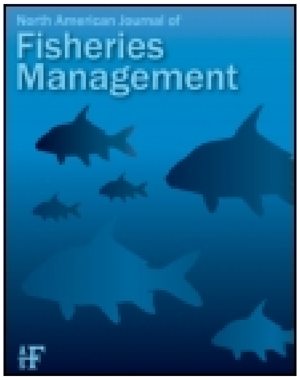

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Abstract.—The recent expansion of the longline commercial fishery has heightened the conflicts among various fisheries in Hawaii, especially between long-liners and other commercial fishing boats (troll and handline) and recreational boats. A recent court ruling against longline fishing in some waters around the Hawaiian Islands may provide an impetus for the expansion of nonlongline commercial activities, which may in turn give rise to conflicts between that fishery and the recreational fishery. This study examines the economic impacts of reallocating the catch of one nonlongline commercial fishing trip to the recreational fishery using the 1992 input–output model for Hawaii. The results show that by itself this shift raises value added per unit of fish landed but lowers overall income and employment. When trade and distribution services are included in the analysis, value added, income, and employment are all lower. When the effects of the decrease in personal consumption expenditures on other sectors as a result of the increase in expenditures on recreational fishing are also taken into account, the total losses in value added, income, and employment are even greater. However, the total indirect impacts of the shift from commercial to recreational fishing on value added, income, and employment are positive in all cases.

Marine fisheries have a long history in Hawaii, and they have both economic and cultural importance to the state. Fisheries are important to the state's economy because of their contributions to the local seafood supply, income, and employment. The mild tropical climate and short distance from shore to deep water also make Hawaii one of the world's finest recreational fishing destinations throughout the year. This not only attracts tourists but also provides local residents opportunities for commercial, subsistence, and recreational fishing activities.

During the last two decades, Hawaii's commercial fishery has experienced rapid and substantial growth, most of which can be attributed to the expansion of the longline fishery. The expansion of commercial fishing has had major biological, economic, and social impacts, which have heightened the conflicts among the various fisheries and user groups and intensified competition for use of a limited resource. Concern about the impacts on endangered species (e.g., sea birds, sea turtles, and marine mammals) and the possibility of localized overfishing led fishery managers to introduce tighter regulations in the early 1990s and to consider further measures in recent years. These include the introduction of limited entry for longline vessels and the closure of nearshore waters in 1991. Currently, measures to reduce the impacts of longline activities on endangered species are being considered. However, there has been a lack of information on the potential economic implications of these regulations.

Broadly speaking, Hawaii's marine fisheries can be divided into three major components, namely, the commercial, charter, and recreational–expense fisheries. The commercial fishery includes long-liners, troll and handline boats, and those that pursue aku *Katsuwonus pelamis* (also known as skipjack tuna), bottom fish, lobster, and other species. The commercial lobster fishery targets two species, the Hawaiian spiny lobster *Panulirus marginatus* and the common slipper lobster *Scyllarides squammosus*; small quantities of the green spiny lobster *P. pencillatus* and the ridgeback slipper lobster *S. haanii* are also caught in the process. In this study, the troll, handline, aku, bottom fish, lobster, and other commercial fleets are grouped into one nonlongline commercial fishery sector because some of these fisheries are too small to treat separately. The conflict between the recreational–expense and longline fisheries was attenuated after the closure of nearshore waters to long-liners in 1991. The recent concern over the impacts of longline activities on endangered species and the consequent court ruling prohibiting longline fishing in certain Hawaiian waters may provide an impetus for the expansion of nonlongline commercial activities. This may give rise to a conflict between

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the recreational–expense and nonlongline commercial fisheries because they fish in the same areas and use similar gears. We believe that this will become an important management issue in the future as the nonlongline commercial fishery expands, the demand for recreational fishing increases, and the fish stock becomes scarce. This study examines the economic trade-offs of reallocating a portion of the allowable catch from the nonlongline commercial fishery to the recreational–expense fishery. As the information presented reveals the differences between the two fisheries and their impacts on the economy, it will be useful in considering future measures relating to the management of these fisheries.

