteratively. Council public testimony was coded a second time using Microsoft Word. On multiple occasions I took a break from coding to organize themes into a coherent theoretical framework. After multiple iterations of coding data and organizing frameworks, I finally settled on one that, as perhaps put best by Pratt (2000: 462), "I believed offered a strong contribution to theory without doing undue violence to my experience." And, like Pratt, I have also discussed my framework with key participants, altering it according to their suggestions [to be completed].

7. Roadmap to Subsequent Chapters

The ensuing chapters consist of three empirical chapters and the study's conclusion. In Chapter Two I begin to examine at-sea sensemaking at the individual-level, examining *why* captains interrelate with natural systems, *what* elements of natural systems they interrelate with, and *how* they interrelate with them. I start by exploring the role of profitability in fishing, primarily in terms of the efficiency imperative it puts on captains. Then I move to discussing the material components of at-sea processes (i.e., target species behavior, the ocean bottom, and weather). I explain how the characteristics of these materialities influence how captains interrelate with them. A key finding is that based on how these materialities recurrently interrelate in time and space, Kodiak trawl captains have a disposition to fish where they have fished before. Yet, due to the inherent indeterminacy of natural systems, this disposition is always a conjecture, and the process of determining exactly where to fish is largely an abductive process. From these findings I produce an individual-level model of abductive sensemaking at sea, which I further explore in Chapter Three and apply in Chapter Four.

In Chapter Three I expand the individual-level work of Chapter Two to the social level. This chapter examines the sensemaking that captains undertake as they work through the three primary environments they enact at sea: the plotter-based environment, the sonar-based environment, and the trawl deck-based environment. Using the model produced in Chapter Two, I model the social processes captains construct as they progress through each environment, and I discuss how sharing experience can increase one another's 'abductive capacity' for making sense of indeterminate natural systems. Furthermore, in this chapter I demonstrate how sharing information about past experiences with materiality in certain times and spaces, or actually sharing those times and spaces, can create discontinuity in captains' progression through their fishing process. This chapter also shows how the retrospective nature of creating meaning at sea, in that captains only know what they were towing from after they have towed from it, can create incongruence between the concrete part of their experience (e.g., actual extracted fish) and the abstract part of their experience (e.g., expectations of extracted fish). I also discuss how captain resolve both discontinuity of progression and incongruence between the abstract and concrete aspects of experience.

Chapter Four is the final empirical chapter. In this chapter I apply the models and findings from chapters One and Two to an extreme real-world event: the Western Gulf Chinook salmon bycatch event. This event was the largest catch of Chinook bycatch in a fishing season on record in the Gulf. This seasonal catch resulted in an annual catch of Chinook in the Western Gulf that was 11.5 times higher than the 15-year average (NPFMC, 2011), and which also exceeded the Endangered Species Act (ESA) trigger for inter-agency consultation (due to the presence of Chinook in the Gulf from ESA-listed streams in the Pacific Northwest). The consultation meant that the Council had to act, and the product of an ensuing seven-month regulatory process was an annual limit on the amount of Chinook Gulf trawlers could catch when fishing for pollock.

The event had both at-sea and on-land components. My examination of the at-sea component reveals that sensemaking functions to connect captains' patterns of activity with their target species' recurring patterns of activity, creating interaction patterns that span social and natural systems. Yet other species, such as Chinook, often enact the same or similar action patterns as target species, such as pollock, do. When captains do not differentiate between these action patterns, they produce bycatch. When this lack of differentiation occurs in a "hot spot," a large-scale bycatch even can occur. Chapter Four demonstrates that due to a lack of expectations for catching high amounts of Chinook bycatch, a high 'acceptable level of ignorance' in the face of concrete cues that something could be amiss, and regulatory and natural conditions that made changing locations costly, trawl captains did not attempt to differentiate their target species from Chinook salmon.

The regulatory response to the at-sea portion of this event was a rational decision-making process aimed preventing the creation of large-scale bycatch events. To do so, the Council instituted a limit on the amount of Chinook the trawl fleet can catch, the purpose of which is to incentivize captains to operate at the species-level in addition to the action-pattern level. The Council created a 'sensemaking incentive,' which was intended to encourage captains to take action to 'know, at the species-level, before they tow.'

And finally, Chapter Five concludes this dissertation. After reviewing the content from the previous chapters, I provide implications for future research and recommendations for practice.

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Chapter Two
From the Past, Through the Present, and Into the Future: The Basics Elements of Sensemaking at Sea

"Consider the subtleness of the sea; how its most dreaded creatures glide under water, unapparent for the most part, and treacherously hidden beneath the loveliest tints of azure."
--Melville, H. *Moby Dick,* p. 247

1. Introduction

The research question driving this study is, *How do frontline commercial fishing managers make sense of indeterminate natural systems as they attempt to extract material resources from them?* In this chapter I begin to answer this question by examining the elements of the process through which Gulf of Alaska (Gulf) trawl captains interrelate with natural systems in the interest of creating a profitable fishing practice. Captains seek a "workable level of certainty" (Weick, 1969: 40) regarding which particular natural systems, processes, or actors ('entities') to organize with. In order to create a workable level of certainty, captains engage in sensemaking to answer the question, "What's the story here?" in terms of the contextual conditions in which they are or may be operating, and, "What's next?' (Weick et. al, 2005: 410) in terms of how to move toward their goals, whether they are short-term or long-term, of enacting certain future events. The goal of this chapter is to build a basic model of the sensemaking that captains conduct in order to interrelate with natural systems at the frontline of commercial fishing. My purpose is to produce a model that allows researchers to analyze sensemaking processes in similar contexts.

To build an analytical model of sensemaking at sea, I draw primarily on data from fishing trip and fleet-meeting observations and personal interviews[4] in order to examine the elements of sensemaking at sea, using the following questions to structure this analysis: 1. *Why* do captains go fishing? 2. *What* natural systems do captains fish from? 3. *How* do captains make sense of which specific natural systems to fish from? Thus, each section below is constructed using a

[4]All informants in this chapter are Kodiak trawl captains, unless otherwise noted in the text; all data were collected by the author.

different adverbial tool (why, what, and how), to elucidate parts of the sensemaking at-sea process. A key finding is that captains, as managers of the business organization that is a fishing vessel, have an imperative to fish efficiently, and, coupled with the predictability offered by recurring relationships among natural systems, and facing the indeterminacy of the specific time and location, and composition of a target species aggregation, makes sense of where to fish using the operating model of fishing where they have fished before. Yet, the selection of an actual spot to fish in, from the many they have fished before, is influenced by current conditions of natural systems, primarily the particular behavioral traits of target species, the nature of the ocean bottom, and weather conditions. Because captains must choose a fishing spot efficiently, yet they must also choose one that will plausibly offer them the ability to enact a profitable fishing trip, they engage in abductive sensemaking. Abduction is the process of "comparing existing conditions to a relatively simple operating model" (Abolafia, 2010: 353). This chapter demonstrates that captains not only make sense of experience by 'connecting the abstract with the concrete,' (Weick et al., 2005: 412) but they also merge the past and the future, from which they produce a story of what is happening, from which they conjecture what action to take next.. Focusing on the process of determining where to fish, this chapter dissects the sensemaking at-sea process into the abstract, concrete, past, and future parts of experience, and produces a model in which captains draw from these parts of experience in order to tell a story of what is happening and conjecture what should happen next. In the next chapter I set this model in motion by examining episodes of abductive sensemaking throughout a fishing trip.

2. Why: Profitability

At the heart of a successful fishing process is the ability of the captain, crew, and owner to, as several interviewees put it, "make a living from it." Whether a fishing vessel is a small, owner-operated operation or part of a corporate conglomeration of vessels and processing plants, captains have a common duty of enacting profitable fishing processes because, as is the case with most businesses, profitability is the overarching goal of commercial fishing. In fact, to even go fishing captains must consider the venture to be a contribution to running a profitable business, as the following example of a captain sitting at the dock, rather than fishing, exemplifies:

> "That's why I'm not fishing right now is the [processing plant] wasn't going to pay enough money for the fish. . . They wanted me to go rock sole fishing, and I said, 'I can't do it.' The money isn't there because you are only getting 26 cents [per pound] for those big rock sole . . . I mean, on an average trip this boat here will

> burn almost two thousand gallons of fuel, at $3.80 a gallon. So you are looking at seven thousand dollars off the top on just fuel costs."

Going fishing was a not a viable option for this captain because he determined he would pay more for overhead costs, particularly fuel, than he would make from fishing for rock sole, which is a type of flatfish. As another captain put it, he would "go backwards." The reason this captain was able to make such a determination is because he knew, to an approximate degree, what his trip was going to cost. Such knowledge is apparent in another captain's description of the common overhead costs embedded in trawl fishing: "It's not cheap to take these things out fishing, it's not cheap. It's probably close to three thousand dollars a day just for fuel, plus observer[5] costs and groceries and everything else." Captains know, at a general level, what each fishing trip will cost due to predictable overhead costs; as another captain stated: "Between the cost of the fuel and the cost of the [NMFS fisheries] observer, you have some pretty heavy fixed costs on a daily basis." The captain's job is to find a place to fish that offers the possibility of catching enough fish, and doing so in a sufficiently efficient manner, to pay such costs, and have as much profit left over as they can muster. To accomplish this task, captains must continually wrest determinacy from indeterminate material systems, so that they can know, to a workable degree, the economic viability of a embarking on a certain fishing trip, of going to a certain fishing spot, and of a making certain tow.

In addition to profitability, other factors that can determine the viability of a fishing process include safety and regulatory compliance. Thus, like profitability, an actual or potential violation of a regulation can render a potential fishing process unviable. Yet, while certain regulations were salient topics of interviews and observed conversations, such concerns were usually framed in terms of how regulatory compliance actually or potentially impacted profitability. The following comment exemplifies this relationship between profitability and

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[5] Fisheries observers are biologists who work onboard fishing vessels and within processing plants to collect data according to statistical models on the catch amounts and composition. As stated in the Observer Manual (2013: 2-18), "The Bering Sea and Gulf of Alaska Fisheries are among the best managed in the world, in large part due to the data collected by observers. Statisticians and fisheries managers rely heavily on observer data and also rely heavily on the assumption that these data have been collected a specific way." NMFS uses their data, along with landings data provided by processing plants, to determine how much of each species Kodiak vessels are catching, keeping, and discarding. Observers also collect data on fishing locations and times. Kodiak trawl vessels have to carry observers for approximately 30% of their fishing time. The industry-funded pay structure has recently changed, from vessels paying a daily rate depending on when an observer is on their vessel to paying a % of their income to a pool, from which observers are paid.

regulatory compliance:

> "It's frustrating, but most of the time how I deal with it is I go, "Ok, these are the rules, and am I going to fucking make money like this." So I go out there, no matter what [regulation] I've got shoved up my ass, I've got to just go out there and not think about it and think about, ok, here's my options, and how do I still make a living for this vessel and my crew and everybody else? And that's what I got to do, and that's what I think about."

In addition, although all study participants would agree that safety is *the* primary concern when fishing, because there was only one marine casualty during my research, such concerns tended to live more in the background of interviews and observations of fleet meetings and fishing processes. Only in one interview, in which a captain had just returned from a fishing trip in which his vessel turned on its side due to a rogue wave, was safety a primary topic of conversation. The ability for invested parties to make a living from at-sea operations, due to efficient operations, was, however, a topic of conversation in nearly all of my interviews and observations.

Profitability is simply the income from selling the resources extracted from natural systems minus the costs of extracting those resources. Yet, within the profit derived from commercial trawl fishing is the incomes of the captain and crew. Thus, because incomes are typically derived from a share of the profit, how much the captain and crew make from a fishing trip depends on how profitable the trip was. Therefore, the lower the cost of catching fish, the more fish that are caught, and the more the caught fish are worth, the more the captain and crew will make. Put differently, how efficiently a captain enacts a fishing trip, part of which is how effective he is at choosing good fishing spots, has a direct impact on how much both he and his crew make from that trip. Income at the frontline of commercial trawl fishing lies in the nature of how captains organize with natural systems.

A profitable future imposes a demand on the present for an efficient means of bringing itself to life. At sea the onus falls upon captains to fashion an efficient pathway out of the past, through the present, and into the future. Captains noted that the skill required to continually keep the margin of income above the margin of costs is one of the aspects of being a captain that they value most, as the following exemplifies:

> "That's kind of why we are all fishermen - because the future is not dictated to us. We make our future. Whether we are successful with this or not, at least I leave town and my future is dictated by me, not by AT&T or Apple or who owns that company. Your talent dictates how successful you are, not some CEO of some

corporation."

Or, as another captain analogized, "We like the challenge, we like the competition, the professional athletics." The challenge captains face is to interrelate with indeterminate natural systems so that their margin of income is as far above their margin of costs as they can safely and legally manage, and the talent of doing so involves sensemaking at the frontline: creating a workable level of certainty in the face of the indeterminate, that enables them to efficiently extract fish and fill their vessels. Captains face an efficiency imperative at sea that shapes all

Table 3: Dimensions of the efficiency imperative captains face at sea

Dimension	Representative Quotes
General relationship between fuel costs and towing a trawl net	"These are high volume, low margin fisheries. Unlike the crab fishery, we have high operating costs, the trawlers have the highest overhead. With towing you burn a lot of fuel. The other guys just drop their pots and pick them up. We have to tow a big net."
Spatial influence of fuel costs: fishing as close to town as possible	"We run to the closest spot and we fill the boat in three or four hours." "We pretty much go to the closest area that's open." "[Area] 630 is vast, it goes all the way from Seward to the south end of [Kodiak] and the whole fleet catches their two pollock trips in about 15 minutes ten miles from town."
Spatial relationship between fuel costs and searching for fish	"Especially with rockfish, sometimes you just need to drive around and look for a long time. You try to figure out where they are and how congregated they are. But that is difficult with the costs of fuel and other fixed costs."
Biological and economic source of Ttemporal pressure induced by : deteriorating fish quality	*Interviewer:* "Is there a certain time you have to be back at the plant by?" *Captain:* "Well, once that fish [in the fish hold] gets about three days old, that's about it. . . That's what the problem is; we've been out here for four or five days so we are not gonna stop to get a good night's sleep." (fishing trip observation)
Temporal pressure induced by competition for a shared quota	"Thirty minutes could make or break a trip during this race for fish. . . I don't want to get lapped at the dock, I don't want to miss out on my last trip of the season over 30 minutes. . . This is a short little season, and this is our make or break time of the year - March is everything." (personal observation, fleet meeting observation)
Generalized sense of temporal pressure	"I don't know if it ever goes away, maybe the next generation of fishermen that's gonna grow up with catch shares will not have it, but you always have this sense of, we got to hurry up, got to fill the boat, got to get turned around, we got to get back there, we got to fill it up."
Relationship between fuel costs and temporal pressure	"It would be nice if we could stop and sleep, but the clock is running. . . .with the cost of fuel for you to come out here, you got to bring some fish back." (fishing trip observation)
Combined spatio-temporal aspect of fuel	"Fuel is cheap in the winter when the weather is bad, and fuel gets more expensive in the summer when weather is good. So guys are

costs and deciding when to fish	going try and fish when the fuel is cheap, no matter what."

aspects of at-sea processes, including how they make sense of natural systems.

Table 3 elaborates different dimensions of the efficiency imperative that captains face at sea, primarily focusing on space and time. Fuel costs are used to elaborate spatial demands for efficiency, for every movement of a vessel at sea, whether for the purpose of trawling or merely steaming, requires an expenditure of fuel. In fact, of all the costs of operating a vessel, fuel costs is the one that informants were most concerned with: captains mentioned "fuel prices" as a concern 14 times while on four fishing trips, and 22 captains mentioned issues related to fuel costs 51 times, and concerns with fuel costs were common topics of conversation in fleet meetings. One of the reasons for this concern is dramatically rising fuel prices, something captains in fisheries around the world face (Cheilari, Guillan, Damalas, & Barbas, 2013; Tyedmers, Watson, & Pauly, 2005). In Kodiak, fuel costs have increased over the past 10 years from an average of $1.40 per gallon in 2003, to $2.78 per gallon in 2007, to $3.63 per gallon in 2012 (archival data[6]). The sources of temporal pressure for efficiency are many, from the influence of competing with other captains for a shared quota in a "race" fishery, to the time restrictions canneries put on how long fish can sit below deck in a hold before they will start to lower the amount they will pay for them, to simply a more generalized sense of always having to hurry. Fuel also imposes impose temporal pressure, for the longer a vessel takes to steam or fish, the higher the fuel costs. Time is money at sea because, whether fishing or steaming, passing time is accompanied by burning fuel, as well as other accumulating overhead costs. It is these factors, among others, that constitute the efficiency imperative captains face when organizing their vessel with material systems at the frontline of commercial fishing.

3. What: Nexuses of Natural Materiality

A determination of where to fish is largely a determination of what materiality to fish from. Captains make sense of their ability to efficiently interrelate three interlinked natural systems - ecological processes in the form of aggregating behaviors of target species, the ocean bottom in its many manifestations (e.g., mud, rock, mountain, slope), and weather. Natural processes, at the level of concern in this study, are created by relationships among natural materialities, which, at a lower-level of organization, are themselves created by natural

[6] Monthly fuel prices for Kodiak were extracted using the database provided by the Fisheries Economics Data Program of the Pacific States Marine Fisheries Commission; http://www.psmfc.org/efin/data/fuel.html

processes. The concept ‘natural materiality’ describes objects and processes that have mass, can be assigned their own points on a geographical coordinate system, and “can exist outside of society” (Bansal & Knox-Hayes, 2013: 75). This type of materiality merges what Bansal and Knox-Hayes (2013), emphasizing its temporal and spatial attributes, call “physical materiality,” and what Whiteman and Cooper (2011), emphasizing its ecological and biological attributes, call “ecological materiality.” Natural materiality is not born of social processes, though it may be impacted by them.

This section examines the role that particular natural materialities (organized below as, a. Fish aggregations; b. The ocean bottom; c. Weather) play in Kodiak captains’ sensemaking at sea. An element of this role, which is addressed in each section, is whether each materiality is primarily a source of indeterminacy or determinacy when captains attempt to find a place to fish that meets their efficiency imperative. The data suggest that captains are disposed to interrelate not so much with distinct ecological and geophysical systems, but instead with recurring relationships among them. The sections below discuss these natural systems, including how they tend to interrelate recurrently.

a. Fish aggregations

When finding a place to fish, captains attempt to align their operating processes with their target species’ behavioral processes. First, captains attempt to find a particular place and time (i.e., a fishing spot) in which individuals of their target species are interrelating in time and space, or aggregating. Each trawl target species typically aggregates in certain places at certain times of year, whether they do so to feed or for spawning.[7] Yet, different target species aggregate differently. For example, certain rockfish form “little schools” in which fishing them is “like target practice,” while certain flatfish tend to gather on particular bottom types. In addition, schools of the same target species aggregate differently depending on factors such as location and time of year. For example, in certain spots pollock tend to gather with multiple other species in mid-water “feed bands,” while in other spots pollock pack tightly to the bottom, forming what

[7] For example, fisheries ecologists who study flathead sole populations in the Gulf area state, “Adults exhibit a benthic lifestyle and occupy separate winter spawning and summertime feeding distributions on the EBS shelf and in the GOA. From over-winter grounds near the shelf margins, adults begin a migration onto the mid and outer continental shelf in April or May each year for feeding. The spawning period may range from as early as January but is known to occur in March and April, primarily in deeper waters near the margins of the continental shelf” (McGilliard, Palsson, Stockhausen, & Ianelli, 2013: 614).

captains call “carpet.” Regardless of these differences, captains routinely attempt to fish their target species when its individual fish are gathered in space and time.

Yet, while there is variation in aggregating behavior depending on location and time of year, there is also variation in the size and frequency of aggregations across years. For example, the arrowtooth flounder biomass has increased steadily since the early 1990s, and since 2004 it has been the largest target species biomass in the Gulf (A’mar, Thompson, Martin, & Palsson, 2011: 247); meanwhile, the size of the cod biomass in the Gulf has varied immensely in recent years, increasing from 233 thousand metric tons in 2005 to 520 thousand metric tons in 2007 and 753 thousand metric tons in 2009, then dropping back to 501 thousand metric tons in 2011 (National Marine Fisheries Service, 2013). Such trends impact the extent to which captains can find significant aggregations of target species to fish from, as the following captain describes in terms of trends in the pollock biomass:

> “The Shelikoff [Strait] has been really consistent the last three or four years - just a lot of fish over there. But five, six, or seven years ago you go over there and tow and maybe get 10 thousand pounds an hour. You would tow for over a day to get a full trip. Generally it seems like the last few years you can fill up pretty fast. . . it gets really good over there at the end of February and March, like towing for 150 thousand an hour.”

Yet, even in times of relative scarcity, captains still attempt to find target fish that are sufficiently aggregated. Kodiak trawl captains are disposed to fishing from temporal and spatial interrelations of target species, i.e., aggregations, even if ecological factors constrain their ability to do so.

The fleet-wide disposition to fish from aggregations is driven by the dependency of trawl mechanics on aggregating behavior and the efficiencies that aggregating fish offer a trawl process. In terms of the dependency of trawl mechanics on aggregated fish, trawl gear works by actively overtaking fish rather than passively drawing fish to it through an attractant, such as bait on a hook or in a pot. Therefore, for a trawl net to be effective it has to be towed through an appreciable biomass of fish, a necessity a captain explained in detail during a fishing trip:

> “This area is huge, thousands of square miles of fishable ground. There's flathead, rex, dover, all the species of sole live in this area. All the species of midwater pelagic fish of Alaska live in this area too. But the problem with this area is it’s vast, and we're only covering 500 feet of it, and the net is only actually covering 56 feet of it. Theoretically we are herding fish toward the net with our sweeps (see Figure 4 in Chapter One), but how absolutely effective that is, we don’t know. So the fish have to be aggregated to some degree to catch very much.”

Trawl gear requires its target to be gathered to a certain degree, otherwise gear that more passively draws fish to it would be a more profitable approach.

Within a trawl net's effectiveness is its main appeal - the temporal efficiency it brings to a fishing process. Thus, the primary benefit of trawl gear is that it offers a relatively high rate of catch, which is dependent on its interpenetration with fish that are significantly aggregated. A captain explains the relationship between aggregated fish and efficiency in the following:

> "When the fish are congregated together, when they are schooled up and are more interested in spawning or feeding or whatever, it's the easiest for us to catch them. When there's a million pounds between here and the jetty (pointing to a chart), it's easy for us to catch them, but when they are dispersed in the water column, it's difficult for us to catch them."

What this captain means by "easy" fishing is what other captains refer to "fast fishing." If other factors such as weather or the structural nature of the ocean bottom (e.g., muddy, rocky) do not impede fishing, a general rule is the more aggregated target fish are, the quicker the vessel can fill its fish hold, and the quicker the vessel can finish a trip. These efficiencies tend to reverberate throughout the fishing process: the quicker a vessel can finish a trip, the less its captain and crew will likely spend (from their own income) on overhead costs, as well as the quicker the vessel will likely offload its catch at a processing plant and get back out fishing. Which means that, in a fleet that fishes in multiple fisheries, and in seasons that overlap, many of which involve captains attempting to fish as fast as they can before they collectively exhaust a shared, fleet-level quota, the greater the chance that the captain and crew will get in another trip. As one captain described,

> "You are directly competing with other boats and you only have limited amount of time to get your fish. . . If it takes you three or four hours longer than the other guy to fill your boat, that could end up costing you a trip over the season, or two."

An additional trip is about a $30 to $50 thousand net difference, depending on the target species. Captains and crew operate on potential, and efficiencies tend to increase their potential to either "make a living from it."

Another general rule is that the more a captain fishes from aggregating fish, the less prohibited species bycatch he will produce. Thus, we can further specify the efficiency–based benefits of fishing from an aggregation in terms of prohibited species bycatch efficiency. As is described in Chapter One, two prohibited species in the Gulf trawl fisheries have their own catch limits: Pacific halibut and Chinook salmon. Prohibited species catch limits are shared by the fleet, and they apply to all the target fisheries in which they are caught. These bycatch limits function as a sort of quota for halibut and Chinook, and regulatory fisheries managers work to prevent the fleet from overfishing these limits. For regulatory manager to either open a fishery in which these species are bycaught, or to keep such a fishery open, there must be prohibited species limit available to support the Chinook and halibut that might be caught in them.

The amount of halibut or Chinook a captain catches in one trip, or even in one tow, can deplete the amount that is available for subsequent trips and seasons for the entire fleet. A plant manager describes the effect that catching a lot of Chinook or halibut can have on the fleet and on subsequent fisheries in the following:

> "[If one boat] goes out and destroys the whole limit, that means everybody in town is done fishing, not just our boats, everybody's boats are done, whether they caught a Chinook or not. They can go out and fish cleanly and just because one boat caught all the salmon they can't fish anymore."

The reason that fishing from aggregated fish tends to produce prohibited species bycatch efficiency is largely due to ratios. Simply, an aggregation of target fish tends to contain within it high ratios of target species to prohibited species. Thus, even if the amount of a prohibited species in the water is such that it could potentially constrain subsequent fishing, when this amount is coupled with high amounts of target species, it is diluted. The effect is that when fishing aggregations, less prohibited species bycatch limit tends to be used to catch target species, which leaves more of prohibited species catch limit available for use by all captains in subsequent tows, trips, and seasons. As the Kodiak fleet's fisheries management consultant stated during a fleet meeting, fishing where there is a low ratio of target species to prohibited species means "you are gonna shoot yourself in the head" in terms of limiting their ability to continue to fish for target species. Kodiak trawl captains prefer not to shoot themselves in the head. As one further explains,

> "Now the managers say you only got X amount of halibut, so when your halibut's done then you are done fishing; so if you go out there and you are *careless* your season lasts three days and if you are *careful* it will last three weeks."

Because, as discussed in Chapter One, "you never know until you tow," one difference between being careful and being careless is fishing from aggregated fish rather than fishing un-aggregated fish. Targeting and fishing from aggregations is a recurring means by which captains move from an unworkable level of certainty toward a workable level.

The above discussion does not mean, however, that captains *always* fish from aggregations. One captain analogized fishing for flatfish in a certain area to "mowing your lawn," in which they "tow down one strip, move over and tow down another strip." This captain further contrasted that approach to fishing for cod in which he will "drive over them a few times and set on them and pick them up and go find another school," which is an approach to fishing for cod that other captains noted as well. When captains do not fish from aggregations of a significant size (i.e, that offers a desirable level of efficiency), they are doing what they call "scratching." Captains may scratch because they cannot find aggregated fish due to ecological dynamics, because they do not have the time to go out and search for aggregated fish due to constraints imposed by having to compete with other vessels for shared quota, or, as one captain critically noted, they simply choose to not "go out and look." Even though there are natural, structural, and individual sources of variation in the extent to which this fishing approach is enacted, an individual disposition for fishing for a target species when and where its individual fish are interrelated is a fleet-level characteristic of being a Gulf trawl captain.

i. How this natural system influences fishing practice

A primary source of indeterminacy involved in fishing from aggregated fish is the particularity of where and when a certain target species will aggregate. While most target species tend to aggregate at the same general times and in the same general places, the specific times and places in which aggregations show up is a source of indeterminacy nestled within more general determinacy. As one captain commented, "Basically, we know when the fish are going to show up, it's a matter of finding them." To "show up" means that individual fish are aggregated to an extent that they can be effectively caught with a trawl net. The effectiveness of fishing with a trawl net, and the efficiency of trawling in general, is reliant on targeting a species that aggregates predictably at a general level, and then finding particular aggregations. One of the primary duties trawl captains are charged with is moving from the abstract predictability of general places and times in which aggregations might be found to the concrete particularity of specific places and times in which aggregations will be found. It is demonstrated below that this movement is accomplished through sensemaking.

b. The ocean bottom

While the nature of trawling requires that captains attempt to fish from aggregations of target species, doing so requires captains to also organize with geophysical processes, manifested as the ocean bottom, that these aggregations tend to be found on or near. There are three interrelated characteristics of the ocean bottom that impact where a trawl captain will choose to fish. First, the Kodiak fleet fishes ‘groundfish,’ which means, just as it sounds, that most of their target species live on or close to the ocean bottom. This in turn means that, when targeting an aggregation with a trawl net, captains must drag their net across the ocean bottom. For instance, when fishing cod the net must, depending on the area, “hug the bottom;” whereas when fishing for certain rockfish species captains try to fish “a little lighter on the hard bottom” in order to prevent too much damage to the trawl net.

The second characteristic that impacts where a trawl captain will choose to fish is the tendency of certain species to associate with certain types of ocean bottom. For example, two species of rockfish are typically found around rocky bottom, while another is found in the deeper water, ‘off the edge’ or ‘up and down the bank.’ Some flatfish are found on sandy bottom, others are found ‘on the edge’ between sandy and rocky bottom, while pollock is found off the bottom in some places and tightly packed on the bottom in other places. In the following a captain, while on a fishing trip, describes targeting one type of flatfish, arrowtooth flounder, while trying *not* to catch another flatfish, Pacific halibut, which the crew must immediately sort out of the catch and toss back into the water:

> “The problem is right now there's arrowtooth fishing at four or five thousand pounds a minute, 10 thousand pounds a minute, but its right on the edge of where the hard bottom and soft bottom meets. So if you get a little far this way (pointing to a place on a nautical chart) you will get 100 thousand pounds of arrowtooth but you will also get three thousand pounds of halibut. Well, it’s a pain in the ass to put the arrowtooth down [into the fish hold] and not put the halibut down too. You will get a fine if you put down too much halibut, so you got to sort it out. So it’s kind of a fine line.”

A common characteristic of fishing for flatfish is attempting to catch one type of flatfish, such as arrowtooth flounder, while trying to avoid catching another type of flatfish, Pacific halibut, due to its stature as a prohibited species. Having to sort out and discard a lot of halibut takes time, and therefore impacts the efficiency of a fishing process. A key point is that the captain above described organizing his fishing process with relationships – the relationship between his target species and one bottom type and another relationship between Pacific halibut and another bottom type. An implication is that captains organize not so much with fish or with the bottom, but with relationships between fish and bottom.

The third characteristic of the ocean bottom that influences where a captain chooses to fish is the ability for certain bottom types to damage a trawl net. The effect is that certain bottom types constrain where captains can trawl, as one captain describes in the following: “A trawl can only fish in specific areas, and they are very limited areas. They can't fish in rocky bottom, they can't fish on too muddy of a bottom." During my fieldwork, a common concern captains had on fishing trips was "hanging up" on rocky bottom, which often meant tearing a net (which are typically made of nylon). A torn net can reduce efficiency by detracting from fishing time, for crews usually repair torn nets at sea. Nets that sustain too much damage, however, have to be repaired on land, and a common sight in Kodiak is a trawl net laid out over a parking lot with three or four crewmen sewing it back together while multiple bald eagles scavenge from it. The reason captains, and owners, are disposed to undergo such risk is due to the level of profit that can be derived from fishing for rockfish (primarily the species 'sablefish' that is caught along with rockfish). Similar to interrelating with ecological systems, captains' disposition for organizing with the ocean bottom is shaped by the need for profitability, and that need manifests in a disposition toward efficiency, which can vary depending on the level of potential profit.

i. How this natural system influences fishing practice

While the specific location of an aggregation is a source of indeterminacy when deciding where to fish, the bottom can be a source of determinacy. This determinacy is derived from a combination of the relatively slow rate in which the ocean bottom changes, which means that the nature of the ocean bottom that captains encounter in a particular place does not, from their perspective, change from year to year, and the fact that wheelhouse electronics and nautical charts provide captains with *a priori* knowledge regarding the spatial characteristics (e.g., shapes, relative distances) and depths of the bottom in any given area. When captains pair these concrete spatial characteristics of a particular stretch of bottom with past experiences fishing on that bottom, or bottom similar to it, they are equipped to formulate a conjecture regarding how a certain stretch of bottom and a trawl net will interrelate, before actually fishing there. The following demonstrates a captain producing such a conjecture:

> "A trawler is not gonna be able to fish where it goes from 50 fathoms to 13 fathoms, so a trawler is not gonna be able to fish here at all (pointing to the chart). He will be able to fish right here, he will be able to fish maybe right here (pointing to different spots on the chart). If you try to come out of 50 fathoms and go up over this hard spot, you wont be able to tow there because your net will hang up on the hard bottom. This is hard, rocky bottom right here. . . 99.9% of the time you couldn't tow out of 50 fathoms over 13 fathoms and back down and not hang up, tear your gear, or lose it altogether. . . Usually the reason this bay is here is probably a glacier came down and pushed this down into here, and the moraine that created this fjord will all be piled up here, rocks the size of this building

maybe."

By merging abstractions from past experience in the form of knowledge of geological processes and distillations of trawling events with cues from more concrete circumstances in the form of the topographical details in a nautical chart, this captain was able to hypothesize about a trawler's ability to tow on particular stretches of bottom. These hypotheses are the product of sensemaking about a potential future event – they are sense the captain makes of a potential place to fish. The relatively unchanging determinacy of the ocean bottom, paired with both the generalized predictability of aggregating behavior over time and the propensity for certain target species to associate with certain bottom types results in a recurring coincidence of certain bottom types and aggregations of certain target species. Figure 9 below captures this relationship

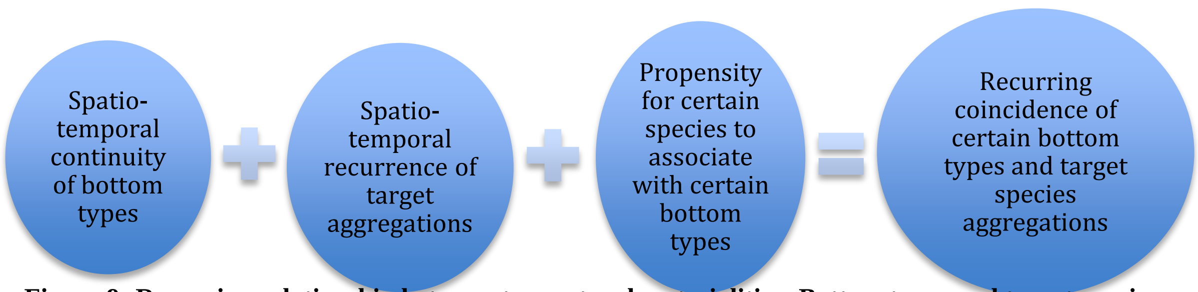

Figure 9: Recurring relationship between two natural materialities: Bottom types and target species aggregating behavior

between these three factors. The seed of predictability from which captains make sense of where to fish is born of the recurring nature of these relationships.

c. Weather processes

Like the ocean bottom, weather can constrain where a captain can fish, and captains must manage their relationship with weather as well. While in the field, the rockfish trip I observed was delayed a day due to bad weather and the route the captain took to the fishing grounds was influenced by bad weather. In addition, one captain I interviewed had just returned from a fishing trip in which his vessel turned 90 degrees on its side, nearly capsizing due to bad weather. The start to several fisheries was also delayed due to bad weather. When captains talk about where or when they will fish, their discussion usually contains a weather qualification, such as the one stated nearly in unison by four captains when, during a fleet meeting, the fleet was asked when they were going to start fishing: "It depends on the weather." A more detailed example of the weather's influence on a potential fishing trip was given by a captain when asked if he planned to fish for rockfish on his next trip:

> If the weather is good. We don't want to deal with rockfish in tough weather, we don't want to be hung to the bottom in rough weather. It will be entirely dependent on the weather - if the weather is good we will be rockfishing, if the weather is lousy we will be tied up in town.

As this quote suggests, one of the reasons the weather plays such an influential role is that it impacts whether or not captains can organize with interrelated aggregations and bottom types.

i. How this natural system influences organizing

Unlike the determinacy of the ocean bottom, captains must manage the indeterminacy weather imposes into a determination of where to fish. While abstract annual weather patterns lend themselves to predictability, the particular weather in a particular fishing spot lends itself to varying levels of unpredictability. The manner in which weather does this is twofold, the first being the temporal unpredictability of weather, the second is its spatial unpredictability. Unlike the bottom that changes on a geological time scale and aggregations that change on an annual time scale, the weather changes on a daily or even hourly scale, as one captain observed during a fleet meeting:

> "I don't know about you all, but I've only been here for 27 years but I don't think any of us could call the weather on the 15th or 16th which is four days from now; I can't call the weather frickin' 24 hours ahead."

In terms of spatial indeterminacy, finding a place to fish often involves potentially not knowing the specific nature of the weather on certain fishing grounds. If a captain is first to the grounds or is lacking information from captains who are already there, he cannot be sure of the weather on those grounds until he is actually there. In the following, a captain describes having to abandon a fishing trip because he did not realize how bad the weather on the fishing grounds was until he got there:

> "I've gone over [to the grounds] the day before the fishery closure and I've steamed back home empty because of the weather. I made a decision of safety over dollars. And that's the decision and its a tough one to do. I turned around five times, steamed, steamed back, shitty; steamed, steamed back, shitty. Five times I did it, and I finally said, "fuck it I'm going home, safety first," and forfeited a load."

This captain could steam about in the inclement weather, but he decided he could not fish from an aggregation due to the weather. The relationship between the weather and other frontline materialities is yet another frontline relationship that captains attempt to organize their fishing processes with. Thus, although a captain may have an idea of a certain spot to fish in, embedded in which is a potentially profitable co-incidence of a target aggregation and bottom type that is conducive to trawling, his decision to fish in there is always made in light of the likely weather conditions in that spot.

The upshot of the natural materialities and relationships among them described thus far - the spatio-temporal recurrence of aggregations of target species, the spatio-temporal continuity of the ocean bottom, the co-incidences of certain species with certain bottom types, and the embeddedness of all of these relationships in variably constraining and enabling weather - is that captains attempt to organize with certain 'nexuses' of relationships among natural materialities. A nexus of natural materiality occurs when different materialities share the same spatial and temporal properties. Thus, a nexus of natural materiality is created by different materialities that are interrelating as a larger whole which can be assigned its own location on a Cartesian coordinate system.

Nexuses of natural materialities are what captains organize their operations with. Figure 10 depicts the combination of spatio-temporal relationships among materialities that form a nexus. Table 4 further explores the intersection of nexuses of material relationships and captains' processes of attempting to organize with them, primarily in terms of the certainty such relationships can offer captains' attempts to gain workable levels of certainty of where to fish.

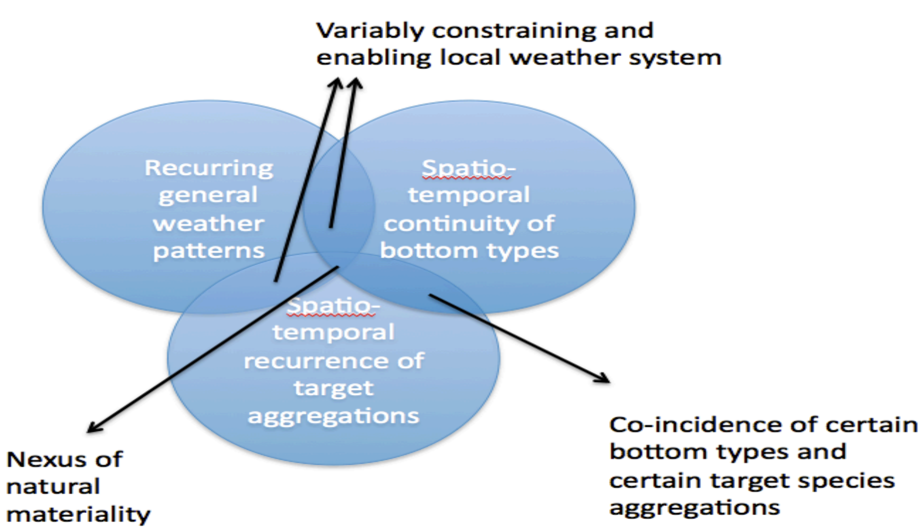

Figure 10: Relationships among natural materialities forming a nexus

Table 4: Characteristics of material relationships as sources of certainty	
Characteristic	**Representative quotes**
Recurring coincidence of target species and different bottom types	"There's a couple places that we fish the exact same strip [of bottom] – there's a strip where the sand meets the gravel and right in there is where you catch the fish." (fishing trip observation)
Predictable coincidence of target species and specific bottom areas	"A pollock net is extremely fragile, and we have two areas that have soft bottom where you can fish. . . There are two areas that produce, and I'm just shooting from the hip, 80% of the pollock here. And typically there is not fish in both areas – if the fish are in one, they are not in the other – they are not in both areas at the same time"
Predictable coincidence of target species and bottom depths	*Interviewer:* **"**Where do Pacific ocean perch [rockfish] like to hang out?" Captain: "They just slide up and down the bank here, they hang out deeper – they live off of the edge. You get them, like on that coral patch there (pointing to a chart), they go up there sometimes, but they normally they stay outside of 70 [fathoms]. That's where they usually are." (fishing trip observation)
Enabling effect of weather on organizing with relationships between bottom and target species	*Interviewer:* **"**How much of catch fish is experience and how much of it is technology? *Captain:* "Well, there is some fancier stuff that we don't have that would help, there's Doppler current sounders, there's real fancy stuff to put on your net that we don't have, but a lot of it is experience and luck. But, I've just learned that, after a while you just look back at all the times you ever were really successful catching rockfish, its almost always been when the weather was really good" (fishing trip observation) "Northern rockfish especially, they are in little schools, and you just have to hit 'em, you can't be off. . . If the weather is good, or if I can tow into the weather, then I can usually hit a pretty small spot. But when you are going sideways to the weather the boat has to turn, it makes the gear go goofy. The gear tends the bottom best when it's just straight behind the boat. So when you start trying to force your way on to the rockpile, it usually doesn't end well. . ." (fishing trip observation)

4. How: Integrating Dimensions of Experience

Captains are predisposed to fish from aggregations, which are embedded in larger nexuses of natural materiality. Yet, individual nexuses offer nothing to a captain's determination of where and when to fish - it is their potential recurrence in time and space that enables nexuses to be targets of fishing effort. Recurring nexuses are wellsprings of potential, offering captains an ability to create the "workable level of certainty" (Weick, 1969: 40) they need to interrelate with indeterminate systems, and it is the captain's duty to convert that potential into profitable reality.

Due to the predictability offered by nexuses that tends to recur, Kodiak trawl captains are disposed to fish the same places over and over. This disposition is a fleet-level characteristic of being a Kodiak trawl captain, from which arises identifiable patterns of action. One captain elaborates this strategy for determining where to fish in the following:

> "We fish the same spots; for one reason, some of the bottom isn't conducive to fishing. There's fish there, but the bottom's not good and after you have had to repair enough nets, you find out that its not beneficial to go into these places, so you don't go in there. I mean, you got to have pretty good reward to take a big risk. So you've learned that you fish these other areas - fish come in there different times a year, and you fish them."

The data show that Kodiak trawl captains have a fleet-level disposition for organizing their fishing operations with recurring nexuses of natural materialities. This disposition is born of past profitable experiences with recurring nexuses. Table 5 provides examples of captains describing their fleet-level disposition to fish in the same spots during interviews, as well as examples of captains actually deciding to fish in a spot that they have before while on fishing trips. Inherent in these examples is both a demonstration of a common strategy, as well as its diverse manifestation in terms of patterns of fishing activity.

Table 5: Strategies and practices of fishing the same spots over and over

Characteristic	Representative Quotes
Strategy of fishing in the same spots	"We fish the same spots; for one reason, some of the bottom isn't conducive to fishing. There's fish there, but the bottom's not good and after you have had to repair enough nets, you find out that its not beneficial to go into these places, so you don't go in there. I mean, you got to have pretty good reward to take a big risk. So you've learned that you fish these other areas - fish come in there different times a year, and you fish them."
	"There's only a few places we can fish, and we fish the same places year after year after year, and they are always productive. . . Like Chiniak Gulley, we've been fishing there for 30 years and you can still go out there at certain times of year and just load up in 24 hours on sole flatfish."
	"I know I've made this tow (indicates a place on a chart) 250 different times in my life, and I know that I can go back there and make this tow in a given year in a given circumstances and I will catch the same amount of fish."
	"So if you look at the data, we tow in the same place year after year, for 40 mother fucking years, we are towing on the same edge of Chiniak Gulley or any of our other spots, and we are still going there today. . . If you overlay the data for 40 years, the draggers will be here, here, and here (pointing to areas on a chart), year after year after year."
	"I have fished out there for 30 years. You go to the same place, to the same dot on the chart. The tides come, and within one day you can't find

	a trace of the trawl, but the fish are there year after year.”
Practice of fishing in the same spots	*Interviewer:* Is this a tow you have done before? *Captain*: Yeah, you can see all the times I've been through here *Interviewer:* So what influenced you to fish here? *Captain*: Oh it’s just where I've caught duskies before, I've done pretty well out there.
	Interviewer: **“**Are these all tows you’ve done before (pointing to markings on the wheelhouse plotter)?” *Captain*: “These are all fish, where I've towed for duskies. This one (pointing to a mark on the plotter) I think is what I'm gonna try **-** the last time I dusky fished a couple of years ago I did ok up in there, and then this over here has always been fairly good (pointing to a different mark on the plotter).” *Interviewer:* “So are you typically going to go to where you have gone before? *Captain*: Yeah, or somebody tells you about a spot”
	Interviewer: “Why did you chose to fish up there?” *Captain:* “It’s just been traditionally a really great spot and we don’t have to compete with other groups when we go there. Like this time of year usually its cleanest, winter time is usually the time to fish in Portlock because the halibut aren't there.”
	“This my other spot here, as you can see I've made a few tows there, I might go check that out. . . I know they are gonna be there, because that's where they have always been.”
	“When we left town, most of the fleet was already out. I talked to them, asked how it was going, half the fleet went to one area, half went to another area. The three boats I control, we all went to the same spot we each went to last year. That’s what most people do.”

