EFFORT MANAGEMENT IN THE MAINE LOBSTER FISHERY

by

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ABSTRACT

The Maine lobster fishery is one of the most economically valuable fisheries in the United States. In 2010 the fishery brought in a record 93 million pounds of lobster and was valued at nearly $310 million. Annual catch has risen steadily over the last seventy years as a result of both good conservation practices and increasing effort in the fishery. The fishery is an extremely valuable resource for the state of Maine and the entire Northeast region. However, current research suggests that the fishery may have reached a point of overcapacity and that catch-per-unit-effort (CPUE) is not being maximized, thus resulting in lost productivity. Conflicts over excessive effort have been prevalent at the local, state, and interstate levels of management. There are environmental, social, and economic costs associated with excessive effort, but several proposals for effort management have been rejected by the industry and its managers. Effort management regulations that were established as part of the 1995 co-management law have been largely ineffective, and recent surveys have indicated that the majority of lobstermen are concerned about the number of traps fished in their areas. There is substantial anecdotal and experimental evidence supporting the need for effort reduction in the fishery, yet very little progress has been made toward achieving such a reduction. The objective of this report is to use official landings and effort data collected by Maine's Department of Marine Resources to assess the nature and extent of the excessive effort problem in the Maine lobster fishery. The report provides a comprehensive assessment of the biological and economic status of the fishery. The analysis is used to assess the need for an effort reduction plan and to identify specific barriers to achieving effort reduction. Short-term and long-term recommendations are provided.

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INTRODUCTION

The world's fisheries are in a state of crisis. At present, nearly 70% of fisheries are being exploited at a level beyond the maximum sustainable yield (Acheson 2010). In stark contrast, the Maine lobster fishery is one of the world's most successful fisheries, and it is arguably the most important fishery in the Northeast United States (Acheson 2010). With recent annual catches as high as 93 million pounds and bringing in more than $300 million in revenue each year, the lobster industry is hugely important and represents an example of effective fisheries management in the United States (Wilson 2007).

Much of the fishery's success stems from conservation regulations that were developed or initiated by the industry (Acheson 2003). After a "lobster bust" in the 1930s, when the stock reached all-time lows, several conservation measures were created that placed limitations on the exploitation of the stock. Minimum and maximum size regulations were established to protect juveniles and brooding adults. A prohibition of taking "berried" lobsters with eggs attached and the practice of "v-notching" were put in place to maintain the reproductive potential of the stock. These measures allowed the stock to replenish and have resulted in steadily increasing catches since the 1940s. From 1947 to 1989 the annual total catch averaged about 20 million pounds. From 1989 to 2000, the average annual catch was more than 30 million pounds. And from 2000 to 2010, the average annual catch has been more than 50 million pounds with high years around 90 million pounds (Figure 1; Acheson 2010; Wilson 2007; Griffin 2008).

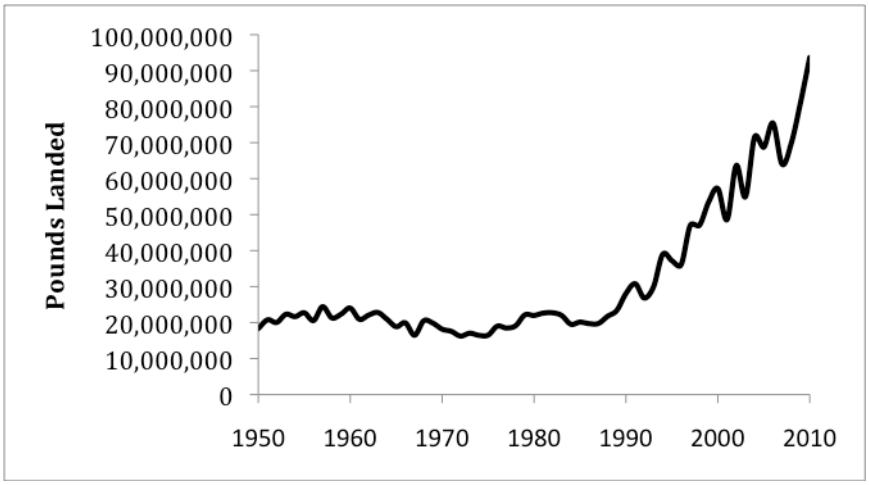

Figure 1: Landings over a 60 year time series in the Maine lobster fishery

These years of record highs came to a halt in 2007 when the overall catch dropped to 56 million pounds, causing some alarm in the fishery (Griffin 2008). While multiple factors may have contributed to this drop, including changes in the dealer reporting system and natural fluctuations in the stock, many signs indicate that excessive fishing effort was to blame. However, the annual catch has risen steadily in the three subsequent years and peaked at an all-time record in 2010 with more than 93 million pounds landed.

In addition to these fluctuations in catch, which can create economic stress for participants in the fishery, lobstermen have been reporting declining catch per unit effort (CPUE) for decades due largely to increases in effort outpacing increases in catch. Although the numbers of lobsters caught per trap has remained relatively stable, and has even increased slightly in recent years, lobstermen are reporting that they must fish for more months of the year and haul their traps more frequently to maintain a steady income. Through both anecdotal and experimental evidence, it is becoming clear that lobstermen are expending consistently greater effort to make a living.

The majority of Maine's lobstermen and the lobster fishery's mangers agree that there is a need for effort reduction, but there is widespread disagreement about how such a reduction should be achieved. One of the greatest challenges facing fisheries managers worldwide is regulating levels of fishing effort. The primary objective of fisheries management plans is often to maximize the profitability of the fishery. However, designing a plan based solely on maximizing gross income can inadvertently lead to overcapacity and excessive effort by allowing too many fishermen or too much fishing effort to enter the fishery during early stages of high productivity.

When a previously unutilized fishery is first commercially exploited, fishers often enjoy a very high CPUE. Such success prompts more individuals to enter the fishery, which usually requires that they invest a substantial amount of money in new gear. As the number of participants in the fishery grows with respect to the available fishery resource, many if not most individual fishers inevitably experience decreased CPUE. Despite this reduction in profitability and productivity, fishers are reluctant to reduce their effort or leave the fishery because they have invested in fishing gear.

This situation has led to the decimation of fish stocks as well as the deterioration of fishing communities worldwide. As the number of participants and the amount of gear in a

fishery grows, fishers have to work harder and harder to maintain a steady income. In some cases they are able to maintain steady catch levels by increasing the amount of gear they use, increasing the amount of time spent fishing, or by doing both. In Maine, these trends are evidenced by an increasing number of traps in the water and a CPUE that is substantially lower than its peak levels (Figures 2 and 3).

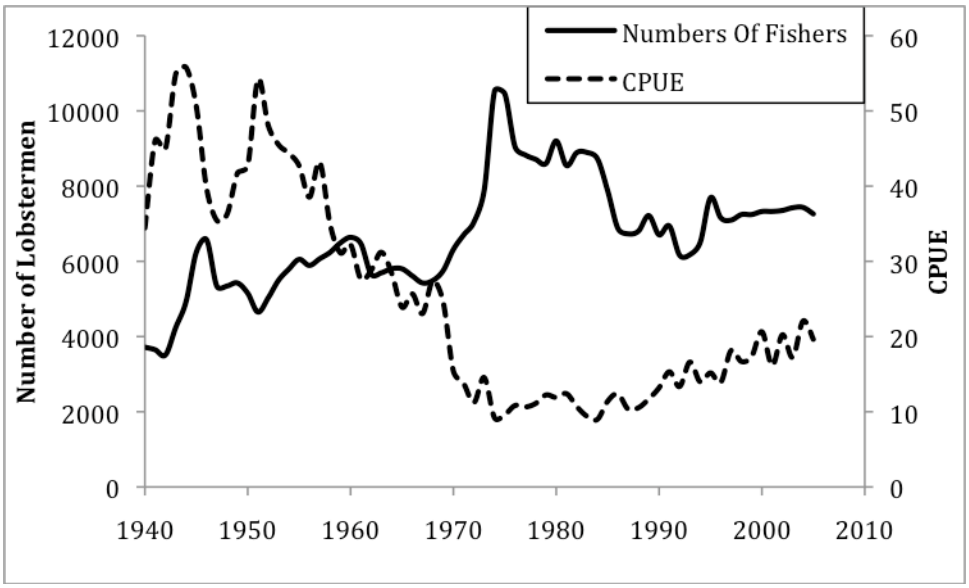

Figure 2: Numbers of licensed lobstermen and CPUE, 1940-2005

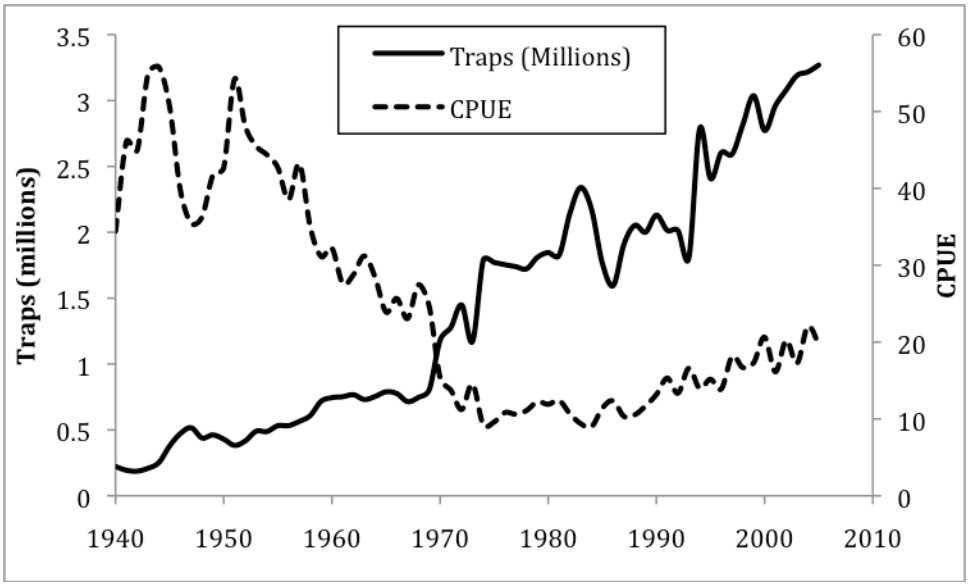

Figure 3: Numbers of traps and CPUE, 1940-2005

This increasing level of effort has led to an array of problems in the fishery. Gear entanglements and harbor congestion are becoming greater nuisances, territorial conflicts among lobstermen are frequent, and lobstermen have to work more days at sea to make ends meet.

