



**Creel Analysis and Economic Impact of Pennsylvania's Lake Erie Tributary Fisheries in Erie County, Pennsylvania,
with Special Emphasis on Landlocked Steelhead Trout (*Oncorhynchus mykiss*)**

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Abstract

Pennsylvania's steelhead fishery on the Lake Erie tributaries provides a unique angling experience for Pennsylvania anglers. An abundance of fish, public access and high angler catch rates make steelhead an attractive fishery for many non-resident anglers as well. Overall angler effort estimates (trips) have nearly tripled in the last decade, increasing from 72,413 trips in 1993 to 200,816 trips in 2003. Based on a catch rate of 0.630 steelhead per hour and a harvest rate of 0.150 steelhead per angler hour, anglers caught an estimated 533,873 steelhead and harvested an estimated 126,880 steelhead on Pennsylvania's Lake Erie tributaries during the 2003-2004 steelhead season. The Erie steelhead fishery is actively enjoyed by thousands of anglers. Because the fishery attracts a large number of visitors to the region it provides a notable contribution to the Erie County economy. Survey results suggest that anglers attracted to the Erie County, Pennsylvania stream and shoreline steelhead fishery spent nearly \$9.5 million on trip-related expenditures in 2003. Overall, this activity generates \$5.71 million in new value-added activity in Erie County, supporting 219 jobs in the economy through direct and indirect effects.

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Introduction

The streams that flow into Lake Erie in Pennsylvania provide a series of unique seasonal fisheries. One of the most successful is the trout and salmon program. The Pennsylvania Fish and Boat Commission (PFBC) has been managing for a potamodromous (freshwater fish migration between lake and stream) fishery on Lake Erie for over 40 years. Species stocked

by the PFBC and local sportsman's cooperative nurseries to create and maintain a seasonal (fall-winter-spring) tributary fishery on Pennsylvania's Lake Erie streams have included; Chinook salmon; Coho salmon; rainbow/steelhead trout; brown trout and brook trout. Pink salmon are sometimes caught in PA streams draining to Lake Erie and may have developed from a naturalized Great Lakes population that originated from an accidental release in Lake Superior in 1956.

During the late 1960's and throughout the 1970's, emphasis was placed on stocking landlocked Coho and Chinook salmon. Coho continued to be the focus of this fishery with increasing prominence of landlocked steelhead /rainbow trout through the 1980's. Rainbow trout have dominated the stocking efforts almost every year since 1990 (Figure 1). Over time, the consensus among the Lake Erie fisheries management agencies is that steelhead trout appear to be the best suited among these salmonines for the warmer, shallower waters of Lake Erie. Chinook and Coho salmon enjoyed only a limited success in Lake Erie. Limited coldwater habitat in the relatively warm waters of Lake Erie precluded long-term success of the Coho and Chinook salmon fisheries. Ultimately, Chinook and Coho salmon stocking by the other Lake Erie fishery agencies had ceased by 1997 (Table 1).

The PFBC formally terminated their Coho program in 2003 for a number of reasons. Abiotic and biotic factors limited the success of Coho in Lake Erie. Lake conditions (warm temperatures) during fall spawning runs hindered return rates and resulted in low egg viability from naturalized Coho broodstock that did return to nursery streams (Flett et. al. 1991). Low egg viability of Coho was also linked to elevated thiaminase levels in rainbow smelt (Fitzsimons et. al, 1996), the primary diet item for Coho.

This decision was also reinforced by concerns over a declining forage base and the demands placed upon this resource by Coho salmon. The declining forage fish population in the eastern basin of Lake Erie and the desire of the Great Lakes Fisheries Commission's Lake Erie Committee to reduce predation on a fragile eastern basin rainbow smelt population prompted the PFBC to limit Coho stocking to no more than 100,000 Coho annually after 1995. This action coincided with reductions in lake trout stocking as well.

From a fisheries management perspective, production (hatchery) costs were higher for Coho salmon relative to steelhead trout. Creel survey results from 1981, 1993 and the Fall of 1996 demonstrated a declining interest in Coho salmon and a commensurate increase in steelhead trout angler effort over this time. The same creel survey results showed a declining return to the creel of Coho salmon relative to steelhead trout based on adjusted stocking numbers (Murray and Hoopes, 1999).

Steelhead were first stocked in Lake Erie by the PFBC in 1961 when 15,000 fingerlings were released. Steelhead plantings were discontinued from 1966 through 1968. In 1968, 3-C-U trout association resumed the steelhead program by stocking 3,400 steelhead smolts into Lake Erie.

Since the inception of the program, the steelhead fishery has been successful beyond the expectations of many. The original PFBC steelhead management plan for Lake Erie hoped for an annual harvest of 20,000 steelhead, based on annual stocking efforts of 500,000 steelhead smolts (PFBC, 1986). Estimates from the 1993 Lake Erie Angler Survey estimated a total catch of 68,000 steelhead and a harvest of 34,000 steelhead. Based on a stocking rate of 1 million smolts during that survey, the program was meeting the expectations of the PFBC, but had room for growth.

Several recommendations from the 1993 Steelhead Angler Survey were intended to increase angler opportunity and increase use of this burgeoning fishery. In 1996, the PFBC reduced the spring stream closures from April 1 – Mid-April to closure thirty-six hours before the trout opener, essentially giving anglers an additional 2 weeks to target steelhead trout during prime fishing conditions.

Tributary Creel Surveys

Previous creel survey work on Pennsylvania's tributaries to Lake Erie has attempted to estimate angler effort in the major tributaries to Lake Erie in Pennsylvania. Table 2 shows total estimated angler hours on the major PA tribs during the 1981 (Young and Lahr, 1982) and 1993 (Murray and Hoopes, 1995) comprehensive creel surveys. Total effort on these tributaries increased approximately 21% between 1981 and 1993. Shifts in use were evident based on the primary target species of each survey. During the 1981 creel survey; about 58% of the tributary anglers targeted Coho salmon, 32% targeted steelhead trout and 21% targeted Chinook salmon. During the 1993 survey; approximately 69% of the tributary angler effort was directed at steelhead trout, and 12% at salmon (Coho and Chinook combined).

Both the 1981 and 1993 surveys showed relatively little effort was directed at steelhead by open lake boat anglers. During the 1993 angler survey approximately 6% of the total steelhead angler effort was by boat anglers. The Lake Erie Research Unit (LERU) has conducted open lake boat angler surveys on PA waters of Lake Erie since 1996. Results from the Lake Erie Boat Angler Survey estimated an average effort of 35,000 hours (about 7,000 trips) annually since 1996 (Table 3). Anglers targeting yellow perch and walleye dominate the open lake boat fishery. Directed effort at these species fluctuates based on the quality

of the respective fisheries. In 2003, yellow perch anglers accounted for 187,770 hours (45% of total) of the open lake boat angler effort and walleye anglers accounted for 159,039 hours (40% of total) of the open lake boat angler effort. Anglers targeting steelhead trout accounted for only 15,535 hours or about 3% of the total open lake boat angler effort.

The Pennsylvania Fish and Boat Commission

The PFBC has demonstrated a considerable commitment to Lake Erie fisheries and especially the Lake Erie tributary fishery. The PFBC Bureau of Fisheries stocks over one million steelhead smolts annually to sustain this popular fishery. This typically exceeds more than half of the total steelhead trout stockings in Lake Erie by all other state or provincial agencies combined. This effort is supplemented by additional catchable-size brown trout (> 9") stocking in Crooked Creek, Elk Creek, Cascade Creek and Twentymile Creek prior to the annual opening day of trout season.

Prominent access areas are provided and maintained by the PFBC at several major Lake Erie tributaries. Stream habitat improvements at Walnut Creek in 1999 created additional fish holding areas within the public access area maintained by the agency. Annual maintenance is required for these holding areas. As a result, angler trips have visibly increased within this area. The PFBC constructed a large parking area on the east side of Elk Creek in 2001, and had provided vehicle access directly to the mouth of Elk Creek by 2003. Angler use has increased dramatically as a result of these projects as well. Continued progress was made in 2002, when the PFBC partnered with the Pennsylvania Department of Environmental Protection-Coastal Zone Management and North East Township to acquire access at Twentymile Creek. A developed parking area was constructed by the PFBC and ready for anglers use at the start of the Fall 2003 tributary season. The agency continues to be active in purchasing public access to the Lake Erie tributaries.

Due to the growing popularity of this fishery, law enforcement presence on Lake Erie tributaries is among the highest in the state. Supplemental law enforcement is often necessary during the peak of the fall tributary fishery. In 2003, waterways conservation officers (WCO's) were brought in from across the commonwealth for 10 clandestine details during October, November and December that resulted in over 500 written citations and warnings (R. Nestor, personal communication. 2004.). This was in addition to routine patrols by local officers. Erie County WCO's continuously receive and address landowner complaints; many privately owned stream access areas remain open to public fishing because of landowner appeasement efforts by the local WCO's.

The PFBC also supplies the local sportsman's cooperative nurseries (3-CU) with eggs and/or juvenile steelhead and brown trout for their hatchery programs; technical guidance and support, including disease monitoring and control in accordance with the recommendations of the Great Lakes Fish Health Committee. With the assistance of the PFBC, the cooperative nurseries make a significant contribution to the Lake Erie trout and salmon program by stocking an average (since 1987) of 115,000 steelhead smolts and 25,000 brown trout annually.

Tributary Angling

Virtually all steelhead trout fishing is concentrated in the tributaries. In 1993, creel survey results estimated that approximately 93% of the total steelhead angler effort (hours) originated onshore.

