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The Fishery as a Watery Commons: Lessons from the Experiences of Other Public Policy Areas for U.S. Fisheries Policy

Lawrence J. White [*]

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[*] Lawrence J. White is an Arthur E. Imperatore Professor of Economics at the Stern School of Business, New York University. He can be contacted at Lwhite@stern.nyu.edu. An earlier draft of this paper was presented as a report to Environmental Defense. The author would like to thank David Festa, Gary Libecap, Robert Repetto, James Sanchirico, Bernard Shull, and Tom Tietenberg for helpful comments on an earlier draft.

Executive Summary

Open access, combined with modern technologies of fishing, has created serious problems of overfishing and threatens the sustainability of many U.S. fisheries. The common pool problem -- the ocean version of "the tragedy of the commons" -- is the root cause of the overfishing.

The major regulatory policies of the past few decades that have tried to address overfishing -- restrictions on fishing methods and inputs (in essence, “command and control” regulation) -- have largely been failures. Indeed, they have often perversely exacerbated fisheries’ overfishing problems by encouraging “fishing derbies” or “races for the fish”.

Fisheries are not alone in facing a common pool problem. Other areas of the U.S. economy have confronted similar problems, and public policies have developed to deal with them. This paper discusses seven of these other areas: the use of the electromagnetic spectrum, the control of sulfur dioxide emissions by electric utilities, grazing on public lands, forest logging on public lands, oil-gas-coal extraction from public lands and offshore waters, hard rock mineral (metal) mining, and surface water usage.

Important lessons can be gleaned from the policies that have been developed in these other areas, and this paper applies those lessons to the design of U.S. fisheries policy.

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"Imagine what would happen if the USFS were to offer a timber sale and select the top two, or five, or even 100 bidders rather than selecting the high bidder. The selected firms would be told that at a certain date and time they could begin cutting within a certain plot that featured a certain amount of board feet. But no individual firm would know its specific allocation. A race, or perhaps even mayhem, would be the consequence. Forest and range management avoids the results common in fisheries by specifying individual exploitation opportunities." (Macinko and Bromley, 2002, p. 28)

"Although the IFQ is no panacea, it deserves a place in the array of techniques that may be needed in any particular fishery management plan. Its value in matching harvesting and processing capacities to the resource, slowing the race for fish, providing customers with a better product, and reducing wasteful and dangerous fishing has been demonstrated repeatedly." (NRC, 1999a, pp. 11-12)

1. Introduction

Many of America's fisheries are in serious difficulties or are headed in that direction. Within the past decade four major national reports[1] have documented these difficulties.[2] The annual domestic catch from all U.S. fisheries peaked in 1993 and 1994 at just under 10.5 billion pounds, worth about $3.8 billion in each year. The quantity and value of the annual catch have declined and stagnated since then. In 2004, the annual catch was only 9.6 billion pounds, with a value of $3.7 billion.[3]

The immediate source of these difficulties is generally understood: overfishing, compounded by incidental species and habitat damage. The "deeper" source of these problems -- a "common pool" phenomenon, compounded by the reduced costs and improved technologies of fishing and harvesting -- is less widely recognized. And there is yet less agreement on the appropriate remedies for the problems of these overfished fisheries.

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[1] See NRC (1999a, 1999b), Pew Oceans Commission (2003), and U.S. Commission on Ocean Policy (2004). The first two reports focus primarily on fisheries' difficulties; the latter two address a wider range of ocean issues. A review of the latter two reports is provided by Sanchirico and Hanna (2004).

[2] In addition to the four reports just cited, recent books that discuss U.S. fishery difficulties, sometimes within the context of a wider range of ocean problems, include Wilder (1998), Iudicello et al. (1999), Cicin-Sain and Knecht (2000), Weber (2002), Ellis (2003), Fujita (2003), Pauly and Maclean (2003), and Sloan (2003).

[3] These data can be found in the annual Fisheries of the United States, published by the National Marine Fishery Service. The report for 2004 can be accessed at: http://www.st.nmfs.gov/st1/fus/fus04/index.html.

Fisheries are not alone in facing this common pool problem. Other areas of the U.S. economy have confronted similar problems, and public policies have developed to deal with them. This paper will describe briefly seven of these other areas, their problems, the public policies that have developed for these areas, and the advantages and disadvantages of those policies. The lessons and insights that can be gleaned from these other areas will then be applied to the problems of fisheries and specifically to the design features and characteristics of an especially promising way of dealing with the common pool problems of fisheries: dedicated access programs (DAPs) that can create quasi property rights in fish harvesting.

This paper will proceed as follows: In Section II we will provide an overview of the common pool and habitat destruction problems of fisheries. Section III describes briefly the past policies that have attempted to deal with these problems. Section IV surveys seven other areas of the U.S. economy where common pool problems are actually or potentially present -- the use of the electromagnetic spectrum, the control of sulfur dioxide emissions by electric utilities, grazing on public lands, forest logging on public lands, oil-gas-coal extraction from public lands and offshore waters, hard rock mineral (metal) mining, and surface water usage -- and the ways in which public policies have evolved to deal with the problems in these areas. Section V draws the lessons and insights from this survey of the other seven areas. Section VI briefly describes the actual and potential use of DAPs in fisheries. Section VII applies the lessons and insights from the other seven areas to address the design issues for fishery DAPs. And Section VIII provides a set of recommendations and conclusions.

2. The Problems of U.S. Fisheries

In its most recent annual assessment of the state of U.S. fisheries, the National Marine Fisheries Service (NMFS) reported that as of 2005, of the 251 fish stocks whose status could be ascertained by the NMFS, 73 (29%) were overfished, subject to overfishing, and/or approaching an overfished condition.[4] These stocks included such well known fish categories as cod, haddock, flounder, hake, sea scallop, monkfish, red snapper, grouper, black sea bass, conch, yellowfin tuna, marlin, sailfish, and albacore.

[4] The NMFS issues these reports on an annual basis. The report for 2005 was issued on June 20, 2006,

Perhaps most dramatic is the story of the U.S. Atlantic cod fishery. The cod fishery catch hit a peak in 1980 of 118 million pounds. Landings have declined severely since then. In 2004 the catch was only 16 million pounds, less than 14% of its peak level 24 years earlier.

The reasons for these fishery declines are primarily overfishing -- too many boats and fishermen chasing too few fish -- and secondarily incidental species and habitat damage. The overfishing problem, in turn, is due to the common pool nature of open-seas fishing. The remainder of this section will expand on these issues.

The common pool problem and overfishing

The standard model for agricultural production is that of the owner-occupier farmer who owns the land, tills the soil, cultivates the crops, harvests the crops, and brings them to market. This standard model generally aligns incentives with ownership of the resources.

By contrast, the open-seas model for fishing does not provide the fisherman/harvester with the ownership of the harvesting environment. Instead, the open seas generally provide open access to all on a first-come, first-served basis.[5] In essence, the open seas are a watery "commons". The fish do not become the property of the harvester until they are caught.

So long as the fishermen are few as compared with the availability of fish ("biomass") in a fishery, the open access conditions do not create a major problem. As the number of fisherman grow and/or their technological effectiveness in harvesting increases, however, their joint efforts create the potential and -- as the experiences of fisheries in the U.S. and elsewhere show -- the actuality of a "tragedy of the commons".[6] In order for the fish stock to replenish itself, enough fish must remain uncaught so as to allow for breeding and nursery growth. But, from the perspective of the individual fisherman, an uncaught fish is simply one that another fisherman is likely to catch. Each fisherman is likely to think primarily of his own gain and to ignore the consequences for others -- a problem of negative "externalities" or spillover effects.

In essence, each fisherman reasons to himself, "If I refrain from catching fish in hopes of

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and can be accessed at: http://www.nmfs.noaa.gov/docs/Report_text_FINAL3.pdf.

[5] Even after the U.S. extended its exclusive economic zone (EEZ) to 200 nautical miles in 1976 under the Fishery Management and Conservation Act (subsequently renamed the Magnuson-Stevens Act), access to fisheries within the EEZ generally remained open. The EEZ is split into state waters (typically from the shoreline out to three nautical miles) and federal waters (typically from three to 200 nautical miles). This paper will focus on fisheries in federal waters.

allowing the stock to replenish, it's likely that some other fisherman will catch those fish anyway, and the stock won't replenish; so, I might as well be the one to catch those fish." Equivalently, each fisherman may reason, "My extra harvesting effort won't make a big difference as to whether the overall stock replenishes itself or not." But if all fishermen behave in this way, the overall stock will become depleted. And, as mentioned above, as the number of fishermen increases and/or as the technology of fishing improves, the overfishing problem will become more severe.

