Special Report No. 85

of the

Atlantic States Marine Fisheries Commission

Healthy, self-sustaining populations for all Atlantic coast fish species or successful restoration well in progress by the year 2015

The Cumulative Social, Cultural, and Economic Effects of Seasonal Closures on Fishing Communities

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The Cumulative Social, Cultural, and Economic Effects of Seasonal Closures on Fishing Communities

by

ASMFC Committee on Economics and Social Sciences

June 2005

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Section 1 – Introduction

The Atlantic States Marine Fisheries Commission (ASMFC) asked the Committee on Economics and Social Sciences (CESS) in 2002 to provide a position paper on the cumulative social and economic effects of seasonal closures on fishing communities. A subcommittee of CESS was formed to look into the issue. At subsequent meetings of the CESS, many issues were discussed, such as wanting to determine who is impacted and how the impacts are felt within the community. Initial action was taken to survey the literature. This paper seeks to synthesize issues brought up in the literature and discussions among CESS members.

General consensus is that fishing communities are affected by fishery regulatory actions. Impacts of a single regulatory action are routinely assessed. More difficult to assess are the accumulated impacts of multiple regulations over time.

Additionally, fishing communities, like all communities, change over time regardless of fisheries management. Fishing communities are subject to many endogenous and exogenous factors that impact nearly all coastal communities – tourism, gentrification, rising real estate values, migration patterns, habitat degradation, pollution, and so on. All of these events may be created by or conditioned by other outside factors, such as changes in the larger economic and political conditions. Even things such as national and international mass media and access to the Internet have an effect on the lives of community members. It is simplistic to assume all social or economic change, positive or negative, occurring in fishing communities is related to regulatory actions, or fishing activity, in general.

This paper will first highlight the federal legal mandates that guide managers to consider cumulative impacts. There is then a discussion of the socioeconomic factors that affect fishing communities, followed by a discussion of seasonal closures and their impact on the fisheries. Two case studies are provided to highlight how these issues have played out. Lastly, implications of cumulative impacts of seasonal closures for consideration by fisheries managers are examined.

Although the ASMFC is not mandated to consider the socioeconomic implications of its actions, including cumulative impacts, it is important that these types of data be gathered to inform the Commission process and ensure that ASMFC is pursing the best possible policies to achieve recovery and sustainability goals.

Section 2 – Cumulative Effects

Section 2.1 – Definition of and Federal Legal Mandates Requiring Cumulative Effects

In the United States, the National Environmental Policy Act (NEPA) of 1969 requires analysts to consider direct, indirect, and cumulative effects on resources, ecosystems, and human environments when conducting environmental assessments for proposed federal actions. The Council on Environmental Quality (CEQ) defines "cumulative effects" in its regulations for the implementation of the procedural provisions of NEPA. The definition (Code of Federal Regulations 2004) states,

> Cumulative impact is the impact on the environment, which results from the incremental impact of the action when added to other past, present,

> and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7)[1].

The primary way in which cumulative effects differ from direct and indirect effects is that cumulative effects accrue over time from more than one source. The purpose of analyzing cumulative effects is to ensure that an agency considers the full range of effects of their actions. Federal agencies make thousands of incremental, project-level decisions without considering the effect on regional resources. As a result, effects may accumulate over time, causing serious harm to invaluable resources. Therefore, cumulative effects analysis (CEA) should consider all past, present, and future actions on a resource, not just the potential effects of the current project proposal.

Such analysis is complicated, however, because of the difficulties of defining the geographic (spatial) and time (temporal) boundaries (CEQ 1997). Reviewers must ensure that the spatial and temporal boundaries are large enough to include all potentially significant effects on the resource (EPA 1999). For example, only considering area/land under government control is insufficient, in some instances, to determine the complete nature of the cumulative effects of the proposed action.

Various approaches for completing CEAs have been identified, including checklists, matrices, indices, and detailed models (MacDonald 2000). However, there is not a single, universally accepted conceptual approach or set of guidelines. The most commonly utilized process set forth by the CEQ in a report titled "Considering Cumulative Effects Under the National Environmental Policy Act" (1997) contains three main components: scoping, describing the affected environment, and determining the environmental consequences. During the scoping process, the analyst must remember four basic principles: (1) include past, present, and future actions, (2) include all Federal, non-Federal, and private actions, (3) focus on each affected resource, ecosystem, and human community, and (4) focus on truly meaningful effects (CEQ 1997). This first stage embodies the main points of the definition.

The second step in the process, describing the affected environment, gives analysts the opportunity to evaluate current stress levels on the resource, ecosystem, or human environment and to determine if additional stresses will have an important cumulative effect (CEQ 1997). This is an important aspect of cumulative effects analysis because it focuses on the larger picture. Lastly, the analyst must determine the environmental consequences of cumulative effects. In this final stage, the potential for the resource to sustain itself in the future and whether the proposed action will affect this potential must be determined. All additive, countervailing, and synergistic effects should be taken into consideration (CEQ 1997). The most important concept to remember when conducting cumulative impact analysis is that these effects accumulate over time from more than one source. Nothing happens in a vacuum.

Even with the passage of NEPA and the CEQ regulations, little attention has been given to the concept of cumulative effects in environmental impact analysis over the last three decades. Few studies have been done that examine the cumulative social, cultural, and economic effects of fisheries management measures.

[1] The terms effects and impacts are used interchangeably in the CEQ regulations.

Section 2.2 – Cumulative Socioeconomic Effects in Fishing Communities

While few studies focus specifically on cumulative socioeconomic effects of fisheries management measures, virtually all social impact assessments (SIAs) conducted for proposed management alternatives consider, to some degree, cumulative effects. This is less an intended objective of SIAs and more a consequence of employing baseline descriptions of communities. Baseline community descriptions are used to frame the discussion of alternatives by illustrating present conditions and, in some cases, past actions that have contributed to those conditions. Most baseline descriptions are designed to reveal the 'what' about communities and not 'how' conditions came into being. The 'how' question is indispensable to the goal of cumulative effects analysis, which requires a much more clearly articulated connection between baseline conditions and the forces shaping them. The success of predicting cumulative effects hinges on the quality and depth of historical data brought to bear on the question, in conjunction with a holistic assessment of present socioeconomic conditions, and foreseeable future actions.

This attention to historical depth and socioeconomic holism must be tempered by a focus on the proper spatial and temporal levels of analysis. The many complex and remote spatial and temporal degrees of relatedness between causes and effects are difficult to ascertain. Related to the need for focus is the importance of understanding that, while cumulative socioeconomic effects can have innumerable causal chains and myriad manifestations, those associated with fisheries management measures and fishing communities tend to have distinct characteristics. This section will describe the domains of cause that are most closely tied to fisheries management and the socioeconomic domains of effect in which the cumulative causal forces make their most indelible mark.

Domains of Cause

The most obvious causal forces that work in conjunction with proposed fisheries management measures are preexisting fisheries regulations. Forecasting the cumulative effects of a seasonal closure requires an intimate knowledge of the present regulatory regimes and their historical trajectory. The phrase “regulatory regimes” does not simply refer to the regulations governing the particular fishery in question, but to the host of regimes across fisheries, policy levels, and geographic space. For example, Amendment 9 of the Squid, Atlantic Mackerel, and Butterfish Fishery Management Plan (FMP) included an alternative that would have closed the tilefish Habitat Area of Particular Concern (HAPC - National Marine Fisheries Service (NMFS) statistical areas 616 and 537 between the 300-foot and 850-foot isobaths) to bottom-tending otter trawl fishermen. This alternative could only be assessed in the context of the broad, multilayered regulatory environment in which fishermen are embedded, including: historical, incremental cuts in days-at-sea for multispecies groundfish permit holders; historical incentives for entry into fisheries involving underutilized species; recent imposition of Gear Restricted Areas for the protection of scup; and numerous other regulations affecting effort (McCay et al. 2002). Untangling the knot of regulations is a necessary challenge for predicting cumulative effects, especially because it is not always apparent how regulations act in concert - not only in the same fishery, or even between commercial fisheries and gear types, but also between entirely different sectors such as sport fishing and commercial fishing. By way of example, imagine the web of regulations governing striped bass, eel, and horseshoe crabs: sport fishermen love striped bass; striped bass love eel; commercial eelers love eel; eel love horseshoe crab; commercial fishermen love horseshoe crab; birds love horseshoe crab eggs; birders love birds; more horseshoe crab regulations = less horseshoe crab for commercial eelers’ bait = less eel for sport fishermen's striped bass bait; and so forth.

This scenario illustrates a second domain of cause that works in conjunction with fishery regulations to create cumulative effects: the cultural domain of natural resource use values and meaning systems; the political movements by which they are deployed; and the demographic processes that set competing values on a collision course at the local level.

There are numerous cultural models from which are built competing conceptions of the nature and proper use of marine resources (Paolisso 2002). Well-funded and politically motivated interest groups that not only lobby for legislation that embodies their views but also fund their own scientific studies support many of these competing views. There are, for example, groups representing commercial fishermen, sport fishermen, animal rights advocates, environmentalists, and a host of other constituents with an interest in marine resource use. The power of political action lobbies can be exercised far from the local community and still have a very significant local effect. Obvious examples include the legal challenges leveled by environmental lobbies against the Commerce Department and the National Oceanic and Atmospheric Administration, and state level actions that have resulted in bans on fishing gear such as the haul seine in New York and the gillnet in Florida.

Demographic trends are bringing the battle of competing views to local communities where it is waged on planning boards and in the courts. It is uncommon to find any fishing community on the Atlantic Coast that does not feature a diverse population with competing value and meaning systems. Even among what are considered isolated fishing communities on the Eastern Shore of Virginia, for example, local fishermen speak of the clash of cultures resulting from the wave of "come-heres." The demographic composition of many waterfront communities up and down the coast has been transforming as the second-home and real estate investment market grows. Transformations in the demographic composition of communities often result in the collision of competing use values and divergent cultural systems of meaning. The sights, smells, and sounds associated with a working waterfront of commercial fishermen may be incongruent with the aesthetics that newcomers bring with them when they move into a fishing community. There are numerous examples of new waterfront property owners filing complaints and bringing lawsuits against fishermen and fishing operations. In some communities, a respect for the history and tradition may result in measures that protect working waterfronts and prevent a new aesthetic from eroding the fishing industry. In others, the conflict may lead to zoning and planning measures that displace and/or eliminate infrastructure and the attachment to a cultural identity based on fishing traditions.

The ideological and cultural conflicts have an important economic dimension. The 'gentrification' of fishing communities that involves shifts in cultural values is typically associated with the trend toward rising property values. The premium placed on waterfront property can threaten the viability of existing businesses and fishing infrastructure, eliminating access and eroding the support system for commercial enterprises.

Therefore, the cumulative effect of any particular fishery management alternative will depend on the degree to which changing cultural values and real property values threaten the existence and sustainability of fishing operations. This can be measured, in part, by analyzing the support that the industry receives from the community in the face of economic development and gentrification. Support can come in the form of zoning protections, planning initiatives, and political mobilization and lobbying efforts. It is, therefore, imperative to consider the historical trajectory of a community's demographic composition, the local ordinances that govern waterfront access and community economic development, and the level and nature of support and recognition that the fishing industry receives. This examination should also consider the political

power of participants in the fishing industry and measure the level of their representation and involvement at various levels of policy-making.