There are essentially 12 major tributaries that attract the majority of the steelhead angler use. Anglers also fish for steelhead in Presque Isle Bay, Cascade Creek and directly in the lake off the westside and eastside shorelines.

Public access areas attract a large proportion of the steelhead anglers. The PFBC provides public access at Walnut and Elk Creeks, two of Pennsylvania's most popular and productive steelhead streams. Additional access areas are provided at Presque Isle State Park and by local municipalities that have secured land through the PADEP Coastal Zone Management Program. Municipal public access is provided at Raccoon Creek, Elk Creek, Eightmile Creek, Twelvemile Creek, Sixteenmile Creek and Twentymile Creek.

Guaranteed public access is paramount to the success of Pennsylvania's steelhead fishery. In 1993, over 2/3 of the steelhead angling effort was on publicly owned land. The access areas at the mouths of Walnut and Elk Creeks alone accounted for over 25% of the total steelhead angler effort. The potential for this fishery to grow is limited by angler's ability to access the steelhead streams.

An overview of economic impact analysis

Previous analysis of economic impact of the Erie fisheries in 1982 estimated fishing related expenditures at 6.7 million dollars for all fisheries (Hammer, Siler and George, 1983). Total expenditures attributed to all salmonids totaled about 2.4 million dollars or 36% of the total expenditures (Coho;24%: Chinook; 7%: and steelhead; 5%). Yellow perch generated about 1.45

million dollars (22%) and panfish generated about 1.37 million dollars (20%) in fishing related expenditures. Steelhead trout accounted for about \$360,000, or 5.3% of the total. No attempt was made to estimate the total economic output of the Erie fisheries during this analysis. Our analysis will apply an economic model to the data to generate an estimate of total economic stimulus provided through the steelhead fishery.

Typically, any recreation-related industry's economic contribution to a local economy originates from participants spending money in the local economy. Generally, this effect is reported in terms of total sales (or output), employment (expressed as jobs or wages and salaries), and value-added (value-added is also known as income when looking at the Gross State Product accounts). (*Value-added represents the portion of total sales directed to employee income, taxes, rent and profit. It excludes the cost of intermediate inputs, and as such, is the preferred measure of the net economic gain to the region.*) In order to assess how this spending affects the regional economy, we turn our attention to examining how these sales translate into countywide economic activity.

In examining the fishery's impact on the county economy, we discuss two separate effects. Direct effects are the economic effects created by angling-related expenditures. For the most part, these are purchases at related businesses, such as lodging, food, transportation (e.g., fuel) and gear and bait.

But the economic contribution extends far beyond its initial effect. Because the directly impacted businesses purchase supplies and services from other Erie businesses, they generate additional economic activity, and subsequently jobs across the county. Similarly, because employees in these businesses spend money in the local economy at places such as the grocery store and the movie theater, the impact is even more pronounced. These secondary effects are often called the ripple effects.

Overall, then, we see that an initial dollar of purchases by an angler at one fishery-related business can generate more than a dollar of total activity in the regional economy as it ripples through the other businesses and households buying goods and services. This is known as the economic multiplier effect, as the value of one dollar of initial sales may be multiplied throughout the economy. The multiplier process continues with each additional round of income/spending, but typically becomes smaller as money "leaks" out of the county economy to purchase goods and services produced outside the county.

Methods

The LERU was charged with developing a creel survey to update creel data collected a decade earlier. Resources were allocated to update the results of the 1993 Lake Erie Angler Survey and provide an estimate of the economic stimulus provided by this popular fishery. The Pennsylvania Sea Grant contracted the PSU Center for Economic and Community Development to employ an economic model to the survey data and provide an economic profile of the steelhead fishery.

Although not as comprehensive as the original 1993 survey, the 2003 survey would concentrate solely on the tributaries. The 2003-2004 tributary survey was expected to measure angler effort, catch and harvest and the derivatives of typical creel assessment during the fall 2003; winter (weather permitting); and spring 2004.

Two routes were constructed that covered 23 of the most popular fishing sites on tributaries to Lake Erie. Seventeen of the sites were previously surveyed in 1993 and represented about 86% of the total estimated effort during that time. An additional 5 sites were added to measure angler use in previously un-assessed areas on upper Elk Creek (Table 4).

Two creel clerks were assigned three (one weekend day and two weekdays) randomly selected days each week from October 1, 2003 through April 30, 2004. The survey encompassed 31 weeks (213 days). Survey days were 10 hours (0700 hrs - 1700 hours).

Angler Counts

Estimates of total effort were derived from angler count data collected through a randomized access bus-route design survey (Robson and Jones, 1989). First priority for a clerk while on-site was angler counts. Two shoreline counts of anglers were conducted during each visit to a site; one at arrival and the second at departure. The two counts during a wait at a site were averaged and expanded to give an estimate of angler hours for the sample period by multiplying the average angler count times the sample period length divided by the wait time.

Total angler effort was estimated and expanded from instantaneous count data at sites randomly selected by computer generation. Analysis was stratified by site, by daytype (weekend or weekday) and calculated by the following equation:

$$E = (\sum (c_{i+tT}) * n/N) * N$$

c_i = mean site count of anglers at time i

t = wait time

T = day length

n = number of sample days in strata

N = total number of days

where,

E = Effort (angler-hours)

The 95% confidence intervals were estimated by doubling the standard error of the mean counts as calculated by the stratifiers (site, day type).

Total effort estimates for areas and months not sampled in 2003 would be extrapolated from the proportion of sampled areas (0.137) and months (0.180) that were sampled in 1993, but excluded in 2003 for logistical reasons.

Interviews

Second priority for clerks on site was angler interviews. Data was obtained from all cooperative anglers, as time would allow. A sample interview sheet is shown in the appendix.

Creel information included the amount of time spent fishing, target species (up to 3), and the number of species caught and harvested. Targeted effort, catch rates and harvest rates were calculated from site-specific angler interviews. The product of total estimated angler effort (from count data) and species-specific effort, catch rate and harvest rate produced estimates of targeted effort, total catch and total harvest.

A variety of other information was solicited from interviews including: angler's zip code, license type (resident; non-resident; youth; 3-day tourist; 7-day tourist; senior annual or senior lifetime) and gear type (fly or spin).

A series of questions were asked to develop a socio-economic profile of the steelhead fishery in Pennsylvania. Anglers were asked if they had hired the services of a professional guide, how much money they spent on travel, lodging, food and fishing related expenses and the proportion of these expenses they spent locally (in Erie county).

Anglers were also asked how many times a year they fished for steelhead, if they had purchased their fishing license specifically to fish for steelhead, and questioned on their support for a Lake Erie Permit: "**Are you willing to pay an additional (\$3.00; \$5.00; \$10.00) fee to support Lake Erie Fisheries?**" Three interview sheets were used, each with a different dollar (\$3.00; \$5.00; \$10.00) amount.

Economic assessment: Methodology and Definitions

In this analysis, we estimate the total contribution of the Erie County steelhead fishery to the Erie County economy using an economic impact software program known as IMPLAN (Impact Analysis for Planning). Originally developed by the US Forest Service, IMPLAN is an input-output model that is widely-used to quantify how businesses use technology, labor and materials (i.e., inputs) to produce a product (i.e., output). The IMPLAN software and database (www.implan.com) establishes the characteristics of economic activity in terms of 10 broad industrial groups, involving as many as 528 sectors. In practice, the IMPLAN model is used in every state and hundreds of communities across the nation to catalog economic activity and predict the effect of alternative policies and various economic changes. In this analysis we use IMPLAN to generate information on a number of important economic indicators.

In order to use models such as IMPLAN to examine the role of an industry in a local economy, analysts should have information on the final demand (i.e., expenditures) for any related goods and services. The angler expenditure data we collected in the survey serve as the basis for our analysis. In this study, final demand is expressed by the total expenditures by category. To determine the direct and secondary effects, we matched the total expenditure data with the IMPLAN sectoring scheme, and entered the appropriate in-county amounts as a final demand "shock" to the model. This generates estimates of both the direct and indirect economic effects. As appropriate, expenditures were entered either on an industry or a commodity

basis. For the retail sectors, we applied IMPLAN's default household margins. Secondary effects are based on the IMPLAN Type SAM multipliers, with households endogenous.

Because IMPLAN models are quite stable from year-to-year, we applied the 2001 multipliers (the most recent year available) to the 2003 survey data to determine the results provided in Table 17. In the remainder of this section we define multipliers and other topics related to this analysis. The material is largely drawn from the IMPLAN User's Guide. A detailed description the IMPLAN sectoring scheme is available on the IMPLAN website.

Method: Estimating the contribution of the fishery using the 2003-04 survey and the IMPLAN model

While the steelhead fishery is certainly a unique "industry" in the region, the methods for analyzing the associated economic activity is analogous to many other recreation-related sectors. As such, analysts have developed a well-understood framework for estimating the relevant impacts.

In practice, the most common approach to estimating the economic contributions of recreation-related activities with the IMPLAN model is to examine how much economic activity is generated by visitor spending, such as anglers. This approach consists of a two-step process. The first step is to estimate the total unique local expenditures--by category--that are supported by the fishery. The second step is applying these expenditures to the IMPLAN model in order to estimate the subsequent economic activity.

Careful economic impact analyses of recreation-related activities distinguish between "new" economic activity and that which would have occurred anyway. In this case, "new" activity is generated only by expenditures that would not otherwise be made in the county economy. Recognizing this, we use the survey responses to consider two primary sources of "unique" fishery-related expenditures:

Type 1 expenditures are made by those people who live outside Erie County and would otherwise not fish in the county.

