Assessment of the Relative Economic Impacts of the Sport and Commercial Fisheries on Ohio's Lake Erie

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Executive Summary
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Fishery managers and other decision-makers are often pressured to reallocate fish from commercial fishing to sport anglers. Wise decisions require an evaluation of the relative changes in economic value and economic impact(s) of various allocation strategies for Lake Erie fish between sport and commercial fisheries. In this report we estimate the relative economic impacts (changes in output, income, and employment) from a reallocation of $1m dockside value in commercial fish harvest to sport anglers.

The economic impact from reallocation of yellow perch, and possibly white bass, from commercial to sport anglers would probably not increase the overall economic impact of the Lake Erie fishery in Ohio. Reallocation of $1m dockside value of yellow perch would mean an estimated loss of $1.5m of economic output from commercial fishing and the potential gain of $3.4m from sport fishing. However, the gain from sport angling would probably not be realized. Based on the different economic multipliers for sport and commercial fishing, to break even, i.e., to cover the estimated commercial loss of $1 million in dockside value and $1.5m in economic output, sport anglers must increase their effort and spend an additional $1.1 million. Sport anglers did not increase yellow perch fishing effort in response to increased perch availability during 1993 to 1996 sufficiently to generate this break even impact; total economic impact was higher with commercial fishing for yellow perch than it would have been without. In addition, if sport angling efforts continue to decline, the short-term losses described above will increase.

The removal of yellow perch from the commercial harvest would greatly increase the probability that Ohio's commercial fishing industry would disappear. Commercial fishing contributes to tourism and sport angling in two ways. First, yellow perch is a highly important menu item in restaurants of Lake Erie coastal counties and most of those served in coastal restaurants are imported from Canada. The Ohio commercial yellow perch harvest helps lower yellow perch prices by reducing imports from Canada and makes Ohio's North Coast a more attractive visitor destination. Second, the harvest of less valued species (carp, drum, catfish, white perch, etc.) has a potentially positive effect on walleye and yellow perch populations in Lake Erie. While there is no documented relationship between the populations of lesser and higher valued species, there is a potential for a negative effect on walleye and yellow perch from continued increases of one or more of the less valued species if they were no longer harvested. Are we willing to risk the loss of the commercial industry and its possible consequences? Are we willing to become totally dependent on Canada for our commercial supply of yellow perch in Ohio?

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This report was prepared to assist fishery managers and decision-makers as they attempt to evaluate the economic impacts of various allocation strategies for Lake Erie fish between sport and commercial fisheries. Hushak et al. (1986) provides estimates of the relative economic impacts of commercial and sport fishing, but is based on 1978 data. A more recent impact study (Vilaplana, 1991 and Vilaplana et al. 1991) uses the same region and the same economic sectors, but with an improved input-output model and a 1985 database. However, the results of Vilaplana (1991) have not been used to calculate the relative economic impacts of sport and commercial fishing as done in Hushak et al.

In this report, I present the 1978 results from Hushak et al. and calculate the comparable output impacts for 1985 based on Vilaplana (1991) using the same procedures as Hushak et al. (1986). I then put the results in a broader context using other economic studies I have conducted, information from Ohio creel data reports, the national survey of fishing, hunting and wildlife associated recreation for 1985 and 1991, and information on fishing license holders from the Division of Federal Aid, U.S. Fish & Wildlife Service. Finally, I raise some questions not addressed by these results, but which affect the outcome of any decision.

Previous Studies

The most closely applicable study is Hushak el al. (1986) where we estimated the relative output, income, and employment impacts of reallocating $1m of fish, dockside value, from the commercial sector to the sport sector. The data base for the study consisted of an input-output model for the year 1978 covering a 17-county Lake Erie region in northern Ohio and surveys of sport anglers during the summer walleye (May - August) and autumn yellow perch (September - October) seasons during 1981.

The key results of this study are in Table 1, where estimated impacts of a $1m reallocation of fish from commercial to sport fishing are presented under the assumption of a forward linkage from commercial fishing to food processing. Commercial fishing was modeled as selling 92% of its $2.5m of output to food processing and the output impact of these fish through food processing was estimated at $9.83m of output. The more standard backward linkage multiplier impact of the commercial sector was estimated at $4.05m of output, i.e., commercial fishing alone contributed $4.05m of the $9.83m.

Table 1. Key results for a $1m transfer of fish from commercial to sport fishing with assumption of a forward linkage in the commercial sector.

