

ASSOCIATION OF ENVIRONMENTAL AND RESOURCE ECONOMISTS (AERE)

WORKSHOP

ENVIRONMENTAL MONITORING AND ENFORCEMENT:

THEORY AND PRACTICE

University of Delaware
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SESSION I

Agency and Judicial Perspectives on Environmental Enforcement Policies

Cheryl Wasserman, U.S. Environmental Protection Agency

"Environmental Compliance and Enforcement: Theory, Practice, and the Challenge to Environmental Economists"

Nancy Firestone, U.S. Department of Justice

"An Overview of Natural Resource Enforcement Issues at the Department of Justice" (No paper accompanying presentation)

Lee G. Anderson, University of Delaware

"Enforcement Issues in Selecting Policy Instruments"

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THEORY, PRACTICE, AND THE CHALLENGE TO ENVIRONMENTAL ECONOMISTS"

Delivered to

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Environmental Monitoring and Enforcement:
Theory and Practice

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ENVIRONMENTAL COMPLIANCE AND ENFORCEMENT:
THEORY, PRACTICE, AND THE CHALLENGE TO ENVIRONMENTAL ECONOMISTS

I. INTRODUCTION

Compliance is essential to the success of any environmental program. However, there is little empirical data on how best to gain broad-scale compliance with environmental laws. There is comparatively little in the traditional economics literature on the subject of compliance, and still less on environmental compliance and enforcement: what works, does not work, in what circumstances, and why. This paper reviews the theories that federal, state and local regulators and law enforcement personnel draw upon in implementing enforcement programs, how the realities of implementation differ from theory, and the need for further research by environmental economists and those in related social science disciplines.

II. WHY COMPLIANCE AND ENFORCEMENT MATTER

In the early 1970s much of the attention of government officials at the federal, state, and local levels was devoted to standard setting, and to permit issuance. While enforcement was undertaken as a basic element of each environmental program, it first began to assume its place as the subject of significant policy interest and priority in the latter part of the 1970s and 1980s. This in large part reflects a natural evolution in the programs, shifting to field implementation once requirements were put in place and in part, reflects the introduction of statutory penalty authorities in the latter part of the 1970s. There are several reasons why concerns about the extent of compliance and the effectiveness of enforcement efforts are important:

1. Effectiveness: Compliance is critical to realizing the benefits envisioned by environmental policy, statutes, regulations, standards, and permits. The vast regulatory apparatus we have put in place to protect public health and the environment amounts to empty words and deeds without compliance. It is the regulatory bottom line. All of the cost-benefit or cost-effectiveness studies that may go into assessing the best regulatory route become meaningless if the costs and benefits do not play out as predicted, usually with assumptions of full compliance.

2. Efficiency: Environmental economics, among other things, seeks to identify the most efficient solution to achieving desired public health and welfare benefits. If regulations and permit conditions are designed to be economically efficient, inconsistent enforcement will lead to economically inefficient results.^{1/}

3. Equity: A consistent enforcement response provides an element of fairness to the regulatory process that would be missing if those who failed to comply benefit relative to those who do, or if regulatees are treated very differently depending upon their location and circumstance.

4. Credibility: The rule of law and the credibility of our governmental institutions require that laws that are put in force are taken seriously. The expectation that violations will generate a predictable and proportionate enforcement response is essential to the credibility of our regulations. Support for escalating enforce-

ment response to known violations, and following through from the less costly to the more resource intensive enforcement responses until compliance is achieved is the ultimate test of the public will to see a program through to its full implementation.

III. BASIC THEORIES ON COMPLIANCE AND ENFORCEMENT

There are several concepts and/or operative theories underlying environmental enforcement: some are explicit in guidance and policy, while others can be surmised from practice through observation. All are interrelated. This discussion first distinguishes between compliance and enforcement. Second, it presents the theory of deterrence fundamental to enforcement strategies and the focus of the contributions of economic theory to date. Third, it discusses other theories or assumptions about what motivates compliance behavior, and the implications for more efficient and effective compliance and enforcement programs.

Compliance is defined as the ultimate goal of any enforcement program. Compliance is essentially a state of being. When a regulated source is in compliance, it is achieving required environmental standards or regulations. Enforcement is defined as a set of legal tools, both informal and formal, designed to achieve compliance. The term enforcement response usually applies to those agency actions specifically intended to convey legal sanction and/or penalty. Traditional enforcement programs only encompass compliance monitoring and informal and formal enforcement response. Recently, the broader range of both coercive and noncoercive techniques used to effectively change or deter

source behavior are being tied together into comprehensive compliance strategies for each of the major environmental programs and their components.

Deterrence is perhaps the most important underlying theory of enforcement: however, it is used somewhat differently in the literature than in practice. The concept of deterrence is that a strong enforcement program deters the regulated community from violating in the first instance. Specific deterrence is deterring an individual violator from violating again. General deterrence is deterring the broader regulated community from violating. The prevailing theory on creating deterrence states that three elements are necessary: 1) a credible likelihood of detection of the violation: 2) swift and sure enforcement response; and 3) appropriately severe sanction.^{2/} Some would add the condition that each of these factors be perceived as real, whether supported or not.

Deterrence is viewed in practice as creating a multiplier effect for each enforcement action, the magnitude of which depends on the strength of each of these factors. The multiplier effect is important. No enforcement program can provide sufficient presence all of the time for all violations. It is therefore generally held that an enforcement program must rely upon and to some extent develop a complying majority and devote its resources to addressing the remainder that do not comply. In contrast, pure deterrence theory as described in the literature would have us believe that there is no "voluntary compliance", that it is only

the direct threat of some legal action and sanction that motivates a source to comply.

Economic theory as it has been applied to enforcement is compatible with and indeed could be said to quantify the principles of deterrence theory. Both describe the would be-violator as an amoral, rational calculator. Economic theory argues that each source calculates whether it is to its economic self interest to comply or to violate requirements. This economic calculus compares the cost of coming into compliance with the likelihood of getting caught times the penalty of violating. Economic self-interest could also take into account future liability, the economic value of a negative impact on the **firm's** reputation if caught, etc., but at bottom it comes down to dollars and cents.

Neither pure deterrence theory nor its economic compliment addresses the broader array of motivations that may explain compliance behavior, such as societal norms, moral values, sense of professional conduct, etc. Because compliance behavior is just that, behavior, it cannot readily be predicted and is more likely the result of complex motivations, only some of which are rational, reasonable,. and economically motivated. That is not to say that economic theory and analysis is without merit or potential value here. It is to say that environmental economics as applied to enforcement is not a simple matter.

The behavioral school of compliance theory argues that, at least for corporate compliance, individuals within a firm are motivated less by conscious decisions based on profit/loss less than motives of personal advancement, by fear of corporate sanction, or by social influence through an individual relationship with the regulator/inspector, peers, and/or social and moral norms. 4/ The literature takes two approaches to this more behavior-driven compliance. One group presents the business firm or regulatee as a political citizen, postulating that enforcement is not costeffective because of its high transaction costs, and that it is really not necessary in most instances given the inherent willingness of sources to comply with the law. This school argues for a more cooperative approach to gaining compliance, and to the promulgation of rules that are perceived as reasonable, since those motivated by citizenship will not obey rules perceived as arbitrary or irrational.

Another group in the literature focuses less on cooperation than on sanctions, arguing that because fines and penalties are unlikely to be sufficiently high to overcome the low likelihood of detection and are not coming directly out of the individual's pocket, that criminal sanctions, with the threat of personal incarceration, or other sanctions adversely affecting individuals within an organization, are far more powerful tools to gain compliance. 5/

The literature presents a third potential image of the violator, that of the incompetent, with violations stemming from a

failed organization or procedure. Under deterrence theory, the threat of sanction is thought to be the best motivation to establish proper systems and internal controls to motivate against the safety of blissful ignorance. Those who advocate for cooperation, argue that a strong enforcement response is inappropriate here as it is the lack of capacity, and not the will to comply that must be overcome. As to what truly motivates preventive behavior, there will soon be an emerging body of literature on corporate culture and how it might affect compliance behavior. Some case studies are under development by Tufts University. EPA is funding this project as well as a series of expert groups from academia, industry, and government regulators on what motivates compliance. The bulk of this work is being done through the University of Buffalo School of Law. 6/

Some of the recent work in the field of enforcement is derived from game theory and operations research. This work attempts to establish a research framework for predicting behavior, given the complex relationship between the regulator and regulatee, borrowing from economic literature but adding situational variables that respond more accurately to a variety of possible motivations to comply. 7/

One factor to keep in mind is that, in enforcement, perception is as important or even more important than reality. The perception of a strong enforcement effort, of the willingness to pursue sanctions and to escalate enforcement action can be created by the manner in which government enforcement .

actions are taken, as well as by the actual number of actions themselves. While one cannot create perceived action from nonaction, in the annals of military history, there have been many successful battles won where few in number have created an image of a formidable fighting force, thereby demoralizing and successfully competing against superior forces. The point is that there is an element to a successful enforcement effort that cannot be correlated to quantification of action and result: there is a multiplier effect that must capture these other factors or theory is likely to paint an unrealistically gloomy portrait of what it would take to do the job.

Finally, enforcement strategies must reflect a mix of these theories. At any stage in the process*, the mix of compliance promotion and enforcement response could vary, based upon the nature of the requirements, the level of public support and technical know-how. Moreover, for students of human nature, it would seem, that there is always a need for some enforcement. Chester Bowles, in 1971 of the wartime Office of Price Administration suggested that there will always be 5% of individuals who will violate no matter what, 20% who will comply no matter what, and 75% who will comply only if the violators are punished and/or the requirements are perceived as nonarbitrary. This means that there will always be a question of timing and mix of enforcement response versus technical assistance, whether you **"stroke°em"** or **"poke°em"** first or second or at the same time, in some changing proportion.

*It may be useful to postulate five stages for compliance and enforcement programs: Stage I, the compliance promotion phase, is primarily cooperative. Regulated entities need clear communications on what is required and how they might go about complying with requirements. This stage occurs during the time lag before sources must comply with new requirements. Stage II might be called the enforcement initiative phase, at which time it might be most important for enforcement to be visible and forceful in initiating the program's requirements, and in creating the public's perception of their importance. At this stage, visible enforcement need not be extensive and might best be accompanied by continued technical assistance. Stage III, the initial compliance stage, during which the installation of control or monitoring equipment and the adoption of certain procedures, reports or practices is required, focuses on whether or not these items are in place. This stage may require more extensive enforcement to systematically ensure compliance. Stage IV, Continuing Compliance, emphasizes operations and maintenance or management practices and it may suffice to use selective enforcement combined with information dissemination. Finally, Stage V, could represent steady state compliance, or a return to stage III for retrofitting aging equipment.

IV. COMPLIANCE MONITORING AND ENFORCEMENT PROGRAMS: THEORY, REALITY, AND OPEN QUESTIONS

The strategies currently in use at the U.S. Environmental Protection Agency and its counterparts at the State and local levels generally address the following elements:

- establishing program priorities and identifying the regulated community;
- promoting compliance within the regulated community;
- monitoring compliance within the regulated community;
- responding to violations including timeliness and appropriateness of the enforcement response;
- imposing civil penalties and other sanctions for non-compliance;
- clarifying roles and responsibilities of federal and state or local agencies; and
- evaluating results.