The central political issue facing Hawaii's fishery management is how to balance the conflicting interests of different fisheries (Pooley 1993). As noted by Skillman et al. (1993), existing information on the distributive issues among different fisheries is inadequate to support fisheries management. Owing to the lack of analytical tools and quantitative information on the relative economic importance of the various fishery components, regulations are adopted with a high degree of uncertainty as to their effects on fishermen and the economy (Pooley 1993). To improve fisheries management, it is thus imperative that we develop analytical tools capable of giving fisheries managers reliable and comparable measures of the economic impacts of alternative management options, both from the perspective of the entire fishery sector and from that of each fishery individually. Quantitative models capable of revealing the trade-offs in terms of the net economic contributions to the entire economy and each individual fishery under different management objectives or different policy scenarios can be particularly useful in determining the appropriate policies for Hawaii's fisheries management.

Two analytical tools have recently been developed to assist Hawaii's fisheries managers in determining the appropriate regulatory measures and predicting their economic impacts. The first is a multilevel, multiobjective mathematical programming model (Pan et al. 1999), the second a modification of Hawaii's state input–output (I–O) model to estimate the economic contributions of Hawaii's fisheries (Sharma et al. 1999). The objective of this study was to use the 1992 I–O table to examine the trade-offs among value added, income, and employment associated with a reallocation of a portion of the allowable catch from the nonlongline commercial fishery to the recreational–expense fishery. The 1992 I–O table is the one most recently available.

Input–Output Analysis in Fisheries Management

An input–output model is a comprehensive, detailed table of the sales and purchases of goods and services among producers (industries), final consumers (households, visitors, government, and purchasers outside the state [exports]), and resource owners (of labor, capital, and land) in an economy during a specified time period (usually a year). One of the most important functions of I–O analysis is to assess the economic impacts of changes that are exogenous to the economy, such as those arising from the introduction of new fishery regulations. The Magnuson–Stevens Fishery Conservation and Management Act of 1976 (as amended through 1996) and other federal statutes (particularly Executive Order 12866 [1993] and Economic Analysis of Federal Regulations and the Regulatory Flexibility Act [1996]) require comprehensive economic analyses of any new fisheries management regulations. Consequently, analysis of the economic impacts of fishery regulations has become an essential part of public policy formulation. Economists have used several methods to measure the relative economic value of various fisheries, namely, I–O analysis, benefit–cost analysis, travel cost valuation, and contingent valuation. When the task is to measure the relative importance of fisheries in terms of their actual economic contributions, I–O analysis is perhaps the most appropriate method to use. Hushak (1987), Edwards (1990), and Herrick et al. (1994) describe the use of I–O analysis in the context of fisheries management.

Several studies have applied I–O models in determining the overall economic value of fisheries. Harris and Norton (1978) illustrated the use of an I–O model to examine the income and employment effects of commercial fisheries. Briggs et al. (1982) applied the I–O framework in an economic analysis of Maine's fisheries. King and Shellhammer (1982a, 1982b) employed an I–O model to describe the interdependencies between California's fisheries and the rest of the state's economy and to determine the economic value of fishing industries in California. Hushak et al. (1986) applied an I–O model of northern Ohio to examine the economic impacts of reallocating a portion of Ohio's Lake Erie fishery from commercial fishing to sport fishing as well as to analyze the relative economic impacts of sport fishing and commercial fishing. The impacts of the North Pacific Fishery Management Council's (NPFMC) proposal to shift a portion of the quotas for walleye pollock *Theragra chalcogramma* and Pacific cod *Gadus macrocephalus* from the offshore to inshore harvesting sector in waters off Alaska were estimated with both I–O and benefit–cost approaches (NPFMC 1991; Herrick et al. 1994). More recently, Storey and Allen (1993) conducted an I–O analysis to estimate the economic impact of recreational marine fishing in Massachusetts. Several other applications of I–O models to fisheries can be found in Andrews and Rossi (1986) and Hushak et al. (1986). To our knowledge, however, except for Hushak et al. (1986), I–O models have not been used to measure the net economic contributions of catch reallocation between recreational and commercial fisheries. As noted by Berman et al. (1997), studies of the net economic impacts of such reallocations with other methods are also limited.

