

Enforcement Issues in Selecting Fisheries Management Policy

LEE G. ANDERSON

College of Marine Studies
Department of Economics
University of Delaware
Newark, DE 19716

Abstract *The purpose of this article is to present a frame of reference in which to compare fisheries regulations and to identify enforcement issues that can be important in practical policy application. The issues discussed include dockside vs. at-sea monitoring; ease of government implementation; period at risk when in noncompliance; ease and cost with which industry participants can achieve ability to comply; ease of distinction between honest mistakes, sloppy practices, and deliberate cheating; initial vs. continued compliance; ease with which requirements can be communicated; ease with which noncompliance can be disguised; ease with which agents can detect noncompliance such that it is admissible as evidence; degree to which personal or social benefits from compliance can be demonstrated; potential for citizen cooperation in identifying offenders; likelihood of encouraging rentseeking behavior by industry and of administrators being susceptible to it; ease with which illegal activities can be detected under various conditions; relative ability to which enforcement is efficacious with respect to different management objectives; and ease with which benefit-based priorities for enforcement can be identified.*

Keywords Fisheries enforcement, fisheries management, fisheries rent.

Introduction

The fisheries management literature contains many comparative studies of the relative effectiveness of policy instruments such as taxes, quotas, input restrictions, etc. Most give particular emphasis to achieving economic efficiency, narrowly defined. Little attention, however, has been given to the relative ease of enforcement. (Enforcement includes monitoring activities to identify rule breakers and prosecution activities wherein guilt or innocence is ascertained and penalties are assessed and implemented when guilt is proved.) This is a serious deficiency. If there are practical constraints to enforcement, what may appear to be the overall superior instrument may not achieve program activities.

The purpose of this article is to present a frame of reference in which to compare policy instruments and to identify enforcement issues that can be important in practical policy application. Furthermore, it compares standard policy instruments on their ability to face problems caused by these enforcement issues. At the outset, however, it should be noted that in this broader context, there are often no clear winners and losers. In fact, in many cases, it is not possible to compare general classes such as standard versus

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taxes. The necessary comparison must be between certain types of standards and certain types of taxes.

The new information provided in this article, when added to the existing literature, will provide a framework for choosing the best instrument or instruments for different situations, each with its own economic, biological, and political peculiarities. In certain situations, this more complete framework may result in a different choice of management programs than would be the case if enforcement issues were ignored.

The first section briefly reviews the problem of fisheries regulation when enforcement issues are considered. The second section lists and describes in detail some of the important enforcement issues and how they can affect various regulation programs. Many of the issues may not be obvious to those who concentrate on the more traditional aspects of fisheries policy.

Economic Efficiency and the Enforcement of Environmental and Natural Resource Programs

The prime economic justification for fisheries regulation is market failure. Because of externalities and/or open access to the relevant resource, the unregulated economy will not maximize the value of goods and services produced. Economically optimal regulation programs are based on the premise that they can reallocate inputs associated with these processes so that the net present value of goods and services produced over time will increase. There are many other criteria for evaluating management programs, but only economic efficiency is discussed in this section.

Although the above may be an overly simple statement of the economic foundation of fisheries policy, it does capture its essence. Most practitioners would stress, however, that a regulation program cannot be justified unless the present value of gains is greater than any implementation and enforcement costs. Until very recently, however, these costs have been (explicitly or implicitly) treated as fixed annual amounts that are merely subtracted from the gross gains. Recent work has shown, however, that less restrictive assumptions about enforcement costs are required to obtain a complete analysis. (See, for example, Downing and Watson 1974; Harford 1978; Hucke 1978; Downing and Kimball 1980; Storey and McCabe 1980; Beavis and Walker 1981; Brady and Bower 1982; Downing and Kimball 1982; Krupnick, Magat, and Harrington 1982; Richardson 1982; Ullmann 1982; Lee 1984; Linder and McBride 1984; Malik 1984; Martin 1984; Sutinen and Andersen 1985; Tietenburg 1985; Anderson and Lee 1986; Milliman 1986; Russell, Harrington, and Vaughn, 1986; Beavis and Dobbs 1987.) To set the stage for the analysis to follow, it will prove useful to review some of this discussion.

The net gains from a fishery regulation program can be represented by the schematic in Figure 1 in which all items are measured in present value terms. The important point to note is that there are many types of enforcement-related costs, and these costs will vary with the type of policy instrument and how it is used. That is, although the net benefit of an unregulated fishery may be the difference between the value of the output and the cost of fishing effort, the net benefits of a regulated fishery must take into account all costs that follow as a direct result of the regulation program.

