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[Article]

Quantification of U.S. Marine Fisheries Subsidies

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Abstract.—Subsidies to the fishing industry are common worldwide, and it is well accepted that these subsidies contribute to overcapacity in fishing fleets and overexploitation of fisheries resources. To date, however, most of the quantitative estimates of these subsidies reported in the literature have been at either the multicountry or global level. Estimates are rarely based on a detailed accounting of individual subsidy programs, limiting both their accuracy and usefulness for management decisions. The present analysis helps fill this gap with respect to U.S. fisheries subsidies. Here, we report estimates of the different types of subsidies paid to the fishing sector by different levels of government in the USA. Our analysis shows that from 1996 to 2004, the U.S. fishing industry received a total of US$6.4 billion (1 billion = 10^9) in government subsidies (an average of $713 million per year), federal funds accounting for 79% of this total. This estimate is conservative because it does not include funding for fisheries management, port construction and maintenance, or subsidy program administration. Federal and state fuel subsidies (44% combined) and federal and state fisheries research (40% combined) accounted for the vast majority of fisheries subsidies. The next three largest subsidies were state sales tax subsidies (5%), disaster aid (4%), and fishing access payments (3%). Distribution was heavily weighted toward Alaska and the western Pacific and toward Pacific salmon *Oncorhynchus* spp. and tunas (family Scombridae). Similar detailed examinations of fisheries subsidies in other countries will be necessary in the likely event that the World Trade Organization establishes rules prohibiting subsidies that contribute to overcapacity.

The United Nation's Food and Agriculture Organization estimates that the proportion of overexploited and depleted fishery stocks has risen from about 10% in the mid-1970s to close to 25% today (FAO 2004). Academic research shows an even bleaker situation. The statistics for the USA are similar. According to National Marine Fishery Service (NMFS) data for 2006, a quarter of the nation's 530 monitored fish stocks are overfished and 20% are experiencing overfishing (NOAA 2006).

Although estimates vary, it is also clear that there is a great imbalance between fishing capacity and the number of fish that can be sustainably caught. The Food and Agriculture Organization has calculated that there is about 30% overcapacity in the world's fishing fleet with respect to major stocks (FAO 1999). The World Wildlife Fund has put the figure even higher, estimating that the number of boats on the ocean is 2.5 times the needed number for sustainable catch (WWF 1998). Further indication that current fishing patterns are unsustainable, a 1998 study examining global statistics on fish landings from 1950 to 1994 noted a significant shift in the kinds of fish landed: from long-lived fish at the top of the food chain toward short-lived fish low on the food chain (Pauly et al. 1998).

Although fishery management failures have long been recognized to play a key role in the growing problem of overfishing and overcapacity, more recently a consensus has emerged that government subsidies to the fishing industry are also an important contributor. As the Federal Fisheries Investment Task Force noted in a major report on U.S. fisheries subsidies in 1999 (FFITF 1999),

"A number of studies in recent years have been issued ... concerning subsidies and capacity in world fisheries. The consistent conclusion is that there is overcapacity worldwide, that government subsidies have contributed to this overcapacity, and that overcapacity has contributed to the decline of many marine fishery resources."

A few years later, the United Nations Environment Program summed up current scientific opinion in a key report (UNEP 2004) on the issue as follows: "The fact that fisheries subsidies may increase fishing effort and thus have negative impacts on the level of fish stocks has been universally accepted in the fisheries subsidies literature."

Despite the consensus around the connections

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between subsidies, overcapacity, and overexploitation of fisheries resources, there are probably as many different definitions and classifications of fisheries subsidies as there are studies on the topic. One relatively straightforward set of definitions was put forth by two scientists (Flaaten and Wallis 2000) from the Organization for Economic Cooperation and Development (OECD), who defined subsidies as "the monetary value of interventions associated with fisheries policies, whether they are from central, regional, or local governments."

Khan et al. (2006) identified 11 types of fisheries subsidies: (1) fisheries management programs and services; (2) fishery research and development; (3) tax exemption programs; (4) foreign access agreements; (5) boat construction, renewal, and modernization programs; (6) fishing port construction and renovation programs; (7) fishery development projects and support services; (8) marketing support, processing, and storage infrastructure programs; (9) fisher assistance programs; (10) vessel buyback programs; and (11) rural fishers' community development programs.

Although the effect of a given subsidy depends on the status of the fishery and the management system in place and is therefore difficult to predict, some types of subsidy programs are more likely to be harmful to fisheries resources than others and it is critical to consider such questions in fisheries management decisions (OECD 2006).

Several government bodies have concluded that there is a strong link between subsidies and overfishing in the USA. The Federal Fisheries Investment Task Force (FFITF 1999), for example, found that "federal investment in fisheries development, marketing, and promotion programs have had a direct role in the buildup of capital and capacity in some U.S. fisheries." Similarly, the U.S. Commission on Ocean Policy (2004) concluded that "over the past three decades, federal programs to subsidize the purchase or upgrade of fishing vessels have resulted in U.S. fishing capacity that far exceeds the available catch."

Such findings have prompted the USA to become a key player in the ongoing negotiations in the World Trade Organization (WTO) to ban fisheries subsidies that enhance fishing capacity under the Agreement on Subsidies and Countervailing Measures. Yet while the USA has continued to lobby for strong pro-conservation and pro-transparency language, the details of its own subsidies to the fishing industry remain unclear.

For example, the Federal Fisheries Investment Task Force (FFITF 1999) conducted the most in-depth study of U.S. fisheries subsidies available to date, but it failed to include several key subsidy types and did not attempt to quantify the value of most programs. Although other studies have made estimates of U.S. subsidies, these analyses have been incomplete because they attempted to quantify and compare fisheries subsidies in many different countries and were therefore rarely able to do highly detailed accounting for the subsidies in individual countries (Milazzo 1998; APEC 2000; Flaaten and Wallis 2000; Munro and Sumaila 2002; OECD 2006; Sumaila and Pauly 2006).

The present study was designed to fill this information gap In it, we provide a more detailed quantification of U.S. marine capture fisheries subsidies for the period 1996–2004, including the first estimate of the subsidies provided by state governments and the first breakdown of subsidies by individual subsidy program, geographical region, and fish species.