Despite these largely undocumented social and economic problems, the 2009 Stock Status Report issued by the Atlantic States Marine Fisheries Commission stated that the Gulf of Maine lobster stock is not overfished and that overfishing is not occurring (Atlantic States Marine Fisheries Commission [ASMFC] 2009[1]). The report found that annual juvenile recruitment is currently sufficient for maintaining a healthy lobster stock (ASMFC 2009[1]). All signs suggest that the conservation measures created to restrict overexploitation of the fishery have been effective.

Despite these positive indicators of the fishery's health, there is widespread concern about the current level of effort in the fishery. While the number of licensed lobstermen has decreased significantly since its peak in the mid-1970s, there is evidence that the number of traps fished continues to increase (Figure 3; Steneck 2006). Regulations established in 1995 to limit the amount of effort in the fishery may have backfired to actually cause total effort to steadily increase over the last 15 years (Acheson 2003). Between 1995 and 1998—the period of time in which trap limits were first being implemented—58% of lobstermen surveyed increased the numbers of traps they fished, 25% kept the same number of traps, and only 17% reduced their traps (Acheson 2003).

In 2005 Carl Wilson, a biologist employed by the Department of Marine Resources, conducted a study on Monhegan Island to better understand the effects of trap density on total catch. He created areas of low (50 traps per km^2), medium (167), and high (500) trap densities surrounding the island and left the traps in the water for equal periods of time (Griffin 2008). At the end of the study he found that reducing trap density from 500 to 150 traps per km^2 produced a 143% increase in the pounds per trap hauled (Acheson and Acheson 2010). Wilson's study provided evidence of what many people in the fishery had already suspected: reducing trap density, to an extent, does not decrease total catch, but it does have the potential to increase CPUE. In theory, if everyone reduces the number of traps they fish, they will catch the same numbers of lobsters and receive the same income while incurring reduced expenditures for bait and fuel (Acheson 1998).

Nonetheless, trap reductions are counterintuitive to lobstermens' rational desires to increase the numbers of traps in the water to keep ahead of the competition (Acheson 1998). Individuals are ultimately concerned with having a higher proportion of traps on the bottom relative to other lobstermen, and they are willing to accept lost productivity in order to maintain a perceived advantage over the competition. Wilson has been quick to point out that the Monhegan results were achieved on a small-scale and that they should not be too eagerly applied to the entire fishery (Griffin 2008). The study was conducted on an island with a long history of regulating effort in surrounding waters, and the mainland harbors where the majority of lobsters are caught may have different dynamics that affect the relationship between trap density and total catch. More studies are needed to determine the ideal and appropriate levels of effort throughout the fishery, but it is clear that some adjustment of effort may have the potential to create positive economic, social, and possibly biological, effects.

In addition to concerns raised over lost productivity, marine mammal entanglements in lobster trap trawl and buoy lines have provided an additional impetus for effort reductions. The American lobster fishery has historical bycatch of four large whale species: The North Atlantic Right Whale, the Humpback Whale, the Fin Whale, and the Minke Whale (Department of Commerce, National Oceanic and Atmospheric Administration). Despite several regulations created to reduce these interactions, entanglements still occur. Because there is a direct relationship between the number of traps in the water and the likelihood of entanglements occurring, there has been an additional push for the lobster fishery to create stricter trap limits.

Managers of the fishery at the local, state, and interstate levels are faced with the challenge of developing solutions to this complex problem. The lobster industry has a history of self-regulation, but the institutional framework in place may not be equipped to produce significant effort reductions. Wilson's small-scale study offers a useful starting point for understanding the potential benefits of reducing effort. However, it is necessary to first evaluate landings and effort trends in the fishery to understand the nature and extent of the problem, if there truly is one. Only with a clear picture of the relationship between effort and productivity can managers move toward creating a strategy for effort reduction.

OBJECTIVES

The objective of this report is to provide a thorough analysis of the biological, economic, social, and institutional dynamics of the Maine lobster fishery and to use this information to better understand the excessive effort and overcapacity problem. Specifically, I will address the following research questions:

1) What is the *nature and extent* of the problem?
2) What are the options for effort reduction?
3) What are the barriers to achieving effort reduction?

I will provide short and long-term recommendations for addressing these problems.

BACKGROUND

Biophysical Ecology of the American Lobster

The American lobster (*Homarus americanus*) is a hard-shelled, bottom-dwelling crustacean that is widely distributed on the continental shelf of North America (Iodine 2006). It is found from Labrador, Canada to Cape Hatteras, North Carolina (Figure 4; Iodine 2006). Lobsters are most abundant in the northern portion of their range and are in especially high concentrations in the Gulf of Maine (ASMFC 2009[2]). They prefer cold, shallow waters but can be found at depths of up to 700 meters. They are concentrated at depths less than 150 feet along shores and in shoal areas and prefer rocky bottoms with abundant kelp in inshore areas and submarine canyons offshore (Acheson 2003).

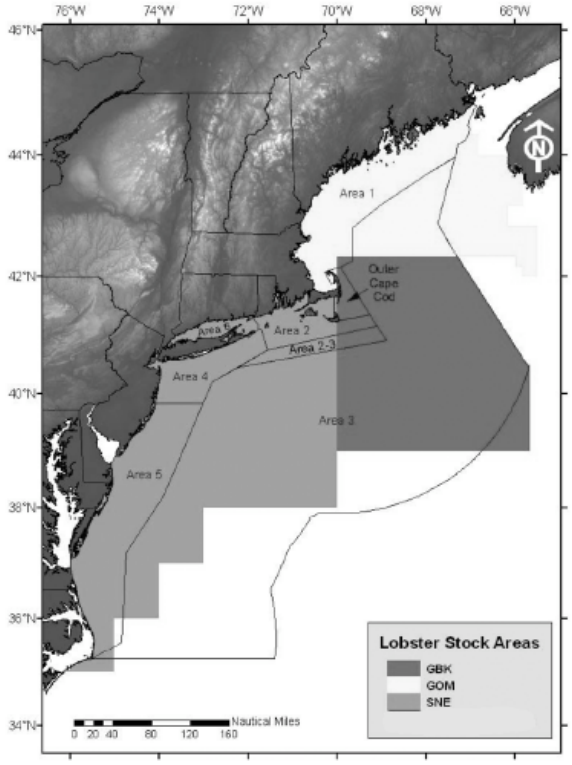

Figure 4: American lobster (*Homarus Americana*) species range and stock ranges in U.S. waters (Source: NOAA Northeast Fisheries Science Center)

The American lobster is a solitary, territorial species with a complex life cycle (Acheson 2003). Reproduction and growth are both linked to the molting cycle (ASMFC 2009[2]). Early in their lives they molt several times per year, but adults molt only once a year at most (Acheson 2003). After molting, females mate and extrude 7,000 to 80,000 eggs under their abdomens where they carry them for 9 to 11 months (Acheson 2003). The eggs hatch from mid-May to mid-June, and the pelagic larvae undergo four molts before developing adult characteristics and settling into rock or gravel covered with algae, salt-marsh peat, eelgrass, seaweed substrates, or firm mud (ASMFC 2009[2]). In inshore waters, larger lobsters travel extensively while smaller ones are more sedentary. Most lobsters stay within a home range of 5-10 km^2 (ASMFC 2009[2]). Offshore

lobsters migrate shoreward in the spring, traveling 80 to 300 km and moving laterally along the continental shelf edge (Goyert 2009).

Adolescent lobsters are most subject to predation by large fish, but very large lobsters have no natural predators and can live for up to one hundred years (Acheson 2003). Most female lobsters do not mature until they reach 3.15-3.7 inches carapace. They become more fecund as they grow—increasing from several hundred eggs to several thousand eggs per extrusion (Acheson 2003).

Lobsters reach commercial market size at about four to nine years of age, depending on a number of biological factors (ASMFC 2009[1]). The fishery has been divided into three main stock areas for assessment and management purposes. These areas are: the Gulf of Maine, George's Bank, and Southern New England (Goyert 2009).

History of the Maine Lobster Fishery

During the early years of the lobster industry, from the 1840s to the 1870s, the laws governing the fishery were vague and very limited. Between 1870 and 1940 three important laws were passed by the state legislature: a minimum size law that protected juveniles, a double gauge law that also protected brooding adults, and a prohibition of taking "berried" lobsters with eggs attached (Acheson 2010, 2006). This first set of rules established a conservation framework that could have effectively protected the health of the fishery if the rules had been followed and enforced, but illegal activity was the norm of the late 19th and early 20th centuries. Although the laws had all been supported by the industry (and in some cases the industry had even lobbied for the rules), a lack of enforcement resulted in widespread rule-breaking (Acheson 1997).

The low catches of the early 20th century culminated in the 1930s with a "lobster bust" when annual catches dropped as low as 5 and 7 million pounds (Acheson 2010). Between 1928 and 1933, lobster fishing became so unprofitable that as many as 40% of lobstermen went out of business (Acheson 2010). At this point the norm in the fishery shifted rapidly from "rule-breaking" to "rule-following." Individuals began providing wardens with information about violators in their area so that wardens were able to target their efforts and punish those violators (Acheson 1997).

In addition to the size regulations, one of the most important conservation measures in the lobster industry is the practice of V-notching. Under the original v-notching program

wardens purchased females that had extruded their eggs after they were captured. They punched holes in the lobsters' tails, marking them as reproductive individuals, and released them. Lobstermen were prohibited from taking lobsters with these markings. In the mid 1940s when the conservation movement had gained a stronghold in the fishery, lobstermen began voluntarily notching the tails of berried lobsters that they caught (Acheson 2010). This program has been so successful that survey data shows that 35% of legal-sized females caught in Maine are thrown back, a figure that indicates widespread acceptance of conservation rules (Woodard 2004). Most lobstermen understand the importance of restricting their catch for the health of the fishery, and this is evident in the emergence of v-notching as a voluntary practice among fishermen.