These elements of a compliance strategy are reviewed below in terms of the current operative theory used by government officials, what we know of practice and how it differs from theory, and finally, what questions should be addressed in further research to lead to the design of more cost-effective compliance and enforcement programs.

1. Establishing program priorities and identifying the regulated community

Environmental requirements now cover virtually every activity involving production, transportation and consumption in our society. Keeping up with the most recent developments in environmental policy is more than a full-time task. The number of Federal Register pages devoted to environmental requirements .

have grown geometrically, and plant-specific permit requirements are now reflecting the complete environmental impact cycle from storage of raw materials of production to disposal of process waste products. As difficult as it is for the regulated community to keep up with these requirements, it is even more difficult for environmental officials to ensure compliance is achieved and to take the necessary enforcement actions. Therefore, priorities must be set to focus enforcement activities.

In theory, enforcement priorities should simply take into account the health and environmental risk posed by failure to comply, much as we do when devising standards and regulations. However, enforcement poses more complex challenges for priority setting. Some requirements, if violated, may pose a very high environmental risk but low probability of violation, such as a requirement where there is liability for damages through other institutions. This might arguably make it a low enforcement priority. Also a violation may be one which has a very low risk of occurring given the reliability of the control system, or may be one for which only a small percentage of the regulated community is out of compliance.

Some requirements for which the violation does not pose any potential threat or harm to public health or to the environment, such as sane monitoring, reporting, and record keeping requirements may be essential to the integrity of the regulatory scheme. In the case of self-reported compliance monitoring data, it might be essential to detecting when and where more serious violations

and harm may occur. Similarly, a violation of a legal order or consent decree may not in itself be significant but must be enforced to demonstrate the significance of a legally imposed order. Therefore, enforcement priorities must reflect an effective mix of concerns for the risk of environmental harm, and the need for a credible enforcement presence.

Enforcement priorities are currently defined through several vehicles. At a very broad level, annual Agency Guidance specifies program priorities. EPA has placed a premium on fully integrating enforcement into every aspect of program implementation. For example, if a major thrust of the Toxics Program is pre-manufacture notification of new chemicals, there must be a parallel enforcement component to that priority which ensures that industry does indeed perform the necessary testing and report results of all of the appropriate test data. More specifically, enforcement priorities are further established in program measures of success which accompany the annual guidance, defining what constitutes Significant Non-Compliance (SNC) in each program. 8/ A measure of program success is then how effectively the Significant Non-Compliers are returned to compliance. In addition, there are other program areas for which an enforcement presence is needed but not necessarily through coverage of all violations. In such aspects of the program, enforcement initiatives may be designed to send a clear message to the regulated community. Enforcement initiatives are targeted and concentrated enforcement actions are timed to have a maximum deterrent impact through press coverage, and packaged to gain economies of scale in preparing cases for litigation.

In practice, the environmental programs have not been entirely successful in effectively establishing priorities based upon risk or on the need for deterrence. In the hazardous waste program for example, an effort was made to establish enforcement priorities at land disposal facilities for groundwater related violations. However, in reality, all groundwater violations do not pose the same level of risk and some very minor violations end up being included on the Significant Non-Complier (SNC) list. The Air program has placed a high priority on violations of pollutant standards in areas exceeding national ambient air quality standards for that pollutant. However, the air program also has included as SNC, violations of any national new source performance standard. Therefore, the failure to conduct a performance stack test upon starting up a new source in an attainment area, has had the same priority as a violation of volatile organic compound (VOC) requirements in an ozone nonattainment area even if federal or state officials have reason to believe the source is in compliance. While refinements are being made, a priority setting scheme is never fully satisfactory at the national level. Federal officials are currently working with EPA Regions and the States to more successfully adjust national priorities to local circumstances.

In a more detailed setting, priorities are also established in those programs which must address continuing compliance and operations and maintenance violations, e.g., air and water. Because no pollution control system can operate in one hundred

percent compliance, one hundred percent of the time, these programs establish priorities by setting limits on actionable violation levels. This does not mean that any violations are countenanced but rather, that given the large numbers of violating sources, limits must be set. Because these limits are for management purposes only, they do not apply to citizen suits, and citizen suits have been effectively brought for violations at lesser levels which were not being addressed by regulatory agencies.

Further, systems are being put in place now within the U.S. EPA to assess whether enforcement actions taken are indeed those that have strategic value and the greatest return for the enforcement investment. All indications are that the majority of enforcement actions are focused on the most significant problems. Where they are not, oversight systems will attempt to correct future case selection.

In reviewing enforcement priorities it is important to recognize that an enforcement response happens late in the enforcement process. Faced with violations, most government agencies would prefer to respond in sane manner. Therefore, strategies for detecting violations and for setting correct priorities at the beginning of the enforcement process can best assure that agency resources are focused on the most important problems. This issue is addressed below in Section 3. Monitoring Compliance.

2. Promoting Compliance within the Regulated Community

Compliance promotion is that set of activities which promote rather than coerce compliance, such as offers of assistance, information exchange, and the like. The theory that underlies most compliance monitoring and enforcement programs is that the best way to promote compliance is to enforce the law; a corollary is that ignorance is no excuse under the law. Nevertheless, in operation, compliance programs at the federal and state level offer a range of programs to disseminate information and provide technical assistance to the regulated community. While it is broadly held that the threat of enforcement is the best motivation for regulatees to avail themselves of these sources of information and assistance, state and federal officials do undertake these compliance promotion activities with a view toward building a complying majority, and tapping the broadest range of motivations to comply.

In practice, compliance promotion activities have been the least well funded and the most expendable activity in compliance and enforcement programs, although some would argue that each time an inspector visits a facility it is and should be used as an opportunity to inform, offer assistance, and convey credibility to the regulatory scheme. In recent years, however, with regulatory activities reaching ever smaller and more numerous sources, providing information to the regulated community (i.e. on the requirements for compliance, on why the requirements are important, on what is required to comply and the consequences of noncompliance) is viewed as more essential by federal and

state regulators. A notable exception reflecting a trend in the opposite direction is the fact that until quite recently compliance promotion activities were the primary response to municipalities for safe drinking water and municipal treatment plant operating violations. The low levels of enforcement against these sources has not been effective and EPA has shifted its emphasis to introduce more vigorous enforcement action. In the case of safe drinking water, Congress has also had a hand in this transition by requiring, in the recent Amendments, enforcement for all violations, a goal which both EPA and States will have difficulty fulfilling.

One research issue that emerges is the efficiency of dollars spent promoting compliance versus enforcing requirements, and the proper balance between the two. Other issues concern the form and nature of regulations themselves as to how likely it is to elicit compliance behavior with little or no help from enforcement. In developing a regulation or standard, the clarity of the requirement and therefore its likelihood of being complied with have not been given full weight in assessing its economic efficiency or effectiveness.

Compliance promotion activities are designed to tap the motivations postulated by cooperative theories of enforcement which in turn rely upon the perceived reasonableness of a regulation. One tradeoff that is often made is between the stringency of a requirement and long term reliability of the control approaches upon which the requirement is based. For

example, 80% control may be 99% reliable whereas 95% control may be 80% reliable. Given an understandable reluctance by industry to invest in new and unproven technology, from an enforcement point of view it makes sense to favor the more reliable option and rely upon accepted industry practice. Nevertheless, many of our statutes seek the best available control approaches, seeking to force technology and enhanced reliability in use. This is not to say that the technology forcing strategy is necessarily less efficient or effective in the long run, but rather that high rates of compliance will take a longer time to achieve and that projected costs and benefits should take this need for greater enforcement into account.

Other ways in which the design of the regulatory approach can affect Compliance include the effect on compliance of individualized permit or other requirements versus general rules of applicability. Rules of general applicability can in theory be easier to communicate to the regulated community, can be easier for inspectors to master, and can offer more standardized enforcement responses. Nevertheless, general rules are historically less economically efficient, and may need to be interpreted as to how they apply to individual facilities; where they do not make sense in individual situations it makes enforcement more difficult. Most important, individually tailored requirements make the facilities or sources far more aware of requirements and the permit specifically interprets how they apply. Therefore, although more complicated to monitor,

and more costly administratively, tailored permits - again in theory - can lead to higher levels of voluntary compliance.

Another aspect of regulatory design that will affect compliance monitoring and enforcement is the type of standard. Regulatory requirements generally fall into one of several groups: ambient standards, mass rate or output standards, technology standards, work practice standards, and information requirements. Clear, simple requirements tailored to a source are most amenable to compliance by the source, monitoring by governmental officials and enforcement. Ambient standards, concentrations most related to health and welfare benefits, must be translated to enforceable requirements that pertain to an individual source. This can be accomplished through technology requirements, or performance requirements. Technology requirements are far simpler to enforce and understand from a compliance standpoint: however, they are viewed as economically inefficient since they do not allow more cost-effective substitutions. Performance standards, while more economically efficient, are enforceable only to the extent that the technology exists to reliably monitor performance.

The point behind all of this is that concerns for compliance must begin with the design of a requirement. There are tradeoffs to be made in the simplicity of a regulatory scheme versus the efficiency of that scheme. Our economics analysis techniques that provide answers on efficient and effective regulation, need to take into account the institutional costs of realizing the benefits of the regulation through enforcement and the likelihood of source compliance given the regulatory design.

3. Monitoring Compliance

Compliance monitoring encompasses all those activities undertaken by the regulated community or government officials to collect information on and assess the compliance status of regulated sources of environmental pollution. There are two principles or purposes underlying compliance monitoring strategies used by environmental regulators. The first is that self-awareness and self-monitoring will lead generators of pollution to take essential preventative and corrective action to maintain compliance. The second is that a credible likelihood of detection by government regulators is an essential prerequisite to deterrence. The two principles are linked in practice. Two other purposes served by compliance monitoring are to provide the evidence needed to support enforcement actions for identified violations and to provide reliable statistics on the progress in implementing environmental requirements.

Source self-monitoring and inspections are the most important approaches to monitoring compliance. Ambient monitoring and aerial surveillance are used, but rarely. In theory, compliance monitoring should be a statistically valid indicator of compliance; the methods should be the same as those on which the standard was based; and the methods should be reliable and cost-effective.

In practice, source self-monitoring is not as widespread as regulators would like. First the development of cost-effective

monitoring devices has lagged behind regulatory developments. Source monitoring is used extensively in the water NPDES program for all dischargers and for groundwater protection from hazardous waste disposal and storage tanks, but to a far less extent in the air program, where continuous emission monitors are expensive and until recently, were not reliable. At the federal level, the Paperwork Reduction Act seeks to limit information requests of industry and States. Often it is compliance monitoring requirements and other related reports that are sacrificed at the expense of information needed to develop sound regulatory proposals.