Myriad additional demographic forces contribute to the cumulative effects of fisheries management measures. A few of the most significant factors include age structure, education, and employment. The educational achievement of community members coupled with the labor market, local employment opportunities, and population age structure may have significant consequences for recruitment in the fishing industry.

Another domain of cause that works in conjunction with other forces to produce cumulative effects among fishing communities is the extra-local political economy. Every fishing community is embedded in a wider network of economic and political power that influences local experience and behavior. The extra-local dimensions of fishing communities have caused considerable debate over the utility of the place-based definition of fishing community provided by the Sustainable Fisheries Act.2 Scholars have designed numerous ways to account for the permeable boundaries of fishing communities. For example, Jacob et al. (2001) suggested the use of central place theory as a way of defining the boundaries of fishing communities. According to this approach, central places (like ports) and hinterlands are the unit of analysis for identifying fishing dependent communities. A second type of regional approach to defining fishing communities and fishery dependence is followed by Hall-Arber et al. (2001) working in New England (see also Dyer and Poggie 2000). This approach employs the concept of Natural Resource Region (NRR), which is "a network of Natural Resource Communities, linked to the marine resources of a Large Marine Ecosystem, whose existence is defined by the interactive flow of total capital" (ibid.:11). A separate study finds that place-based fishing communities are veritably defined by external networks of sociocultural and economic flows, and therefore must be studied in relation to them (Oles 2003). Importation of seafood products and foreign fishing practices are an obvious component of the overarching political economy that influences local conditions. Consider, for example, the numerous local, national, and international dimensions of crab meat importation, its effect on crab picking operations in the mid-Atlantic, and its link to U.S. labor and immigration policy. Other extra-local dimensions of fishing communities relate to the seasonal movements of fishermen, supply chains and market distribution networks, and membership in supra-local political action groups.

Finally, the state of the environment and condition of the resources contribute significantly to the cumulative effects of management measures. It is important to note that this includes not only the resources that are directly related to the alternative in question but to other resources and ecosystems that may be affected by shifts in effort.

Domains of Effect

Analyzing cumulative effects of any management measure requires a description of the environment that is likely to be affected. For studies conducted in accordance with NEPA requirements, the environment is broadly defined to include resources, ecosystems, and human communities (CEQ 1997). The analyst is responsible for determining the spatial and temporal boundaries of the affected entities through the scoping process. Our concern here is with the likely cumulative effects of seasonal closures on fishing communities.

[2] The Sustainable Fisheries Act defines "fishing community" as " a community which is substantially dependent on or substantially engaged in the harvesting or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such communities" (Sec. 3 Definitions 16 U.S.C. 1802).

While there are no studies that address specifically the cumulative effect of seasonal closures on fishing communities, incremental changes in fisheries management measures, coupled with other forces, often compound in similar ways that may forecast likely effects of seasonal closures.

One way that management alternatives have been examined is through an assessment of their impact on the vulnerability of fishing communities (Wilson and McCay 1998). According to this approach, alternative measures are weighed by the likely effect they will have on the vulnerability of fishing operations and businesses within the community to change.[3] Another way of conceptualizing cumulative effects is to couch them in terms of 'quality of life' or job satisfaction (Pollnac and Poggie 1988). The difficulty, of course, is the diverse nature of fishing communities and their constituents, who may have vastly different definitions of quality of life.

Cumulative effects may be measured at a number of different levels. At the level of the individual, for example, we may examine the cumulative effects of alternatives on commercial fishermen, other resource users, seafood consumers, and employees of businesses, to name a few. Among fishermen, new management measures may affect the amount of a resource that they harvest and hence the direct income that they receive. They may affect the flexibility of a fisherman's activities, eliminating participation in some fisheries and/or encouraging effort in other fisheries. Changes in effort may encourage different at-sea harvest patterns and seasonal rounds, reducing or spurring gear conflict between user groups, increasing or decreasing steam times, and raising or lowering safety standards and risk-related behavior. They may have a direct cost to the fishermen in terms of investment in new gear or equipment, which may influence the cost of entry and hence the ability of the industry to recruit participants. Recruitment, which is essential for commercial sustainability, is highly vulnerable to changes through cumulative effects. Reduced harvests and related economic returns, along with constrained occupational mobility, can make it difficult to crew boats with quality hands, which result in greater risks as captains operate undermanned vessels or with inexperienced and unreliable crewmembers. Alternative measures may also influence the individual's perception and trust of management bodies, participation in decision-making processes, and level of compliance with regulations. Taken together, the cumulative effects will impact an individual's job satisfaction, mental and physical health, and overall quality of life.

Cumulative effects on the individual spill over at the level of the household. Alternative measures may increase the need for a commercial fishing family to have members who are employed in land-based jobs with health and employment benefits. The ability to respond in this fashion, however, is tied to the overall economic climate of the area, including available work opportunities. They may indirectly influence family dynamics and emotional relationships among members. Fishermen cite burdensome regulations, associated with declining incomes and longer trips at sea, as contributing to high divorce rates and familial strife. A fishing family's ability to respond to and absorb changes resulting from the cumulative effects of fisheries management measures can vary widely. Smith et al. (2003) describe the factors related to the adaptability and resilience of fishing families affected by the Florida net ban.

[3] The use of the concept of 'vulnerability' as a heuristic can allow an assessment of both positive and negative changes resulting from cumulative effects. However, the term is problematic in that it implies that any measure that increases vulnerability to change is negative - one would not, for instance, speak of being vulnerable to positive change. These limitations suggest that 'vulnerability' is one of the domains of effect and not the rubric under which all effects should be considered.

The cumulative effects of management alternatives on individuals and households ramify to the level of community. A fishing community, by definition, can be characterized as being substantially dependent upon and/or substantially engaged in the harvesting or processing of fishery resources to meet social and economic needs (Sustainable Fisheries Act Sec. 3 Definitions 16 U.S.C. 1802). Therefore, any measures that change the nature of the dependence or engagement in fisheries harvesting or processing affect the community. Communities may experience changes in the following areas: the overall volume of product that is harvested and/or processed; the number of fishing boats that operate in the community; the number of transient fishing boats that visit the community; the composition of the fleet in terms of boat type and fishery; the number of fishing families that live in the community; the level of community solidarity among fishing families and other community members; political activity and community support; the cultural identity and sense of place among community members (EPA 2002); the community character and historical connection to fishing; population shifts and resulting changes in social services, labor markets, housing, community mobility, social stratification, and power structure; levels of social deviance and conflict on land and at-sea (e.g. drug use, domestic abuse, crime); and the overall adaptability of the community to future changes.

Cumulative effects are not easily bounded, especially within a geopolitically defined fishing community that has social and economic ties to a global world. These social and economic networks (most specifically those related to marketing product and obtaining supplies and services necessary for fishing-related industry) may widen or contract as a result of cumulative effects. Therefore, it is necessary to consider cumulative effects on the extra-local social and economic linkages between the fishing communities and other places.

The causal arrows in a diagram depicting cumulative effects are twisted and contorted. Each of the different levels discussed - individual, family, and community (which includes the extra-local linkages) - are embedded in complex feedback loops. These feedback loops connect not only the domains of effect, but also the seemingly external 'causal' domains such as cultural systems of meaning, political action, and even fisheries management. The challenge is to provide a holistic analysis of the historical trajectory of present conditions such that the compound effects of management alternatives may be discerned.

Section 3 – Seasonal Closures

Seasonal closures, as pertains to fisheries management strategies, are just that: closing a particular fishery or suite of fisheries for a set period of time, usually but not strictly, related to a calendar season. Seasonal closures are temporary in nature, and often flexible to reflect varying natural conditions, such as sea temperature. Most commonly, closures are timed to coincide with normal[4] and generally predictable periods when the fish stocks in question are considered to be particularly vulnerable to fishing pressures, such as spawning activity, vulnerable growth periods, or migration of animals.

[4] In contrast, unpredictable events may require emergency (“abnormal”) temporary closures. For example, the Fishery Management Plan for the Shrimp Fishery implemented in 1993 has allowed the US South Atlantic states to request a temporary closure of adjacent federal waters to shrimp trawling when unusually severe winter conditions caused a high mortality of over-wintering white shrimp (South Atlantic Fishery Management Council 1993).

A closure may be further refined to reflect distinct fishing behaviors by humans, such as closures to certain sectors of the fishery (recreational fishing versus commercial fishing) or to be closed to a particular gear type, such as trawling or bottom-tending gear. Sometimes a regulating agency will try to minimize social and economic impacts of a closure by relaxing rules in other fisheries to give fishermen "something to fish for," or will limit the length of a closure. If, for example, a fish stock spawns in both the summer and fall, regulators will close the fishery for just one of those seasons so as to minimize impacts on fishermen and their related communities and markets. Furthermore, fishery managers may try to enhance for fishermen the market value of their product by timing closures to swings in the supply of fish from other areas, such as with the King Mackerel stocks in the Gulf of Mexico and the South Atlantic (see Amendment 15 to the Coastal Migratory Pelagics Fishery Management Plan, 2005).

There are common themes to using seasonal closures as a management tool. One can see that the desire to protect a stock at its most vulnerable times during the year is a major guiding principle of seasonal closures. Also integral to creating a temporal, or seasonal closure, is the spatial component. While some closures are specified only by the species or species complex that managers wish to protect, there is also the possibility of instituting a seasonal closure only in certain geographical areas. Fishing may be closed for a certain time in an area defined by a latitude/longitude position, or it may be that state waters are closed, while the federal Exclusive Economic Zone (EEZ) remains open. Variances of this sort pose problems for fishery law enforcement officers, but may be the only way to fairly manage the stocks for fishermen.

Example: The Snapper Grouper Fishery of the South Atlantic

The South Atlantic Fishery Management Council (SAFMC), through its Amendment 9 to the Snapper Grouper Fishery Management Plan, instituted in 1998 varying closures for four species of the snapper grouper complex in the South Atlantic: red porgy (January through April), gag grouper (March and April), greater Amberjack (April), and black grouper (March and April). All of these species were believed to be experiencing overfishing or on the borderline of being overfished. To remedy this problem and meet the requirement of the Sustainable Fishing Act of 1996, various management measures were introduced, such as increased size limits, decreased bag limits, and the introduction of trip limits and quotas. The intent of the closures was to specifically protect each species from fishing pressure when the fish are most vulnerable during spawning. For example, gag is known to become very aggressive in spawning aggregations, making it more susceptible to taking a hook.

For these species, the fishery is closed in different ways for both the commercial and recreational fisheries. For the commercial fishery, there is a complete ban on the harvest, possession or sale of the above-mentioned species for certain months, but they, along with recreational fishermen, can continue to be restricted to the retention of the bag limit, currently set at one to two fish per person per day, depending on the species.