Legal Mandates and Institutional Framework

The American lobster stock is managed by the Atlantic States Marine Fisheries Commission (ASMFC 2009[1]) and by the individual states in state waters from 0 to 3 miles offshore. 80% of lobsters are caught within inshore waters in Maine (ASMFC 2009[1]). Until 1999 the entire stock was managed by the National Marine Fisheries Service (NMFS) under the New England Fisheries Management Council because lobsters are migratory and regularly move between state and federal waters. In 1999 NMFS transferred responsibility for the stock to ASMFC because an interstate compact and the individual state agencies would have a greater capacity to monitor overfishing (Goyert 2009). NMFS retains authority to promulgate regulations for the lobster fishery from 3-200 miles from shore (ASMFC 2009[1]). NMFS and ASMFC are both under the authority of the Atlantic Coastal Fisheries Cooperative Management Act (ASMFC 2009[1]).

The ASMFC was formed in 1942 through an interstate compact among the fifteen Atlantic coast states (Goyert 2009). The Commission's goal is to manage fishery resources that cross political boundaries (ASMFC 2010). Each member state selects three representatives to serve on the commission: the director of the state's marine fisheries management agency, a state legislator, and an individual appointed by the governor (ASMFC 2010). In 1993 Congress passed the Atlantic Coastal Fisheries Cooperative Management Act, which gives the ASMFC the authority to develop Fishery Management Plans for species under its jurisdiction. Member states are required to enforce the FMPs if they are passed by the Commission (ASMFC 2009[1]).

The American lobster fishery is managed under Amendment 3 to the Interstate Fishery Management Plan and Addenda I-IX (ASMFC 2009[1]). This management plan was established in 1997 and provided a framework within which future management decisions could be made. The goal of this plan is to maintain a healthy American lobster population and to create an effective management regime that provides for sustained harvests, opportunities for participation, and development of conservation measures by all stakeholders (ASMFC 2009[1]). NMFS has implemented a complementary management plan in adjacent state waters that is compatible with the FMP designated by the ASMFC.

Amendment 3 established seven lobster management areas that cover the species' entire range in U.S. waters (National Marine Fisheries Service 1999). Lobster conservation management teams in each area are comprised of industry representatives. These teams advise the ASMFC Lobster Management Board on management issues within their areas. Maine's entire fishery is encompassed in Area 1 (NMFS 1999).

Although the ASMFC creates a broad management plan for the entire fishery, the individual states have a significant degree of autonomy to decide how the laws are implemented. In Maine, the state legislature makes laws for the fishery that comply with Amendment 3, and the Department of Marine Resources is tasked with making specific rules and enforcing the laws. The Maine lobster fishery is managed under Title 12, Chapter 619 of Maine's revised statutes and Chapter 25 of the DMR's Marine Resources Regulations (Goyert 2009).

Several of Maine's laws are more restrictive than those of the ASMFC FMP. Maine prohibits trawling, requires a maximum carapace size limit of 5", and has stricter limitations governing entry to the fishery.

Co-management

The most important feature of Maine's institutional framework is its system of co-management (Acheson 2004). In 1995 the state legislature passed a co-management law that created a lobster zone council system. This system divided authority for managing the lobster stock between the industry and government agencies. Proponents of the law argued that it would maintain political support from within the industry while conserving resources (Acheson 2004). In addition to creating the zone councils, the law established a 1200 individual trap limit, an apprenticeship program for entering the fishery, and a trap tag system to identify the owners of

the traps (Acheson 2003). Most importantly, the law divided the coastal waters into seven zones with approximately equal numbers of licensed lobstermen. Each zone has a zone management council that is comprised of industry members elected from their zones.

Zone councils have authority over four main rules: the numbers of traps per person that may be fished in their zone (below the state-wide limit), the number of traps that may be fished on a single line, the time of day when fishing may occur, and limited entry regulations for their zone (Acheson 2004). Additionally, one member of each council is elected to serve on the Lobster Advisory Council (LAC). The LAC advises the Department of Marine Resources (DMR) commissioner and the DMR Advisory board on management decisions and lobster research programs in the fishery. It also serves as a forum for conflict resolution between the Zone Councils. The state retains authority over biological aspects of the regulations, such as the establishment of a carapace size.

Another important component of the institutional framework involves the agencies charged with marine mammal protection. The 1972 Marine Mammal Protection Act prohibits the take of marine mammals in U.S. waters. NMFS is charged with developing and implementing marine mammal take reduction plans to help protect marine mammals that interact with category I or II fisheries, which are defined as those fisheries in which incidental injury or death of marine mammals is frequent or occasional (Murphy). The American lobster fishery is in category I. Because of the known incidental bycatch of four large whale species in the lobster fishery, NMFS developed the Atlantic Large Whale Take Reduction Plan (ALWTRP) in 1997 to reduce bycatch and mortality of these stocks in the fishery. This plan has implemented gear modifications, time-area closures, disentanglement efforts, outreach, gear research, and monitoring and surveillance, all of which affect the Maine lobster industry (Goyert 2009).

Social Structure of the Fishery

The social structure of the Maine lobster fishery is highly territorial (Acheson and Gardner 2005). While it is relatively easy to obtain a fishing permit from the state, the more significant obstacle to entering the fishery is gaining admittance to a "harbor gang." Harbor gangs are self-organized groups of lobstermen who have traditionally fished in particular territories. Territories are not formal legal entities, but their boundaries are defended fiercely, and fishermen who place their gear in another territory can expect likely destruction or molestation of

their traps (Acheson 1988). Once an individual has become a part of a harbor gang, he may only fish in the territory "owned" by the gang (Acheson 1988).

Territories are typically less than 100 square miles, and they are fished by specific individuals (Acheson 2006). Territory lines near harbors are often known down to the yard, although there are some areas of mixed fishing in deeper water where the boundary lines become blurry. Both offensive and defensive actions play major roles in the interactions within and among harbor gangs. While interactions among gangs are widely studied, the sub-cultures within gangs are equally complicated. Men in harbor gangs interact almost exclusively within their own gang. They can be highly competitive with each other, but they also share information and come to one another's assistance. Success of an individual lobsterman is measured in comparison to other members of his gang (Acheson 1988). In each gang, lobstermen are expected to obey certain rules and conform to group norms. Placement in the complex social hierarchy of the gang is determined by fishing success and adherence to rules and norms of the community (Acheson 1988, 2003).

Effort Management

Stakeholders in the lobster industry have been able to create formal and informal regulations that limit the way they fish, but only limited efforts have been made to restrict *how much* they fish. The 1995 co-management law established a statewide limit of 1200 traps per individual. The law gave zone councils the authority to implement trap limits below the 1200 trap state maximum, and by 1999 all seven zones established trap limits of 600 or 800 (Acheson 2003). These numbers, however, were above what most lobstermen were currently using. As a small number of "big-time" lobstermen pulled thousands of traps out of the water, many part-time lobstermen took advantage of the newly opened territory and actually *increased* the number of traps they were fishing. In the long run, total effort in the fishery has risen as a consequence of these trap limits.

Despite unanimous approval of trap limits by zone councils, there have been significant conflicts within the zones between full- and part-time lobstermen over trap limits (Acheson 2003). Trap limits have a proportionately greater effect on full-time lobstermen, some of whom were fishing more than 2,000 traps before a trap limit was established. These individuals have been forced to reduce their effort by more than half, while some part-time lobstermen have made

no trap reductions, giving them a relative advantage (Acheson 2003, Jones 2005). As part-time lobstermen have steadily increased the numbers of traps they fish, full-time lobstermen are at an increasingly greater disadvantage.

There are potential benefits to reducing effort, but there are substantial obstacles to achieving effort reduction through the system of self-governance and co-management that is currently in place. Four islands off the coast of Maine have achieved effort reduction on a small-scale within their harbor gangs. Two of these islands—Monhegan and Swan's Island—have formally established "conservation zones" around their islands (Acheson 1998, 2003). This status grants them state approval and enforcement of the trap limits they have set around their islands. Two other islands—Criehaven and Green Island—established informal trap limits that have been enforced by the members of the harbor gang.

While these examples prove that self-regulation can result in effort control and increased net revenues on a small scale, most experts feel that this approach would not be successful in the mainland harbors of Maine. The success of the islands in establishing trap limits was largely a result of the homogeneity of their groups (Acheson 2003). The conflicts between full and part-time lobstermen in the mainland harbors are powerful enough to prevent an informal trap limit from being successful. Full-time lobstermen have already been severely disadvantaged by the initial trap reductions while part-time lobstermen reaped most of the benefits of increased productivity. The full-timers are not eager to further limit their own efforts.

DATA COLLECTION AND ANALYSIS METHODS

In order to assess the extent of the excessive effort problem, an analysis of multiple aspects of the fishery's productivity was performed. Rather than including experimental and anecdotal evidence, this report solely considers the official data reports collected by the state. The structure of the DMR's system of data collection and management system results in very limited datasets for use by the fishery's managers.

Data Collection and Management in the Maine Lobster Fishery

The DMR collects most of its fishery-dependent data from dealers who purchase lobsters directly from harvesters. All dealers are required to report landings as well as the average price per month that they pay harvesters. Lobster landings data reporting has been mandatory for all lobster dealers since 2004 when landings reports became a requirement for primary buyer permit renewal. Prior to 2004, data reporting was voluntary. Historically, lobster fishers have not been required to report catch or effort data. In 2008, the Maine Department of Marine Resources began requiring that 10% of Maine lobster license holders, who are randomly selected each year, provide trip-by-trip catch and effort reports. They must file monthly reports that include the following information:

- Harvester name
- Boat name
- Number of people on the boat, captain and crew
- Gear type and number of traps hauled
- Set time (number of hours the gear soaked
- Total number of traps in the water
- Depth the gear was set
- Statistical area, lobster zone, and distance from shore (0-3 miles, 3-12 miles, or 12+ miles) where the gear hauled on each trip was fished
- Time at sea, including travel
- Pounds of all species landed
- License number of dealer the catch was sold to
- Port where the catch was landed
- Reporting harvester's signature
-

The program was implemented partly because dealer reporting failed to provide an accurate estimation of participation and effort in the lobster fishery. Estimates based on licenses

and trap tags sold were likely under-representing fishing effort. The new program also allows managers to validate the accuracy of dealer reports by checking them against harvester reports. The original ASMFC mandate called for 100% reporting, but Maine's ASMFC representatives pushed for a compromise of 10% harvester reporting. Despite this compromise, the new program has been heavily criticized by the lobster industry. Because the program was implemented so recently, there is insufficient data from this system to include in this report.