As a starting point for our research, we examined the range of current U.S. fishing subsidy programs. We included programs identified in previous studies, particularly those performed by Milazzo (1998), Flaaten and Wallis (2000), OECD (2006), APEC (2000), Sumaila and Pauly (2006), and FFITF (1999). We also reviewed the annual subsidy notifications submitted by the USA to the WTO, though we found that these notifications lacked information on major categories of subsidies and often lacked full data on the programs that were included (WTO 2007). Finally, we did extensive research on current U.S. fishing programs and searched both federal and state tax codes to find subsidy programs overlooked in previous studies. Through this process we discovered that no previous studies had made comprehensive estimates of state-level fisheries subsidies.

A few of the identified programs were excluded from this study, either because they were not specific enough to the fishing industry (e.g., Economic Development Administration and Small Business Administration loans) or because they were beyond the scope of this study (e.g., funds for fisheries management and enforcement and expenditures for port construction and maintenance). Subsidies for aquaculture, freshwater, and recreational fisheries were also excluded. Because of these exclusions, our estimates of the total magnitude of U.S. fishery subsidies are conservative.

The final list of subsidy programs selected for analysis consisted of (1) federal and state fuel subsidies, (2) state sales tax subsidies, (3) disaster aid, (4) nonmanagement fisheries research funding, (5) fishing access payments, (6) surplus removal, (7) the Capital Construction Fund, (8) several different seafood marketing programs, (9) fishing vessel and

permit buyback programs, (10) the Fisheries Finance Program, and (11) the Fishermen's Contingency Fund.

The goals of this study were to quantify the value of each of these programs yearly from 1996 through 2004 and to conduct regional and species-level analyses of these programs where possible. We also wanted to provide some perspective on which of these subsidy programs might be beneficial to U.S. fisheries resources, which might be harmful, and which may be ambiguous, based on the work of Khan et al. (2006).

Methods

Our methods for quantifying and analyzing the various subsidies are described below, the programs being listed in order of their total value over the 9-year period. Brief program summaries have also been included for background. As with most other studies of fisheries subsidies, data availability was less than ideal. Where hard numbers were not available, conservative estimates were made. All monetary values are in 2007 U.S. dollars. Administrative costs for subsidy programs were generally not included in subsidy estimates, though they may have been inadvertently included in some of the fisheries research funding estimates.

Fuel subsidies.—The federal government taxes most gasoline and diesel fuel used in the USA, the money from these taxes being earmarked for road construction and maintenance. If the government treated land-based and water-based transportation consistently, fishers would also be required to pay such taxes and the money would go toward port construction and maintenance, the Coast Guard, and other public facilities and services that fishers use. But in contrast to land-based U.S. users of gasoline and diesel fuel, commercial fishers are exempt from all federal fuel taxes, providing the fishing industry with a large subsidy. Commercial fishers are also exempt from state fuel taxes and sometimes state sales taxes on fuel.

Sumaila et al. (2008) estimated that in the year 2000 federal fuel subsidies in the USA amounted to US$221 million. To arrive at federal fuel subsidy estimates for the years 1996–2004, this figure was adjusted up or down based on annual catch statistics from the NMFS Commercial Fisheries Landings database (NOAA 2007a). If the total landings of marine fish were 25% higher than the 2000 catch in a given year, for example, it was assumed that the total subsidy was 25% higher. This extrapolation is defensible because the federal fuel tax only increased by $0.001 from 1996 to 1997 and remained unchanged from 1997 to 2004 and because the 2000 fuel subsidy figure was based on detailed data regarding fuel expenditures per pound of fish landed (USDOT 2005a:Table FE-21B; Tyedmers et al. 2005).

Estimating state fuel subsidies required a different approach because no similar calculations had been conducted previously. To estimate the amount of fuel used by the fishing industry in a given state during a given year, state fishing catch statistics (in pounds of fish per year) were multiplied by 0.062 gal/lb. This value is the average number of gallons of diesel fuel needed to catch a pound of fish in the USA in the year 2000, based on Tyedmers et al. (2005) and Sumaila et al. (2008). The resulting fuel volume was then multiplied by the state fuel tax rate for diesel fuel in that year (USDOT 2005b:Table MF205). If fishers were also exempt from sales tax on fuel in a given state, this additional fuel subsidy was estimated by multiplying the estimated fuel volume used in a given year by the average fuel price that year and by the state sales tax rate on fuel that year (EIA 2007:Table 16). It should be noted that both the federal and state fuel taxes are a fixed price per gallon of fuel rather than a percentage of the price per gallon.

Fisheries research.—Each year U.S. state and federal governments fund a vast array of fisheries research. We requested information from the NMFS, the National Science Foundation, the U.S. Geological Survey, and individual state fisheries agencies from every coastal state on their nonaquaculture, nonrecreational, nonmonitoring fisheries research funding from 1996 to 2006. We considered fisheries monitoring to be more related to fisheries management than to pure fisheries research; we also requested more recent years of data because it was difficult for some agencies to go back as far as we needed them to.

This was a difficult request for many agencies to fill, especially under the time constraints we gave them. As a result, the amount and quality of the data we received varied tremendously from agency to agency and from state to state. Although some agencies provided us with highly accurate figures for each of the years requested, others gave us only a single rough figure. For this reason, although we had initially hoped to present year-by-year and state-by-state breakdowns of fisheries research funding, we are unable to present this level of detail. Rather, we simply averaged the monetary data for each year that state and federal data were available. We then summed those averages to produce a single estimated dollar amount for fisheries research and used that for each of the years in question.

For obvious reasons, the amounts presented here should be considered rough estimates only. It is difficult to determine whether they overestimate, underestimate, or accurately depict the true values, and we probably missed some state and federal fisheries research funds. Similarly, some aquaculture-, recreation-, or monitoring-related research may have

been included in the monetary amounts we were given. Nevertheless, the exercise was valuable in that it revealed the general magnitude of fisheries research funding and the general proportion of state versus federal research funds available.

Because we were also interested in exploring whether fisheries research could be considered universally beneficial or should be considered ambiguous in terms of its potential effects on fisheries, we also requested a list of the research funded by each state and federal agency for at least 1 year during the 1996–2006 period. Although not every agency complied with our request, we did receive titles for several hundred research projects, which we deemed a reasonably sized sample to begin to examine this question. To this end, we reviewed the titles of the entire set of funded projects, highlighting any that appeared to be oriented toward increasing or enhancing the effectiveness of commercial fishing rather than enhancing conservation or general fisheries knowledge. Titles, of course, are not always perfectly indicative of the true nature of the research, so this approach has its limits; however, there is no reason to expect inherent bias.