The closures for red porgy, gag grouper, greater amberjacks, and black grouper has had different impacts on the two different sectors of the fishery, and has caused conflict and animosity between commercial and recreational fishermen. The commercial fishermen at first believed that the closures would benefit them, as they believed that when the fishery re-opened in May, there would be plenty of fish to catch, and the fish would be of a larger size. However, with increasing numbers of recreational fishermen, particularly in the spring off the east coast of Florida, commercial fishermen have complained that the closure has not benefited them at all. They

believe that the recreational fishermen, due to the large number of participants, take a large amount of fish, and that restaurants illegally buy the recreationally caught fish, depressing the price of gag when the season reopens. This conflict is now (2005) being addressed by the SAFMC in their Amendment 13B to the Snapper Grouper fishery, whereas it is proposed that there be no take at all of gag grouper during the seasonal closure.

Section 4 – Case Studies

Section 4.1 – North Carolina Pamlico Sound Gillnet Restricted Area

Background

Since 2000, the commercial gill net fisheries operating in Pamlico Sound, North Carolina had management measures imposed that restrict areas, seasons, and allowable sea turtle interactions. This area is now referred to as the Pamlico Sound Gill Net Restricted Area (PSGNRA) (Figure 1). The PSGNRA was established based upon increased sea turtle strandings (washed ashore dead or injured) sighted in 1999 in the southeastern portion of Pamlico Sound. Investigation of the fisheries operating in the area at that time identified large (> 5-inch stretched mesh) and small (< 5-inch stretched mesh) mesh gill net fisheries as a potential source of fishery interaction with sea turtles.

Observations of gill net fisheries indicated a shallow water large mesh gill net fishery along the Outer Banks, a deep-water large mesh gill net fishery farther from shore, and a shallow water small mesh gill net fishery operating throughout Pamlico Sound. Both the deep water and shallow water large mesh gill net fisheries targeted southern flounder (*Paralichthys lethostigma*) (Figure 2). The deep-water fishery operated in depths ranging from 10 to 20 feet from September to December. The shallow water large mesh gill net fishery operates in depths ranging from 6 to 11 feet in areas next to the barrier islands (Figure 2). The small mesh gill net fisheries are composed of the runaround and set net fisheries and targeted species that generally include spotted seatrout (*Cynoscion nebulosus*), weakfish (*Cynoscion regalis*), and bluefish (*Pomatomus saltatrix*) (Gearhart 2003).

Initial monitoring of gill net fisheries in 1999 identified the large mesh gill net fishery as a source of sea turtle interactions in Pamlico Sound during the months of September through December. With this information, the NMFS initially issued an emergency rule closing this area to large mesh gill net fishing operations to protect endangered and threatened sea turtles (Gearhart 2003). To maintain this economically lucrative flounder fishery, the North Carolina Division of Marine Fisheries (NCDMF) applied for and received an Incidental Take Permit (ITP) under Section 10 of the Endangered Species Act (ESA) in 2000. The ITP contained a comprehensive conservation plan, which was designed to reduce sea turtle interactions by establishing restricted areas and intensive monitoring, while allowing the gill net fisheries to operate. Observations in 2000 under the ITP identified the deep-water region of Pamlico Sound as the primary source for sea turtle interactions. Based on this information, NMFS established a permanent rule for the 2001 fishing season to close all potential fishing grounds utilized by the deep-water large mesh gill net fisheries (Gearhart 2003). In 2001, NCDMF again consulted with NMFS and prepared an application for and received an ITP under Section 10 of the ESA (Gearhart 2003). Restricted areas were established throughout the PSGNRA where fishermen could continue operations as stipulated in the ITP (Figure 3).

In order to participate in the fall southern flounder gill net fishery in the PSGNRA fishermen must obtain a permit that requires them to allow observers on their boat when asked. Additionally, they are required to report weekly to the NCDMF regarding turtle interactions as well as port of landing, amount of flounder harvested, area fished, yards of gill net fished, and soak time (Bianchi 2004).

From 2001 to present, NCDMF has successfully managed the large mesh gill net fisheries in Pamlico Sound from September to December. Observed levels of sea turtle interactions in gill net fisheries remained below thresholds as established by the ITP in 2001 and 2002 (Gearhart 2003, 2002; Price 2004).

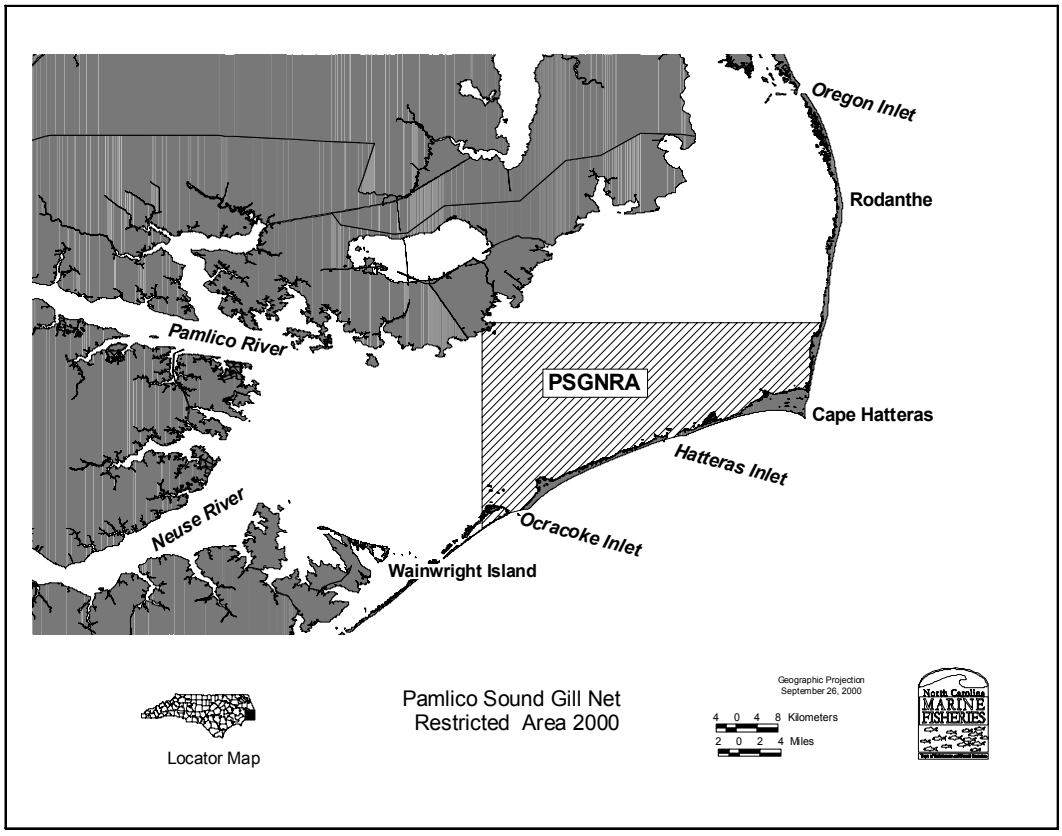

Figure 1. Map of southeastern Pamlico Sound and the 2000 Pamlico Sound Gill Net Restricted Area (PSGNRA).

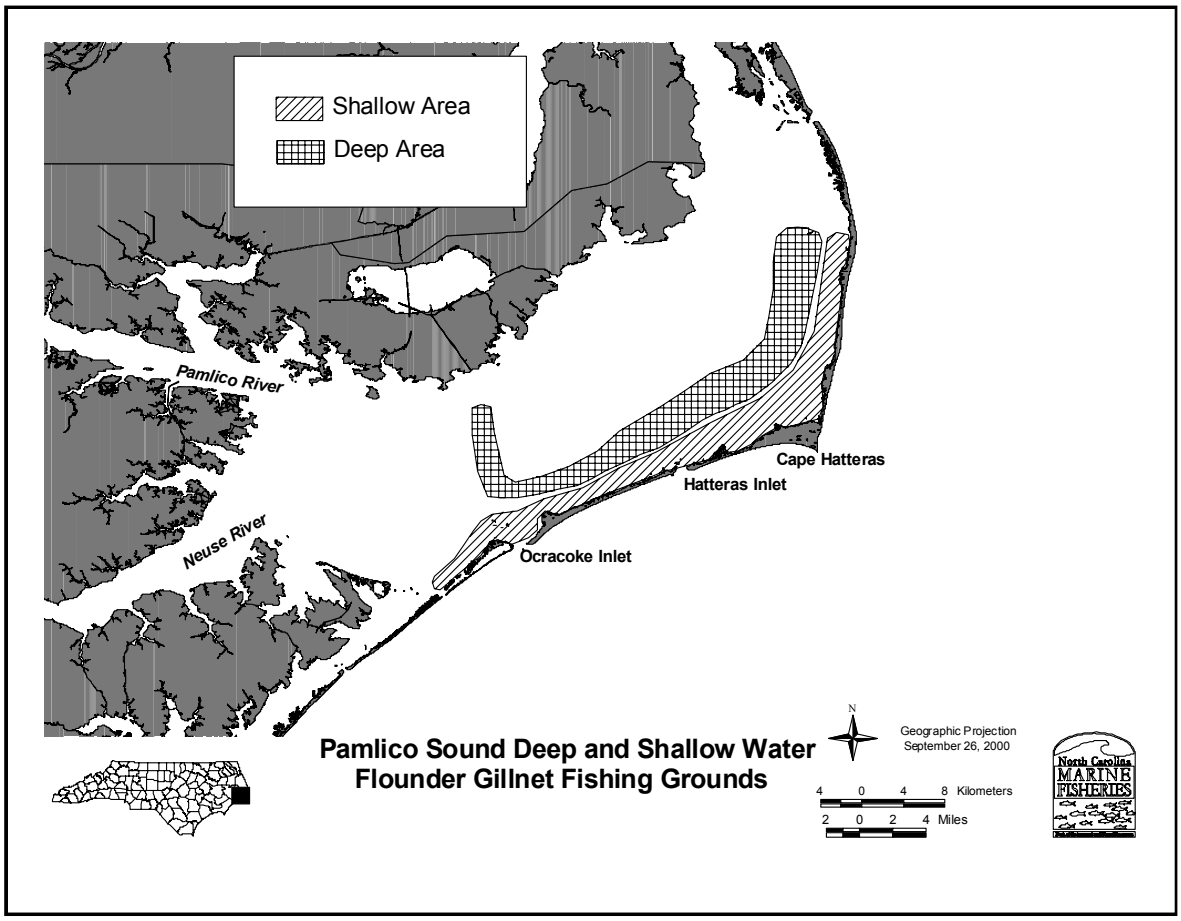

Figure 2. North Carolina estuarine flounder Gill Net fishing grounds in southeastern Pamlico Sound.