To make sense of where to fish using the strategy of fishing the same spots, captains import certain places and times someone has fished either successfully or unsuccessfully before - a past fishing event - into the present. Yet, what events they import from the past are shaped by regulatory factors of the present, such as the specific fishery they are fishing in, open and closed fishing areas, and conditions of natural materialities, such as what the weather is like in a certain area. Captains then integrate potential fishing spots with current abstract and material conditions, with one reciprocally modifying the other, from which they produce a conjecture of a place to fish. A conjecture of a place to fish is a sense of what to do next. In the following a captain discusses the strategy of integrating past experiences with current conditions in order to find a profitable fishing spot:

> “Nobody knows the ocean floor better than a fisherman. We see, eat, sleep, and breathe that ocean on a day-to-day basis. And some days there will be more fish than you know what to do with on a particular rock, and the next 10 days there will be no fish on that rock. And knowing those days and the weather conditions

> and the things that produce the right conditions to make those fish school up on those rocks is something that fishermen spend their whole entire lives trying to learn."

Sensemaking at sea involves the merging of the abstract and concrete sides of experience, as understood from past experience, with the goal of enacting certain future experiences. Sensemaking at sea is aimed at creating a sense that a potential fishing spot, one that a captain has fished before, is the "right" spot under the current natural – and regulatory - conditions. This sense is emergent from the integration of human and natural processes: recurring patterns of natural relationships provide the substrate from which captains integrate past experiences and potential future events, in light of current abstract and conditions, in order to conjecture what to do next.

Finding a current fishing spot within a larger time and space and set of past fishing spots is a process of inquiry that is neither completely deductive, nor completely inductive, but rather 'abductive.' Abduction is a process of "intelligent guessing" aimed at creating conjectures and hypotheses that are "marked by good sense" (Peirce, 1931-1958, cited in Rescher, 1978: 42). As the concept's founder Charles S. Peirce argued, abduction is the first stage of all inquiries when there is something in need of explanation (Fann, 1970: 5, citing Peirce, 1931-1958). What is in need of explanation to fishing captains is where to find sufficient aggregations to fish from, and what the composition of those aggregations may be. Abduction is the stage of inquiry in which we attempt to create theories or explanatory hypotheses that we later assess. As Peirce (1995: 171) outlines, "deduction proves that something *must* be; Induction shows that something *actually is* operative; Abduction merely suggests that something *may be."* Abduction is the only kind of reasoning that is 'synthetic' in that it merges the abstract and the concrete parts of experience, and due to its synthetic nature, abduction is the only kind of reasoning capable of producing new ideas (Peirce, 1931-1958, cited in Rescher, 1978: 42).

The problem of what may be, or what may come next, "is perhaps the fundamental problem of ordering and organizing" (Cooper & Law, 1995: 242). This problem is also a salient issue in commercial fishing – the problem of expending resources to steam to a certain fishing spot and extracting materiality from indeterminate natural systems. Abduction is the primary method captains use to make sense of where to fish next, which is exemplified in the following response a captain gave when asked why he was going to a certain area to fish during a flathead sole fishery:

> "I'm going over here because I have a feeling that there's gonna be some flathead over here . . . And its gonna be better weather over here. . . You know, in the spring they spawn, and I've been seeing flathead my last three trips, some nice flathead with some eggs in them. There is a volume here - there is quite a bit of flathead over here all the time, year round there's flathead over here, it's just whether or not they are together enough to make a living fishing for them. . . And I know I'm not gonna hang up on anything, so it's a pretty easy fishery on everything except for the fuel you burn."

This captain converged cues from current concrete conditions, such as amenable weather, conducive bottom type, and recent flathead aggregating behavior, with more abstract knowledge, derived from past experiences, of recurring flathead behavioral patterns. The product of this convergence was "a feeling." This feeling was a conjecture of what to do next, namely that towing in that spot would, at a workable level of certainty, contribute to creating a profitable fishing trip. Past experience, converged with current conditions, enabled the captain to produce a conjecture of what to do next. Thus, while the extent of actual flathead aggregation was indeterminate at the time of towing ("whether or not they are together enough"), the captain's convergence of past experience with current conditions gave him sufficient certainty to go ahead and tow.

When determining where to fish, captains look to fishing events in the past to determine where to fish in the future. This disposition provides a source of actionable similarity in a sea of interminable variety. Yet, because they will never steam into the same ocean twice, captains know that their past experience must be informed by the current conditions of their material context. Captains integrate past experiences with cues from current natural materialities with the goal of telling a story of what is happening, from which they can produce a plausible conjecture of what to do next in order to move toward a desired future event. Captains' general desired future event must be, as demonstrated above, a profitable fishing trip. Both telling a story of what is happening and conjecturing what to do next in order to move to a certain future constitute an 'abductive sensemaking episode.'

a. Analyzing the abductive sensemaking episode

The abductive sensemaking episode is an analytical framework anchored in two dimensions of experience: past←→future and abstract←→concrete. What it means to be 'abstract' and 'concrete,' however, requires some elaboration. 'Abstract,' as it is used here, refers to things that are "comprehensible without reference to some one particular occasion of experience. To be abstract is to transcend particular concrete occasions of actual happening" (Whitehead, 1925: 159). In being transcendent, according to Whitehead, abstractions have "connections with other occasions of experience." As common parts of different occasions of experience, abstractions function to render one occasion relatable to another. Whenever someone says, "there it is again," abstractions are the things that can "be again" (1919: 144). Thus, to be concrete is to be a particular event, occasion, or bracketed portion of experience that is never to "be again." A particular codfish is never to "be again," but its name, the category into which a bracketed entity is conceptually fitted, will "be again" many times over. Similarly, a fishing spot can be again, but the particular occasion of being there, and the particular tows captains conduct there, cannot. And, just as 'past' and 'future' are relative terms in that we cannot know one without the other, 'abstract' and 'concrete' are relative as well. We cannot know what is abstract without reference to some concrete aspect of experience, and we cannot know what is concrete without reference to some abstract part of experience.

While a primary activity of perhaps any sentient entity is managing the transition from its past to its future, another primary activity is managing the relationship between its abstractions and its experience. As Hernes (2008: 57) states: "The dimension of concrete experience versus abstraction captures a central activity of organization." Weick (2009: 28) describes the often ill-fitted and troubling relationship between abstract categories or labels and the portions of concrete experience we apply them to:

> Labeling imposes order, but often at a cost. When organizations generalize and compound their abstractions, they put increasing distance between direct perceptions of continuous flow and indirect recasting of those perceptions into discrete conceptions. The benefits of compounded abstractions are that they facilitate shared images and allow collective coping. The cost if compounded abstractions is that people lose sight of differences that make a difference.

It is demonstrated here that the dimensions of abstract ←→ concrete and past ←→ future, when integrated within the same model, capture a central activity of sensemaking in commercial fishing contexts: In order to solve the problem of where to fish, captains integrate past, future, abstract, and concrete elements of experience to conjecture that a certain fishing spot they fished before will be viable again under current conditions.

Figure 3 depicts a sensemaking episode that is embedded in, and anchored by, the past←→future and concrete←→abstract dimensions of experience. As the model depicts, the abstract—←→and past←→future dimensions are broader than any one episode, and any one episode is a slice of ongoing experience. These slices, however, can have profound impacts on organizing. While these constituents of an episode overlap in actual experience, the purpose of the model is to dissect episodes of sensemaking into 1) identifiable parts, and 2) relationships among those parts. In doing so, researchers are better equipped to understand how captains, or other frontline managers, organize with indeterminate systems (whether natural or human).

The model captures the moments of sensemaking in which actors answer the questions, “What’s the story here?” and, “Now what should I do?” (Weick et al., 2005: 410). These answers bring an event into existence by telling its story as well as giving it operative meaning by conjecturing how it shapes ongoing operations (Weick et al., 2005: 410). Together, these questions and answers give captains the “workable level of certainty” (Weick, 1969: 40) they need to interrelate their operations with indeterminate natural materiality.

Thus, the model in Figure 11 breaks the abstract←→concrete and past←→future dimensions of sensemaking into parts, while also emphasizing their interconnectedness. These interconnections are partitioned into two levels in the model: the outer arrows (1, 2, 3, 4) and the inner arrows (a, b, c, d); these levels, however, are themselves interconnected. If we trace our way through the model, starting with the concrete side, desired future events impact what captains look for and see in the concrete side of their experience (arrow 4). Yet, at the same time past experiences influence what captains look for and see in the materiality of current experience (arrow 3). The focus of this study - how frontline managers make sense of indeterminate natural systems in order to extract resources from them - means that the concreteness of concern is some form of natural materiality. Thus, both past experiences and a desired future event work together to influence which cues captains will see and attend to from the natural materiality they are currently organizing their operations with (arrow c).

In terms of the abstract side of an episode, captains employ ‘interpretive schemata’ to give meaning to extracted concrete cues from natural phenomena. Interpretive schemata, which several scholars note are a key component of sensemaking (Balogun & Johnson, 2004; Rerup, 2011) are “structured units or clusters of thematically related knowledge” that actors draw on “to interpret, understand, and respond to events and data,” which helps them “negotiate a complex and confusing world” (Balogun & Johnson, 2004: 525). Abstractions from both desired futures (arrow 1) and past experiences (arrow 2) are part of the interpretive schemata that captains use to give meaning to cues from concrete phenomena (arrow a). These abstractions include past

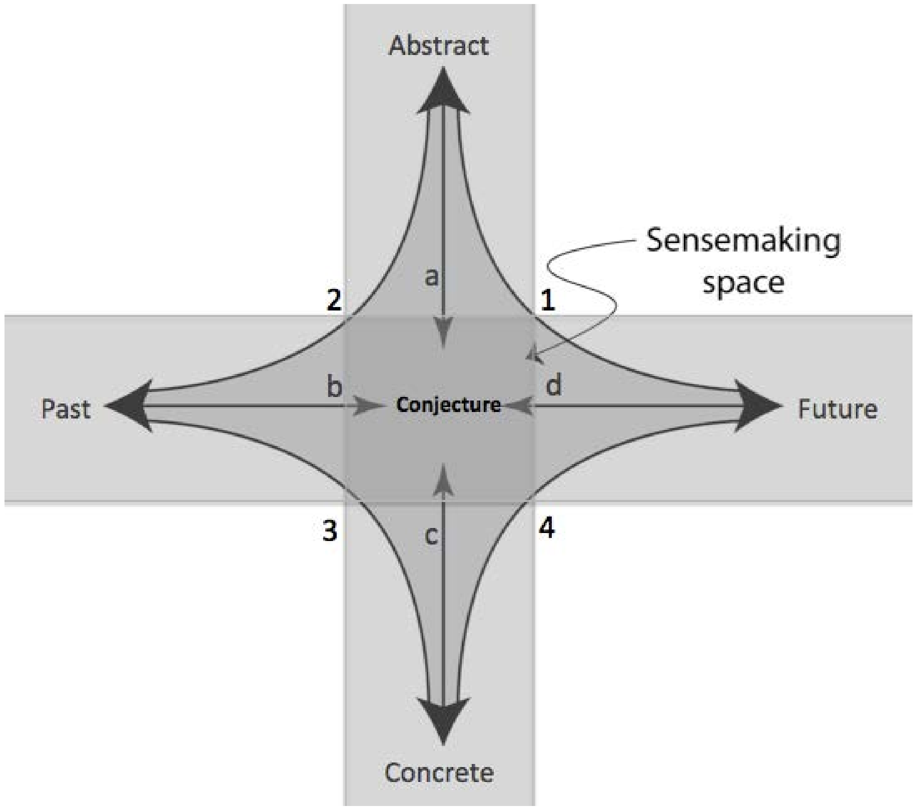

Figure 11: The abductive sensemaking model, embedded in the past—future and abstract—concrete dimensions of experience

fishing experiences, knowledge of fishing regulations, and profitability-related knowledge, such as how much fish one needs to catch in a certain period of time to be profitable. This is all conceptual knowledge that can 'be again' in that it is not tied to any specific concrete phenomena. When captains integrate arrow a and arrow b, merging that which can never be again with that which can be again, and what is abstract with concrete phenomena, making them congruent, they tell a story (i.e., sense) of what is happening. As the model indicates, this story is already shaped by future events and past experiences. Thus, "to make sense is to connect the abstract and the concrete" (Weick et al., 2005: 410), but in a manner that is shaped by the past and future.

But the sense made is mere abstract understanding of elapsed experience unless it helps the captain answer the second sensemaking question - "Now what?" (Weick 2003: 186) The answer to this question is a conjecture - it is a prediction of an event that has yet to occur. Yet, as the model depicts, the conjecture is the temporal sense made of what to do next (arrows b & d), embedded in which is a sense of what is happening (arrows a & c). Thus, the internal arrows signify that the created sense of current experience is re-integrated with the past and future as a conjecture that connects the two. While the emphasis in the external arrows is on creating a story of what is happening under the terms defined by what has happened in the past and what can happen in the future, the emphasis in the internal arrows is on creating a sense of how to move from the past to a particular future under the terms defined by a story of what is happening. Thus, to conjecture is to connect the past and the future, but in a manner that is shaped by the selective influences of the abstract and the concrete.

A final aspect of the model is that the selective influences depicted by the external arrows (1, 2, 3, 4) are bi-directional. Thus, in terms of arrow 1, interpretive schemas influence the nature of the future that is brought into current experience, such as when lessons from past experiences, captured in interpretive schemas, define what is possible in the future; likewise, abstracted future events that are part of interpretive schemata may influence which past experiences are brought into the present (arrow 2). In terms of the concrete side of experience, the concrete materiality a captain is confronting can impact the potential future he desires (arrow 4), as well as which past experiences he may consider in the present (arrow 3). While all eight external selective influences are present in any episode of sensemaking, some will be more salient and/or influential than others.

5. Conclusion

The research question that motivated this chapter was, how do frontline managers organize with natural systems in the commercial fishing context? The findings show that when captains set out to fish, they set out to organize with recurring nexuses of natural relationships, for doing so offers “a workable level of certainty” (Weick, 1969: 40) that their fishing process will be efficient in terms of both vessel operations and prohibited species bycatch. Yet, captains may have certainty in terms of what they want to fish from, but they do not yet have certainty of where they will actually fish. Captains may fish in different places than they did previously, or they may fish in the exact same areas, but how they alight on a certain spot is a product of the day-to-day mechanics of sensemaking.

Captains start the process of gaining a workable level of certainty of where to fish by fishing where they have fished successfully before. This is a disposition for action (Birnholtz, Cohen, & Hoch, 2007) that is characteristic of being a Gulf trawl captain. In acting according to this disposition, captains seek an aggregation of target species they can profitably tow from, which is associated with a bottom type they can profitably tow on, in a weather system they can safely tow in. Thus, captains attempt to organize their fishing operation with natural organization of ocean bottom, fish aggregation, and weather. The recurring nature of these natural relationships disposes them to predictability, which captains take advantage of by acting according to their past experience. Thus, a primary means of determining where to fish is accomplished by merging past experience, in the form of abstract knowledge of system characteristics and past fishing events, with current relationships among natural conditions in order to determine what to do next.

Captains create workable levels of both natural and economic certainty by merging experience abstracted from the past with cues extracted from more concrete conditions, with the goal of moving toward a particular future. The product of this abductive process is a conjecture or hypothesis of what to do next. Such products are objects of certainty that captains need in order to steam out to the grounds so that they can tow before they actually know what they will be towing from. These aspects of gaining a workable level of certainty are captured in the abductive sensemaking model.

The fishing captain leaving the dock is presented with a vast ocean of possibility in terms of where to fish. The captain's task is to abduct a particular place to fish by merging past experience and concrete conditions, thereby forging a workable level of certainty in terms of a specific aggregation to fish from. Similarly, as philosopher of science Nicholas Rescher explains, "The task of abduction is to determine a limited area of promising possibility within the overall domain of theoretically available opportunity, a region which is at once small enough for detailed examination and research, and large enough to afford a good chance of containing the true answer" (Rescher, 1978: 42). For a fishing captain, the 'true answer' is a fishing spot, composed of interrelated ecological, geological, and atmospheric processes, that contains within it the opportunity to make his fishing process a profitable one. The analysis above shows that captains find a profitable place to fish by taking past experience, captured in abstracted events, as well as in more general knowledge of natural processes, such as geology or target species life history traits, and merging it with cues bracketed from concrete experience, such as interrelated ecological, geological, and atmospheric processes. This approach is a strategy of abduction.

In terms of the broader relationship between abduction and sensemaking, sensemaking scholars have addressed abduction in several ways. Scholars have theorized about the overlap between abductive modes of inquiry and sensemaking (Maitlis & Sonenshein, 2010; Weick, 2006, 2010, 2012), they have used an abductive lens to interpret data (Cunliffe & Coupland, 2012; Kramer, 2007), and one has explicitly studied the abductive processes that organizational actors themselves enact (Abolafia, 2010). In addition, scholars have implicitly studied various forms of abductive processes, such as constructing 'detective stories' by merging plots and clues (Patriotta, 2003), employing metaphors to merge individual accounts and societal expectations (Cornelissen, 2012), and using stories to make sense by "relating the particular and the universal" (Islam, 2013: 34).

The overlap of abduction and sensemaking, however, is perhaps most apparent in discussions of the basic structures of each. In terms of abduction, Harrowitz (1983: 190) demonstrates that abduction merges an observed fact with an explanatory rule, in which "the observed fact is read through the rule" to produce a new understanding, idea, or "case." Similarly, Schruz (2008: 205) characterizes abduction as consisting of the merger of 'beliefs or cognitive mechanisms which drive the abduction' with 'evidence which the abduction intends to explain,' which produces a hypothesis or conjecture. And Weick (2012: 149) formulates abduction as "cue + frame + connection," from which order is produced. Meanwhile, the basic conceptual structure of sensemaking bears a striking resemblance: Weick et al. (2005: 410) state, "To make sense is to connect the abstract with the concrete," while according to Mills (2003: 53), "In essence, everyday sensemaking involves a frame, a cue, and a connection;" and, as Jeong and Brower (2008: 230) state, sensemaking is "a kind of combining process in which the cue is connected to a frame of reference, through which a state of affairs (meaning) of the cue is constructed." Both the abductive and sensemaking process concerns merging the abstract with the concrete, from which some form of sense, be it a conjecture, hypothesis, or idea, is produced.

The phenomena analyzed here suggest one addition to the way abductive processes have been conceptualized thus far. This is the added dimension of time. At the heart of sensemaking at sea are abductive approximations of the future in the present, based on the past. The future is read through the past, in the present, the product of which is sense of what to do next. Thus, there is always an abstract component of sensemaking in relation to a concrete component, and there is also always a future component in relation to a past component. Together, these component form sensemaking episodes, which act as a sort of vector in that they move actors further along in an organizing process by producing a conjecture of what to do next in terms of moving toward a desired future event of a profitable fishing process.

While sensemaking has is understood to be a process of connecting the abstract and the concrete (Mills, 2003; Jeong & Brower, 2008: Weick, et al., 2005), the present to the past (Mills, 2003; Taylor & Van Every, 2000; Weick, 1995; Weick, et al., 2005), and a growing body of literature is devoted to examining how sensemaking connects the present to the future (Gephart, Topal, & Zhang, 2010; Gioia, Corley, & Fabbri, 2002; Hernes & Maitlis, 2010; Stigliani & Ravasi, 2012), scholars have yet to conceptualize and investigate these aspects of sensemaking as interdependent parts of the same process. The internal horizontal arrows in Figure 3 represent the Janus-faced, retrospective and prospective nature of a sensemaking (Gioia & Mehra, 1996; Weick, 1979, 1995), and the internal vertical arrows represent sensemaking as a process of connecting the abstract and the concrete (Jeong & Brower, 2008; Mills, 2003; Weick et al., 2005). Together, they are the parts of a conjecture that is required when one needs a sense of what to do next. Furthermore, Weick's (1995) influential seven properties of sensemaking, introduced in Chapter One, do not include a temporal dimension or a concrete component. This study demonstrates that both are inherent properties of the sensemaking process. The model constructed here and further developed in Chapter Three interconnects dimensions of sensemaking that have thus far been disconnected in the literature, while making the case that two additional properties are indispensible to understanding the process..

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Chapter Three
From Plotters to Sonars to Codends: A Sensemaking Progression Through a Fishing Trip

"Consider also the devilish brilliance and beauty of many of its most remorseless tribes, as the dainty embellished shape of many species of sharks."
--Melville, H. *Moby Dick,* p. 247

1. Introduction

In the last chapter I produced a foundational model of the abductive sensemaking episode. Abductive sensemaking is a process of "comparing existing conditions to a relatively simple operating model" (Abolafia, 2010: 353), in light of past experience and desired future events, in order to answer the two questions of sensemaking: "what's the story here?" and "now what do I do?" (Weick et al., 2005: 410). Thus, the process concerns telling a story about ongoing experience, from which actors can produce a conjecture or hypothesis (Harrowitz, 1983; Rescher, 1978; Weick, 2006, 2010, 2012) of how to move forward to a desired future event. But, when charged with making a profit by interrelating with indeterminate natural systems, abductive sensemaking is typically not an individual affair. While Chapter Two explored the basic elements and process of abductive sensemaking, it did not explore its social character. This chapter demonstrates that in order to efficiently interrelate with indeterminate natural systems, Kodiak trawl captains seek information about natural conditions from other captains in order to increase their capacity to enact an efficient fishing trip. While researchers have studied sensemaking as a social process (e.g., Balogun & Johnson, 2004; Donnellon, Grey, & Bougon, 1986; Dunbar & Garud, 2009; Maitlis, 2005; Weick & Roberts, 1993), and social interaction and interdependency is considered one of sensemaking's primary characteristics (Weick, 1995; Weick, et al., 2005), the relationship between sensemaking's abductive function and its social nature has garnered little attention (Weick, 2006).

This chapter extends the model of the sensemaking episode produced in Chapter Two by analyzing the sensemaking processes Kodiak trawl captains undertake as they progress through a fishing trip. The analysis shows that captains use other captains' experiences to increase their capacity to not only, upon leaving the dock, conjecture that a certain fishing spot will offer them

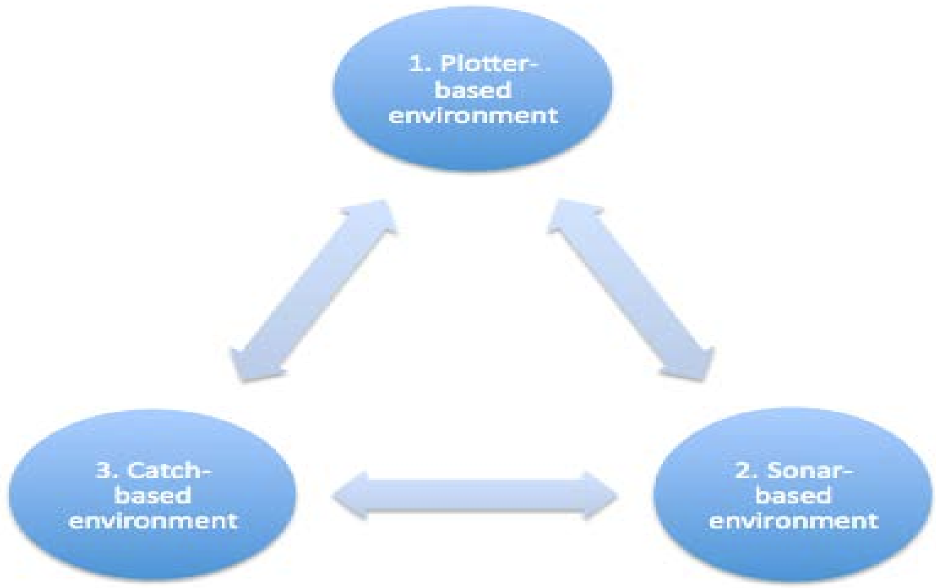

Figure 12: The stages of a fishing trip based on the progression from one enacted environment to the next. While a captain may move back and forth between environments, this chapter is organized as a progression from the plotter to the sonar to the catch on deck. Once the catch is on deck, the captain map return to his plotter, or he may return to his sonar, depending on if he chooses to update the natural materiality he is interrelating with.

the ability to enact an efficient fishing process, but to also make sense of the natural materiality they find in that spot once they get there, as well as determine where to fish next once they have extracted materiality and turned it into a artifact of the fishing process. This chapter introduces the concept of 'abductive capacity,' and demonstrates that captains increase their capacity to produce accurate conjectures by using the experience of other captains to enhance their own experience.

To further elaborate the abductive sensemaking model, I track sensemaking episodes as captains progress through different stages of a fishing trip.[8] These stages are delimited by key shifts in the environments captains must make sense of - their progression of 'enacted environments.' Enacted environments are the sources of information that actors confront as a result of their own actions (Smircich & Stubbart, 1985; Taylor & Van Every, 2000; Weick 1979). Enacted environments are outputs of organizing, yet inputs to sensemaking (Weick, 2003,

[8] The analysis in this chapter is based on interviews of Kodiak trawl captains, conversations during fishing trips aboard Kodiak trawlers, as well as observations of Kodiak fleet meetings. All quotes are taken from these interviews, conversations, and observations. The text distinguishes one context from another when it is meaningful to do so..

1979). Taylor and Van Every (2000: 145) vividly explain the concept of the enacted environment in the following:

> Imagine yourself in a dark field, at night, with only a flashlight. The objects you can pick out dimly around you with your unaided sight are ambiguous: Is that just a bush, or is it a dangerous animal, crouching to attack? By turning on the flashlight, you create a circle within which things are made clear, and you can now act with some assurance. It was the initial action of turning on the light that effectively created a new environment where things become interpretable. But it is still just a circle of light, and what is outside the circle remains as mysterious as ever, until you redirect your flashlight beam to it.

As captains progress through a fishing trip, they move from one circle of illuminated context to the next - from one type of enacted environment to another (see Figure 12). Thus, when captains set out to sea, their "flashlight" is an instrument called a 'plotter,' from which they tell a story of what is happening and conjecture that a certain fishing spot, of the many past fishing spots they have fished before and which are displayed on their plotter, will offer them the ability to enact a profitable fishing trip. When captains get to a particular fishing spot, their sonar enacts their next environment, from which they tell a story of what is happening and conjecture that a particular bracketed portion of natural materiality (i.e., an aggregation of fish and/or a strip of ocean bottom, or part of a particular aggregation) is what they should extract fish from. [9] And when captains bring their catch on board after fishing from a certain aggregation or strip of bottom, they are presented with an enacted environment of actual fish – catch on deck. From the enacted environment of catch on deck, captains tell a story of what they were doing when they were fishing, from which they decide what to do next, i.e., whether to fish again from the same materiality or move to a different spot in order to update the materiality they will extract. In a context in which "you never know until you tow," it is only when captains enact an environment of actual fish on deck that they finally know what they were steaming to and what they were fishing from. The progression of a fishing trip is the progression of making sense of one enacted environment in order to produce a conjecture that enacts the next environment. But, while

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[9] I use certain prepositions to denote the different relationships between a fishing vessel and natural systems, natural materialities, or a particular intersection of time and space (i.e., a fishing spot). I use the phrase "fish within" when describing captains interacting with systems that are both under (ocean bottom, aggregations) and above (weather) the vessel. When I describe the relationship between a vessel and the natural materiality of an aggregation of fish I used the phrase "fish from," for in this relationship captains are attempting to extract fish *from* a thing they are spatially separated from. And when describing a fishing 'spot,' I use the phrase "fish in," for an entity typically acts 'in' time or 'in' space rather than 'within' time and space, and 'from' time or space connotes a different meaning.

captains illuminate a unique enacted environment at each stage, their sensemaking of it is always embedded in a network of other captains' experiences, upon which they draw in order to enhance their own sensemaking.

The analysis below is organized in three stages of enacted environments. I examine the processes in which captains make sense of 1) which spot to steam to based on their plotters, 2) what the composition of the materiality will be that they extract at that spot based on their sonars, and 3) where to fish next - whether to fish within the same systems, from the same materiality, or update the materiality they are interrelating with. After analysis of these three stages, I review the primary findings in the Discussion section.

2. Going fishing: Creating a workable level of certainty of where to fish

Going fishing at the start of a fishing season sets in motion a concatenation of events, which ultimately leads to a determination of where to fish *next*, but which must along the way produce a determination of where to fish *first*. To fish from a nexus of natural materiality that will contribute to a profitable fishing trip, captains must first gain a workable level of certainty that they will find such a nexus within a particular space. To analyze how captains gain the certainty they need to bet their profitability, and therefore both their and their crew's income, for a trip on a certain spot, this section first describes the enacted environment that captains must make sense of, the primary element of which is their 'plotter.' Then the section describes how captains make sense of this enacted environment.

a. The plotted environment

The wheelhouse plotter is the trawl captains' primary enacted environment when beginning a fishing trip. Plotters are instruments that locate objects in space and time. All vessels in the Kodiak trawl fleet have a plotter that is typically on continual display on a computer monitor in the wheelhouse. Tied to the vessel's navigational system, the plotter is a computer program that plots objects from the past and present in space according to the Cartesian coordinate system, and in time according to 'clock time.' Similar to the geographical information systems that are increasingly commonplace in academic, governmental, and technical industries, plotters display types of objects in layers, starting with a base layer that differentiates sea and land, then building in layers of information upon other layers, culminating in a rich picture of the vessel's temporal and spatial environment. Such layers include bottom contours, depths,

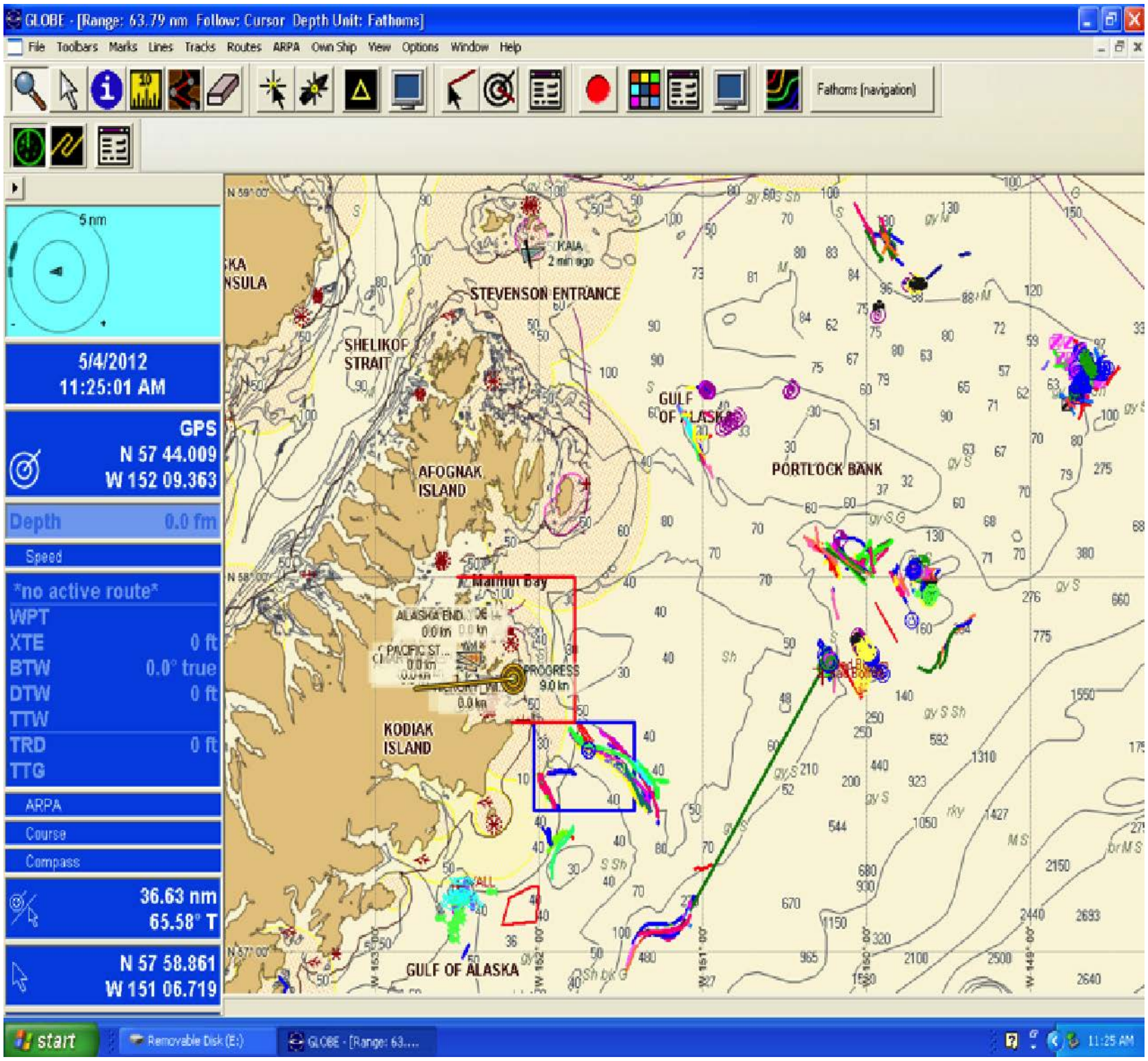

Figure 13: Screen capture of a wheelhouse plotter display. The dispersed gray numbers are depths of the ocean bottom, the gray lines depict the contours of the bottom. The colored lines and curves are tow lines. Different colors represent different target species and/or fishing seasons, depending on the captain's labeling scheme. Groups of tow lines exemplify spots that are fished relatively often. The boxes (the red one above "Alaska", the blue one above that, and the red box above the blue box) are areas that are closed to trawling, either permanently or based on "triggers" (hence the blue box with tow lines inside it). The gold-colored line conjoined to two nested gold circles above "KODIAK ISLAND" is the vessel ("PROGRESS") in which this plotter is displayed. Other vessels can be seen above this gold line (e.g., "Pacific St" for Pacific Star).

locations of other vessels, regulatory fishing areas, and past fishing and navigational events. These are the raw data that captains use to tell a story of what is happening, form which to conjecture what to do next, i.e., where to fish.

One of the primary ways in which plotters influence captains' sensemaking of where to fish is by recording and recalling fishing and navigational events. Plotters are the means by which captains see in the present what they have done in the past. They save towing information, while also allowing captains to annotate that information. In addition, captains create symbols to capture events for future use, such as profitable tows, interactions with navigational or towing hazards such as wrecks or lost fishing gear, and places and times in which they have spotted potentially profitable aggregations (or bottom types that suggest potentially profitable aggregations), even if they did not fish there. As one captain described, “We mark hangs where the boat's hung up, where other boats have hung up, fish marks, hard bottom marks. . . these are all marks of all the stuff around here, this Christmas-tree stuff here is all of my personal marks. . . I got thousands of marks from 20 years ago.”

Figure 13 is a screen capture from a plotter aboard a vessel on rockfish fishing trip. This screen displays land and sea, bottom depths and contour lines, markings of “hangs” and fishing events the captain has entered in the past, past towing track lines, other vessels, areas closed to fishing, among other objects. While this screen capture is necessarily static, in the wheelhouse the display moves as the vessel moves through space. The following is an example of a captain attempting to make sense of where to fish using the plotter from which this screen capture was taken:

> “This set here I think is what I'm gonna try (pointing to a mark on his plotter). The last time I fished for dusky rockfish here, a couple of years ago, I did ok up in there. This is real tough towing up through here (pointing to a different area), and then this over here has always been fairly good (pointing to a different spot).”

Objects on the plotter display serve as input to the captain’s production of a hypothesis of where to find a potentially profitable nexus of natural materiality to fish in. Using the plotter, the captain integrates past and future in the present, exemplifying the “What’s the story here?” portion of a sensemaking episode.

i. Building abductive capacity to find a fishing spot

To make sense of their plotted environment, captains tend to supplement their own experience with other captains’ experiences. Thus, the past experience that the last chapter demonstrated to be an integral part of making sense at sea need not be one’s own - it may be another's. While observing fishing trips and fleet meetings during my field research, I often found captains sharing fishing experiences. One captain, when asked in an interview to divide up the amount of time he spent on the radio with other captains between talking about fishing conditions and strategy, political stuff, or ‘other,’ stated, “I'd say 10% other, 20% political, and the rest is fishing. The majority is fishing for me.” Captains seek out information about natural conditions at sea from other captains so they can, as another captain stated, “know what to expect” before they arrive at a fishing spot. Obtaining information from a captain who has recently fished in a certain spot is, as a captain noted, “a good indicator” of what one will find there, yet, speaking to the inherently indeterminate nature of natural materiality in this context, this captain continued with, “if you are not right in the exact same spot, it could be something different, but [information from another captain who has been there] is a pretty good indicator of what it is, it’s just not a hard and fast rule.”

Captains are disposed seek information about natural materiality from other captains. This disposition complements the disposition to fish where one has fished before, as one captain exemplified in his response to being asked if he typically fishes in spots he has fished in before: “Yeah, or somebody tells you about a spot.” The disposition to use another’s experience with natural materiality is due to the efficiency imperative. We can see the relationship between importing information from other captains and the efficiency of locating aggregations in one captain’s response when asked how often he relied on other captains to determine where to fish: “Probably 50% or so. If there's a lot of fish around you don’t need to ask a lot of questions, but if they're hard to find, then you get on the radio.” As another captain put it, “There's lots of us out there, and if somebody finds something, we go to that spot; we’re not going spend time driving around where there's nothing.” Captains import experience from one another in order to enhance their ability to efficiently know, with as much certainty as they feel is necessary or possible (i.e., a workable level), what they will catch in a certain spot before they expend the resources to steam there. In other words, captains choose a fishing spot based on a workable level of individual certainty, which is often socially attainted.

Importing information from another’s experience with natural materiality is one way in which captains enhance their ability to efficiently make sense of their plotted environment, or what I call ‘abductive capacity.’ Captains not only engage in abduction, as Chapter Two demonstrated, but they use an abductive mode of inquiry, rather than solely deduction or induction, because it is a comparatively efficient process. Rescher (1978: 42) characterizes the the economy of abduction in the following: “Conjectural fancy is limitless, but resources are scarce and life is short. . . possibilities in practice cannot be spun out forever.” Similarly, Peirce argues that economy is *the* driving force of abduction: “[Economy] is in all cases the leading consideration in Abduction. . . Economy of money, time, thought, and energy" (Peirce, 1931-1958: 5.598 − 5.600, cited in Rescher, 1978: 66). Abductive capacity is the ability to engage in, what Peirce calls, "intelligent guessing" in order to efficiently alight upon a plausibly effective next step in one's organizing process. Captains increase their abductive capacity by incorporating information about natural materialities from other captains' experiences into their own sensemaking so that they can more intelligently guess where they will find a profitable nexus to fish in.

The disposition to increase abductive capacity by importing experience from other captains manifests in various patterns of interaction. These patterns range from haphazard information-sharing events, such as in passing to and from the fishing grounds, to less haphazard events, such as when captains are gathered in meetings before and after seasons, to more routine information-sharing processes, such as when captains operate in an established fishing group. The following conversation among two captains sitting at the dock preparing to go fishing and one who is already fishing exemplifies a haphazard occasion of increasing abductive capacity by importing information about material conditions at sea:

> *Docked captain #1*: "It looks like you are traveling at tow speed, what are you doing?"
> *At-sea captain*: "Towing my last tow then coming in"
> *Docked captain #1*: "Is this your first tow on the east side?"
> *At-sea captain*: "Yeah, just made a three-hour pass"
> *Docked captain #2*: "You must have found some fish"
> *At-sea captain*: "Roger that"

The docked captains in this example were tracking the at-sea captain's movement on their plotters. From the nature of the at-sea captain's movement they could tell he was fishing. Thus, before leaving the dock, the captains located a fishing spot that another captain had evidently already conjectured would be a profitable place to fish. Yet, they sought to enhance their understanding of that fishing spot by importing the at-sea captain's experience with the material conditions in that spot.

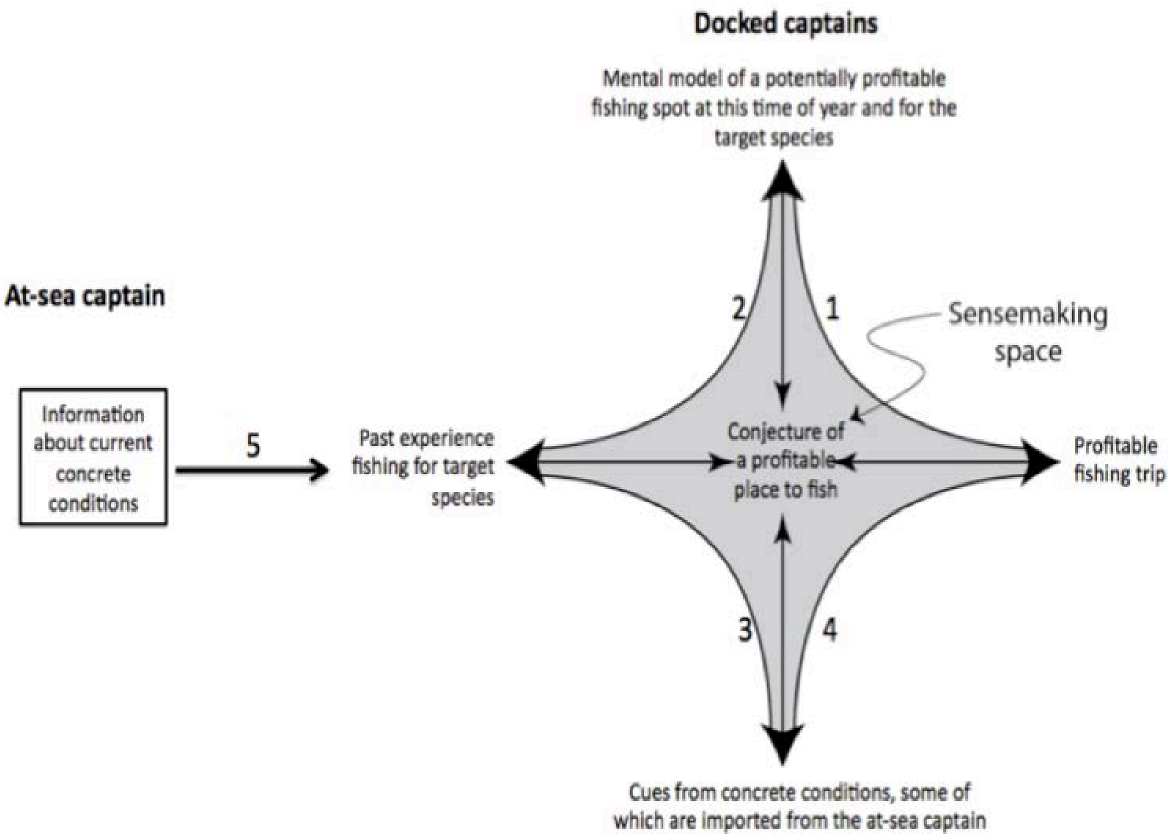

Figure 14: Diagram of an abductive sensemaking event that is distributed across two sets of captains occupying two different locations – one who is fishing, the others who are at the dock preparing to go fishing

Figure 14 diagrams the contribution this interaction makes to the docked captains' abductive capacity to find a profitable fishing spot. First, we can assume that the docked captains, based on their own past experience, have existing interpretive schemata of the characteristics of a profitable fishing spot at that time of year based on their target species (arrow 2). We can also assume that the specific quota amounts the captains can catch, and the profit they want to make at the end of the trip, are also incorporated into their interpretive schemata (arrow 1). These captains, however, sought information from the captain at sea to better understand current material conditions, based on that captain's experience (arrow 5). Due to the information they received - that the at-sea captain towed for at least three hours - the docked captains were able to increase their understanding of at-sea conditions, such as how aggregated target fish might be in that spot (arrow 3). In terms of arrow 4, the reason the docked captains were seeking concrete information about a certain fishing spot was to attempt to understand whether that spot would help them move toward their desired future event of enacting a profitable trip. The concrete information they gained informed their conjecture as to whether fishing in that spot will help them move toward their desired future event of enacting a profitable fishing trip (arrow c). What we do not know is whether the docked captains updated any part of their respective sensemaking spaces based on the new information, such as altering their desired future event by changing the amount of profit they expected to make. Nonetheless, we do know that the docked captains enriched their capacity to produce a conjecture of what to do next by using another captain's experience to inform the concrete part of their abductive sensemaking.

A less haphazard situation in which captains import experience from one another is at regular gatherings on land, such as fleet meetings. Fleet meetings, as described in Chapter One, are typically held to so the fleet can structure how they enact a particular fishery, or how they progress from one fishery to another, all with the goal of maximizing the ability of each vessel to have access to a target species quota. I regularly observed captains seeking and sharing experiences regarding natural conditions at sea before, during, and after such meetings. The following exchange at a fleet meeting between two captains who are regular members of the Kodiak trawl fleet and one who is a regular member of the nearby Sand Point (i.e., Western Gulf) trawl fleet (but who attended a Kodiak fleet meeting), demonstrates a more regular situation in which one captain shares cues about material conditions with another:

> *Kodiak captain #1*: "How much do we know about the boats from Sand Point that are coming out to harvest the pollock quota?"
> *Kodiak captain #2*: "One of those guys is right here (points to another captain), why don't you ask him?" (general laughs in the room)
> *Sand Point captain*: "The reason we came out here is because there wasn't any fish around Sand Point. We're probably going to go back there and look again to see if there's any fish"
> *Kodiak captain #2*: "I saw plenty above Mountain Top"
> *Sand Point captain*: "Pardon?"
> *Kodiak captain #2*: "I saw plenty of fish above Mountain Top the other day"
> *Sand Point captain*: "Did you?"
> *Kodiak captain #2*: "Oh shit yeah, I would have loved to set on it!"

This interaction during a fleet meeting, diagrammed in Figure 15, consists of an information-sharing event that connects two implied sensemaking episodes. The first implied sensemaking episode is part of Kodiak captain #2's experience at sea in which he made sense of the natural materiality at Mountain Top; the second is the Sand Point captain's future episode, before he goes fishing, in which he will conjecture that a certain place to fish is his best choice among whatever options are available to him. And one of those options is, due to this conversation, Mountain Top. Thus, we know that Kodiak captain #2 conjectured that Mountain Top would be a profitable place to fish, even though he did not fish there (the pollock season was not yet open). To produce this conjecture, Kodiak captain #2 integrated interpretive schemata, distilled from past experiences, of what a profitable place to fish for pollock looks like with cues from the natural materiality he encountered at Mountain Top. Although we cannot know to what extent the Sand Point captain integrated the Kodiak captain's experiential information into his own sensemaking, we can assume that his abductive capacity for finding a place to fish was enhanced based on his statement that prior to the meeting he could not find "any fish around Sand Point."