State sales tax subsidy.—Some U.S. states give fishermen special breaks on sales tax for fishing-related expenses, but there have been no previous attempts to quantify these subsidies. An extensive search for such state laws uncovered at least one type of sales tax exemption in Alabama, California, Connecticut, Florida, Georgia, Louisiana, Maine, Maryland, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Rhode Island, South Carolina, Texas, Virginia, and Washington.

The individual tax exemptions were classified as to whether they gave tax breaks for the purchase of fishing vessels, repairs and maintenance, fishing gear, or materials (supplies and equipment). These exemptions were also classified as either sometimes exempt or always exempt, based on the particular rules outlined in the state tax law. For those purchases in the sometimes-exempt category, we assumed in our subsidy calculations that either 50% or 10% of the purchases in this category were exempt from sales taxes, based on how extensive the various exemptions were. Fuel sales taxes were grouped with fuel subsidies, as noted above, and not considered in the overall state sales tax subsidy calculations.

Historical state sales tax data for each relevant state were compiled,[1] as were fishing cost : earnings data from nine studies covering several different U.S. regions (Gautam and Kitts 1996; Hamilton and Huffman 1997; Hartman 2002; Larkin et al. 2000; TechLaw 2001; O'Malley and Pooley 2003; Squires et al. 2003a, 2003b; Kirkley et al. 2004). The fishing cost data were grouped into the same four types of fishing-related expenses, as described for tax exemptions, and a weighted average cost for each of these expense categories per pound of fish landed was calculated. The different studies were weighted according to the total pounds landed and the relevant state or fishery they represented. The final weighted subsidy estimates included fishing vessel expenses ($0.059/lb of fish landed), repair and maintenance expenses ($0.069/lb), fishing gear expenses ($0.052/lb), and materials expenses ($0.098/lb).[5]

To estimate the value of these four categories of tax exemptions in each state, the average cost per pound figures were multiplied by the total weight of fish landed in each relevant state for each year and cost category. The value of the sales tax subsidy was then estimated as follows: if a particular cost category was always tax exempt in a particular state, the sales tax subsidy was assumed to be equal to the estimated sales tax figure for that cost category; if a particular cost category was sometimes exempt, the estimated sales tax figure was reduced by either 50% or 90%, depending on the extent of the particular exemption; and if a particular cost category was not exempt from sales taxes (or no such exemption was found), the subsidy was assumed to be zero for that state.

Adjustments were also made to account for the fact that some states exempt food from sales taxes while others do not. For states that have some sort of tax exemption for materials (supplies and equipment) but do not tax food, the value of the sales tax subsidy was reduced for this category by 22%, which is the median percentage of food costs in the studies that separated these costs out from other supply expenditures (Gautam and Kitts 1996; Hamilton and Huffman 1997; Hartman 2002; O'Malley and Pooley 2003). For states that tax food at a lower rate than other items, similar adjustments were made accordingly. Each cost category subsidy was summed for each state to arrive at the overall sales tax subsidy figure for that state.

Disaster aid.—The U.S. Congress can appropriate disaster assistance for fisheries at its discretion, whether or not there has been an official government disaster determination and whether or not the cause of the fishery collapse was of natural or anthropogenic cause. The form of this fisheries subsidy can vary

[5]State sales tax rates were compiled by searching the Federation of Tax Administrators' (FTA) state sales tax rate tables (www.taxadmin.org/fta/rate/sales.html) via the Internet archive (www.archive.org/index.php) for the years 1996–2004; the FTA's web site only has tables for the current year but appears to be the best general source of information about state sales tax rates.

widely, but most often it is given as direct payments to fishers, fishing communities, and (or) fishing-related businesses. Occasionally, federal appropriations are made only if individual states also provide at least some amount of matching funds. Disaster aid can either mitigate or encourage overfishing, depending on its form. On the positive side, it can provide temporary assistance to fishers impacted by a natural disaster, or training for fishers who want to leave the business. On the negative side, it can help propagate continued overfishing, whereby fishers are not motivated to leave a fishery because the government allows them to avoid experiencing the full financial impact of a fishery collapse.

Data on all state and federal fishery disaster assistance provided during the years 1996–2004 were acquired via public records requests and by examining official summaries of commercial fishery disaster determinations (NOAA 2007b). When the data from these two sources conflicted, we assumed that the data in the official disaster determination documents were correct. For the sake of consistency within the larger subsidy analysis, all disaster allocations for fishery research and fishing permit buybacks were excluded from tallies of disaster aid subsidies. Rather, these funds were counted as subsidies in the fishery research and permit buyback subsidy categories.

If disaster aid was distributed as grants, all of the funds were considered to be fisheries subsidies. If disaster aid was distributed as loans, only a fraction of the total funds were considered subsidies, based on the White House Office of Management and Budget (OMB) annual reestimated subsidy rates for federal disaster loans (OMB 2007:Table 7). If a loan had a negative reestimated subsidy rate, it was assumed that the government subsidy was zero.

Fishing access payments.—Since the Multilateral Treaty on Fisheries went into effect in 1988, the U.S. government has given money to 16 South Pacific island nations in exchange for the right for a few dozen U.S. tuna boats to fish in certain areas of Pacific, including in some of these countries' exclusive economic zones. The terms of the treaty were obtained from public records request, congressional testimony, and documents available on the internet (U.S. Government 1987, 2003, 2005; West 2002; NOAA 2009). Subsidy value was considered to be the amount of money the U.S. government paid each year for fishing access without receiving full refund from the industry of the amount paid on their behalf. Subsidy payments were prorated for the year 2003 because the terms of the treaty changed on June 15th of that year. As part of the treaty the U.S. tuna industry also pays some money to the island nations, but only a fraction of what the federal government spends; the industry payments were not included in the subsidy figures.

Surplus removal.—The U.S. Department of Agriculture has long had a food purchasing program designed to help "stabilize prices in agricultural commodity markets by balancing supply and demand," while providing food for the National School Lunch Program, other federal nutrition programs, and international aid programs (USDA 2007). Some of this purchasing is market-driven, where schools make requests, and the department uses a competitive bidding process to fill the bids; fish purchases via this process were not considered subsidies to the fishing industry. In contrast, Section 32C purchases of fish were considered subsidies to the fishing industry because such purchases are made specifically to remove surplus commodities from the market and therefore to artificially prop up prices (USDA 1998).

Data on all Section 32C purchases of fish for the years 1997 through 2004 were obtained from the Department of Agriculture. For these years, we assumed that the annual value of the subsidy was the total purchase price of surplus fish. No such data were available for 1996, but from our research on the program it appeared likely that surplus salmon (but not tuna) purchases were made in that year (CRS 2007). To estimate the subsidy value for salmon in 1996, we used the median Section 32 total purchase price for the years 1997–2004 as obtained through our public records request; we assumed that the subsidy for tuna in 1996 was zero.