Most significantly, no agency can afford to conduct unlimited inspections. The question is therefore one of priorities and the allocation of the scarce inspector resources. To date, priority schemes for inspections are very unsophisticated. They are more focused on one element of the program, the need for breadth of coverage, than they are on targeting inspections on those sources and violation types most likely to yield the greatest benefit from enforcement action. Environmental inspection programs for air and water usually call for inspections of the major sources, generally defined by size and potential environmental impact, at least once per year, biennially for minor sources. In the hazardous waste program the focus has been on land disposal facilities. States and many EPA Regions complain that, given limited resources, meeting national requirements for minimum inspection frequency has prevented them from visiting individual sources that are more likely to be having problems or which locally pose a greater risk.

Recently, there has been some effort using applied statistical techniques to assess how inspection resources can be used more efficiently and effectively . In response to a GAO report and inquiries from Congress, the air program has been developing some alternative models for directing inspections.^{9/} This application of statistical techniques was based upon some interesting theoretical research at Johns Hopkins University which uses operations research game theory to establish ideal inspection strategies.^{10/} In addition, in a not yet published study, Duke and Northwestern University economists have tried to correlate federal and state inspections with reductions in effluent in 75 pulp and paper plants over several years.^{11/} They did identify a statistically significant reduction in effluent after a 4-6 month lag, with little recidivism, following inspections during the period 1977-1985. In the view of this author, further analysis of this data would be desirable, especially on the effects of different types of inspection, the effect of subsequent enforcement action, and the effects of alternative internal management approaches/corporate culture on source compliance behavior.

A result missing from all of the analysis done to date, is a sense of the value of compliance monitoring information. If government officials are constrained from imposing an undue burden on the regulated community in monitoring their ongoing compliance, the question is what is that information worth and who should pay for it? Economic theory would seem to support a source paying

for compliance monitoring as the operating cost of doing business and cost of running the pollution control devices that were the subject of significant source investment but regulators need better ways to build these costs and benefits into the initial justifications for and contents of proposed requirements.

What is less easy to address from the perspective of environmental economics is the trend in the most recent set of regulations, from primary use of performance standards and technology to work practice requirements and a growing concern for the regulation of the whole process stream. In what circumstances does it make sense for enforcers to inspect interrelated processes and environmental impacts to ensure the most efficient outcome from the regulatory scheme? Given that work practices are often related to general management, are there economic indicators that correlate well with a plant's environmental performance?

Finally, an issue related to behavior theory and compliance monitoring is whether source self-monitoring should be reported on an exceptions basis or whether there should be complete reporting of all data. Some argue for economic efficiency; only information absolutely needed by regulators should be required. They also argue that reams of data are unuseable by agency officials and that they are better off with less data and more information. Others argue, on behavioral grounds, that regulators can control the quality of data and there is more management attention paid to routine reporting of all monitoring data results.

4. Responding to Violations: Timely and Appropriate Enforcement Response

The concept that enforcement response should be timely and appropriate to the violation is now a key component of current enforcement theory and practice. Swift and sure response is one of the three elements that traditional deterrence theory would deem essential to success. However the concept was only first introduced operationally at the federal and state levels in 1984 through the Policy Framework for State/EPA Enforcement Agreements and program-specific implementing guidance.^{12/} The Policy Framework was the product of a Steering Committee of state and federal officials from all EPA programs charged with defining expectations, roles, and relationships for an effective national enforcement program.

The Policy Framework defines the timeliness part of the concept in terms of specific points in time at which there should be an initial response to a violation, formal enforcement action (i.e. when informal means are not effective in returning the violator to compliance after a specified period of time), and timely follow through and escalation in the event the violator fails to comply, until full physical compliance has been achieved.

The Policy Framework also defines "appropriate" enforcement response as having three elements. First, there is the appropriate level of formality of enforcement response. An initial violation can be addressed through a full range of informal and formal enforcement tools such as a phone call, site visit, warning letter, notice of violation, formal administrative complaint,

and/or proposed law suit. The Policy Framework generally holds that any and all approaches that the government official believes will be most cost-effective are acceptable - unless and until compliance problems extend beyond a specified period of time and have not been resolved, i.e., it holds that at a certain point in time the response should be formal. The Policy Framework defines formal action as a law suit or formal administrative response, i.e., it is independently enforceable, defines the violation, defines the required response and a date certain for achieving full physical compliance. Another exception is the need for court-imposed action where a violator's schedule to comply exceeds a statutory deadline.

A second element of "appropriate" enforcement response is that it should correct the violation. A third element is that it must include a penalty or other sanction as appropriate to create the necessary deterrence for future violations by that source or other sources. Because only certain enforcement mechanisms can be used to impose a penalty or sanction, where they are needed it requires the more costly formal enforcement responses to be used.

The Policy Framework sets a priority on first meeting timely and appropriate enforcement response for Significant Non-Compliers. Recognizing that requiring timely and formal enforcement action for all violators would overburden limited resources, the policy Framework only encourages federal and state officials to meet it for non-SNC violations. Furthermore, the concept is used to establish appropriate state and federal roles in delegated or

approved States. Under most statutes EPA retains parallel enforcement authority following delegation or approval of a state program. According to the Policy Framework, if the State is pursuing timely and appropriate enforcement response, EPA will defer to the State. However, once the timeframes are passed, EPA will take action if, after discussions with the State, it determines that the State is not moving expeditiously on a case.

The timely and appropriate enforcement response system is built on the concept that it is the willingness of government officials to follow through on less costly enforcement responses and to escalate responses in a timely manner that gives weight and force to lesser responses. Each higher order enforcement response carries with it a multiplier effect in its deterrent value. Initially, to build credibility, officials may be forced to utilize more costly formal administrative or judicial action, but the expectation is that in most instances a simple notice will send violators scrambling to quickly resolve a compliance problem or cooperatively negotiate its resolution.

How has this policy worked in practice? The EPA program offices responsible for implementation of air, hazardous waste, and water programs performed an analysis on the 1986 Fiscal Year experience in a study coordinated by the Office of Enforcement and Compliance Monitoring's Compliance Policy and Planning staff.^{13/} This analysis will be repeated annually. The analysis found that the concept that enforcement should be "timely and appropriate" is widely accepted as an important measure of the effectiveness

of the enforcement effort, but that EPA and the States are wide of the mark in meeting its goals.

Recognizing that there are differences among the programs in the definition of the target universe of Significant Non-Compliers, the timeframes the programs established as goals, and the enforcement tools available, NPDES was able to meet its timely and appropriate criteria about 75% of the time, RCRA was able to meet theirs about 46% of the time and the air program only 22% of the time. The RCRA target for formal enforcement response was 135 days for high priority violations, the NPDES goal is within two quarters of the SNC violation, and the air program is only 120 days. Normalizing for differences in the required timeliness of enforcement response among programs, it appears that all three programs were able to return about 75% of the Significant Non-Compliers into compliance within 270 days.

Some of the reasons for failing to take timely or appropriate enforcement response include inadequate resources, cumbersome enforcement procedures - particularly a lack of simple administrative penalty authorities - and/or a reluctance to pursue formal enforcement action.

At this juncture, there is a real need for research on what should constitute timely and appropriate enforcement response. First, we do not have a good feel for the impact or cost-effectiveness of the various forms of enforcement response. This analysis is complicated because the cost-effectiveness of lesser responses is dependent on the use of more costly and onerous

responses. In a dynamic system, how much escalation to the more costly forms of enforcement such as law suits or administrative orders do we have to pursue to underwrite less costly responses? Second, we should carefully examine the value of timeliness of response versus severity of response. There have been some interesting applications of decision theory and economic models in Superfund settlement cases. These cases involve huge sums of money. The models address whether the government should continue to negotiate, sue, or settle, given the strength of the case, its value and needed deterrence.^{14/}

Further, our legal systems for formal response are complex, in part to safeguard personal property and freedoms from unwarranted government intrusion. Nevertheless, there is room for reform. How much is it worth to 'society to reduce and streamline these procedures, and at what cost to society in terms of guarantees of certain rights? How much should we be willing to invest in more administrative law judges and the like to speed the processing of appeals on administrative complaints and thereby speed the environmental results? These are all questions that are amenable to economic analysis.

5. Imposing Civil Penalties and other Sanctions

Civil penalties and other sanctions such as criminal conviction, shutdown of operations, sewer bans, etc., play an important role in enforcement actions. The imposition of a sanction is a critical third element in deterrence theory. In the past, many enforcement actions merely set forth tailored compliance

agreements detailing remedies and schedules for correcting the violation. However, it is now generally recognized that if there is no consequence to violating an environmental requirement (except having to meet with government officials to agree to do what was required in the first place), there is little incentive to undertake any costs of compliance before getting caught. This has proven to be true even when it is broadly understood that clean-up costs will increase substantially if violations are not corrected early and where there has been an actual cost savings from compliance activities.

The Policy Framework for State/EPA Enforcement Agreements addresses three aspects of current operating theory related to civil penalties and other sanctions. First, as noted above, each environmental program is to identify where a penalty or sanction is essential for an enforcement response to be effective, recognizing that penalties cannot easily be sought in each and every case. It is more costly to bring an enforcement action which seeks sane sanction both in terms of agency time and resources. This cost is in large part due to the legal protections noted above. The complexity of our enforcement procedures are proportionate to the potential severity of the sanction. The cost in time and resources in seeking penalties also reflects the fact that penalties are more hotly disputed by violators than the fact of the violation and/or needed remedies. Finally, requiring sanctions in all cases of a certain type emphasizes general rather than specific deterrence. In some instances the equities of an

individual case could argue against a penalty. Current policy would identify certain violations where sanctions are a must, placing more emphasis on looking beyond the good faith efforts of an individual violator in order to set an example and create an incentive for others to do all they can to comply and avoid a penalty. In such cases, if a State enforcement action contains no penalty or sanction, EPA will seek to pursue its own penalty case to fulfill this need for consistency and broad deterrence on a national basis.

The second aspect of penalties that is addressed in the Policy Framework is the level of a civil penalty. Economic theory has been most directly used in enforcement in this area. The theory, embodied in the Clean Air Act's Section 120 Administrative Penalty authority and in EPA penalty policies, is that the recovery of the economic benefit of noncompliance is essential to deter would-be violators from seeking economic gain by deferring the required expenditures on environmental pollution controls. The theory has much appeal. EPA first adopted it formally as a minimum desired level of penalty in 1984.¹⁵ (Note that the penalty policies not only call for recoupment of the economic benefit of noncompliance, but also would have penalty levels add a gravity component reflecting the severity of the violation, its potential harm, the compliance history of the violator, etc.) Several States also have adopted penalty policies which articulate this philosophy. ¹⁶ However, many States do not share the view that

it is necessary to recover the economic benefit of noncompliance to deter violations. Indeed most States simply invoke the maximum statutorily permissible penalty level and proceed to negotiate from there. It is EPA policy that State enforcement actions should attempt to recover economic benefit at a minimum, but this is not required. However, EPA will seek to take its own enforcement action to recover additional penalties if a state penalty is grossly deficient under the circumstances. The criteria for this determination include whether the penalty bore any reasonable relationship to the seriousness of the violation, and/or economic benefit gained by the violator.

