US Army Corps of Engineers
Walla Walla District

SPORT FISHERY USE AND VALUE ON THE UNIMPOUNDED SNAKE RIVER ABOVE LEWISTON, IDAHO

PHASE II REPORT : PART 1
RESERVOIR SPORT FISHERY DURING 1997

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EXECUTIVE SUMMARY

A creel survey of the sport fishery in the 48 km (30 mile) unimpounded reach of the Snake River immediately upstream of Asotin, Washington, was initiated in September 1997, and continued through March 1998 as part of the *Lower Snake River Feasibility Study*. The survey was designed to provide data that could be used to estimate potential angling use of the 220 km (137 mile) impounded section of the lower Snake River if restoration to natural river level was the selected alternative. Use of these data, along with data from a companion survey, also permitted estimation of the monetary worth of the sport fishery in the restored river section.

Survey methods were similar to those utilized in the reservoir sport fishing analysis (Phase I study). A combination of aerial flights and in-person ground interviews at several access points along the river was used to estimate angler effort, catch and harvest, catch and harvest rates, and various angler attributes. Aerial and ground survey methods worked well, and the results were improved by follow-up phone calls to many anglers interviewed while fishing to obtain a larger sample of completed trips. Interviewed anglers were also asked to participate in a follow-up economic survey to estimate the monetary worth of the sport fishery in that reach.

Angler distribution was fairly uniform along the study reach in September and March, but was more clustered relative to the locations preferred by shore and boat anglers during the peak months of use. Boat anglers were aggregated near the town of Asotin and, especially, from the vicinity of Heller Bar upstream to the Oregon border. Shore anglers predominated along the 10 km section of river downstream of Heller Bar. The spatial distribution of anglers along the study reach reflected the species pursued, the mode of fishing, access, preferred type of water for a particular fishing method, and upstream progress of the steelhead run. During September, when many anglers sought residence species, angling pressure was diffuse throughout the reach, and many access points were used. During the peak steelhead angling months of October and November, anglers were distributed where there was good access for larger boats (near Asotin or Heller Bar), or where steelhead tended to aggregate (vicinity of Heller Bar). Despite known steelhead aggregations, some anglers (*e.g.*, fly fishers) elected to seek more isolated locations to fish.

A total of 16,120 angler trips produced an estimated 88,940 hours of fishing effort on the river upstream of Asotin. Monthly effort during the period peaked during November (39,909 hours) and declined substantially after December, to the least effort in March (620 hours). Boat angler use formed 83.5% (74,281 hours) of total effort. Boat angler use peaked in November, whereas shore angler use was highest in October.

Anglers caught an estimated 20,592 fish, and kept 12,026 (58.4%) of those caught. The highest catch occurred in November, and the lowest was in March. October (4,372 fish) and November (4,322 fish) represented the peak harvest months. Boat anglers caught and harvested about nine times more fish than shore anglers. Steelhead comprised 68.5% of the total catch and 74.3% of the harvest, and were the predominant sport fish taken from October through February. Boat anglers accounted for about 90% of the catch and harvest.

The principal resident sport fishes sought in this reach were smallmouth bass, northern pikeminnow, and white sturgeon. Most anglers pursued these species in September or March, reflecting the fact that these species are more typically sought during the spring and summer months. Much of the angling for northern pikeminnow was likely in response to bounties paid for harvested, large pikeminnow, as part of the "Sport Reward Program" funded by Bonneville Power Administration. The principal resident species caught were northern pikeminnow and smallmouth bass. Anglers caught an estimated 3,320 northern pikeminnow and kept 2,527, mostly in September and October. Anglers caught 1,537 smallmouth bass and harvested 477. Most of the catch and harvest occurred in September, largely the result of boat angling. Other species occasionally caught included suckers, channel catfish, peamouth, chiselmouth, white sturgeon, mountain whitefish, and bull trout.

The catch and harvest rates for the overall sport fishery during September through March averaged 0.225 and 0.126 fish/hour, respectively. Boat anglers were twice as successful as shore anglers. Monthly catch and harvest rates were highest in September and lowest during the winter.

Angling for steelhead was the preference expressed by 93% of the anglers interviewed. The remaining anglers targeted mostly smallmouth bass, northern pikeminnow, or white sturgeon. Boat anglers sought mostly resident fish species in September, and steelhead thereafter.

The overall directed catch and harvest rates for those anglers specifically seeking steelhead were 0.153 and 0.093 fish/hour. Directed catch rates were highest in October (0.170 fish/hour) and November (0.173 fish/hour). While catch rate for boat anglers were also highest in these months (0.199 and 0.196 fish/hour, respectively), the catch rate for shore-based steelhead anglers was highest in September (0.188 fish/hour). Steelhead catch and harvest rates for guided boat anglers were up to three times higher than for unguided boats throughout the peak months of the season. The directed catch and harvest rates for smallmouth bass (1.047 and 0.321 fish/hour) and northern pikeminnow (1.861 and 1.763 fish/hour) exceeded those for any other resident species. The highest directed catch and harvest rates for smallmouth bass occurred in September, while those for northern pikeminnow were highest in October.

Anglers from 18 states and Canada fished the Snake River during the 1997-1998 steelhead season. Most of the out-of-region anglers were from Montana or California. However, the 48 km reach of the Snake River above Asotin was visited primarily by local anglers (Lewiston, Clarkston, Asotin) and anglers from the population centers

north of the area (*i.e.*, Spokane, Coeur d'Alene, and Moscow-Pullman). About 8% of those interviewed resided in Washington metropolitan areas west of the Cascades. Anglers from the northern population centers and cities west of the Cascades outnumbered local anglers in the peak angling months of October and November.

More than 50% of overall angler use resulted from day trips. However, during October, one of the peak months, 71% of the anglers stayed in facilities (paid or otherwise) or camped along or near the Snake River. Camping use was highest in September and October during the best weather. Use of motels was highest in October and November when the fishing success was also the highest.

Most steelhead angling was by boat anglers who fished from private craft, but more than 26% of all boat anglers used guide services. About equal use of bait, lures, or a combination of both was reported by steelhead anglers, but lure use was more prevalent early in the fishing season, whereas bait use predominated in later months. Fly rod anglers were most common in October. Most steelhead anglers fished with either a Washington license (49.6%), or also possessed an Idaho fishing license (21.6%).

The fall-winter sport fishery of the 48-km reach of Snake River upstream of Asotin was clearly dominated by anglers pursuing steelhead. During October through February, virtually all anglers sought steelhead, although some monthly variability in the distribution of effort was found between shore and boat anglers and among species sought. Growth of the steelhead fishery in the mid-Snake River has continued since initial effort estimates were made by Washington Department of Fish and Wildlife in 1984-85 to 1986-87, despite variable, often lower, hatchery output and adult returns in recent years. Our estimates of use suggest growth in angler effort may have leveled off, and could represent saturation of this stream reach in terms of the ability to support more steelhead angling.

The highest catch rates for this fishery occurred in October and November, coincident with the beginning of sustained, reduced flow volumes released from Hells Canyon Dam. Consistent flows enabled anglers, especially those in guided boats, to more efficiently locate concentrations of steelhead. Steelhead catch rates during the peak months of October and November in the free-flowing section (0.172 fish/hour) were about four times those observed in each of the lower Snake River reservoirs (range 0.030 in Little Goose reservoir to 0.048 fish/hour in Lower Monumental reservoir).

We consider our survey results to be precise with narrow confidence intervals. We believe the survey estimates to be conservative because of the count adjustments required for data expansion. Although the survey accurately portrays the scope and characteristics of the steelhead fishery in this reach, sport fishing for resident species remains largely unassessed during those spring and summer months when resident species are mostly pursued.

We compared the steelhead sport fisheries between the reservoirs and the free-flowing reach. Angler use estimates for September through November 1997 for the reservoir system, which largely reflected effort targeting steelhead, were compared to effort in the 48-km reach upstream of Asotin. Although usage was comparable when standardized by reach length (1,578 versus 1,473 hours/km), use per hectare was about 2.8 times higher in the free-flowing reach (68.4 versus 24.7 hours/ha). Steelhead catch and harvest rates were three to four times higher in the unimpounded reach. Greater steelhead density and use of guides may explain the higher success rates upstream of Asotin.

More anglers from a wider geographic area utilized the unimpounded reach. During the peak use period, more than 70% of anglers were non-local. Other differences included greater use of "traditional" techniques or methods such as fly rods, and a lack of night fishing in the flowing water reach.

To make our predictions of angling use in a restored Snake River, we made two assumptions. Our initial assumption was that run sizes would remain similar, although the proportion of wild fish may change. Secondly, we assumed that access to the restored river would eventually be available in a pattern similar to current availability. We then examined trends in steelhead angling growth on the unimpounded Snake River, and made our predictions of future use on the restored river based on the assumption that current use in the flowing water section has reached saturation.

We predict that usage for September through November on a restored lower Snake River will eventually approach 324,060 hours, and may attain 407,600 hours over a full steelhead angling season of September to March. The estimated monetary worth of steelhead angling on a restored lower Snake River is $1.87 million. Initially, several factors will depress angling use in the normative river. Reduced access, unstable banks, and turbid flows will likely persist for several years, and deter angler use. Once these conditions abate and anglers become familiar with fishing conditions in the restored river channel, steelhead angling may increase to the intensity now experienced in the reach upstream of Asotin.

A greater diversity of anglers and angling opportunities will develop in a restored lower Snake River. Fly fishermen and guide services will take advantage of the riverine fishing conditions. Such opportunities will be attractive to anglers 3 or 4 hours away, in urban areas such as Portland and Seattle-Tacoma. Anglers on a restored river should also experience higher catch and harvest rates than at present on the reservoirs. However, the ease of access that characterizes current reservoir steelhead angling will be lost.

EXECUTIVE SUMMARY

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers (Corps) initiated the Lower Snake River Juvenile Salmon Migration Feasibility Study (Feasibility Study) in response to a Biological Opinion issued by the National Marine Fisheries Service (NMFS) in 1995 that addressed hydrosystem measures needed for the future survival of listed Snake River salmon stocks. The Feasibility Study is investigating three courses of action to improve juvenile salmon migration in the lower Snake River following recommendations made by the Corps in an Interim Status Report issued in 1996. One of the three options under investigation is permanent drawdown to natural river level. This option would restore a more natural river hydrograph (termed a "normative river") (Independent Scientific Group, 1996) since upstream regulation will continue), and allow the pre-impoundment topography and riparian plant and animal communities to reestablish.

Restoration of the lower Snake River to natural river level would also affect the extensive recreation infrastructure developed by the Corps to provide access to the river following complete impoundment of the lower Snake River system in 1975 (Figure 1-1). The natural river alternative would also affect the reservoir fish communities and fisheries management programs that developed during nearly four decades as a lentic environment. Pronounced changes in access to the Snake River and sizes and types of fish communities available to recreational anglers as a result of a return to a lotic environment will likely impact the amount and type of sport fishing pursued. The Corps also included consideration of values in addition to regional resources in the Feasibility Study. As a result, a Sport Fishery Use and Value Study was implemented to obtain current estimates of sport fishing activity and worth on the lower Snake River, and estimate the amount and economic value of sport fishing expected to occur following the return to natural river levels.

The Sport Fishery Use and Value Study consists of two phases. The objectives of Phase I were to estimate reservoir fishery use in angler days or angler hours and determine the monetary value of the existing reservoir recreational fishery. These data are reported in Parts 1 and 2 of the Phase I Report herein. The Phase II objectives were to determine recreational steelhead/salmon angling use and monetary worth in a regional stream section similar in character to an unimpounded lower Snake River, and, based on the data collected in this "surrogate" stream reach, estimate the amount of use and monetary value that would occur if the lower Snake River were returned to a riverine environment.

This report addresses all the objectives of the Phase II studies, and consists of two parts. Part 1 includes the entire Phase II sport fishing investigation, estimates of the amount of sport fishing effort that might occur in the lower Snake River upon return to natural river level, and the estimated worth of the fishery that would develop. Part 2 contains the detailed economic report, including the current worth of the sport fishery in the "surrogate" reach. A list of common and scientific names of fish discussed herein is shown in Table 1-1.

Table 1-1
Common and Scientific Names of Fishes Used in This Report

Common Name	Scientific Name
White sturgeon	*Acipenser transmontanus*
Chinook salmon	*Oncorhynchus tshawytscha*
Steelhead, rainbow trout	*Oncorhynchus mykiss*
Mountain whitefish	*Prosopium williamsoni*
Bull trout	*Salvelinus confluentus*
Chiselmouth	*Acrocheilus alutaceus*
Common carp	*Cyprinus carpio*
Peamouth	*Mylocheilus caurinus*
Northern pikeminnow*	*Ptychocheilus oregonensis*
Bridgelip sucker	*Catostomus columbianus*
Largescale sucker	*Catostomus marcrocheilus*
Brown bullhead	*Ameiurus nebulosus*
Channel catfish	*Ictalurus punctatus*
Pumpkinseed	*Lepomis gibbosus*
Bluegill	*Lepomis macrochirus*
Smallmouth bass	*Micropterus dolomieui*
Largemouth bass	*Micropterus salmoides*
White crappie	*Pomoxis annularis*
Black crappie	*Pomoxis nigromaculatus*
Yellow perch	*Perca flavescens*

*Formerly northern squawfish

1.1 Previous Investigations

Quantitative estimates of angler use in any reach of the Snake River in Washington prior to impoundment are lacking (Mark Schuck, Washington Department of Fish and Wildlife, personal communication). The Washington Department of Fish and Wildlife began surveying steelhead anglers on a portion of the lower Snake River during the 1982-83 season (Mendel and Aufforth 1985). Subsequently, a more comprehensive creel survey effort was designed and conducted on nearly the full length of the Snake River in Washington beginning in the fall 1984 (Figure 1-1). The surveys continued for three seasons (September through March) and were designed to estimate effort, harvest, and catch and harvest rates for steelhead anglers on the Snake River for two reaches: 1) from the mouth below Ice Harbor Dam upstream to Lewiston/Clarkston at Red Wolf Bridge (lower Snake River), and 2) from Red Wolf Bridge upstream to Lime Point, just above the confluence with the Grande Ronde River (termed the mid-Snake River). Creel clerks also measured and examined fish for tags and fin clips to determine origin (hatchery or wild). The survey reach for the Phase II studies formed a portion of the so-designated "mid-Snake River," and data from each of the three seasons surveyed by Washington (1984-85, 1985-86, and 1986-87) were extracted from the annual reports and recombined to enable a reasonable comparison of effort for a comparable stream reach.

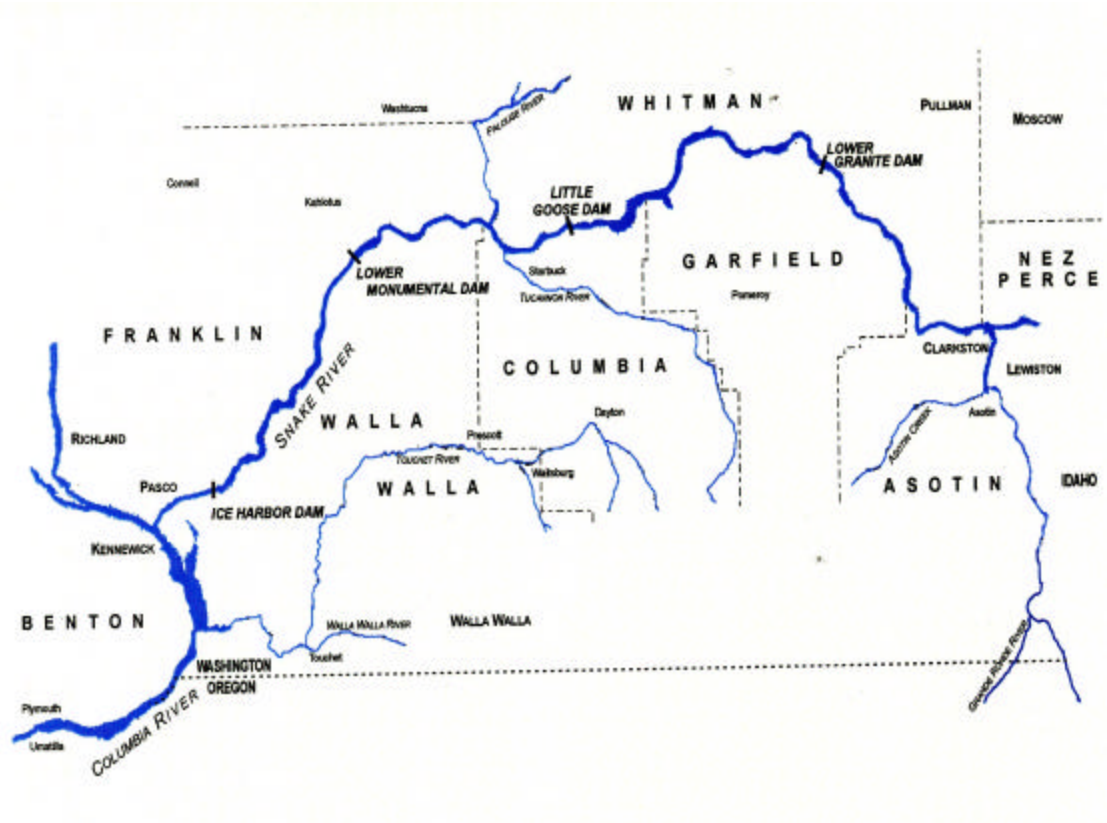

Figure 1-1. Location map of hydro dams and reservoirs on the lower Snake River and the mid-Snake River upstream of Asotin, Washington

Following these three surveys, the Washington Department of Fish and Wildlife continued to annually contact steelhead anglers at various sites of angler concentration along the reservoirs and the mid-Snake River. Catch and harvest data were recorded, but the principal focus of their efforts was to check landed steelhead for coded wire tags. Similarly, Idaho Fish and Game personnel sampled steelhead anglers during fall near the peak of the run in uppermost Lower Granite Reservoir and the mid-Snake River to collect catch and angler data in a cooperative effort with the Washington Department of Fish and Wildlife. The annual surveys provided catch rates to evaluate run size for among-year comparisons, but were not designed to quantitatively estimate angler effort.