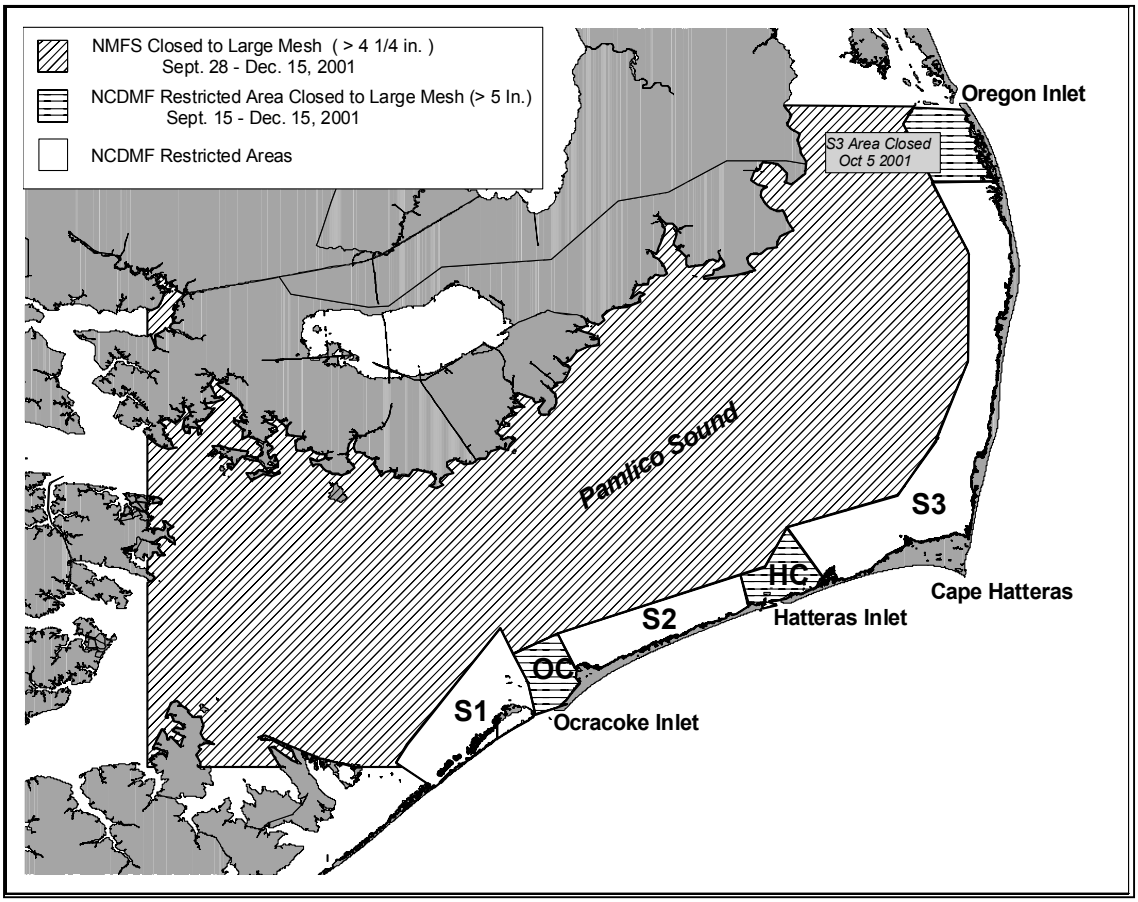

Figure 3. NCDMF 2001 Pamlico Sound Gill Net Restricted Area (PSGNRA) and NMFS closed area. S1=Shallow Water Gill Net Restricted Area 1; S2=Shallow Water Gill Net Restricted Area 2; S3=Shallow Water Gill Net Restricted Area 3; OC=Ocracoke Inlet Corridor; HC=Hatteras Inlet Corridor.

Other Studies

Santora (2003) interviewed 34 fishermen in 2001; one year after the PSGNRA was put into place. The goal of her research was to determine the social impacts of the seasonal closures and the process used to implement the closures. In general, the fishermen agreed with the need to protect endangered species such as sea turtles. However, many felt that the actions taken were too unilateral and could have been improved by an increased level of precision in delineating the closed areas. Some fishermen complained that the closed areas were unfair because they impacted some communities more than others.

Not all of the possible regulatory actions that could have been, or were considered by fisheries managers, met with unilateral resistance from the fishermen. In general, regulations that were more sweeping in prohibiting fishing met with the most resistance: gill net attendance, limited entry, and large area closures. At least 50% of the respondents supported targeted or critical area closures, and different take limits for shallow and deep water areas, since turtles that interact with gill nets in deep water areas are less likely to survive the interaction.

Fishermen stated they felt left out of the process that decided how and which restrictions were put into place. While the ESA does not require social or economic considerations when making decisions about protecting endangered species, there is evidence that achieving buy in from the affected fishermen will greatly enhance the probability of success (Murawski 1995, cited by Santora 2003). There are likely consequences of ignoring social and economic impacts of closures, many of which were identified by the fishermen interviewed by Santora (2003). For example, the fishermen she interviewed were concerned about the displacement from the large mesh flounder gill net fishery into other fisheries.

NCDMF Trip Ticket Analysis

Researchers from the NCDMF examined the fishing behavior of a subset of fishermen who were affected by the PSGNRA seasonal closures (Daniel 2004). The goal of this research was to track the impacts of closing the area to protect sea turtles, and assess how fishermen reacted to being unable to fish in the closed area. An analysis of the data from North Carolina's trip ticket program was performed to identify highly active participants in the fishery. The analysis yielded 40 fishermen who used gill nets to land at least 1,000 pounds of southern flounder per month from the PSGNRA during the months of September through December 1999.

Figure 4 shows how the fishery first quickly developed in the mid-1990s and escalated rapidly to a peak in 1999. The regulations implemented to protect sea turtles resulted in a large reduction in the flounder landings for the 40 selected fishermen.

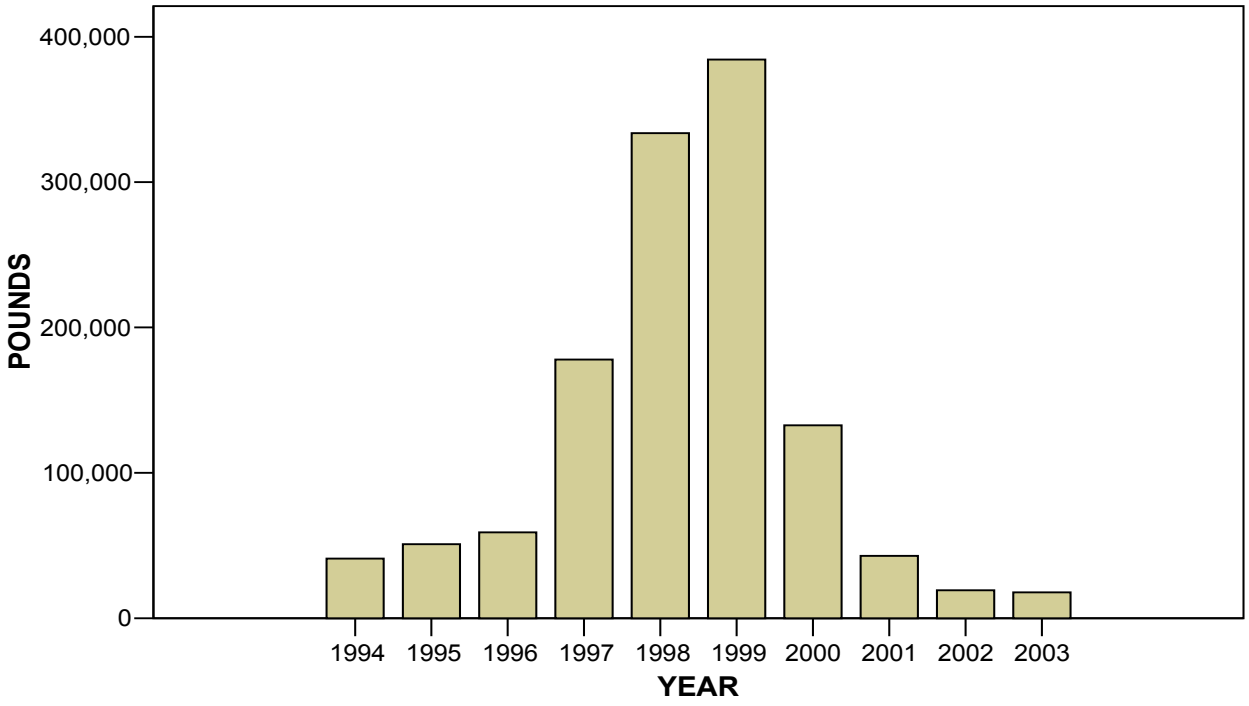

Figure 4. Southern flounder landings in pounds by 40 PSGNRA fishermen (1994 – 2003).

North Carolina fishermen are known for their behavior of switching between fisheries, gears, and water bodies as conditions warrant. They will fish wherever and however they think they will get

the greatest economic return. When the fishermen lost the ability to make money as a result of the PSGNRA closures, they moved to other fisheries.

Some fishermen remained inshore and targeted species in the estuarine systems, while others moved to fishing in the ocean. In 1999, many of the fishermen were already fishing in the ocean, but, after the PSGNRA seasonal closure, they increasingly targeted their efforts towards ocean fisheries. Table 1 shows trends in the fishing behavior of the 40 fishermen from 1999 through 2003. Additionally, an analysis of trip ticket landings gave an indication of the ex-vessel value of their catches.

Table 1. Fishing behavior and the resulting changes in landings values following the PSGNRA seasonal closures (1999 – 2003).

	Change in Annual Ex-Vessel Value, 1999-2003				
	Increase	Same	Decrease	Mixed	Total
Mostly Inshore	4	2	8	1	15
Mostly Ocean	1	2	1	0	4
Moved to Ocean	4	0	2	1	7
Inshore -> Ocean -> Inshore	1	0	1	0	2
No Pattern	1	2	2	1	6
Left Fishing	0	0	6	0	6
Total	11	6	20	3	40

Fishermen who primarily fished inshore were most likely to see a decrease in the ex-vessel value of their landings (Table 1). Those fishermen who shifted their efforts from primarily inshore fisheries to ocean fisheries were most likely to see an increase in the ex-vessel value of their landings. But it is also quite likely that, with the move from inshore fisheries to ocean fisheries, the fishermen probably incurred increased operating expenses that potentially negated some of the positive impact of the increased ex-vessel value.

This analysis of the NCDMF trip tickets showed that, of the original 40 fishermen, two permanently dropped completely out of all commercial fishing activities by 2001, three more dropped out by 2002, and one additional fisherman had dropped out by 2003. This is an attrition rate of 15% of these previously highly active fishermen. The role, if any, that the PSGNRA seasonal closures had in affecting their decision to leave fishing in North Carolina is unclear from current analyses.

Regardless of how the fishermen adapted to the closure, 50% (20 out of the 40 fishermen) saw a net decline in the ex-vessel value of their landings (Table 2). With the exception of 2002, this group of fishermen lost an average of over 8% of their annual ex-vessel value from one year to the next (Table 2). Ex-vessel landings values (unadjusted for inflation) by the 34 fishermen still fishing in 2003 were only 93% of their 1999 average annual ex-vessel landings.

