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Confounding the Goals of Management: Response of the Maine Lobster Industry to a Trap Limit

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Abstract.—The behavior of fishermen is often far more complicated than assumed by fisheries managers. Those concerned with the Maine lobster (i.e., American lobster *Homarus americanus*, hereafter “lobster”) fishery have long favored a cap on the number of traps each license holder can use. Fishermen favor trap limits primarily to cut costs and limit congestion, and managers believe such limits will help reduce fishing effort. Yet when trap limits were imposed by the legislature and the lobster zone councils between 1995 and 1998, the number of traps fished in Maine waters increased greatly. A survey of half the lobster license holders carried out in the summer and fall of 1998 revealed that the response of fishermen to trap limits was highly differential. Some fishermen reduced, but more increased, the number of traps they fished. A complicated set of variables influenced those decisions concerning trap numbers, including the regulatory environment, age and characteristics of the fishermen, relative economic opportunities, and reference group behavior. One of the assumptions running through the literature on fisheries management is that fishermen are homogenous and respond in similar ways to management initiatives. In fact, if we can judge by the data from the Maine lobster fishery, the response of fishermen to a management initiative can be quite diverse, and license holders may respond to a wide variety of social and economic factors in ways that confound the goals of management. This study points out that the effects of management cannot be ascertained unless we have an accurate and relatively sophisticated understanding of the myriad factors motivating the decisions of the fishermen.

Theory and Problem

In fisheries management circles, it is an article of faith and hope that laws designed to cut fishing effort will, in fact, result in less effort on fish stocks. However, innumerable instances have been recorded where fishermen have not responded as predicted to attempts to manage fisheries. Maiolo and Orbach (1982) point out that the results of fisheries management policies are notoriously difficult to predict. “Often,” they write, “behavior proceeds in a direction opposite to that predicted! Such seems to be the case in many areas of fishery policy.” In all too many cases, fishermen have responded to management initiatives in ways that circumvent the goals of management. In some cases, they go into the political arena and work to have the management regulations changed or annulled. Sometimes they violate the rules. In other cases, they innovate their way around regulations by adopting new technology. In still other instances, they respond in ways that result in increased effort, even though their actions are perfectly legal.

This article analyzes the response of Maine lobster (i.e., American lobster *Homarus americanus*, hereafter “lobster”) fishermen to the imposition

of a 1995 trap limit. Despite the fact that Maine fishermen are overwhelmingly in favor of a trap limit, their responses in the years following the imposition of this law were highly differential. Many fishermen increased the number of traps they fished while others decreased that number. The net effect was that the total number of traps in use increased after the trap limit was imposed, exacerbating an already serious problem with trap congestion and gear tangles.

Decisions by the numerous fishermen who increased the number of traps fished were influenced by a complicated set of factors. The objective of this article is to analyze these factors, with a view toward understanding their effect on fishing effort in the Maine lobster industry. Analyzing these factors gives a better appreciation of the complexity of the decision-making processes of fishermen, the outcome of which, though perfectly legal, can undermine the cause of management. A secondary goal is to discuss the kinds of data that need to be collected if managers hope to predict the response to regulation and the effect of those regulations.

Maine Lobster Industry and Its Management

The Maine lobster industry throughout its history has been an inshore trap fishery. The typical lobster fisherman has a boat about 35 ft long equipped with a diesel or gas engine, which is

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operated alone or with one helper. The typical lobster fishermen in 1997 also had 535 traps (average) made of wood or wire and equipped with funnel-shaped nylon "heads," which make it easy for lobsters to climb in the trap but difficult to find their way out. The traps are connected to a wood or styrofoam buoy by a "warp line." The buoys are painted with a distinctive combination of colors registered with the state that serve to identify the traps of each license holder (Acheson 1988). Traps are baited with fish remnants.

The lobster fishery is one of the world's most successful fisheries. In an era in which most of the world's fisheries are in a state of crisis, including most of those in the Gulf of Maine, the lobster fishery is experiencing unprecedented success. Despite heavy fishing pressure, the lobster catch in Maine has remained very stable since 1947, when the current catch records program began, averaging about 20 million pounds. Since 1989, lobster catches have been in excess of 30 million pounds annually, and in 1997, 1998, and 1999 they have exceeded 45 million pounds (Table 1). Although there is no agreement about the cause of these high catches, we have argued in other papers that they are due to a long history of effective regulation in combination with environmental factors (Acheson 1997b; Acheson and Ste-neck 1997).

Virtually all of the conservation laws in force have been promulgated by the Maine legislature, which until 1977, had sole responsibility for managing the lobster resource. One of the most important laws is the "double gauge," a type of slot measure, which specifies that lobsters can only be taken if their carapace exceeds 3.25 in but is less than 5 in. The minimum size measure is designed to protect juvenile lobsters, while the oversize limit prohibits taking large, reproductive lobsters. It is also illegal to take female lobsters with eggs attached to their bellies (i.e., "berried" or egged lobsters). Moreover, a fisherman may cut a notch in the tail of egged lobsters caught, and as long as the "V-notch" lasts (usually two to four molts), that lobster never can be legally taken because it is considered "proven breeding stock." Many Maine fishermen believe the V-notch law is the most important conservation measure. According to Maine law, lobsters may only be taken in traps equipped with escape vents that allow undersized lobsters to escape (Acheson 1988; Kelly 1990). There is strong support for all of these conservation laws in the lobster industry.

