Angler Use, Harvest and Economic Assessment on Trout Stocked Streams in Pennsylvania

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Stocked Trout Stream Angler Use, Trout Catch, & Economic Contribution in Pennsylvania

Executive Summary

The Pennsylvania Fish and Boat Commission's adult trout-stocking program provides trout angling opportunities over a broad range of streams across the state. There were 1,856,500 adult trout stocked in 1,082 stream sections prior to the opening day in 2005; an additional 1,478,800 trout were stocked after the opening day through the end of May2005. Angler surveys were conducted during the spring of 2005 to quantify use and harvest statistics from a group of 30 randomly selected trout stocked stream sections that were representative of trout stocked streams statewide. Information collected from these surveys was expanded to estimate total stocked trout stream angler trips; numbers of trout caught, harvested, and released on all stocked trout streams statewide. In addition, information was also collected to assess the economic contribution of stocked trout stream angling in Pennsylvania. The survey was designed to provide an estimate of fishery statistics and the economic contribution of trout fishing for two periods, the opening weekend of season (April 16-17, 2005) and the remainder of the spring sample period (April 18 – June 12, 2005).

An estimated 2,124,821 angler trips were made on Pennsylvania's stocked trout streams during the first eight weeks of the regular trout season (April 16 –June 12, 2005). Approximately 21.3% of the angler trips (452,220 trips) to stocked trout streams were made during the opening weekend of regular trout season. Angler effort was estimated at 171.9 angler hours per day per mile of stream on opening weekend and 16.8 angler hours per day per mile of stream for the remainder of the survey period after opening weekend. Angler catch rates exceeded 1.0 trout/hour during both opening weekend (1.07/hr) and for the remainder of the survey period after opening weekend (1.13/hr). Anglers caught an estimated total of 6,770,094 trout on stocked trout streams during the spring of 2005. Approximately 25.8% of the total catch (1,745,373 trout) occurred on opening weekend. Anglers released 63.1% (4,272,571 trout) of the trout caught on stocked trout streams over the course of the study period. The estimate of trout caught is more than 1.5 times the number of adult trout stocked; there are at least two contributions to this effect. Based on the 63% release rate, there appears to be a high level of recycling of stocked trout. Also, there are wild trout in about 50% of the streams stocked with trout that would also contribute to the trout catch.

Based on the results of this study angling on stocked trout streams contributed over 65.7 million dollars to Pennsylvania's economy during the first eight weeks of the regular trout season in 2005. Angling on stocked trout streams also supported 1,119 jobs in Pennsylvania. An economic assessment of stocked trout fishing on lakes has not yet been conducted but Pennsylvania stocks about 20% of its adult trout into lakes each.

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Introduction

To provide trout angling opportunities on a statewide basis, the Pennsylvania Fish and Boat Commission (PFBC) manages a wide variety of stream sections with the planting of adult hatchery-reared trout. For example, during the 2005 season, the PFBC provided adult trout stocking in a total of 1,082 stream sections covering 4,742 miles of stream in the Commonwealth. Annually, the Commission invests a considerable amount of revenue into the adult trout-stocking program. Therefore, the efficient use of this resource is desirable.

Angler use and harvest surveys provide information that is essential to assessing the stocked trout fishery and may provide insight into how catch and harvest rates may be increased. Previous use and harvest assessments on trout stocked streams were completed on a cross section of streams from 1988-1991, a set of streams managed under Delayed Harvest regulations in 1993, as well as an individual stream section in 1996 (PFBC, 1993a, PFBC, 1993b, Greene and Weber, 1996). Since the time these surveys were conducted, changes to the stocking program have occurred stemming from a reduction in statewide adult trout production in 2002. Therefore, to collect updated information, the PFBC conducted a survey of anglers on trout stocked streams during the 2005 season.

The purpose of this survey was to determine the amount of angler effort that occurs on stream sections stocked with adult trout in Pennsylvania and to obtain information on the total number of trout caught, harvested and released on these waters. In addition, information was also collected to assess both the economic contribution and the economic impact of stocked trout stream angling in Pennsylvania. Overall, the survey was intended to quantify use and harvest statistics from a group of randomly selected stream sections that were stocked with adult trout and were representative of stocked streams on a statewide basis. Information collected from this study was expanded to estimate angler effort, numbers of trout caught, harvested, and released on all stocked streams statewide. Ultimately, PFBC staff will use the information from this study in attempt to increase angler use and catch rates by refining the allocation of stocked trout among streams. The evaluation occurred over an eight-week period in the spring, and extended from the opening day of regular trout season on April 16, 2005, through June 12, 2005.

The objectives of this sampling effort were to estimate fishery statistics for stocked trout streams on opening weekend (16-17 April 2005) and after opening weekend (18 April–12 June 2005). These statistics included angler effort (angler hours), angler trips, catch by species, harvest by species, number of trout released by species, and harvest rate by species. Fishery statistics were estimated for 4,742 miles of trout stocked streams.

To carry out this project, Fisheries Management Division staff worked with personnel from the Pennsylvania State University. For example, staff worked closely with Dr. Robert Carline and Dr. Duane Diefenbach from the Pennsylvania Cooperative Fish & Wildlife Unit on the overall study design. The Cooperative Fish & Wildlife Unit also provided the statistical analysis of angler use, catch, harvest, and release data. In addition, staff worked with Dr. Martin Shields from the Department of Agricultural Economics and Rural Sociology to develop a questionnaire to assess the economic benefits of stocked trout stream angling. Dr. Shields also provided the data analysis for the economic benefits portion of the study.

Methods

Angler Use and Harvest

Waters considered for the study included stream sections that were stocked with adult trout during the regular trout season in 2005. PFBC staff identified 1,082 stream sections ranging from 0.5 – 27.7 miles long that represented 4,742 miles of stocked streams. Because angler use is known to be greater on opening weekend, the sampling effort was stratified by opening weekend versus the remainder of the sampling period.

The sampling period between April 16, 2005, and June 12, 2005, included a total of 18 weekend and holidays and 40 weekdays. A total of 15 creel clerks were employed to conduct field sampling. Each of the clerks was assigned to work two stream sections for a total of 30 stream sections evaluated over the survey period (Appendix 1). The 30 stream sections (Range 1.0–12.8 miles long) were randomly selected from the PFBC database of 1,082 stream sections that received adult trout stocking in 2005.

The entire daylight period (sunrise to sunset) could not be sampled during one survey shift. Therefore, a randomly selected sub-sampled portion of the day was sampled. The sub-sampled portion of the day corresponded to a morning/afternoon or afternoon/evening time period. The afternoon/evening time shift was designed to end at a time near the average time of sunset for each month. Morning/afternoon shifts covered the portion of the day contiguous with but in advance of the afternoon/evening shift. Survey shifts were defined to be 6.5 hours in duration. Survey shift starting and ending times were defined such that that sampling period encompassed as much of the fishing day (sunrise to sunset) as possible.

During opening weekend (April 16 & 17, 2005), both the morning/afternoon and afternoon/evening shifts were sampled on all study sections. This strategy was used to account for the high rate of angler use that is typically associated with the opening weekend of regular trout season on stocked streams. After opening weekend, stream sections were sampled according to an allocation process that ensured each study section was sampled on one weekday shift and one

weekend day shift per week throughout the sampling period. Therefore, in any given week, sampling for an individual creel clerk consisted of four 6.5-hour sample days composed of both weekend days and two randomly selected weekdays. An average day length of 14.5 hours was used during the sampling period.

The creel survey process required a creel clerk to travel the length of the stream section and record the number of anglers along the stream. Creel clerks were required to conduct a total of four angler counts per survey shift. The first count was conducted at the beginning of the shift and subsequent counts were completed at one and one half hour intervals.

In the time period between use counts, clerks interviewed all possible anglers actively fishing within the designated stream section. Angler interview information was collected on the length of time fished, completed or incomplete trip, species of trout caught (i.e., brook, brown and or rainbow trout), number of trout harvested by species, number of trout released by species, and the type of tackle used by the angler. In addition, anglers were asked a series of questions to collect information on their opinions, attitudes, and tendencies, as well as, demographic, and economic information (Appendix 2).

For simplicity, each count was treated as an instantaneous count, although it was recognized the length of time required to make a count varied among streams. For each stream subsection survey in stratum h we calculated the average number of angler-hours/day/mile as:

$$y_{hi} = \frac{1}{n}\sum_{j=1}^{n}\frac{14.5\,hrs \times c_{ij}}{d_i},$$

where n is the number of visits to stream subsection i, c_{ij} is the mean count of anglers for day j (opening weekend or remainder of season) in stream i, and d_i is the length in miles of stream subsection i.

To estimate angler effort we define the following:

h = stratum, where 1 = opening weekend and 2 = remainder of survey period,

n_h = total number of sampled stream subsections in stratum h, and

y_{hi} = number of angler-hours/day/mile in stream subsection i in stratum h.

Then calculate the following:

$\bar{y}_h = \frac{\sum_{i=1}^{n_h} y_{hi}}{n_h}$ = sample mean (angler-hours/day/mile) for stratum *h*

$s_h^2 = \frac{1}{n_h - 1}\sum_{i=1}^{n_h}(y_{hi} - \bar{y}_h)^2$ = sample variance for stratum *h*

$SE_h = \sqrt{\sum_{h=1}^{2}\frac{s_h^2}{n_h}}$ = Standard error for stratum *h*

The estimated average length ($\bar{t}$ hours) of a fishing trip was based on all interviews with anglers who had completed their fishing trip. Estimated catch rates of anglers was derived by recording the length of time an angler had fished (t_i) and the number of trout caught up to the time of the interview; however, we excluded data from interviews in which an angler had been fishing for <0.5 hours (Pollock et al. 1994). We calculated the mean catch ($\overline{C}$), harvest ($\overline{H}$), and release ($\overline{R}$) per angler by sampling period (*s*) and species *f* as, for example,

$$\overline{C}_{fs} = \frac{1}{n}\sum_{i=1}^{n} C_{fsi},$$

and the rates (i.e., catch/hr, harvest/hr, and release/hr) as the average, for example, catch per hour of angling,

$$C_{fs} = \frac{1}{n}\sum_{i=1}^{n}\frac{C_{fsi}}{t_i},$$

rather than the ratio of total catch divided by the total number of angler hours. This method of calculating catch, harvest, and release rates is less biased if data from incomplete fishing trips are used (Pollock et al. 1994).

Using estimates of angler hours; average length of a fishing trip; and catch, release, and harvest rates; the following parameters were estimated:

Total angler hours by stratum ($\hat{A}_h$)	$= days \times miles \times \bar{y}_h$	Where *days* = 2 for opening weekend, *days* = 56 for after opening weekend, and *miles* = 4,742.
Total angler hours ($\hat{A}$)	$= miles\sum_{h=1}^{2} days \times \bar{y}_h$	
Total angler trips or angler trips per stratum	$= \frac{\hat{A}}{\bar{t}}$ or $\frac{\hat{A}_h}{\bar{t}}$	Where $\bar{t}$ is the average time spent fishing per trip

Total catch, harvest, and release were estimated by stratum (opening weekend or remainder of the season) as the product of angler hours and each corresponding rate, and summed to obtain total catch. Similarly, catch, harvest, and release were estimated per mile by stratum as the product of angler-hours per mile and the corresponding rate. Variances of these parameters were calculated for the product of two independent variables (Seber 1982).

For calculation of 95% confidence intervals a log-normal distribution was assumed, rather than a normal distribution, because in the latter the lower confidence limit can be <0. Let

$$V = \exp\left[z_{\alpha/2}\sqrt{\ln\left(1+cv(\theta)^2\right)}\right] \text{ and } \quad 95\%\ \text{CI} = \left[\theta/V, \theta \times V\right],$$

where θ represents the parameter of interest and cv(θ) = SE(θ)/ θ.

The proportion of stocked fish harvested was estimated for opening weekend, and for the complete season. This parameter was estimated by dividing the estimated total harvest by the number of stocked fish.

To evaluate whether certain factors (i.e., parking spaces, land ownership, etc.) affect angler effort on stocked streams, we correlated average angler counts per mile of stream per number of fish stocked (by stream, n = 30) with stream width, percent of stream in public ownership, percent of stream in private ownership but with public angling access, percentage of stream with access within 100 m, percentage of stream with access within 300 m, percentage of stream with access within 500 m, human population density, human population density in the sub-sub basin (SSB), number of parking spaces along stream, density (per km) of legal wild brook trout, legal wild brown trout, and legal wild trout, number of stocking points preseason, and number of stocking points inseason.

Overview of Economic Impact Analysis

The basic premise of any economic impact assessment is to determine the effects of an activity on the broader economy. Here, our purpose is to examine how stocked trout anglers contribute to the state 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).[1]

In examining economic impacts, we discuss two separate effects. Direct effects are the economic effects created by expenditures generated in support of stocked trout fishing itself. For the most part, these are purchases at affiliated businesses, such as lodging,

[1] 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.

food, transportation (e.g., fuel) and gear and bait shops. In our analysis, angler-spending patterns were collected in our survey.