FISHERY ANALYSIS

Biological Stock Assessment

The 2009 Lobster Stock Assessment published by the ASMFC reported that "current abundance of the GOM stock overall is at a record high compared to the 26-year time series. Recent exploitation rates have been comparable to the past whereas recruitment has steadily increased since 1997" (Figures 5 and 6; ASMFC 2009[1]). However, the report also asserts that, although increasing, low recruitment levels are having a negative effect on egg production.

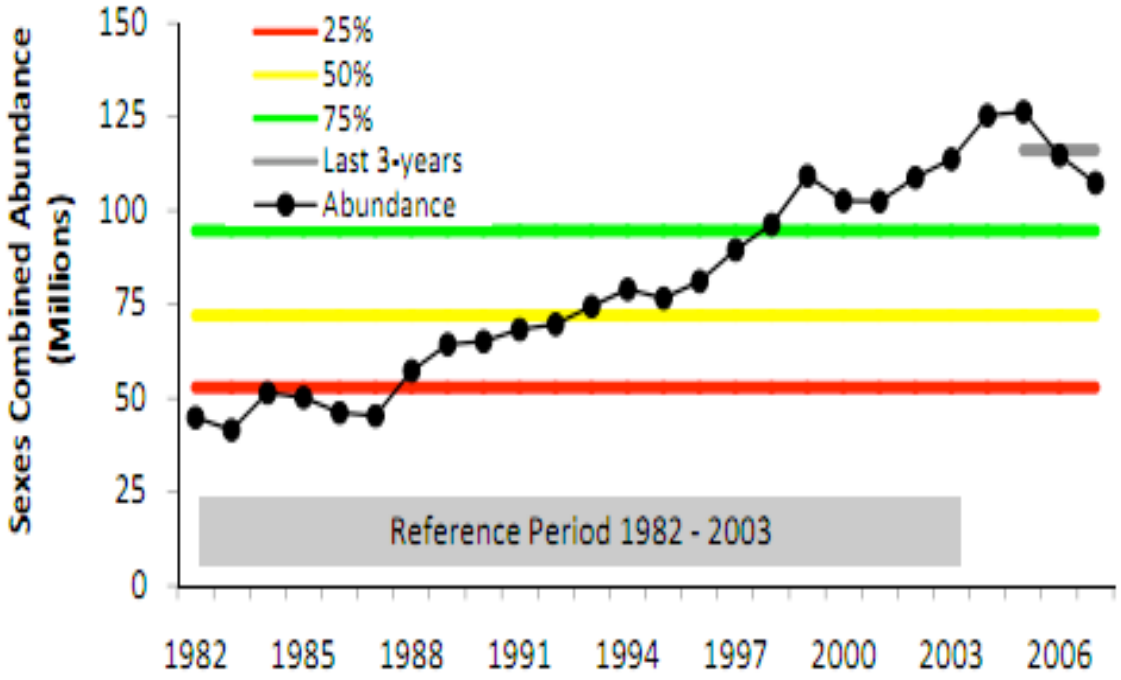

Figure 5: Gulf of Maine Lobster Abundance Reference Points, 1982-2007 (Source: ASMFC American Lobster Stock Assessment, 2009)

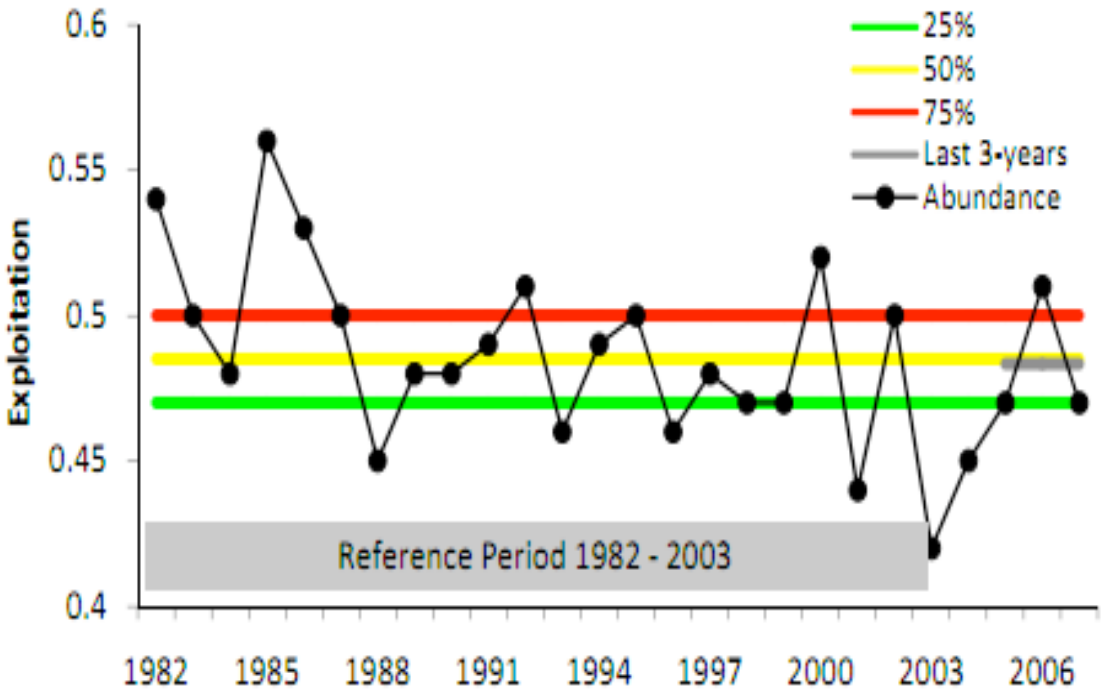

Figure 6: Gulf of Maine Lobster Exploitation Reference Points, 1982-2007 (Source: ASMFC American Lobster Stock Assessment, 2009)

The Gulf of Maine stock is also in good condition relative to the other two lobster stocks, the George's Bank and the Southern New England stocks. The Gulf of Maine stock has accounted for 87% of lobster landings in the United States since 2002. Both the Gulf of Maine stock and the George's Bank Stock are at levels of exploitation below the threshold of "overfishing" and at abundance levels above the threshold for being considered "overfished" (Figure 7). Therefore, the report determined that the Gulf of Maine stock "*is not overfished and overfishing is not occurring.*" The Southern New England stock abundance is at its lowest point since the 1980s, and exploitation and recruitment rates are declining.

Variable	GOM	GBK	SNE
Effective exploitation			
Effective exploitation threshold	0.49	0.51	0.44
Recent effective exploitation 2005-2007	0.48	0.3	0.32
Effective exploitation below threshold?	YES	YES	YES
Reference abundance			
Abundance threshold	72,030,500	1,912,355	25,372,700
Recent abundance 2005-2007	116,077,000	4,698,670	14,676,700
Abundance above threshold?	YES	YES	NO

Figure 7: Stock statuses relative to exploitation and abundance thresholds for GOM, GBK, and SNE stocks (Source: ASMFC American Lobster Stock Assessment, 2009)

Recent research suggests that the increase in lobster landings may be more closely related to biological interactions than the fishery's management. Boudreau and Worm (2010) found strong evidence that the decline in groundfish, particularly cod, has allowed the abundance and habitat of American lobsters to expand. Lobstermen have reported that they are catching lobsters at depths where they have never been caught before, suggesting a shift in the dynamics of the Gulf of Maine ecosystem.

Licenses and Traps

The number of licensed lobstermen increased fairly steadily from 1940 until the early 1970s when the number declined from around 10,000 to 6,000 in the early 1990s (Figure 8). Since then the number of lobstermen in Maine has hovered between 6,000 and 7,000.

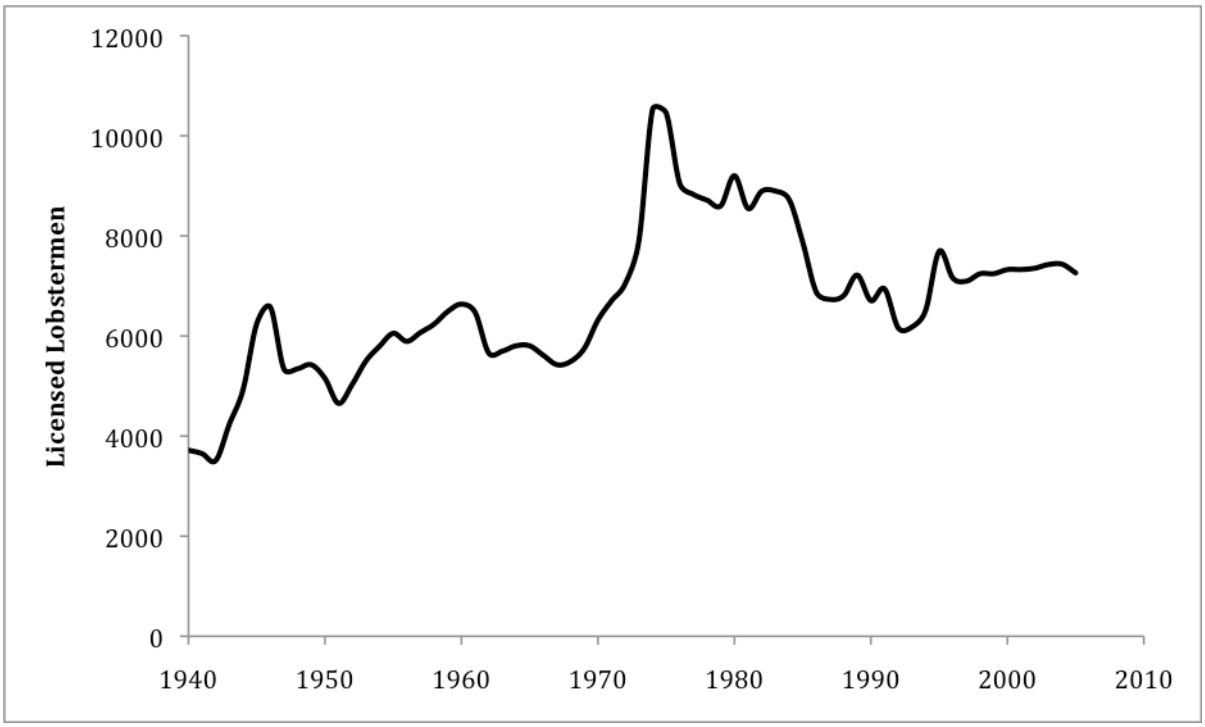

Figure 8: Number of licensed lobstermen in the lobster fishery, 1940-2005

The number of lobster traps in Maine state waters has increased steadily over the past 70 years. Trap numbers increased from about 22,000 to 3.3 million between 1940 and 2005 (Figure 9). It is interesting to note that during the period from 1995 to 1999 when trap limits were established in all zones, the number of traps in the water actually increased substantially. This may be due, in part, to Maine's "use it or lose it" policy regarding trap tags. If a lobsterman does not purchase his full allotment of trap tags in a given year, his maximum allotment will be decreased in the following year. The establishment of trap limits may have caused lobstermen to actually increase the number of trap tags that they purchased as "insurance" that they would have the option to purchase the maximum possible number of tags in future years. Regardless of the cause, it is clear that trap limits did not have the desired effect of reducing the number of traps used in the fishery.

