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## Managing longline fishing in Hawaii—practical aspects of regulatory economics

Theoretical economists tend to focus on highly mathematical models, and even applied academic economists tend to emphasize abstract principles of efficiency criteria for decision-making. Yet in the trenches of regulatory economics such niceties tend to be overwhelmed by limited information, inadequate data, simplistic models, and too little time. (We discount the possibility of inadequate analysts!) This note provides a brief review of such a situation in which the author played an active role.

In April 1991 an emergency moratorium[1] restricting new entry into the rapidly growing domestic longline fishery in Hawaii was implemented under the U.S. Magnuson Fishery Conservation and Management Act of 1976 (MFCMA). The emergency regulations were followed by a three-year moratorium on new entry which continues through April 1994, at which point it is either replaced by a formal limited entry program or lapses into open access.

The 1991 emergency moratorium and three-year moratorium contained two main measures: 1) a restriction on new entry into the Hawaii-based domestic longline fishery, and 2) restricted transferability of newly instituted longline permits. The Council identified two central reasons for the moratorium: 1) interaction between the growing longline fleet and the mixed domestic fleet of small commercial, charter, subsistence and recreational trollers and handliners which operate in the near-shore waters of Hawaii, and 2) the potential biological impact of the growing longline fleet on some pelagic species, particularly on North Pacific swordfish and Pacific-wide blue marlin. The first reason lay at the heart of the political pressure prompting the moratorium: physical gear conflicts between the two fleets and the perception by the small boat fleet of interception of their catch by longliners.[2] The second reason represented a conservative, conservationist approach to resource management recommended by the Council's scientific advisers. Because there was essentially no information on the dynamics of swordfish in this fishery, the recent and reputably negative experience of the Atlantic swordfish fishery weighed heavily on the plan monitoring team (Berkeley, 1989).

The moratorium was proposed in a heated political climate where the number of active longline fishing vessels in Hawaii had increased from 35 in 1987 to 135 in 1990 and where longline landings of tuna and related species (excluding swordfish)

[1] Approved by the Western Pacific Regional Fishery Management Council (Council) in December 1990 and implemented through federal regulations by the National Marine Fisheries Service (NMFS) four months later.

[2] There was also a parallel regulation under consideration proposing closure of some main Hawaiian Island waters to longline fishing. This in fact occurred in June, 1991.

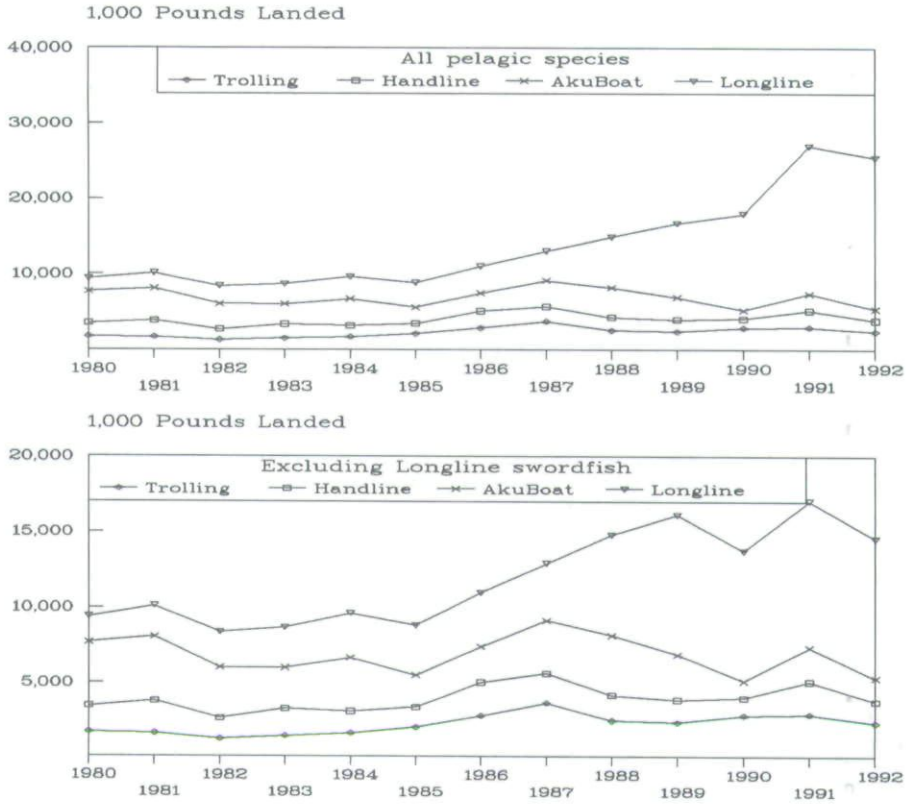


**Figure 1.** Hawaii's pelagic fishery, 1980–92 by gear type.

had increased from 1,700 t to 3,900 t in the same period (Figure 1a and 1b).[3] At the same time, landings of many pelagic species by the troll and handline fleet had recently declined, with yellowfin tuna (their primary target species) declining from 1,950 t in 1987 to 900 t in 1990 (Ito, 1992).

