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Managing Conflict and Compatibility of Use: A Case Study of Stakeholder Groups Associated with Blue Crabs (*Callinectes Sapidus*) in Coastal North Carolina

Leigh C. Habegger
University of Rhode Island, leighhabegger@gmail.com

MANAGING CONFLICT AND COMPATIBILITY OF USE: A CASE STUDY OF STAKEHOLDER GROUPS ASSOCIATED WITH BLUE CRABS (*CALLINECTES SAPIDUS*) IN COASTAL NORTH CAROLINA

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LEIGH C. HABEGGER

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LEIGH C. HABEGGER

APPROVED

Thesis Committee

Major Professor Tracey Dalton

Richard Burroughs

Kathleen Castro

Nassar H. Zawia
DEAN OF THE GRADUATE SCHOOL

ABSTRACT

Coastal zone management has become an increasingly important topic as coastal populations continue to grow and the numerous ocean and coastal uses associated with coastal development exert tremendous pressure on the marine environment and its resources. Marine spatial planning (MSP) is a process that can help direct when and where multiple coastal activities take place, and can also make areas of conflicting and compatible uses more visible to fisheries and coastal managers.

Stakeholders in North Carolina are concerned about the sustainability of the economically and culturally significant blue crab fishery after significantly reduced landings during the late 1990s and early 2000s. Managers are currently exploring the relationships among stakeholder groups whose activities impact the blue crab including navigational dredgers, shrimp trawlers, commercial crab and oyster dredgers, and blue crab potters. Identifying conflicting interactions between blue crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging may improve management and add valuable information to marine spatial planning efforts in North Carolina's coastal zone.

Through 25 semi-structured interviews with fishermen (blue crab potters, shrimp trawlers, commercial crab and oyster dredgers), fisheries and coastal managers, and Army Corps of Engineers' staff in cities and towns along the coast of North Carolina, this study examines how these stakeholder groups perceive crab potting to interact with navigational dredging, shrimp trawling, and commercial crab and oyster

dredging, and the drivers of these interactions. Interviews were transcribed and then coded for the types of interactions and drivers of these interactions. Ten different types of interactions emerged in the interviews including: spatial, temporal, gear, benthic, water quality, biological, knowledge, traditional use, environmental conditions, and mutual respect. Subsequently, frequency of compatible and conflicting interactions mentioned by the respondents were analyzed to understand the perceptions of the stakeholder groups. Additionally a variety of drivers emerged during the interviews as respondents discussed particular activity pairs. The frequencies of mentions for the different drivers were analyzed to see which ones seemed to most heavily influence the interactions between activities.

The results indicate that respondents perceive crab potting as generally compatible with navigational dredging, shrimp trawling, and commercial crab and oyster dredging. Respondents also discussed compatibility-related drivers more frequently than conflict-related drivers for crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging. It appears that regional and demographic characteristics may influence fishermen's perceptions of how crab potting interacts with other activities. Also, fishermen and managers seem to have differing perceptions of how crab potting interacts with shrimp trawling. The managers do not seem to be aware of the informal arrangements that exist between crab potters and shrimp trawlers. Furthermore, the fishermen interviewed in this study frequently noted that mutual respect between fishermen facilitates interactions between crab potting and shrimp trawling more than fisheries regulations do. Lastly, results suggested that there is a lack of communication amongst the four stakeholder

groups. A better understanding of how these stakeholder groups interact and what drives the interactions among them will help managers develop appropriate regulations and policies to ensure the sustainability of the blue crab fishery in North Carolina and conservation of the coastal zone.

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CHAPTER 1

INTRODUCTION

In North Carolina, significantly reduced landings of the economically and culturally important blue crab (*Callinectes sapidus*) in the past 15 years have caused industry concern and managers have identified the need for more research on the human activities that could be impacting the blue crab population (Deaton et al. 2010). In particular, managers are working to understand the interactions between bottom disturbing activities and the blue crab, and are exploring the relationships among stakeholder groups whose activities impact the blue crab including navigational dredgers, shrimp trawlers, commercial crab and oyster dredgers, and blue crab potters. Bottom disturbing activities (e.g. navigational dredging, shrimp trawling, commercial crab and oyster dredging) have the potential to disrupt or destroy benthic habitat that may be used by blue crabs throughout their life cycle, yet there is little research identifying if these activities conflict with blue crab potting within North Carolina's coastal zone. Because these different activities have the potential to overlap in time and/or space and impact the each other, it is important to understand the interactions and relationships amongst these different activities. By doing so, managers can develop more sound policies and valuable information will be provided for improved marine spatial planning efforts in North Carolina's coastal and marine environments (Douvere, 2008; Halpern et al. 2008; Brody et al. 2004; Brody et al. 2006).

Because too often the social landscape is excluded when conducting marine spatial analyses and remains a "missing layer" in decision-making (St. Martin and

Hall-Arber, 2008), this research project focused on understanding how different stakeholder groups (fishermen from Northern and Southern regions in coastal North Carolina, coastal and fisheries managers, Army Corps of Engineers' staff) perceive the interactions between blue crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging. The objectives of this research are to:

1) *Identify the conflicts and compatibilities that exist between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging, and how the perceptions of these conflicts and compatibilities vary among fishermen, managers, and the Army Corps of Engineers staff members;*

2) *Identify the drivers of conflict and compatibilities between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging, and how the perceptions of these drivers vary among fishermen, managers, and the Army Corps of Engineers staff members.*

A better understanding of how these stakeholder groups interact and what drives the conflicts and compatibilities that exist among them will help managers develop appropriate regulations and policies to ensure the sustainability of the blue crab fishery as well as the conservation of the coastal zone.

Chapter 2 presents background information on fisheries and coastal management in North Carolina, blue crabs, and the management of the blue crab fishery. Chapter 3 presents methods for data collection and analysis. Chapter 4 provides results. Chapter 5 discusses key findings and highlights management implications and potential areas for further research, and Chapter 6 presents conclusions.

CHAPTER 2

BACKGROUND

In this chapter, I discuss important aspects of this thesis: (1) fisheries and coastal management, (2) basic characteristics of blue crabs, (3) the North Carolina blue crab fishery, (4) potential impacts to the blue crab fishery, and (5) the North Carolina blue crab Fishery Management Plan. While these topics are interrelated, they are discussed in separate sections in order to provide the background information necessary to understand their connection to each other and to help understand the research that was conducted. This chapter will provide some insight regarding the challenges associated with coastal zone and fisheries management regarding the blue crab in North Carolina.

2.1 FISHERIES AND COASTAL MANAGEMENT

2.1.1 THE COASTAL ZONE MANAGEMENT ACT OF 1972

In response to the growing national concern for coastal zone degradation and fueled by the environmental movement of the 1960s and 1970s, Congress passed the Coastal Zone Management Act (CZMA) in 1972. The purpose of the CZMA, as stated in Section 303, is "to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations" (16 U.S.C. 1452). This landmark piece of legislation established a voluntary national program within the Department of Commerce to encourage and aid states in developing coastal zone management programs that address coastal zone

threats and pressures. States wishing to participate in this partnership must develop a coastal zone management program that is subsequently approved by the federal government in order for the state to receive any federal funds or assistance.

Currently, 34 of the possible 35 coastal states participate under this Act. Each of these states has a federally approved coastal zone management plan that defines their coastal zone, identifies activities and uses within the area that will be regulated by the State, the way in which these uses would be managed, and the broad guidelines for priorities of uses within the coastal zone (FWS, 2012).

2.1.2 NORTH CAROLINA FISHERIES AND COASTAL MANAGEMENT

North Carolina's coastal and fisheries regulatory departments fall within its Department of Environment and Natural Resources (NCDENR). This umbrella department, authorized by North Carolina General Statute 113-128.3, contains many departments and divisions responsible for implementing a variety of programs, including North Carolina's Coastal Zone Management Program and fisheries management.

2.1.2.1 North Carolina Coastal Management Program (NCCMP)

North Carolina's Coastal Management Program (NCCMP) was approved by the federal government in 1978 and is administered by North Carolina's Division of Coastal Management (DCM). DCM works to "protect, conserve and manage North Carolina's coastal resources through an integrated program of planning, permitting, education, and research" (Final Assessment and Strategy of the NCCMP, 2011). A

variety of resource management laws and regulations, state policies, and Governor's Executive Orders, as well as the Coastal Area Management Act (CAMA), comprise the NCCMP (Kennedy, 2006). The major activities of the NCCMP include permitting and enforcement, federal consistency, land use planning, the North Carolina Coastal Reserve System, waterfront access sites, and the Clean Marine Program (Moye, *Coastal Wetland Regulations*).

In addition to administering the North Carolina Coastal Zone Management program in the 20 coastal counties, DCM works to carry out North Carolina's Coastal Area Management Act (CAMA) and the Dredge and Fill Act. The CAMA is a piece of legislation that strives to balance coastal development with environmental protection through permitting (CAMA Rules, 2009). The Dredge and Fill Act governs the dredging and filling of the coastal waters along North Carolina (CAMA Rules, 2009). The Coastal Resources Commission, a regulatory body created in 1974 when the North Carolina General Assembly adopted the Coastal Area Management Act (CAMA), establishes policies for the NCCMP and develops and adopts regulations for CAMA and the Dredge and Fill Act (NCDCM, 2007). DCM staff serves as staff to the CRC (Final Assessment and Strategy of the NCCMP, 2011).

2.1.2.2 North Carolina Division of Marine Fisheries (NCDMF)

The North Carolina Division of Marine Fisheries (NCDMF), in conjunction with the North Carolina Marine Fisheries Commission (NCMFC), is specifically responsible for the stewardship of marine and estuarine resources within state waters extending up to three miles offshore (NCDMF, Homepage). Their mission is to

"ensure sustainable marine and estuarine fisheries and habitats for the benefit and health of the people of North Carolina" (NCDMF, Homepage). In addition to managing state fisheries, this division conducts fisheries research, implements habitat restoration projects, issues licenses and permits for commercial and recreational fishermen, enforces management rules and regulations, and provides public information and education. Currently, there are nine sections of NCDMF that collectively help to implement their mandates of managing commercial and recreational fisheries in North Carolina (NCDMF, Homepage). The Secretary of the Department of Environment and Natural Resources (NCDENR) and the Marine Fisheries Council establishes NCDMF policies and regulations.

2.1.2.3 North Carolina Marine Fisheries Council (NCMFC)

The NCMFC was re-authorized in the Fisheries Reform Act of 1997 (S.L. 1997-400 Section 143B-289.21). This Reform Act focuses on ensuring healthy fish stocks, the recovery of depleted fish stocks, and the wise use of North Carolina's fisheries resources. Additionally, this Act focused on five areas of reform: licensing policies, the Marine Fisheries Commission, Fishery Management Plans, Coastal Habitat Protection Plans, and law enforcement. Specifically, one of the NCMFC's duties is to develop rules and policies "to manage, restore, develop, cultivate, conserve, protect, and regulate the marine and estuarine resources within its jurisdiction" (S.L. 1997-400 Section 143B-289.21). Furthermore, the NCMFC is charged with "authorizing, licensing, regulating, prohibiting, prescribing, or restricting all forms of marine and estuarine resources in coastal fishing waters with respect to:

a. Time, place, character or dimensions of any methods of equipment that may be employed in taking fish;
b. Seasons for taking fish;
c. Size limits on and maximum quantities of fish that may be taken, possessed, bailed to another, transported, bought, sold, or given away" (S.L. 1997-400 Section 143B-289.22).

The NCMFC is also responsible for adopting Fishery Management Plans (FMPs) for all species within state marine or estuarine waters that are commercially and recreationally significant (NCDMF, Fisheries Management Plans Details). These FMPs are adopted by the NCMFC in order of priority and each plan contains the following information: 1) pertinent information for the fishery (e.g. management goals, current status of the stocks, any environmental considerations, social and economic impacts of the fishery, and any user conflicts); 2) management recommendation actions for the fishery; 3) conservation and management measures that will provide the greatest benefit to the fishery and the State; and 4) specifies the time period, not exceeding 10 years from the date of the adoption of the plan, for ending overfishing (NCDMF, Fisheries Management Plans Details).

2.2 USER CONFLICT AND MARINE SPATIAL PLANNING

2.2.1 USER CONFLICT AND ECOSYSTEM-BASED MANAGEMENT

Conflict arises when "the interests of two or more parties clash and at least one of the parties seeks to assert its interests at the expense of another party's interests" (FAO, 1998) and generally has a negative connotation. However, conflict can act as a catalyst for positive social change (Warner, 2000) by concentrating attention on something that needs to change (Bennett et al., 2001). It is necessary to understand the sources and drivers of conflict in order to develop ways to manage and resolve

conflict through cooperative means (Hirsch et al., 1999). Natural resource conflict generally emerges because resources are embedded in an environment where resources are inextricably linked and actions by one user affect others' ability to utilize the resource. Additionally, natural resources exist within social systems that have complex and unequal relations, they are subject to increasing exploitation and scarcity, and they are often symbolic of cultures and peoples (Buckles and Rusnak, 1999).

Conflicts revolving around natural resources can be organized into a framework that includes resource use drivers, user group drivers, and institutional structure drivers (Figure 1). Resource use characteristics that can drive conflict include competitive/multiple uses (Cicin-Sain and Knecht, 1998), poorly defined rights and responsibilities (Burroughs, 2011), and habitat quality (Talaue-McManus et al., 1999). The user group drivers include user group relationships (Buckles and Rusnak, 1999), values and interests (Burroughs, 2011), and knowledge and interpretation of facts (Bruckmeier, 2005). Lastly, the institutional structure characteristics that contribute to conflict include fragmented and uncoordinated regulatory structure (Burroughs, 2011), unclear or discriminatory regulations (FAO, 2000; Buckles and Rusnack, 1999), and poor implementation and enforcement (FAO, 2000; Brown et al., 2002).

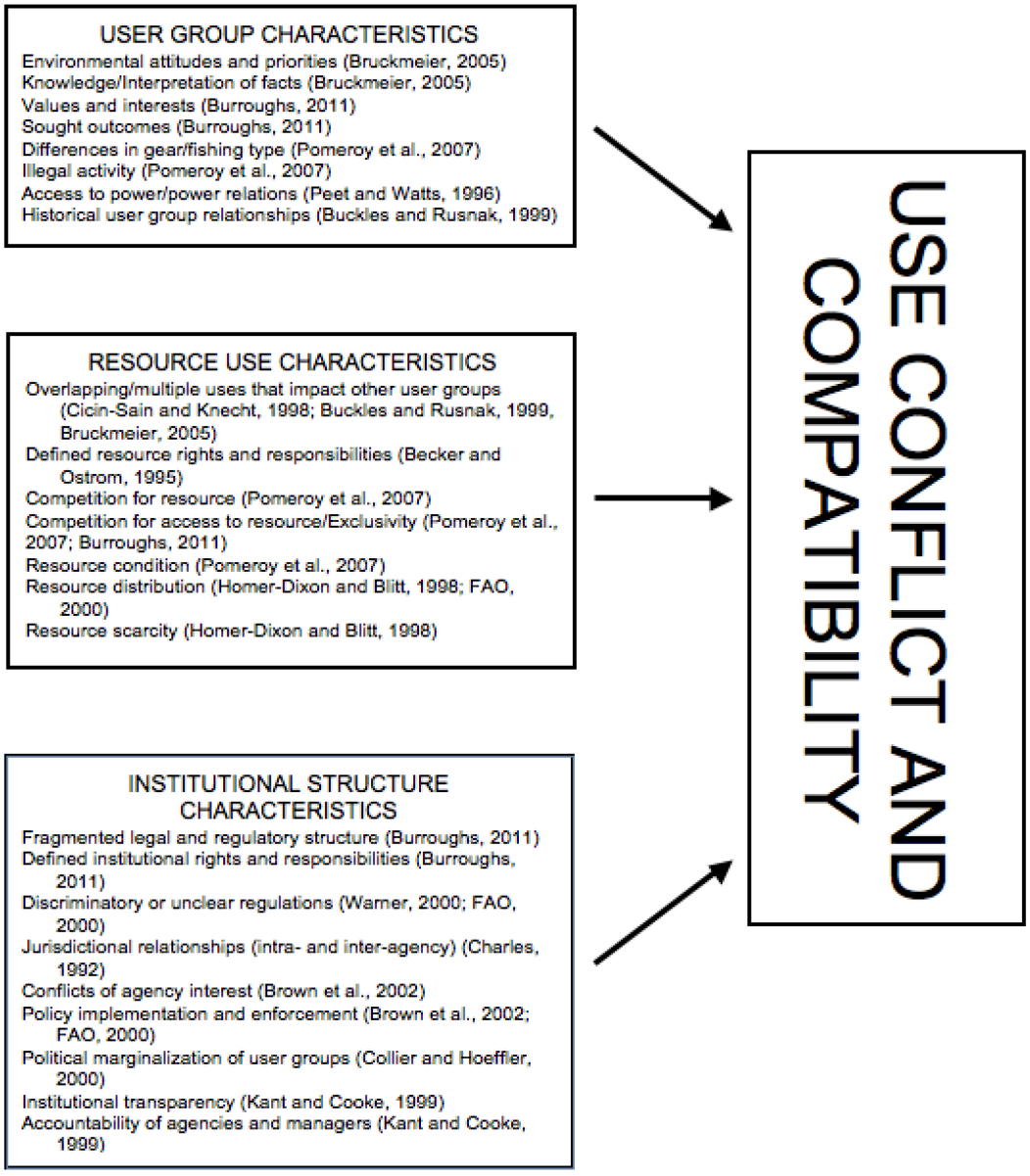

Figure 1. Analytical framework of drivers of use conflict and compatibility.

2.2.2 MANAGEMENT APPROACHES FOR ADDRESSING CONFLICTS AND COMPATIBILITIES

As coastal populations continue to grow, ocean and coastal uses also increase in number and frequency and can create areas of multiple uses. In fact, in some areas of the world, the demands for human use of ocean space have actually exceeded three times the available space (Maes et al., 2005; Barry et al., 2003). Furthermore, these demands and uses are not always compatible and if they overlap, these different activities can create conflict amongst stakeholder groups (Cicin-Sain and Knecht, 1998). As terrestrial resources and space become increasingly limited, coastal and marine environments are being used more often for food and energy, further exacerbating conflicts arising in areas of multiple uses (Berkes et al., 2006). To help manage multiple objectives for a single area and the potential conflicts, managers have turned to a more integrated approach to coastal management to help improve management and conservation efforts (Douvere, 2008).

The idea of integrated management has a long history in the U.S., originating in the 1930s (Misund, 2006). Today, the concept has morphed into the ecosystem-based management (EBM) approach which is founded on the principle that nature itself is integrated and to effectively manage an integrated system, managers should focus on the entire system, including humans, rather than managing on a sector-by-sector basis (McLeod et al., 2005).

2.2.3 MARINE SPATIAL PLANNING (MSP)

As the concept of EBM continues to evolve, managers have begun to incorporate comprehensive spatial planning and zoning practices to help improve their

policies and regulations. The idea of zoning and spatial planning first developed in terrestrial environments as the demand for land space increased yet available land space diminished. Spatial planning helped to mitigate conflicting terrestrial activities and effectively separate activities (Douvere, 2008).

However, because coastal and marine ecosystems extend from the ocean floor through the water column and to the ocean surface, they occur on wide and various scales, and they are primarily bounded by physical and biological features, applying the same spatial planning and zoning practices to these systems is more difficult (Crowder and Norse, 2008; Douvere, 2008). As a result, with few exceptions, comprehensive marine spatial plans for coastal and marine environments that outline a vision for future development and use do not exist (Douvere and Ehler, 2009). This does not mean that coastal and marine systems have not been managed; in fact, they have been managed for a number of years, but in a more sectoral manner. Marine cargo and shipping lanes, disposal areas, marine protected areas (MPAs), and individual marine species management all represent sector-based management (Young et al., 2007).

Unfortunately, sectoral management often leads to disjointed and ineffective management strategies. As a result, managers have begun to incorporate marine spatial planning (MSP) into their EBM strategies, which focuses on managing places and systems rather than sectors. Marine spatial planning has become an increasingly popular tool for managers because it can:

1) Address the heterogeneity of the marine ecosystem in a practical manner;
2) Focus on influencing the behavior of humans and their activities over time;
3) Provide a management framework for new and previously inaccessible scientific information;

4) Make conflicts and compatibilities among human uses visible and therefore more tangible; and
5) Guide single-sector management toward integrative decision-making. (Douvere, 2008).

MSP is a process that can help direct where and when human activities take place in the marine environment and can also make areas of conflicting and compatible uses more visible and tangible to managers (Halpern et al., 2008). By using MSP, managers are better able to see the "bigger picture" when trying to manage the multiple uses and activities occurring within marine space, especially in heavily used areas where there are conflicts between stakeholder groups and/or the environment (Douvere, 2008). MSP also allows for long-term planning in such a way that processes and activities within marine and coastal spaces become more transparent; this, in turn, results in improved permitting, planning, and allocation for developers, stakeholder groups, and coastal and fisheries managers (CoastNET, 2003).

2.3 BASIC CHARACTERISTICS OF THE BLUE CRAB (*CALLINECTES SAPIDUS*)

2.3.1 GENERAL CHARACTERISTICS

The blue crab, *Callinectes sapidus*, ranges as far north as Nova Scotia and Maine to as far south as northern Argentina, including Bermuda and the Antilles (Williams, 1974). There are seven species within the genus *Callinectes* with varying color and morphology that occur along the eastern and southern Atlantic seaboard (Williams, 1978).

2.3.2 LIFE HISTORY

The life history of *C. sapidus* includes three stages: larval (approximately 6 months), juvenile (approximately 12 months), and adult. A blue crab will undergo several molts throughout its lifetime in order to grow (Van Engel, 1958) and few blue crabs live more than 1 year after reaching maturity (Tagatz 1968).

Upon reaching sexual maturity, males will mate several times while females mate only once while in their soft shell stage (Dudley and Judy, 1973). Once mating has finished, the female crab will migrate back to higher salinity waters, such as inlets and along ocean beaches, to spawn (Dudley and Judy, 1973). Males will stay in upper estuary waters to mate with other females. This migration pattern has been observed in numerous areas along the eastern and southern Atlantic seaboard and was specifically documented in the Newport and White Oak Rivers in North Carolina by Judy and Dudley (1970).

Mating typically occurs in low salinity, shallow waters of rivers and sounds from late spring to early fall (Mense and Wenner, 1989). Spawning in North Carolina waters typically occurs from mid-March to October (Williams, 1971) with peak spawning in the Beaufort Inlet occurring from June to August (Dudley and Judy, 1971). In their larval stage, blue crabs live as plankton and will molt 6-8 times before transforming into megalopae (Costlow et al. 1959; Costlow and Bookhout, 1959). Studies have concluded that the greatest population of larval blue crabs occurs off the coast of North Carolina from June through August and the greatest population of megalopae occurs from September through November (Eggleston and Johnson, 2004). After about 30 days, the megalops and juveniles move back into the estuary by means

of a variety of episodic atmospheric events involving tidal shifts (Mense and Wenner, 1989).

Once juveniles return to estuarine waters, they settle in high salinity waters with vegetated areas (Pile, 1996). These areas provide predator protection as well as the necessary nutrients for growth. Between the third and fifth instar stage, juveniles will begin to disperse into less vegetated habitats and by the 9^{th} instar stage, most crabs are found in unvegetated habitats in varying salinities (Pile, 1996).

Because blue crabs require specific habitat during various phases of their life cycle, the loss or degradation of spawning, nursery, and molting areas, reduced deep-water habitat, and crowding in shallow habitat may have detrimental long-term impacts on blue crab populations. Habitat disrupting activities, including dredging may have significant but hard to measure impacts on crab populations (Steele and Perry, 1990).

2.4 THE NORTH CAROLINA BLUE CRAB FISHERY

The blue crab is a commercially and culturally significant marine resource found in North Carolina's coastal waters. Its significant decline in recent decades has caused industry concern about the sustainability of the stocks and created demands for improved stock management.