In addition to occasional information-sharing events, most captains have groups they regularly fish in. Groups tend to range in size from three (e.g., a group the fleet calls "The Three Amigos") to five or six vessels, and the members of groups tend to share a common

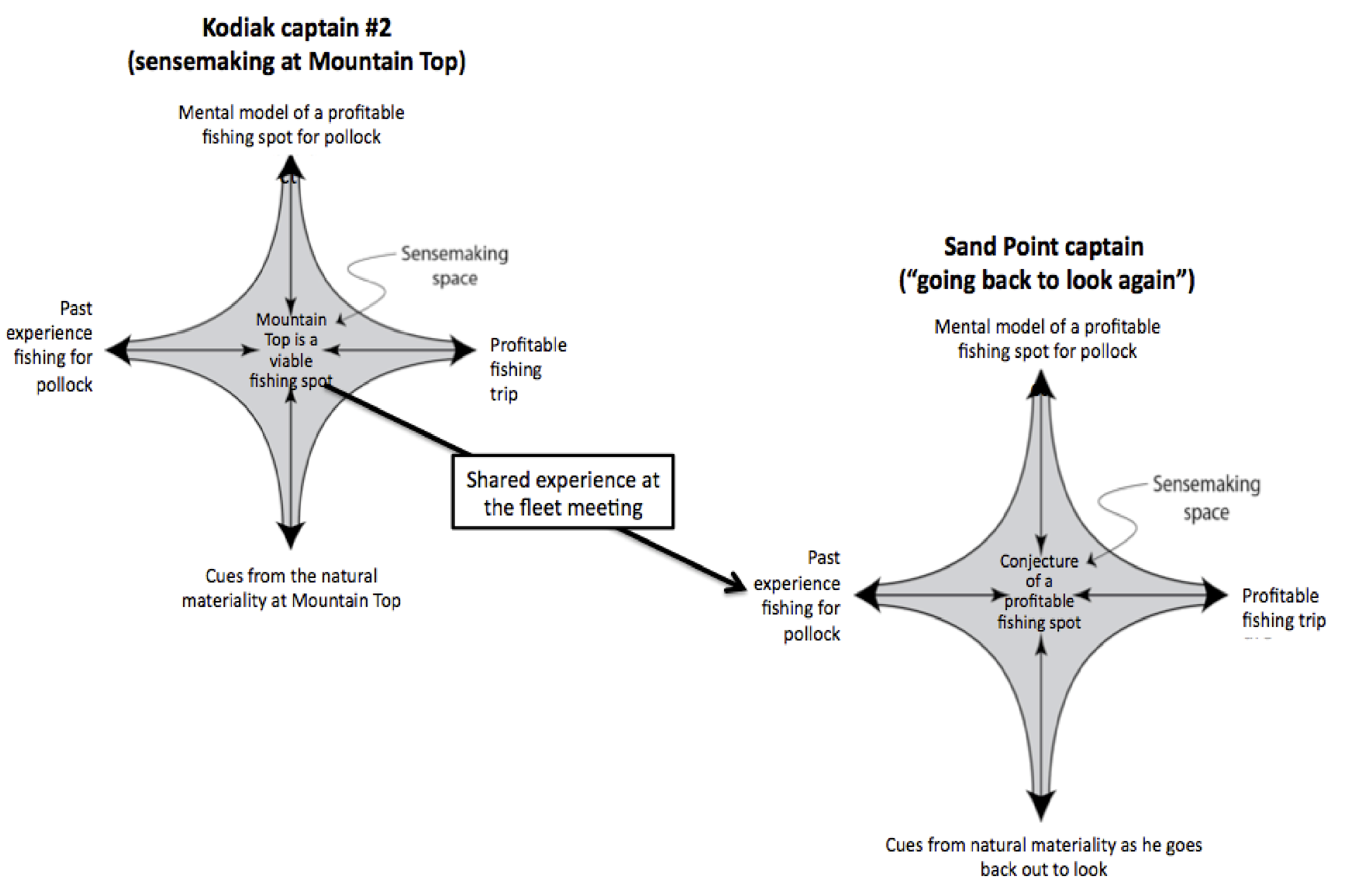

Figure 15: Diagram of two sensemaking episodes, one in the past (at Mountain Top), the other in the future when the Sand Point captain goes fishing, which are linked by an information-sharing event at a fleet meeting. This event served to distribute the Sand Point captain's sensemaking of where to fish across these two captains.

characteristic in addition to fishing in the same spots, such as delivering to the same cannery (e.g., “The Trident Boats”), having the same general homeport (e.g., “The Oregon Boats”), perhaps even the same hometown (e.g., “The Newport Boats”), or operating vessels that have common owners. Groups share information about material conditions across multiple vessels, enhancing individual abductive capacity to make sense of where to fish. In the following quote a captain, who is also an owner of three vessels, describes the first day of a pollock fishery, demonstrating a group approach to finding a place to fish:

> “I control three boats, it’s a luxury. When we left town, most of the fleet was already out. I talked to them, asked how it was going. The three boats I control, we all went to the same spot we went to last year. That’s what most people do. We went to three different areas. As for the fleet, half the fleet went to one area, half went to another area. . . The other two boats would tell us what biomass they were seeing [on their sonar], and I would compare that to what I was seeing. Well, based on what I saw, the two other boats picked up and ran all night to get to where I was. . . As an owner, I was looking at the bottom line of making money. Because I have three boats and work with the fleet, nine times out of ten I am on the fish.”

A common strategy among Kodiak trawl captains is to steam to the fishing grounds a day or two before the regulatorily-prescribed start to the season in order to find profitable fishing spots. Because the fishing season of interest in this quote was the first pollock season of the year, captains had time to go out to the grounds to look at concrete conditions before the season started. Figure 16 depicts the sensemaking process described by this captain/owner.

In this sensemaking process, there is one production of a conjecture, but it is informed by cues from materialities from different locations. In order to obtain such cues, each captain put the fleet’s disposition to fish in the same spots they have fished before into action. After steaming to their individual spots, the captains, using sonar, examined the materiality beneath their vessel for aggregations large enough to satisfy their desired future event of fishing in the most profitable spot of their three options. Captains then shared those cues with the owner of the three vessels over their radios (arrow 5), which he used to inform his understanding of concrete conditions at all three locations (arrow 3). Using an interpretive schema for choosing the best fishing spot of the three (a schema built from past experience, arrow 2, and a desired future events, arrow 1), the owner conjectured that one spot was better than the others (arrows a + c), from which he conjectured that if they all fished in that spot, they would all be better off than fishing from the

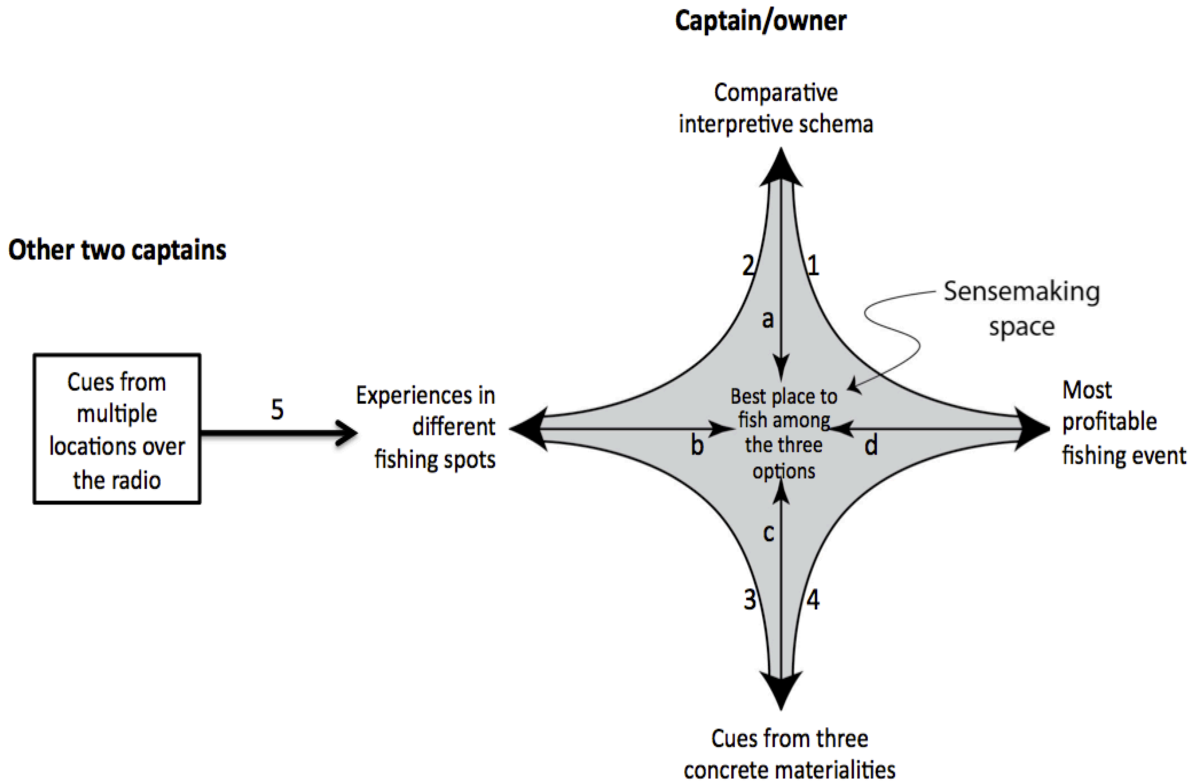

Figure 16: Group-level abductive sensemaking episode aimed at conjecturing that one fishing spot is the best choice of three fishing spots in terms of moving toward a desired future event. In this episode, one individual (Captain/owner) informs the concrete portion of his sensemaking space by communicating with other captains who are in different spatial locations, and are experiencing different material conditions.

other two, moving them from the past and into the future (arrows b + d). Thus, after this conjecture, "two boats picked up and ran all nigh" to the third boat.

ii. Information sharing and incongruity

While captains are disposed to seek information about the conditions of natural materiality from other captains, they are not always disposed to share such information. When fishing in conditions in which sharing experience might impact their efficiency, captains are less prone to share information that may lead to physically sharing a fishing spot. These are conditions in which, as one captain put it, "If you give away your secrets you diminish your opportunity to catch more." Seen through the lens of the abductive sensemaking model, the primary issue is when sharing information about concrete conditions one is interrelating with can create incongruity in the movement toward one's desired future event. In the following a captain describes how sharing information about where he is fishing can disrupt his ability to move toward a desired future event of a profitable fishing trip:

> "These guys are my friend friends, but I don't fish with them. . . It's just that the fishing spots aren't very big. . . If you call them up and tell them, "Hey, there's some really hot fishing over here, you should come over here," then they call another guy and go, "Hey, what's his face just said there's some hot fishing over here," and then he says it to somebody else, and fuck it's over with."

What this captain means by "it's over with" is that the greater the number of vessels that fish from the same aggregation, the more depleted that aggregation will become. The depletion of an aggregation reduces efficiency in terms of the amount of time and fuel it takes to fill a trawl net, as another captain explains:

> "If there's nobody else there messing with them it's a lot easier to catch them; if you are the only boat in an area and if you find some fish it's certainly a lot easier to catch them. And that just means less bottom contact, less time towing, less fuel, less everything, more productive fishing."

The potential incongruity between sharing actual materiality and moving toward a desired future event influences captains to not share information about material conditions, eliminating potential increases in their abductive capacity. Table 6 further explores sources of congruity and incongruity in terms of sharing natural materiality and moving toward desired future events.

3. Fishing: Creating a workable level of certainty of what to fish from

To enact a profitable fishing trip, captains engage in a process of progressive determination of the indeterminate. After they have arrived at their chosen fishing spot, their context shifts from above the sea to beneath the sea, their enacted environment moves from their plotter display to their sonar display, and the natural materiality they are interrelating with progresses from past to present experience. Captains must make sense of the natural materiality that is beneath their vessel, for they must set their net into a particular aggregation or upon a particular strip of bottom in order to turn potential profit into actual profit. Determining which aggregation or strip of bottom to set upon is largely an exercise of reading the output of their sonar, which is an input to their sensemaking. The following examines the processes captains engage in to make sense of the natural materiality beneath their vessel so that they can know, at a workable level of certainty, where to tow.

Table 6: Aspects of the incongruity that emerges between sharing information about material conditions and progressing toward desired future events	
Aspect	***Representative quotes***
Source of incongruity: Sharing natural materiality influences behavioral patterns of target species, changing the nature of the natural materiality one is interrelating with	". . . the resource acts different when there's three or seven boats compared to 30 boats, how the fish go up and down, and they get confused. . . What they do is the come up and down in the same spot. Well, if you get a lot of [fishing] effort, they are gonna hang out up [and not come down], or move."
Source of incongruity: How changing the nature of the natural materiality one is interrelating with can create incongruity in one's progress toward a desired future event	"You can imagine, ok each boat, 30 boats. . . the gear is about a quarter mile wide roughly, so quarter mile, quarter mile, quarter mile (indicates with hands multiple quarter mile lengths side by side), a mile wide. . . and we are there at the back [of the line of boats]. It doesn't take a rocket scientist to know what's gonna happen with your [catch efficiency], it's gonna go to hell. And that really affects us, you know, our income."
Source of incongruity: How sharing natural materiality can create incongruity in one's progression toward the desired future event of avoiding bycatch (which eventually can impact profitability)	"When you first get there the first day there's a lot of codfish and everybody will get fairly clean tows, but the whole fleet will just keep pounding back and forth on these tows and it will get dirtier and dirtier because the ground gets stirred up, more halibut come in . . . and there's less cod to dilute them. But if one guy goes there, you can look around and say, 'Oh there's a school, I'm gonna set on it.' You, alone, can target codfish; but with 30 boats there, you can't do that. By the time you turn around to set on it, somebody else is on it, so you got to just tow. So it works with one or two guys there. . . Anybody can go there and get clean numbers if they are by themselves."
Source of incongruity: How sharing natural materiality in limited spatial conditions influences behavioral patterns of captains	"Usually it is 30 guys running over the top of each other, saying, 'Get out of my way asshole!' and 'I was there first!' and 'My boat is bigger than yours, so if you don't move I'm going to mow your ass over.'"
Source of congruity: Avoiding sharing natural materiality due to the influence doing so can have on captains' behavioral patterns	"I'm one of those guys that, if there are 25 boats in one spot I 'm the guy that drives 20 miles away, me and one or two other guys. Which doesn't always work out so well - there is a reason those 25 guys are there usually. It's just a hassle to fight with them sometimes."
Source of continuity: How non-limited conditions of natural materiality creates a lack of potential incongruity, which enables information sharing	*Captain:* "Its been different here with the [lack of competition in a 'catch share' fishery], the information has been freer; they will call you up and say, 'Hey they are right here.' Especially last year - the pollock fishing was so hot, guys will just call you and say, 'Here at such and such place, set and you are gonna be full in 10 minutes.'" *Interviewer:* "Because it wasn't a risk for them to share information?" *Captain:* "Not with they way the pollock was in the Shelikoff, it was just incredible." *Interviewer:* "Even a race (i.e., competitive) fishery?" *Captain:* "Even a race fishery."
Source of congruity:	*Interviewer:* "What makes another captain good to work with?"

Interlinked desired future events opening the door to sharing information in the interest of cooperating to find profitable natural materiality	*Captain:* "Somebody that, for me, it would be a captain that is more concerned with the bottom line that his big head. . . . because if he is concerned about his bottom line, and he is doing everything to make his profit margin as high as he can, and I'm on the same page, and our two combined goals is to make both of our bottom lines higher, its easier to do it with two people"

a. Echoing an enacted environment

Captains rely on sonar systems to provide a visual display of the bottom and the water column beneath their vessels, including aggregations of fish on the bottom or in the water column. Sonar is how captains extract information about materiality before they extract fish from it. Yet, the world the sonar perceives lacks important detail. The sight of the sonar is derived from differences in the speed and timing of sound waves it has emitted toward the sea floor and which have been echoed back to it. The sonar's transducer continually measures these differences and turns them into a visual display. In doing so, the sonar is able to display the density, location, size, and shape of objects beneath the vessel. Such objects include the ocean bottom, material on the bottom such as wrecks, large aggregations of fish or fishing gear, as well as sizable aggregations of fish that are off the bottom and in the water column. Material objects that cause large and sustained differences in reflected sound waves are more likely to be seen by the sonar. Aggregations of fish that have air bladders are particularly visible, for an air bladder, which is an internal sack that allows fish to move vertically through the water column, has acoustic properties that echo 85% of a sound wave it encounters (Bazigos, 1981). 'Roundfish,' such as rockfish, pollock, cod, and salmon, typically have air bladders, while bottom-dwelling 'flatfish,' such as flounders, sole, and halibut, typically do not. Whether echoes are caused by fish, fishing gear, submerged vessels, or the ocean bottom itself, the sonar translates echoed differences into a real-time picture of the water column and its detectable inhabitants beneath the vessel (see Figure 17). As the vessel progresses along its path, what would be a cross-sectional depiction becomes a moving picture. This picture is on continual display on a wheelhouse monitor during a fishing trip.

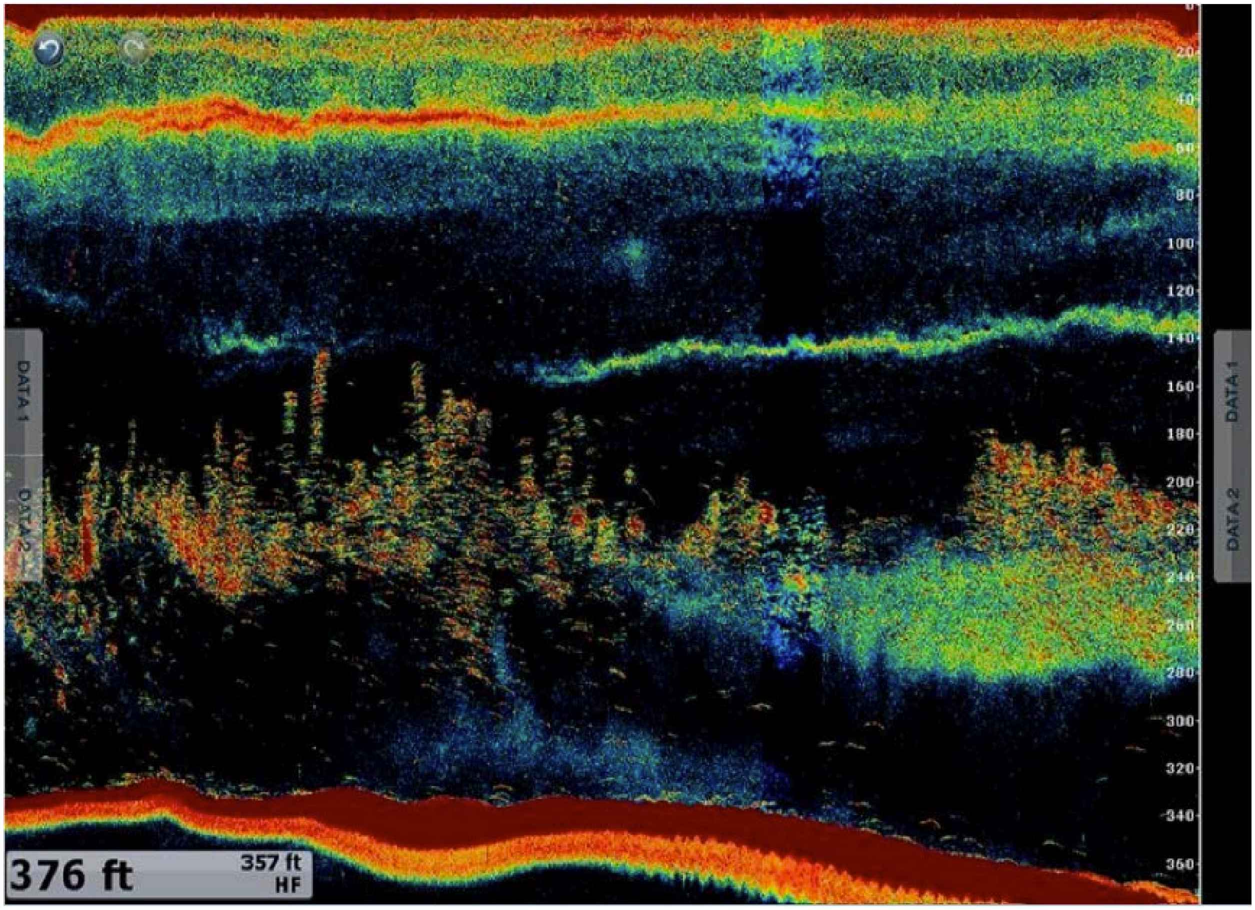

Figure 17: Screen capture of a sonar display. This is a cross-section of the water column as it moves in front of the vessel. The thick red and orange band at the bottom is the ocean bottom, and the thinner red band at the top is the water surface. The grouped red and green blotches from the left to the center of the middle of the display is fish 'sign.' From the middle to the right of the center, this sign turns into a 'feed band.' The different colors represent different densities, with red being the most dense. (From http://www.thehulltruth.com/marine-electronics-forum/521286-garmin-chirp-vs-furuno-chirp-shoot-out-3.html#b)

The sonar's display is based on information derived from "differences which make a difference" (Bateson, 2000: 459) to it. Yet, differences which make a difference to the sonar are not all the differences which make a difference to captains: the sonar's display is under-specified in relation to the story captains need to tell about the natural materiality beneath their vessels. Under-specification can be a problem because captains must choose an aggregation to fish from or a strip of bottom to fish upon based on differences between species that are imperceptible to the sonar. In the following a captain explains the limited differences the sonar picks up:

> "You can't see sole. The only thing an echo sounder will really truly show you is something that it can bounce sound off of, and to bounce sound off of something it has to have an air bladder in it, otherwise everything you see just looks like the

> bottom. A sole does not have an air bladder, but if you find a place where the sole is thick enough, if you get in a place where you are catching 100 thousand pounds of sole in an hour, the whole bottom looks a little bit different. . . Feed, smelt, and stuff doesn't really have an air bladder, but sometimes there's just so much of it that it shows up like backscatter. . . Like this stuff here (pointing to his sonar monitor), we don’t really know what that is, I don’t believe that we are actually seeing the sole so much as we are seeing what the sole is feeding on. . . But it doesn’t have to be feed, it could be a difference in water temperature, or a current rip could do the same thing. It picks up the difference.”

While sonars pick up differences between mere water and large solidities such as the bottom or thickly aggregated fish, and between aggregations of different densities and with different spatial characteristics, they do not pick up differences between species with similar morphological and behavioral characteristics. Thus, the sonar will not depict differences between fish that have air bladders and which swim in the same areas of the water column at the same time, such as pollock and Chinook salmon, even though they are different species and are regulated quite differently.

Due to the limited nature of the information a sonar perceives, captains do not know the species composition of an aggregation they are towing from until they have extracted part of it and brought it on board. As Gulf trawl captains are wont to say, “You never know until you tow.” And all individuals of most species that trawlers bring on board are dead, save an estimated 40% of the Pacific halibut that tend to survive the ordeal (North Pacific Fishery Management Council, 2012). As described in both Chapters Two, due to regulatory limits on how much Chinook salmon and Pacific halibut Gulf trawl captains can incidentally catch when fishing for their target species, catching high amounts of those fish can constrain the amount of target species the fleet can catch, potentially stranding economic gain. Thus, the under-specification of an aggregation can be a problem when fishing for flatfish on the bottom, as halibut is a flatfish, and it can be a problem when fishing for roundfish off the bottom, which is where Chinook salmon swim.

i. Building abductive capacity to differentiate natural materiality

One of a captain’s primary duties is wading into their sonar environment and making sense of under-specified objects. The objects that tend to incite the most sensemaking are called ‘sign.’ ‘Sign’ is a general term for objects on a sonar display that suggest the presence of fish. Sign might be target species, or it might be, as the captain above suggested, another difference detected by the sonar, such as feed, which has shown itself to be a reliable proxy for target species. The following quote concerning fishing for pollock exemplifies the role sign plays when determining where to fish: "We look for what we call ‘sign,’ we are looking for feed. Guys will say, ‘It looks like a bunch of feedy crap,’ or ‘it’s a lot of something.’ Nobody says, ‘It’s a lot of pollock.’” The captains’ reliance on sign to determine what natural materiality to fish from once they are on the fishing grounds puts a heavy burden is on sensemaking if they are to meet regulatory demands for specificity and the imperative for efficiency.

To make sense of sign, captains integrate objects on their sonar display with descriptors, cues from other instruments, and past experience. From these integrations, captains produce conjectures regarding what sign is (“What’s the story here?”) and what it might mean in terms of moving toward desired futures (“What’s next?”). In terms of descriptors, captains have developed a collection of adjectives and metaphors for describing the shape and location of sign, such as “carpet,” “fluffy stuff,” “clumps,” and “tight scruff,” which they will enrich using colors that connote density, such as “light purple,” “blue,” “dark red,” as well as numbers that communicate depth. In addition, captains supplement these descriptors with cues from other instruments, such as time of day, time of year, latitude and longitude, water temperature, and tide information. In applying a system of descriptors and external cues to objects on the sonar display, captains complicate the simple differences the sonar measures.

Yet, dressing up an object with adjectives, metaphors, and other cues is still mere description. Mere description lacks meaning in terms of moving toward desired future events. Captains may gain a sense of the object’s physical characteristics, but they do not have a sense of how that object integrates into their process of enacting a profitable trip. Only when captains overlay an object with past experience can they conjecture what it means in terms of moving toward desired future experience. Thus, only when the abstract meets the concrete within the dimension of past and future can captains engage in the abductive sensemaking required for interrelating with indeterminate natural materiality. For example, while looking at the sonar display the first day of a fishing trip, a captain gave the following interpretations of different objects: “That’s some nasty mud there,” “That’s actual fish right there,” “That’s the bottom there.” This captain was able to identify objects beyond mere adjectival description because he had encountered them, or something similar to them, before. In other words, he was able to overlay them with past experience. And only then could he conjecture what the sign might mean for his ability to move toward desired future events. On the other hand, I, having little experience with a sonar display, could not make such meaningful identifications, for I did not have the interpretive schemata built from past experience that would allow me to give objects on the display meaning in terms of interrelating with them. Reading the sonar is a process of sensemaking: it is a process of imposing differentiation where differentiation is lacking in order to tell the story of what is happening and conjecture what should happen next.

A relatively recent discovery Kodiak trawl captains made demonstrates the role of past experience in reading sign, telling a story of what it means, and then producing a conjecture of what to do with it. “A couple or three years ago” (as stated in 2012), captains encountered sign they thought was flatfish, but which they eventually determined was pollock, yet not until after they fished from it and brought the fish on board. Fishing for flatfish in an area where pollock were not known to frequent that time of year, captains encountered sign that was “plastered across the bottom, glued to the bottom” and “up in the shallows.” These behavioral patterns indicated by sign were characteristic of flatfish. Yet, when captains fished from this sign and started catching a lot of fish in a short amount of time, which was uncharacteristic of flatfish, they experienced a loss of a sense of what they were catching, as the following captain exemplifies while describing his first experience fishing from this sign: “All of a sudden it was like, 'I'm not seeing it, but shit is pouring in the net!’ And it was like, 'holy shit!’” This captain knew that he was catching large amounts of fish based on his instruments, but he could not conjecture which species of fish it was, hence his use of the generic “shit” to describe his understanding of what he was catching. The captain also knew that his unstated previous conjecture, that the sign indicated flatfish, was false. In the following another captain describes this sign, explaining how past experience with this sign is needed to accurately interpret it, and often to even see it:

> “You got to know it’s there. You can see it on both sonars (net and at the front of the vessel), but if you didn't know what it was you would drive right over it. [The reason we found it was] somebody was towing for sole and then started seeing this stuff and then hauled up a huge bag of pollock. . . . And I mean it just adds up so fast that you can see it on your net sonar going in the net. But if you didn't know what it was you would just drive right over it because it doesn't look like much of anything. . . if you are looking up in the water you will see nothing, there's nothing there.. . . And if you saw it on the bottom, you would think it was cod or feed, you wouldn't think it was pollock at 35 fathoms in the fall.”

In discovering that the sign was pollock, as well as discovering that the sign was not flatfish, captains moved from incongruity in their abductive sensemaking to continuity.

Figure 18 diagrams this transition from incongruity to continuity. In part A, captains import past experience into the present in order to know what to look for in their concrete experience (“You got to know it’s there”) (diagram A, arrow 3), as well as to know what meaning to give to what is seen (“you would think it was cod or feed”) (diagram A, arrow 2). In

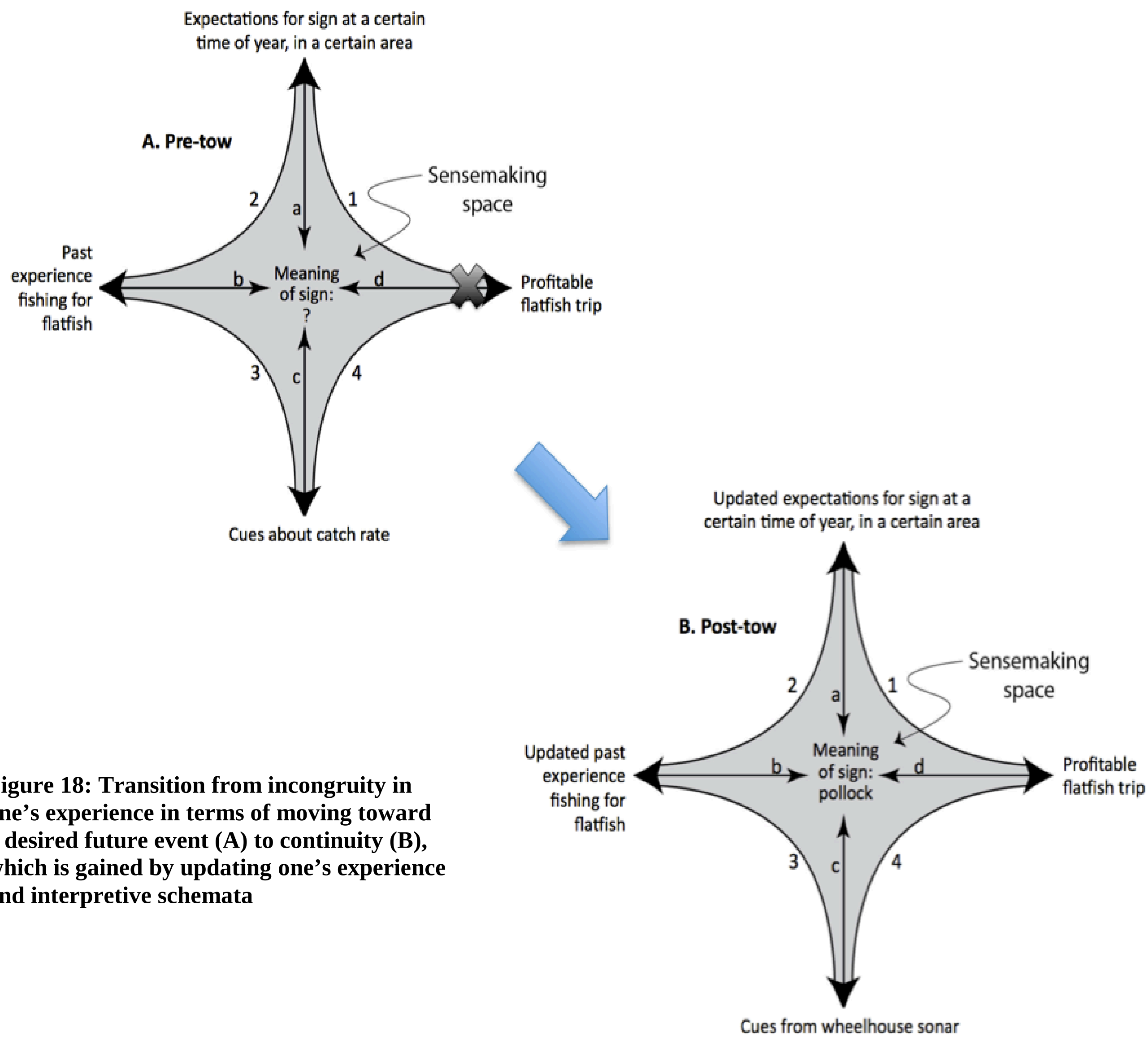

Figure 18: Transition from incongruity in one’s experience in terms of moving toward a desired future event (A) to continuity (B), which is gained by updating one’s experience and interpretive schemata

addition, captains’ interpretive schemata are also influenced by their expected future event of profitably filling their vessel with flatfish, such as an expectation for a certain catch rate (diagram A, arrow 1). Captains integrate past and future events into interpretive schemata for understanding concrete cues (diagram A, arrow a). Where captains choose to fish is also influenced by a desire to catch a profitable amount of flatfish (diagram A, arrow 4) and past experience catching flatfish (diagram A, arrow 3). The cues that captains bracket and bring into experience are an integrated output of these past and future influences on their concrete experience (diagram A, arrow b). In this case, as diagram A of Figure 18 displays, there was an incongruous relationship between the captains' abstract and concrete parts of experience. This incongruity resulted in a loss of sense. When captains experience a loss of sense, in this case, they face incongruity in their ongoing experience in terms of moving toward their desired future event.

Part B of Figure 18 diagrams the reconciliation of the abstract and concrete parts of experience, and the production of new sense. In diagram A, captains are fishing based on expectations that certain sign at a certain depth and time of year signifies flatfish, and they experienced incongruity between those expectations and cues from concrete experience. Due to the under-specified nature of sonar, captains cannot resolve the incongruity until they haul up their nets (i.e., they never know until they tow). In diagram B, captains have hauled up their net, realizing that the sign they thought indicated flatfish actually indicated pollock. Although captains 'never know until they tow,' after they tow they can update what they know (i.e., their interpretive schemata for both pollock and flatfish). Thus, after they tow the captains can integrate new experience into their interpretive schemata for making sense of sign on their wheelhouse sonars. And the better captains are at reading sign, the better their conjectures tend to be of what species certain sign indicates. As one captain explained, "Once you have stared at it long enough you can start to see the little differences in the sounder, but I think that takes a lot of experience."

Just as captains use experience from other captains to gain a workable level of certainty of a spot to steam to, they also use experience from other captains to gain a workable level of certainty of what sign means - to have greater ability to discern and give meaning to "little differences in the sounder." The following radio conversation between two captains fishing side-by-side for duskies, Northerns, and perch, which are types of rockfish, exemplifies captains working work together to interpret sign, and in doing so increasing one another's abductive capacity:

Captain #1:” You saw a little bit of sign yesterday, right?”
Captain #2: “Yeah, there was some decent sign early to mid-afternoon. . .”
Captain #1: “Roger. . . I tried to set at 11:30, there was some fluffy stuff on the bottom, and then it all went up [into the water column], and then it came down [to the bottom] at around 3 pm.”
Captain #2:” In the afternoon it started doing that?”
Captain #1: “Yeah, roger.”
Captain #2: “Ok, well, I haven't figured out what they do in relation to the tides. . . What depth was it when you got your duskies up north there?”
Captain #1: “I was like 65 fathoms, yeah I think it was around 66, 65.”
Captain #2: “Ok, same here. I fished here one trip last year and if I stayed at 66” and up I got duskies and Northerns, but if I got much deeper I got into perch. Yesterday I got into 69 and 70 and there was still no real sign of perch.”
Captain #1: “Yeah, up there a couple years ago, I think I was at 67, and boy I thought I was really in them, the sign looked the pretty much the same, just a lot better, and it was straight perch.”

This conversation depicts captains, who are fishing in the same spot, using a combination of descriptors (‘fluffy stuff’), cues from other instruments, such as depth and time of day, and past experience (e.g., “I fished here one trip last year”) to make sense of sign. In addition, the captains used differences in time and location to produce a sense of ecological process, which can be seen in the description of sign moving off the bottom at 11:30 and back down to the bottom at 3 pm. These captains are telling a story of what is happening in the present based on what has happened in the past, and in doing so they are creating sense that they will employ when they encounter similar sign in the future. Put more succinctly, they are abducting conjectures in the present that will be imported as expectations in the future. The product of this social abductive sensemaking episode is sense that enables the captains to “know what to expect.” Figure 19 diagrams this collective sensemaking episode.

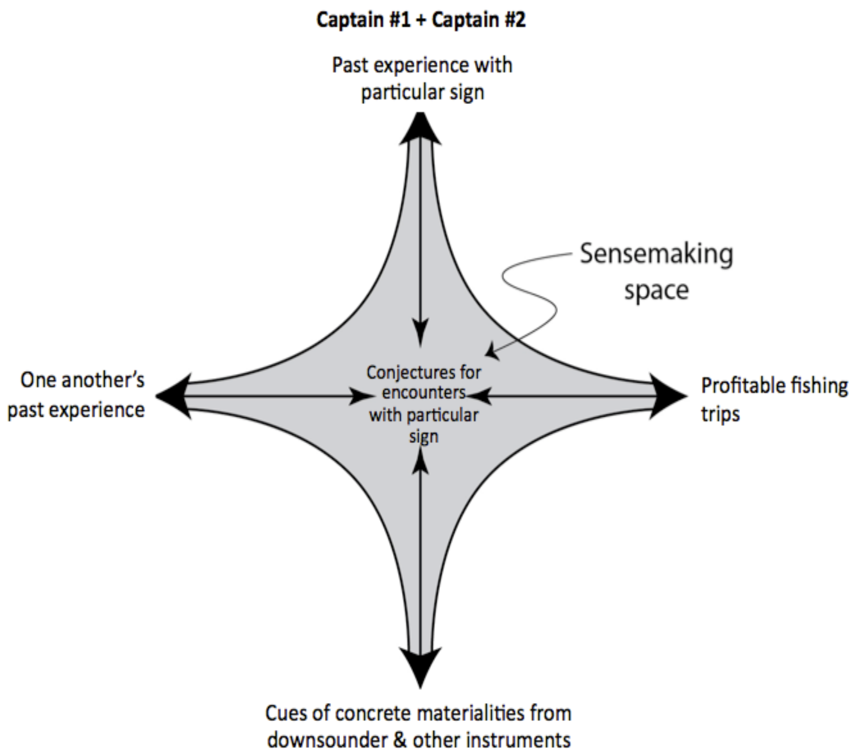

Figure 19: Diagram of a collective sensemaking episode in which captains share the same material conditions but use different past experiences to make sense of them

Table 7 provides additional examples of the interplay between the indeterminacy of natural materiality and the workable level of certainty captains try to create, both individually and socially, as they wade into their sonar display's enacted environment. The first two rows evidence the indeterminacy that emerges from the relationship between submerged materiality and the limited differences a sonar measures and the resulting lack of specification in the objects the sonar displays. The table proceeds through the ways in which captains impose specification, from their own experience to distributing the abductive process across other's experiences, so that they can know, at a workable level of certainty, which species they are likely extracting, and which they are likely not extracting, before they tow.

3. To stay or leave?: Creating a workable level of certainty of where to fish next

A fishing trip consists of captains progressing through enacted environments, from their past fishing spots captured on their plotters when they first set out to fish, to the natural materialities captured on their downsounder display when selecting materiality to fish from, to their captured fish after they haul it on board when determining whether to fish in the same spot again or to move to a different spot. This section examines the sensemaking process aimed at their enacted environment of actual fish.

a. The catch-based environment

Once captains and crew haul their catch on board, what was potential is now actual, what was fish is now catch. Natural materiality that was previously detected only through past experience and sonar technology will available for personal inspection. Assuming the vessel is not full, a captain must decide to either "throw [the net] back out" in the same spot or move to a

Table 7: Creating a workable level of certainty from the enacted environment of the sonar display

Empirical concept	***Representative Quotes***
Sonar's under-specification of natural materiality	*Captain:* "The big question is fishing what you can't see on the sonar. Those are all the flatfish, sablefish are hard to see, halibut, salmon, things that are in the feed bands." *Interviewer:* "Do you fish the feed bands?" *Captain:* "Lots of times, most of the time that's where the fish is. Your net only pulls out the big stuff. . . . That's how it is fishing in the Shelikoff, it has a big feed band with salmon, sharks, everything" *Interviewer:* Do you still see things on the downsounder that you are not sure what they are? *Captain:* All the time. You are never sure what it is until you put your net down in it. Last year I drove out [to the grounds] and I saw this sign and I made a short tow because I didn't know what it was and I had caught mackerel there like two weeks before. I hauled back, and got straight pollock, and I said, 'All right!' So I went and threw it back out, pulled it up and it was like 50% mackerel that time - same spot, same sign. I mean what the hell are you supposed to do? It was pretty frustrating" "I don't know, it looked like it almost lifted off [of the bottom], like if we would have had midwater gear we could have caught something, but it didn't look quite right either, it almost went....but if I didn't catch it I wont find out what it was. But I don't know what I am going to do next. Make sure the net is in one piece. I can see how any kind of weather is no good for this." "That possibly could be some fish, but it could be distortion too."
Under-specification due to inexperience	*Interviewer:* **"**What are those little spots off the bottom there? (pointing to sonar display) *Captain:* "I believe those are fish. I don't do this enough to get really good at it. Now that looks like fish right there (pointing to new object on the sonar). I don't know where it came from, but I'll

	take it. I sure hope it's fish."
Experience enhancing sonar specification	*Captain:* "I mean if you are in a place and a time when the sign on the sounder that you've seen it so many times, you say, 'I know what that is' *Interviewer:* "Based on experience?" Kent Leslie: "yeah" "There are different subtleties. Sometimes it isn't a lot. Sometimes you can't even tell until you get out of the fish and you are towing through something that just doesn't go in your net."
Enhancing abductive capacity through both distributed cognition and action	*Interviewer:* **"**What still surprises you?" *Captain:* "Oh, not much. Reading the sonar still does. Here's an example, last fall me and another guy were out fishing and there was this ball [on both of our downsounders] and we were both scared to death to set on it. What if it was rockfish? Not only would we have to waste a bunch of rockfish, but then you have to spend hours cleaning the fish out of the gear. We were both looking at it and we were both like, should we?" *Interviewer:* **"**What did you do?" *Captain:* "One guy did a quick dip. But most of the time we're pretty good about knowing what we're seeing on the sonar. But then you might hit a ball of herring on the way up. I had that happen, that can ruin your day too. There are times when such things can shut down an area for other guys."
Implied group-enhanced abductive capacity	"Cod fishing can be very difficult. There's times that the whole fleet will go out and fill their boats, but that's because the cod is in a big area where anybody can catch them. But 95% of the time cod is a very elusive fish, and there are a certain group of boats that constantly catches the cod, and there are boats that constantly struggle with that fishery"

different spot. In other words, captains must tell a story of what they have caught so that they can conjecture what to do next. Yet, captains already have some idea of how much they have caught based on the towing process, in which they use wheelhouse electronics to help them determine when to haul up the net so that they do not catch too much fish, or instead when they should give up towing due to catching too little fish. Catching too much fish can reduce fish quality and damage the net and vessel, as well as pose a danger to the deck crew when attempting to haul an over-filled net on board. Alternatively, catching too little fish can result in an insufficiently efficient fishing process. Both catching too much and catching too little undermine profitability. But a captain's idea of how much he has caught, before actually bringing the net on deck, can vary by as much as tens of tons or as little as a few tons.

Thus, when telling their story of what they have done in order to determine what to do next, captains work primarily from the actual catch on deck. In cod and flatfish fisheries, in which the catch is usually smaller (est. 30 to 60 tons) but more diverse (in Central Gulf P. Cod fisheries, an estimated 27% of the catch is not cod and 10% of the catch is discarded; NPFMC, 2008), the crew empties the entire net on deck to sort the salable fish from the non-salable fish. In pollock and rockfish fisheries, in which the nets and catch tend to be much larger (est. 80 to 120 tons), as well as less diverse (in pollock fisheries, an estimated 93% of the catch is pollock, with less than 1% discarded, NPFMC, 2011), the crew typically rapidly dumps unsorted catch straight from the net into the fish hold in order to maintain vessel stability. It is primarily from these enacted environments - the catch on deck or the net being dumped into the fish hold - that captains tell a story of what they have caught, from which they conjecture what to do next.

i. Building rate-based sense

The primary tool captains use to gain a workable level of certainty of what to do next based on their enacted environment of actual fish is the catch rate. The catch rate tells a simultaneously retrospective and prospective story - it captures how much fish the captain caught and the amount of time it took him to catch it, and it predicts how fast the captain will be able to catch fish in the next tow, if the nexus of natural materiality in which he is fishing does not significantly change. If a captain wants a different rate he typically has to move to a different fishing spot, in which he can fish within a different nexus of natural materiality.

To construct a catch rate, captains first determine how much fish they have caught - a catch weight. Captains construct a catch weight by employing their knowledge of how much the net holds and comparing filled net with empty net; or, captains employ their knowledge of how much their fish hold holds and comparing occupied fish hold to empty fish hold; or, captains simply look at the catch sprawled on the trawl deck and, drawing on years of experience, intuitively estimate a weight. The particular interpretive schema captains use depends on the captain and whether the net is dumped on deck for sorting or directly into the fish hold. In any case, captains integrate their perception of actual catch with an abstract interpretive schema, and in doing so produce a catch weight. The production of a catch weight provides a basic example of merging the abstract with the concrete.

The catch weight feeds into a determination of the catch rate. To construct a tow's catch rate, captains pair their sense of the catch weight with another factor of the tow – the time it took to catch the fish. From this pairing captains create a new sense of the tow in terms of pounds or tons per hour. A production of a catch rate is apparent in the following conversation with a captain after towing for flatfish:

> *Interviewer:* “How much fish do you think that is (looking at catch emptied onto the back deck)?”
> *Captain:* “Oh, about seven thousand pounds. This tow only paid for itself. We had four hours invested in that tow, we have to do better than that.”