The issue of penalty or sanction is perhaps the most sensitive issue in the state/federal enforcement relationship. If compliance can be achieved more expeditiously by a violator who is willing to agree to a schedule and remedial actions but who will dispute proposed penalties or sanctions, many States would prefer to forego penalties or to agree to a lesser penalty amount than would EPA. This ignores questions of equity, fairness, and effectiveness in the context of general deterrence created by a penalty.

Third, the Policy Framework explicitly recognizes that there are non-monetary sanctions which can have a deterrent effect that may be more powerful than monetary penalties, and that those will be acceptable substitutes. The Policy calls for national guidance as to what alternative sanctions would be acceptable for this purpose. This includes sewer bans, pipeline severance, permit revocation, and incarceration, all of which impose some economic cost.

In relating theory to practice, addressing first the issue of whether a penalty or other sanction is sought, EPA seeks a sanction or penalty in a high percentage of its formal enforcement responses where this authority exists, and the percentage has been increasing. In the RCRA and air programs, EPA sought penalties in 93% and 81%, respectively, of the formal enforcement actions taken. In contrast, the States seem to seek penalties in far fewer enforcement actions. The States sought penalties in 49% of the RCRA enforcement actions and 62% of the air actions for which penalties presumably should have been sought.

These discrepancies reflect the continued philosophical differences between EPA and States on the use of penalties in the overall compliance program. This is particularly true in the municipal compliance arena for water discharge requirements. States have not fully bought into the position that enforcement should be undertaken regardless of the availability of construction grant subsidies for building municipal treatment plants. While many States are indeed seeking penalties as is EPA, a legitimate question remains whether municipal penalties have an effect comparable to the deterrent effect of penalties imposed on industry given the nature of municipal finance. Nevertheless, officials have reported that municipalities seem much more willing to enter into negotiations and settle disputes on violations now that there is a record of high penalty assessments against municipal non-compliers. Several questions remain to be answered: Where do monetary penalties make a difference? How is

that difference in behavior manifest? Would other sanctions be more effective?

The second area of actual practice involves EPA's success in recovering the economic benefit of noncompliance as advocated by theory. Based upon a recent study completed by the Compliance Policy and Planning Staff at EPA, it is doubtful that, until recently, penalties levied in many environmental enforcement cases actually approached the levels necessary to recover the economic benefit of noncompliance.^{17/} However, the 1984 EPA Penalty policy strengthened the provisions setting recovery of economic benefit as a floor where the concept is applicable. In the 1985 Fiscal Year alone, EPA imposed one third of all penalties imposed in its entire 10 year history and levels were more like what one would expect from the economic models. Thus, despite policy encouraging EPA staff working on enforcement case settlements to recover, at a minimum, the economic benefit of noncompliance, only the most recent penalties approach those levels. Realistically, some of the huge sums that emerge from the very successful EPA model used to compute economic benefit cannot be sustained in all settlement negotiations, although the Courts have upheld EPA policies and citizen groups have used it very effectively in some significant court cases. ^{18/}

Despite the historical failure to fully recover the economic benefit of noncompliance, air and water programs have "reportedly" achieved fairly high rates of compliance.^{19/} This would suggest

that there are other factors at work besides a simple economic calculus on the part of the regulated community. The evidence is that something else is driving compliance besides a simple economic decision. This is particularly significant given that the expected cost according to the economic equation (the probability of a penalty times the expected penalty amount) can be quite small due to the low likelihood of discovering a violation.

The fact that experience is not explained by the most clear application of economic theory to environmental compliance gives one pause, although the theory is clearly one that makes sense as something to strive for. What is not clear however, is what other factors are motivating the behavior of non-compliers and how they can be addressed.

Unfortunately, there is no empirical data on the systematic use of sanctions beyond those associated with monetary penalties. In response to the emerging body of literature that suggests a more sophisticated approach to compliance behavior and the application of economic theory, the Environmental Law Institute, under a grant from EPA's Economic Benefits staff, is currently reviewing the range of these other sanctions available to and used by EPA and the States.

Criminal sanctions are viewed by many as the most effective deterrent in the environmental enforcement arsenal, particularly by those who favor the behavioral models of compliance. Indeed, environmental crimes have gained substantial public support

as compared to other crimes.^{20/} Criminal sanctions are increasingly being sought by federal EPA, the Department of Justice and the Federal Bureau of Investigations and in a growing number of state program. It is however, generally valid only for intentional circumventing of the law, for negligence under the Clean Water Act, and in all instances of unpermitted dumping into our waterways under the Safe Rivers and Harbors Act. Criminal cases are quite costly and involve very complex procedures. A relatively small but growing number of cases where jail terms have been meted out have begun to change some corporate management ethics. ^{21/} Pronounced policy on compliance with environmental laws and general compliance programs is no defense (nor mitigating factor for sentencing purposes) for corporate officials charged with the criminal wrongdoing of their employees. Courts will only consider environmental programs with strong oversight and follow through for the specific activities in question. This seems to be having a significant effect on prevention of violations through internal compliance systems and employee compliance incentives within a firm.

Moreover, EPA is seeking to tap these internal corporate incentives by introducing environmental audit provisions into consent decree negotiations in cases where there is a clear pattern of environmental management problems or a pattern of a given type of violation within a company.^{22/} This creative sanction is also supported by the behavior theory schools which would

advocate establishing, to the extent possible, self-policing and internal control systems within a company, tied to environmental compliance. This policy has been supplemented by a campaign by EPA to illustrate by case example, the benefits to industry of sound environmental management and periodic environmental auditing. 23/

EPA is also making increasing use of its Contractor Listing authority whereby a listed company/facility is deprived of the right to be awarded federal government contracts as long as it is on the list. This is mandatory for successful criminal cases and is discretionary for facilities in violation of Clean Air Act and Clean Water Act requirements. The sanction has offered significant economic leverage in several difficult compliance cases. In addition, EPA is placing increasing emphasis on the use of publicity surrounding its enforcement actions and in creative settlements requiring violators to use publicity to enhance deterrence.

6. Clarifying the State/Federal Relationship

It is very important that enforcement be viewed as firm, effective, and fair on a national basis. In 1984 EPA and the States drew up a Policy Framework for implementing State/EPA Enforcement Agreements which set forth clear roles and responsibilities in enforcement. The Policy clarifies the expectations for good performance in implementing a strong enforcement effort, and establishes protocols for advance notification and consultation on all inspection and enforcement matters. In addi-

tion it establishes the importance of consistent national reporting of key indicators to assess how effectively the national compliance and enforcement program is being carried out.

A key principle was the introduction of timely and appropriate enforcement response criteria and the definition of what is required in the form of a sanction, If a State is not getting what it should through its enforcement program, EPA will. The ideal of presenting a unified face to the regulated community, and consistency in response has been widely regarded by both industry and state and federal officials alike, as essential steps toward a more effective enforcement program.

Recent evaluations show that these Agreements are beginning to have an effect. However, there are still philosophical differences between EPA and some States which will have to be worked out over time. A key factor here for environmental economists is the fact that while EPA does less than 10-30% of inspections under the delegable programs, it is responsible for about 30% of all formal enforcement actions nationally. Any assessment of improved efficiencies and effectiveness in enforcement response must take into account the role of state and local governments involved in the process.

7. Evaluating Performance and Accountability

Formal reporting and accountability systems that have been established for all environmental enforcement programs set forth five key indicators of performance: 1) the rate of

compliance, 2) the progress in addressing Significant Non-Compliers and returning them to compliance, 3) the number of inspections (or number or percentage of facilities inspected), 4) the number of administrative actions taken, and 5) the number of civil and criminal judicial enforcement actions taken. In addition to these indicators, at the federal level, each year efforts are made to assess federal penalty practices and the question of whether enforcement by both federal EPA and States has been timely and appropriate. Furthermore, EPA internally assesses the extent of compliance with consent decrees and any follow up action taken.

There is increasing attention to issues such as penalty collection and state penalty assessment practices or other sanctions but there is no systematic oversight or data collection at this time.

The traditional economic literature would have us examine only the likelihood of having a violation detected and the mount of penalties imposed in reviewing the performance of our enforcement programs. The author would like to see more realistic measures of program effectiveness developed and applied.

V. THE CHALLENGE TO ENVIRONMENTAL ECONOMISTS

Compliance with and enforcement of our environmental laws should be a central issue for environmental economists but the economics of enforcement has received little attention to date. The economic literature has made a great contribution to the

issue of compliance penalties, with the theory that enforcement programs should recover the economic benefit of noncompliance. The theory is widely regarded as a basic tenet of enforcement programs at the federal and state level. Nevertheless, theory does not always equal practice. While it is worthwhile to base our penalty assessment practices upon this theory, we must recognize that compliance motivation and the realities of an enforcement program are far more complex than this simple theory adequately addresses.

The challenge to environmental economists is to provide analysis of empirical data on compliance and to develop decision tools and techniques that are practical and can be used by state and federal officials to make this increasingly difficult task more cost-effective and efficient - starting with the design of regulations to compliance monitoring and promotion strategies to enforcement response and accompanying sanctions. The issues are well defined, the answers are not.

There are several difficulties environmental economists will face in meeting this challenge. The first is the fact that data is not conveniently collected in one data system, nor is it systematically compiled over time. The recent report on Federal Civil Penalty Practices was a painstaking effort for EPA staff, who labored through hundreds of manual calculations in developing data sets on penalty trends and statistics. In the future, this information will be computerized, but at the time of the study it was not. when it is computerized, the data on the environmental

effects of a facility, inspection activities, self-monitoring reports, administrative and judicial enforcement actions are often located in different computer systems and they are difficult to cross reference.

The second, and perhaps greater difficulty is the fact that compliance results cannot be explained by economic theory alone. The challenge here is to draw from other disciplines and empirical studies of decision-making within the regulated community to derive a more complete understanding of compliance behavior.

In conclusion, environmental economic research and applications in enforcement and compliance monitoring have been limited to date, which is surprising given the potential payoffs in enforcement and compliance for learning something more about the economic efficiency of our environmental regulations and standards. What information is needed by environmental regulators or by the regulated community on compliance and enforcement that environmental economists can deliver? We need more information on:

- Compliance motivation:

What motivates compliance? under what circumstances?
What is the effect of the form of the requirement i.e. performance, technology or work practice standard, permit or general regulation? the cost and availability of technology?

What is the effect of corporate culture and management systems design on compliance?

What is the effect on environmental compliance of the competitive environment/of reputation, in different economic markets?

Are firms which are financially unsound less likely to comply?
What are the implications for targeting of enforcement give

the likely difficulties in collecting large penalties from marginal firms which may not be able to pay?

- Compliance Practices:

What are the quantifiable benefits of specific environmental management practices? What are the costs to regulated entities of past, present and future noncompliance?

How can liability costs be incorporated into internal economic decision making? what algorithms can be used by company managers (financial managers, engineers and plant managers) to factor future environmental liabilities (both compliance related and risk related) into internal decision making? How can activities which have short term costs (environmental auditing, waste minimization) be better presented to show long term benefits?

- Compliance Monitoring:

What is the value of information on compliance in different settings given the risks to the environment and public health from a violation and its probability of occurring?