2.0 METHODS

2.1 Study Area

The Phase II field investigations were conducted from Chief Looking Glass Park in Asotin, WA upstream to the Oregon border (Figure 2-1). Chief Looking Glass Park was defined as the upstream limit of impounded water during Phase I studies. The Oregon border was deemed an appropriate upriver limit for the Phase II study by both Washington and Idaho fisheries agencies because this free flowing portion of the mid-Snake River had a relatively open river valley and similar length of shoreline access available. The length of this reach is approximately 30 miles (48 km). A major tributary to this reach is the Grande Ronde River, which originates in Oregon and joins the Snake River about 24 miles upriver from Asotin, WA.

Figure 2-1. Principal access sites along the 48-km unimpounded section of the Snake River upstream of Asotin, Washington

The Snake River above Asotin is paralleled along the Washington shoreline by Asotin County Road 209 (Snake River Road) to the confluence with the Grande Ronde River (Figure 2-1). Shore anglers may access the river from the road throughout the reach, whereas boat anglers principally utilized a developed launch at Hellers Bar, just below the Grande Ronde River confluence. Boat anglers also accessed this reach from developed launch sites in Lewiston (Hells Gate), Clarkston (Swallows Nest), and Asotin

(Chief Looking Glass Park) or from one of four informal, undeveloped launch sites along the parallel road (see Appendix Table A-1 for descriptions). Thus, the study design included four developed boat launches, each sampled as an individual site, as well as all the undeveloped shore and boat access areas along the entire parallel road that were treated as a single access site. Thus, the "road access" site sampled all shore and boat anglers encountered along the Snake River Road paralleling the river.

Throughout this report, the Snake River from Asotin to the Oregon-Washington border is referred to as the "surrogate" reach, the flowing water reach, or the unimpounded reach, depending upon context. The lower Snake River after dam breaching is termed the "normative river" (a reference to continued upstream regulation), or the restored reach.

The complemented aerial-access point survey design developed to allow thorough coverage of the reservoir sport fisheries in Phase I was extended to this upriver reach beginning in early September 1997. Aerial angler counts were used to determine effort, while ground interviews obtained catch and angler characteristics. The present survey was designed to estimate total angling effort and catch attributes for this flowing water section of the Snake River, and achieve a precision level of 20-25 % for the estimates of angler use.

2.2 Aerial Surveys

Aerial angler counts were conducted from fixed-wing aircraft flown out of Pullman, WA. Flight direction was randomized between upstream and downstream direction, and between morning and afternoon strata. During September through November, the river upstream of Asotin was surveyed either prior to or at the conclusion of reservoir count flights. When regular flights over the reservoirs ended November 30, the direction of flights over the flowing water reach during December through March was randomized to either begin or end at Asotin. The time of counting flights varied according to day length, but was scheduled to occur during expected maximum use during a morning or afternoon period, based on Knox (1982) and the most recent week’s ground survey data.

The number of flights within each month, and within weekday or weekend/holiday strata and morning or afternoon strata is shown in Table 2-1. Friday through Sunday were considered weekend days, while Monday through Thursday comprised the weekday strata (Knox 1982). Major holidays (*e.g.*, Thanksgiving, Christmas) were considered weekend days. The distribution of flights between weekend and weekday strata was similar to Phase I, and also based on reported angler distribution in 1979 and 1980 on Snake River reservoirs when weekend anglers were about 2.5 times more numerous than weekday anglers (Knox, 1982). Flights cancelled due to bad weather were rescheduled as soon as possible. Flights were made during routine wind and rain conditions to avoid potential bias of flying only during good weather (Pollock *et al.*, 1994).

Shore and boat anglers were enumerated from about 500 ft above the water. Several passes were made over areas of angler concentration to assure an accurate count, and to separate fishing boats from those engaged in other types of recreation. As the weather cooled during October and November and boat anglers sought shelter, fishing boats were identified and enumerated, as most anglers in a boat were hidden from view. Subsequently, for the entire survey through March, ground survey data were utilized to determine a mean number of anglers per boat, and applied to the number of boats counted to determine the number of boat anglers for a given aerial count.

Table 2-1
Distribution of Aerial Flights Among Monthly and Morning/Afternoon Strata During Phase II Sport Fishing Survey

Month	Weekend/ Holiday AM	Weekend/ Holiday PM	Weekday AM	Weekday PM	Total
September	3	4	2	1	10
October	4	4	2	2	12
November	4	4	2	3	13
December	3	3	2	2	10
January	4	2	2	3	11
February	3	4	2	2	11
March	4	4	2	2	12
Total	**25**	**25**	**14**	**15**	**79**

2.3 Ground Surveys

Ground surveys were conducted based on stratified cluster sampling (Scheaffer *et al.*, 1996). Clusters were half-day periods of 5-6 h depending on day length, separated at 1200 h prevailing time. Ground surveys were scheduled each week for both morning and afternoon clusters on two weekdays and each weekend day/holiday. The individual access points included in the survey design are listed in Appendix Table A-1, and shown in Figure 2-1.

An interview period during a cluster was 3-4 h. During that period, the clerk interviewed departing anglers to record information on time spent fishing, residence (zip code), fishing method, visitor status (day trip by local resident, camper, etc.), days away from home, species sought, and harvest data, including fish released. Emphasis during

ground surveys was on completed trip anglers, but anglers fishing at the conclusion of an interview period were also queried to increase sample size for residence and catch information. Creeled fish were counted and measured (total length for all species except steelhead, which were measured fork length).

Some additional information about steelhead fishing was sought at the request of Washington and Idaho state biologists. Such data are typically obtained by the biologists investigating Snake River steelhead runs. Anglers were asked about their use of a guide, the state of license purchase, and their specific method of fishing (lure, bait, fly, or combination). Anglers were also asked about the sex and wild/hatchery status of both creeled and released fish.

Because angler distribution along the parallel road was diffuse, waiting for a few fishermen to complete their trip at a single access point was not an efficient use of time. As a result, the entire road was traversed during a single survey period, contacting as many anglers as possible. All the basic interview information was obtained (see above) and anglers were asked if they could be phoned at home later that evening or within one to two days to obtain completed trip catch and harvest data. Most anglers agreed to be contacted, thus greatly enhancing the number of completed trip interviews available, particularly for shore anglers.

2.4 Computational Methods

Monthly sport fishery use for the unimpounded Snake River was estimated from ground and aerial surveys. Estimates of angler effort were measured in angler trips and angler-hours, and were calculated based on creel survey methodology used during the Phase I lower Snake River reservoir creel survey (Normandeau Associates *et al.*, 1998). Methods of deriving angler characteristics and attributes were similar to those used by Knox (1982), although recent publications on creel survey techniques and analyses were also consulted (Robson and Jones 1989; Pollock *et al.*, 1994; Jones *et al.*, 1995; Lockwood, 1997; Pollock *et al.*, 1997).

2.4.1 Estimating Angler Effort

2.4.1.1 Estimating Total Angler Trips

Aerial counts provided excellent use data during the time periods of approximately 8-10 AM and 2-4 PM. Although historical data showed that these time periods reflected maximum angling pressure during the respective AM or PM fishing periods (Knox 1982), it could not be assumed that 100% of the anglers present were observed during the entire half-day period. To account for those hours during the half-day period in which anglers were not counted and obtain a more accurate estimate of effort, ratio estimators were used to adjust total angler trip estimates to represent the total number of anglers throughout the fishing days. The sightability of anglers also differed for each access point, and between boat and shore anglers (Pollock *et al.*, 1994). Ratio estimators were therefore derived for shore and boat anglers separately.

During the Phase I reservoirs study, boat anglers generally fished longer distances from their points of access, which made comparing aerial counts and ground observations futile since it was difficult to determine the access site of origin. In contrast, the relativity small sampling area in this reach of the free flowing Snake River, and the relatively few boat launches, allowed good agreement between ground and aerial counts for boat anglers. As a result, ratio estimators for boat and shore anglers were both calculated at those access sites attended by a creel clerk during an aerial survey as:

$$\hat{R} = \frac{\sum_{i=1}^{n} y_i / n}{\sum_{i=1}^{n} x_i / n} = \frac{\bar{y}}{\bar{x}}$$

where:

$\hat{R}$ = ratio estimator,

$\bar{y}$ = mean number of observations (anglers interviewed) from ground surveys,

$\bar{x}$ = mean number of observations (anglers) from aerial counts.

The variance of the ratio estimator was calculated for each reservoir as (Schaeffer *et al.*, 1996):

$$\hat{V}(\hat{R}) = \hat{V}\left(\frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i}\right) = \left(\frac{N-n}{nN}\right)\left(\frac{1}{\mu^2_x}\right) s_{\hat{R}}^2$$

where:

$$s_{\hat{R}}^2 = \sum_{y=i}^{n} \frac{\left(y_i - \hat{R}x_i\right)^2}{n-1}$$

where:

$\hat{V}(\hat{R})$ = variance of the ratio estimator,

$s_{\hat{R}}^2$ = variance of the angler count,

N = total number of half-days in strata per month,

n = number of half-days observed,

μx^2 = estimated by sample mean of x,

x_i = aerial count for half-day i

y_i = ground counts for half-day i.

Bounds of error (similar to 95% confidence interval) of estimation were calculated using the estimated variance:

$$\hat{R} \pm 2\sqrt{\hat{V}(\hat{R})}$$

Estimates of total angler trips in the unimpounded Snake River were determined separately for each stratum from weekday and weekend aerial counts. The estimated total number of anglers was calculated for shore anglers and boat anglers following Schaeffer *et al.* (1996):

$$\hat{T}_1 = (N_{1i}\bar{y}_{1i})\hat{R}$$

where:

$\hat{T}_1$ = estimated total number of angler (boat/shore) trips,

N_{1i} = total number of sampling units (half-days) in stratum i (weekday/weekday),

$\bar{y}_{1i}$ = mean number of observations (shore/boat anglers) in stratum i (weekday/weekday),

$\hat{R}$ = the corresponding ratio estimator.

The variance of the estimated total number of angler trips was calculated for each stratum following (Schaeffer *et al.*, 1996):

$$\hat{V}(\hat{T}) = \sum_{i}^{L} N_i (N_i - n_i) \left(\frac{s_{yli}^{\ 2}}{n_i} \right) \hat{R}^2$$

where:

$$s_{yli}^{\ 2} = \frac{\sum_{i=1}^{n} (y_{1i} - \bar{y}_1)^2}{n - 1}$$

where:

$\hat{V}(\hat{T}) =$ the estimated variance of total number of anglers for the reservoir,

s_{y1i}^2 = variance of the total number of anglers in stratum i,

N_i = total number of sampling units (half-days) in stratum i (weekday/weekend),

n_i = total number of units (half-days) sampled in stratum i,

y_{1i} = the number of anglers observed in the ith instantaneous aerial count,

$\bar{y}_1 =$ the mean of all instantaneous counts in the stratum,

$\hat{R} =$ the corresponding ratio estimator.

Once the estimated variance of total angler trips was calculated, the bounds of error of estimation (similar to 95% confidence interval) were calculated following Scheaffer *et al.* (1996):

$$\hat{T}_1 \pm 2\sqrt{\hat{V}(\hat{T}_1)}$$

Estimates of total angler trips for each month were combined to estimate total angler trips for the unimpounded Snake River from September 1997 through March 1998. The variance associated with each month was additive.

2.4.1.2 Estimating Total Angler Hours

Angler-hours or the sum of all hours fished by anglers were estimated for shore and boat anglers and then for all anglers. Estimates were made for each stratum and then combined to obtain a monthly estimate for the entire reach. It was found that for both weekday and weekend stratum, anglers interviewed during the PM stratum fished longer that those interviewed during the AM stratum. Therefore, the strata were treated separately before being combined in the final analysis.

Average trip length was determined exclusively from completed fishing trips of at least 0.5 h duration collected during access point surveys. The estimated mean angler trip length was calculated for each stratum as:

$$b = \frac{\sum_{i=1}^{k} (f_i b_i)}{n}$$

where:

b = average trip length,

b_i = trip length of party i,

f_i = number of anglers in party i,

k = number of parties interviewed,

n = total number of anglers interviewed.

The variance of the average angler trip length was calculated for each stratum as:

$$\hat{V}(b) = \left(\frac{1}{n-1}\right)\left[\sum_{i=1}^{k} f_i b_i - \frac{\left(\sum_{j=1}^{k} f_i b_i\right)^2}{n}\right]$$

where:

$\hat{V}(b) =$ estimated variance of angler trip length,

b_i = trip length of party i,

f_i = number of anglers in party i,

k = number of parties interviewed,

n = total number of anglers interviewed.

Bounds of error of estimation were calculated using the estimated variance as:

$$b \pm 2\sqrt{\hat{V}(b)}$$

Estimates of total angler hours were calculated by multiplying average trip length by the mean number of anglers observed from the aerial survey within respective strata as:

$$\hat{T}_2 = \left[\sum_{i=1}^{4} N_i(b_i \bar{y}_{1i})\right] R_i$$

where:

$\hat{T}_2 =$ the estimated total angler hours for the stratum,

N_i = total number of sampled periods for the ith stratum,

$\bar{y}_{1i} =$ the mean number of anglers in stratum i,

b_1 the average trip length for stratum i,

R_i = the ratio estimator for the ith reservoir.

The variance of the estimated total angler hours for each stratum was then calculated following Schaeffer *et al.* (1996):

$$\hat{V}(\hat{T}_2) = \left[\left(\frac{\sum_{i=1}^{L} N_i(N_i - n_i)}{n_i}\right)\left(\frac{s_{yli}^{\,2}}{n}\right)(b_i)^2\right] R_i^{\,2}$$

where:

$$s_{yli}^{\,2} = \frac{\sum_{i=1}^{n}(y_{1i} - \bar{y}_1)^2}{n-1}$$

where:

$\hat{V}(\hat{T}_2) =$ the estimated variance of total angler hours,

s_{y1i}^2 = variance of the number of anglers in stratum i,

N_i = the total number of half-days in the stratum (weekday/weekend),

n_i = the number of instantaneous counts in a random sample,

y_i = the number of anglers observed in the ith instantaneous aerial count,

$\bar{y}_1 =$ the mean of all instantaneous aerial counts in the stratum,

b_i = the average trip length for stratum i,

R_i = the ratio estimator for the reservoir.

Bounds on the error of estimation were calculated using the estimated variance:

$$\hat{T}_2 \pm 2\sqrt{\hat{V}(\hat{T}_2)}$$

Separate estimates of total hours were calculated for each month and then summed to estimate total hours expended by anglers in the unimpounded Snake River from September 1997 through March 1998. The variance associated with each month was additive.

