MARKET BASED ENVIRONMENTAL STANDARDS FOR SUSTAINABLE FISHERIES

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ABSTRACT

Many fisheries management agencies struggle with developing management frameworks that can deliver sustainable fisheries. Over fishing, by-catch of non-target fish species, marine mammals, seabirds, and damage to benthic habitats remain serious problems. Management methods based on traditional command and control approaches may meet with initial successes yet additional progress is often marginal requiring managers to implement additional regulations to achieve improvements in environmental performance. In contrast to the terrestrial environment, few policymakers in the marine environment have actively experimented with market-based policy tools for controlling fishing impacts on the marine environment. This institutional inertia is due to poorly developed property rights for marine resources and habitats, institutional constraints, paucity of relevant policy models, and lack of political will and institutional creativity. Developing rights based standards for large scale aspects of marine ecosystems may be perceived as technically too difficult, politically too challenging, and legally in conflict with public trust doctrine. Despite these barriers, market-based standards, particularly in the context of rights-based systems such as dedicated access privileges, are potentially powerful instruments for addressing environmental externalities in the marine environment. This paper identifies market-based approaches used in terrestrial contexts that have potential for managing the environmental impacts of fishing. It explores key issues in the use of market based environmental standards in fisheries management and demonstrates through case studies how the use of market-base approaches can enhance traditional command and control approaches to environmental standards for fisheries.

Keywords: Market-based standards, Environmental impacts of fishing

INTRODUCTION

Fisheries managers almost universally adopt concepts of “sustainability” -- the use of natural resources to meet today’s needs without compromising the needs of future generations -- as the guiding principle of fisheries policy. However, fisheries managers struggle in developing management frameworks that can achieve ecologically sustainable and profitable fisheries. Part of the problem is that the output of harvesting fish includes environmental “externalities” to the environment such as over-fishing, by-catch of non target fish species, marine mammals, and seabirds, and damage to benthic habitats.

A standards-based approach is a coherent framework for building a successful environmental policy process. The major components of this approach include 1) an environmental goal; 2) input, process, or performance standards whose achievement correlates with goal achievement; 3) incentives and strategies which compel managers and policy actors to achieve standards; 4) evaluation; and, 5) revision and adaptation. A credible standards-based approach must also be consistent with relevant policies and legal mandates, achieve its goals at the lowest cost or greatest benefits, and be fair and equitable.

There is less agreement, however, on which type of policy approach would most effectively incorporate standards and achieve environmental goals. The major approaches can be categorized into four classes: 1) government regulated input or output standards (Model 1); government regulated performance standards (Model 2); government sanctioned market-based performance standards (Model 3); and, community or industry voluntary performance standards (Model 4). The regulatory input/output model is the most predictable and often the most commonly employed in managing marine environmental impacts and it tends also to be the most inefficient. Although government regulated performance standards are usually more efficient than input-output standards, among world leaders in environmental management there is increasing testing and adoption of Models 3 and 4 given their significant advantages in harnessing market and social forces for achieving environmental goals.

Except in the case of ITQ's for commercial fisheries, few management regimes have embraced or actively experiment with market-based policy tools for controlling fishing impacts to the marine environment. This institutional inertia is due to poorly developed property rights for marine resources and habitats, institutional constraints, paucity of relevant policy models, inadequate and costly science, and lack of political will and institutional creativity.

Nevertheless, there are a variety of market-based policy instruments developed for terrestrial and non-marine environments that could be used for managing the environmental effects of fishing. This paper explores the use of market-based instruments for achieving environmental standards in fisheries. It begins with a discussion of environmental standards and the use environmental markets in designing standards. It then explores four conceptual policy models that incorporate standards based approaches to managing environmental problems. Key issues and challenges associated with the use of market-based standards in the marine environment are reviewed. The paper concludes with two cases where market-based mechanisms could potentially enhance the performance of existing environmental standards for the environmental impacts of fishing,

ENVIRONMENTAL STANDARDS

The development and use of *standards* is fundamental to any management or regulatory process designed to protect the environment. In fact a *standard* – or its synonyms *criterion, target, norm, value, benchmark, rule* – is fundamental to any systematic process designed to achieve some measurable goal. Associated with achieving an environmental goal is a set of standards in which the *performance* of an individual, household, firm, industry, or community is evaluated according to its progress in achieving the goal. The performance is evaluated in terms of specific quantifiable targets or "standards" that have a functional relationship with the environmental goal. In many cases standards may also be prescribed for the types of inputs which can be used or the type of technology. Standards may also be proscribed for the environmental management process itself (*process standards*) which are used to provide quantifiable targets in meeting policy objectives. For the typical environmental management policy process, there will be a system of standards to guide, evaluate, motivate and/or constrain the behavior of economic and policy actors who directly or indirectly influence the success of meeting the environmental goals.