The regulatory impact review (RIR)[4] for the three-year moratorium (Pooley, 1991)[5] provided a qualitative evaluation of the Council's management alternatives.[6] The Council's preferred option was a complete moratorium on new entry. Two alternatives were the "no action" alternative (*i.e.*, open access), and a partial moratorium which would allow new entry beyond the 200-mile EEZ.[7] Table 1 identifies the range of fishery components which might have been affected by the moratorium. Table 2 lists the types of impacts evaluated and Table 3

[3] The growth of the fishery is documented in several reports prepared by NMFS, including Dollar (1992) and Ito (1992).

[4] A regulatory impact review is mandated by Executive Order 12291 (1981) requiring a cost-benefit assessment of potential Federal regulations. It distills the economic analysis which is conducted during the regulatory decision-making process.

[5] The RIR also considered two "separable" issues: Transferability of permits, and native Hawaiian and traditional fishing rights and practices. These are not discussed in this note.

[6] Because of limitations on information available concerning the potential physical effects of the proposed action (and its alternatives) on fishing vessel performance and shoreside operations, a defensible quantitative approach was not considered to be possible.

[7] This alternative was rejected by the Council because of enforceability concerns.

**Table 1**
Types of Fishing Vessels Potentially Affected by the Longline Moratorium

(Number in parenthesis is a *rough estimate* of the number of vessels in each category.)

1. Included Hawaii longline fishing vessels (140)
2. Excluded Hawaii longline fishing vessels (30)
3. Hawaii trollers and handline fishing vessels, full-time equivalent number (475 commercial, of which 75 are full-time charter boats, and 200 frequently active recreational fishers)
4. Excluded Hawaii fishing vessels (e.g., small-scale vessels which might have outfitted for short-set longliners, bottomfish, lobster, and albacore fishing vessels which might have outfitted for longline fishing) (25)
5. Excluded U.S. mainland longline fishing vessels (50)
6. Excluded U.S. mainland non-longline fishing vessels (number unknown)
7. Potential fishing vessels (i.e., those subject to investment) (number unknown)

(Pooley, 1991.)

presents the qualitative summary of impacts. The derivation of these impacts is the heart of the story.

The RIR was constructed by developing hypothetical operating relationships for affected fishing vessels and shoreside businesses (*e.g.*, cost-earnings-operating relationships for longline and troll-handline boats) and testing the sensitivity of the results (*e.g.*, total income and net revenue) to changes in operating parameters. Results were presented as ordinal measures (multiple *pluses* and *minuses*). Figure 2 outlines this procedure. The results were viewed as merely indicative of the range of potential effects because information on the possible relationship between the regulatory alternatives and components of the fishery was extremely limited. This was true both in terms of the effect of the regulation

**Table 2**
Types of Impacts Longline Moratorium Alternatives

1. Loss of total income for excluded Hawaii longline fishing vessels
2. Improvement in the trend of catch per unit effort for both
3. Improvement in the trend of average size of fish caught by either fleet
4. Increases in the distance traveled by longliners allowed to fish only outside the EEZ
5. Improvements in dockside queuing by longline vessels waiting to unload or to be serviced
6. Reduced gear conflicts in near-shore waters
7. Improvements in market prices
8. Reductions in total market revenue and reduced value—added to Hawaii seafood dealers
9. Reductions in the volume of shoreside provisioning
10. Reduced risk of over-fishing

(derived from Pooley, 1991.)

**Table 3**
Relative Fleet Impacts Longline Moratorium Alternatives

Impacts scaled from [− − − − −] for relatively substantial costs to [0] for no apparent impacts to [+ + + + +] for relatively positive benefits, evaluated for each type of fishing vessel, seafood markets, and shoreside infrastructure. Costs and benefits figured in *total* income, i.e., the sum of labor income and net revenue (profit).

| | |
|---|---|
| 1. Included Hawaii longline fishing vessels | |
| —No moratorium | 0 |
| —Partial moratorium | 0 |
| —Complete moratorium | + + |
| 2. Excluded Hawaii longline fishing vessels | |
| —No moratorium | 0 |
| —Partial moratorium | − |
| —Complete moratorium | − − |
| 3. Hawaii trollers and handline fishing vessels | |
| —No moratorium | 0 |
| —Partial or complete moratorium | |
| —Baseline effect | 0 |
| —1% effect | + |
| —1987 effect | + + |
| —Complete moratorium | + + |
| 4. Excluded Hawaii non-longline fishing vessels | |
| —No moratorium | 0 |
| —Partial moratorium | − |
| —Complete moratorium | − − − |
| 5. Excluded U.S. mainland longline fishing vessels | |
| —No moratorium | 0 |
| —Partial moratorium | − |
| —Complete moratorium | − − − |
| 6. Excluded U.S. mainland non-longline fishing vessels | |
| —No moratorium | ? |
| —Partial moratorium | ? |
| —Complete moratorium | ? |
| 7. Potential fishing vessels | |
| —No moratorium | ? |
| —Partial moratorium | ? |
| —Complete moratorium | ? |
| 8. Hawaii seafood market | |
| —No moratorium | 0 |
| —Partial moratorium | 0 |
| —Complete moratorium | − − − |
| 9. Hawaii shoreside provisioners and suppliers | |
| —No moratorium | 0 |
| —Partial moratorium | 0 |
| —Complete moratorium | − − − |
| 10. U.S. mainland markets and infrastructure | |
| —No moratorium | ? |
| —Partial moratorium | ? |
| —Complete moratorium | ? |