2.4.2 Catch and Harvest Rates

Catch rates were calculated using creeled as well as released fish to quantify rates for anglers with a catch-and-release ethic, or those anglers subject to length slot limits or harvest constraints associated with specific fishes (*e.g.*, white sturgeon or steelhead). Only creeled fish were used to calculate harvest rates. Mean catch and harvest rates were compared between boat and shore anglers and among months in the unimpounded Snake River. Catch and harvest rates were calculated for all anglers as well as those targeting specific fishes (directed rates).

Catch rates and harvest rates were determined using a ratio-of-means estimator, which is recommended when using completed trip interviews (Jones *et al.*, 1995). The ratio-of-means estimator is calculated by dividing the total catch by the total effort of all the interviewed anglers within the stratum. This estimator is defined as:

$$\bar{x} = \frac{\sum_{i=1}^{n} (x_i)}{\sum_{i=1}^{n} (c_i)}$$

where:

$\bar{x}$ = mean catch rate or harvest rate for the stratum,

n = the number of party interviews in the stratum,

x_i = the catch or harvest of the ith party i=1,.....,n,

c_i = the total angler hours expended by the ith party.

The estimates of variance of the mean catch or harvest rate were calculated by using the single cluster sampling with replacement formula described by Jones *et al.* (1995):

$$\hat{V}(\bar{x}) = \frac{1}{N(\bar{x})^2} \left(\frac{\sum_{i=1}^{n} (x_i - \bar{x} c_i)^2}{n} \right)$$

where:

$\hat{V}(\bar{x})$ = estimated variance of the mean catch or harvest rate,

n = the number of party interviews in the stratum,

x_i = the catch or harvest rate for the ith party i=1,.....,n,

c_i = the total angler hours expended by the ith party,

N = number of anglers in the stratum or given day,

$\bar{x}$ = estimated mean catch or harvest rate for the stratum.

Using the variance of the means, the bounds on the error of estimation were calculated:

$$\bar{x} \pm 2\sqrt{\hat{V}(\bar{x})}$$

Monthly catch rates and harvest rates determined for anglers in the unimpounded Snake River combined to an overall estimate (September 1997-March 1998) of catch and harvest rates by:

$$\bar{x}_{st} = \left(\frac{1}{\sum_{i=1}^{L} n_i} \right) \sum_{i=1}^{n} n_i \bar{x}_i$$

where:

$\bar{x}_{st}$ = the estimated mean catch rate or harvest rate for the reservoir,

n_i = the number of parties interviewed in stratum i, i=1,.....,L,

$\bar{x}_i$ = the mean catch rate or harvest rate for stratum i.

The estimated variance of the catch or harvest rates was calculated by:

$$\hat{V}(\bar{x}_{st}) = \left(\frac{1}{\left(\sum_{i=1}^{n} n_i \right)^2} \right) \sum_{i=1}^{n} n_i^2 \hat{V}(\bar{x}_i)$$

where:

$\hat{V}(\bar{x}_{st})$ = the estimated variance of mean catch or harvest rate for the reservoir,

n_i = the number of parties interviewed in stratum i, i=1,.....,L,

$\hat{V}(\bar{x}_i)$ = the estimated variance of mean catch or harvest rate for stratum i.

Bounds on the error of estimation for the mean catch or harvest rates were calculated from variance estimates by:

$$\bar{x}_{st} \pm 2\sqrt{\hat{V}(\bar{x}_{st})}$$

2.4.3 Catch, Harvest, and Yield

The method of determining total catch and total harvest for individual species and for all species combined estimated effort determined from aerial surveys with catch rates determined from ground interviews, similar to those methods described by Pollock *et al.* (1994). Effort in angler hours was multiplied by the respective catch or harvest rate within a stratum to estimate the number of fish caught and/or kept. Stratum totals were summed to estimate catch and harvest for shore and boat anglers, and individual months.

The biomass of creeled fish was estimated from length measurements obtained during interviews by grouping fish into size classes and calculating weights from appropriate length-weight equations obtained from fish collections (Appendix Table A-2). Yield (kg/hectare; lb/acre) for individual species was estimated by dividing the total biomass of harvested fish by the river area. Biomass and yield of steelhead were not calculated. Rather, harvest of steelhead was expressed only as the number of fish per kilometer (km) or hectare (ha).

The area of the designated "surrogate" reach was computed by using scaled satellite photographs. River width was measured in systematic 1 km increments, averaged, and then multiplied by the reach length (48 km) to calculate river area. Estimated river area was 1,033.4 hectares (2,563.6 acres).

2.4.4 Angler Characteristics

Angler residence, visitor status, and species sought were assessed for all anglers interviewed (*i.e.*, both complete and incomplete trip data were used). The percentages of anglers interviewed seeking a particular species of fish were compared among months and between boat and shore anglers. Additionally, steelhead anglers were sorted by their fishing method (bait, lure, fly), use of a guide, and licensing state.

Residence profiles for anglers utilizing the unimpounded Snake River were calculated from individual angler zip codes. Many angling parties, particularly large groups (5 to 8 people), were typically comprised of anglers from several zip codes. To the extent possible, such individual zip codes within a party were recorded to more accurately portray the origin of the angling population.

Logical geographic regions were used to aggregate zip codes (Appendix Table A-3). Major regions of origin were identified by the region's dominant city or cities (*e.g.*, Yakima-Wenatchee represented all towns in Central Washington with zip codes beginning with 988 and 989) for graphical presentation.

3.0 RESULTS

3.1 Angler Effort

3.1.1 Seasonal Trends in Angler Distribution (Observed Data)

Angler distribution in the unimpounded Snake River changed from an even spatial distribution along the entire study reach in September to one of specific concentration in certain locations during October through February, and then returning to a more even spatial distribution in March. During September angling pressure was observed throughout the 48 km reach, and was evenly represented by shore and boat anglers (Figure 3.1-1). A noticeable increase in focused angling pressure began in October. Shore anglers predominated along the 10 km section of HW 209 below Heller Bar, whereas boat anglers predominated in the river section downstream from the Oregon/Washington border near the Grande Ronde River-Snake River confluence as well as in the lowermost river section nearest Asotin, Washington. By December, angling pressure in the mid-Snake River began to decline as a result of fewer boat anglers. Angling pressure continued to decline throughout the winter and remained low in the flowing water reach until the conclusion of the survey March 31, 1998. During these final months, the few anglers that were observed were evenly distributed throughout the study reach.

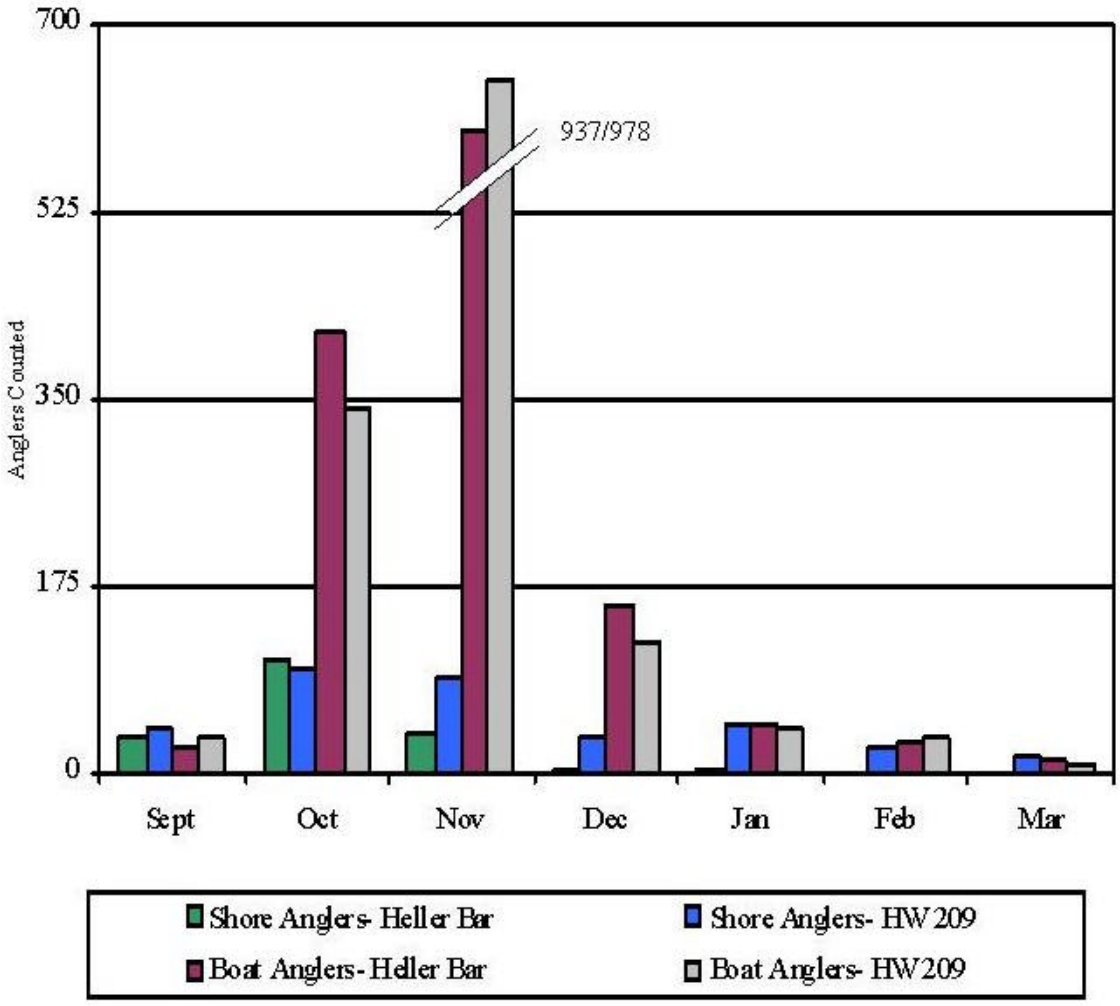

Figure 3.1-1. Monthly aerial counts of shore and boat anglers separated among access sites in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

3.1.2 Estimates of Angler Effort

From September 1997 through March 1998, a total of 16,120 angler trips accounting for 88,940 ±5,933 (±6.7%) angler hours were estimated for the 48 km section of the Snake River upstream from Asotin, Washington (Appendix Table B-1). Monthly estimates of angler effort portrayed a unimodal distribution of angler hours throughout the September-March sample period (Figure 3.1-2). Angler effort peaked at 39,309 angler hours (±3,384) in November whereas March received the least angler use (620 ±333 angler hours). The November proportion of angler use constituted 44% of total effort (Figure 3.1-3). The 95% confidence limits for monthly estimates of effort ranged from ±8.6% to ±25.7%, except in March when they were ±53.7%. Precision of the monthly

use estimates was highest in fall when daily effort was the most consistent.

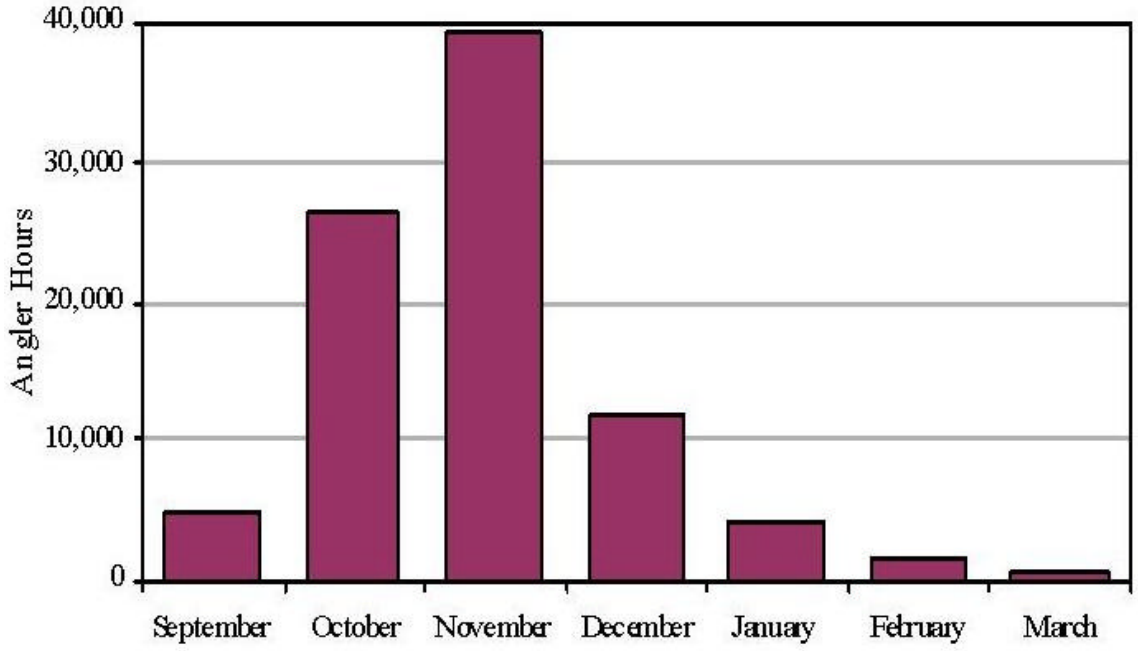

Figure 3.1-2. Estimated monthly angler hours on the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

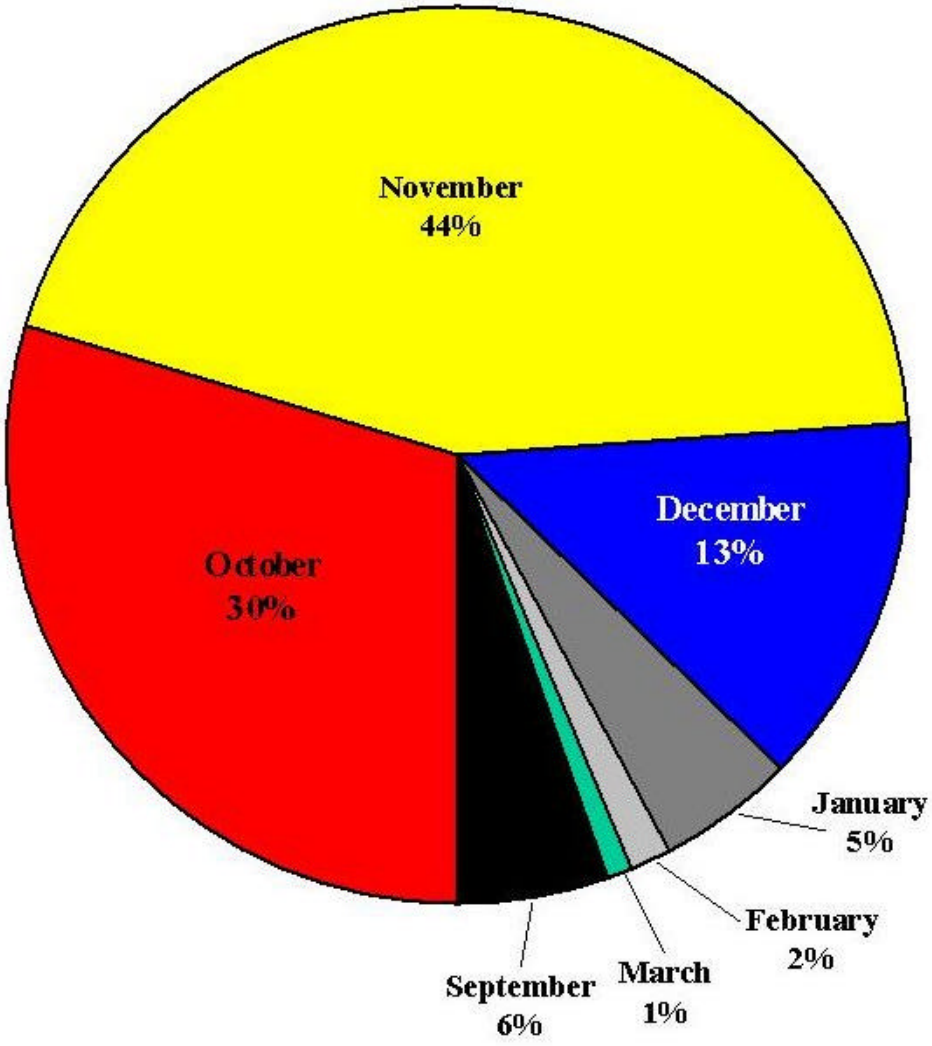

Figure 3.1-3. Monthly proportions of estimated total angler use (hours) for the unimpounded Snake River, September through March 1997-1998.