Fishermen involved in this fishery typically use crab pots but crab trawls and crab dredges are also types of gear used in the blue crab fishery. Crab pots are wire-mesh boxes that measure approximately 3 feet by 2 feet with funnel shaped openings designed to let crabs enter but prevent their escape. The crab trawl is a commercial

blue crab fishing gear that has bottom to mid-water nets with small mesh netting and doors. The netting size depends on the crab size that is being targeted (Draft NC BCFMP, 2011). The blue crab dredge is another commercial blue crab fishing gear that has large metal claws that dig into the mud to catch buried blue crabs during the wintertime (Henry, pers. comm.). The crab dredge is rarely used by commercial blue crabbers and can only be used in a small-designated area per North Carolina fish regulations (15A NCAC 03R .0109).

2.4.1 THE COMMERCIAL BLUE CRAB FISHERY

The blue crab fishery is the most valuable commercial fishery in terms of total landings, value, processing, participation, and employment in North Carolina (Henry and McKenna, 1998). Until 1993, North Carolina was ranked as the 3rd largest producer of blue crabs, accounting for 13% of the total blue crab harvest. However, from 1994 until 1999, NC was the top blue crab producing state, responsible for more than 24% of the total national harvest (Draft NC BCFMP, 2011). Since 1999, NC has been one of the top five blue crab producing states (Draft NC BCFMP, 2011).

Blue crab harvest is divided into three main categories: hard, peeler, and soft crabs. Hard crabs comprise the majority of landings, accounting for approximately 49 million pounds (M lbs) and an average dockside value of $33 million (NC BCFMP, 2004). Peeler crabs account for only 0.9 M lbs and soft crabs account for even less, 0.7 M lb (NC BCFMP, 2004). Of the 28 waterbodies in North Carolina where blue crabs are harvested, the Albemarle and Pamlico Sounds are the two largest producers of blue crabs, responsible for more than 55% of the total landings and value of blue

crabs in North Carolina (NC BCFMP, 2004). Blue crabs can be harvested throughout the year, but the majority of landings occur from May to October (Draft NC BCFMP, 2011).

2.4.2 THE RECREATIONAL BLUE CRAB FISHERY

The estimated blue crab harvest by recreational fishers accounts for less than 0.05% of the total blue crab catch for 2001 and 2002. Nobles et al. (2002) surveyed recreational crabbers in 2001 and estimated that total recreational blue crab catch was 118,050 pounds. In 2002, NC Division of Marine Fisheries (NCDMF) conducted a survey of all Recreational Commercial Gear License (RCGL) holders and reported that blue crabs accounted for 13% of total poundage harvested. From 2002-2008, it was estimated that recreational blue crab landings accounted for less than 1% of commercial harvest despite study results indicating that blue crabs were the most abundant species landed (by weight) by RCGL holders (Draft NC BCFMP, 2011). Based on these studies, it is unlikely that recreational blue crab landings are contributing to a decline in blue crab stocks off North Carolina's coast.

2.4.3 INDUSTRY TRENDS

Hard crabs account for approximately 97% of total blue crab landings. The percentage of hard blue crab commercial landings significantly increased from 1972 to 1998, with historically high landings in 1996-1998 (Figure 2). The industry saw a large decrease in blue crab landings from 1999 to 2001, followed by a slight rebound in 2002. Hard blue crab landings decreased again after 2002 with a slight rebound in

2009. The large decrease in crab landings after record high landings in 1996-1998 caused industry concern about the health and sustainability of the blue crab fishery. In 1996, blue crabs landings reached a record high with 65.7 million pounds. Landings have since fallen to approximately 20.6 million pounds in 2007 (Figure 2).

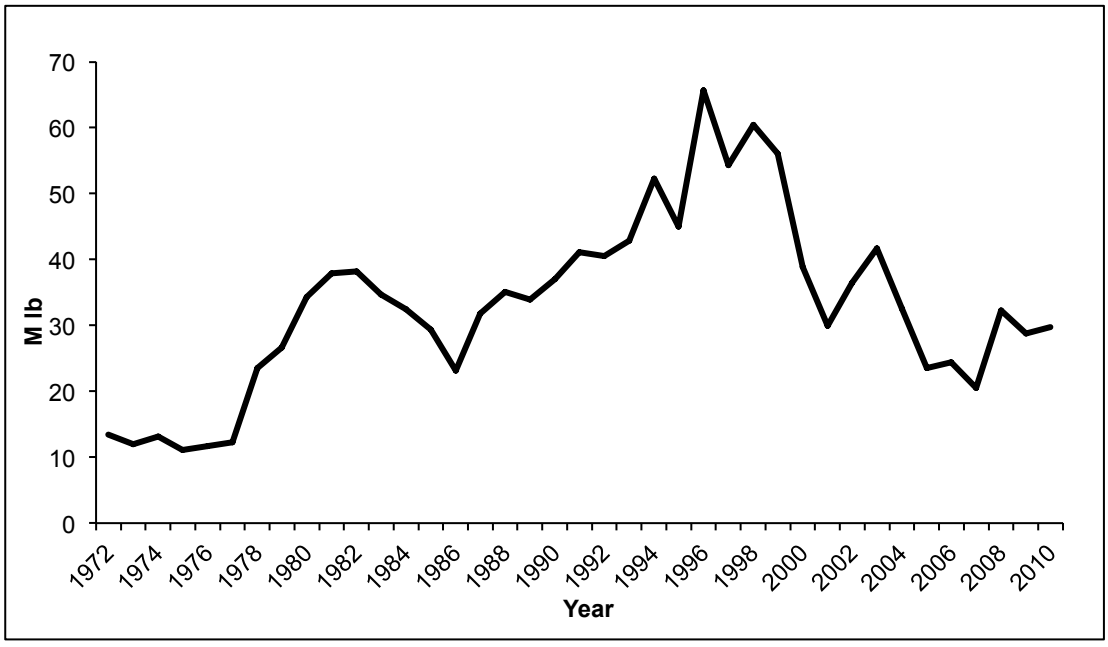

Figure 2. Annual hard blue crab landings from 1972-2010. Source: http://portal.ncdenr.org/web/mf/statistics/comstat

The peeler and soft blue crab industry makes up a much smaller percentage of the total annual blue crab catch. However, developments in this fishery, specifically on-shore shedding systems and the peeler pot, have encouraged steady growth in landings and value since the 1980s. The peeler pot increased its contributions to total shedder harvest (includes peeler and soft crabs) from approximately 4% in 1996 to 39% in 2002. The peeler and soft blue crab industry has seen similar declines as the hard crabs in recent years (Figure 3).

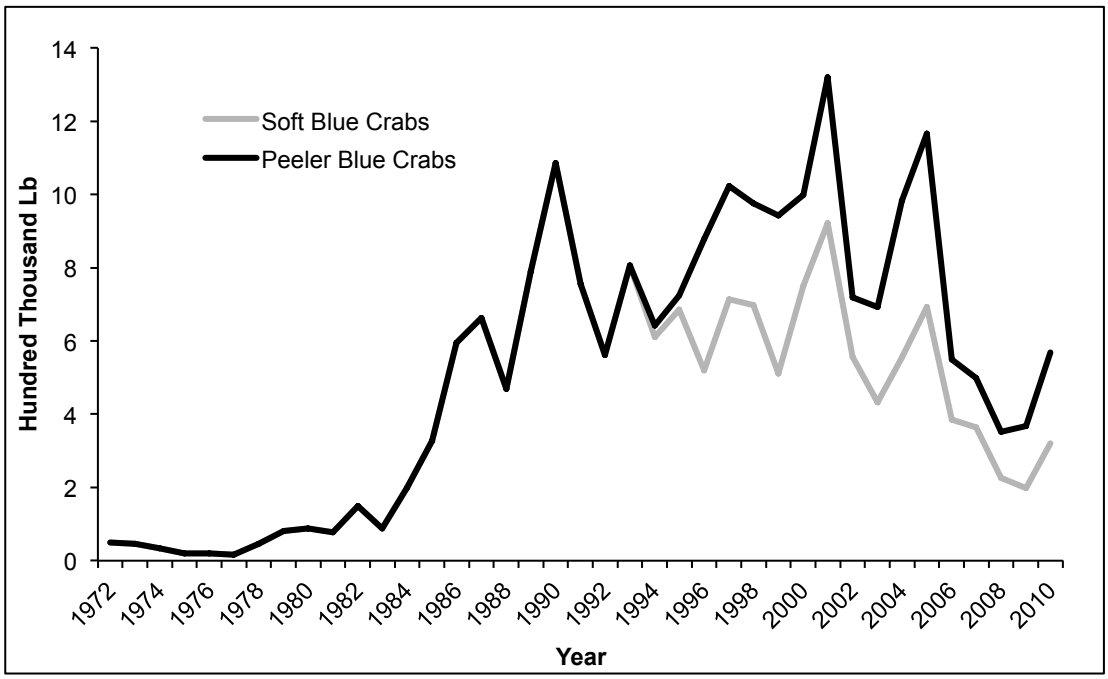

Figure 3. Annual soft and peeler blue crab landings from 1972-2010. In 1994, the trip ticket program was implemented, allowing for more precise data to be collected for each crab category, reflected in the graph where the two data sets diverge from the single black line in 1993. Source: http://portal.ncdenr.org/web/mf/statistics/comstat

2.5 IMPACTS TO THE BLUE CRAB FISHERY

Because blue crabs require specific habitat during various phases of their life cycle, the degradation or total loss of spawning, nursery, and molting areas, reduced deep-water habitat, and crowding in shallow habitats may have long-term impacts on crab populations. Habitat disrupting activities that impact the benthic environment, including dredging, may have significant but hard-to-measure impacts on blue crab populations (Steel and Perry, 1990).

2.5.1 NAVIGATIONAL DREDGING

The direct removal of blue crab habitat is the most obvious impact of dredging on the blue crab population. Dredging for navigational purposes, marinas, or

infrastructure can result in the loss of large tracts of submerged aquatic vegetation (SAV), a critical habitat for blue crab post-larval settlement and juvenile development, and overwintering (Heck and Orth, 1980; Wilson et al., 1990).

While more structured habitats such as marsh, wetland, SAV, and shell bottoms traditionally have a greater abundance of blue crabs, unstructured riverine and sub-tidal soft bottom habitats are also important habitat for blue crabs. Many studies have illustrated soft-bottom habitats' importance in providing refuge from wave energy and predation, overwintering habitat, while simultaneously providing blue crabs with sufficient levels of benthic prey (Grabowski et al. 2000; Thomas et al., 1990). Additionally, blue crabs often burrow in the sediment during winter months and may be killed by dredging activities during this time (Draft NC BCFMP 2011). It is thought that dredging for navigational purposes poses the greatest primary physical threat to this critical soft bottom habitat (Draft NC BCFMP 2011).

The indirect effects of dredging on blue crabs are primarily encountered in the water column. Water quality characteristics, such as salinity and turbidity, can affect the amount of suitable habitat for blue crabs. Salinity is a determining factor in the distribution of blue crabs and can be affected by freshwater discharge (Deaton et al. 2010). Dredging to widen or deepen a channel, or to create or alter an inlet can result in changes to the fresh- and saltwater flow regime, impacting blue crabs' life cycles and migration patterns (Steele and Perry, 1990). Additionally, an increase in turbidity due to suspended solids and sediments after a dredging event can result changes to many water quality characteristics including temperature, light penetration, and dissolved oxygen. Water temperature triggers blue crab spawning and turbidity can

decrease light penetration, reducing the productivity of SAV and thereby reducing suitable crab habitat (Deaton et al. 2010). Dissolved oxygen levels may also decrease as a result of a reduction in the photosynthetic-based primary production (SAV) (Darnell, 1976) and force blue crabs into shallow habitat and cause crowding and cannibalism (Selberg et al., 2001; Aumann et al., 2006).

2.5.2 COMMERCIAL FISHING: TRAWLING AND DREDGING

Trawls and dredges are also used as a form of fishing to catch benthic species such as clams, crabs, and oysters. These gears directly and indirectly disturb the benthic habitat as they are dragged across the seafloor. Direct effects include mortality, increased food availability, and loss of habitat. The indirect effects of these activities include the downstream consequences of these direct effects (NRC, 2002).

Trawling and dredging can reduce habitat complexity by removing erect and sessile epifauna, reducing benthic roughness and rugosity, and removing taxa that provide structure (NRC, 2002). Additionally, trawl gear may crush, bury, or expose benthic organisms and vegetation and further reduce habitat complexity (Auster and Langton, 1999). One study in Florida, for instance, implicated trawls and dredges in reducing tree corals of 1-2 m in diameter down to 2-3 cm rubble (Koenig et al., 2000).

Repeated trawling and dredging events may also visibly change benthic communities (NRC, 2002). A common response of benthic communities to increasing disturbance frequency and intensity is an increased number of small opportunistic species and juvenile life-history stages (Thrush et al., 1998). Commercial dredging pressure was found to be a significant factor in altering benthic community

composition and reduced echinoderm, polychaete, and mollusk densities anywhere from 10-65% (Bergman and Hup, 1992). Furthermore, infaunal abundances decreased by 20-30% following commercial scallop dredging (Currie and Parry, 1996)

Additionally, bottom trawling has been shown to reduce the productivity of benthic habitats by encouraging a shift to communities comprised of smaller, faster-growing species versus a community comprised of larger, slower-growing species that encourage benthic productivity and support predatory fish species (NRC, 2002). One study found a 75 percent decrease in total infaunal productivity between undisturbed and trawled plots (Jennings et al., 2001). Another found that, immediately after trawling disturbances, the number of species, the species abundances, and the benthic diversity decreased in the trawled area relative to the reference area (Sparks-McConkey and Watling, 2001).

Changes to the benthic habitat can result in changes in community structure, even to those species not directly targeted by the trawl or dredge. For instance, the juvenile life stage of some pelagic fish rely on benthic and demersal biomass. Any removal of this biomass could have detrimental impacts on the pelagic species (NRC, 2002).

The indirect effects of trawling and dredging often result from the direct effects and include changes in nutrient cycling in the system, changes to the community trophic structure, impacts to the naturally occurring ecosystem processes, and increased susceptibility to other stressors (NRC, 2002). Because trawls and dredges are types of gear that disturb the benthos, they can also change the sediment grain size distribution or characteristics, suspended sediment load, and the magnitude

of sediment transport processes (Churchill, 1989; Dyekjaer et al., 1995; Pilskaln et al., 1998; Riemann and Hoffman, 1991). Trawling and dredging may also resuspend and bury biologically recyclable organic material, altering the nutrient flow through the system (Mayer et al., 1991).

Recovery rates after dredging events vary depending on the type and extent of habitat alteration (Peterson et al., 1987; Stephan et al., 2000), the intensity and frequency of the disturbance (Odum, 1982; Auster and Langton, 1999; Emeis et al., 2001), the spatial scale of the disturbance (Thrush et al., 1998) and the physical characteristics of the habitat type (i.e. sediment type, hydrodynamics) (Collie et al., 2000; NRC, 2002). Recovery may also depend on the life histories of the organisms that inhabit the disturbed area. One study found that recovery time is generally one to five times the generation time of the organism (Emeis et al., 2001)

Dredging activities, both for commercial fishing and navigational purposes, can have significant impacts on the benthic habitats and water quality of aquatic environments and as such, it is important to understand how these impacts affect the life cycles and survivorship of the species inhabiting dredged areas. Specifically, the most recent North Carolina Coastal Habitat Protection Plan highlights the need for research on the impacts of dredging on blue crab populations (Deaton et al., 2010).

2.5.3 OTHER IMPACTS

In addition to dredging and other bottom disturbing fishing practices, there are other factors that may influence the perceptions of stakeholder groups concerning the blue crab fishery. The alarming rate at which blue crabs are declining may also be

attributable to overfishing, especially of spawning females, and nutrient pollution (CBF, 2008).

Some blame the overharvesting of blue crabs as the main factor contributing to the decline of the species in North Carolina. Biomass-based modeling to estimate relative biomass is often used to estimate if a stock is overfished; relative fishing mortality complements relative biomass estimates to determine if the overfishing of a stock is occurring. In his dissertation, Johnson modeled relative biomass and relative fishing mortality for North Carolina blue crabs in 2002 and found that the North Carolina blue crab stock is heavily exploited (Johnson, 2004).

In addition to low biomass levels and unsustainable levels of fishing, declining water quality has a large impact on blue crabs and their habitat. In their natural state, estuarine systems are well equipped to process and assimilate nutrients. However, when excess nutrients are added to the system, referred to as eutrophication, the estuaries become unbalanced and water quality declines, leading to a cascade of impacts affecting blue crab populations (Ernst, 2003). Eutrophic conditions encourage algal blooms which result in reduced oxygen levels in the estuary (Ernst, 2003). Reduced oxygen levels can cause crowding in some areas of the estuary, particularly near shores, as the blue crabs search for areas with enough oxygen (Bell et al., 2003).

Additionally, poor water quality can also affect blue crab habitat by reducing the amount of SAV. Nutrients, as well as any accompanying sediment or particles, can cloud estuarine waters, making it difficult for SAV to photosynthesize and survive (Ernst, 2003). This, in turn, can impact blue crab populations because blue crabs rely

heavily on SAV in their juvenile stage as foraging grounds as well as protective cover from predators (Orth and van Montfrans, 1987).

2.6 THE BLUE CRAB FISHERY MANAGEMENT PLAN

The NCMFC is responsible for developing a Fishery Management Plan for the state managed blue crab population in North Carolina. The main purpose of this FMP is to manage blue crabs in such a way that "conserves the stock, protects its ecological and economic value, and optimizes the long-term use of the resource" (Draft NC BCFMP, 2011). The FMP outlines seven objectives to help achieve these goals:

1) Utilize a management strategy that provides resource protection and sustainable harvest, promotes blue crab ecological and economic value, and provides opportunity for resource utilization, and considers the needs of all users;
2) Promote harvesting practices that minimize waste of the resource and environmental damage;
3) Promote the protection, restoration, and enhancement of habitats and environmental quality necessary for the perpetuation of the blue crab resource;
4) Maintain a clear distinction between conservation goals and allocation issues;
5) Minimize conflicts among and within user groups, including non-crabbing user groups;
6) Identify and promote research to improve the understanding and management of the blue crab resource;
7) Promote education and public information to help users understand the causes and nature of problems for blue crabs in North Carolina, its habitats and fisheries, and the rationale for efforts to address resource management. (Draft NC BCFMP, 2011).

2.6.1 MANAGEMENT PROBLEMS

The BCFMP also outlines five major management problems that need to be addressed in the North Carolina blue crab fishery to ensure its sustainability. First, the environmental issues such as water quality and submerged aquatic vegetation (SAV)

extent need to be addressed. Because blue crabs rely on specific habitats throughout their life cycles, these habitats need to be protected; the loss or degradation of these habitats is likely to have long-term negative impacts on crab populations (Draft NC BCFMP, 2011). Secondly, the blue crab stock needs protection. Generally, blue crab landings have decreased in the past decade, leading to multiple requests from various stakeholder groups to protect the remaining stock (Draft NC BCFMP, 2011). Third, the conflicts within the fishery due to the increasing number of pots need to be addressed. In recent years, the increasing number of crab pots in the water has led to more frequent and severe conflicts over fishing space between crab potters and other stakeholder groups, specifically other fisheries involving trawling and haul seining, and recreational users (Draft NC BCFMP, 2011). Fourth, the rules and regulations governing the blue crab fishery should be evaluated on a regular basis in order to determine if they are still relevant to fisheries management, clear to the public, and facilitate consistent enforcement (Draft NC BCFMP, 2011). Lastly, harvest practices should be evaluated to ensure they are effective and efficient. Wasteful and damaging fishing practices and gear associated with the blue crab fishery can have a negative impact on the resource and various parts of the fishery.

2.6.2 CONFLICTS AND COMPATIBILITIES AMONG ACTIVITIES ASSOCIATED WITH THE BLUE CRAB FISHERY IN NORTH CAROLINA

Managers are working to understand the conflicting and compatible interactions between bottom disturbing activities and the blue crab, and are exploring relationships among stakeholder groups whose activities may impact the blue crab including trawlers, commercial crab and oyster dredgers, blue crab potters, fisheries

and coastal managers, and staff at the Army Corps of Engineers who permit navigational dredging operations. Identifying areas where activities are compatible or conflicting can improve management and add valuable information to marine spatial planning efforts in the coastal zone (e.g. Douvere, 2008; Halpern et al. 2008; Brody et al. 2004; Brody et al. 2006). This research project aims to identify the conflicts and compatibilities that exist between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging, and the drivers of these interactions in order to provide pertinent information for improved marine spatial planning for North Carolina's coastal zone. The specific research questions that I will explore include:

1) *What are the conflicts and compatibilities between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging? How do the perceptions of conflicts and compatibilities vary among fishermen, managers, and the Army Corps of Engineers' staff?*

2) *What are the drivers of conflict and compatibility between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging? How do the perceptions of the drivers of conflict and compatibility vary among fishermen, managers, and Army Corps of Engineers' staff?*

I hypothesize that there are perceived conflicts and compatibilities that exist between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging. Additionally, I hypothesize that conflict will be driven by different or misaligned user group characteristics, overlapping or negative impacts of resource uses, and/or unclear or inefficient institutional structure characteristics. Compatibility will be driven by similar or aligned user group characteristics, little to no overlap or

impacts of resource uses, and/or clear and efficient institutional structure characteristics.

CHAPTER 3

METHODS

3.1 STUDY AREA

This study was conducted along the coast of North Carolina because little is known about (1) the interactions between blue crabs and bottom disturbing activities in this region and (2) the relationships among multiple stakeholder groups that have the potential to impact each other (Deaton et al., 2010). Interviews were conducted in June and July 2012 in Hyde, Dare, Pender, and New Hanover counties. These counties represented the Northern (Hyde and Dare counties) and Southern (Pender and New Hanover counties) fishing regions. I selected these regions because the Northern region straddles the Albemarle and Pamlico Sound where the majority of blue crabs in North Carolina are harvested (Draft NC BCFMP, 2011) and the Southern region experiences more frequent dredging as a result of the major port in Wilmington and the populated waterfront. These regions vary in size, population, coastal environments, and fishing methods (Table 1).

Table 1. Characteristics of each county where fishermen were interviewed. Fishermen interviewed in Hyde County are considered to be part of the northern region of the state while fishermen interviewed in New Hanover County are considered to be part of the southern region of NC. Source: U.S. Census Bureau, 2010

	Area (miles^2)	Pop	Typical Coastal Environment	Fishing methods	Primary industries	Income	% of Pop with Bachelor's degree
Hyde* (northern)	613	5822	Rural wetlands and sounds, low-lying farmland, rivers and creeks	Crabbing, trawling, dredging	Farming, fishing (16.9% employed in agriculture, forestry, fishing, hunting, and mining)	Median: $38, 265 Mean: $44,956	7.5%
New Hanover✦ (southern)	191	206,189	Developed beaches, urban and working waterfronts	Crabbing, trawling	Tourism (0.2% employed in agriculture, forestry, fishing, hunting, and mining)	Median: $48,553 Mean: $67,902	21.9%

* The two respondents in Dare County were just over the border in a fishing town that was more similar to the towns in Hyde County than to those in Dare County. Therefore, the characteristics of this town were grouped with Hyde County.

✦ The one respondent from Pender County was just over the border of New Hanover County and lived in a town that resembled the fishing community in New Hanover rather than the wider Pender County area. Therefore, the characteristics of this town were grouped with New Hanover County.