	Commercial Decrease	Sport Increase	Net Change
Output ($m)	3.9	0 to 8.2	-3.9 to 4.3
Income ($m)	0.4	0 to 2.9	-0.4 to 2.5
Employment (yrs)	41.4	0 to 253.2	-41.4 to 211.8

Source: Hushak et al. (1986), Table 5

The first column of Table 1 shows the expected decrease in economic activity in commercial fishing from the $1m reallocation. Total regional (17-county area) output is expected to decrease by $3.9m ($9.83m/$2.5m) including multiplier effects from reduced commercial fishing, while income decreases $400,000 and employment by 41 person-years.

In the second column, regional output from increased sport fishing is expected to increase up to a maximum of $8.2m, while income can increase up to $2.9m and employment up to 253 person-years. In the sport fishery, economic impacts occur as a result of expenditures in economic sectors such as charter fishing, marine trades, restaurants, hotels, service stations and grocery stores. The sport increases are stated as a range because there is no guarantee that sport angling will increase in proportion to the fish reallocated from commercial fishing. The expected response of sport anglers is discussed later in the report. The final column is sport increase less the commercial decrease.

Vilaplana (1991) developed an input-output model for the same region using the base year of 1985. He used 1987 survey data to develop charter fishing and marine trades sectors and sport fishing expenditure patterns similar to those of the 1978 model. The output of the commercial sector was allocated (sold) to eight sectors in contrast to Hushak et al. (1986) where nearly all output was sold to food processing, and the forward linkage assumption of the earlier study is not appropriate. Therefore we compare output impacts from Vilaplana to Hushak et al. using only backward linkages, i.e., the impacts only from purchases by commercial fishing on the regional economy. From Hushak et al., the economic impact of the $1m reallocation in the commercial sector is $1.6m ($4.05m/$2.5m) under this assumption (Table 2). The sport angling output impact does not change.

From Vilaplana (1991), the impact of a reallocation from commercial fishing to sport angling results in a negative economic impact of $1.5m ($3.4m output/$2.28m dockside value) from commercial fishing, an estimate very similar to Hushak et al. (Table 2). However, the maximum sport angling impact is much smaller at $3.4m. Using Ohio creel data, Vilaplana estimated the total economic impact of sport angling on the regional economy at $41.9m in 1985. I estimated the 1985 dockside value of the sport fish harvest at $12.5m (3.7m walleye times 1.7 lbs. = 6.3m lbs. of walleye plus 7.3m yellow perch times 0.2 lbs. = 1.5m lbs. of yellow perch, or 7.8m lbs. of fish times $1.60 per lb. live weight). Average dockside prices of yellow perch (there is not an observable dockside price for walleye in Ohio) varied from a low of $1.03 to a high of $2.61 during 1984 to 1995.

Table 2. Comparison of total output effects of the 1978 and 1985 models for a $1m transfer of fish from commercial to sport fishing using the standard backward linkage in the commercial sector ($m)

	Commercial Decrease	Sport Increase	Net Change
1978, Hushak et al.	1.6	0 to 8.2	-1.6 to 6.6
1985, Vilaplana	1.5	0 to 3.4	-1.5 to 1.9

Sources: Hushak et al. (1986), Vilaplana (1991), Vilaplana et al. (1991).

A major reason for the reduced sport impact per $1m of fish was a very large walleye sport harvest more than offsetting a reduced yellow perch harvest in 1985 as compared to 1978. This leads to a large dockside value of the sport harvest. In addition, however, Vilaplana's model has smaller multipliers because of better accounting for inputs purchased from outside the 17-county region than Hushak et al., resulting in smaller indirect effects and smaller total output impacts for both commercial and sport angling.

One limitation of these results is that there are no standard errors or confidence intervals for the estimated impacts. Input-output models like those used in these studies are deterministic models; the parameters are not statistically estimated from sample data with standard errors.

Several questions must be addressed in using these results to evaluate a fisheries reallocation issue in 1996 in contrast to the 1980s when this research was completed. 1) Are these relative impacts applicable to yellow perch and white bass in the present fishery? 2) To what extent can we expect a reallocation from commercial to sport angling to be utilized by sport anglers? 3) What are some additional questions which need to be addressed in a broader context of reallocation?

Are these relative impacts applicable to yellow perch and white bass?

Hushak et al (1986) was completed under the assumption that the reallocation would be yellow perch. At the time of the study, the commercial industry was no longer harvesting walleye in Ohio. In addition, Hushak el al. (1988) shows that the recreational trip expenditures and consumer surplus estimates for walleye during May-August and yellow perch during September-October were very similar.