Overall, 14,658 shore angler hours and 74,281 boat angler hours were estimated for the unimpounded Snake River section (Appendix Table B-1). Boat angler use accounted for 83.5% of the 88,940 total angler hours estimated during September through March. Shore angler hours peaked in October (5,660 hours, 38.6% of the total), whereas boat angler hours peaked in November (35,948 hours, 48.4% of the total) (Figures 3.1-4 and 3.1-5). After January, both shore and boat angler use declined markedly. Confidence limits were consistently higher for shore anglers, ranging from ±27.2% to ±74.1%, than for boat anglers, which ranged from ±5.4% to ±24.5% (Appendix Table B-1).

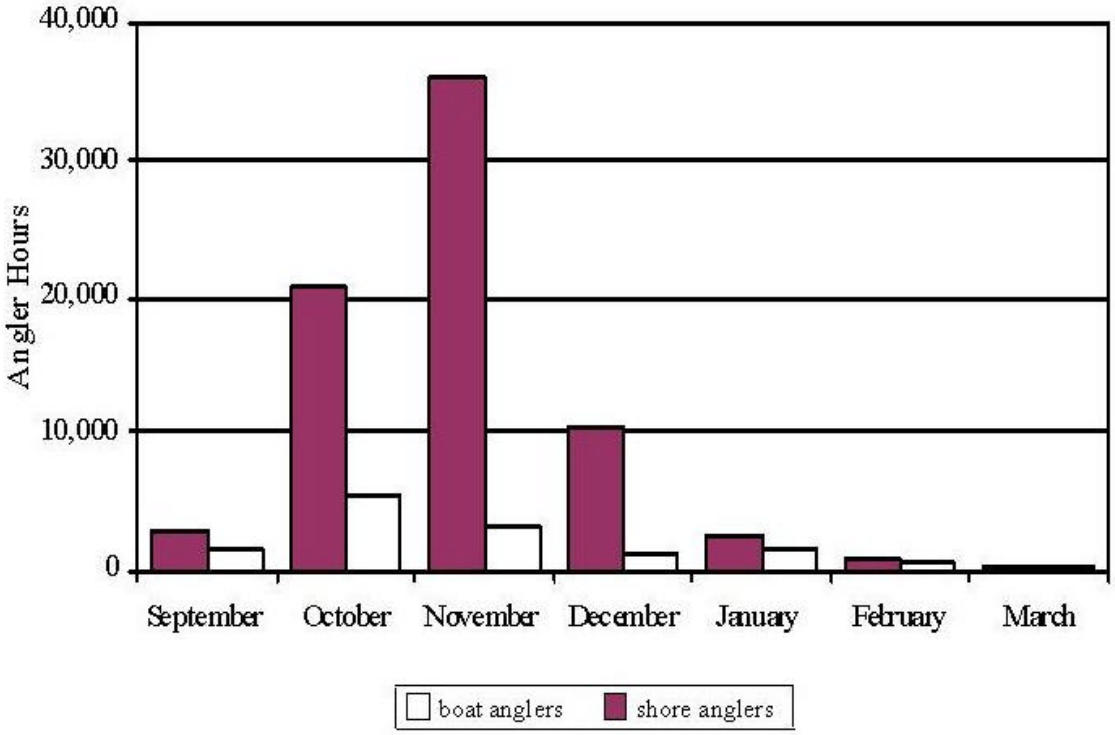

Figure 3.1-4. Estimated monthly boat and shore angler hours for the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

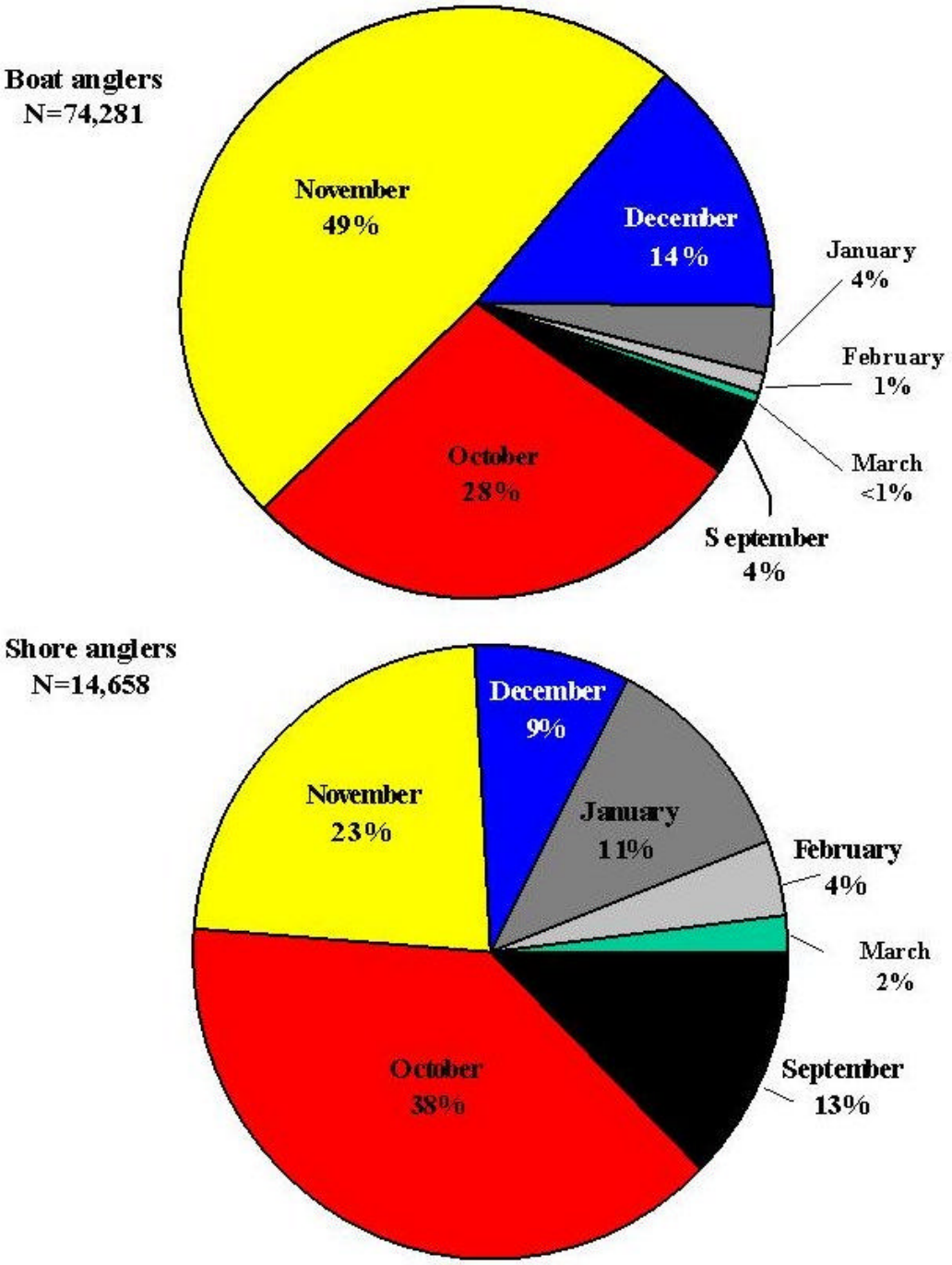

Figure 3.1-5. Monthly proportions of estimated total boat and shore angler use (hours) for the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

3.2 Catch and Harvest

3.2.1 Total Catch and Harvest

Anglers caught an estimated 20,592 fish in the unimpounded section of Snake River between Asotin, Washington, and the Oregon/Washington border, and harvested 58.4% (12,026) of those caught (Table 3.2-1). Total angler catch was highest in November (7,239 fish), whereas angler harvest was similar in magnitude in October (4,372) and November (4,322) (Appendix Table B-2; Figure 3.2-1). Angler catch and harvest (C/H) were both lowest in March (92/19 fish). Monthly harvest estimates for the unimpounded Snake River ranged from 21-67% of the catch. The proportion of fish harvested was highest during October-December (60-67%), and lowest in March (21%).

Table 3.2-1
Estimated Total Catch and Harvest by Boat, Shore, and All Anglers In The Unimpounded Snake River
From Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

	Angler Catch	95% CI (+/-)	Angler Harvest	95% CI (+/-)
Shore	2,111	360	1,008	165
Boat	18,481	1,345	11,018	780
Total	20,592	1,376	12,026	771

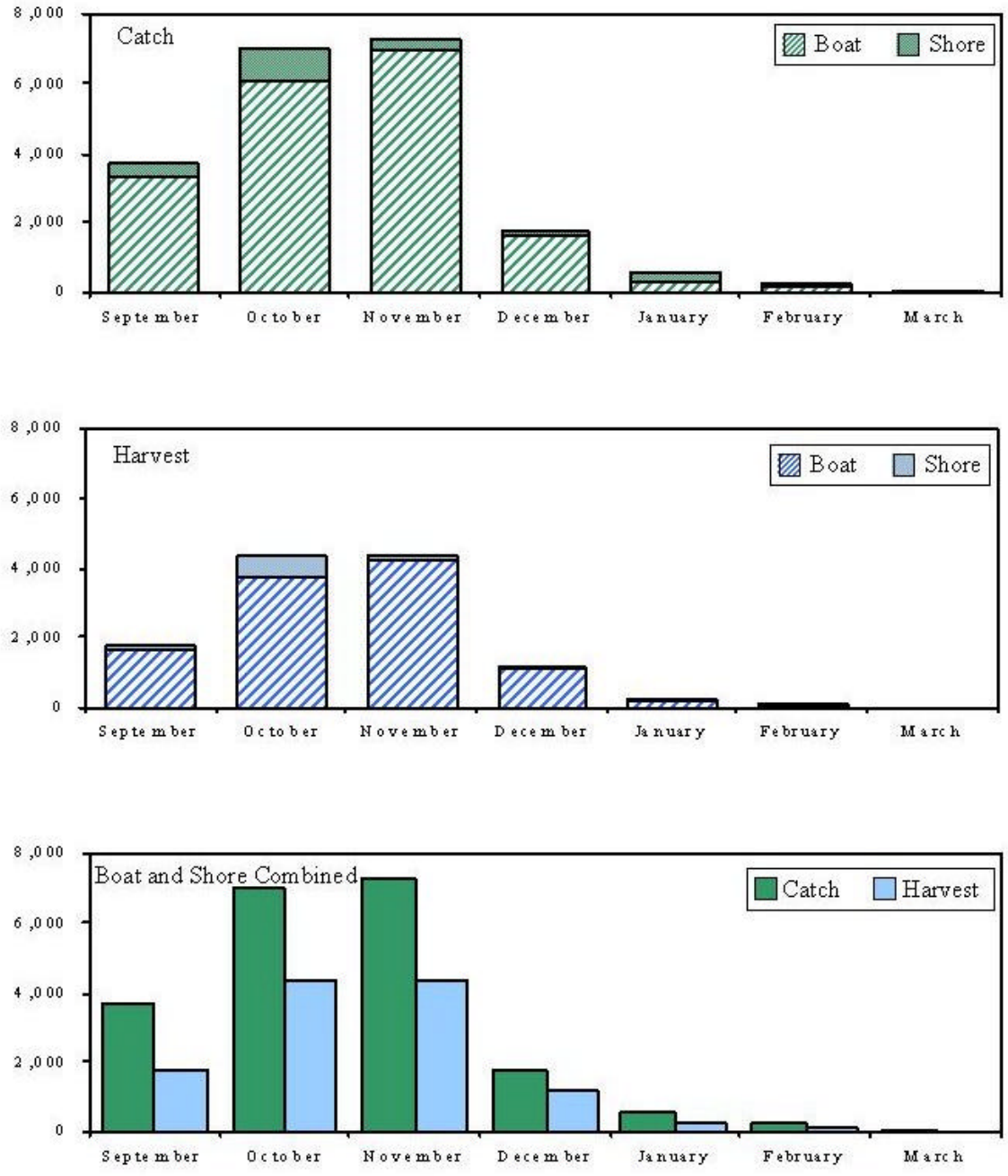

Figure 3.2-1. Estimated total monthly catch and harvest by boat, shore, and all anglers combined for the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

Total angler catch and harvest was disproportionate between boat anglers and shore anglers (Table 3.2-1). Boat anglers caught and harvested about 9 times the number of fish as shore anglers. The highest boat angler catch and harvest (C/H) occurred in November (6,959/4,217 fish), although boat angler catch and harvest during October

were also substantial (Appendix Table B-2; Figure 3.2-1). The highest shore angler catch and harvest occurred in October (892/606 fish); in most other months shore angler catch and harvest was less than 300 fish. Boat anglers generally harvested a higher percentage of fish caught, ranging among months from 35.3% to 69.6% (59.6% overall) compared to shore anglers, which ranged from 16.2% to 67.9% (47.7% overall).

3.3 Individual Species Catch, Harvest, and Yield

3.3.1 Catch and Harvest

The catch and harvest of fish in the unimpounded Snake River in September to March was diverse, comprising at least 13 species (Table 3.3-1). The composition of the catch and harvest illustrates the importance of anadromous steelhead to the overall fishery in this reach (Figure 3.3-1), and to both shore and boat components (Figure 3.3-2). Northern pikeminnow and smallmouth bass accounted for most of the catch and harvest of resident fishes. All catch and harvest data are listed in Appendix Table B-3.

Table 3.3-1
Estimated Catch and Harvest of the Principal Sport Fishes in the Unimpounded Snake River
From Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Species	Combined Anglers			
	Total Catch	Percent of Total	Total Harvest	Percent of Total
Smallmouth bass	1,537	7.5	477	4.0
Channel catfish	179	0.9	43	0.4
Sucker spp.*	965	4.7	22	0.2
Northern pikeminnow	3,230	15.7	2,527	21.0
Rainbow trout	99	0.5	6	0.0
Adult steelhead	14,099	68.5	8,935	74.3
White sturgeon	122	0.6	0	0.0
Other**	361	1.8	16	0.1
Total	**20,592**		**12,026**	

*Includes largescale and bridgelip sucker.
**Other includes common carp, chiselmouth, peamouth, bull trout, sunfish spp., crappie spp., mountain whitefish, and residual steelhead smolts.