Type 2 expenditures are made by those people who live in Erie County and would otherwise fish outside the county.

Determining Unique Local Expenditures

To adequately represent the impacts of the fishery, it is necessary to only examine the local activity uniquely supported by the industry. Careful economic impact analyses of recreation-related activities distinguish between "new" economic activity and that which would have occurred anyway. For example, if people would fish in Erie County regardless of whether or not the steelhead fishery was available, then it is the activity, rather than the fishery itself, that is the source of the impact. Similarly, if the fishery was not available and anglers chose instead to spend their money on other local activities, such as movie tickets, then the economic impacts generated by the fishery are simply substituting for other local economic activity. In both instances the net economic effects of the fishery per se would be negligible. Conversely, should the fishery itself be the sole reason that substantial new monies enter (or remain in) the region then the impact can be attributed to the fishery.

Accordingly, to measure the "true" impact of the fishery on the local economy we must consider only economic activity in Erie County related to the fishery that would otherwise not occur. To this end, the study uses the survey responses to consider two primary sources of "unique" fishery-related expenditures: 1) expenditures by people who live outside Erie County and would otherwise not fish in Erie; and 2) people who live in Erie County and would otherwise fish elsewhere. In the first instance, Erie County is "exporting" fishing as an economic activity, while in the second instance the fishery is keeping money in the local economy that would otherwise "leak out" (import-substitution). Note that this excludes two important users of the fishery, namely those who would still fish elsewhere in the county, and people who would not fish in the county, but would spend their money locally anyway.

Economic assessment definitions

Multipliers

Input-output models are driven by final consumption (or final demand). Industries respond to meet demands directly or indirectly (by supplying goods and services to industries responding directly). Each industry that produces goods and services generates demand for other goods and services and so on, round by round. These so called *ripple effects* are described by **multipliers**. A multiplier examines how much spin off economic activity is generated by a marginal change in an industry. For example, multipliers can describe how many total jobs in the economy are created when an industry adds one new job. In general, input-output modelers describe three types of multiplier effects when examining the role of an industry in the county economy.

1. The **direct effect** is the contribution of the industry itself. It may represent the total revenue (output), employment or employee compensation. The value of the direct effect multiplier is always 1.
2. The **indirect effects** are effects of the industry on its suppliers. This multiplier captures the additional activity in businesses that provide inputs to the industry of interest.
3. The **induced effects** capture the impacts of changes in spending from households as income changes due to the direct effect. This effect captures the impact of spending by a) employees of the industry being studied, and b) employees of the input supplying businesses. These effects usually show up in retail and service industries. In the study here, the *secondary effects* are the sum of the indirect and induced effects.

In this study we use the IMPLAN type SAM multipliers. The Type SAM multiplier is obtained according to the following formula:

Type SAM multiplier = (direct effect + indirect effect + induced effect) ÷ direct effect

Input-output analysis is a means of examining the relationships within an economy both between businesses and between businesses and final consumers. It captures all monetary transactions for consumption in a given time period. The resulting mathematical formulae allow one to examine the effects of change in one or several economic activities on an entire economy.

Industry output is a single number in dollar for each industry. The dollars represent the value of an industry's total production. In IMPLAN, the output data are derived from a number of sources including Bureau of Census economic censuses and the Bureau of Labor Statistics employment projections. Another way to think about industry output is as the total revenue generated by an industry.

Employment is total number of wage and salary employees and self-employed jobs in a region. It includes both full-time and part-time workers and is measured in total jobs. The data sets used to derive employment totals in the IMPLAN model are the ES-202 data, County Business Patterns, and the Regional Economic Information System (REIS) data.

While output captures the total dollar value of economic activity, its use as a measure of economic activity can be over counted in that it captures the value of all intermediate stages of the production process as well. For example, the price one pays for a car at the local auto dealership in large part represents economic activity that occurred in the production process. If one were to consider the price one paid for a car as the contribution to the local economy, then one would likely be overstating its impact. This is called double counting. To avoid double counting, economists usually examine economic contributions in terms of **Value Added**. At the local level, value added is equivalent to the concept of Gross Domestic Product in that it examines the unique contribution of an industry to the overall economy. In input-output analysis, value added consists of four components.

1. **Employee compensation** is wage and salary payments as well as benefits including health and life insurance, retirement payment, and any other non-cash compensation. It includes all income to workers paid by employers.
2. **Proprietary income** consists of payments received by self-employed individuals as income. This is income recorded on Federal Tax Form 1040C. This includes income received by private business owners, doctors, lawyers and so forth. Any income a person receives for payment of self-employed work is counted here. Note: labor income is the sum of employee compensation and proprietary income.
3. **Other property type income** consists of payments for interest, rent, royalties, dividends and profits. This includes payments to individual in the form of rents received on property, royalties from contracts, and dividends paid by corporations. This also includes corporate profits earned by corporations.
4. **Indirect business taxes** consist primarily of excise and sales taxes paid by individual to businesses. These taxes occur during the normal operation of these businesses but do not include taxes on income or profit.

Results

Twenty-three sites were visited 1,772 times. Creel clerks counted over 15,000 anglers and conducted more than 3,200 interviews with cooperative anglers between October 1, 2003 and April 30, 2004 (Table 5).

Approximately 84% of the interviewed licensed anglers were Pennsylvania residents, 13% were non-residents and 3% were youth anglers. Table 6 gives a breakdown of anglers based on the license type they possessed.

Summary of zip code data provided by interviewed anglers showed that Pennsylvania resident anglers accounted for 86% of interviewed anglers and originated from 60 of Pennsylvania's 67 counties (Figure 2). Anglers within the Interstate 79 corridor represented 75% of all PA resident anglers.

Interviewed non-resident anglers represented 23 different US states and Canada (Table 7). Over 80% of all non-resident anglers were from bordering states with Ohio (44%), West Virginia (15%), New York (12%), Maryland (6%) and New Jersey (4%) representing the majority of the visiting anglers.

Total Angler Effort

Anglers spent an estimated 618,806 hours fishing on Lake Erie tributaries at the 23 survey sites. Of that total, an estimated 595,584 hours (96%) were directed at steelhead; 13,017 hours at brown trout (2%); 9,314 hours at "anything that bites" (1.5%) and 891 hours at Coho salmon (0.1%) (Table 8).

Steelhead Angler Effort

Anglers directed an estimated 595,584 hours fishing for steelhead trout. Based on a mean trip length of 4.22 hours as calculated from completed trip interviews (N=319); trips directed at steelhead totaled 141,134 at the 23 survey sites. October (48,653 trips) and November (39,560 trips) accounted for 63% of all steelhead angler trips. Participation decreased in December and dropped precipitously in January and February as winter set in. As the weather warmed and the streams thawed, moderate increases in effort were seen in March and April (Figure 3).

Elk Creek (41%) and Walnut Creek (40%) together accounted for 81% of the steelhead angler trips as measured during this survey. Lake Erie at the mouth of Trout Run accounted for 7% of the total, followed by Twentymile (3%) Godfrey Run (3%), Twelvemile Creek (2%), Fourmile Creek (2%), Sevenmile Creek (1%) and Sixteenmile Creek (1%) (Table 9).

Angler attraction to guaranteed public access at lower Walnut Creek and Elk Creek is evident. Lower Walnut Creek (US Route 5 north to Lake Erie) accounted for 213,043 hours of effort (50,484 trips). On Elk Creek, most of the effort was concentrated in lower Elk (US Route 5 north to Lake Erie). There were an estimated 129,629 hours (30,718 trips) directed at steelhead within this area.

Effort extrapolation estimates from the 23 sites assessed during this survey to all sites and months not surveyed are shown in Table 11. These estimates are expanded from the proportion of 1993 shore angler sites that were not sampled in 2003 (0.137). These estimates were then inflated by the proportion of 1993 months that were not sampled in 2003 (0.180). Based on these expansion estimates, total shoreline effort directed at steelhead trout in all shoreline areas over a twelve month period totaled 847,444 hours or 200,816 trips.

Total Catch and Harvest

Anglers caught an estimated 590,954 fish and harvested 88,644 fish. Most of the catch was comprised of steelhead trout (63%), smolts (26%), suckers (6%) and brown trout (3%). Most of the harvest was composed of steelhead trout (91%), brown trout (8%) and Coho salmon (1%) (Table 12).

Steelhead Catch and Harvest

Anglers caught an estimated 373,329 steelhead and harvested 80,984 steelhead at the 23 survey sites. Based on these totals, anglers harvested about one of every five (22%) steelhead they caught. The creel retention rate (number harvested/number caught) varied by site, ranging from a high of 42% at the I-79 pool on upper Elk Creek to a low of 9% at Elk Creek at Struechen flats. Monthly analysis of catch and harvest showed that creel rate was highest in October (35%) and lowest in December (13%).

Steelhead catch and harvest was highest during the fall. October accounted for 16% of the total catch and 26% of the total harvest. November accounted for 30% of the catch and 33% of the total harvest.

Using the expanded effort estimates (847,444 tributary angler hours) from above and estimated catch rate (0.630) and harvest rate (0.150) from below, anglers caught an estimated 533,873 steelhead and harvested an estimated 126,880 steelhead from all shore areas over a twelve-month period.

Angler Catch Rate

Based on all interview data, overall angler catch rate was 0.630 steelhead per angler hour and overall harvest rate was 0.150 steelhead per angler hour. Based on these rates, an angler caught a steelhead for every 1.6 hours (95 minutes) fished. Half of all anglers that were targeting steelhead were successful in catching at least one steelhead.