In 1995, Maine finally succeeded in obtaining a

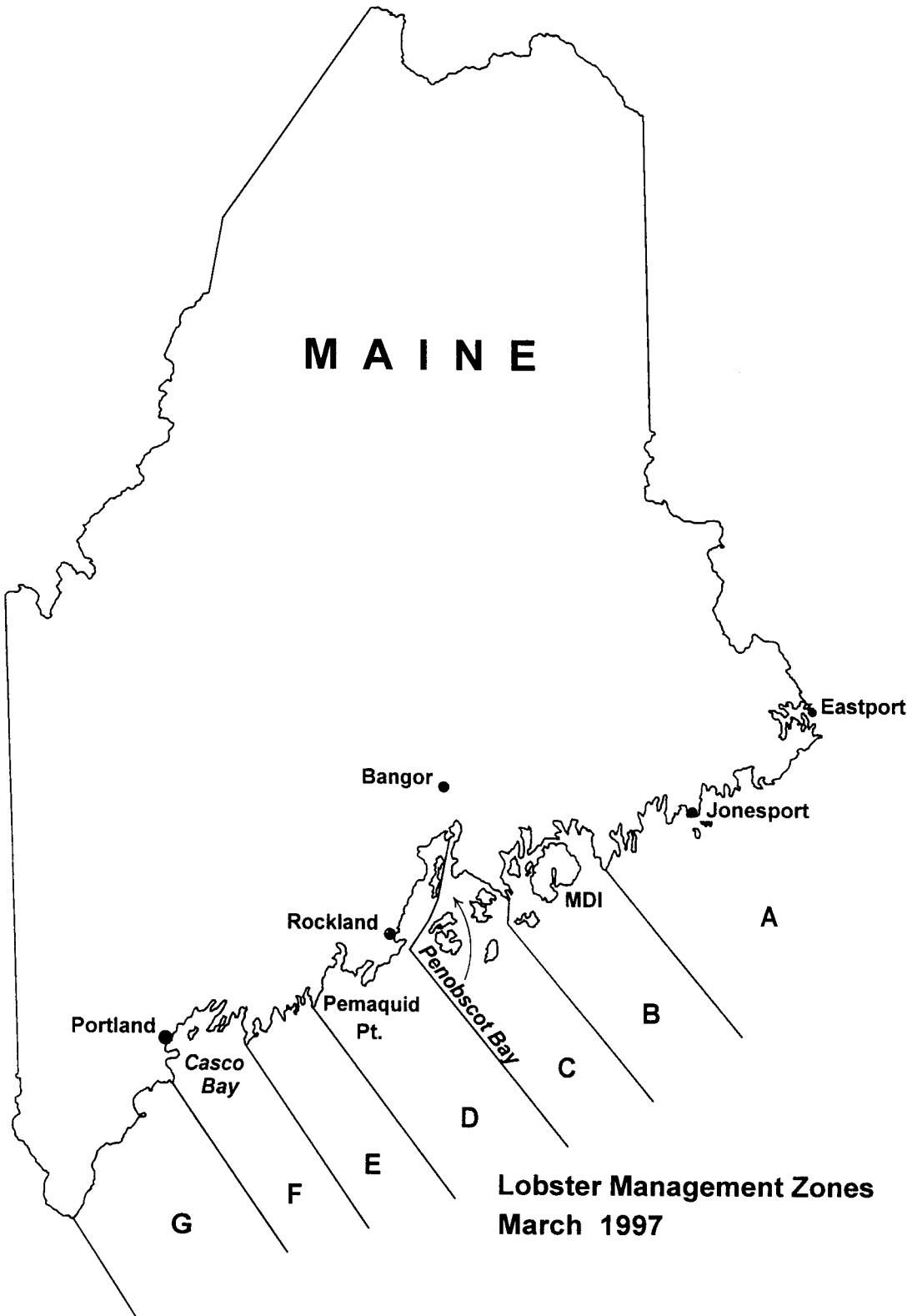
trap limit law, which was part of a comprehensive law establishing comanagement for the Maine lobster industry. This law gives certain powers to the industry, while conferring most management control to the Maine Department of Marine Resources (MDMR).

In 1977, lobster management was complicated by the passage of the Fisheries Conservation and Management Act (FCMA), which made the U.S. federal government responsible for the management of all fisheries from the 3-mile line out to 200 mi. Currently the governments of the coastal states generally control the fisheries from the shore to the 3-mile line. Since 1995, day-to-day lobster management in the federal zone has been in the hands of the Atlantic States Marine Fisheries Commission (ASMFC), a compact of the coastal states. However, in 1996 the Sustainable Fisheries Act was passed, giving agencies of the federal government (i.e., the National Marine Fisheries Service [NMFS], National Oceanographic and Aeronautics Administration [NOAA], and Department of Commerce) ultimate authority for ensuring that all fisheries conservation laws are effective.¹ This means that the Secretary of Commerce can preempt the power of the ASMFC and the states, if it is judged they are doing a poor job in managing "overfished" stocks under their jurisdiction.

In practice, state officials and legislatures work in close coordination with the ASMFC and the NMFS because everyone recognizes that it makes little sense to have one set of rules for state waters and another in the waters under federal jurisdiction. But lines of responsibility between these units of government are often unclear, and negotiations are clouded by obfuscation and veiled threats. The

¹ This law amends the Fisheries Conservation, and Management Act (FCMA) of 1977. Among the most important changes was the provision that if a fishery were judged "overfished" the stock would have to be rebuilt within 10 years, and the law gave NMFS a lot of power to achieve this goal.