A successful standards approach is based on an institutional and management process which 1) is consistent with relevant policies and legal mandates, 2) achieves its goals at the lowest cost (i.e., cost effectiveness) or greatest net benefits (economic efficiency), and 3) is fair and equitable. Planning and designing a standards process must include analysis of the success of the process in meeting these broad objectives.

Designing standards for evaluating effects of human behavior on species, habitats, or ecosystems is more challenging than measuring a single chemical pollutant. This is particularly true in the marine environment where it is difficult to determine the status and fundamental processes of species and habitats. Because direct measurements are costly, indirect *indicators* that may be correlated with anthropogenic effects are used to represent changes in the marine environment (McNeil 2003). Often a single indicator may not be adequate to represent the status of a habitat, environment, or ecosystem and multiple indicators will be used to produce an *index* of environmental or ecosystem health. An index score can then represent progress in achieving the long run environmental goal. Standards will be structured to evaluate progress of economic or policy actors in collectively moving toward that goal. *Reference points* are specific levels of an indicator that are used for comparative purposes or to trigger new policies or standards (Restrepo et al. 1998).

INCENTIVES, PROPERTY RIGHTS AND ENVIRONMENTAL MARKETS

The Benefits of Economic and Market Incentives

The inefficiencies of input/output and command and control policy models for controlling environmental externalities are well documented (Andersen and Leal, 2001; Heal 2000; Anderson 1997). Even voluntary "best practices" standards may be inefficient because they provide no financial incentive to improve beyond the minimum standard. In many cases economic incentives may have significant advantages relative to other policy approaches (NCEE 2001) including: harnessing forces of the market place; supporting flexibility and creativity; reducing levels of pollution or environmental externalities relative to traditional regulation; thwarting perverse incentives associated with the tendency of government to ratchet up the standards once they are achieved; coordinating activities of thousands of players without directly controlling behavior, and; stimulatings technologies and innovations.

Types of Incentives and Market Systems

There are various types of incentive-based economic policy instruments (Van Beuren 2003; Sterner 2003) including 1) fees, charges, and taxes; 2) subsidies; 3) deposit-refund systems; 4) marketable permits (e.g., cap and trade or credit systems): 5) liability (e.g., performance bonds); 6) environmental accreditation; 7) information disclosures; and 8) voluntary eco-labeling. In addition there are four basic classes of marketable permit systems (Heal 2000) including cap and trade, baseline and credit, bubble programs, and emissions averaging. These marketable permit systems can be designed and adjusted to accommodate other policy instruments. For example, cap and trade systems can incorporate an allowance to purchase or retire pollution effects to meet standards associated with third party certification schemes (Anderson and Leal 2001). Trading ratios can be designed to control and reduce overall emissions or environmental impacts by requiring that the purchaser of a unit of credit receive the right to only use some proportion of that credit according to the trading ratio formula. Cross pollution (or cross externalities) trading for different types of pollution or environmental effects can be allowed based on specified trading ratios. Banking and borrowing can encourage firms to invest in new pollution or environmental impact control technologies, and gain from their investment through the use of various tradable credit schemes. Credits can then be awarded and banked when pollution or impacts are lowered below permitted levels**.**

Designing Environmental Standards

The conceptual structure of any standards process for managing environmental impacts is relatively straight-forward including 1) determining management and environmental objectives; 2) analyzing potential economic behavior and effects on these objectives relative to alternative institutional designs; 3) selecting the rules, institutions, incentives and standards which best achieve management and environmental objectives; 4) monitoring, measuring, and evaluating the effect of incentives for achieving the standards and standards in achieving environmental objective(s); and revise and adapt if necessary. This conceptual structure embeds the key components of any system of standards including objectives, behavioral relationships, incentives, enforceable standards, measurement, accountability, learning, and adaptation.

The broad elements of this approach have been used for most environmental problems, particularly in controlling air and water point-source pollution. It is also the basic framework for ISO 14000 and related Eco-Management and Audit Schemes for meeting firm-level environmental standards (Mech and Young 2001). These schemes have been used by thousands of private firms to increase profitability while simultaneously reducing environment effects (Gilbert and Gould 1998).