Incidental damage

A second source of problems for fisheries is incidental damage to a species or its habitat by fishermen who are pursuing their desired species. One form of incidental damage is "bycatch": the inadvertent capture and death of members of another species. The example of dolphins' being caught in tuna nets is the best-known example of bycatch, but its prevalence and seriousness extends much farther. A second form of incidental damage comes from damage to another species' habitat as a consequence of the pursuit of a species. Bottom dredging for shellfish is an example of a practice that damages the habitat of other species.

These problems of incidental damage are also examples of negative externalities: one fisherman's actions having negative consequences for other fishermen (or for others who value the damaged species in other ways). Ironically, as is discussed in the next Section, some of the policy efforts that have been harnessed to try to deal with fisheries' overfishing problems have tended to exacerbate these incidental damage problems.

3. Past Policy Efforts to Deal with Fisheries' Problems

U.S. policy efforts to deal with fisheries' problems can categorized into three broad areas: (a) limit the catch through restrictions on fishing methods and fishing inputs; (b) close part of the affected fishery to fishing efforts; and (c) limit the catch through DAPs. We will briefly discuss each policy direction.

Limiting methods and inputs

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[6] Hardin (1968).

Where fisheries are recognized to be overfished, regulators[7] have often tried to restrict the size of the catch (so as to allow replenishment) by setting a target limit for the annual catch and then trying to meet this target by instituting restrictions on fishermen's use of inputs. These limitations include limits on the number of calendar days during which the fishery is open for fishing; limits on the type of gear that can be used while fishing; limits on the size or type of vessel that can be used in fishing; limits on the number of one-day trips that boats can make into the fishery; and limits (licenses) on who can do the fishing.

All of these input limitations have the characteristics of "command-and-control" regulation, in which regulators attempt to exercise detailed control over the production processes (e.g., in environmental regulation or workplace safety regulation) of (often) hundreds or even thousands of producers that vary in their technologies and capabilities. Such "technology standards" stand in contrast with "performance standards", whereby regulators set performance goals for the regulated entities and then let the latter figure out their preferred ways (given their differing capabilities) of meeting those goals. Unless regulators are omniscient, technology standards are likely to create greater impediments to efficiency and to technological improvements than do performance standards.[8]

In the case of fisheries, these input limitations -- especially the limits on the number of calendar days for fishing -- have led to "fishing derbies" or "races for the fish", in which fishermen try feverishly to maximize the amount of fish harvesting that they can accomplish within the limited time period available to them. Such derbies then have a large number of unfortunate aspects and adverse impacts:

- They create inefficiency, by encouraging vessel owners to maximize vessel, gear, and crew for the short "open" period rather than allowing for a more measured pace and for the appropriate inputs that would accompany a more measured pace; concomitantly, the equipment, gear, and crew are idle for the remaining part of the year or are used in less suitable alternatives.[9]

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[7] Fishing regulation occurs primarily through eight regional fishery management councils, under the auspices of the NMFS, which is a branch of the National Oceanic and Atmospheric Administration (NOAA), which is an agency within the U.S. Department of Commerce.

[8] The sulfur dioxide limitation program, discussed below, provides a salient example of the efficiency gains from performance standards. See Ellerman et al. (2000) and more generally, Hahn (1989).

[9] Subsidies to encourage more fishing by American fishermen after the extension of the EEZ to 200 nautical miles in 1976 have also been partly responsible for the excessive amount of capital (vessels and gear) in many fisheries. The effort to expand vessels and gear to maximize output during fishing derbies is often described

- Similarly, processing facilities and labor are inefficiently utilized for only a short period and are idle the remaining part of the year.

- A short-term glut of harvested fish means lower prices for fishermen.

- The short-term glut of fish means less fresh fish (and more frozen fish) will be available in the market; again, this means lower prices for fishermen.

- The frenzied pace exacerbates problems of on-board crew safety.

- The frenzied pace exacerbates problems of bycatch and habitat destruction, since fishermen are unlikely to take the time necessary to be careful and avoid capturing unwanted species.

- The frenzied pace exacerbates problems of gear waste and abandoned gear, which in turn can lead to "phantom fishing" and more unproductive destruction of fish.

Further, where the restrictions take the form of limits on gear, fisherman ingenuity and technological improvements often foil and overcome the limiting intent of the restrictions. Together with the frenzied derbies, the result is likely to be an aggregate exceeding of the target catch. Such "overages" often lead to yet tighter restrictions and yet greater inefficiencies.[10]

Fishery closures

Though no fishery in the U.S. has experienced a complete closure because of depletion, parts of fisheries have been closed so as to encourage replenishment.[11] In an important sense, however, when the fishing season is limited to a small number of calendar days in a year, as was described above, the fishery is effectively closed for the remaining days of the year.

Dedicated access programs

In a few U.S. fisheries, DAPs are in place as an alternative to the command-and-control

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as "capital stuffing".

[10] The contraction of the Alaska halibut season is a "poster child" for this process. From an open season of over 150 days in the early 1970s, the season length shrank to only 47 days by 1977 *and then collapsed to an average of only 2-3 days per year between 1980 and 1994*. See NRC (1999, pp. 71-72, 304-307), Gates (2005), and Leal (2006). Similarly, the collapse of the surf clam fishery in the Mid-Atlantic region caused a progressive shortening of allowable fishing time until, in 1990, a surf clam vessel was permitted to fish *only 6 hours every other week*. See Wang (1995).

[11] The closure of part of a fishery -- e.g., spawning grounds -- may also occur, as closure of the spawning grounds may be the most effective means of stock replenishment.

limitations on inputs discussed above. The essence of a DAP is the setting of a "total allowable catch" (TAC), an allocation of percentage shares of that catch among fishermen according to a specified method, and credible monitoring and enforcement of the allocations. By focusing on the allocation of the catch, a DAP involves a direct limitation on an individual fisherman's output (i.e., how much he catches) rather than the indirect limitation on inputs (i.e., how he fishes). A more extensive discussion of DAPs will be forthcoming in Sections VI-VIII below.

4. Other Common Pool Problems, and Other Public Policies

As was noted in the Introduction, fisheries are not alone in experiencing common pool problems. This Section will provide brief descriptions of the problems in seven other areas of the U.S. economy and the public policies that have developed in response.[12]

Electromagnetic spectrum

The use of the electromagnetic spectrum -- e.g., for radio broadcasting, television broadcasting, satellite transmissions, cellular telephony, etc. -- involves potential or actual problems of "interference", which is another form of negative externality: One party's transmissions will interfere with a second party's transmissions, if the two are at the same place, time, and frequency band.

Interference became a recognized problem for radio broadcasting in the U.S. in the mid 1920s. The federal government's response was the Radio Act of 1927 and the Communications Act of 1934, which declared the electromagnetic spectrum to be a national resource, with its use to be regulated by the Federal Communications Commission (FCC) as the steward on behalf of the general public. In essence, the FCC has overcome the interference problem by identifying specific broadcast locations, frequency bands, power limits, uses for the broadcast transmissions (e.g., radio, TV, telephone, satellite, etc.), and the specific holder of a license who could use the spectrum at that location and frequency band. Prior to the 1980s, where there were competing candidates for a specific license, the FCC would hold comparative hearings (which became known as "beauty

[12] A somewhat similar set of comparisons can be found in NRC (1999a, pp. 45-58). Except for water rights (which are the domain of the states), this paper focuses on federal policies, although in some areas (e.g., grazing, forestry, oil-gas-coal leasing) some states own relevant lands and pursue their own policies.

contests") that would determine which candidate was the best suited for the specified use "in the public interest".

The licenses are "use-it-or-lose-it" permits, with no fees and with fixed terms but also with strong presumptions of renewal. The licenses are not transferable as a "naked" license, but one company can acquire another company that has a license and (with the FCC's permission) thereby acquire the license. For radio and television broadcast licenses, there are limits as to the number of licenses that can be held by a single individual or company.

The detailed site-power-use-user restrictions of the FCC on the broadcasting license fit well into the mold of command-and-control regulation.

The "beauty contest" format collapsed in the early 1980s when the FCC was swamped with applicants for the burgeoning business of providing cellular telephone service. The Congress passed legislation that instead allowed lotteries among pre-qualified applicants. The subsequent large windfalls that transpired when lottery winners were bought out by other companies provoked a political reaction, which led (along with Congress's desire to increase budgetary revenue) in 1993 to legislation that authorized auctions for cellular telephone spectrum and similar frequency bands.