But the economic contribution extends far beyond its initial effect. Because the directly impacted businesses purchase supplies and services from other Pennsylvania businesses, they generate additional economic activity, and subsequently jobs across the Commonwealth. Similarly, because employees in these businesses spend money in the state 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 money initially spent by stocked trout stream anglers at fishing-related businesses generates additional activity in the state's 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 state economy to purchase goods and services produced outside the state.

Economic Assessment

In this analysis, we estimate the total contribution of stocked trout stream fishing to the state 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 (Social Accounting Matrix) multipliers, with households endogenous.

Because IMPLAN models are quite stable from year-to-year, we applied the 2003 multipliers (the most recent year available) to the 2005 survey data to determine the results provided throughout the report. In the remainder of this appendix we define multipliers and other topics related to this section. The material is largely drawn from the IMPLAN User's Guide. A detailed description the IMPLAN sectoring scheme is available on the IMPLAN website.

Estimating the economic contribution of stocked trout stream fishing using the 2005 survey and the IMPLAN model

While fishing on the state's stocked trout streams is a rather specialized activity, the method for analyzing its economic effects is analogous to many other recreation-related sectors. As such, analysts have developed a comprehensive and commonly adopted framework appropriate for estimating impacts.

For analysts using IMPLAN, the most common approach for estimating the economic impact activities such as stocked trout fishing is to examine how much economic activity is generated by angler spending. This approach consists of a two-step process. The first step is to estimate the total expenditures--by category--that are supported by stocked trout stream fishing. The second step is applying these expenditures to the IMPLAN model in order to estimate the subsequent economic activity.

In this approach, the first critical piece of information is an accurate estimate of the number of anglers. According to estimates from the Pennsylvania Fish and Boat Commission, there were 2,124,821 angler days over the period of study. Of these, 452,220 occurred on the two days of opening weekend (April 16 and 17, 2005), and the remaining trips (1,672,601) were made over the remainder of the study period (Table 1).

After determining the appropriate number of angler days, the next step in estimating the economic effect of stocked trout stream fishing in Pennsylvania with the IMPLAN model is approximating the total expenditures by category. This information is generated from our angler survey. Specifically, anglers were asked to report their spending on four categories of trip-related expenses: accommodations, food, travel and bait and gear. Coupled with supplied information on the length of fishing trips, we were able to calculate the average daily expenditures per angler for each category. Having the number of anglers and their average expenditures allows us to calculate total expenditures for each of the four categories.

The next step of the process is to use the IMPLAN model to examine the effect of these total expenditures, by category, in the state economy. To determine the direct and secondary effects, we

matched the expenditure data with the IMPLAN industry-sectoring scheme, and entered the appropriate expenditure 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 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 cannot be considered a local impact. Recognizing this, we applied IMPLAN's default household margins for the affected retail sectors (transportation and sporting goods).

Determining Unique Local Expenditures

To adequately represent the impacts of the stocked trout streams, it is necessary to only examine the activity uniquely supported by the industry. Careful economic impact analyses of recreation-related activities distinguish between new economic activity and that which might have occurred anyway.

Accordingly, to measure the true impact of stocked trout fishing on the state economy we must consider only economic activity in Pennsylvania related to stocked trout fishing that would otherwise not occur. To calculate this, analysts that investigate recreation and other tourism type impacts often examine the expenditures of those who travel at least 50 miles one-way in state (i.e., D.K. Shifflet's annual study of tourism in Pennsylvania), as well as those who visit from out-of-state.

Estimates of the number of trips greater than 50 miles were derived from the survey information. We used GIS to calculate the linear distance between the point of the interview and the geographic centroid of the respondents reported home zip code.

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.

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. Multipliers describe these so called ripple effects. 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

Use and Harvest

For the study, creel clerks surveyed 30 stream sections statewide. A total of 21,052 anglers were counted on the survey waters during the study period. Creel clerks interviewed a total of 4,126 anglers, of which 3,803 fished for >0.5 hours and 1,629 had completed their fishing trip. Based on completed trip information, the average length of time spent fishing ($\bar{t}$) was 3.61 hours (n = 760, SE = 0.0931) on opening weekend and mean completed trip length was 2.67 hours (n = 840, SE = 0.0614) after opening weekend.

Overall, an estimated total of 5,538,087 angler hours and 2,124,821 angler trips were expended by anglers on all stocked trout streams in Pennsylvania from opening day through June 12, 2005.

Approximately 29.4% of the estimated angler effort (1,629,825.4 angler hours, SE = 110,619) and 21.3% of the estimated angler trips (452,220 angler trips, SE = 82,558) occurred during the opening weekend of season. In comparison, 70.6% of the angler effort (3,908,261.6 hours, SE = 320,514.63) and 78.7% of the angler trips (1,672,601 trips, SE = 278,959) occurred after opening weekend (Table 1).

Average daily angler effort on all stocked streams was much greater on opening weekend (814,912.7 hours, SE = 55,310), as compared with the time period sampled after opening weekend (79,760.4 hours, SE = 6,541). Total angling pressure per mile of stream averaged 171.9-angler hours/day/mile (SE=11.66) on opening weekend and 16.8-angler hours/day/mile (SE = 1.38) after opening weekend (Table 1).

Anglers fishing on opening weekend had a mean catch rate of 1.07 trout/hour and a mean harvest rate of 0.45 trout/hour. By species, opening weekend catch rates were 0.61/hr for rainbow trout, 0.24/hr for brook trout, and 0.22/hr for brown trout. Opening weekend harvest rates were recorded at 0.25/hr for rainbow trout, 0.11 for brook trout, and 0.09/hr for brown trout. During the remainder of the survey period anglers had a mean catch rate of 1.13 trout/hour and a mean harvest rate of 0.40 trout/hour. After opening weekend catch rates were 0.42/hr for brown trout, 0.41/hr for rainbow trout, and 0.30/hr for brook trout. During this time frame harvest rates were recorded at 0.15/hr for brown trout, 0.14/hr for rainbow trout, and 0.11/hr for brook trout (Table 2).

By combining catch rate and fishing pressure estimates, the total numbers of trout caught, released, and harvested were computed (Table 3). Estimates of trout caught, released and harvested included hatchery trout and wild trout. During the survey period, an estimated total of 6,770,094 trout were caught from all stocked streams. The estimated total catch was composed of 41.6% rainbow trout (2,818,345 trout), 32.6% brown trout (2,207,799 trout), and 25.8% brook trout (1,743,950 trout). Overall, 25.8% (1,745,373 trout) of the estimated total catch occurred on opening weekend. The opening weekend catch was composed of 57.1% rainbow trout (996,851 trout), 22.8% brook trout (398,042 trout), and 20.1% brown trout (350,480 trout). The remaining 74.2% (5,024,720 trout) of the catch occurred over the remainder of the survey period. Total catch during this time frame was composed of 37% brown trout (1,857,318 trout), 36.2% rainbow trout (1,821,494 trout), and 26.8% brook trout (1,345,908 trout).

An estimated total of 4,272,571 trout were released. By species, an estimated total of 1,760,729 rainbow trout, 1,416,141 brown trout, and 1,095,701 brook trout were released. Overall, 63.1% of the trout caught during the survey period were released (Table 3).

An estimated total of 2,497,523 trout were harvested including, 1,057,616 rainbow trout, 791,658 brown trout, and 648,249 brook trout. Overall, 731,898 trout were harvested during opening weekend or 41.9% of the total opening weekend catch. By species, 43.3 % of the brook

trout (172,259 trout), 41.6% of the brown trout (145,869 trout), and 41.5% of the rainbow trout (413,770 trout) catch was harvested during opening weekend. An estimated total of 1,765,625 trout were harvested after opening weekend or 35.1% of the total catch. By species, 35.4% of the brook trout (475,990 trout), 35.3% of the rainbow trout (643,846 trout), and 34.8% of the brown trout (645,789 trout) catch was harvested after opening weekend. Overall, about 36.9% of the total catch was harvested (Table 3).

The estimated proportion of trout harvested is presented in Table 4. It should be noted that the estimated number of harvested trout includes hatchery trout and any wild trout that may have been harvested from stocked stream sections. Therefore, these estimates would result in an overestimation of the actual proportion of stocked trout harvested. With that in mind, during opening weekend the number of trout harvested from all stocked streams amounted to about 39% of the number of trout stocked in those waters. For the remainder of the season, the number of trout harvested from stocked streams amounted to about 75% of the number of trout stocked

No variables were significantly correlated with angler effort per mile per number of stocked trout (Table 5). We also investigated whether angler effort per acre per number of stocked trout provided better insight into what factors may affect angler effort. However, results were nearly identical to the analysis on a per-mile basis.

We found a positive relationship between angler surveys conducted on opening day, or opening weekend, and seasonal angler effort. However, the relationship was not sufficiently strong that opening weekend surveys could preclude season-long surveys to accurately measure angler effort. The correlation between opening weekend effort and season effort was 0.74 (n = 30, R^2 = 0.55, P < 0.001), and the correlation with the first survey on opening day with season effort was 0.72 (n = 30, R^2 = 0.52, P < 0.001).

Angler Success

A total of 4,126 angler interviews including 1,629 completed angler trip interviews were recorded during the survey period. Angler success (based on all trips for harvested and released trout) revealed that 41.1% of the anglers had not caught a trout at the time they were interviewed. Anglers caught two trout or less at the time they were interviewed on 68.8% of the trips, and anglers had caught five trout or more at the time they were interviewed on 16.5% of the trips to stocked trout streams (Table 6). Angler success (based on all trips for harvested trout) indicated that anglers did not harvest a trout at the time they were interviewed on 65.5% of the trips. Anglers harvested two trout or less at the time they were interviewed on 85.8% of the trips, and anglers harvested the creel limit of five (5) trout per day at the time they were interviewed on 4.3% of their trips (Table 7).

Angler success (based on completed trips for harvested and released trout) indicated that anglers did not catch a trout on 35.3% of the angler trips. Anglers caught two trout or less on 60.1% of the trips and anglers caught five trout or more on 23.7% of the trips to stocked trout streams (Table 8). For completed trips based on harvested trout only, anglers did not harvest a trout on 61.1% of the trips, anglers harvested two trout or less on 79.4% of the trips, and anglers harvested the creel limit of five (5) trout per day on 9.1% of their trips (Table 9).

Angler Demographic Information

Based on angler interview information, 87.3% of the anglers fishing on stocked trout streams were licensed anglers over 16 years of age, and 12.7% of the anglers were less than 16 years of age (Table 10). On the basis of gender, 92.4% of the anglers interviewed were males and 7.6% were female anglers (Table 11).

Tackle Preference

In regards to tackle preference, 68.2% of the interviewed anglers on stocked streams used bait, 14.3% used a combination of tackle types, 9.0% used flies, and 8.5% used artificial lures (Figure 1). Of the anglers that used bait, 30.2% used some form of multiple baits, 28.2% used red worms or night crawlers, 14.0% used minnows, 11.6% used meal worms or wax worms, 6.5% used Power bait and the remaining 9.5% used a variety of other forms of bait (Table 12).

Angler Trip and Fishing Tendency Responses

Initially, anglers were asked how many days they would be fishing during their trip. Responses ranged from one to nine days. Of the 3,992 responses to this question, 83.6% of the anglers reported that they would be making a day trip and 10.1% of the anglers responded that they were fishing for two days on their trip. The responses ranged from three to nine days for the remaining 6.3% of the anglers (Table 13).

Anglers were asked what they would have done for the day if they could not fish for trout. Overall, 18.5% of the 4,096 respondents claimed that they would have gone fishing for some other species of fish and 81.5% of the anglers said they would have done something else aside from fishing (Table 14).

Anglers were then asked how many times a year they go trout fishing in Pennsylvania. A total of the 3,984 anglers responded to this question and their responses ranged from 0 to over 100 trips a year. Overall, 31.9% of the anglers claimed to make between one and ten trout fishing trips per year, 29.4% reported that they make between 11 and 25 trout fishing trips per year, 23.6% claimed to make between 26 and 50 trout fishing trips per year, and 15.1% of the

respondents reported that they make over 50 trout angling trips in Pennsylvania per year (Table 15).

Finally, anglers were informed that the Commission had approved a change in trout production for 2007. Plans were to increase the average size of the trout stocked by 30% in weight (11 inches in length). However, in order to accomplish this there would be 20% reduction in the number of adult trout produced and the goal would be to raise 3.2 million trout instead of 4 million trout annually. Anglers were asked if they agreed or disagreed with this change. Of the 3,851 respondents to this question, 64% agreed and 36% disagreed with the idea of rearing larger but fewer adult trout in the future (Table 16).

Economic Benefit Analysis

Trout fishing on Pennsylvania's stocked and wild trout streams is an important recreational activity. For example, from the opening day of regular trout season (April 16, 2005) through June 12, 2005, more than 2.1 million angler days were spent on Pennsylvania's stocked trout streams. Although this does not reflect all angler trips made for the year on stocked trout streams, it does cover those trips made during the traditional spring period when angler use is at its peak on stocked trout streams in Pennsylvania.