A standards approach is most easily used when there is a discrete environmental problem involving relatively few players, and when cause and effect are known. This approach, however, can break down for large and "messy" public policy environmental problems (Dorcey 1986). "Messy" problems are characterized by: 1) numerous and heterogeneous policy participants, 2) multiple agencies, 3) vague laws and legal standards, 4) lack of consensus on environmental management objectives, 5) multi-dimensional environmental objectives involving many species, habitats, and ecosystems, 6) significant uncertainty about the natural environment, 7) an unpredictable and unstable policy environment, 8) lack of economic-policy information on causal relationships, 9) insufficient funding, and 10) inadequate policy leadership.

INSTITUTIONAL MODELS USING ENVIRONMENTAL STANDARDS

There are considerable challenges inherent in developing standards-based institutions for managing the complex process of sustainable development of the marine environment. In many case the challenges are greater than on terrestrial environments because terrestrial ecosystems 1) have undergone a longer institutional management experience, 2) are more thoroughly studied and researched, 3) have more sessile and less fugitive organisms, and 4) are characterized by better defined and secure property rights. Except for having possibly fewer policy actors and agencies, the marine environmental management problem poses a "messier" challenge than found on terrestrial landscapes and watersheds.

The following section summarizes four alternative institutional models that which employ a standards-based approach for managing environmental problems. To some extent these models are used as a heuristic devise to isolate the essential features of alternative institutional strategies – in the practical policy environment there will be considerable overlap between these approaches.

Four Policy Models

There are four conceptual policy models which incorporate standards-based approaches for managing environmental problems:

Model 1 -- Government regulated input or output standards: Central government employs a scientific-bureaucratic model to dictate inputs, technology, and/or output of goods and services for controlling environmental impacts. The standards are developed to define the minimum or maximum inputs, technology, or outputs. Although there may be some consultation there is little direct public involvement. The government may employ various incentives to achieve standards. Government coercion is used to enforce the standard.

Model 2 -- Government regulated performance standards: Central government employs a scientific-bureaucratic management model to dictate performance in production of environmental externalities. The standards focus on maximum target level of environmental pollution or damages for each entity. This allows flexibility in choice of inputs and outputs of goods and services. It tends to involve higher degree of public consultation and may employ various incentives to achieve standards. Government coercion is used to enforce the performance standard.

Model 3 – Government sanctioned market based performance standards: Institutions are structure to provide a form of legal property right or privilege to provide market discipline and economic efficiencies for achieving the standard. Standards can be narrowly focused on a single externality or species or broadly structured to incorporate habitats or ecosystems. This approach allows considerable flexibility across communities of interest and rights holders and there is a significant degree of consultation. Incentives are internally generated through workings of market system. Enforcement is through government coercion supported by internally generated motivation.

Model 4 -- Community or industry designed voluntary performance standards: Standards based process which is developed, owned, and managed by groups of households, firms, or communities in response to a collective need for improving the environment. Often driven by potential gain/loss of utility and profits associated with product/service market demand or potential regulation by the state. Provides considerable flexibility across the community of interest. Can include incentives and cooperative rights structures. There is a significant degree of consultation by community members and incentives are internally generated through social structures. Government coercion and enforcement not directly relevant but implicit threats of government action may be a contributing motivation.

Table 1 illustrates that each of these policy models has strengths and weaknesses relative to some of the key attributes of successful policy institutions. In general, model 1 (input/output regulatory models (also known as “command and control” -- see next section) tends to score low except for the simplicity of the process it employs. These low scores are a direct result of an institutional structure that places high value on centralized control and top-down rulemaking strategies. In general, a process that embraced other attributes would be unlikely to select input/output controls. The government mandated performance-based standards model tends to score moderately well in all categories since it is based on standards directly linked to controlling the environmental externality and involves greater public participation. However, although the standards model allows each “polluter” to select the best individual approach for meeting the standard, it does not provide opportunities for trade among heterogeneous “polluters” that could lead to substantial improvements in efficiency and welfare. Conversely, while the market-based performance standards (model 3) can generate potentially greater efficiency, depending on the environmental goods, the extent of the rights, and number and heterogeneity of agencies and policy actors, the approach can raise social-equity issues and generate contentious debate. Similar to model 4, however, it has significant potential for devolving the day-to-day management to the rights holders. While the voluntary approach to standards has many advantages, it requires unique conditions for its development including a relatively small community of interests, effective community leaders, potential for significant gains (or minimum losses) for its members, and supportive public agencies.

Attribute	Model 1	Model 2	Model 3	Model 4
Adaptability	Low	Moderate	Moderate-High	High
Public Participation	Low-Moderate	Moderate	Low-High	High
Economic Efficiency	Low	Moderate	Moderate-High	Moderate-High
Equity	Low	Moderate	Low-High	High
Simplicity of Policy Process	Moderate-High	Moderate	Low-High	Moderate

Table 1: Relative strengths of standards-based institutional models for managing environmental problems.