Capital Construction Fund.—The Capital Construction Fund (CCF) is a federal program that allows fishers to defer fishing-related taxable income if this money is placed in a special account for later use in boat construction, reconstruction, or purchase. Once the purchase has been made or the vessel-related project has been completed, taxes are "recaptured" by the Internal Revenue Service by a reduction in the amount of depreciation that can be used to offset income. The program provides, in effect, an interest-free loan from the government and can be considered a direct federal subsidy that promotes the growth of the U.S. fishing fleet. Each account is supposed to be tied to a specific boat construction project.

Data on all CCF deposits for 1996 to 2004 were obtained via a public records request. Deposits were in one of three forms: ordinary income, capital gain, and capital account; we included only ordinary income deposits in the subsidy calculations. Accounts were excluded if no boat construction project was specified or boats were used exclusively for freshwater fishing. If a boat was specified as being for both freshwater and marine fishing, we assumed that one-half of the funds

were for marine fishing and included that amount in the subsidy calculations. The value of the subsidy for a given year was assumed to be 11% of the total value of deposits to the fund in that year; this percentage was previously estimated by the OECD as the subsidy associated with such deposits (OECD 1989).

Seafood marketing programs.—The federal government funds a variety of different programs designed to promote U.S. agricultural commodities domestically and internationally. Between 1996 and 2004, four of these programs have funded efforts to increase seafood sales: the Market Access Program, the Emerging Market Program, the Foreign Market Development Program, and the Federal–State Marketing Improvement Program. Data on these programs were obtained for the years 1996–2004 via public records request and the U.S. Department of Agriculture's Web site. Subsidy values were considered to be the dollar value of the seafood marketing promotion grant.

During the research process, several instances were discovered where substantial federal money was distributed for seafood marketing campaigns independent of any official government program. These funds were grouped into an "other" category. Because there is no way to do a systematic search for such funding, the subsidy figures for this category are probably underestimates. Funds distributed for aquaculture product promotion were excluded. In the one case where funds were distributed to promote a combination of seafood, meat, and poultry, one-third of the total amount was attributed to seafood promotion.

Fishing vessel and permit buybacks.—If overfishing in a certain area becomes severe, the federal government will sometimes choose to buy vessels, permits, or both from fishers to reduce fishing pressure. These buybacks may be funded entirely through government grants or loans or may be a mixture of public and private financing. Data were collected on all buyback programs from 1996 to 2004 through public records request, official summaries of commercial fishery disaster determinations, and buyback rule descriptions published in the Federal Register (NOAA 2001, 2003a, 2003b, 2007c). When funding was directly appropriated to a buyback program, all of this money was assumed to be a subsidy. When funding for a buyback program was offered as loans, the subsidy was determined by referring to OMB's 2007 subsidy reestimates of these loans, in a manner similar to that for disaster aid loans (OMB 2007). Buyback programs were excluded from the analysis if there was no interest among fishers in participating and, therefore, no money spent or loaned.

Fisheries Finance Program.—This program lends money to fishers for the construction and reconstruction of fishing boats or shoreside facilities (such as fish unloading, processing, and distribution facilities) as well as for the purchase of individual fishing permits. Although the OMB's 2007 subsidy reestimate data indicate that Fisheries Finance Program loans cost the U.S. government little if anything to administer over the long-term, there nonetheless appears to be a hidden subsidy (OMB 2007). According to the Financial Services Division Chief of the National Marine Fisheries Service, most fishers that get Program loans would qualify for federal loans, but the main advantage of these loans is that fishers can get longer terms than are usually available with private lenders. These fishers benefit financially from lower short-term costs resulting from government action; therefore this government program is providing a subsidy.

To calculate the value of this subsidy, data on all nonaquaculture loans for 1996 to 2004 were obtained via a public records request, and the total loan amounts were multiplied by 3.45%. This value is the difference in the average interest rate on a 30-year mortgage for $500,000 or more given buyers with good credit as opposed to those with subprime credit (FICO credit scores of 700–759 versus 500–579 in August 2007; FICO 2007). Fisheries Finance Program loans are typically for at least this amount, with repayment periods of 15 or 25 years.

Fishermen's Contingency Fund.—Funded by a tax on the oil and gas industry, the Federal Contingency Fund is a small program that compensates fishermen for economic and property losses caused by oil and gas operations on the U.S. Outer Continental Shelf. Data for this cross-industry fisheries subsidy administered by the federal government were acquired from public records requests for all claims paid from 1996 to 2004. The subsidy was defined as the value of the claims paid.

National-level analyses.—To obtain nationwide totals, we summed the amounts computed for each of the types of subsidies above for each year to get annual estimates for the study period. For the most part, subsidy programs were either entirely federally funded or entirely state funded. In the few cases where funding came from a combination of both state and federal governments, these subsidies were allocated by source in calculating the contribution of federal and state subsidies to national totals.

Geographical region-level analyses.—Not all fisheries subsidy data were available at the individual fishery or state-level. For the purposes of this study, seven different fishing regions were defined to allow for geographic analysis within the constraints of the data. These regions were Alaska, the Pacific Northwest (Oregon and Washington), California, the northern

Atlantic (Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey), the southern Atlantic (Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, the east coast of Florida, and the Caribbean Islands), the Gulf Coast (Texas, Louisiana, Mississippi, and the west coast of Florida), and the western Pacific (Hawaii and American Samoa).

Although we initially considered using other regional breakdowns, including those used by NMFS and the regional fishery management councils, this was determined to be impractical. The regions used by NMFS, for example, are at very different geographical scales (e.g., Georges Bank, Chesapeake Bay, West Coast, and East Coast). For the sake of comparability, we strived for geographical areas that were roughly similar in size. Although the regions employed in this study are not dissimilar from those used by regional management council areas, a one-to-one correspondence was not possible given our concern for roughly comparably sized areas and the fact that North Carolina sits on both the Mid-Atlantic and South Atlantic fishery management councils.

Where data sets used larger or different regions than the ones we employed (e.g., some boat owners in the CCF program defined their fishing area as "West Coast" or "East Coast"), splits of subsidy funds were made according to total state landings data for 1996–2004 (NOAA 2007a). Data were excluded from this analysis when the target region was unspecified or unhelpful (e.g., "worldwide"). Data limitations made it impossible to conduct regional analyses for federal fuel subsidies or fisheries research and for some subsets of the data from the CCF, Fisheries Finance Program, and seafood marketing programs.