The spectrum auctions, which began in 1994 and have continued to the present, have raised tens of billions of dollars for the U.S. Treasury while allowing the purchaser/users substantially greater flexibility in use and technology than has been true for the traditional command-and-control spectrum license (which has remained the predominant form of license across the spectrum).[13] The auctioned licenses are usually for newly opened swaths of spectrum (or for spectrum that has had limited numbers of traditional users, who can fairly easily be cleared and moved to other spectrum bands) and are for limited terms -- 10-15 years -- but carry a strong presumption of renewal. It is also worth noting that some auctions have been structured so as to favor smaller businesses and other groups in the bidding.

The spectrum auction system is considered a highly successful innovation in the way that spectrum is allocated.

Sulfur dioxide (SO_2) emissions

Environmental pollution is a general negative externality problem. Federal efforts to limit

[13] Discussions of the auctions can be found, for example, in Cramton (1997, 1998), McMillan (1994),

pollution have generally been of the form of command-and-control regulation, often involving technology standards rather than performance standards. During the 1970s and 1980s there were some modest efforts at developing performance standards and permitting greater flexibility among pollutant emitters in achieving targets.[14]

The 1990 Amendments to the Clean Air Act, however, provided a major advance in the use of incentives, by establishing a tradable permit system for SO_2 emissions (which are precursors to "acid rain") by electric utilities.[15] In essence, a national annual maximum aggregate amount of allowed SO_2 emissions from U.S. electric utilities for 1995 and after (with a lower national total that applied in 2000 and after) was allocated among the utilities, based proportionately on the 1985-1987 historical SO_2 emissions by each utility. The emissions permits were distributed at a zero price to the utilities and are valid in perpetuity (although subject to change by national legislation). They are freely tradable and are purchasable by anyone. They can be banked for future use, or not used at all (e.g., if bought by environmental groups that wish to reduce SO_2 emissions below the aggregate capped level). Electric utilities are fined heavily if their annual SO_2 emissions (as monitored by the U.S. Environmental Protection Agency) exceed the amount for which they have (or have bought) allowances.

The tradable permits give each utility the greatest amount of flexibility in controlling emissions, while still ensuring that the aggregate target is achieved. Each utility can reduce its emissions level by adjusting its fuel mix (e.g., by using low-sulfur coal or petroleum or even by switching to natural gas), adjusting its combustion processes, installing smokestack scrubbers, or any other control method. A utility that has relatively low incremental costs of control can reduce its SO_2 emissions below the level of its allocated permits and sell its "surplus" permits to a utility with relatively high incremental costs of control; the aggregate amount of emissions from the two utilities, of course, is unaffected by the trade, but aggregate efficiency is improved as compared with the absence of trading possibilities. Active markets have in fact developed for trading these permits.[16]

McAfee and McMillan (1996), and White (2001).

[14] See, for example, Hahn (1989).

[15] For more discussion of this experience, see, for example, Joskow et al. (1998), Stavins (1998), Schmalensee et al. (1998), Joskow and Schmalensee (1998), Ellerman et al. (2000), and Raymond (2003, ch. 3).

[16] The EPA also holds "zero-revenue" auctions annually, in which it calls back slightly less than 3% of

The flexibility that is concomitant with the tradable permit system has yielded substantial efficiency gains and cost savings in meeting the SO_2 targets.

Grazing on Public Lands

Prior to the turn of the twentieth century, the grazing of livestock -- cattle and sheep -- on public lands was largely a free-for-all.[17] The absence of specific property rights meant that a commons problem was present: over-grazing and clashes among livestock owners. In essence, the grass couldn't be owned until it was eaten by the animals.

The federal government first began the process of limiting access by livestock owners with the passage of the Forest Management Act of 1897, placing public-lands grazing under the auspices of the U.S. Department of the Interior (DOI); further limits and the institution of fees followed the formation of the U.S. Forest Service (USFS) within the U.S. Department of Agriculture in 1905 and the transfer of forests and some grazing lands to the USFS. Only in 1934, however, with the enactment of the Taylor Grazing Act, did the structure of grazing permits solidify into its current form.

Grazing permits are distributed by the DOI's Bureau of Land Management (BLM), which administers 160 million acres of grazing land, and by the USFS, which administers 95 million acres in national forests. Fees (specified by a legislative formula) are charged by both agencies, much of which is retained by the agencies or the states for range development; the fees are below market rates.[18] The permits are for 10 years, with a strong presumption of renewal. The primary qualification for obtaining a permit is owning land (e.g., a ranch) that is adjacent to the public grazing area.[19] The permits have a "use-it-or-lose-it" requirement, with the exception that the BLM allows a permit holder to sub-lease. The permits cannot be traded "naked", but they can be acquired

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each utility's permits and auctions them, with all of the proceeds being directly transmitted back to the individual utilities. The original idea was to ensure that permits would be available (at a price) to new entrants.

[17] See, for example, Nelson (1997), Cody and Baldwin (1998), Macinko and Raymond (2001), and Raymond (2003, ch. 4).

[18] The strongest evidence of these below-market levels is that higher rates are received when (as the BLM allows, but the USFS does not) a permit holder sub-leases the grazing rights to another rancher. See Hess and Holechek (1995).

[19] Also, in the initial allocation of permits after enactment of the Taylor Act, the historical patterns of grazing by individual ranchers played a role. See Macinko and Raymond (2001) and Raymond (2002, ch. 4).

(with the issuing agency's approval) as part of the acquisition of the ranch that is the basis for the permit.

Although the permit system has dealt with the general common pool problem, there are still substantial problems with the permit system, which embodies command-and-control features. First, the combination of use-it-or-lose-it requirements plus specified grazing utilization levels has often led to overgrazing and deterioration of the grazing land.[20] Second, use-it-or-lose-it requirements have meant that lands that might be better suited to other uses -- or better just retired -- cannot be so used. Third, with incomplete property rights to the grazing lands themselves, permit holders require agency approval for and have often been reluctant to invest in facilities improvements, such as better fences or watering areas; potentially efficient improvements remain undeveloped.

Timber auctions on public lands

The federal government first exercised control over logging on public lands in 1891. After a ban of six years, the DOI first allowed logging on these lands in 1897. With the formation of the USFS in 1905, public forest land that could be logged was transferred to the USFS's national forests.[21] Today the national forests encompass approximately 193 million acres.

If the USFS were to allow open logging access to the national forests, the common pool problem would immediately arise. Instead, from the beginning, the USFS has placed at auction specific tracts of land, with the highest bidder getting the sole right (permit) to log that tract.[22] The winning bidder must log the land; i.e., the permit embodies a use-it-or-lose-it requirement. Permits are for a limited period -- around three years -- but can be extended/renewed by the USFS. Permits can be transferred with the permission of the USFS. Some auctions are reserved for small business bidders only.

The USFS had been criticized for subsidizing timber sales by building excessive and excessively costly roads that facilitate the logging, for structuring its auctions in ways that may not maximize the revenues from the auctions, and for allowing environmentally damaging practices such as clear-cutting. Also, there have been controversies with respect to whether specific

[20] See, for example, Hess and Holechek (1995).

[21] The DOI, of course, retained the administration of the national park system. Also, some of the USFS national forest areas have been designated as wilderness areas in which logging is forbidden.

[22] A concise description of the USFS's auction procedures can be found in Baldwin et al. (1997); see also

environmentally sensitive national forest areas (e.g., the Tongass National Forest) should be subject to logging.

Oil, gas, and coal extraction from public lands and offshore waters

Since the Mineral Lands Leasing Act of 1920, drilling/mining/extraction rights for oil, gas, and coal on specific tracts of public lands have been auctioned by the DOI.[23] Again, in the absence of this unitization, a common pool problem would arise; the sole winner aspect of the auction solves this problem.[24] The auction winner gets a lease, typically for 5-10 years for oil and gas and for 20 years for coal. The leases carry use-it-or-lose-it requirements. The lease is renewable by the DOI; the lease is transferable with the permission of the DOI.

Controversies with respect to these leases have arisen when environmentally sensitive areas have been placed at auction and (especially for coal) when environmental damage follows in the wake of extraction.