In addition to providing important recreational benefits, stocked trout fishing also provides important economic benefits to the Commonwealth. In this section, we quantify the economic contribution and impact of stocked trout fishing in Pennsylvania. Drawing on information gathered in the 2005 survey conducted on the state's stocked trout streams, we see that anglers spend millions of dollars annually on a variety of goods and services, including gear and bait, lodging, food, and associated travel expenses. These fishing related expenditures create jobs across Pennsylvania at hotels, restaurants, guide services and sporting goods shops. But the effects do not stop with angler spending. Through multiplier effects, trout fishing's effects on Pennsylvania's economy are witnessed across a multitude of industries.

In our study we surveyed nearly 4,000 anglers on Pennsylvania's stocked trout streams. In this section we use information from this survey to describe the effects of angling on Pennsylvania's stocked trout streams on the state economy. Given that there are several ways of describing the economic effects, we conduct analysis at two separate levels. First, we provide an estimate of the total *contribution* of stocked trout stream fishing to the Pennsylvania economy. This accounts for all spending related to Pennsylvania stocked trout stream angling.

Recognizing that local anglers might be substituting one type of expenditure for another, we then consider a subset of the first scenario, specifically anglers that traveled more than 50 miles one-

way within Pennsylvania or from out-of-state. By doing so we are able to estimate the unique economic *impact* of stocked trout stream angling. As part of this work we further separate this analysis into opening-weekend and the remainder of the survey period after opening weekend.

Scenario 1.1 The estimated 2005 Pennsylvania economic contribution of stocked trout stream angling.

In the first scenario we describe the activity's economic contribution. This captures the effects of all spending related to stocked trout fishing in Pennsylvania. This is the broadest measure possible, as it does not take into account the notion that money spent on fishing is, in many cases, money that could have been spent on other activities in Pennsylvania. Because of this, the contribution estimate should not be considered the economic impact. As we describe below, economic impacts account for the unique economic effects that likely would not have otherwise occurred.

In Table 17 we present the average daily Pennsylvania expenditures related to stocked trout stream fishing for the study period. On average, these anglers spent about $24.53 per day on trip-related expenses. This includes $1.25 on lodging, $8.02 on travel, $5.48 on food and $9.78 on bait and gear. To estimate total expenditures, the per trip expenditure profiles (which include only spending in Pennsylvania) are multiplied by the total number of angler days for the study period (2,124,821). Based on these per day expenditures, we estimate 2005 stocked trout fishing expenditures in Pennsylvania totaled about $52.119 million. Accounting for retail margins, the related expenditures in Pennsylvania are estimated at $37.305 million.

We report the results of our economic contribution analysis in Table 18. Here, stocked trout stream angling generates a direct output effect (accounting for retail margins) of $37.305 million. Based on the IMPLAN model, this translates into 859 jobs, with an annual total compensation for these workers of $17.640 million per year ($20,548 per worker). In addition, our analysis suggests stocked trout fishing directly generates about $27.272 million of value-added activity.

Secondary effects are the spin-off or ripple effects. 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 spending by employees of the angler-related business as well as supporting industries. Using IMPLAN, we estimate that these effects result in more than $28.395 million in additional output, of which about $16.575 million is value-added. This translates into 260 additional jobs in the state economy, and more than $9.528 million in employee compensation.

In terms of multipliers, the employment multiplier is 1.30, suggesting that for every job in a stocked trout-related business an additional 0.30 jobs are supported in the state economy. The labor income multiplier is $1.54, suggesting an additional dollar in employee compensation in stocked trout-based recreation wages supports $0.54 of wages and benefits in other state businesses. Similar interpretations can be given to the output multiplier ($1.76) and value-added multiplier ($1.61).[2]

Overall, the direct and secondary contributions of stocked trout fishing are estimated at more than $65.7 million in output, of which over $43.8 million is value-added. Of the value-added, slightly more than $27.169 million is employee compensation. From an employment standpoint, this translates into 1,119 jobs.

Scenario 1.2 The estimated 2005 Pennsylvania economic contribution of stocked trout stream angling: All Anglers (opening weekend)

In this and the following scenario we disaggregate the economic contribution into two effects, opening weekend and the remainder of the survey period after opening weekend. For opening weekend we estimate 452,220 angler days lead to margined expenditures of about $14.037 million (Table 19).

The total economic contribution of opening weekend is shown in Table 20. Accounting for multiplier effects, we see that there is about $24.661 million in output generated. This activity supported $16.567 million in value added, and 432 total jobs.

Scenario 1.3 The estimated 2005 Pennsylvania economic contribution of stocked trout stream angling: All Anglers (remainder of the survey period after opening weekend)

Looking at the remainder of the survey period we estimate 1,672,601 angler days lead to margined expenditures of about $23.267 million (Table 21). The largest contribution is travel ($9.059 million), followed by gear and bait ($7.052 million).

The total economic contribution of the remainder of the survey period is shown in Table 22. Accounting for multiplier effects, we estimate that there is about $41.040 million in output generated. This activity supports about $27.281 million in value added, and 687 total jobs.

Scenario 2.1 The estimated 2005 economic impact of stocked trout stream angling: within state trips greater than 50 miles one way and all out-of-state anglers

[2] 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.

In this and the following scenarios we describe the economic impact of stocked trout stream fishing in Pennsylvania. An impact differs from a contribution in that it attempts to quantify economic activity that would otherwise have not occurred; while contribution analysis considers all spending related to the activity, impact analysis accounts for the fact that some spending on trout angling might simply substitute for other activities. For example, when people fish locally, the money that they spend on bait and gear might just as well be spent on movie tickets. Here we simply see a substitution of fishing for movie going, with more jobs at the bait shop resulting in fewer jobs at the movie theatre. Accordingly, impact analysis accounts for the unique economic contribution of the activity.

To account for this, analysts that investigate recreation and other tourism-type impacts often examine the expenditures of those who travel at least 50 miles one-way in state (e.g., D.K. Shifflet's annual study of tourism in Pennsylvania), or visit from out-of-state. In this study we use GIS to determine the linear distance between the latitude and longitude of the spot on the stream where the survey was conducted and the centroid of the angler's reported zip code of residence.

In Table 23 we present the average daily expenditures for the subset of anglers that are the source of the economic impact. Here, this includes Pennsylvania residents who traveled more than 50 miles one way, and all out-of-state residents capturing about 17.4 percent of all stocked trout stream fishing days. To estimate total expenditures, the per trip expenditure profiles (which include only spending in Pennsylvania) are multiplied by the total number of trips (370,518). This yields a total unique expenditure of about $18.531 million. After applying retail margins, the output impact is about $14.355 million.

We report the results of our economic impact analysis in Table 24. Here, stocked trout stream angling generates a direct output effect (accounting for retail margins) of $14.355 million. Based on the IMPLAN model, this translates into 308 jobs, with an annual total compensation for these workers of $6.384 million per year ($20,749 per worker). In addition, our analysis suggests stocked trout fishing directly generates $9.977 million of value-added activity.

Secondary effects are the spin-off or ripple effects. Using IMPLAN, we estimate that these effects result in more than $11.207 million in additional output, of which about $6.510 million is value-added. This translates into 102 additional jobs in the state economy, and more than $3.751 million in employee compensation.

In terms of multipliers, the employment multiplier is 1.33, suggesting that for every job in a stocked trout-related business; an additional 0.33 jobs are supported in the state economy. The labor income multiplier is $1.59, suggesting an additional dollar in

employee compensation in stocked trout-based recreation wages supports $0.59 of wages and benefits in other state businesses. Similar interpretations can be given to the output multiplier ($1.78) and value-added multiplier ($1.65).

Overall, the direct and secondary impacts of stocked trout fishing are estimated at nearly $25.563 million in output, of which over $16.487 million is value-added. Of the value-added, more than $10.135 million is employee compensation. From an employment standpoint, this translates into 410 jobs.

Scenario 2.2 The estimated 2005 economic impact of stocked trout stream angling: within state trips greater than 50 miles one way and all out-of-state anglers: Opening weekend

In this scenario we examine the economic impact of opening weekend fishing on Pennsylvania's stocked trout streams. In Table 25 we present the average daily expenditures on opening weekend for the subset of anglers that are the source of the economic impact. Here, this includes Pennsylvania residents who traveled more than 50 miles one way, and all out-of-state residents capturing about 24 percent of all stocked trout stream fishing days on opening weekend. To estimate total expenditures, the per trip expenditure profiles (which include only spending in Pennsylvania) are multiplied by the total number of trips (106,254). This yields a total unique expenditure of about $6.779 million ($5.063 million after accounting for margins).

We report the results of our economic impact analysis in Table 26. Here, stocked trout stream angling generates a direct output effect (accounting for retail margins) of nearly $5.063 million. Based on the IMPLAN model, this translates into 114 jobs, with an annual total compensation for these workers of $2.306 million per year ($20,229 per worker). In addition, our analysis suggests stocked trout fishing directly generates nearly $3.556 million of value-added activity.

Using IMPLAN, we estimate that the spin-off effects result in more than $3.941 million in additional output, of which about $2.285 million is value-added. This translates into 36 additional jobs in the state economy, and more than $1.312 million in employee compensation.

In terms of multipliers, the employment multiplier is 1.31, suggesting that for every job in a stocked trout-related business an additional 0.31 jobs are supported in the state economy. The labor income multiplier is $1.57, suggesting an additional dollar in employee compensation in stocked trout-based recreation wages supports $0.57 of wages and benefits in other state businesses. Similar interpretations can be given to the output multiplier ($1.78) and value-added multiplier ($1.64).

Overall, the direct and secondary opening weekend contributions of stocked trout fishing are estimated at more than $9.004 million in output, of which almost $5.841 million is value-added. Of the value-added, slightly more than $3.619 million is employee compensation. From an employment standpoint, this translates into 150 jobs.

Scenario 2.3 The estimated 2005 economic impact of stocked trout stream angling: within state trips greater than 50 miles one way and all out-of-state anglers (remainder of the survey period after opening weekend)

In this scenario we examine the economic impact of fishing during the remainder of the survey period after opening weekend on Pennsylvania's stocked trout streams. In Table 27 we present the average daily expenditures during the survey period after opening weekend for the subset of anglers that are the source of the economic impact. Here, this includes Pennsylvania residents who traveled more than 50 miles one way, and all out-of-state residents—capturing about 12 percent of all stocked trout stream fishing days during this period. To estimate total expenditures, the per trip expenditure profiles (which include only spending in Pennsylvania) are multiplied by the total number of trips (264,265). This yields a total unique expenditure of about $11.752 million ($9.293 million after margining).

We report the results of our economic impact analysis in Table 28. Here, stocked trout stream angling generates a direct output effect (accounting for retail margins) of nearly $9.293 million. Based on the IMPLAN model, this translates into 194 jobs, with an annual total compensation for these workers of $4.078 million per year ($21,055 per worker). In addition, our analysis suggests stocked trout fishing during the remainder of the survey period after opening day directly generates $6.421 million of value-added activity.

Using IMPLAN, we estimate that spin-off effects result in more than $7.265 million in additional output, of which about $4.225 million is value-added. This translates into 66 additional jobs, and more than $2.438 million in employee compensation.

In terms of multipliers, the employment multiplier is 1.34, suggesting that for every job in a stocked trout-related business an additional 0.34 jobs are supported in the state economy. The labor income multiplier is $1.60, suggesting an additional dollar in employee compensation in stocked trout-based recreation wages supports $0.60 of wages and benefits in other state businesses. Similar interpretations can be given to the output multiplier ($1.78) and value-added multiplier ($1.66).

Overall, the direct and secondary after opening weekend contributions of stocked trout fishing are estimated at more than $16.558 million in output, of which $10.646 million is value-added. Of the value-added, nearly $6.517 million is employee compensation. From an employment standpoint, this translates into 260 jobs.

Discussion

Angler Use

In terms of angler hours per day per mile of stream, the estimated angler effort per day was much greater during opening weekend, as compared with the 56 days of the study period after opening weekend. For example, angler effort was estimated at 171.9 angler hours per day per mile of stream on opening weekend and only 16.8-angler hours/day/mile for the remainder of the study period (Figure 2). These findings are consistent with the results of previous angler opinion survey information that have indicated that opening day is an important part of the angling experience for most Pennsylvania trout anglers. As part of the survey, a sample of 1,600 anglers were asked if opening day was an important part of their trout fishing experience. Overall, 72% of the anglers agreed or strongly agreed that opening day was an important part of their trout fishing experience (Hummon, 1992).

Angler use was estimated at 344 hours/mile on opening weekend, 824 hours/mile for the remainder of the study period after opening weekend, and totaled 1,168 hours/mile for both periods combined. Opening weekend accounted for over 29% of the angler use during the eight-week study period. This high amount of angler participation also reflected the importance of the opening weekend of season for many trout anglers in Pennsylvania (Figure 3).