Who should pay for compliance monitoring? What are the implications for types of inspections? for required compliance self-monitoring and reporting in regulations and permits? for research and development on compliance monitoring techniques?

How frequently and what kind of inspection should be undertaken, at what facilities, to maximize deterrence and provide accurate compliance statistics within a given budget?

- Enforcement Response:

Given the environmental risks from noncompliance, how much should governments spend to ensure high levels of compliance?

What are the multiplier effects and cost-effectiveness of individual enforcement response options, given their interdependence? in different contexts?

- Sanctions:

How effective are alternative sanctions in providing the necessary disincentive to non-compliance in what settings? Is the sanction equitable, and fair in addition to being effective?

What are the effects on competition and markets of uneven enforcement? How consistent does national enforcement need to be?

What levels of penalty should be imposed for reporting and record keeping violations? (The economic theory of recovering the costs of non-compliance does not work well here.)

Do high penalties and enforcement actions targeted at a few influential actors within the regulated community have a greater deterrent impact than lesser penalties imposed on a larger percentage of violators? How does either approach compare in terms of equity, cost-effectiveness, etc.?

○ Tax Policies, Technical Assistance and Subsidies:

What are the effects of tax policies and capital markets on compliance? What are the compliance implications of alternative policies?

FOOTNOTES

- 1/ See "Project 1 Report on Economic Efficiency of Enforcement and Enforcement Related Monitoring (March 1986) Unpublished Draft Report to the EPA Office of Policy Planning and Evaluation by Professors Wesley A. Magat at Luke University, W. Kip Viscusi at Northwestern University, Richard Feckhauser, Harvard University and Peter Schuck at Yale University (March, 1986).

See also Enforcement of the Clean Water Act: Theory, Policy and Practice". Unpublished Draft Report prepared by ICF, Incorporated for the Office of Policy, Planning and Evaluation (January 31, 1987).

- 2/ See " Study of Literature Concerning the Roles of Penalties in Regulatory Enforcement", September 1985, Thomas Charlton, Compliance Policy and Planning Branch, Office of Enforcement and Compliance Monitoring.
- 3/ See John T. Scholtz, "Cooperation, Deterrence, and the Ecology of Regulatory Enforcement", Law and Society Review, Volume 18, No. 2, 1984.
- 4/ See Robert A. Kagan and John T. Scholtz, "The *Criminology of the **Corporation**° and Regulatory Enforcement Strategies", Enforcing Regulation, edited by Keith Hawkins, and John M. Thomas, Law in Social Context Series, 1984, Kluwer-Nijhoff Publishing.

See also "Psychological Factors Influencing Compliance", February 7, 1985, by Dale T. Miller, Study for the Federal Statutes Compliance Project, Department of Justice, Ottawa.

- 5/ See note 2 infra.

See "Analysis of Environmental Compliance Theories", June, 1987, Unpublished draft report submitted to **EPA's** Office of Policy Planning and **Evaluation**,° by Errol Meidinger, Barry Boyer and John Thomas of SUNY at Buffalo.

See also "Environmental Compliance and Corporate Culture: Methods and Motivations", April, 1987. Draft workplan submitted to **EPA's** Office of policy Planning and Evaluation, by Kurt Fischer at Tufts University, Center for Environmental Management.

- 7/ See Note 4 infra.
- 8/ See Memorandum from Thomas L. Adams Jr., titled Summaries of FY 1988 Enforcement Priorities", (April 16, 1987)
- 9/ See "Final Phase II Report Stationary Source Inspection Modelling Project: Allocation of a **State's** Inspection Resources, July, 1987, by Barnes Johnson, **EPA's** Office of Policy Planning and Evaluation.
- 10/ See "Mathematical Techniques for Optimization of Enforcement Strategies" (August, 1985), Jerry A. Filar, Assistant Professor, Department of Mathematical Studies, The Johns Hopkins University.

- 11/ See "Project 2 Report on Economic Efficiency of Enforcement and Enforcement ated Monitoring" March 30, 1987. Unpublished draft report to **EPA's** Office of Policy, Planning and Evaluation, Professors Wesley A. Magat at Duke University, W. Kip Viscusi, at Northwestern University.
- 12/ See Memorandum from A. James Barnes, Deputy Administrator, titled "Revised Policy Framework for Implementing State/EPA Enforcement Agreements" (August 26, 1986)
- 13/ See Memorandum from Thomas L. Adams, Jr. Assistant Administrator for Enforcement and Compliance Monitoring, titled "Report on the Implementation of the Timely and Appropriate Enforcement Response Criteria" (January 15, 1987)
- 14/ See Memorandum from Lloyd Guerci, Director CERCLA Enforcement Division, titled "Release of Updated Computer Model for Decision Tree Analysis of Proposed Superfund Settlements" (June 3, 1987). This model was developed in early cooperative work by EPA staffer Bob Fuhrman, then of the Office of Policy, Planning and Evaluation and Brad Wright of the Office of Waste Programs Enforcement.
- 15/ See Policy on Civil Penalties, EPA General Enforcement Policy #GM- 21 (February 16, 1984).
- 16/ See Environmental Law Institute, "State Civil Penalty Authorities and Policies" (September 30, 1986) report prepared for the U.S. EPA, Compliance Policy and Planning Branch, Office of Enforcement and Compliance Monitoring.
- 17/ See Memorandum from Thomas L. Adams, Jr., titled "Report on Federal Penalty Practices" (to be issued), Carol Hudson Jones, Compliance Policy and Planning, Office of Enforcement and Compliance Monitoring.
- 18/ See Chesapeake Bay Foundation v. Gwaltney of Smithfield, Ltd., 611 F. Supp. 1542 (E.D. Va. 1985), Aff'd 791 F. 2d 304 (4th Cir. 1986) Cert. pending on unrelated issue, S. Ct. No. 86-473.
- 19/ See "Improving the Efficiency and Effectiveness of Compliance Monitoring and Enforcement of Environmental Policies, United States: A National Review" Cheryl Wasserman, October, 16, 1984 prepared on behalf of the Organization for Economic Co-operation and Development. Group of Economic Experts.
- 20/ See United States Department of Justice, Bureau of Justice Statistics Bulletin, January 1984, in which 60,000 people were asked in a public opinion poll, to rank the severity of particular crimes. Environmental crimes ranked seventh after murder but ahead of heroin smuggling and skyjacking.

21/ Since 1986, federal judges imposed over 144 years in prison for environmental crimes, of which over 36 years will be served and over \$4.6 million in fines were levied. About 70% of those convicted have been individuals, mostly senior corporate managers.

22/ See "Environmental Auditing Policy Statement; Notice" Federal Register Vol. 51, No. 131, Wednesday, July 9, 1986, page 25004. See also Memorandum from Thomas L. Adams Jr., titled "Final Policy on the Inclusion of Environmental Auditing Provisions in Enforcement Settlements". (November, 14, 1986)

23/ See Benefits of Environmental Auditing, Case Examples, December, 1984, Arthur D. Little, Inc., prepared for EPA's Regulatory Reform Staff.

Benefits to Industry of Environmental Auditing, August, 1983, Arthur D. Little, Inc., prepared for EPA's Regulatory Reform Staff.

Annotated Bibliography on Environmental Auditing, Sixth Edition
November 1986, EPA's Regulatory Reform Staff.

Annotated Bibliography on Environmental Management, First Edition,
November 1985, Arthur D. Little, prepared for EPAs Regulatory Reform
Staff.

ENFORCEMENT ISSUES IN SELECTING POLICY INSTRUMENTS

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INTRODUCTION

In the literature on both pollution control and fisheries management, there are many comparative studies of the relative effectiveness of policy instruments such as taxes, quotas, input restrictions, etc. Most give particular emphasis to the ability of the instrument to achieve economic efficiency. Little attention, however, has been given to comparisons according to the relative ease of enforcement. Enforcement is defined to include monitoring activities to identify rule breakers, and prosecution activities wherein the formal guilt or innocence is ascertained and penalties are assessed and implemented where guilt is proved. This is a serious deficiency because if there are practical constraints to enforcement, what may appear to be the overall superior instrument, may be a dismal failure as far as actually achieving program benefits.

The purpose of this paper is to identify enforcement issues that can be important in practical policy application and, where appropriate, to evaluate standard policy instruments on their ability to face problems caused by these issues. At the outset, however, it should be noted that there are no clear winners and losers as there are in evaluations based on economic efficiency of producing effort. In fact, in many cases, it is not possible to compare general classes such as standards vs. taxes. The necessary comparison must be between certain types of standards and certain types of taxes. Due to the author's background and predilection, the presentation will be primarily in terms of fisheries management.

Some of the discussion can be directly applied to pollution control programs but for a complete description of some of the specifics, a separate analysis will be required.

The first section will briefly review the problem of environmental and natural resource regulation when enforcement issues are considered. The second will describe the current monitoring and enforcement options and policies under existing fisheries management law. This will provide a better background to understand the overall enforcement problem. The third section will list and describe in detail some of the important enforcement issues and how they can affect the bottom line results of various regulation programs. Many of the issues may not be obvious to those who concentrate on the more traditional aspects of environmental and resource policy.

The new information provided in this paper, 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, environmental, 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 ENFORCEMENT OF ENVIRONMENTAL AND NATURAL RESOURCE PROGRAMS

The prime economic justification for pollution control and 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. Optimal regulation programs are based on the premise that they can reallocate inputs associated with these processes such that the net present value of goods and services produced over time will increase.

While the above may be an overly simple statement of the economic foundation of environmental policy, it does capture its essence. Most practitioners would stress, however, that a regulation program can not 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 the problem is much more complicated. [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; and 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 where 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 used and to the degree to which bureaucracies are willing or able to pursue their enforcement activities. That is, while 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 which follow as a direct result of the regulation **program.**¹

Compliance costs are those initial expenses born 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.

Items such as 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 attempts to get the rules changes so that current operations will be in compliance.

¹ Similarly to measure the gains from a pollution program, it is necessary to look beyond the difference between the net value of marketable output and abatement costs. All costs directly attributable to the implementation and enforcement of the regulation program must also be considered.

Avoidance costs are the expenses firms may undertake to hide non-compliance or to make it appear as if they are in compliance with the rules. For example, boats could have two sets of nets on board if there are mesh size regulations, or boats could off load part of the catch at out of the way ports or to other vessels if there were trip limit regulations.

While 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 preparing memos to assign 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 to detect deviance. The latter can range from formal court proceedings to administrative hearings and all of the negotiations, bargaining, and other transactions that accompany them. See Sutinen (1986) and Wasserman (no date).

While considering these extra costs when measuring the net value of a regulated fishery, it is necessary to determine how each

varies both with the type of instrument used, and the level at which it is used. While it will be beyond the scope of this paper 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 such 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 (i.e., the type and size of the total quota or the nature and the extent of trip limits) and the inputs used to support their application (i.e., the number of person years of labor allocated to the various aspects of enforcement) will affect each of the elements in the net gains equation.