(Pooley, 1991.)

on vessel participation and fishing patterns and of the effect of these changes in participation on net revenues and total incomes in the various components of the fishery.

The following provides some brief examples of the application of this proce-

Regulatory alternative =======:>
Estimated number and location of longline fishing vessels
=======:> Predicted change in total longline catch and catch composition
=======:> Estimated physical change in related activities (for example, troll-handline catch rates)
=======:> Estimated economic costs or benefits (change in income) of individual effects (for example, change in troll-handline operator incomes)
=======:> Fleet segment change in economic values (for example, change in total troll-handline fleet income)
=======:> Relative ranking of regulatory alternatives

**Figure 2.** Causal Relationships in the Regulatory Impact Review

dure to the evaluation of four of the potential effects: the opportunity losses of the excluded longline vessels, the potential catch and market competition effects between the two fleets, and the impact of the moratorium on shoreside provisioning.

### *Loss of Income for Excluded Fishing Vessels*

The basic idea for evaluating this effect was that exclusion of any longline vessels represented a reduction in their operating choices as demonstrated by their [revealed] preference expressed for entry into the Hawaii longline fishery (Figure 3). Although they might operate in other fisheries, and nothing was known about the relative economic returns for the choice between fisheries, the moratorium would represent an opportunity cost to the excluded vessels. This cost was "measured" by estimating the transitional costs which the excluded vessels would have to bear in order to return to other locations or refit their vessels to other fisheries. These were estimated using a cost-earnings statement for a protypical *lobster* boat (for which quite a lot was known), modifying the operational characteristics to reflect longline fishing, and estimating the administrative and logistical costs of transfer back to mainland U.S. fisheries. These were judged to include the administrative and logistical costs of transfer back to mainland U.S. fisheries ($49,600), travel costs of $2,000 based on transit to the west coast, and opportunity costs of $26,000 based on lost fishing time. Such costs are frequently incurred by a number of

Moratorium =======:>
Reduced fishing opportunities for excluded longline fishing vessels
=======:> Transitional costs to alternative fisheries

**Figure 3.** Loss of income longline vessels excluded from fishing in Hawaii by the moratorium

vessels in the Hawaii lobster fishery as those vessels often move between Hawaii and west coast fisheries but would represent real one-time losses to the excluded longline vessels as a result of the moratorium.

The RIR identified the lost income and additional expenses which would accrue to the excluded longline vessels. Typically in cost-benefit analysis, these would be weighed against the gains to the troll and handline sector to determine net national benefits. The catch and market competition sections of the RIR (discussed below) are a qualitative attempt to make that weighting, but it was an implicit rather than explicit weighting.[8]

### *Catch Competition (Improvement in the Catch-Per-Unit Effort for the Troll-Handline Fishing Fleet)*

No statistically valid relationship between catch rates and expanded fishing effort has been identified in the Hawaii fishery (Boggs, 1993), but this relationship may be shielded by natural variability in the pelagic fisheries and by the extremely short time-series of information available. The RIR evaluated the impact of the exclusion of longliners from the Hawaii pelagic fishery by estimating what their catch would have been and applying several parameters reflecting various levels of risk of catch competition (Figure 4). The RIR estimated this "reduction" in catch (compared to the open access alternative) at 18 percent. Applying this to a longliner catch to troll/handline catch-per-unit-effort relationship of 3/10 of 1 percent (extension of an informal analysis prepared by the author in 1991),[9] the annual impact of the moratorium was estimated as a $150 increase in gross rev-

<u>Main Hawaiian Islands EEZ effect only</u>

Moratorium =======:>
decline in MHI longline catch levels
{impact of exclusions and restrictions on permit transferability and vessel upgrading}
=======:> potential <u>increase</u> in troll-handline catch rates
=======:> potential <u>increase</u> in catch rates for remaining longliners

Open access =======:>
increase in MHI longline catch levels
=======:> potential <u>decrease</u> in troll-handline catch rates
=======:> potential <u>decrease</u> in catch rates for current longliners

**Figure 4.** Catch competition (change in relative catch rates for longline and troll-handline fishing vessels)

[8] Executive Order 12291 requires "Sec 3 (c) . . . agencies shall prepare Regulatory Impact Analyses of major rules . . . (d) . . . [which] shall contain the following information: (1) (2) (3) A determination of potential net benefits of the rule, including an evaluation of effects that cannot be quantified in monetary terms." (Reprinted in Smith, 1984, p. 241–246.)