More recent surveys conducted in 1987 for private-boat sport fishing and in 1990 and 1992 for Lake Erie based recreation are in general consistent with the 1981 study but are not directly comparable because of a different population base and different objectives. Hushak and Jeng (1990) compares some of the data from the 1981 and 1987 surveys; the 1987, 1990 and 1992 surveys did not distinguish between walleye and yellow perch angling. White bass and other species sought by sport anglers, small mouth bass for example, were not highlighted in any of the studies.

The major change since 1981 has been the purchase of gill net rights from commercial fishermen. This purchase removed from Lake Erie the primary harvest technology for yellow perch, thereby reducing the commercial catch of yellow perch by 88% from 2.0 mil. lbs. in 1981 to 245,000 lbs. in 1982. Commercial harvest of yellow perch has varied widely since 1982.

The expected effect of removing gill nets is to increase the economic impacts from commercial fishing of the $1m reallocation because, with reduced efficiency in the commercial industry, it takes more resources to harvest each unit of fish. The Vilaplana model was specified for 1985 after gill net rights were purchased. The Vilaplana model has smaller multipliers than Hushak et al., so although the commercial fishing impact is lower in Vilaplana, it is actually larger than expected based on the expected economic reduction in multipliers between Vilaplana and Hushak et al.

To conclude, these estimates are primarily applicable to yellow perch and walleye allocations because of similar expenditures and consumer surplus values to sport anglers and their similar dockside values in commercial markets. They are applicable to white bass to the extent that this species would generate similar sport angling behavior; I do not have data to document this behavior. The estimated impacts from Vilaplana are, in my judgment, the more accurate because of better modeling of commercial fishing and charter fishing and a more accurate model overall.

To what extent can we expect any reallocation from commercial to sport angling to be utilized by sport anglers?

From Table 2, each $1m of fish reallocated from commercial fishing is expected to result in a reduction of $1.5m in regional economic output (This output reduction is from reduced harvest of yellow perch; it is recognized that in many years since 1982 the commercial sector has not harvested $1m of yellow perch plus white bass). In this case, the $1.5m results from a $1m decrease in dockside value of fish harvested and a $0.5m decrease in other economic activity. In commercial fishing, the total impact is the output multiplier which is 1.5.

In the sport fishery, expenditures occur in economic sectors such as charter fishing, marine trades, restaurants, hotels, service stations, and grocery stores. The economic impact of sport fishing of $41.9m is the sum of expected expenditures by private-boat anglers and charter anglers in these related sectors. Each sector has its own multiplier. For purposes of comparison, I use a weighted average output multiplier for these sectors, which I estimated from Vilaplana as 1.37.

To put sport angling on a comparable basis with commercial fishing, we need to convert the sport impact to a per unit of fish basis, which is why the total sport impact is divided by the estimated dockside value of the sport harvest ($12.5m in 1985). Each $3.4m of potential economic impact from sport angling in Table 2 is composed of $2.5m of direct expenditures by private-boat and charter anglers and $0.9m of indirect effects.

To break even, i.e., to just offset the lost economic impact from commercial fishing of $1.5m, would require about $1.1m in new expenditures by private-boat and charter anglers, and the remaining $0.4m is generated through indirect or multiplier effects. Can we expect that sport anglers will spend at least $1.10 for each $1.00 of revenue lost or transferred from the commercial sector from an increased allocation of yellow perch and/or white bass?

Tables 3 and 4 present data compiled from the Ohio creel and commercial fishing reports about changes in sport and commercial harvest and effort for the period 1980 to 1996. With the exception of the 1995 and 1996 rows in each table, the most recent years, the information is presented for 3-year averages of 1980-82, 1986-88, 1990-92, and 1993-95.

The harvest and effort statistics in Tables 3 and 4 present a grim picture of Ohio's Lake Erie fishery over the past 10 years. Walleye sport harvest during 1993-5 was 41% of 1986-8 while effort was 56%. And 1995 was the poorest year of the three. Yellow perch harvest during 1993-5 averaged 47% of 1986-8 while effort averaged 60%. The harvest and effort statistics suggest that yellow perch and white bass may have reversed the downtrends they have experienced since the early 1980s in 1995, while 1996 may be the turning point for walleye.