Methods

The 1992 Hawaii I–O table (Sharma et al. 1997; DBEDT 1998) originally contained 118 sectors, including one commercial fishing sector (sector 14) that covered all commercial fisheries production activities except for fishery services, which were included in agricultural, forestry, and fishery services (sector 17). Similarly, charter fishing was included in miscellaneous amusement services (sector 97). For the purpose of estimating the economic contributions of Hawaii's fisheries (Sharma et al. 1999), the original table was aggregated to 69 sectors, including the original commercial fishing sector. The latter was subsequently disaggregated into a longline fishery and a nonlongline commercial fishery. In addition, two new recreational fishery sectors, the charter and recreational–expense fisheries, were added to the table. Recreational and expense fishing activities were combined because the primary motive for both of them is recreation and their expenditure patterns are quite similar. Thus, the modified I–O table used in estimating the economic contributions of Hawaii's fisheries in Sharma et al. (1999) and in examining the trade-offs between the recreational–expense and commercial fisheries in this paper had 72 sectors, including 4 fishery and 68 nonfishery sectors. As the I–O multipliers in the original and modified I–O models were very similar, the modified model was adopted for computational convenience.

Most of the data needed to incorporate the four fishery sectors into the 1992 I–O model came from recent cost–earnings surveys of various fishing boats. These include the cost–earnings survey of longline vessels conducted in 1994 (Hamilton et al. 1996), the survey of small commercial, recreational, and expense boats (troll and handline) in 1996 (Hamilton and Huffman 1997), and the survey of charter boats during 1997 and 1998 (Hamilton 1998). The sample for cost–earnings analyses included 95 long-liners, 569 small boats (including 184 commercial, 227 expense, and 158 recreational boats), and 63 charter boats. The total number of active fishing boats in the state was estimated to be 122 for the longline fleet (Dollar 1993) and 188 for the charter fleet (Hamilton 1998). Similarly, following Pan et al. (1999), the total number of other boats was estimated to be 3,823 (381 nonlongline commercial, 952 expense, and 2,490 recreational boats). The total statewide economic activity (output, purchases of inputs, labor income, and employment) of each of these fisheries was estimated from sample averages from the cost–earnings surveys and total fleet size. Additionally, to check the estimates based on the cost–earnings surveys and to estimate exports, intermediate fish sales, and the leakage from the fishery sectors (i.e., their imports), 27 fishing suppliers (2 wholesalers and 25 retailers), 6 repair and dry dock facilities, and 7 seafood dealers and brokers in the state were also surveyed during 1996 and 1997. Based on information obtained from the fishery dealers and suppliers, only 10% of expenditures on fishing supplies, gears, baits, and boats and equipment accrued to Hawaiian industries; the remaining 90% was imports.

Because the I–O table was based on 1992 data and the cost–earnings surveys were conducted during 1993–1998, the cost–earnings data were deflated to their 1992 levels for temporal consistency. The interindustry transaction and technical coefficients for the longline fishery were estimated from the cost–earnings data, information from the surveys of fishery dealers and suppliers, and the coefficients for the commercial fishing sector in the original I–O table. The nonlongline commercial fishery sector was modeled in the same way, except that sales and expenditure patterns for the aku and lobster boats were assumed to be the same as those for the troll and handline boats owing to the lack of data for the former. Similarly, the production relation for bottom fish was assumed to be similar to that of troll and handline boats because, according to the cost–earnings study, commercial bottom fish trips account for a considerable proportion of total troll and handline com-

TABLE 1.—Output, inputs, and employment of Hawaii's fisheries. Values are from Sharma et al. (1999).