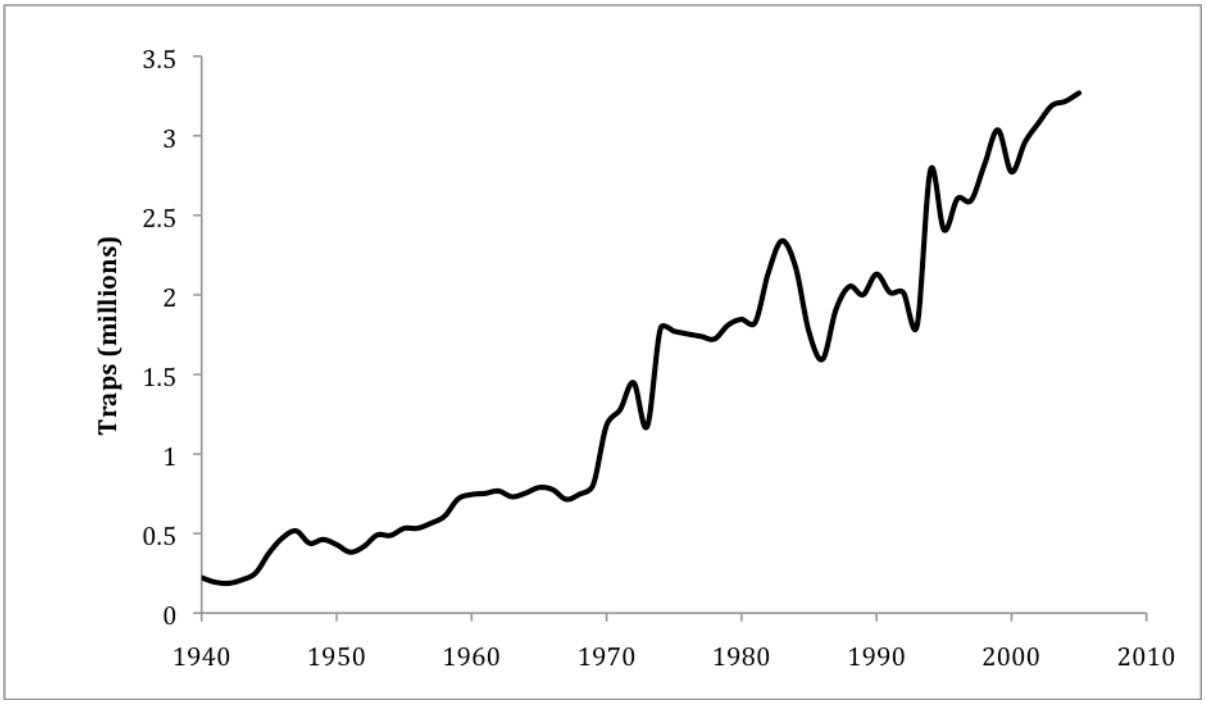

Figure 9: Number of traps in the lobster fishery based on the number of trap tags sold , 1940-2005

Landings

The increase in traps is evident in the steady growth in landings since the mid 1980s. Landings have more than quadrupled from approximately 20 million in 1985 to nearly 94 million in 2010 (Figure 10).

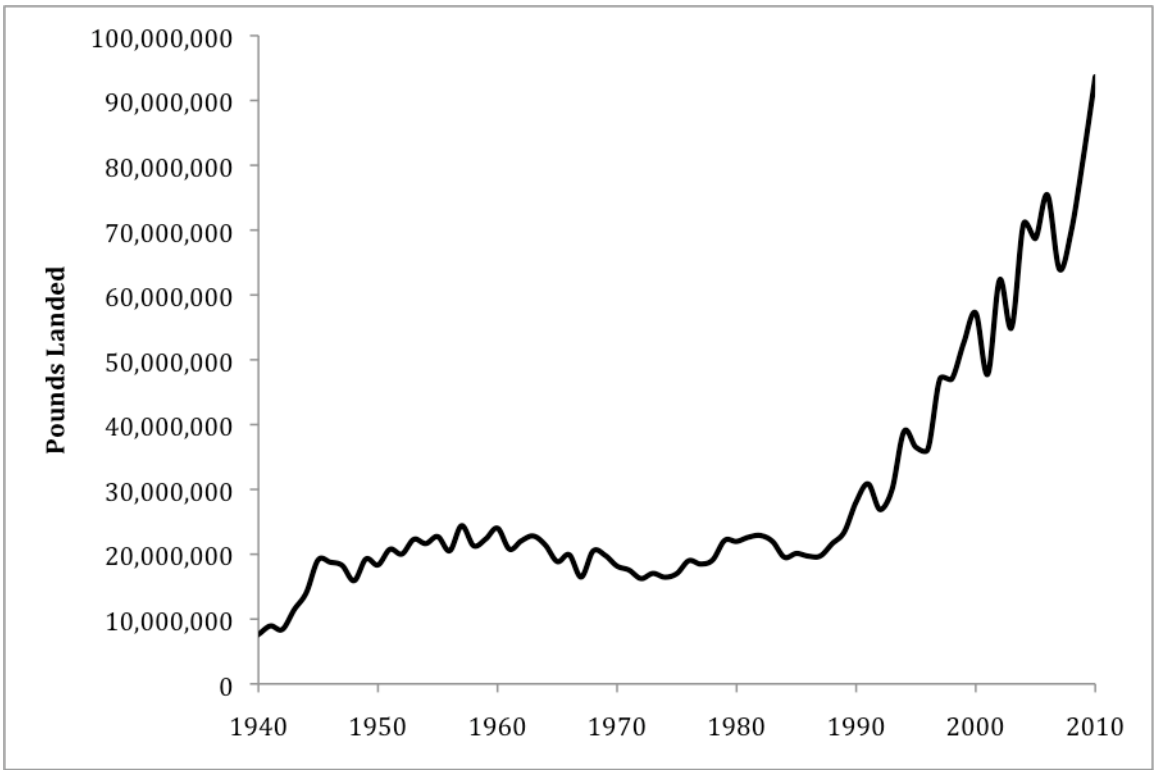

Figure 10: Pounds of lobster landed in Maine, 1940-2010

Within the entire Gulf of Maine lobster fishery, the great majority of lobsters are landed in Maine. Growth in Maine landings is responsible for most of the changes in total landings for the fishery (Figure 11).

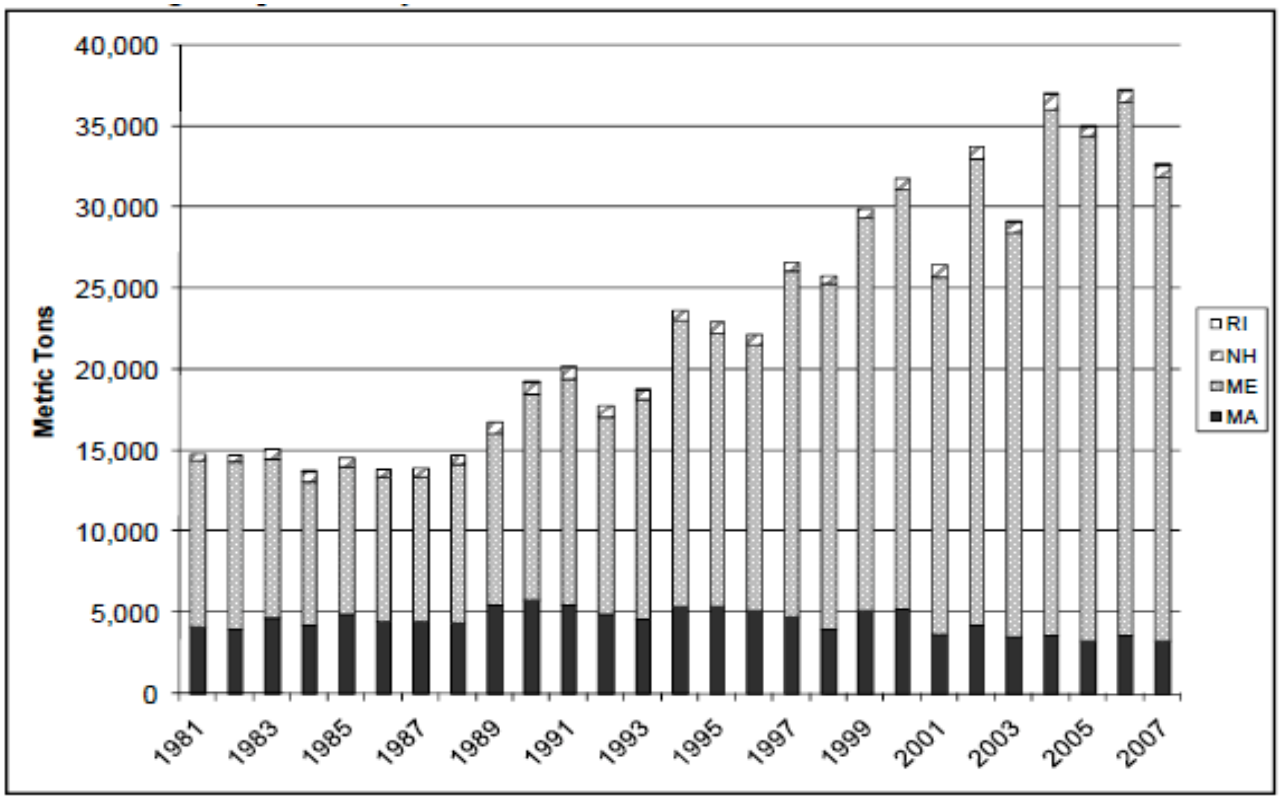

Figure 11: Relative annual lobster catch in Rhode Island, New Hampshire, Maine, and Massachusetts, 1981-2007

Effects of Effort

Although research has suggested that CPUE is currently very low, data based on the pounds of lobster caught per trap annually indicate that in 2005 (the most recent year available) CPUE was more than two times higher than its all-time low in 1975 (Figure 12). CPUE is calculated based on the landings per trap per year and does not account for increasing haul frequency, which may play a significant role in CPUE. While CPUE is substantially lower than mid-20th century levels, it has gradually increased despite the steady growth in trap density.