Extraction of "hard rock" minerals from public lands

A quite different regime applies to the discovery and extraction of "hard rock" minerals (i.e., metals) from public lands.[25] The guiding legislation is the General Mining Law of 1872. Under the Mining Law, anyone can search for minerals on public domain lands, such as those administered by the BLM (but not national parks, wilderness areas, and other protected areas). Upon finding a recoverable deposit, the discoverer can stake a claim (but must provide evidence that a minable deposit is present) with the DOI. A claim can be no larger than 20 acres, but multiple claims can be made. Preserving the claim requires an annual fee of $100 per claim. The discoverer can then take

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Gorte (1995).

[23] See, for example, Watson (2005). The prospecting for and mining of some less prominent minerals, such as sulfur, phosphates, sodium, and potash, is handled through a different set of procedures -- prospecting permits -- that gives preference to the discoverer but also involves royalties. See, for example, Teisberg (1979).

[24] Even with a sole winner of an oil/gas auction, there may still be a common pool problem if the geographic boundaries of the tract that is auctioned encompass an area that is smaller than the area of the oil or gas pool below ground and adjacent tracts overlap this underground pool. In this case, each tract lessee will race to drill first and extract as quickly as possible, both of which actions are likely to come at the expense of efficient extraction of the oil or gas. For a discussion of some of the problems of a further stage of unitization (i.e., a single extractor per pool), see, for example, Libecap and Wiggins (1985) and Wiggins and Libecap (1985).

the next step of filing a mineral "patent" and thereby gaining full ownership to the claim territory. The patenting process requires a one-time fee of $2.50-$5.00 per acre, plus some additional administrative fees.[26] With possession of the patent, the owner can then mine the land or use it for any other purpose.

This file-claiming and patenting process clearly solves the potential common pool problem that unrestricted access would pose. The criticism of this process centers largely on the small fees and absence of royalties -- in essence, the giving away of valuable public resources -- and on the environmental damage that may follow in the wake of the mining operations that are undertaken.

Surface water usage

Water rights are primarily governed by state law. The states generally declare that water bodies are the property of the state, with individuals having the right to use the water for beneficial purposes. There are two general state models for the specification of water rights. For the states that are east of the Rocky Mountains, "riparian" water rights generally apply: The owners of the land that is adjacent to a body of water are those that have the strongest claim to remove water from it. For the more arid states of the Rocky Mountains and westward, "prior appropriation" water rights generally apply: The earliest (in chronological time) claims to remove water from a body of water are the strongest (this is often paraphrased as "first in time is first in right").

Water use rights are usually in perpetuity. Especially in "prior appropriation" states, they usually have use-it-or-lose-it requirements. They are usually difficult to sell "naked", although such transactions are becoming more common. Water rights, however, usually attach to the land or the business of the water user and can be transferred with the land or business, with the permission of the state. Where water comes from a dam or special irrigation project, fees are usually charged to users; but the fees, especially to agricultural users, are usually below market/opportunity cost levels.

Because the water rights are usually expressed in absolute quantity terms, difficulties arise in dry years when water flows are insufficient to satisfy all claims. Under riparian water rights, users

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[25] See, for example, Gerard (1997) and Humphries (2003).

[26] As is indicated above, this procedure applies to minerals that are found on "public domain" lands -- i.e., those public lands that the federal government obtained by treaty, conquest, cession by states, and certain purchases. For "acquired" public lands (lands that have been granted or sold to the federal government by a state or a citizen), a more limited procedure of exploration permits and then 20 year leases, with royalties paid to the government, apply.

generally absorb proportional reductions; under prior appropriation water rights, higher priority users maintain their removal levels and lower priority users bear the brunt of the reductions.

Water rights systems have been criticized because of their inflexibility and inefficiencies.[27] Restrictions on trading prevent water from being transferred from lower-value uses to higher-value uses, as do use-it-or-lose-it mandates. In addition, it is difficult to accommodate "in-stream" uses and rights -- for boating, fishing, and other recreation -- with the traditional water removal rights system, so that (again) the diversion of water to potentially higher-value recreational uses may be difficult. Since the 1980s there has been some progress in facilitating trading in water rights and thus in accommodating higher value uses and users.[28]

5. Lessons and Insights from the Experiences of Other Policy Areas

There are a number of important lessons and insights that can be distilled from the policy experiences of the other natural resource areas that were reviewed briefly in the previous Section.[29]

1. Permits[30] (or licenses) are a generally used method for successfully addressing actual or potential common pool problems. However, the details of the permit systems vary among these other areas, and the differences are important for how successful the permit systems are in addressing economic efficiency and other issues.

2. Permits have value. Sometimes this value is captured for the public fisc through auctions (as in cell-phone spectrum since 1994, forestry, and oil-gas-coal); sometimes fees (but below market levels) are charged (as in grazing, surface water, and hard rock mining); and sometimes the valuable resource is simply given away (as in SO_2 emission permits and "traditional" spectrum licenses). Where auctions are held or fees charged, some or all of the proceeds can be earmarked for covering the costs of the program as well as for investments in the resource.

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[27] See, for example, Tietenberg (2003, ch. 10).

[28] For examples, see Anderson and Snyder (1987), Tietenberg (2003, ch. 10), and Brookshire et al. (2004).

[29] See Macinko and Raymond (2001) for another view of comparisons across resource policies.

[30] As should be clear from the discussion of permits in the context of the seven programs that were reviewed in the previous Section, “permits” denote secure access privileges to specific quantities of public resources that are granted to private users. In that sense, they are considerably more specific and focused than, say, a “fishing license” or other permit that provides access to a fishery but that does not

3. The conditions and attributes that accompany the permits can greatly influence the economic efficiency with which the resource governed by the permits is utilized.[31] The permit attributes that encourage greater efficiency are generally:

- longer tenure (so that permit holders can make longer-range allocation and investment decisions);

- greater security of tenure (again, so that permit holders can feel secure in making costly investments);

- greater tradability (so that less efficient permit holders can sell more readily to users that place a higher value on the resource);[32] and

- more flexibility in the use of the permit (so that a wider range of uses – or even non-use – can be accommodated.

The experiences of the SO_2 emissions trading program, the cell-phone spectrum auctions since 1994, and the hard rock mining patents are strong support for these attributes.

4. Permits solve only the common pool problem. Though this represents a major achievement for permit systems, they do not solve other negative externality problems, as is indicated by the problems of over-grazing on public lands, clear cutting in national forests, and environmental destruction in the aftermath of oil-gas-coal and metals extraction. Other measures are needed for these other problems.

5. Use-it-or-lose-it requirements are common. This is understandable, since the laws governing the use of the resources usually have had a pro-development emphasis, reflecting the resource-development ethos that originally underlay the laws. Nevertheless, it is important to recognize that use-it-or-lose-it requirements often are inconsistent with more modern notions of natural resource stewardship and can carry substantial costs, by forcing inefficient uses (water, forestry) and even encouraging environmental destruction (grazing).

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restrict the quantities that a permit-holder can harvest.

[31] Economic efficiency in the use of the resource encompasses not only standard notions of short-run production efficiency but also a longer-run concept of the resource being used in the highest value way among competing uses.

[32] If the trading markets involve low transactions costs -- as has been true for the SO_2 permits, for example -- then there will be only a small difference in efficiency between an initial allocation through auctions (which will immediately identify the highest-value users) and an initial allocation through some other method (and then subsequent low-cost trading allows the highest-value users to obtain the permits).

6. There has been a trend since the late 1980s toward replacing command-and-control regulation with more market-oriented mechanisms, as is indicated by the SO_2 emissions trading program, the cell-phone spectrum auctions, and increased trading in surface water rights.

7. Permits must be allocated initially through some mechanism. Auctions (for cell-phone spectrum since 1994, for timber, and for oil-gas-coal) solve this problem by awarding the permits to the highest bidder. A lottery (as for cell-phone spectrum in the 1980s) solves this problem through chance. Other distribution systems try to have some concrete basis for the allocation. For traditional spectrum, it was "beauty contests" in which the FCC tried to pick the applicant that would best serve "the public interest". For grazing, it was who held land adjacent to the grazing land and historical grazing patterns. For SO_2 emission permits, it was SO_2 emissions during the historical 1985-1987 period. Political considerations inevitably enter into the details of these systems.[33]

8. Allocation mechanisms can be weighted so as to favor specific groups. For the post-1994 spectrum auctions, in some instances the bidding rules have been adjusted so as to favor small businesses and other groups; similarly, some USFS timber auctions have been reserved for small businesses. These modifications are, of course, an aspect of those political considerations mentioned above.