[9] This rate, 3/10 of 1%, is *statistically* insignificant but was used as a simulation possibility.

enue and $120 in total income per troll-handline vessel. The annual impact on charter boats was estimated as a $96 increase in gross revenue and $86 in total income per vessel.

Because these effects were so small, despite a) small-boat operators' beliefs that the effect has been much greater, and b) the actual decline in annual average troll-handline catch rates from 1987 to 1990, the RIR calculated two sensitivity tests for this effect: one based on a 1 percent relationship between the hypothesized decline in longline fishing effort and increased troll-handline catch rates and another based on the ratio of 1987 troll-handline catch rates to 1990 catch rates. The latter effect was rather substantial (11.1 percent) and the moratorium would then increase annual total income per troll-handline vessel by $3,000.

From a cost-benefit and from a fisheries management perspective, this is a classic "allocation" issue, where explicit weighing of the alternative benefits to the two types of fleets was marginal at best. However, the fishery management councils are charged with weighing both, and the RIR should reflect not only executive Order 12291 dictates but the needs of the regional decision-makers as well.

### *Market Competition*

The hypothesis was that increased landings of longline-caught fish have, and would, depress troll-handline prices for similar species (Figure 5). Pooley (1991) could not find a statistically valid relationship using recent data for yellowfin tuna (the primary target species), but evaluating troll-handline catch for all species combined, there was a small (although still statistically insignificant) effect: an 18 percent decrease in fishing effort and catch by the longline vessels excluded by the moratorium could increase market price by 1 percent for trollers and handliners.[10]

Moratorium =======:>
Reduction in longline tuna fishing effort
=======:> Potential reduction in competition with troll-handline tuna
=======:> Potentially higher tuna prices to troll-handline vessels operators

Open access =======:>
Increased longline tuna fishing effort
=======:> Potential increase in competition with troll-handline tuna
=======:> Potentially lower tuna prices to troll-handline vessel operators

**Figure 5.** Market competition (Hawaii's market for fresh tuna)

[10] Small-boat fishers in Hawaii are convinced that the longline fleet has had a substantially negative impact on their average prices. Although our data cannot reveal that impact, it is possible that a more refined analysis could untangle the relationship. Pooley (1987) found a clearer effect when analyzing Hawaii bottomfish catch and price. However it is also the

This amounted to $95 in gross revenue per year per troll or handline vessel, a negligible quantity. The impact on consumers, in terms of reduced availability of fresh fish and higher prices, was unpredictable because a) retail markups are not known, and b) substantial volumes of the longline caught tuna were exported to markets where there is sufficient competition to make the Hawaii component marginal at most. Given the small effect, consumer are not likely to experience any substantial change in prices.

Someone used to estimating net national benefits under typical cost-benefit terms might ask, how could "market competition" be considered a *cost* in any sense? You of course would be correct, in a strictly net-benefits perspective. However, the seafood market serves two functions in Hawaii: it provides a means of product exchange and income valorization for commercial fishing operators, and it provides a means of offsetting subsistence and recreational fishing costs for "noncommercial" small-boat operators. Thus, "competition" from the longliner would reduce the nonmonetary advantages of subsistence fishing and reduce the opportunities for recreational fishing experiences. The RIR made no judgement on commercial vs. subsistence and recreational benefits, except to attempt to quantify them.

### *Impact on Shoreside Businesses*

The RIR estimated that a complete moratorium would reduce total market revenue and income to Hawaii seafood dealers by $15.4 million (independent of price effects) based on the loss of landings from the excluded vessels (Figure 6). The loss to the seafood dealers would be $3.8 million in value-added, based purely hypothetically on a 25% value-added on total ex-vessel longline revenue. Similar losses would accrue to firms supplying equipment and supplies to the longline fleet, with no offsetting increase in troll-handline provisioning.

From a net national benefits perspective, these "losses" are national losses (or even regional or local losses) only if the Hawaii seafood firms have unemployed or underemployed labor and capital from which to draw. Otherwise they merely represent a shifting of resources from one use to another. Given the relative levels of unemployment in the United States and the lack of productive investment in general, reductions in shoreside business volume would seem to represent real losses to the national economy.

The other potential effects were evaluated in a similar manner, with similar problems in quantifying the relationships between the management alternatives and the various fleet and business components. Because of the weak statistical base on which these per-unit estimates were made, they were not summed to estimate the relative costs and benefits of the moratorium alternatives. Thus the RIR did not really estimate the efficiency gains or losses from the moratorium but instead concentrated on identifying the distribution of gains and losses, including their impact on secondary businesses (*e.g.*, the shoreside provisioning firms). Nonetheless, the RIR indicated that the greatest cost of the preferred alternative would be the opportunity losses of Hawaii longline vessels which were excluded

case that if an annual aggregate relationship cannot be found, then one week's price declines are probably another week's price increases (subject to Friedman's (1992) warning).