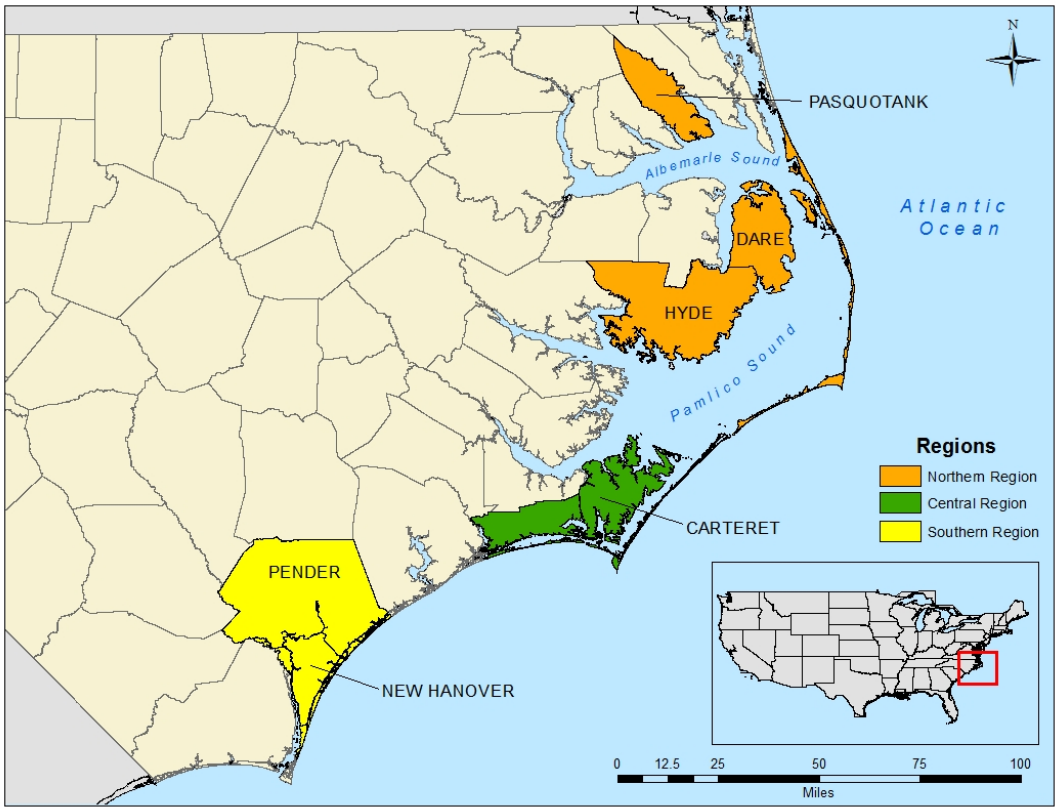

Figure 4. Coastal counties where study respondents were interviewed.

3.2 STUDY POPULATION

I conducted interviews in different parts of the state to capture the varying perspectives of stakeholders along the coast of NC. For the purposes of this research, I will use Beatley et al.'s definition of stakeholder: "major interest groups that seek to influence or are influenced by the allocation of coastal resources" (2002, pg. 96).

I conducted twenty-five semi-structured interviews concerning activities that impact *C. sapidus* with individuals in four different stakeholder categories: Northern fishermen, Southern fishermen, coastal and fisheries managers, and Army Corps of Engineers employees. I interviewed seventeen fishermen (13 Northern fishermen and four Southern fishermen), six managers (two coastal managers and four fisheries managers), and two individuals employed by the Army Corps of Engineers who permit dredging activities. These particular stakeholder groups were targeted because they are the ones most closely associated with the blue crab fishery.

I began by interviewing one or two individuals within each stakeholder group and then used the snowballing technique to identify additional respondents (Bernard, 2002). The snowballing technique simply involved asking respondents to suggest other likely candidates for my research (Bernard, 2002). I purposefully chose respondents from each stakeholder category who could provide pertinent information concerning my research and not necessarily respondents who represented the general population of coastal stakeholders in North Carolina. Although my results cannot be easily generalized to the wider population of North Carolina fishermen and managers, this purposive sampling allows for insights from a diverse yet relevant sample (Bernard, 2002).

3.3 INTERVIEWS

Semi-structured interviews were conducted with respondents in each of the user groups (Bernard, 2002). The interviews were designed to answer the following research questions:

1) *What are the conflicts and compatibilities between crab potting and navigational dredging, shrimp trawling, and commercial dredging? How do the perceptions of conflicts and compatibilities vary among fishermen, managers, and Army Corps of Engineers' staff?*

2) *What are the drivers of conflict and compatibility among crab potting and navigational dredging, shrimp trawling, and commercial dredging? How do the perceptions of the drivers of conflict and compatibility vary among fishermen, managers, and Army Corps of Engineers' staff?*

The interviews were conducted in English and ranged from approximately 10 minutes to 2 hours. Each interview consisted of two parts. The first part addressed the respondents' background and demographics. I asked six questions about their age, time in their profession, and further questions pertaining to their industry or job. The second part of the interview included sets of seven open-ended questions about the interactions of crab potting with different activities. Each interview was comprised of sets of seven questions. Each set included the same three questions that addressed the types of conflicts and compatibilities that exist between activities and what drives the conflict or compatibility (Table 2). I also asked four additional questions about stakeholders' perceptions of management measures but these responses are not included in this analysis because of time constraints and space considerations. The number of sets of questions asked varied depending on the number of relevant user group interactions for each respondent. The following table outlines the three interview questions and the research question that each was designed to answer.

Table 2. Three interview questions asked for each user group interaction. The interview questions are paired with the research question(s) that is addressed through the respondents' answers.

Interview Question	Research Question Addressed
1. Can you describe your relationship/interactions between your group and _____ (fill in the blank with another relevant user group)	Question 1 (conflicts/compatibilities)
2. Can you tell me a little bit more about [*specific negative interaction*]? Why do you think this interaction is occurring?	Question 1 (conflicts/compatibilities), Question 2 (drivers of conflicts/compatibilities)
3. Now, can you tell me a little bit more about [*specific positive interaction*]? Why do you think this interaction is occurring?	Question 1 (conflicts/compatibilities), Question 2 (drivers of conflicts/compatibilities)

3.4 DATA ANALYSIS

I analyzed interviews according to the grounded theory approach (Glaser and Strauss, 1967; Bernard, 2002). This analytical approach allows the researcher to identify categories and concepts that emerge from within the interviews and to link these themes into meaningful conclusions. Through memoing and coding, this iterative process helps the researcher to become *grounded* in the data and to understand it more deeply (Glaser and Strauss, 1967; Bernard, 2002).

All interviews were digitally recorded and subsequently transcribed using the Transcriptions software. I imported each of the transcribed interviews into NVivo, a coding software. Use of this software allowed for a systematic analysis of the qualitative information.

I began coding the interviews by identifying different types of interactions between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging. Interactions between pairs of activities were coded

according to types of interactions described in the literature and those that emerged throughout the interviews (i.e. those interactions that were consistently mentioned by respondents), resulting in ten categories of interactions (Table 3). I then coded each interaction as positive or negative. An interaction was considered to be positive if the user groups interacted peaceably or if a respondent noted there was no interaction between the two user groups. These are referred to as compatibilities throughout this thesis. Alternatively, a negative interaction was considered one in which at least one of the user groups had a negative impact on the other. These are referred to as conflicts throughout this thesis.

Table 3. Codes for identifying *what* conflicts and compatibilities exist between the stakeholder groups.

Interaction	Compatibility	Conflict
Spatial	Uses do not overlap in space, or overlapped but did not harm one another	Uses overlapped in space and at least one had a negative impact on the other
Temporal	Uses do not overlap in time, or overlapped but did not harm one another	Uses overlapped in time and at least one had a negative impact on the other
Gear	Gear types did not impact another use	Gear negatively impacted another user
Benthic Impacts	Uses do not affect the benthos or uses benefit the benthos	Uses negatively impacted the benthos
Water Quality	Uses do not affect water quality or improved water quality	Uses contributed to a decline in water quality
Biological Impacts	Uses had no biological impact or had beneficial biological impacts	Uses had harmful biological impacts
Knowledge	Users shared a common knowledge about the resource; users knew other uses	Knowledge was misaligned among users; users were not familiar with other users
Traditional Use	Traditional uses do not impact other uses or positively impact other uses	Traditional uses negatively impact other uses
Environmental Conditions	Uses contribute to improved environmental health/functioning	Uses contribute to a decline in environmental health/functioning
Mutual Respect	Users acts considerately towards other uses and user groups	Users do not act considerately towards other uses or user groups

After determining what conflicts and compatibilities existed between crab potting and other activities, I coded each interview for compatibility-related and conflict-related drivers. A driver is defined as an aspect of groups' interactions that influence the conflict or compatibility. Drivers were coded according to those drivers described in the literature and those that emerged throughout the interviews (i.e. those

drivers that were consistently mentioned by respondents), resulting in 3 sets of drivers (resource use drivers, user group drivers, and institutional structure drivers) and specific drivers within those sets (Figure 1). Resource use drivers are those drivers related to how the resource is accessed, shared, and used. User group drivers are those related to the characteristics of the users within each user group. Institutional structure drivers are those related to how institutional agencies operate and perform. Ten specific resource use drivers, seven user group drivers, and six institutional drivers emerged in my interviews (Tables 4-6). Then I determined if the driver contributed to a conflict or a compatibility among activities (Tables 4-6).

Table 4. Resource use drivers and the specific drivers within this driver category.

Resource Use Drivers	Compatibility	Conflict
Access competition	There is little to no competition between users for access to the resource	Competition exists between users for access to the resource
Defined rights	The rights to the resource are clearly defined or there is no need for regulated rights distribution	There are unclear rights to the access among users
Environmental	Environmental factors help in mitigating impacts of uses; environmental factors contribute to use compatibility	Environmental factors contribute to conflicting uses
Historic Use	Past resource use has not created or contributed to any conflicts	Past resource use has contributed to current conflicts
Resource distribution	Resources are distributed evenly; resources are arranged in such a way that does not contribute to conflict	Resources are unevenly distributed; resources are arranged in such a way that contributes to conflict
Resource competition	There is little to no competition for resources	Competition for resources exists among users
Resource condition	Users do not negatively impact the state or condition of the resource	Users harm or negatively impact the state or condition of the resource
Resource scarcity	There is no lack of resources	Resources are limited
Spatial overlap	There is little no resource overlap in space	Resource use occurs in the same space
Temporal overlap	There is little to no temporal resource use overlap	Resource use occurs during the same time period

Table 5. User group drivers and the specific drivers within this driver category.

User Group Drivers	Compatibility	Conflict
# of participants	The number of participants is low, such that is little to no impact of one group on another	There is a great number of participants such that it is causing impacts to be felt by other user groups
Environmental attitudes	Environmental attitudes are in line with resource conservation/stewardship	Environmental attitudes disregard resource conservation/stewardship
Gear differences	Differences in gear between user groups do not negatively impact other uses	Differences in gear among the user groups negatively impact other uses
Historic interactions	Historic interactions between user groups have been generally congenial and positive	Historic interactions between user groups have been generally negative
Knowledge/interpretation of facts	User's perspectives/knowledge aligns with others and/or with published science	User's perspectives/knowledge does not align with others and/or with published science
Mutual respect	User expresses respect for other uses and user groups	User expresses little or no respect for other uses and user groups
Values, interests, priorities	User's values, personal interests, and priorities align with other users and/or groups	User's values, personal interests, and priorities do not align with other users and/or groups

Table 6. Institutional structure drivers and the specific drivers within this driver category.

Institutional Structure Drivers	Compatibility	Conflict
Agency accountability	Agency is accountable for their actions and responsibilities	Agency is not accountable for their actions and responsibilities
Defined responsibilities	Agency has clear responsibilities and is performing them	Agency has unclear responsibilities and/or is not performing those responsibilities
Fragmented structure	Agency has a streamlined, efficient structure	Agency has a disjointed and confusing structure
Institutional transparency	Agency's actions are made public and justifiable	Agency's actions are unclear and not made public
Policy implementation and enforcement	Agency is implementing sound policy and/or enforcing policy appropriately	Agency is not implementing sound policy and/or is not effectively enforcing policy
Unclear regulations	Agency provides a clear understanding of regulations and policies	Agency does not provide a clear understanding of its regulations and policies

Once all the interviews were coded for types of interactions and drivers of interactions, I performed matrix queries based on the codes to provide the number of times an interaction or driver was mentioned by a respondent in one of the four stakeholder groups. A mention is defined as a single quote or story that reflects an interaction or driver. Note that there can be more than one mention per respondent per interview for a particular interaction or driver. For my analysis, the number of mentions of a particular type of interaction provides an indication of the relative amount of interaction (conflict or compatibility) between crab potting and other activities. The number of mentions of a particular driver provides an indication of the relative influence of the driver on conflict or compatibility. For instance, a pair of

activities would be considered compatible if compatible interactions are discussed more frequently by respondents than conflicting interactions. Additionally, a driver (or set of drivers) that is discussed more frequently by respondents is considered to have more influence on conflict or compatibility than the other drivers (or sets of drivers) (Frazier et al., 1984). Quotes, or exemplars, were pulled out to support the conclusions (Glaser and Strauss, 1967; Strauss and Corbin, 1990).

CHAPTER 4

RESULTS

In this chapter, I present the results from the 25 semi-structured interviews I conducted along the coast of North Carolina. The results are presented in two main sections: 1) types of interactions (compatibility or conflict) and 2) drivers of interactions (resource use, user group, and institutional structure). Within each of these two sections, results are broken down by activity (how crab potting interacts with navigational dredging, shrimp trawling, and commercial crab and oyster dredging) and subsequently by respondents' stakeholder group (Northern fishermen, Southern fishermen, Managers, and Army Corps of Engineers' respondents). I begin with an overview of my sample.

4.1 GENERAL CHARACTERIZATION

4.1.1 FISHERMEN

In total, seventeen fishermen participated in this study; thirteen were categorized as Northern region fishermen and four were categorized as Southern region fishermen.

The age of the Northern fishermen in my study ranged from 18-68 years old and the average age is 50.9 years old. Similarly, these fishermen had lived anywhere from 18 to 68 years in North Carolina; the average time in North Carolina is 50.9 years. All the Northern fishermen interviewed in this study were born in North Carolina and lived there all their lives. The fishermen in the Northern region have

spent anywhere between 5 and 52 years in the fishing industry; the average time in the fishing industry is 34.6 years. All but one of the Northern fishermen had a family member in the fishing industry. Only one Northern fisherman had a Bachelor's degree. Approximately 75% of the fishermen interviewed in the Northern region had participated in some type of fisheries management. Most of the Northern fishermen fished for more than one type of fish, with more than 90% fishing for crab, almost 70% fishing for shrimp, and just over 60% fishing for oysters and fish. Over 75% of the fishermen in the Northern region used crab pots, 23% used crab trawls, almost 40% used shrimp trawls and oyster dredges, and just over 60% used gillnets. Almost 50% of the fishermen in the Northern Region said they fished year-round.

The age of the four Southern fishermen in my study ranged from 30-53 years old; the average age is 46.3 years old. These Southern fishermen had lived in North Carolina anywhere from 8 to 53 years with an average of 40.8 years. The fishermen in the Southern region had spent anywhere between 6 and 48 years in the fishing industry; the average of time in the fishing industry is 32 years. All four of the Southern fishermen had a family member in the fishing industry. Only one Southern fisherman had a Bachelor's degree. Additionally, all of the Southern fishermen had participated in some kind of fisheries management. All four of the Southern region fishermen fished for crab and fish, one fished for shrimp, and none of them fished for oyster. All of the Southern fishermen used crab pots and gillnets, one of them used a shrimp trawl, and none of them used the crab trawl or the oyster dredge. Three of the four Southern region fishermen said they fished year-round.

4.1.2 MANAGERS

There were six managers interviewed for this study. The age of the managers ranged from 38-64 years old; the average age is 51.5 years old. These managers had spent anywhere from 14 to 55 years in North Carolina with the average being 39.2 years. Lastly, the mangers had spent an average of 26.3 years in fisheries management, ranging from 14-36 years.

4.1.3 ARMY CORPS OF ENGINEERS' EMPLOYEES

There were two employees with the Army Corps of Engineers that were interviewed for this study. They were 34 and 44 years old. One had spent 16 years in North Carolina while the other had spent their entire life (44 years) in North Carolina. Additionally, one had spent eight years with the Army Corps of Engineers while the other had spent 20 years.

4.2 TYPES OF INTERACTIONS: CONFLICTS AND COMPATIBILITIES

4.2.1 CRAB POTTING VS. NAVIGATIONAL DREDGING

Based on the total number of mentions of compatible and conflicting interactions by all of the interview respondents, crab potting and navigational dredging are perceived as being generally compatible. Compatible interactions between crab potting and navigational dredging were mentioned 135 times while conflicting interactions were mentioned 117 times. However, the Southern fishermen seemed to have a different perspective (Figure 5); they mentioned conflicting interactions (66 mentions) between crab potting and navigational dredging more frequently than

compatible interactions (23 mentions). Respondents discussed all of the types of interactions except compatibilities related to gear and mutual respect and conflicts related to mutual respect (Table 7).

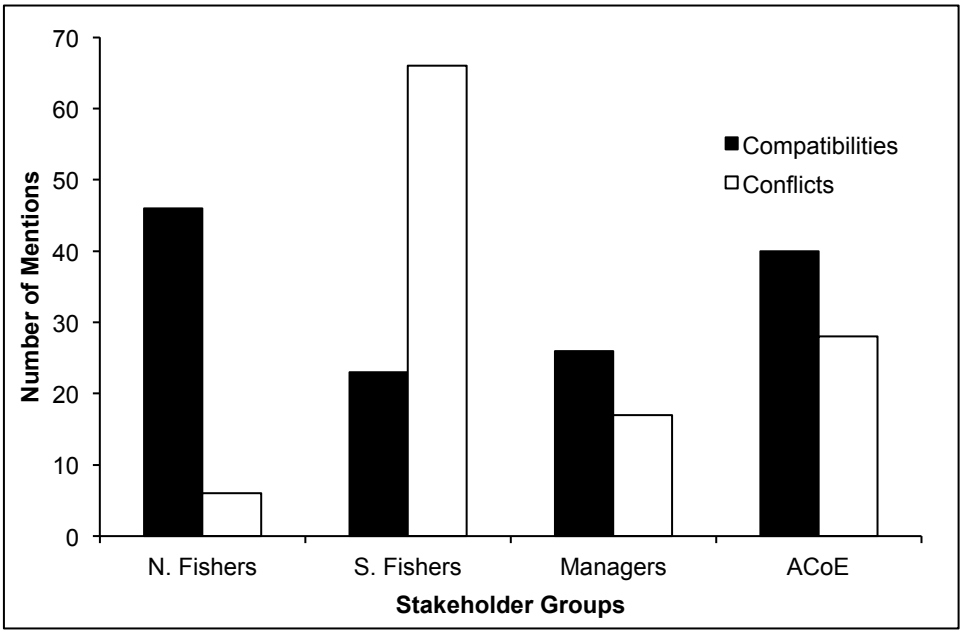

Figure 5. Compatibilities and conflicts between crab potting and navigational dredging mentioned by each relevant stakeholder group.

Table. 7. Types of compatibilities and conflicts mentioned by respondents in the four different stakeholder groups regarding crab potting and navigational dredging.

	Northern Fisherman	Southern Fisherman	Managers	Army Corps of Engineers
Compatibilities				
Spatial	●	●	●	●
Temporal		●	●	●
Gear				
Benthic Impacts	●	●	●	●
Water Quality	●	●		●
Biological Impacts	●	●	●	●
Knowledge				●
Traditional Use	●		●	
Env Conditions	●	●	●	
Mutual Respect				
Conflicts				
Spatial			●	●
Temporal	●	●	●	●
Gear		●	●	
Benthic Impacts	●	●	●	●
Water Quality		●		●
Biological Impacts	●	●	●	●
Knowledge		●		●
Traditional Use				●
Env Conditions	●	●		
Mutual Respect				

4.2.1.1 Northern Fishermen

The Northern fishermen mentioned more total compatible interactions than conflicting interactions between crab potting and navigational dredging (Figure 5). They focused most on the compatible *biological* and *environmental* interactions between crab potting and navigational dredging – each interaction was mentioned 10 times. When one Northern fisherman was asked if he thought there were any *biological* interactions between crab potting and navigational dredging, he replied, "I'm sure, but probably limited, ya know?" He went on to illustrate how the *environmental conditions* in the Northern region helped to mitigate any conflicting

interactions by describing how the tides and water movement help to keep the sounds flushed out: "Actually, probably, the deeper channels [helps] the water move in and out of the sound, probably keeps the sound alive and better anyway. Keeps the water moving."

The compatible *benthic* and *spatial* interactions were the next most frequently cited compatible interactions between crab potting and navigational dredging (7 mentions each). One Northern fisherman highlighted the compatible *benthic* interactions by saying: "From what I've seen here, in my personal opinion, I would say there is very little effect [from navigational dredging]. Unless they were to pump it on oyster rocks or something like that, you know, which they never do." During one interview, a Northern fisherman discussed how the Army Corps of Engineers is aware of and careful to not disrupt the benthos:

> "And from what I saw, it looked like [the Army Corps] was very careful to handle the [dredge spoils] in a manner where it would do the least amount of harm, put it in a fill area. I mean they run pipe for miles to make sure they pump it in an old fill area, so I'd say they went the extra mile to keep from, ya know, messing up anything."

Only three fishermen from the Northern region mentioned any conflicting interactions (6 mentions) between crab potting and navigational dredging. Two fishermen each noted conflicting *benthic* interactions and another two fishermen each noted conflicting *biological* interactions. One fisherman discussed the potential *biological* interaction: "[…dredging] is gonna affect anything that's going through the inlets at the time that it happens. I mean, it's going to chew it up." Conflicting *temporal* and *environmental* interactions were also each mentioned once.

4.2.1.2 Southern Fishermen

In contrast to the Northern fishermen, the fishermen in the Southern region were much more vocal about the conflicting interactions between crab potting and navigational dredging. Conflicting interactions were mentioned 66 times as compared to compatible interactions that were mentioned only 23 times (Figure 5).

The Southern fishermen mentioned compatible interactions between crab potting and navigational dredging infrequently. *Environmental* (7 mentions), *biological* (6 mentions), and *benthic* (5 mentions) interactions were the most frequently mentioned compatible interactions. One Southern fisherman discussed the compatible *benthic* and *biological* interaction when he said,

> "…if you make deeper spots, you're going to make spots where crabs are gonna go in the wintertime. The boat basin in Carolina Beach, that is all a manmade area behind the bridge, that's not something that's been there. It's a good place for crabbing in the wintertime because there's not flow through there so you get this silty mud, like a real soupy mud, and that's where a crab will love to go because […] they can just go and hangout in the wintertime."

However, the Southern fishermen mentioned many more conflicting interactions; each of the four Southern fishermen mentioned at least four different conflicting interactions. *Benthic* interactions were the most discussed conflicting interaction between crab potting and navigational dredging (25 mentions). Southern fishermen discussed how navigational dredging can destroy benthic habitat in the short-term and negatively affect crab populations for up to two years after dredging. One of the Southern fishermen referenced the *benthic* impacts when he stated:

> "So, there's a creek there now that's forever been called 'Old Mud,' and we all joke about it now because over the years of sidecast dredging, there's not any mud there no more, it's all sand. The oyster rocks that were there are completely covered up by sand and the oyster rocks are where the juvenile

> crabs grow up. So, as this sand keeps covering up our oyster rocks, it's very much depleting our crabs, you know?"

Additionally, every Southern fisherman addressed the conflicting *biological* interactions between crab potting and navigational dredging. This was the second most frequently cited conflicting interaction by the Southern fishermen (16 mentions). One Southern fisherman described the conflicting *biological* interaction:

> "The crabs [are] buried up that time of year. They're dormant. They can't move, they're like bears sleeping, you know, or something like that. They just lay there and get sucked up. If they were active, they wouldn't be there. They would have already moved […] they stay [mudded up] all winter and in the spring, when the water warms up, they come out of the mud and start feeding. They're dredging it all [winter], I know it takes out millions of them, it's got to. No other way it can't, it's gotta be doing something."

Southern fishermen also seemed concerned about the conflicting *temporal* interactions (7 mentions). All but one Southern fisherman mentioned the time during which navigational dredging occurred as a conflicting interaction between crab potting and navigational dredging. According to the Southern fishermen, dredging ports, channels, and inlets during the winter is the worst time to dredge because blue crabs overwinter buried in the sediment. One crab potter describes this:

> "And every year they dredge the channel and in the wintertime when the crab hibernates. Naturally, it goes to deep water to stay warmer and hibernate and then they go over that with the big dredges and they dredge 'em out and it kills 'em."

Another Southern fisherman echoed this statement: "And if they're laid there buried up, they can't get away. So I always thought that killed a lot of crabs. I never liked to see the dredge in the wintertime."