² Advocates for a trap limit argue that having a law specifying the maximum number of traps a fisherman could fish would confer benefits for all. There are only so many lobsters that molt into legal size each year. If all fishermen were restricted to a smaller number of traps, they would catch the same number of lobsters over the annual cycle. There would be substantial savings in that fewer traps would have to be built, baited, and tended. Moreover, fishing smaller numbers of traps would allow fishermen to tend them with smaller boats operated by smaller crews. Perhaps most important, having fewer traps would alleviate the vexing problems of trap congestion and gear tangles.



legislation has produced strange alliances and strategies.

Establishing a Trap Limit in Maine

In the past few decades, the number of lobster license holders in Maine has increased modestly, but the number of traps in use has increased astronomically. In 1970, there were 6,316 license holders who fished an estimated 1,180,000 traps. In 1994 there were about the same number of fishermen (i.e., 6,503), but the number of traps had more than doubled to 2,786,000 (MDMR1994). Our interviews indicate that fishermen using 300 traps in the 1970s now fish 900–1,000 traps. Trap escalation has been particularly severe in Casco and Penobscot bays (zones C, F; Figure 1), where several hundred full-time fishermen had over 1,500 traps in 1995 and “gangs” of 2,000–3,000 were far from uncommon.

Trap escalation has been driven, in large part, by competition among fishermen. Several innovations made it possible for fishermen to build and tend more lobstering gear, including the hydraulic trap hauler, nylon twine, and a law making it legal to fish multiple traps on a single line (Kelly 1990).

Shortly after the trap numbers began to escalate in the 1950s, individuals in the lobster industry began to lobby for a trap limit, arguing that such a law would cut costs and reduce trap congestion while maintaining catches.² Despite the fact that large numbers of fishermen were favorably disposed towards a trap limit, for more than 30 years the legislature failed to pass such legislation. Finally, a trap limit was enacted in 1995 as part of a comanagement bill.

Efforts to establish a trap limit had foundered on a lack of consensus in the industry. Legislators, knowing that there were deep rifts among their constituents, were unable to agree on any specific trap-limit bill for two reasons. First, large numbers of fishermen favored a trap limit, but there was no consensus on what the trap limit should be, partly because full-time fishermen generally fished far more traps than part-time fishermen with other jobs. Also, the average number of traps fished in various parts of the coast differed widely. Second, there was a strong feeling that a trap limit would do no good unless it was coupled with a limit on licenses (“limited entry”), the logic being that a

TABLE 1.—Maine lobster catch, number of traps, and number of licenses, 1980–1999 (Maine Department of Marine Resources 1994, with figures for 1995 to 1999 updated by Kelvin Kelly of the MDMR).

Year	Lobster catch (millions of pounds)	Number of traps	Number of licenses
1980	22.0	1,846,000	9,200
1981	22.6	1,825,000	8,548
1982	22.8	2,143,000	8,891
1983	22.0	2,340,000	8,895
1984	19.5	2,175,000	9,730
1985	20.0	1,766,000	7,879
1986	19.7	1,595,000	6,875
1987	19.7	1,909,000	6,730
1988	21.7	2,053,000	6,804
1989	23.5	2,001,000	7,215
1990	28.1	2,130,000	6,706
1991	30.8	2,015,000	6,940
1992	26.9	2,012,000	6,162
1993	30.0	1,860,000	6,176
1994	38.9	2,786,000	6,503
1995	36.5	2,408,000	7,409
1996	36.2	2,605,000	7,362
1997	46.9	2,646,000	7,551
1998	46.8	2,832,456	7,626
1999	53.1	3,043,154	7,220

trap limit would not relieve congestion if new entrants added thousands of new traps to the fishery. On several occasions since the 1970s various industry groups have promoted bills combining limited entry and a trap limit. However, limited entry has always been received with ambivalence because it would limit employment prospects in coastal towns (Acheson 1975).

By the 1990s, there was a growing interest in comanagement, which Department of Marine Resources Commissioner Robin Alden and several key legislators had come to favor.³ Late in the

³ Over the course of 2 decades a sizeable body of literature had been produced documenting the effectiveness of local management (Ruddle and Johannes 1985; McCay and Acheson 1987; Berkes 1989; Ostrom 1990; Anderson, and Simmons 1993). This gave rise to a growing interest in comanagement (i.e., governance structures in which authority to manage fisheries was shared by government and industry groups; Pinkerton 1989). In 1993, interest in comanagement began to emerge in the Maine fishing industry, the Marine Resources Committee of the Legislature, and the Maine Department of Marine Resources after a session on comanagement was held at the Maine Fishermen’s Forum.

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FIGURE 1.—The lobster management zones (A–G) established in March 1997. Each zone is managed by an elected council of lobster license holders.

spring of 1995, the legislature passed what became known as the "Zone Management Law" (Public Law 1995, Chapter 468), which was a true co-management law that incorporated a trap limit. This broad-based law changed many aspects of regulation. It established an individual trap limit of 1,200 traps by the year 2000, a trap tag system to identify owners of traps, an apprenticeship program for new entrants into the lobster fishery, and eligibility criteria to qualify for a commercial lobster and crab license.

Most important, this law has created a co-management system. Specifically, it establishes a framework by which the Commissioner of Marine Resources can create lobster policy management zones. Each lobster zone is managed by an elected council of lobster license holders. The 1995 law gave each council the power to propose rules on (1) the maximum number of traps each license holder is permitted to fish (a trap limit), (2) the number of traps that may be fished on a single line, and (3) the times when lobster fishing will be allowed. If the proposed rules are passed by a vote of two-thirds of the license holders in that zone, the zone council is obligated to convey the results of the referenda to the Commissioner of Marine Resources. If the Commissioner judges them to be "reasonable," the rules will become departmental regulations and will be enforced.