Compliance costs are those initial expenses borne by firms as they prepare to change their behavior to come into compliance with regulations. With provisions such as gear restrictions, this can involve the purchase of new gear or the adaptation of old. Taxes, on the other hand, may require no capital expenditures per se but only the acquisition of the appropriate forms and the knowledge of how to prepare them.

$$\begin{array}{r}
 \text{Value of Fisheries Output} \\
 \text{minus} \\
 \text{cost of Fishing Effort} \\
 \text{minus} \\
 \text{Compliance Costs} \\
 \text{(Cost of Industry Adapting or} \\
 \text{Complying with Regulations or} \\
 \text{of Lobbying Activities)} \\
 \text{minus} \\
 \text{Avoidance Costs} \\
 \text{(Industry Costs to Avoid} \\
 \text{Detection or to Facilitate} \\
 \text{Noncompliance)} \\
 \text{minus} \\
 \text{Initial Government Implementation Costs} \\
 \text{minus} \\
 \text{Government Enforcement Costs} \\
 \text{Including Monitoring} \\
 \text{and Prosecution Costs}
 \end{array}$$

Figure 1. Net gains from regulated fishery.

Lobbying costs to amend regulations or obtain variances and litigation expenses to get regulations overturned or at least have their implementation delayed or to obtain exemptions can also be classified as compliance costs. Rather than meet specified standards or behavioral patterns, the firm engages in rent-seeking behavior to get the rules changed so that current operations will be in compliance (see Johnson and Libecap 1982; Karpoff 1987).

Avoidance costs are the expenses firms may undertake to hide noncompliance or to make it appear as if they are in compliance. For example, boats could have two sets of nets on board if there are mesh size regulations, or boats could offload part of the catch at out-of-the-way ports or to other vessels if there were trip limit regulations. Different types of policies will provide different potentials to engage in these wasteful activities. All else being equal, the ones which allow less avoidance waste are economically superior (see Anderson and Lee 1986; Milliman 1986).

Whereas the first two costs are imposed on regulated firms, the other two classifications are government expenses. Initial government implementation costs are the start-up costs of getting the program operating. If the regulation is similar to other government programs (i.e., quotas for a newly managed fishery when quotas are used in many other fisheries) and existing organizations or agencies can perform the task, these costs could range from little more than assigning tasks to existing staff to hiring and training new personnel. If the regulation is radically different, however, these costs can be quite high as new agencies or branches are established, personnel are hired, standard operating procedures are established, etc.

Government enforcement costs include both monitoring and prosecution activities. The purpose of the former is to encourage compliance and detect deviance. The latter can range from administrative hearings to formal court proceedings and all the negotiations, bargaining, and other transactions that accompany them (see Sutinen 1986; Wasserman, n.d.).

While considering these extra costs, it is necessary to determine how each varies with both the type of instrument and the level at which it is used. Although it is beyond the scope of this article to present a formal model of this optimization process, sufficiently precise policy conclusions for the analysis to follow can be derived from a rather simple statement of the problem. For more detail, see Anderson and Lee (1986).

In the most general case, the problem for the management agency is to select the appropriate combination of policy instruments and to allocate implementation and enforcement inputs so that the net gains from the regulated fishery are maximized. To solve this problem, it is necessary to know how the types of instruments used and levels to which they are applied and the inputs used to support their application will affect each of the elements in the net gains equation. For example, how will the type and size of the total quota or the nature and the extent of trip limits affect compliance costs or the number of person-years of labor allocated to the various aspects of enforcement affect avoidance costs?

At the risk of being redundant, it is important to emphasize that it is not a matter of maximizing the net revenue from the fishery or of minimizing regulation costs. It is the algebraic sum of all terms in the equation that is crucial. Furthermore, each term can be affected by the types and extent of regulation. The value of fishery output will be affected according to the efficacy of the regulation program in actually changing industry participants' behavior (i.e., how much it will actually reduce effort in an overextended fishery.) In addition, the quality of the marketable product may be affected for good or ill. For example, a regulation plan which would increase the length of the Pacific halibut season would allow for more fish to be sold fresh. On the other hand, in other fisheries, a restrictive quota which can easily be circumvented by landing at out-of-the-way ports and trucking the catch to central marketing areas may increase the average time it takes to get the fish to the processor or the consumer and hence will likely result in a decrease in quality.

The type of regulation can also affect the cost of producing effort. This has been the focus of most of the economic analysis of policy instruments. The universal conclusion is that traditional measures such as gear restrictions, closed seasons, closed areas, and total quotas cause fishing effort to be produced at a higher cost than is necessary. Furthermore, except for total quotas, such measures will not be completely efficacious in the long run as industry participants modify their fixed and variable inputs to maximize profits subject to the constraints posed by the regulations. On the other hand, controlled-access-type regulations such as taxes, individual transferable quotas, and to some extent, license restriction programs produce incentives for efficient production (see Rettig and Ginter 1978; Pearse 1979; Sturgess and Meany 1982; Beddington and Rettig 1984; Anderson 1987).