With appropriate property rights, pricing incentives, and adjustment of national accounting frameworks to include environmental services, that markets can be used to substantially manage environmental impacts. Successful markets to manage water and air pollution exist, particularly in the United States. This has important implications for each conceptual model. Because Model 1mandates inputs and/or outputs, it cannot take advantage of economic incentives and opportunities for trade to efficiently and innovatively meet environmental standards. In contrast, the performance standards of Model II can be incorporated within a property rights structure if the performance is evaluated across the entire system rather than for each individual actor. Generally however, government mandated performance standards are mandated for each agent, which does not take advantage of market based trading to achieve efficient solutions for meeting environmental standards. Model III is based on market-based approaches for achieving an overall environmental standard for a species, habitat, or ecosystem. If appropriately designed, it can take full advantage of property rights systems to efficiently meet and even exceed the market-based environmental standards. And Model IV, although having many attractive features that can work congruently with property rights systems, will only be effective if the achievement of the standard is in the individual (or collective) interest, and if the property rights are sufficiently strong to provide agent(s) with the control needed to achieve the standard.

If rights are relatively weak, or if achievement of the standard is not in individual and/or collective interest (although it may be in society's interest) the approach can fail, or at best have only minor consequences. In addition, a collective voluntary system may not necessarily be efficient if it is not structured to take full advantage of opportunities for trades in achieving the standard.

Mix of Policy Instruments

In practice tradable permit systems almost always co-exist with other environmental policies, so a mix of environmental policy instruments, rather than one single instrument may prove to be more effective when seeking to address environmental concerns in fisheries. Examples of this dependence include: the use of direct regulations in permit allocation or credit creation; the use of taxes or penalties to ensure compliance; and, the 'voluntary nature of adherence to credit-and-baseline schemes. For instance, it is quite common for individual transferable quota regimes in fisheries to co-exist with technology-based regulations such as gear restrictions as well as spatial and temporal restrictions on fishing activity. The OECD (2003) identifies specific conditions under which the joint use of tradable permits in conjunction with other policy instruments may be preferable to the application of one or the other instrument on its own: dealing with spatial differentiation of impacts, addressing technology market barriers and failures, expanding regulatory scope and reach, and reducing compliance cost uncertainty.

ISSUES, CHALLENGES AND OPPORTUNITIES FOR MARKET-BASED MECHANISMS IN THE MARINE ENVIRONMENT

Environmental "Club" and "Local" Goods: Three Classes of Adverse Impacts

Creating marine resource property rights generates positive and negative incentives that can be exploited to develop, implement, and manage environmental standards. These incentives stem from the 1) actions by resource users, 2) the effects of these actions on the marine environment, and 3) the impact of these effects on the rights holders and other marine resource user groups (consumptive and non consumptive). These effects are represented by three classes of adverse impacts which result from the actions of the users of these property rights (e.g., fishing quota holders) or changes to the asset value of their rights:

- Class I: Adverse impacts are caused by a user group's collective "club" good or "local" public good activities which reduces the productivity of the resource and lowers the asset value of their user right;
- Class II: Adverse impacts are caused by a second party's activities (e.g., a second group of rights-holders) that reduce the productivity of the resource and lowers the asset value of the primary group's property right;
- Class III: Adverse impacts are caused by a user group's activities but do not influence the productivity of the resource, nor directly lower the asset value of their user right.

For Class I impacts, it is in the collective interest of the club members to internalize the externality and voluntarily reduce the adverse environmental impact to levels which maximizes the asset value; i.e., where the marginal benefits of reducing the impact are just offset by the marginal opportunity costs from the loss of use of the resource. If the club is the only recipient of value from the environmental good, then that good is a "club good" in which the impacts or the good itself could be owned and managed by the club.

For Class II impacts, the primary party being impacted may have legal standing to seek compensation from the second party. In most cases, however, the environmental good is a public good and held in public trust; in this case the primary affected party would seek redress through the political process. If the primary and secondary parties hold similar types of user rights then the "super" club representing all related rights holders could assist the parties in voluntary arbitration and equitable and efficient settlements which internalize the externality. If the only parties affected by the adverse impact are members of the "super" club, then it is in the interest of the "super" club to voluntarily manage the adverse impacts. If the members of the "super" club are the only recipients of value from the environmental good, then the good could be a local or club good owned and managed by the "super". With appropriate rights structure within spatially defined areas, a broad range of resource user groups and their environmental effects could be managed by an "environmental management company" that efficiently optimizes and internalizes the environmental externalities (McClurg 2003).