Catch rates, harvest rates and angler success were noticeably higher on the eastside streams (Table 13). Care must be taken when comparing catch rates among streams because sample sizes, increased angler avidity and the ease with which steelhead are sight-fished can be major influencing factors on the spatial differences seen in angler success and catch rate.

Temporal differences in angler catch rate varied greatly between October 2003 and April 2004 (Table 14). Catch rate was lowest in October (0.30 steelhead/angler hour) and more than doubled by December. Catch rates over one steelhead per hour were seen in December and February. Although temporal catch rates are also influenced by angler avidity, monthly distribution of angler catch rate also correlates with increased abundance of steelhead in the streams during the late fall through the early spring period.

Steelhead Angler Characterization

Anglers were asked if they had purchased their license specifically to fish for steelhead. About 22% of all interviewed anglers indicated that they had purchased their fishing license (and trout stamp) to fish for steelhead (Table 15). Results were dramatically different based on the residency of interviewed anglers. About 14% of the Pennsylvania resident anglers (resident adult, senior lifetime and senior annual) indicated that they had purchased their fishing license to fish for steelhead while 68% of all non-resident anglers (annual non-resident, 3-day tourist and 7-day tourist) indicated that they had purchased their license to fish for steelhead.

When anglers were asked how many times a year they fished for steelhead, most (~40%) replied that they fished for steelhead 5 times per year or less (Figure 5). About 2% indicated that this was their first time fishing for steelhead. About 10% of the anglers said they fished for steelhead more than 50 times per year. Based on the response of all anglers (N= 3,215), the mean number of trips taken by anglers was 18 per year, and the median number of trips was 8 trips per year.

Angler Support for a Lake Erie Permit

Steelhead anglers overwhelmingly supported some form of supplemental revenue for Lake Erie Fisheries, especially if the money would be used to secure more public access. Overall, nearly 75% of all interviewed tributary anglers favored supplementary financial support for the Lake Erie fisheries. Support was greatest for a \$3.00 fee (83%) less for a \$5.00 fee (79%) and least for a \$10.00 fee (61%) (Table 16).

Economic Impact Results

Results from our survey show that anglers spend a substantial amount of money on various goods and services in the local economy, including gear and bait, lodging, food, and associated travel expenses. In turn, this spending supports jobs in the economy, both directly through fishing party expenditures and indirectly through ripple effects

Estimates of the number of trips by angler type were derived from the survey, a copy of which is provided in the appendix. We converted the respondent-provided home zip code to county-of-residence by using a proprietary data set. Total visitors were calculated as follows:

Type 1 anglers:

Number of unique trips by out-of-county anglers = estimated total number of trips * sample percentage of trips from people living outside Erie County * sample percentage of people living outside Erie County responding that they would otherwise not fish in the county.

Here: $153,990 = 200,816 * 80.6\% * 95.1\%$

Type 2 anglers:

Number of unique trips by in-county anglers = estimated total number of trips * sample percentage of trips from people living inside the county * sample percentage of people living inside the county responding that they would otherwise fish outside the county.

Here: $1,634 = 200,816 * 19.4\% * 4.2\%$

Total expenditures by category by angler type were derived by multiplying the average expenditure by category by type per trip (obtained from the survey) by the estimated total number of trips. These results appear in Table 17.

As noted above, we estimate that there were nearly 201,000 unique trips to the fishery in 2003-04. Based on survey responses, we estimate that 153,990 trips were taken by Type 1 anglers and 1,634 trips were taken by Type 2 anglers. The remaining trips were taken either by county residents or visitors who would have fished elsewhere in the county.

With this in mind, the first step in estimating the economic impact of the steelhead fishery with the IMPLAN model is approximating the total expenditures by category (lodging, food, transportation (e.g., fuel) and gear and bait). This information is generated from the survey, which asks respondents, among other things: 1) where they live; 2) how much they spent on various activities over the course of the trips; and 3) what percentage of these expenditures was spent in Erie County. Based on this, our total per trip expenditure estimates are as follows:

1. Individuals who a) live outside Erie County, and b) would not otherwise fish in Erie County spend an average of \$61.27 per trip. The breakdown by category is shown in Table 17.
2. Individuals who a) live inside Erie County, and b) would otherwise fish outside the county spend an average of \$6.60 per trip (Table 17).

To estimate total expenditures, the per trip expenditure profiles are multiplied by the number of trips of each type. This yields a total expenditure of \$9,435,188 for Type 1 activity and \$10,782 for Type 2 activity (Table 17).

The second step of the process is to use the IMPLAN model to examine the impacts of these total expenditures, by category, in the county economy. To determine the direct and secondary effects, we matched the expenditure data with the IMPLAN industry sectoring scheme, and entered the appropriate in-county amounts as a final demand "shock" to the model. This generates estimates of both the direct and indirect economic effects.

It is important to note that, due to the structure of input-output models, all recreation-related spending reported in Table 17 does not accrue to the region as final demand. The primary problem is with retail purchases of goods. For goods that are manufactured outside of the region, only the retail margin appears as final demand for the region. The cost (producer price) to the retailer or wholesaler of the good itself leaks immediately out of the region's economy, and can not be considered a local impact. Recognizing this, we applied IMPLAN's default household margins for the affected retail sectors (transportation and sporting goods).

We report the results of our analysis in Table 18. Here, the direct output effect (accounting for retail margins) of the steelhead fishery itself in the county is \$6.85 million. Based on the IMPLAN model, this translates into 170 jobs, with an annual total compensation for these workers of \$2.66 million per year (\$15,625 per worker). In addition, our analysis suggests the fishery directly generates \$3.57 million of value-added activity.

Secondary effects are the spin-off or ripple effects of the fishery. For example, anglers purchase a variety of inputs and services; and the businesses that produce these goods and services also need labor. Accordingly, the secondary effects also capture the impact of local spending by employees of the angler-related business as well as supporting industries. Using IMPLAN, we estimate that these effects result in nearly \$3.84 million in additional output, of which more than \$2.13 million is value-added. This translates into 49 additional jobs in the county economy, and more than \$1.26 million in employee compensation.

In terms of multipliers, the employment multiplier is 1.29, suggesting that for every job in a fishery-related business, an additional 0.29 jobs are supported in the county economy. The labor income multiplier is \$1.48, suggesting an additional dollar in employee compensation in the fishery-based recreation wages supports 48 cents of wages and benefits in other Erie County businesses. Similar interpretations can be given to the output multiplier (\$1.56) and value-added multiplier (\$1.60). (*Economic multipliers are used to translate the direct impact into the total impact; multiplying the direct impact by the multiplier gives an estimate of the additional economic activity generated by a change in output. To derive the multiplier, simply divide the total impact (direct plus secondary) by the direct impact.*)

Overall, the direct and secondary contributions of the fishery are estimated at more than \$10.68 million in output, of which more than \$5.7 million is value-added. Of the value-added, \$3.92 million is employee compensation. From an employment standpoint, this translates into 219 jobs.

Discussion

The steelhead fishery has grown tremendously over the last ten years. Total estimated shore trips have increased from 72,000 in 1993 to over 200,000 trips in 2003. Although some angler trips were added through the supplanting of Coho angler trips (10,000), or through increased assessment of upstream areas (23,500 trips), the majority of growth has occurred because of

increased interest in steelhead angling.

Much of this growth can be attributed to increased media exposure over the last decade. The Pennsylvania Angler and Boater (a PFBC publication) has featured numerous articles that highlight the opportunities and tactics for catching Pennsylvania steelhead on the Erie tributaries. Several books have been published that focus on Great Lakes steelhead fishing. Regional newspapers in western Pennsylvania provide weekly reports on the steelhead fishery from September through May. Internet sites provide background information and angler catch reports, providing additional exposure of Pennsylvania's Lake Erie steelhead fishery. Out of state anglers are attracted to Erie by national media (television and magazine) coverage that has highlighted Great Lakes steelhead fishing and the great fishing opportunities in the heart of "Steelhead Alley."

Long-term analysis of steelhead angler catch rate suggests that steelhead fishing has never been better. Results from the Lake Erie Cooperative Angler Diary Program estimate steelhead angler catch rates have remained high over the last 5 years, averaging nearly one steelhead per line hour (Figure 6). Although this group of anglers (diarists) is considered specialists, the catch rates as calculated from this survey verify the high quality of Pennsylvania's steelhead fishery. An overall catch rate of 0.630 steelhead per angler hour among all levels of experienced anglers, as calculated from this analysis, would be considered exceptional compared to any steelhead fishery.

Each steelhead season is approached with great anticipation by anglers. The onset of cooler waters and increased precipitation in the fall can trigger strong runs of fish into the tributaries. If moderately high stream flows are maintained, the fish are able to navigate to the upper reaches of the tributaries earlier in the season. Anglers quickly disperse as the fish move upstream.

Most trips are taken in October and November in response to the first runs of the season, but some of the best steelhead fishing occurs later in the season as angler numbers decline. This survey showed that catch rates increased in November, peaked in December and remained high through March. These months provide the best opportunity for potential increases in angler use, provided the weather cooperates. A mild winter, or an early spring can provide excellent late-season opportunities for steelhead anglers.

Guaranteed public access can attract large numbers of anglers. These areas have demonstrated some of the greatest increases in use over the last decade. Angler effort increased 454% on Lower Elk Creek and increased 224% on Lower Walnut Creek. Estimated angler effort on the newly acquired (2003) public access area on Twentymile creek increased from 2,800 hours in 1993 to over 45,800 hours in 2004 an increase of 1,561% (Figure 3).