That the type of regulation program can affect avoidance and government implementation and enforcement costs should be obvious from the discussion above. It follows, therefore, that in order to provide a complete economic evaluation and comparison of policy instruments, it is necessary to give more detail on how each will affect the six elements in the net gains equation.

To carry the economic efficiency analysis one step further, the problem facing most resource agencies is more than a simple maximization problem in which they optimally choose policy instruments and allocate implementation and enforcement inputs. In the first place, they seldom know the exact nature of the gains function to be maximized. In the second place, there may be other (explicit or implicit) maximands (mostly dealing with income distribution and other politically sensitive issues) that are often the driving

force behind agency operations. Incidentally, the agencies may be just as uncertain about the true nature of these other maximands as they are about the net gains equation. Finally, they are constrained by an operational budget. In reality, then, the agency faces a constrained maximization problem in which there is a good deal of uncertainty about the nature of the maximand.

Because of the constraint, the economic efficiency effects of the allocation of agency inputs is just that much more critical. Therefore, the relative as well as the absolute effects of the various instruments on items in the net gains equation will be of interest. Furthermore, the budget allocation problem is made more difficult because it is not just a matter of knowing how to allocate funds among different regulation inputs per se, but also between regulation inputs as a group and research activity devoted to obtaining a better picture of the biological, ecological, and economic aspects of the world in which they operate. That is, they have to use scarce inputs to better define their maximand and the institutional and ecological constraints under which they operate. In this regard, comparison of policy instruments with respect to what is currently known or can be known about their effects will be important.

Enforcement Issues in Selecting Policy Instruments

The purpose of this section is to introduce issues that can be of importance in selecting fishery management regulations. In particular, the focus is on the effect each can have in the determination of the size of the elements in the net gains equation depicted in Figure 1. The discussion of each issue is brief, but the goal is to explain exactly how the issue is related to the direct or related costs or the effectiveness of regulation.

Dockside versus At-Sea Monitoring

Each monitoring type has different relative abilities to detect noncompliance with specific types of regulation, and, just as important, each has different relative costs. In general, at-sea monitoring is more expensive, but it does offer the potential to observe all aspects of the fishing operation. Although dockside monitoring is relatively less expensive, it is also remote from the fishing activity. The key question is whether this remoteness will frustrate the purpose of management by allowing activities to take place between harvesting and landing which make it more difficult to determine if the fishing operation was conducted in a legal manner. More formally, the question is whether the loss in compliance benefits is greater than the cost savings from going from at-sea to dockside enforcement.

The comparison of at-sea versus dockside enforcement is ambiguous in fisheries management enforcement. First, there is obviously more than a simple trade-off between cost and relative efficacy. For example, at a more technical level, there is the question of what is the most important objective and the best way to enforce to achieve it. Consider a fishery where both total catch limits and prohibitions on retaining small individuals will provide benefits. Assume that the total limit is more productive in producing net gains. Because it can be enforced at dockside, net gains may be maximized by regulating the catch of young fish in a way that can also be enforced dockside. For example, in this hypothetical case, mesh size restrictions might be better, in an overall sense, than incidental catch restrictions, even though the latter may have an absolute advantage in reducing mortality of small fish *if* enforced with an effect at-sea monitoring program. Although the mesh size restrictions may not be as effective as a strictly enforced inciden-

tal catch limit, the marginal cost of enforcing it in combination with the dockside monitoring of total catch may be so much lower than enforcing the incidental catch limit at sea that the overall net benefits of the mesh size restrictions will be much higher. All else being equal, then, cost reductions may be possible by selecting combinations of regulations such that only one monitoring mode is required, even if some of the governing instruments chosen are second best in an absolute sense (Pallozzi and Springer 1985).

Another problem with the at-sea/dockside controversy is that an optimal management program may produce distributional or biological effects that when viewed in isolation appear suboptimal. For example, consider a fishery that requires restrictions on the number of small fish taken. This can be accomplished by minimum mesh size limits or by area restrictions if fish migrate over their life cycle or if the stock breaks into patches of relatively old or young fish in various parts of the ocean at different times of the year. However, because of the relatively high cost of enforcing at sea, it is possible that a simple possession prohibition on small mesh nets or of small fish, which can be enforced at dockside, may be the regulation that produce the highest net gains.