Output, inputs, and empoyment	Longline fishery	Nonlongline commercial fishery	Charter fishery	Recreational–expense fishery	Total
Output (millions of 1992 US$)	43.88	13.92	16.46	23.89	98.15
Intermediate demand	22.41	6.51	0.68	3.06	32.66
Final demand	21.47	7.41	15.79	20.83	65.49
Inputs (millions of 1992 US$)	43.88	13.92	16.46	23.89	98.15
Intermediate inputs	15.44	6.67	8.91	18.78	49.81
Value added	23.74	6.20	7.19	0.00	37.14
Labor income	21.24	5.53	6.39	0.00	33.16
Other value added	2.50	0.68	0.80	0.00	3.98
Imports	4.70	1.04	0.36	5.11	11.21
Employment (number of jobs)	652	357	417	0	1,426

mercial trips. For these reasons, the production relation used for the nonlongline fishery was the average for different gear types (i.e., troll, handline, aku, bottom fish, and lobster boats). Although it would have been more appropriate to estimate a separate production function for each gear type, some of these gears are too small to be treated separately. Production and sales patterns for the charter boat fishery were estimated from the information in the charter boat cost–earnings survey. Because charter boat activities were subsumed under the miscellaneous amusement services sector in the original model, the inputs and outputs that we estimated for the charter boat fishery were deducted from the miscellaneous amusement services sector in the modified table. These procedures are presented in greater detail in Sharma et al. (1999).

Modeling of the recreational–expense fishery sector was less straightforward than that of the commercial and charter fishery sectors. Although expense boats sell some of their catch to recover part of their expenses, the ratio of their total sales to their total expenditures is smaller than for commercial boats. Furthermore, recreational boats do not sell any of their catch and hence only incur expenses. According to Hushak et al. (1986), various expenses (e.g., fuel, bait, and supplies) that are incurred by local residents on recreational–expense fishing trips may be thought of as personal consumption expenditures (PCE) for goods and services produced by other industries (e.g., petroleum refiners, manufacturing, trade, etc.). However, this approach poses two problems. First, it is not correct in the case of the expense fishery, which purchases some goods and services in order to harvest fish for sale. Second, treating fishing expenses as final demand precludes estimating I–O multipliers for the recreational–expense fishery. In this study, therefore, the recreational–expense fishery was defined as a producing sector. The column entries for the sector are the input purchases of goods and services by recreational–expense fishermen from the various row sectors. To eliminate double counting, final demands in the original model were adjusted by subtracting these quantities from the PCE of industries supplying inputs to the recreational–expense fishery. The row shows the intermediate and final sales of fish output and lump sum PCE in recreational–expense fishing.

Results

Economic Values of Hawaii's Fisheries

In 1992, Hawaii's fisheries generated US$98.15 million of output, $37.14 million of value added, $33.16 million of labor income, and 1,426 jobs (Table 1). The nonlongline commercial fishery accounted for 14.2% of total fishery output, 16.4% of total labor income, and 25% of total employment. The recreational–expense fishery accounted for about 25% of total fisheries output. The recreational–expense and nonlongline commercial fisheries also accounted for 37.8% ($18.78 million) and 13.5% ($6.67 million), respectively, of total fishery input purchases from Hawaii's industries.

Because the nonlongline commercial fishery contributes to income and value added directly (that is, in addition to its purchases from other industries) and, by definition, the recreational–expense fishery makes no direct contributions to income and value added, the expenditure patterns of the two fisheries are quite different (Table 2). For example, industry purchases account for nearly four-fifths (78.6%) of total inputs for the recreational–expense fishery compared with less than half (47.8%) for the nonlongline commercial fishery. In other words, the share of industry purchases in total inputs is much higher for

TABLE 2.—Purchased inputs by sector of the recreational–expense and nonlongline commercial fisheries in Hawaii. Monetary values are in 1992 U.S. dollars. Data are from Sharma et al. (1999).