Table 3. 3-year average sport harvest and effort (thousands of fish and angler hours)

	Walleye			Yellow Perch			White Bass			Total
	Harvest		Effort	Harvest		Effort	Harvest		Effort	Effort
Year	Total	%SO	Total	Total	%SO	Total	Total	%SO	Total	%SO
1980-82	2,700		5,680	11,389		3,016	1,033		206	
1986-88	4,576		8,966	7,457		1,743	360		55	
1990-92	1,981	3.8	5,971	2,230	68.4	922	64	9.4	11	12.6
1993-95	1,864	1.3	5,044	3,496	63.4	1,053	91	25.3	20	12.7
1995	1,435	1.0	4,345	4,313	68.6	1,029	124	52.1	20	
1996	2,316	0.8	4,688	5,667	37.0	1,141	161	1.6	27	

SO = September and October
Sources: Ohio's Lake Erie Fisheries, Status, various years

The sport harvest of walleye has been at extremely low levels beginning with 1990, with 1995 showing the lowest harvest since 1976; 1996 was an up year. Attempts to establish a fall walleye fishery appear to have failed with only 1.3% of the walleye harvest during 1993-95 occurring in September-October; it was less in 1995 and 1996. The ratio of harvest to effort was .23-.28 during September-October in 1994, 1995, and 1996, about two-thirds of the full season rate (Ohio's Lake Erie Fisheries, 1994, 1995, 1996).

Table 4. Three-year average commercial harvest (thousands of pounds)

Year	Yellow Perch	White Bass
1980-82	1,675	1,071
1986-88	513	444
1990-92	882	404
1993-95	461	226
1995	429	89
1996	628	101

Sources: Ohio's Lake Erie fisheries, Status, various years.

Sport anglers will apparently not seek walleye at catch rates of .23-.28 in the fall. Can we expect angler effort to respond to an enlarged fall yellow perch and white bass fishery? The prognosis is not highly optimistic. First, the 1995 yellow perch harvest exceeded the 1993-95 average by over 800,000 fish, but 1995 angler effort was less than the 1993-95 average. The 1996 harvest increased by 31 percent (by 1.35 million fish) over 1995 while effort increased 9 percent.

What would be required to reestablish the 1986-88 level of yellow perch sport harvest of 7.5m fish and effort of 1.7m angler hours? This would mean an increase of about 4 mil. fish or an increase of 113% and an increase in angler hours of 700,000 or 65%. Using Vilaplana's model, these 4 mil. fish had a dockside value of $1.28m in 1985 (approximately $2m in 1995 prices).

The 700,000 angler hours is about 9% of 1985 total angler hours or 6% of average 1986-88 angler hours. These hours would generate expected output impacts of $3.8m ($41.9 x .09) or $2.5m ($41.9 x .06), respectively, in 1985 prices from yellow perch fishing if fully utilized. This compares to an output impact of $1.9m from commercial fishing ($1.28 x 1.5 in 1985 prices). The sport angling economic impact is less than the maximum of $4.4m ($1.28 x 3.4) estimated from Vilaplana, but exceeds the expected commercial fishing output impact. The open question, however, is whether a harvest of 7.5m yellow perch, or a combination of yellow perch and white bass, would generate 1.7m hours of yellow perch fishing effort. The creel data for 1995 and 1996 suggest it would not.

Looking at a broader context

There are still a number of questions which need to be addressed that go beyond the scope of these studies, but unfortunately do not have clear answers. In this section, I address two sets of questions. There are others.

One set of questions revolves around the future preferences of people for sport angling. For example, Hushak and Jeng (1990), Chart 3, shows that older persons angle less frequently than younger persons, a finding supported by Duda et al., and the U.S. population is growing older. There is also some evidence suggesting that the proportion of anglers is lower among younger people as compared to older people.

Data from Federal Aid on fishing license holders through 1994 is not definitive about trends. Total U.S. fishing licenses, tags, permits, and stamps declined slightly in 1994 from a 1993 peak of 38.1 mil. In Ohio, licenses peaked at 1.37 mil. in 1990 and appear to have stabilized around 1.2 mil. since. Non-resident licenses in Ohio have been steady in the 11-12% range throughout the 1990s as compared to 9.3% for 1986-88. The National survey of fishing, hunting and wildlife associated recreation (1985, 1991) suggests that Ohio Lake Erie fishing declined by about one-third between 1985 and 1991 (the 1996 survey is in the field), a larger decline than shown by the Ohio creel. Based on these and other demographic changes, it is my judgment that the sport angling population will be smaller in 2005 that it is today.

Another set of questions revolves around the probability of and potential costs of losing Ohio's commercial fishing industry. If yellow perch and white bass were taken from the commercial industry, would the commercial industry survive by harvesting low valued species only? In my judgment the probability of its survival would decrease substantially. And the commercial industry provides some benefits which are not fully accounted for in the impact models. First, walleye and yellow perch are highly important menu items in restaurants of Lake Erie coastal counties and nearly all of the fish served by these restaurants are imported from Canada. To the extent that the Ohio commercial yellow perch harvest helps lower yellow perch prices by reducing imports, Ohio's North Coast is a more attractive visitor destination.