In this discussion, the captain paired the catch weight (“seven thousand pounds”) with the amount of time that passed while catching it (“four hours”), which is a rate he used to determine that the tow was not profitable (“This tow only paid for itself”). In declaring “we have to do better than that”, the captain is implying that there is currently an incoherent relationship between the natural materiality in his fishing spot and his desired future event of enacting a profitable fishing trip. Thus, there is an incoherent relationship between the concrete and future aspects of his sensemaking space, which he must resolve.

But the captain is not yet finished telling the story of the last tow. In addition to incoherence due to a catch rate that is too low, a captain may also experience incoherence because his prohibited species bycatch rate is too high. Because catching too much halibut or Chinook salmon can result in one or more trawl fisheries closing before their target quotas are caught (see Chapter One, section 5.g. for a more detailed explanation of this relationship), resulting in stranded potential target catch, captains also often engage in sensemaking that concerns a desired future event of not catching a potentially constraining amount of prohibited species bycatch. When captains do so, they engage in a different abductive sensemaking process, differentiated by different constituents of his sensemaking space. Captains attempt to make sense of how much halibut and/or Chinook they have caught in order to project how much they will likely catch if they fish again in the same spot. The tool captains use to gain a workable level of certainty of how much prohibited species bycatch they will catch next is again a catch rate.

The production of a prohibited species bycatch rate is similar to the production of a target catch rate. A rate for halibut bycatch is the percentage of the total catch that is halibut. To produce such a rate captains will watch as the deck crew sorts the halibut from the cod or flatfish and estimate a percentage of the catch that is halibut. The result is a rate of [x] percent halibut per tow, which the captain then projects as the likely percentage of halibut in the next tow, if the next tow is conducted in the same nexus of natural materiality.

The process for producing a Chinook catch rate is somewhat different. To track Chinook bycatch, captains typically rely on the deck crew to count the number of Chinook they see (Chinook are managed by numbers rather than weight) as fish rapidly flow from the net into the fish hold. Because the crew cannot see all the Chinook during this process, the captain uses an interpretive schema to extrapolate a perceived number of Chinook into a conceived number of Chinook. Such an extrapolation model states, in general, that for every one Chinook someone saw, there are [x] Chinook in the tow. The models captains use vary, with [x] ranging from five to ten fish for every one Chinook. The reason for this variance is that extrapolation models are interpretive schemata that are distilled from numerous individual experiences of comparing the number of Chinook seen at sea to the more accurate number of Chinook a processing plant reports were delivered in the catch. A captain describes his process for creating Chinook rates in the following:

> "When we haul back I have my crew standing there as the fish are dumping in [the fish hold]. If you see one you might have 10, or if you see one there might be one; but if we start seeing five or six, then I tell the [captains] that are around me, "Hey there might be a bunch of salmon here, be careful and watch your haulbacks." And, you know, if it's ridiculous we'll get out of there."

The upshot is that, by merging an abstract structure with cues from concrete experience, captains can determine a rate of the prohibited species bycatch in a completed tow, and then use that rate to conjecture that the next tow will either have the same rate or a different rate depending on whether captains update their material conditions or not.

ii. Updating a rate-based sense of where to fish next

After captains tell the story of what has happened, both in terms of a catch or prohibited species rate, they must determine what to do next. A determination of what to do next is either a product of, or aimed toward, congruence among the elements of their sensemaking process. If there is congruence between the relatively abstract and concrete aspects of one's experience, in the terms defined by both the past and the future, there is no need to change one's fishing practice, and interrelating with natural materiality can proceed without incongruity. If there is incongruence in their sensemaking, a captain will update one or more constituents of his sensemaking space in order to establish congruence and continue interrelating with natural materiality. Thus, based on the abductive sensemaking model, captains may alter their version of a desired future event and/or they may look to different past experiences in order to tell a different, more congruent story of their current experience. Or, captains may choose to create congruence by updating the concrete side of their fishing process by moving to a different fishing spot. In one case, captains alter the relatively abstract side of their sensemaking in order to establish congruence with their concrete materiality, in the other case captains update their concrete materiality to establish congruence with the relatively abstract side of their sensemaking. The following exemplifies a captain deciding to update the concrete portion of his sensemaking space after creating a halibut rate that was incongruent with his (relatively abstract) understanding of what an appropriate level of halibut bycatch is:

> *Interviewer*: “What's the plan now?”
> *Captain*: “We are gonna run three or four miles and find a new spot. We had to move, there was just too much halibut in that spot.”
> *Interviewer*: “A new spot just based on experience?”
> *Captain*: “Based on one tow I made 11 years ago, but it was in May. Same thing, couldn’t catch anything here, weather was blowing hard out of the [Simidi Islands], and I ran over there and loaded the boat up in three tows of straight arrowtooth. But they were schooled fish, so it’s a whole different deal - a ‘they are either there or they are not’ type of deal.”

This captain’s implied creation of a halibut rate told a story of incongruence between his desired future event of not catching too much halibut bycatch on his fishing trip and the ratio of target to halibut in the natural materiality he was fishing from. This story set in motion a process of making sense of what should happen next in order to restore congruence and continue interrelating with natural materiality. The sensemaking episode in which the captain produces a conjecture of where to fish next is diagrammed in Figure 20. First, the sense the captain made in the interest of creating congruence employed the same disposition he employed to get to his previous fishing spot - fishing where he has fished before (arrow 3, from past to concrete). But, to update the natural materiality he will fish from, the captain looked to different past experiences, perhaps for one that shared a similarity to current concrete conditions (“weather was blowing out of the Simidis”) (arrow 3, from concrete to past). Using different past experiences, the captain selected a different fishing spot to fish in next, which was a conjecture that by fishing in that spot he would catch less halibut, establishing congruence with his desired future event of not catching an amount of halibut that would constrain the fleet’s ability to catch target quotas in the future (arrow 4).

The decision to move requires captains to redeploy a sensemaking process of determining where to fish. Thus, the previous sensemaking episode captures the reciprocal nature of the process of enacting a fishing trip: interrelating with potential concrete materiality by choosing a space in which to fish, choosing an actual nexus of natural materiality to fish within, and then either continuing to fish within the same nexus or updating the concrete portion of one’s fishing process by moving to a different spot in order to fish within a different nexus of natural materiality. When choosing to move, captains return to interrelating with potential materiality rather than actual materiality. Yet, they do so in order to find natural materiality that is constituted by a bigger and/or more homogeneous aggregation of target species. This

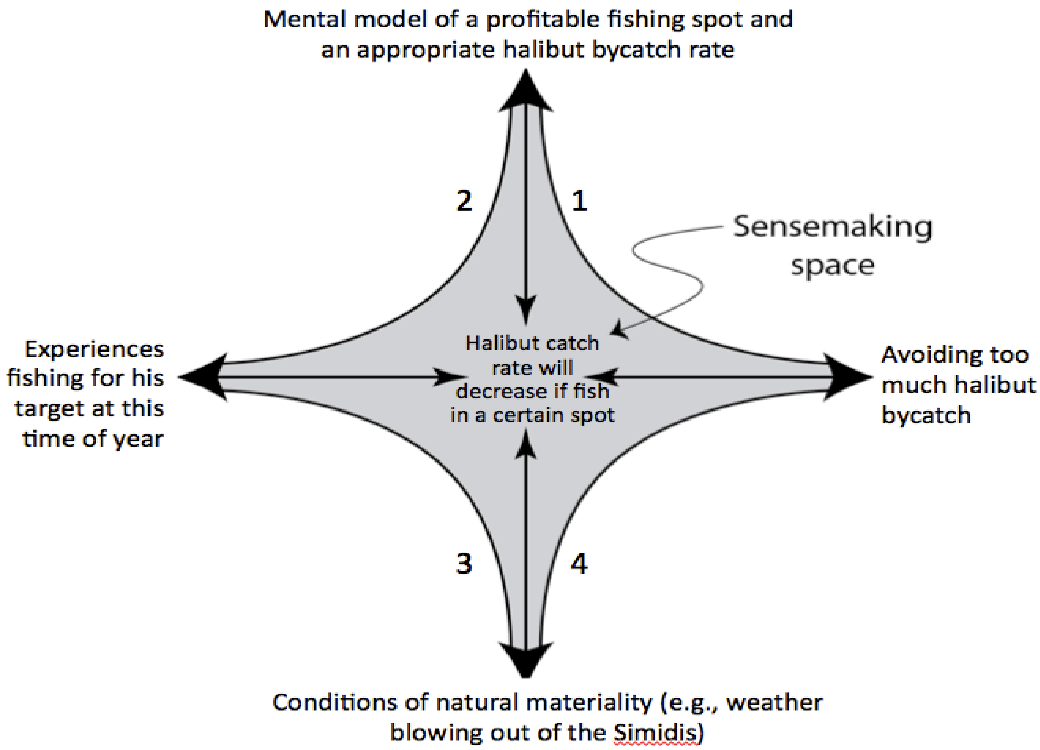

Figure 20: Conjecturing that updating the natural materiality one is fishing from by moving to a different fishing spot, based on different past experiences in light of current conditions, will reduce the halibut bycatch rate one produces

sensemaking will again be constructed using one or both of the dispositions to fish where one has fished before and to seek experience from other captains. Table 8 provides examples of captains determining where to fish next by employing the disposition of seeking experience from other captains, and in doing so expanding their abductive capacity to find natural materiality to fish from that better satisfies their desired future.

Table 8: Examples of captains increasing their abductive capacity to determine where to fish next after deciding to move from their initial fishing spot	
Empirical concept	***Sensemaking episodes***
Choosing a spot based on one's own experience and the experience of other captains, influenced by the desired future event of	*Interviewer:* "What made you come down here to fish?" *Captain*: "This is where [captain A] and [captain B] were, and I have fished here before. . . . I was a little concerned when I set in that last spot. Yeah, if I can just get another quick one. I'm tired, I might have fallen asleep a couple of times."

producing a profitable trip	*Interviewer:* "Yeah, this seems like its been a pretty tiring trip" *Captain*: "This seems like this is how it always is. It would be nice if we could stop and sleep, but the clock is running. Its not like you are up against other guys beating you to the dock, but you are still, with the cost of fuel for you to come out here you have got to bring some fish back."
Choosing a spot based on another captain's past experience, influenced by concrete conditions	*Interviewer:* "How did you decide where to set?" *Captain*: "Um, towing here before, wanting the right depth, from some years of experience. But, then I had another boat come through here last night, he was just fishing here, and he says he didn't catch anything, he was all discouraged. I was gonna fish 20 miles further south, but he said, 'Well the further I got to the north the better the fishing got.' So that's one reason we're here right now."
Choosing a spot based on two captains' past experiences	*Interviewer:* "Good morning, how is it going?" *Captain:"* Ok. I talked to another [Boat A], he said [fishing] wasn't any good at the Potato Head. . . . but then there's another boat at the Coral Patch. . . I talked to him and he got 50 thousand pounds yesterday. . . We need another 25 to fill the tanks." *Interviewer:* "Who was at the Potato Head?" *Captain:* "[Boat A], he said he had about 25 thousand and he tore his net up real bad; he said he didn't think there's much there and he knows that spot really good. So I hope this works out. I'm getting tired of not making good decisions, I think we probably should have just stayed where we were." *Interviewer:* "So nobody is doing that great?" *Captain:* "Well 25 or 50 down here doesn't sound that bad, we didn't do that much better where we were [before we moved]."
Choosing a particular tow (a predetermined track of bottom) based on the experience of another captain, influenced by the desired future event of enacting a profitable trip	*Interviewer:* "Where are we steaming to?" *Captain*: "Marmot" *Interviewer:* "That's on the other side of the island?" *Captain*: "Yeah, we were fishing over here (pointing to a spot on the plotter), now we're going to the other side of Afognak. All this really is the closest place you can find anything, nothing real special." *Interviewer:* "Were there guys fishing over here recently?" *Captain*: "The last guy that did fish here that I know of is [boat C], oh [boat D] fished here also; actually I'm making the exact same tow that [the captain] on [boat D] made, and this one tow was worth $5 thousand to [that captain]. But I haven't seen any fish; it's almost like somebody flipped a switch. Three boats in the last three days have tied up because they went out, looked at it and found nothing. I don't know if it's the lunar phase or what, but its almost like somebody threw a switch. But this happens."

4. Conclusion

Three interrelated findings stand out from the previous analysis: 1) Captains have a disposition to inform their understanding of material conditions by importing another's past experience; 2) Sensemaking at sea can be a social process that captains use to enhance their capacity to gain a workable level of certainty in terms of where to fish; and 3) In a context characterized by indeterminate systems, sensemaking often concerns the transition from incongruity between the concrete and the abstract, in the terms defined by the past and present, to congruity among those elements. Furthermore, when sharing information has the potential to induce incongruity in terms of determining what comes next, captains are less prone to share information. The following discusses these findings in greater detail.

The previous analysis traced the progression of sensemaking that is part of the infrastructure of a fishing trip. This progression moves through stages, from making sense of *where* to fish first, to making sense of *what* to fish from, to making sense of where to fish *next*. Each of these stages corresponds to a different enacted environment. While captains make individual sense of these enacted environments, their sensemaking is embedded in a social nexus of past experiences. Captains make sense of their enacted environments using past experience, their own or another's, in light of current conditions and shaped by desired future events. A Kodiak trawl captain not only has a disposition to fish where he has fished before, he has a disposition to fish where someone else has fished before, and to seek information to that end. As captains attempt to organize with inherently indeterminate systems, past experience imported from other captains helps them answer the first sensemaking question, 'What's the story here?' in terms of the particular spot another captain has experience with, so that the captain receiving the information can, in drawing on a richer set of experiences, provide a more informed answer to the second sensemaking question, 'What's next?' In other words, imported past experience, one's own or another's, enhances a captains creation of a workable level of certainty in terms of where to fish.

The first sensemaking stage of a fishing trip consists of the enacted environment that is the wheelhouse plotter. Plotters allow captains to turn experiences into objects that can be used to inform subsequent fishing processes. A fishing trip starts with captains applying abductive sensemaking to their plotter's enacted environment in order to gain a workable level of certainty of which fishing spot to steam to under current conditions. The next enacted environment is the sonar display, in which captains use abductive sensemaking to determine, at a workable level of certainty, whether an object beneath the vessel offers the opportunity to conduct a profitable tow. The next enacted environment is emergent from the previous two - the enacted environment of actual catch, from which captains employ abductive sensemaking to decide whether to fish within the same nexus of natural materiality or to move to a different spot in order to fish within a different nexus. At each stage captains stand in the actuality of the present, which is interpreted through the lens of a desired future and a selected past, and tell a plausible story of what is happening in order to produce a plausible conjecture of what should happen next.

The indeterminate nature of natural materiality at sea, in relation to Kodiak captains' imperative for efficiency and regulatory demands for species-level specificity, puts a heavy burden on sensemaking. This burden requires captains to socially-construct and impose differentiation into their enacted environments. To enhance their ability to make differentiated sense of potential natural materiality as they leave the dock and actual natural materiality as they arrive at their chosen fishing spot, captains look outside their own sensemaking space to the sensemaking spaces of other captains for experiences that can complement their own. Captains use other captains' experiences to enhance their ability to efficiently make plausible conjectures, what I call 'abductive capacity.' In doing so, captains engage in social abductive sensemaking.

One of the aspects of captains' experience that incites abductive sensemaking is incongruity between the concrete and the abstract sides of their sensemaking spaces. Incongruent relationships, such as when there is a mismatch between expectations distilled from past fishing events and cues from current concrete materiality, lead to incongruity in terms of moving toward one's desired future event. This incongruity requires updating aspects of experience in order to re-establish congruence between the abstract and the concrete, which allows for continuation of one's experience. Updates may come in the form of a new understanding of concrete materiality, a new desired future event to work toward, a different past experience to draw from, or new concrete materiality to organize with.

Taken together, the purpose of the model constructed in Chapter Two and expanded in this chapter is to enable the dissection of abductive sensemaking events into 1) identifiable parts, and 2) relationships among those parts. In doing so, we are better equipped to understand how sense breaks down and is re-made when attempting to organize with indeterminate materiality. This chapter demonstrates that the breaking down and re-making of sense is both an individual and social process of constructing congruity between the abstract and concrete parts of experience, in the terms defined by past and future experiences, in the interest of continuity of interrelating.

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Chapter Four
From Hot Spots to Lightning Strikes: Making Sense of Chinook Salmon Bycatch

"Consider once more, the universal cannibalism of the sea; all whose creatures
prey upon each other, carrying on eternal war since the world began."
--Melville, H. *Moby Dick*, p. 247

1. Introduction

In Chapter Three I expanded the model introduced in Chapter Two to the social level, and well as longitudinally throughout a fishing trip. This chapter expands our ongoing analysis of sensemaking at sea to the system level by examining relationships between regulatory processes on land and sensemaking processes at sea. In doing so, I go beyond the approach taken in previous chapters of examining fundamental aspects of the process of commercial trawl fishing to examining how broader parts of a fisheries management system interrelate to impact one of the most important conservation issues today - fisheries bycatch (Davies, Cripps, Nickson, & Porter, 2009; FAO, 2010; Lewison, et al., 2011; Patrick & Benaka, 2013).

This chapter is a ‘focused ethnography’ of an extreme bycatch event that occurred in the Gulf of Alaska. Rather than examining commonalities across an array of events, a focused ethnography takes as its object of inquiry a particular event, phenomenon, or situation that has been delimited in time and space (Nicolini, Mengis, & Swan, 2012: 615, citing Alvesson, 1996). The event of interest is a rare event, which was extreme in nature. Extreme events are rare but “significant interruptions, exaggerations of a type of stimulus that organizations routinely encounter on a smaller scale” (Christianson et al., 2009: 846). These types of events are valuable as case studies because they allow researchers to see pernicious factors that come to light in such

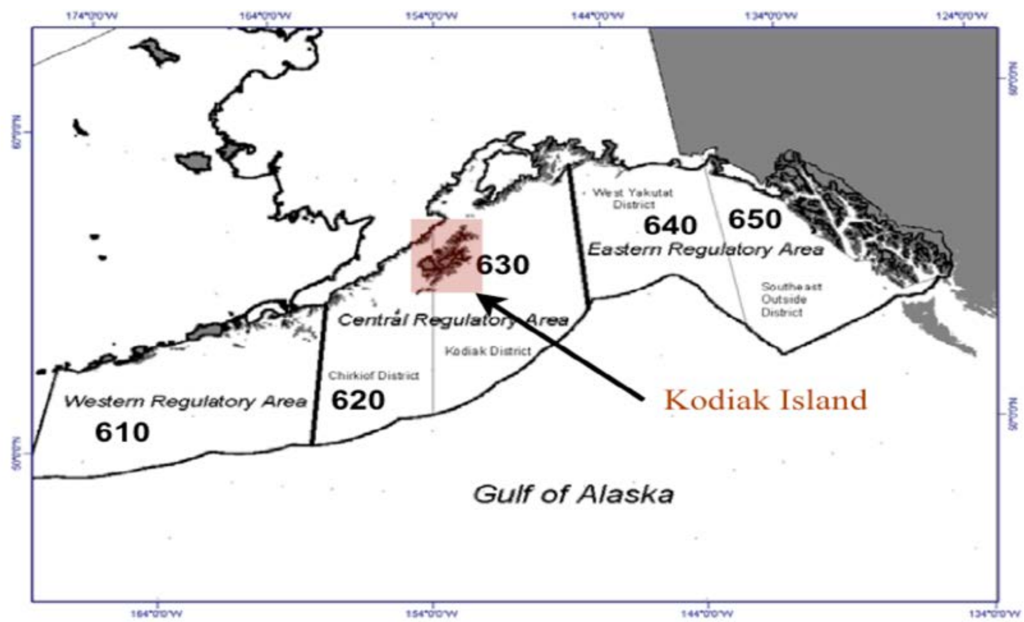

Figure 21: The regulatory areas that constitute the Gulf of Alaska federal management area

events, but which otherwise tend to be taken for granted and/or are beneficent (Eisenhardt, 1989; Yin, 2009). This chapter uses an extreme event in the commercial fishing context to extend organizational theory, but it also uses organizational theory to extend our understanding of commercial fishing, specifically bycatch that is discarded, which is a primary concern among fisheries managers and fisheries management scholars (e.g., Abbott & Wilen, 2009; Lewison, Crowder, Read, & Freeman, 2013; Patrick & Benaka, 2013). As stated by Bellido et al. (2011: 318), “discarding is currently one of the most important topics in fisheries management, both from economic and environmental points of view.”

2. The Western Gulf Chinook Bycatch Event

In 11 days in October of 2010, approximately 20 vessels participating in a pollock fishery in the Gulf of Alaska accidentally caught 28,000 Chinook salmon. This event was the ‘D’ season pollock fishery in the Western Regulatory Area (see Figure 21). To review from Chapter One, regulators annually create one overarching quota for pollock in the Gulf of Alaska (Gulf), which they split across four pollock seasons (A, B, C, D), each of which occurs in areas 610, 620, and 630. Each of the four seasons start at the same pre-determined, regulatorily-defined dates in each area, two in the winter (A, B) and two in the fall (C, D). Thus, there are twelve annual pollock fisheries in the Gulf. Because pollock and Chinook have similar patterns of activity that recur at certain times of the year in Alaskan waters, vessels tend to incidentally catch Chinook while fishing for pollock.

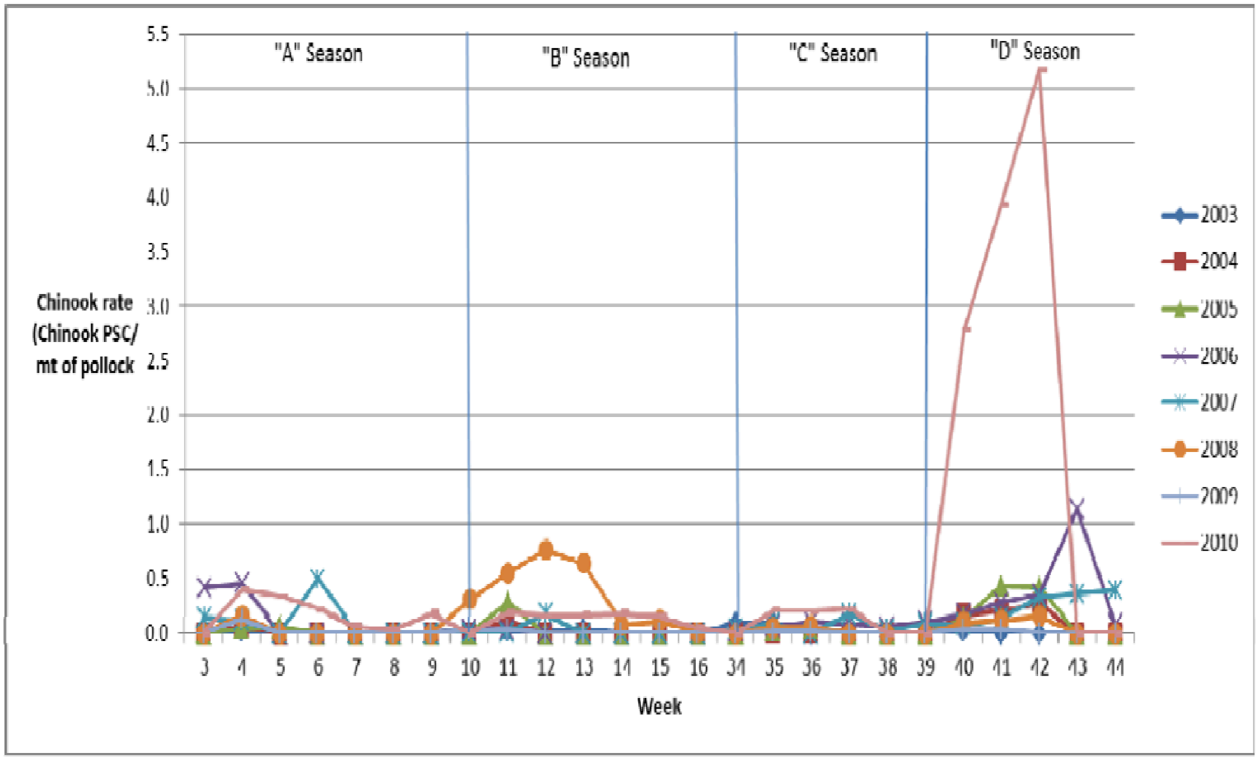

Figure 22: Seasonal (A, B, C, D) and annual Chinook salmon bycatch rates in the Western Gulf pollock fisheries. A and B seasons are regulatorily scheduled to start on January 20th and end by May 31st, and the C and D seasons are scheduled to begin on August 25th and end by November 1st. The 2010 spike in the D season is the at-sea portion of the Western Gulf bycatch event. (NPFMC, 2011: 57)

Chinook, or 'king,' salmon is the largest, least abundant, and most expensive of the five salmons caught in Alaska; it is also one of the most culturally important fish to Alaskans, as indicated by its status as the Alaska state fish. Due to regulation, Chinook salmon is 'bycatch' when caught in a pollock fishery. Bycatch is "fish other than the primary target species that are caught incidental to the harvest of the primary species" (NOAA, 2006: 5). There are two types of bycatch: organisms that are retained and sold and organisms that are discarded. Fishery participants (i.e., captains or processing plants) discard catch for one of three reasons: mechanical and structural limitations (e.g., fish may be too small to process or catch may be too heavy to bring aboard), the catch does not have economic value - or as much economic value as other catch does (e.g., captains may discard pollock in favor of retaining Pacific cod), and regulations that require certain species, when caught in certain fisheries, to be discarded. Chinook fall in the latter category in all pollock fisheries in Alaska.

The extreme nature of Chinook bycatch in the 2010 D season pollock fishery in the Western Gulf (are 610) is depicted in Figure 22. The rate of bycatch (i.e., the number of Chinook caught for every ton of pollock caught) in the event was 3.45, which was 20 times the average rate for the previous seven years (0.17 Chinook/ton of pollock). Put differently, the amount of Chinook salmon bycatch in the Western Gulf in October 2010 was 165 times the amount caught in the same D season fishery in 2009 (six days of fishing) and 19 times the annual amount of Chinook caught in that fishery over the previous five years (est. 1,500 fish), over an average of 14 days of fishing.

While all the pollock and Chinook salmon caught in a trawl net die in the process, due to regulation, all the Chinook salmon must be either discarded or donated to a food bank. Yet, a system for donating bycaught fish to a food bank was not instituted in the Gulf fisheries until 2011. [10] Therefore, all of the Chinook caught in the Western Gulf bycatch event was discarded (approx. 105 tons, or the equivalent of 70 Volkswagens beetles), as was the total amount of Chinook caught by Gulf trawl vessels that year (est. 54,000 fish, 200 tons), all of the Chinook caught by trawl vessels in previous years in the Gulf (avg. 11,000 fish for the previous 15 years, or 40 tons per year). While captains are required to discard Chinook salmon in all trawl fisheries in the Gulf, at the time of this event there was not a limit on the amount they could catch.

The extreme event did not end with a mass catch and discard of Chinook salmon. While the North Pacific Fishery Management Council (Council), which is the body in charge of regulating all federal fisheries in Alaskan waters (see Chapter One, section 5a), had been analyzing and discussing how to regulate Chinook salmon bycatch in the Gulf trawl fisheries for several years, the 2010 Western Gulf Chinook bycatch event infused Council regulators with a sense of urgency. One reason for this urgency was that the amount of Chinook caught in the 2010 Gulf pollock fisheries violated the Endangered Species Act. Another reason is that the event garnered a relatively high amount of media attention in Alaska, as well as outcry from the salmon industry and from conservation groups. The ensuing regulatory process spanned four pre-determined Council meetings (the Council normally holds five meetings a year, at the same

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[10] In 2013, approximately 20% of the Chinook bycaught in the Gulf was donated to a food bank. The structure for regular food bank donation was instituted largely by efforts of the Kodiak trawl fleet in 2011. While I have the obtained the donation amounts, in pounds, for 2013 through personal communication with the food bank that manages bycatch donations in Alaska (i.e., SeaShare), I am currently attempting to get additional data on the amount of Chinook bycatch that has been donated since 2011. The calculation of 20% is as follows: In 2013, 19,373 lbs. of Chinook salmon was donated. At an average of 7.5 lbs. per fish caught in Gulf trawl fisheries (NPFMC, 2011: 117), approx. 2,580 fish were donated. There were 13,158 Chinook bycaught in the Gulf in 2013. Therefore, the number donated was approximately 20% of the number bycaught.

times each year, but in different locations across Alaska, Washington, and Oregon), which were held in December 2010, February 2011, April 2011, and June 2011. The purpose of this process was "*to provide immediate incentive*" for the Gulf pollock fleet to reduce their Chinook salmon bycatch (NPFMC, 2011: i). The process culminated in a 25,000 limit on the number of Chinook captains can annually catch Gulf-wide when fishing for pollock. This means that every year the Gulf pollock fleet can catch 25,000 Chinook salmon as bycatch in order to catch their twelve pollock quotas. But this also means that 25,000, or approximately 85 tons, of Chinook salmon can be wasted each year**.** This limit became active in the fall of 2012 (prorated for mid-year implementation), and was promptly exceeded in the same October fishery that initiated its creation two years earlier.

This is a story about an extreme event, which was constituted by fishing processes at sea that precipitated a regulatory process on land. This regulatory process on land was reciprocally intended to prevent such extreme events at sea from recurring. Figure 23 depicts this extreme event. A "hot spot" is the regulatory and ecological substrate from which large-scale bycatch events emerge. A "lightning strike" is the unpredictable integration of fishing activity and a hot spot; and a large-scale bycatch event is the unchecked proliferation of lightning strikes across multiple vessels. The Western Gulf bycatch event was essentially comprised of A) processes that initially produced lightning strikes from a hot spot and then allowed lightning strikes to accumulate into a large-scale bycatch event; and, B) the regulatory process aimed at preventing individual lightning strikes from becoming large-scale bycatch events in the future. Thus, as Figure 23 depicts, there are two pathways that can form when captains fish from a hot spot: the production of a lightning strike and the ensuing formation of a large scale bycatch event, or the production of a lightning strike and the avoidance of a large scale bycatch event.

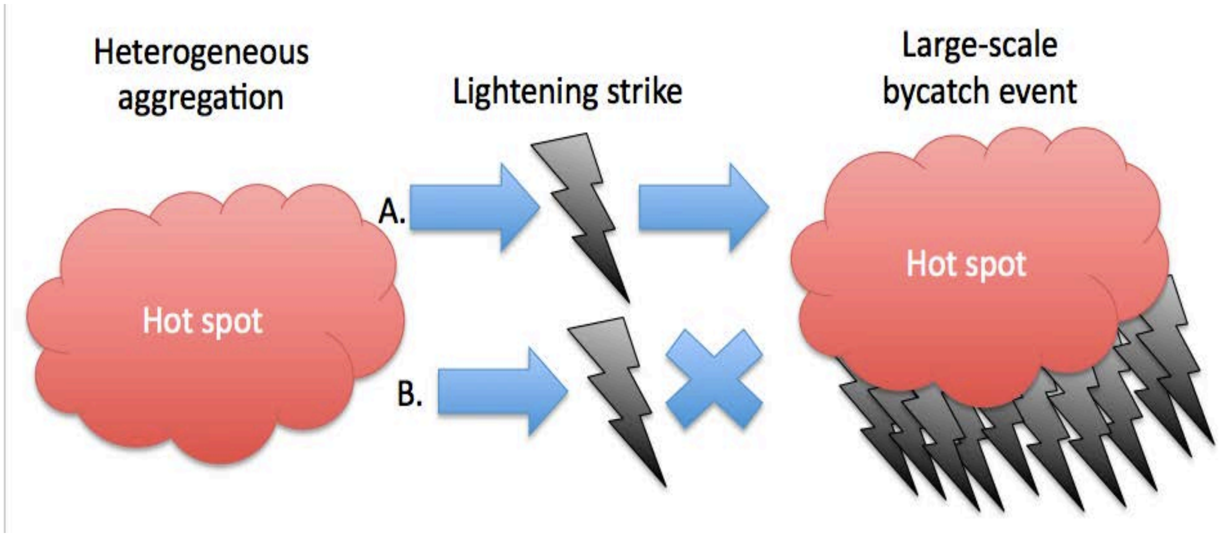

Figure 23: Diagram of two pathways that can form when fishing effort is integrated with a hot spot. Pathway "A" leads to a large-scale bycatch due to the unchecked proliferation of lightning strikes, and pathway "B" does not lead to a large-scale bycatch event due to the identification of lightning strikes and alternation of action patterns.

Figure 23 organizes the remainder of this chapter. Hot spots are necessary conditions for a large-scale bycatch event, but they are not sufficient by themselves to create one. They merely provide the backdrop of opportunity. As the backdrop upon which the Western Gulf extreme bycatch event was constructed, the conditions that form hot spots are the subject of section 3 of this chapter, which is constituted by a) a discussion of the materiality of hot spots, both in terms of ecological processes and the ocean bottom, and b) a historical discussion of the regulatory structures that currently create the 'hot' in hot spot. In section 4 I analyze the at-sea processes that fostered the development of lightning strikes and the large-scale bycatch event from that hot spot (pathway A), as well as the on-land regulatory process aimed at preventing such future progressions (pathway B). And in the Conclusions section I discuss the issues that led to the extreme bycatch event at sea and how regulators on land attempted to solve those issues.

3. Hot Spots

Chapter Two demonstrated that, due to their efficiency imperative, trawl captains have a disposition to fish from aggregations. But what Chapter Two did not discuss is the occasion in which an aggregation is significantly heterogeneous in terms of species composition rather than mostly homogeneous. A heterogeneous aggregation forms when two or more species enact similar patterns of behavior, what are described below as 'action patterns,' such as feeding on the same substrate at the same time. When a captain fishes from a heterogeneous aggregation, and his fishing gear does not differentiate between species enacting similar action patterns, he will catch bycatch. When this bycatch has been assigned its own regulatory catch limit, and catching too much of it can constrain how much target species captains can catch, the heterogeneous aggregation is "hot." Thus, the "hot" in hot spot a regulatory construction imposed on interrelating social and natural systems. Without the regulatory imposition of the bycatch limit, an aggregation of multiple species would simply be a 'spot' in which to fish. The natural and regulatory components of a hot spot are explained below.

a. The ecological creation of heterogeneous aggregations

The type of hot spot of concern in this chapter is one that is formed by pollock and Chinook as they engage in similar 'recurring action patterns.' I use the concept of recurring action pattern, which I derive from the literature on routines, to better understand pollock and Chinook heterogeneous aggregations, and how captains interrelate with them. A routine is variably defined as a "pattern of behaviour that is followed repeatedly, but is subject to change if conditions change" (Winter, 1964: 263), "flexible patterns offering a variety of alternative choices" (Koestler, 1967: 44), and "a repetitive, recognizable pattern of interdependent actions, involving multiple actors" (Feldman & Pentland, 2003: 96). Apparent in each of these definitions is the basic component of a routine - the recurring action pattern (Feldman & Pentland, 2003; Parmigiani & Howard-Grenville, 2011; Rerup & Feldman, 2011; Pentland, Feldman, Becker, & Liu, 2012). A recurring action pattern is "a coherent ecology of recurrent actions that affects the world in a recognizable way" (Birnholtz, Cohen, & Hoch, 2007: 316). The spatial and temporal organization that is the recurring action pattern is a new whole created from what would otherwise be a mere aggregation of activity. The whole that "is more than the sum of its parts" is the recurring action pattern, while the "sum" is simply the unorganized aggregation of actions (Buckley, 1967: 42).

The parts of recurring action pattern are actions, patterns, and recurrences. Actions, as defined by Pentland et al. (2012: 1484), are "the things that actors do." As the "elementary unit of social life" (Elster, 1989: 13), actions are the smallest units of analysis in social settings (Lofland et al., 2006). The pattern of a recurring action pattern is composed of interdependent actions in that the production of one is dependent on the actual or potential production of another (Berger & Luckmann, 1966). Because of the interdependence of actions, one activity can only be understood in relation to other activities, and together they create a coherent set of characteristic activities (Birnholtz, Cohen, & Hoch, 2007). In being coherent, interdependent actions "powerfully suggest" broader patterns of behavior (Birnholtz, Cohen, & Hoch, 2009: 143). Because action patterns recur over time, they become characteristic of the entity enacting them. Being 'characteristic' means that action patterns can be recognized as "the same" by those familiar with them, and their recurrence offers familiar observers predictability. This predictability allows actors to identify actions that are "in character" or "out-of-character" (Birnholtz, Cohen, & Hoch, 2007: 317). In other words, based on the recurrence of patterns of action, familiar observers can create expectations. Yet, due to the contingencies inherent in the passage of time and in changes in attributes of space, there is "pattern-in-variety" (Cohen, 2007). Thus, recurring action patterns are "subject to change if conditions change" (Winter, 1964: 263), yet are also flexible enough to not change their overarching character as they accommodate different circumstances (Feldman & Pentland, 2003; Turner & Rindova, 2012).

Both human and natural entities construct, and are constructed of, interdependent actions that recur over time and space. In humans these recurring action patterns are not only fundamental components of routines, they are also fundamental to practices (Orlikowski, 2002), processes of collective mind (Weick & Roberts, 1993), processes of institutionalization (Berger & Luckmann, 1966), and organizational capabilities (Cohen et al., 1996). In non-humans, recurring action patterns are labeled "life history traits" (Roff, 1992; Stearns, 1992). The non-human recurring action patterns of certain species are what humans attempt to interrelate with in the interest of extracting natural materiality. The following are examples of life history traits that form the foundation of both fishing practice and fisheries science:

- "Pacific cod are known to undertake seasonal migrations, the timing and duration of which may be variable (Savin 2008)" (A'mar, Thompson, Martin, & Palsson, 2013: 162)
- "Walleye pollock in the Gulf of Alaska undergo an annual migration between summer foraging habitats and winter spawning grounds." (Dorn et al., 2011: 151)
- "[Adult flathead sole] exhibit a benthic lifestyle and occupy separate winter spawning and summertime feeding distributions on the [Eastern Bering Sea] shelf and in the GOA. From over-winter grounds near the shelf margins, adults begin a migration onto the mid and outer continental shelf in April or May each year for feeding. The spawning period may range from as early as January but is known to occur in March and April, primarily in deeper waters near the margins of the continental shelf" (McGilliard, Palsson, Stockhausen, & Ianelli, 2013: 614)

As these statements suggest, it is the recurring action patterns of certain species, primarily the recurring action patterns that form significant aggregations, that enables them to be a profitable target of fishing activity.

Little is known about recurring Chinook salmon action patterns outside of what is derived from their interception either as target fish in directed Chinook fisheries or as bycatch in other fisheries (NPFMC, 2011). After spending their first three months to two years in freshwater, Chinook spend from one to five years in the ocean before returning to the same river in which they were hatched to spawn (they are anadromous species that die after spawning). These 'runs' of Chinook salmon recur annually from May through July (NPFMC, 2011). Chinook target fisheries, including commercial, sport, personal use, and subsistence fisheries, form each year at the mouths of various large river systems based on these recurring action patterns. Although Chinook do not feed during this migration, when Chinook are feeding their primary diet is eupheusiids, i.e., krill, and they have also been found to prey on immature pollock (Davis, Armstrong, & Meyers, 2003).

Pollock spend their entire lives at sea, but during that time they engage in annual migrations between summer foraging locations and winter spawning grounds (NPFMC, 2011: 110). The spawning portion of this larger recurring action pattern is itself a recurring action pattern, as the following assessment of pollock populations in the Gulf indicates: "Peak spawning at the two major spawning areas in the Gulf of Alaska occurs at different times. In the Shumagin Island area, peak spawning apparently occurs between February 15 - March 1, while in Shelikof Strait peak spawning occurs later, typically between March 15 and April 1" (Dorn et al., 2012: 56). Pollock form large aggregations during spawning periods, yet also aggregate during non-spawning periods, most likely interacting with aggregations of 'feed.' The primary feed source for pollock is, like Chinook salmon, eupheusiids (Dorn et al., 2013).

It is clear from the fact that 1) Chinook are most commonly bycaught in pollock fisheries; 2) this bycatch follows "a predictable pattern" of occurring January through April and in October and November (NPFMC, 2011: 116; Witherall, Ackley, & Coon 2000: 59) and 3) pollock and Chinook feed on the same substrate, that Chinook and pollock enact similar recurring action patterns. Pollock captains catch Chinook when constructing their operations according to the recurring action patterns of pollock, and Chinook captains catch pollock when constructing their operations according to the recurring action patterns of Chinook (archival data: North Pacific

Fishery Management Council public testimony). In the winter, pollock captains catch Chinook when targeting pre-spawning aggregations of pollock, and in the fall they catch Chinook when targeting pollock that are aggregating for other reasons, such as feeding on aggregations of krill. Whether they are feeding on the same substrate, or Chinook are feeding on pollock, pollock and Chinook tend to enact similar recurring action patterns, which form heterogeneous aggregations..

b. The regulatory construction of hot spots

For a heterogeneous aggregation to be 'hot,' however, requires the imposition of regulatory structure. A hot spot is a heterogeneous aggregation that contains target species and one or more bycatch species that have been given their own catch limits, but at a proportionally smaller size. If captains are fishing from an aggregation within which the ratio of target species to a certain bycatch species is smaller (i.e., more bycatch species in relation to target species) than the ratio of available target species quota to the limit that is available to catch that bycatch species, captains can reach the bycatch limit before catching their target species quota. Thus, the smaller limit can act as a constraint on captains' ability to catch all of their target species quota. The regulatory logic is that this potential constraining effect will incentivize captains to construct their operations to curb how much they catch of that bycatch species. Certain 'prohibited species' in federal Alaskan fisheries have been given their own catch limits, and are intended to have this effect on fishing behavior.

Prohibited species are species that tend to be caught along with federally managed groundfish species (i.e., pollock, cod, flatfish, rockfish), which are the types of species trawl captains fish for, but which are also managed as target species by other regulatory bodies. Thus, the prohibited species in federal groundfish fisheries are themselves targets of other 'directed fisheries,' but these other fisheries are managed by another governing entity. The prohibited species in federal Alaskan groundfish fisheries are the Alaskan salmons (Chinook, chum, coho, sockeye, pink), Pacific halibut, Pacific herring, king crab, and tanner crab. The State of Alaska manages directed fisheries for king and tanner crab, all salmons, and herring, and both the US and Canada jointly manage halibut through a treaty organization. Prohibited species must be discarded either at sea or by the processing plant, or they can be given to a food bank. The prohibited species approach to bycatch management is the product of a chain of historical political events that captured contemporaneous directed fisheries and institutionalized them in regulations, which continue to structure how fisheries are managed today.

The reason the State of Alaska manages crab, salmon, and herring, and the US and Canada jointly manage halibut, is a product of the historical development of political entities and the concomitant historical development of fisheries. Salmon and herring fisheries developed in the late 1800s in coastal Alaskan waters, and crab fisheries developed in the 1950s in the Bering Sea, emerging later further south in the Gulf (Woodby et al., 2005). Between Alaska's purchase from Russia in 1867 and its statehood in 1959, the federal government managed the territory's natural resources. Historians characterize federal fisheries management in Alaska in this period as "weak, poorly funded, and ineffectively enforced" (Woodby et al., 2005: 2). One of the forces driving Alaska's movement toward statehood, inherent in which was Alaskans' desire to "seize control of their own destiny, free of outside interests" (Owens & Shively, 2010: 194), was taking "management control of its fishery resources from the federal government" (Woodby et al. 2005: 2). Natural resource policy, therefore, "played a central role" in the territory's constitutional convention (Owens & Shively, 2010: 1995). Upon becoming a state, Alaska took the reins of management of fisheries that local Alaskans engaged in, but which until then been managed by the federal government.

Pacific halibut fisheries developed in the North Pacific in the late 1800s, both in US and Canadian territorial waters and in "extra-territorial waters." The International Pacific Halibut Commission (IPHC) was created by a treaty between the US and Canada in 1923, and since 1930 the IPHC has managed halibut fisheries in the coastal and extra-territorial waters of the US and Canada. Thus, when Alaska became a state, the Pacific halibut fisheries established in its coastal and extra-territorial waters were already managed partly by another country, and therefore beyond the grasp of the newly created state. The seeds of the prohibited species concept, however, can be seen in the development of the IPHC. The 1919 draft of a halibut treaty, which was an outgrowth of the 1918 Canadian-American Fisheries Conference, contained a provision that "restricted sale of halibut taken incidentally to other fishing" (Bell, 1981: 148). Yet, it was not until 1944 that the IPHC prohibited the targeting of, and limited the incidental catch of, halibut by trawl vessels (Bell, 1981), creating a de facto prohibited species designation.

While the species that are designated as prohibited species in federal groundfish fisheries are the targets of fisheries that developed as early as the late 1800s, the federal groundfish fisheries did not develop into major domestic commercial fisheries until the mid-to-late 1980s. Prior to this period, pollock, cod, and flatfish fisheries were fished by foreign fleets, primarily

Russian and Japanese operations in the Bering Sea, and were managed through international agreements and treaties, such as the International Convention for High Seas Fisheries of 1959. But domestic shrimp and red king crab stocks in the Gulf crashed in the late 1970s, stocks which had, since the 1950s, supported "large and historically important commercial fisheries" (Woodby et al. 2005: 25). This crash is largely attributed to a climate-induced shift from a cold to a warm water regime, an outgrowth of which was an "ecological community reorganization" in Gulf waters. This reorganization is evidenced in the precipitous increase of groundfish catch in the mid to late 80s that followed a precipitous decrease in shrimp and red king crab catch in the early to mid 80s (Anderson & Piatt, 1999).