9. Where permits have limited lives (i.e., for spectrum, grazing, forestry, and oil-gas-coal leases), there is usually a strong presumption -- but no guarantee -- of renewal for the incumbent.[34] This presumption encourages more efficient investments; but the presumption is not the same as having secure property rights and therefore does not provide the complete security that would generate the most efficient investments.

The laws that have created these permits have been deliberate in the straddling of the issue of security of tenure and property rights.[35] The Congress has generally not wanted to create a set of full property rights in the permits; it wanted to give itself the flexibility of future revocations of the

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There is, however, a substantial difference in who receives the scarcity rents from the distribution.

[33] Joskow and Schmalensee (1998), Ellerman et al. (2000), and Raymond (2003, ch. 3) discuss the political considerations that underlay the initial allocation of SO_2 emissions permits; Macinko and Raymond (2001) and Raymond (2003, ch. 4) discuss the political considerations that underlay the initial allocation of grazing rights.

[34] Where historical activity plays a role in determining the initial allocation, in an important sense incumbency is an important determinant of this historical pattern.

[35] See, for example, the discussion in Raymond (2003).

permits in the event that different policies would be pursued and avoid the possibility that such revocations would be considered to be unconstitutional "takings" of private property. Yet, at the same time, the Congress often wanted the permit holders to be able to treat the permits as collateralizable property when (for example) the permit holders were applying for loans from financial institutions. Inevitably, this straddling has meant tradeoffs.

10. If permits are expressed in absolute amounts (rather than relative amounts) and the underlying supply of the resource is variable (as in surface water), allocation problems and inefficiencies can arise.

11. Limits can be put on the accumulation of permits (as in spectrum) if there are fears that unimpeded accumulation could lead to economically or socially undesirable concentration of permits in a relatively few hands.

6. DAPs for Fisheries: The General Argument

Dedicated access programs (DAPs) for fisheries follow the same logic as the permit and license programs that were reviewed in the previous two Sections: DAPs provide an output-based mechanism for dealing with the common pool problem that open access and relatively low fishing costs create. By focusing on outputs rather than on fishing methods and inputs, DAPs allow fisheries managers to escape from the inputs-based mechanisms -- "command-and-control" regulation -- and focus directly on the aspect of fishery management that is crucial: limiting the overall catch to levels that are sustainable and allow replenishment of the stock.[36] The remainder of this Section will describe briefly the major features of DAPs and their advantages, as well as their potential problems. More details on the operation of DAPs and the potential alternative characteristics and design features that can be embodied in DAPs will be provided in Section VII below.

The basics

There are fundamentally three steps to the operation of a DAP:

1. Using scientific estimates of the fish stocks that are needed for replenishment and a

[36] In an important sense, replacing input regulation with DAPs is an extension of the replacement of

sustainable fishery, a governmental body (e.g., the NMFS in the U.S.) must annually set a maximum total allowable catch (TAC).

2. This annual TAC must then be allocated, through a DAP mechanism, among the appropriate stakeholders. If a fisherman group or community is relatively small, cohesive, and embodies a strong culture of cooperation (so that the common pool problem is overcome through cooperation), the allocation process could be delegated to the cooperating group or community, which then makes the specific allotments.[37] In the absence of a cooperative with these characteristics, a more formal process of allocation among stakeholders is required -- e.g., through an "individual fishing quota" (IFQ) that specifies the percentage of the TAC (and thus, for any specific TAC, the specific quantity) that the IFQ holder is allowed to harvest in that year.[38] DAPs have traditionally been allocated to local fishermen, using some historical catch criteria; but, so long as the DAPs are tradable, a wider allocation base is (in principle) possible.

3. The allocations must be monitored and enforced in a credible manner, so that each fisherman harvests only the permitted quantity and will be confident that any cheating by anyone will be detected, substantially punished, and thus unlikely.

The advantages of DAPs over input restrictions are important to emphasize: With DAPs, fishing derbies cease. Instead, permit holders can decide how and when best to use their permits. Efficiency and innovation are encouraged. Peaking problems are reduced, since the permit holders can spread their efforts over the calendar year as they see fit. With reduced peaking, a better use of the fishermen's equipment and crew will follow, including improved safety, as well as a better use of processing equipment and labor force. Fish gluts will be reduced, implying higher prices for fishermen. The spreading-out of the harvest will also mean that more fresh fish can be sold throughout the year, with less need for freezing, again implying higher prices for fishermen.

With effective, credible enforcement, overage problems -- fishermen in the aggregate catching more than the TAC -- that have accompanied input-control regulatory regimes should be reduced or eliminated, since the DAP focuses directly on the size of the catch.

The absence of fishing derbies should reduce problems of bycatch and habitat destruction,

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"technology standards" with "performance standards" in other areas of environmental regulation.

37 See, for example, Leal (1996), Criddle and Macinko (2000), and Matulich et al. (2001) for further discussion of cooperative DAPs.

38 In the U.S., the eight regional fishery management councils would provide this function, with oversight

since the better-paced harvesting that accompany a DAP should give the fishermen greater opportunities to avoid these practices. DAPs are unlikely to eliminate these negative externalities entirely, however, so other measures will still be required.[39]

DAPs do not cure all fishery problems. As was just indicated, other negative externality problems are likely to remain and to require other measures. In addition, there are at least two ways in which DAPs may exacerbate overfishing problems: First, DAPs may encourage "highgrading": the discarding at sea of smaller, less valuable fish in favor of larger, more valuable fish to fill out a fisherman's quota.[40] Since the mortality rates among discarded fish are likely to be high, such highgrading will have negative consequences for the replenishment of the stock.[41] If DAP enforcement takes the form of on-boat monitoring of a fisherman's catch, however, highgrading is unlikely to be a substantial problem.[42]

Second, to the extent that fishermen anticipate that a DAP is going to be implemented and that the allocations of the DAP to individual fishermen will be based on the catch history, this anticipation will likely lead to greater overfishing in the period prior to the implementation of the DAP. However, if the DAP is allocated through an auction system (and the fishermen correctly anticipate the auction route), no such anticipatory overfishing should occur.[43]

As this review indicates, DAPs do not eliminate the need for government involvement in fishery management. Governmental efforts are still required to:

- monitor overall fish stocks;

- estimate the annual TAC that will allow for the sustainable replenishment of the stock of fish;

- allocate the TAC among fishermen in some manner;

- monitor and enforce the allocation to ensure that individual fishermen catch only their

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and approval by the NMFS.

[39] This necessity for separate policies to deal with these separate problems is also recognized by Hilborn (2007 forthcoming).

[40] See Copes (1986) and Branch et al. (2006).

[41] It is worth noting, however, that at least one form of input control -- trip limits -- similarly encourages highgrading.

[42] See Branch et al. (2006).

[43] Also, to the extent that any catch-history basing of DAP allocations underweights or ignores recent years, and fishermen correctly anticipate this weighting, the problem of anticipatory overfishing is reduced or eliminated.

permitted amount;

- invest resources in improving the fishery; and

- deal with the remaining negative externality problems (e.g., bycatch and habitat destruction, as well as highgrading) that DAPs do not directly address.

Thus, government involvement remains extensive, even in the presence of a DAP; but the involvement is focused more directly on the output measure that matters: limiting the total catch.

A logical extension

Because most fish do not remain in a small, confined area, the specification of a TAC and the direct or indirect (i.e., via a cooperative) allocation of percentage shares of the TAC is a sensible way of establishing permits. For shellfish and crustaceans that move very little or not all, a logical extension of the DAP idea is simply to allocate specific territories to individual fishermen. This kind of allocation has been described as "territorial use rights in fishing" (TURFs).[44] The concept might also be extended to fish that tend to congregate around specific reefs or around other natural or artificial structures.

With a specific territory assigned, the fisherman becomes similar to a land farmer, who generally can make efficient decisions with respect to planting, cultivating, and harvesting and also with respect to long-run replenishment of the resource.[45] However, issues of possible negative externalities with respect to neighboring harvesters and their territories still remain.

DAPs and eliminating excess capacity

A major goal in the rationalization of fisheries is the elimination/retirement of the excess capacity of fishing vessels and gear that have accompanied the open access regimes of the past few

[44] See, for example, Baskaran and Anderson (2005) and the report issued by the Food and Agriculture Organization (FAO), "Territorial Use Rights in Marine Fisheries: Definitions and Conditions", accessible at: http://www.fao.org/docrep/003/t0507e/t0507e01.htm.