Conflicts between crab potting and navigational dredging associated with *water quality* were also discussed (7 mentions). One southern fisherman said,

> "Like in the fall when they're [dredging] a lot, I'll go out one day and the water'll be crystal clear and I'll be looking at mullets and I'll get to the ramp the next day and the water is just nasty and I'll go 'Oh! The dredge is back.'"

4.2.1.3 Managers

The managers more frequently mentioned compatible interactions (26 mentions) than conflicting interactions (17 mentions) between crab potting and navigational dredging (Figure 5). Managers discussed the compatible *biological* interactions between crab potting and navigational dredging most often (6 mentions). When I asked one manager if he had heard anything about reduced crab catches in an area after a dredging event, he replied with, "I haven't heard anybody say anything about it." Furthermore, another manager stated, "Dredged channels are only a portion of your inlet. So, it could be that there's enough area that isn't dredged and the crabs aren't hurt."

Additionally, the managers discussed the compatible interactions in terms of the *benthic impacts* and *environmental conditions* (5 mentions each). Managers noted that they had received few, if any, complaints from crab potters that navigational dredging was having negative impacts on the *benthos*: "Yeah, I'm sure potters don't have any concerns with it and we haven't raised any [concerns] that I'm aware of [in terms] of covering up habitat." Half of the managers also discussed the compatible *environmental* interactions. In addition to the tide and wind helping to minimize the conflicting interactions of navigational dredging and crab potting, managers argued that navigational dredging facilitated the flushing of the sounds and kept them healthier.

Five of the six managers discussed the conflicting interactions between navigational dredging and crab potting. Conflicting *biological* interactions were most frequently discussed (7 mentions). One manager stated,

> "I mean, there are times when we have a relatively, probably significant number of crabs that are going through the inlets out to the ocean to spawn and if they're doing a dredging operation during that time, then yeah, they could impact them."

Conflicting *temporal* and *benthic* interactions were also mentioned (5 and 3 mentions, respectively). Each of the five managers who discussed the conflicting interactions cited conflicting *temporal* interactions and talked about how navigational dredging operations could harm the adult burrowing crabs during the wintertime. One manager touched on the conflicting *temporal* interactions when he said: "They'll [dredge] some of that in the winter. Yeah…and that definitely has an impact on the population."

4.2.1.4 Army Corps of Engineers

Overall, the two respondents from the Army Corps of Engineers discussed compatibilities more frequently than conflicts between crab potting and navigational dredging (Figure 5). These two respondents most frequently discussed the compatible *biological* interactions (11 mentions). One of the Army Corps of Engineers respondents stated,

> "We work with the resource agencies to identify an environmental window that minimizes impacts to other spawning or larval transport. So, those critical transport periods within the inlet corridors are most times avoided. We structure our dredging windows around larval recruitment periods or whatever it may be at that particular inlet and that particular action. We would be coordinating with the resource agencies to help us find the least impactful

> period of time. And, traditionally it's in the winter. A lot of our dredging is in what we call the lower biological productivity period in the winter."

Both Army Corps of Engineers' respondents also discussed compatible *water quality* interactions (7 mentions). One respondent stated, "All of our areas that we do [sidecast dredging] are coarse sand so your turbidity risk is low."

The two ACoE respondents also noted the compatible *benthic* interaction that exists between crab potting and navigational dredging (6 mentions). While the Southern fishermen touched on the conflicting *benthic* interaction 25 times, the two Army Corps of Engineers' respondents both argued that there was, in fact, a compatible *benthic* interaction between navigational dredging and crab potting. One respondent stated, "A lot of the science shows that if you avoid the recruitment period and you use compatible sediment, meaning that you're not placing silt on a sandy beach, that these communities recover quickly." Furthermore, the respondent went on to say,

> "The other thing that is recommended, which we've done on some projects, is to kind of leave some gaps for some of these areas that haven't been impacted to recruit into the areas that have been impacted. […] Another thing is not digging too deep, kind of digging shallower and wider, just a big hole so you don't have as much of that transition habitat. […] Another thing is with the different dredge types, they're not so precise. Like the hopper dredges leave a striped pattern so you get recruitment away from the unimpacted areas. So, depending on the action and how you design your borrow area you can minimize that impact as well."

The two ACoE respondents also addressed some conflicting interactions between crab potting and navigational dredging. They most frequently discussed the conflicting *biological* interactions (9 mentions). One Army Corps of Engineers' respondent addressed the potential conflicting *biological* interaction associated with navigational dredging and described that impacts would likely be seen in the blue crab

larval transport stage when dredging occurs within an inlet. The other respondent addressed the conflicting *biological* interaction by stating, "Oh yeah, anywhere they dredge, if there's something there, it's gone. And on the beach where they're placing the fill material, it's buried."

Lastly, both Army Corps of Engineers' respondents commented on conflicting *knowledge* interaction; these respondents agreed that there is a lack of information shared between fishermen and the Corps. One respondent stated, "I think [fishermen] have an unbelievable wealth of knowledge on things that they don't even realize they know. […] And, I don't believe that there's an effective means of taking that knowledge base and relaying it […]."

4.2.2 CRAB POTTING VS. SHRIMP TRAWLING

Based on the total number of mentions of compatibilities and conflicts by all of the interview respondents, crab potting and shrimp trawling are perceived as being generally compatible. In total, respondents mentioned fewer conflicts than compatibilities, especially by Southern fishermen (Figure 6). There were 94 compatible interactions mentioned while there were 77 conflicting interactions mentioned between crab potting and shrimp trawling. However, managers more frequently mentioned conflicting interactions (23 mentions) than compatible interactions (14 mentions) (Figure 6).

All compatibilities, except those related to water quality and knowledge, were discussed by respondents in all groups. None of the respondents mentioned conflicts related to benthic impacts, water quality, or environmental conditions (Table 8).

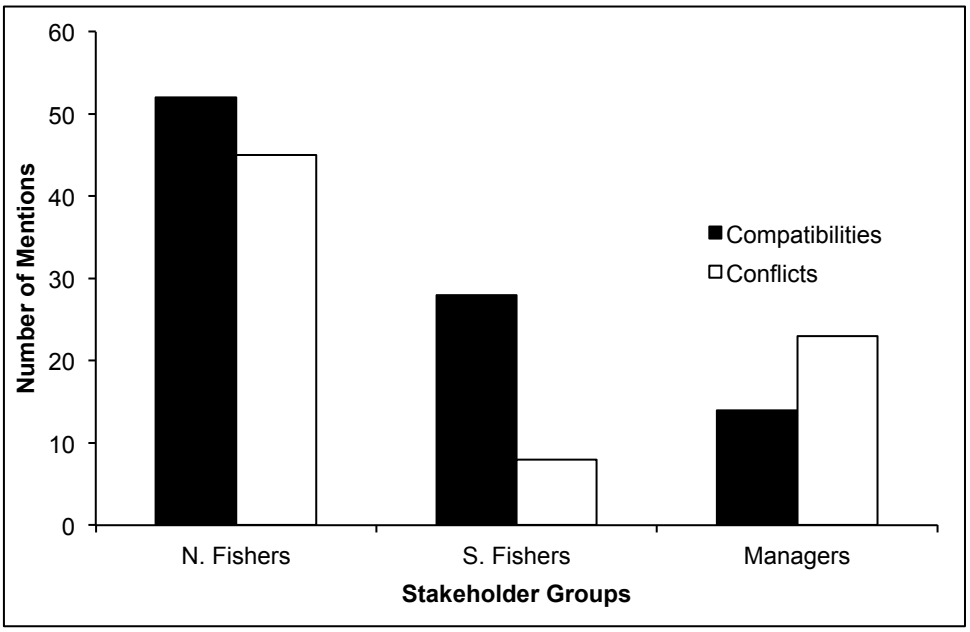

Figure 6. Compatibilities and conflicts between crab potting and shrimp trawling mentioned by each relevant stakeholder group.

Table. 8. Types of compatibilities and conflicts mentioned by the three relevant stakeholder groups regarding crab potting and shrimp trawling.

	Northern Fishermen	Southern Fishermen	Managers
Compatibilities			
Spatial	●	●	●
Temporal	●	●	●
Gear	●	●	●
Benthic Impacts	●	●	●
Water Quality			
Biological Impacts		●	
Knowledge			
Traditional Use	●	●	●
Env Conditions		●	
Mutual Respect	●	●	●
Conflicts			
Spatial	●	●	●
Temporal	●		
Gear	●		●
Benthic Impacts			
Water Quality			
Biological Impacts			●
Knowledge	●		
Traditional Use	●	●	●
Env Conditions			

4.2.2.1 Northern Fishermen

The Northern fishermen more frequently mentioned compatible interactions between crab potting and shrimp trawling than conflicting interactions (Figure 6). They most frequently mentioned compatible *spatial* interactions between crab potting and shrimp trawling (22 mentions). Most of the fishermen who spoke about these compatible *spatial* interactions referred to the ways the crab potters and trawlers had figured out to work around each other. One fisherman stated that crab potters typically move out of the way of trawlers because crab potters are more mobile:

> "Well, [crab potters] take up [their pots] and move 'em somewhere where [trawlers] wasn't working. There's a lot of places where [potters] can move where [trawlers] don't work. Ain't a whole lot of places where those trawlers do work. [Crab potters] can go up on a shoal, an ebb shoal somewhere, and get out the way."

There is also a management regulation in North Carolina that requires crab potters to stay inside the 6 foot contour line after June 1, effectively separating these groups in space (15A NCAC 03J .0104(b)(6)). This regulation affects the Northern fishermen the most because it applies mostly in the Northern rivers. Some of the Northern fishermen cited this regulation as contributing to the *spatial* compatibility.

The second most frequently discussed compatible interaction between crab potting and shrimp trawling mentioned by the Northern fishermen was *mutual respect* (13 mentions). Almost half of the Northern fishermen mentioned that nearly all of the interactions between crab potters and trawlers were respectful. One Northern fisherman stated, "Talk to the people, that's the main thing. See what's going on, see who it is, talk to them. Most of them will say, 'I'm sorry! I didn't mean to do that!' or whatever and you do the same thing, ya know? It doesn't hurt nobody." Another Northern fisherman said,

> "I've got most of their phone numbers so if their crab pots are in the area where I know that the shrimp boats are getting ready to work, I'll call them ahead of time and say, 'There's some shrimp right over your crab pots. You should probably move them because there's gonna be 20-30 boats working there tomorrow night.' We all know each other. I mean our families grew up together. […] So I mean, you see each other in town, you don't want to make each other mad."

The Northern fishermen mentioned conflicting *spatial* interactions an equal number of times as compatible *spatial* interactions (22 mentions each). When I asked a crab potter if he had ever interacted with the trawlers out on the water, he replied,

"Yeah, [trawlers] catch on the [crab] pots all the time." Another fisher said, "I mean, if they come working where you're at, you either move your gear or you lose it." However, many fishermen shared the sentiment expressed by this Northern fishermen: "But after you go by the one initial time that day, then you go on around them and it's alright…I work around them," suggesting that informal arrangements may exist amongst the crab potters and shrimp trawlers.

Another frequently mentioned conflicting interaction discussed by the Northern fishermen was *gear* interactions (13 mentions). One fisherman described the interaction well when he stated, "The gear conflicts, one [crab pots] stays there all the time, one [trawl net] goes through and leaves so you know, they're gonna have conflicts, but it's not as bad as you would hear it made out to be." Another fisherman stated, "Yeah, just people getting mad 'cause a trawler got in his pots or a trawler getting mad because a crab potter set where he been working."

4.2.2.2 Southern Fishermen

The Southern fishermen also more frequently mentioned compatible interactions between crab potting and shrimp trawling than conflicting interactions (Figure 6). They most frequently discussed the compatible *spatial* interactions among crab potters and trawlers (10 mentions). One Southern fisherman stated, "Yeah, we don't have no problems. No, just certain places they drag and we stay outta their way and a lot of places they can't drag so we got it to ourselves. So no, we usually don't have no problems. Very rarely." Another Southern fisherman described the dynamics between shrimp trawling and crab potting in the Southern region:

> "Around here, you're going to get a lot of…the shrimp trawlers are either in the river – the bigger ones are going to be in the river or they're going to be in the ocean. And where we are is Masonboro Sound which is behind Masonboro Island […]. So basically behind there, the only shrimp trawlers we'll see would be small boats, really small, and there's only one area where you're actually able to trawl in and literally, I see one maybe once a year in springtime. I don't even think I remember seeing one this year, but years past I have."

There were six mentions of the compatible *benthic* interactions between crab potting and shrimp trawling. I asked one Southern fisherman if there was any impact of shrimp trawling on blue crab habitat and he replied, "No, I don't think it's enough to hurt anything. Not in this area. […] There's only just this little bit of ground they drag on." Half of the Southern fishermen stated that they did not set crab pots where trawling occurs: "I crab up in the river where it's not even open for shrimping or anything like that. So I'm never around any shrimpers."

Like the Northern fishermen, the Southern fishermen most frequently noted conflicting *spatial* interactions, but it was only mentioned a total of three times. One fisherman stated that conflicts arise "when [crab potters] set their pots in the same area [the trawlers are] shrimping in. Everybody wants to be in the same place."

Southern fishermen also mentioned that there were conflicting interactions because the fishermen were *disrespectful* (2 mentions). These two mentions, however, were in reference to the relations between crab potters and shrimp trawlers in the Northern region, not in their own fishing grounds. One Southern fisherman stated, "But like I said, in the Pamlico, they got so many people that are from South Carolina, Georgia, Alabama, all over, and they don't get along with their own selves anyway. They don't get along too well. […] We don't have that problem here."

4.2.2.3 Managers

In total, the managers mentioned more conflicting interactions between crab potting and trawling than compatible interactions (Figure 6). The managers most frequently mentioned the compatible *spatial* interactions between crab potters and shrimp trawlers (5 mentions). I asked one manager from the Southern region to tell me about the relationship between crab potters and trawlers and he replied, "It's never really been a big issue down here just because I think the guys realize that shrimp trawlers can take up your gear so [potters] want to move their crab pots."

The managers mentioned compatible *benthic* interactions as the next most frequently cited compatibility between crab potters and shrimp trawlers (3 mentions). One manager stated, "I can't say that they've ever come to us and said, 'They're disturbing our crab habitat and they don't need to be in this area.'"

Like the other stakeholder groups, the managers also discussed the conflicting *spatial* interactions between these two user groups most frequently; four managers mentioned spatial conflicts a total of 10 times. One manager stated,

> "It's mainly just [crab potters saying,] 'This is where we have crab potted for years and these trawlers are coming in and swiping up our gear and things.' Because generally, it is the flat, sand, low, you know, not a lot of current and waves, where the crab pots can be set. They're not going to set them on a seagrass bed or oyster rock on purpose. And so the areas, flat sand, mud bottom is where both of these groups want to go. So that's where most of these problems arise."

Another manager, when asked if crab potters and trawlers have any conflicting interactions, replied, "Yeah, because [crab potters] were putting their pots out there where [trawlers] are going. The trawlers want to go in there for the fish."

The second most frequently mentioned conflict between crab potters and shrimp trawlers was the *gear* used by each group (7 mentions). One manager described the *gear* conflicts between these two activities:

> "You have the stationary pot gear with their pots on the bottom with buoys and ropes sticking up. They're gonna conflict with mobile gear, like trawlers. […] So shrimp trawling, long hauling, and crab trawling are the mobile gears that need room and clear bottom and things and they're the ones that conflict with crab pots, mainly."

4.2.3 CRAB POTTING VS. COMMERCIAL CRAB AND OYSTER DREDGING

Based on the total number of mentions of compatibilities and conflicts by all of the interview respondents, crab potting and commercial crab and oyster dredging are perceived as being generally compatible. There were 56 compatible interactions mentioned while only 9 conflicting interactions mentioned between crab potting and commercial crab and oyster dredging. Northern fishermen discussed most of the compatible interactions and no conflicts, while Southern fishermen discussed no compatibilities and a couple of different conflicting interactions between crab potting and commercial crab and oyster dredging (Figure 7).

Respondents discussed all of the different types of compatibilities except those related to knowledge. The only conflict related interactions mentioned were gear, benthic impacts, and biological impacts (Table 9).

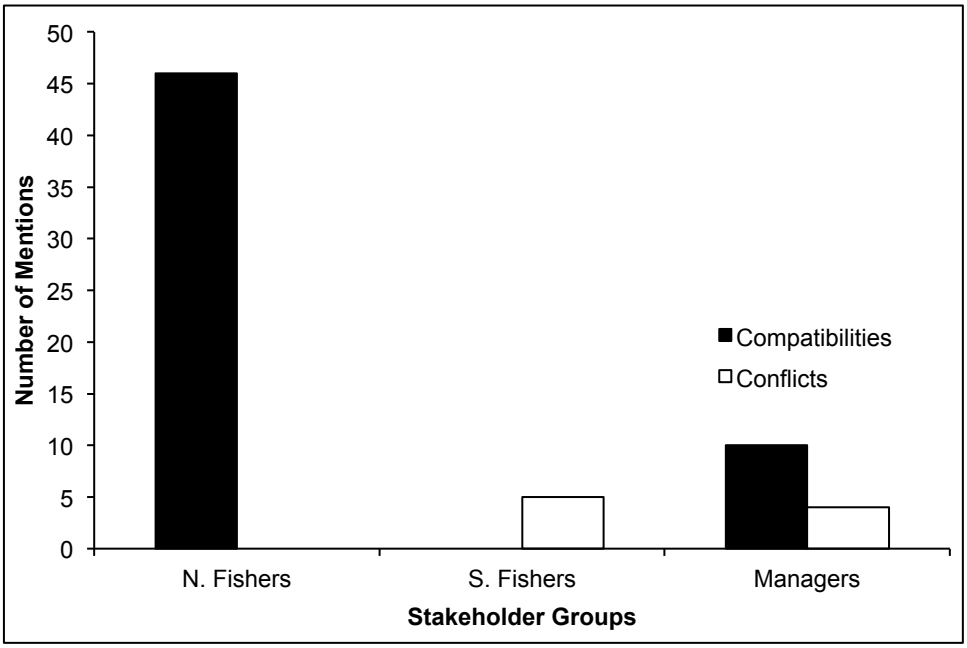

Figure 7. Compatibilities and conflicts between crab potting and commercial crab and oyster dredging mentioned by each relevant stakeholder group.

Table 9. Types of compatibilities and conflicts mentioned by the three relevant stakeholder groups regarding crab potting and commercial crab and oyster dredging.

	Northern Fisherman	Southern Fisherman	Managers
Compatibilities			
Spatial	●		
Temporal	●		●
Gear	●		●
Benthic Impacts	●		●
Water Quality	●		
Biological Impacts	●		●
Knowledge			
Traditional Use	●		
Env Conditions			●
Mutual Respect	●		
Conflicts			
Spatial			
Temporal			
Gear		●	●
Benthic Impacts			●
Water Quality			
Biological Impacts		●	●
Knowledge			
Traditional Use			
Env Conditions			
Mutual Respect			

4.2.3.1 Northern Fishermen

The Northern fishermen more frequently mentioned compatible interactions than conflicting interactions between crab potting and commercial crab and oyster dredging (Figure 7). They most frequently noted the compatible *benthic* interactions between crab potting and commercial crab and oyster dredging (14 mentions). The Northern fishermen who mentioned this compatible interaction agreed that commercial crab and oyster dredging turned over the benthic habitat and kept it alive. A Northern fisherman described this shared sentiment by saying, "Oh yeah, [oyster dredging] keeps everything up where the bottom's alive. It ain't dead."

Along these same lines, some Northern fishermen discussed the compatible *biological* interaction between crab potting and commercial crab and oyster dredging (8 mentions). One Northern fisherman said,

> "As far as oyster dredging that digs into the bottom, see all these shells out there…If you don't work that stuff a little bit and keep them shells out of the bottom, they ain't going to catch nothing 'cause they're going to sand up, mud up, cover up. If you work them and keep them out of the bottom, then they can catch, they'll have a chance to do something."

When asked if he thought commercial crab and oyster dredging affected the biology of the bottom habitat at all, another Northern fisherman replied, "I think it does but I think it's actually a healthy practice. If there's not too much done." This fisherman went on to say, "I think if you just let the sound alone and didn't do anything to it, it would probably [...] it'd probably get dirtier […]."

Northern fishermen also noted *spatial* compatibilities that occurred between commercial crab and oyster dredging and crab potting (7 mentions). Oyster dredging and crab potting are separated in space, thus oyster dredging has little to no direct, harmful impacts on the crabbing industry. One fisherman described this separation by stating,

> "[Oyster dredging] is mostly right on top of hills. You just don't drag for scattered oysters, very seldom do you do that around here. It's right on a concentrated area. You put flags out and you stay right on the very crest of the lump."

Some of the fishermen also noted that crabbing and commercial crab and oyster dredging take place during different time periods, creating a *temporal* compatibility (5 mentions). One fisherman said, "Well, the oyster dredges and the crab potters have very little conflict as they're really two different seasons." This idea was echoed by a fisherman who said,

> "Once the oystering starts, the crabs are already in the mud, I mean it's cool enough they'll go into the mud. It'll affect 'em a little bit, but not a whole lot I don't believe. Most of your crabs, they'll go right on in the bottom when it gets cold. You won't see 'em, you won't catch 'em until it gets cold."

None of the thirteen Northern fishermen respondents noted any conflicting interactions between crab potting and commercial crab and oyster dredging.

4.2.3.2 Southern Fishermen

The Southern fishermen, in contrast to the Northern fishermen, did not mention any compatible interactions between crab potting and commercial crab and oyster dredging; this stakeholder group only mentioned conflicting interactions (Figure 7).

The two fishermen who discussed the conflicting interactions mentioned conflicting *biological* (3 mentions) and *gear* (2 mentions) interactions. One Southern fisherman described the conflicting *biological* interaction: "I imagine that dredging hurts crabs, I imagine that it hurts them pretty bad. […]." The other fisherman had similar thoughts, "I'm glad there ain't none of that here, though. I think it kills more than it catches."

Additionally, these same two fishermen noted the conflicting *gear* interactions. One fisherman said,

> "Yeah, I think that's a bad practice right there. Crab ain't got a chance against that big piece of metal. If it touches him, it's probably just going to crack his shell, destroy or kill him. I bet you every 10 crabs, 5 or 6 ain't no good. They either full of sand or crushed up. I bet it's a sorry way of catching crabs. Just about have to be – if you're digging them out of sand, that's a pretty fragile thing, a crab is, I mean people think they're tough, but they ain't that tough, you know? Not for that metal drag and hydraulic wench and stuff […]."

The other fisher had a similar statement:

> "If you got a lotta boats doing it, if it's just 2 or 3 boats doing it, I don't see it hurtin' them too bad, but a lot of boats, I could see them killing as many crabs as they catch. I think it would be a wasteful thing, a way to catch crabs. You know wasteful on the product – killing a lot more than they really keep."

4.2.3.3 Managers

The managers more frequently discussed compatible interactions between crab potting and commercial crab and oyster dredging than conflicting interactions (Figure 7). Four of the six managers mentioned compatibilities between crab potting and commercial crab and oyster dredging. Compatible *temporal*, *benthic*, *biological*, and *environmental* interactions were all mentioned twice. One of the managers described the *temporal* compatibility by saying, "But actual active pots and active oyster dredges and crab dredge season? They don't really overlap so much […]."

Two managers also noted the *benthic* compatibilities between commercial crab and oyster dredging and crab potting. One manager said, "There's not a lot of negative sentiment towards a dredger by a potter because he's out there doing a bottom disturbing activity. A lot of these guys believe that by doing that bottom disturbing activity, they're actually helping the ecosystem." The other manager, from the Southern region, stated, "I mean down here, it's primarily hand harvest with occasional tong, single tongs, or even up tongs, but that's our main gear for harvesting oysters. You can actually see what you're getting, look at what you're grabbing," implying that this practice was much less detrimental to the benthos than using a dredge.

Only one manager talked about the *biological* compatibilities between crab potting and commercial crab and oyster dredging, but his remarks mirrored those of many of the fishermen. He said,

> "Some of those smaller oysters that they say have gotten down into the mud and probably going to suffocate at some time, but them pulling them up in the dredge and then throwing them back over, they're saying that they're getting up out of the mud and getting them on top of the sediment where they won't smother or be covered as readily by mud or whatever. But if the oyster dredge comes through and churns up some small clams or worms or whatever out of the bottom or small oysters, then the crabs are going to come in there and have a feast!"