By May 1997, the zones had been established and the bylaws for the zone councils had been created (Figure 1). By June 1998, all seven zones had held referenda in which restrictive trap limits had been established. Some of these zones have passed very restrictive trap limits by a wide margin. Zone E, for example, passed a 600-trap limit, with 82% of voters in favor. These trap limits went into effect within a few months.

Imposition of trap limits had some serious distributional effects, which quickly led to political pressure for further legislation. Many of the full-time fishermen with large gangs of gear became very unhappy with the trap limits, arguing (with justification) that these trap limits put them at a competitive disadvantage and benefited small fishermen. That is, most full-timers had to reduce traps, while part-timers were free to increase the numbers of traps they fished. Adding to their chagrin was the fact that trap limits were not reducing effort.

In Zone G, four full-time fishermen were so unhappy with the 800-trap limit imposed on them that they sued the state late in 1997, claiming that the Zone G council had violated its own bylaws.

After months of deliberation, a judge ruled in their favor and annulled the Zone G trap limit. Zone G had to go back to the 1,200 trap limit, the maximum allowed by the state. This action left fishermen in Zone G in a liminal state, feeling that all of their efforts to impose meaningful trap limits by democratic means had failed.

From 1997 to 1999, some full-time fishermen persistently argued for changes in rules that would stop the increase in fishing effort and spread the cost of conservation more evenly. In 1999, two laws resulted from these efforts. One was a restraint on trap tag issuance, which essentially permitted people fishing under 800 traps to purchase only 100 more trap tags than they were issued as of November 20, 1998 (Public Law 1999, Chapter 397). The second law (Public Law 1999, Chapter 508) made it possible to establish limited entry by zone based on a ratio of entrants to people who give up their licenses. The first law prevents part-timers from building up the amount of gear they fish, whereas full-timers are forced to reduce their trap numbers. The second stops entry into the industry other than through permit transfers and eventually will reduce numbers of license holders. In promoting these laws, the full-timers were being both altruistic and very self serving. Both laws were designed to stop the trap escalation, which was continuing despite the moratorium on entry and trap limits, and limit the competition full-timers faced from part-timers.

By September of 2000, Zones D, E, F, and G in the overcrowded western portion of the state had requested limited entry, and their request was honored by the commissioner in the fall of 2000. In Zone A, where overcrowding is less and there is more concern about employment possibilities for young people, the zone council voted not to seek limited entry. How Zones B and C will act has yet to be determined.

Data Sources

Virtually all of the data for this study were obtained in 1998 and 1999 during the course of a study financed jointly by the University of Maine Sea Grant Program and the Maine Department of Marine Resources.

The data for the project were collected by two different methods. In June 1998, 3,400 questionnaires were mailed to a random sample of lobster license holders. Approximately half of the license holders in the state were surveyed in this way, and 862 of these questionnaires were returned (or 24.5%). In addition, four interviewers were hired

TABLE 2.—License holders changing the number of their traps between 1995 and 1998.

Number and percentage	Over 200-trap decrease	Decrease of 1–199 traps	Same number of traps	Increase of 1–199 traps	Over 200-trap increase
License holders	160	19	260	350	266
Percentage	15.2	1.8	24.6	33.2	25.2

by the MDMR to administer the same interview form in person in all seven lobster zones. Those to be interviewed at docksides were randomly selected from the license holders in each zone who had over 400 trap tags and who had not been sent a mail survey. This produced another 255 interviews. All told, information was obtained from 18% of all the 1997 lobster license holders in the state. The completed questionnaires were coded by students at the University of Maine, and their work was checked by the principal investigator. The coded data were then used to compile tables, graphs, and statistics (using Excel and Systat), which were incorporated into the final report to the Legislature (Acheson and Acheson 1999). (The data in Tables 2–5 were obtained from this survey.)

These data were supplemented by telephone interviews with questionnaire respondents who indicated they wished to give additional information. Sixty additional face-to-face interviews were also conducted with specially selected respondents to explore their opinions on trap limits in far more detail.

Figures on numbers of traps and catches were obtained from official figures of the Maine Department of Marine Resources (Table 1) and were updated by Kevin Kelly of the MDMR. Historical data on the trap limit came from archival sources and interviews with people who had participated in the events reported.

Factors Leading to an Increase in Trap Numbers

Official state statistics (see Table 1) indicate that in 1994, the year before the trap limit went into effect, there were a total of 2,786,000 traps in use in Maine. For the next several years, the number increased, so that by 1999 there were 3,043,000 trap tags issued (Table 1). Our survey of lobster fishermen in the summer of 1998 found that fishermen fished a mean number of 432.5 traps in 1990, 503.6 traps in 1995, 552.4 in 1997, and 571.1 in 1998.

More than half of the fishermen increased the number of traps they fished. As can be seen in Table 2, Of the 1,055 lobster license holders suc-

cessfully interviewed, 616 or 58.4% reported that they had increased the number of traps they fished between 1995 and 1998; 260 or 24.6% said they fished the same number of traps they had the year previously; and 179 or 17% said they actually fished fewer traps than they did in the past year.⁴ The net result was an overall increase in the number of traps fished, not the predicted decrease.