	Recreational–expense fishery			Nonlongline fishery		
Sector	Annual total ($ million)	Average/ trip ($)	Percent of total inputs	Annual total ($ million)	Average/ trip ($)	Percent of total inputs
Food products and ice	2.75	18.70	11.5	1.65	40.86	11.9
Petroleum refining and products	6.20	42.15	26.0	2.13	52.74	15.3
Transportation equipment	3.44	23.39	14.4	0.83	20.55	6.0
Miscellaneous manufacturing products	0.18	1.22	0.8	0.06	1.49	0.4
Transportation	0.60	4.08	2.5	0.15	3.71	1.1
Wholesale trade	2.42	16.45	10.1	0.77	19.07	5.5
Eating and drinking	0.52	3.54	2.2	0.16	3.96	1.1
Retail trade	0.69	4.69	2.9	0.22	5.45	1.6
Finance and insurance	1.98	13.46	8.3	0.68	16.84	4.9
Total intermediate inputs	18.78	127.67	78.6	6.65	164.66	47.8
Addendum:						
Value added	0.00	0.00	0.0	6.20	153.52	44.5
Labor income	0.00	0.00	0.0	5.53	136.93	39.7
Other value added	0.00	0.00	0.0	0.68	16.84	4.9
Imports	5.11	34.74	21.4	1.04	25.75	7.5
Total inputs	23.89	162.41	100.0	13.92	344.67	100.0

the recreational–expense fishery. Because of value added, including payments to households (i.e., labor income), the total input requirements for a nonlongline commercial fishery trip ($344.70) are more than twice those for a recreational–expense trip ($162.40). On a per trip basis, total intermediate input requirements are about 30% higher for the former ($164.66) than for the latter ($127.67). This difference is attributable to higher oil–fuel and food–ice requirements for the nonlongline fishing trips. Important sectors supplying inputs to both of these fisheries include the petroleum refinery and products, food processing, transportation equipment, wholesale trade, and finance and insurance sectors (Table 2).

In 1992, Hawaii's fisheries accounted for $65.5 million worth of final demand for goods and services, of which 31.8% ($20.83 million) was attributable to the recreational–expense fishery and 11.3% ($7.41 million) to the nonlongline commercial fishery. The nonlongline commercial and recreational fisheries accounted for $6.51 million and $3.06 million, respectively, of intermediate sales to Hawaii's industries, which are about 20% and 10% of the total intermediate sales of the entire fishery. Thus, the fishery sectors are linked to the economy both as purchasers of outputs from various Hawaiian industries and as suppliers of outputs to meet nonfishery final demand. These linkages between Hawaii's fisheries and their output, value added, income, and employment contributions to the economy are examined in detail in Sharma et al. (1999).

Economic Impacts of Fishery Reallocation

The exvessel value of fish sold was estimated to account for $63.1 million of the $98.15-million total output of Hawaii's fisheries in 1992. The direct revenue from charter patrons ($15.1 million) and expenditures on the recreational–expense fishery ($20.0 million) accounted for the remainder of total fishery output (i.e., $35.1 million). Of total exvessel value in 1992, $43.9 million was attributable to long-liners, $13.9 million to nonlongline commercial boats, $3.9 million to expense boats, and $1.4 million to charter boats.