Table 2. Annual changes in pounds and ex-vessel value by fishermen who participated in the Pamlico Sound gill net flounder fishery in the fall of 1999.

Year	Pounds	% Change from Previous Year	Ex-Vessel Value	% Change from Previous Year
1999	4,879,495		$3,187,729	
2000	4,504,571	-7.7%	$2,926,353	-8.2%
2001	4,635,569	2.9%	$2,681,451	-8.4%
2002	4,491,699	-3.1%	$2,751,234	2.6%
2003	4,356,245	-3.0%	$2,512,513	-8.7%

As previously stated, many of the fishermen moved into other fisheries. Tables 3 and 4 show the ocean and inshore landings, respectively, by species and the number of these fishermen who participated in a fishery each year from 1999 to 2003. The percent change column in the tables refers to the change in economic value from one year to the next, and thus reflects not only the amount of biomass removed but also changes in the price per pound paid to the fishermen.

Table 3 shows that there were large increases in the landings of some ocean species. In 2001 and 2002, there were many more Atlantic croaker (*Micropogonias undulatus*) landed than in 1999 and 2000. When the price per pound dropped in 2003, these fishermen landed fewer croaker. The price per pound for blueline tilefish (*Caulolatilus microps*) reached a high in 2002 of $.90. More fishermen began targeting blueline tilefish and, as a consequence, also caught more snowy grouper (*Epinephelus mystacinus*) on the same trips. In 2003, as the price for blueline tilefish came down, there was less directed effort in the fishery. No more than six fishermen in any given year had blueline tilefish landings, and the primary gear used was bandit gear. It is not clear whether the fishermen were landing the fish under the recreational bag limit or if they were fishing on their own vessel.

Table 3. Selected ocean fisheries annual landings by the case study fishermen following the PSGNRA seasonal closure, 1999 – 2003.

Species	Year	Participants	Trips	Pounds	Value	$/lb.	% Change in Annual Value
Atlantic Croaker	1999	30	455	985,624	$341,493	$0.35	
	2000	34	392	923,631	$303,454	$0.33	-11.14%
	2001	27	667	1,558,225	$435,551	$0.28	43.53%
	2002	25	397	1,281,667	$459,667	$0.36	5.54%
	2003	21	285	840,221	$167,885	$0.20	-63.48%
Menhaden (Bait)	1999	10	41	15,499	$1,589	$0.10	
	2000	15	38	14,588	$1,605	$0.11	0.97%
	2001	16	54	39,338	$3,934	$0.10	145.15%
	2002	11	64	42,025	$6,222	$0.15	58.18%
	2003	12	46	19,641	$1,768	$0.09	-71.59%
Sea Mullet	1999	20	126	3,859	$3,965	$1.03	
	2000	22	231	6,663	$6,318	$0.95	59.34%
	2001	21	259	5,177	$5,281	$1.02	-16.42%
	2002	19	260	32,947	$32,054	$0.97	507.02%
	2003	20	220	21,375	$21,161	$0.99	-33.98%
Spanish Mackerel	1999	8	71	22,286	$13,130	$0.59	
	2000	13	173	66,547	$51,601	$0.78	293.00%
	2001	14	283	119,501	$100,164	$0.84	94.11%
	2002	14	279	125,960	$115,638	$0.92	15.45%
	2003	8	181	55,847	$52,121	$0.93	-54.93%
King Mackerel	1999	10	105	52,011	$81,138	$1.56	
	2000	9	200	79,283	$125,227	$1.58	54.34%
	2001	13	290	63,370	$102,466	$1.62	-18.18%
	2002	12	166	35,619	$52,239	$1.47	-49.02%
	2003	9	96	25,425	$39,756	$1.56	-23.90%
Snowy Grouper	1999	3	15	5,106	$9,989	$1.96	
	2000	*	10	*	*	*	*
	2001	3	17	2,636	$5,306	$2.01	-46.88%
	2002	4	31	8,715	$16,942	$1.94	219.26%
	2003	*	18	*	*	*	*
Blueline Tilefish	1999	3	15	2,940	$2,457	$0.84	
	2000	4	17	3,071	$2,331	$0.76	-5.12%
	2001	6	32	7,223	$5,442	$0.75	133.42%
	2002	4	40	16,445	$14,786	$0.90	171.71%
	2003	*	18	*	*	*	*
Summer Flounder	1999	15	64	51,385	$88,723	$1.73	
	2000	18	85	31,241	$55,747	$1.78	-37.17%
	2001	16	69	43,599	$69,743	$1.60	25.11%
	2002	9	41	50,118	$73,530	$1.47	5.43%
	2003	7	42	56,783	$93,944	$1.65	27.76%
Sharks	1999	9	50	3,577	$1,567	$0.44	
	2000	13	127	18,019	$5,678	$0.32	262.32%
	2001	18	191	48,909	$26,185	$0.54	361.15%
	2002	18	168	190,514	$97,193	$0.51	271.18%
	2003	15	218	164,030	$97,700	$0.60	0.52%

* Confidential

Table 4. Selected inshore fisheries annual landings by the case study fishermen following the PSGNRA seasonal closure, 1999 – 2003.

Species	Year	Participants	Trips	Pounds	Value	$/lb.	% Change in Annual Value
Atlantic Croaker	1999	32	415	16,272	$5,475	$0.34	
	2000	30	384	13,828	$4,442	$0.32	-18.9%
	2001	30	317	32,843	$9,397	$0.29	111.6%
	2002	16	127	27,338	$9,576	$0.35	1.9%
	2003	17	120	27,020	$5,414	$0.20	-43.5%
Pigfish	1999	13	55	440	$103	$0.23	
	2000	8	40	1,717	$378	$0.22	268.4%
	2001	8	57	4,466	$1,072	$0.24	183.8%
	2002	4	20	2,876	$684	$0.24	-36.2%
	2003	4	8	33	$9	$0.27	-98.7%
Menhaden (Bait)	1999	12	113	30,135	$3,090	$0.10	
	2000	14	106	46,199	$5,082	$0.11	64.5%
	2001	17	223	253,038	$25,304	$0.10	397.9%
	2002	15	259	176,396	$26,118	$0.15	3.2%
	2003	14	155	96,927	$8,723	$0.09	-66.6%
Weakfish	1999	39	1,386	79,584	$43,079	$0.54	
	2000	34	853	54,062	$31,883	$0.59	-26.0%
	2001	28	445	22,370	$11,504	$0.51	-63.9%
	2002	22	255	22,988	$11,946	$0.52	3.8%
	2003	22	235	8,863	$5,289	$0.60	-55.7%
Spotted Seatrout	1999	23	588	45,938	$57,507	$1.25	
	2000	20	350	14,462	$18,541	$1.28	-67.8%
	2001	13	135	2,298	$2,914	$1.27	-84.3%
	2002	11	135	3,107	$3,878	$1.25	33.1%
	2003	14	85	1,025	$1,313	$1.28	-66.2%
Pompano	1999	12	68	177	$273	$1.54	
	2000	8	77	508	$715	$1.41	161.7%
	2001	10	43	548	$571	$1.04	-20.1%
	2002	8	28	232	$318	$1.37	-44.3%
	2003	10	93	2,763	$3,416	$1.24	975.0%
Southern Flounder	1999	40	1,452	451,931	$810,131	$1.79	
	2000	32	869	190,635	$344,123	$1.81	-57.5%
	2001	25	458	126,945	$203,952	$1.61	-40.7%
	2002	18	261	53,967	$87,962	$1.63	-56.9%
	2003	16	275	31,279	$53,866	$1.72	-38.8%
Shrimp	1999	8	155	88,842	$228,372	$2.57	
	2000	9	148	133,462	$320,819	$2.40	40.5%
	2001	5	88	47,470	$116,722	$2.46	-63.6%
	2002	9	163	141,801	$287,237	$2.03	146.1%
	2003	2	28	94,039	$203,297	$2.16	-29.2%
Hard Blue Crabs	1999	34	1,728	1,460,835	$786,946	$0.54	
	2000	28	1,894	1,468,372	$1,102,755	$0.75	40.1%
	2001	27	1,689	1,057,229	$808,262	$0.76	-26.7%
	2002	20	1,442	1,561,357	$992,742	$0.64	22.8%
	2003	22	1,967	2,344,042	$1,480,194	$0.63	49.1%

After the PSGNRA was instituted, some of the 40 fishermen shifted towards gill netting for summer flounder in the ocean. There was a trend towards a greater amount of summer flounder harvested using ocean gill nets. Additionally, following the PSGNRA closure, there were large increases in the number of participants, trips, and pounds landed of sharks, primarily from gill nets. Between 1999 and 2003, the removed amount of shark biomass increased by nearly 4,485%, from 3,577 pounds in 1999 to 164,030 pounds in 2003. The individual shark species that were landed with the greatest frequency were sandbar (*Carcharhinus obscurus*), Atlantic sharpnose (*Rhizoprionodon terraenovae*), and thresher (*Alopias vulpinus*) sharks.

In the inshore small mesh gill net fishery (Table 4), the typical species landed were Atlantic croaker, pigfish (*Orthopristis chrysoptera*), Atlantic menhaden (*Brevoortia tyrannus*), weakfish, and spotted seatrout. In terms of the biomass removed, Atlantic croaker saw an increased amount of removal from the ecosystem; however, the fisherman typically received a lower price per pound for the fish they landed. Menhaden is usually considered bycatch in this fishery, but these fishermen removed greater amounts of menhaden biomass in 2001 and 2002.

As was shown in Figure 4, there were large decreases in the amount of southern flounder landed by these fishermen. Table 4, however, shows the southern flounder landings from all inshore water bodies by the fishermen in this case study. The overall decrease in southern flounder harvest was very large, going from roughly 452,000 pounds in 1999 to a little over 31,000 pounds in 2003, a decrease of nearly 91%.

With the exception of 2001, hard blue crabs (*Callinectes sapidus*), primarily harvested with crab pots, saw an increase in pounds landed from 1,460,835 pounds in 1999 to 2,344,042 pounds in 2003, an increase of 60%. This increase is not due solely to an increase in effort as much as an increase in catch per unit effort.

In license year 2001 (July 1, 2000 to June 30, 2001), only 20 of the original 40 fishermen obtained a PSGNRA fishing permit. By license year 2003 (July 1, 2002 to June 30, 2003), only 8 of the original 40 fishermen obtained a PSGNRA permit. Table 5 shows, by license year, the number of PSGNRA permits issued and the number of the original 40 fishermen who obtained a permit.

Table 5. Total number of PSGNRA permits issued and study participants who received a permit, by year.

License Year	Total Permits	Study Participants
2001	140	20
2002	238	16
2003	161	8

Further analysis by NCDMF for this case study showed there were communities that were impacted by the PSGNRA closures. Each of the 40 fishermen identified in the Daniel (2004) study were matched to their community of residence. Table 6 shows the communities where there were at least three fishermen affected by the PSGNRA closure. Additionally, it shows the percentage of commercial fishermen from the community who were affected. The small Outer Banks communities of Rodanthe and Frisco, along with two rural Hyde County communities,

Fairfield and Engelhard, had the greatest percent of their commercial fishermen affected (between 14% and 20% of active commercial fishermen).