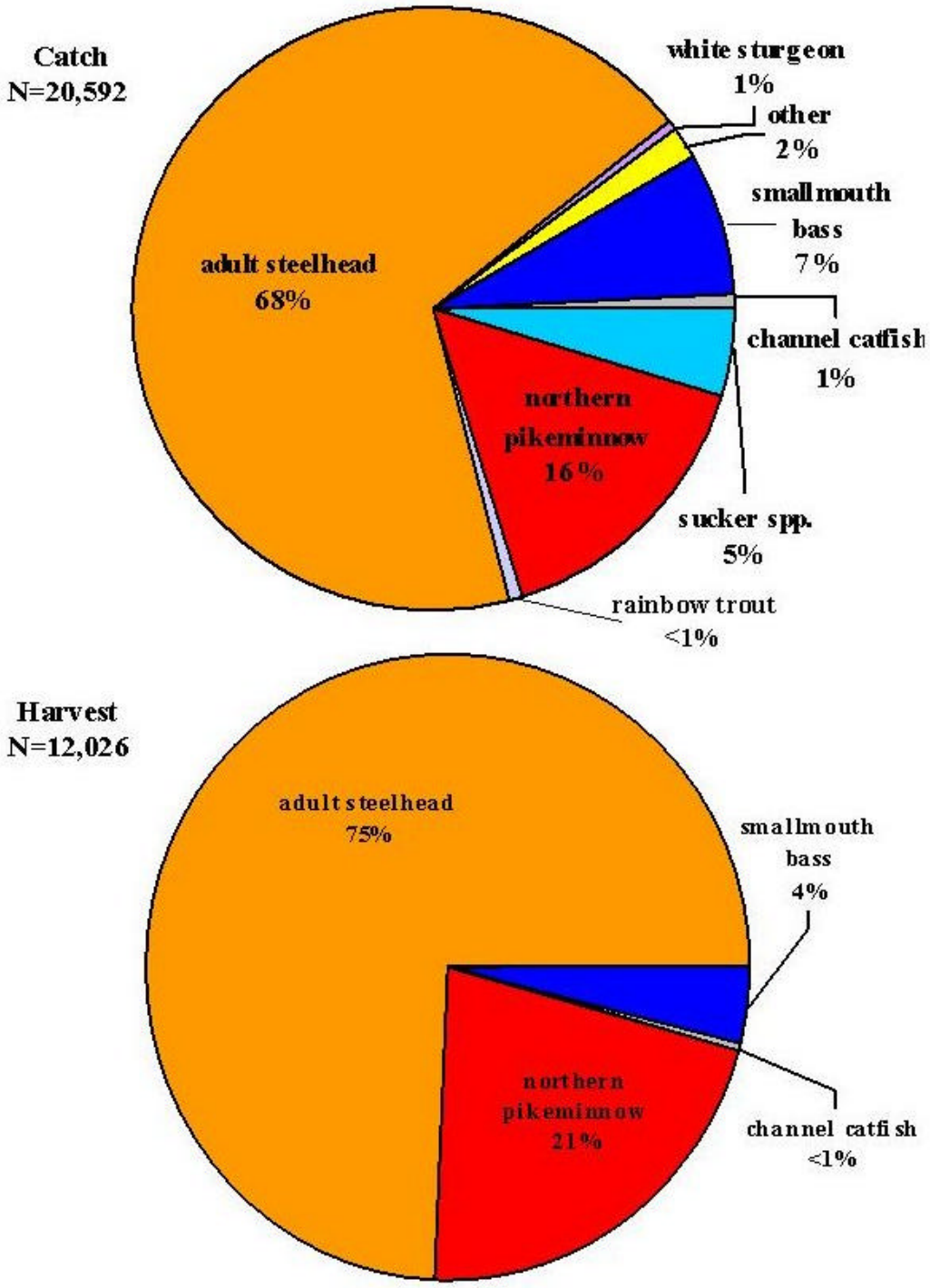

Figure 3.3-1. Composition of angler catch from the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

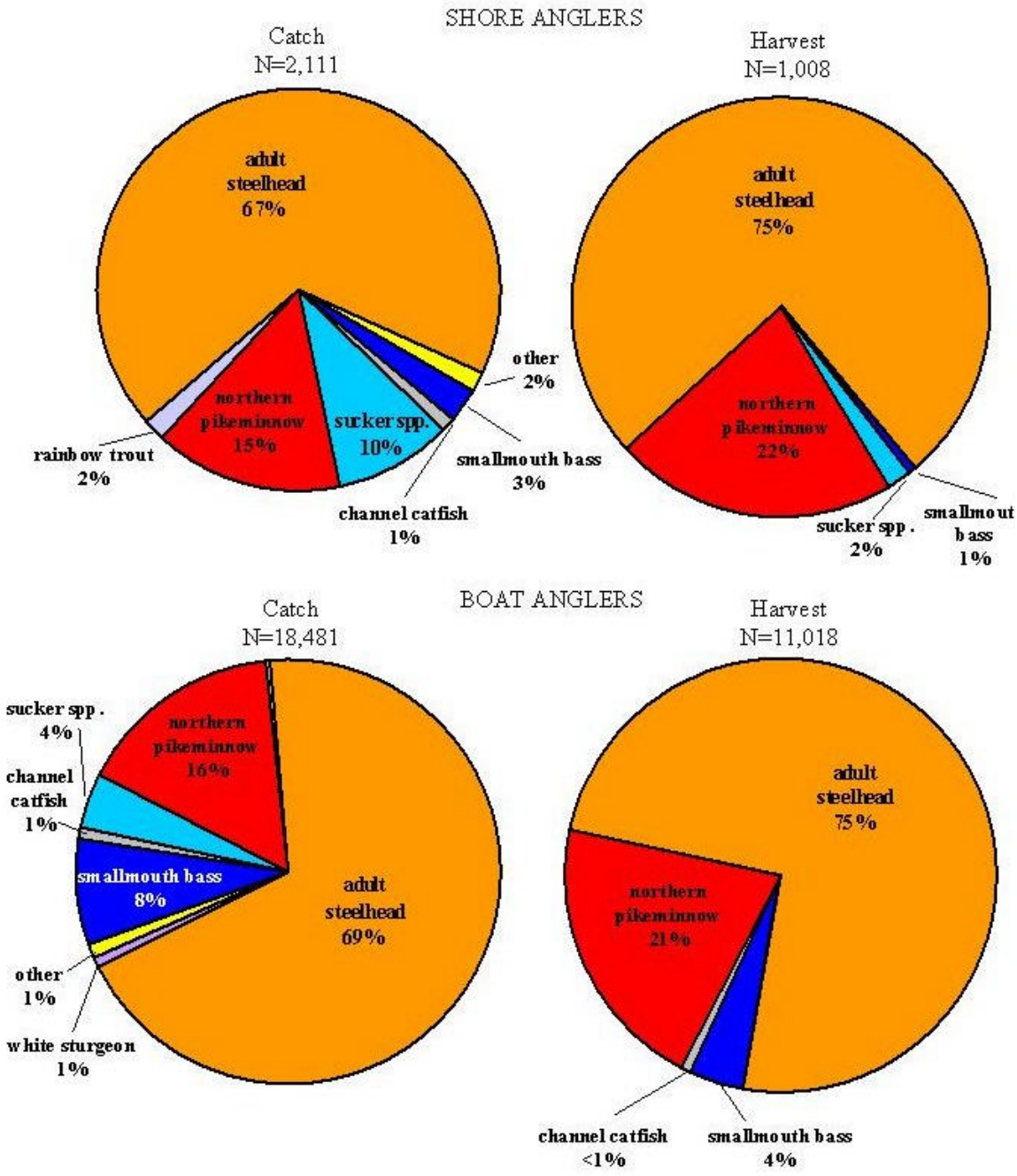

Figure 3.3-2. Composition of shore and boat angler catch and harvest from the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

Overall, steelhead accounted for 68.5% of total angler catch (14,099 fish) and 74.3% of the harvest (8,935 fish) in the unimpounded Snake River (Table 3.3-1; Figure 3.3-1). Steelhead were the most numerous sport fish caught and harvested by anglers each month during October through February (Figure 3.3-3). Anglers caught (6,458) and harvested (4,319) the most steelhead in November (Figure 3.3-3). The length distribution of harvested steelhead is shown in Appendix Figure C-1.

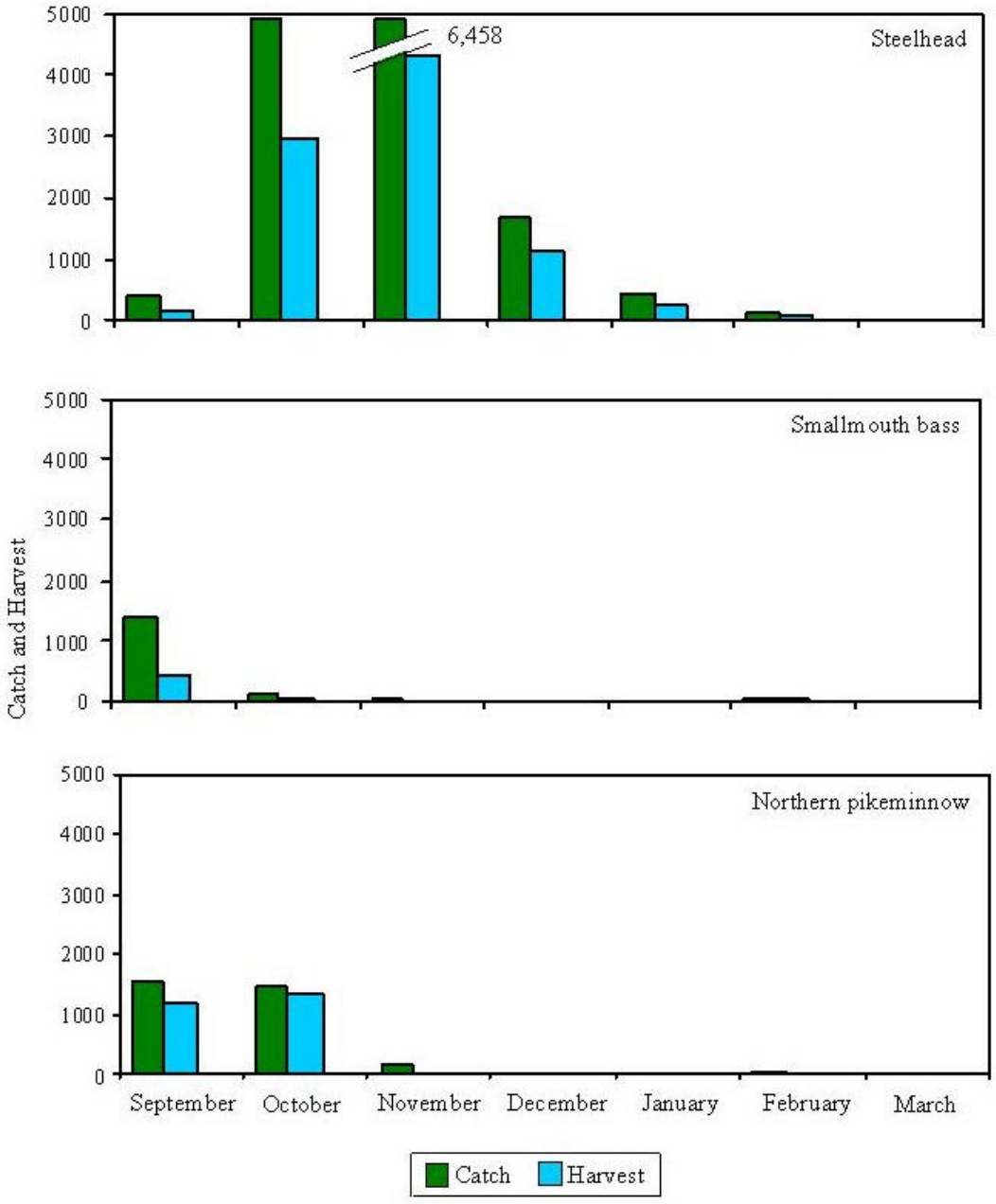

Figure 3.3-3. Monthly angler catch and harvest for adult steelhead, smallmouth bass, and northern pikeminnow for the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through October 1997-1998.

Boat anglers accounted for 89.9% (12,669) of the total steelhead catch and 91.6% (8,187) of those harvested (Appendix Table B-3). The catch and harvest of steelhead by boat anglers was highest in October and November (10,658/6,783 fish combined), whereas the catch and harvest (C/H) of steelhead by shore anglers was highest during September and October (904/558 fish combined) (Figures 3.3-4 and 3.3-5).

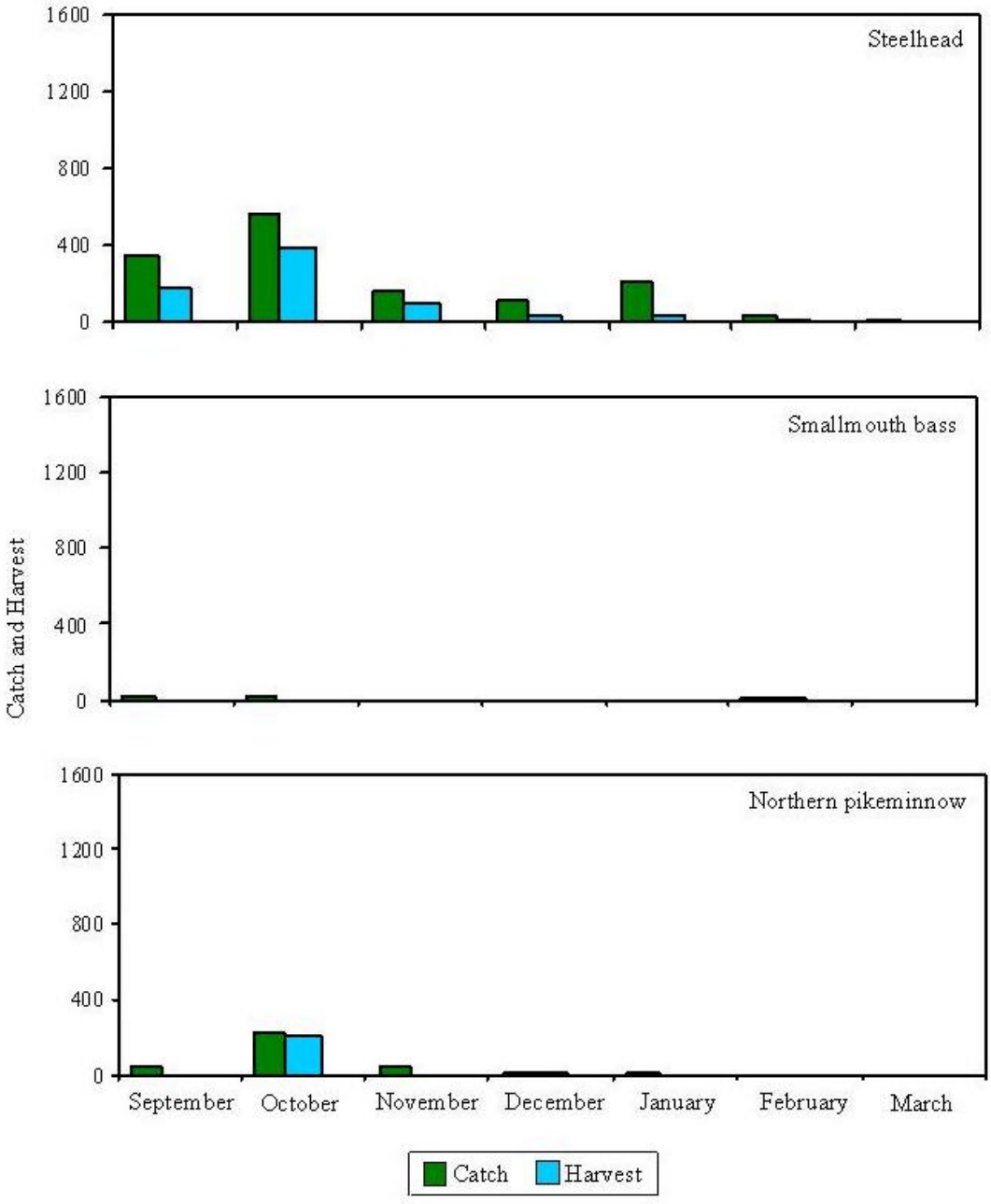

Figure 3.3-4. Monthly shore angler catch and harvest for adult steelhead, smallmouth bass, and northern pikeminnow for the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

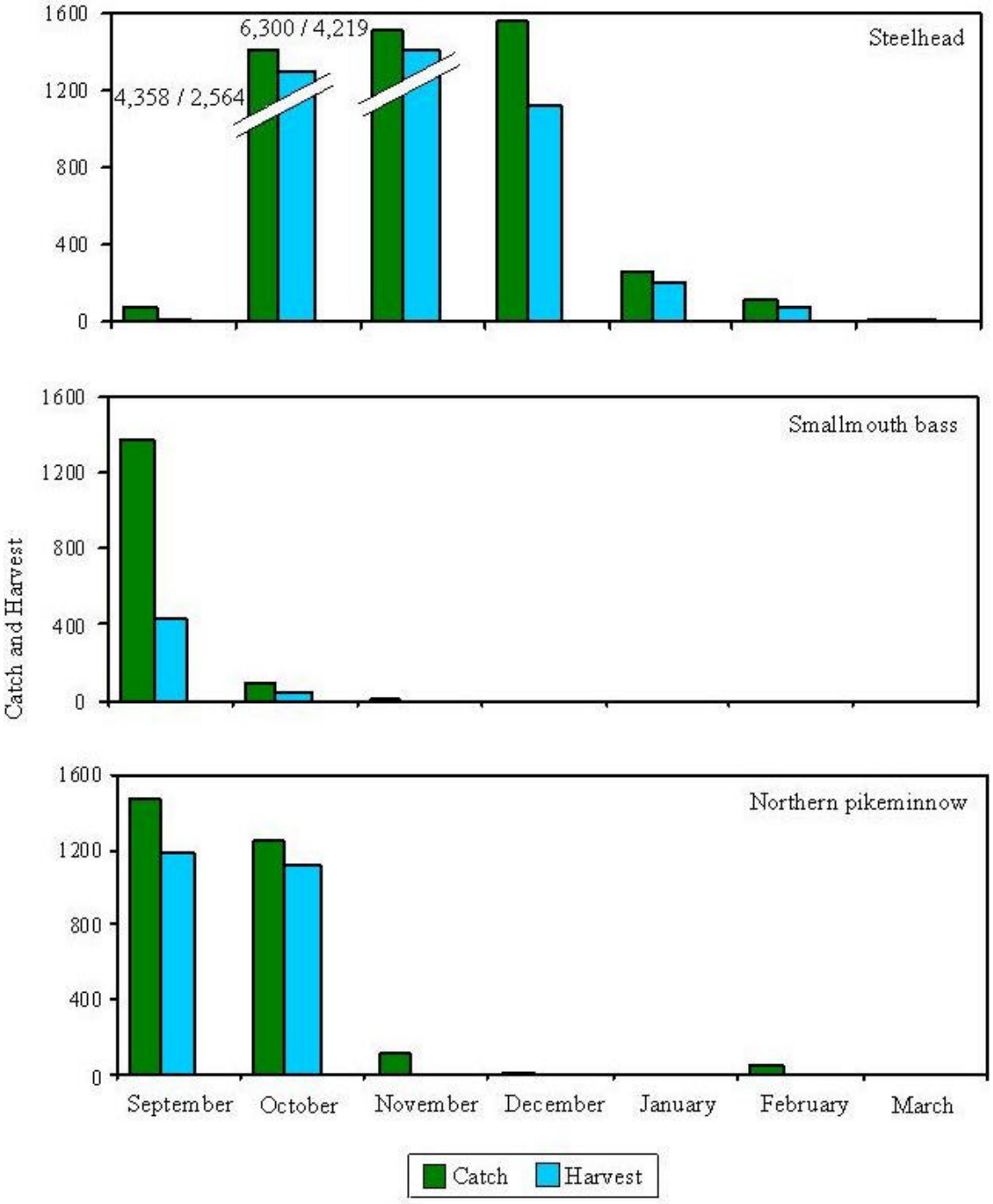

Figure 3.3-5. Monthly boat angler catch and harvest for adult steelhead, smallmouth bass, and northern pikeminnow for the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

Anglers caught an estimated 3,230 northern pikeminnow in the flowing water section of the Snake River during September-March, which ranked second to steelhead (Table 3.3-1). The retention rate of northern pikeminnow was highest among all species harvested; anglers kept 78.2% (2,527) of those caught. The large majority of northern pikeminnow were caught during September and October, although anglers continued to catch a small number of northern pikeminnow throughout the study period (Figure 3.3-3). Boat anglers accounted for most of the catch and harvest (C/H) of pikeminnow (2,907/2,310) (Appendix Table B-3; Figure 3.3-2).