For Class III impacts, the adverse environmental impacts have no direct effect on the asset value of the user right. Unless markets compensate resource users for reducing the adverse impact (e.g., eco-labeled products, third party certification), users will not voluntarily reduce the level of adverse impacts. In order to internalize the externality, it will be government's responsibility to develop a standards process to avoid, remedy or mitigate the impact using policy approaches that maximize social welfare and balance utilization and sustainability mandates.

Table 2 summarizes the relationships between the classes of adverse impacts and the four classes of institutional policy models. The table demonstrates that when the adverse environmental impacts primarily affect club members, they will voluntarily internalize the externality and manage the environment to reduce the impacts to an "optimal" level. In this case, it is in society's interest to create an environmental property right to facilitate the club's efficient management of that right using economic incentives. Conversely, when the user's activities produce adverse impacts that only affect non-club members, government should establish institutions which internalize the externality. Consistent with the analysis in this report, the position of the X's indicate that unless there are significant transactions costs, performance-based environmental property rights (Model 3) offers the most promise for environmental management consistent with balancing utilization and sustainability requirements.

Impact Class	Model 1	Model 2	Model 3	Model 4
Class I Club Good Externality				XXXX
Sub-class Ip Club Good Externality & Property Right			xxxx	
Class II Super Club Good Externality				XXXX
Sub-class IIp Super Club Good Externality & Property Right			xxxx	
Class III Public Good Externality		XX	XXXX	XX

Table 2. Policy models associated with five classes of environmental impacts. The four classes of policy models are Regulatory Command & Control (Model 1), Regulated Performance (Model 2), Market Based (Model 3), and Voluntary (Model 4). The number of X's indicate relative degree of relevancy and efficiency. The small *x's* indicates relevancy and efficiency when the environmental good is privatized and managed by club members

SUBSTITUTING COMMAND AND CONTROL WITH MARKET BASED APPROACHES: TWO CASES

Over fishing, by-catch of non-target fish species, marine mammals, seabirds, and damage to benthic habitats remain serious fisheries problems. Management methods based on traditional "command and control" regulatory approaches such as closed areas, aggregate quotas for non-target fish stocks, mandated gear modifications, and restrictions on fishing methods have met with some success. But many of these "blunt instruments" are often inefficient and inflexible. In many cases, after an initial response, progress remains marginal, requiring managers to implement additional regulations in order to achieve improvements in environmental performance.

Regulators have rarely developed market-based standards to control the environmental impacts of fishing. In most cases it is considered too costly or politically impractical (Sharp 2002). These "impracticalities", however, may be due as much to a lack of knowledge, experience, and a common vision, than any political or technical "transactions" cost. Because communities will tend to address environmental problems consistent with their history, cultures, and existing institutions, it is difficult to implement fundamental institutional change that may be efficient, but also less predictable (Miles *et al*. 2002).

Two case studies demonstrate that progress is being made in addressing the environmental impacts of fishing. In each case, however, the "progress" is being achieved using traditional command and control regulation, best practices technology, or government mandated performance standards. Property-rights and market-based incentives have not been used to address the environmental management of fishing. For each case study market-based mechanisms to enhance the mandated environmental standards are suggested.

Case I: Eastern Tropic Pacific (ETP) Purse-Seine Yellowfin Tuna Fishery

Issue: Dolphin bycatch
Existing Standard: 5,000 dolphins/year fleet-wide; individual vessel bycatch levels determined by number of qualified vessels. Meeting "zero bycatch standard" qualifies as "dolphin free"

The ETP yellowfin tuna fishery is conducted over an eight million square mile area of the Pacific Ocean. It produces roughly 800 million pounds of skipjack and yellowfin tuna per year, supplying 20 to 25 percent of the world's canned tuna supply (Platt 1996). Many nations participate in the ETP fishery, including Costa Rica, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Panama, Peru, the United States, and Venezuela. Millions of dolphins live in the ETP, about 10 million of which are commonly found swimming in association with yellowfin tuna. Of these 10 million, three species – the northern offshore spotted, eastern spinner, and coastal spotted dolphins – are considered "depleted" under the Marine Mammal Protection Act (MMPA) (NOAA 2003).

In the 1950's, fishermen discovered that yellowfin tuna were likely to be found swimming 200 feet below dolphin stocks. Fishing methods were consequently developed using purse seines which encircled both dolphins and tuna. This method resulted in the deaths of hundreds of thousands of dolphins in the early years of the fishery. By the 1970's public pressure and citizen boycotts caused Congress to amend the MMPA to address the dolphin bycatch issue. Throughout the next 20 years Congress continued to amend the MMPA imposing stricter regulations on both U.S. fishermen and the importation of foreign tuna. By 1990 the U.S. fleet's participation in the ETP tuna fishery declined to less than ten vessels. The decline was due to economic opportunities in the Western Pacific Ocean and MMPA prohibitions in the ETP.