PFBC management initiatives have added approximately 10,000 additional trips by opening previously closed tributaries to angling during the first two weeks of April. Other actions by the PFBC that have resulted in increased use are improvements (parking lot construction and direct access to the mouth) at the Elk Creek access area and the stream habitat enhancement project at Walnut Creek.

The steelhead fishery in Pennsylvania is thriving. Based on the objectives of the original steelhead management plan in 1986, the program is successful well beyond those original goals. Based on annual stocking of 1,000,000 steelhead smolts, annual harvest expectations would be 40,000 adult steelhead. Results from this survey estimated harvest at nearly 81,000 steelhead at the 23 survey sites alone. The expanded harvest estimate (to all areas and all months) was 126,880 steelhead; over three times the targeted harvest level.

Steelhead anglers are very much in favor of adopting a "Lake Erie stamp". Three out of four anglers surveyed were in favor of some form of special funding through a permit or stamp. As expected, support was highest for a \$3.00 stamp and diminished as the proposed cost increased.

Many anglers have asked the PFBC to consider the adoption of special regulations on Lake Erie tributaries, including; gear and tackle restrictions (i.e. fly fishing only or artificial lures only), or for establishment of catch and release areas on certain streams. Based on the high level of catch and release (nearly 80%) among tributary steelhead anglers, there is little evidence to support making the regulations more restrictive based strictly on angler exploitation. Additional regulations would also increase the burden on local law enforcement efforts and dilute the effectiveness of the present corps to enforce the existing regulations and address the increasing problems of angler – landowner conflicts.

As the steelhead fishery has increased in prominence among anglers, the economic impact of the fishery has also increased. Steelhead/salmon angler expenditures increased from an estimated 2.4 million dollars in 1982 to over 9.5 million in 2003. In addition to bait and tackle purchases, significant expenditures are made on travel, food and lodging by anglers visiting from outside Erie County. The contribution of tourist dollars is evident from the fact that over 80% of the anglers interviewed during this survey resided outside Erie County and traveled an average of 108 miles.

The estimates of angler purchases in this survey are somewhat conservative, representing only trip related (short-term) angling expenditures, and accounting only for the economic impact within Erie County. Although the majority (>95%) of trip related expenditures on food, bait and lodging are made within Erie County, only about 50% of the travel related expenditures are made within Erie county.

Research compiled by the Erie Regional Chamber and Growth Partnership (2003) on the economic impact of sport fishing in Erie County, Pennsylvania, estimated total angler expenditures in the range of 28-36 million dollars. Total economic output from their examination was estimated between 56 and 72 million dollars, and generated between 521 and 683 jobs. Based on these summary results, the steelhead fishery contributes significantly to the overall economic stimulus of Pennsylvania's Lake Erie fisheries. The steelhead fishery alone accounts for approximately 30% of all angler expenditures, 17% of total economic output and approximately 37% of the sport fishing related jobs in Erie County.

Conclusions

Agency efforts to increase angler use of the steelhead fishery on Lake Erie have been very successful.

All aspects of the steelhead fishery have improved considerably since the 1993 survey, including angler effort (trips), catch rate, steelhead catch and steelhead harvest.

Tributary anglers demonstrated a relatively high catch and release rate (78%), providing the opportunity for a steelhead to be caught and released multiple times.

There is considerable participation by "out-of-town" anglers in the steelhead fishery and the economic benefit of the steelhead program to the Erie County economy is significant, generating about 6 million "new" dollars and supporting 219 jobs annually.

Public access is very important to the future of the steelhead tributary fishery.

Management Recommendations

Future surveys should include Raccoon Creek, Crooked Creek and Conneaut Creek to improve accuracy of the present creel survey results. Recent efforts to enhance Conneaut Creek steelhead runs and increase angler catch rates may attract new angler trips to this underutilized stream.

Endorse, and participate in any interagency Lake Erie efforts to monitor the steelhead population in Lake Erie, including tagging and marking initiatives, diet studies and creel surveys.

Ensure that steelhead-stocking levels are sufficient and appropriate fisheries management techniques are employed to maintain desired angler participation rates.

Considerations for acquisition of new access areas should include the ease with which angler access can be gained, and the capacity of the stream to hold fish within these areas.

Public access is critical to the future growth, success and sustainability of the steelhead tributary fishery. A review of existing public access areas should explore opportunities to increase angler use in these areas and should examine the potential for creating or improving in-stream structures within the public access areas that improve fish habitat and increase the amount of areas suitable for holding fish. The structures should be resilient and require minimal annual maintenance.

A pamphlet should be produced that includes a map of all public access areas and promotes the superior angling opportunities in the early winter (late November and December) and spring (March and April).

A brochure should be produced for distribution to riparian landowners that identifies the advantages of allowing public fishing access. The brochure should include:

- Highlights of cooperative efforts between the PFBC, local conservation groups and landowners (i.e. stream clean-up and enhancement projects).
- Enhanced PFBC fish code enforcement.
- Potential eligibility for conservation easements by allowing angler access.

- An explanation of the legal protection provided through the Pennsylvania Landowner Liability Act.
- Contact information for Erie County WCO's and PFBC offices and facilities.
- Signage could be made available to landowners to notify anglers that they are fishing on private property, and should be cognizant of their behavior.

References

Erie Regional Chamber and Growth Partnership. 2003. Economic Impact Report: Sport Fishing in Erie County.

Fitzsimons, J.D., S. Brown, and L. Vandenbyllaardt. 1996. Thiamine levels in the food chains of the Great Lakes. American Fisheries Society Symposium, Early Mortality Syndrome: Reproductive disruptions in fish of the Great Lakes, New York Finger Lakes, and the Baltic region. August 28, 1996, Dearborn, Michigan.

Flett, Peter A., Kelly R. Munkittrick, Glen Van Der Kraak, and John F. Letherland. 1991. Overripening as a cause of low survival to hatch in Lake Erie Coho salmon (*Oncorhynchus kisutch*) embryos. Can. J. Fish. Aquat. Sci.

Hammer, Siler and George Associates. 1983. Erie Fishery Development Program. Prepared for the Erie-Western Pennsylvania Port Authority.

Lake Erie Research Unit .2004. Lake Erie Fisheries Status and Trends Report 2003. Report to the Lake Erie Committee, Pennsylvania Fish and Boat Commission, Division of Research, Lake Erie Research Unit. Fairview, PA.

Murray, C. K. and R. L. Hoopes. 1995. Lake Erie steelhead fishing. Lake Erie Angler Survey. Pennsylvania Fish and Boat Commission. Division of Research. Lake Erie Research Unit. Fairview, Pennsylvania 16415-0531.

Murray, C. K. and R. L. Hoopes. 1999. Pennsylvania's Lake Erie Coho salmon fishery. Pennsylvania Fish and Boat Commission. Division of Research. Lake Erie Research Unit. Fairview, Pennsylvania 16415-0531.

Nestor, Robert. Northwestern Regional Law Enforcement Supervisor. PFBC State Highway 98, Meadville, PA 16335

PFBC 1986. A plan for the management of steelhead trout in the Pennsylvania waters of Lake Erie. Pennsylvania Fish and Boat Commission Bureau of Fisheries Bellefonte, PA.

Robson D. and C. M. Jones. 1989. The theoretical basis of an access site angler survey design. Biometrics 45:83-98.

Young, L. M. and R. A. Lahr. 1982. Lake Erie angler and boater use and angler harvest study. Pennsylvania Fish Commission.

Tables and Figures

Table 1: Final year of Coho and Chinook salmon stocking in Lake Erie by jurisdictional water.

	Coho	Chinook
Michigan	1989	1977
New York	1992	1997
Ohio	1988	1980
Pennsylvania	2003	1995

Table 2: Estimated angler hours on selected Lake Erie tributaries from the 1981 and the 1993 Lake Erie Angler Surveys

Stream / Fishery	1981 Hours	1993 Hours
Raccoon Creek	2,300	5,436
Crooked Creek	1,100	3,405
Elk Creek	49,200	96,175
Godfrey Run	7,400	10,224
Trout Run	80,100	70,349
Walnut Creek	102,100	109,537
Fourmile Ck	400	2,032
Sevenmile Ck	N/A	122
Twelvemile Ck	2,500	17,493
Sixteenmile Ck	18,000	6,318
Twentymile Ck	9,600	10,414
Total Effort on Major Erie Tributaries	272,700	331,505

Table 3: Estimated steelhead angler effort, trips, steelhead catch and harvest from the 1996-2003 Lake Erie Boat Angler Surveys.

Year	Effort (hours)	Trips	Catch	Harvest
1996	23,897	5,010	1,525	880
1997	45,163	9,468	2,752	1,721
1998	39,513	8,284	7,174	5,295
1999	66,939	14,033	9,945	7,401
2000	28,575	5,991	15,669	11,011
2001	31,371	6,577	13,372	7,053
2002	29,819	6,251	8,825	5,229
2003	15,535	3,257	4,205	1,717

Table 4 : Sampling sites for the 2003 – 2004 Lake Erie Tributary Creel Survey (October 1, 2003 – April 30, 2004).