Moratorium =======:>

Reduction in longline tuna fishing effort

=======:> Potential reduction in availability of high-value tuna for local consumption and export

=======:>

=======:> Decreased income for local wholesalers

=======:> Increased fresh tuna prices for local consumers

Reduction in fleet size

=======:> Reduction in volume of

----- fleet repair {shipyard, ect.}

----- provisioning {fuel and oil, ice, supplies, ect.}

=======:> Potential decrease in waiting time for some services {for example, annual haul-out}

=======:> Potential increase in some costs to all segments of pelagic fleet {for example, loss of ice machine or increased charge due to sub-optimal operating levels}

Open access =======:>

Opposite effect of most moratorium effects

**Figure 6.** Hawaii shoreside business volume

from the fishery (some longliners had begun fishing or had begun investment to longline in Hawaii after a control date, June 1990, but before the first emergency moratorium was actually implemented in April 1991) and by Hawaii market and shoreside industries denied additional income by lost growth in the size of the longline fleet. Ironically, the largest benefit from the complete moratorium was expected to be improvements in logistics for the included longline vessels (*i.e.*, less crowding dockside).

While it could hardly be said that the RIR provided strong justification for the moratorium, in the context of a political compromise by the various parties to the Council decision-making process it did not identify catastrophic costs if the moratorium were implemented for up to three years (at which point NMFS said that a flexible limited entry plan would be required).

> Evaluation of the moratorium alternatives is particularly difficult because neither the short-term nor long-term physical effects on changing levels of longline fishing on the pelagic species are known. This review attempts to pose meaningful scenarios of the possible effects with the view to posing the issues succinctly for the Council. Ultimately, however, it appears that the decision on the moratorium alternatives is likely to be a pragmatic one which is ultimately reversible after three years. (Pooley, 1991, p. 16).

It might also be useful to note that while the outline of the RIR was presented to the Council at the time of their decision on the three-year moratorium, almost no comments or questions were posed of its author. This was true throughout the

regulatory drafting process, which perhaps suggests that in fisheries management the weight of economic efficiency is quite limited.

The Council is now in the process of evaluating limited entry alternatives to replace the moratorium in 1994, but it is doing so without any substantive change in the amount of information available on which to evaluate the potential impacts of regulatory alternatives. The apparently viable alternatives at this stage are the "no action" alternative (*i.e.*, a return to open access), a long-term moratorium (with extremely limited access and permit transferability), and a more flexible permit transferability system with an adaptive approach to the number of permits (perhaps combined with some sort of "fractional licensing" system (Townsend, 1991; Townsend and Pooley, 1993)). This decision was planned for August 1993 for implementation in April 1994.

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## Who Should Pay to Preserve the Marine Environment?

Why are many environmental policies incompletely implemented and weakly enforced when public sentiment for conserving marine resources and minimizing marine pollution is so strong (Panayotou 1993, Thorne-Miller and Catena 1991)? One important answer is that, when benefits are distributed broadly and the costs are concentrated, representative democratic governments often delay, dilute, or dispense with actions to maintain environmental quality. One useful tool for achieving higher levels of environmental qualities is to compensate those who suffer economic losses (Burtraw 1991).

Compensation (providing cash or in-kind replacement of a lost resource) and mitigation (modifying actions so that the final outcome has a smaller impact) play important roles in conserving marine fisheries. Mitigation measures include development of alternative fisheries, construction of public infrastructure to entice new marine industries into fishing communities, and job training programs. Compensation measures include vessel reduction programs, which are also known as buyback, buydown, and scrapping programs. Although these programs have been judged harshly by narrow economic efficiency criteria, they help offset economic and social dislocation during times that fishing fleets must be downsized or diverted to other fisheries.

The purpose of this report is to share some thoughts on the possible role of compensation as one component in a portfolio of environmental initiatives. Because the principal application used to illustrate the issues is the recovery plan for Columbia River salmon stocks, background on those fish and their environment is also provided. The discussion benefits greatly from a paper by Burtraw and Frederick (1992) which reviews the possible use of compensation to ease the burden of parties impacted by one of the most controversial components of proposed salmon recovery measures: a drawdown of one or more reservoirs of water contained behind Snake River dams in eastern Washington.

### *Salmon in the Columbia River Basin*

About one billion dollars of public expenditures has been spent in the 1980s to reverse declines in Columbia River basin salmon stocks, and these expenditures will continue, probably at a much higher rate in the coming decade. The decline in salmon stocks in the Pacific Northwest was caused by many factors, including overharvest, habitat degradation caused by practices in mining, logging, and agriculture, and water pollution. However, a dominant factor was the series of large hydroelectric dams on the Columbia and Snake Rivers accounting for about ⅔ of the decline since the dams were added. Salmon runs in the Columbia River basin dropped from 10–16 million fish to current production of about 2.5 million fish of which about ⅕ may be wild (not spawned in hatcheries).