Species-level analyses.—In many cases, species-level analysis was straightforward. Some data sets clearly defined target fish species; others were entirely independent of fish species or included no species-level information at all. In still other cases, funds were distributed to groups of fish, and the subsidy funds had to be split for the purposes of this analysis. For the CCF and Fisheries Finance Program, three types of target fish were often identified, and the funds split evenly between the named fish for this analysis. For disaster aid subsidies, funds were distributed according to average landings in the relevant region during the 5 years before aid disbursement. Data limitations prevented us from conducting species-level analyses for fuel subsidies, fisheries research, the Fishermen's Contingency Fund, state sales tax subsidies, and for some subsets of the data from the CCF, Fisheries Finance Program, and seafood marketing programs. For these last three programs, species-level subsidy amounts represent only the fraction of the subsidy data that could be parsed by species.

Subsidy categorization.—Relying on a model that considered subsidies to be either investments or disinvestments in the natural capital assets of a fishery, Khan et al. (2006) categorized 11 fishery subsidy types as either good, bad, or ugly subsidies. They classified fishery management programs and service and fisheries research as "good" because such efforts were likely to "enhance the growth of fish stocks through conservation, and the monitoring of catch rates through control and surveillance measures to achieve a biological optimal use." They classified tax exemption programs, foreign access agreements, boat construction renewal and modernization programs, fishing port construction and renovation programs, and fishery development projects and support services, as well as marketing support, processing, and storage infrastructure programs as "bad" because such efforts were likely to "lead to disinvestments in natural capital assets once the fishing capacity develops to a point where resource exploitation exceeds the maximum economic yield." They classified fisher assistance programs, vessel buyback programs, and rural fishers community development programs as "ugly" because they were likely to lead to either "positive impacts such as resource enhancement programs or to negative impacts such as resource overexploitation," depending on the exact nature and context of the subsidy program.

To provide fishery managers and policy makers with a framework for considering how government subsidies might affect U.S. fisheries, we classified each subsidy program according to the scheme described above, with two modifications. First, good, bad, and ugly were renamed "beneficial," "harmful," and "ambiguous," respectively, to provide slightly more descriptive category names. Second, although Khan et al. (2006) categorized fisheries research funding as a beneficial subsidy, our review of the various types of research being funded by federal and state governments suggested that it would be more appropriate to place this program into the ambiguous category (see below).

Results

From 1996 to 2004, U.S. state and federal governments provided the U.S. fishing industry a total of US$6.4 billion (1 billion = 10^9) in subsidies (excluding management costs), the annual total ranging from $682.7 million to $756.6 million and averaging $712.9 million per year (Tables 1, 2). The largest proportion of this money stemmed from federal and state fuel subsidies, which accounted for 11.6% to 32.4% of total subsidies over the 9-year period (Table 1). A close second was federal and state fisheries

TABLE 1.—U.S. fisheries subsidies, by program, 1996–2004.

Subsidy program	Subsidy value (million US$)	Percent of total	Funding source	
			Federal	State
Fuel subsidies	2,825	44	x	x
Fisheries research	2,536	40	x	x
State sales tax exemptions	338	5		x
Disaster aid	257	4	x	x
Fishing access payments	159	2	x	
Surplus fish purchases	117	2	x	
Capital Construction Fund	65	1	x	
Seafood marketing	61	1	x	
Vessel, permit buybacks	55	1	x	
Fisheries Finance Program	2	<1	x	
Fishermen's Contingency Fund	1	<1	x	
Total	6,416	100	[a]	[a]

[a] Federal sources accounted for 79% of all fishing subsidies, state sources for 21%.

research funding, which accounted for 3.8–35.7% of total subsidies. The next three largest contributors were state sales tax exemptions (5% of total subsidies), disaster aid (4%), and fishing access payments (3%). Federal funding accounted for 79% of the total subsidies and state funding accounted for 21%.

Overall, 28% of the total subsidy funds from 1996 to 2004 could be assigned to a particular geographic region; the remaining 72% were composed entirely of federal fuel subsidies and research subsidies (Table 3). The two regions that received the greatest share of U.S. subsidies during 1996–2004 were the western Pacific region (28%) and Alaska (23%), followed by the northern (16%) and southern (14%) Atlantic regions (Figure 1).

Only a relatively small fraction of total estimated subsidy amounts (10%) from 1996 to 2004 were clearly associated with particular fish species (Table 4). Of these funds, however, the vast majority went to salmon (29%) and tuna (29%), with most of the remainder of the money split between two large groups of fish: groundfish (26%) and shellfish (15%) (Figure 2). In the shellfish category, shrimp (primarily Crangonidae and Penaeidae) fishers received the most subsidy (39% of the total amount), followed by crab fishers (primarily Cancridae, Lithodidae, Majidae, and Portunidae; 32%), and lobster fishers (Nephropidae; 15%). Similar analyses could not be made for groundfish because several of the subsidy programs grouped groundfish into a single category, and the particular details of the programs made splitting money out by species according to catch statistics difficult.

All of the subsidies included in this study were classified as harmful or ambiguous subsidies, according to the (slightly modified) classification scheme put forth by Khan et al. (2006). The harmful subsidies identified included federal and state fuel subsidies, state sales tax exemptions, fishing access payments, surplus fish purchases, the CCF, seafood marketing programs, the Fisheries Finance Program, and the Fishermen's Contingency Fund. Because the ambiguous subsidies identified—including fisheries research, disaster aid, and vessel and permit buybacks—depended on the exact nature of these programs, they could be considered beneficial or harmful subsidies. From 1996 to 2004, 56% of government funds went to harmful subsidies and 44% went to ambiguous subsidies (Figure 3).

TABLE 2.—U.S. fisheries subsidies (millions of 2007 U.S. dollars), by program and year.