	Site Number	Site	Fishery	Section	Surveyed in 1993
Route 1					
	101	Godfrey Run	Godfrey Run	Godfrey Run	Y
	102	Elk Creek Access	Elk Creek	Lower Elk	Y
	103	PFBC Elk Creek Access	Elk Creek	Lower Elk	Y
	104	Elk Creek Elk Park Road Bridge	Elk Creek	Middle Elk	Y
	105	Elk Creek Sewage Treatment Plant	Elk Creek	Middle Elk	Y
	106	Elk Creek Old Ridge Road Bridge	Elk Creek	Middle Elk	Y
	107	Elk Creek Legion Park	Elk Creek	Middle Elk	Y
	108	Elk Creek Folly's End	Elk Creek	Upper Elk	N
	109	Elk Creek Streuchen Flats	Elk Creek	Upper Elk	N
	110	Elk Creek West Road	Elk Creek	Upper Elk	N
	111	Elk Creek Rick Road Bridge	Elk Creek	Upper Elk	N
	112	Elk Creek I-79 Pool	Elk Creek	Upper Elk	N
Route 2					
	201	Trout Run	Trout Run	Trout Run	Y
	202	Walnut Creek Access Area	Walnut Creek	Lower Walnut	Y
	203	Walnut Creek Manchester Road	Walnut Creek	Lower Walnut	Y
	204	Walnut Creek Route 5	Walnut Creek	Middle Walnut	Y
	205	Fourmile Creek	Fourmile Creek	Fourmile Creek	Y
	206	Sevenmile Creek	Sevenmile Creek	Lower Sevenmile Ck	N
	207	Twelvemile Creek	Twelvemile Creek	Lower Twelvemile Ck	Y
	208	Sixteenmile Creek	Sixteenmile Creek	Lower Sixteenmile Ck	Y
	209	Sixteenmile-Sewage Treatment Plant	Sixteenmile Creek	Middle Sixteenmile Ck	Y
	210	Twentymile Creek Access Area	Twentymile Creek	Lower Twentymile Ck	Y
	211	Twentymile Creek Route 5	Twentymile Creek	Middle Twentymile Ck	Y

Table 5: Number of site visits, sum of raw angler counts and number of interviews by site for the 2003-2004 Lake Erie Tributary Creel Survey.

Site Number	Site	Site Visits	Sum of Angler Counts	Number of Interviews
101	Godfrey Run	80	360	103
102	Elk Creek Access	80	2,493	328
103	PFBC Elk Creek Access	80	868	225
104	Elk Creek Elk Park Road Bridge	80	541	118
105	Elk Creek Sewage Treatment Plant	80	201	95
106	Elk Creek Old Ridge Road Bridge	80	300	79
107	Elk Creek Legion Park	79	607	186
108	Elk Creek Folly's End	80	285	159
109	Elk Creek Streuchen Flats	79	650	173
110	Elk Creek West Road	79	240	80
111	Elk Creek Rick Road Bridge	80	187	51
112	Elk Creek I-79 Pool	78	312	81
201	Trout Run	77	1,017	180
202	Walnut Creek Access Area	79	3,625	392
203	Walnut Creek Manchester Road	79	1,771	269
204	Walnut Creek Route 5	79	143	47
205	Fourmile Creek	78	346	92
206	Sevenmile Creek	79	183	65
207	Twelvemile Creek	79	382	119
208	Sixteen Mile Creek	79	200	87
209	Sixteen Mile-Sewage Treatment Plant	79	10	5
210	Twentymile Creek Access Area	79	441	210
211	Twentymile Creek Route 5	30	205	79
Total		1,772	15,360	3,223

Table 6: Angler characterization by fishing license type for the 2003-2004 Lake Erie Tributary Creel Survey.

License Type	Number	Percent
Adult Resident	2,434	75.6%
Annual Non-Resident	354	11.0%
Senior - Lifetime	248	7.7%
Youth	103	3.2%
3 Day Tourist	59	1.8%
Senior - Annual	11	0.3%
7 Day Tourist	8	0.2%
Military	1	0.0%

Table 7: State / Country of angler origin for the 2003-2003 Lake Erie Tributary Creel Survey. N=3,045.

State	Percent of Anglers
Pennsylvania	86.21%
Ohio	6.01%
West Virginia	2.13%
New York	1.61%
Maryland	0.85%
New Jersey	0.53%
Virginia	0.46%
Michigan	0.43%
Canada	0.36%
Kentucky	0.20%
Florida	0.16%
Minnesota	0.16%
Texas	0.16%
North Carolina	0.13%
District of Columbia	0.10%
California	0.07%
Massachusetts	0.07%
South Carolina	0.07%
Indiana	0.07%
Georgia	0.07%
Wyoming	0.03%
Tennessee	0.03%
Connecticut	0.03%
Colorado	0.03%
Mississippi	0.03%

Table 8: Total estimated effort (angler hours), 95% confidence interval of total estimated effort and species specific (targeted) estimated effort by site for the 2003-2004 Lake Erie Tributary Creel Survey.

SITENUM	Site	Total Estimated		Anything That			
		Angler Hours	CI Angler Hours	Bites	Steelhead	Brown Trout	Coho
101	Godfrey Run	10,017	5,063	113	9,815		89
102	Elk Creek Access	100,197	39,141	2,341	96,330	1,489	36
103	PFBC Elk Creek Access	35,513	13,332	1,168	33,294	1,050	
104	Elk Creek Elk Park Road Bridge	22,349	9,903	383	21,784	182	
105	Elk Creek Sewage Treatment Plai	7,749	3,379	53	7,696		
106	Elk Creek Old Ridge Road Bridge	11,528	5,951	287	10,858	383	
107	Elk Creek Legion Park	24,322	9,202	1,177	22,071	1,067	7
108	Elk Creek Folly's End	11,371	4,461	77	10,356	938	
109	Elk Creek Streuchen Flats	25,848	8,617		24,383	1,465	
110	Elk Creek West Road	9,972	4,534	251	8,030	1,691	
111	Elk Creek Rick Road Bridge	8,545	8,089		7,437	1,108	
112	Elk Creek I-79 Pool	13,627	10,424	295	11,315	2,017	
201	Trout Run	39,808	21,672	444	39,050		412
202	Walnut Creek Access Area	139,448	55,560	1,242	138,098	108	
203	Walnut Creek Manchester Road	69,416	25,475	318	68,721	99	278
204	Walnut Creek Route 5	6,224	3,839		6,224		
205	Fourmile Creek	13,313	5,423	63	13,187	63	
206	Sevenmile Creek	7,347	3,137		7,242	105	
207	Twelvemile Creek	15,313	6,320	130	15,183		
208	Sixteen Mile Creek	7,630	2,823		7,630		
209	Sixteen Mile-STP	371	429		371		
210	Twentymile Creek Access Area	17,736	7,584	470	16,161	976	129
211	Twentymile Creek Route 5	21,163	12,124	501	20,347	275	39
Total		618,806	266,484	9,314	595,584	13,017	990

Table 9: Estimated steelhead angler trips, steelhead catch and harvest by fishery from the 2003-2004 Lake Erie Tributary Creel Survey.

Fishery	Effort (Angler Hours)	Trips	Steelhead Catch	Steelhead Harvest
Elk Creek	243,840	57,782	151,921	23,672
Godfrey Run	15,571	3,690	10,958	2,943
Trout Run	43,465	10,300	24,688	7,855
Walnut Ck	238,888	56,609	137,326	37,787
Fourmile Ck	10,327	2,447	9,611	2,261
Sevenmile Ck	6,969	1,651	9,089	838
Twelvemile Ck	12,392	2,936	11,458	2,171
Sixteenmile Ck	6,110	1,448	6,324	715
Twentymile Ck	18,023	4,271	11,954	2,743
Total	595,584	141,134	373,329	80,984

Table 10: Estimated steelhead angler trips, steelhead catch and harvest by month from the 2003-2004 Lake Erie Tributary Creel Survey.

Month	Steelhead Angler Trips	Steelhead Catch	Steelhead Harvest
October	48,653	59,868	21,171
November	39,560	111,631	26,627
December	15,797	80,107	10,895
January	3,651	9,797	2,713
February	3,801	19,099	4,563
March	15,506	61,214	9,140
April	14,166	31,614	5,875
Total	141,134	373,329	80,984

Table 11: Total estimated angler hours and trips for the 2003-2004 Lake Erie Tributary Creel Survey after expansion from areas and months not sampled during the 2003-2004 survey.

Tributary / Area	Angler Hours	Trips
Westside Shoreline	23	5
Raccoon Creek	7,588	1,798
Crooked Creek	6,421	1,521
Elk Creek	381,460	90,393
Godfrey Run	11,816	2,800
Trout Run	46,958	11,128
Walnut Creek	279,268	66,177
Presque Isle Bay	12,897	3,056
Cascade Creek	1,967	466
Eastside Shoreline	578	137
Fourmile Creek	15,705	3,722
Sevenmile Creek	8,667	2,054
Eightmile Creek	211	50
Twelvemile Creek	18,116	4,293
Sixteenmile Creek	9,438	2,237
Twentymile Creek	46,333	10,979
Total	847,444	200,816

Table 12: Targeted effort (angler hours), catch and harvest for all species encountered through the 2003-2004 Lake Erie Tributary Creel Survey.

Species	Effort (Angler Hours)	Catch	Harvest
Steelhead	595,584	373,329	80,984
"Smolt"		155,708	256
"Sucker"		34,876	0
Brown Trout	13,017	20,449	6,693
Round Goby		2,768	0
Coho	891	2,245	608
Smallmouth Bass		699	0
Carp		406	0
"Chub"		334	0
Lake Trout		103	103
Brook Trout		37	0
"Anything That Bites"	9,314		

Table 13: Steelhead angler directed effort statistics including number of interviews (N), percent success, catch per angler hour and harvest per angler hour by fishery and total from the 2003 Lake Erie Tributary Creel Survey.