At the risk of being redundant, it is important to emphasize that it is not a matter of maximizing the net benefits from the fishery per se, or of minimizing regulation costs. It is the algebraic sum of all terms in the equation that is crucial. Further, each one 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 being 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 it 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. Further, except for the latter, they 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 Gitner, 1978; Pearse, 1979, Sturgess and Meany, 1982; Beddington and Rettig, 1984; and 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 will be necessary to give more detail to how each will affect the five elements in the net gains equation.

To go one step further, however, the problem facing most resource agencies is more difficult than a straightforward application of a simple maximization problem which allows them to optimally choose policy instruments and to 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 will 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 and one where there is a good deal of uncertainty about the nature of the maximand.

Because of the constraint, the allocation of the agency inputs is just that much more critical. For this reason, the relative, as well as the absolute effects of the various instruments on items in the net gains equations will be of interest. Further, 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.

In summary, when comparing policy instruments, it is necessary to go beyond the efficiency effects on the production of effort (or the efficiency effect on the production of waste product abatement in the pollution case). 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 the proper regulation program.

MONITORING AND PROSECUTION PROCEDURES IN CURRENT FISHERIES POLICY

The purpose of this section is to briefly describe existing enforcement procedures for fisheries policy in the United States today. Knowledge of the strengths and limitations of the current operational institutions is necessary for complete policy evaluation.

Monitoring

There are two basic monitoring modes: at sea and dockside. According to the National Marine Fisheries Service Office of Enforcement (Pallozzi and Springer, 1985), the former includes (1) observers placed on board fishing vessels, (2) boarding and inspecting vessels at sea, (3) ship patrols to observe fleet activity by remaining at sea for long periods of time, (4) boat

patrols to observe fleet activity by vessels which have more limited range and endurance due to inability to handle rough weather and to remain at sea for long periods of time, and (5) aircraft patrols to observe fleet behavior from the air.

Dockside modes include (1) monitoring landings, gear types, record keeping, etc. at the point where the harvest is discharged, (2) inspection of dealers or processors at steps further down the production process as the fish is passed to on to final consumers, and (3) investigations such a reviewing self reporting forms prepared by fishermen but also including undercover operations, radio monitoring, data analysis, use of informants, etc.

Each monitoring type has different relative abilities to detect deviance from 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. The trade-off is that while dock-side 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.

There is obviously more to this question than a simple trade-off between cost and relative efficacy. First, at a more technical level, there is a serious question of what is the most important regulation objective and how is the best way to enforce it. For

example, it may be that in a certain fishery both total catch limits and prohibitions on retaining small individuals appear to have potential value as possible **regulations**.² If the total limit is thought to be more important, and since it can be adequately enforced at dockside, it makes sense to regulate 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 effective on-board monitoring program. While the mesh size restrictions may not be as effective as a strictly enforced incidental 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 equal then, it may make sense to select the 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.)

Along these same lines, an optimal management program may produce distributional or biological effects, that, when viewed in isolation, appear sub-optimal. For example, consider a fishery which requires restrictions on the number of small fish taken.

² The purpose of the total limit is to protect the spawning stock while the constraint of landing small individuals is to allow them to reach larger size before harvest.

This can be accomplished by minimum mesh size limits or 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 simple possession prohibitions of small mesh nets, or of small fish, which can be enforced at dockside, may be the regulations which produce the highest net gains.

Possession restrictions on small mesh nets are not only enforceable dockside but 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).

While mesh size restrictions with prohibition on possession of small mesh nets can be enforced at dockside, they can cause distributional problems. Some boats may make a habit of switching 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. So while a regulation that only allows one set of nets on board at any one time, may significantly reduce overall enforcement costs and indeed may be the only way that is really enforceable, such a plan may

significantly increase costs to all or part of the fleet. In essence while the regulation costs to the government will fall significantly, there will be some large 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 ways to overcome this problem, however. For example, as part of its controlled access program where fishermen are given quasi-property rights in the fisheries, Australia has instituted a user pays system where 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, p. 155)

As a second example of a management program with side effects which appear irrational, consider prohibitions on the possession of small fish. While such restrictions would be easy to enforce on land and while this would encourage individuals to operate in areas or times when small fish are less frequently caught and also to shift locations if small fish are taken on the first set, they will result in the dumping of any small fish that are taken whether or not they are dead or alive when returned to the sea. In some instances however, the loss of this product may be less 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.

As another point in favor of dockside enforcement, it should be noted that under current law considerable leeway is granted to dockside monitoring. If used effectively with appropriate regulations, this flexibility could make dockside monitoring a very powerful monitoring mode. For example, section 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, et al., 1987, p. 112). "Sting" operations on distributors, could seriously damage the market for illegal fish and hence the incentive for harvesters to ignore fishing restrictions.

Prosecution Procedures Under Existing: Laws³

The first step in the prosecution procedure is to have a violation documented by a Coast Guard or a NMFS agent. The agent then prepares an Offense Investigation Report (OIR) which names the violator, describes the offence and the conditions surrounding the arrest, and discusses any pertinent details regarding the particular case. This report is forwarded to the regional law enforcement division of NMFS where a lawyer determines if the case is legally sound. If so, the attorney issues a Notice of Violation and Assessment (NOVA). The contains the same information in the OIR but it also assesses a penalty and names the party responsible for paying it. The penalty can be assessed, either jointly or individually, on the boat owner and the captain to discourage the former from giving orders for deviant behavior or from hiring individuals who might engage it in and to directly discourage the latter from disobeying regulations.

The maximum size of the penalty is determined by law (\$25,000 for each violation), but the size of the assessment depends upon the seriousness of the infraction, the number of offenses by the respondent, ability to pay, and the perceived effect of the size of the fine as a deterrent to others and upon the incentives of the

³ The material for this section is drawn from Dolan and Kundin (1985), Frailey (1985), Matera (1985), Nies (1985), Sutinen (1986), and Sutinen and Hennessey (1985). The summary provided here will be all too brief due to space constraints, but the reader interested in the actual prosecution of fisheries regulation will find all of the above very interesting. Similarly those interested in the enforcement of pollution control laws, should obtain at least as comprehensive a treatment of enforcement procedures in that area as is provided for fisheries in these papers.

respondent to contest the decision. The latter two elements are especially important with respect to overall program success and the optimal allocation of the limited amount of attorney time.

The respondent can agree to pay the fine, attempt to negotiate a reduced fine, or request a hearing. The last two responses are not mutually exclusive. If negotiations between the attorney and the respondent fail, the case can be brought before an administrative law judge who, after reviewing all the evidence and hearing arguments from both sides, can dismiss the case, or change the amount of the fine in either direction. If the respondent disagrees with this decision, he or she can appeal to the administrator of National Oceanic and Atmospheric Administration, the agency in which the National Marine Fisheries Service is located. If the outcome is still not satisfactory, the respondent has the opportunity to move to the federal district court system and appeal the case as far up as the Supreme Court.

At the end of the negotiation and/or appeal procedure, a final order is issued with the statement of the fine. If the assessment is not paid in a timely manner, the Attorney General is authorized to recover the amount in federal district court. Since the Attorney General has a full range of duties to perform, the final collection of the fine is sometimes only undertaken with encouragement and pressure from the NMFS regional attorney's staff. Any failures to actually collect assessed fines in a timely way obviously reduces incentives to comply with regulations. In fact even the successful postponement of fines can significantly lower

their present value and, as such, can diminish their retarding effect on illegal behavior. This is especially true given the likely high discount rate of fishermen.

In certain instances the regional attorneys have another penalty option besides fines. The MFCMA allows councils to require participants to obtain a fishing permit as a condition of working in Federally regulated fisheries although not all management plans take advantage of this option. Where permits are required, the attorney may revoke the permit of the respondent as part of the penalty, the length of the revocation time being subject to the same set of conditions that determine the amount of a fine. In addition, the permit may be revoked for those individuals who have outstanding unpaid fines. Therefore, enforcement agents working in fisheries where permits are required have another tool at their disposal. Given the potential loss of income that could result from a permit revocation, it is a powerful tool indeed.

The MFCMA also authorizes enforcement officers to seize a fishing vessel including gear and other items on board that reasonably appear to have been used in violation of the act. Independently, or as part of a vessel seizure, officers may also seize fish illegally taken and retained. Although this would seem to have a very strong deterrent effect, it is only used for very serious or repeated violations. (Jacobson, et al., 1987, p. 116.) Exceptions are the surf clam and scallop fisheries, where seizures are common for catches violating a minimum size restriction.

Technically under the law, fishermen can be charged with criminal violations if they interfere with enforcement activities. This includes such things as resisting arrest, threatening enforcement officers etc.. However, there appears to be a move to decriminalize fishing violations as much as possible, and so this section of law is used very sparingly. For example a Japanese vessel was alleged to have fished in US waters without a permit, refused the admittance of a Coast Guard boarding party, attempted to evade seizure, and positioned itself to ram the arresting Coast Guard vessel. Even so the decision was made to only press for the civil penalty of forfeiture of the vessel and its catch.

ENFORCEMENT ISSUES IN SELECTING POLICY INSTRUMENTS

Introduction

The purpose of this section will be to introduce issues that can be of importance in selecting fishery management regulations. In particular, the focus will be 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 will be brief, but the goal will be explain exactly how the issue is related to the direct or related costs or the effectiveness of regulation. The issues will be discussed in no particular order.

Ease of Governmental Implementation

There are two separate points here. The first is the legality of various types of regulations. Obviously if certain types of

NET GAINS FROM REGULATED FISHERY

VALUE OF FISHERIES OUTPUT
MINUS
COST OF FISHING EFFORT
MINUS
COMPLIANCE COSTS
(COST OF INDUSTRY ADAPTING OR
COMPLYING WITH REGULATIONS)
MINUS
AVOIDANCE COSTS
(INDUSTRY COSTS TO AVOID
DETECTION OR TO FACILITATE
NON-COMPLIANCE)
MINUS
INITIAL GOVERNMENT IMPLEMENTATION COSTS
MINUS
GOVERNMENT ENFORCEMENT COSTS
INCLUDING MONITORING
AND PROSECUTION COSTS

FIGURE 1

controls 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. For one thing, 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 can't be charged with misreporting their catch because they can declare ignorance of the exact amount landed. (Peacock and MacFarlane, 1986, p. 226.)

Further, 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 inter-jurisdictional conflicts and at best it can cause time-wasting delays in co-operative 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 couldn't 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 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, 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 proportion 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 its 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 ITQ system.

(Carouthers, 1987.)

Period at Risk When in Non-compliance

The issue here is the length of time the regulatee is at risk of being identified as being not in compliance. Obviously, all else equal, the longer the period, the more effective the regulation will be. In fisheries, area closures are at one extreme. The fisherman is only at risk 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 landed. The other extreme would be an individual transferable quota program where a specific 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 if it could just get to the open area before being detected. On the other hand, if total catch records can be crossed 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 tracks" on the transfer of sale through the markets are available. For example, the harvesters of "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 With Which Industry Participants Can Achieve Ability to Comply

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 non-compliance or using avoidance activities to conceal non-compliance. While 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 easily- comply on a day to day basis, detections of deviant behavior may prove of little use, because 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 solve this problem. All else 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 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 puts the brunt of costs on their competitors.