Subsidy program	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fuel subsidies	325.0	336.3	308.1	316.3	303.5	308.8	303.2	303.9	319.8
Fisheries research	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8	281.8
State sales tax exemptions	43.3	45.2	37.7	41.1	36.8	36.1	34.6	31.9	31.9
Disaster aid	0	0	9.9	53.8	45.5	47.3	10.9	89.9	0
Fishing access payments	18.4	18.0	17.8	17.4	16.8	16.3	16.1	18.2	19.7
Surplus fish purchases	14.4	1.7	15.1	11.7	32.3	6.1	12.3	9.5	13.7
Capital Construction Fund	9.8	8.3	7.7	10.9	7.0	6.0	6.9	5.9	2.6
Seafood marketing	4.3	4.8	4.1	3.8	3.1	2.9	3.2	15.2	19.1
Vessel and permit buybacks	0	6.0	19.0	0	14.4	0.0	13.3	0	2.7
Fisheries Finance Program	0.2	0.4	0.5	0.2	0.2	0.3	0.1	0.3	0.2
Fishermen's Contingency Fund	0.3	< 0.1	0	0	0.1	0.3	0.3	0.1	0.2
Total	697.3	702.5	701.5	736.9	741.4	705.9	682.7	756.6	691.6

TABLE 3.—Distribution of U.S. fisheries subsidies (millions of 2007 U.S. dollars), by program and region, for 1996–2004.

Subsidy program	Western Pacific	Alaska	Northern Atlantic	Southern Atlantic	Pacific Northwest	California	Gulf Coast
State fuel subsidies	230.1	100.0	121.4	100.1	104.8	83.4	4.0
State sales tax exemptions	104.3	0	108.9	58.0	19.7	47.6	0
Disaster aid	9.1	161.9	22.9	27.6	3.9	2.1	29.7
Fishing access payments	158.7	0	0	0	0	0	0
Surplus fish purchases	0	50.6	1.4	6.6	5.0	8.4	44.5
Capital Construction Fund	5.6	34.2	13.3	1.5	5.6	3.6	1.1
Seafood marketing	0	51.3	0.3	2.2	1.6	0.1	0.1
Vessel and permit buybacks	0	21.8	14.4	0	19.3	0	0
Fisheries Finance Program	0.6	0.3	0.8	0	0	<0.1	0.1
Fishermen's Contingency Fund	0	0	0	0	0	0.1	1.2
Total	508.3	420.0	283.4	196.0	159.9	145.2	80.6

Fisheries research was classified as ambiguous after we noted that it was not uncommon to find funded projects geared toward greater fisheries exploitation. Such projects included, for example, studies on the commercial utilization of several species of mackerel (Scombridae), crab, and Pacific salmon *Oncorhynchus* spp.; an investigation of the Asian market for dried fish, at least four industry demonstration projects; and various other commercial fishery development projects, including investigations into new shrimp, abalone (Haliotidae), and octopus (Opisthoteuthidae) fisheries. Although the vast majority of projects appeared to be geared toward fishery conservation, monitoring, or basic fisheries biology, the fact that these fisheries exploitation-oriented projects existed cannot be dismissed. For this reason, it did not seem accurate to consider all funded fisheries research either beneficial or harmful, but more appropriate to place it in the category of ambiguous subsidies.

The fact that the state fuel subsidies and sales tax exemptions amounted to a significant fraction of the subsidy total is notable, given that this study is a first attempt to quantify these programs. For this reason, detailed tables of subsidy totals have been provided for state fuel subsidies and sales tax exemptions (Tables 5, 6). In both of these programs, the value of the subsidy in a given state depends both on the fish landings there and the extent of the particular tax breaks available to fishers in that state; the values for some states are zero.

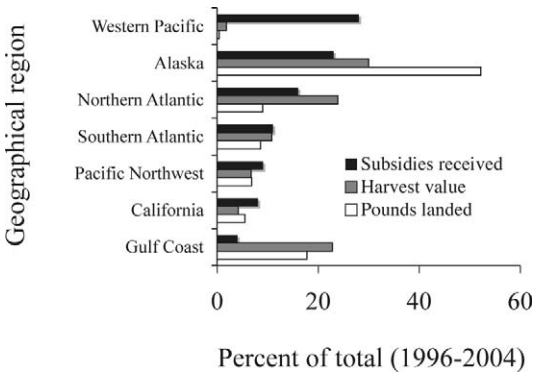

FIGURE 1.—Regional distribution of U.S. fisheries subsidies as compared with number of pounds and value landed, 1996–2004.

Discussion

There have been several previous attempts to identify and quantify U.S. fisheries subsidies, the estimates spanning several orders of magnitude. Milazzo (1998), for example, tallied the "fishing effort- and capacity-enhancing subsidies" in domestic budgeted programs and estimated that these amounted to approximately $30 million annually. Milazzo identified many other subsidy programs in the USA (subsidized lending, certain tax preferences, vessel and permit buybacks, fuel subsidies, etc.) but did not make an effort to calculate their value. Although Milazzo's study was the first major attempt to analyze fisheries subsidies at the international level, today it is incomplete and out of date when it comes to U.S. subsidies because it does not include all programs and does not reflect program changes that have occurred in the nearly 10 years since its publication.

In 1999, the Federal Fisheries Investment Task Force completed its investigation of U.S. government subsidies to the fishing industry (FFITF 1999). Although this effort significantly advanced the state of knowledge on the issue, the study was severely hampered by data limitations, as noted both by the Task Force itself and by a World Wildlife Fund study that examined international fishing subsidy transparency (2000). The Task Force found that even when data did exist, it was typically "held in an uncoordinated fashion in dozens of different filing cabinets in local and regional government offices across the country" (WWF 2000). Such disarray (which we also encountered with this study) prevented the Task Force from quantifying the various subsidies identified in its report.

TABLE 4.—Distribution of U.S. fisheries subsidies (millions of 2007 U.S. dollars), by program and taxon, for 1996–2004.

Subsidy program	Salmon	Tuna	Groundfish	Shellfish[a]	Other
Capital Construction Fund	5.9	3.5	24.7	24.1	6.4
Fisheries Finance Program	< 0.1	2.3	0.2	0.6	0.5
Disaster aid	79.4	4.5	96.4	71.5	5.4
Vessel and permit buybacks	7.1	0	45.9	2.4	0
Surplus fish purchases	95.8	17.4	0	0	0
Seafood marketing	0.1	0	0	0.1	0.3
Fishing access payments	0	158.7	0	0	0
Total	200.6	189.2	187.5	118.3	17.7

[a] Includes abalone (Haliotidae); clams (primarily Mactridae and Arcticidae); crabs, lobsters, and octopuses (Octopodidae); oysters (Ostreidae); scallops (Pectinidae); sea cucumbers (primarily Holothuridae and Stichopodidae); sea urchins (Echinoidea); shrimp (primarily Crangonidae and Penaeidae); squid (primarily Loliginidae); and additional species within the general "shellfish" category of the National Oceanic and Atmospheric Administration.