Table 6. Percent of commercial fishermen from North Carolina commercial fishing communities affected by the PSGNRA seasonal closure, 1999.

Community	Fishermen	% Affected
BELHAVEN	3	2%
ENGELHARD	7	14%
FAIRFIELD	3	20%
FRISCO	8	14%
RODANTHE	3	23%
SWAN QUARTER	5	7%
WANCHESE	3	2%

The analysis of the NCDMF trip ticket data clearly show there are large impacts resulting from the PSGNRA seasonal closure, not only on the livelihoods of commercial fishermen, but in terms of placing increased pressure on other species managed at state, council, and federal levels.

Section 4.2 –The Texas Shrimp Fishery Closure

Background

Shrimp have long been an important resource for many of the coastal communities in Texas and other states along the Gulf of Mexico. Commercial harvest records for shrimp date back to 1880 in Texas and Louisiana. Before 1900, fishermen used shallow water haul seines that required nearly 20 men to operate. Because the nets could only be used in shallow water, "many stocks of shrimp were used only seasonally, if at all. This factor appears to have been important in limiting the early growth of the fishery" (Klima et al. 1982). However, in 1915, shrimpers began using the otter trawl, which could be utilized by smaller crews in deeper waters, allowing for expansion within the fishery. Then, in 1972, commercial fishermen switched to the twin trawl system, where four trawls are towed simultaneously, from each side and to the stern of the vessel. By the early 1980s, this was the most widely used system in both the Gulf and Atlantic regions (Klima et al. 1982).

Three of the nine shrimp species found in the Gulf are caught commercially. They are the brown (*Farfantepenaeus aztecus*), white (*Litopenaeus setiferus*), and pink (*F. duorarum*) shrimp. However, prior to World War II, only white shrimp were caught because their lighter color offered better marketability. The Bureau of Commercial Fisheries started keeping accurate records of catch statistics in 1956, which indicate that brown shrimp is now the primarily targeted species in Texas (Klima et al. 1982).

Together, Texas and Louisiana account for almost 75 percent by weight of the Gulf of Mexico shrimp landings. Historically, the regulations in these two states have had two very different foci. "In Texas, shrimping regulations generally restrict the landing of small shrimp, whereas in Louisiana there are few restrictions on the taking of small shrimp. The overall results of these two diametrically opposed regulatory schemes are that in Texas the bulk of the catch comes from

an offshore fishery and consists mostly of large shrimp, whereas in Louisiana, there is a substantial inshore fishery producing a large volume of small brown and white shrimp" (Klima et al. 1982). These differences were at the crux of what many believed to be a disadvantage of future management measures.

In order to improve shrimp catches by allowing the shrimp to grow to a large size before they were harvested, Texas authorized a "closed" season beginning in 1959. This 45-day closure during the early summer months encompassed all offshore waters out to three marine leagues (nine nautical miles). The area could be opened, if there was an excess amount of shrimp emigrating early, or kept closed longer. However, the closure could not exceed 60 days. During this time, Texas allowed a daytime white shrimp fishery out to four fathoms (Klima et al. 1982). "The objective of the 1960 through 1980 Texas territorial sea closures was to ensure that a substantial portion (>50%) of the shrimp in Gulf waters had reached 65 tails/pound or 112 mm in length by the season's opening. Thus, these temporary closures of the offshore fishery from mid-May to mid-July each year result in larger shrimp to the fishery and subsequently a higher market value" (Nance 1996). The objectives of the original seasonal closure focused on both biological and economic issues within the fishery.

In 1981, the Gulf of Mexico Fishery Management Council (GMFMC) enacted the Gulf of Mexico Shrimp Fishery Management Plan (FMP), which allowed a closure of the brown shrimp fishery from the coastline to the 200 nautical mile limit off the Texas coast (Nance et al. 1988). Figure 5 illustrates the extent of the Federal Fishery Conservation Zone (FCZ) mandated in the 1981 FMP. "The objectives of the closure were: to increase the yield of brown shrimp [F. aztecus]; to eliminate the waste caused by the discard of undersized shrimp caught during the period in their life cycle when rapidly growing, allowing the shrimp to reach larger size before harvesting; and to increase the economic value of the harvest, since large shrimp bring a higher price per pound than smaller ones" (Nance et al., 1994).

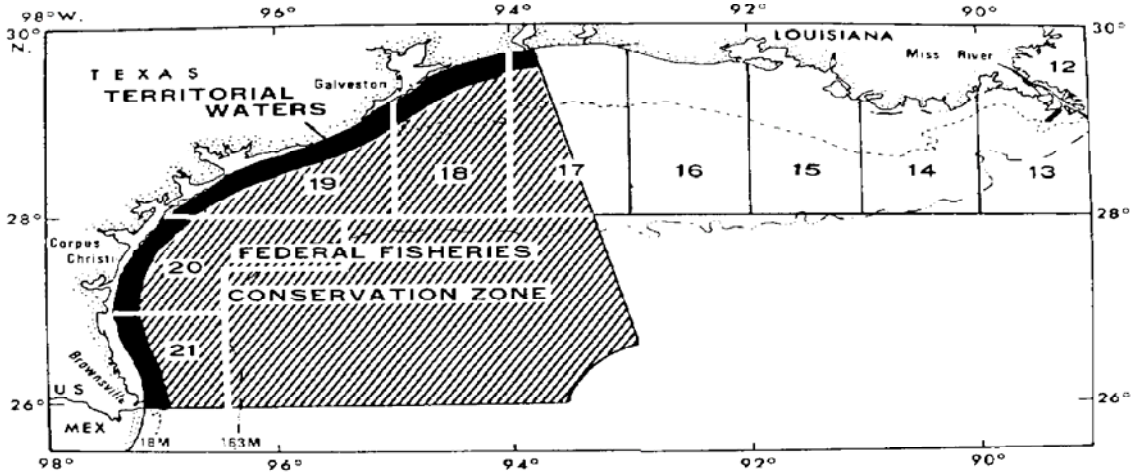

Figure 5. Spatial extent of the Federal Fisheries Conservation Zone (striped area) relative to statistical subareas (polygons numbered 12-21) and Texas territorial waters (solid black band) (Klima et al. 1982).

From 1981 through 1985, the closure extended from the shoreline out to 200 nautical miles. In 1986, the FCZ only extended out to 15 nautical miles from shore. The 15-mile closure remained in effect for the 1987 and 1988 fishing seasons. "It was determined by the Council that this type of closure would still allow small brown shrimp to be protected from harvest but would also

allow taking of larger brown shrimp by fishermen in deeper waters" (Nance et al. 1988). However, in 1989, the GMFMC once again adopted a 200-mile closure. Table 7 outlines the dates and extent of the Texas closure from 1981 through 1995. Also, beginning in 1990, the daytime white shrimp fishery out to four fathoms, which had been permitted during the 1960-1989 closure periods, became prohibited (Nance 1996).

The FCZ closure is still in effect today. The closed area continues to cover the entire EEZ. However, the current FMP regulates the closing and opening of the EEZ with the Texas territorial sea closure (Nance et al. 1988). The dates and duration of the closed season are similar to those of the early to mid-1990s. "Current regulations establish a federal closure from May 15 to July 15, each year, but provide an allowance for annual adjustments by the Regional Administrator of the National Marine Fisheries Service (NOAA Fisheries)" (NMFS 2004). The Texas Parks and Wildlife Department sets the closing and opening dates for the fishery by assessing abundance, size, and growth rate of shrimp in Texas waters during April and June (Bryan 1985, cited in Nance et al. 1988). April is the time of peak recruitment of the postlarvae shrimp into the estuary. The area is used as a nursery before they migrate back to the Gulf as subadults in May and June (Klima et al. 1982).

Table 7. Temporal and spatial extent of the Texas shrimp fishery closure (1981-1995).

Year	Closed Dates	Number of Days	Extent of Closure
1981	May 22-July 15	55	200 mi
1982	May 25-July 14	51	200 mi
1983	May 27-July 15	50	200 mi
1984	May 16-July 6	52	200 mi
1985	May 20-July 8	50	200 mi
1986	May 10-July 2	54	15 mi
1987	June 1-July 15	45	15 mi
1988	June 1-July 15	45	15 mi
1989	June 1-July 15	45	200 mi
1990	May 15-July 8	55	200 mi
1991	May 17-July 6	51	200 mi
1992	May 15-July 6	53	200 mi
1993	May 15-July 6	53	200 mi
1994	May 13-July 7	56	200 mi
1995	May 15-July 15	62	200 mi

Analysis of the closures

NOAA Fisheries has conducted biological and economic reviews of the Texas shrimp fishery closure since its implementation in 1981. However, studies regarding "the social impacts of the closure and fishermen's attitudes towards it did not begin to be systematically assessed until 1986" (Nance et al. 1994). These social impact studies were only carried out for the 1986, 1987, and 1988 fishing seasons.

In 1986, NMFS port agents interviewed shrimp vessel captains at 11 ports along the Gulf coast during the week of 13 July 1986. The survey sites included six Texas ports (Port Isabel, Brownsville, Port Aransas, Freeport, Galveston/Bolivar, and Sabine/Port Arthur), three Louisiana ports (Cameron, Delcambre, and Houma), one Mississippi port (Pascagoula), and one Alabama port (Bayou Labatre). They tried to interview at least 30 captains in each port (Klima et al. 1987).

The social survey for the 1986-fishing season focused on vessel mobility and opinions about the FCZ closure. A total of 346 captains completed the survey. Almost half of the respondents had vessels with homeports in Texas. When the data were analyzed according to fishing port, the researchers found that 66% of the vessel captains in either Alabama or the lower Texas coast favored a federal closure. A large portion of captains from Mississippi and Delcambre, LA had no opinion about the closure. Lastly, nearly half of the captains from the other two LA ports and all of the ports along the upper Texas coast were opposed to the FCZ. "Overall, about 35% of interviewed captains fishing for shrimp in Gulf waters were opposed to the FCZ closure along the Texas coast…but 53% of the captains fishing in Texas waters were in favor of an FCZ closure" (Klima et al. 1987). However, the fact they approved of an FCZ closure does not necessarily mean they wanted a closure of the entire EEZ.

The researchers also analyzed the type of closure most preferred by the captains who were in favor of the FCZ. A majority of the non-Texas captains did not have a preference for the distance of the closure. Eighty percent of the homeport Texas captains who were in favor of the closure had an opinion about the closure distance. There was almost an equal split in Sabine between no limit and a 200-mile limit. However, in Freeport the split was between no limit and a 15-mile closure. Lastly, three-quarters of the captains in Galveston were in favor of the 15-mile limit. The two lower Texas ports (Brownsville and Port Isabel) favored a closure in the entire EEZ (Klima et al. 1987). Those with no opinion regarding the closure or its distance were the least likely to be affected by it—Mississippi and central Louisiana.