According to the recent cost–earning survey of troll and handline boats (Hamilton and Huffman 1997), the total annual catch of recreational–expense boats in Hawaii was 6.4 million lb and that of nonlongline commercial boats 4.6 million lb, with an average catch per vessel of 1,864 lb and 11,992 lb, respectively (Table 3). The total number of fishing trips annually was estimated to be about 147,100 for the recreational–expense fleet and about 40,400 for the nonlongline commercial fleet, with an average catch per trip of 44.4 lb and 110.7 lb, respectively. Thus, in terms of the amount of catch, one nonlongline commercial trip was equivalent to 2.49 recreational–expense trips. In other words, in terms of present catch rates, eliminating one nonlongline commercial trip would allow the number of recreational–expense trips to increase by 2.49. Such a reallocation would increase the recreational–expense fishery's expenses and relat-

TABLE 3.—Estimation of the changes in final demand and related forward-linked margins per trip in the recreational–expense and nonlongline commercial fisheries owing to the reallocation of commercial fishery catch to the recreational–expense fishery. Monetary values are in 1992 U.S. dollars.

Final demand variable	Recreational–expense fishery	Nonlongline commercial fishery
Number of boats	3,442	381
Yearly average catch/boat (lb)	1,864	11,992
Total catch/year (million lb)	6.4	4.6
Average yearly number of trips/boat	42.0	108.3
Average boat catch/trip (lb)	44.4	110.7
Total number of trips/year	147,098	40,386
Total final demand ($ million)	20.83	7.41
Final demand plus trade and distribution services/trip ($)	144.39	269.90
Final demand/trip ($)	141.60	183.48
Forward-linked trade and distribution services/trip ($)	2.79	86.42

ed activities in the economy and would reduce those associated with nonlongline commercial fishing. These changes are assumed to translate into changes in each sector's final demand through the current final demand–output ratio. Owing to the differences in the interindustry sale and purchase patterns of the two sectors, a given change in final demand would have different impacts on the economy depending on the sector in which it occurred. For example, as shown in Table 1, total final demand accounted for more than 87% of the output of the recreational–expense fishery, compared with 53% for nonlongline commercial fishery.

In 1992, total final demand (i.e., PCE, exports, and visitors' expenditures) for the recreational–expense and nonlongline commercial fisheries was estimated to be $20.83 million and $7.41 million, or $141.60/trip and $183.48/trip, respectively (Table 3). Final demand in the fishery sector also creates demand for the services of the various trade and distribution sectors involved in the sale of seafood products from harvest to final purchase by consumers. The value of these forward-linked services (or margins) was estimated as $0.41 million ($2.80/trip) for the recreational–expense fishery and $3.49 million ($86.40/trip) for the nonlongline commercial fishery. Including these forward-linked margins, final demand per trip was estimated as $144.39 for the recreational–expense fishery and $269.90 for the nonlongline commercial fishery.

Reallocation of the catch from one nonlongline commercial trip to the recreational–expense fishery would increase the number of recreational–expense trips by 2.49. This would be equivalent to an increase in final demand in the recreational–expense fishery of about $353.10 without factoring in the forward-linked trade and distribution services and $360.00 factoring in those services. By the same token, the reallocation would be associated with decreases in final demand in the nonlongline commercial fishery of $183.50 without factoring in the forward-linked services and $269.90 factoring them in. These changes in final demand and forward-linked margins can be used in conjunction with I–O multipliers for output, value added, income, and employment to estimate the direct, indirect, and total economic impacts of the catch reallocation. The output, value added, income, and employment multipliers (type I) for the recreational–expense and nonlongline commercial fisheries are presented in Table 4. Also shown are the corresponding impacts of the changes in PCE for all sectors except the recreational–expense fishery. This information was used in computing the net economic impacts of the increase in recreational–expense fishing expenditures vis-à-vis those of the corresponding decrease in PCE in other sectors in the economy.

Like the expenditure patterns, the I–O multipliers are quite different for the two fisheries. As shown in Table 4, the output multiplier (which shows the change in total output that would result from a $1 change in final demand) is higher for the recreational–expense fishery than for the nonlongline commercial fishery, whereas the multipliers for value added, income, and employment are lower for the recreational–expense fishery than for the nonlongline commercial fishery. The output multiplier is higher for the recreational–expense fishery owing to the higher share of interindustry purchases in that fishery's total input requirements; the multipliers for value added, income, and employment are lower owing to the absence of direct value added and payments to households by that fishery.