Possession restrictions on small mesh nets are not only enforceable dockside; they may be the only practical way to assure compliance. If more than one mesh size were allowed on board, at-sea monitoring would be required to ensure that the smaller mesh nets are not used. And even with at-sea monitoring, it may not be possible to achieve compliance if successful prosecution requires the boarding officer to find the illegal net in the water (See detailed discussions below.)

Prohibitions on the possession of small fish do have serious drawbacks, however. Although such restrictions would be easy to enforce on land and would encourage individuals to operate in areas or times when small fish are less frequently caught and to shift locations if small fish are taken on the first set, they would require the dumping of all small fish whether they are dead or alive when returned to the sea. In some instances, the loss of this product may be less than the savings in enforcement costs as compared to other types of regulation. However, complaints focusing exclusively on the discard of small edible fish can make a fisheries agency look very bad.

Similarly, mesh size restrictions with prohibition on possession of small mesh nets can cause distributional problems. Some boats may switch from fishery to fishery in the course of a trip according to fish availability, relative prices, etc. Therefore, they will desire to carry more than one set of nets (each legal for at least one fishery) in order to operate as profitably as possible. Although a regulation that allows only one set of nets on board may significantly reduce overall enforcement costs and indeed may be the only way that is really enforceable, such a plant may significantly reduce net revenues for all or part of the fleet. In essence, although the regulation costs to the government could fall, there may be increases in regulation costs to the industry. An angry constituent complaining to his or her legislator that a "silly bureaucratic law" requires the boat to return to shore and unload catch before changing nets is likely to find a sympathetic ear.

There are some distribution problems here. Dockside monitoring may increase total net benefits by lowering government costs while at the same time lowering net revenue to the fleet. There are ways to give industry incentives to support dockside enforcement if it is appropriate, however. For example, as part of its controlled access program in which fishermen are given quasi-property rights in the fisheries, Australia has instituted a user-pays system in which the owners must pay a levy to cover some of the operational costs of enforcement. This levy is currently around 38% of the assessed enforcement costs, and there are plans to increase it to 50%. Under this system, industry pressure for supplementary regulations which must be enforced at sea have significantly declined (Lilburn 1986, 155).

Another point in favor of dockside monitoring is that considerable leeway is granted to it under current law. If used effectively with appropriate regulations, this flexibility could make dockside monitoring a very powerful monitoring mode. For example, sect. 1857(1)(G) of the Magnuson Fishery Conservation and Management Act (MFCMA) makes it illegal to "ship, transport, offer for sale, sell, purchase, import, export, or have custody, control, or possession of, any fish taken or retained in violation of this Act" or its implementing regulations, permits, or Governing International Fishing Agreements. The same section imposes strict liability on fish processors or merchants in that violations do not require elements of willfulness, intent, or even knowledge (Jacobson, Connor, and Tozer 1987, 112). Sting operations on distributors could seriously damage the market for illegal fish and hence the incentive for harvesters to ignore fishing restrictions.

Ease of Government Implementation

The ease with which a regulation can be implemented has a direct bearing on enforcement and monitoring costs and hence on net benefit of management. There are two separate points here. The first is the legality of various types of regulations. Obviously, if certain types are forbidden by legislation or precluded by constitutional guarantees, they will not be enforceable. However, constitutionality is often not determined until after legal challenge. For example, state fisheries laws which prohibited or unduly restricted residents of other states from fishing were declared unconstitutional on the basis of equal protection under the law.

The issue is more complicated, however. In addition to the legality of the regulation, there must also be suitable procedures to enforce it. As an extreme example, although there is a per vessel quota in the Nova Scotia herring fishery, there is no regulation stating that the fishermen must weigh the fish they sell. Therefore, they cannot be charged with misreporting their catch because they can declare ignorance of the exact amount landed (Peacock and MacFarlane 1986, 226).

Furthermore, authority over fisheries is often vested in many jurisdictions, including the various states and the management councils. What is permitted in one state may be illegal in another. At worst, this can cause interjurisdictional conflicts, and at best, it can cause time-wasting delays in cooperative management as individual states pass conforming legislation. This has been a serious problem in enforcing the Common Fisheries Policy of the EEC; the overall agreement included some stipulations that were forbidden under the laws of some of the member countries. Those countries could not enforce the rules until the domestic laws were changed, and when the others saw this, they were hesitant about enforcing them if it would disadvantage their citizens (EEC 1986).