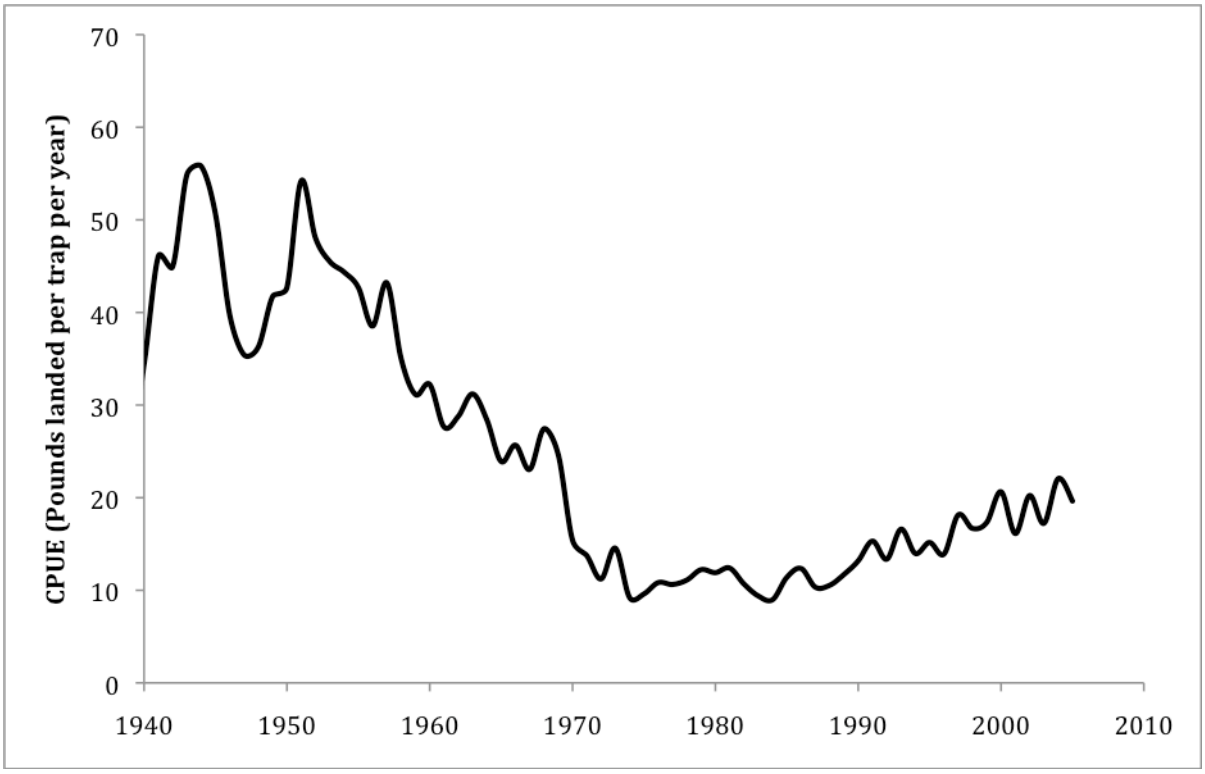

Figure 12: CPUE in the Maine lobster fishery, 1940-2005

To investigate the claims that landings would not be affected by significantly reducing the number of traps in the water, landings data were analyzed to determine the relationship between number of traps and landings. This analysis revealed a positive relationship between traps and landings (Figure 13). Between 1988, the first year in which the number of traps surpassed 2 million, and 2002, the first year when there were more than 3 million traps, total landings nearly tripled. This data does not provide any evidence of landings "leveling off" with increasing numbers of traps.

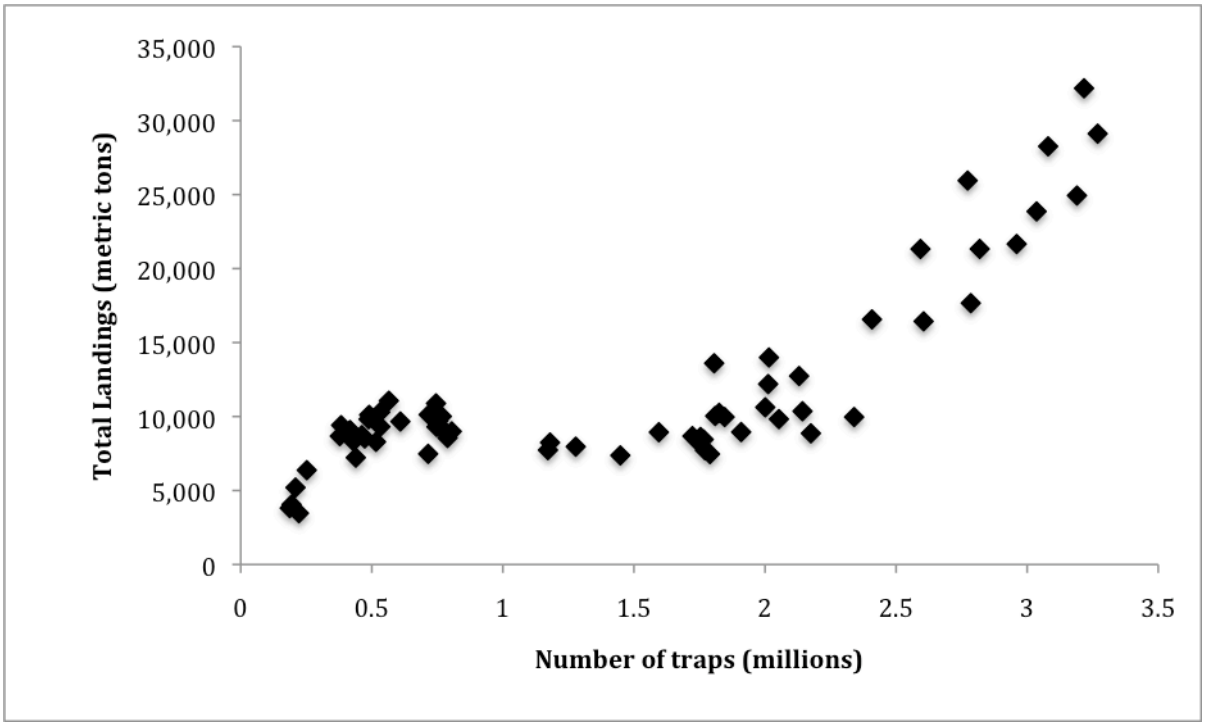

Figure 13: Total landings relative to the number of traps in the Maine lobster fishery, 1940-2005

Economics

The economic value of the Maine lobster fishery has grown steadily since the 1950s. In 2005 the fishery's value was a record high at $317 million (Figure 14). While it has declined slightly since then, in 2010 it was valued at $309 million.

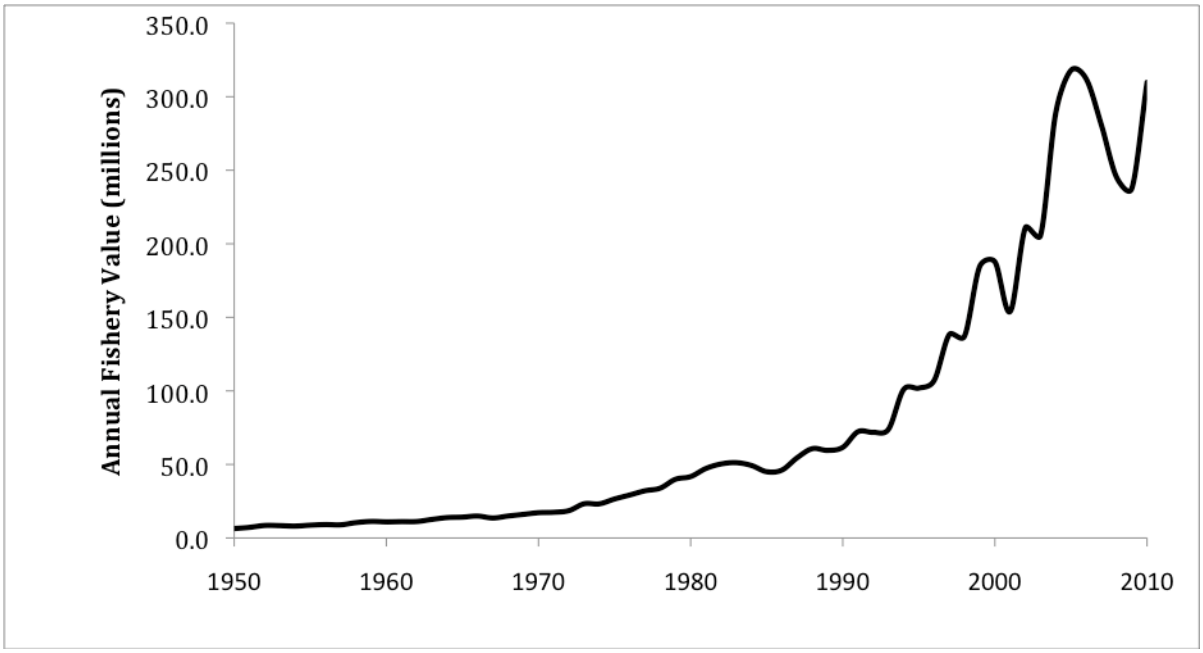

Figure 14: Annual value of the Maine lobster fishery, 1950-2010

Increasing fishery output often results in reduced market prices, but the price of lobster has risen steadily between 1950 and 2007 (Figure 15). A drop in the price of lobster since 2007 may reflect decreasing demand due to the economic recession.