[45] Bromley (2002) and Macinko and Bromley (2002) point out that if a harvester discounts the future at a high enough rate, the harvester will want to maximize short-run gains and exhaust the resource rather than husbanding it for the longer term. While this is correct as a theoretical proposition, casual empiricism suggests that this short-run exploitation is not a common phenomenon among farmers. The U.S. agricultural sector has shown no signs of imploding in the way that this short-run exploitation would suggest. There seems no reason to expect that shellfish and crustacean harvesters would react differently. Indeed, the evidence indicates that specified geographic areas for shellfish harvesters do yield the expected benefits. See, for example, Agnello and Donnelley (1975) and De Alessi (1996).

decades. As is argued below, if fees (and/or the revenues from auctioned IFQs) accompany the implementation of DAPs, one of the uses of the revenues can be the buying out of this excess capacity.

In the absence of a DAP (and instead the continued presence of controls on fishing methods and inputs), funds spent to retire capacity are unlikely to solve the excess capacity problem, since productivity improvements in the technology of fishing could well overwhelm any realistic capacity retirements. This has been the experience of the U.S. agricultural sector, where five decades of capacity retirements (e.g., land banks and dairy cattle slaughtering) have been overwhelmed by continuous improvements in agricultural technology, and price supports and subsidies continue to be used to maintain agricultural incomes.

Existing DAPs in the U.S.

There are seven fisheries under federal management in the U.S. that currently use DAPs.[46] They are (including the type of DAP and the year that the DAP began):

- Alaska pollock (cooperative, 1998);
- Alaska halibut (IFQs, 1995);
- Alaska sablefish (IFQs, 1995);
- Alaska king crabs (IFQs, 2005);
- Pacific whiting (cooperative, 1997);
- South Atlantic wreckfish (IFQs, 1992); and
- Atlantic surf clams/ocean quahogs (IFQs, 1990).

After a few IFQs had been formed, the Congress in 1996 passed legislation that placed a moratorium on IFQs for four years and in 2000 extended the moratorium for an additional two years.[47] The moratorium has since expired. It seems likely that, in the absence of the moratorium, more IFQs would have come into existence. As of the late summer of 2006, the Gulf of Mexico red snapper fishery is scheduled to implement an IFQ program in early 2007.

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[46] Wyman (2005) identifies three additional fisheries that were under international or state management that, as of 2002, were using DAPs: the Atlantic bluefin tuna (purse seine fleet), the Maryland summer flounder informal cooperative, and the Alaska weathervane scallop harvesting cooperative.

[47] Congressional concerns about the distributional consequences/windfalls that followed from the pre-1996 IFQs and the historical experiences that were the bases for those IFQs appear to have been the motivation for the moratorium.

The DAPs that have been implemented in the U.S. do appear to have achieved the types of fishery improvements (i.e., reduced overfishing), safety improvements, and efficiency improvements among the fishermen, including the ending of the derbies and the associated deleterious consequences, that were described above.[48]

Other countries' use of DAPs

Other countries have used DAPs of various kinds. These countries include:

- New Zealand
- Australia
- Canada
- Iceland
- The Netherlands
- Norway
- Greenland
- Japan
- Chile
- Russia
- Estonia.

As is true of the U.S. experience with DAPs, other countries' experiences with sensibly designed DAPs[49] have generally been favorable.[50]

7. DAP Design Issues, Using the Insights from Other Policy Areas

[48] These results are reviewed by the NRC (1999a, ch. 3 and App. G). Favorable reviews can also be found in Iudicello et al. (1999) and Leal (2000, 2002, 2005, 2006). More critical views are found in Bromley (2002), Macinko and Bromley (2002), and MFCN (2004).

[49] An example of a not-so-sensibly designed DAP is worthy of notice: New Zealand originally allocated IFQs in terms of absolute quantities of fish that could be caught. When some fish stocks subsequently declined and the sustainable TACs declined, the New Zealand Government was forced to buy back quota from some of its fishermen. That costly experience led New Zealand subsequently to allocate IFQs in percentage terms only.

[50] NRC (1999a, ch. 3 and App. G) provides details on the experiences of New Zealand (see also Newell et al. (2005)) and Iceland and provides a bibliography on other countries' experiences. See also Iudicello et al. (1999). Repetto (2001) provides a comparison of the successful experience of the Canadian sea scallop fishery with the neighboring but far more problematic American sea scallop fishery.

The overview of DAPs for fisheries in the previous Section will now be expanded into a discussion of the important details that should be considered in the design of fishery DAPs. The insights gleaned from the other policy areas that were addressed in Sections IV and V will inform this discussion. Also, there clearly are inter-related aspects among some of these design features; for example, if a use-it-or-lose-it requirement is present, this will affect who is qualified to hold an IFQ; or, if an IFQ is not tradable, then this also will affect who will be willing to bid at an IFQ auction.

Cooperative or IFQ?

A DAP is a mechanism for overcoming the common pool problems that accompany open-access fishing. If a fishing group or community is small and cohesive and has a culture of cooperation and mutual trust among its members, then a cooperative may be able to overcome the common pool problems. The cooperative will then have to develop mechanisms for implicitly or explicitly assigning shares of the TAC and for ensuring that quota limits are adhered to. Without this cohesion and culture, IFQs will be necessary for overcoming the common pool problems.

Since cooperative arrangements will implicitly or explicitly have to deal with more-or-less the same design issues as will the managers of an IFQ program, the remaining discussion in this section will focus explicitly on IFQs.

What initial allocation method?

There are basically three generic choices for an initial allocation mechanism: an auction; a lottery; or a set of specific allotments based on some specified criteria. The pluses and minuses of each method will be discussed.

Auctions

Auctions place the DAP shares in the hands of the users who place the highest value on the resource. They are thus a mechanism that encourages economic efficiency.[51] Auctions capture

[51] As was noted above, if IFQs are tradable at relatively low costs, then post-allocation trading can also yield an outcome where the shares are held by those who value the resource the highest. The major value of auctions in this respect is that they reduce the need for post-allocation trading and thus reduce any associated transactions costs.

revenues from the scarcity value of the resource for the seller -- in this case, the U.S. Government -- and they avoid the distributional windfalls that accompany lotteries or specific allotments. Since fisheries are a public resource, the auction revenues can be seen as recompense to the public for the use and exploitation of the public's resources. Also, as was discussed above, to the extent that auctions are anticipated as the allocation mechanism, there would be no reason for fishermen to engage in excessive fishing prior to implementation.

Auction revenues can be used to cover the costs of administering the IFQ program (including enforcement), to cover improvements in the fishery, to buy out the excess fishing and processor capacity that has developed as a response to the command-and-control regulatory regimes of the past (and to past subsidies), and to help fishing communities generally adjust to the changed economic circumstances that accompany IFQs.

A potential downside to auctions is that bidders require access to capital -- to owned resources, or to borrowing capabilities -- in order to bid successfully. Auctions will thus tend to favor larger enterprises over smaller ones and richer individuals over those who are less well off.[52] But, as the experience of cell-phone spectrum auctions and USFS timber auctions indicate, auctions can be structured so as to allow otherwise disfavored groups to gain better access (at the potential cost of reduced revenues and reduced efficiency).

Lotteries

Lotteries have an element of fairness, in the sense that they avoid the arbitrariness and political considerations of specific allotment mechanisms and they also avoid the access-to-capital issue of auctions. However, as is discussed below, there is still the question of who is allowed to enter the lottery. And, as the experience of cell-phone spectrum license lotteries in the 1980s indicated, there are clearly windfall issues that accompany the winning of the lottery.

Specific allotments

With a limited supply of a valuable resource (the IFQs) and in the absence of an auction or a lottery, there will be excess demand for the IFQ allotments, and the fishery managers must develop a

[52] Although the possibility of borrowing funds to finance a bid should reduce the extent of imbalances, the wariness of lenders as to whether borrowers will actually be able to repay their loans (the problems of "asymmetric information" in lending markets) will still place smaller and younger enterprises and individuals with less of a "track record" with respect to loan repayment at a disadvantage.

set of criteria for determining the sizes of the allotments to qualified recipients (this qualification issue is addressed immediately below). The historical catch experience has been the main criterion (this historical experience criterion was true initially for grazing as well). But even with history as the main criterion, there are still questions as to how recent or how far back the relevant historical experience should extend and whether every year in the relevant range should count equally or whether some years should be weighted more heavily. Also, if fishermen in a specific fishery anticipate that an IFQ allotment system that is based on catch history is a likely prospect, this may well induce them to engage in yet greater pre-allotment fishing and overfishing.[53]

Because the allotments are valuable and (unless fees are charged) are distributed for free, the receipt of an allotment is a windfall. Consequently, it is not surprising that disputes arise over the relevant catch history range and weights, with the various parties finding justifications for the range and weights that most favor them. Again, it was unhappiness over the windfalls that accompanied the pre-1996 IFQ allocations in American fisheries that caused the Congress to legislate the 1996-2002 moratorium on new IFQs.