Since 1990, several substantial international dolphin conservation efforts have resulted in a dramatic reduction in dolphin mortality (NOAA 2003). The La Jolla Agreement in the fall of 1992 placed voluntary limits on the number of dolphins that could be incidentally killed in the tuna purse seine fishery. It also lowered the maximum number each year over seven years, with a goal of eliminating dolphin deaths in the fishery. In 1995, the United States agreed to import tuna from other countries and signed the Panama Declaration, an international agreement to continue long-term dolphin protection through participation in the international dolphin conservation program (NOAA 2003).

In 1999, the current international environmental standard for dolphin mortality was set by the Agreement on the International Dolphin Conservation Program (IDCP). The Agreement limits the total incidental dolphin mortality limit (DML) in the purse-seine tuna fishery to no more than five thousand annually. At sea-observer coverage and support of research to improve gear design, deployment, and retrieval are among measures required by the Agreement to help reach this goal. Through the IDCP, observed dolphin deaths have been cut from 133,000 in 1986 to fewer than 2,000 annually since 1998 (Agreement on the International Dolphin Conservation Program 1998).

Two percent of the total DML are managed separately, leaving 4,800 dolphin to be allocated among all vessels (in all countries) participating in the ETP tuna fishery. The two percent is considered "reserve" and is managed at the discretion of the Inter-American Tropical Tuna Commission (IATTC). Vessels that do not normally participate in the tuna fishery may request allocation of the reserve.

Every year, each country submits a list of vessels to The Inter-American Tropical Tuna Commission that they believe are qualified to receive dolphin mortality quota. Qualified vessels are determined through examination of criteria such as performance records (past infractions, fishing history, etc.), carrying capacity, and crew certification in dolphin release and rescue techniques. The IATTC closely monitors all vessel request lists and has authority to determine the eligibility of each vessel's DML. By November 1 of each year, all countries submit their lists of vessels requesting DML to the Commission. Once qualified vessels are approved, the total allowed dolphin mortality (4800) is divided by the total fleet-wide number of qualified vessels. This number is referred to as the ADML (average individual vessel DML). This number is then multiplied, on a per country basis, by the number of vessels requesting DML (e.g., if a list of 100 fleet-wide vessels is approved, the ADML=4800/100= 48. If a country has two qualified vessels, their DML =2*48= 98. The country may split this dolphin mortality between the vessels evenly, or divide it up at their discretion, with one vessel receiving more DML than another (Bratton-personal communication).

Proposed Alternative Policy Instruments and Standards

By any reasonable "standard", the reduction by the ETP fleet in dolphin bycatch has been a significant environmental achievement. Although there are some concerns that the tightening restrictions have compelled "dirty" operators to target tuna located beneath floating logs and attractors with unregulated and disproportionately higher bycatch, in general the program has met or exceeded its specific goals. Today, dolphin bycatch is less than 2% of the 1986 bycatch and less than 40% of the existing aggregate bycatch cap. The program is considered a model of successful international cooperation in research and management for controlling environmental effects of fishing. Tuna caught in individual seine sets that meet a zero bycatch standard may be sold and labeled as "dolphin free." In addition the program adopted the relatively progressive step of allocating individual quotas per vessel which has been a key incentive in reducing and managing bycatch.

The fishery, however, stopped short of adopting potentially more effective and flexible policy instruments including transferable dolphin bycatch quotas. Given that the aggregate dolphin cap is not binding (i.e., total bycatch is less than 40% of the total quota), but vessel quotas are binding for some individual vessels, there exist opportunities for trade among vessels. Although trading could increase total bycatch in early years of the program (although still below the aggregate fleet wide cap), *trading ratios* could be used to permanently retire some of the bycatch credits and therefore permanently lower the total fleet allowable bycatch cap. As an example, assume that each dolphin was assigned 10 credits and a four to one trading ratio was required. If vessel “A” exceeded its initial bycatch by one dolphin it would be required to purchase 40 credits (e.g., to avoid paying a substantial penalty). Thirty credits would then be permanently retired from the system, effectively lowering the total allowable bycatch cap by three dolphins (from 5,000 to 4,997).