Fishery	N	% Success	Catch Rate	Harvest Rate
Elk Creek	1,488	48%	0.565	0.114
Godfrey Run	101	52%	0.531	0.187
Trout Run	178	50%	0.680	0.273
Walnut Ck	697	55%	0.624	0.166
Fourmile Ck	91	59%	0.820	0.219
Sevenmile Ck	64	67%	1.075	0.151
Twelvemile Ck	116	56%	0.878	0.224
Sixteenmile Ck	92	49%	0.823	0.084
Twentymile Ck	276	45%	0.665	0.174
Overall	3,103	50%	0.630	0.150

Table 14: Steelhead angler catch rate and harvest rate by month and total for the 2003-2004 Lake Erie Tributary Creel Survey.

Month	N	Catch Rate	Harvest Rate
October	871	0.302	0.106
November	655	0.656	0.170
December	388	1.008	0.179
January	81	0.730	0.144
February	144	1.039	0.299
March	480	0.856	0.173
April	450	0.565	0.107
Overall	3,069	0.630	0.150

Table 15: Percent of anglers (by license type and among all license types) that purchased their fishing license specifically because of the steelhead fishery.

Did You buy your license specifically to fish for steelhead trout?			
License Type	N	Yes	No
Adult Resident	1,741	14%	86%
Annual Non-Resident	291	64%	36%
3 Day Tourist	45	91%	9%
7 Day Tourist	3	100%	0%
Senior - Annual	5	20%	80%
Senior - Lifetime	164	7%	93%
All Licensed Anglers	2,249	22%	78%

Table 16: Steelhead angler support for a "Lake Erie Permit".

	N	Yes	No
Would you support a \$3.00 fee to support Lake Erie Fisheries?	1,059	83%	17%
Would you support a \$5.00 fee to support Lake Erie Fisheries?	1,043	79%	21%
Would you support a \$10.00 fee to support Lake Erie Fisheries?	1,042	61%	39%
Overall	3,144	74%	26%

Table 17: Unique expenditures by category for steelhead anglers.

Expenditure	Type 1 (n = 153,990)		Type 2 (n = 1,634)	
	Per Trip	Total	Per Trip	Total
Lodging	\$14.65	\$2,256,478	\$0.00	\$0
Transportation	\$11.71	\$1,802,742	\$2.32	\$3,790
Food	\$22.76	\$3,504,301	\$1.92	\$3,137
Bait and Gear	\$12.15	\$1,871,667	\$2.36	\$3,855
Total	\$61.27	\$9,435,188	\$6.60	\$10,782

Table 18: The Erie steelhead fishery's estimated contribution to the Erie County economy, 2003.

	Direct Effect	Multiplier Effect	Total Effect (Direct + Indirect)	Multiplier
Industry Output (millions)	\$6,848,621	\$3,837,794	\$10,686,415	\$1.56
Value Added (millions)	\$3,571,615	\$2,133,612	\$5,705,227	\$1.60
Employment	170	49	219	129
Labor Income (millions)	\$2,656,286	\$1,262,771	\$3,919,057	\$1.48
Per Worker Compensation	\$15,625	\$25,876	Average of \$17,895	

Figure 1: Trout and salmon stocking in Pennsylvania water of Lake Erie from 1968-2003.

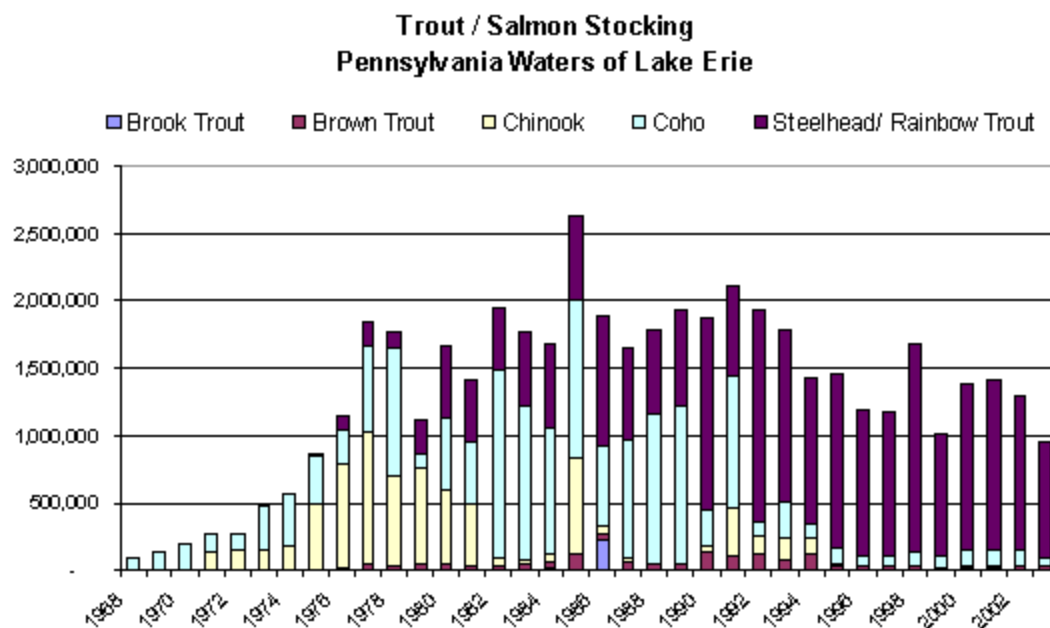


Figure 2: Percent composition of Pennsylvania resident angler origin by county for the 2003-2004 Lake Erie Tributary Creel Survey. (N=2,625)

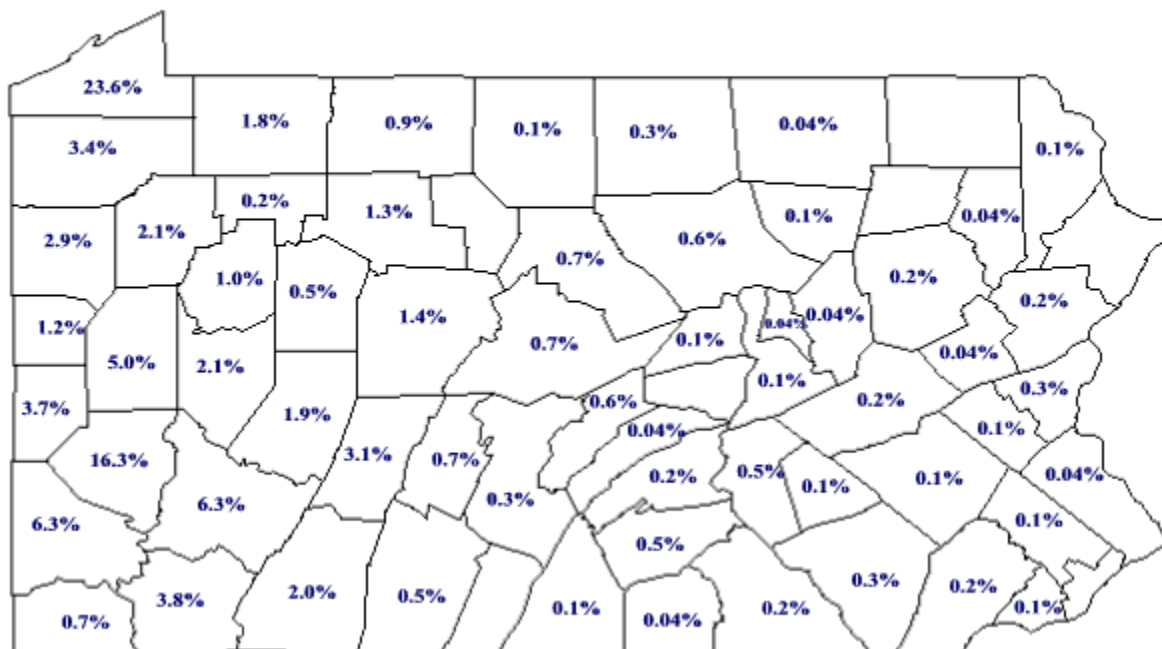


Figure 3: Total estimated steelhead angler trips, steelhead catch and steelhead harvest by month from the 23 survey sites from the Lake Erie Tributary Creel Survey October 1, 2003 – April 30, 2004.

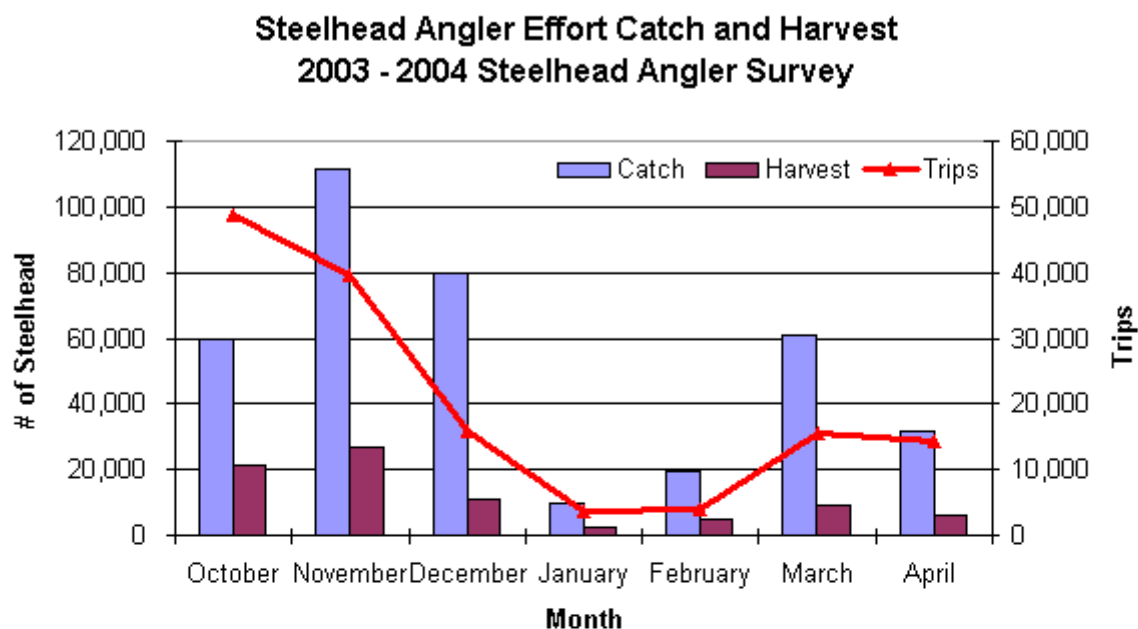


Figure 4: A comparison of the estimated angler hours in common areas from the 1993 Lake Erie Angler Survey and the 2003-2004 Lake Erie Tributary Creel Survey.