Another measure of early season angling effort can be drawn from angler count information. Based on angler count information, a total of 21,052 anglers were counted on the study streams over the course of the survey period. Overall, nearly 81% of the total number of anglers counted (16,973 anglers) during the survey were counted during the opening two weeks of season (Table 29).

Angler use information was also compiled for the 30 study sections. Total angler effort ranged widely from 172 to 18,132 hours per section (Table 30). Mean angler use per stream section was recorded at 353.89 hrs/acre, 123.1 trips/acre, and 20.7 angler trips/day. During the study period, an average of 0.62 angler trips were generated per trout stocked.

Based on information collected during a similar survey on wild trout streams in 2004, angler use on wild trout streams averaged only 82 hours/mile over the course of the regular trout season extending from opening day through Labor Day (20 weeks)compared to 1,168 hours/mile over just an eight-week period in the present study. Had the surveys on stocked streams been carried out over the entire regular trout season period, the differences in angler use between stocked and wild trout streams would have been even more pronounced (Figure 3).

None of the variables that were evaluated (e.g. stream width, percent of stream in public ownership, human population density, etc) were significantly correlated with either angler effort per mile per number of stocked trout or angler effort per acre per number of stocked trout (Table 5). This is likely because stocking efforts by the PFBC are well known among anglers and are based on such factors as parking, access, and human population density. Consequently, angler effort is well distributed according to these factors previously identified as likely to affect angler use. If angler effort was related to any of the variables measured to a significantly higher degree than was observed, we could conclude that those factors should be weighted more heavily in the stocking formula than occurs now. Since this was not the case, we conclude that stocking rates are reasonable in relationship to those factors that affect angling use.

Angler Catch, Harvest, and Release Rates

Overall, catch rates for all trout species combined on stocked streams were very good and exceeded a rate of 1.0 trout/hour during both opening weekend (1.07/hr) and after opening weekend (1.13/hr). In comparison, this exceeds the goal of 0.50/hr for high quality streams that are managed with a combination of wild and hatchery trout in New York (Engstrom-Heg 1990). Similarly, one of the goals of Colorado's Gold Medal Trout Management Program (primarily directed towards wild trout management) is to produce a catch rate of at least 0.70 trout/hour (Espegren et al. 1990).

Based on the catch rates recorded from this survey, anglers caught one trout for every 56 minutes fished during opening weekend and one trout for every 53 minutes fished after opening weekend. Release rates were 0.62/hr during opening weekend and 0.73/hr after opening weekend. Harvest rates were somewhat lower at 0.45/hr during opening weekend and 0.40/hr and after opening weekend. Expressed another way, one trout was harvested for every 2 hours and 13 minutes fished on opening weekend and one trout was harvested for every 2 hours and 30 minutes fished after opening weekend.

By species, average catch rates for rainbow trout were 0.41/hr after opening weekend and 0.61/hr during the opening weekend (Figure 4). Based on these catch rates, anglers caught one rainbow trout for every 1 hour and 38 minutes fished on opening weekend and one rainbow trout for every 2 hours and 26 minutes fished after opening weekend. Release rates for rainbow trout were 0.36/hr for the opening weekend and 0.26/hr after opening weekend. In comparison to release rates, harvest rates for rainbow trout were lower, averaging 0.25/hr on opening weekend and 0.14/hr after opening weekend. Based on these harvest rates, one rainbow trout was harvested for every four hours fished on opening weekend and one rainbow trout was harvested for every 7 hours and 9 minutes fished after opening weekend.

Catch rates for brown trout averaged 0.22/hr on opening weekend and 0.42/hr after opening weekend (Figure 4). Based on these catch

rates, anglers caught one brown trout for every 4 hours and 33 minutes fished on opening weekend and one brown trout for every 2 hours and 23 minutes fished after opening weekend. Release rates for brown trout were 0.13/hr during opening weekend and 0.27/hr after opening weekend. In comparison to release rates, harvest rates for brown trout were lower, averaging 0.09/hr on opening weekend and 0.15/hr after opening weekend. Based on these harvest rates, one brown trout was harvested for every 11 hours and 7 minutes fished on opening weekend and one brown trout was harvested for every 6 hours and 40 minutes fished after opening weekend.

Catch rates for brook trout were 0.24/hr on opening weekend and 0.30/hr after opening weekend (Figure 4). Based on these catch rates, anglers caught one brook trout for every 4 hours and 10 minutes fished on opening weekend and one brook trout for every 3 hours and 20 minutes fished after opening weekend. Release rates for brook trout were 0.14/hr during opening weekend and 0.20/hr after opening weekend. In comparison to release rates, harvest rates for brook trout were lower, averaging 0.11/hr on both opening weekend and after opening weekend. Based on these harvest rates, one brook trout was harvested for every 9 hours and 5 minutes fished on opening weekend and after opening weekend.

Of the three species, rainbow trout had the highest catch, harvest, and release rates during opening weekend, followed by brook and brown trout. Conversely, brown trout had the highest catch, harvest, and release rates after opening day followed by rainbow and brook trout. Rainbow trout were the only species where catch, harvest, and release rates were higher during opening weekend as compared to the remainder of the study period (Table 2).

Typically most stream sections are stocked with a combination of species composed of either a mix of brown and rainbow trout or a mix of brown and brook trout. For example, the preseason stocking is generally composed of 70% brook or rainbow trout and 30% brown trout. Whereas, the inseason stocking is composed of 70% brown trout and 30% brook or rainbow trout. Therefore, the differences in seasonal catch, harvest, and release rates between the species are likely related to the seasonal differences in species composition for stocking.

Differences in catch, harvest, and release rates may also be a function of water temperature. For example, the results from creel survey work conducted on trout stocked waters between 1988 and 1991 indicated that return to the creel rates for hatchery trout were much better for rainbow (71%) and brook trout (62%), as compared with brown trout (54%) during the opening nine days of season. However, following inseason stockings, return to the creel rates improved for brown trout (61%) and fell between the return rates observed for brook (67%) and rainbow trout (59%). At this time the species composition for stocking typically involved a mix of 50% brown trout and 50% brook or rainbow trout for both the preseason and inseason stocking periods (Anonymous, 1993). Similar results were observed during an intensive

two-year study conducted by the New York DEC on hatchery brown and rainbow trout in the Genesee River. The conclusions from that study were that rainbow trout harvest exceeded brown trout harvest during the early part of the season (April), whereas, brown trout harvest exceeded the harvest of rainbow trout during May and June (McKeown, 1989). During the early part of the season, water temperatures in many Pennsylvania streams remain below the optimal temperature range for brown trout of 48-60^{o}F (Piper, et al. 1982). Based on the results of these studies it appears that brown trout catch improves later in the spring or during a time that coincides with water temperatures within this species' optimal temperature range.

Over the course of the survey period, anglers caught an estimated average of 1,428 trout/mile from all stocked streams. Anglers caught an average of 368 trout/mile or 25.8% of the total catch on opening weekend and 1,060 trout/mile or 74.2 % of the total catch after opening weekend. Anglers harvested an average of 526 trout/mile or 36.8% of their catch on stocked stream sections (Figure 5). By species, anglers harvested an average of 223-rainbow trout/mile, 167-brown trout/mile, and 136-brook trout/mile (Figure 6).

Anglers caught an estimated total of 6,770,094 trout on stocked trout streams during the spring of 2005. Approximately 25.8% of the total catch (1,745,373 trout) occurred on opening weekend. Anglers released 63.1% (4,272,571 trout) of the trout caught on stocked trout streams over the course of the study period. The estimate of trout caught is more than 1.5 times the number of adult trout stocked. There are at least two contributions to this effect. Based on the 63% release rate, there appears to be a high level of recycling of stocked trout. Also, there are wild trout in about 50% of the streams stocked with trout that would also contribute to the trout catch.

Angler catch and harvest was much greater on stocked streams as compared with wild trout streams (Figures 5 & 6). Results from a similar study conducted on wild trout streams in 2004 revealed that anglers caught an average of 124 trout/mile on wild trout streams and harvested an average of only 9 trout/mile or 7.3% of the total catch (Greene, et al. 2005).

In summary, angler catch and catch rates were very good over the course of the study. Anglers released the majority of their catch for all three species of trout caught on stocked trout streams.

Tackle Use

The primary tackle type used by anglers during the study period was bait, followed by anglers using some combination of tackle types, flies, and artificial lures. From the angler interview information anglers reported that they caught a total of 9,857 trout. Based on this catch information, interviewed bait anglers caught a total of 6,585 trout, anglers fishing with a combination tackle caught 1,598 trout, fly anglers caught 983 trout, and anglers fishing with

artificial lures caught 691 trout. In terms of angler harvest by tackle type, bait anglers harvested 39.9% of their catch, followed by anglers fishing with a combination of tackle (34.6%), anglers fishing with artificial lures (31.1%), and fly anglers (11.6%). Based on these results, regardless of tackle type, anglers released the majority of their catch from stocked trout streams in 2005 (Table 31).

Angler Tendencies

Based on the information collected from the angler interviews, some general tendencies can be drawn on stocked trout stream anglers. For example, the majority of the anglers interviewed during the survey were male anglers (92.4%). This was similar to the results from previous surveys on stocked trout waters (Greene and Weber, 1996, 1998, 2002a, 2002b). The majority of the trips on stocked trout streams (93.7%) were short one or two day angling trip. However, most of the interviewed anglers (68%) fishing on stocked trout streams reported that they made eleven or more trout fishing trips in Pennsylvania during the year. Therefore, although angler trips to stocked trout streams may be rather short in duration, anglers frequently make a number of trips to stocked trout streams over the course of the season.

Economic Benefits

Over the course of the eight-week survey period (April 16 – June 12, 2005), the direct and secondary economic contributions of angling on stocked trout streams in Pennsylvania were estimated at greater than $65.7 million in output, of which over $43.8 million was value added. Of the value added, slightly more than $27.1 million was employee compensation. From an employment standpoint, this translated into a total of 1,119 jobs in Pennsylvania. In comparison, similar economic benefits analyses were conducted on wild trout stream angling in Pennsylvania from April 17 through September 3, 2004. From the wild trout stream study the direct and secondary economic contributions of wild trout stream angling in Pennsylvania were estimated at more than $7.16 million in output, of which nearly $4.16 million was value added. Of the value added, over $2.87 million was employee compensation that translated into a total of 105 jobs in the Commonwealth (Greene et al. 2005). Despite the much shorter evaluation period, the estimated economic contribution of stocked trout stream angling in Pennsylvania was more than nine times the estimated economic contribution for wild trout stream angling (Figure 7). In addition, the estimated number of jobs created from stocked trout stream angling was nearly 10.6 times greater than the jobs created from wild trout stream angling.

The economic impact of stocked trout stream angling was also determined as part of the stocked trout and wild trout stream studies. Economic impact is the contribution that was uniquely due to stocked trout or wild trout stream angling but that would not have otherwise contributed to the state economy. The direct and secondary economic

impacts of angling on stocked trout streams in Pennsylvania were estimated at greater than $25.5 million, of which over $16.4 million was value added. Of the value added, over $10.1 million was employee compensation. From an employment standpoint, this translated into a total of 410 jobs in Pennsylvania. In comparison, direct and secondary economic impact of angling on wild trout streams in Pennsylvania in 2004 yielded an estimate of over $2.6 million, of which over $1.5 was value added. Of the value added, over $1.0 million was employee compensation. From an employment standpoint this translated into a total of 38 jobs in Pennsylvania.

Conclusions

1. Angler use averaged 1,168 hours/mile on stocked trout streams over the course of the eight-week study period from opening day through June 12, 2005.

2. Opening weekend angler use composed 29.4% of the angler use observed on stocked trout streams over the eight-week study period.

3. Angler use on stocked trout streams was much greater on the opening weekend of trout season (171.9 angler hours/mile/day) in comparison to the remainder of the study period after opening weekend (16.8 angler hours/mile/day).

4. Stocked trout stream angling contributed over $65.7 million to the Pennsylvania economy during the first eight-weeks of the 2005 trout season. The economic impact of stocked trout stream angling, i.e., the amount uniquely due to wild trout stream angling that would not have otherwise contributed to the state's economy through other recreational pursuits, was over $25.5 million.

5. Average angler catch rates on stocked trout streams exceeded 1.0 trout/hour for both the opening weekend of trout season (1.07/hr) and the remainder of the study period after opening weekend (1.13/hr).

6. Anglers released 63.1% of the trout caught on stocked trout streams during the study period.

7. Approximately 61% of the anglers did not harvest a trout during their trip to a stocked trout stream and 35% did not catch a trout during their trip to a stocked trout stream.

8. In terms of tackle preference, bait anglers composed the largest group of anglers on stocked trout streams followed by fly anglers and lure anglers.

9. Most angler trips made to stocked trout streams are short in duration (one or two days). However, most stocked trout stream anglers reported that they make eleven or more trout fishing trips per year.