In a sociological process occurring somewhat parallel to the Gulf ecological community reorganization, the US Congress was crafting the Magnuson-Stevens Fishery Conservation and Management Act (MSA), which it passed in 1976. The MSA is the organic act for all federal fisheries, and has four primary provisions. First, the law established eight Regional Fishery Management Councils, whose cumulative jurisdictions cover all the coastal waters of the US. One of these councils, the North Pacific Fishery Management Council (Council), manages federal Alaskan fisheries. The Council is made up of 11 appointees who represent fishing industries from Alaska and Washington, and four additional members consisting of heads of state and federal fisheries agencies, the Coast Guard, and an interstate fisheries commission. Second, the MSA requires all councils to create Fishery Management Plans (FMP) for the fisheries under their jurisdictions. Third, the FMPs are to be constructed so that the enactment of a fishery complies with ten National Standards. The two National Standards that heavily influence bycatch management are the following:

> 1. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery.
>
> 9. Conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. (U.S. Department of Commerce, 2007: 58-59)

The Council implemented its first FMP in 1978, which was for the Gulf of Alaska. In 1982 the Council produced the Bering Sea FMP. The Gulf FMP has been amended 95 times, and the Bering Sea FMP has been amended 99 times. In an early effort to balance the competing demands of National Standards 1 and 9, in 1982 a Bering Sea FMP amendment designated Chinook salmon a prohibited species on foreign vessels trawling in US waters off Alaska, and established a prohibited species catch (PSC) limit. As described by Witherell and Pautzke (1997: 16), “Any nation that exceeded their salmon allocation would be prohibited from fishing in much of the Bering Sea for the remainder of the season. This amendment set a precedent for fleetwide catch limits at trigger areas or entire fisheries closures.” The next year, through another FMP amendment, this prohibited species designation was extended to domestic vessels fishing in the Bering Sea, and a domestic PSC limit was enacted. PSC limits act as a bank account for fishing for target species: as long as captains have enough PSC limit available to support fishing for a species whose action patterns are similar to prohibited species’ action patterns, meaning that the captains will likely catch one when fishing for the other, they can fish. When the PSC limit runs out, fishing ceases. Thus, PSC limits are the product of the regulation of two species that are managed in directed fisheries by different agencies, but which tend to enact similar recurring action patterns. Yet, while pollock and Chinook enact similar action patterns in the Gulf just as they do in the Bering Sea, the Council did not enact a PSC limit in the Gulf until the Western Gulf bycatch event.

Fourth, the MSA created the Exclusive Economic Zone (EEZ). For the preponderance of the resource management era prior to the MSA, the US’s territorial waters extended three miles offshore. Then in 1966 Congress added a nine-mile contiguous fishery zone adjacent to its territorial waters. This act relegated the three-mile zone to state control, and the adjacent nine miles to federal control. The MSA expanded the US’s territorial waters, now the EEZ, to 200 miles offshore. This action, accompanying the ecological community reorganization, consigned to the US some of the largest and most productive fisheries in the world.

The current organization of intercepted fish into target and prohibited species categories is largely the result of the regulatory capture of moments in the historical development of fisheries rather than our full scientific understanding of ecological systems. The fisheries that existed prior to the 1976 passage of the MSA and creation of the EEZ were locked-in to their existing management agencies, regardless of their location relative to the EEZ’s boundary between state and federal waters, while the fisheries that developed afterward are managed according to the spatial location of fishing effort relative to the EEZ. Thus, crab fisheries, which occur in both state and federal waters, are managed by the State of Alaska (with federal oversight in the Bering Sea); halibut fisheries, which occur in both state and federal waters, are managed by the IPHC; and salmon and herring fisheries, which only occur in coastal waters, but which are regularly intercepted in significant numbers in federal waters (herring only in terms of the Bering Sea), are managed by the State of Alaska. Meanwhile, pollock, cod, and flatfish fisheries, which developed as large-scale domestic fisheries after the passage of the MSA, are managed by both state and federal agencies depending on spatial patterns of fishing effort.[11] The species that were the target of major fisheries that developed prior to the MSA became prohibited species in fisheries that developed after the MSA, without regard to spatial location of fishing effort in relation to the EEZ.

4. The At-sea Enactment of Lightning Strikes

The previous discussion of this event focused primarily on its historical regulatory roots. The following discussion is empirical, and is structured to align with the two parts of the event: the at-sea portion that created a large-scale catch of Chinook salmon, and the on-land portion aimed at preventing future events.[12] In terms of the at-sea portion, first I analyze the hot spot that formed in the Western Gulf in October 2010. Then I examine the sensemaking processes that enabled lightning strikes to be created from this hot spot, and that also fostered the unchecked proliferation of lightning strikes into the largest bycatch event, including the largest waste of Chinook salmon, in the recorded history of Gulf groundfish fisheries. Next, I analyze the regulatory process through which the Council imposed a Chinook bycatch control structure on the Gulf trawl fleet. This structure was designed to prevent future interactions of fishing effort and hot spots from recurring as large-scale bycatch events.

a. Creating pathway A

On October 1, 2010, 20 vessels set out to fish for a pollock quota of 7,577 tons in the Western Gulf regulatory fishing area. The average length of this season is 12 days (2001 - 2010), ranging from as fast as a 3-day fishery to as slow as a 31-day fishery. In 2010, NMFS 'in-season' fisheries managers, who track catch rates (both target and PSC) and open and close fisheries to

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[11] There are no flatfish fisheries in State waters due to a ban on bottom trawling, with exception of a small flatfish fishery in Southeast Alaska, but which has not been fished since 1999 (Woodby et al., 2005).

[12] Unless otherwise noted in the text, the data sources for these analyses are interviews and public testimony at the four pertinent Council meetings. The data below are identified by regulators, industry members, and community stakeholders. Industry members consist of two primary groups that organized in response to this issue: pollock trawl and salmon groups; data within these groups are further differentiated by two key professions: captains and industry managers.

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both avoid overfishing and to maximize optimal yield, first closed the fishery at noon on the 9th. This closure was based on a prediction as to when the fleet would reach their pollock quota. Due to the amount of target quota left after the 9th, in-season managers re-opened the fishery on the 14th for a pre-determined three days of fishing. In the first eight days of the fishery, the fleet caught 7,300 tons of pollock and 24,000 Chinook, and in the last three days the fleet caught 900 tons of pollock and 4,000 Chinook. The bycatch rate in the first opening was 3.32 Chinook per ton of pollock, and in the second opening it was 4.55 Chinook per ton of pollock.

In the sections below, I discuss this at-sea portion of the event first in terms of the materiality that captains described interacting with during this fishery (aggregations and ocean bottom), and second in terms of the sensemaking processes within that interaction that allowed lightning strikes to cumulate into a large-scale bycatch event.

i. The Western Gulf hot spot

When captains fish in the fall Western Gulf pollock fisheries, they organize their fishing practice with certain recurring action patterns of pollock, which are primarily defined by their spatial and temporal attributes. As described in chapters Two and Three, a fishing process consists of captains choosing a spot to fish in, and within that spot searching for and selecting an aggregation to fish from. Pollock are known to aggregate in two or three areas in the fall in the Western Gulf, and year after year captains steam to these areas, enacting their own recurring action patterns in order to fish from those aggregations, from which emerge recurring interaction patterns.

Yet, Chinook salmon tend to enact similar action patterns that pollock enact. Such heterogeneously-enacted, homogeneously-presented natural action patterns are at the heart of the following reason a Western Gulf captain gave the Council for the high amount of Chinook bycatch in the 2010 D season: “My fear is that we are catching lots of them because there *are* lots of them.” The NMFS in-season manager who opened and closed the fishery made a similar observation during a discussion at the December 2010 Council meeting, which was the first meeting held after the at-sea portion of the event:

> *Council member:* **“**As someone who has observed this for quite some time now, do you have any observations or insight as to why the big increase [in Chinook bycatch] from 2009 to 2010?”
> *NMFS in-season manager:* **“**I think that there was just a lot of salmon in the Gulf in 2010, and that it fluctuates from year to year. . . as far as I’m aware in the Western Gulf most of those vessels were fishing in the same area. I don’t think

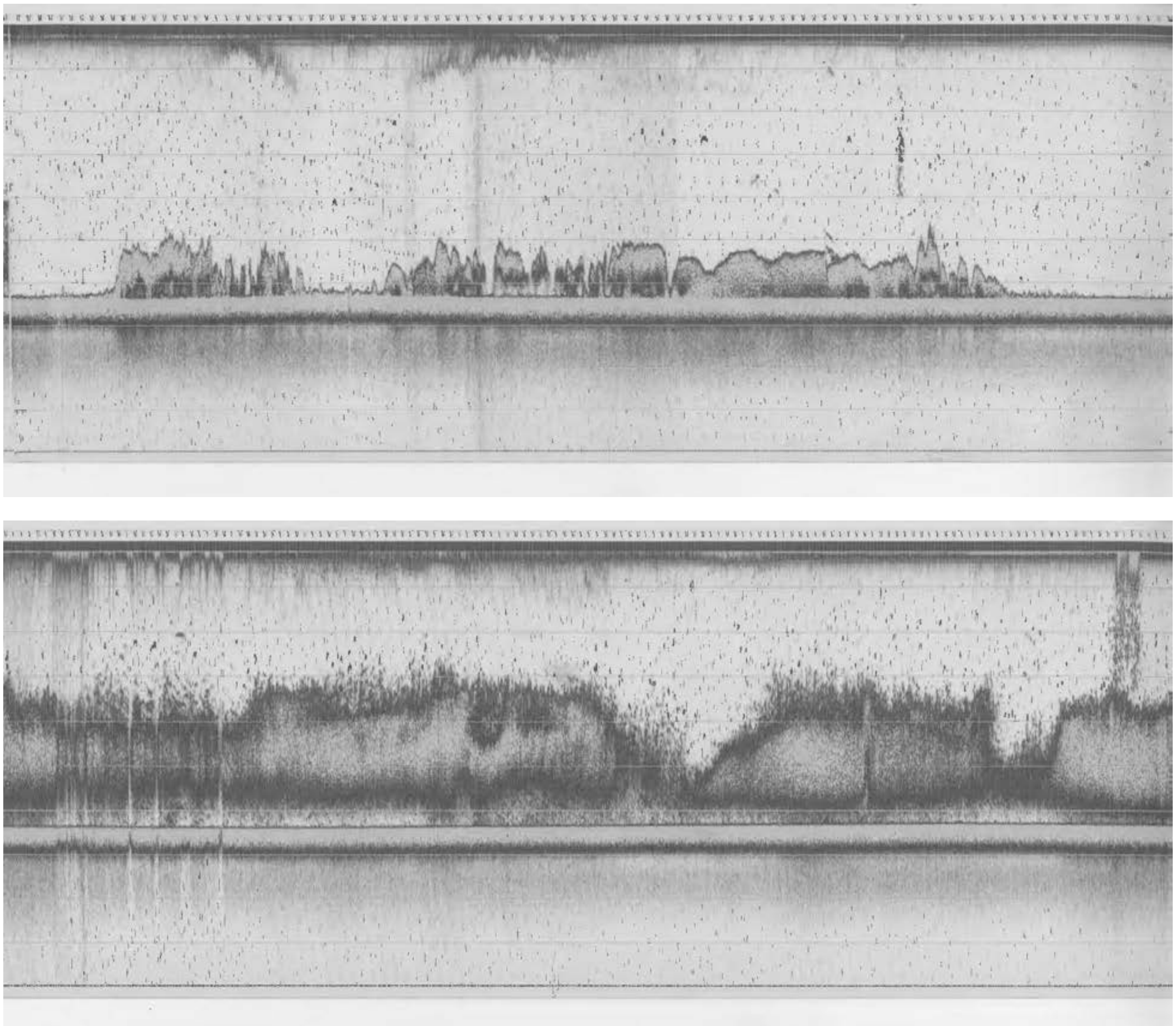

Figure 24: Sonar depictions of feed bands of pollock from the same space; the top picture is the daytime, the bottom is the ensuing night time. The straight horizontal line in the middle of each picture is the ocean bottom and the blotches rising up from the bottom are bands of pollock (and other intermixed species).

that there's been reports of fishing in different areas than usual."

Captains fish at the level of action pattern, and organize their operations based on the recurrence of those action patterns, but those action patterns may also be enacted by species that they do not want to catch, for doing so may limit their ability to catch their quota of target species.

The type of heterogeneously-enacted, homogeneously presented aggregation captains tend to fish from in the Western Gulf is a 'feed band.' Feed bands are large, dense aggregations of multiple species that form to feed on a large mass of krill (which is itself aggregating for its own reasons). These aggregations appear on captains' sonar displays as horizontal bands (see Figure 24). A trawl captain describes feed bands in general in the following: "Most of the time that's where the fish is. Your net only pulls out the big stuff." Another trawl captain describes interacting with Western Gulf feed bands in the following:

> "We have really thick feed bands. . . . We look for what we call, sign, we are looking for feed. Guys will say, 'It looks like a bunch of feedy crap' or 'It's a lot of something.' Nobody says, 'It's a lot of pollock.' Or as one guy said, 'If 1% of this is pollock, we're doing good.' You just can't tell using your electronics."

Furthermore, these feed bands display their own recurring patterns of behavior, which several trawl captains described to the Council, an example of which is the following:

> "During the day there are two distinct bands – you see the feed band and then you see the fish band. At night it's all one band, everything kind of, we call it, it 'blows up.' It all becomes one big band."

Figure 24 demonstrates the pollock feed bands captains see on their sonar display, differentiated by day as sitting on the ocean bottom, and by night as having lifted off the bottom and expanded in size.

Yet, according to captains' testimony, the feed bands they encountered in October 2010 tended to not display typical action patterns. As one captain described to the Council,

> "A lot of the time in this D season the feed and the pollock never did separate in the daytime. Like [another captain] said, there was so much feed that we basically went the entire D season and never saw a pollock. You just towed and hoped there was pollock in the feed. I mean you couldn't avoid it."

Captains entered the D season pollock fishery in the Western Gulf, found a feed band, and fished from it much the way they had in previous D seasons. Although there were apparent differences in terms of the size and behavior of the feed band, these were not differences that incited captains to change how they constructed their fishing operations. Captains recurrently enacting typical operational action patterns.

Aggregations of pollock and Chinook were not the only natural materiality captains were interrelating with in the at-sea portion of the Western Gulf Chinook bycatch event. Captains also built their operations in relation to the ocean bottom. As described in Chapter Two, aggregations of different species tend to interrelate with certain bottom types. In the Western Gulf, pollock tend to recurrently form aggregations, which are sufficient to fish from, in only two or three areas of the bottom. Further, captains also stated that pollock tend to be in only one of those areas at a time, as the following captain states: "There's not a vast amount of square miles where we fish, there's the predominant areas, so if you are not here, you are there." In the following a Western Gulf captain describes the relationship between fishing areas, pollock aggregations, and catching Chinook:

> "There are two areas that produce, and I'm just shooting from the hip, 80% of the pollock here. And typically there is not fish in both areas - if the fish are in one, they are not in the other - they are not in both areas at the same time. So you either catch Chinook salmon, or you don't fish."

As this quote suggests, the fact that captains recurrently organize their operations according to the recurring action patterns of their target species means that, reciprocally, the recurring action patterns of their target species limits the fishing operations captains can construct. In the Western Gulf Chinook bycatch event, at least one of the two or three areas in which pollock typically aggregate contained a heterogeneous aggregation born of overlapping pollock and Chinook action patterns.

Table 9, drawing from personal interviews and statements both pollock and salmon captains made during the Council process following this event, provides quotes that describe the natural conditions that occur in the Western Gulf pollock fisheries. The quotes expand from describing overlapping pollock and Chinook action patterns to overlapping pollock, Chinook, whales, and krill action patterns, to feed bands, and they expand from describing natural conditions in the Western Gulf during the event, to the Western Gulf more generally, to the broader Gulf of Alaska. The table also includes quotes that describe pollock action patterns forming in relation to only two or three bottom areas in the Western Gulf, including how these interrelationships limit where captains can fish.

Table 9: Characteristics of overlapping pollock and Chinook action patterns, as well as characteristics of how captains interact with them, in pollock and salmon fisheries, in the Western Gulf and in the broader Gulf of Alaska

Characteristic	Source	Representative quote
Overlapping action patterns of pollock and Chinook in the Western Gulf	Trawl captain	"Based on my 35 years of salmon fishing, what I think what we saw this year was a huge abundance of king salmon, it was spoken to when they were talking about the fishing in Cook Inlet in October. Where those fish came from, or how they got there, that's the first thing we have to look at. . . . I don't deny it's a problem. Nobody like bycatch, nobody that fishes pollock out there likes bycatch."
Overlapping action patterns of pollock and Chinook in salmon fisheries in the broader Gulf of Alaska	Salmon captain & Council members (3)	*Council member:* "The Western Gulf had a major increase above their average bycatch last October; apparently the conditions were such that there was a lot of feed, a lot of pollock, a lot of king salmon. Were you fishing at all in Kachemak Bay in last October, and did you notice the same thing? Can you give us any insight into as to why that spike in king salmon occurred?" *Salmon captain:* "I was, and I think we talked about this in December. It was phenomenal, and it is a lot of times in October

		in the fall, a lot of things conspire to make that a wonderful thing. It's not every year, the Coho population goes up and down too. There's always variables in fishing. . . ." *Council member:* "Do you ever fish in the Glacier Spit, the Bera Cove area in June for summer kings?" *Salmon captain:* **"**The refrigerator hole? Of course" *Council member:* "Isn't it true that at that time you go through a lot of bait because there's a tremendous amount of pollock up there, but the kings tend to be so large that its actually worth it to stay in that mixed group?" *Salmon captain:* **"**I carry a lot of bait during that time**"** *Council member:* Do you do salmon charters in [Katchemak] bay there? *Salmon captain:* Salmon and halibut *Council member:* Because I know I do a lot of sport trolling there and a last couple of months I noticed a really high incidence of pollock and really high incidence of king salmon in Katchemak Bay, and I don't know if that's just me getting lucky or is everybody noticing the same thing *Salmon captain:* its been a good fall, its been a good fall, and there is a high incidence of pollock, you are right *Council member:* It just seems like, that's, I don't know what you make of that. I'm not trying to be scientific about it but I noticed it, they seem to hang together. There's a lot of bait in the water and they all showed up at the same place, same time *Salmon captain:* Its good for the people who sell bait (laughs).
Overlapping natural action patterns of pollock, Chinook, and krill in the Western Gulf	Trawl captains (3)	"We are giving a short overview of a cooperative [research vessel] survey of our region that we have been associated with. We are presenting this in order to show that the high catch of Chinook may relate to unusually high forage fish activity. The survey was developed to assist the National Marine Fisheries Service Gulf of Alaska pollock survey by investigating the variation and distribution of pollock. Recently the survey has been expanded to survey krill and forage fish. And in 2010 marine mammal observations were added. Preliminary results of the 2010 survey indicated that krill abundance was very high in 2010 and the biomass of pollock and forage fish presumably accounted for the high abundance if Chinook in the survey area. The survey [vessel] captured a total of four Chinook during its test tows. Normally one or two are taken over the course of the survey. . . It should be recognized that this was an anomalous year and that the Chinook appeared to be much more abundant than in previous years." "If you look back on some of [the data], the hot spots here, they are always moving. It doesn't happen in the same place from year to year. It goes with where the feed is and where the currents are

		and different things. "
Overlapping action patterns of pollock, krill, and whales in the Western Gulf	Western Gulf community member	"This year with my boat I went back and forth across the north end of the Shumigans (which are islands in the Western Gulf) quite a bit and the ecosystem has changed. There are a lot of fin-backed whales that I've never seen before except the last couple of years with a huge biomass of feed, and that's where some of the pollock boats fish. I think they are capelin myself and we did catch some in the harbor in Sand Point when the whales were around. . . ."
Overlapping action patterns of pollock, Chinook, and krill forming feed bands	Trawl captains (2)	"The problem I saw in this last October was the Chinook seemed to aggregate in the feed band, which at night lifts up. . .I think the key is the timing – day or night." "You notice that you are on the grounds and the feed layer is here and the fish are below that and then at night the fish start coming up, so the fish come up at nighttime and they are in that feed layer. . . "
(Non)Recurring feed band action patterns	Trawl captains (2)	"We have really thick feed bands, but this fall I did not see it. Two years ago (2010) the ocean was alive, that was the year we massacred the king salmon." "In a normal year the smaller pollock congregate with the feed higher in the water column and the larger pollock aggregate near the bottom. . . .how it looked for us this year (2010), it was very hard to distinguish pollock from the feed. . . "
Recurring pollock action patterns in terms of bottom types in the Western Gulf	Trawl captains (3) Trawl captain & Council	"There's not a vast amount of square miles where we fish, there's three predominant areas, so if you are not here, you are there." "We're limited in areas that we can fish. . . I've fished [in the Central Gulf], and we've towed over 50 miles in one direction. The longest tow we have in the Western Gulf, where our fish is traditionally caught in C and D seasons, is about eight miles long. And a lot of times there will only be fish on half the tow, so it will work an area of maybe six miles long. We just don't have a lot of options if we identify that as a hot spot." "I'm gonna be a bit loose with gestimates here, but there's basically 2 trenches, one north of Sand Point, one south of Sand Point, and 80% of the pollock is taken out of those two trenches. And sometimes the only place there will be fish is in one of those two trenches. And we will take the C and D quota or the A and B quota out of that one area. If there happens to be a high abundance of salmon when the fish is available, I just don't see us agreeing to not fish there." *Council member:* "From your experience over the years, are you are aware of changes in fishing patterns in different areas compared to the past? And this is just expressing my lack of understanding about the fishery, but are people really fishing in the same areas they have fished in generally over the last 10-15

	member	years, or has there been some or any change where people are fishing knowing possibly that they have had trips with high amounts of bycatch in particular areas? *Trawl captain:* "The fleet is fishing pretty much where we always fish. . . The salmon move around. If you look back on the hot spots here, it's always moving. It doesn't happen in the same place from year to year. It goes where the feed is and where the currents are and different things. . . When the gun goes off, once you start fishing, our seasons are so short, it's really hard to move the stop and move an area. . . and so we're pretty much fishing the same areas, and that's what is driving it.

ii. Expectations of lightning strikes

When captains fished in the 2010 Western Gulf D season pollock fishery, they encountered a hot spot. By fishing from that hot spot, they incurred lightning strikes. Lightning strikes are unpredictable yet relatively large catches of a prohibited species, and are usually limited to one vessel (unless they go unchecked). The following are two descriptions of lightning strikes captains incurred in this event:

> **"**There was a boat my size that had horrible [Chinook bycatch] numbers, and I have no clue why, because I was pretty much towing where he was towing."

> *Interviewer*: "What was the first clue that something was going on out there?"
>
> *Trawl captain*: "When I hauled back and had an assload of salmon in my net."

Incurring a lightning strike of Chinook salmon while fishing for pollock is one of the primary reasons captains repeat the axiom, 'You never know until you tow.' Captains know they will incur lightning strikes, but they cannot predict when, or even where. Therefore, they are only aware they have incurred a lightning strike after they have been struck. An example of a lightning strike from outside of this event occurred in a 2011 pollock fishery in the Central Gulf. In this case, several trawl vessels were fishing from the same aggregation, but only one vessel caught a large amount of Chinook salmon bycatch. As this captain commented in a fleet meeting, "There is no rhyme or reason to the salmon. I had the highest salmon numbers, and I was fishing right there with everyone. So if I had reported my numbers, everyone would have left!" (personal observation). What this captain means is that the other captains fishing from the same aggregation would have unnecessarily used fuel and time if they moved based on his Chinook bycatch numbers.

Nonetheless, while captains 'never know until [they] tow,' as chapters Two and Three demonstrated, captains engage in abductive sensemaking to create a workable level of certainty before they tow. Workable levels of certainty take the form of expectations when they are used to enact organizing processes (Weick 1995). Expectations are assumptions about how the world will react to our actions. They affect what we notice, consider, react to, and remember (Weick & Sutcliffe, 2007). Built from understandings of what past events were, expectations are predictions of what future events will be; they bridge the past and the future, and help us organize our experience by suggesting the probable course of events (Weick, 1995). In contexts characterized by obscured and hidden complex systems, to expect that something will happen is to propose a hypothesis (Weick & Sutcliffe, 2007: 25). As Chapter Two demonstrated, the production of a hypothesis in this context is an abductive process.

The recurrence of pollock action patterns offers captains the predictability that allows them to create hypotheses as to what will come next. Only after acting on hypotheses, however, can captains assess whether their expectations were appropriate. Through expectations, captains act their way into understanding, and only in retrospect can they understand how accurate their expectations were. It is from hypotheses shown to have a workable level of accuracy predicting action patterns that captains construct their operations so that they can 'tow before they know.' The question is, did captains expect to catch high levels of Chinook in the 2010 D season in the Western Gulf?

To analyze captains' expectations, I divide them into two temporal categories: distal and proximate. Distal expectations in this context are derived from past fishing seasons, and proximate expectations are built within a current fishing season, either from a previous tow in the same trip or a from a previous trip. Both can be based on one's own or another's experience, as Chapter Three demonstrated. To understand the past experience that could have informed captains' distal expectations for catching high amounts of Chinook in the 2010 D season, I examine at the amounts of Chinook captains caught within the same year and across years (according to personal communication with NMFS in-season managers, typically the same captains fish the Western Gulf C and D seasons in the same year and across years). Thus, I look at the 2010 C season, as well as across past D seasons.

The 2010 C season pollock fishery in the Western Gulf is regulatorily slated to open at noon on August 25th to and close on noon October 1, or when in-season managers predict the fleet will catch the pollock quota. In 2010 the pollock quota for the C season was the same as the

Table 10: Historical pollock and Chinook catches and Chinook bycatch rates in the Western Gulf D season			
Year	Tons of pollock	Number of Chinook	Chinook bycatch rate
2010	8,168	28,203	3.45
2009	5,196	178	0.03
2008	6,065	623	0.1
2007	6,998	1,519	0.021
2006	6,462	1,928	0.3
2005	12,425	4,356	0.37
2004	7,894	1,418	0.18
2003	4,718	75	0.02

D season (7,570 tons), and in-season managers closed the C season on September 16th. While the number of days the fleet fished in the C season was double the number fished in the D season, the amount of Chinook the fleet caught was 16 times fewer (1,800, at a rate of 0.18 Chinook per ton of pollock). Therefore, it is unlikely that captains created expectations for catching high amounts of Chinook in the D season, which would open a mere 15 days later, based on the amount they caught in the C season, and the rate at which they caught it.

Captains also could have formed expectations about the amount of Chinook they might catch in the 2010 D season from their experiences in previous D seasons. The 2009 D season, however, was also an extreme bycatch event, but in the opposite direction of the 2010 D season. While the pollock quota in the 2009 D season was a little more than half the 2010 D season quota (4,391 tons), the amount of Chinook caught was 155 times less (180 fish), at a rate of 0.03 Chinook per metric ton of pollock. In fact, the amount of Chinook caught in all four pollock seasons in the Western Gulf in 2009 was a mere 441 fish.

But captains may have formulated expectations for the 2010 D season based on a broader range of past pollock D seasons. The average amount of Chinook trawl captains caught in the Western Gulf D seasons in the six years prior to 2009 was comparatively low, even if somewhat variable (see Table 10). Thus, quantitative data suggest that captains likely did not expect to catch a high amount of Chinook bycatch in the 2010 D season, even though through the years Chinook bycatch amounts were variable. Qualitative data also support this suggestion, as the following interaction between a Council member and a Western Gulf captain suggests:

> *Council member:* "It seems that in the Western Gulf there was fair consistency of Chinook catch over time, with some variation - 2005 was up a little bit all across the Gulf. So was there anything different about 2010 relative to the activity in these other years? Because I think the Western Gulf was very, not level necessarily, but had a consistent rate of Chinook bycatch in all years except 2005 prior to the 2010 season."
> *Trawl captain:* "So you are asking me if I thought there was anything different?"
> *Council member:* "Yes"
> *Trawl captain:* "We were blindsided. We were commenting amongst ourselves,

> ‘Where are all these salmon coming from?’ . . . Did I see anything that I thought was different? No. Again, we were like, ‘Where are all these coming from?’”

In terms of expectations based on distal experience, both quantitative and qualitative data suggest that captains did not expect to encounter a high amount of Chinook salmon in the 2010 Western Gulf D season.

Another type of expectation is more proximate in terms of the hypotheses captains form from one fishing trip, or tow within a fishing trip, to the next. In terms of formulating hypotheses from one trip to the next, based on the total amount of actual pollock catch in the event (8,168 tons), the number of vessels fishing (20), the Gulf-wide regulatory limit on how much vessels can deliver each trip (300,000 pounds), and personal interviews, we can assume that on average captains made three fishing trips in this event. Three trips from the dock, to the fishing grounds, and back to the dock to unload means that on two occasions captains headed back out to fish after delivering their catch to a processing plant. In the following, a trawl captain describes to the Council their fishing process as it extends from one trip to the next:

> “First of all I want to kind of give an overview of what happens when we go fishing. We go out fish, the fish go in the [net], we bring them aboard, we go to town, we deliver. When we deliver the pump goes in the hatch, the fish come out, they go across the sorting table, employees from the cannery pull all the prohibited species, bycatch, anything that’s not pollock out of what's coming out of the pump. And they go into totes, the totes get weighed individually, they get assigned to the boat, and we go back out fishing again.”

In addition to these steps, at some point after delivering their catch a captain is issued a ‘fish ticket,’ which itemizes the catch they delivered by species. One of the items on the ticket is a count of Chinook salmon. Thus, from this information captains could have formulated hypotheses about what they might catch on their next trip if they fish in the same spot they fished during their previous trip. Based on an assumption that captains on made an average of three trips, captains had two opportunities to head out to sea with knowledge of how much Chinook salmon they caught on their previous trip. Yet, according to captains and processing plant managers, it is typically on the next delivery that captains receive their fish tickets from their previous delivery. One captain describes the effect of this information lag in the following: “We literally didn't know how many Chinook we caught until a week or two after the D season was over.” A commonly discussed aspect of the at-sea portion of the event, by both captains and regulators, was untimely feedback on Chinook bycatch amounts from processing plants. This untimely feedback meant that captains were less likely to formulate expectations that would enable them to stem the accumulation of lightning strikes into large-scale bycatch events.

A second potential source of proximately-constructed expectations for catching Chinook salmon occurs between tows within the same trip. Chinook salmon bycatch becomes potentially visible when captains dump the contents of their net into the vessel's fish hold. Yet, a common description of this process given by interviewees and public testifiers, as well as testimony from a NMFS manager,[13] is that due to 1) the speed in which pollock are dumped from the net into the fish hold, 2) the spatial characteristics of the transition, in which the net tends to be directly over the hatch into which the fish flow, and 3) the similar size of Chinook and pollock found in a trawl net, it is difficult to visually differentiate salmon from pollock during this transition. One trawl captain describes this factor to the Council in the following:

> "What we've actually tried to explain is that on our vessels we don't get a very good picture of what actually is going into the fish hold. We have a very narrow space to work with, so we don't see a lot. Most of it just goes right in. You might see one [Chinook] here or there."

The transition between the net and the vessel fish hold is more of a potential place to perceive feedback on how much Chinook one is catching than an actual one. A point of discussion in the Council process was slowing the process of dumping the net, which captains decried due to stability issues that arise with having a large, heavy net on the back of the vessel. Table 11 below provides additional examples, taken from personal interviews and public testimony at Council meetings, of inhibitors of to forming proximate expectations both between trips and within a trip.

Table 11: Inhibitors of creating proximate expectations between and within fishing trips

Characteristic	Source	Representative quotes
Between fishing trips: Untimely feedback from processing plants in the 2010 D season	Trawl captain (2)	"We've all been talking about this - better information. We literally didn't know how many Chinook we caught until a week or two after the D season was over. If we get better daily information from the plants we can absolutely address the issue." "We didn't have the data in a timely fashion, we didn't even know there was a problem until after the D season closed."
	Trawl industry manager	"In the Gulf, we get after the fact bycatch accounting at the processing plant, and a vessel could be well into the next trip before we know what's going on in the grounds."

[13] Which I can personally verify from work experience as a fisheries scientist on board Alaskan trawl vessels

Between fishing trips: Untimely feedback from processing plants in other seasons and years	Trawl captain	"We need data sharing and catch accounting between the processors and vessels. Even during the A and B seasons we were not getting the hard data, i.e., fish tickets, in a reasonable time frame. . . we are very dependent on this information."
	Trawl captain & Council member discussion	*Council member:* "Perhaps you could share with me then what the thinking in the fleet was in 2005 and 2006 when the western gulf catches were nearly double what they had been previously. Can you tell me what the thinking was when those blips occurred, and how the fleet reacted to that?" *Trawl captain:* "That goes back to your statement about poor information, we were just never told that it was a problem."
Within a fishing trip: The difficulty of differentiating pollock and Chinook when dumping a trawl net	Trawl industry manager	"We came to the Council I think it was 22 years ago asking that these folks not be fined for bringing salmon on board because the problem was then, and this continues to be a problem now, that with small Chinook the fishermen can't see them when that bag goes on deck and gets unzipped down into the hold. Occasionally there will be a 40 pound king and you can see that and fishermen have thrown those overboard."
	Trawl captain	"We have no idea what's going in our hauls. We fill that bag up, pull the zipper, drop it in the well, and it all goes there. We thought that we would see a few salmon or something like that but… the talk on the grounds has been a real struggle in that sense."
	Trawl captain & Council member discussion	*Council member:* "[A NMFS manager] and a lot of other people have allowed us how the numbers that come from the plant aren't really reliable because you don't know what happened at sea, we don't know how many you tossed over at sea, and I just don't know how easy it is to sort, maybe you could give a brief description, I guess everybody probably knows this, but how easy is it to discard large numbers of Chinook in, what is it a 30 or 40 thousand pound tow that you bring aboard?" *Trawl captain:* "I think that's what I was trying to explain how it kind of works when we go out fishing. A lot of times half of our delivery is still in the codend when we get to the dock. We fill the boat up, and then we go towing again, and we fill the codend up, so we have got 150k pounds in the boat and we have got 150k pounds in the codend to make our trip limit. So that still hasn't been touched. I was looking through videos to try and find what I could bring to show what actually happens when we dump a bag. . . It's literally, there's a zipper in the bottom of the net, its right over an 18 by 24 Freeman hatch, well you heard [the NMFS manager] even say it, it's virtually impossible for us to try to sort anything out. . ."

Both the lack of timely feedback from processing plants and the inability to see Chinook at sea decreases the ability of captains to construct proximate expectations for catching high amounts of Chinook. It is proximately-constructed expectations that allow captains to react to lightning strikes and prevent them from developing into large-scale bycatch events. For example, it became apparent as Council members and captains discussed the event that pollock and Chinook action patterns overlapped less during the day than at night. One trawl captain described his experience with this pattern in the following:

> "The major part of the bycatch of Chinook was at night. I only made three night tows, but I could just tell by what was coming in the net that there was more Chinook in those tows, and then my fish tickets verified that. [My fish tickets stated] 15, 20, 30 Chinook per delivery, but in my night tows there was over 100 - I think 113 in one and 96 in another. So you could definitely see a difference right there. That would have been something easy [to change], we could all volunteer not to fish at night, and that's fine with me, nights are for sleeping. So if we would have even had the data faster, we would have known that."

The upshot is that if captains had received more timely feedback about what they were catching after delivering their catch to processing plants, perhaps they could have formulated expectations about where and when they would catch high amounts of Chinook on their next fishing trip. From those expectations they could have adjusted their operational action patterns to match the expected temporal action patterns of feed bands. Only with proximate expectations could captains adjust their action patterns with the goal of avoiding additional lightning strikes, which would potentially preclude the proliferation of lightning strikes into a large-scale bycatch event.

iii. An acceptable level of ignorance

We derive our expectations from actions, and we test our expectations when we act on them. Expectations built from distal or proximate past experience require cues from ongoing experience to confirm or disconfirm their hypotheses about what will happen. Thus, captains formulate hypotheses about what will happen next, but they also test those hypotheses. Such hypothesis-testing contributes to a sense of what is happening. When cues bracketed from ongoing experience support an expectation, a unit of meaning about ongoing experience is produced (Bruner, 1986; Weick, 1995), from which the ongoing construction of organizing processes (i.e., action patterns) takes shape (Weick et al., 2005). As I demonstrate in Chapter Three, when cues do not support an expectation or conjecture about future events, incongruence forms, and actors must search for alternate explanations to connect to that cue in order to resolve that incongruence, and therefore make sense.

This event demonstrates that one way of making sense is by accepting that an cue does not fit with expectation, and that this lack of fit is not meaningful. Thus, the cue does not rise to the level of creating incongruence in a captain's abductive sensemaking, and instead is accepted as not surpassing an 'acceptable level of ignorance.' The following exchange between a Council member and a Western Gulf captain exemplifies the sorts of aberrant cues that captains perceived in the 2010 Western Gulf Chinook bycatch event, but accepted as not meaningful in terms of altering their sense of being able to move toward their desired future event:

> *Council member:* "Can you tell me was there anything markedly different between this year's D season where there was a clear spike in bycatch versus what you have seen in previous years? Were you fishing in different areas, different times of day, was there a difference that you could identify or was it, were the fish, did they seem to be more mixed together?"
> *Trawl captain:* **"**I think what we all noticed was a change in the whole area we call Wooly Head where we fish, it was alive with krill, or we don't know what it was, we saw it on the [sonar], but it was alive. There were hundreds of whales there, more than we've ever seen. Something definitely changed in the whole ecosystem just in that little space that for some reason there was more Chinook. And you would see fish jumping, this was late August, middle of September, you would see fish jumping, and we were wondering what they were; we thought they might be silvers (Coho salmon), but I think they were smaller Chinook, and we've never seen that before. I don't know what changed but something changed to bring them in like they were, there was definitely more of them around."

While this captain noticed differences (e.g., whales, jumping silvers, more Chinook), they were not differences that influenced his sense of his ability to move toward his desired future experience, and therefore fit within an acceptable level of ignorance. Additional examples of captains describing cues that did not inspire them to alter the construction of their operations are demonstrated in the following statements made by trawl captains:

- "This area is usually just alive with fish and feed, and last fall it was just a dead zone. Usually we have a lot of whales, I know when we got that hit [of Chinook salmon] I counted 60 to 70 whale spouts on the horizon."
- "I know there was one vessel that was delivering to Dutch Harbor. . . He actually made the comment on the radio in October, 'there's a lot of these silver bullets around.' It got his attention. . ."

Captains did not adjust their action patterns in relation to novel cues to construct new action patterns. Put differently, captains were aware of differences, but these differences were not, as Bateson wrote, "differences which make a difference" (Bateson, 2000: 459). Their acceptable ignorance allowed captains to move forward with enacting another recurrence of their own established action pattern, i.e., fishing where they fished before, instead of enacting a new action pattern.

The data suggest, however, that at least one captain did alter his construction of action patterns within the event. This captain did so only after he realized he was catching high amounts of Chinook salmon, and therefore was able to formulate a proximate expectation that fishing both in a certain place and at night would likely produce high Chinook bycatch:

> *Interviewer:* "So you said you had a trip with a lot of salmon, and then you went back out and made a tow. What happened?"
> *Trawl captain:* "There was a lot of salmon in it. I got right on the radio, there were two other boats there, and [one captain] told me, 'I was over on that other edge further to the southwest and I didn't have that salmon problem.' Well he was fishing during the day, and I went over there but I didn't get there until night. And low and behold I had another bad salmon tow. So I said 'Ok that's it, I can't do this anymore.' So I moved over to the other side of the islands and found some fish and wacked 'em and it was clean as a whistle. There wasn't one salmon in it. Full boatload, not one. So you know, with a little communication amongst the fishermen."

Expectations are products of abductive processes, and, as this quote demonstrates, captains can enhance their ability to create expectations about what they will catch by enhancing their abductive capacity through communication. Thus, communication among participants can lead to an enhanced ability to build expectations about potentially catching Chinook, but the data also show that expectations for potentially catching Chinook can lead to increased communication, primarily in terms of identifying hot spots and moving to avoid those hot spots (even though locations to move to are extremely limited in the Western Gulf, as previous data indicate). Table 12 provides further data on the Council's and captains' realization that enhanced communication, both among captains and between captains and processing plant managers, can enhanced the construction of expectations, and that enhanced expectations can in turn increase communication.

Table 12: Characteristics of enhancing capacity to create expectations for potentially catching Chinook salmon

Characteristic	Source	Representative quote
Expectations built since the event leading to more communication	Trawl captain & Council member discussion	*Council member:* "How do you interact with your processor? What kind of collaboration or communication do you have with your processor in addition to the fish tickets?" *Trawl captain:* "I fish for Trident, and we do talk to the plant manager daily. But if they can convey to us what we are catching a

among vessels and between processing plant managers and vessels		little bit better. . . and keep us more aware of it I think that would help. . . I fished both A and B seasons (in 2011), and . . . there is more awareness, like [another captain] said, we are communicating with one another.”
	Trawl captain (3)	“Bycatch is a concern. It has always been a concern of mine, and I have noticed it to be a concern in the fleet. I think [another captain] spoke to it, we sort of got blindsided by this. . . I guarantee you that next D season there's gonna be a lot of talk on the channel that we share and with our processors about king salmon,” “The fishermen, we all talk amongst ourselves, there is one general channel we are all on. We don’t necessarily share all of our fishing information, but when it comes to the possibility of losing fishing time because somebody has gotten into some Chinook, we are gonna be sharing that.” “We talk a lot [at sea] and we don’t want to be shut down. The biggest problem for us has been C and D season, and the C and D seasons in the last three, four, five years abundance [of pollock aggregations] really hasn’t been an issue. We could move a little bit. In the A and B seasons abundance is kind of an issue sometimes, and you get stuck fishing somewhere because that's the only place there's any fish - but we haven't had a Chinook problem in the winter. In the fall when we have a couple more places where we can actually fish, it’s easier. We are definitely willing to talk with each other to move around.”
	Trawl captain & Council member discussion	*Council member:* **“**Skippers have been up here today, including you guys, have all said, 'Hey, we are gonna work on this,' and I am sure you are. But not all of the skippers are here obviously, and not all of them are necessarily motivated the same way you guys are. And I am wondering what your suggestions are for making sure that there aren't just one proportion of the fleet out their changing their behavior and working at reducing bycatch. How do we as a council make sure that everybody out there is sort of similarly motivated and operating on a level playing field relative to bycatch reduction expectations?” *Trawl captain:* “Its hard, there's 17 of us, I mean, communication is everything. We only fish in a couple of different spots. We have to fish very close to each other most of the time. I mean, this winter the first question everybody asked, was, ‘Did you catch any salmon?’ ‘Did you catch any salmon?’ ‘Did you catch any salmon?’ There was one spot where there was a few salmon this winter and we avoided it. I have to go back to fish ticket data, but I got five salmon all winter. I mean, I guess we will need a cap at some point, but we need to know how many we are catching first, and somebody needs to believe we know how many we are catching, I guess is the biggest thing right now.”

b. Regulating Pathway B

Recurring action patterns also constitute the regulatory process enacted by the Council. This section analyzes the action patterns the Council enacted in its response to the at-sea interaction patterns that produced the extreme amount of bycatch. The on-land portion of this event was a seven-month process that ran through four consecutive meetings, starting in December 2010 and ending in June 2011. Captains operate at the action pattern level, organizing with pollock by creating and testing hypotheses about the recurrence in time and space of their action patterns. In doing so, captains construct their own recurring action patterns. Together, pollock and captains form recurring interaction patterns at sea. The Council, whose construction of regulatory operations is driven by the need to uphold historically-constructed regulations that differentiate fisheries by species and management agency, operate at the species level. The result is at-sea operations that function at one level, and on-land operations that function at another level, and a broader fisheries management system that is more about maintaining historical differentiations than managing according to current ecological processes. The following traces the Western Gulf Chinook bycatch event through the Council process.

The Council typically meets five times a year - February, April, June, October, and December - in order to create and revise fishery management plans (FMPs) and set quotas for upcoming years. Changes to FMPs start with a proposal from the public, a stakeholder group, NMFS, or the Council itself, which is presented to the Council at a meeting or in writing. The Council then decides whether to place the issue on an agenda for a future meeting. Once an issue is on a meeting's agenda, it is elevated from a mere topic of concern to an "agenda item." The Council's process of discussion, deliberation, public testimony, motion-making, and voting on each agenda item strictly follows Robert's Rules of Order.

Although the regulatory portion of the Western Gulf Chinook salmon bycatch event began in earnest at the Council's December 2010 meeting (the meeting after the at-sea portion of the event), the issue of Chinook salmon bycatch in the Gulf was previously a recurring agenda item as part of the process called 'Gulf rationalization.' Gulf rationalization was a four-year process (2003-2006) in which the Council and stakeholders worked toward developing a catch-share plan for all groundfish fisheries in the Gulf. A primary goal of this process was reducing prohibited species bycatch, including Chinook salmon. Gulf rationalization was brought to a halt, however, when Alaska Governor-elect Sarah Palin sent the "kill letter" to the Council (see

Appendix A). On its face this letter advised the Council to postpone its work on Gulf rationalization, but in effect it created a political condition on the Council in which the Gulf rationalization program would not receive enough votes to pass. The Council, therefore, tabled that agenda item.

The agenda item aimed at reducing Chinook bycatch in the Gulf was revivified in October 2007 when the Council tasked its staff analysts (fisheries scientists, economists) with producing a discussion paper on developing measures to reduce both crab and salmon bycatch in the Gulf. As is the case with all issues that the Council elevates to discussion papers, the Council reviews discussion papers, deliberate the issue, hears input from its industry and scientific advisory committees, and discusses the issue with the public during the public testimony that is part of every agenda item. From these discussions the Council suggests additional information and analyses for its staff analysts to include in the paper, as well as determines what steps to take next. The Council reviewed the salmon and crab bycatch discussion paper in June 2008, at which time it narrowed the issue to tanner crab and Chinook salmon bycatch in the Western and Central Gulf.

After one or more rounds of discussion papers, the Council will vote on whether to elevate the item again, the next level of which is initial public review. An initial public review is the first formal step the Council takes when it is planning to create an amendment to an FMP. At this time, analytical staff will enhance the discussion paper into a formal analytical document. This step usually includes the construction of a problem statement and a suite of initial alternatives for the regulatory action the Council will ultimately take, both of which guide the ensuing construction of the analytical document, Council deliberation, committee input, and public testimony, motion-making, and voting. Thus, the Council constructs and assesses a set of alternatives in the interest of choosing the optimal one, all of which is made possible by a formalized structure of recurring action patterns.