Lastly, two managers spoke about the *environmental conditions* associated with the compatibility between commercial crab and oyster dredging and crab potting. One manager described how the environment in the Southern region is not conducive for most commercial crab and oyster dredging, and thus, prevents any conflict between crab potting and commercial crab and oyster dredging from even developing: "Down here, especially in this area, from Topsail Sound south, we have intertidal so at low tide, they just walk out there and the oysters are there. So gear, a lot of it is hand."

Only one of the managers noted any conflicts between crab potting and commercial crab and oyster dredging. He mentioned conflicting *biological* interactions twice and conflicting *benthic* interactions once. When describing the *biological* conflicts, the manager stated, "Let's say if that dredge injured the crab or killed the crab by pushing oysters against it or the actual dredge hitting the crab and killing it, of course that crab is not going to be doing very well."

He also touched on the conflicting *benthic* interactions, "Yeah, I mean anytime you're taking a piece of habitat out of the water or destroying, well yeah, you could say it's destroying or moving a piece of habitat, it's going to have an impact."

4.3 DRIVERS OF INTERACTIONS: WHY DO COMPATIBILITIES AND CONFLICTS EXIST BETWEEN ACTIVITIES?

In general, compatibility-related drivers were mentioned more frequently than conflict-related drivers between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging (Table 10, Figure 8). The frequency of mentions for specific drivers sets are discussed below (Tables 11-13).

Table 10. The total number of mentions of compatibility-related and conflict-related drivers for each pair of activities examined in this study.

Activities	Total mentions of compatibility-related drivers	Total mentions of conflict-related drivers
Crab Potting and Navigational dredging	156	138
Crab Potting and Shrimp trawling	86	84
Crab Potting and Commercial crab and oyster dredging	46	17

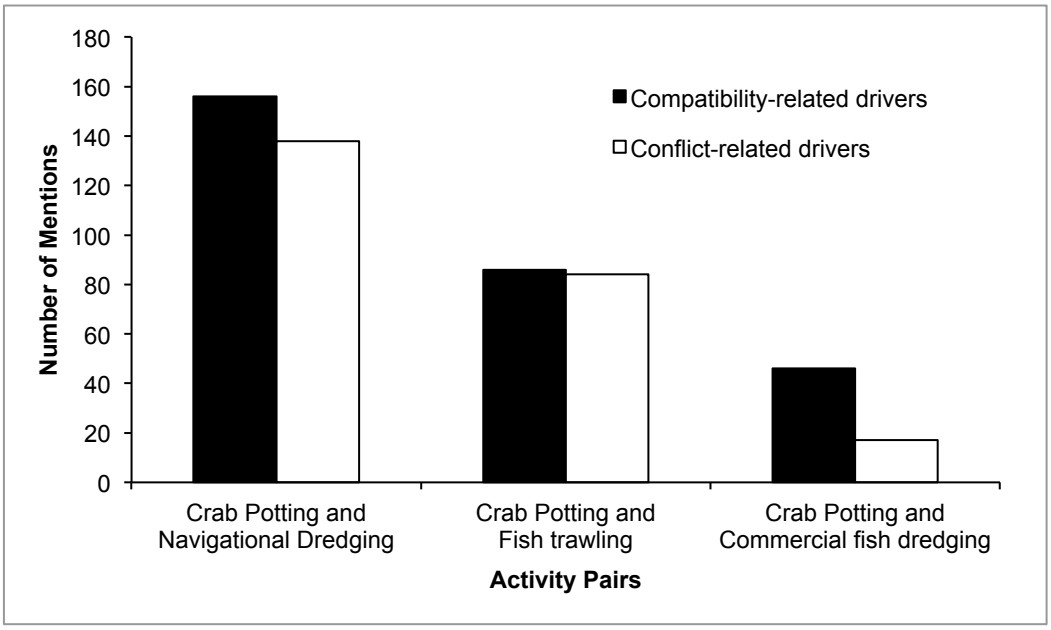

Figure 8. The total number of mentions of compatibility-related drivers and conflict-related drivers mentioned by interview respondents regarding each pair of activities.

4.3.1 CRAB POTTING VS. NAVIGATIONAL DREDGING

In total, there were more mentions of compatibility-related drivers than mentions of conflict-related drivers when study participants discussed the interactions between crab potting and navigational dredging (Table 11). Resource use drivers (181 total mentions) between crab potting and navigational dredging were mentioned most frequently and the four stakeholder groups mentioned more compatibility-related resource use drivers than conflict-related resource use drivers. User group drivers (92 mentions) were also discussed, but had fewer total mentions. There were more mentions of conflict-related user group drivers than mentions of compatibility-related user group drivers by the four stakeholder groups. The respondents mentioned institutional drivers infrequently (20 mentions) and there were more mentions of

conflict-related institutional structure drivers than mentions of compatibility-related institutional structure drivers.

All compatibility-related resource use drivers between crab potting and navigational dredging were mentioned except the following: access competition, resource competition, and resource scarcity. All conflict-related resource use drivers were mentioned except access competition and resource scarcity. All compatibility-related user group drivers were mentioned. All conflict-related user group drivers were mentioned except the following: the number of participants, historic interactions, and mutual respect. All compatibility-related institutional structure drivers were mentioned except fragmented structure and unclear regulations. All conflict-related institutional structure drivers were mentioned except defined responsibilities and fragmented structure (Table 11).

Table 11. Drivers of the perceived compatibilities and conflicts mentioned by relevant stakeholder groups regarding crab potting and navigational dredging activities. The numbers in the table reflect the number of mentions for each driver.

	Northern Fishermen		**Southern Fishermen**		**Managers**		**Army Corps of Engineers**		**Total Interact-ions**
DRIVERS	*Compat*	*Conf*	*Compat*	*Conf*	*Compat*	*Conf*	*Compat*	*Conf*	
Resource Use									
Access Competition	0	0	0	0	0	0	0	0	0
Defined Rights	1	0	0	1	2	0	0	0	4
Environmental Conditions	8	0	4	4	6	1	0	0	23
Historic Use	0	0	0	1	2	0	2	1	6
Resource Distribution	0	0	4	9	5	0	2	0	20
Resource Competition	0	0	0	1	0	0	0	0	1
Resource Condition	13	0	4	24	5	1	15	7	69
Resource Scarcity	0	0	0	0	0	0	0	0	0
Spatial Overlap	4	0	3	10	9	1	12	5	44
Temporal Overlap	0	0	2	3	3	1	5	0	14
TOTAL	26	0	17	53	32	4	36	13	**181**
User Group									
# of Participants	1	0	0	0	0	0	0	0	1
Environmental Attitudes	9	1	0	5	1	0	0	1	17
Gear Differences	1	0	0	2	0	0	3	2	8
Historic Interactions	0	0	1	0	0	0	1	0	2
Knowledge, Interpretation of facts	2	0	4	17	0	3	2	19	47
Mutual Respect	1	0	0	0	0	0	0	0	1
Values, Interests, Priorities	4	1	0	3	2	0	4	2	16
TOTAL	18	2	5	27	3	3	10	24	**92**
Inst. Structure									
Agency Accountability	1	1	0	2	0	0	2	1	7
Defined Responsibilities	0	0	0	0	0	0	1	0	1
Fragmented Structure	0	0	0	0	0	0	0	1	1
Institutional Transparency	0	0	0	2	0	0	1	3	6
Policy Implementation & Enforcement	1	0	0	1	1	0	0	1	4
Unclear Regulations	0	0	0	0	0	0	0	1	1
TOTAL	2	1	0	5	1	0	4	7	**20**

4.3.1.1 Northern Fishermen

Resource Use Drivers

The Northern fishermen more frequently discussed the compatibility-related resource use drivers between crab potting and navigational dredging than conflict-related resource use drivers. The most frequently mentioned specific resource use driver was *resource condition* driver (13 mentions). The compatibility-related *environmental conditions* driver was the next most frequently discussed (8 mentions), followed by *spatial overlap* (4 mentions) (Table 11).

When discussing the interactions between crab potting and navigational dredging, the Northern fishermen respondents most frequently discussed the compatibility-related *resource condition* resource use driver. When asked if navigational dredging was hurting the blue crabs around Albemarle and Pamlico Sounds, one fisherman replied,

> "I think [navigational] dredging, if anything, would help the crabs, it wouldn't hurt them. I don't think dredging hurts a damn thing. I think getting more water in the sound helps everything. Ain't no way it can do more harm than the good the saltwater will do. The water can flood a hell of a lot better than whatever [navigational dredging] can damage, I'll guarantee you."

The Northern fishermen also often mentioned *environmental conditions* as a resource use driver of the compatibility between crab potting and navigational dredging. When I asked one Northern fisherman if he thought there was any biological impact on blue crabs around where they dredge, he emphasized how the tides helped mitigate the impacts of navigational dredging: "I'm sure, but probably limited, ya know? With the movement in the water." Another fisherman stated that

natural events do more damage than any dredge is capable of: "Mother nature does more than any man could ever do."

None of the thirteen Northern fishermen respondents noted any conflict-related resource use drivers between crab potting and navigational dredging.

User Group Drivers

The Northern fishermen also more frequently mentioned compatibility-related user group drivers between crab potting and navigational dredging than conflict-related drivers (Table 11). The most frequently mentioned compatibility-related user group driver discussed by the Northern fishermen was *environmental attitudes* (9 mentions). They also discussed the following compatibility-related user group drivers: *values, interests, and priorities* (4 mentions), *knowledge and interpretation of facts* (2 mentions), *number of participants* (1 mention), *gear differences* (1 mention), *and mutual respect* (1 mention).

Eight Northern fishermen expressed positive *environmental attitudes* towards the impacts of navigational dredging. One Northern fisherman said,

> "I think dredging helps, it might hurt something right that second, but if you go there and dig a channel, it's like digging this boat basin – this wasn't natural, somebody dug it and things'll come in here just like a nursery area and they'll grow here – manmade nursery area."

Another Northern fishermen who expressed a positive *environmental attitude* toward the impacts of navigational dredging mentioned that dredging operations help to keep the inlet clean by allowing more water movement in and out of the sounds.

The *values, interests, and priorities* of the Northern fishermen and those involved in navigational dredging operations appeared similar. When I asked one

Northern fisherman about his feelings concerning navigational dredging, he replied, "It's important. Well they've got to keep the channels open for navigation. If they don't, what have you got? You don't have anything. You got a hole in the water, a sandbar…" Another Northern fisherman noted that dredging may, albeit unintentional, create help create habitat: "[…] why not dredge it out and fish'll come and go, and shrimp. I think it helps in the long run for there to be deep places next to the shallows."

Only two mentions of conflict-related user group drivers between crab potting and navigational dredging were discussed among the Northern fishermen. *Environmental attitudes* and *values, interests, and priorities* were each mentioned once.

Institutional Structure

The Northern fishermen mentioned institutional structure drivers very infrequently when they discussed the interactions between crab potting and navigational dredging (3 mentions total). There were only two mentions of any compatibility-related institutional structure drivers between crab potting and navigational dredging. One Northern fisherman mentioned *agency accountability* and *policy, implementation, and enforcement* each once. This fisherman expressed his opinion of the Army Corps of Engineers' *accountability* and their dredging *implementation*:

> "And from what I saw, it looked like [the Army Corps] were very careful to handle the [dredge spoils] in a manner where it would do the least amount of harm, put it in a fill area. I mean, they run pipe for miles to make sure they

> pump it in an old fill area, so I'd say they went the extra mile to keep from, ya know, messing anything up."

A single Northern fisherman mentioned one conflict-related institutional structure driver between crab potting and navigational dredging. This fisherman noted a lack of *agency accountability*: "I've been around it, they do it when they really need it and things. But they're really slow to get to the inlets opened up so we can get to work." He continued on to say that he wished the ACoE would be more accountable to their responsibilities in keeping major inlets opened for boat traffic and navigation.

4.3.1.2 Southern Fishermen

Resource Use

In general, the Southern fishermen more frequently mentioned conflict-related resource use drivers between crab potting and navigational dredging than compatibility-related drivers (Table 11). However, the most frequently discussed compatibility-related resource use drivers mentioned by Southern fishermen were *environmental conditions*, *resource distribution*, and *resource condition* (each mentioned 4 times). Other discussed compatibility-related resource use drivers include: *spatial overlap* (3 mentions), *temporal overlap* (2 mentions), and *defined rights* (1 mention).

One Southern fisherman spoke about the *environmental conditions* (shifting sand) that allow crab potting and navigational dredging to occur in close proximity:

> "If you were talking about inlet dredging, I just don't see that as killing crabs 'cause they can't. The sand shifts so much anyway they can't mud up there. [Crabs are] gonna go further back in or they go off the beach. You know here, they go off in the ocean and mud up."

A second Southern fisherman discussed the water depth and tide strength as *environmental conditions* that allow blue crab potting and navigational dredging to both occur:

> "[…] But for us? We wouldn't get into…the channels that they're dredging with the way the tide is here, we wouldn't keep a crab pot there because it's too strong, too deep."

Resource distribution and *resource condition* were also both mentioned as specific compatibility-related resource use drivers between crab potting and navigational dredging by the same two Southern fishermen. One fisherman noted that the *distribution* of crabs does not really overlap with the inlet dredging: "[…] I don't think…as far as, like inlet dredging, the inlet dredging wouldn't bother them because they don't bed down in that sand in the inlets." The other fisherman thought that dredging actually helped the blue crabs because it created potential habitat for blue crabs.

The Southern fishermen, however, more frequently mention the conflict-related resource use drivers between crab potting and navigational dredging (Table 11). The most frequently discussed conflict-related resource use driver was *resource condition* (24 mention). *Spatial overlap* was discussed next most frequently as a conflict-related resource use driver (10 mentions), followed by *resource distribution* (9 mentions). Other conflict-related resource use drivers discussed by Southern fishermen include: *environmental conditions* (4 mentions), *temporal overlap* (3 mentions), *historic use* (1 mention), and *resource competition* (1 mention).

Every Southern fisherman mentioned the conflict-related *resource condition* driver between crab potting and navigational dredging at least once and one fisherman

discussed it 13 times. One respondent stated that he thought wintertime was the worst time to do navigational dredging projects because it killed the blue crabs buried in the mud:

> "I know there's crab buried all in that bank, tons of them. They stay there all winter and in the spring, when the water warms up, they come out of the mud and start feeding. They're dredging it all the time. I know it takes out millions of them, it's got to. No other way it can't, it's gotta be doing something!"

Additionally, every Southern fisherman also mentioned the conflict-related *spatial* resource use driver between crab potting and navigational dredging. One Southern fisherman stated: "And when he's out on this bar dredging, we can't set traps at the mouth where the inlet comes into the waterway because the sand moves so much that it'll sand up our pots and we can't get 'em back." Another Southern fisherman described another instance of *spatial overlap* between the crab potting and navigational dredging that contributes to the conflict between them:

> "I know they dredge in a spot that we crab, the Carolina Beach Inlet and pretty much, it's been every year the last few years. We crab there in the wintertime, …we lost a lot of crab pots because they lay all these pipes and they'll roll over our buoys, smash the pots, and we lose them or whatever. It happens all the time so that's frustrating."

Two of the Southern fishermen also discussed conflict-related *resource distribution* resource use drivers between crab potting and navigational dredging. One Southern fisherman, when asked if dredging impacts the blue crab responded by saying, "Yeah. Because the crabs is buried up that time of year. They're dormant. They can't move, they're like bears sleeping, you know, or something like that. They just lay there and get sucked up." Two other fishermen described how blue crab habitat distribution was reduced as a result of navigational dredging operations. The first stated, "We're running out of estuary here – between all types of beach

renourishment with the dredging and all, the sand is building up," and the second fisherman said, "I think they're filling in habitat. I don't think it, I know they're filling in habitat. Bad."

User Group

Compatibility-related user group drivers between crab potting and navigational dredging were only mentioned five times by the Southern fishermen while conflict-related user group drivers were mentioned 27 times (Table 11). The most frequently discussed compatibility-related driver was the alignment of the *knowledge and interpretation of facts* (4 mentions). *Historic interactions* was also mentioned once as a compatibility-related user group driver.

One Southern fisherman stated that dredging in sandy inlets would not harm blue crab populations during the winter because they are not bedded up in shifting, sandy environments, which agrees with what the Army Corps' respondents and managers stated. The other Southern fisherman expressed concern for dredging in areas where seagrass beds are found:

> "I think the dredging you'd see, if you go into a place and there's a lot of this subaquatic vegetation growing on the bottom, you're going to see probably…I would imagine that would change the availability of crabs. Crabs and grass go hand in hand. They go in there to hide, they go in there to feed, they go in there to shed."

This statement agrees with what managers and scientists believe is critical habitat for blue crabs.

The Southern fishermen more frequently mentioned the conflict-related user group drivers than the compatibility-related drivers between crab potting and

navigational dredging. The following conflict-related drivers were mentioned most frequently: *knowledge and the interpretation of facts* (17 mentions) and *environmental attitudes* (5 mentions). Other conflict-related user group drivers mentioned include *values, interests, and priorities* (3 mentions) and *gear differences* (2 mentions).

All four Southern fishermen had conflicting *interpretation of the facts* about navigational dredging and its potential impacts when compared to the Army Corps of Engineers' respondents. The Southern fishermen all agreed that winter was the worst time to dredge channels and inlets while the Army Corps' respondents thought it was the best time. One Southern fisherman expressed his concern:

> "I know there's crabs buried all in that [channel] bank, tons of them. They stay there all winter and in the spring when the water warms up, they come out of the mud and start feeding. They're dredging it all the time, I know it takes out millions of them, it's got to."

Additionally, three of the four Southern fisherman thought that man-made, dredged holes recover slowly while the Army Corps' respondents thought the recovery of dredged areas could happen quickly. One Southern fisherman stated:

> "No, I think [navigational dredging] screws the bottom up somehow and they [crabs] don't go back to it. I don't know what is, but a lot of manmade ditches and stuff don't hold after a dredge. Don't hold stuff for some reason. […] Like a dredge pond. It took it years for fish to even go in there and it was a prime place. It was a nice place and it took it years for fish to go in there and still, I don't think there are any crabs in the dredge hole at all."

Three Southern fishermen also expressed negative *environmental attitudes* towards navigational dredging impacts. One Southern fisherman said that navigational dredging caused more trash to move up and down the rivers while another fisherman described how beach renourishment projects may cause estuaries to fill in with sand:

> "[…] they dredge offshore sometimes and pump it to the beach – that sand's coming back into the back creeks. […] And that's where the problem is with the dredging. There's so much sand coming from the front of the beach and it has nowhere to go on the back of the beach no more expect for the deep holes. And as we lose all our deep holes and mud bottom, we're losing our estuary, ya know?"

Institutional Structure

None of the Southern fishermen mentioned a compatibility-related institutional structure driver between crab potting and navigational dredging (Table 11).

Conflict-related institutional structure drivers between crab potting and navigational dredging were mentioned three times by a Southern fisherman: *institutional transparency* (2 mentions) and *policy implementation and enforcement* (1 mention). This fisherman discussed, through a series of stories, how he did not believe the Army Corps of Engineers is consistent or transparent in its actions:

> "Like I say, you got an 8 or 9 knot current coming, [Army Corps] tell ya, 'We only dredge on a falling tide on the demarcation line which is the beach front. Now, outside of that, we'll dredging on a rising or falling tide because the sand don't move more than 200 ft and we're not putting anything in the estuaries.' [But], if you've got a good northeast wind, like a good 20 knot, 25 knot northeast wind and he's in that inlet right there outside the demarcation line dredging on a rising tide, you can see the sand all the way back in the waterway where I'm at. Like in the fall when they're doing it a lot, I'll go out one day and the water'll be crystal clear I'll be looking mullets and I'll get to the ramp the next day and the water is just *nasty* and I'll go, 'Oh! The dredge is back.'"

4.3.1.3 Managers

Resource Use

The managers more frequently mentioned compatibility-related resource use drivers between crab potting and navigational dredging than conflict-related resource use drivers (Table 11). The managers discussed every compatibility-related resource

use driver but two between crab potting and navigational dredging. The most frequently discussed compatibility-related resource use drivers were *spatial overlap* (9 mentions), *environmental conditions* (6 mentions), *resource distribution* (5 mentions), and *resource conditions* (5 mentions). Other compatibility-related resource use drivers between crab potting and navigational dredging discussed by managers include: *temporal overlap* (3 mentions), *defined rights* (2 mentions), and *historic use* (2 mentions).

Most managers mentioned *spatial overlap* as a compatibility-related driver between crab potting and navigational dredging. One manager summarized the general sentiment when he said, "Most of the dredging in the small areas, we try to get the Corps to do it during the winter time if they can. There's not a lot of crab potting going on during that time period."

Another frequently discussed compatibility-related resource use driver between crab potting and navigational dredging was *environmental conditions*. Managers emphasized the conditions, specifically the tidal flow, that helped mitigate the potential conflict between crab potting and navigational dredging. When I asked one manager if crab potting and navigational dredging occurred in the same area, he responded: "Well, yeah, they work some of those areas but the tide is usually so strong in those areas that a lot of the guys don't work those areas. […] They'll work back from a lot of the dredge areas."

Managers also discussed compatibility-related *resource condition* and *resource distribution* resource use drivers that seem to influence the interactions between crab potting and navigational dredging. One manager described an example of the

compatibility-related *resource condition* driver when he discussed how other coastal resources and organisms may actually benefit from navigational dredging operations near Roanoke Sound:

> "And some of the dredge spoil is put on dredge spoil islands, particularly in Roanoke Sound. There's quite a few dredge spoil islands along that channel. That channel has to be maintained not on too regular of a basis, but every once in awhile, there will be a shoal area in there and those dredge spoil islands are pretty much full and are being utilized as bird nesting habitat, colonial bird nesting habitats. If you build an island, they'll use it eventually."

Another manager described the compatibility-related *resource condition* driver as he discussed how navigational dredging probably does not have a large impact on the blue crab resource:

> […] as far as the other areas, I think the guys just realize it's a, it just happens, and it is going to impact the blue crabs, but hopefully not as bad, hopefully not too bad. And if they do it right now [in the summertime], the crabs are active so they should be able to avoid the gear."

One manager described the compatibility-related *resource distribution* resource use driver when he suggested that it was unlikely that the navigational dredge operations were impacting blue crabs because the blue crab spawning sanctuaries are on the western edge of the inlets while the "eastern edge of these inlets [are] usually very high energy and [have] a lot of tide, a lot of wind, and that's usually where the dredging occurs."

The managers mentioned very few conflict-related resource use drivers between crab potting and navigational dredging; only half of them mentioned any conflict-related drivers (4 mentions). *Environmental conditions, resource conditions, spatial overlap,* and *temporal overlap* were all discussed as negative resource use

drivers (1 mention each). One manager discussed the potential *spatial* and *temporal* conflict-related resource use drivers:

> "I mean, there are times when we have a relatively, probably significant number of crabs that are going through the inlets out to the ocean to spawn. And if they're doing a dredging operation during that time, then yeah, [navigational dredging] could impact them."

User Group

Compatibility-related and conflict-related user group drivers between crab potting and navigational dredging were each mentioned three times (Table 11). The following compatibility-related drivers were mentioned by the managers: *values, interests, and priorities* (2 mentions) and *environmental attitudes* (1 mention). One manager described how fishermen in the Northern region share similar values and environmental attitudes towards navigational dredging:

> "A lot of the commercial guys, particularly in the [Albemarle and Pamlico Sound] area are pro-stabilization of the inlet and they know that it has to be dredged constantly almost to keep that inlet open so that they can navigate or their friends can navigate in and out of that inlet. So, they may not say anything about dredging or have a negative opinion about dredging because it's a positive to them because it keeps the flow of traffic going."

The only conflict-related user group driver between crab potting and navigational dredging mentioned by the managers, *knowledge and interpretation of facts*, was discussed only three times. Much of the discussion revolved around the managers' lack of knowledge about certain aspects of blue crab biology or why navigational dredging occurred during the winter months. For example, one manager stated,

> "But when you're talking about the inlet dredging, channel dredging – that's where those adult crabs…this is where you need to talk to the crab guys. But, supposedly that's where they bury down in the winter. Well, we tell them to

> dredge in the inlets in the winter because there's turtle restrictions, bird restrictions, more productivity in warmer weather."