Who qualifies?

Regardless of the allocation method, there must be some criteria for who is qualified -- to enter the auction, to enter the lottery, or to receive a specific allotment.[54] Further, to the extent that the IFQs are tradable, there is the additional question of who is qualified to buy and hold an IFQ in the secondary market.

For an auction, a wider eligibility will likely result in higher auction values. For lotteries or for specific allotments, involvement in the fishing industry is a common criterion. Nevertheless, this still leaves open a number of candidate groups: vessel owners; ship captains; crew members; processors; and fishing community organizations. Again, as was true of the use of historical experience, the windfall nature of the IFQ allotment makes disputes among the interested parties

[53] As was noted above, however, if fishermen anticipate (perhaps through clear policies and/or observation of other DAP distributions) that recent catch histories will not be part of DAP allocation formula, then the overfishing incentive is muted.

[54] This point is clearly related to use-it-or-lose-it requirements and tradability issues that are discussed below.

highly likely, with each group providing arguments that would justify their claims.[55]

What about fees?

All three allocation methods may be accompanied by fees. For lotteries or specific allotments, the fees recapture some of the windfall received by these IFQ recipients; for auctions, a pre-specified fee structure will reduce the auction prices and, in effect, spread over time the revenues paid by the winning IFQ permit holders. Like the revenues from auctions, these fees can be seen as recompense to the general public for the use and exploitation of the public's fishery resources. Also, like auction revenues, fees can be used to cover the costs of administering the IFQ program, to finance improvements in the fishery, to buy out excess fishing and processor capacity, and to help fishing communities adjust to the changes that accompany IFQ programs.

There is an additional role that fees can play: Differential fees -- higher fees on higher-valued fish, lower fees on lower-valued fish -- could help alleviate highgrading.[56]

What length of tenure for an IFQ?

Longer tenure allows IFQ holders to make longer-range plans, reduces uncertainty, and encourages efficiency and technological improvements. In an auction system, longer tenure will yield higher auction revenues. If an IFQ tenure has a finite length (rather than an indefinite length, or, in essence, in perpetuity), then a presumption of renewal provides an effective lengthening of the tenure (as is true for spectrum, grazing, forestry, and oil-gas-coal leasing); but the presumption is not the same as certainty and thus not the same as an indefinite tenure (as is true of SO_2 emission permits, hard rock mining patents, and water rights).

How tradable/transferable is the IFQ?

Greater tradability/transferability for an IFQ gives it greater value, since it can thereby be acquired by the party that places the highest value on it. At one extreme, an IFQ could be traded to and held by anyone (as is true for SO_2 emission permits and hard rock mineral patents); at the other extreme, an IFQ could be held and used only by the party to which it is issued, with the IFQ

[55] In practice, the five IFQ programs in the U.S. have all allocated their initial allotments to vessel owners.

[56] See Huppert et al. (1992).

reverting to the NMFS at the end of its term (or at the demise of its owner, whichever comes first). One intermediate possibility would be transferability only to specified categories of qualified parties (which a use-it-or-lose-it requirement would imply); another intermediate possibility would be transferability only with the approval of the NMFS; a third possibility would be transferability only as part of the transfer/sale of the underlying vessel or fishing business (various combinations of these intermediate possibilities apply to spectrum, grazing, timber auctions, oil-gas-coal leases, and surface water rights).

Similar possibilities arise with respect to the possibility of the permit holder's being able to lease an IFQ to another party.

Separately, there is the question of whether the IFQ can be divided, with only a portion being sold or leased. Again, greater flexibility will increase its value.

Finally, there is the question of whether there should be limits on the accumulation of IFQs, beyond those that the antitrust laws (e.g., the Clayton Act, which prohibits mergers that create or enhance market power) would bring to bear, because of special community concerns (such extra limits apply to some spectrum licenses).

Though greater transferability raises the value of an IFQ, it also means that the IFQs are more likely to pass out of the hands of the original community of holders and into the possession of parties that are outside of this original community.

Use-it-or-lose-it?

Use-it-or-lose-it requirements are another way of restricting IFQs to a specified group of commercial fishermen (use-it-or-lose-it requirements apply in spectrum, grazing, forestry, oil-gas-coal leasing, and prior-appropriation water rights). Though these requirements encourage development of the resource and may thereby reassure local communities whose livelihood depends on the continued exploitation of the resource, they also restrict the possibilities of alternative uses and of environmental groups' conservation efforts.

Are IFQs bankable for future years?

If the use of any year's allocation of IFQs can be deferred to future years, this added flexibility will give them greater value (SO_2 emission permits are bankable, and some delays in timber harvests and oil-gas-coal extraction are possible). But fish-stock sustainability gains and

losses from such delayed use may not be commensurate.

What about overages?

Again, allowances for overages will increase the value of IFQs. Small, accidental overages may sometimes be unavoidable and are probably adequately handled through simply requiring that small overages be deducted from the following year's IFQ.[57] But large overages clearly pose a greater problem because of the fish-stock sustainability issues.

Should processors be given a separate set of processing quotas?[58]

The possibility of separate processing quotas has been suggested as a way of dealing with the problems of processor adjustments to the fishermen's IFQs.[59] However, processors do not face the common pool problem that is the motivating factor underlying the use of IFQs for fisheries. Further, to the extent that a separate processor quota system is established, this system would then effectively cartelize the processors and provide them with market power in the purchase of the fresh fish from the fishermen (as well as providing the processors with market power in the sale of the processed fish). This processor cartelization is generally at odds with the pro-competition stance of much public policy, such as the antitrust laws, and would be counter to the interests of the fishermen for whom the IFQs are supposed to provide benefits.[60]

What about enforcement?

As was discussed in Section VI, effective and credible enforcement by the NMFS is crucial to the success of an IFQ program. In essence, each fisherman's catch must be monitored and measured, so that it does not exceed the IFQ and so that all fishermen are reassured that all are staying within their IFQ limits.

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[57] Additional discouragement may just cause the fishermen to destroy the excess fish before landing them, to no good end.

[58] Note that this is a separate issue from that of whether processors should be given some of the initial allotments of IFQs.

[59] See Matulich et al. (1996), Matulich and Sever (1999), and Matulich et al. (2001). A separate set of processor quotas were established as part of the Alaska king crab IFQ.

[60] Also, as was discussed above, if the rationalization of excess processor capacity (which may have arisen because of the peak-load fishing derby phenomena) is considered to be a legitimate policy goal, then a portion of auction revenues and/or IFQ fee revenues can be devoted to payments to processors to

If the number of vessels are comparatively few, such monitoring could occur on board the vessels. Such on-board monitoring also has the advantage of helping deter highgrading, bycatch, and habitat destruction.[61]

If the vessels are more numerous but the feasible landing points are few, then monitoring could occur at the point of landing. If the number of processors is few, then monitoring could occur at the point of transfer to the processors or through the records of the processors (which could require the registration and certification of processors). In essence, the monitoring function should occur where there are the fewest "choke points" in the vertically related procedures of catching and processing fish.

Though the costs and logistics of enforcement of an IFQ program may appear daunting, it is important to keep in perspective the point that input-oriented regulatory programs must also be enforced and therefore also require monitoring.

Should an IFQ be "property" or just a "permit"?

Again, greater IFQ value accompanies greater "propertiness". But the retention of the flexibility to pull back from an ill-designed program, without invoking a "takings" problem, may also be worthwhile from a societal perspective.

8. Conclusions/Recommendations

Open access, combined with modern technologies of fishing, has created serious problems of overfishing and threatens the sustainability of many U.S. fisheries. The common pool problem -- the ocean version of "the tragedy of the commons" -- is the root cause of the overfishing. The major regulatory policies of the past few decades that have tried to address overfishing -- restrictions on fishing methods and inputs (in essence, command and control regulation) -- have largely been failures. "More of the same" is surely a recipe for continued failure and for economic hardship in the communities that rely heavily on fishing for their livelihood.

Fortunately, there is a superior policy direction: dedicated access programs (DAPs). DAPs

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help rationalize their capital stock.