The Council operates as a rational system with clearly-defined goals that provide criteria for choosing between alternative actions, guided by explicitly formulated patterns of action (Scott & Davis, 2007). This formalization allows "stable expectations to be formed" by participants (Simon, 1997: 110). Formalization also, according Scott and Davis (2007: 38),

> enables participants or observers to diagram the social structures and the work flows, allowing them to depict these relationships and processes with the possibility of consciously manipulating them - designing and redesigning the

division of responsibilities, the flow of information or materials, or the ways in which participants report to one another.

The Council's action patterns are designed to be rational, and with every recurrence - with the process every agenda item goes through - a rational decision-making system re-emerges.

In terms of recurring rational action patterns involving Chinook salmon bycatch, the Council further reviewed the evolving tanner crab and Chinook salmon bycatch discussion paper at multiple meetings, split the issue, and in April of 2010 the Council scheduled its next discussion of the paper for its December 2010 meeting. At the June 2010 meeting, this discussion was changed to "tentative" on the Council's public calendar. After the October meeting, which was held before the outcome of the Western Gulf D season pollock fishery was known, the discussion of the Chinook salmon bycatch paper scheduled for the December meeting was still tentative.

At the December 2010 meeting, the first meeting after the at-sea portion of the Western Gulf Chinook bycatch event, what was a tentative agenda item was elevated to an "expedited review and rule making" process. After hearing discussion of the event from NMFS in-season managers, discussion of Chinook bycatch amounts and patterns in the Gulf from Council and NMFS analysts, the council discussed the event with both trawl and salmon industries during public testimony. A primary goal of these discussions, and discussions at all subsequent meetings, was understanding the nature of captains' fishing processes, the nature of Chinook ecological processes, and the nature of their interrelationship.

At the end of the first meeting after the at-sea portion of the event, the Council tasked its analytical staff to elevate the Chinook salmon bycatch discussion paper to an initial review paper. The Council also deliberated, voted on, and passed a motion in which it divided the issue into a longer-term process of addressing salmon bycatch in all Gulf trawl fisheries and a shorter-term process of addressing Chinook bycatch in Gulf pollock fisheries. In terms of the shorter-term, "fast track" process, the Council created a problem statement and constructed a set of initial alternatives of regulatory actions, including a Gulf-wide limit on Chinook bycatch, called a 'hard cap', which means that when the fleet caught their limit of Chinook, all fishing for pollock would cease, the creation of "bycatch control cooperatives," in which groups of vessels would work together to control their Chinook bycatch amounts, and other measures. Although creating hard caps was a common method the Council employed to control bycatch, as was evidenced by Pacific halibut hard caps in the Bering Sea and Gulf and Chinook hard caps in the

Bering Sea, bycatch control cooperatives had never been instituted by the Council.

At the Council's next meeting, which took place in February 2011, it reviewed its work plan for the expedited process, tentatively slating "final action", in which the Council selects one alternative as a new regulation, for its June 2011 meeting. In February the Council also modified its alternatives, including providing more detail for its conceptualization of Chinook bycatch caps and control cooperatives, and revised its problem statement, including adding the following sentence: "*Management measures are necessary to provide immediate incentive for the GOA pollock fleet to be responsive to the Council's objective to reduce Chinook salmon PSC.*" The logic of using incentives to control Chinook bycatch in the Gulf guided and pervaded the Council's ensuing discussions, deliberations, public input, and its ultimate selection of a new regulatory measure. The following is illustrative of the incentive-based logic the Council used to integrate its action patterns with at-sea interaction patterns:

> "If there isn't a cap, what's the incentive to change your behavior? If the council was to take no action, or delay action into some time in the future, what's the incentive to change your behavior?"

Table 13 provides examples of both the Council's and the public's emphasis on incentives as a means to, as several Council members stated, "change behavior." The Council enacted a recurring action pattern, but the goal of that process was to use incentives to manage how captains enact interaction patterns.

The initial review document released for the next meeting did what all initial review documents do – it analyzed the initial alternative actions in much greater detail. The initial review presented at the Council's April 2011 meeting was a 295-page document that included a Regulatory Impact Review, which is a cost-benefit analysis required by Presidential Executive Order, an Environmental Assessment as required by the National Environmental Policy Act, and an Initial Regulatory Flexibility Analysis as required by the Regulatory Flexibility Act. In terms of meeting mechanics, the analytical staff presents the initial review document to the Council, the Council is advised of its committee's opinions on the alternatives, and hears public testimony. Then the Council will deliberate and choose a preliminary preferred alternative, or perhaps send the document back to the analytical staff for further analyses (or both). The selection of a preliminary preferred alternative, which signals what will likely be the Council's final action, gives stakeholders time to prepare comment before final action. Because Chinook bycatch issue was on the "fast track," with final action tentatively set for the June 2011 meeting, the Council both issued its initial review paper and chose a preliminary preferred alternative at the April 2011 meeting.

In April the Council formally selected the preliminary preferred alternative of a Gulf-wide hard cap of 22,500 Chinook salmon. The Council also eliminated the mandatory bycatch cooperative alternative from the suite of alternative actions based on a determination by NOAA General Council that it would be an illegal delegation of management authority to resource users. Other measures were also included, but are beyond the scope of this chapter. The primary decision left to be made at the June meeting was whether to adjust the preliminary preferred alternative. After further discussion of the document, public testimony, and Council deliberation, in June the Council took final action in which it voted to institute an annual Chinook bycatch limit of 25,000 in the Gulf pollock fisheries. After the Council takes its final action on any issue, it hands the process over to NMFS, which will begin its rule making process according to the Administrative Procedures Act, which governs all federal government rule making. Thus, regulators met their institutional requirement to "minimize" Chinook bycatch in the Gulf, "to the extent practicable," over 35 years after the requirement to do so was instituted by the MSA. The Council did this by incentivizing captains to avoid catching one species that shares patterns of action with the species that they are targeting.

i. The hard cap sensemaking incentive

The hard cap incentive is meant to encourage captains to avoid integrating their fishing process with homogeneous natural action patterns that are heterogeneously created by pollock and Chinook. An incentive-based approach to managing behavior assumes that, "when faced with several courses of action, people usually do what they believe is likely to have the best overall outcome" (Elster, 1989: 22). Incentives are means by which rational systems control the behavior of its actors, which it assumes are rational as well. Thus, they are structures that link the system to the individual. A hard cap works as an incentive to change behavior when two species that are caught together, one of which can be sold, the other of which cannot, are given catch limits such that catching the limit of one will constrain an ability to catch the limit of the other. When the ratio of one catch limit to the other is smaller than ratio of abundance in which the species are found together in the water, captains will be in jeopardy of not being able to maximize their catch of the species they can sell. For example, if a catch limit ratio is 100 tons of pollock for every 1 Chinook, but captains are encountering 3 Chinook for every 100 tons of pollock, they will run the risk of reaching their Chinook limit faster than they will reach their pollock limit. Thus, catching relatively high amounts of Chinook when catching pollock could decrease the fleet's potential to catch the full pollock quota, thereby reducing potential economic gain.

Table 13: Examples of incentive-based language in Council public testimony
Council member: I'm concerned by your pessimism, or I guess by your unwillingness to acknowledge the importance of trying to find a solution, and I'm just not understanding why it is so impossible to at least work toward some solutions to reduce bycatch in that fishery. *Trawl captain:* Well first of all, I hope I'm wrong. You know I hope we get together and we say, "hey let's make an attempt on excluders," but to back up what [another captain] said, the fleet is, for arguments sake, divided in half. There's half that are serious pollock fishermen, and then there's another half than when fishing is good, they suit up. And there has been a number of C and D seasons the last several years, where they've come out and tried it for a day or so, and it's not been good enough, so they quit. . . . And I just don't see them going to the expense and putting the effort into making an excluder work. . . . You know if it were just for me, if I had a bycatch pistol to my head, yeah I'm going to be putting in an excluder. But to do it for someone else, does that make sense? *Council member:* I'll guess I'll follow up on your last comment: What makes you think that you don't have a bycatch pistol to your head? *Trawl captain:* Ok I do have a bycatch pistol to my head. I understand that. But if only 30% of us put in the effort and the expense to reduce bycatch, is that going to be enough?
Council member: "Do you suppose then that it would be equitable for the council to try to establish a similar level of incentive to avoid salmon in the western gulf and in the central gulf by deciding how to split the cap?"
Council member:" Skippers have been up here today, including you guys, have all said, 'hey, we are gonna work on this,' and I am sure you are. But not all of the skippers are here obviously, and not all of them are necessarily motivated the same way you guys are, and I am wondering what your suggestions are for making sure that there aren't just one proportion of the fleet out their changing their behavior and working at reducing bycatch, how do we as a council make sure that everybody out there is sort of similarly motivated and operating on a level playing field relative to bycatch reduction expectations?"
Council member: If there's a cap or some type of closure or some type of action that limits bycatch, wouldn't that create an incentive within the fleet to look at all different ways of reducing bycatch including gear modification versus having to mandate that? Because there could be many ways of reducing bycatch.
Council member: **"**Do you suppose then that it would be equitable for the council to try to establish a similar level of incentive to avoid salmon in the western gulf and in the central gulf by deciding how to split the cap?
Council member: "How do we as a council make sure that everybody out there is sort of similarly motivated and operating on a level playing field relative to bycatch reduction expectations?"
Council member: "If there were an incentive or a disincentive economically in the Gulf, don't you think your fleet will respond and work within a bycatch cap and figure out how to catch the pollock?"

Salmon industry manager: “The 30k and the 22.5k (alternative level hard caps) are rewards for dirty fishing, and I think that we need the hard cap of 15k because it will provide the incentive to change behavior and it will also remove the complacency that does come into being within a couple of years, it’s like an 'oh well, it’s just a couple of kings' type of deal. They need to get off the hot spots, they have to stop bunching together, they have to slow down, they cannot have night fishing, and the fishermen do know what to do, and the processor needs to help the fishermen to do the right thing. . . Bycatch is wrong. It is unacceptable, and it is an additive impact to coastal communities . . . So I think the 15,000 king crown is needed so that the boys can get to work on the solutions of behavior . . . They know what to do, and they need the incentive from you.”
Salmon industry manager: “We need to manage on a precautionary level, and establish a meaningful cap as stated in the problem statement, 'management measures are necessary to provide immediate incentive for the GOA pollock fleet to be responsive to the Council's objective to reduce Chinook salmon PSC.' The incentive lies in the cap.”
Trawl industry manager: “The other part that I wanted to address is the idea that the only way you are going to get good behavior from fishermen is if you hammer them over the head. In Kodiak, the fishermen that I work for care about conservation. We are trying to be proactive on the salmon, but I realized after our experience this year that the only way that you are gonna get true bycatch reduction versus bycatch control is a full-blown quota share, rationalization fishery at the pollock level. Otherwise, it’s like trying to collar a bunch of people who want to do the right thing but their whole livelihood depends on the target fish, where the money flows. . . So I have some big concerns about how this is gonna move forward and we all end up in the right place.”
Trawl industry manager: “The problem that we have is that we are assumed to be the bad guy. We are the disobedient child that this council needs to stand up and slap up around to make us behave.”

Yet, while the Council, beholden to its rational decision-making assumptions, took an incentive-based approach, this incentive was clearly intended to influence captains’ sensemaking at sea of potential and actual Chinook bycatch. During each meeting that comprised the on-land portion of this event, the Council went to great lengths to understand how captains constructed their fishing operations to interrelate with natural systems. The following are examples of such questions Council members asked trawl captains:

- “[Captain], you have a lot of experience on both large and small boats relatively speaking in the trawl world. I is there a difference between the two, the way larger and smaller boats operate in the trawl fisheries that we need to be aware of in terms of bycatch, or it is it pretty much the same?”
- “The [agency] person isn’t here today but he told us, and a lot of other people have told us, how the [Chinook bycatch] numbers that come from the plant aren’t really reliable because we don’t know what happened at sea, we don’t know how many you tossed over at sea; and I just don’t know how easy it is to sort [Chinook out of the catch at sea], so maybe you could give a brief description. How easy is it to discard large numbers of Chinook in, what is it a 30 or 40 thousand pound tow that you bring aboard?”

- “You mentioned something that I don’t know that I have ever heard before and I'd like to explore a little bit, you described that you could see when you were making those night tows that you were getting more Chinook than you were when you were fishing during the day. Could you describe what you were seeing that told you that when you were fishing?”
- “I know that you are restricted somewhat because the areas you can fish now for pollock are fewer than they were before the sea lion restrictions, so I guess my question is, if you are fishing and you do encounter large numbers of Chinook salmon, do you know that? And if so, can you communicate that to other boats” Do you all go to the same radio channel at some point and say ‘Hey I found a hot spot’? But [if you do], really is there any other place to go? I'm just sort of exploring what people in the fleet can do should they encounter large numbers. Are you aware of it, and if so, what can you do about it?”
- “I am just wondering, now that we've got your attention, what kinds of changes you are thinking you will make to your pollock fishery, and your own fishing, next year relative to managing Chinook bycatch?”
- “Are you thinking of net modifications at all [to avoid Chinook bycatch], like trying to fish with an excluder? I know it gets really tough on a small operation like yours, but I’m just wondering if you think it scales down at this point, or what?”

After a four-meeting, seven month Council process that included questions such as those above, and answers to those questions provided by trawl captains, the Council homed in on several reasons they believed the Chinook hot spot in the Western Gulf in 2010 transitioned into a large scale bycatch event. Key reasons include a lack of communication among captains regarding material cues that actually or potentially indicate the presence of Chinook salmon, captains not able to see how many Chinook are in their catch as they dump the codend into the fish hold, and a lag in communication between processing plants and captains in terms of informing captains of how many Chinook they delivered in their catch prior to the captains returning to sea (often to the same fishing spot). The council created the Chinook salmon hard cap to incentivize to be more aware of cues that potentially indicate, or that actually indicate, the presence of Chinook salmon bycatch, to communicate those cues, and to communicate with processing plant managers about the amount of Chinook salmon in their previous delivery before heading back out on a subsequent fishing trip. In short, the Council created a rational choice theory tool in the form of an incentive, but their intention was to influence captains’ sensemaking at sea. They created a ‘sensemaking incentive.’

In the Western Gulf Chinook salmon bycatch event, unexpected cues captains noticed

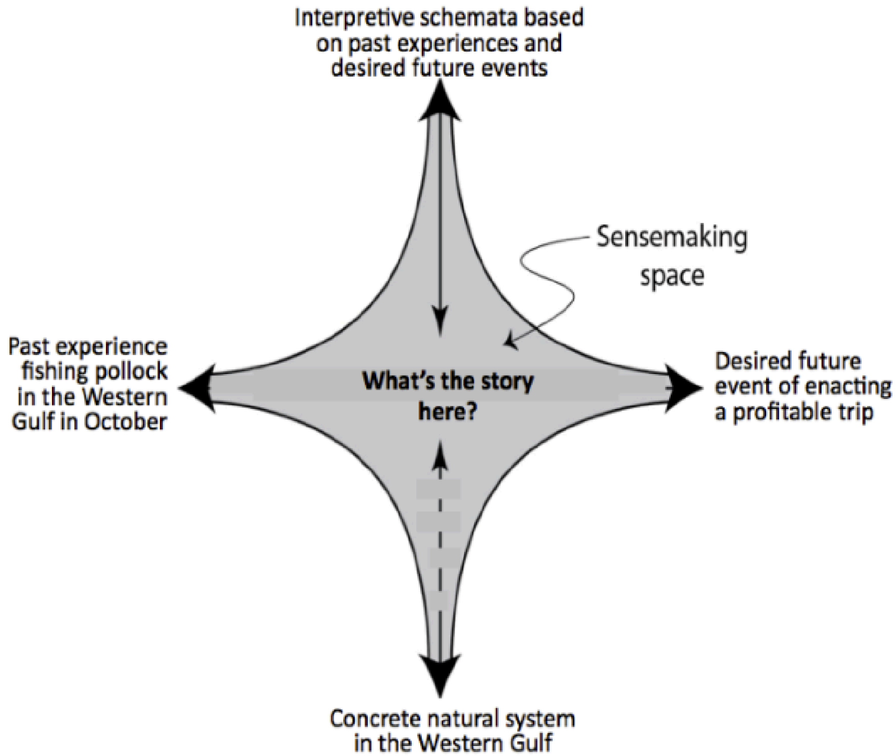

Figure 25: Model of Abductive sensemaking in the Western Gulf Chinook bycatch event, characterized by a partial disconnect from concrete materiality created by not heeding, and not seeking, cues regarding the presence of extreme amounts of Chinook salmon

when they set out to fish, such as hundreds of whales, a huge feed band of pollock, krill, and Chinook that did not separate during the day, "silver bullets" in the catch, all went unheeded. This means captains did not incorporate cues from the concrete portion of their experience into their abductive sensemaking of where to fish, what to fish from, and where to fish next. This lack of incorporation of certain natural cues into their action patterns left captains selectively disconnected from part of the concrete portion of their experience (Figure 25). Captains told a story of what was happening, but it was an impoverished, selective account, based on certain cues from concrete experience, and in both conscious and unconscious ignorance of others due to their acceptable level of ignorance. The conjectures captains produced from those stories were routine conjectures, such as continuing to fish where they had fished before. The hard cap sensemaking incentive was intended to strongly encourage captains to incorporate such cues into their abductive sensemaking in subsequent pollock fisheries, to incorporate Chinook salmon into their stories of what is happening, as well as their conjectures of what to do next.

5. Conclusion

The fisheries management system demonstrated in the Western Gulf bycatch event is comprised of at-sea and on-land processes of integrating action patterns from disparate systems. At sea, captains integrated cues from natural action patterns with their expectations for those patterns, built from past recurrences of natural action patterns, from which they built their own operational recurring action patterns. Captains used abductive processes to accomplish this integration. Such integration creates an emergent system of interaction patterns, and individual fisheries are fleet-level recurrences of these interaction patterns. Due to fishing from a hot spot and lack of expectations for high Chinook bycatch, as well as cues that were judged to not warrant a change in the enactment of established action patterns, the system created at sea resulted in a large-scale bycatch event.

On land, the Council integrated species-level outcomes from the at-sea portion of this event into their pre-established recurring action patterns, creating another emergent system of interaction patterns. The Council used rational decision-making structures to make sense of species-level outcomes from the 2010 Western Gulf pollock D season, as well as with outcomes Gulf-wide pollock fisheries across multiple years. Each Council process, from agenda item to final action, creates an emergent system of interaction patterns. Guided by a historically-structured system of regulations, the emergent system the Council created on land – the species-level annual Chinook hard cap – was an incentive-based structure intended to prevent large-scale bycatch events from recurring. One of the primary goals of fisheries management is to control the extent to which the interaction of fishing operations and hot spots moves beyond lightning strikes and develops into large-scale bycatch events. A rational system of management assumes that it can shape the behavior of its actors through incentives, and influence its own inputs.

While the relationship between sensemaking and rational choice processes and tools tends to be depicted in the literature as alternative approaches to understanding the same phenomena (e.g., Scott & Davis, 2007; Weick, 2003), this chapter demonstrates the two as complementary parts of a greater whole. The trawl captains' axiom, "You never know until you tow," points to the retrospective relationship between knowing and acting. Because captains operate based on indeterminate inputs, they learn what they were fishing from after they have extracted it from the depths. The rational choice theory version of the trawl axiom would be, "You must know before you tow," in which captains should know what they are towing from, at the species-level, before they tow from it. This version points to the prospective relationship between knowing and acting. Both versions are extreme retrospective and prospective aspects of the relationship between acting and knowing (see Figure 26). The hard cap incentive ideally pulls the two closer to the middle, in which regulators recognize that captains cannot know everything they need to know before they tow, and captains alter their action patterns to engage in more sensemaking in an attempt to know more before they tow than they did prior to operating under the hard cap. Thus, the hard cap incentive moderates the antipodal relationship between abductive sensemaking and rational choice approaches to creating interaction patterns.

Fishing is contemporaneously a retrospective and prospective process. Because awareness of which species, and the relative abundances of species, one is catching is retrospective, captains must operate prospectively using expectations. As natural entities construct action patterns proximately in space and time, and as these action patterns recur with regularity over time, captains observing and interacting with these recurring action patterns are able to construct expectations. These expectations are hypotheses as to how their actions will

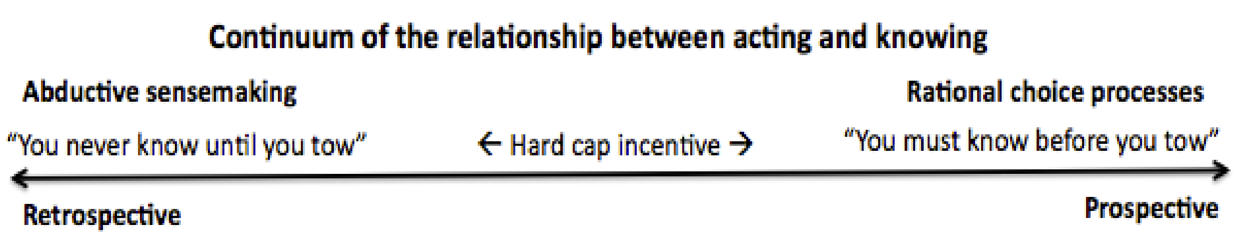

Figure 26: Continuum of the antipodal relationship between abductive sensemaking processes and rational choice processes in terms of the relationship between knowing and acting; in abductive sensemaking, actors are acting in order to then know, and in rational choice processes, actors are acting after knowing. The hard cap incentive requires actors to know more before they act, and to also learn more after they act.

interrelate with natural action patterns, from which captains construct their own action patterns. When captains act on their hypotheses to enact action patterns, they create interaction patterns. Acting on their hypotheses generates cues that test those hypotheses, and therefore captains can only know the validity of their hypotheses after they have acted. This is the basis of the axiom, “You never know until you tow.” It is the matching of expectations and cues at a workable level of certainty, embedded in which is an acceptable level of ignorance, that gives captains a sense of what is happening. Captains’ prospective actions, which operate at the level of action pattern, allow them retrospective clarity at the more abstract species level. As this process repeats, the result at the level of action is recurring interaction patterns, and the result at the level of species is patterns of target catch and bycatch amounts, which are inputs to regulatory processes.

Hot spots, ecologically-speaking, are aggregations of different species that are enacting similar action patterns. Regulatorily-speaking hot spots are aggregations of a target species and a prohibited species that has its own catch limit and which can constrain how much of the target species captains can catch. Bycatch is a foreseeable outcome of species-level regulation of action-pattern level interactions with heterogeneous aggregations. Yet, while fisheries regulators incentivize captains to avoid fishing from hot spots, captains can only know they have fished from a hot spot after one or more captains have already done so. This mismatch between species-level regulation and action-pattern level fishing is made congruent by the logic that discard, up to a certain level, is an appropriate element of a bycatch management system. Prohibited species bycatch reduction programs in federal Alaskan fisheries, whether they are hard caps, catch shares, cooperatives, or mixed approaches, all rely this logic. This is why an acceptable outcome of the regulatory process was a rule that the Gulf trawl fleets can catch, and discard, up to 25,000 Chinook salmon in the Gulf pollock fisheries each year (the Bering Sea trawl fleet is allowed 55,000 Chinook each year in their pollock fisheries, which they must either discard or donate). In 2013, a year and a half after food bank donation programs were installed in the Gulf, only 20% of the Chinook that was bycaught was donated. The wastage of Chinook salmon, as well as Pacific halibut, is due to historically-, rather than ecologically-, derived regulations.

There is a mismatch between the level of regulatory management and at-sea operations. This mismatch is more a factor of the historical trajectory of regulatory development than the ecological nature of managed species. The product of this mismatch is great waste of life and resources. In the Conclusion chapter, I make recommendations for alternative approaches to bycatch management, in which fisheries management systems emerge from congruent on land and at-sea systems, rather than achieving congruence after the fact by requiring waste.

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APPENDIX A:

Palin's "Kill Letter", and the Council's regulatory and political responses

Palin
Parnell
New Energy For Alaska

November 28, 2006

Honorable Stephanie Madsen
Chair, North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501-2252

Re: Agenda for the December 6th to December 12th 2006 Council Meeting

Dear Ms. Madsen:

The Agenda for the upcoming meeting of the North Pacific Fishery Management Council (NPFMC) under Item C, New or Continuing Business, indicates that the Council will be considering Gulf of Alaska (GOA) Rationalization (Item C-4).

The implementation of rationalization programs and their potential impact of the fishing community in Alaska are of real and genuine interest to my new Administration. The effects of crab rationalization were dramatic. For example, one study estimates that crab rationalization resulted in the loss of approximately 1350 crab fishing jobs.

As Governor-Elect, I have both the duty and the desire to work with the Council to ensure that future rationalization programs are carefully discussed, designed and implemented. I would, therefore, ask that the Council defer discussion of this issue until October, 2007 so my Administration can have time to work with the Council in a constructive and meaningful manner. I would request that GOA Rationalization be moved to a subsequent Council meeting.

I am concerned that the Council, by making GOA Rationalization a formal Agenda item just two days after the start of the new Administration, may unintentionally create a situation which is not in the best interests of all parties.

I thank you for your consideration of this request and look forward to your reply.

Sincerely,

Sarah Palin

Sarah Palin
Governor-Elect

By ADF&G
12/10/06

Motion on Gulf Rationalization

There are several developments which affect the Council's activities on Gulf Rationalization.

- The Magnuson-Stevens Act, the legal framework under which the Council operates, has just been reauthorized and time will be needed to evaluate the legal impacts on the existing alternatives and placeholders in the document.
- Governor Palin has recently taken office and has requested the Council to slow its proceedings on Gulf rationalization to allow her administration to evaluate policy regarding fisheries in the Gulf of Alaska.
- The 18 month review of the Bearing Sea Aleutian Islands Crab Rationalization program will begin in April, 2007 and will provide important data to inform future decisions.

Accordingly, I move that the Council take the following actions:

1 – Defer action on any new individual quota share-based rationalization programs such as Gulf rationalization until NOAA-Fisheries has issued regulations implementing H.R. 5946 – the Magnuson-Stevens amendments of 2006 as they pertain to new legal requirements for Limited Access Programs.

2 – Continue to review and modify, as necessary, existing programs such as BSAI crab, halibut and sablefish IFQ, American Fisheries Pollock cooperatives, or Amendment 80 applying to flatfish.

3 – Continue our work to find a long-term solution to the Halibut Charter issue.

4 – Consider more traditional management measures, such as season or gear limits, or sector allocations to address concerns raised in the Gulf of Alaska Rationalization Problem Statement or other fishery management concerns.

North Pacific Fishery Management Council

Stephanie Madsen, Chair
Chris Oliver, Executive Director

Telephone (907) 271-2809

605 W. 4th Avenue, Suite 306
Anchorage, AK 99501-2252

Fax (907) 271-2817

Visit our website: http://www.fakr.noaa.gov/npfmc

November 29, 2006

Honorable Sarah Palin, Governor-Elect
Transition Office
Anchorage, Alaska

Dear Governor-Elect Palin:

Thank you for your letter yesterday regarding Gulf of Alaska rationalization. As you note, we are scheduled to resume discussion of this issue at our upcoming meeting next week, after a lengthy hiatus, and the focus of our discussion would be on simply reassessing where we are in the overall landscape. No major decisions are expected to be made at this time relative to Gulf rationalization, though in response to your concerns, I expect the future nature and speed of our progress on this issue will be part of those discussions by the Council.

Because our Council agendas are set a month in advance of our meetings, approved by the Council membership, and published in the FEDERAL REGISTER as required by law, it is not possible to remove this as an agenda item at this time. Additionally, many members of the public and fishing industry have made travel and other plans to attend this meeting, specifically for discussions of this agenda item.

It may well be that the Council hearing from these constituencies, and taking into account the concerns expressed in your letter, will help us determine an appropriate schedule and course of action that best accommodates those concerns. Indeed, there may be smaller, interim measures, such as beginning the discussion of possible sector splits, which although not part of rationalization, may be prudent to initiate at this time in order to better allow for a delayed consideration of the larger issue, consistent with your request.

On behalf of the Council, I want you to know that we are eager to work with your Administration, all affected members of the fishing industry, and dependent Alaska coastal communities to ensure we craft appropriate and effective management programs. We share your concern that any future rationalization program is carefully discussed and designed well before any plan is considered for approval. We will take your concerns into serious account as we discuss this issue at our December meeting, and look forward to working with you in future Council deliberations on this important issue.

Please contact me or the Council's Executive Director, Chris Oliver, if you or your staff have further questions with regard to this or any other fisheries issues before the Council.

Sincerely,

Stephanie D. Madsen

Stephanie D. Madsen
Chair

Chapter Five
Conclusion

"Consider the subtleness of the sea; how its most dreaded creatures glide under water, unapparent for the most part, and treacherously hidden beneath the loveliest tints of azure. Consider also the devilish brilliance and beauty of many of its most remorseless tribes, as the dainty embellished shape of many species of sharks. Consider once more, the universal cannibalism of the sea; all whose creatures prey upon each other, carrying on eternal war since the world began. Consider all this; and then turn to this green, gentle, and most docile earth; consider them both, the sea and the land; and do you not find a strange analogy to something in yourself?"
--Melville, H. *Moby Dick,* p. 247

1. Introduction

My goal in conducting this research was to provide an answer to the following question: *How do commercial fishing managers make sense of indeterminate natural systems as they attempt to extract material resources from them?* My purpose in conducting this study was to elucidate the sensemaking processes commercial fishing captains enact as they interrelate with natural systems at sea. In doing so, I provide an understanding of fishing processes that cannot be found in a fisheries management literature dominated by rational choice theory assumptions and frameworks, and an understanding of sensemaking that cannot be found in a literature dominated by social processes and artifact-based materiality. These understandings coalesce in the following overarching finding: In order to interrelate with natural systems that are typically indeterminate, commercial trawl captains move through different yet interdependent enacted environments during a fishing trip, each of which requires them to tell a story of present experience by merging abstract interpretive schemata with cues extracted from concrete natural phenomena, a move that is informed by past experiences of their own or other captains,' and guided by desired future events. Based on that story, captains decide what to do next by conjecturing that a certain action will efficiently move them toward a desired future event. This is the abductive sensemaking event. Abductive sensemaking is the process through which captains “narrow the range of ‘might occurs’” and establish “a workable level of certainty” (Weick, 1969: 40) in the face of the indeterminacy inherent in natural systems at sea. Furthermore, conjectures issuing from an abductive sensemaking event help enact future environments, and actors objectify and import past abductive sensemaking events into future enacted environments to aid sensemaking of those environments. This reciprocal process of making sense of natural systems enables captains to transform indeterminate natural systems into determinate material artifacts.

The practical issue this study addressed is fisheries bycatch. Bycatch, one of the primary concerns among fishing captain and fisheries managers, regulators, and scholars, is fish that is neither retained for personal use nor for sale. Most of what is bycaught in trawl fisheries does not survive, but is nonetheless returned to the sea, and therefore is wasted. This practical issue can be informed by the theoretical issues this dissertation addressed because bycatch starts out as ‘natural’ materiality in that is can exist outside of society (Bansal & Knox-Hayes, 2012), but, through processes of interrelating at sea captains integrate it into social systems, at which point it becomes artifactual. Because the processes that produce bycatch stem from indeterminacy in the relationship between captains and natural systems, specifically the indeterminacy created when different species enact the same action patterns, the relationship between captains and natural systems is an appropriate subject of an abductive sensemaking analysis.

The empirical chapters of this dissertation unfolded as follows: I first elucidated the natural elements captains attempt to make sense of as they build their operations to interrelate with and ultimately extract resources from natural systems at sea. Then I constructed a model of the sensemaking processes through which captains interrelate with natural systems. Next I expanded that model to social processes, as well as to situations characterized by a loss of sense. My final move was to apply this model to a real-world event in which making sense of natural systems was clearly deficient and an issue of concern in the broader fisheries regulatory system.

I conclude the previous chapters in six additional parts. In part 2 I discuss the primary theoretical concepts that were both introduced to and emerged from my empirical chapters, namely why I used the interpretive perspective of sensemaking, the emergence of the concept of abduction. In this section I also discusses the embedded relationship between sensemaking and decision making, which is counter to how current literature describes their relationship (i.e., interacting yet separate), as therefore counter to how I conceptualized them in the Introduction chapter. In part 3 I examine how the concepts of abduction and sensemaking work together when combined into one concept, the abductive sensemaking event, and analytical tool, the abductive sensemaking interpretive framework. Part 4 demonstrates how the abductive sensemaking framework works as an analytical tool by re-examining the three enacted environments explored in Chapter Three (i.e., plotter, sonar, catch), while also breaking down the Western Gulf Chinook bycatch event into those three enacted environments. In part 5 I discuss additional theoretical implications of the empirical chapters, namely the 'concatenating' model of abductive sensemaking, and clarifying the relationship between sensemaking and storytelling by examining the transition from the one abductive sensemaking moment to another. Part 6 discusses suggestions for future research (i.e., additional sensemaking studies conducted in natural resource contexts, at frontlines, and further exploration of the relationship between sensemaking and decision making). And finally, in part 7 I provide recommendations for practice, focusing on the issue of bycatch discard.

2. Theoretical Elements of Previous Empirical Chapters

All trawl target species enact recurring action patterns in which they aggregate in certain time and spaces, year after year. It is the predictability of their aggregative action patterns that enable them to be targets of commercial trawl fishing operations. Yet, the specific location of an aggregation that is sufficient for enacting a profitable fishing trip is creates indeterminacy. Trawl captains must not only find sufficient aggregations, but these aggregations must also be associated with weather that is conducive to fishing, and ocean bottom that is amenable to trawling. Captains must make sense not only of the location of an aggregation of a certain target species in time and space, they must also make sense of its relationship to other natural materiality, primarily weather and ocean bottom. The combination of a sufficient aggregation, amenable bottom, and conducive weather is a nexus of natural materiality. Trawl captains have a disposition to fish recurring nexuses of natural systems that enable them to move toward their desired future event of enacting a profitable fishing trip, and they do so recurrently.

When setting out to fish, captains choose a spot to steam to that they feel will provide them with the ability to efficiently fill their vessel. When determining what to fish from, captains make sense of the species composition of an aggregation at that fishing spot, and set their nets into an aggregation, or upon a strip of bottom, they feel will provide them with the ability to efficiently fill their vessel. When determining where to fish next, captains make sense of what they have caught in order to choose to either stay in the same spot or move to a different spot, depending on which one they feel will provide them with the ability to efficiently fill their vessel. Due to the indeterminacy of the time and location of target species aggregating behavior, as well as how long aggregations will occur in any given location (either due to dispersal behavior or vessel extractive activity), the species composition of an aggregation, and even the species composition of actual catch, trawl fishing is an adventure in the unknown. Yet, due to their efficiency imperative, captains cannot readily sample multiple potential locations, take test tows from aggregations, or identify all the fish in their catch in an attempt to engage in rational decision-making. Captains must engage with the unknown while efficiently telling a story of what is happening and they conjecturing what to do next. This conjectural process of inquiry is aimed at efficiently creating a workable level of certainty in the face of the indeterminacy inherent in interrelating with, and ultimately extracting from, natural systems. The following explains why this is a sensemaking process, why it is abductive, and what makes it an abductive sensemaking process as well as a decision-making process.

b. A sensemaking process

To explain how the process of interrelating with indeterminate natural systems is a sensemaking process, I start with the textbook instigators to sensemaking: “Explicit efforts at sensemaking tend to occur when the current state of the world is perceived to be different from the expected state of the world, or when there is no obvious way to engage the world.” And in the face of either difference or deficiency of meaning, “people look for reasons that will enable them to resume the interrupted activity and stay in action” (Weick, Sutcliffe, & Obstfeld, 2005: 131). Sensemaking is a process inquiry enacted in the interest of understanding how to proceed. When setting out to sea, captains cannot know where their next sufficient aggregation will be. The natural conditions at a certain fishing spot are a source of indeterminacy. They also never know what the species composition of an aggregation will be until after they have towed from it. The composition of an aggregation is a source of indeterminacy. Absent sensemaking, captains would either never leave the dock, or never set their nets. Or, alternatively, they would engage in a rational decision-making process of gathering all the information they need (rather than what is available) about each fishing spot by both steaming to multiple spots and sampling the aggregations at each spot and communicating with captains at other spots. Based on their complete and accurate information about the location and composition of aggregations at potential fishing spots, captains would then engage in a comparative process, ultimately choosing the one correct answer in terms of which spot that will provide them with the most efficiency. Such an approach to determining where and from what to fish, however, would require so much time and fuel that it would render the practice unprofitable.

As Rescher (1978: 42) states describing the work of scientists, “Conjectural fancy is limitless, but resources are scarce and life is short.” The same need for economy of inquiry that shapes the scientific process shapes the fishing process. Both scientists and captains inquire into the unknown, and both face constraints born of efficiency imperatives on enacting a rational decision-making process. Yet, managing a commercial fishing vessel is more akin to the type of management Robert Chia describes, rather than the type of processes scientists undertake:

> Managing is firstly and fundamentally the task of becoming aware, attending to, sorting out, and prioritizing an inherently messy, fluxing and chaotic world of competing demands that are placed on a manager’s attention. It is creating order out of chaos. It is an art, not a science. Active perceptual organization and the astute allocation of attention is a central feature of the managerial task. (2005: 1092)

Captains engage in the art, rather than the science, of commercial fishing, and are not beholden to the strictures of precision that scientists are. But they are beholden to the need for accuracy. Captains never know until they tow, yet they must tow somewhere, and more importantly, they must tow somewhere that offers them the ability to enact an efficient, profitable fishing process. They are continuously faced with potential incongruence in terms of moving toward their desired future events due to the indeterminacy of concrete natural phenomena, and abductive sensemaking is how they resolve that incongruity.

a. An abductive process

The process of determining where, when, and from what to fish is primarily an abductive, rather than deductive or inductive, process of inquiry. In deductive processes of inquiry, known conclusions must follow from the premises; in inductive and abductive processes of inquiry, conclusions are unknown. The process of selecting a fishing spot is not deductive because the conclusion that a sufficient aggregation will be at a chosen fishing spot does not necessarily follow from the premise that having found such an aggregation there before in certain conditions means an aggregation will be there again in similar conditions; captains, in fact, operate from the premise that they can never be certain what they will find in a spot until they arrive in that spot.

While both inductive and abductive types of inquiry are used when conclusions are unknown, only one, based on a distinction identified by Schurz (2008), applies to the processes captains undertake: induction and abduction have different targets of inquiry. Induction is used in planning when one needs to infer something about the future course of events in order to adapt one's actions to them. Abduction, however, concerns identifying explanatory reasons for future events (i.e., hypotheses) in order to adapt the course of events to one's interests. Abduction concerns enacting future events in order to meet one's interests, while induction concerns adapting one's interests to inferred future events. Rescher (1978: 42) describes abduction's function of identifying explanatory reasons in the following: "The task of abduction is to determine a limited area of promising possibility within the overall domain of theoretically available hypotheses, a region which is at once small enough for detailed examination and research, and large enough to afford a good chance of containing the true answer." The future fishing spot or the species composition of an aggregation is an abductive inquiry in that its purpose is extending knowledge beyond observation in the interest of adapting the course of events to the captain's need to enact an efficient fishing trip. Captains no not simply infer something about the course of future events; as one captain said, "The future is not given to us, we create our future."

c. An abductive sensemaking process

Abductive sensemaking is a process of inquiry into the unknown, but which offers both efficiency and a plausible opportunity to find the answer one is seeking. What distinguishes an abductive sensemaking process from more traditional sensemaking processes is its emphasis on economy, the instigators to sensemaking, and the interrelationship of decision making and sensemaking. In terms of economy, when undertaking an inquiry in which given conclusions do not follow directly from premises, in which actors are venturing into the unknown, actors must tell a story of what is happening, and what may happen next, both intelligently and efficiently. An actor engaging in a process of inquiry into the unknown is "launched upon a boundless ocean of possibilities" (Peirce, 1931-1958, cited in Rescher, 1978: 49), yet, as is the case in most practical contexts, "possibilities cannot in practice be spun out forever" (Rescher, 1978: 42). Captains fish where they have fished before, but they have fished multiple spots before, and due to their efficiency imperative, captains cannot sample multiple past fishing spots. Abduction becomes important when the "main problem [a group faces] is, how, with a given expenditure of money, time, and energy, to obtain the most valuable addition to [their] knowledge" (Pierce, 1931-1958, cited in Rescher, 1978: 70). Although the 'father of abduction,' Charles S. Peirce, drew from the scientific process to argue that a primary function of abduction is providing scientists with efficiency in their explanatory processes (Rescher, 1978; Schurz, 2008), this dissertation demonstrates that the same concerns for efficiency hold true when trawl vessel captains inquire into the unknown and must act their way into knowing.

In terms of instigators to sensemaking, the at-sea context houses environmental cues that are different from the contexts found in most of the sensemaking literature. Existing theories of sensemaking concern cues that are weak (Rerup, 2009; Weick & Sutcliffe, 2007), ambiguous (Corley & Gioia, 2004; Vaara, 2003), equivocal (Weick, 1979, 1995), shocking (Bean & Eisenberg, 2006), or discrepant (Jett & George, 2003), resulting in problems of either identifying cues (Rerup, 2009; Weick, 1993; Weick & Sutcliffe, 2007), or the categorization (Dunbar & Garud, 2009), classification (Stigliani & Ravasi, 2013), and labeling (Gioia & Thomas, 1996) of cues, or both (Whiteman & Cooper, 2011). Taken together, the sensemaking problem in existing research primarily concerns a struggle with fitting a cue from concrete phenomena to abstract interpretive schemata (i.e., a cue to a frame), which multiple authors have noted to be the basic act of sensemaking (e.g., Mills, 2003; Jeong & Brower, 2008: Weick, et al., 2005). This is a problem because it creates incongruence between the meaning of current experience and an ability to continue to progress toward desired future experiences. This incongruence is the reason the fundamental problem of organizing has been argued to be "the problem of what will come next" (Cooper & Law, 1995: 242). What will come next is the problem that actors engaging in sensemaking attempt to solve (Weick et al., 2005), whether that 'next' involves understanding a past event or how to move toward a future event.

While all sensemaking concerns a question of what will come next, the instigators of that problem can be different. When sensemaking concerns unexpected or weak cues, the problem of what will come next focuses on correcting connections between cues and interpretive schemata, either in terms of updating schemata or finding alternative cues to fit existing schemata. The problem in the at-sea context faced by trawl captains, however, is akin to the context of the Bhopal disaster analyzed in Weick (1988, 2010). Rather than being a problem of alertness and detecting weak cues, or a mismatch between detected cues and interpretive schemata, the problem in the Bhopal disaster was one of missing or invisible cues. In the face of missing, invisible, or otherwise indeterminate cues, sensemaking takes on more of a conjectural form (Weick, 2006, 2010). An overt examination of the nature of sensemaking when cues are missing, invisible, or otherwise unknowable is rare. This study demonstrates that abductive sensemaking is a process of determining what's next in order to find missing cues. As Rescher (1978: 47) states, "Abduction tells us where to shine the beam of inquiry's light. There is no point in researching, however carefully, in the wrong spot." In contexts in which cues are known to be invisible, missing, or, more generally, indeterminate, but not unexpected or weak, sensemaking takes a conjectural approach, producing intelligent guesses about the cues that will be found in future experiences.

The final difference between abductive sensemaking and traditional sensemaking is the interrelationship of decision making and sensemaking. I have demonstrated that abductive sensemaking is a process of producing a conjecture of what to do next when faced with the indeterminacy of natural materiality. This conjecture is a decision. Furthermore, captains engage in a conjectural process in the interest of efficiency, which is one of the primary interests of decision-making researchers (Elster, 1989). Captains select certain places to fish at a certain time that will offer them the potential to enact an efficient fishing process. But captains do not have the resources to conduct a rational analysis of alternative fishing spots in order to obtain perfect information of current conditions. Their decisions are often based on "a feeling," a conjecture or hypothesis, as well as information of current conditions. Abductive sensemaking at sea includes salient decision points, but these points are mere slices of the broader sensemaking process of which they are a part; yet decisions are key parts of sensemaking processes, both in terms of spotting them, understanding them, and identifying and understanding how they connect to other events.

A I detained in Chapter One, sensemaking and decision-making have been conceptualized as characteristic of distinctive views of organizations (Scott & Davis, 2007). They have also, however, have been conceptualized as distinctive yet interdependent processes. Maitlis and Christianson (2014: 21) make the case for this distinctiveness and interdependency in a recent review of the sensemaking literature: "Sensemaking thus both precedes decision making and follows it: sensemaking provides the "clear questions and clear answers" (Weick, 1993: 636) that feed decision making, and decision making often stimulates the surprises and confusion that create occasions for sensemaking." Rudolph, Morrison and Carroll (2008), in a rare study that incorporated both sensemaking and ration decision-making frameworks, came to a similar conclusion:

> In action-oriented problem solving, choice follows sensemaking. Indeed, there can be no choice without a previous sensemaking process; action and interpretation are needed to make available the information used for choice. And sensemaking follows choice as the selection of a new guiding hypothesis sets the problem solver on a new course of action. In contrast, classic rational choice approaches posit that preconstituted information is given and perfectly understood, and the decision process is decoupled from the sensemaking process that created the preconstituted information. (749)

In this study I demonstrate a different relationship between sensemaking and decision-making processes. In the preceding chapters, decision-making is embedded in sensemaking. Decision-making is part of the sensemaking process, and is often intended to influence sensemaking, such as the sensemaking incentives generated by the North Pacific Fishery Management Council. Sensemaking, however, clothes decision making in broader processes. To examine decision making alone first requires excising its connections to the broader processes of which it is a part, and then abstracting it for attention. Weick (2003: 186) describes this type of relationship between sensemaking and decision-making in stating that sensemaking is "intended to break the stranglehold that decision making and rational models have had on organizational theory. Sensemaking implies that key organizational events happen long before people even suspect that there may be some kind of decision they have to make."