To reverse this trend, fish harvests have been slashed, forest practices have been restricted, mining and grazing practices are under strict scrutiny, water pollution abatement expenditures have increased sharply, habitat has been rehabilitated, hatchery practices have been revised, irrigation intakes have been screened, bypass facilities at dams have been modified, juvenile salmon have been barged downstream, and the flow of water through dams in the basin has been reshaped. Salmon spawn in fresh water and their offspring spend early life stages

there. Migration to the ocean coincides with historic high levels of water flow as spring rains and melting snow increase streamflow in the spring. Columbia River dam operators "reshaped" this flow by storing water in the spring to avert floods and moving it through hydroelectric generators during the winter when power demands were greater. The mandate for "fish flows" means that the rivers follow more closely their historic flow regimes, which implies less hydroelectricity. Associated measures which draw down water levels in the late spring and summer to accelerate the salmon's downstream migration curtail barge movements on the Snake River and drop the river to levels below the reach of irrigators' water intakes.

All these actions create private as well as public costs. Commercial fishing fleets, recreational anglers, and the businesses that buy from (for example, fish processors) and sell to (for example, boat builders and fishing guides) harvesters lose profitable opportunities to continue their businesses at previous levels. Energy-intensive industries such as aluminum refining must adapt to higher costs. Agricultural and forest products industries that ship by barge must pay more to use alternative transportation modes or ship their products at different times. Marinas and other tourism-based businesses along the Snake River face increasing costs and decreasing revenues as river and reservoir levels drop in the spring and summer. Although some of these costs are spread broadly across society, others hit some groups harder than others. Is their share of the costs equitable? Are there reasons of equity or economic efficiency to ask others to help them? Should this relief be temporary or permanent?

### *Takings*

Compensation must be paid if environmental regulations constitute a taking of property. Under the Fifth Amendment to the U.S. Constitution, "The government is prohibited from 'taking' private property without showing just cause (that is, a benefit to the public which outweighs the disadvantage to the unwilling landowner) and without fair compensation" (Rolston 1991, p. 49). Although environmental policies that diminish the bundle of property rights on private land have been litigated extensively, what constitutes a taking in a new case—one that has not been through the courts—is uncertain.

Does a careful analysis of a particular government regulation in terms of the "physical invasion" test (where the government takes property by physically invading the property) and the "noxious use" test (where a taking does not occur if government action promotes public health), and the "diminution in value" test determine whether taking has occurred? "To put it mildly, no "set formula" is used in, or explains, the Supreme Court's decisions." (Munzer 1990, p. 447).

On June 29, 1992, the U.S. Supreme Court used many of these same arguments to decide a question of takings arising from a coastal zone management ruling. David Lucas bought two residential lots on a South Carolina barrier island two years before the state legislature enacted the Beachfront Management Act, barring him from building permanent habitable structures on his land. Lucas sued the state for just compensation on the grounds that the ruling had stripped him of any economically viable use of his property, *i.e.*, that the diminution in value test argued for compensation under the eminent domain and due process clauses of the U.S. Constitution. The state trial court agreed, but was reversed by the South

Carolina State Supreme Court on the grounds that the legislative action was designed to prevent "harmful or noxious" uses of property. The U.S. Supreme Court reversed the South Carolina Supreme Court and remanded the case for reconsideration. The specific deliberations required were whether there was any remaining economic value (*i.e.*, whether the diminution in value was total as alleged but never ruled on in court) and whether the South Carolina common law of nuisance would have prevented construction without the Beachfront Management Act. Once again, the U.S. Supreme Court tried to provide clear and unambiguous language to guide lower courts, but left substantial ambiguity.

In summary, the constitutional basis for compensation to parties suffering economic losses from the salmon recovery plan is tenuous at best. After criticizing all branches of government, but especially the U.S. Supreme Court, for muddying the legal grounds, Susan Rose-Ackerman argues that the case for compensation should be made on grounds of economic efficiency, then modified to reflect legislatively mandated principles of justice. What are these other grounds for compensation? Some but not all of the following are taken from Burtraw (1991).

### *Reasons to Compensate*

The most important reason to compensate losers is also the most complex and arises from uncertainty about the future. Property owners invest with some level of expectation that their current sacrifices will reap future rewards. Timber owners defer harvest expecting to get a better return on their investments by waiting. Irrigators place pumps and other equipment on their property expecting to grow more productive or valuable crops. Fishers buy vessels and fishing equipment expecting future harvests. Yet each is aware that nature is an uncertain mistress; that their plans were based on incomplete information and may encounter snags; that the demands of consumers, technology, and the forces of competition constantly change; and that the laws and regulations governing them could change.

Many of the parties affected by the salmon recovery plan are relatively small and have small investment portfolios. Thus the risk to their farms, fishing enterprises, wood products firms, grazing operations, etc. cannot be easily diversified. Some sources of risk can be averted through the purchase of insurance, but one source of risk is not insurable: the uncertainty that the laws and regulations affecting them will change. Risk-averse people may avoid investments that would make a positive contribution to the economy for fear that they will not reap the rewards of that investment. The Oregon Forest Practices Act places many restrictions on timber harvesting including a requirement that harvest not take place within a specified distance of certain streams and specified requirements about logging roads. The uncertainty that the Oregon Legislature could amend the Forest Practices Act to further reduce the timber they harvest provides an incentive to cut trees now rather than investing in additional years growth to maturity.