Anglers caught an estimated 1,537 smallmouth bass in the free flowing Snake River, although less than one third (31.0%-477) were harvested (Table 3.3-1). The highest catch of smallmouth bass occurred during September (1,401), when 90.6% (432) of the total smallmouth bass harvest occurred (Figure 3.3-3). After September, the catch of smallmouth bass was negligible, as only an estimated 136 bass were caught and 45 harvested from October through March. Angler catch of smallmouth bass was skewed in favor of boat anglers, who accounted for 96.3% of the total number of smallmouth bass caught and 98.7% of those harvested (Appendix Table B-3; Figure 3.3-2).

Estimates of angler catch and harvest for other resident fishes were also small (Appendix Table B-3). Suckers, channel catfish, peamouth, and chiselmouth were occasionally caught but few were harvested (Table 3.3-1). The largest catch and harvest of channel catfish occurred during September and October, and was principally by boat anglers. Other species were caught sporadically throughout the season.

An estimated 122 white sturgeon were caught in the unimpounded Snake River, exclusively by boat anglers. Harvest restrictions in the flowing water section of the Snake River prevented angler harvest of white sturgeon and, based on the results, complete compliance was observed (Table 3.3-1).

3.3.2 Yield

The overall estimated yield (biomass/unit area) was 1.57 kg/hectare for resident fishes in the unimpounded Snake River from September to March (Appendix Table B-4). Northern pikeminnow (1.35 kg/hectare), smallmouth bass (0.12 kg/hectare), and channel catfish (0.07 kg/hectare) provided the largest yields among resident fish species.

3.4 Catch and Harvest Rates

3.4.1 All Species Combined

The overall catch and harvest rates for the unimpounded Snake River sport fishery in September to March were 0.225 and 0.126 fish/hour, respectively (Appendix Table B-5). Catch and harvest rates for boat anglers were about twice as high as for shore anglers. Angler catch rates were highest in September (0.836 fish/angler hour), and lowest in January (0.116 fish/angler hour) (Figure 3.4-1). Angler harvest rates were also highest in September (0.424 fish/angler hour), but were lowest in March (0.031 fish/angler hour).

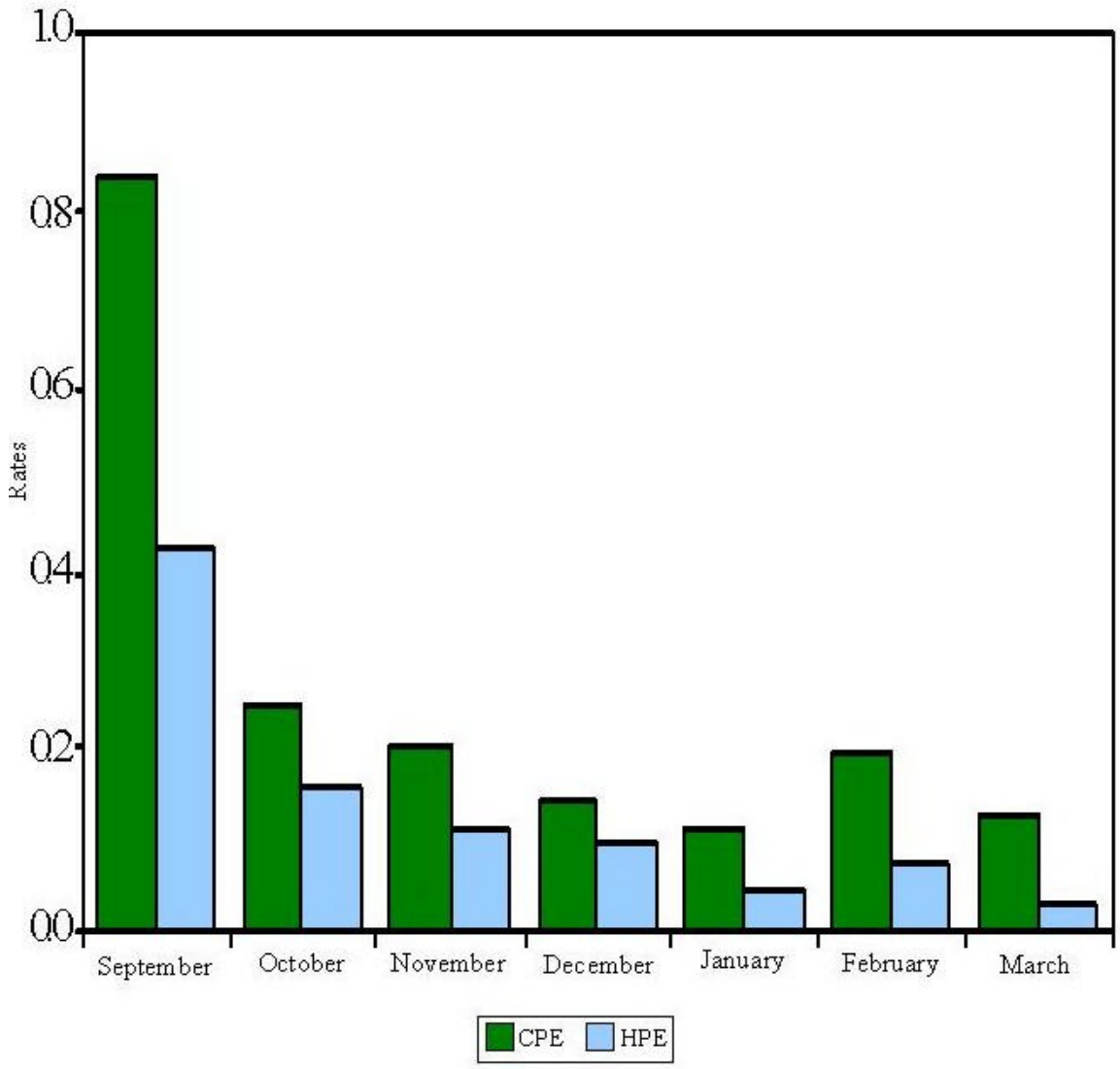

Figure 3.4-1. Estimated monthly angler catch and harvest rates for the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

Catch and harvest rates varied among months for each fishing mode (Figure 3.4-2). Catch rates for both shore and boat anglers were highest in September (0.239 and 1.005 fish/angler hour, respectively). The lowest catch rates occurred in February for shore anglers (0.051 fish/angler hour), and in March for boat anglers (0.114 fish/angler hour). Harvest rates for shore anglers were highest in October (0.107 fish/angler hour), whereas boat anglers experienced the highest harvest rates (0.520 fish/angler hour) in September. Harvest rates were lowest for both shore and boat anglers in March (0.015 and 0.039 fish/angler hour). Boat anglers generally exhibited higher catch rates than shore anglers throughout the fall and winter, except in January and March when catch rates for shore anglers exceeded those of boat anglers.

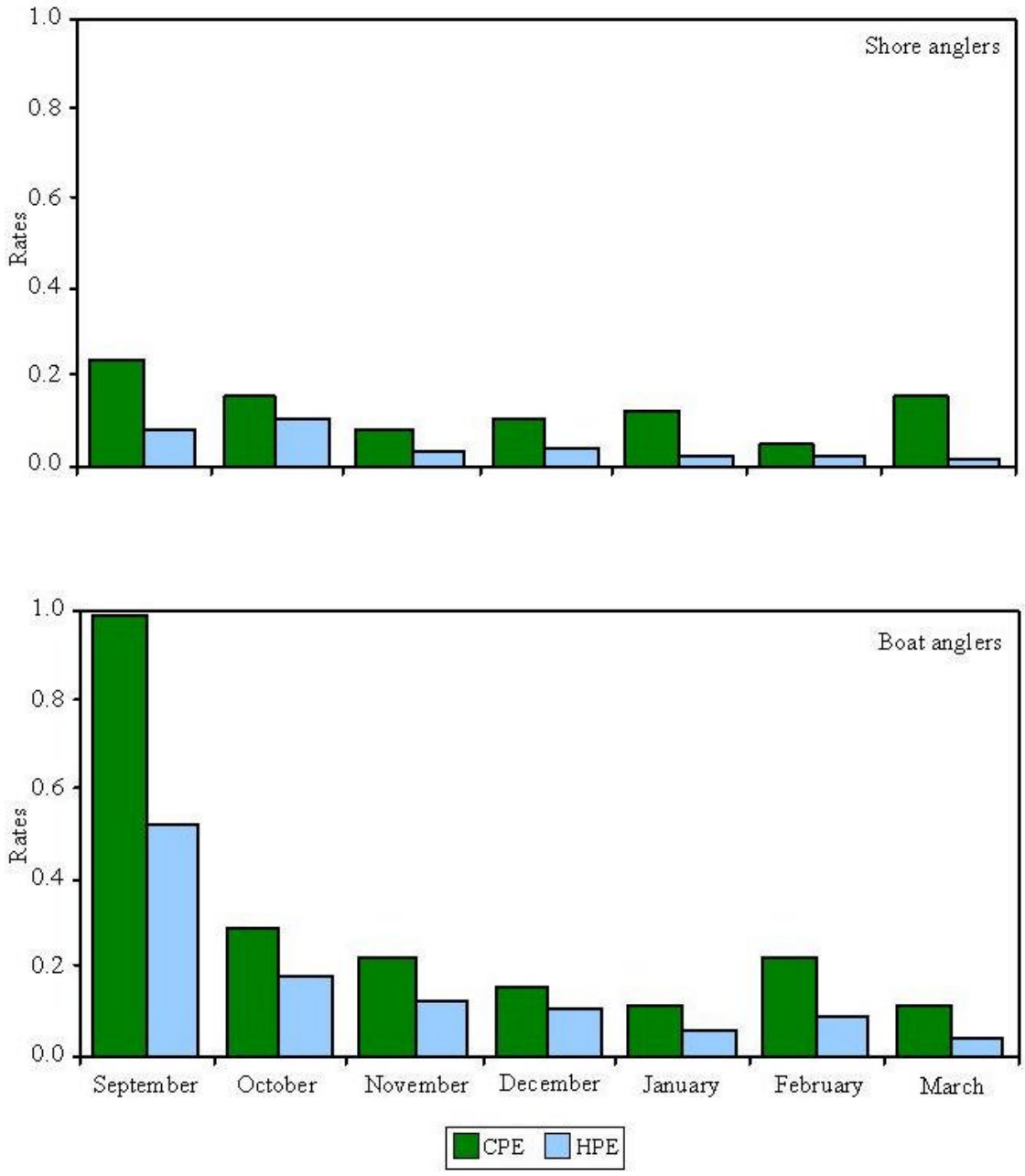

Figure 3.4-2. Estimated monthly shore and boat angler catch and harvest rates for the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

3.4.2 Individual Species

The catch and harvest rates for species other than steelhead were representative of the disproportionate amount of total effort directed at steelhead throughout the 7-month period in this reach of the Snake River. As a result, overall catch and harvest rates for other species are provided in Appendix Table B-6 for reference only. The most useful catch rate data are those for anglers specifically seeking a particular species (see Section 3.5.2).

3.5 Directed Fisheries

3.5.1 Species Preferences

More than 93% of all interviewed anglers specified a preference for steelhead between September and March in this 48 km section of the Snake River (Figure 3.5-1). Smallmouth bass was the most highly sought resident fish, accounting for 2.4% of all anglers interviewed. Northern pikeminnow and white sturgeon were each sought by about 1% of those interviewed.

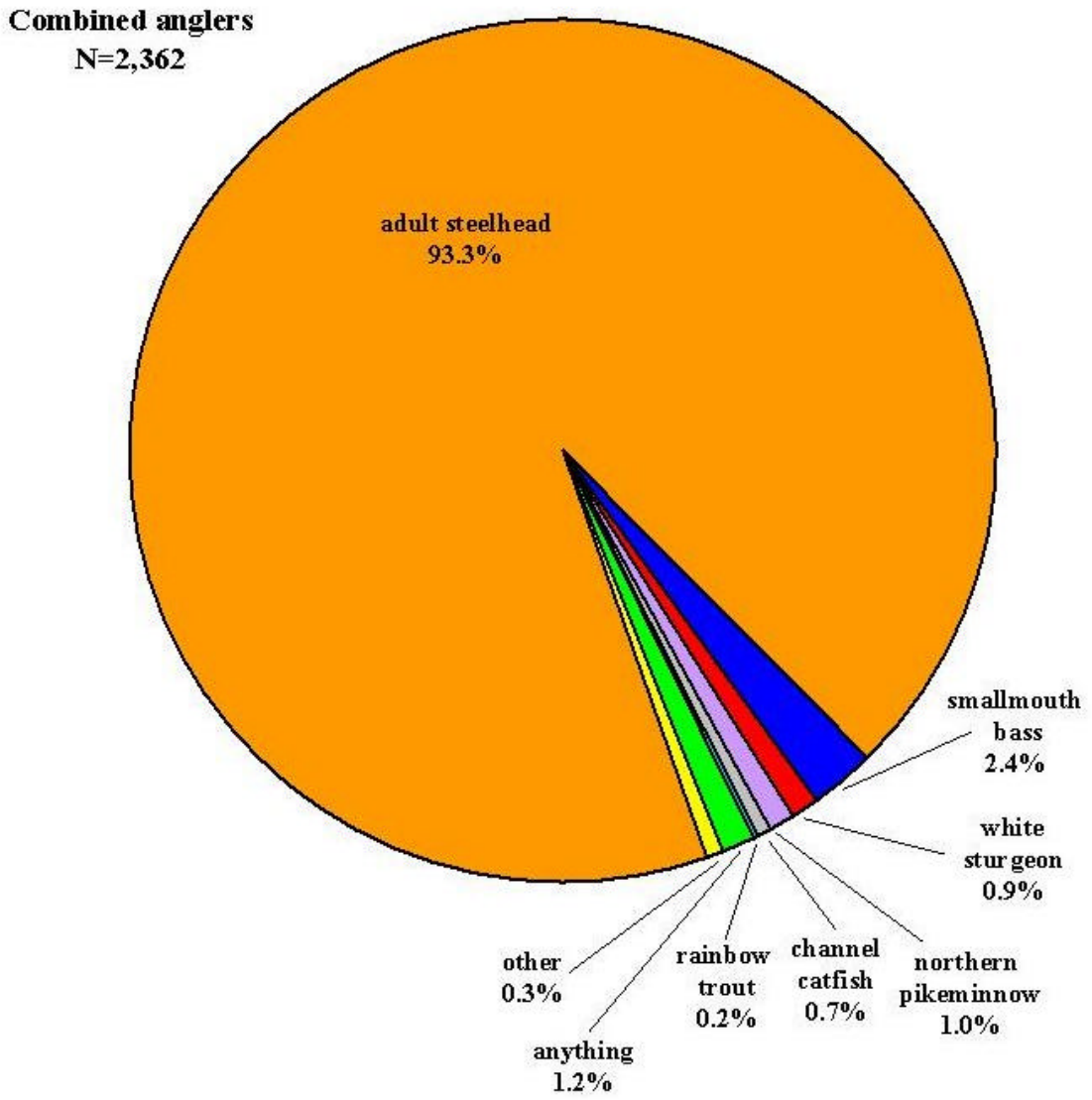

Figure 3.5-1. Species preferences for all interviewed anglers in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

The proportion of anglers seeking a particular species was generally similar for shore and boat anglers (Figure 3.5-2). Slightly more shore anglers sought resident fishes (mainly smallmouth bass and channel catfish) than boat anglers.