Most fisheries regulations have compliance costs, but it is difficult to make any general rankings. Gear restrictions will 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 cost more 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 transactions 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 it can be checked against a quota. There will also be the transaction costs of buying, selling, renting, or leasing of ITQs such that the full economic efficiencies of the program can be achieved. While 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 from 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 of 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 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 the firms will attempt to have their actions judged as honest mistakes, or at worst, a one time unintentional error.

Prosecuting the first and third types of activities with equal fervor has certain moral ramifications. In addition it can decrease popular support for the program which will make overall enforcement that much more difficult. 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 number of previous or similar 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 to, initially at least, work with firms which have the first two types of problems to help them come into compliance. On the other hand, immediate and sure punitive actions which cause expected

losses to be 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 regulation's stipulations has occurred, it is fairly easy to distinguish deliberate cheaters on quota regulations (both ITQs and total quotas) and closed seasons. These appear to be fairly black and white issues. Once the total quota is captured or if you don't 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 vs. 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, program cannot be successful unless firms come into initial compliance by obtaining the appropriate equipment. While 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, 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 where the distinction does apply, say, a limit on length, horse power, or displacement, monitoring costs will be quite low. However, their overall effectiveness 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 in efficiently.

Ease With Which Requirements Can be Communicated

Obviously individuals cannot conform to regulations, even if they desire to co-operate, if they can not 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 tons, 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 every day 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, no date).

Ease With Which Non-Compliance Can Be Disguised

This issue is self-explanatory but there are some subtle distinctions which should be illuminated. By use of detection avoidance activities, fishermen are able to appear to be in compliance. Avoidance activities make it more difficult for agencies to detect the actual amount of fishing. They 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, Non-compliance will cause total catch to be higher than the desired amount. However if avoidance activities are relatively expensive (i.e., carrying two sets of nets or landing fish in secondary ports), then the problem is two dimensional. The management objectives will not be achieved and in addition, extra economic resources will be drawn into the fishery lowering the net economic gains.

Where avoidance costs are low, all else equal, non-compliance will normally be quite high because the gains from cheating will be higher than the costs. This will be especially true 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 non-compliance 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 non-compliance 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 With Which Agents Can Detect Non-Compliance Such That It is Admissable as Evidence

The key to this issue is the last few words. Detecting non-compliance in such a way that the agent is very sure that it exists is one thing, but obtaining evidence that will stand up in court is quite difficult. As Perry Mason would say "Does the evidence show beyond a reasonable doubt that the individual is in non-compliance."

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 admissable evidence on prohibitions of the use of small mesh nets as it is on one prohibitions 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 in

problematic. Even if the small mesh net is found to be wet and to contain fish, it is not possible to argue beyond a reasonable doubt that spray did not get it wet and the fish from the large mesh net fell into it. On the other hand, with prohibitions on small mesh nets, it is fairly easy to establish that a small mesh net is on board.

A second point is ease with which agents can be trained to obtain appropriate evidence. This is probably more of a problem in pollution regulation than in fisheries, but it is only a matter of degree. 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 parts per thousand emitted on average over a two week period for pollution control or average number of individuals per pound of product landed for a several thousand pound catch for regulation of a scallop or clam 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're 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 individual who are more inclined to non-compliance. 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, all else equal, because monitoring resources can be used more carefully.

Degree to Which Personal or Social Benefits from Compliance Can Be Demonstrated

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 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 non-optimal social results, therefore it 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. More correctly, individuals will suffer no guilt pains for non-compliance 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 Co-operation in Identifying Offenders

The degree to which participants or others are willing and able to provide information on the non-compliance of others (with or without a reward) will obviously lower monitoring costs which should increase overall net benefits. 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 here and this will be related to the nature of the regulation. Casual observers will be able to discern non-compliance with area and seasonal closures much easier than with gear restriction or catch limits.

Likelihood of Encouraging Rentseeking Behavior by Industry and of Administrators Being Susceptible to It

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. While rent seeking can sometimes provide at least temporary gains for private individuals, they produce 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 which directly or indirectly encourages 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 a public service. Those management institutions which are most sheltered from industry pressure will not encourage wasteful behavior, but at the same time, they may miss the opportunity to obtain important 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 as well. 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 degree 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.

Ease With Which Illegal Activities Can Be Detected 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, susceptibility 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 or different groups each of which has their 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 in those particular times where the motivation for non-compliance is relatively strong and when non-compliance can have the most serious deleterious effects on the objectives of management. For example, Zavolta, Strand, and Swartz (1986) found that 5% of the 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 this individuals even if the other 95% are not affected.

Relative Ability to Which Enforcement is Efficacious With Respect to Different 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 decision makers who more often focus on employment and distribution of income effects. In some instances, while it may be difficult to enforce a certain type of regulation such 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.

Ease With Which Benefit Based Priorities For Enforcement Can Be Identified

While 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. Since 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 as well so that the rational behind what may otherwise appear as a random enforcement can understood. Without this understanding, a lack of respect for the management program could develop which could seriously reduce the net benefits of management.

SUMMARY

(to be added later)

REFERENCES

- Anderson, Lee G. 1987. "Expansion of the Fisheries Management Paradigm to Include Institutional Structure and Function." *Transactions of the American Fisheries Society*.
- Anderson, Lee G., and Dwight R. Lee. 1986. "Optimal Governing Instrument, Operation Level, and Enforcement in Natural Resource Regulation: The Case of the Fishery." *American Journal of Agricultural Economics* 68(3): 678-690.
- Beavis, Brian, and Ian Dobbs. 1987. "Firm Behaviour under Regulatory Control of Stochastic Environmental Wastes by Probabilistic Constraints." *Journal of Environmental Economics and Management* 14: 112-127.
- Beavis, Brian, and M. Walker. (1981). "Random Wastes, Imperfect Monitoring and Environmental Quality Standards." *Journal of Public Economics* 21: 377-387.
- Beddington, John R., and R. Bruce Rettig. 1984. Approaches to the Regulation of Fishing Effort. FAO Technical Paper #243. Rome: AFO. 39 p.
- Bhagwati, Jagdish N. 1982. Directly Unproductive, Profit Seeking Activities. *Journal of Political Economy* 90: 988-1002.
- Brady, G. L., and B. T. Bower. 1982. "Effectiveness of the U.S. Regulatory Approach to Air Quality Management: Stationary Sources." *Policy Studies Journal* 11 (September).
- Buchanan, James M., Robert D. Tollison, and Gordon Tullock (eds.). 1980. Toward a Theory of Rent-Seeking Society. Texas A&M University Press, College Station, Texas.
- Carouthers, S. 1987. Personal communication.
- Dolan, Hugh J., and Cynthia L. Kundin. 1985. "Administrative Law Judges and Proceedings." Workshop on Fisheries Law Enforcement, University of Rhode Island, October 1985, 22 p.
- Downing, Paul B., and William D. Watson, Jr. 1974. "The Economics of Enforcing Air Pollution Controls." *Journal of Environmental Economics and Management* 1: 219-236.
- Downing, Paul B., and James N. Kimball. 1980. "Enforcing Administrative Rules: The Case of Water Pollution Control." NBER Conference Paper Series, No. 66 (National Bureau of Economic Research).

- Downing, Paul B., and James N. Kimball. 1982. "Enforcing Pollution Control Laws in the U.S." *Policy Studies Journal*, September, p. 55-64.
- European Economic Communities (EEC). 1986. "Report on the Enforcement of the Common Fisheries Policy." Com (86) 301. Brussels. 30 p.
- Frailey, Margaret H. 1985. "Problems of Case Management." Workshop on Fisheries Law Enforcement, University of Rhode Island, October 1985, 22 p.
- Harford, Jon D. 1978. "Firm Behavior Under Imperfectly Enforceable Pollution Standards and Taxes." *Journal of Environmental Economics and Management* 5: 26-43.
- Hucke, J. 1978. "Bargaining in Regulatory Policy Implementation: The Case of Air and Water Pollution Control." *Environmental Policy and Law* 4: 109-115.
- Jacobson, Jon, Daniel Conner, and Robert Tozer, editors. 1987. "Federal Fisheries Management: A Guidebook to the Magnuson Fishery Conservation and Management Act." Revised edition. University of Oregon Law School. 161 p.
- Krupnick, A., W. Magat, and W. Harrington. 1982. "Understanding Regulatory Decision-Making: An Econometric Model." *Policy Studies Journal* 11(1): 44-54.
- Lee, D. R. 1984. "The Economics of Enforcing Pollution Taxation." *Journal of Environmental Economics and Management* 11: 147-160.
- Lilburn, Bruce. 1986. "Management of Australian Fisheries: Broad Developments and Alternative Strategies." In *Fishery Access Control Programs Worldwide: Proceedings of the Workshop on Management Options for the North Pacific Longline Fisheries*. Alaska Sea Grant Report No. 86-4, p. 141-187.
- Linder, S. H., and M. E. McBride. 1984. "Enforcement Costs and Regulatory Reform: The Agency and Firm Response." *Journal of Environmental Economics and Management* 11: 327-346.
- Lowman, Dorothy. 1986. "Legal Aspects of Effort Limitation." In *Limited Access Alternatives for the Pacific Groundfish Industry*, edited by Daniel D. Huppert, NMFS, p. 105-118.
- Malik, A. A. 1984. Noncompliance and the Economic Theory of Pollution Control, unpublished Ph.D. dissertation, Johns Hopkins University.

- Martin, Lawrence W. 1984. "The Optimal Magnitude and Enforcement of Evadable Pigovian Charges." *Public Finance* 39(3): 347-358 (Netherlands).
- Matera, Marguerite. 1985. "Regional Management of Fisheries Law Enforcement Cases: The Assessment of a Civil Penalty." Workshop on Fisheries Law Enforcement, University of Rhode Island, October 1985, 11 p.
- Milliman, Scott R. 1986. "Optimal Fishery Management in the Presence of Illegal Activity." *Journal of Environmental Economics and Management* 13(4): 363-381.
- Nies, Thomas A. 1985. "Evaluating Enforcement Effectiveness." Workshop on Fisheries Law Enforcement, University of Rhode Island, October 1985, 11 p.
- Palozzi, Morris M., and Steven C. Springer. 1985. "Enforcement Costs in Fisheries Management: The Alternatives." 14 p.
- Peacock, F. Gregory, and Dougald A. MacFarlane. 1986. "A Review of Quasi-Property Rights in the Herring Purse Seine Fishery of the Scotia-Fundy Region of Canada." In *Fishery Access Control Programs Worldwide: Proceedings of the Workshop on Management Options for the North Pacific Longline Fisheries*. Alaska Sea Grant Report No, 86-4, p. 215-230.
- Pearse, Peter H. 1979. "Symposium on Policies for Economic Rationalization of Commercial Fisheries." *Journal of the Fisheries Research Board of Canada* 36(7): 711-866.
- Rettig, R. Bruce, and Jay J. C. Ginter, editors. 1978. Limited Entry As a Fishery Management Tool. Seattle: University of Washington Press.
- Richardson, G. 1982. "Policing Pollution: The Enforcement Process." *Policy Studies Journal* 11(1): 153-164.
- Russell, Clifford S., Winston Harrington, and William J. Vaughn. 1986. Enforcing Pollution Control Laws. Resources for the Future, Washington, D.C.
- Storey, D. J., and P. J. McCabe. 1980. "The Criminal Waste Discharger." *Scottish Journal of Political Economy* 27: 30-40.
- Sturgess, N. H., and T. F. Meany, editors. 1982. Policy and Practice in Fisheries Management. Proceedings of the National Fisheries Seminar held in Melbourne, 1980. Canberra: Australian Government Publishing Service.