The timber example leads immediately to a solution to this dilemma. If a tightening of forest practice regulations that diminished the value of the land was offset by at least some compensation, the landowner would be more inclined to harvest the timber closer to the age at which it would be cut with no threat of government regulation changes. This principle holds generally: compensation can act like insurance against whatever uncertain changes trigger it (Blume and Rubinfeld 1984). People are more likely to live in hurricane-prone areas and flood-

plains if they can purchase insurance against hurricanes and floods, and they also are more likely to live there if the government compensates them for losses when hurricanes and floods strike.

The hurricane and flood analogies suggest the major problem with compensation as a tool to encourage investments by providing the equivalent of insurance. First, society does not always wish to encourage certain risks. Burtraw and Frederick (1992) point out that irrigation in the Pacific Northwest was developed with subsidies from the federal government and that some irrigated crops are subsidized. An investment that appears profitable to a farmer may not increase net national product. Second, provision of compensation and insurance may create a moral hazard problem: the insured parties or the people expecting compensation could alter their behavior in a way more likely to encounter risk. Too much insurance (compensation) for parts of the risk of enterprises may lead to excessively risky decisions from a social perspective. Of special interest to this argument is the concern that expectations of compensation could cause someone to invest in ways that they would not otherwise.

Compensation may force government to consider more carefully the opportunity costs of their actions. The cold hard reality that imposing a cost on someone in the private sector requires compensation and that people in government agencies are accountable makes the concept of cost more tangible and real. Officials at the Bonneville Power Administration must go to their customers and announce a hike in the price charged for power because they spend money on the Fish and Wildlife Program (the set of activities identified by the Northwest Power Planning Council to offset the loss of fish and wildlife caused by the power system). These people are aware of the costs of their actions and are reluctant to undertake costly actions unless the saving in fish and wildlife is cost-effective.

Compensation can reduce the cost of changing legal rules. Displaced fishers, farmers facing reduced incomes, and others facing losses place high demands on management agencies to be strictly accountable for every action taken. Even when the agency complies with all required procedures, adversely affected parties may litigate or bring political power to bear. For example, opposition from members of the Alaska congressional delegation is thought to have played a key role in the slow development of fleet rationalization policies developed by the North Pacific Fishery Management Council. All these activities cost both private parties and public agencies dearly. Efforts to mitigate the economic losses or provide partial or full compensation reduce opposition and, consequently, the need to spend so much negotiating an outcome.

Compensation can lead to better rules. Politically influential groups that are unable to defeat environmental measures, such as the salmon recovery measures, force changes which can blunt the value of the recovery. Compensation causes these groups to lose their interest in opposition and may enable a plan which is more likely to meet the underlying biological objectives of recovery. In the case of Columbia River salmon recovery, compensation has not played a major role in discussions, but large expenditures to mitigate the impacts of recovery measures appear to have fostered a more cooperative attitude in searching for approaches acceptable to most parties involved.

Compensation can reduce long-run transaction costs. Denying compensation when the public considers it valid undermines faith in the law. This reduces the willingness of people to act on faith and increases expenditures on investigating

rules. A widely held perception is that the greater the uncertainty about new environmental measures, the wealthier will become the lawyers. All interest groups, including state and federal agencies, are spending large sums of money on legal research, which would be less necessary if more people accepted the validity of recovery actions. An associated problem is that people spend time and effort evading rules and agencies must respond with more time and effort to enforce relevant rules. One of the lessons of the natural resource co-management literature is that people who "buy in" on a policy reduce transaction costs and improve effectiveness of management (Jentoft 1989, Pinkerton 1989). Although Jentoft and the authors presenting papers in the Pinkerton volume emphasize sharing of management responsibility, the same principles may hold when affected parties accept compensation or approve of mitigative measures.

Compensation is consistent with widely held social norms. For example, people should not be punished for operating under incorrect assumptions when others didn't know what was right and what was wrong. Perhaps of even greater importance is a presumption of entitlement to the use of a natural resource. That is, many believe that when their actions were condoned, perhaps supported, in the past, government implicitly awarded them rights. On the other hand, other parties who were left out historically may challenge the validity of these entitlements.

### *Concerns about Compensation*

Compensation can also create problems. A key concern was already alluded to in terms of incorrect signals about appropriate investment behavior. But other concerns can be added.