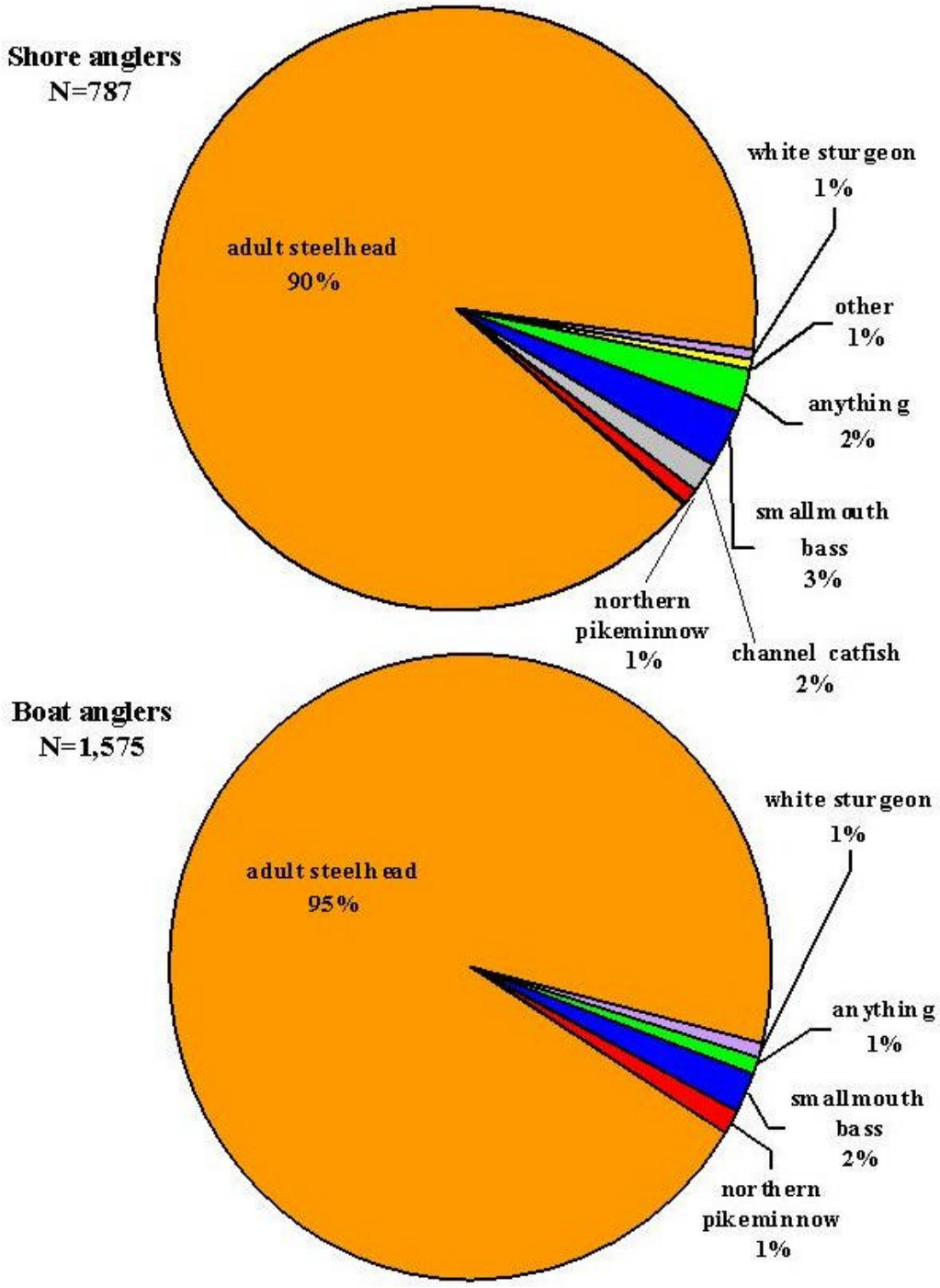

Figure 3.5-2. Species preference for interviewed shore and boat anglers in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

The highest number and proportion of anglers sought steelhead during November (N=768, 34.8% of total anglers seeking steelhead), whereas the lowest proportion seeking steelhead occurred during March (N=51, 2.3% of those anglers seeking steelhead) (Figure 3.5-3). Resident species (chiefly smallmouth bass, northern pikeminnow and white sturgeon) were sought mainly in September and March. Anglers seeking channel catfish were interviewed exclusively in January through March, and in March accounted for 11.6% (11 anglers) of those interviewed.

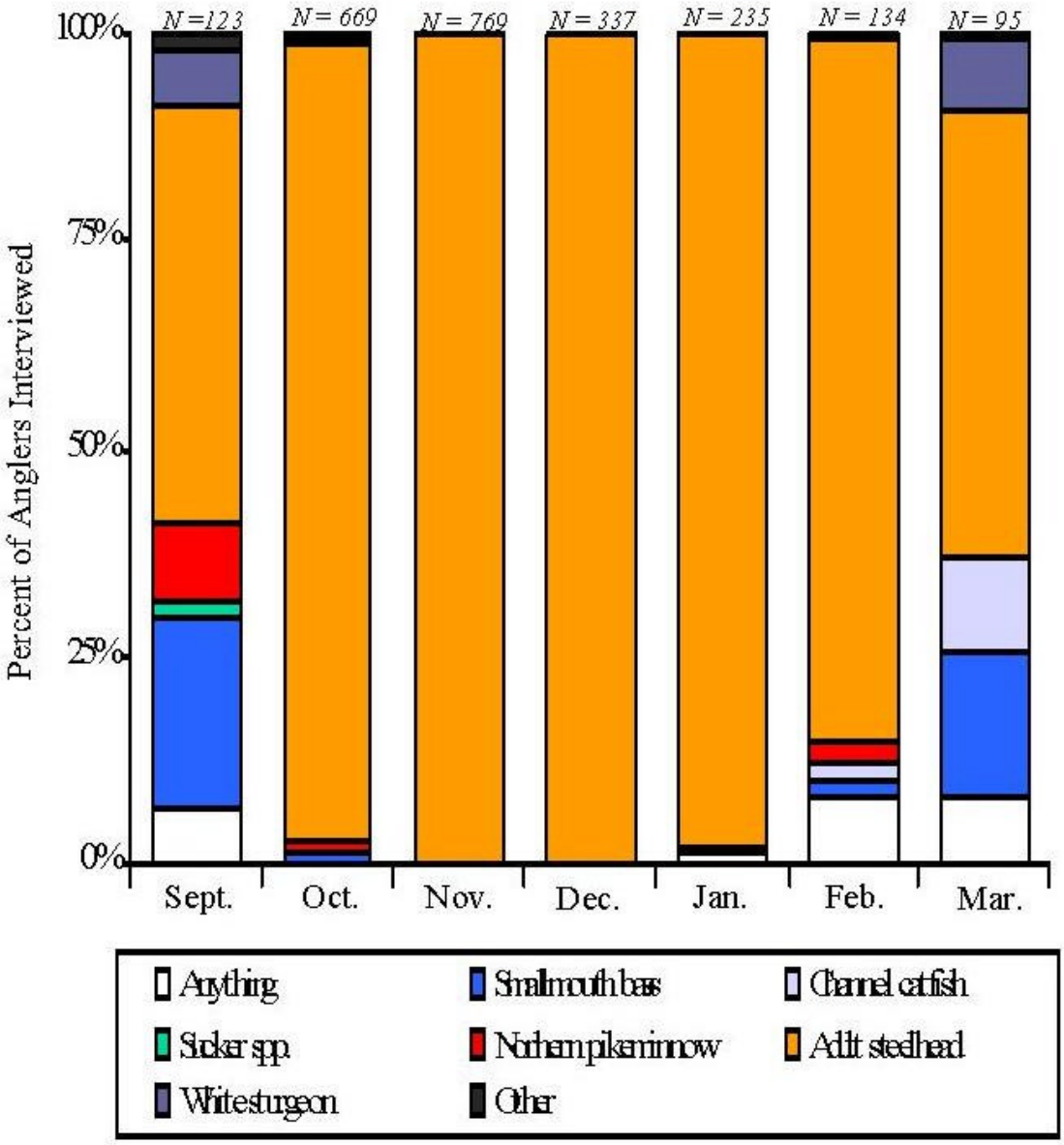

Figure 3.5-3. Species sought by all anglers in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

Some differences in angler preferences among months for shore and boat anglers occurred (Figure 3.5-4). The monthly proportions of boat anglers seeking steelhead ranged from 30.5% in September to 100% from November through January; only in September was the proportion less than 90%. Pursuit of steelhead by shore anglers was highest in October, when at least 35% (250 anglers) of all shore anglers seeking steelhead were interviewed. Boat anglers mainly sought resident species in September, whereas shore angler preferences became more diversified in February and March (Figure 3.5-4).

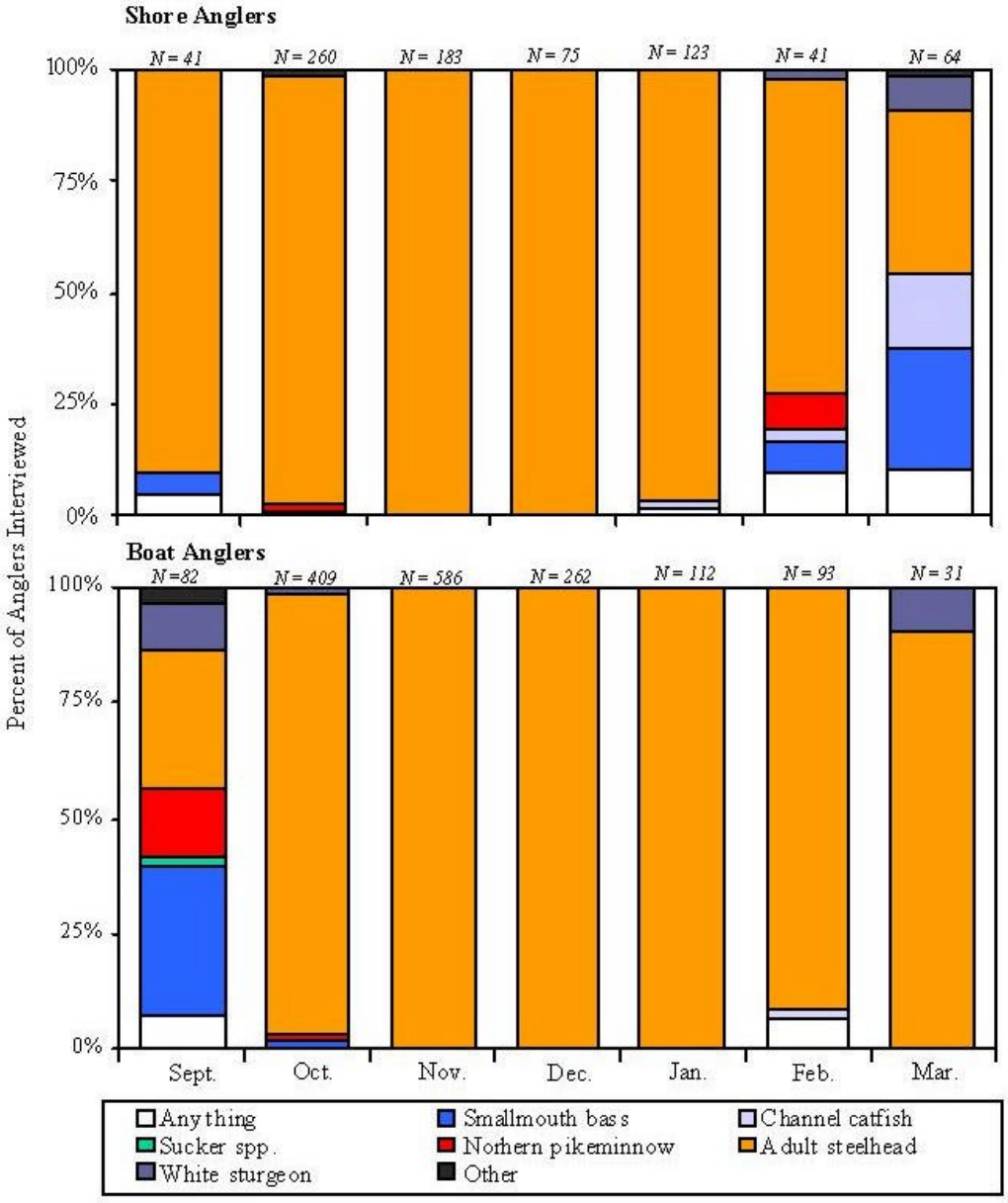

Figure 3.5-4. Species sought by shore and boat anglers in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

3.5.2 Directed Catch and Harvest Rates

Directed catch and harvest rates for the principal species sought were highest for northern pikeminnow (1.86 fish/angler hour) and smallmouth bass (1.05 fish/angler hour; Appendix Table B-7). Boat anglers consistently experienced higher success rates than shore anglers when seeking the major species (Figure 3.5-5). Anglers seeking smallmouth bass exhibited the highest directed catch rates among shore fishermen (0.44 fish/angler hour), while those seeking northern pikeminnow exhibited the highest catch rates among boat anglers (1.86 fish/angler hour) (Appendix Table B-7; Figure 3.5-5).

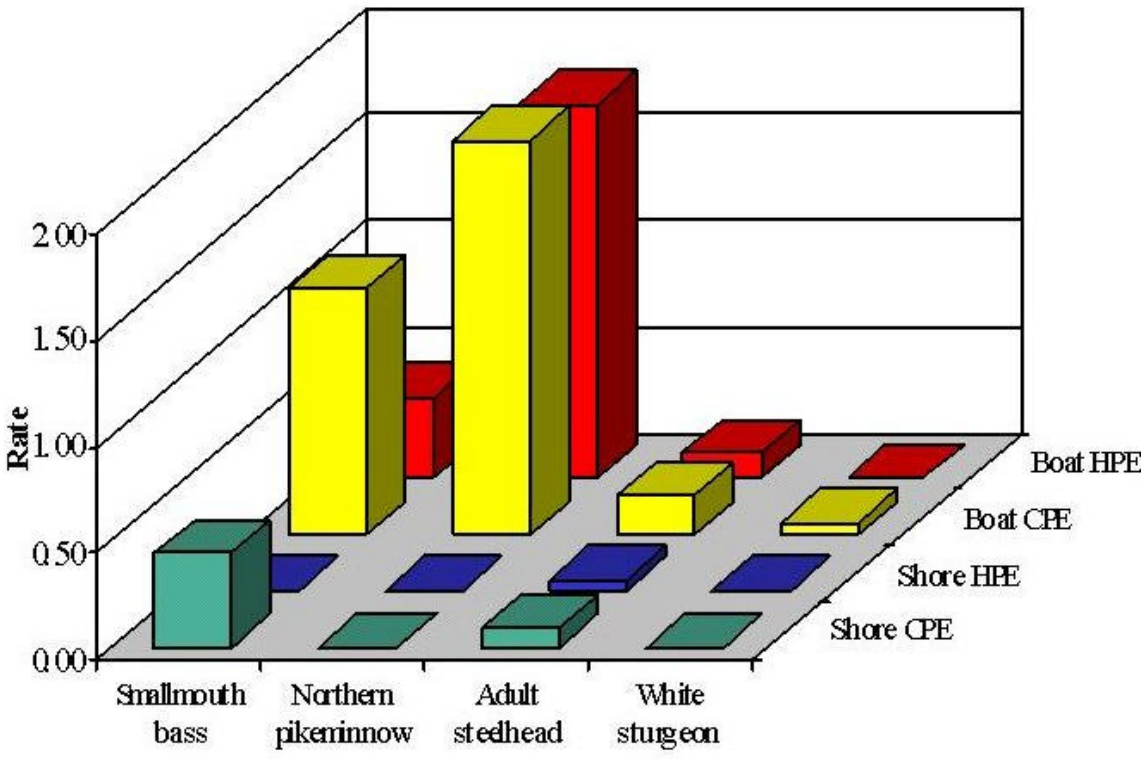

Figure 3.5-5. Directed catch and harvest rates for smallmouth bass, northern pikeminnow, adult steelhead, and white sturgeon boat and shore anglers in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

Anglers seeking steelhead experienced the highest catch rates during October and November (0.170 and 0.173 fish/angler hour, respectively) (Figure 3.5-6). Catch rates for steelhead greater than 0.10 fish/angler hour were observed from September through December, and in February. Boat anglers seeking steelhead experienced the highest catch and harvest rates (C/H) in October (0.199/0.113 fish/angler hour) and November (0.196/0.126 fish/angler hour). Catch and harvest rates for shore anglers seeking steelhead were highest in September (0.188/0.086 fish/angler hour) and were more than 10 times higher than those estimated for boat anglers in September (Appendix Table B-8).