Legislation and Uncertainty

In some ways, fishermen's response to trap limits was a response to a whole plethora of proposed and enacted regulations and to uncertainty about what the future would bring. After 1995, federal, state, and ASMFC regulations evolved so quickly that fishermen literally did not know from one month to another where they stood. As one fisherman responded in a questionnaire, "We are not sure who is going to be able to fish, where we will be able to fish, or how many traps we will be able to fish." Not knowing what the future would bring, many thought it necessary to protect themselves. That is, thinking it unlikely they would be allowed to increase the number of traps they fished in the future, they believed they could "grandfather" a maximum share for themselves by increasing the traps they were fishing. David Cousins, Maine Lobstermen's Association president, summarized the attitude of many of these men by saying, "Many guys figured it was now or never."

When asked why they had increased the number of traps they fished between 1995 and 1998, many license holders openly said they were responding to uncertainty caused by government action.⁵ The

⁴ There is an inconsistency in the data from the surveys concerning the number of fishermen that neither increased nor decreased the number of traps fished; 260 respondents said they fished the same number of traps in 1998 as they had in 1995 (Table 2). In responding to an open-ended question about why they changed the number of traps they fished, 199 respondents said they fished about the same number as they had previously (Table 5).

⁵ Other social scientists have also noted that the actions of the government have increased risks for fishermen (e.g., Smith. 1988).

following are typical responses from fishermen received on our survey in explaining why they changed the numbers of traps they fished: "Federal laws. We are afraid of what they might do." "You made me change [i.e., increase traps] by saying we were going to be limited [to under 1,200 traps]." "To get the number of traps up. That's when the feds, tree huggers, and all the other groups that know nothing about lobstering put us on a limit of some kind, hopefully they will leave me enough to make a living, where 100% of my living comes from lobstering." "Because when they started fooling with trap limits and issuing tags, I didn't know what it would lead to as far as how many traps I had in the water. So, I increased the number in case they went by a percentage of previous years." "Over-regulation."

Such statements show some free floating anxiety, but they also reflect the fact that fishermen, and many other observers, were very uncertain what trap limit would be imposed on them and by whom. This was partially caused by the uncertainty about whether the referendum votes in the zones would reflect their individual interests. Men fishing large amounts of gear were worried (with justification, it turned out) that their gear could be limited through the maneuvering of license-holders fishing small and medium amounts of gear. Conversely, the part-timers were worried that full-timers would put them out of business by imposing rules prohibiting fishing late in the afternoon and on weekends.

In large measure this uncertainty was due to a jurisdictional issue occurring at the federal level. At the same time the Maine zone management bill was being implemented in 1996, the ASMFC announced its lobster management plan in the spring, fall, and winter of 1996. This plan wisely divided the lobster-producing area off the Atlantic coast into six zones, which would be managed with different laws. The ASMFC Zone 1, which included the coastal lobster fishery from Eastport Maine to Cape Cod, was to have a V-notch law and an over-size measure (5 in), for which the Maine delegation had strongly lobbied. There was also to be an increase in the escape vent to $1\frac{5}{16}$ in. Most importantly, the ASMFC plan called for a rolling trap limit to be imposed in ASMFC Zone 1, including Maine, which would allow license holders to fish a maximum of 1,200 traps in 1998, 1,000 traps in 1999, and 800 traps in the year 2000.

Officers of the NMFS were convinced that the ASMFC plan did not restrict fishing effort sufficiently to conserve lobsters. Empowered by the

Sustainable Fisheries Act, they readied their own plan, which was rumored to be far more stringent than the one passed by the ASMFC. Throughout late 1997 and 1998, there were constant discussions of this plan in industry and management circles. In 1998 the NMFS reported that it was considering a trap limit in which fishermen would have to "build down" to 475 traps over the course of 5 years. Large numbers of fishermen were very upset by this news, fearing that such a low trap limit would make them into part-time fishermen or put them out of business all together. Hearings were held on this plan in 1998, but nothing was done for months; meanwhile, the industry waited anxiously. Finally, in December 1999, the NMFS plan was released in final form. Essentially, it endorsed the ASMFC plan (i.e., 1,200 traps in 1998, 1,000 in 1999, and 800 in 2000), but fishermen were left wondering whether the ASMFC rules or the more stringent NMFS rules would prevail. Their uncertainty was increased by other events influencing trap limits, such as the limited entry proposals and the Zone G lawsuit.

The trap-tag provision of the zone management law raised special anxieties. When the trap-tag law was passed in 1995, the commissioner promised that the trap-tag data would never be the basis for limiting or freezing the number of tags fished. Many fishermen were very disbelieving, predicting that the government would use the trap-tag information to freeze the number of traps a person could fish, or that a required build-down in traps would be calibrated to the number of tags that a person had. Indeed, this came to pass. The draft NMFS plan, which did not come to fruition in 1999, had a provision that fishermen were to build down to 475 traps by 10%/year from the number of traps they currently held. Moreover, the Lobster Advisory Council seriously discussed freezing traps according to the number of tags a person had in 1998. As a result, fishermen who increased their trap tag numbers would be better off if the likely reduction in trap numbers was ordered.

Throughout this period, lobster fishermen became increasingly aware that control of their industry was passing to people and organizations (federal bureaucrats, environmentalists, scientists, judges, etc.) over whom they had little influence and whose behavior they could not predict or understand. Zone meetings became increasingly devoted to discussing ASMFC rules, NMFS plans, "whale-take reduction" strategies, and lawsuits. The zone management councils began to react to events at the state and federal level, rather than

solely reflecting the wishes of the fishermen in their respective zones. In several zones, trap limits were imposed that mirrored those proposed by the ASMFC, which most fishermen supported. This gave many fishermen the feeling that management was out of their hands, in that the zone councils felt they were being forced to respond to federal initiatives.