A potential benefit of a commercial industry is the harvest of less valued species (carp, drum, catfish, white perch, shad). While there is no documented relationship between the populations of less and higher valued species, there is a potential negative effect from continued increase of one or more of the less valued species if no longer harvested.

Finally, does Ohio's commercial industry play a role in Ohio DNR's ability to negotiate total allowable catch limits for walleye and yellow perch, and Ohio's share of these limits? Does Ohio get a larger share because it has a commercial fishery? Is the Ohio sport industry better or worse off if ODNR manages part of the commercial harvest through an Ohio industry than it would be if all commercial fishing occurs in Canada?

Concluding issues and comments

Unfortunately, there is not an easy answer to allocation of fish stocks to sport fishing from commercial fishing. The issue is more difficult because the reallocation probably means the loss of Ohio's commercial fishing industry which raises additional questions.

The economic impact from reallocation of yellow perch, and possibly white bass, from commercial to sport anglers would probably not increase the immediate economic impact of the Lake Erie fishery in Ohio. Estimates based on Vilaplana (1991) show that reallocation of $1m dockside value of yellow perch would mean the loss of $1.5m of economic output from commercial fishing and the potential gain of $3.4m from sport fishing. However, the gain is not certain. To break even, sport angling must generate $1.10 in direct expenditures for each $1.00 dockside value of commercially harvested yellow perch. Sport anglers may not increase fishing effort sufficiently to generate even this break even impact. In addition, if the sport angling population declines over the next 5-10 years, any immediate loss would be increased.

The removal of yellow perch from the commercial harvest would greatly increase the probability that Ohio's commercial fishing industry would disappear. Are we willing to risk the loss of the commercial industry and its possible consequences? Are we willing to become totally dependent on Canada for our commercial supply of yellow perch and walleye in Ohio?

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Glossary of Technical Terms

Backward Linkage: The standard way of generating multipliers in an input-output model. When a dollar of output is produced by a business, that business purchases inputs from other businesses. These businesses in turn purchase inputs to make the output they sell to the purchasing business. These linkages are called backward linkages because they move "back" in the economic production system toward more basic and less processed products being purchased as inputs. The method by which these backward linkages are used to generate multipliers is defined in the multiplier section.

Employment The number of jobs at businesses in the region. Jobs are in terms of "full-time-equivalent" or work of 40 hours per week for 50 weeks per year.

Forward Linkage: In this case, we use one type of forward linkage. In Hushak et al. (1986), commercial fishing sells nearly all of its output (92%) to food processing (fish processors in this case). Under the condition that fish processors could not obtain dockside fish from other sources, such as importing from Canada, it is valid to estimate the value of processed fish when they leave food processing (dockside value plus value added in food processing) and then estimate the total economic impact of processed fish using backward linkages and the multipliers from food processing as the economic impact of commercial fishing. These linkages include commercial fishing as one input, but also the other inputs purchased by food processing to generate processed fish, all of which would be lost if the commercial fish were not harvested and sold to food processing. In Hushak et al., this forward linkage generates an estimated economic impact of commercial fishing of $9.83m, of which $4.05m is due to the backward linkages from commercial fishing only.

Income: The money earned by people employed at businesses in the region.

Input-Output Model: A standard form of economic impact model where the economy is divided into economic sectors, each sector producing a similar set of products or outputs. Outputs are separated into those purchased by other businesses in the economy (intermediate inputs) and those purchased for consumption (final demand).

Multiplier: The total (direct plus indirect) effect per unit of direct change. Indirect effects come about as output is produced; when a business makes its output, it buys inputs from other businesses which in turn buy inputs in order to make the outputs they sell to the initial purchasing business (see the definition of backward linkages). The indirect effect is the sum of all these additional effects that result from buying inputs to make your product.

> Output multiplier - the total dollar change in output for each dollar of output purchased by consumers or for final demand.
>
> Income multiplier - the total change in income per direct dollar change in income. The direct income change is the income which results from producing one dollar of output. The indirect income is the income which results from the indirect output effect. The income multiplier is the direct plus indirect income divided by the direct income.
>
> Employment multiplier - the total change in employment per direct change in employment. The direct and indirect employment effects are defined in the same way as the income effects.

Output: The dollar value of the goods and services produced within the region for the specified year.