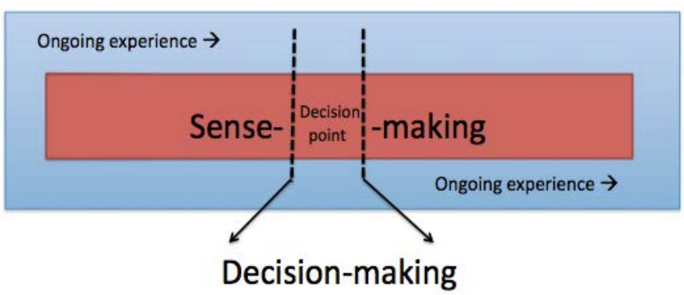


Figure 27: The abstraction of decision making from sensemaking

In the perspective recommended here, decisions are an abstraction from broader sensemaking processes. This in turn means that sensemaking processes are more concrete than decisions are. While we tend to think of concepts as increasing in abstraction the more complex they are, i.e., the more they include other concepts under their umbrella, abstractions from experience are the opposite - the simpler they are, the more abstract they are. The closer we are to describing the complexity of concrete systems, the less abstract we are operating. Conversely, the closer we are to describing the complexity of intellectual systems, the more abstract we are operating. The narrower our bracketed cue is from concrete phenomena, the greater our abstraction from those phenomena. Whitehead (1968: 138) describes the implications of this difference between abstract concepts and abstraction from experience in the following:, "An abstraction is nothing else than the omission of part of the truth. The abstraction is well-founded when the conclusions drawn from it are not vitiated by the omitted truth." Excisions from concrete experience are more abstract the thinner the slice of experience; the question that Whitehead elucidates is, have we excluded too much in our abstraction? For instance, the concept of 'species' is more abstract than the ecological processes from which it was excised, for it includes less concrete complexity, capturing a thinner slice of the concrete phenomena captains experience at sea. Operating in terms of species excises much of the ecological processes of which they are a part. There is a loss of the complexity that is inherent on concrete phenomena. When increase our abstraction from concrete phenomena, we can know more about that abstracted element, but at the same time we know less about the concrete world of which it is a part. This is why Whitehead argues, "You cannot think without abstractions; accordingly, it is of the upmost importance to be vigilant in critically revising your *modes* of abstraction" (1967: 59). A previously unstated purpose of this dissertation is to 'critically revise our modes of abstraction' from frontline fishing practice. This revision expands a traditional focus on decision making to a less abstract, and more concrete, focus on sensemaking, for the latter subsumes the former. We cannot know sensemaking without knowing decision making, and it is important to revise our mode of abstraction from frontline fishing processes to include the sensemaking processes of which decision making is a part.

3. The Abductive Sensemaking Event

Abductive sensemaking is a process of drawing from two interdependent dimensions of experience, abstract <—> concrete and past <—> future, in order to produce a workable level of certainty in terms of progressing through the present, into a desired future, while in the shadow of the past. Scholars have discussed sensemaking as a process of merging the abstract and the concrete (e.g., Cunliffe & Coupland, 2012; Jeong & Brower, 2008; Mills, 2003; Weick et al., 2005), and they have discussed how sensemaking connects the future to the present (e.g., Gephart, Topal, & Zhang, 2010; Stigliani & Ravasi, 2012) and the present to the past (e.g., Brown, 2004; Gephart, 1993; Taylor & Van Every, 2000). None, however, have formally modeled all four anchors of experience within the same process. As this study demonstrates, the future and past parts of experience are inseparable from the abstract and concrete parts. As Whitehead (1967: 43-44) states, "Either there is something about the immediate occasion which affords knowledge of the past and future, or we are reduced to utter skepticism as to memory and induction." The abductive sensemaking model is a tool for analyzing how captains merge the abstract, concrete, past, and future anchors of experience in order to tell a story of what is happening and produce a conjecture of what should happen next. In what follows I break the abductive sensemaking event into abductive sensemaking moments, then I combine those moments into the abductive sensemaking analytical model. Following those discussions, I apply this model to the enacted environments analyzed in empirical Chapter Three, while breaking down the Western Gulf Chinook bycatch event to correspond to those enacted environments.

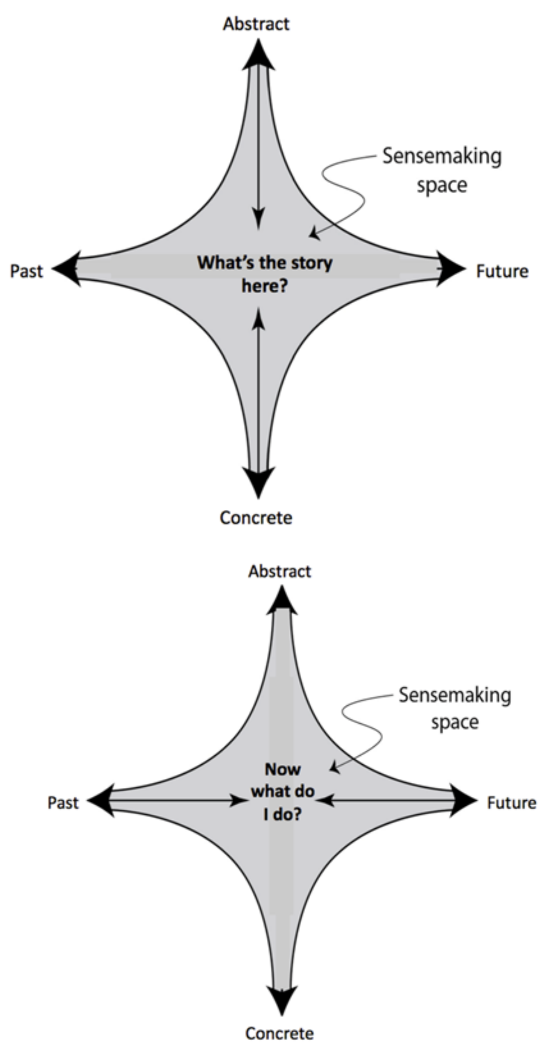


Figure 28: The abductive sensemaking moments of telling a story of what is happening and conjecturing what to do next

a. Abductive sensemaking moments

While producing a workable level of certainty is done in the interest of continuing with ongoing organizing projects (Weick, 1969), sensemaking is the processes by which actors produce a workable level of certainty (Weick et al., 2005). The production of a workable level of certainty, as a function of sensemaking, therefore can be broken down into the two sensemaking questions: "What's the story here?" and, "Now what?" (Blatt et al., 2005; Cunliffe & Coupland, 2012; Weick et al., 2005**)**. The abductive sensemaking event is constituted by two parts, or moments, of sensemaking that correspond to these questions (Figure 28). First, actors merge cues from concrete phenomena with abstract mental models, what I have been calling 'interpretive schemata,' in order to answer the question, 'What's going on here?' As the top model in Figure 28 indicates, this merger is influenced by past experiences and potential future experiences (as external arrows), but as they are instantiated in abstract interpretive schemata and influence the selection of the concrete phenomena captains are interacting with. In this study, the natural processes that captains encounter at sea were the primary concrete phenomena of interest, and interpretive schemata, such as operating models like the disposition to "fish where we have fished before," regulatory structures such as prohibited species regulations, and the efficiency imperative continually imposing its will from desired future events, were the primary abstractions of interest.

In the bottom model of Figure 28, actors use stories of what is happening to answer the question, 'Now what do I do?' in terms of moving from past experience toward desired future experiences. The common past events that were salient in this study are past fishing events, and the future event that was a primary concern among all captains was the experience of enacting a profitable fishing trip. The connection between the past and future is a decision point, yet this connection relies on abstract interpretive schemata and concrete phenomena of interest, which are, in this moment, relegated to the background of external arrows.

In terms of the sensemaking formula, "How can I know what I think until I see what I say?" (Weick, 1977, 1988), as well as the trawling axiom, "You never know until you tow," the first moment of abductive sensemaking concerns the present experience of looking back on elapsed experience and telling a story of what is happening at sea based on the plotter, or what is happening beneath the vessel based on the sonar, or what is happening with the catch based on the fish on deck. The second moment concerns progression from that experience, in which the captain, with a newly enhanced repertoire of past experiences, conjectures what to do next. Both moments make up the whole that is an abductive sensemaking event.

b. The abductive sensemaking model

The two moments of sensemaking form a sensemaking event, which is modeled in Figure 29. But in order for these two parts to constitute the whole that is a workable level of certainty of what to do next, the relationships among anchors of experience must be congruent. Thus, there are six potential sources of incongruence in the relationships depicted by the internal and external arrows. Starting with the external arrows, for experience to be sensible, what is abstract, such as regulations or dispositions toward certain actions, must be congruent with past experience (arrow 2) and desired future experience (arrow 1). Likewise, cues extracted from concrete phenomena must be congruent with past experience (arrow 3) and desired future experience (arrow 4). In terms of the internal arrows, past experiences must be congruent with desired future experiences (arrows b & d), and interpretive schemata must be congruent with concrete phenomena (arrows a & c). Each of these requirements for congruence is also a potential instigators to sensemaking. This study has focused on how natural systems, in their inherent indeterminacy in relation to human systems, are ongoing sources of potential incongruence.

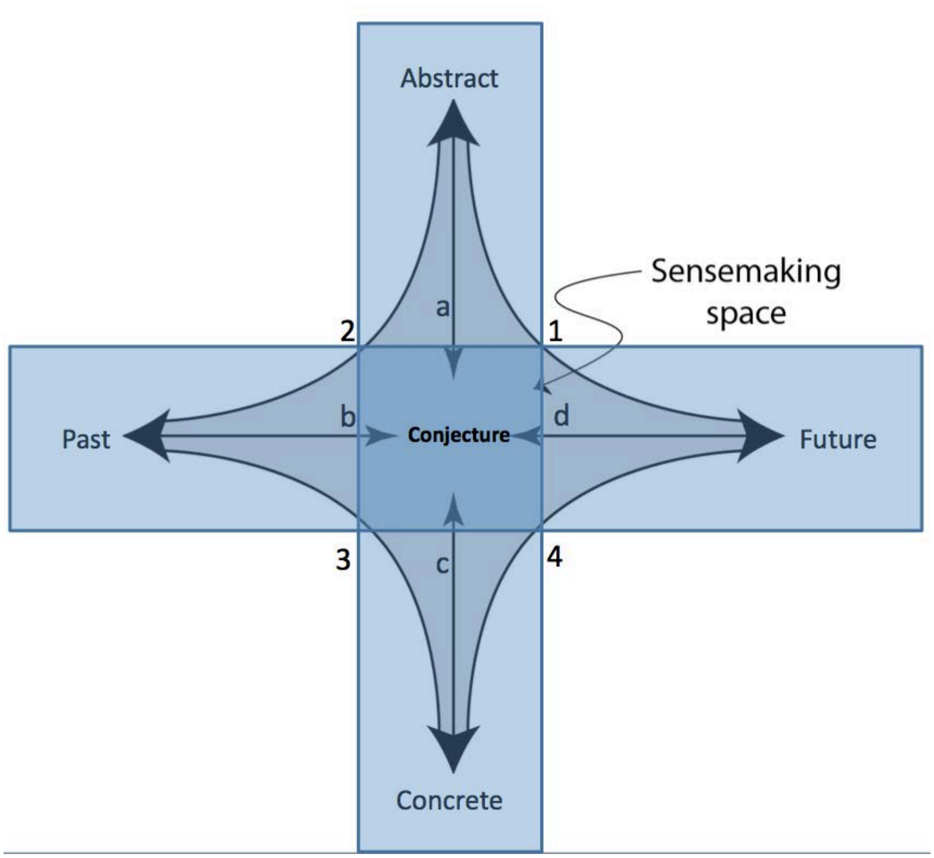


Figure 29: The abductive sensemaking event overlaid with the two dimensions of experience: past←→ future and abstract←→ concrete

Using the abductive sensemaking model s an analytical framework requires three steps.. First, it requires the researcher to dissect an event to four key parts. These parts are the abstract and concrete sides of experience that are salient in the event, and the past and future events that are imported into the present to inform abstractions and shape the selection of cues from concrete phenomena. These four key parts will be constituents of the story an entity tells of phenomena. Second, the framework requires elucidation of relationships among those parts that may be

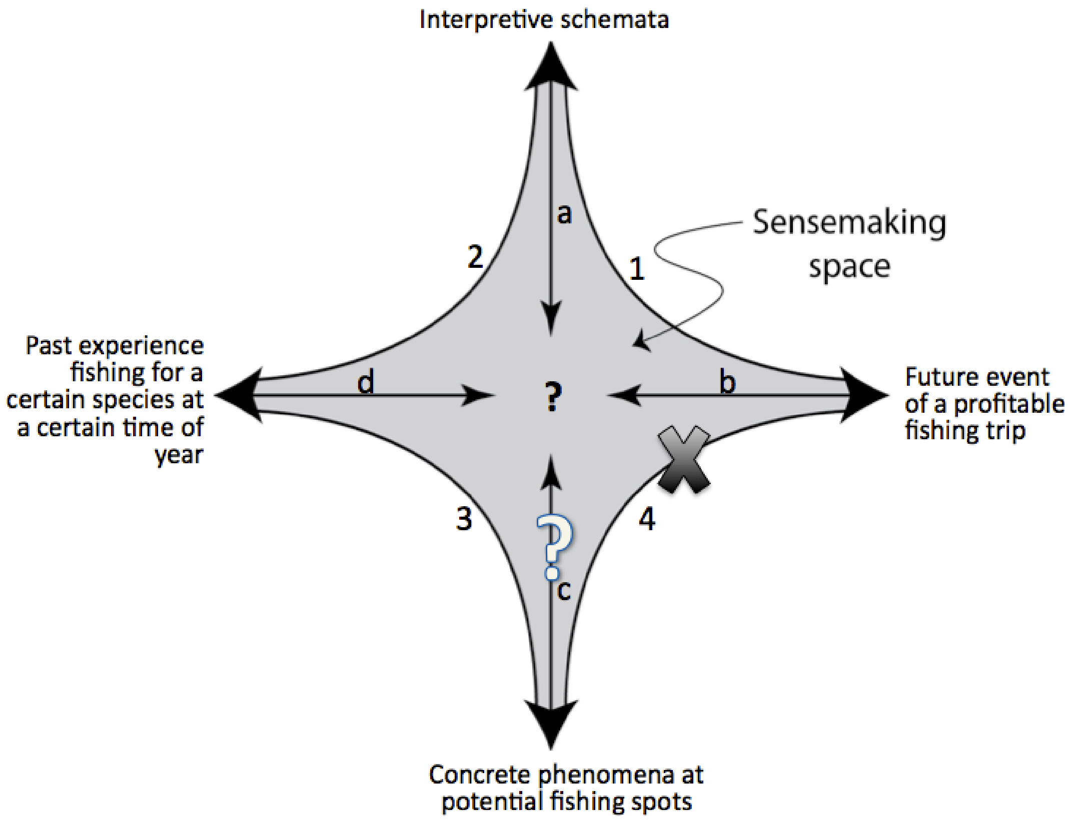


Figure 30: Indeterminacy ("?") and potential incongruence ("x") at the plotter-based stage of a fishing trip

sources of incongruence. And third, the framework requires the identification of the conjecture that resolves the incongruence, allowing the entity to move on.

4. The abductive sensemaking events of this study

Chapter Three introduced three of the primary enacted environments that captains work through when enacting a fishing trip: the plotter, the sonar, and fish on deck. Each of these environments require decisions in which captains answer the sensemaking question, "now what?" In each enacted environment, captains face indeterminacy inherent in their relationship with natural systems, which creates potential incongruences at that point in their fishing trip. Therefore, at each enacted environment, captains must decide how to move forward in the face of potential incongruences. Captains must resolve the potential incongruence born of indeterminacy, and do so efficiently. The following applies the abductive sensemaking analytical framework to three primary enacted environments - the plotter, the sonar, and the catch - both in terms of a typical fishing trip and in terms of the Western Gulf bycatch event described in Chapter Four.

a. Plotter-based abductive sensemaking

The first enacted environment analyzed in this study is the plotter. Because cues from natural processes at a particular fishing spot are unknown at the dock, (see Figure 30, the “?” stemming from the concrete material phenomena portion of their experience), captains cannot give a fully-informed account of what is happening that allows rational decision-making. Rather, captains must instead determine what to do next based on incomplete information. Captains know that they “never know until they tow,” but they also know that they must tow somewhere, and from something. Every decision to steam to a certain spot is a conjecture that in that spot will be an aggregation of fish that is sufficient enough to conduct an efficient fishing trip. The potential incongruence at this point lies in the relationship between indeterminate concrete phenomena and desired future experience of enacting a profitable trip (Figure 30, arrow 4). This incongruence is the focus of sensemaking in this enacted environment.

As Chapter Three demonstrated, captains can enrich their ability to produce an accurate conjecture of what they will find at a fishing spot by importing experience of other captains,

Figure 31: Captains sharing past experience at the plotter-based stage of a fishing trip to enhance their abductive capacity to resolve potential incongruence; note that Captain B’s abductive sensemaking model is displayed in reverse

perhaps captains who have fished at that same spot in the recent or distant past, or who are fishing there contemporaneously. Figure 31 depicts the relationship in which two captains share past experiences, with Captain A importing the past experience of Captain B (note that the model of Captain B's abductive sensemaking is depicted conversely to Captain A's, such that their past experiences overlap). They are sharing past experiences so that Captain A can resolve the potential incongruence in his abductive sensemaking of a particular place to fish in terms of the relationship between the potential concrete material phenomena at a certain spot and his desired future event of enacting a profitable fishing trip. These captains are sharing past experiences, but not actual concrete phenomena, conjectures, or interpretive schemata. Put differently, one is, or both are, increasing their abductive capacity by sharing past experiences, but not by engaging in shared abductive sensemaking.

In the Western Gulf bycatch event, viable fishing spots to choose from at the dock were limited. Captains stated that, based on the aggregating action patterns of their target species, pollock, there are typically three areas in which they can fish in that fall pollock fishery. Captains further noted that pollock aggregations are typically in only one or two of the three fishing areas at a time. The combination of an efficiency imperative, a race regulatory structure, and the limited variation in action patterns of their target species led captains to fish where they had fished before. In addition, plotters tell captains the locations of other vessels, whether they are docked or fishing, from which captains can infer in which spot the pollock aggregations are. The action patterns of pollock inspire vessel action patterns, and captains use these interaction patterns to determine where to fish. Thus, in this event there was little sensemaking of where to fish because there was little indeterminacy in terms of the natural phenomena occurring at the three fishing spots, and therefore little potential incongruence. In such cases, the decision to steam to a certain fishing spot is neither a pure rational decision-making process, nor a pure sensemaking process, but more of a routine process enabled by interaction patterns between target species and vessel behavior.

At the plotter stage in the Western Gulf bycatch event, before captains arrived at their chosen fishing spot, there is the remaining issue of anomalous cues from natural phenomena, such as "hundreds of whales," "silvers jumping," things captains "had not seen before. Several captains stated that such cues suggested something had changed in the "whole ecosystem." Yet, because these cues did not correspond to any sort of incongruence in their ability to move toward their desired future event of enacting a profitable fishing trip, captains did not incorporate them into their abductive sensemaking of where to fish. Thus, captains saw the cues, but ignored them based on their lack of indication of an incongruent relationship with their desired future events. These were not weak cues in that they did not signal any potential threat (Rerup, 2009). Instead, they were simply ignored cues.

b. Sonar-based abductive sensemaking

The next enacted environment is the sonar that depicts aggregations ("sign") at a fishing spot a captain has steamed to. At this point, captains are on the fishing grounds. The sonar enacted environment allows captains to assess their previous conjecture that a selected spot will offer an ability to enact a profitable fishing trip. But it is also a source of indeterminacy. The indeterminacy inherent in the sonar enacted environment is the species composition of the aggregation the sonar is depicting. Every decision to tow is a conjecture that the sign on their

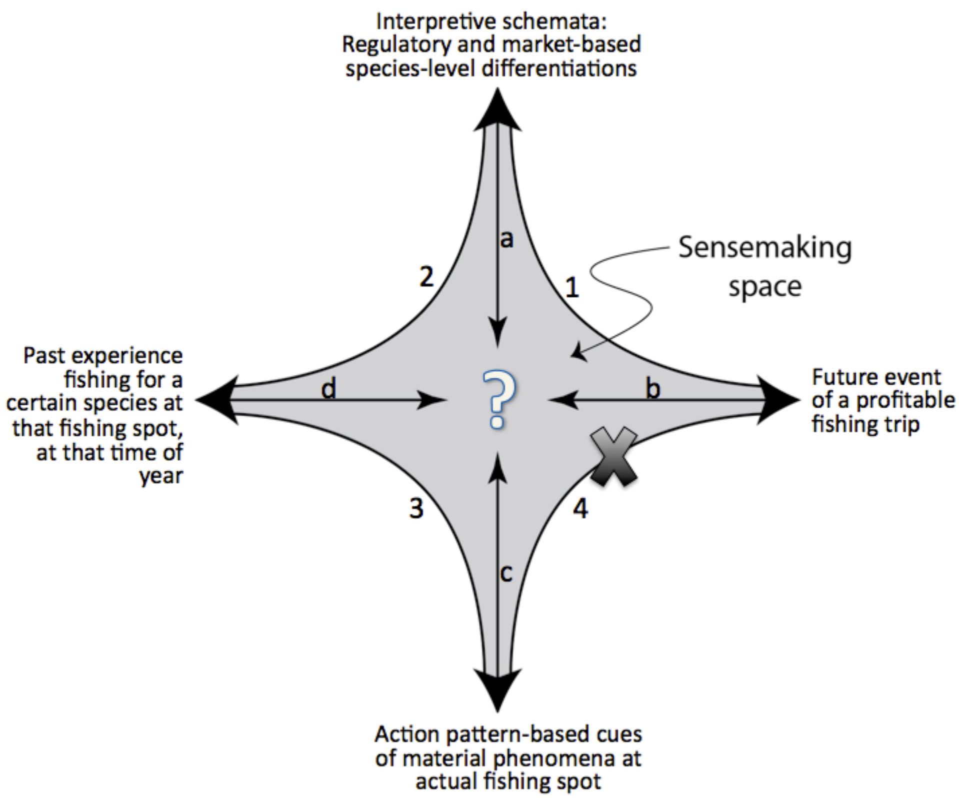


Figure 32: Depiction of an abductive sensemaking event at the sonar-based stage of a fishing trip, in which the captain cannot create a conjecture due to the mismatch between the level of abstraction that regulatory structures impose on frontline processes and the level of abstraction he is able to discern from his sonar-based environment. This mismatch created potential incongruence between his concrete phenomena and his ability to move toward his desired future event

sonar is a certain species, or at least enough of a certain species to be worth the cost of towing. At this decision point, the potential incongruence stems from the inability to differentiate species that are managed differently, and have different economic profiles, but that enact the same action patterns as depicted by the sonar. These similar action patterns cause different fish to appear the same on the sonar. Because captains fish based on the recurring action patterns of their target species, these are, at this level of abstraction, the same fish. Extracted fish of a certain species are merely outcomes of fishing based on the recurring action patterns of that species. Lightning strikes occur when captains target one species based on its recurring action patterns, but unexpectedly catch a high amount of another species that was enacting the same action patterns. I experienced several lightning strikes firsthand while working as a fisheries observer, and secondhand during my field research. Lightning strikes of non-target, non-prohibited species can violate captains' efficiency imperative, while lightning strikes of prohibited species that have catch limits (i.e., Pacific halibut and Chinook salmon) can close target fisheries, impeding the fleet's ability to be profitable. When lightning strikes go unchecked, large-scale bycatch events can form, such as the one that occurred in the Western Gulf Chinook bycatch event. Large-scale bycatch events of prohibited species that have catch limits pose a great threat to profitability.

The indeterminacy of the species composition of sign imposes a potential incongruence between concrete material phenomena and the desired future event of enacting a profitable fishing trip. This incongruence stems from the different levels of abstraction from concrete phenomena and abstract interpretive schemata. The job of the captain is to conjecture that certain action pattern-based cues correspond to certain species-level abstractions (Figure 32). Lightning strikes occur when captains make inaccurate conjectures, in which there is a mismatch between the species-level category captains impose on action pattern-level cues, and the actual species captains extract. This potential inaccuracy creates potential incongruence between concrete material phenomena and the desired future event of enacting a profitable fishing trip, season, or, more extremely, year.

Like the plotter enacted environment, captains can enrich their ability to produce an accurate conjecture of the species-level meaning of sign by importing experience of other captains, perhaps captains who have fished from sign that looks the same, who have fished at that same spot in the recent or distant past, or who are fishing alongside the captain attempting to make sense of the sign. Figure 33 depicts the relationship in which captains are looking at the same sign on their sonars, sharing past experiences, interpretive frameworks, and desired future events. These captains have moved beyond simply sharing past experience to engaging in shared abductive sensemaking in an attempt to conjecture what that sign is at the species-level. This is another way captains can increase their adductive capacity to ‘know before they tow.’

In terms of the Western Gulf bycatch event, the data suggest that captains, especially across the Kodiak and Sand Point fleet, only minimally shard past experiences or engaged in shared abductive sensemaking. There are multiple reasons captains did not increase their abductive capacity through communicative processes, but I will focus on two. One is the conditions of the natural systems that tend to form the fishing grounds around Sand Point Island, which is where pollock fishing tends to occur in the Western Gulf. These conditions are such that the places captains can fish from sufficient aggregations are limited. The greater the number of vessels that target the same aggregation, the faster the aggregation will be depleted, and the greater the potential incongruence between concrete material phenomena and the desired future event of enacting profitable trip. And as Chapter Three demonstrated, this potential incongruence

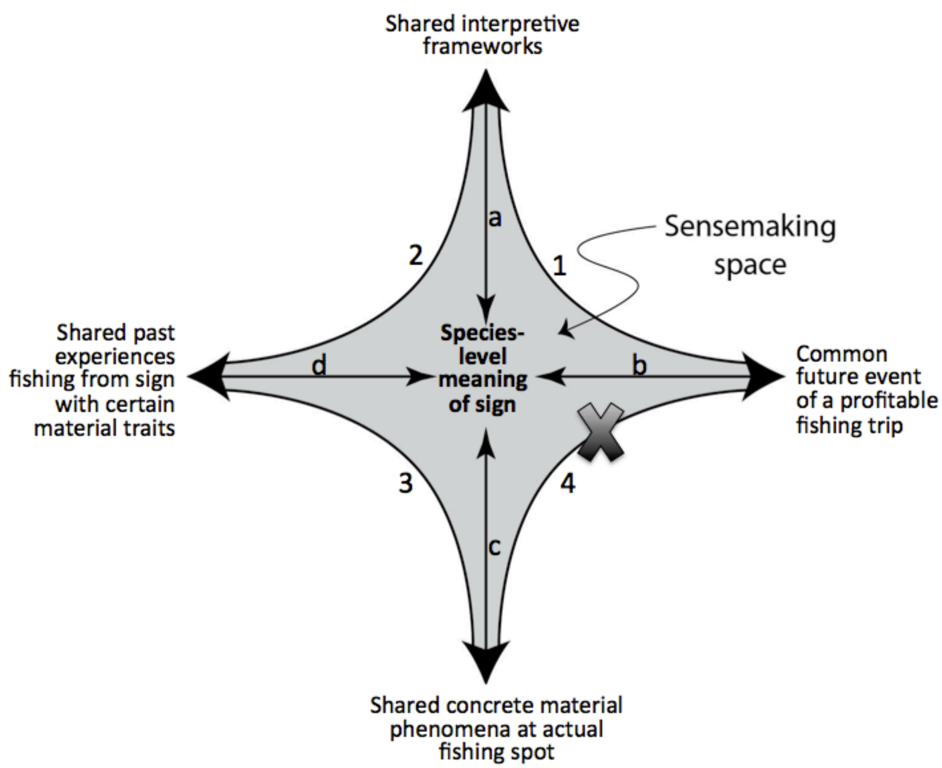


Figure 33: A model of a shared abductive sensemaking event. This model depicts two captains who are sharing past experiences, interpretive frameworks, concrete phenomena in that they are fishing in the same spot, and desired future events in that they both want to fish both efficiently and profitably.

decreases the extent to which captains are likely to share information. They conjecture that sharing information about where they are fishing will impact their ability to be efficient. Thus, this potential incongruence limits the extent to which captains increase their abductive capacity by sharing past experience (see Figure 34).

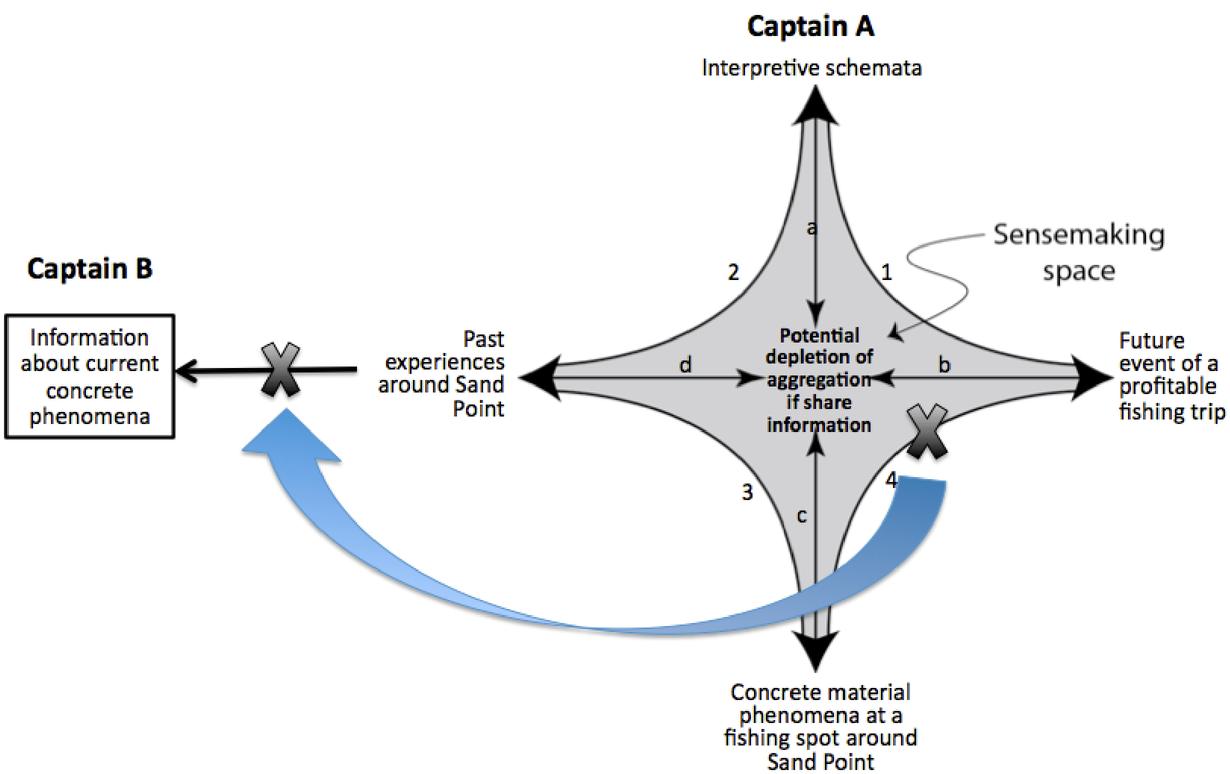


Figure 34: A model of an abductive sensemaking event in which captains do not share past experience due to the potential incongruence doing so can interject into a captain's (Captain A) abductive sensemaking of how to move toward a desired future event of enacting a profitable fishing trip.

The second reason captains did not share experiences or engage in shared abductive sensemaking in terms of the species composition of the aggregations on their sonar is because they did not need to. They were not incentivized to make sense of sign at a more abstract level than the action-pattern level. Even though captains perceived anomalous cues in relation so the sign, such as the feed band not separating during the day, they did not have a profitability-based reason to make more abstract sense of the sign on their sonars. This was the primary logic that the North Pacific Fishery Management Council (Council) employed in their rational process of imposing a regulation that would prevent large scale bycatch events like the one that occurred in the Western Gulf in 2010 from recurring. The creation of "hard cap" on Chinook salmon interjects a potential incongruence in captains' abductive sensemaking in terms of moving towards a profitable trip, season, or even year. The new potential incongruence lies between concrete natural phenomena and desired future experience of enacting a profitable fishing trip, and it incentivizes captains to tell a more nuanced story, but a more abstract story, of their sonar enacted environment. The Council also employed the logic that this potential incongruence would inspire captains to share past experiences as well as engage in shared abductive sensemaking. The Chinook salmon hard cap was a "sensemaking incentive," which further argues for the overlap of sensemaking and decision making perspectives.

c. Catch-based abductive sensemaking

The final enacted environment is catch on deck. When captains bring up the catch, they have their first encounter with the materiality they have been making sense of since they left the dock, and they have the ability to check their assumptions from their previous conjecture about the composition of aggregations on their sonar. At this point, captains can also interpret the natural systems at the same level of abstraction in which regulatory processes interpret them - the species-level. Yet, as Chapter Four demonstrated, in pollock fisheries captains have difficulty differentiating pollock from Chinook salmon on deck due to morphological similarities and the mechanics of dumping a large bag of pollock, as well as an efficiency imperative to dump the bag as fast as they can and set it back out to fish. Thus, in the pollock fisheries, there is remaining indeterminacy. In the Western Gulf bycatch event, captains often did not know how much Chinook salmon they caught in a trip until after they delivered their catch to a processing plant and were back out fishing. Some did not know until after they delivered their next vessel load to the processing plant. This lag in updating the species-composition of their catch creates indeterminacy between past experiences and regulatory limits on prohibited species catch (Figure 35, arrow 2). This lag also creates potential incongruence between the profitability of desired future events and the concrete phenomena in the fishing spot a captain will chose in terms of whether it is a hot spot or not (arrow 4).

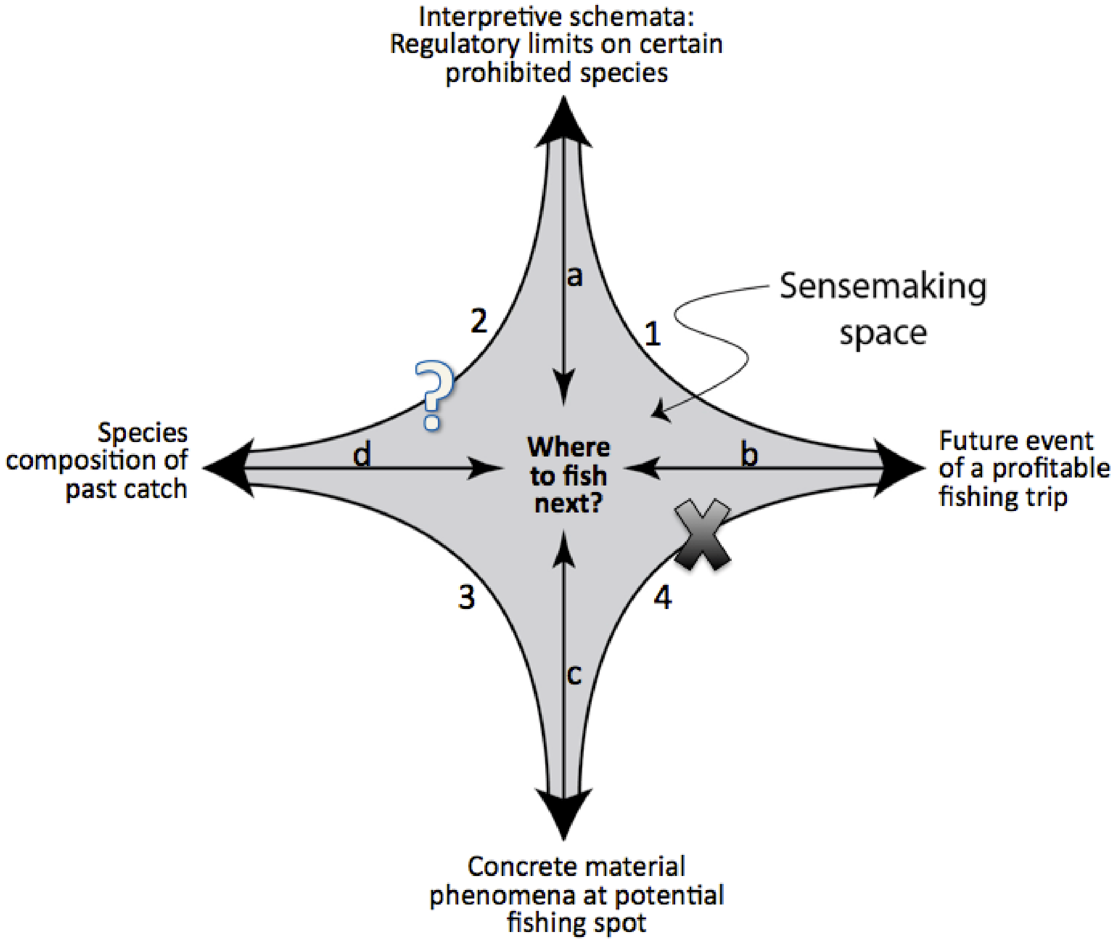


Figure 35: An abductive sensemaking model from the catch-based part of a fishing trip, in which the captain does not learn the amount of Chinook he caught in his last trip before he has to make sense of current concrete conditions in terms of choosing his next fishing spot. This lag in feedback creates potential incongruence in terms of the material phenomena he may find at his next fishing spot and moving toward his desired future event of enacting a profitable trip

In the Western Gulf bycatch event, the indeterminacy of actual catch amounts of Chinook salmon were not tied to a catch limit, and therefore there was no potential incongruence that emerged from that indeterminacy. A goal of the Council, therefore, was to create potential incongruence that would incentivize captains to slow down the process in which they dump their codends in order to look for Chinook salmon, as well as encourage them to find out from processing plants how much Chinook they caught on a trip after delivering their catch and before heading back out to sea. Learning the amount of Chinook salmon they caught on their previous trip would in turn impact their abductive sensemaking at the docks from their plotter-based environment as they chose their next fishing spot. Thus, the plotter-based environment is an outgrowth of the catch-based environment, which is an outgrowth of the sonar-based environment. The abductive sensemaking conducted at each environment uses outcomes from the previous environment as inputs, and provides outcomes for abductive sensemaking at the next enacted environment.

5. Additional theoretical implications

The preceding analysis was one long elucidation of the abductive sensemaking process and analytical model, which extends our current understanding of, and provides a tool for future analyses of, sensemaking in natural resource extraction contexts. Embedded in the contribution detailed above are specified relationships between sensemaking and abduction, sensemaking and decision making, and sensemaking and materiality. There are, however, two additional key theoretical contributions embedded in this study. The first contribution involves the processual nature of sensemaking, in terms of whether it is continual or episodic (Maitlis & Christianson, 2014; Weick, 2012). As Maitlis and Christianson (2014) state in a recent review of the sensemaking literature, "Although epistemological differences regarding the nature of sensemaking may not be resolved, a more detailed examination of its temporality, whether or when sensemaking starts and stops, and how sense is made and remade will greatly enrich our theorizing." (Maitlis & Christianson. 2014: 97). The second further specifies the relationship between sensemaking and storytelling.

a. The concatenating model of abductive sensemaking

Thus study demonstrates how abductive sensemaking processes, composed of interlinked abductive sensemaking events, which are composed of interlinked sensemaking moments, help captains 'know before they tow.' This product of the preceding analyses helps address an emerging tension in the sensemaking literature. As Weick (2012: 146) describes, "The tension is generated by the question, is sensemaking episodic or continuous?" Does sensemaking "start with chaos" (Weick et al. 2005: 411) or does it "never start" (Weick 1995: 43)? The answer to this question has important implications for the role sensemaking plays in natural resource management, primarily in terms of whether extraction processes should be managed to allow for sensemaking in the face of crisis events, or should the extraction process itself be managed as one ongoing sensemaking process.

The sensemaking literature, as Maitlis and Christianson state in a recent review, "diverges on whether sensemaking takes place continuously or in an episodic fashion" (2014:

97). There are multiple clear examples in the literature of an episodic conceptualization of sensemaking, in which the process is triggered by a disruption that produces a loss of sense, and ends with the reconstruction of sense, or, more tragically, with the loss of the ability to make sense. For example, Cunliffe and Coupland (2012) studied an episode of "sensemaking within the flow of experience" (65) in documentary footage of a rugby team, which started with a disruption and ended with a redemptive narrative; Cornelissen (2012) studied the use of different metaphors by communication professionals to make sense of, and move on from, multiple critical incidents; Blatt et al. (2006) studied multiple "mishap incidents" in which hospital residents experienced and recovered from lapses in reliability; Maitlis (2005), in her study of orchestra organizations, produced a typology of sensemaking "accounts" ("discursive constructions of reality that interpret or explain" pp. 21, citing Antaki, 1994), which she labeled "guided, restricted, fragmented, and minimal"; Luscher and Lewis (2008) studied the episodic nature of sensemaking within a strategic restructuring process, in which the process began with a "mess," progressed through several stages, and ended with workable certainty.

Alternatively, there are also examples of sensemaking studied as a continuous process. Such studies conceptualize sensemaking as an interpretive and enactment process that is not so much triggered by a disruption but instead continually emerges from the ongoing need to create meaning as actors carry out their practices. Studies of continual sensemaking, however, due to the temporal constraints imposed by the research process, tend to focus on a bracketed period of sensemaking that is extracted from a continual process, from which scholars construct a model of how actors accomplish sensemaking as an ongoing process. For example, Weick and Roberts (1993) studied ongoing sensemaking on aircraft carrier and found that a variant of ongoing sensemaking - heedful interrelating - supports reliable functioning, and is accomplished through acts of contributing, representing, and subordinating; Stigliani and Ravasi (2012), in their study of a product design process within a larger firm, produced a model of future-oriented sensemaking in which the transition from individual to collective sensemaking is mediated by material objects, and which was constituted by processes of noticing and bracketing, articulating, elaborating, and influence; and Abolafia (2010), in his study of Federal Reserve meetings, produced a model of sensemaking as narrative construction, which was constituted by continuous processes of abduction, plotting, and selective retention, and facilitated by the logic of appropriateness.

Rather than a dichotomy, this study presents a model of sensemaking in which the process is both continuous and episodic. Abductive sensemaking relies on importing experiences across space, time, and people in order to create outputs (i.e., conjectures) that move one forward toward a desired future event, but in doing so enacts new environments. These subsequent enacted environments are the source of new, and novel, sensemaking events. Jeong and Brower (2008: 235) make a similar point: “sensemaking as enactment can be said to be an interdependent authoring process (Giddens, 1979) in which individual actors continuously invite new situations (settings) that often require further sensemaking." Sensemaking of the plotter-based environment set in motion events that led to the sonar-based environment, and sensemaking of the sonar-based environment set in motion events that led to the catch-based environment. And sensemaking of the catch-based environment set in motion events that led to the next plotter-based environment. These events interlink into a sensemaking process that is the backbone of a fishing trip. This conceptualization of a sensemaking process aligns with Herne’s (2008: 45) conceptualization of the relationship between events and process: “Events make processes, and they can make processes only by connecting to other events. Also, they can make up processes only by embodying the past, the present, and the future. . . In this lies an inherently process view, however difficult it may seem for practical research.” Abductive sensemaking events create the enacted environments from which subsequent enacted sensemaking events arise, and actors use past events of sensemaking to make sense of those newly enacted environments.

The model below (Figure 36) depicts sensemaking events as occasioned by different enacted environments, interlinked by conjectures that both enact future environments and are imported into the next event as past experiences. The ‘sense’ that is the product of one sensemaking process serves a progressive authoring function by enacting new environments, and is also objectified and imported into subsequent sensemaking processes where it serves a retrospective interpretive function. Czarniawska makes a similar argument: “The difficulty here is that, in order to grasp the practice of organizing, it is not enough to study single events. The whole point is to know how they are related to other events, to study chains of events. Again, events do not chain spontaneously: the actors or the observers tie them to one another, usually in the activity of story making” (2004: 779). This is the concatenating model of sensemaking, in which one sensemaking process is both outcome and input to other sensemaking processes, across time, space, and people.