TABLE 4.—Output, value-added, income, and employment multipliers for the recreational–expense fishery, the nonlongline commercial fishery, and non-recreational/expense personal consumption expenditures (PCE) in Hawaii. Values are from Sharma et al. (1999).

Multiplier	Recreational–expense fishery	Nonlongline commercial fishery	Non-recreational–expense fishery PCE
Output ($/$ final demand)	1.98	1.61	1.32
Value added ($/$ final demand)	0.39	0.68	0.83
Income ($/$ final demand)	0.25	0.54	0.49
Employment (jobs/$ million of final demand)	8.52	30.89	18.48

The estimated direct, indirect, and total impacts on value added, income, and employment of the catch reallocation are presented in Table 5 (with and without factoring in the forward-linked trade and distribution services). With present catch rates and expenditure patterns and ignoring the forward-linked trade and distribution services, reallocation of the catch from one nonlongline commercial trip to the recreational–expense fishery would increase total value added by $12.99, reduce income by $12.42, and reduce total employment by 2.65 jobs per 1,000 commercial trips. When the forward-linked trade and distribution services are included, the reallocation would entail losses of value added and income of $59.23 and $57.79, respectively, as well as a decrease in employment by 4.6 jobs for every 1,000 nonlongline commercial trips. The net direct effects of the reallocation on value added, income, and employment are all negative because the recreational–expense fishery makes no direct contribution to those variables. However, the net indirect effects of the reallocation on value added, income, and employment are all positive whether or not the forward-linked trade and distribution services are included (although the effects are smaller when those services are included). This is the case not only because of the larger change in final demand in the recreational–expense fishery but also because of the higher ratio of indirect to direct effects in that fishery.

The above analysis represents a situation in which increased expenditures in the recreational–expense fishery would have no effect on PCE in other sectors of Hawaii's economy. This would be the case, for instance, if Hawaii's residents simply reduced their spending on out-of-state vacations in order to take additional recreational fishing trips in Hawaii. In all probability, however, there would be some shift in PCE from other sectors of Hawaii's economy to recreational fishing. Thus, the reallocation of the catch from the nonlongline fishery to the recreational–expense fishery would have additional impacts owing to shifts in consumer spending. The economic impacts of the catch reallocation when these shifts are taken into account are presented in Table 6. In this case, both the net direct and the net total economic impacts are negative. The increase in recreational fishing at the expense of one nonlongline commercial fishing trip would result in losses of total income and val-

TABLE 5.—Economic impacts of the reallocation of nonlongline commercial fishery catch to the recreational–expense fishery in Hawaii, with and without inclusion of forward-linked trade and distribution margins.

Impact	Direct		Indirect		Total	
	Without margins	With margins	Without margins	With margins	Without margins	With margins
Income ($/commercial trip)	−72.80	−108.45	60.38	50.66	−12.42	−57.79
Recreational–expense fishery	0.00	3.22	87.12	87.80	87.12	91.02
Nonlongline commercial fishery	−72.80	−111.67	−26.74	−37.14	−99.54	−148.81
Value added ($/commercial trip)	−81.71	−138.78	94.70	79.55	12.99	−59.23
Recreational–expense fishery	0.00	5.08	137.29	138.48	137.29	143.56
Nonlongline commercial fishery	−81.71	−143.86	−42.59	−58.93	−124.30	−202.79
Employment (number of jobs/1,000 commercial trips)	−4.70	−6.30	2.05	1.68	−2.56	−4.61
Recreational–expense fishery	0.00	0.14	3.02	3.04	3.02	3.19
Nonlongline commercial fishery	−4.70	−6.44	−0.97	−1.36	−5.67	−7.80

TABLE 6.—Economic impacts of the reallocation of nonlongline commercial fishery catch to the recreational–expense fishery in Hawaii including the effects on personal consumption expenditures (PCE) elsewhere in the economy.