Two of the most prominent issues following the implementation of the FCZ were vessel mobility and employment effects. Almost no difference was observed between the 1985-fishing season (200-mile closure) and the 1986-fishing season (15-mile closure), regarding the fishing habits of vessels with homeports in Alabama, Mississippi, Louisiana, or Sabine, Texas. Even though the FCZ was open in Texas beyond 15 nautical miles, most captains chose to fish off Louisiana, just like in previous years. However, the general trend for the other five Texas ports indicates a major increase in activity off the Texas coast in 1986, "but only a slight decrease in vessel activity off Louisiana when 1986 was compared to 1985" (Klima et al. 1987).

The issue of finding alternate forms of employment during the closure was of primary interest to the NMFS researchers. A high percentage of captains in Freeport, Port Aransas, and Brownsville, Texas did not shrimp during the closure period. However, the percentage of those who did not shrimp in 1985 versus in 1986 dropped by at least 10% in all three ports. In Freeport, half of these captains found alternate forms of employment. Also, the majority of shrimp captains in

Brownsville were also able to find other jobs during the summer. On the other hand, in Port Aransas in 1985, 90% of the captains who were unable to shrimp were also unemployed, and most of them were unemployed the following year as well. However, in 1986, shrimpers received a higher price for their catch. When coupled with the 50% decline in fuel prices, 1986 was an extremely profitable year for most shrimpers in the Gulf of Mexico (Klima et al. 1987).

The reviewers concluded that the goals of the FMP were only partially attained in 1986. On the one hand, the closure protected small emigrating brown shrimp, allowing them to grow to an average size of 44-count, and there was minimal discarding because of the high price received for all sizes of shrimp. However, the researchers believed that the closure should have been extended until July 15. This would have allowed fishermen to harvest larger shrimp (4-10% in pounds) and to receive a higher value for their harvest (15-19%). Also, problems with enforcement were noted beginning around mid-June with the 15-mile limit. For this reason, they believed that a closure of the entire FCZ would aid in enforcement efforts (Klima et al. 1987).

Impact of the closures

NMFS port agents conducted social surveys in 1987 and 1988 as well. The survey questions were slightly different for all three years. In 1987, port agents attempted to interview 30 captains in 13 ports. They completed 277 interviews in the same 11 ports as the year before, as well as Ft. Myers and Key West in Florida. For 1987, NMFS also interviewed vessel owners (someone who owned two or more shrimp vessels) in order to gain a broader perspective of the social impacts to the communities.

Responses in 1987 regarding opposition to the closure were similar to those given in 1986, as well as the responses regarding the extent of the closure. Eighty-five percent of the captains from Alabama and 83% from lower Texas favored a closure, with the majority from lower Texas favoring a 15-mile limit. Once again, captains from Louisiana and upper Texas opposed the EEZ closure. However, those who were in favor of it preferred a 15-mile closure (Nance et al. 1988).

The 1987 survey also asked captains why they were for or against the closure. Responses were placed into one of five categories: no opinion of the closure, too many boats in my state because of the closure, closure just is not working, closure helps conserve shrimp and allows them to grow, closure is needed to enforce management efforts. The responses in Texas were split based on port location. Thirty-nine percent of upper Texas captains said that the closure just is not working. On the other hand, half of the lower Texas captains said that the closure is needed to help conserve shrimp and to allow them to grow. Another 24% of lower Texas captains said the closure is needed to enforce management efforts (Nance et al. 1988).

When asked about the advantages and disadvantages of the closure, nearly two-thirds of lower Texas captains said it yielded better catches. Nearly the same percentage of upper Texas captains said there was no advantage to the FCZ, and the biggest disadvantage was pulse fishing. In the lower Texas ports, 22% of the captains said the biggest disadvantage to the closure was that they were not making any money because of it. Another 31% of captains in lower Texas mentioned lack of enforcement as the biggest disadvantage (Nance et al. 1988).

Fifty-one vessel owners were interviewed in 1987 as well, with 28 from lower Texas, eight from Florida, six from upper Texas, five from Alabama, and two each from Louisiana and Mississippi. A majority of the owners (69%) were in favor of the closure. Of this group, 45% preferred a 15-mile closure, and 18% preferred a full EEZ closure. The remaining owners (30%) did not want any closure in federal waters. Those that favored the closure wanted it to protect the small,

brown shrimp and to allow them to grow. Those that opposed it said it either was not working or that small, brown shrimp are not found in federal waters. Twelve percent of owners (all from Florida and Alabama) said that the closure caused too many Texas boats to fish in their state waters. Eighteen percent (all from Texas) said the closure caused pulse fishing. The same percentage also mentioned that the EEZ closure was not enforced and many boats fished illegally in the closed waters. The biggest disadvantage as viewed by owners (31%) was the loss of money because of dropped prices or increased travel time for vessels (Nance et al. 1988).

As in 1986, the reviewers felt that the goals of the closure were only partially fulfilled with a 15 nautical mile closure instead of a complete EEZ closure. The successes were the same for this year as the previous one. However, poaching and other closure violations with little or no punishment being exacted on the violators was the largest problem for officials and caused even greater skepticism from Gulf shrimpers (Nance et al. 1988). Increasing distrust and skepticism amongst stakeholders can severely harm relations with regulators, making enforcement even more difficult.

In 1988, the social survey was conducted by vessel homeport. A total of 348 surveys were completed. Captains were interviewed in the same 13 ports as in 1987 during the last week of July and the first week of August. Popularity for the closure continued to increase in lower Texas ports, with 95% of the captains in favor of the closure. The majority of these captains (80%) preferred a 200-mile limit. More than 60% of upper Texas captains still opposed the FCZ. However, all "states showed less captains against the closure this year when compared to 1987" (Nance et al. 1989). Once again the majority of positive responses came from captains in Florida, Alabama, and lower Texas, whereas Louisiana and upper Texas port captains continued to voice their dissatisfaction with the closure.

Enforcement continued to be the issue of greatest concern for shrimp captains. Almost all (91%) of the captains from lower Texas ports and 46% from upper Texas ports stated that there were problems with the enforcement of the closure during the past year. Florida captains also saw problems with enforcement. Florida and lower Texas captains offered a few solutions to this problem. First, they suggested posting more agents. Second, a 200-mile closure should be reestablished. Lastly, there should be stiffer punishments for those caught violating the closure zone. For this reason, the 15-mile closure was not considered to be completely successful. This was the case for all three years that a complete closure of the EEZ was not enforced (Nance et al. 1989).

Economic analyses and studies of the fishery began in 1982, four years before the first sociological study. Examining the economics was important because the "penaeid shrimp fishery is one of the most valuable fisheries in the United States in terms of ex-vessel value…The total impact on the Texas economy, including multiplier effects, is about $580 million annually with the fishery employing some 20,000 fishermen" (Cody et al. 1989, cited in Griffin and Hendrickson 1992). In 2002, commercial landings for all shrimp species in Texas totaled more than 75 million pounds valued at $147.7 million (NMFS 2003). However, this was a decrease from both 2000 and 2001.

In 1982, NMFS scientist John Poffenberger estimated the effects on shrimp prices as a result of changes in offshore landings due to the Texas closure and calculated the change in gross revenue to the brown shrimp fishery. According to his report, the gross revenue of the fishery from May through August 1981 (the majority of which was during the closure) was nearly $119 million. However, if the regulation had not been in place, the "fishermen would have received slightly higher prices for the shrimp but would have caught about 11.7 million pounds fewer shrimp"

(Nichols 1982, cited in Poffenberger 1982). The gross revenue without the closure would have totaled about $97.5 million, $21.5 million less than what was actually received. Therefore, the net benefit to the fishermen was about an 18% increase in ex-vessel value (Poffenberger 1982).

A study by Griffin and Hendrickson (1992) evaluated the change in landings and the consequent effects on revenue, cost, and rent, while holding effort constant for five different closure scenarios. The five scenarios were (1) a 200-mile, 45-day closure, with the 4-fathom zone open; (2) a 200-mile, 45-day closure, with the 4-fathom zone closed; (3) a 200-mile, 45-day closure, with the 4-fathom zone closed and effort re-directed inshore; (4) a 200-mile, 60-day closure, with the 4-fathom zone closed; and (5) a 200-mile, 60-day closure, with the 4-fathom zone closed and effort re-directed inshore.

Griffin and Hendrickson (1992) concluded that scenario (4) represented the best alternative for achieving the goals of the closure. The rent to the fishery increased by more than $3 million and discards decreased by 42,000 pounds. Benefits declined when effort was re-directed inshore (scenario (5)) but still offered greater returns than the original closure. However, crewmembers were worse off under all five scenarios than under the original Texas closure.

On the other hand, increasing rents to vessel owners can also have negative implications. The positive impact of the increased rent could eventually become a negative impact because it will lead to a greater competition within the fishery. "Without some form of effort limitation or limited entry program, any policy that generates an increase in rent for the fishery will be short-lived in its effectiveness" (Griffin and Hendrickson 1992). Policy measures cannot be considered and/or implemented in a vacuum.

A 1991 study by Nance and Garfield examined the demographic profiles of participants in two Gulf of Mexico skipjack fisheries and their responses to the Texas closure. During the summer of 1987, 159 shrimp boat captains were interviewed: 89 in Galveston Bay, Texas and 70 in Calcasieu Lake, Louisiana. This was the first study to analyze the social impacts incurred by inshore shrimpers in response to the closure regulation.

The community on the eastern side of Galveston Bay consists almost entirely of Caucasians. However, the more urbanized areas are much more ethnically diverse: Caucasians, Blacks, and recent immigrants from Southeast Asia (mostly Vietnam), Latin America, and Italy. All of these groups participate in the inshore fishery. The Texas Parks and Wildlife Department uses both seasonal closures and gear restrictions to regulate the commercial bay fishery. Fishermen are able to target larger, more valuable white shrimp, which remain mostly in the bays and near shore areas during the closure periods. However, shrimping with a bay license is prohibited from 15 July to 15 August each year and for five months between the fall and spring seasons. "Overall, the regulations allocate the more highly migratory brown shrimp primarily to the offshore shrimpers, and the less migratory white shrimp to the inshore shrimpers. Both management regimes target large valuable shrimp" (Nance and Garfield 1991).

The ethnicity of the population that participates in the inshore shrimp fishery in Calcasieu Lake is highly homogenous. It is almost entirely Caucasian, with less than one percent of the residents being from ethnic minorities (Nance and Garfield 1991). This homogeneity may make it easier for legislators and managers to enact and implement management measures. During their review of the 1987 shrimp fishery, NMFS researchers said, "Asian fishermen present a complex problem to the management of the fishery. This group of captains had little idea about the purpose of the closure and no expressed opinions about the fishery regulations." They believe that "special attention must be focused on this segment of the population" (Nance et al. 1988). The Calcasieu

Lake fishermen target small shrimp destined for canneries. The seasonal closures for the inshore fishery in Louisiana are very similar to those in Texas, with only a few differences. For example, the closure between the spring and fall seasons is a complete closure (Nance and Garfield 1991).