10. Most stocked trout stream anglers are adult males.

11. Peak angler use on stocked trout streams occurs during the first two weeks of the season.

Management Recommendations

1. Based on the amount of angler use generated on stocked trout streams, the PFBC should continue to manage appropriate stream sections with the planting of adult hatchery trout to provide recreational angling opportunities on these streams.

2. To determine the effects of future management changes on angler participation, angler surveys should be conducted periodically to update angler use, harvest, and opinion information on stocked trout streams. The information from these surveys should be used to update management plans applied to the adult trout-stocking program on stocked trout streams.

3. Greater emphasis should be placed on concentrating stocking efforts when angler use is greatest during the early spring (Preseason and April). This could be accomplished by reducing Inseason stocking frequency and applying higher stocking rates to Preseason and remaining Inseason stockings.

4. Based on the tendency of brown trout to provide poor catch, harvest, and release rates during the early season and improved catch, harvest and release rates later in the season, the stocking of brown trout should be concentrated more during the Inseason stocking period.

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Table 1. Angler effort for opening weekend (16-17 April) and after opening weekend (18 April – 12 June) on stocked trout streams, Pennsylvania, 2005.

Angler effort	Stratum	Mean or total	SE	95% CI
Angler-hours/day/mile	opening weekend	171.9	11.66	150.5 – 196.3
	after opener	16.8	1.38	14.3 – 19.7
Angler-hours/day	opening weekend	814,912.7	55,309.74	713,515.9 – 930,718.9
	after opener	79,760.4	6,541.11	67,935.5 – 93,643.7
Angler-hours	opening weekend	1,629,825.4	110,619.48	1,427,031.8 – 1,861,437.7
	after opener	3,908,261.6	320,514.63	3,328,838.0 – 4,588,540.6
Angler trips	opening weekend	452,219.85	82,558.25	317,118.5 – 644,878.2
	after opener	1,672,600.80	278,959.39	1,208,919.5 – 2,314,127.0

Table 2. Number of fish caught, harvested, and released per hour (n = 3,803) for opening weekend (16-17 April) and after opening weekend (18 April – 12 June) on stocked trout streams, Pennsylvania, 2005.

	Opening weekend			After opening weekend		
Species	No./hr	SE	95% CI	No./hr	SE	95% CI
Brook trout						
Catch	0.244	0.0197	0.208-0.286	0.302	0.0207	0.264-0.345
Release	0.138	0.0148	0.112-0.170	0.195	0.0159	0.166-0.229
Harvest	0.105	0.0102	0.087-0.127	0.107	0.0100	0.089-0.128
Brown trout						
Catch	0.215	0.0131	0.191-0.242	0.416	0.0199	0.379-0.457
Release	0.125	0.0103	0.106-0.147	0.272	0.0169	0.241-0.307
Harvest	0.089	0.0078	0.075-0.106	0.145	0.0093	0.128-0.164
Rainbow trout						
Catch	0.610	0.0357	0.544-0.684	0.408	0.0234	0.365-0.456
Release	0.357	0.0269	0.308-0.414	0.264	0.0193	0.229-0.305
Harvest	0.253	0.0180	0.220-0.291	0.144	0.0107	0.125-0.167
All species						
Catch	1.069	0.0443	0.986-1.159	1.126	0.0398	1.051-1.207
Release	0.621	0.0356	0.555-0.694	0.731	0.0329	0.669-0.798
Harvest	0.448	0.0223	0.406-0.494	0.396	0.0187	0.361-0.434

Table 3. Number of fish caught, released and harvested, for brook, brown, and rainbow trout on stocked trout streams in Pennsylvania, 2005.

	Catch		Release		Harvest	
Streams	No. fish	95% CI	No. fish	95% CI	No. fish	95% CI
Brook trout						
Opening[a]	398,042	279,774 - 566,304	225,783	154,676 - 329,578	172,259	119,284 - 284,760
After opener[b]	1,345,908	995,326 - 1,819,975	869,918	635,620 - 1,190,582	475,990	343,397 - 659,782
All	1,743,950	1,303,907 - 2,332,498	1,095,701	796,004 - 1,508,234	648,249	461,746 - 910,083
Brown trout						
Opening	350,480	250,206 - 490,941	204,611	143,641 - 291,461	145,869	101,928 - 208,752
After opener	1,857,318	1,395373 - 2,472194	1,211,529	900,747 - 1,629,539	645,789	479,344 - 870,029
All	2,207,799	1,717,655 - 2,837,808	1,416,141	1,078,452 - 1,859,568	791,658	596,798 - 1,050,140
Rainbow trout						
Opening	996,851	712,886 - 1,393,929	583,082	411,752 - 825,702	413,770	293,206 - 583,908
After opener	1,821,494	1,359,429 - 2,440,613	1,177,648	867,407 - 1,598,851	643,846	473,783 - 874,952
All	2,818,345	2,127,671 - 3,733,222	1,760,729	1,290,454 - 2,402,385	1,057,616	768,507 - 1,455,486

[a] Opening weekend, 16-17 April 2005.
[b] After opening weekend, 18 April–12 June, 2005.

Table 4. The proportion of stocked fish harvested in Pennsylvania, 2005.

	Opening weekend		Season	
Species	$\hat{H}$	95% CI	$\hat{H}$	95% CI
Brook Trout	0.401	0.277-0.579	1.002	0.713-1.406
Brown Trout	0.256	0.179-0.366	0.538	0.406-0.714
Rainbow Trout	0.483	0.342-0.682	0.876	0.637-1.206
All species combined	0.394	0.284-0.548	0.751	0.583-0.968

Table 5. Correlation of characteristics of streams (n = 30) with angler effort per mile per number of stocked trout and per acre per number of stocked trout, Pennsylvania, 2005.

	Per mile		Per acre	
Variable	*r*	*P*	*r*	*P*
Stream width	-0.17	0.380	-0.25	0.177
Percent of stream in public ownership	-0.04	0.853	-0.08	0.681
Percent of stream in private ownership but with public access	0.04	0.845	0.08	0.671
Percent of stream with access within 100 m	0.14	0.464	0.10	0.593
Percent of stream with access within 300 m	0.19	0.325	0.15	0.425
Percent of stream with access within 500 m	0.08	0.660	0.07	0.718
Human population density	0.01	0.942	-0.05	0.776
Human population density in the sub-subbasin (SSB)	0.09	0.620	0.05	0.781
Number of parking spaces along stream	-0.03	0.857	-0.09	0.601
Density (per km) of legal wild brook trout	0.01	0.946	0.01	0.954
Density (per km) of legal wild brown trout	-0.16	0.398	-0.14	0.456
Density (per km) of legal wild trout	-0.15	0.415	-0.14	0.472
Number of stocking points preseason	-0.29	0.116	-0.29	0.118
Number of stocking points inseason	-0.25	0.181	-0.29	0.121

Table 6. Angler Success - All trips (Number of trout caught)

# Caught	# Anglers	Percent
0	1,697	41.1
1	644	15.6
2	497	12.0
3	369	8.9
4	239	5.8
>5	680	16.5
	4,126	100

Table 7. Angler Success - All trips (Number of trout harvested)

# Caught	# Anglers	Percent
0	2,702	65.5
1	500	12.1
2	337	8.2
3	242	5.9
4	166	4.0
5	179	4.3
	4,126	100

Table 8. Angler Success - Completed trips (Number of trout caught)

# Caught	# Anglers	Percent
0	575	35.3
1	214	13.1
2	191	11.7
3	166	10.2
4	97	6.0
>5	386	23.7
	1,629	100

Table 9. Angler Success - Completed trips (Number of trout harvested)

# Caught	# Anglers	Percent
0	996	61.1
1	157	9.6
2	142	8.7
3	115	7.1
4	71	4.4
5	148	9.1
	1,629	100

Table 10. Age group of interviewed anglers.

Age Group	# Anglers	Percent
Adult	3,602	87.3
Youth	524	12.7
	4,126	100

Table 11. Gender of interviewed anglers.

Gender	# Anglers	Percent
Male	3,813	92.4
Female	313	7.6
	4,126	100

Table 12. Type of bait used by interviewed Bait Anglers.

Bait Type	# Anglers	Percent
Red Worms	529	16.4
Night Crawlers	381	11.8
Minnows	451	14.0
Meal Worms	192	5.9
Wax Worms	184	5.7
Power Bait	209	6.5
Corn	95	2.9
Salmon Eggs	81	2.5
Maggots	68	2.1
Bread	10	0.3
Cheese	7	0.2
Crickets	1	0.0
Multiple Baits	976	30.2
Other	48	1.5
	3,232	100

Table 13. Summary of response from question: How many days will you be fishing during this trip?

# Days	# Anglers	Percent
1	3,337	83.6
2	404	10.1
3	136	3.4
4	53	1.3
5	31	0.8
6	9	0.2
7	15	0.4
8	2	0.1
9	5	0.1
	3,992	100

Table 14. Summary of response from question: What would you have done if you could not fish for trout today?

Response	# Anglers	Percent
Fish for something else	756	18.5
Other	3,340	81.5
	4,096	100

Table 15. Summary of response from question: How many times a year do you go trout fishing in Pennsylvania?

# Trips	Frequency	Percent
0	2	0.05
1-10	1,273	31.95
11-20	1,170	29.37
26-50	939	23.57
>50	600	15.06
	3,984	100

Table 16. Summary of response from question: The Commission approved stocking larger trout in 2007 averaging 30% more in weight and 11 inches in length. However, there will be 20% fewer trout in number and the goal would be to raise 3.2 million trout, down from 4 million trout. What is your opinion of this change?

Response	Frequency	Percent
Agree	2,463	63.96
Disagree	1,388	36.04
	3,851	100

Table 17. Estimated 2005 expenditures by category for stocked trout stream anglers

Category	Expenditures per day	Total Expenditures	Margined Expenditures
Lodging	$1.25	$2,646,897	$2,575,997
Travel	$8.02	$17,047,763	$12,872,434
Food	$5.48	$11,647,105	$8,482,747
Gear	$9.78	$20,777,457	$13,373,864
Total	$24.53	$52,119,223	$37,305,042

Number of trips = 2,124,821

Table 18. Estimated 2005 economic contribution for stocked trout stream anglers

Indicator	Direct	Secondary	Total	Multiplier
Output	$37,305,042	$28,395,488	$65,700,530	$1.76
Value Added	$27,271,898	$16,575,453	$43,847,351	$1.61
Employment	859	260	1,119	1.30
Labor income	$17,640,385	$9,528,622	$27,169,007	$1.54
Per worker comp	$20,548	$36,620	$24,286	

Table 19. Estimated 2005 expenditures by category for stocked trout stream anglers on Opening Weekend

Category	Expenditures per day	Total Expenditures	Margined Expenditures
Lodging	$1.02	$460,366	$460,366
Travel	$10.81	$4,889,372	$3,813,710
Food	$10.15	$4,589,567	$3,442,175
Gear	$21.18	$9,577,734	$6,321,304
Total	$43.16	$19,517,039	$14,037,556

Number of trips = 452,220

Table 20. Estimated 2005 economic contribution for stocked trout stream anglers on Opening Weekend

Indicator	Direct	Secondary	Total	Multiplier
Output	$14,037,555	$10,622,987	$24,660,542	$1.76
Value Added	$10,375,327	$6,191,408	$16,566,735	$1.60
Employment	335	97	432	1.29
Labor income	$6,756,321	$3,551,896	$10,308,217	$1.53
Per worker comp	$20,180	$36,467	$23,851	

Table 21. Estimated 2005 expenditures by category for stocked trout stream anglers for the remainder of the survey period

Category	Expenditures per day	Total Expenditures	Margined Expenditures
Lodging	$1.31	$2,186,531	$2,115,631
Travel	$7.27	$12,158,391	$9,058,724
Food	$4.22	$7,057,538	$5,040,572
Gear	$6.70	$11,199,723	$7,052,560
Total	$19.49	$32,602,184	$23,267,486

Number of trips = 1,672,601

Table 22. Estimated 2005 economic contribution for stocked trout stream anglers for the remainder of the survey period

Indicator	Direct	Secondary	Total	Multiplier
Output	$23,267,487	$17,772,501	$41,039,988	$1.76
Value Added	$16,896,571	$10,384,045	$27,280,616	$1.61
Employment	524	163	687	1.31
Labor income	$10,884,064	$5,976,726	$16,860,790	$1.55
Per worker compensation	$20,783	$36,712	$24,561	

Table 23. Estimated 2005 expenditures by category for stocked trout stream anglers traveling at least 50 miles or from out-of-state

Category	Expenditures per day	Total Expenditures	Margined Expenditures
Lodging	$6.27	$2,321,909	$2,321,909
Travel	$20.08	$7,438,358	$5,801,919
Food	$13.29	$4,923,479	$3,692,609
Gear	$10.38	$3,846,998	$2,539,019
Total	$50.01	$18,530,744	$14,355,456