Compensation may lead people to lose the incentive to anticipate changes and act early. Not only do the eminent domain and due process clauses of the Constitution encourage people to conform to existing institutions, they also discourage people from anticipating and adopting new institutions early (Friedman 1992). Compensating people who are disturbed by new environmental rules encourages them to operate as they have in the past. If the signal society wishes to send is that the old practices were not consistent with sustainable development and that people should rapidly adopt sustainable practices, then people need incentives to adopt new approaches and disincentives to maintain old ways of doing business. Discussion of license limitation programs including buyback elements not only delay the exit of fishers from declining fisheries, it also attracts those who have left back into the depleted fishery.

If the adversely affected parties were earning monopoly profits, compensation may lead to what is perceived to be excess profits. Some urban residents believe that the agricultural interests seeking compensation are owned by large corporate interests. Although this does not appear to be a problem with compensating those affected by salmon recovery, the concern is valid as a general principle and merits careful examination.

Many environmental policies are adopted to improve public health and safety. Such corrections to previous externalities (elimination of nuisances) do not warrant compensation on either economic or moral grounds. In the Columbia River basin, this issue turns out to be quite complex. One of the measures being proposed is flow augmentation: acquisition of additional water in the upper Snake River basin which would be flushed down the river at a time that approximates

historic flows. To acquire the additional water, negotiations are taking place with irrigators in the upper Snake River basin. One of the complexities now recognized about water markets arises from concern for third parties. In Idaho, some irrigation water evapotranspirates, but much reenters groundwater aquifers and, directly or indirectly, returns as an available resource downstream. Because the nature of externalities among the various water users is complex, the criticism that externalities had been widespread is a subject of careful examination at this time.

All of us face risky outcomes. To the extent that modification of natural resource policies in the Columbia River basin is simply an extension of previous actions, the risk is analogous to the "normal risks of economic life," and compensation is not warranted. This criticism is one of several parts to an argument that the salmon recovery plan measures should be introduced gradually over a long time period with substantial opportunity for adjustment. Fishers, farmers, and other natural resource users understand that change is inevitable; what is less well accepted is the cost driven by rapid change.

If costs of making the compensation exceed the damages done, consider not doing it. Norway's fishing vessel scrapping program illustrates this principle (Brochmann 1983). Drawing on experiences of vessel reduction programs in the 1960s and 1970s, most recent programs either buy back licenses rather than vessels or, as was the case in Australia (Wesney 1989) and was the case in the last vessel reduction program carried out by Oregon in the Columbia River (Rettig 1986), they rely on less expensive ways of getting the job done.

### *Summary and Conclusion*

Although recovery of threatened and endangered salmon species ultimately will include a wide range of actions, four major thrusts are at the center of current discussions. First, the Power Council and associated state and federal agencies are working to improve the fish habitat for returning salmon. Second, these groups, as well as private dam operators, are introducing improved devices such as fish screens that should reduce mortality rates. Third, fishery management agencies have been reducing the harvest of threatened and endangered salmon stocks in both the ocean and the river; these actions are likely to continue and may become even more restrictive. Fourth, water management agencies are considering ways to reduce mortality in migration through altering the flow of water.

The recovery plan for any threatened or endangered salmon stocks is the responsibility of the National Marine Fisheries Service (NMFS). Although NMFS delegated much planning authority for habitat measures to the Northwest Power Planning Council, fishery management measures will be developed by the Pacific Fishery Management Council and related fishery planning and management agencies (especially the Oregon Department of Fish and Wildlife, the Washington Department of Fisheries, the Columbia River Inter-Tribal Fish Commission, and the institutions that these groups use to coordinate fish management in the Columbia River).

Two strategies, which will be further examined by the various fishery management bodies, have been mentioned by the Power Council. These are to reduce fishing rates (the fraction of available adult fish that is taken in a particular fishery) and to redirect fishing effort away from stocks that include Snake River salmon.

Since these measures probably will reduce the economic opportunities available to the non-Indian gillnet fishery, the Council suggests that the States of Oregon and Washington be given funds to buy some fraction of the fishing licenses in those fisheries from the fishermen (the non-Indian gillnet fishery in the Columbia River requires licenses which are transferable). That is to say, the Power Council suggested that someone consider compensating, at least partially, non-Indian gillnet fisherman for their losses in income. During public hearings this proposal was sharply criticized because of its implicit assumption that fishing opportunities would be reduced; the commercial fishermen and their associated communities are not ready to concede this point and fear that acceptance of a buyback program would legitimize a significant reduction in commercial fishing. A later proposal for a "leaseback" (non-Indian gillnetters would receive payments for not fishing during a few years but they would retain the ability to re-enter the fishery when salmon stocks recover) was set aside when Indian fishers, who harvest fish commercially upstream from the non-Indian gillnetters, refused to forego their rights to harvest the fish that were not taken downstream. Who has what rights and what limits can be placed on rights is of high concern to fish harvesters and water users and to their critics.

Mitigation and compensation strategies should be carefully analyzed to determine their economic impacts. There are good economic grounds for helping displaced fishers and other affected parties and their communities, but there are reasons to be concerned about the amount and nature of the public funding to alleviate private distress. In the final analysis, who pays and how much they pay to support salmon recovery must also meet criteria of social justice and political feasibility.

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