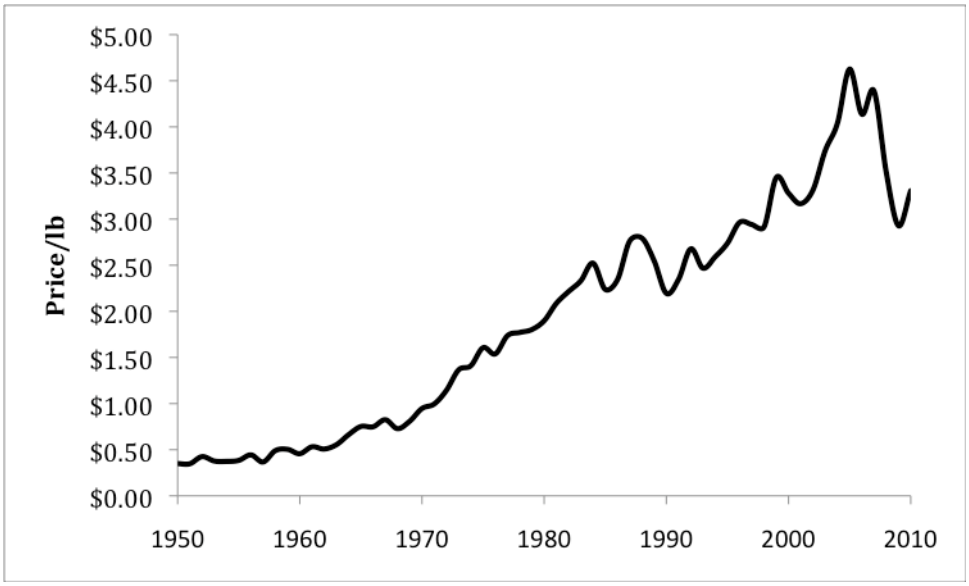

Figure 15: Average price per pound of lobster sold in Maine, 1950-2010

Income per fisher per year has also demonstrated steady upward trends between 1940 and 2005 (Figure 16). In 2005 the average income for a lobsterman was $40,820.

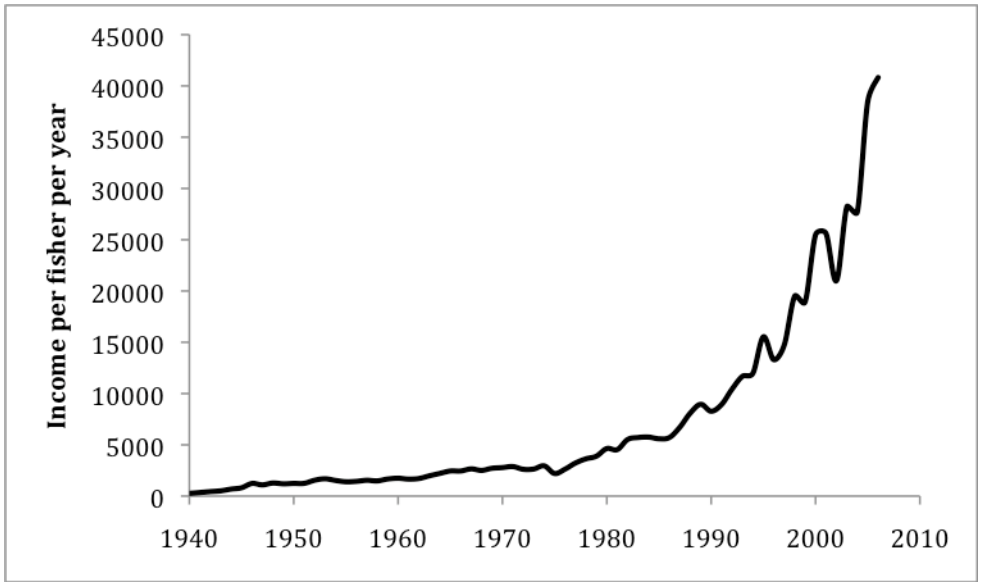

Figure 16: Average fisher income based on annual fishery value in the Maine lobster fishery, 1940-2010

Contrary to claims that increasing trap density will not yield higher catch or profits, increasing trap density has been positively correlated with producer income. If the lobster fishery

had reached a point where increasing effort was having a negligible or negative effect on fishery output, we would expect to see a leveling off or decline of producer income as trap numbers increase. Instead, producer income continues to rise as trap numbers increase (Figure 17).

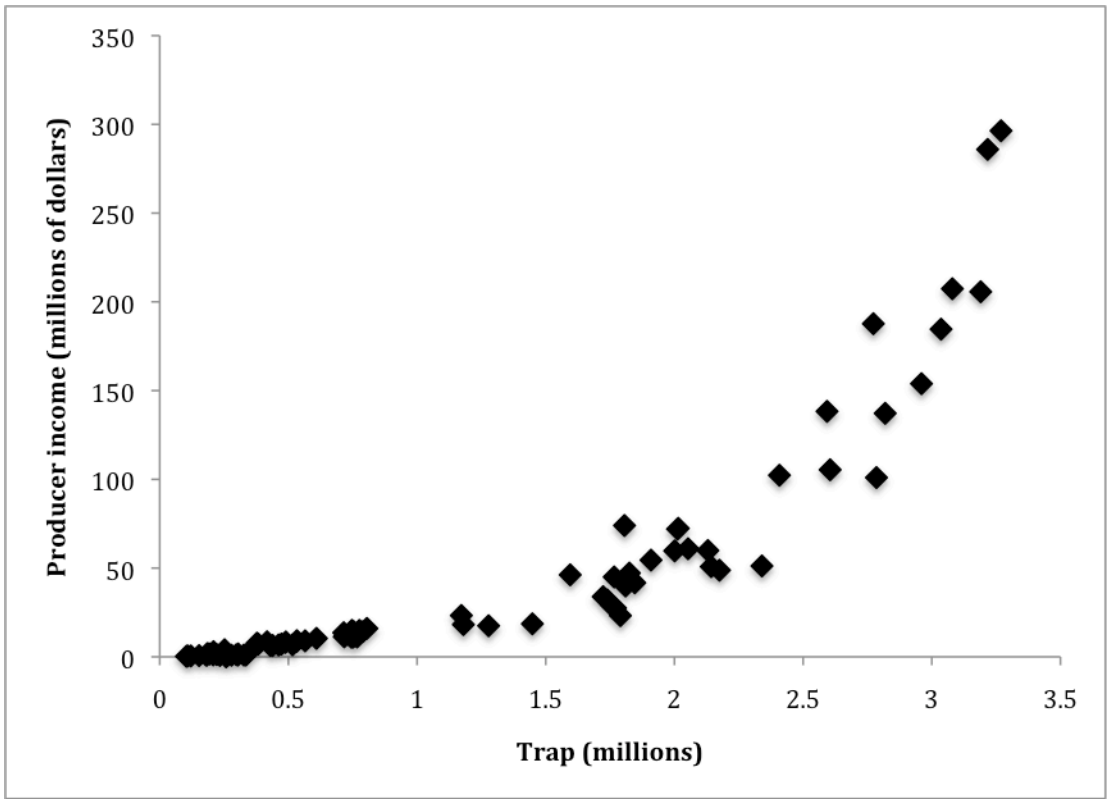

Figure 17: Producer income relative to trap numbers in the Maine lobster fishery, 1940-2005

DISCUSSION

Is Effort Management Necessary?

Effort management is currently one of the most contentious issues in the lobster fishery, yet the biological and economic data available to the fishery's managers do not support the claims that an effort reduction program is necessary. This disconnect indicates that there may be other undocumented variables that are affecting the productivity and efficiency of the fishery. The data available to the DMR to make management decisions does not reflect the excessive effort problem in the fishery, even though the problem has been demonstrated by anecdotal and experimental evidence, suggesting that the current data reporting requirements may not meet management needs and are unreliable indicators of whether a problem exists.

At present, many participants in the lobster fishery face economic challenges that are not reflected in landings and effort data. Ex-vessel prices for lobsters declined 37% from 2006 to 2009 (Acheson and Acheson 2010). This resulted in a 30% decrease in total fishery value between 2005 and 2009. Meanwhile, fuel and bait prices have increased steadily. The price of fuel increased from $1.10/gallon in 1994 to $4.70/gallon in 2008. Although it has since dropped to $2.50 a gallon, lobstermen are still feeling strained by high fuel prices. Exacerbating these problems is the increasing cost and shortage of bait. Bait prices have increased 500% in the last 10 years, from about $25/barrel in 2000 to $150/barrel in 2010 (Acheson and Acheson 2010). Managers of the herring fisheries have cut quotas by 41%, resulting in severe shortages for lobstermen.

It is unclear how the effects of rising bait and fuel prices compare to rising ex-vessel prices and increasing landings. Catches and total income are rising, but these trends do not reflect several important variables such as increasing costs of fuel and bait. Increasing landings may be an indication that lobstermen are having to work harder to remain in business. In the 2008 Lobster Effort Questionnaire, one respondent commented "You hear me right. I now fish 800 traps and I support a 400 trap limit! High fuel and bait will be the down fall of the full time lobsterman."

The available data only provide a few pieces of the puzzle, but it is evident that there is economic distress in the lobster fishery. Although incomes appear to be increasing, these

estimates are based on the total landings and do not take in to account the rising and undocumented *costs* of fishing that lobstermen are incurring.

Effort Reduction Options

In light of these economic struggles, recent management discussions have revolved around mechanisms of effort control—namely, stricter trap limits and limited entry regulations. Several strategies for effort reduction have been proposed, but the zone management councils have passed none. A 2008 survey by the Lobster Advisory Council found that 76% of lobstermen were "very" or "somewhat" concerned about the number of traps fished in their area. 56% said that they would support a trap reduction in their area. With such a high level of support for effort reduction, it is surprising that all of the proposals have been unsuccessful. A closer investigation of the proposed effort reduction strategies helps reveal why none of them have been fully supported by the industry and its managers. The following are some potential alternatives for effort reduction.

Trap Tag Freeze— A trap tag freeze would prohibit lobstermen from accumulating any more traps tags. Under the current system, anyone may enter the fishery and build up their trap tag allocation in increments of 100 per year until they reach the maximum limit for their zone. While it would prevent the number of traps used in the fishery from increasing, a trap tag freeze would not actually result in effort reduction. Because many lobstermen purchase trap tags every year for traps that they never actually put in the water (as a sort of "insurance"), many individuals would be entirely unaffected by a trap tag freeze. In the 2008 LAC survey, 46% of lobstermen were in favor of this strategy and 43% were opposed.