Number of trips = 370,518

Table 24. Estimated 2005 economic impact for stocked trout stream anglers traveling at least 50 miles or from out-of-state

Indicator	Direct	Secondary	Total	Multiplier
Output	$14,355,456	$11,207,272	$25,562,728	$1.78
Value Added	$9,977,286	$6,509,952	$16,487,238	$1.65
Employment	308	102	410	1.33
Labor income	$6,384,498	$3,751,316	$10,135,814	$1.59
Per worker compensation	$20,749	$36,850	$24,752	

Table 25. Estimated 2005 expenditures by category for stocked trout stream anglers traveling at least 50 miles or from out-of-state on Opening Weekend

Category	Expenditures per day	Total Expenditures	Margined Expenditures
Lodging	$3.68	$391,199	$391,199
Travel	$22.00	$2,337,859	$1,823,530
Food	$18.28	$1,942,157	$1,456,617
Gear	$19.84	$2,107,912	$1,391,222
Total	$63.80	$6,779,127	$5,062,568

Number of trips = 106,254

Table 26. Estimated 2005 economic impact for stocked trout stream anglers traveling at least 50 miles or from out-of-state on Opening Weekend

Indicator	Direct	Secondary	Total	Multiplier
Output	$5,062,568	$3,941,814	$9,004,382	$1.78
Value added	$3,555,815	$2,285,083	$5,840,898	$1.64
Employment	114	36	150	1.31
Labor income	$2,306,161	$1,312,938	$3,619,099	$1.57
Per worker compensation	$20,229	$36,674	$24,160	

Table 27. Estimated 2005 expenditures by category for stocked trout stream anglers traveling at least 50 miles or from out-of-state for the remainder of the survey period

Category	Expenditures Per Day	Total Expenditures	Margined Expenditures
Lodging	$7.31	$1,930,710	$1,930,710
Travel	$19.30	$5,100,498	$3,978,389
Food	$11.28	$2,981,323	$2,235,992
Gear	$6.58	$1,739,086	$1,147,797
Total	$44.47	$11,751,617	$9,292,888

Number of trips = 264,265

Table 28. Estimated 2005 economic impact for stocked trout stream anglers traveling at least 50 miles or from out-of-state for the remainder of the survey period

Indicator	Direct	Secondary	Total	Multiplier
Output	$9,292,888	$7,265,458	$16,558,346	$1.78
Value added	$6,421,471	$4,224,869	$10,646,340	$1.66
Employment	194	66	260	1.34
Labor income	$4,078,337	$2,438,378	$6,516,715	$1.60
Per worker compensation	$21,055	$36,945	$25,093	

Table 29. Angler Use Counts by two-week intervals on stocked trout study waters in 2005.

Dates	Total Count	Percent
4/16-4/29	16,973	80.6
4/30-5/13	1,967	9.3
5/14-5/27	1,190	5.7
5/28-6/10	825	3.9
6/11-6/12	97	0.5
	21,052	100

Table 30. Angler Use Assessment from Catchable Trout Stocked Stream Sections Creel Survey Waters 2005

Water	Sec	SSB	Wtrlat/lon	Miles	Acres	Total Trout Stkd Pre	Total Trout Stkd In	Total Stkd	Angler Hours	Angler Trips	Trips/Day	Trips/Trout	Hrs/Acre	Trips/Acre
Black Moshannon Ck	03	8D	410211780329	1.3	3.84	400	300	700	946	397	6.84	0.57	246.35	103
Blue Eye Rn	02	16B	414854792517	3.42	6.64	500	300	800	917	423	7.29	0.53	138.10	64
Bushkill Ck	06	1D	410533745933	2.83	15.24	3100	3000	6,100	5,743	1,565	26.98	0.26	376.84	103
Chartiers Ck, Ltl	02	20F	401641800817	3.35	15.81	3,200	2,400	5,600	9,174	2,659	45.84	0.47	580.27	168
Clarion R, E Br	03	17A	412935784050	2.51	21.29	800	700	1,500	4,634	2,024	34.90	1.35	217.66	95
Cove Ck	02	13B	394742780548	6.94	19.36	1,500	1,000	2,500	6,866	2,100	36.21	0.84	354.65	108
Dyberry Ck, W Br	02	1B	413938751715	1.37	4.92	400	300	700	3,237	1,177	20.29	1.68	657.93	239
Green Spring Ck	03	7B	401036772724	0.99	2.09	300	0	300	1,466	828	14.28	2.76	701.44	396
Hokendauqua Ck	02	2C	404037752925	2.98	17.78	2200	2100	4,300	2,641	655	11.29	0.15	148.54	37
Jones Ck	02	1C	412322752555	1.49	3.9	500	300	800	388	350	6.03	0.44	99.49	90
Jordan Ck	06	2C	403603752742	2.3	21.49	2400	4900	7,300	18,132	6,085	104.91	0.83	843.74	283
Kettle Ck	03	9B	411802775020	2.98	14.67	2900	3300	6,200	4,979	1,293	22.29	0.21	339.40	88
Lizard Ck	04	2B	404743753954	4.42	20.82	2600	2600	5,200	4,483	1,225	21.12	0.24	215.32	59
Medix Rn	02	8A	411705782353	2.11	6.13	1200	1500	2,700	6,192	1,588	27.38	0.59	1010.11	259
Mingo Ck	02	19C	401252795739	3.6	9.39	1900	2100	4,000	6,938	2,710	46.72	0.68	738.87	289
Oil Ck	03	16E	412556794234	3.54	15.39	1100	800	1,900	3,006	717	12.36	0.38	195.32	47
Pine Ck, S Fk	01	17E	405231792811	2.4	7.95	600	400	1,000	4,729	1,695	29.22	1.70	594.84	213
Powell Ck	03	6C	402437765905	6.07	17.36	2800	2800	5,600	3,098	1,192	20.55	0.21	178.46	69
Powers Rn	02	17A	412845784024	1.76	3.93	800	1000	1,800	3,112	1,055	18.19	0.59	791.86	268
Richey Rn	02	16G	411034794201	2.36	5.41	400	0	400	547	150	2.59	0.38	101.11	28
Roaring Bk	03	5A	412407754026	1.98	6.8	800	800	1,600	2,236	656	11.31	0.41	328.82	96
Sandy Ck, Ltl	03	16G	412148795227	1.3	4.07	700	0	700	858	231	3.98	0.33	210.81	57
Shenango R, Ltl	02	20A	412421802335	2.42	7.24	600	400	1,000	2,245	785	13.53	0.79	310.08	108
Sinn Ck, Bennett Br	02	8A	412011780801	3.32	12.6	900	600	1,500	2,506	1,049	18.09	0.70	198.89	83
Sixmile Rn	03	8D	405635780723	3.41	10.87	2200	2400	4,600	6,820	1,858	32.03	0.40	627.41	171
Stony Fk	01	9A	413421772015	1.8	7.02	1400	500	1,900	1,842	808	13.93	0.43	262.39	115
Treaster Rn	02	12A	404235773141	3.97	8.3	800	0	800	263	68	1.17	0.09	31.69	8
West Ck	02	5C	411106762330	4.4	14.47	1100	0	1,100	961	355	6.12	0.32	66.41	25
Wyalusing Ck, M Br	02	4D	414725760414	2.28	6.42	500	0	500	172	94	1.62	0.19	26.79	15
Wysox Ck	02	4D	414628762301	7.57	25.39	2000	1300	3,300	587	216	3.72	0.07	23.12	9
											620.83	18.55	10616.72	3693

Mean Hours/Acre = 353.89
Mean Trips/Acre = 123.1
Mean Trips/Day = 20.7
Mean Trips/Trout = 0.62

Table 31. Trout caught, harvested, and released by tackle type on stocked trout study waters in 2005.

	Bait	Flies	Lures	Combination of Tackle
# Caught	6,585	983	691	1,598
# Harvested	2,625	114	215	553
# Released	3,960	869	476	1,045
Percent Harvested	39.9	11.6	31.1	34.6

Figure 1. Tackle use by interviewed anglers on stocked trout streams in 2005

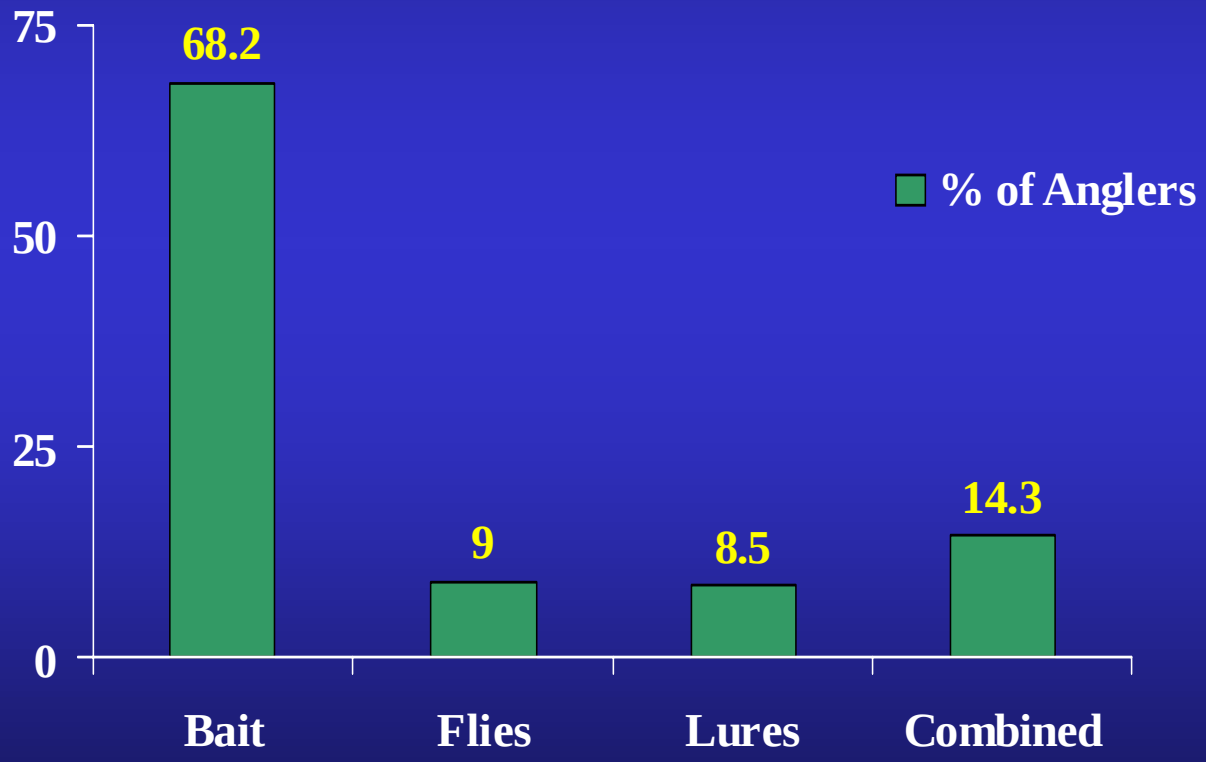


Figure 2. Angler Effort (Angler Hours/Day/Mile)