Besides legality, ease of implementation also depends upon how enforcement will merge with the existing institutional structure. As discussed above, the more a new program differs from existing rules, the more difficult and more costly it will be to implement it. In this regard, traditional regulations such as total quotas, gear restrictions, and closed area or seasons (programs which cause inefficiency in the production of effort) will be easier and less costly to implement, at least on the margin. On the other hand, an individual transferable quota program (the management device that seems best able to encourage efficiency) will be quite expensive to set up. There will be the cost of determining the initial distribution of the quotas. Because of legal constraints, it will be necessary to set up an appeal procedure for those participants who feel they were treated unfairly. Experience has shown that because of the high potential rewards, a large pro-

portion of those who are potentially eligible will appeal, either to get a quota or to increase their share (Lowman 1986). There is also the cost of instituting a control mechanism to keep track of ownership and transfers of quota shares and of matching an individual's catch with his or her purchased or rented quota for a given period. The high implementation costs, however, can be moderated by low continuing enforcement costs. New Zealand, for example, expects that the present value of the reduction of all at-sea monitoring and much of the dockside efforts that were required with more traditional management will more than compensate for the high initial implementation costs of their individual transferable quota (ITQ) system (Carouthers 1987).

Period at Risk When in Noncompliance

The issue here is the length of time the regulatee is at risk of being identified as being not in compliance. Obviously, the longer the period, the more effective the regulation will be. In fisheries, area closures are at one extreme. The fisherman is at risk only during the period in which he or she is in the closed area. In most cases, once a fish is landed, it is impossible to determine where it was caught. The other extreme would be an individual transferable quota program, in which a specified annual catch limit is given to specific individuals or firms. In the first instance, the boat could make a dash into a closed area when fishing is expected to be extremely productive and would be safe again when it returned to an open area. On the other hand, if total catch records can be cross-checked with dock agent reports or, better yet, with company income tax forms, deviance from the annual individual limit could be detected as long as the records remain unaltered and available.

Other regulations fall in between. Gear restrictions such as mesh size limits have a very short period of risk, because the vessel must be caught with the net in the water. Prohibitions on possession of certain types of fish have medium periods of risk, because infractions can be detected from the time of harvest to at least the time of discharge and sometimes longer if adequate paper trails on the transfer of sale through the markets are available. For example, the harvesters of so-called short lobsters are often identified by tracing back from where illegals are found on the market. Possession prohibitions on gear can have a period of risk of the length of the trip for short-term capital, such as type of net, to years for long-term capital, such as engine horsepower or vessel displacement.

Ease and Cost of Compliance

Compliance costs include the costs of installing and using legal gear, less of revenue due to prohibited activities, and increases in business administrative costs. There are at least two separate points to be considered in industry compliance. First, if compliance requires a significant change in operating behavior, the costs in terms of obtaining the requisite capital equipment or acquiring the human capital can be very high. Obviously, the higher the compliance cost, the lower will be the net benefits of the regulated fishery, even when there is complete acceptance of the program. At the same time, however, higher costs will also encourage deliberate noncompliance or avoidance activities to conceal noncompliance. Although avoidance activities will decrease industry compliance costs, they will result in an even lower net present value of benefits from the regulated fishery because of the excess pressure on the stocks.

A separate point is the speed with which the required changes can reasonably be accomplished and hence the speed with which industry behavior is actually changed. If

one can make a reasonable argument that it takes a long time to obtain the physical or human capital to comply easily on a day-to-day basis, detections of unlawful behavior may prove of little use. The firm can persuade the court or the administrative law judge that all reasonable steps have been taken to come into compliance, but full adherence to the regulation will simply take time.

At the surface it may appear simple to address compliance cost problems: All else being equal, choose that procedure which has the lowest cost of industry compliance. However, all else is not always equal. Not only are there other efficacy and efficiency effects associated with each regulation, but the same regulation will often affect heterogeneous industry participants differently. Therefore, it can be quite difficult to select the one with the lowest overall compliance costs. The measurement of compliance costs and the selection process will be made more difficult because each segment of the industry will propose regulations that put the brunt of costs on their competitors.

Most fisheries regulations have compliance costs, but it is difficult to make any general rankings. Gear restrictions obviously have costs, but their size depends upon the exact type of restriction, and the divergence between it and the normal operating mode. Closed seasons and closed areas can have compliance costs if fishing in other areas or seasons is permitted and economically rational (the firm has the choice to cease fishing), and it is more expensive to operate under the restrictions. Likewise, possession limits can have higher costs due to sorting and to search costs to locate appropriate sized fish.

The compliance costs of ITQs will be mostly transaction costs. It will be necessary to work with the agencies responsible for issuing, maintaining, and transferring the quotas, and there may be added costs of landing the fish so that the catch can be checked against a quota. There will also be the transaction costs of buying, selling, renting, or leasing of ITQs so that the full economic efficiencies of the program can be achieved. Although these costs may be quite high initially, it is likely they will decrease as formal and informal networks are developed.