Proportional reduction—A proportional effort reduction would likely be used in conjunction with the aforementioned trap tag freeze. Under this system, all lobstermen would be required to reduce their trap tags by a designated percentage—such as 30% or 50%—to achieve the total desired reduction in effort. In the LAC survey, 32% of lobstermen were in favor of this strategy and 58% were opposed.

Lower trap limit—The legislature can pass a law requiring a lower state-wide trap limit (it is currently set at 1200), or the individual Lobster Management Councils may vote to lower the trap limits in their zones. All of the zones currently have limits of 600 or 800. The LAC survey reported that 51% of respondents were in favor of a lower trap limit across the board, and 43% were opposed.

Tiered licensing system—a tiered licensing system would be designed to address the conflicts that have arisen between full- and part-time lobstermen as a result of previous effort reductions. Full time lobstermen have born the burden of costs associated with the 1995 co-management laws and subsequent effort reductions. Part-time lobstermen have generally benefitted from these changes. A tiered licensing system would classify lobstermen based on their catch history and current trap allocation in the fishery. Distinguishing between full and part-time lobstermen would avoid exacerbating the inequities already caused by effort reductions. Under this system, part-time lobstermen may be required to make more substantial reductions in gear. A tiered licensing subcommittee was established by the LAC in 2009 to explore the feasibility of a tiered licensing system. However, the idea was ultimately dismissed because of difficulties in verifying an individual's catch or income history.

Limited entry/freeze all new licenses—Limiting entry to the fishery would either prohibit new participants from entering the fishery *or* would mandate that all zones use a reduced ratio of entrants to retirees. The LAC survey reported that 50% of respondents were in favor of freezing entry of new licenses, and 42% were opposed.

Barriers to Effort Reduction

All of the aforementioned options could potentially reduce effort and increase productivity, but none have been successful in the legislature or in the zone councils. There are several possible explanations for why these proposals have failed despite widespread agreement that effort reduction is necessary.

Inadequate data collection and management system—One of the greatest barriers to establishing an effort reduction plan is the lack of comprehensive and reliable data in the fishery.

Relative to other fisheries of comparable size in the United States, the Maine lobster fishery has an extremely weak data collection and management system. The DMR collects trip data from only 10% of harvesters who are chosen randomly each year. This system has only been in place since 2008, so there is very limited effort data before 2008 and virtually no effort data before 1995, which was the first year that lobstermen were required to purchase trap tags. Unlike many other fisheries of its size, there are no records of individual historical catch upon which effort reductions can be based. While the fishery is moving toward increased data reporting, the resulting information may still be inadequate for managers to get a comprehensive picture of the fishery.

Latent Effort—While the DMR has estimated effort based on the number of trap tags that are purchased each year, there is substantial latent effort in the fishery. Latent effort is defined as licensed fishing potential that is not used to its maximum extent. In the lobster fishery, latent effort is exhibited by lobstermen who purchase trap tags for traps that they never deploy. Sources report that some lobstermen, in hopes of creating a buffer in the event of an effort reduction program, have been accumulating trap tags that they do not use. Maine's "use it or lose it" policy means that if lobstermen do not purchase their maximum allocation of traps in a given year their allocation will be reduced in the following year. This, in combination with the cheap price of $0.40 per tag, has resulted in high levels of latent effort. While this means that actual effort is probably much lower than estimated effort, it also contributes to a great deal of uncertainty regarding an ideal level of effort. If an effort reduction program is designed to reduce effort by 20% based on current estimates of effort, it may not result in any real reduction of traps in the water, or it may have a disproportionate affect on individuals who are currently utilizing their maximum allotment of trap tags.

Residual conflict between full- and part-time lobstermen—Full-time lobstermen were disproportionately affected by effort reductions following the 1995 co-management law. Some full-timers were fishing more than 2000 traps before a trap limit was established. These individuals have been forced to reduce their effort by more than half, while some part-time lobstermen have made no trap reductions, giving them a relative advantage. Many full-timers feel that trap limits will have no effect on total effort because it will just encourage part-timers to

increase the number of traps they fish. The majority of lobstermen are in favor of lower trap limits, but some of the loudest and most powerful voices on the zone management councils are full-time lobstermen who have already had to make substantial reductions.

Disbelief in principles of effort reduction—A common reason for lobstermen to oppose trap limits is that they feel that they are already constrained by the current trap limit and that reducing their traps could not possibly increase their productivity (Acheson and Acheson 2010). Some believe that the Monhegan study was conducted in a unique setting that should not be used to make management decisions for the rest of the state. Essentially, many participants in the lobster fishery believe that effort reduction is not necessary and would not benefit them.

Disconnect between effort and income—Many Maine lobstermen are experiencing economic hardship, but this is largely attributed to rising bait and fuel prices. The total lobster catch continues to stay at near peak levels. CPUE has not dropped to a point low enough that lobstermen are demanding effort controls.

No biological need for effort control—According to the ASMFC, the Gulf of Maine lobster stock is not overfished, and overfishing is not occurring. Effort reduction would help fishermen financially, but it would not have any effect on fishing mortality (Acheson and Acheson 2010). Because of this disconnect between effort controls and the biological health of the stock, neither the DMR Commissioner nor the State Legislature has an incentive to act.

RECOMMENDATIONS

Short-term recommendations

The first step that the DMR and ASMFC should take in addressing the *potential* problem of excessive effort is to establishing a more comprehensive data collection and management system. The state needs to collect accurate and reliable information about *who* is fishing, *how many* traps they are fishing, *where* they are fishing, for *how long* are they fishing each year (number of weeks or months), *how often* they are hauling their traps, and *how much* they are catching. Only then will they be able to determine the extent of the problem and establish a baseline from which they can attempt to reduce effort.

Fortunately, the mechanisms are already in place for this kind of effort reporting. The DMR simply needs to expand their requirement from 10% harvester reporting to 100%. Under this system, lobstermen would fill out monthly reports detailing all of their catch and effort data. Massachusetts already has a similar system in place and therefore has much more extensive data upon which they can base their management decisions.

Once the new data collection system is in place, managers should work to gain a more accurate and detailed understanding of effort in the fishery. An important component of this is estimating latent effort by comparing the number of trap tags sold with the number that are actually fished. Understanding the difference between actual effort and recorded effort based simply on licenses and trap tags will help the fishery's managers create a reasonable target for effort reduction. With this information about current effort, managers can then move toward developing effort reduction strategies if they are indeed necessary.

During this transition period, it would be useful for the state or academic institutions to conduct more experiments similar to Wilson's Monhegan study. Acheson and Acheson found that 28% of lobstermen believe that a trap reduction would reduce catch and income (2010). Major management changes have never been successful without the support of the lobster industry. More research is needed to prove that lower trap limits actually will have a positive effect. Ideally, these studies would be conducted in harbors along the coast rather than around islands like Monhegan, as most of the lobster fishing in Maine takes place along the coast.

This report suggests that a substantial barrier to achieving effort reduction is disagreement about the existence or extent of the problem. If the data collected by the state and experimental evidence show that effort reduction is necessary, then this information should be synthesized to paint a clear and compelling picture of *why* effort reduction is necessary. Only then will the state government and the lobster industry be able to develop a solution.

Long-term recommendations

If an effort reduction program is in fact necessary and enough evidence is available to support this claim, then trap limits are the most feasible option for reducing effort without a complete overhaul of the existing management framework. A trap reduction program in Maine could potentially be modeled off of the effort reduction program that was used in the Florida Spiny Lobster fishery. This program was designed to address the same issues that the Maine lobster fishery is facing: low trap efficiency, environmental damage, and conflict among fishers (Matthews 1995). The program had two components—trap allocation and a variable trap reduction schedule. A trap certificate law was established in 1992 that required lobstermen to purchase individual transferable certificates that allow the use of one trap per certificate. Lobstermen may sell their certificates, but a $2.00 transfer fee is assessed for certificates that are sold on the open market. Initial allocation of trap certificates was based on each fisher's highest landings during one of three fishing seasons. An appeals board made up of commercial lobstermen was available to settle disputes regarding initial allocation. After the initial allocation, a series of annual trap reductions was made to reach an annual yield that reflects the maximum sustainable yield for the fishery (NRC, 1998).

The Florida Spiny Lobster effort reduction program was largely successful because distributive issues were addressed during the initial allocation of trap certificates *before* any actual reduction was made. Lobstermen who had historically had larger catches than other lobstermen were able to maintain an advantage over their competitors. For an effort reduction program to be successful, it is important that the relative distribution of effort among fishers remains stable even when the total effort is reduced. For this reason, it is imperative that the DMR begins collecting better data about fishing effort. After several years of collecting more accurate information about effort and landings, the DMR and the lobster industry may begin working toward a system similar to the one used in Florida.

CONCLUSIONS

There is compelling anecdotal and experimental evidence that overcapacity and excessive effort may be serious issues in the Maine lobster fishery. However, these problems are not supported by landings and effort data used by the state to make management decisions. While CPUE is much lower than its peak, it has been increasing slowly over the past 15 years. The number of traps in the water is steadily climbing, but landings, income, and total value of the fishery also continue to increase. These variables do not indicate that there is an effort problem. However, there are quite a few variables that are undocumented in state data. The cost of fishing is rising due to increasing costs of bait and fuel. Many lobstermen claim that they are having to extend their fishing season and haul their traps more frequently in order to keep their catch high enough to make a living. Increasing trap density is leading to trap entanglements, harbor congestion, and conflicts among lobstermen. Most of these variables are not taken into account when estimating the catch per unit of "effort," but they all affect the productivity of the fishery.

Effort reduction is one of the most controversial issues in the lobster fishery, and the industry is fairly evenly divided among those who support and oppose it, indicating that there is widespread disagreement about whether there is a problem and whether anything can or should be done to fix it. This report illustrates that the state does not have sufficient information upon which it can develop a successful effort reduction program. Before any steps are taken toward reducing effort, the system of data collection and management must be overhauled. Once the state has collected several years of catch and effort data, they can determine the extent of the problem (if there is one) and develop a strategy for effort reduction that both the industry and the government can support.

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