This system could also be used to improve protection of “depleted” species of dolphins by using the concept of *cross-externality trading ratios*. For example, rather than allocating an annual dolphin bycatch to each vessel, the vessel would be allocated dolphin credits. Assume that each vessel was assigned 400 credits. Also assume that undepleted dolphin species “A” was 10 credits but depleted species “B” was 100 credits. If a vessel had used up its allocated credits and then captured depleted species “B” it would need to purchase 400 credits (assuming a four to one trading ratio) that would effectively retire 300 credits (the equivalent of thirty dolphin from our previous example). One would assume that as the total credits retired from the system began to substantially increase, the trading ratios would begin to reduce until they reached a one to one balance (that is, the aggregate quota was binding or met a specified target).

One could potentially improve the efficiency of the credit system by designing credits as a permanent property right or asset. Rather than having only an annual value they would become a valuable long-term asset. The market could be expanded to include any buyer or seller including non governmental organizations and international agencies that desired to purchase or retire the credits and, therefore, permanently reduce dolphin bycatch. Such a market would provide powerful incentives to further reduce dolphin bycatch and reward harvesters who develop bycatch innovations.

These are examples of possible market and standards-based approaches that use monetary incentives to reduce bycatch by “rewarding” low bycatch vessels and “punishing” high-bycatch vessels. These are also systems that provide considerable flexibility, reduce bycatch over time, and create special incentives to reduce fishing-related mortality of depleted or threatened stocks. Of course, depending on specific goals and issues, these examples may not represent the “best” approach; for example, a permanent cap and trade system for each bycatch species may be even more efficient. These examples, however, illustrate the range of potential policy instruments, incentives, and rights based systems which could reduce environmental impacts over time while simultaneously meeting utilization and sustainability requirements.

New England scallop fishery

<u>Issue</u>: Benthic habitat impacts
<u>Existing standard</u>: Area closures based on biomass and harvest potential--rotational area management and area closure schedules currently being developed by NEFMC

The impacts of dredging on scallop habitat have only been examined in the last 20 years. The possible impacts of fishing activities on benthic habitat in the New England fishery became a major concern in the mid-1990’s. In 1994, three large areas covering 17,000 km^2 of the seabed were closed to help recovery of groundfish. By 2000 it was found that the closures effectively protected many less active species such as flatfishes, skates, and scallops (Kaiser 2001).

Excluding scallop dredges in the closed areas resulted in a 14-fold increase in scallop biomass. Because of this success, fishery mangers are now considering managing scallop areas by rotational closures every 4-5 years (Kaiser 2001). The Scallop Fishery Management Plan (FMP), published by the New England Fishery Management Council (NEFMC) is currently under revision. Public hearings were held during May 2003 to gather comments regarding rotation closures (included in Amendment 10 to the FMP) and the NEFMC is now reviewing comments on Amendment 10 alternatives. Amendment 10 would introduce spatial scallop management, “taking advantage of local differences to improve yield and minimize adverse impacts on other fisheries and the marine environment” (NEFMC 2003).

Conservation measures currently required by the Scallop FMP such as days-at-sea allocations, gear restrictions to improve escapement of juvenile scallops and finfish, and reductions in other inputs have provided limited spatial management outside the closed areas since the mid-1990's. Amendment 10 would retain these strategies while meeting objectives that would rebuild the scallop resource and minimize bycatch and habitat impacts, while ensuring "equitability and regulatory flexibility." The preferred alternative for Amendment 10 consists of adaptive rotations with flexible boundaries. Five types of closures have been proposed: 1) multi-year scallop closures to postpone fishing mortality on strong year classes, 2) controlled access areas that re-open after a scallop rotation closure, 3) open scallop fishing areas where customary limited access and general category rules apply, 4) seasonal closures to avoid unacceptable bycatch, and 5) indefinite, long-term closures to protect sensitive and vulnerable habitat or to avoid unacceptable bycatch. These closures would apply to vessels fishing under the day-at-sea rules and other general rules (i.e. non-day-at-sea rules). The initial scallop rotation area management program will begin in 2004 and run for a three year duration (NEFMC 2003).

The decision to close or reopen fishing areas depends on the expected potential biomass. All area rotation alternatives of Amendment 10 are based on a pre-defined criteria or standard of potential biomass growth rate for scallops. The closure criterion ranges from 25-40% biomass growth per year and a re-opening criteria when growth deceases to 10-25%. Closures in each of the five New England sea scallop management regions (Gulf of Maine, Georges Bank, South Channel, Hudson Canyon and Southern) may not close more than 50 percent of all scallop fishing areas, or 75 percent of the biomass, whichever is less. The proposed target fishing mortality rate for scallops is different for different areas, ranging from F=.20-.40. The TAC for each area is based on the target mortality rate. Target mortality rates will increase each year consistent with the area rotation closures (NEFMC 2003).