Institutional Structure

One manager mentioned a single compatibility-related institutional structure driver between crab potting and navigational dredging once. This manager, from the Southern region, discussed positive *policy implementation and enforcement.*

No managers mentioned any conflict-related institutional structure drivers between crab potting and navigational dredging (Table 11).

4.3.1.4 Army Corps of Engineers

Resource Use

The two Army Corps respondents more frequently mentioned compatibility-related resource use drivers (36 mentions) between crab potting and navigational dredging than conflict-related resource use drivers (Table 11). The most frequently discussed compatibility-related resource use drivers were *resource condition* (15 mentions) and *spatial overlap* (12 mentions). Other compatibility-related resource use drivers discussed by these respondents include: *temporal overlap* (5 mentions), *resource distribution* (2 mentions), and *historic use* (2 mentions).

Both of the Army Corps of Engineers respondents discussed compatibility-related *resource condition* drivers between crab potting and navigational dredging. One of the respondents described a couple of types of dredging that occur in North Carolina and with each type, he explained why there is little risk to the blue crab as a result of dredging with that particular dredge. For example, hopper dredges, the most

common type of dredge used in North Carolina for deepwater ports, have a risk of incidental bycatch, but blue crabs have never been noted as a large portion of the bycatch. The sidecast dredge, a dredge commonly used in an inlet system, has the risk of turbidity, but it is almost exclusively used in areas with coarse sand so the risk of turbidity is reduced. He also stressed that communities living where dredging typically happens are resilient: "A lot of science shows that if you avoid the recruitment period and you use compatible sediment, meaning that you're not placing silt on a sandy beach, these communities recover quickly."

Both of the Army Corps' respondents also discussed the compatibility-related *spatial overlap* resource use driver between crab potting and navigational dredging. One of the Army Corps' employees, when discussing his experience with fishermen, stated that,

> "[…] it's often communicating what you're doing clearly, where, and the short-term and long-term effects. Their biggest concern is always the "not in my grounds" things and once they see that it's not in their area, they don't necessarily have any long-term concerns."

Additionally, many of the non-Civil Works projects needing permits are not where the crab potters typically set their pots:

> "Most of the dredging in the inlet waters are generally within old existing channels and they're just doing maintenance dredging. We don't look at a whole lot of new dredging. I mean we do, but it's infrequent, so the crab pot issue has never come up to my knowledge."

The Army Corps of Engineers' respondents also discussed the compatibility-related *temporal* resource use driver between crab potting and navigational dredging. In general, the Army Corps' respondents thought that by avoiding periods of peak biological activity in the summer, it was possible to minimize the harmful impacts to

the organisms. One employee stated, "If you avoid critical periods of recruitment, which is in the spring and summer, which we tend to do, you minimize that level of impact where that recruitment's much quicker."

However, both Army Corps of Engineers' respondents also discussed some conflict-related resource use drivers between crab potting and navigational dredging (13 mentions). They discussed the conflict-related *resource condition* (7 mentions) most frequently, followed by *spatial overlap* (5 mentions), and *historic use* (1 mention).

Each respondent noted the potential conflict-related *resource condition* resource use drivers between crab potting and navigational dredging. One respondent stated that many of the *resource condition* impacts considered are fishery related:

> "I would say generally from a fisheries standpoint, it's some of your larger projects like your beach nourishment and inlet projects – it's impacts to fisheries as it relates to maybe if they're dredging intertidal areas or shoal areas that are used by fisheries a lot, especially in the inlet areas and impacts to benthics."

Furthermore, when asked about impacts to blue crabs, one ACE employee responded by saying, "Oh yeah, anywhere they dredge, if there is something there [an organism], it's gone. And on the beach where they're placing the fill material, it's buried."

The other major conflict-related driver between crab potting and navigational dredging mentioned by both Army Corps respondents was the potential *spatial overlap*. One employee touched on the potential conflicting *spatial overlap* when he said,

> "I don't know if we've necessarily had interaction with a crabbing group or even a shrimping group. There's probably been only…the only situation I can think of where we may have had some fishery, commercial fishermen concerns is the military wanting to put restricted areas for bombing ranges. And when

> they put restricted areas up, they are no longer able to crab or fish in those areas."

User Group

The Army Corps respondents more frequently mentioned conflict-related user group drivers between crab potting and navigational dredging than compatibility-related user group drivers (Table 11). Only one of the Army Corps of Engineers' respondents touched on the following compatibility-related user group drivers between crab potting and navigational dredging: *values, interests, priorities* (4 mentions); *gear differences* (3 mentions); and *knowledge and interpretation of facts* (2 mentions). This respondent described the process he went through to access the fishermen's *knowledge* to help align the *values, interests, and priorities* of relevant stakeholder groups:

> "What I ended up doing was I went to the university, my old professors at UNCW and early in the study process said, 'Hey, from a resource standpoint, where are the critical blue crab spawning areas? Where are the critical shrimping areas?' And then from that, said 'Where's the industry at?' What we did was we kind of took the area of study and then boxed out these critical resource areas and then we, as the Corps, focused our borrow area investigation around these critical areas. That was how I kind of started the process…"

He concluded that story by saying,

> "It's easy to just say you had a meeting, but it's important to take that initiative and find them because it's not in our interest to spend hundreds of thousands of dollars studying something that once it's all documented [the fishermen] say, 'That's the stupidest thing I've ever seen. You're going to kill us.' We want to get that up front…"

This same respondent also touched on the compatibility-related *gear* driver between crab potting and navigational dredging and how the gear used for some of the navigational dredging in NC does not harm blue crabs:

> "Most of our work here, we do using a dredge called a hopper dredge. Hopper dredging has a risk of incidentally taking sea turtles, which is a big part of my job and a whole other topic. But, as part of that, we're required to have observers and screens on these dredges. Most of the bycatch, a large part of the bycatch is captured in that screening. Most of our bycatch is bottom fishes and a lot of horseshoe crabs sometimes. Blue crabs, though they've been documented, have never…it's not like we've ever, in my experience, been on a dredge where it's like 'Wow! Look at all these crabs!'"

He also describes the minimal impacts of the sidecast dredge that is used in shallow draft areas. He states,

> "The risk is turbidity, and a lot of environmental agencies don't like it because of the potential risk to larvae and fisheries but mainly submerged aquatic vegetation (SAV) and things like that. All of our areas that we do use it are coarse sand so your turbidity risk is low and then of course we're in areas where that risk of impacting some other habitat type is not there, it's just an open sandy environment."

The Corps' respondents mentioned conflict-related user group drivers more frequently than compatibility-related user group drivers between crab potting and navigational dredging (Table 11). These two respondents discussed the conflict-related driver, *knowledge and interpretation of facts* most frequently (19 mentions). They also mentioned *gear differences* (2 mentions), *values, interests, and priorities* (2 mentions), and *environmental attitudes* (1 mention) as conflict-related user group drivers.

While the Army Corps' employees did seem to try to access the knowledge about fishing grounds and habitat from the fishermen, they noted that there were differences in *knowledge and fact interpretation* among stakeholder groups. One Corps' employee described these knowledge differences:

> "But that's the challenge we have because nobody would agree. If you were to put five other people from resource agencies, they would probably disagree. But again, that's part of science. Everybody's going to make their own conclusion based on the data they have at hand."

Additionally, this same respondent noted that there is a general lack of understanding about how sand and sediments move through the ocean and inlet areas:

> "One of the big initiatives of the Corps right now, and actually Congress has been putting money towards, is what we call regional sand management. The acronym is RSM and in simple terms it is, instead of the Corps looking at things project-centric, saying, 'Oh, well we're looking at this study and this is all we're looking at,' it's saying, 'How does sediment move from the rivers to ocean? In that big system, what are all those components that are driving sediment movement? […] Do you truly understand your sediment budget and that inlet complex and littoral transport of material?'"

Gear was also a conflict-related driver between crab potting and navigational dredging discussed by the Army Corps of Engineers' respondents. One of the respondents noted that fishermen might lose their traps and buoys when a dredge comes through: "Well, you lose traps because the traps get pulled under and the buoys pull under and you can't find 'em." The other Corps respondent expressed how the dredge gear might contribute to conflict when he said,

> "The Corps only has a handful of its own fleet and sidecast dredges are one of those dredge types that we actually own and manage and we can quickly just say, 'Oh, Oregon Inlet shoaled in, we'll throw a dredge out there and get moving on it." But that would be…it's the most obvious dredge because you're shooting this sand outside. And I could see how the fishermen see that and go, 'Ohhh…" It's an obvious conflict in their interest.

Institutional Structure

The Corps' respondents mentioned more conflict-related institutional structure drivers than compatibility-related drivers between crab potting and navigational dredging (Table 11). Both Army Corps of Engineers' respondents mentioned some compatibility-related institutional structure drivers (4 total mentions) between crab potting and navigational dredging: *agency accountability* (2 mentions), *defined*

responsibilities (1 mention), and *institutional transparency* (1 mention). One respondent told a story to illustrate *agency accountability* and *institutional transparency*:

> "My effort for this particular project that I'm talking about was to avoid [impacting critical resources]. Once I felt I had down that, still then, disclose what we're doing relative to where [the fishermen] are and I haven't gotten to the point of receiving comments, but once the EIS is put out, I'm hoping that [a DMF employee] will be my liaison to get to [the fishermen], and make sure they have a clear understanding what we're doing and if I need to have a meeting to do that, that's what I would do. And then they would comment on the EIS what their critical concerns are."

Additionally, the second respondent illustrated the compatibility-related *agency responsibility* driver between crab potting and navigational dredging when he said, "So, we've conditioned permits quite often, especially if the dredging is done in the summer months. If it's a smaller type job, we'll require them to put [a silt fence] at the mouth of the canal or basin so any sediment is localized within the basin." The permit conditioning process illustrates the Corps' responsibilities with regard to minimizing impacts to water quality and natural resources.

The most frequently mentioned conflict-related institutional driver between crab potting and navigational dredging was *institutional transparency* (3 mentions). Other conflict-related institutional drivers mentioned include: *agency accountability* (1 mention), *fragmented structure* (1 mention), *policy implementation and enforcement* (1 mention), and *unclear regulations* (1 mention).

The lack of *institutional transparency* seemed to be related to the Army Corps' employees' lack of access to fishermen's knowledge. One of the respondents summarized it well when he said:

> "If it's not brought to our attention and if we don't know of a prime fish spot, then we're not going to know. That's why in some of the larger projects, we have tried to develop a team of different people. We'll have non-profit groups on there, somebody on there that has a consortium of 100 or 1000 people and they kind of represent those people and those interests. We try to get commercial fishermen to be on those teams, to say, 'Okay, this is what's being proposed, these are the things we are going to look at, can you tell us what you're concerned about?'"

I subsequently asked the respondent if he had good feedback from the commercial fishers and he replied,

> "No. […] But it's not like they're not invited. […] The arm is being extended, but they…Maybe it's the time, they don't want to put in the time or they don't have the time to put in to come to these meetings. Yeah, I don't know. But even if they don't come to the meetings, say, when we send out a public notice, they still have the opportunity to provide written comments. Personally, I've never received anything from a commercial fisherman that I remember."

4.3.2 CRAB POTTING VS. SHRIMP TRAWLING

In total, there were a couple more mentions of compatibility-related drivers mentioned (86 mentions) than mentions of conflict-related drivers (84 mentions) when study respondents described the interactions between crab potting and shrimp trawling (Table 12). User group drivers (77 mentions) were mentioned most frequently and the three relevant stakeholder groups mentioned compatibility-related user group drivers more frequently than conflict-related user group drivers. Resource use drivers were also discussed frequently (75 mentions) and conflict-related resource use drivers were mentioned more frequently than compatibility-related resource use drivers. Additionally, there were fewer total mentions of institutional structure drivers (16 mentions) and the three stakeholder groups mentioned conflict-related institutional

structure drivers more frequently than compatibility-related institutional structure drivers.

All compatibility-related resource use drivers were mentioned except the following: access competition, environmental conditions, historic use, and resource scarcity. All conflict-related resource use drivers were mentioned except for environmental conditions, historic use, resource condition, and resource scarcity. All compatibility-related user group drivers were mentioned except for environmental attitudes and historic interactions. All conflict-related user group drivers were mentioned except environmental attitudes. All compatibility-related institutional structure drivers were mentioned except the following: agency accountability, fragmented structured, institutional transparency, and unclear regulations. All conflict-related institutional structure drivers were mentioned except for agency accountability, defined responsibility, and fragmented structure (Table 12).

Table 12. Drivers of the perceived compatibilities and conflicts mentioned by relevant stakeholder groups regarding crab potting and shrimp trawling activities. The numbers in the table reflect the number of mentions for each driver.

	Northern Fishermen		**Southern Fishermen**		**Managers**		**Total Interact-ions**
Drivers	*Compat*	*Conflict*	*Compat*	*Conflict*	*Compat*	*Conflict*	
Resource Use							
Access Competition	0	2	0	0	0	0	2
Defined Rights	4	1	2	0	0	0	7
Environmental Conditions	0	0	0	0	0	0	0
Historic Use	0	0	0	0	0	0	0
Resource Distribution	2	4	1	1	1	1	10
Resource Competition	0	3	2	1	0	0	6
Resource Condition	0	0	4	0	1	0	5
Resource Scarcity	0	0	0	0	0	0	0
Spatial Overlap	7	15	6	2	2	5	37
Temporal Overlap	2	4	0	0	2	0	8
TOTAL	15	29	15	4	6	6	**75**
User group							
# of Participants	1	2	3	1	4	0	11
Environmental Attitudes	0	0	0	0	0	0	0
Gear Differences	0	7	2	0	0	4	13
Historic Interactions	0	0	0	0	0	2	2
Knowledge, Interpretation of Facts	3	1	0	2	2	0	8
Mutual Respect	15	7	4	1	3	0	30
Values, Interests, Priorities	6	6	0	1	0	0	13
TOTAL	25	23	9	5	9	6	**77**
Institutional Structure							
Agency Accountability	0	0	0	0	0	0	0
Defined Responsibilities	0	0	0	0	3	0	3
Fragmented Structure	0	0	0	0	0	0	0
Institutional Transparency	0	1	0	0	0	0	1
Policy Implementation & Enforcement	0	7	0	0	2	0	9
Unclear Regulations	0	3	0	0	0	0	3
TOTAL	0	11	0	0	5	0	**16**

4.3.2.1 Northern Fishermen

Resource Use

The Northern fishermen more frequently mentioned conflict-related resource use drivers between crab potting and shrimp trawling than compatibility-related drivers (Table 12). In terms of compatibility-related drivers, the Northern fishermen

most frequently discussed *spatial overlap* (7 mentions) and *defined rights* (4 mentions) resource use drivers between crab potting and shrimp trawling. They also mentioned *resource distribution* (2 mentions) and *temporal overlap* (2 mentions) as compatibility-related resource use drivers.

Northern fishermen most frequently discussed the compatibility-related *spatial overlap* driver. When I asked if crab potters and shrimp trawlers ever interacted, one Northern fisherman answered, "Not in these bays. Offshore sometimes. In the spring and sometimes in the fall." Another Northern fisherman described how even if crab potters and shrimp trawlers were working in the same area, it was possible to avoid conflict:

> "And most of the guys space the crab pots 20 or 30 yards apart, so a lot of times, I can trawl in between their pots and not even mess 'em up 'cause normally their rows are running with the river and I can tow right beside them […] and not catch 'em."

Northern fishermen also discussed the compatibility-related *defined rights* resource use driver between crab potting and shrimp trawling (4 mentions). Some of the Northern fishermen mentioned the 6-foot depth contour line rule that separates the crab potters and shrimp trawlers to illustrate how clearly *defined rights* encourage compatibility between these crab potting and shrimp trawling. One fisherman stated,

> "When the water's cold, or getting cold, or just starting to warm up, sometimes trawl boats and crab potters are trying to work the same area. But, we usually work our problems out. We stay inside of a certain line [the 6 foot depth contour line] with the crab pots and they stay outside of that line with the trawl nets."

The Northern fishermen more frequently discussed conflict-related resource use drivers between crab potting and shrimp trawling throughout their interviews. The most frequently mentioned conflict-related resource use driver was *spatial overlap*

(15 mentions), followed by *resource distribution* and *temporal overlap* drivers (4 mentions each). *Resource competition* (3 mentions), *access competition* (2 mentions), and *defined rights* (1 mention) were also mentioned by Northern fishermen as conflict-related resource use drivers between crab potting and shrimp trawling.

Almost all of the Northern fishermen noted some sort of conflict-related *spatial* driver between crab potting and shrimp trawling. When I asked one Northern fisherman to describe the relationship between crab potters and trawlers, he said, "I don't know the best way to word that. I mean it's fine, it's okay, as long as you're not trying to work the same areas, I reckon…" Another fisherman described his experience with crab potting and trawling by saying: "There's a little bit of confrontation 'cause sometimes they're trying to work the same grounds and if we're trawling, the crab pots, sometimes they're in your way."

Four different Northern fishermen also discussed the conflict-related *temporal* resource use driver between crab potting and shrimp trawling. Most of these fishermen noted that trawlers often ran over their pots at night. For instance, one fisherman said, "Yeah, we'd get out of their way, but sometimes, you don't know when they're gonna be there and you don't have time to move 'em. Like if they come at night or something." Another fisherman stated,

> "Well, generally you know the seasons and you know where they're gonna work at so you try to keep your gear out of their way. If they come into your area at night, they don't know you're there, they can't see your gear so the best thing you can do is try to get out of their way."

Northern fishermen also touched on the conflict-related *resource distribution* resource use driver between crab potting and shrimp trawling. One fisherman described this driver within the context of the 6-foot depth contour line rule. He

argued that this line prevents the crab potters from going to where the crabs are located:

> "If it was open, see I could, next week when shrimping starts, I could just flip flop my pots over and just go on up the river and that crowd of shrimpers could have that place where I am. And that's where they want to be anyway, they don't want to be in the river shrimping. They want to go where I am, out…"

User Group

Northern fishermen more frequently mentioned compatibility-related user group drivers than conflict-related user group drivers between crab potting and shrimp trawling (Table 12). The Northern fishermen most frequently cited the compatibility-related *respect* user group driver between crab potting and shrimp trawling (15 mentions). *Values, interests, and priorities* (6 mentions), *knowledge and interpretation of facts* (3 mentions), and *number of participants* (1 mention) were also discussed by the Northern fishermen as compatibility-related user group drivers between crab potting and shrimp trawling.

Ten of the thirteen Northern fishermen mentioned *respect* as a compatibility-related user group driver. One fisherman stated, "Well, like if we're crabbing and they're shrimping and they're making a lot of money, you just kind of respect them and get out of the way. Every now and then you'll get a little interaction, but for the most part, I'd say it's pretty good." Another Northern fisherman stated, "I mean I've got friends that are trawlers and they say, 'Man, I'd like to get up there around that oyster rock, around that slough, can you move 10 pots?' I don't care about that. I mean I'm not…I know I don't own that sound."

To complement the *respect* driver, the *values, interests, and priorities* (6 mentions) user group driver also seemed to influence the compatibility between crab potting and shrimp trawling. One Northern fisherman described the compatible *priorities* among the trawlers and crab potters: "They know you're trying to earn a living and they're trying to earn a living as well. I don't want to mess up my gear that'll cost thousands of dollars and they don't want us catching their crab pots that cost $40 a piece." Another fisherman described a similar situation:

> "I think it's like [*name*] told you, the other fellow, every 7 or 8 years there'll be a little conflict and you know, the trawlers might not even get up there because it might be a good year shrimping. You know, they're just trying to fill in their vacancy and I'm trying to make a living in the same place. But usually, we work it out."

The Northern fishermen also mentioned the compatibility-related *knowledge* user group driver between crab potting and shrimp trawling. However, this *knowledge* refers to the tight-knit nature of their fishing community rather than factual knowledge. One Northern fisherman described how the fishermen in the Northern region all know each other:

> "We know most of the boys fishing or trawling, either one of them, we keep up with who's doing what and where. If the shrimp are coming, we'll start telling them, 'In a couple of weeks we're gonna start working at the mouth of the rivers,' and they'll start easing their pots out or moving them inshore."

Another fisherman echoed this sentiment when he said,

> "I've got most of their phone numbers so if their crab pots are in the area where I know that the shrimps boats are getting ready to work, I'll call them ahead of time and say, 'There's some shrimp right over your crab pots. You should probably move them because there's gonna be 20-30 boats working there tomorrow night."

The Northern fishermen most frequently mentioned the following conflict-related user group drivers between crab potting and shrimp trawling: *gear differences*

(7 mentions), *lack of mutual respect* (7 mentions), and *values, interests, and priorities* (6 mentions). Northern fishermen also mentioned *number of participants* (2 mentions) and *knowledge and interpretation of facts* (1 mention) as conflict-related user group drivers between crab potting and shrimp trawling.

The conflict-related *gear* user group driver between crab potting and shrimp trawling was one of the more frequently mentioned by the Northern fishermen. One Northern fisherman summarized the general sentiment when he said, "The gear conflicts, one stays there all the time, one goes through and leaves. So you know, they're gonna have conflicts…"

Four Northern fishermen discussed instances where *mutual respect* was not expressed between crab potters and trawlers. One fisherman stated,

> "Once in awhile, you get someone away from here that don't know anyone that'll just plop down and drag through people's stuff. Most of the time, it's people who come from out of state or even from below that just don't realize what's going on."

Lastly, the misalignment of *values, interests, and priorities* among different fishermen was also mentioned and may influence the conflicts between crab potting and shrimp trawling. One Northern fisherman stated,

> "Most of the guys I work around, they trawl. They're not going to catch my gear and take my gear up because they know my family. I've got a business and a boat, and they understand. If you get somebody that doesn't own the boat and he just jumps on there and he's trying to get his next high, you know?"

Institutional Structure

Northern fishermen mentioned conflict-related institutional structure drivers more frequently than compatibility-related institutional structure drivers between crab

potting and shrimp trawling (Table 12). Only one Northern fisherman discussed a compatibility-related institutional structure driver between crab potting and shrimp trawling: *policy implementation and enforcement*.

Northern fishermen mentioned the following conflict-related institutional structure drivers between crab potting and shrimp trawling most frequently: *policy implementation and enforcement* (7 mentions), *unclear regulations* (3 mentions), and *institutional transparency* (1 mention).

Five different Northern fishermen mentioned the conflict-related *policy implementation and enforcement* institutional structure driver regarding crab potting and trawling. One fisherman described his discontent with the 6-foot depth contour rule,

> "The width is 6 foot where the crabber has to get, legally. That's not where the crabber wants to get most of the time. As long as there's not an issue with dead water, you want to be offshore. And it puts everybody trying to work in one little spot."

Another fisher expressed similar feelings, "The worst thing about that [rule] is, there is very, very little trawling up there [in the rivers] where that [rule is] happening. Years ago there used to be, but now? I mean that's really where we need to be going."

Three Northern fishermen also mentioned *unclear regulations* as a conflict-related driver between crab potting and trawling. One fisherman expressed his frustration with the 6-foot depth contour rule: "Yeah, I hate it. [The 6 foot depth contour rule] is strictly for trawl boaters and it eliminates the crab potters from being able to go out in the deep."

4.3.2.2 Southern Fishermen

Resource Use

The Southern fishermen more frequently mentioned compatibility-related resource use drivers between crab potting and shrimp trawling than conflict-related resource use drivers (Table 12). Southern fishermen most frequently discussed the compatibility-related *spatial* resource use driver between crab potting and trawling (6 mentions). This stakeholder group also mentioned *resource condition* as a compatibility-related resource use driver between crab potting and shrimp trawling (4 mentions), as well as *resource competition* (2 mentions), *defined rights* (2 mentions), and *resource distribution* (1 mention).