[61] On-board monitoring must, of course, be supplemented by some dockside or processor monitoring, so as to ensure that there are no landings by fishermen who lack the requisite IFQ permits.

in principle deal with the common pool problem in a more direct and efficient way than do input controls. DAPs in practice -- in seven fisheries in the U.S. and in many major fishing nations abroad -- have shown their value in curbing overfishing and helping rationalize fisheries.

DAPs should be a central part of U.S. fisheries policy. Drawing on the previous Sections of this paper, this concluding Section will provide specific recommendations for the structure and design of DAPs for U.S. fisheries.

IFQs versus cooperatives

This is a choice that the National Marine Fisheries Service (NMFS), in consultation with the regional fishery councils, will have to make based on group or community characteristics and input. If a local cooperative of fishermen believe that they can successfully overcome the common pool problem without the need for a more formal individual fishing quota (IFQ) structure, they should be given the opportunity. But close monitoring by the NMFS is necessary to make sure that the cooperative has not over-estimated its cohesiveness.

The remainder of this section will address primarily IFQ design questions (although some of these issues have relevance for cooperatives as well).

A first-best IFQ structure[62]

IFQs must be designated as fractions of the annual total allowable catch (TAC), which must be set by the NMFS with the goal of the sustainability of the fishery.[63] These fractions thus become translated into specific quantities each year, once the NMFS has determined the TAC.

Auctions, accompanied by per-pound fees,[64] should be the method for initially allocating IFQs. Anyone should be allowed to bid at the auction.

Auctions generate revenue for the public fisc, which (along with the subsequent flow of fees)

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[62] Some of the specific design features described below are likely to require changes in the Magnuson-Stevens Act. For another discussion of design principles for IFQs, see Townsend et al. (2006).

[63] There is the relevant question as to whether the goal should be the "maximum sustainable yield" or the "efficient sustainable yield"; the latter takes marginal costs into account. See, for example, Tietenberg (2003, ch. 13). In principle, the latter should be the goal. In practice, where the marginal costs of harvesting are relatively low, there will not be a large difference between the two. And, in any event, the major goal should be to move fisheries that are overfished away from that condition and toward a more appropriate level of sustainability.

[64] As was noted in Section VII, differential fees may alleviate problems of highgrading.

can be used to cover the costs of administering the IFQ program, improve the fishery, help retire excess capacity, and help communities adjust to the changed fishery economics of IFQs. Auctions are consistent with the pattern followed in recent spectrum disposition and longstanding forestry and energy practices: The public is receiving a market return for the disposition of the public's resources.

Further, auctions avoid the problem of windfalls (from free allotments) to favored recipients and the political maneuvering (rent seeking) that accompanies the anticipated windfalls.[65] Auctions also avoid the problem of anticipatory overfishing by fishermen who thereby hope that their expanded historical base will entitle them to a larger free allotment.

If auctions are seen as unduly favoring large companies and parties from outside existing fishing communities, there can be special provisions -- set-asides and extra weights for bids by preferential parties -- to help recover an appropriate balance. However, such practices reduce auction revenues and may affect efficiency. An alternative way of helping local communities is simply to direct some of the auction revenues in their direction. Ideally, such measures should be used to help local communities adjust to and accommodate change.[66]

The auctioned IFQs should be for an indefinite term -- i.e., in perpetuity (like the SO_2 emission permits) -- and fully tradable to anyone.[67] They should be divisible and leasable. The NMFS's permission for trades and leases should not be required. There should be no use-it-or-lose-it requirements. This flexibility will encourage the greatest economic efficiency in the fishery, as well as maximizing the initial auction values and any subsequent trading values. It will give the greatest opportunities for new technologies to be used, as well as allowing environmental groups to play a role (if they are willing to pay the price to play).

There is no reason to create a separate set of quotas for processors, under an auction-based

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[65] Recall that the applicants for cellular telephone spectrum licenses overwhelmed the FCC, which led the Congress to authorize lotteries; the windfalls that accompanied the lotteries (along with the desire for budgetary revenue) led the Congress to authorize auctions. For descriptions of rent-seeking efforts in the U.S. Atlantic sea scallop fishery, see Repetto (2001) and Edwards (2001).

[66] For an extended discussion of community issues, see USGAO (2004).

[67] If an indefinite term is somehow not possible, then (like auctioned spectrum) long-lived permits of 10-15 years, with a strong presumption of renewal, may be the next best alternative. If the Congress wishes to preserve its ability to modify IFQ programs but not have to pay compensation for "takings", then it could specify that caveat in any enabling legislation (as it has done with respect to the permit systems in the programs described in Section IV – even for the SO_2 emissions permits, which have been granted in perpetuity).

IFQ program or any other IFQ program. As was discussed in Section VII, processors do not face the common pool problem that generates the need for IFQs for fishermen; if processors are deemed worthy of receiving some assistance in adjusting economically to the fishing markets that accompany an IFQ program, a portion of the fees and auction revenues that accompany the IFQs could be devoted to such assistance.

Since the IFQs are auctioned and are expressed primarily as a percentage of the TAC (and, under severe circumstances, the NMFS may have to set the TAC at zero), they ought to be given a full set of property rights. This security of tenure (albeit expressed in the unavoidable percentage framework) will provide IFQ holders with the greatest incentive to make long-term investment and allocation decisions and thus encourage the greatest efficiency in the fishery, as well as encouraging higher auction values.

Effective and credible enforcement is crucial. If possible, monitoring and enforcement should occur on the vessels of IFQ holders (supplemented by dockside or processor monitoring to prevent landings by non-IFQ vessels). This has the advantage of providing some extra monitoring and discouragement of highgrading, bycatch, and habitat destruction. If on-board monitoring is not feasible, then dockside or processor-based monitoring will be necessary. Small overages may be allowed and deducted against the following year's IFQ; more substantial overages -- in essence, cheating -- must be deterred by substantial penalties (as well as deductions against the next year's IFQ). The banking of small amounts from one year to the next should be permitted.

Since IFQs may ameliorate but will not wholly solve bycatch, habitat destruction, and other negative externality problems, other measures must be employed to deal with those problems.

As a matter of political economy, it is probably unrealistic to expect that an existing group of fishermen in an overfished fishery will agree to an auction-based IFQ program if they believe that a free allotment IFQ program, whereby they receive windfalls, is the alternative. (Historically, it seems unlikely that loggers, if they had been given the choice, would have agreed to USFS timber auctions if they had believed that free logging permits to individual tracts could have been the alternative.) Consequently, if auction-based IFQ programs are to be implemented, the current decision-making process -- whereby a regional fishery council must gain the strong support of the local fishermen before instituting an IFQ program -- may need to be changed. A more centralized decision-making process by the NMFS may well be necessary.

A second-best IFQ structure

As was just discussed, an auction-based IFQ program may well be unrealistic in the absence of a change in how the local fishery management councils function. Consequently, it is worth considering a second-best IFQ structure based on distributed allotments (which would still be a considerable improvement over current "command-and-control regulatory methods).

Under a free distributed allotment program, the other attributes of the IFQs that were just described for the auction structure (i.e., freely tradable and leasable, can be held by anyone, vigorously enforced, etc.) should still hold. The fees per landed fish should be higher, to compensate for the absence of auction revenues; higher fees will also help absorb some of the potential windfalls.

The initial distribution of the IFQ allotments should be made on a wide base within the affected community. For example, every citizen (as of, say, one month prior to the distribution decision) of a community that is closely associated with a fishery could be given a pro rata share of the total IFQ allocation; perhaps, local governments could be given a specified share as well. With broad distribution, the aggregate windfall would be spread more widely, and individual windfalls would be moderated. The political maneuverings and rent-seeking over the initial distribution would be moderated as well. The incentive to fish aggressively prior to the determination of the allotment would disappear. But, nevertheless, with easy tradability, the IFQs should quickly find their way into the hands of the highest-value users, and the efficiency properties of the IFQs would remain.

A final word

Fisheries are too important -- to their communities and to the nation -- to allow them to continue to languish in overfished conditions. DAPs are a reasonable and feasible policy tool, if used in conjunction with other policies, to deal with fishery problems. DAPs have worked in seven fisheries in the U.S. already and also in a number of major fishing nations.

Fisheries are not the only area in the U.S. economy that face common pool problems. The other areas that are surveyed in this paper have all dealt with their actual or potential common pool problems by creating some version of a permit system, with greater or lesser levels of efficiency. Fisheries managers can learn valuable lessons from those other areas and improve both the health and the economic efficiency of U.S. fisheries by adopting DAP programs along the lines described above.

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