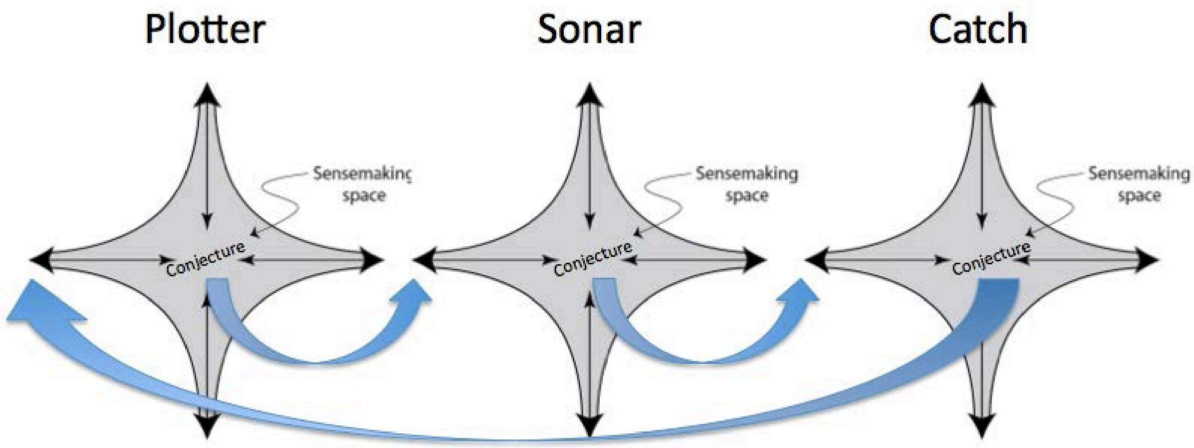


Figure 36: The concatenating model of abductive sensemaking as it occurs in a fishing trip

More generally, a concatenating understanding of abductive sensemaking means that episodes may be connected between different individuals, groups, or, more generically, entities, or the abductive sensemaking events may occur within the same entity; in addition, abductive sensemaking events may be sequential, one happening right after another, or one event may occur at one time, and it may be objectified, picked up and used in an event at an altogether different time, such as captains discussing potential fishing spots in a fleet meeting. Furthermore, events may occur within the same space, such as captains sharing the same fishing grounds and discussing the meaning of rockfish sign, or events may be connected across space, such as a group of captains who are searching for the best pollock fishing spot across in three different locations. Abductive sensemaking events are linked *through* time, but not necessarily *by* time in that the output from one event serves as an input to a future event, but not necessarily the next event. The model encompasses both individual and social, and proximate and distal relationships between events, which may be linked through time and across space, but not necessarily by time or by space.

b. The relationship between sensemaking and storytelling

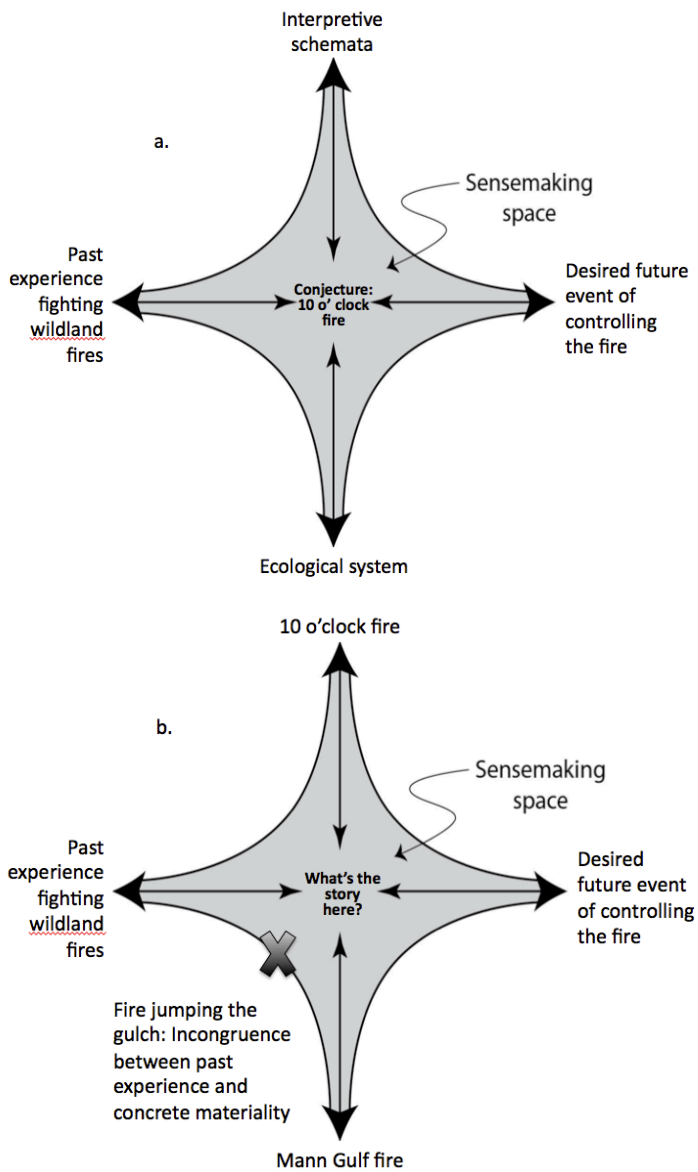
The conceptualization of the abductive sensemaking event as the whole that is constituted by the moments of telling a story and conjecturing what to do next clarifies an ambiguity in the current organizational studies literature. This ambiguity concerns the difference between sensemaking and storytelling. Storytelling is an existing domain of organizational research (e.g., Boje, 1991; Brown, Gabriel, & Gherardi, 2009; Lounsbery & Glynn, 2001), as well as a burgeoning genre within the sensemaking literature (e.g., Brown, 2004; Daily & Browning, 2014; Colville, Brown, & Pye, 2012). According to Maclean, Harvey, and Chia, stories are "sensemaking vehicles" (2012: 19), and as Islam states, "Sensemaking in organizations often takes the form of stories. . . " (2013: 29), while Brown states that "Sensemaking is essentially a narrative process" (2004: 97, citing Brown, 2000). Colville, Brown, and Pye, in their introduction to a special issue of the journal *Human Relations* on linkages among storytelling, sensemaking, and organizing, point to the following relationship between sensemaking and storytelling: "[The] ascription of meaning to experience provides the link between sensemaking and storytelling" (2012: 7). Taken together, sensemaking is a function of storytelling which occurs when actors "attach," "ascribe," or "inscribe" experience with meaning through storytelling or narration (Colville, Brown, & Pye, 2012).

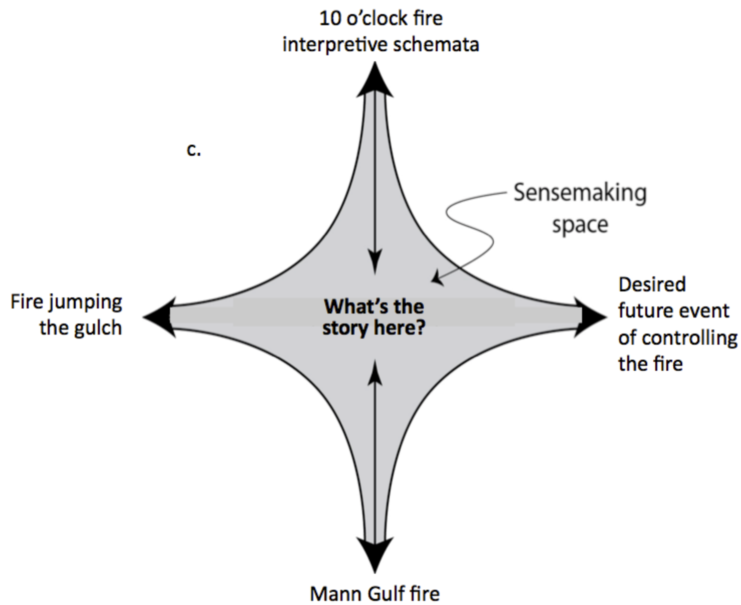
The problem with this current conceptualization of the relationship between sensemaking and storytelling, however, is that we can identify when the two are overlapping (when actors ascribe meaning to experience) but we will never find the two not overlapping. Experience is always being ascribed with meaning, for there is no experience without meaning, and there is no meaning without experience. Without getting mired in the chicken-and-egg question of which comes first - experience or meaning - we need only recognize the fact that even as we bemoan a lack of meaning, we have still inscribed experience with meaning. In other words, we still have told a story. But have we made sense? My argument is that what differentiates sensemaking from storytelling is whether the story is actionable. Thus, a story may be meaningful, but is it meaningful for practice or other ongoing projects? Action has always been regarded as integral to sensemaking (Weick, 1995; Weick et al., 2005), yet stories do not always give rise to actions.

Storytelling is necessary for sensemaking, but it is not sufficient. When the progression of one's experience fails to shift from answering the question, "What's the story here?," to answering the question, "Now what?," a story fails as a sensemaking vehicle. A captain may be able to tell a story of the concrete phenomena on his sonar, but if he has no past experience to draw from in order to determine what to do next, he has failed to make sense. Likewise, if captains merely pontificate about past fishing experiences, but these experiences have no relationship to current or future concrete phenomena, they are simply storytelling. The abductive sensemaking model, as split into moments (see Figure 28) provides a clear demarcation of the point at which storytelling does or does not evolve into sensemaking. When a story fails to progress to a conjecture, it fails as a sensemaking vehicle. This evolution, as Chapter Three demonstrates, turns on the creation or loss of congruence among anchors of experience. When captains import past experiences from others, or share abductive sensemaking processes, they increase their abductive capacity for either producing a plausible conjecture from a story of what is happening, or for telling a story that enables one to make a conjecture, or both.

An examination of Weick's (1993) study of the Mann Gulch disaster, using the abductive sensemaking model, illustrates the relationship between storytelling, congruence, and sensemaking. In this event, 15 Forest Service wildland firefighters were dropped from a helicopter to fight what became an unexpectedly large and dynamic forest fire. The firefighters began with the institutionalized conjecture, distilled from past experiences with wildland fires, that the fire would they would face would be a "10 o'clock fire" (Figure 37, model a). One of the functions of this institutionalized conjecture was to provide the firefighters with interpretive schemata to use to both tell stories of what was happening and conjecture what to do next. Yet, as the firefighters' experience progressed, incongruence formed between cues from the concrete portion of their experience, such as the fire unexpectedly jumping from the other side of the gulch to their side, and their past experiences with fighting a 10 o'clock fire (Figure 37, model b). This incongruence required the firefighters to update their understanding of events by telling a new congruent story of what was happening based on their new past experience of the fire jumping across the gulch (Figure 37, model c.).

Only one fighter, Wagner Dodge, was able to tell a congruent story, drawing from distant past experience involving reading about grassland fires, which enabled him to produce an 'intelligent guess' that was "marked by good sense" (Peirce, 1931-1958, cited in Rescher, 1978: 42). Dodge's story consisted of fitting current material cues to a frame, perhaps guided by the organizing logic of, "this event is similar to another event." Dodge's connection between past experience and current concrete conditions of natural systems allowed him to conjecture that building a “backfire” may save him (Figure 37, model c). Yet, as Weick describes, the other firefighters did not import Dodge’s past experience into their sensemaking. One reason is that, under the dire circumstances, Dodge simply told them what to do instead of sharing his experience with them. The firefighters failed to engage in shared abductive sensemaking, or to even share past experience, either of which could have increased their abductive capacity to conjecture what to do next beyond a decision to run. The upshot is that, at least partly due to an inability to tell a story of what was happening, instead reverting to a primal flight response, 13 firefighter died. The one who lived was able to tell a story of what was happening, and from that story produced a conjecture of what to do next beyond a simple flight response.





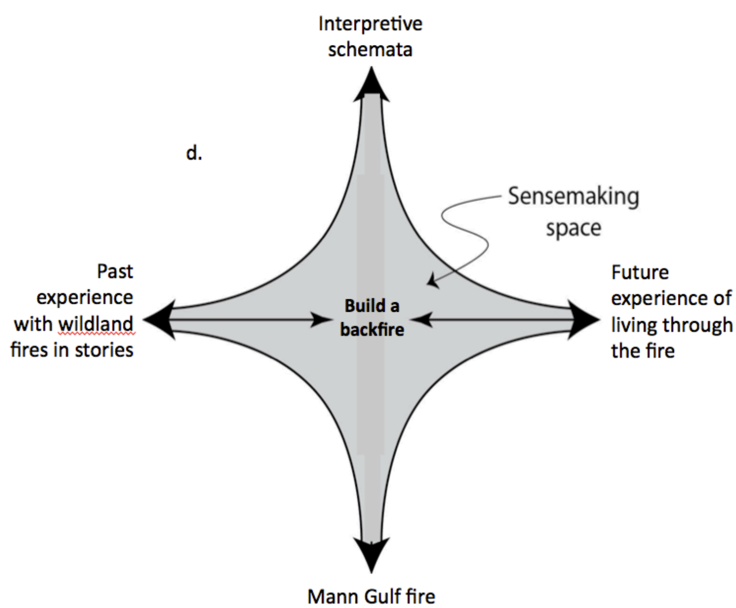


Figure 37: Different stages of abductive sensemaking in the Mann Gulch Fire as analyzed in Weick (1993), moving from a conjecture that it would be a "10 o'clock fire (a) to experiencing incongruence beween concrete natural phenomena and past experience (b), causing participants to attempt to tell a new congruent story of what was happening, to one firefighter conjecturing that a backfire (c) might save him based on distant past experience he imported into the present

C. Sensemaking and routines

In terms of theoretical contributions, this study demonstrates that abductive sensemaking processes are the glue that connects and binds recurring action patterns across social and indeterminate natural systems. While a few studies and conceptual papers examine both routines and sensemaking-related analyses and concepts, such as updating routines on the occasion of rare events (Christianson et al., 2009), the more or less mindful character of routines (Levinthal & Rerup, 2006; Weick & Sutcliffe, 2006), routines as process facilitators of sensegiving (Maitlis & Lawrence, 2007), and the introduction of a routine as an occasion for sensemaking (Colville, Pye, & Carter, 2013), fewer studies have overtly incorporated both sensemaking and recurring action patterns in the same study. The only apparent such study is Weick and Robert's study of interrelating on an aircraft carrier (1993). The authors demonstrate that the recurring heedful interconnection of actions produces a system of stable-yet-flexible recurring action patterns. Yet the creation and maintenance of the glue that binds recurring action patterns across systems has been the unstated subject of several sensemaking studies, including Snook's (2001) study of the "practical drift" or loosening of sense that binds different sources of military action patterns into one system, Kramer's (2007) study of the organization of doubt that is necessary to construct military operations in relation to dynamically complex environments, or Monin, et al.,'s (2013) study of the dialogical sensemaking and sensegiving processes that structure the postmerger integration of two logistics companies. These studies suggest that salient sensemaking episodes are often triggered by the incongruence of action patterns across disparate systems, and a primary duty of the sensemakers in each study to attempt to merge those action patterns into congruent interaction patterns. This study makes the relationship between sensemaking and routines, merely suggested in previous studies, evident, while also, drawing on the abductive sensemaking process detailed in chapters One and Two, detailing the processes through which sensemaking accomplishes this *inter*action.

6. Suggestions for Future Research

The preceding empirical chapters, as well as the deeper storyline elucidated in the previous discussion of this chapter, suggest several areas for future research. These include comparing sensemaking processes across different commercial fishing and natural resource extraction contexts, examining sensemaking across different frontline contexts, and further examining relationships between sensemaking and decision making.

a. Sensemaking in natural resource extraction contexts

In aiming for theory generation, this dissertation is appropriately a single case study of sensemaking processes in one resource extraction context. Yet, as such, all the limitations of case study research apply, the primary one being that I cannot generalize the findings of this study to other contexts (Eisenhardt, 1989; Yin, 2009). Therefore, additional studies in different commercial fishing contexts are needed to assess the generalizability of this study's findings. For example, in fisheries contexts characterized by less indeterminacy, such as salmon set netters and seiners, do captains still engage in adductive sensemaking, or do they engage in another interpretive and decision-making process and they determine where to fish, what to fish from, and where to fish next? Or, is there a different process altogether by which captains chose a fishing spot? Further, in non-trawl fisheries, do captains employ the disposition to fish where they have fished before, or to they engage in more exploratory and trial and error search processes? Another important research question regards the relationship between regulatory structures and frontline fishing processes: How do different regulatory structures impact how captains in other commercial fisheries make sense of natural systems?

A logical extension is to explore frontline sensemaking in other resource extraction contexts. Such research would allow us to understand how sensemaking changes as the character of natural materiality changes. Different natural systems offer different concrete cues and enact different action patterns, and frontline actors generate different expectations based on those cues and action patterns. The material cues bracketed from the natural systems specific to the logging industry are different from the material cues found to be salient in the commercial fishing industry, and they are different from the material cues important in the fracking industry. Because these different natural systems exhibit different action patterns, the interaction patterns resource extractors create in their process of interrelating, are also different. Studying the similarity and variation of salient cues and action patterns across different natural resource extraction contexts would go a long way toward improving our understanding the proximate dimensions of organizational theory, as well as how sensemaking varies, and does not vary, as natural systems vary.

b. Sensemaking in frontlines

Abductive sensemaking is employed, perhaps even required, when actors operating at a frontline must interrelate with parts of a system that are unknown, unpredictable, or in some other way indeterminate. ‘Frontline’ is a commonly used (e.g., Bidwell, 2010; Gabriel, 2002; Maitlis & Sonenshein, 2010; Sonenshein & Dholska, 2012; Whiteman & Cooper, 2011), yet little defined concept. In the broader academy, the concept is typically associated with military operations, medical practice, policing, and service industries. In terms of organizations, the frontline has generally been identified with employees or managers ‘lower’ in the organizational hierarchy than middle managers (Beck & Plowman, 2009; Stein, 2013), as well as with the area at the “periphery of the organization” (Smith, 1965: 390). Beck and Plowman (2009), focusing on the role of middle managers in service industry organizations, characterize the frontline as “the ‘technical’ subsystem that processes materials and provide services to customers” (914: citing Van Cauwenbergh & Cool, 1982). Yet, while Beck and Plowman implicitly refer to interrelational processes between different systems, they curiously locate the frontline within the confines of one organization. Furthermore, concepts such as “boundary spanning structures” and “task environment” (Thompson, 2008, citing Dill, 1958) also do not capture the conceptualization of frontline as described here. Boundary spanning structures extend from an organization’s “technical level” into its task environment in order to adjust to environmental variation, but maintain distinctions between organization and environment. Characterizations that associate a frontline only with certain actors, or that place the frontline within an organization, or that maintain distinctions between an organization and its environment, overlook the interrelational and emergent nature of a frontline. The frontline does not belong to one organization; rather, it is a product of interrelating, and even integrating, processes belonging to different systems into one emergent system.

A frontline is an interaction pattern that emerges from the proximate interplay of action patterns belonging to characteristically different systems. For instance, the frontline of military operations is emergent from the interaction of opposing armies; the frontline of the medical field is emergent from the intermingling of medical personnel and patients; service industry frontlines are products of interacting service personnel and customers; and frontlines in natural resource extraction industries are enacted by the integration of industrial and natural processes. It is an emergent whole that is constituted by parts, which are parts of different systems. To distinguish one system from another, and to distinguish the systems from the emergent frontline, the concept ‘organizational character,’ can be used. ‘Organizational character’ is a coherent ensemble of dispositions or impulses that generate distinctive patterns of action, allowing familiar observers to identify certain actions as "in character," and others as "out of character" (Birnholtz, Cohen, & Hoch, 2007). Defining organizational character according to actions rather than actors enables researchers to include non-human entities, such as populations of fish, stands of trees, and shale gas, alongside more typical human organizations when studying frontlines.

Every entity is always creating frontlines, and those efforts are always being shaped by regulatory and management structures. The emergence of a frontline needs to be managed to a greater or lessor degree depending on the effect of the frontline on its interrelating systems. For example, the interaction of hiker and forest results in the ongoing creation of a frontline, but one that tends to require less management than the interaction of logger and forest, for the logging frontline impacts its systems (i.e., the forest ecosystem and logging industrial system) to a greater degree than the hiker's does. Thus study suggests that it is through sensemaking that frontlines are created. Yet frontlines may also be created through rational decision making processes, routines, as well as other interpretive and action-oriented processes aimed at interrelating disparate systems. Frontlines are paradigmatic places where organizing, interrelating, and integrating occur. They also tend to be places of great conflict, suffering, and destruction. Studies are needed to understand the creation, maintenance, and management of frontlines. Such research requires comparing frontlines across different contexts. Important questions include, what characteristics of frontlines are common across different contexts? How are frontlines created, maintained, and managed in different contexts? How do participants make sense of frontlines in different contexts, and in different types of interrelational processes (e.g., peaceful vs. hostile)? Comparing frontlines, which are necessarily found in every organizing entity, allows researchers to examine the similarities between/among contexts and entities that would otherwise appear incommensurate.

c. Sensemaking and rational decision making

I began this dissertation by justifying my research on sensemaking in the commercial fisheries context by distinguishing sensemaking and rational decision making. I end this dissertation, however, by arguing that the two processes are distinguishable only by the artificial imposition of pre-formed categories. I argue that you cannot understand sensemaking without understanding rational decision making, and you cannot understand rational decision making without understanding sensemaking. Just as rational decision making theory is preoccupied with efficiency (Elster, 1989), sensemaking can also be preoccupied with efficiency. In fact, in this study, captains make sense of how natural systems relate to their efficiency imperative, not of natural systems alone. Abductive sensemaking emerged in this study as necessary for the economy of commercial fishing practice. This point was emphasized in Chapter Four when I analyzed why captains did not incorporate anomalous cues of “hundreds of whales” and “silvers jumping” into their abductive sensemaking processes. While one study has examined relationships between sensemaking and decision-making (Rudolph, Morrison, & Carroll, 2009), which supported the pre-existing notion that the processes are distinct, this study, which finds that the processes are distinguishable only by conceptually slicing one out of the other, opens the door to research on a number of topics that have thus far been rendered separate along with sensemaking and decision making. The inclusion of decision making within sensemaking, rather than the separation of the two, opens the door to connecting two extensive bodies of literature that have largely been disconnected. This study demonstrates that sensemaking can take on some of the same properties that decision-making does, such as an overarching concern with efficiency, clear decision points, and a goal of accuracy. For example, we can now study how actors make sense of efficiency, how efficiency imperatives impact sensemaking, and how sensemaking itself be a source of efficiency or inefficiency. We know that in many contexts, actors try to maximize their economic potential; this study suggests that abductive sensemaking is a key contributor to that maximization. In what other contexts is this the case? In what contexts is this not the case? How do the economics of sensemaking change in different contexts? What facts enable or impede sensemaking to act as a source of economy of organizing?

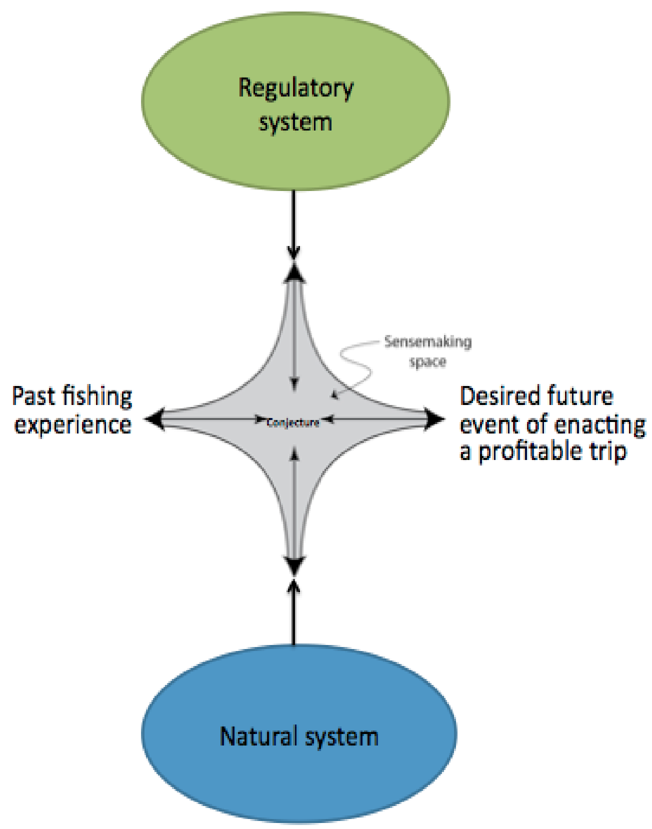


Figure 38: A model of the abductive sensemaking process as a tool to align inputs from regulatory systems with inputs from natural systems

7. Recommendations for practice

My primary recommendation for practice is directed at on-land policymaking, but grounded in at-sea sensemaking. Kodiak trawl captains are charged with aligning their operations with both natural and regulatory systems, guided by, their need to, as multiple captains stated, “make a living.” As Figure 38 depicts, captains align their operations with natural and regulatory systems through abductive sensemaking. This is the frontline of commercial fishing. The way in which captains align their operations with natural systems shapes how they align their operations with regulatory systems, and the way in which captains align their operations with regulatory systems shapes how they align their operations with natural systems. My recommendation for regulatory practice focuses on one of the ways in which the federal Alaskan regulatory system influences how captains interrelate with natural systems, namely the incentivized and required discarding of certain species.

Worldwide, the amount of fish that is discarded is anywhere from 8%, which is over seven million tons (Kelleher, 2005) to 25% (Davis, 2002) of the total catch. In the US, annual estimates are around one million metric tons (Harrington, et al., 202; Kelleher, 2005). Discards, as Kelleher (2005:1) states, “are generally considered a waste of fish resources and inconsistent with responsible fisheries.” Similarly, as Diamond and Beukers-Stewart (2011: 232) put it, “It is widely considered accepted that the dumping of fish at sea is unethical and represents a substantial waste of resources.” The following recommendations regarding discarding at the frontline the Kodiak trawl fleet consists of four parts. In the first part I define discarding. In part (b) I review the regulatory roots of discards, specifically prohibited species, in Alaskan fisheries. In part (c) I introduce potential problems with the regulatory practice of requiring or incentivizing discarding. And in part (d) I suggest an alternative approach to managing the catch of certain non-target species, one that aligns with findings from this study regarding how captains actually determine where to fish, rather than how rational choice theory, upon which regulations are built, assumes they should.

a. Defining discarding

Discarding is a primary issue in the fisheries management literature (e.g., Abbott & Wilen, 2009; Bellido et al., 2011; Catchpole, Frid & Gray, 2005; Cook, 2001). As defined by Kelleher (2005: 1), discarding is “that portion of the total catch which is dumped or thrown overboard at sea.” While some definitions of discard and bycatch differentiate the two, for the purposes of this dissertation, they are the same. Bycatch is “fish that are captured in a fishery but not retained for sale or personal use” (Patrick & Benaka, 2013: 470). Therefore, both target and non-target species can be bycatch if they are discarded. Animals belonging to a target species may be discarded if they are too small or damaged to be sold or processed, or if it is too dangerous to bring them onboard, and certain non-target species are often retained and either sold or kept for personal use. Kelleher (2005: 56) further defines “good” and “bad” discards, in which good discards are animals that have both survived being caught and will live after being discarded, and bad discards are those that have been killed in the process of being caught. This discussion concerns bad discards.

b. The regulatory construction of discards

The practice of discarding can be grouped in two categories: discretionary and regulatory. Some discarding is the result of a choice captains make based on whether the animal is salable or not, or whether it is more or less salable than other animals are. Thus, captains may keep one species over another species based on which will fetch a higher price, thereby maximizing the value of their fish hold space. Regulatory discard, however, “refers to catch that could have been retained if regulations had not prohibited retention” (Patrick & Benaka, 2013: 470). My recommendation for practice concerns regulatory discards, specifically what are called ‘prohibited species discards’ in federal Alaskan groundfish fisheries management.

‘Prohibited species’ are certain bycatch species caught in Alaskan waters that trawl captains are required by regulation to discard, even though these species tend to be targets in state-regulated fisheries. The Gulf groundfish fisheries management plan (FMP) offers more detail on prohibited species regulations:

> Prohibited species identified in this FMP are Pacific halibut, Pacific herring, Pacific salmon, steelhead trout, king crab, and Tanner crab. Species identified as prohibited must be avoided while fishing groundfish and must be immediately returned to the sea with a minimum of injury when caught and brought aboard. . . (NPFMC, 2014a: 40)

An important aspect of the prohibited species discard requirement is that all herring, salmon, trout, and 65% of the halibut (NPFMC, 2014b) and 80% of the crab (NPFMC, 2007) are “bad” discards in that they die in the process of being caught in a trawl net.

While the language above states that captains must return all prohibited species to sea, other language in the Gulf FMP allows captains to donate Chinook salmon and Pacific halibut to food banks. Prior to 2011, in which infrastructure for donating prohibited species catch in the Gulf was first constructed, donating prohibited species catch in the Gulf was not an option. The option to donate Chinook salmon and Pacific halibut to a food bank potentially mitigates the negative effects of prohibited species discard. Yet, limited available data indicate that only around 1% of the halibut caught each year in the Gulf trawl fisheries is tallied at the dock as donated to food banks.[14] And due to the incommensurability of the way Chinook salmon bycatch is managed (by numbers) and the way they are recorded by food banks (by dressed weight), it is impossible to derive an accurate percentage of the amount of Chinook that is donated. Nonetheless, based on personal communication with SeaShare, the organization that manages all food bank donations from federal trawl fisheries in Alaska, in 2013 only 19,373 pounds of the 29,367 individual salmon caught in Gulf trawl fisheries (which tends to be 90% Chinook and 10% chum) made its way into the food bank system. Donations are low because it requires expenditures of resources for both vessels and processing plants, which, in terms of vessels, amounts to space that could otherwise be occupied by salable fish. Because captains cannot sell them, they are incentivized to discard them. The upshot is that every year thousands of tons of prohibited species are discarded, and over the decades hundreds of thousands of tons have been wasted.

But amounts of discards are not important to my policy recommendation. Rather, what is important is that the federal Alaskan regulatory system requires or encourages *any* fish to be wasted. As Chapter Four explained, the prohibited species regulations are artifacts of historically-constructed management authorities, which act contemporaneously to maintain those authorities. Throughout history, fisheries have developed where salable species aggregate to an extent that catching them is a profitable endeavor. But just as 'history is written by the victors,' fisheries were written into regulatory structures in terms of the species sold at market, not the species that were discarded along the way. Furthermore, in Alaskan fisheries the agencies that seized management control of those marketable fisheries, in which they determine who gets to deliver those fish to market, and when, where, and how they get to catch them, have maintained that control, regardless of changes in political boundaries that would now assign management authority to a different governing body. Thus, the International Halibut Commission continues to

[14] Personal communication with, and archival data from, SeaShare, Inc. SeaShare is the organization that manages all prohibited species food bank donations in Alaska.

manage halibut, even though since its start in 1930 political boundaries have been established that situate halibut fishing within state and federal waters. Similarly, the State of Alaska continues to manage king crab fisheries (with federal oversight), regardless of the fact that aggregations of king crab are recurrently targeted in federal waters. Fisheries established after passage of the Magnuson-Stevens Act (MSA) in 1976, however, are managed based on the location of fishing effort relative to the state, federal, and international boundaries it established.

The disaggregation of catch into target species, bycatch, and prohibited species is a historical social construction imposed on current frontline operations that captains attempt to construct to align with current ecological patterns. Prohibited species regulations in the federal groundfish fisheries requires captains to disaggregate their catch by agency authority, and then discard those fish whose regulatory authority is not the same as the agency under which they are fishing (e.g., catching Chinook, which is managed by the State of Alaska in a pollock fishery, which is managed by the federal government).

But fish do not heed regulatory boundaries, nor do they behave differently based on which political entity is managing them. Fisheries tend to develop where species are known to recurrently aggregate to a profitable degree, but as the Western Gulf bycatch event demonstrated, species also aggregate where they are not recurrently targeted, resulting in large-scale bycatch events. And as less extreme/more regular bycatch patterns show, species are also caught as bycatch where they do not aggregate (i.e., are not swimming in schools). Species managed by the State of Alaska and the International Halibut Commission are caught along with federal trawl target species when they enact the similar action patterns that federally-managed target species do. Catching more than one species at a time is an unavoidable product of the necessary commercial fishing practice, grounded in sensemaking as chapters Two and Three demonstrate, of fishing based on the recurring action patterns of target species. Discarding certain non-target species caught as they are co-occurring with target species is an avoidable product of the historical construction of federal fisheries management in Alaska

Discarding prohibited species is a regulatorily-constructed solution to the regulatorily-constructed problem of species encountered together at sea and but managed by separate agencies on land. Yet, the regulatory construction of both the prohibited species problem and discard solution appears to be little recognized in the literature. For example, Bellido et al. (2011: 318), in an article on discarding on a global scale, characterize all discarding as discretionary:

"Discarding involves a conscious decision made by fishers to reject some part of the catch." Similarly, Kelleher (2005: 56) states that "bad" discards "indicate undesirable fishing practices." The federal Alaskan prohibited species regulations, however, take discarding decisions, as they relate to prohibited species, out of the hands of captains, predetermining the practice. My recommendation is derived from the alternative perspective that bad discards indicate undesirable fishery regulations, which lead to undesirable fishing practices.

c. The problem with discards

Discarding has been shown to have primarily negative ecological and entirely negative economic impacts. In terms of ecological impacts, while discarding has been shown to have a positive influence on bird populations (Cook, 2001), it has been shown to disrupt food chains and create pollution (Murawski, 1996) which can lead to localized anaerobic conditions (Chapman, 1981). Further, Diamond and Beukers-Stewert (2011) found that a Norwegian ban on discarding in the Northeast Arctic is associated with increases of stocks and economic performance of cod, haddock, saithe, and herring fisheries. Yet, as Kelleher (2005: 69) states, many ecological impacts remain unquantified.

While the ecological soundness of discarding is unclear, scholars are largely in agreement that discarding is economically unsound (Alverson, Freeburg, Murawski, & Pope, 1996; Branch, Rutherford, & Hilborn, 2006; Diamond & Beukers-Stewart, 2011; Patrick & Benaka, 2013; Pascoe, 1997;). Scholars discuss both the loss of the value of the discarded catch that could be sold at market and the relationship between discarding and foregone potential catch. Foregone potential catch is an outcome of early fisheries closures triggered by reaching catch limits attached to discarded species. Early fisheries closures results in foregone target catch. These two economic issues, however, are distinct. The wastage of caught fish that has economic value has its own economic costs in terms the loss of income from caught fish, regardless if any catch limit is triggered. The trigger limit is a separate regulation to the one that requires certain species be discarded. Thus, captains could reach a limit that triggers fisheries closures, even if they were not required to discard, and waste, those fish.

d. Solving the discard problem: Aligning levels of abstraction

Discarding salable fish is antithetical to catching fish. During my field research, Gulf trawl captains lamented, on multiple occasions, having to discard fish. Multiple captains suggested "full retention" as the solution to the bycatch problem. Similarly, according to Kelleher (2005: 60), "Discard bans have wide support among fishers if they are applied in a fair and pragmatic manner." And as Bratton (2000: 2) describes in her study of two commercial fisheries, "This author and her students, in a series of interviews of both commercial fishers and charter fishers, on the Pacific coast of the US and in Ireland, found that fishers dislike waste of any commercial species, and protest regulations which force them to toss edible catch overboard." In my research, and in my experience working as a commercial fisheries observer, I do not recall encountering a captain who expressed pleasure in dumping salable or edible fish overboard, and I do recall several captains expressing displeasure. My proposed solution, admittedly ambitious, is aimed at creating a better fit between the level at which regulators make sense of frontline fishing operations and impose regulations (the species-level) and the level at which fishing captains make sense of natural systems and extract catch (the action pattern-level). These are two different levels of abstraction, and the species-level is, perhaps counterintuitively, more abstract, i.e., less concrete, than the action pattern-level is.

Due to the prospective indeterminacy of marine systems, captains fish according to certain behavioral traits related to schooling, or what I have called recurring action patterns. Using past experience, their own or another's, and the co-incidence of other natural factors (e.g., weather, the structure of the ocean bottom), captains hypothesize that certain patterns of activity are being enacted by certain species. Yet, as suggested by bycatch lightning strikes, captains may increase the intelligence of their conjectures, but they will never really know until they tow. Until captains are afforded perfect information regarding the natural systems they are extracting fish from, which would allow captains to construct rational decision-making processes at sea, there will always be bycatch. A sensemaking view of at-sea operations makes it clear that although captains act their way into understanding the natural system they were interacting with, after which they have the opportunity to adjust their actions to act their way into different interactions, captains still encounter unexpected catch. Captains attempt to increase their abductive capacity, but they ultimately never know until they tow. Perfect information about natural systems is unattainable at sea, which is the reason sensemaking is a core component of commercial trawl fishing. Captains can increase the plausibility of their stories, and the intelligence of their guesses of what's next, but they cannot create determinacy before they tow. Chapters Two, Three, and Four demonstrated this aspect of the art of commercial trawl fishing.

The catch captains extract, however, does allow for retrospective determinacy. Captains can know the species composition of what they were towing after they have towed (though as described in Chapter Four, in pollock fisheries this knowledge is not always easily attainable). As do regulators, for it is the determined species composition of catch that is the primary input from frontline fishing operations into regulatory processes. Due to these determinate inputs, regulators construct their rational decision-making action pattern with an understanding of the species that captains were catching, and then attempt to predetermine the maximum amounts of certain species that captains will catch in the future. In other words, regulators, based on retrospective species-level catch information, and through their own rationality-based action patterns, attempt to determine their own species-level inputs.

As Chapter Four demonstrated, regulators interject species-level regulations, in the form of target species quotas and prohibited species bycatch limits, into action pattern-level operations. Regulatory inputs force captains to operate at the species-level, but the indeterminacy of marine systems forces captains to operate at the action pattern-level. The species and action pattern levels are different levels of abstraction from natural systems. And because more than one species can display the same action patterns, yet only one species can be one species, the species level is more abstract than the action pattern level is. This understanding of abstraction is explained in section b.iii. Captains are required to reconcile the level of abstraction at which they determine where and from what to fish, the action pattern-level, with the regulatory level of abstraction, which is the species-level.

If regulations were constructed at the same level of abstraction that fishing operates, the Western Gulf extreme bycatch event would not have been a bycatch event at all. Rather, it simply would have been a catch event in which two predominant species were enacting the same action patterns. Conversely, if captains operated at the same level of abstraction that on-land regulators operate, i.e., the species level, the Western Gulf extreme bycatch event again would not have been a bycatch event. Rather, it would have been a pollock catch event, for captains would have been able to differentiate pollock from Chinook prior to extracting fish. Discarding would not be necessary if captains knew what they were interacting with and could separate it into different species before they towed. When regulations impose one level of abstraction from natural systems on practice that operates at another level, incongruence may emerge. This incongruence is a system-level creation, which the Western Gulf extreme bycatch exemplifies.

Alternatively, when each part of the frontline system (natural systems, operational processes, and regulatory structures) operates at the same level of abstraction, congruence is achieved. But, as Chapter Three demonstrated, operating at the species-level in the enacted sonar environment of a fishing trip is not possible. Captains, operating from their enacted trawl-deck environment may be able to react to the species-level composition of their catch, perhaps fishing differently in the same spot or moving to a different spot, but they still encounter lightning strikes. They still fish at the action pattern-level. They never know until they tow. Absent technology for prospectively differentiating target species from other species,[15] captains must operate at the action pattern level, even if catch can retrospectively be differentiated at the species level.

As Chapter Four also demonstrated, regulators recognize the incongruence between species level regulations and action pattern operations, and take a two-pronged approach to resolving it. The first prong is a prospective means, in which regulators use incentives to encourage abductive sensemaking at sea. The goal is for captains, using their own and others' past experiences, to create informed conjectures about the species-level differentiations of the natural systems they are interrelating with. In other words, to guess intelligently before they tow, even if they still only know for sure after they tow. Yet, because natural systems at sea are indeterminate, and because multiple species can enact similar action patterns, incongruence cannot be fully resolved through abductive sensemaking. Even when the Council enacts catch share structures, as they are planning to do for Gulf trawl fisheries, which afford captains much more flexibly in terms of when and where they fish, as well as how much they communicate when they fish, captains still never know until they tow. Under catch share regimes, captains may be better able to update their action patterns in response to bycatch, or they may be better

[15] Prohibited species excluder technology is a method of prospectively differentiating target species and prohibited species based on behavioral and biological characteristics. Alaskan trawl fisheries have designed and tested halibut and salmon excluders, which are sewn into trawl nets. In the Gulf trawl fisheries, halibut excluders are currently being used, and salmon excluders are currently being tested. Halibut excluders allow halibut to escape in cod and sole fisheries. Salmon excluders are used in pollock fisheries. Salmon excluders have been shown to reduce Chinook salmon catch by 25 - 40% on Bering Sea trawl vessels, which tend to be larger and more powerful than Gulf trawl vessels (Gauvin, 2012), and halibut excluders have been shown to reduce halibut in the Gulf trawl vessels by 86% (Rose, n.d.). But because not all captains use excluders (several captains who participated in this study expressed a dislike for halibut excluders, and many expressed a distrust of the untested salmon excluder), and because excluders do not exclude all fish of a certain species, prohibited species catch is unavoidable, and limits are necessary.

able to conduct ‘test tows’ to get an idea of the species composition of the aggregation they are interacting with before the conduct a full tow. But they will still face an efficiency imperative due to fuel costs, other overhead costs, and the need to return caught fish to the processing plant in order to maintain freshness. Thus, captains will still attempt to enact an efficient fishing process in order to increase their profitability. They will never be able to know with certainty before they tow, and they will alway attempt to fish efficiently, which means they will not always take the time to know as much as they can before they tow. Trawl captains will always catch multiple species enacting similar action patterns, which is why catch share regimes still have prohibited species catch limits..

Therefore, the second prong of the Council’s approach to resolving the incongruence created by merging different levels of abstraction is requiring, or incentivizing, the discarding of certain species from the catch so that captains do not bring them to market. Discarding is a retrospective means of matching the level of abstraction from at-sea operations to the level of abstraction from on-land regulations. Discarding may solve the problem in which captains catch fish whose management is ‘owned’ by other agencies, but it creates its own issues when discarding involves “bad” discards. It is the ecological and economic issues that discarding creates, in the interest of solving a regulatorily-constructed problem, which makes it a perverse management tool.

The discarding approach to creating retrospective congruence favors maintaining historically-created management authorities over creating congruence with current ecological realities. My recommendation is that rather than imposing history on the present at a potential ecological cost and an actual loss of economic potential, regulations should allow the present to determine the present. As sensemaking at-sea processes tell us, catching fish ancillary to the species one is targeting is unavoidable. But requiring and incentivizing its waste is avoidable. If we constructed fisheries management structures anew today, it is difficult to imagine that the system would divide the management of species that are caught together into different agencies, and further require that those species ‘belonging’ to one agency be discarded when caught under the authority of another agency. Fisheries should be managed based on current ecological and economic realities, not historical management authorities.

The interaction pattern, which is the regulatory-shaped, sensemaking-accomplished conjoining of natural and operational action patterns, is the actual underlying structure of a fishery, and should play a central role in fisheries management regimes. I recommend the interaction pattern as the basic unit of fisheries management. But fisheries management scholars, deeply committed rational choice frameworks, see entities, rather than processes of interaction, as the basic units of management. For example, eminent fisheries management scholar Ray Hilborn argues, "We don't manage fish, we manage people" (2007). This proposed shift in emphasis is a move in the right direction, but it goes too far. It suffers from the same assumption that supported the outdated notion, according to Hilborn, that managing fisheries is managing fish. This is the assumption that we manage separate systems. Hilborn overlooks perhaps the most important entity in his consideration of the entities that we may or may not manage: the recurring interrelated patterns of action that mutually define both fish and fishers. In other words, frontline interaction patterns.

My (working) solution to the discard problem is to begin to interject rules which allow fisheries to be constructed from the ground up, as well as from the top-down. This construction starts at the natural end of the spectrum from humans to nature, with fisheries science-based assessments of fish populations, from which species-level fishing quotas are derived. Thus, we maintain quota-based management for both target and bycatch species. From there the system moves into the overlap of natural systems and fishing operations, i.e., at-sea interaction patterns. Because it is the nature of multiple species to enact similar action patterns, and because captains fish for these action patterns, fishing activity should be regulated according to recurring interaction patterns of multiple fish species and fishing operations (in addition to regulating based on fish populations). Therefore, when captains, fishing for certain species, continually encounter other species that are enacting the action patterns as the target species that captains are fishing for, captains must keep those species and deliver them for sale (unless, of course, catch may be turned into good discards). My recommendation allows good discarding and disallows bad discarding. Nothing salable should be discarded at sea or wasted by a processing plant. This includes retaining non-target, 'trash' fish for fishmeal.

As long as captains do not exceed a limit they are fishing under, be it target or bycatch limit, they sell all that they catch. Which means that processing plants buy all that they are delivered. Outside of at-sea operations, this regime would force processing plants to adapt to receiving multiple species at a time, such as being more entrepreneurial in developing markets for fish that are currently discarded. There have been multiple instances in which new markets have been developed for species that was ‘trash fish’, such as spiny dogfish on the US east coast and skate wings in Alaska. There is also a current effort by a group of chefs called Chefs Collaborative to serve “Trash Fish Dinners.” These are dinners, held in different locations nationwide, in which eminent chefs introduce the public to fish for which markets have not been developed, and therefore are discarded by captains at sea or processing plants on land.

In terms of the potential issue of captains targeting non-target species that they are not licensed to target, quota amounts can be crafted in ways that incentivize captains to avoid certain species in favor of targeting another or other species - such as avoiding Chinook in favor of targeting pollock. These limits may be at the individual, group, or fleet levels. This approach is simply a matter of setting the limit for Chinook low relative to the amount of Chinook captains are likely to encounter when fishing for pollock. When captains reach their Chinook limit, but have not reached their pollock limit, they must stop fishing. Such an approach is already taken in Alaskan fisheries, as was exemplified in Chapter Four in terms of the Council creating a ‘hard cap.’ But in this case, the compensation captains get from selling salmon or halibut can help make up some of the difference of foregone target catch. Furthermore, there is enough monitoring through fisheries observers and satellite tracking that mangers would know if captains were operating outside of their normal fishing grounds in the interest of targeting non-target species.

Nature should not be wasted in the interest of maintaining ownership that has been determined by archaic political events. What a captain can keep and sell, rather, should emerge from the ground-up based on sensemaking at-sea, while being structured from the top-down based on rational decision-making on-land. This ‘no-discard regime’ is a mere sketch, or collection of principles, to be elaborated into a contextually appropriate fisheries management system, or to serve as guidance for altering current systems. Norway is an exemplar of the no discard regime, which, as Kelleher (2005: 61) describes in the following: “It is incumbent on a particular fishery to justify discards or show why they are unavoidable. Then, legislation may make allowance for such unavoidable discards, and agencies can examine means of reducing the discard, developing alternative fishing opportunities, or financing the phasing out of the wasteful fishing technologies.” Alaskan federal fisheries regulators, now that they understand the sensemaking processes through which captains catch fish, should construct regulatory regimes to accommodate and encourage those processes, while also recognizing the limitations of sensemaking at sea, rather than taking the simplistic approach of regulating according to how rational choice theory assumes captains *should* catch fish,

William Wordsworth's poem, *The Tables Turned*, which began this dissertation, captures the nature of sensemaking at sea as well as the larger approach to commercial fisheries management that I have been laboring to describe and justify. Captains make sense of the natural systems they interact with through day-in-and-day-out experimentation, trial and error, leaps of faith, and communication. The most successful Kodiak trawl captains, as one captain described, "are just uncanny. They have been fishing for a long, long time too. They know where to go, they know what to look for, and they know how to make their gear work in any different situation to its utmost potential." Being a successful captain is not a rational decision making process, it is a sensemaking process. The abstractions imposed by those detached from the frontline create differentiations that do not exist in the concrete reality that captains encounter. They "dissect" in order to differentiate current nature into historical categories of who can reap value and who cannot, and what can be retained and what cannot. Such an approach "murders" in that it creates economic waste and ecological problems. Fisheries instead should be regulated to encourage and support the sensemaking processes through which captains gain an "uncanny" ability to operate in natural systems, while also constraining the rational processes through which captains may overuse natural systems.

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