Catches, Income, and Increase in Full-Time Fishermen

Another factor increasing the total number of traps and average number of traps in use was a general increase in the number of full-time fishermen. Although the total number of license holders did not increase appreciably in the last 20 years, the number of fishermen whose primary target species is lobster has increased by leaps and bounds.

In the past, most of the people holding lobster licenses were part-time lobster fishermen who earned over half of their income in other jobs (especially other fisheries). In a 1973 study of the lobster industry, it was estimated that "less than a third of the these licensed fishermen could be considered full time" (Huq and Hasey 1973:1; Acheson 1975: 661).

By the mid 1990s, the majority of lobster fishermen had become full-time lobster fishermen and earned very little of their income in other fisheries or in nonfishing jobs. Our 1998 survey showed that, in every zone, over 50% of the license holders reported earning between 50% and 100% of their income from lobstering (Table 3). Over 50% of the respondents said they earned no income in any other fishery, and over 50% said they earned nothing in any nonfishing job.

Moreover, our survey substantiated that license holders earning a high percentage of their income from lobstering fished a much larger number of traps than those earning a smaller percentage of their income from the fishery. In the state as a whole, license holders earning 75–100% of their income from the lobster fishery used an average of 732 traps, those earning 50–74% of their income from lobstering used 535 traps, and those earning 25–49% of their income from the lobstering used only 311 traps (Table 4). Clearly the move from part-time to full-time status was accompanied by a great increase in the average number of traps used.

This move into full-time lobstering was prompted by the record high incomes to be earned in the industry, which stemmed from record high catches

and good exvessel prices. Although no definitive study of lobster fishing incomes has been done recently, there are a number of reliable reports of mid-1990s lobster fishermen catching over 40,000 lb of lobster and earning over US\$200,000 gross income. In our survey, 264 license-holders of the 1,083 respondees (24.4%) said that they caught over 25,000 lb of lobster in 1997. Because the average exvessel price per pound in that year was about \$3.75, it is reasonable to assume that these men grossed over \$93,750 during that year. Other estimates indicate that full-time fishermen with average-sized operations might gross \$65,000 and have a net income (after taxes and expenses) of \$40,000.

At the same time, conditions in other fisheries have been terrible. In Maine, catches of groundfish, have plummeted in recent years due primarily to overfishing (Murawski et al. 1997), which has resulted in a sharp reduction in numbers of boats and people employed in that fishery. Throughout the 1980s and 1990s, people switched from groundfishing into a variety of alternative occupations. Many entered the lobster industry on a full-time basis. However, most had held lobster licenses but were relatively or completely inactive in the lobster fishery. Thus, the entry of these men into the lobster industry has been reflected in the increase in numbers of traps but not in an increase in numbers of licenses (Table 1).

Competition

Typically in open-access fisheries, competition feeds on itself. This certainly occurred in the lobster fishery. Once some men in a harbor expanded the number of traps, others felt they were forced to follow suit or see the percentage of traps they fished decline, along with their incomes. Many, however, were very reluctant to fish more gear, knowing that it would contribute to an already severe congestion problem and increase business costs. They also knew that a trap limit was coming and that they probably would have to reduce the numbers of traps they fished in the near future. However, when faced with the prospect of losing income to more aggressive fishermen, they put more traps in the water to keep up with the competition.

The social aspects of competition deserve to be emphasized as well. Lobstermen are not lone entrepreneurs making decisions with price and income alone in mind. They are members of groups, which I call "harbor gangs," who fish from the same harbor. Members of these groups interact a

TABLE 3.—Percentage of 1997 income reported as earned from lobstering, by zone.

Income (%)	Zone A		Zone B		Zone C		Zone D	
	N	%	N	%	N	%	N	%
0	11	5.5	13	11.1	7	4.8	18	7.2
1–24	27	13.6	15	12.8	14	9.6	29	11.5
25–49	18	9.1	14	11.9	13	8.9	22	8.7
50–74	38	19.2	12	10.2	22	15.1	25	9.9
75–100	104	52.5	63	53.8	89	61.4	162	62.5
Total	198	100	117	100	145	100	256	100

good deal and depend on each other for mutual aid, and the group controls many aspects of an individual's career. These groups also enable members to measure themselves against one another in assessing relative success and skill, and a tremendous amount of prestige is garnered by the "high liners" (the most successful fishermen) in the group. Much approbation can be heaped on inept fishermen (Acheson 1988: 48–59). Under these conditions, keeping up with the competition not only maintains income but also one's social standing.

Factors Leading to a Decline in Trap Numbers

Of those interviewed in our 1998 survey, 179 respondents (17%) said they had fished fewer traps between 1995 and 1998 (Table 2). Three different factors were involved, which are relatively straightforward and easy to understand.

Trap Limit

There were a number of license holders in the sample who reduced the number of traps they fished because of the trap limit. When the zone management law went into effect in 1996, fishermen with over 1,200 traps were forced to begin to reduce the number of traps they fished in increments to meet the state-mandated 1,200-trap limit. When the zone trap limits were announced in 1997 and 1998, more fishermen had to begin to reduce the number of traps they fished. Still others who had consistently favored a trap limit reduced the number of traps they fished by attrition, in the certain knowledge that trap limits were coming and that it was nothing short of foolish to buy more traps under these circumstances. These people were making the kind of choice many observers had assumed would be general in the industry.