The purchase of ITQs from the government or other participants is a transfer payment and not a compliance cost in a social sense. However, from the private perspective of an individual operator, they will be considered as such, and the market price of ITQs will be a factor in the decision to comply with the program. This statement should be interpreted with care, however. A high-value fishery will have high ITQ prices, but there will be incentives to cheat when the returns are high no matter what type of regulation is used.

Ease of Distinction between Honest Mistakes, Sloppy Practices, and Deliberate Cheating

To use an example, the problem here is to differentiate between fishermen who do not comply with, say, size restrictions, because (1) they had difficulty ascertaining average individual size given the total amount of fish landed, the available measuring equipment, and the ease of working it on an open deck in rough seas; (2) the catch was undersized because of inadequate training or supervision of workers or because they simply failed to do their jobs on a given day; or (3) the boat deliberately fished for small individuals or at least failed to discard that part of the catch that was known to be illegal. When it is difficult to distinguish between actions, it is difficult to know what to do on a case-by-case basis. Accordingly, firms will attempt to have their actions judged as honest mistakes or, at worst, one-time, unintentional errors.

Prosecuting the first and third types of activities with equal fervor has certain moral

ramifications. The issue of equal treatment of the second and third types is similar but not so clear-cut. The problems can be reduced by having the severity of the penalty depend upon the number of previous or smaller violations. This must be done with care, however, because if the initial penalty is too low, the first violation may be viewed as a freebie, and everyone will be encouraged to take it.

Long-term economic efficiency may require enforcement agencies, initially at least, to work with firms which have the first two types of problems to help the come into compliance. On the other hand, immediate and sure punitive actions which cause expected penalties that are greater than gains from cheating are necessary to eliminate the third type of behavior.

It is difficult to rank regulation types as to how they handle this issue, but some tentative conclusions are possible. After the initial communication of the required procedures has occurred, it is fairly easy to distinguish deliberate cheaters on quotas (both ITQs and total quotas) and closed seasons. These appear to be fairly black and white issues. Once the total quota is capture, or if you do not have an ITQ, you should not be fishing. Similarly, fishing during the closed season cannot be called a mistake. Area closures are fairly straightforward, especially if an individual is caught in the middle of a 100-square-mile closed area with all his or her navigational equipment working. The issue is not so clear-cut when the areas are small or the individual is caught only slightly over the border. The seriousness of the last problem can sometimes be reduced by instituting buffer zones around the actual area meant to be closed. Gear restrictions can be troublesome unless they are simple prohibitions or otherwise unambiguous. Possession restrictions by species or size are straightforward, at least as long as the fish remain in round form. However, when there is a mixed catch, it can sometimes be difficult for the fisherman to sort out the catch and land only permitted individuals.

Initial versus Continued Compliance

This is a particularly important issue in pollution control because regulation almost always involves a change in operating procedures, requiring new or modified capital equipment. Therefore, a program cannot be successful unless firms come into initial compliance by obtaining the appropriate equipment. Although it is relatively easy to detect initial compliance, having the equipment is not always enough to guarantee a reduction in effluent. In most instances, proper maintenance and operation of the pollution control equipment is also required. Nonetheless, the relatively low cost of initial compliance monitoring and the increased probability of continued compliance it produces normally makes it highly productive.

This is an important issue for gear restriction fisheries regulations as well because initial compliance often corresponds to the procurement of a piece of capital equipment. However, with regulations such as fishery-wide total quotas and area closures, the distinction between initial and continued compliance is not so clear. Therefore, with most fisheries regulations, there is no analogous one-time check on initial compliance. Except for permanent gear restrictions and perhaps some safety devices, fisheries enforcement will have to be continuous to be effective.

In those cases in which the distinction does apply, say, a limit on length, horsepower, or displacement, monitoring costs will be quite low. However, effectiveness of these types of limits may leave something to be desired. Due to other margins that operators can use to increase effort, these limits place an elastic control on effort and cause effort to be produced inefficiently.

Ease of Communicating Requirements

Obviously, individuals cannot conform to regulations, even if they desire to cooperate, if they cannot understand exactly what is expected of them. There are at least two parts to this problem. First there is the simplicity or complexity of the regulation. A simple prohibition of a particular type of gear is quite easy to understand. But with prohibitions on harvesting certain species in certain areas with certain gear types which change over the course of the year (as was the case in the first cod, haddock, and yellowtail flounder plan prepared by the New England Fishery Management Council in 1977), it is very difficult to know what is permissible at any point in time.

Second, there is the language or framework that is used in posing the requirements. It is important to use generally recognized measurement and analytic methods. For example, if there is to be a trip limit, it should be defined in the way the particular fishery measures its output. For example, surf clams are measured in cages, groundfish in pounds, and salmon by the number of fish.