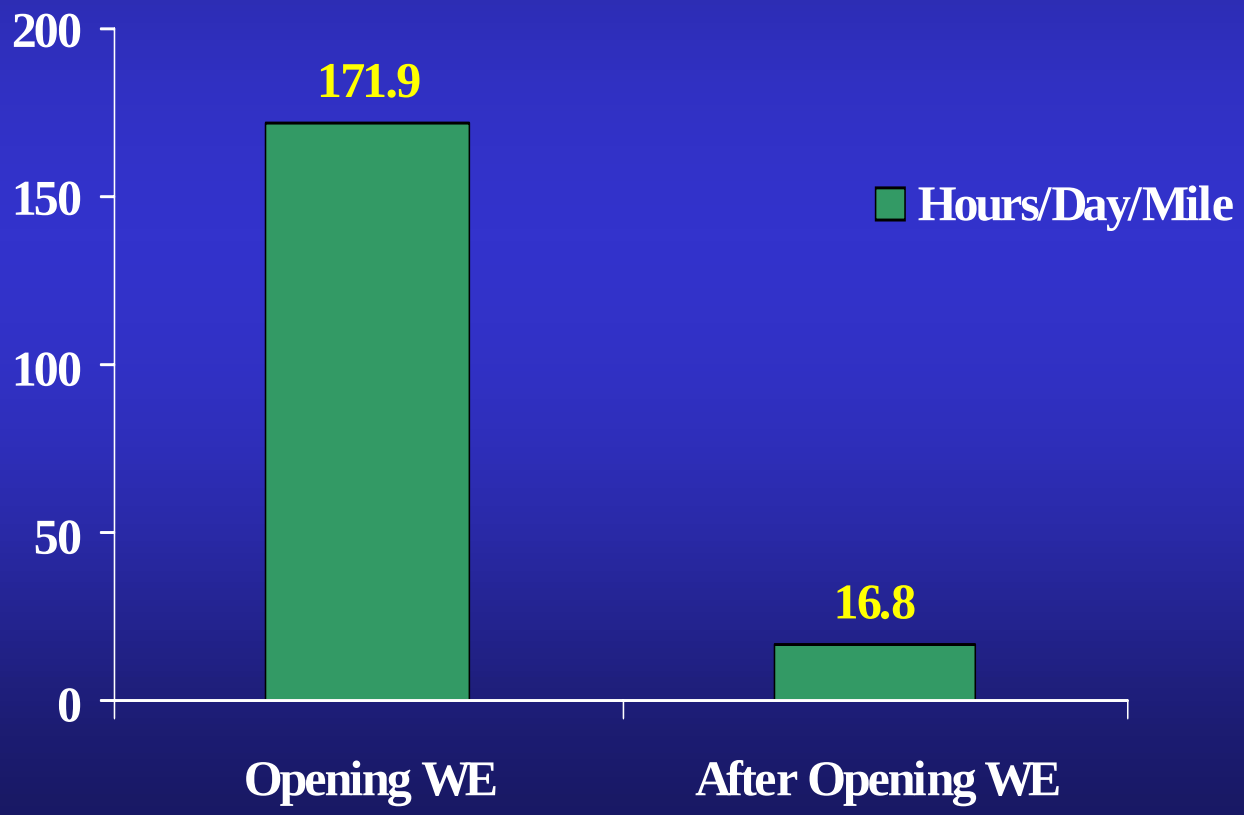


Figure 3. Angler Effort by Survey Period

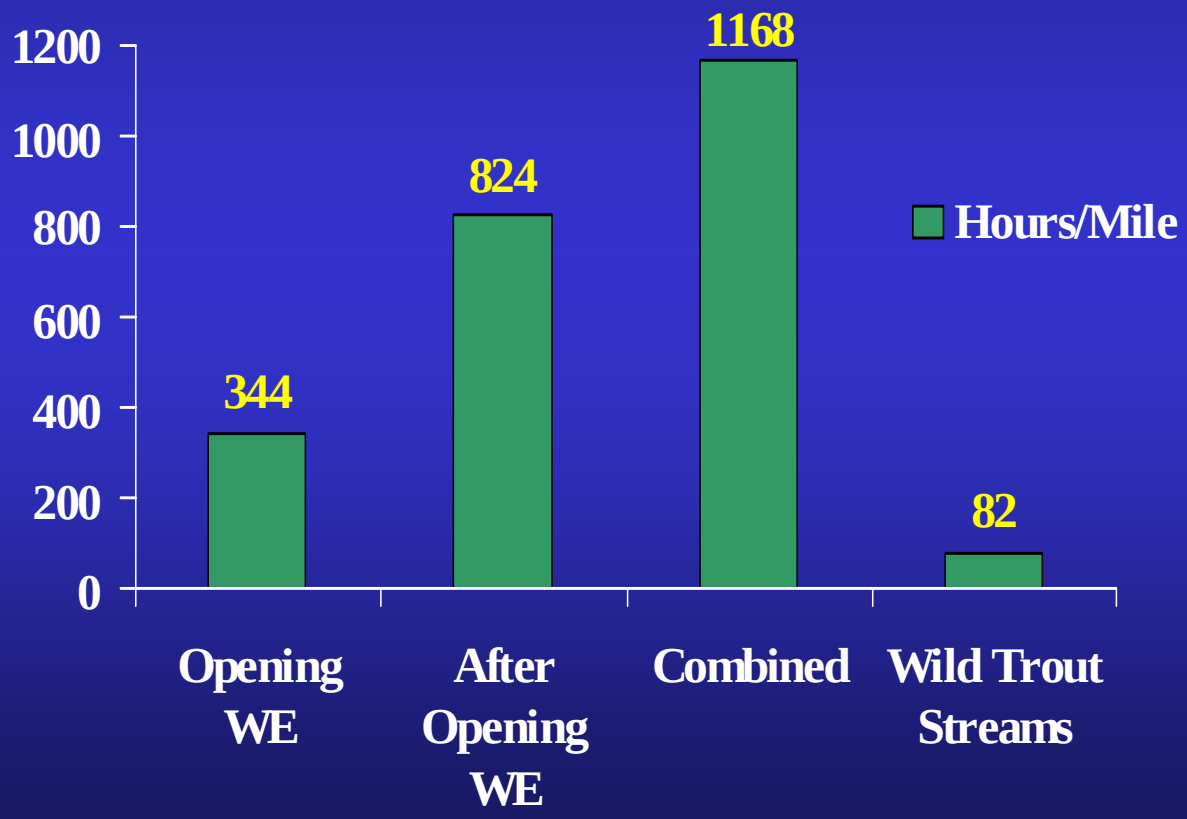


Figure 4. Angler catch rates per hour by species

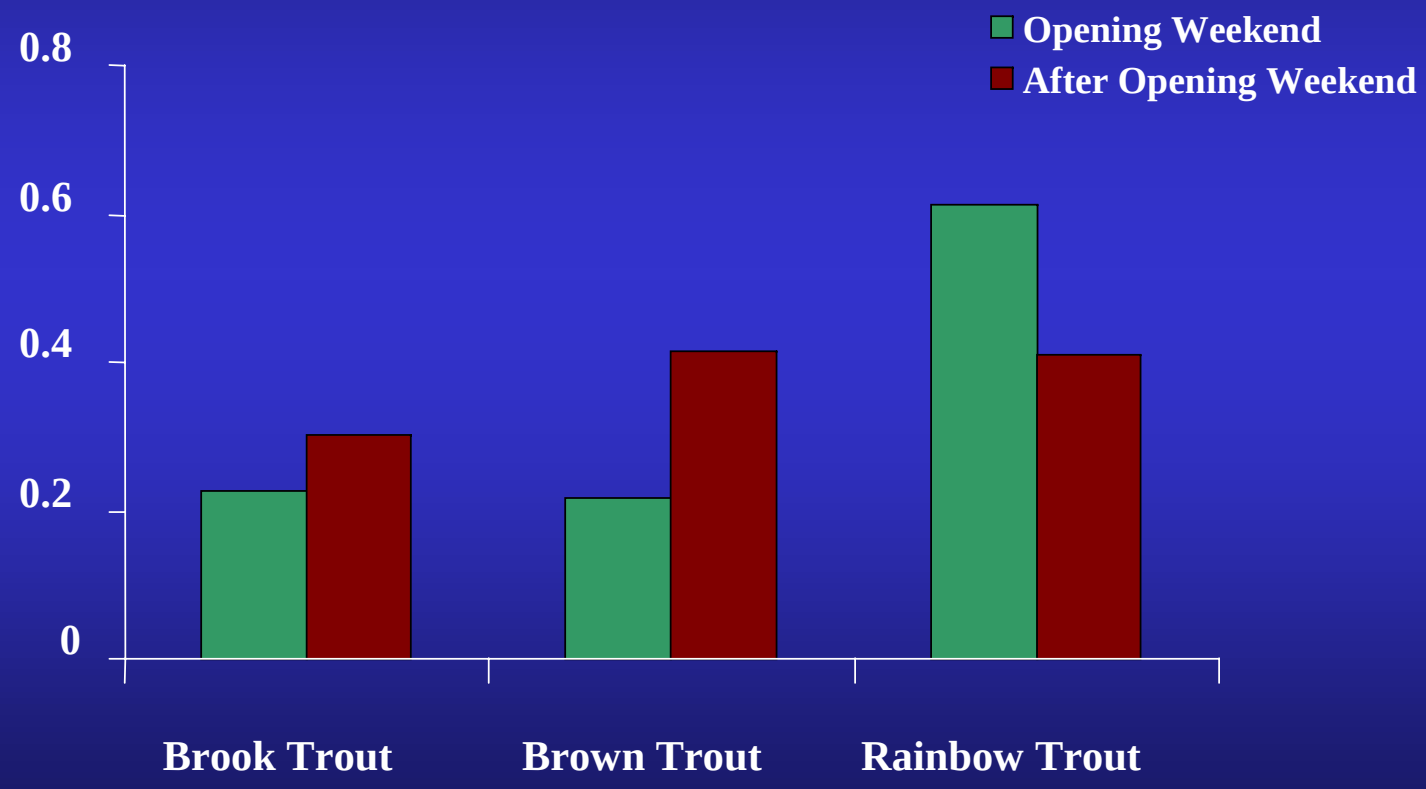


Figure 5. Angler Catch/Mile and Angler Harvest/Mile by Survey Period

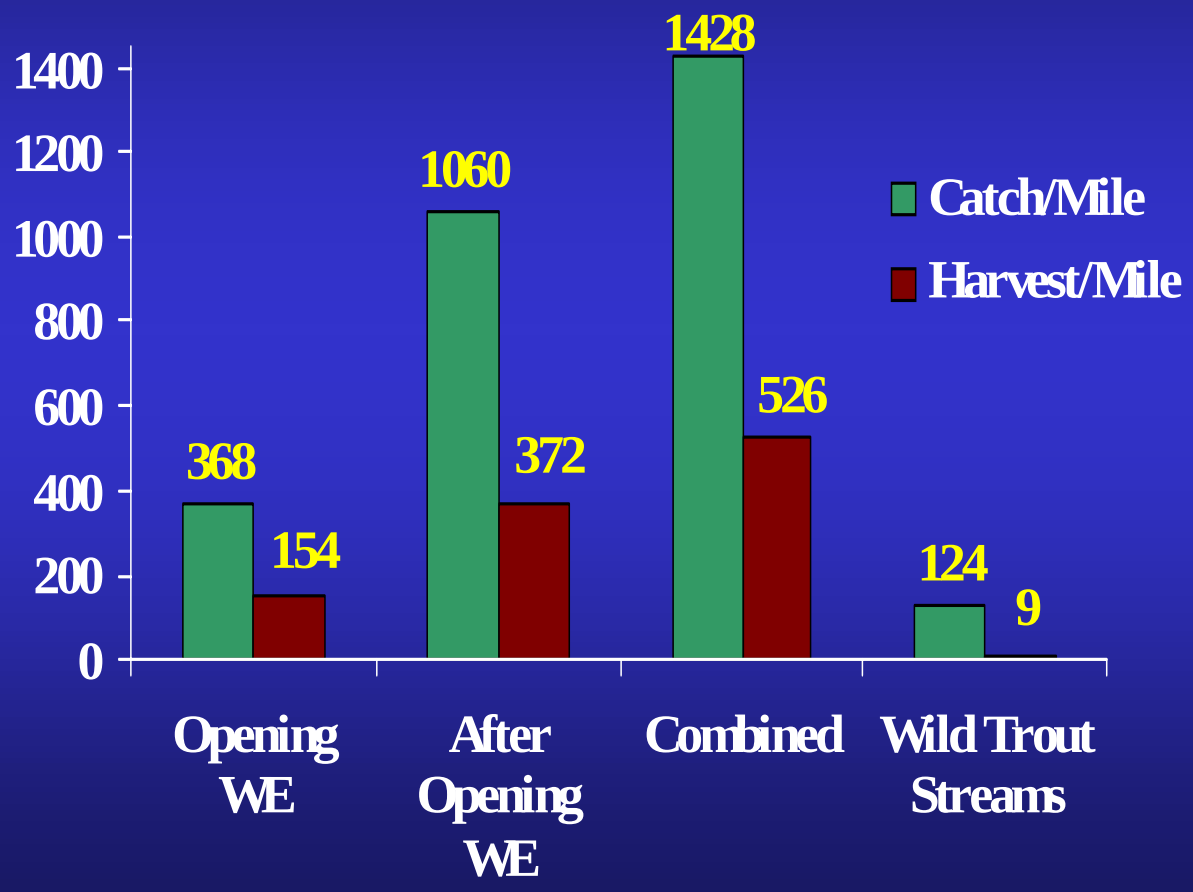


Figure 6. Angler harvest per mile by species

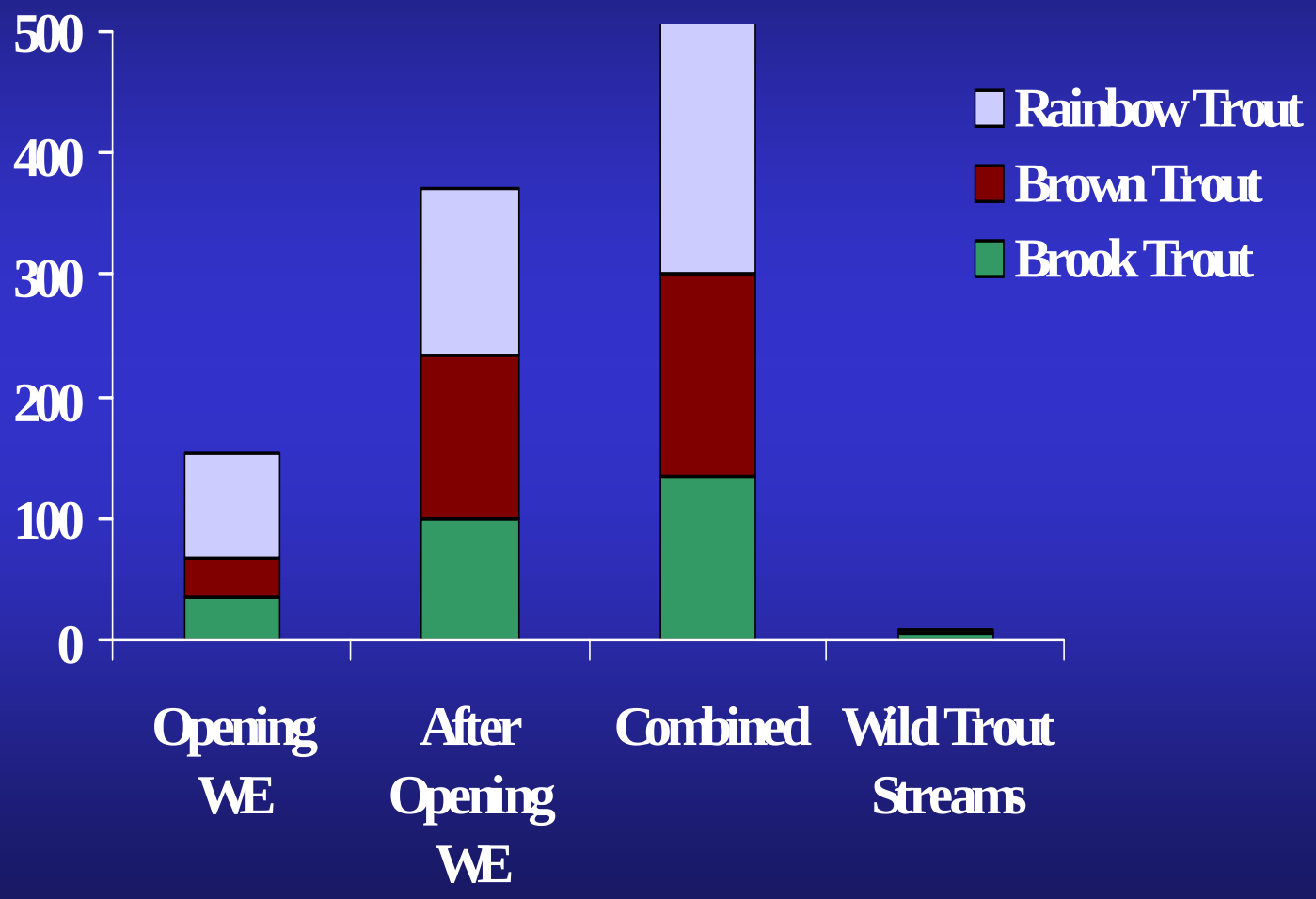
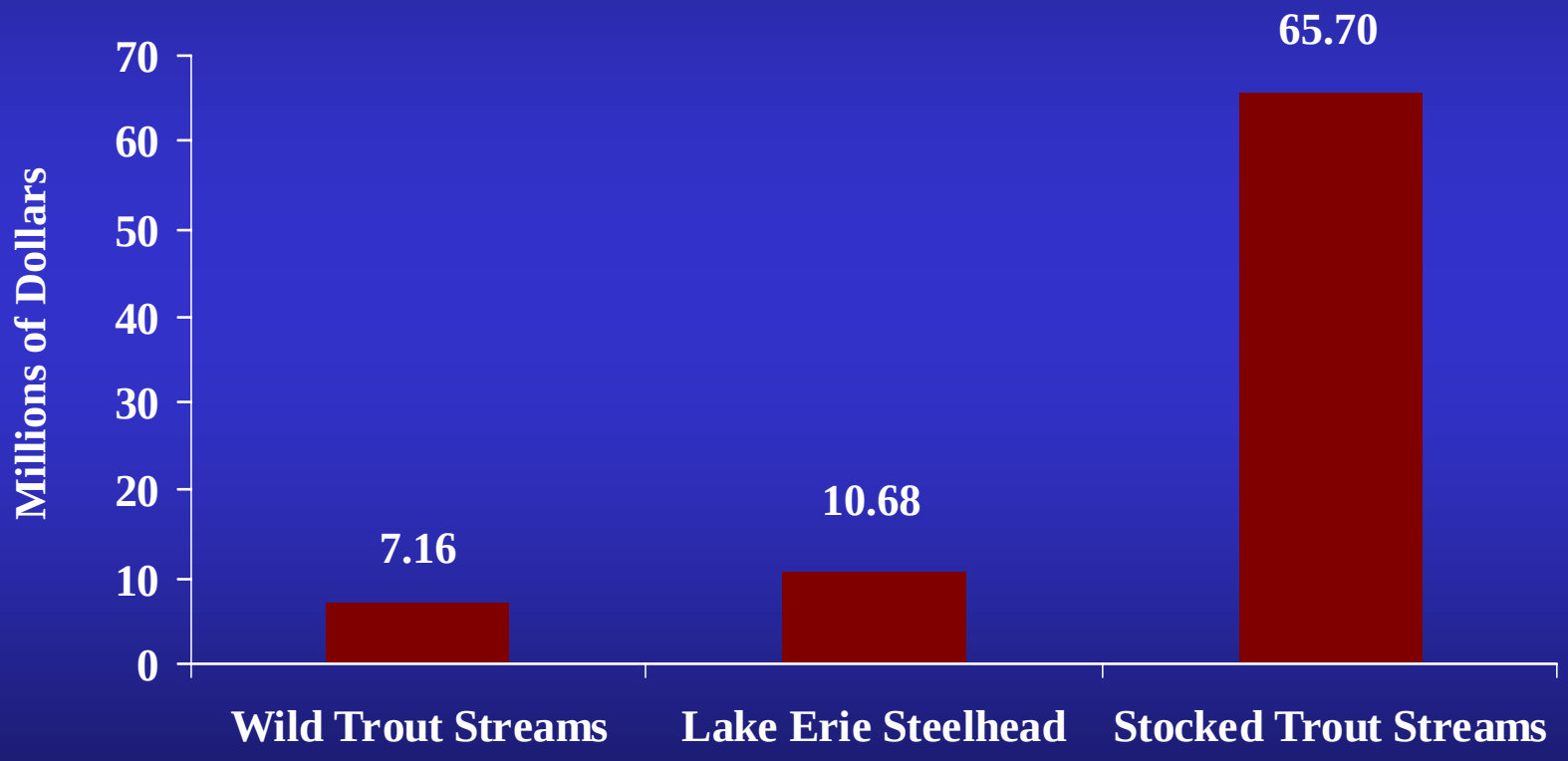


Figure 7. Comparison of Economic Contribution from Wild Trout Waters in 2004, Lake Erie Tributaries from Fall 2003 and Spring 2004 and Stocked Trout Streams from 2005.



Appendix 1. List of stream sections surveyed for 2005 Angler Use & Harvest assessment on Stocked Trout Streams in Pennsylvania

Water	WtrLat/Lon	Sec Num	Subbasin	Sub Subbasin	County	Sec Miles	Sec Acres	Width (m)	% Public	% Private Open	% Closed	In Stkg Announced	Regulations
BLACK MOSHANNON CK	410211780329	3	8	D	CENTRE	1.30	3.84	7.4	100	0	0	Y	DH
BLUE EYE RN	414854792517	2	16	B	WARREN	6.31	12.28	4.88	70	30	0	Y	SR
BUSHKILL CK	410533745933	6	1	D	MONROE-PIKE	3.41	18.4	13.54	100	0	0	Y	SR
CHARTIERS CK LTL	401641800817	2	20	F	WASHINGTON	3.35	15.81	11.86	0	100	0	Y	SR
CLARION R E BR	412935784050	3	17	A	ELK	4.78	40.63	21.34	26	70	4	Y	SR
COVE CK	394742780548	2	13	B	FULTON	6.94	19.36	7	0	100	0	Y	SR
DYBERRY CK W BR	413938751715	2	1	B	WAYNE	8.49	28.01	9.04	97	3	0	Y	SR
GREEN SPRING CK	401036772724	3	7	B	CUMBERLAND	0.99	2.09	5.3	0	100	0	No Inseason	SR
HOKENDAUQUA CK	404037752925	2	2	C	NORTHAMPTON	8.00	20.58	6.46	0	99	1	Y	SR
JONES CK	412322752555	2	1	C	WAYNE	1.49	3.9	6.6	0	100	0	Y	SR
JORDAN CK	403603752742	6	2	C	LEHIGH	5.52	32.97	15	81	19	0	Y	SR
KETTLE CK	411802775020	3	9	B	POTTER	2.98	14.67	12.38	56	44	0	Y	SR
LIZARD CK	404743753954	4	2	B	CARBON	7.07	33.37	11.85	0	96	4	Y	SR
MEDIX RN	411705782353	2	8	A	CLEARFIELD-ELK	2.11	6.13	7.3	100	0	0	Y	SR
MINGO CK	401252795739	2	19	C	WASHINGTON	3.60	9.39	6.55	100	0	0	Y	SR
OIL CK	412556794234	3	16	E	CRAWFORD	9.49	41.3	10.93	0	100	0	Y	SR
PINE CK S FK	405231792811	1	17	E	ARMSTRONG	9.92	32.93	8.33	0	100	0	Y	SR
POWELL CK	402437765905	3	6	C	DAUPHIN	7.79	17.36	7.2	0	100	0	Y	SR
POWERS RN	412845784024	2	17	A	ELK	2.73	6.09	5.6	76	24	0	Y	SR
RICHEY RN	411034794201	2	16	G	CLARION-VENANGO	2.36	5.41	5.75	0	100	0	No Inseason	SR
ROARING BK	412407754026	3	5	A	LACKAWANNA	1.98	6.8	8.6	0	100	0	Y	SR
SANDY CK LTL	412148795227	3	16	G	VENANGO	1.30	4.07	7.85	82	18	0	No Inseason	DH