Age and Illness

Some in our survey said they were reducing the number of traps they fished due to either increasing

age or illness or because they were entering retirement or semiretirement. Others cited illness of someone in their family. Those who were scaling down with retirement in mind almost certainly did not increase the number of traps they fished. Younger men with injuries or illnesses were, however, likely to increase the number of traps they fish after they recover.

Overcrowding and Shore-Based Job

Another set of respondents reduced the number of traps they fished either because they had to devote more time to a full-time job, because of severe trap overcrowding, or both. A few of them were leaving fishing altogether to enter another business or go back to school. Others said they were reducing the number of traps they fished because they were going back to "fishing singles" (i.e., fishing one trap on a line) as a means of coping with gear congestion. One man said, "I am getting a lot of overtime now (on his full-time job) and haven't got as much time for lobstering as I used to. With all the tangles it takes me longer to pull my gear than it used to. When 50 traps wore out last fall, I didn't replace them."

Reasons to Change Trap Numbers

How important were these factors in influencing the decisions of fishermen concerning the changes in trap numbers? This is difficult to say because the questionnaires and follow-up interviews revealed that many men were influenced by a number of variables. However, some indication of relative importance of these variables can be obtained from analyzing the answers to the survey question: "If you changed the number of traps you fished in the last 5 years, explain why you made these changes?" The answers received are summarized in Table 5.

The responses to this question indicate that the most important factor influencing an increase in traps is an increase in economic opportunities in the lobster fishery brought about by high stock

TABLE 3.—Extended.

Income (%)	Zone E		Zone F		Zone G		State	
	N	%	N	%	N	%	N	%
0	12	8.4	21	14.3	7	6.2	89	7.9
1–24	21	14.7	28	19.0	15	13.2	149	13.3
25–49	9	6.3	9	6.1	3	2.6	88	7.9
50–74	20	13.9	12	8.2	12	10.6	141	12.6
75–100	81	56.6	77	52.4	76	67.2	652	58.3
Total	143	100	147	100	113	100	1,119	100

sizes and record high catches. There was money to be earned in the lobster fishery, and people responded by putting more traps in the water to get higher catches and returns. They phrased the reasons for their actions in different terms: 161 said they were “expanding [their] business,” 139 said they were putting more traps in the water to get more income for “consumption purposes,” and 41 said they were expanding the number of traps they fished to get money for a “new investment,” such as a boat. The 341 fishermen giving these three answers represented 30% of the whole sample.

Another important reason for increasing the numbers of traps—keeping up with the competition or reference group—was indicated by 130 (11%). Sixty-one license holders (5%) increased traps fished because of the uncertainty brought about by regulation and government actions. But concern about the actions of government may have been more of a factor than these numbers alone indicate. That is, general concern with actions of the government was laced throughout the responses. Fishermen were very aware that bureaucracies were in the process of making sets of decisions that would redefine lobster fishing. They also knew that they had direct control only over the zone management process, and many were not certain zone referenda would produce the results they wanted. So, the fishermen were certainly preoccupied with positioning themselves for an uncertain future.

Another 51 (5%) indicated that they were mov-

ing into lobster fishing from other troubled fisheries or shore-based jobs. Although many lobster fishermen in recent years have been very concerned about the influx of “draggermen” and people from other fisheries, such movement since 1995 has been relatively slight. However, movement out of the failing groundfish industry has been ongoing since the late 1980s; thus far, more than 3% of the lobster license holders have experience in the groundfish fishery.

Three reasons were mentioned for decreasing the numbers of traps fished: age or illness, the trap limit, and a switch to a shore-based job. None of these factors motivated large numbers of fishermen, and all three reasons appear to be of equal importance in motivating their use of fewer traps.

The fact that fishermen chose to increase the number of traps they fished in the face of a trap limit, is certainly counterintuitive. I was one of many who predicted that the number of traps fished would quickly decline when the trap limit was imposed. We were wrong. In retrospect, it is difficult to understand our lack of insight, particularly when all of the variables that produced the increase in traps were present in 1995 when the lobster zone management law embodying the trap limit was passed.

Broader Issues for Fisheries Management

The fact that regulations designed to cut fishing effort resulted in increasing effort raises a number of questions for managers.

TABLE 4.—Average number of traps fished in 1997, by percentage of income from lobster fishing.

Income from lobstering (%)	Zone								State average
	A	B	C	D	E	F	G		
0	32	71	53	34	11	37	25	38	
1–24	218	93	169	136	143	134	169	152	
25–49	302	313	381	276	337	232	333	311	
50–74	553	552	501	590	347	553	651	535	
75–100	735	569	674	844	584	929	790	732	

TABLE 5.—Primary explanations for changing numbers of traps used.

Reason offered ^a	Number of fishermen	Percentage of cases
Competition	130	11
Uncertainty due to laws and government action	61	5
Expanding business	161	14
Increase income for investment (new boat, etc.)	41	4
Increase income for consumption (bills, college, house)	139	12
Switching to lobstering from less desirable fishery	20	2
Switching to lobstering from shore job (increase)	31	3
Decrease due to trap limit	47	4
Decrease due to age or illness	77	7
Decrease due to overcrowding or switch to shore-based job	72	6
Fishing about the same number	199	17
Other explanation or no explanation	158	14
Total	1,136	100

^a Some are reasons given for increasing the number of traps fished; others are reasons for decreasing trap numbers.