Alternative Policy Instruments and Standards

The New England scallop case study demonstrates the importance of spatial and temporal strategies for managing benthic related species and habitats. For the case of New England scallops, it took area closures designed to rebuild groundfish stocks – stocks that were over-harvested in part due to poorly defined property rights – to discover this important management principle.

The concern, however, is that this "discovery" and a myopic focus on a powerful "regulatory" tool could limit the policymaker's vision for other potentially more beneficial concepts and strategic alternatives. The fundamental issue is understanding the impacts of benthic gear to the productivity of the marine environment; that is, the "performance" of the gear with respect to "adverse" benthic impacts. Armed with this knowledge, policymakers could design management approaches that effectively balance utilization and sustainability. Strict reliance on a relatively coarse policy tool of temporal and spatial closures based on biological species growth, may not provide industry with the flexibility to address variation in industry's individual and collective needs and differences, and changes in technology, input or output markets, and the marine environment.

As one alternative or complement to rotational strategies, consider a market-based performance standard using a "benthic impact credit" trading scheme. The scheme would be based on the assumption that benthic environmental impacts are a function of gear size, design, operation, and frequency of use. Based on scientific research, performance standards would be designed for each gear within each habitat. For example, within a specific spatially defined habitat, scientific analysis would determine that no more that 10,000 "credits" of impact could be sustained per year (or some other relevant time period) in order to meet management goals and balance utilization and sustainability requirements. Based on objective field tests, a "high" impact dredge may be assigned 10 credits per nautical mile of tow, a "medium" impact dredge 5 credits, and a "low" impact dredge 1 credit. Industry would report information from gear sensors and other recording instruments (e.g. GPS-- date, location, tow path, tow duration), in order to account for, and track credits over time, plus record other relevant management and scientific information. Credits could be leased or bought and sold within an "environmental benthic credit market." Benthic habitat more easily damaged or considered more productive or essential would require a higher level of credits per unit effort (for example, instead of 10 "credits" per nautical mile, "high" impact gear would be assigned 50 "credits"). Credits across different habitat types could then be traded. Credits would be totaled across all habitats to produce a total credit level (e.g., 1,000,000 benthic credits) Caps within each habitat area could maintain some "flex" (e.g., up to 20% above the habitat-specific target level) in order to provide for flexibility in utilizing highly valuable commercial resources that may be found within any given habitat. Any increase in benthic impacts in one area, however, would be compensated or "mitigated" by a decrease in other areas; that is, total allowable benthic impacts to all areas could never exceed 1,000,000 credits. Unused credits could also be banked for future use and/or retired over time. For example, user groups could collectively bank "excess" credits and retire them in exchange for financial incentives from government or NGO's.

SUMMARY AND ONGOING RESEARCH

Many individuals remain unconvinced that market or voluntary approaches can work, particularly for managing large-scale and diverse environmental public goods problems. They remain skeptical that institutions can be developed to efficiently or equitably redirect the behavior of those who helped create the problem. Presently, there is no worldwide consensus, and policy experiments and empirical research are needed to design, demonstrate, and evaluate effective market-based institutional approaches to managing the environmental impacts of fishing.

Relative to simpler and more traditional input/output and command/control policy approaches, property rights are relatively new and require a higher level of policy craftsmanship in order to achieve their objectives. Since market-based programs are not without inherent challenges, experts advocating these programs must demonstrate potential benefits relative to traditional regulatory approaches. Assessing and then demonstrating these benefits will require policy analysis, education, regulatory flexibility, and a willingness to take policy risks. Conducting comparative analysis and undertaking policy experiments and will be important strategies to support their adoption.

The overview of issues associated with the use of market-based environmental standards in fisheries management is part of an ongoing project to help managers, policymakers, and the public evaluate the strengths, weaknesses, and tradeoffs associated with the potential use of market-based environmental standards in mitigating the adverse impacts of fishing on marine ecosystems compared to the use of traditional command and control - based approaches. The key components of this study, focuings on fisheries on the west coast of the USA, include:

- Completing a comprehensive review of the literature on alternative market-based approaches that could be used to set environmental standards for marine fisheries.
- Developing a policy relevant decision support framework to evaluate the potential efficiency, effectiveness, and acceptability of market-based environmental standards \ relative to more traditional and widely used command and control approaches.
- Using the decision support model engage representative stakeholders and the public in the identification and evaluation of alternative policy models for setting environmental standards, with particular emphasis on the development of incentives and market-based standards for addressing fisheries issues of significance.
- Surveying participants at the beginning and end of the project to assess perceptions and attitudes towards market-based environmental standards relative to traditional command and control approaches to setting environmental standards for marine fisheries.

The results of this research will be reported at a future IIFET conference.

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