Both communities relied on shrimp houses for distributing the majority of their catch (73% in Calcasieu Lake and 63% in Galveston Bay). In turn, the shrimp houses relied heavily on processors as markets for their shrimp. Locally caught inshore shrimp are the mainstay for the majority of these shrimp houses (89% in Louisiana and 83% in Texas during the spring season and 97% during the fall season). Also, many of the shrimp house owners are integrated with another aspect of the local fishery (i.e. own commercial shrimp boats, own retail seafood markets, etc.) (Nance and Garfield 1991). Even though they are heavily integrated, all of their businesses rely upon shrimp.

The shrimp fishermen differ from the shrimp house owners regarding integration. For many of the fishermen, shrimping is their only source of income. "Overall, 54 percent of the Calcasieu Lake shrimpers and 62 percent of the Galveston Bay shrimpers reported to be fully dependent on these occupations for monetary support. In both populations there was an increased number of shrimpers fully dependent upon their occupation for income as vessel size increased" (Nance and Garfield 1991). Therefore, the implementation of new management measures has the ability to severely affect the livelihoods of more than half the fishery participants in both communities.

Nance and Garfield (1991) also surveyed captains regarding opinions and perceived impacts of the closure. The majority of Calcasieu Lake shrimpers (75%) had no opinion on the closure, and 20% opposed it. In Galveston Bay, 55% had no opinion, 24% favored it, and 20% disapproved of the closure. The largest impacts felt by the fishermen in Louisiana were overcrowding, reduced catches, and reduction in both supplies and dock space available to local shrimpers because of the displaced Texas boats. According to Jones et al. (1982) this was an anticipated effect of the redistribution of shrimping vessels. Many of the larger boat captains also said that their incomes were negatively affected by the reduction in catch levels. Galveston Bay captains with large and medium sized boats said that overcrowding in the Bay and a decrease in the price of shrimp following the opening of the closure led to decreased incomes. The larger vessel captains also mentioned another disadvantage—"traveling to Louisiana to shrimp because it was too dangerous and uneconomical to travel farther out than 15 miles (the extent of the Texas closure during the 1986-88 seasons)" (Nance and Garfield 1991).

Texas fishermen also felt other negative impacts of the closure. For example, immediately following the opening of the closure, several of the boats were under-manned and therefore unable to head their entire catch, in some instances leading to discarding (one of the reasons for implementing the closure) or landing of the catch heads-on. The discarding was short-lived as additional crewmembers were placed aboard the vessels to handle the larger catches (Klima et al. 1982). Similarly, processors did not anticipate the large landings that occurred at Texas ports after 15 July 1981, causing difficulties in processing the catch. Vessels were delayed in unloading their catch, and in many instances the shrimp had to be shipped to other Gulf ports for processing (Jones et al. 1982; Klima et al. 1982).

In 2002, researchers at Texas A&M University completed "A Social and Economic Study of the Texas Shrimp Fishery" (Anderson and Ditton 2002). While the report does not specifically measure impacts from the closure, it does offer some important insight into the social and economic importance of the Texas shrimp fishery. In order to measure the socioeconomic dimensions of the fishery, the researchers developed two surveys. The first was sent to Texas shrimp fishermen and collected information related to the extent of the fishermen's shrimping

operations, their attitudes towards their business and shrimp management in Texas bays, and their "economic health" and well-being. The second questionnaire was sent to commercial shrimp dealers. They were asked many of the same questions regarding their opinions of Texas shrimp management. However, other questions regarding the size and operation of their businesses were added (Anderson and Ditton 2002). The types of questions used in these surveys allowed the researchers to gain a better understanding of the social and economic environments of the Texas shrimp fishery and the possible effects new management measures could have on stakeholders.

Regulations that restrict those involved in the shrimp industry can have detrimental effects both economically and socially. An equal percentage of fishermen and dealers (59% for each group) said that they "did not earn any income from work other than shrimping or selling fish or fish-related products in the previous twelve months." Also, more than half of the dealers with a spouse noted that their spouse did not earn income from work other than selling fish or fish-related products in the previous 12 months. Similarly, 38% of the fishermen "reported that between 91% and 100% of their household's gross annual income comes from shrimping activities" (Anderson and Ditton 2002). For many of these fishermen and dealers, a closure severely affects their monetary flow during the closed season. They would have to do well before the closure period in order to survive financially.

In most port areas, fishing is a way of life and has been for decades. Many fishing communities have Blessing of the Fleet ceremonies and other events commemorating and celebrating their fishing culture. In many areas, shrimping operations are passed down from one generation to the next. For example, of the 89 shrimp boat captains interviewed by Nance and Garfield (1991), 62 (70%) came from fishing families. Captains were considered to be from a fishing family if a parent or grandparent was a commercial fisherman. Anderson and Ditton (2002) found that 69% of shrimp dealers would not encourage young people to enter the seafood dealing business. An even greater majority of fishermen (83%) said that they would not encourage young people to enter the shrimping business. The longstanding social tradition of entering the family fishing business is in jeopardy. On the other hand, more than 70% of each group expected to still be employed in their respective profession in four years time. Perhaps this is because there is nothing else for them to do, not because it is profitable for them to remain in the shrimp industry.

One reason the profitability of the domestic shrimp industry is declining is because of imports. "In the face of rising consumer demand, prices declined 27% in the Gulf of Mexico and 24% in the southern Atlantic states shrimp fisheries between 1997 and 2002 as imports increased 300%" (NMFS, in prep.). Even though consumption within the US has increased in recent years, the high volume of imported shrimp has contributed to the continued decline in value for domestic shrimp. Not only are revenues declining, but operating costs are rising. In 2002, fuel costs, which represent about 25% of commercial fishermen's total cost of harvesting shrimp, began to soar (Ward et al. 1995, cited in NMFS, in prep.). These two factors, increasing costs and decreasing ex-vessel value, increase the probability that shrimpers will exit the fishery. Yet, it would not be economically sound to prohibit all imports of shrimp either. "Murray (2003) suggests that the economic impact from imported shrimp approaches $9 billion in economic output and contributes 138,000 jobs to the national economy" (NMFS, in prep.). According to the GMFMC's Socioeconomic Panel (2002), closed seasons can cause the commercial sector to lose some of its market because of the inability to produce continuous supply. This in turn leads to a decline in ex-vessel value, which is the case in the Gulf region. Therefore, while the closure did not appear to have severely negative effects on the stakeholders in the early years of implementation, new circumstances in the Gulf shrimp fishery are compounding the negative impacts of domestic fisheries management.

In this case, a seasonal closure proved to be a good way to eliminate the waste caused by the discard of undersized shrimp caught during the period in their life cycle when rapidly growing. The effect of the closure was an increase in the size of the shrimp caught that lead to an estimated 18% increase in ex-vessel value (Poffenberger 1982). Fishermen from different parts of the Gulf region felt differently about the closures, depending on how they thought their fishing methods and catches would be affected. Although the closure did yield better catches, NMFS survey work during 1986-1988 uncovered some disadvantages during the closed periods including increased fishing effort in open areas, reduced catches for fishermen who historically fished in the open areas, enforcement problems, increased travel time for vessels, and reduction in both supplies and dock space available to local shrimpers in open areas. There were also problems upon the opening of the closed area relating to pulse fishing, overcrowding and a decrease in the price of shrimp.

Although there were some complications, the closure itself did not significantly harm the participants of the shrimp fishery. The closure, the subsequent loss in ex-vessel shrimp value, the effects of rising costs and increased competition with imports, have combined to shape the current state of the fishery. It is the cumulative effect of these things and many others, not the initial closure, which is causing the current decline in the Gulf of Mexico shrimp fishery.

Section 5 – Implications for Management Measures

The following are considerations recommended by the Committee on Economics and Social Sciences to assist in the management process:

- Begin any management activity with defining your biological, social, or economic goals and objectives. For biological goals (protecting spawning aggregations, eliminating discard of undersized individuals, etc.) seasonal closures may be the only option. For social goals (such as reducing recreational and commercial conflict) and economic goals (increasing market value), other options may be available.
- If other options are available, they need to be evaluated on a case-by-case basis. They may or may not have fewer social and economic disadvantages than seasonal closures.
- During the development of regulatory actions, managers should consider how fishermen are likely to adapt when presented with the proposed regulation. Interviewing fishermen is one way to do this.
- Managers can try to prepare for the consequences but there will always be unexpected outcomes.
- Care should be taken to determine the social and economic effects of one action before additional management actions are taken.
- Strong fisheries data collection programs, such as the North Carolina Trip Ticket Program, can provide valuable information for socioeconomic studies and should be encouraged.
- Managers and regulators should realize that the use of seasonal closures is an iterative process and should continually investigate and survey the impacts of their management schemes.
- Managers should start doing cumulative impact assessments before and after management actions. Once there are enough case studies, managers may be able to see some significant past trends.

The following are some significant past trends related to seasonal closures that managers should keep in mind:

- Seasonal closures in one fishery tend to move fishermen towards adding additional pressure on other fisheries. The economic outcome of the movement between fisheries can lead to profits for some fishermen and losses for others.
- Locations of the closure make a difference on what groups are impacted. Inshore closures tend to hurt the smaller vessels because they are incapable of moving farther offshore with larger vessels.
- Closures can lead to additional conflicts between user groups, such as recreational and commercial fishermen.
- Closures can lead to increased sizes at harvest, which are more valuable.
- Closed seasons can cause a fishery to lose some of its market because of the inability to produce continuous supply. This in turn can lead to a decline in ex-vessel value.
- Fishermen from different areas may have very different opinions on the same closure, depending on their perceptions of how it will affect them.
- The use of seasonal closures is a valuable management tool only if the closures are enforceable.
- At the conclusion of the closed season, there can be problems relating to pulse fishing, overcrowding, and a decrease in prices due to a flooding of the market.
- There is evidence that achieving buy in from the affected fishermen will greatly enhance the probability of success.

Section 6 – Conclusions

Federal fisheries managers are explicitly obligated under Federal law to assess the impacts of management measures on the environment, including the human environment. Although the law is clear on what ought to be done, performing these analyses is not easy or straightforward. Even deciding on a definition of what constitutes a fishing community is not clear-cut. Nonetheless, we know that management measures, including seasonal closures, do impact fishing communities. Some of these impacts are cumulative and form a sort of a gestalt, that is, the total impact of multiple management measures is greater than the simple sum of those individual impacts.

Fisheries managers can in many cases anticipate some impacts of seasonal closures. Past research shows that there also tends to be unanticipated impacts, as well. Unfortunately, surprisingly little research has been conducted to assess the cumulative impacts of any management measures, let alone specifically determine the cumulative impacts of seasonal closures. In order for fisheries managers to be able to better predict the impacts of seasonal closures and minimize the unexpected impacts, greater emphasis needs to be placed on cumulative impact research. This would in turn allow better understanding of how fishery stocks might rebuild and recover when necessary, and what socioeconomic factors might help or hinder that recovery. Cumulative Effects Analysis is also a critical component to taking the next step in fishery management – ecosystem-based management.

A greater understanding of cumulative impacts is definitely needed. If nothing else, understanding is needed to avoid unintended consequences of management actions and bring greater success to management of both the human and natural environment.

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