- Sutinen, Jon G. 1986. "Enforcement of the MFCMA: An Economist's Perspective." American Fisheries Society's Annual Meeting, September, 1986, Providence, RI. 32 p.
- Sutinen, Jon G., and Peder Andersen. 1985. "The Economics of Fisheries Law Enforcement." Land Economics 61(4): 387-397.
- Sutinen, Jon G., and Timothy M. Hennessey. 1985. "Fisheries Law Enforcement: An Overview and Analysis." Workshop on Fisheries Law Enforcement, University of Rhode Island, October 1985, 30 p.
- Tietenberg, T. H. 1985. Emissions Trading, An Exercise in Reforming Pollution Policy. Resources for the Future, Washington, D.C.
- Ullmann, A. 1982. "The Implementation of Air Pollution Control in Germany." Policy Studies Journal 11(1): 141-152.
- Wasserman, Cheryl. No date. "Improving the Efficiency and Effectiveness of Compliance Monitoring and Enforcement of Environmental Policies - United States: A National Review." U.S. Environmental Protection Agency.
- Zavolta, S. M., Ivar E. Strand, and David G. Swartz. 1987. "Supply Response in the Harvest of Striped Bass." Conference on Economics of Chesapeake Bay Management II. Annapolis, Maryland. 27 p.

SESSION II

Modeling Optimal Enforcement Strategies

Clifford S. Russell, Vanderbilt University

"Game Theory Lessons for Structuring Monitoring and Enforcement Systems"

Clifford S. Russell, Vanderbilt University

Gary V. Johnson and Thomas S. Ulen, University of Illinois

"The Behavior of the Firm When Facing Uncertain Enforcement of Ex Ante
Environmental Regulation and Tort Liability Standards"

Arun S. Malik, University of Maryland

"Markets for Pollution Control When Firms are Noncompliant"

GAME THEORY LESSONS FOR STRUCTURING
MONITORING AND ENFORCEMENT SYSTEMS

Clifford S. Russell*

Prepared for the Association of
Environmental and Resource Economists'
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and Enforcement: Theory and Practice

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Whenever laws or regulations require individuals or firms to act in ways contrary to their narrow self-interest some provision must be made for monitoring — to see that those subject to the requirements comply with them — and enforcement — to punish noncompliance so as to encourage compliance by the offender and others. Without such provisions, the legal requirements effectively become only calls for voluntary sacrifice. But the provision of monitoring and enforcement requires resources; how much and what kind depending on the requirements at issue. In general it is not worthwhile to devote enough resources to catch every instance of noncompliance, nor is it practical to institute penalties sufficiently draconian to discourage all noncompliance when the probability of being caught is less than one. This much is rough common sense, codified and extended by economists writing on crime and punishment (eg: Becker 1968 and McKean 1980).

At the same time, there is considerable, albeit fragmentary, evidence that in a variety of environmental contexts, current monitoring and enforcements efforts by U.S. EPA and its state agency partners are producing lacklustre results. (For a catalog of this evidence from air, water and hazardous waste management contexts, see Russell 1987). For example, self-monitoring reports of over 770 major water pollution point sources were examined by the U.S. General Accounting Office (GAO) for periods in 1978/79 and 1980/82. These reports revealed that fully one quarter (U.S. GAO 1980, U.S. GAO 1983) of the sources produced significant violations of their discharge permit terms during the periods of examination. ("Significant" was defined to mean a greater than 50 percent violation on one or more pollutant limits continuing for at least four months.) About sixty-five percent of the reports revealed at least one violation of a permit requirement for one month

or more. And 30 percent of the sources violated one or more permit terms by some amount for at least six months.

Considering that these data come from self-reporting records for which no independent verification is or ever can be available, it is reasonable to view them as representing lower bounds on actual violation rates.¹ Whether actual violation rates are "too high" is, of course, a difficult question if a technically correct answer is required. That answer would require estimates of the damages to be avoided by producing lower rates along with the costs of the efforts required to produce those lower rates; and implicitly, an understanding of the mechanism by which the greater effort encouraged the improvement in compliance. None of this information and related modeling is easy to produce, but by far the greatest obstacle to finding the "socially correct" amount of monitoring and enforcement effort, and hence the correct violation rate, is the requirement for estimates of damages avoided. While much effort and ingenuity have gone into improving methods and data bases for damage (benefit) estimation in the pollution control field, the available measures are still for the most part crude and aggregate relative to the rather fine-scale marginal damage estimates required for monitoring and enforcement system design.

Therefore one must judge the evidence on compliance and violation on a much looser basis; and on such a basis it is hard to disagree with the theme of the several GAO reports on this subject that the current rates are unsatisfactory and threaten the attainment of ambient quality improvements being sought under the various laws. (See, for example, GAO 1979, 1980, 1983, 1985.)

This is not to say that EPA and the states are unaware of the problem. While the first decade of experience under the major environmental

laws of the early 1970s involved concentration on getting control technology in place ("initial compliance"), recently there has been a recognition that improving continuing compliance must become a priority. (Wasserman 1984). But there is every reason to expect rather tight budget limits on any enforcement activity. Certainly this is the message of current general budget stringency. It is also implied by past levels of monitoring effort as revealed in surveys of state agencies. For example, a Resources for the Future survey in the early 1980's found that large air pollution sources were visited by state agencies' enforcement personnel for discharge measurement purposes on average once every 8 months, while large water pollution sources were visited on average once every 5 months (Russell 1982). These rates should be viewed in the context of permit terms that generally involved limits on mass discharges per hour (the most common choice for air permits) and per day (most common for water permits) (Russell 1982). The mean visit rates cited above, if one assumes that each visit results in 8 hours of measurements, imply that about 0.4 to 0.7 percent of the possible events (violation or compliance choices) are being sampled for large sources. (See, for example, Casey, et al. 1983.) Or, said another way, if the visits were random, the probability of being monitored for permit-term compliance would be in the neighborhood of 0.005.²

Further, such evidence as has been gathered strongly suggests that these low probabilities of being monitored are not being offset by the levying of very large fines for discovered violations. Thus a survey reported in Russell, Harrington and Vaughan (1986) of state experience shows a range of values of expected penalties per discovered violation from zero to over \$2500. In only two of 17 states were fines large enough to bring the expected value above \$1000 and in only six was that value even above \$100.

The above observations imply that suggestions for improvement in

monitoring and enforcement system for pollution control should take account of several limitations:

- they should not depend on the availability of damage estimates
- they should be predicated on continuing budget tightness
- they should not depend on the introduction of extremely large fines to make up for infrequent monitoring and consequent low probability of being caught.

One feature of the existing system will not and should not be taken as given. That is the fact that most air and water pollution monitoring of point sources involves preannounced visits (Russell et al. 1986). Whether or not this completely vitiates the incentive features of the enforcement system is an empirical question tied to features of source controllability: how long it takes to bring a non-controlling source into control and how much it costs. For the following discussion, it is assumed that random, unannounced monitoring visits are possible. That these are the rule in nuclear power plant and hazardous waste handling facilities encourages one to believe that assumption not particularly far fetched (eg: USNRC 1983).

This paper outlines a route to improved monitoring and enforcement design that does reflect the above limitations, a route based on a game theoretic view of the monitoring and enforcement problem. In the process, the important problem of measurement error is addressed and its implications for system design explored. The result is a method that, for the same budget limitation and size of fine, allows the attainment of higher compliance levels than does simple application of random visit timing, where the information on past detection is thrown away after any resulting enforcement action is taken. That is, using past violations to influence probabilities of future monitoring visits provides an extra incentive for compliance. The impact of the

incentive varies with other features of the problem, in particular with the importance of the fines being levied and the size of the errors of inference.

The Model For Single Periods

It will be convenient to begin with a particularly simple version of an agency monitoring problem. In it there will be N identical sources of pollution all subject to the same limit on their discharges. Each source can save C dollars per period by not complying with the limit. The agency responsible for enforcing the discharge limits can choose in principle to monitor or not monitor each source during each period. If monitoring is undertaken, it costs M dollars per visit.³ The agency, however, faces a budget limitation, B , which it will later be convenient to express as a fraction of the cost of monitoring every source in a period: $r = \frac{B}{M \cdot N}$

The monitoring instruments available to the agency are not perfect but rather display random errors. The distributions of these errors are such that, in combination with the agency's rule for deciding on the existence of a violation, they imply the following probabilities:

α = the probability of falsely identifying a violation when the source is in compliance (Type I error)

β = the probability of falsely identifying as in compliance a source that is in fact in violation. (Type II error)

The sources are assumed to be risk neutral in this context; that is, they make decisions for the purposes of the monitoring game on the basis of expected monetary value.

The Game

The essence of the game for a source is that the agency and the source jointly determine the payoff for a particular period by their choices of

strategy, the agency choosing whether or not to monitor and the source choosing whether or not to comply. Using the assumptions and notation just developed, a source's payoff matrix is as follows:

		Source Strategy	
		Comply	Do Not Comply (Violate)
Agency Strategy	Monitor	$C + \alpha F$	$(1-\beta)(F+C)$
	Do Not Monitor	C	0

In the game context, with the possibility of random, unannounced monitoring visits, a natural question to ask is: what probability of monitoring, call it m , the agency would have to choose in order to give such a source the incentive to comply in every period, even though it is not monitored in every period? This may be determined by looking at the expected value of the two alternative source strategies when m is the probability of being monitored.

$$E(\text{comply}) = m(C + \alpha F) + (1-m)C$$

$$E(\text{violate}) = m(1-\beta)(F+C) + (1-m)0$$

keeping in mind that these are costs, and solving for the value of m such that $E(\text{comply}) < E(\text{violate})$ gives after manipulation that:

$$m > \frac{C}{(1-\beta)(C+F) - \alpha F}$$

is sufficient to provide an incentive for source compliance. In later discussion, it will be convenient to define F as a multiple, f , of C , so that $F = fC$ and the key value of m can be written as:

$$m > \frac{1}{(1-\beta)(1+f) - \alpha f}$$

In table 1 a few illustrative values of f, α , and β and the implied values of m are provided.

Table 1: Monitoring Probability That Induces Compliance As A Function Of Fine And Error Sizes*

Relative fine $f = \frac{F}{C}$	Type I error α	Type II error β	Monitoring probability m
1.2	0.05	0.2	0.585
2.2	0.05	0.2	0.408
3.2	0.05	0.2	0.312
1.2	0.01	0.01	0.460
2.2	0.01	0.01	0.318
3.2	0.01	0.01	0.242

$$* m = \frac{1}{(1+f)(1-\beta) - f\alpha}$$