All four Southern fishermen mentioned the compatibility-related *spatial* resource use driver. One fisherman, when asked if he ever encountered shrimpers out on the water, replied, "I don't, no. Not the type of crabbing I do. So I crab in the, up the river where it's not even open for shrimping or anything like that. So, I'm never around any shrimpers." Another Southern fisherman described crab potters and trawlers' interactions by saying,

> "Yeah, we don't have no problems. No, just certain places they drag and we stay outta their way and a lot of places they can't drag so we got it to ourselves. But no, we usually don't have no problems. Very rarely. If the tide moves a pot out and they're dragging the bottom, some of them might get mad but we move it right back out of the way. It ain't no problem."

Southern fishermen also noted compatibility-related *resource condition* drivers; three Southern fishermen discussed the minimal impact of shrimp trawling on the blue crab. One fisherman described this by saying,

> "[Trawlers] catch mostly white shrimp here. We ain't got no brown shrimp in the river no more. That [brown shrimp] net trawled more on the bottom and

> caught a few crabs but the white shrimping net, they pretty much drag over top of them. So I mean I don't think, that's not enough impact to hurt anything. There's only just this little bit of ground they drag on […] so it's not enough here to hurt anything."

The Southern fishermen also mentioned some conflict-related resource use drivers between crab potting and shrimp trawling. The most frequently discussed conflict-related resource use driver was *spatial overlap* (2 mentions). The conflict-related *resource distribution* and *resource competition* resource use drivers were each mentioned once.

One Southern fisherman described the potential *spatial overlap* that contributes to conflict when I asked him what it was like when crab potters and trawlers interacted:

> "When they're setting pots in the same area they're shrimping in…everybody wants to be in the same place. You know, sometimes they'll have to move some traps to help some people out. Stuff like that. Places where they may want to turn around. It's open for those types of things at the same time."

User Group

The Southern fishermen more frequently mentioned compatibility-related user group drivers between crab potting and shrimp trawling than conflict-related user group drivers (Table 12). They most frequently mentioned *mutual respect* as a compatibility-related user group driver between crab potting and shrimp trawling (4 mentions). They also mentioned *number of participants* (3 mentions) and *gear differences* (2 mentions) as compatibility-related user group drivers between crab potting and shrimp trawling.

To illustrate the compatibility-related *respect* and *number of participants* user group drivers, one Southern fisherman commented on the unique nature of the fishing community in the Southern region:

> "No, I mean we don't have no problem with [the trawlers]. […] all of us know each other and stuff, stay out of each other's way. It's a pretty friendly environment around here – it's kind of a neat place. Ain't that many people shrimp and ain't that many people crab. It works out good. We got a good group of people around here. This is kind of a neat area around here, it's a real neat area."

Another Southern fisherman discussed the compatibility-related *gear* driver. One of his quotes summarizes the general sentiment well: "Yeah, we don't have no problems. No, just certain places they drag and we stay outta their way and a lot of places they can't drag so we got it to ourselves. But no, we usually don't have no problems. Very rarely."

The Southern fishermen also discussed some conflict-related user group drivers between crab potting and shrimp trawling: *knowledge and interpretation of facts* (2 mentions)*, number of participants* (1 mentions)*, mutual respect* (1 mention)*, and values, interests, and priorities* (1 mention). One Southern fisherman expressed the conflict-related *knowledge* driver when he discussed whether he believed trawling was actually beneficial for the benthic environment:

> "You know? I'll be honest with you. I don't know, and I also do a trip where I drive all the way to Cedar Island, […] and I asked them about how the, seeing the difference year to year and ask about their catch and I know this sounds crazy, but they think that a lot of times when you stir up the bottom from trawling that it's going to re-grow. I know it sounds crazy, but at the same time, they may have something to it […]."

Institutional Structure

Only one Southern fisherman mentioned a compatibility-related institutional structure driver between crab potting and shrimp trawling once: *policy implementation and enforcement*. This fisherman noted,

> "Well, NC is different from most states. We have a line, when shrimp season starts, they put up poles, [crab potters] can't go on one side of them and shrimpers can't go on the other side of them down this way. So we [crab potters] have hardly no controversy with the other group [shrimpers]."

None of the Southern fishermen discussed any conflict-related institutional structure drivers between crab potting and shrimp trawling.

4.3.2.3 Managers

Resource Use

The managers mentioned compatibility-related and conflict-related resource use drivers and equal number of times each (6 mentions) (Table 12). The coastal and fisheries managers mentioned a few different compatibility-related resource use drivers between crab potting and shrimp trawling. The two most frequently mentioned compatibility-related drivers were *spatial overlap* and *temporal overlap* (2 mentions each). Managers also discussed *resource distribution* and *resource condition* (1 mention each) as compatibility-related resource use drivers between crab potting and shrimp trawling.

One manager discussed the compatibility-related *spatial* driver when he said, "A lot of times, these are relatively small areas [where a trawler wants to go], so a guy probably wouldn't have over 25-50 pots in that area so he could get them up in a very short time and put them back in very short time." Another manager stated after a

certain time, "[crabbers] have to stay within the 6 foot depth contour or [they] have to stay within 300 yards of the shore. So it kind of separates the groups [crab potting and shrimp trawlers]. It's so full of pots, [trawlers] can't navigate very well in there so [they] stay out."

Two managers also noted that there was a lack of *temporal overlap* which influences the compatibility between crab potting and shrimp trawling. One manager described how many fishermen participate in multiple fisheries during which occur during different seasons:

> "A lot of the crabbers will crab during the season, which is most of the, well, from early spring on through maybe it's December and then they'll take up their pots and they'll go to oystering or trawling. So, there are a lot of multi-fishery [guys]."

The managers also discussed two conflict-related resource use drivers. They discussed the conflict-related *spatial overlap* resource use driver between crab potting and shrimp trawling most frequently (5 times) and only mentioned *resource distribution* once.

Four of the six managers noted the conflict-related *spatial overlap* resource use driver. One stated, "If you have both of these groups in the same area, then conflicts arise. You have the stationary pot gear with their pots on the bottom with buoys and ropes sticking up." When asked to describe the relationship between crab potters and shrimp trawlers, one manager stated, "As long as they're separated, everything goes real well."

One manager described the conflict-related *resource distribution* resource use driver as he spoke about how the resources desired by crab potters and shrimp trawlers

overlapped: "[Crab potters] were putting their pots out there where [trawlers] were going. The trawlers want to go in there for the fish!"

User Group

The managers more frequently mentioned compatibility-related user group drivers between crab potting and shrimp trawling than conflict-related (Table 12). The managers mentioned three compatibility-related user group drivers between crab potting and shrimp trawling: *number of participants* (4 mentions), *mutual respect* (3 mentions), and *knowledge and interpretation of facts* (2 mentions).

Two managers noted that the *number of participants* in the shrimp trawling industry were low enough to not cause serious conflict. One manager stated, "And then down here, the Cape Fear […] the guys know each other. It's a much smaller crew, it's pretty difficult to get into, so that definitely seems to control it."

Three managers also each discussed *respect* as a compatibility-driver between crab potting and shrimp trawling. One manager said, "The guys that have pots in that area – and these guys know, they've worked in that area a lot together – they'll get their pots out of there so that guy can go long haul and then after he's done, they can put their pots back."

Only two conflict-related user group drivers between crab potting and shrimp trawling were mentioned by any of the managers: *gear differences* (4 mentions) and *historic interactions* (2 mentions). When describing the conflict-related *gear differences*, one manager said,

> "If you have both of these groups in the same areas, then conflicts arise. You have the stationary pot gear with their pots on the bottom with buoys and ropes

> sticking up. They're gonna conflict with mobile gear, like trawlers, like recreational and commercial boaters."

Institutional Structure

Managers more frequently mentioned conflict-related institutional structure drivers between crab potting and shrimp trawling than compatibility-related institutional structure drivers. In terms of compatibility-related institutional structure drivers, a single manager discussed clearly *defined responsibilities* (3 mentions) and effective *policy implementation and enforcement* (2 mentions). This manager described the processes and rules in place to help deal with conflicts and separate crab potting and shrimp trawling to illustrate *defined responsibilities*. When describing effective *policy implementation and enforcement*, this manager stated,

> "They started having conflicts because you don't want to get a pot caught in your trawl and you don't want to lose your pot to a trawler because it does damage. So that's why the designated pot areas – that's the way it's references in our rule – the 6 foot contour. And then there are some areas that have a yardage distance from shore, but we've tried to go to all the depth contours because that's easier for law enforcement and it's easier for the crabbers to know where they're at, and the trawlers also. Everyone can look at a map or a depth finder and within a foot or two of reason, they can determine where they are and where they should be."

No managers discussed any conflict-related institutional drivers between crab potting and shrimp trawling.

4.3.3 CRAB POTTING VS. COMMERCIAL CRAB AND OYSTER DREDGING

In total, compatibility-related drivers were mentioned more frequently than conflict-related drivers as study participants discussed the interactions between crab potting and commercial crab and oyster dredging (Table 12). Resource use drivers (38

mentions) were most frequently mentioned and the three relevant stakeholder groups mentioned more compatibility-related resource use drivers than conflict-related resource drivers. User group drivers (19 mentions) were mentioned next most frequently and the three stakeholder groups also mentioned more compatibility-related user group drivers than conflict-related user group drivers between crab potting and commercial crab and oyster dredging. Additionally, only two mentions were made for any institutional structure drivers and these were both compatibility-related drivers between crab potting and commercial crab and oyster dredging.

All compatibility-related resource use drivers were mentioned except for access competition and resource scarcity. All conflict-related resource use drivers were mentioned except access competition, historic use, resource distribution, resource competition, and resource scarcity. All compatibility-related user group drivers were mentioned except the number of participants and environmental attitudes. All conflict-related user group drivers were mentioned except the following: number of participants, environmental attitudes, gear differences, and historic interactions. The only compatibility-related institutional structure drivers mentioned were defined responsibility and policy implementation and enforcement. No conflict-related institutional structure drivers were mentioned (Table 13).

Table 13. Drivers of the perceived compatibilities and conflicts mentioned by relevant stakeholder groups regarding crab potting and commercial crab and oyster dredging activities. The numbers in the table reflect the number of mentions for each driver.

	Northern Fishermen		**Southern Fishermen**		**Managers**		**Total Interact-ions**
Drivers	*Compat*	*Conflict*	*Compat*	*Conflict*	*Compat*	*Conflict*	
Resource Use							
Access Competition	0	0	0	0	0	0	0
Defined Rights	1	1	0	0	0	0	2
Environmental Conditions	5	0	1	0	6	0	12
Historic Use	0	0	0	0	1	0	1
Resource Distribution	3	0	1	0	2	0	6
Resource Competition	1	0	0	0	0	0	1
Resource Condition	1	0	0	1	1	0	3
Resource Scarcity	0	0	0	0	0	0	0
Spatial Overlap	3	1	0	0	2	0	6
Temporal Overlap	3	1	0	0	3	0	7
TOTAL	17	3	2	1	15	0	**38**
User group							
# of Participants	0	0	0	0	0	0	0
Environmental Attitudes	0	0	0	0	0	0	0
Gear Differences	1	0	0	0	1	0	2
Historic Interactions	0	0	0	0	1	0	1
Knowledge, Interpretation of Facts	0	7	0	0	1	0	8
Mutual Respect	3	1	0	0	1	0	5
Values, Interests, Priorities	1	1	0	0	1	0	3
TOTAL	5	9	0	0	5	0	**19**
Institutional Structure							
Agency Accountability	0	0	0	0	0	0	0
Defined Responsibilities	0	0	0	0	1	0	1
Fragmented Structure	0	0	0	0	0	0	0
Institutional Transparency	0	0	0	0	0	0	0
Policy Implementation & Enforcement	0	0	0	0	1	0	1
Unclear Regulations	0	0	0	0	0	0	0
TOTAL	0	0	0	0	2	0	**2**

4.3.3.1 Northern Fishermen

Resource Use

Northern fishermen most frequently mentioned compatibility-related resource use drivers between crab potting and commercial crab and oyster dredging than

conflict-related resource use drivers (Table 13). Fishermen in the Northern region most frequently mentioned *environmental conditions* (5 mentions) as a compatibility-related resource use driver between crab potting and commercial crab and oyster dredging. They also mentioned *resource distribution*, *spatial overlap*, and *temporal overlap* as compatibility-related resource use drivers (3 mentions each). *Defined rights*, *resource competition*, and *resource condition* were each mentioned once as compatibility-related resource use drivers between crab potting and navigational dredging.

The four Northern fishermen who discussed *environmental conditions* as a compatibility-related resource use driver between crab potting and navigational dredging cited seasonal water temperatures as helping these two activities to coexist. One Northern fisherman stated, "Once in a while, the crabs go on the [oyster] shells. But once the oystering starts, the crabs are already in the mud. I mean it's cool enough they'll go into the mud. [Oystering] will affect 'em a little bit, but not a whole lot I don't believe."

When discussing *resource distribution*, one fisherman stated, "Like I said, most of the crabs, when it's time to oyster, they've moved to the eastern side, they're not here no more. I mean it's got to be cold enough to catch 'em. I mean we've never had any trouble with them."

When talking about the compatibility-related *spatial overlap* driver, one Northern fisherman stated,

> "No, all the times we're oystering, when we're working those areas you're talking about, we call 'em oyster rocks, but anyway, if you catch any crabs, sometimes you'll catch crabs around the edges of 'em 'cause around the edges

> of them a lot of time is soft bottom and you'll catch some crabs. But that's rare […]."

Lastly, one Northern fisherman succinctly described the compatibility-related *temporal overlap* resource use driver between crab potting and commercial crab and oyster dredging when he said, "Well the oyster dredgers and the crab potters have very little conflict as they're really two different seasons."

Northern fishermen also mentioned a few conflict-related resource use drivers between crab potting and commercial crab and oyster dredging, but very infrequently. *Undefined rights*, *spatial overlap*, and *temporal overlap* were all mentioned once by the same Northern fisherman.

User Group

The Northern fishermen more frequently mentioned conflict-related user group drivers between crab potting and commercial crab and oyster dredging than compatibility-related user group drivers (Table 13). Northern fishermen most frequently mentioned *mutual respect* when discussing compatibility-related user group drivers between crab potting and commercial crab and oyster dredging (3 mentions). *Values, interests, and priorities* and *gear differences* were also discussed as compatibility-related user group drivers (1 mention each).

Three different Northern fishermen each mentioned the *mutual respect* compatibility-related user group driver. One fisherman stated that, "Everyone just works around each other […]."

The most discussed conflict-related driver was the difference in *knowledge and interpretation of facts* (7 mentions). *Mutual respect* and *values, interests, and priorities* were also mentioned as conflict-related user group drivers (1 mention each).

The conflict-related *knowledge* user group driver between crab potting and commercial crab and oyster dredging was evident when some Northern fishermen discussed the idea that bottom disturbing activities may actually be beneficial for the benthos while few of the managers held this same view. One fisherman expressed this idea:

> "As far as oyster dredging that digs into the bottom…see all these shells out there and stuff and the oyster. If you don't work that stuff a little bit and keep them shells out of the bottom, they ain't going to catch nothing 'cause they're going to sand up, mud up, cover up. If you work them and keep them out of the bottom, then they can catch, they'll have a chance to do something. But a lot of people don't understand that, that that's what you gotta do."

Another fisherman compared this practice to farming: "[Oyster dredging] cleans the bottom. That bottom out there ain't no different from farmland. If you don't plow it every now and then, it won't grow up. Nothing's gonna grow on it."

Institutional Structure

No Northern fishermen mentioned any compatibility- or conflict-related institutional structure drivers between crab potting and commercial crab and oyster dredging (Table 13).

4.3.3.2 Southern Fishermen

Resource Use

There were only two compatibility-related resource use driver mentions and only one conflict-related resource use driver mention between crab potting and commercial crab and oyster dredging (Table 13). Only one Southern fisherman mentioned two resource use compatibility-related drivers between crab potting and commercial crab and oyster dredging: *environmental conditions* and *resource distribution* (1 mention each.) He described how the water temperature in the Southern region was not conducive for enough crabs to bury down in the winter for crab dredging to be profitable:

> "But as far as like crab and oyster dredging, I think more of that you're going to see further North. It'd be like, there's just no reason for it down here because it's just so warm. If it got cold enough and the market demand was enough, you'd see more of that."

Additionally, only one Southern fisherman discussed any conflict-related resource use conflict drivers between crab potting and commercial crab and oyster dredging. This fisherman discussed the potential harmful impacts of commercial crab and oyster dredging on the *resource condition*:

> "I think that's a bad practice right there. […] I bet it's a sorry way of catching crabs. Just about have to be – if you're digging them out of sand, that's a pretty fragile thing, a crab is. I mean people think they're tough, but they ain't that tough, you know?"

User Group

No Southern fishermen mentioned any compatibility- or conflict-related user group drivers between crab potting and commercial crab and oyster dredging (Table 13).

Institutional Structure

No Southern fishermen mentioned any institutional structure compatibility or conflict drivers between crab potting and commercial crab and oyster dredging (Table 13).

4.3.3.3 Managers

Resource Use

The managers mentioned compatibility-related resource use drivers between crab potting and commercial crab and oyster dredging more frequently than conflict-related resource use drivers (Table 13). The managers discussed several compatibility-related resource use drivers between crab potting and commercial crab and oyster dredging. The most frequently discussed compatibility-related driver was *environmental conditions* (6 mentions). Managers also mentioned *temporal overlap* (3 mentions), *spatial overlap* (2 mentions), *resource distribution* (2 mentions), *resource condition* (1 mention), and *historic use* (1 mention) as compatibility-related resource use drivers between crab potting and commercial crab and oyster dredging.

One manager described the *environmental condition* compatibility-related resource use driver when he answered why there was very little commercial crab and oyster dredging that goes on in the Southern region: "I think just the location of these small waterbodies, they just don't do it down here. Just such small areas and ours are intertidal." This manager continued on to say,

> "Down here, especially in this area, from Topsail Sound south, we have intertidal areas so at low tide, they just walk out there and the oysters are there. So gear, a lot of it is hand. I mean down here, it's primarily hand harvest with occasional tong, single tongs or even up tongs, but that's our main gear for

harvesting oysters. You can actually see what you're getting, look at what you're grabbing. So dredging is non-existent down here."

Another manager discussed the lack of *temporal overlap* when he described the crab potting and oyster and crab dredge season: "But actually active pots and active oyster dredge and crab dredge season? They don't really overlap that much."

Managers infrequently mentioned conflict-related resource use drivers associated with crab potting and commercial crab and oyster dredging (4 mentions total). Two managers discussed the potential *temporal overlap* between crab potting and commercial crab and oyster dredging (2 mentions). Additionally, these two managers noted that there was potential *spatial overlap* and *environmental conditions* that may contribute to conflict between the two groups (1 mention each). One manager summed up these conflict-related drivers when he stated: "On a mild winter, you won't be crab dredging, but on a mild winter some of the guys might be potting and you'll see oyster dredges out there, too."

User Group

The managers more frequently mentioned compatibility-related user group drivers between crab potting and commercial crab and oyster dredging than conflict-related user group drivers (Table 13). Two managers mentioned a variety of compatibility-related user group drivers but each only once: *gear, historic interactions, knowledge and interpretation of facts, mutual respect*, and *values, interests, and priorities*. One manager stated that *historic* dredging practices are generally well accepted: "The oyster dredge areas are areas that have historically been dredged and they don't feel like they're doing too much damage to the resource."

Additionally, one manager explained that the *mutual respect* that exists between crab potting and commercial crab and oyster dredging facilitates to the compatibility between the activities:

> "[…] everybody knows that this guy's trying to make a living doing what he does and this guy's trying to make living doing what he does. There's not a lot, not that I've heard, there's not a lot of negative sentiment towards a dredger by a potter because he's out there doing a bottom disturbing activity."

None of the managers discussed any conflict-related user group drivers between crab potting and commercial crab and oyster dredging.

Institutional Structure

Only one manager discussed any compatibility-related institutional structure drivers between crab potting and commercial crab and oyster dredging. This manager discussed clearly *defined responsibilities* and *policy implementation and enforcement* once.

None of the managers discussed any conflict-related institutional drivers between crab potting and commercial crab and oyster dredging (Table 13).

CHAPTER 5

DISCUSSION

This chapter provides a brief overview of the results, focusing on the most important interactions along North Carolina's coast and the drivers behind these interactions. I also address the hypotheses that I stated in Chapter 2. I discuss the results of this study within the context of the current literature to examine if the participants in my study experienced interactions and/or held perceptions similar to participants in other comparable studies. I also discuss the management implications and how these findings can be used to inform managers and improve marine spatial planning efforts in North Carolina. Finally, I discuss other issues dealing with this study and how this study can be improved upon in the future.

5.1 OVERVIEW

Different stakeholder groups thought differently about how crab potting interacts with navigational dredging, shrimp trawling, and commercial crab and oyster dredging along North Carolina's coast. Overall, each pair of activities examined was perceived as compatible. In terms of crab potting and navigational dredging, the Northern fishermen, managers, and Army Corps of Engineers' staff thought these two activities were generally compatible while the Southern fishermen tended to think they conflicted (Figure 5). In terms of crab potting and shrimp trawling, the Northern and Southern fishermen perceived these activities to be compatible while managers generally thought they conflicted (Figure 6). In terms of crab potting and commercial

crab and oyster dredging, the Northern fishermen and managers perceived these activities to be compatible while the Southern fishermen perceived them as conflicting (Figure 7).

5.2 TYPES OF INTERACTIONS: CONFLICTS AND COMPATIBILITIES

My first research hypothesis stated, *There are perceived conflicts and compatibilities that exist between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging.* Based on interviews with North Carolina stakeholders, I identified 10 types of interactions that occurred between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging: spatial, temporal, gear, benthic, water quality, biological, knowledge, traditional use, environmental conditions, and mutual respect. Spatial, temporal, gear interactions, and mutual respect (identified as cooperation/collaboration in the literature) were all interactions that emerged in my interviews that were also identified in the literature I reviewed. Additionally, some literature identified environmental concerns as a type of conflict, but did not specify the specific types of environmental concerns as I did in my study (environmental condition, water quality, benthic impacts, biological impacts). The other types of interactions were not based in the literature I reviewed; instead, these interactions emerged after employing the grounded theory approach. Because there were a variety of conflicts and compatibilities identified in this study between the pairs of activities, my first hypothesis was supported by the results of this study.

The four stakeholder groups (Northern fishermen, Southern fishermen, Managers, and ACoE staff) had different perceptions of how the four activity pairs interacted along North Carolina's coast. Overall, crab potting was perceived as compatible with navigational dredging, shrimp trawling, and commercial crab and oyster dredging because, for these activities, compatible interactions were discussed more frequently than conflicting interactions. However, as noted above, different conflicts and compatibilities were identified and emphasized among the stakeholder groups.

Differences in perceptions of conflicts and compatibilities of the different activities may be explained, in part, by differences in the Northern and Southern regions. Specifically, the types of fishing and dredging that go on in the two regions may influence respondents' perspectives. Commercial crab and oyster dredging does not occur in the Southern region but is still practiced, albeit on a small-scale, in the Northern region. Because Northern fishermen are more likely than Southern fishermen to participate in commercial crab and oyster dredging, they might be more accepting of the activity. Additionally, navigational dredging occurs primarily in the Southern region because the Port of Wilmington is located there and requires more frequent and intense maintenance than the inlet channels that are dredged in the Northern region. As a result, the fishermen in the Southern region may be more sensitive to the effects of navigational dredging and more likely to fault this activity for changes in the blue crab fishery. The presence, intensity, and frequency of these activities appear to be influencing stakeholder groups' perceptions of their compatibility or conflict with crab potting.

Additionally, the differences in perceptions of conflicts and compatibilities between the three pairs of activities may be partially explained by demographic differences among the fishermen respondents. Demographic characteristics, especially age and education (Jones and Dunlap, 1992; Van Liere and Dunlap, 1980; Dietz et al., 1998), have been show to influence perceptions, attitudes, and beliefs about one's surroundings. Other characteristics such as gender (Brody, 1984; Mohai, 1992) and race (Bullard, 1990; Dolin, 1988) have a much weaker and less consistent relationship to environmental perspectives and attitudes (Dietz et al., 1998). In the current study, education seemed to influence the responses and perception of two study participants in particular.