In 2000, two major multinational studies on the extent of fisheries subsidies were completed that included the US. The first, conducted for Asia Pacific Economic Cooperation (APEC), was notable in that it was the first to include some of the state-level tax exemptions, but it did not assign dollar values to most of the U.S. fisheries subsidies identified (APEC 2000). The second, conducted by OECD scientists Flaaten and Wallis (2000), contained the first comprehensive estimate of subsidies to the U.S. fishing industry, which they placed at $1.1 billion.

In 2006, the OECD updated the calculations made by Flaaten and Wallis (2000) estimating that, on average, between 1997 and 2003 the USA spent $103.6 million on "direct payments," $19.9 million on "cost reducing transfers," and $916 million on "general services," for a total of $1.0 billion (OECD 2006). That same year, two global studies (Khan et al. 2006; Sumaila et al. 2008) estimated the total nonfuel and fuel subsidies to the fishing industries of the USA and 143 other countries. Their estimates for the USA were $1.27 billion and $221 million, respectively, in 2000, for a total of $1.49 billion.

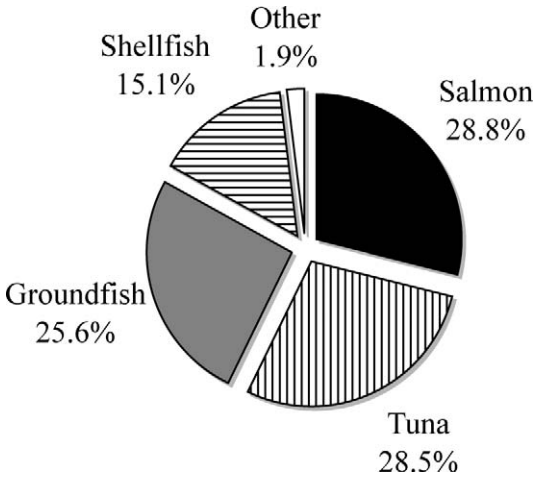

FIGURE 2.—Distribution of U.S. fisheries subsidies by taxa, 1996–2004.

When comparing the U.S. subsidy estimates presented in our study with those cited above, it is important to note what types of subsidies were included in each of the studies. Specifically, our study excluded government funds provided for fisheries management or management-related research, infrastructure, and enforcement because those subsidies, typically the bulk of subsidy funding in the USA and other countries, are generally indirect. Instead, we decided to take a close look at U.S. government programs that subsidize the fishing industry in a more direct manner and that may need to be redesigned or phased-out to comply with WTO rules on fishing subsidies now under consideration. For this reason, although the U.S. subsidy estimates presented in this study may appear at first glance significantly lower than the estimates made by other studies cited above, this is actually misleading.

In fact, accounting for these differences in study focus, it is apparent from the data presented here that previous studies have significantly underestimated the annual value of the more direct subsidies. For example, the OECD's estimated value of direct payments and cost-reducing transfers between 1997 and 2003 ($123 million on average) was 3.5 times lower than the value we calculated for those subsidies ($436 million) (OECD 2006; fisheries research funding was excluded from this total because it falls into the OECD's "general services" category.) Similarly, the estimates for these same subsidy categories by Khan et al. (2006) and Sumaila et al. (2008) for the year 2000 ($368 million) were 1.25 times lower than our subsidy calculation for 2000 ($460 million).

The reasons for these differences in subsidy estimates are varied. The OECD (2006) study, for example, was missing at least one federal U.S. subsidy

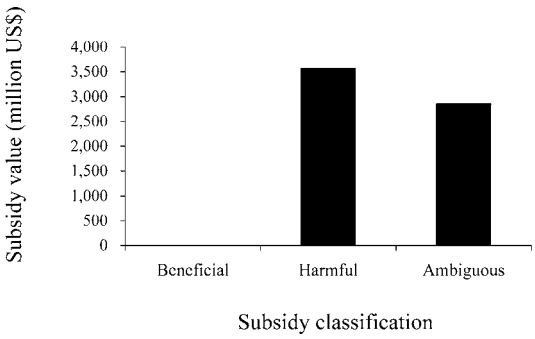

FIGURE 3.—U.S. fisheries subsidies by type of impact (see Methods), 1996–2004.

program (fishing access payments), did not attempt to calculate state subsidies, acknowledges that fuel subsidies were broadly underestimated in its study, and relied on less detailed data to arrive at subsidy estimates. The differences between the estimates of Khan et al. (2006) and Sumaila et al. (2008) combined and those of our study can mainly be attributed to the fact that those two studies did not consider state-level fuel or sales tax subsidies, relied on less detailed data to arrive at subsidy estimates, and made no attempt to estimate U.S. fisheries research funding (though they did for other countries considered in the studies).

To arrive at an updated estimate of total U.S. fisheries subsidies, we can combine the findings of our study with those of Khan et al. (2006) for indirect subsidies. Our study estimated that fisheries management and services amounted to $1.12 billion in 2000. Therefore, if we add the average annual subsidy value for 1996–2004 presented here ($712.9 million), to the above annual figure for fisheries management and service ($1.12 billion), we arrive at revised total U.S. fisheries subsidy estimate of $1.83 billion. This amount is roughly 50% higher than the overall figure put forth by Khan et al. (2006) and Sumaila et al. (2008), but it is still an underestimate because it does not include subsidy program administration costs, port construction and maintenance costs, and fisheries management related research.

TABLE 5.—State sales tax exemptions representing subsidies to commercial fishers for 1996–2004.

State	Subsidy value (2007 US$)
Alabama	966,000
Alaska	0
California	47,559,000
Connecticut	2,333,000
Delaware	0
Florida	10,351,000
Georgia	41,000
Hawaii	0
Louisiana	83,881,000
Maine	26,008,000
Maryland	2,456,000
Massachusetts	29,332,000
Mississippi	6,702,000
New Hampshire	0
New Jersey	31,048,000
New York	4,612,000
North Carolina	21,202,000
Oregon	0
Rhode Island	15,549,000
South Carolina	275,000
Texas	5,093,000
Virginia	31,304,000
Washington	19,698,000
Total	338,410,000

TABLE 6.—State fuel subsidies to commercial fishers for 1996–2004 combined.