Industry Heterogeneity and Management

One of the problems that has attracted the attention of the small group of social scientists interested in fisheries management is the reactions of fishermen to regulations. In general, this group of authors has stressed the costs and unforeseen consequences of management measures. This issue was discussed in detail by Estellie Smith (1978) in a paper entitled “What you wants is results. What you gits is consequences.” Many of the consequences are very counterproductive. We are told that “subsidies will result in over development of the fleet” (McGoodwin 1990: 171). Managing stocks by imposing taxes on vessels will not motivate people to switch target species or vessels quickly enough to reduce effort on overfished species (Crutchfield 1979; Beddington and Rettig 1984). Restricting gear and technology can result in evasion of rules (McGoodwin 1990). Management by size rules will result in high grading (discarding dead, undersized fish; Anderson 1977). Management by total allowable catches (TACs) will probably result in overcapitalization (McGoodwin 1990: 169). Closed seasons will divert fishing pressure to unclosed areas and “encourage overcapacity in the fleet [and a] competitive race for fish” (Anderson 1977: 168). Individual transferable quotas (ITQs) can result in ownership of rights to fish concentrated in the hands of a few (Palsson and Helgason 1996: 53). There are un-

doubtedly cases where large numbers of skipper and vessel owners did respond in these ways.

One problem with these ideas is that they embody a simplistic view of the behavior of fishermen. It assumes that fishermen are homogenous and make similar decisions in response to regulations. The data from the Maine trap-limit case suggests this is a vastly oversimplified view. In Maine, fishermen’s response to the new trap limit was highly differential and driven by a complicated set of factors. This was true even though these people were in the same fishery, used the same gear, and faced the same market possibilities and most of the same regulatory constraints.

This has profound implications for management. If social scientists and managers are going to predict the effects of management, they will have to predict how fishermen will respond to management initiatives. Rules that result in all fishermen lowering effort will have one effect on stocks; rules that motivate large numbers of fishermen to evade the regulations or increase effort will very likely have another effect. Gathering such data poses some major problems. There are three kinds of variables affecting fishermen’s decisions. One is the organizational features and subculture of the fishing industry in question. The second is the characteristics of the fishermen in question (e.g., age, education, borrowing capacity, family income, commitment to the industry and community, etc.), which vary widely. Each fishing industry has some unique organizational and cultural features, and there are likely to be dozens of personal variables that influence decisions. The third variable is the degree of uncertainty caused by management itself and the probable response of various sets of fishermen to that uncertainty. This means that if we want to understand the range of responses of fishermen to a regulation, broad generalizations will not suffice. Managers will need specific studies of the complex decisions of fishermen to each proposed rule, industry by industry. Those studies ideally should be done by someone who is very knowledgeable about the industry in question.

Two different kinds of studies might be contemplated in this connection. The first would focus on asking fishermen how they would respond to specific proposals and why. Under some conditions, such studies can produce misleading results (Ordeshook 1986), but if done correctly they can be very revealing.

Another kind of approach that would produce useful information are case studies documenting what really happened in fisheries when regulations

were imposed. These case studies would focus on the responses of various classes of fishermen to management decisions and the effect of those decisions on the stocks. One such set of studies appears in the volume edited by Pálsson and Petursdóttir (1997) on the effects of various kinds of quota systems in North American and European fisheries. Much the same thing could be done with other kinds of management techniques.

The Relative Success of the Maine Comanagement Law

Does the fact that the number of traps increased after the trap limit indicate the Maine comanagement law has failed? If we take a short view, it might seem that management efforts have been less than successful, but it is difficult to make the case for failure if we take a longer view of the problem. To be sure, the trap limit law has not produce the quick reduction in traps hoped for, but the response of the industry to this temporary setback was to lobby [successfully] for a limited entry law. The combination of the trap limit and limited entry will almost certainly bring a reduction in the number of traps in time. It is difficult to imagine how numbers of traps can continue to climb in the long term (Table 1) when the number of traps is capped at 600 or 800 and the numbers of licenses will decline. Moreover, even in the short term, these rules have almost certainly had an effect. Were it not for the trap limits and moratorium on licenses, the boom in the lobster industry would almost certainly have attracted additional fishermen and motivated established fishermen to buy even more traps.

To focus on the fact that traps in the Maine lobster industry increased after a trap limit was imposed is to overlook the most important fact concerning zone management in Maine—namely that Maine lobster fishermen have been very successful in constraining themselves. This happens all too rarely. In all too many cases, fishermen operate with a “gold rush” mentality and seek to take as many fish as quickly as possible, regardless of the consequences for the stock. The result is the well-known “tragedy of the commons.” If the experience with the comanagement law in Maine has done nothing else, it has demonstrated that it is possible for fishermen to curb their own exploitive effort under some conditions. Those conditions are very complicated and have been described in detail (Acheson 1997a, Acheson 2000, Acheson and Wilson 1996; and Acheson and Knight 2000). Whether

these factors are replicated elsewhere is an open issue.

This suggests that one of the most important problems facing fisheries management is determining under what circumstances fishermen will generate rules to conserve fisheries. As the rational choice theorists can attest, such a determination is not at all obvious (Elster 1989; Knight 1992).⁶ Nevertheless, it is probably the ultimate question facing managers at present.

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⁶ Unfortunately, it is not at all clear under what conditions rules will be generated. In the literature there is currently a good deal of discussion on this topic (North 1990; Ostrom 1990; Knight 1992).

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