Impact	Direct	Indirect	Total
Income ($/commercial trip)	−203.43	18.01	−185.42
Recreational–expense fishery	0.00	87.12	87.12
Nonlongline commercial fishery	−72.80	−26.74	−99.54
Other PCE	−130.63	−42.37	−173.00
Value added ($/commercial trip)	−307.67	27.62	−280.05
Recreational–expense fishery	0.00	137.29	137.29
Nonlongline commercial fishery	−81.71	−42.59	−124.30
Other PCE	−225.96	−67.08	−293.04
Employment (number of jobs/1,000 commercial trips)	−9.76	0.59	−9.18
Recreational–expense fishery	0.00	3.02	3.02
Nonlongline commercial fishery	−4.70	−0.97	−5.67
Other PCE	−5.06	−1.47	−6.52

ue added of $185.42 and $280.05, respectively, and a decrease in employment of 9.18 jobs per 1,000 commercial trips. However, it should be noted that the net indirect effects of the reallocation are all positive.

Discussion

Following most previous I–O applications to fisheries, we used I–O multipliers in conjunction with changes in final demand to estimate the economic trade-offs of reallocating the catch of one nonlongline commercial fishing trip to the recreational–expense fishery. As discussed above, the recreational–expense fishery generally has lower impacts on value-added, income, and employment, especially when the decrease in other PCE owing to the increase in expenditures for recreational fishing is considered. This information can be useful in considering the impacts of new fishery regulations on the economy overall as well as on the affected fisheries themselves. Although traditional benefit–cost analysis (BCA) focuses on the net gains or losses in economic welfare (taking into account nonmarket benefits like recreational fishing as well as market benefits), it does not provide an economywide impact assessment. In other words, BCA only accounts for the net benefits accruing to the fishery sector, not those in other sectors of the economy. In addition, traditional BCA measures net benefits only in terms of economic efficiency. Although maximizing economic efficiency is generally considered an important goal for fisheries management, maximizing the economywide or regional income and employment can be equally important. We believe that in evaluating the reallocation of the catch from the commercial to the recreational fishery, I–O analysis can provide the added dimension of economywide assessments of output, value added, income, and employment. This is by no means to imply that BCA is not useful; rather, it is to point out that I–O analysis can provide additional information to fisheries managers. An expanded BCA that incorporated the many objectives of fishery management as well as economywide assessments would offer a fruitful framework for further research.

However, the results presented here pertain to the special case in which the reallocation of the commercial catch is fully exploited by an increased number of recreational–expense fishing trips without altering the catch rates and expenditure patterns. In reality, the behavior of fishermen may be quite different, with different impacts on the economy. The recreational catch rates may increase owing to the reallocation, thereby necessitating fewer than 2.49 additional recreational–expense trips to fully exploit the harvest of one nonlongline commercial trip. It is also possible that recreational–expense boats will not fully exploit the reallocated catch. This might happen, for example, because recreational–expense fishers do not necessarily catch the same composition of species as nonlongline commercial fishers. In either case, the increase in expenditures or final demand in the recreational–expense fishery would be smaller than anticipated under the model, and thus the economic losses from the reallocation would be higher. The economic losses from the reallocation would also depend on whether the increased expenditures for recreational fishing came from external sources (such as substituting recreational fishing trips in Hawaii for out-of-state vacations) or internal sources (such as shifting PCE from other sectors of Hawaii's economy to recreational fishing). For these reasons, this paper provides a range of economic impact estimates for the proposed fishery reallocation. Furthermore, it should be noted that the estimates presented here are based solely on Hawaii's residents' actual expenditures for recreational fishing without considering the nonmarket values of such fishing.

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