SHENANGO R LTL	412421802335	2	20	A	MERCER	12.77	38.16	7.5	0	100	0	Y	SR
SINN CK BENNETT BR	412011780801	2	8	A	CLEARFIELD	4.34	16.52	9.55	0	100	0	Y	SR
SIXMILE RN	405635780723	3	8	D	CENTRE	3.41	10.87	8	93	7	0	Y	SR
STONY FK	413421772015	1	9	A	TIOGA	1.80	7.02	9.8	100	0	0	Y	SR
TREASTER RN	404235773141	2	12	A	MIFFLIN	3.97	8.3	5.25	100	0	0	No Inseason	SR
WEST CK	411106762330	2	5	C	COLUMBIA	4.40	14.47	8.26	0	100	0	No Inseason	SR
WYALUSING CK M BR	414725760414	2	4	D	SUSQUEHANNA	5.89	18.5	7.88	0	100	0	No Inseason	SR
WYSOX CK	414628762301	2	4	D	BRADFORD	7.57	25.39	8.43	0	100	0	Y	SR

Regulations/Program

DH - Delayed Harvest

SR - Statewide Regulations

Appendix 2. Angler Interview Form for 2005 Angler Use and Harvest Assessment on Stocked Trout Stream Sections.

2005 STOCKED TROUT ANGLER USE AND HARVEST SURVEY

Clerk: _____

Water Name _____ SSB _____ Section _____

Date: _____ (mo., day, yr.) Age Group _____ 1 = Adult 2 = Youth Angler Gender _____ 1 = Male 2 = Female

Start Fishing Time: (2400 Time)_____

Time of Interview: (2400 Time)_____ Zip Code:_____

County or State (If not in PA) _____

Trip Complete _____ 1 = Yes; 2 = No

Terminal tackle used: Flies_____ Lures_____ Bait Type_____

Species Caught	Total # Harvested		Total #Released	
	/	/	/	/
	/	/	/	/
	/	/	/	/

Questions:

1. How many days will you be fishing during this trip? _____
2. Will you be staying away from home overnight? Yes_____ No _____
   - 2a. If yes, how many nights will you be staying? _____
   - 2b. Where will you be staying?
     - Motel/Hotel/B&B_____ Friends_____ Camping_____
     - Cottage/Camp/RV(owned)_____Cottage/Camp/RV(rented)_____
     - Other_____
   - 2c. What is the total cost of the lodging? _____
3. How much will you spend on travel this trip? _____ Amount at home_____
4. How much will you spend on food and drink this trip?_____Amount at home_____
5. How much will you spend on gear and bait this trip? _____Amount at home_____
6. What would you have done if you could not fish for trout today?
   Fish for something else _____ Other _____
7. How many time a year do you go trout fishing in Pennsylvania? _____
8. How many anglers rode in your vehicle today? _____
9. The commission approved stocking larger trout in 2007 averaging 30% more in weight and 11 inches in length. However, there will be 20% fewer trout in number and the goal would be to raise 3.2 million trout, down from 4 million trout. What is your opinion of this?
   _____Agree _____Disagree

Brief comments: _____