One Northern fisherman and one Southern fisherman had strikingly different perspectives and responses than the other respondents in each of their stakeholder groups and both of these respondents had earned bachelor's degree while most other fishermen in the study did not attend college. The Northern fisherman repeatedly voiced his unique concerns over the way inlet dredging is carried out, arguing that from a biological perspective, allowing natural inlets to come through would be beneficial. Additionally, he was the only respondent in the entire sample, including the managers, to mention individual fishing quotas as a possible management strategy.

The fisherman from the Southern region responded differently than the other three respondents regarding navigational dredging. For the most part, this fisherman had a positive perspective of navigational dredging and its impacts versus the other Southern fishermen who were adamant about its harmful impacts on the blue crab and the marine environment. Unlike the other three Southern fishermen who stated that

navigational dredging was filling in habitat, this fisherman argued that navigational dredging often created habitat by making deeper spots with soupy mud where crabs like to go.

The responses of these fishermen reflect unorthodox perspectives that the other respondents did not hold, suggesting that education may influence how these respondents perceive activities to interact. This is supported by McMillan et al.'s assertion that education exposes a person to a broader range of ideas and beliefs (1997).

5.3 DRIVERS OF INTERACTIONS: WHY ARE THERE CONFLICTS AND COMPATIBILITIES?

My second research hypothesis stated*, Conflict will be driven by different or misaligned user group characteristics, overlapping or negative impacts of resource uses, and/or unclear or inefficient institutional structure characteristics. Compatibility will be driven by similar or aligned user group characteristics, little to no overlap or impacts of resource uses, and/or clear and efficient institutional structure characteristics.* This hypothesis can be addressed by examining the various drivers that the respondents discussed throughout the interviews. Ten resource use drivers (Table 4), seven user group drivers (Table 5), and six institutional structure drivers (Table 6) were identified in the participants' responses. Multiple resource use drivers emerged that were identified in the literature including: access competition, defined rights, resource distribution, resource competition, resource condition, resource scarcity, and spatial overlap. Additionally, environmental, historic use, and temporal overlap resource use drivers emerged during my coding but were not

previously identified in my literature review. The user group drivers that were identified in the literature and emerged during interview coding include: environmental attitudes, gear differences, historic interactions, knowledge/interpretation of facts, and values, interests, and priorities. Mutual respect and the number of participants were user group drivers that emerged during coding but were not previously identified during my literature review. All of the institutional drivers that emerged during my interviews were also identified in the literature. This second hypothesis is supported because the conflict- and compatibility-related drivers outlined in the three driver sets of my framework (Figure 1) emerged during the interviews.

As noted in Chapter 3 (Methods), numbers of compatibility-related and conflict-related driver mentions may be indicative of the relative level of influence of each driver on compatible and conflicting interactions (Frazier et al., 1984). Interestingly, there were more total mentions of compatibility-related drivers than conflict-related drivers for each of the pairs of activities examined in this study (Table 10, Figure 8). This seems to support the results associated with my first hypothesis; each activity pair was perceived as generally compatible and for each activity pair and compatibility-related drivers were mentioned more frequently than conflict-related driver mentions.

Specifically, when discussing crab potting and navigational dredging, respondents more frequently mentioned compatibility-related drivers than conflict-related drivers, which appears to support the perception of compatibility between these activities. However, resource use drivers were the only driver set where

compatibility-related drivers were mentioned more frequently than conflict-related drivers (Table 10). Resource use drivers were also the most frequently mentioned drivers, suggesting that this set of drivers may be most influencing the perceived compatibility between crab potting and navigational dredging activities (Table 10).

When respondents described interactions between crab potting and shrimp trawling, they more frequently mentioned compatibility-related drivers than conflict-related drivers, which appears to support the perception of compatibility between these activities. Compatibility-related drivers were mentioned more frequently than conflict-related drivers for the user group driver and institutional structure driver sets (Table 10). Additionally, in total, the user group drivers were mentioned most frequently, suggesting that these drivers may have the greatest influence on the perceived compatibility between crab potting and shrimp trawling (Table 10).

When discussing the interactions between crab potting and commercial crab and oyster dredging, respondents more frequently mentioned compatibility-related drivers than conflict-related drivers, which appears to support the perception of compatibility between these activities. For all three driver sets, compatibility-related driver mentions outnumbered conflict-related driver mentions (Table 10). However, the resource use driver set had the greatest number of compatibility-related driver mentions, suggesting that the resource use drivers may have the greatest influence on the compatibility between crab potting and commercial crab and oyster dredging (Table 10).

In order to effectively address natural resource-based conflicts, managers must first understand human values are the root of the conflict (Cicin-Sain and Knecht,

1998). Typically, conflicts arise because of disagreements over values, interests, or facts (Cicin-Sain and Knecht, 1998). Conflicts rooted in differences in interests and facts are generally easier to resolve than those based on values. Factual conflicts, for example, can be more easily resolved through improved communication of facts versus trying to reconcile fundamentally different values among users (Cicin-Sain, 1992).

Cicin-Sain and Knecht (1998) argue that the first challenge for coastal managers when dealing with conflict is to understand *why* the conflicts are occurring and what kinds of consequences they may be incurring. Often times, conflict-mapping, a research methodology that is similar to the one used in this study, is employed to understand stakeholders' positions, the reasons for their positions, and the areas of compatibility and conflict (Cicin-Sain and Knecht, 1998). Understanding the dynamics of the conflicts and compatibilities is a prerequisite to developing effective resolutions (Buckles and Rusnack, 1999). Nie (2003) argues that there are four major areas managers need to understand in order to create effective and acceptable resolutions:

> "1) When conflicts are driven primarily by competing and mutually exclusive values
> 2) When conflicts are driven primarily by value trade-offs and problems stemming from the ranking of these values
> 3) Whether conflicts are due to competing values or to competing interests; and
> 4) When conflicts are driven primarily by more controllable factors, such as adversarial political institutions and processes, problematic statutory language, budgetary incentives, and divisive interest group strategies" (p. 309)

The driver sets examined within this study help to shed light on *why* these conflicts and compatibilities may be occurring. Specific drivers within each driver set provide clues as to whether the conflicts among these activities are value-based and interest-based (*values, interests, and priorities*), or fact-based (*knowledge and interpretation of facts*). Understanding the nature of the conflicts will help managers determine if the drivers are controllable or not and also provide a way to think about the problems underlying the current state of the policy and management processes (Nie, 2003).

5.4 DIFFERING PERCEPTIONS OF FISHERMEN AND MANAGERS

The fishermen and managers who participated in this study did not share the same perceptions of crab potting and shrimp trawling interactions. Both the Northern and Southern fishermen more frequently discussed compatible interactions between crab potting and shrimp trawling while the managers more frequently discussed conflicting interactions. It appears that managers were not aware of the unspoken agreements that existed between crab potters and shrimp trawlers that appear to influence the compatibility between crab potting and shrimp trawling. Nor did managers seem to fully understand how mutual respect largely allows these two seemingly conflicting activities to actually co-exist.

5.4.1 INFORMAL ARRANGEMENTS

The Northern and Southern fishermen both referred to informal arrangements that existed amongst the crab potters and the shrimp trawlers. The fishermen in both

regions have developed these arrangements for areas and times when crab potters and shrimp trawlers encounter each other. For instance, the fishermen in Sneed's Ferry, a small fishing town, have arranged specific times and areas for crabbing and shrimp trawling without any formal management intervention.

The managers perceived spatial overlap between crab potting and shrimp trawling to be a conflicting interaction because of the stationary nature of the crab pots and the highly mobile nature of the shrimp trawl. While the fishermen acknowledge that the spatial overlap *could* be a conflicting interaction, most discussed the ways they work around each other on a day-to-day basis to avoid this conflict. During times when they are not separated by the 6 foot depth contour rule (the management boundary established to separate crab potters and shrimp trawlers), crab potters will typically move their gear while a trawler is in an area and then replace his pots once the trawler has left.

These informal arrangements that exist along North Carolina's coast are similar to those that exist within the Maine lobster fishery, a fishery governed by both formal and informal arrangements. These arrangement have resulted in credible rules that have high levels of compliance and have influenced how Maine's lobster fishery is managed at the state level (Acheson, 2003; Wilson et al., 2007).

Additionally, Wilson et al. (2007) argue that collective action is more likely to occur and to be effective if it is consistent with the interests of the affected individuals. Interestingly, two of the most frequently discussed reasons for avoiding the trawling and crab potting conflicts seem to develop out of self-interest: 1) crab pots are very expensive and the crab potters do not want them to be destroyed or lost as a result of

trawling, and 2) trawlers don't want to waste time untangling pots from their nets. Both of these reasons involve the self-interests of both types of fishermen but more research should be conducted to better understand the informal arrangements between these crab potters and shrimp trawlers.

5.4.2 MUTUAL RESPECT

The fishermen in both regions most frequently mentioned mutual respect as the major driver influencing compatibility between crab potting and shrimp trawling. In fact, eight of the thirteen Northern fishermen discussed mutual respect as a driver while half of the Southern fishermen mentioned it. Mutual respect was the single most frequently mentioned compatibility-related driver between crab potting and shrimp trawling, suggesting that it is one of the most important factors influencing how these two crab potting and shrimp trawling interact.

Respect has been cited as a factor that can foster improved communication between stakeholder groups (Mackinson and Nottestad, 1998) and one that can help fishermen in different conflicting sectors co-exist (Woodhatch and Crean, 1999). Indeed, in the current study, fishermen in both regions noted that within their small town or within their fishing community, everybody knew each other and did not want to interfere with another fisherman's ability to make a living and support his family; the fishermen appeared willing to work together with other fishermen when their activities conflicted. Additionally, fishermen frequently discussed the constant communication between participants in each activity. For instance, if one fisherman

heard that trawlers would be working in an area where another fisherman set crab pots, he would call the crab potter to warn him.

5.5 INFORMATION SHARING

Throughout the interviews, it became increasingly clear that there is a lack of communication amongst some of the stakeholder groups. The fishermen and Army Corps' staff reported having had difficulty accessing the other stakeholder groups while the managers seemed content with the feedback they receive from fishermen. The fishermen reported having tried to communicate with the managers as well as having tried to get involved in various fisheries management councils and boards. However, several noted that they were often quickly discouraged when they realized that their opinions and/or presence were more for show than for any actual contribution. On the other hand, managers claimed that the fishermen usually participate when rules and regulations are being developed or amended. Additionally, managers stated that there are some fishermen who will come to them with problems or to discuss a rule or regulation. The Army Corps' staff, however, claimed that they had, in their experience, never received any feedback from the fishermen. The two Corps' respondents did both agree, however, that fishermen posses a lot of fisheries knowledge that could help improve management and dredging operations.

Many studies have highlighted the importance of local and fisher ecological knowledge (LEK and FEK) in fisheries (Mackinson and Nottstad, 1998; Johannes et al., 2000; Wilson et al., 2006; Bundy and Davis, 2013). Because systems, especially the marine environment, are often extremely complex, management may benefit from

improved information sharing (Hahn et al., 2006; Berkes, 2009). In their study, Johannes and his colleagues (2000) describe how FEK can provide critical information about fishing strategies and can, where long-term data sets are unavailable, provide insight into historical changes in fish stocks and environmental conditions. Additionally, because the populations that depend on these systems are also constantly changing, managers should be cautious when relying on a static information base and prescribed management strategies (Ostrom, 2007). LEK and FEK can provide more dynamic and up-to-date information useful for adaptive management.

5.6 MANAGEMENT IMPLICATIONS

Understanding how crab potting interacts with navigational dredging, shrimp trawling, and commercial crab and oyster dredging and what drives these interactions is especially important for fisheries and coastal management in North Carolina because it is just as important to manage human conflict as it is to manage the fisheries and coastal activities in order for efficient and successful management to occur (Daniels and Walker, 1996). Considering these interactions within the context of MSP can help make these conflicts *and* compatibilities more visible and tangible to managers (Halpern et al., 2008). The current study highlights both types of these interactions and their drivers in order to help fisheries and coastal managers in North Carolina identify issues on which to focus their efforts.

Because the North Carolina blue crab fishery, one of the most economically and culturally significant fisheries in the state, has experienced significantly reduced landings in the past 15 years, there has been widespread concern about the

sustainability of the fishery. Because of this concern, coastal and fisheries managers throughout the state have been working to understand how different coastal activities may influence blue crabs. This study sought out the perceptions of various stakeholders in order to get a holistic picture of how these activities interact and potentially impact the blue crab fishery and to contribute relevant, up-to-date information that could be beneficial for MSP efforts in North Carolina. Understanding how various ecosystem components and coastal activities are distributed throughout the coastal zone can help to maximize the delivery of ecosystem services as well as the extent of human activities in a specific area (Halpern et al., 2008).

Throughout this study, some key management implications emerged that should be considered in fisheries and coastal management and MSP in North Carolina. It should be noted, however, that these management implications are drawn from the responses of the twenty-five participants and further research should be conducted before adopting any changes to fisheries and coastal management and/or regulations. Management implications of this study include:

1) Conflicts and compatibilities exist and managers should consider both types of interactions. Most notably, there seem to be considerable conflicts between crab potting and navigational dredging. Coastal, as well as fisheries managers should focus on understanding the biological, ecological, and socioeconomic impacts of navigational dredging on the blue crab fishery.

2) Regional differences exist within the state and managers should be aware of these differences. The different types of activities that occur in each region seem to influence the perceptions of these activities. Fisheries and coastal managers should consider understanding the regional differences and account for them, to the extent possible, in management strategies.

3) Informal arrangements dictate the interactions among some fishing sectors and managers should recognize and support these agreements in their management strategies. Understanding the dynamics of these informal arrangements can help managers focus their efforts on more pertinent fisheries issues.

4) Mutual respect among fishermen is a key driver of compatibility in some fisheries and should, to the extent possible, be supported and facilitated by managers. Encouraging respect among stakeholder groups may help reduce conflict and the need for management intervention.

5) Communication between relevant stakeholders is important and may help to improve fisheries and coastal management. LEK and FEK can play an important role in improving fisheries management and rebuilding marine ecosystems. Efforts should be made to access and incorporate LEK and FEK into North Carolina's management strategies and MSP.

5.7 FUTURE RESEARCH

This study provides useful insights about how stakeholder groups perceive interactions between different activities in North Carolina's coastal zone. Stakeholder interviews highlighted many important issues including the regional differences that exist in North Carolina, the possible influence of demographics on perceptions, the differences between managers' and fishermen's perceptions of interactions, and the limited information sharing among stakeholder groups. However, there remain several topics for future research on these topics and additional questions to explore. Future research goals include:

1) A larger sample size would increase the understanding of interactions on a broader scale. Respondents from a variety of backgrounds should be included in a future study of user interactions in order to compare how regional and demographic differences may influence perceptions and interactions. Additionally, other types of fishermen could be included to expand the study and further aid comprehensive MSP efforts in North Carolina.

2) Informal arrangements that exist in some of the North Carolina fisheries should be examined further. Because these informal arrangements may have implications for fisheries and coastal management, it would be valuable to understand where they exist and how they develop. If managers are aware of these arrangements, they can focus their efforts on other issues that may be more pertinent to fishermen and the marine ecosystem.

3) Research should also focus on fishermen's participation in management. Management may be inefficient and/or ineffective as a result of poor information sharing among relevant stakeholder groups; therefore, continued research examining the relationships between managers and stakeholder groups and an improved understanding of the dynamics governing these relationships would be beneficial. Doing so may help facilitate information sharing and ultimately, improve fisheries and coastal management in North Carolina.

CHAPTER 6

CONCLUSION

This study highlights different stakeholder groups' perceptions of how blue crab potting interacts with navigational dredging, shrimp trawling, and commercial crab and oyster dredging and what drivers seem to facilitate these interactions. By doing so, I hope to provide fisheries and coastal managers in North Carolina with relevant and up-to-date information to use in not only focusing management efforts, but also in marine spatial planning efforts.

The results of this study have underscored a couple of key points that may be useful for fisheries and coastal managers to consider. First, a variety of compatible and conflicting interactions exist among these coastal activities and managers should be aware of and consider both types of interactions. Discussions surrounding crab potting and navigational dredging elicited the most number of conflicting interaction mentions, suggesting that fisheries managers should focus on understanding the various biological, ecological, and socioeconomic impacts of navigational dredging on the blue crab fishery.

Second, perceptions of interactions differed between the Northern and Southern fishermen. These regional differences in perceptions of interactions may exist because different types of activities occur at varying intensities and frequencies in the Northern and Southern regions. Specifically, navigational dredging occurs more frequently and intensely in the Southern region which may influence the perceptions

of the Southern fishermen. Fisheries and coastal managers should consider these regional differences when developing and amending management regulations.

Third, the fishermen frequently described informal arrangements that exist between crab potters and shrimp trawlers. These informal arrangements appear to help mitigate potential conflicting interactions and define the roles of each type of fishermen. Managers should seek to understand how these informal arrangements develop and where they exist. By doing understanding the dynamics of these arrangements, fisheries and coastal managers may be able to divert their time, efforts, and resources to other more salient coastal zone issues.

Fourth, the fishermen also frequently described the mutual respect shown to others in the fishing industry. Many fishermen noted that because of the close-knit communities to which they belonged, they knew each others' families and did not want to interfere with others' abilities to make a living and provide for their family. Additionally, some fishermen noted that they participated in multiple fisheries and this helped them to understand and respect other fishing industries. This mutual respect should be supported and facilitated by managers, to the extent possible, to help reduce conflict and the need for management intervention.

Last, every stakeholder group highlighted a lack of communication and information sharing among the stakeholder groups. In particular, the perspectives held by different stakeholders vastly differed based on the information to which each stakeholder group had access. This lack of information sharing may contribute to ineffective management strategies and regulations so managers should consider improving the lines of communication among relevant stakeholders.

This study highlights the key interactions between crab potting and navigational dredging, shrimp trawling, and commercial crab and oyster dredging, and provides some insight into what drives these interactions. The contributions made by this study will add to the present literature, provide guidance for coastal and fisheries managers in North Carolina, provide relevant and up-to-date information for MSP efforts in North Carolina, and lead to a better understand of how these specific activities interact within the coastal zone of North Carolina.

APPENDIX A. INTERVIEW PROMPTS

Interviewer: _____ Date: _____ Location of Interview: _____

Context: Go over consent form and have the respondent sign it. Then explain: "I'm going to ask you some questions about the interactions of users groups related to blue crabs. Your answers will remain confidential so please feel free to speak honestly and openly."

I. Background questions

I have a few basic questions I'd like to ask to get started.

1) Town/city of residence of interviewee:
   _____

2) How long have you lived in NC? _____

3) How long have you been working in _____?
   (fill in blank with crabbing, dredging, bottom fishing, management)

4) How long have you lived in the coastal region?

5) Do you or have you participate(d) in crabbing or dredging management? If so, how?
   For instance, did you attend public meetings, did you comment on any policies, did you sit on an advisory board?

6) For fishers and crabbers *only*:
   6a) Do you have now (or have you ever had) any other family members who fish? Who?

   6b) What type of fishing gear do you use?

   6c) When do you fish most?

   6d) Do you belong to a fishing association or cooperative?

   For dredgers *only*:
   6e) What type of dredging gear is used in this region?
   Bucket: dipper, ladder
   Hydraulic: hopper, plain suction, draghead suction, pipeline cutterhead
   6f) What is the most common reason for dredging (i.e. navigational, marina, maintenance)? Where is it done?

Context: Now, let's talk a little bit about your interactions with other user groups that impact blue crabs. We will talk about the interactions between your user group and each of the other three user groups. I'll also ask you to talk a little bit about management.

II. Conflicting and compatible uses

1) Can you describe your relationship/interactions between your group and [*crabbers*]?
   * The interactions between the respondent's user group and each user group within brackets will be examined
   [*bottom fishers*]
   [*dredgers*]
   [*managers*]

2) I first want to focus on what you might describe as [*negative interactions*]
   Can you tell me a little bit more about [*specific negative interaction*]?
   How long has it been going on? Where/when does it occur?

   Why do you think this negative interaction is occurring?

   Prompt for: relationships between user groups, location of interaction, policy or management, culture of user groups, money priorities

3) Do you think the [*negative interaction*] has been managed at all?
   If so, how?

4) What are your thoughts about the management of the [*negative interaction*]?
   If it wasn't managed, how do you think it *should* be managed?

5) Now, I'd like to focus on what you might describe as [*positive interactions*]
   Can you tell me a little bit more about [*specific positive interaction*]?
   How long has it been going on? When, where does it occur?

   Why do you think this positive interaction is occurring?

   Prompt for: relationships between user groups, location of interaction, policy or management, culture of user groups, money priorities

6) Do you think the [*positive interaction*] has been managed at all?
   If so, how?

7) What are your thoughts about the management of the [*positive interaction*]?
   If it wasn't managed, how do you think it *should* be managed?

So now we'll move on to the next user group interaction.

1) Can you describe your relationship/interactions between your group and [*crabbers*]?
   * The interactions between the respondents user group and each user group within brackets will be examined
   [*bottom fishers*]
   [*dredgers*]
   [*managers*]

2) I first want to focus on what you might describe as [*negative interactions*]
   Can you tell me a little bit more about [*specific negative interaction*]?
   How long has it been going on? Where/when does it occur?

   Why do you think this negative interaction is occurring?

   Prompt for: relationships between user groups, location of interaction, policy or management, culture of user groups, money priorities

3) Do you think the [*negative interaction*] has been managed at all?
   If so, how?
4) What are your thoughts about the management of the [*negative interaction*]?
   If it wasn't managed, how do you think it *should* be managed?

5) Now, I'd like to focus on what you might describe as [*positive interactions*]
   Can you tell me a little bit more about [*specific positive interaction*]?
   How long has it been going on? When, where does it occur?

   Why do you think this positive interaction is occurring?

   Prompt for: relationships between user groups, location of interaction, policy or management, culture of user groups, money priorities

6) Do you think the [*positive interaction*] has been managed at all?
   If so, how?

7) What are your thoughts about the management of the [*positive interaction*]?
   If it wasn't managed, how do you think it *should* be managed?

We'll move on to the last user group interaction.

1) Can you describe your relationship/interactions between your group and [*crabbers*]?
   * The interactions between the respondents user group and each user group within brackets will be examined
   [*bottom fishers*]
   [*dredgers*]
   [*managers*]

2) I first want to focus on what you might describe as [*negative interactions*]
   Can you tell me a little bit more about [*specific negative interaction*]?
   How long has it been going on? Where/when does it occur?

   Why do you think this negative interaction is occurring?

   Prompt for: relationships between user groups, location of interaction, policy or management, culture of user groups, money priorities

3) Do you think the [*negative interaction*] has been managed at all?
   If so, how?

4) What are your thoughts about the management of the [*negative interaction*]?
   If it wasn't managed, how do you think it *should* be managed?

5) Now, I'd like to focus on what you might describe as [*positive interactions*]
   Can you tell me a little bit more about [*specific positive interaction*]?
   How long has it been going on? When, where does it occur?

   Why do you think this positive interaction is occurring?

   Prompt for: relationships between user groups, location of interaction, policy or management, culture of user groups, money priorities

6) Do you think the [*positive interaction*] has been managed at all?
   If so, how?

7) What are your thoughts about the management of the [*positive interaction*]?
   If it wasn't managed, how do you think it *should* be managed?

Is there anything else you'd like to add?

III. Participatory mapping

I want to talk a little bit more about the *spatial* interactions, about how your user group may overlap in the same area and use the same resource or habitat as another group. I brought a map with me and I'd like to ask you to put a few things on them for me.

1) Please place a dot on the map at the central location(s) where dredging occurs. You can draw a boundary around the dot to indicate the wider area of the activity.

2) On the same map, please place dot on the central location(s) where crabbing occurs. Go ahead and draw a boundary around that dot as well, if you need to, to indicate the wider area of the activity.

3) Now, place a dot on the central location(s) where bottom fishing occurs. Go ahead and draw a boundary around that dot to indicate the wider area of the activity.

4) Lastly, on the same map, please place another dot on the areas where you think the *most* negative interactions on the water take place. Feel free to draw a boundary around the dot if the interaction extends beyond that central location.

IV. Follow-up questions

Before we finish up, I just have two more background questions to ask you.

1) How old are you? _____

2) What was your last completed grade in school? _____

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