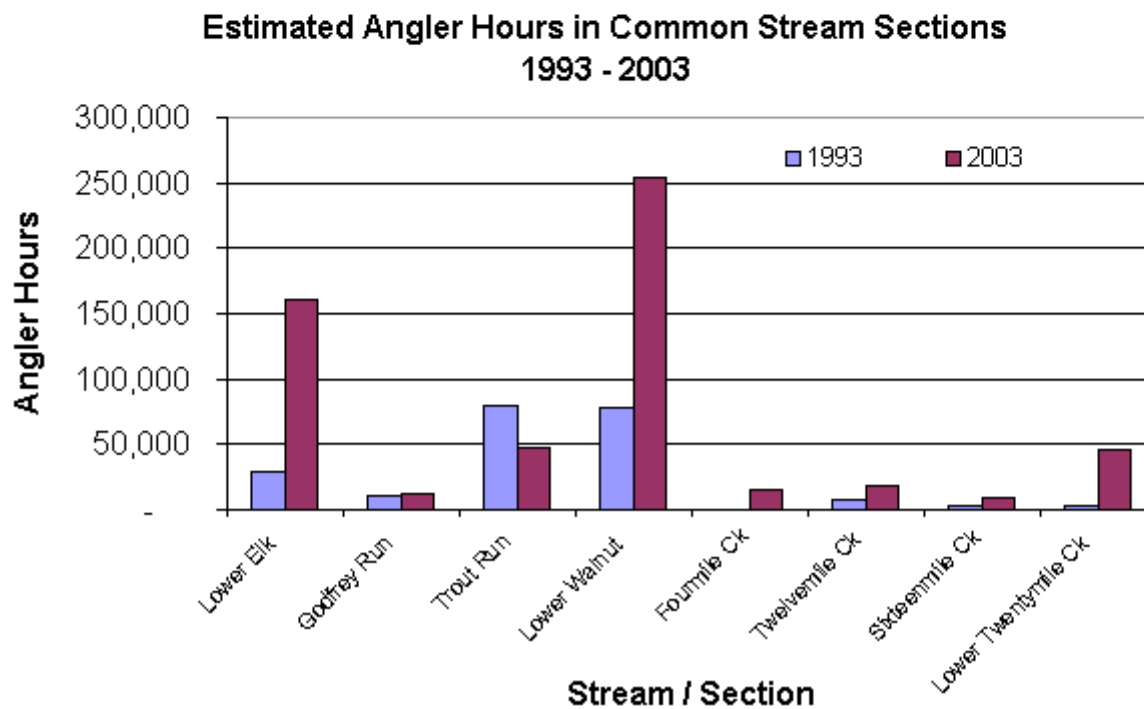


Figure 5: Angler response to question: "How many times a year do you fish for steelhead trout? (N=3,215).

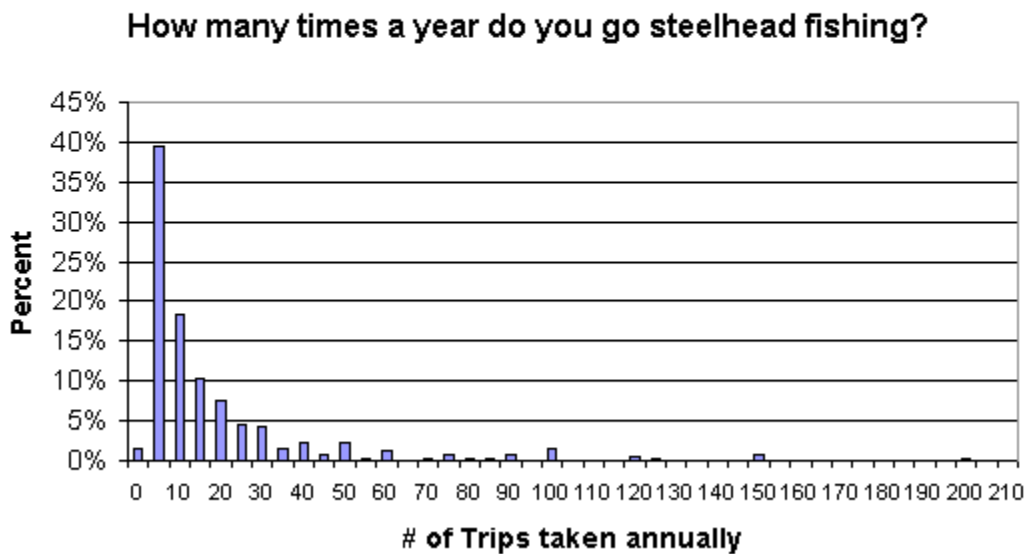
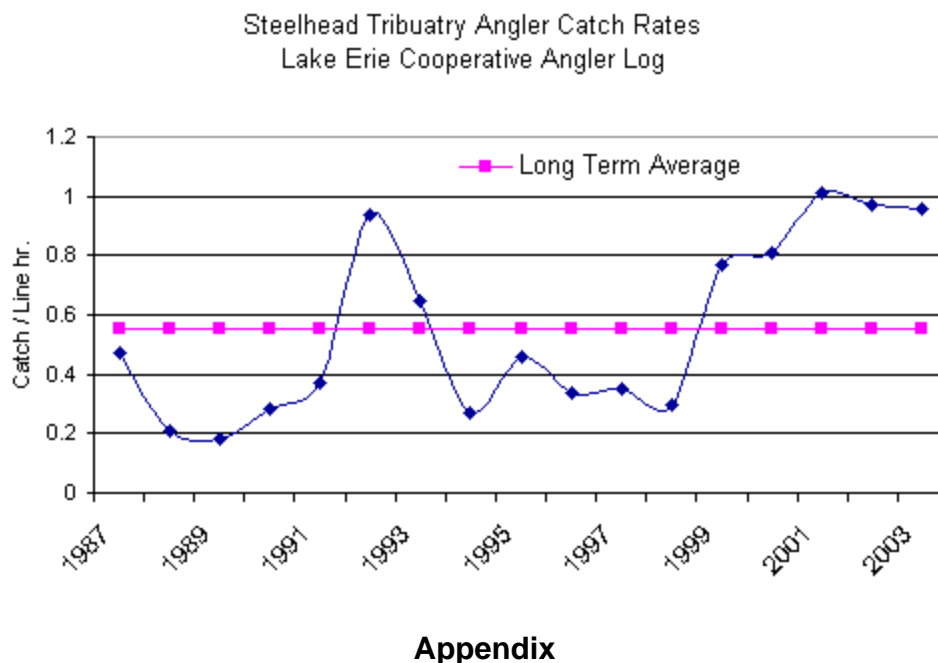


Figure 6: Steelhead angler catch rate as measured through the results of the Lake Erie Cooperative Angler Log 1987-2003.



Pennsylvania Fish and Boat Commission

2003 / 2004 Tributary Angler Survey

Clerk # : 1 2 Day Type: Weekday Weekend

Site Number: _____ Time: _____ Date: ____/____/____

Have you been interviewed previously today ?

Trip: Complete Incomplete Zip Code: _____

How many people drove in you vehicle today? _____

License Type: Youth _____ Adult Resident _____
 Non Resident _____ Senior Life _____ Senior Annual _____

Did you buy your fishing license specifically to fish for steelhead? No Yes

Gear: _____ Spin # of Rods: _____
 _____ Fly

How long have you been fishing today:

Hours: _____ Minutes: _____

	Target Species	# Caught	# Harvested
Any		X	X
Steelhead			
Coho			
Brown Trout			
Smolts			

"The following questions relate to the money you spent to go fishing today. Please try to give answers based on your share of the costs"

1 Are you using a professional guide today? N Y
 (If Yes:) How much is your share of the cost? \$ _____

2 How many days will you fish during this trip? _____

3 Are you staying away from home overnight? N Y
 (If Yes:) How many nights on this trip? _____
 Where are you staying?
 Mtl, Htl, B&B _____, Friends _____, Camping _____, Cottage/Camp _____
 What is the total cost for lodging? \$ _____ % Erie County _____

4 How much will you spend on travel this trip? \$ _____ % Erie County _____

5 How much will you spend on food & drink this trip? \$ _____ % Erie County _____

6 How much will you spend on gear & bait this trip? \$ _____ % Erie County _____

7 What would you have done if you could not fish for steelhead today?
 _____ A: Fish for something else in Erie?
 _____ B: Fish someplace else other than Erie?
 _____ C: Travel to Erie for another reason?
 _____ D: Other

8 How many times a year do you go steelhead fishing in Pennsylvania? _____

9 Are you willing to pay an additional (\$ 3.00, \$ 5.00, \$ 10.00) fee to support Lake Erie fisheries ? N Y