The way monitoring is performed can reduce these problems if the agents view part of their role as showing industry participants exactly what the rules mean in terms of their everyday behavior and how they can change their operations to come into compliance. Overall management costs can be reduced if the agents can produce the ability as well as the motivation to conform (Wasserman, n.d.).

Ease of Disguising Noncompliance

This issue is self-explanatory, but there are some subtle distinctions that should be illuminated. By use of detection-avoidance activities, fishermen are able to appear to be in compliance. These activities can be anything from underreporting to subterfuges such as fishing or landing fish at night or the use of remote ports or fishing grounds. If the avoidance activities are costless (i.e., 150 pounds of fish are put in a standard box when the rule of thumb used by enforcement officers to measure total catch is 125 pounds per box), then the problem is only one-dimensional. Noncompliance will cause total catch to be higher than the desired amount. However, if avoidance activities use real inputs (i.e., carrying two sets of nets or landing fish in secondary ports), then the problem is two-dimensional. Management objectives will not be achieved, and in addition, extra economic resources will be drawn into the fishery, lowering the net economic gains.

If avoidance costs are low, noncompliance will normally be quite high because the gains from cheating will be higher than the costs. Cheating will be encouraged if the individual can see little private gain from compliance and if others are not complying either. However, when avoidance costs are relatively high, the amount of noncompliance will decrease.

Accordingly, when studying the possibility of deliberate avoidance that is likely to accompany any particular regulation, both the types and the costs of possible avoidance activities and the potential gains from noncompliance must be considered. In high-value fisheries, incentives for avoidance will be there, and unless the regulatory program can be designed accordingly, one or both dimensions of this problem may result.

Ease of Detecting Noncompliance That Is Admissible as Evidence

The key to this issue is the last few words. Detecting noncompliance in such a way that the agent is very sure it exists is one thing, but obtaining evidence that will stand up in

court is quite difficult. As Perry Mason would say: "Does the preponderance of evidence show that the individual is in noncompliance?"

There are at least three points here. One has to do with the nature of the regulation. For example, it is not as easy to obtain admissible evidence on prohibitions of the use of small mesh nets as it is on prohibitions on the possession of a small mesh net. From the time a Coast Guard boat is spotted on the horizon until it can board a fishing vessel, there is often plenty of time to switch from a small-mesh net to a large-mesh net. Unless the boarding team can find the small-mesh net in the water, evidence of use is problematic. Even if the small-mesh net is found to be wet and to contain fish, it may be possible to argue that sea spray or rain got it wet and that fish from the large-mesh net fell into it. On the other hand, if small-mesh nets are prohibited, it is fairly easy to establish that a small-mesh net is on board.

A second point is the ease with which agents can be trained to obtain appropriate evidence. The technical issues discussed in the previous paragraph may require some legal training as to what types of evidence are formally admissible, but that is not the real point. When the regulations are in terms of the permitted average number of individuals per pound of product landed for a several-thousand-pound catch, as it is with the scallop fishery, there can be some very difficult technical and statistical measurement problems (see Russell, Harrington, and Vaughn 1986). If it is very difficult to train individuals to draw their samples correctly and to use the equipment and also to retain their services once they are competent, then enforcement costs will be high and enforcement efficacy will vary over time.

Finally, it is easier to obtain convincing evidence if scarce monitoring resources can be focused on those individuals who are more inclined to noncompliance. Therefore, those regulations which have an easy trigger to identify cheaters, even if that particular information will not stand up in court, can be relatively more effective, because monitoring resources can be used more carefully.

Demonstrating Personal or Social Benefits from Compliance

The private decision to comply with a regulation is very complicated. Certainly the relative private benefits and costs of compliance play a part. But in addition, the individual's view of himself as part of a society and the responsibility that such membership entails is also important. Therefore, the more that fishermen can see individual benefits from the program in general and from their cooperation in particular, the more likely it is that they will comply. Along the same line, programs which are perceived as providing benefits to the fishery as a unit, or perhaps even for the society as a whole, will be easier to enforce on those individuals who consider these things to be important.

Regulation is required in the first place because private actions lead to nonoptimal social results. It therefore follows that private compliance with a properly formulated control program will also involve net costs. Nonetheless, the higher the perceived benefits, the higher will be the compliance rate. Or to look at it the other way around, some individuals will suffer no guilt pains for noncompliance with a program that has no perceived benefits to anyone.

In some ways this argument is compounding. For example, regulations which are thought to be unenforceable will likely be viewed as producing no benefits; therefore the motivation to comply will be low.

Potential for Citizen Cooperation in Identifying Offenders

The degree to which participants or others are willing and able to provide information on the noncompliance of others (with or without a reward) will obviously lower monitoring costs which should increase overall net benefits. Programs to encourage such behavior are used in freshwater recreational fisheries. In some states there are signs near streams listing open and closed seasons and encouraging people to call a hotline number if they see illegal fishing. Similar programs might work in some commercial fisheries.