State	Subsidy value (2007 US$)
Alabama	3,446,000
Alaska	99,946,000
California	83,370,000
Connecticut	3,186,000
Delaware	0
Florida	22,806,000
Georgia	657,000
Hawaii	3,980,000
Louisiana	171,032,000
Maine	32,827,000
Maryland	9,764,000
Massachusetts	34,927,000
Mississippi	25,768,000
New Hampshire	2,176,000
New Jersey	16,075,000
New York	8,108,000
North Carolina	25,321,000
Oregon	40,280,000
Rhode Island	24,051,000
South Carolina	1,686,000
Texas	13,122,000
Virginia	56,600,000
Washington	64,483,000
Total	743,611,000

The subsidy amounts presented in our study underestimate actual values in other ways as well. For example, given that it was not possible to perform a systematic search for state-level tax breaks given to fishers, it is almost certain that we inadvertently missed some in our search and inadvertently underestimated the associated subsidy. The same holds true for government appropriations used to fund seafood marketing campaigns not associated with any particular government program.

One might also argue that our methods of calculating subsidies for disaster aid and the Fishermen's Contingency Program do not capture their true value if one thinks of these programs as forms of insurance, which is what they actually are. From this perspective, tallying the payout amounts would underestimate the actual subsidy value because the fishing industry

would be benefiting from lowered financial risks without having to pay any price for this service.

Along these same lines, the fishing industry does not bear the vast majority of the considerable financial costs associated with fisheries management. These costs are clearly subsidies because they would not exist in the absence of the fishery, but they were not considered in our study because of necessary limitations of scope. In addition, there is also the on-going question of resource rentals, which are common in other extractive industries (e.g., forestry, oil and gas leases) but not in the fishing industry. This could also be considered a subsidy but we did not, again owing to necessary limitations of scope.

In contrast to OECD (2006), which found a marked increase in U.S. fisheries subsidies from 1996 to 2003, we did not see a discernable trend in fisheries subsidy totals during 1996–2004 (note that the OECD did not adjust for inflation in its calculations). We did, however, find a considerable (about $75 million per year) fluctuation in fisheries subsidy totals over the 9-year period, and this fluctuation would probably be substantially greater if our data on fisheries research funding were more detailed (Table 2).

Importantly, the percentage of total subsidies received by a given region was often not related to the volume or value of fish landed there (Figure 1). This discrepancy was most pronounced in the western Pacific, which enjoyed the highest subsidies yet had the lowest catch volume and landed value of all the regions. The vast majority of this subsidy funding stemmed from the fishing access payments the U.S. government makes each year to allow up to 45 fishing vessels to operate in the waters of several South Pacific Island states. This funding equates to more than $400,000 per vessel per year.

While only a fraction of the subsidies were directly tied to individual fish species, it is nonetheless interesting to consider the highly skewed breakdown of subsidy funding going to different fish species. Salmon and groundfish both receive substantial proportions of the total subsidy pie, and it is these types of fish that consistently top the list for total pounds of fish landed per year (NOAA 2007d). Shellfish, which received a considerable proportion of subsidy funds, typically top the list in terms of total value of landed catch each year. Tuna, on the other hand, receives a huge proportion of U.S. fisheries subsidies, yet ranks much lower in terms of total pounds and value landed each year. These findings are also notable given that the 2006 data indicate that some salmon stocks are currently overfished or approaching an overfished condition, as are at least some tuna stocks (NOAA 2006).

It is generally accepted that the effects of fisheries subsidies will depend on the effectiveness of the management system in place and how well it is enforced; the better the system and the enforcement, the lower the likelihood that subsidies will have effects on fish stocks (OECD 2006). Of course, these two factors are not only difficult to quantify but will vary from fishery to fishery as well as over time in the same fishery. For these reasons, it is impossible to accurately predict what effects any given subsidy program will have on a given fishery or set of fisheries. That said, we felt it would be remiss not to consider this question at least in general terms because moving away from harmful subsidies and toward beneficial subsidies will be critical in the coming years to ensure fishery sustainability.

To this end, we classified all the U.S. subsidy programs according to the classification scheme put forth by Khan et al. (2006; see Methods). This exercise demonstrated several things. First, it became evident that it was inappropriate for Khan et al. to classify subsidies for research as universally beneficial because at least some of the government-funded fishery research projects we encountered were clearly geared toward developing new fisheries or developing current fisheries further. As such, this research would be likely to increase fishing effort, rather than, as Khan et al. (2006) states, "enhanc[ing] the growth of fish stocks through conservation, and the monitoring of catch rates through control and surveillance measures to achieve a biological optimal use." Although the proportion of such fishery development-oriented projects appears to be very low compared with more benignly oriented projects or conservation-oriented projects, their presence indicates that fisheries research should be considered to be an ambiguous subsidy because its effect will depend on the nature of the government funded research in question.

Khan et al. (2006) and Sumaila et al. (2008) estimated that in 2000 the USA provided its fishers with $332 million in harmful subsidies, $36 million in ambiguous subsidies, and $1.1 billion in beneficial subsidies. In this same year, our study estimates that the USA spent $400 million on harmful subsidies and $342 million on ambiguous subsidies. The discrepancies between these two estimates stem from several sources. First, as explained above, we classified fisheries research as ambiguous subsidies rather than beneficial subsidies, unlike in Khan et al. (2006). Second, our estimates for many of the subsidy categories were higher than Khan's because our accounting was more thorough. Third, because of scope and resource limitations, we did not consider fisheries management costs in this study, yet this was

the largest contributor to the estimate of beneficial subsidies reported in Khan et al. (2006).

The results of this study show that U.S. government subsidies to the fishing sector are large, amounting to over $700 million per year. Most of this subsidy goes to encourage artificially high fishing effort, which is likely to result in the overexploitation of the nation's fishery resources. To achieve the objectives of fishery management as stipulated by the Magnusen–Stevens Act, one of the obvious things to do is to cut all harmful subsidies. In this way, the market can be used to reduce pressure on U.S. fish stocks, many of which are already in dire conditions.

Finally, when examining the breakdown of U.S. fisheries subsidies, one should keep in mind that the dollar value of a given subsidy program may not correspond to the degree to which it contributes to increased fishing capacity. In particular, the Capital Construction Fund program has been singled out as being particularly harmful, yet it is not a large monetary contributor to the overall U.S. fisheries subsidy program total (FFITF 1999).

Similarly, one should also keep in mind that some fisheries subsidies have environmental impacts that extend well beyond the fisheries world. Specifically, the OECD (2006) recently concluded, in its major study on the implications of fisheries subsidies, that the environmental impacts of fuel tax exemptions are "potentially significant." Such findings are underscored even more by the fact that the U.S. fishing industry uses approximately 800 million gallons of fuel each year (Sumaila et al., 2008).

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