The motivation to help monitor is obviously important. This is partly related to the personal benefits participants or the general public expect to obtain from successful program operation. In commercial fishing, such gains are possible if two or more user groups are competing for a stock and informing on rival groups will improve the relative position of one's own group.

The ability to identify offenders is also important, and the ease with which this can be done is related to the nature of the regulation. Casual observers will be able to discern noncompliance with area and seasonal closures much easier than with gear restriction or catch limits.

Encouraging Rent-Seeking Behavior

The more that individual participants feel that pressure applied on the management agency will yield favorable results, the more they will engage in such rent-seeking behavior. Although rent seeking can sometimes provide at least temporary gains for private individuals, it produces net losses at a social level. There is an extensive literature on rent seeking with respect to government operations in general, but the logic applies to fisheries management as well (see Bhagwati 1982; Buchanan, Tollison, and Tullock 1980). Management institutions that directly or indirectly encourage industry input will motivate resource waste because all industry participants will be inclined to participate in such activities in order to remain competitive.

There is a delicate balance here, however. Industry can often provide information that is extremely useful to the management process. But at the same time, it is not hard to find examples where industry participation must be viewed as lobbying rather than as a public service. Those management institutions that are most sheltered from industry pressure will not encourage wasteful behavior, but at the same time, they may miss the opportunity to obtain important management information at low costs.

Although the type of management institution is important in determining the amount of rent-seeking activity, the type of regulation can also be a factor. For example, gear restrictions and closed areas seem to invite specific lobbying because they normally hurt various sectors of the fleet differently. Individual interests will be highly motivated to get an exclusion for their gear type or what amounts to the same thing, a more restrictive control on the gear type of their competitors. Petitions to change the boundary lines for closed areas by a few degrees of latitude or longitude for much the same purposes are also common occurrences. Not only do these actions slow up the implementation of management, the loopholes provided can strongly affect the potential for gains. Also, the higher the number of variances to a specific ordinance, the harder it is to communicate the rules to industry and the more difficult it is to monitor.

Detection of Illegal Activities under Various Conditions

Compliance with most regulations will likely vary across time, space, type of vessel or gear, species sought, etc. because the gains and losses of obeying the rules can critically depend on such operational parameters. For example, the susceptibility of fish to certain gear types may vary throughout the year, and so cheating may be more profitable in January than it is in July. Likewise, the stock may be exploited by two different types of gear of different groups, each of which has its own enforcement problems.

It is important, therefore, that the ability to enforce be flexible enough to be able to handle the various situations that are likely to prevail. More important, of course, is the ability to be able to work at those particular times when the motivation for noncompliance is relatively strong and when noncompliance can have the most deleterious effects on the objectives of management. For example, Zavolta, Strand, and Swartz (1987) found that 5% of fishermen accounted for the great majority of the commercial striped bass harvest in Chesapeake Bay. To be effective, a regulation program will have to be enforceable on individuals even if the other 95% are not affected.

Efficacy of Enforcement with Respect to Management Objectives

While economic efficiency is obviously an important management objective by which to compare different types of regulations, it is seldom, if ever, of most concern to real-world decisionmakers, who more often focus on employment and distribution of income. In some instances, although it may be difficult to enforce a certain type of regulation so that one type of goal is achieved, obtaining sufficient compliance for another goal may be relatively easy. Therefore, rating regulation types is not possible unless the full range of management objectives is considered.

Identification of Benefit-Based Priorities for Enforcement

Although a management program may prohibit several activities, the net benefits of perfect enforcement of each part may not be the same. For example, with fast-growing cohorts, gear restrictions will provide more protection to small fish earlier in the season. Therefore, the gains in terms of increased value of fisheries output from enforcement of gear restrictions will vary throughout the season. Because enforcement resources are always scarce, information on when and where to enforce can be quite valuable. Therefore, it is important to be able to identify not only the change in behavior that is likely to result from varying degrees of enforcement but also the net gains the changes in behavior will produce. The need for government to be able to identify these differences is obvious, but it is also important for industry to see them so that the rationale behind what may otherwise appear as a random enforcement can be understood. Without this understanding, a lack of respect for the management program could develop which could seriously reduce the net benefits of management.

Summary

Although this has been a detailed discussion, it can be summarized quite succinctly. When comparing fisheries regulation programs, it is necessary to go beyond the efficiency effects on the production of effort. The absolute and relative effects on industry compliance and avoidance costs as well as government implementation and enforcement

costs can also be very important in determining which program produces the largest net benefits.

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