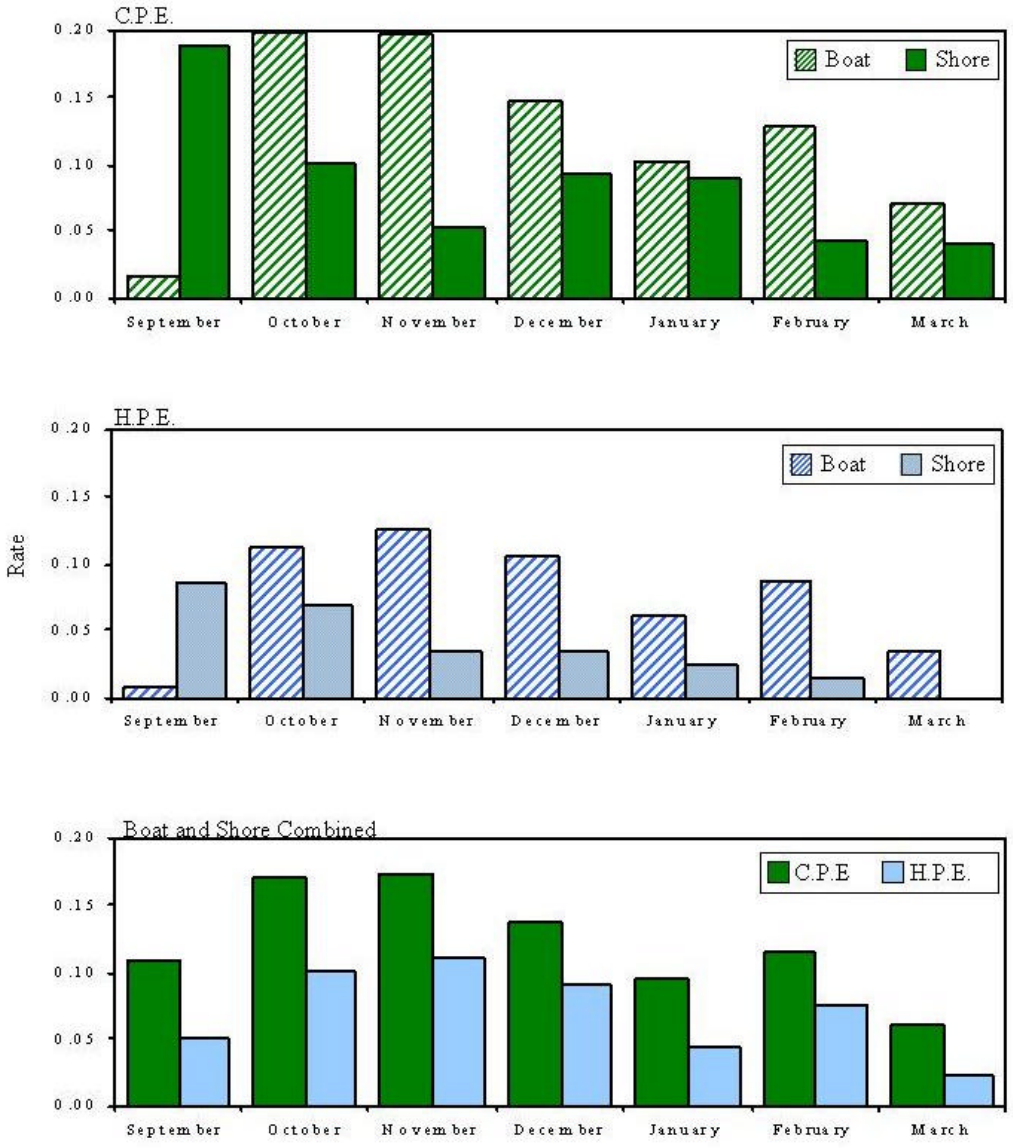

Figure 3.5-6. Monthly directed catch and harvest rates for steelhead in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

Catch (and harvest) rates were substantially higher for guided boat anglers compared to anglers in private boats (Figure 3.5-7). During the peak steelhead season (October-December), guided boat catch rates for steelhead were up to three times higher than for private boats. Guided boat CPE was highest in November (0.36 fish/angler hour) compared to 0.12 fish/angler hour for steelhead anglers in private boats.

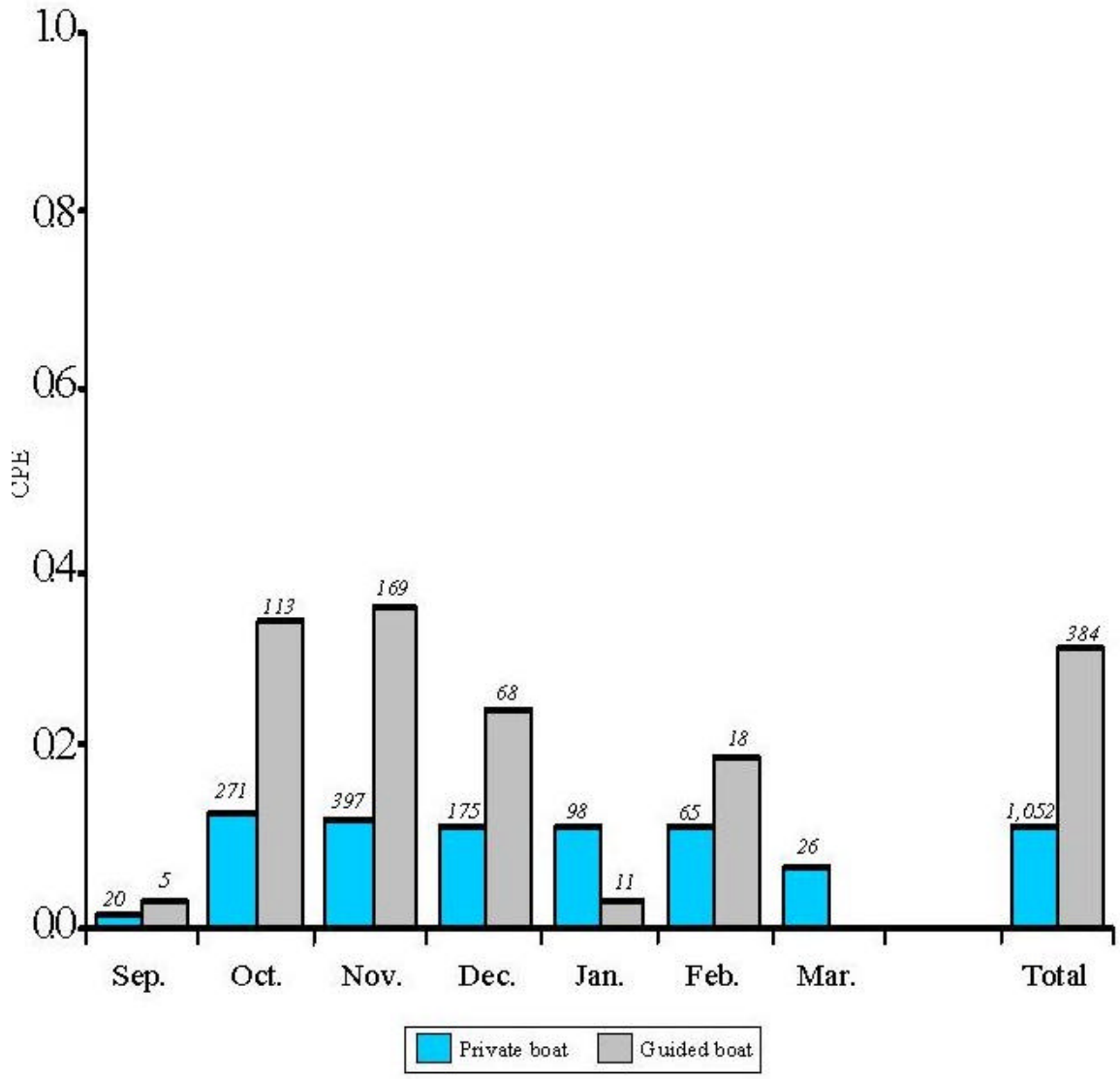

Figure 3.5-7. Comparison of catch rates between private and guided boat anglers on the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September 1997 to March 1998.

Anglers specifically seeking smallmouth bass were only successful (C/H) during September (1.160/0.355 fish/angler hour), although a small number of anglers sought smallmouth bass in October (2), February (2), and March (1) (Appendix Table B-8). Boat anglers had only slightly higher success rates for smallmouth bass than shore anglers. The large difference between catch and harvest rates for bass anglers suggests that most smallmouth bass caught were released. A very few bass were caught in months other than September by anglers targeting other species.

Boat anglers seeking northern pikeminnow experienced the highest catch and harvest rates in October (2.358/2.318 fish/angler hour), although success rates were also high for northern pikeminnow in September (1.654/1.530 fish/angler hour; Appendix Table B-8). Anglers did not seek northern pikeminnow during November to March.

3.6 Angler Characteristics

3.6.1 Angler Origin

The unimpounded Snake River upstream of Asotin was targeted by anglers primarily from the immediate area (Lewiston, Clarkston, and Asotin) and throughout the region north of the Snake River (Spokane, Coeur d'Alene, Moscow, Pullman). More than 72% of all anglers interviewed came from these areas (Table 3.6-1). The next largest group of anglers (8.2%) came from west of the Cascades in the Seattle-Tacoma-Olympia corridor. All other regions combined (*e.g.*, Boise area, Tri-Cities, etc.) within the principal catchment states of Washington, Idaho, and Oregon represented 13.9% of the angling population.

Table 3.6-1
Residence of Anglers Fishing the Snake River
From Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Residence	Percent of Total
Lewiston-Clarkston-Asotin	39.3
Spokane-Coeur d'Alene-Moscow-Pullman	33.1
Seattle-Tacoma-Olympia	8.2
Other Regional Areas (WA, ID, OR)	13.9
Other States	5.0
Canada	0.5
Total	**100.0**

Local anglers comprised at least 44% of the angling population in all months except October and November (Figure 3.6-1). Anglers from Spokane, Coeur d'Alene, and Moscow-Pullman were the most prevalent during October and November. Similarly, visitation by anglers from Seattle-Tacoma-Olympia and all other areas both within and outside the region peaked during October and November. Although the peak of non-local angling occurred in October and November, this reach of the Snake River remained attractive to distant anglers in all months except March, when the fishery reverted to more local participants.

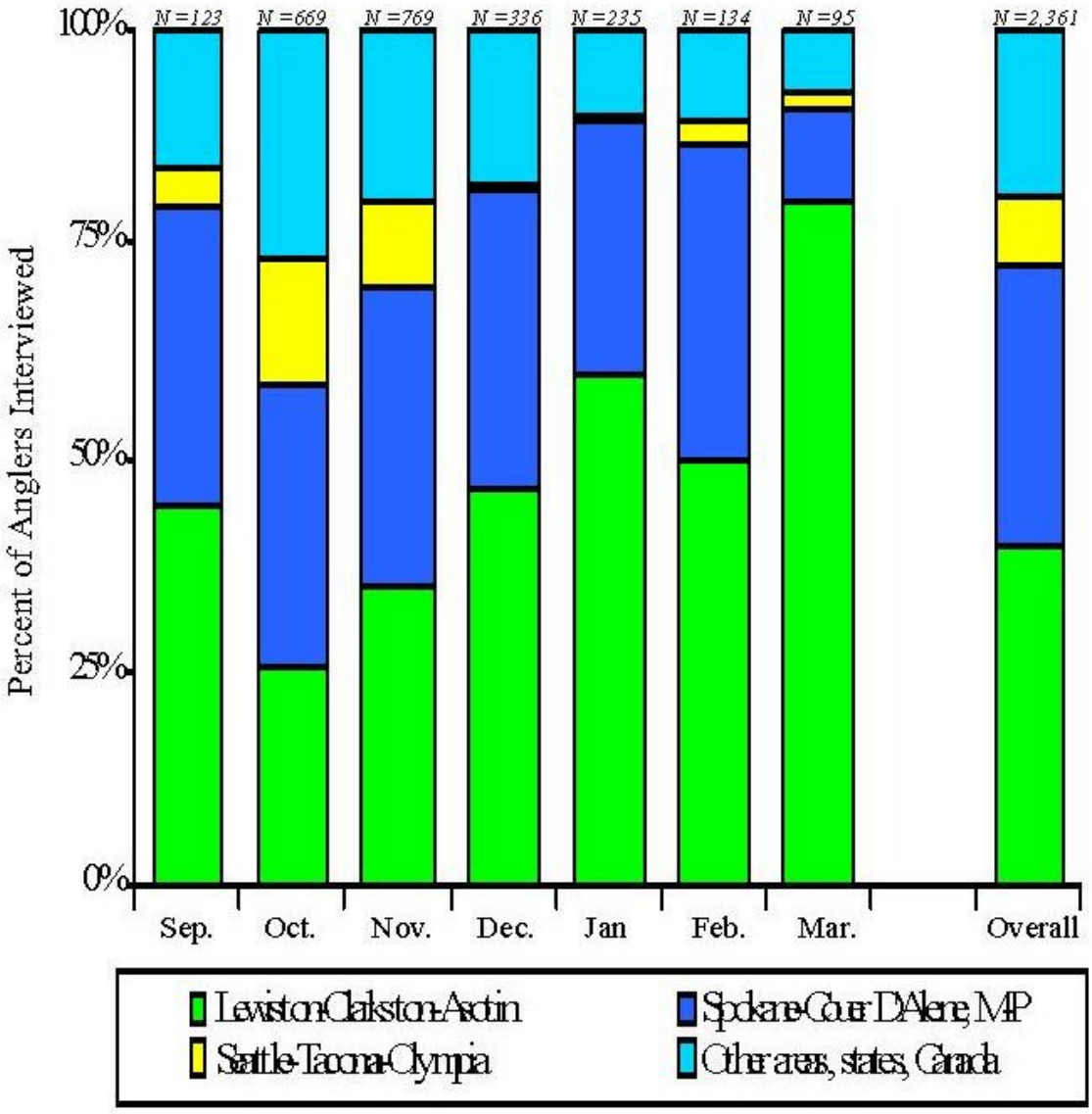

Figure 3.6-1. Residence of anglers on the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

Anglers from 18 states and Canada also fished the unimpounded Snake River. Anglers from outside the catchment area peaked at 5.5% of those interviewed in October. The most common states represented from outside the region were Montana and California. Anglers from all other regions of the country were also noted, including Alabama, New York, Arizona, and Iowa.

3.6.2 Visitation Status

Overall, slightly more than 50% of angler use resulted from day trips (Figure 3.6-2). Day trips represented at least 46% of angler use in all months except October. During October, when day trips represented 29% of angling, 71% of angler use was made by those traveling to fish and stay along or near the Snake River. The next largest category was "other non-paid," which principally included those camping along the river at informal campsites or at the confluence of the Grande Ronde River. Camping along the river peaked in September and October during the best weather. Secondarily, anglers in the "other non-paid" category stayed with friends or relatives or in private cabins upriver from the Grande Ronde River confluence. The category "other paid" included those anglers staying at motels in Lewiston and Clarkston, or at cabins at Heller Bar. Anglers paying for lodging represented 16 to 23% of visitation during October through February, but was most common in October and November, coinciding with the highest use and best fishing success.

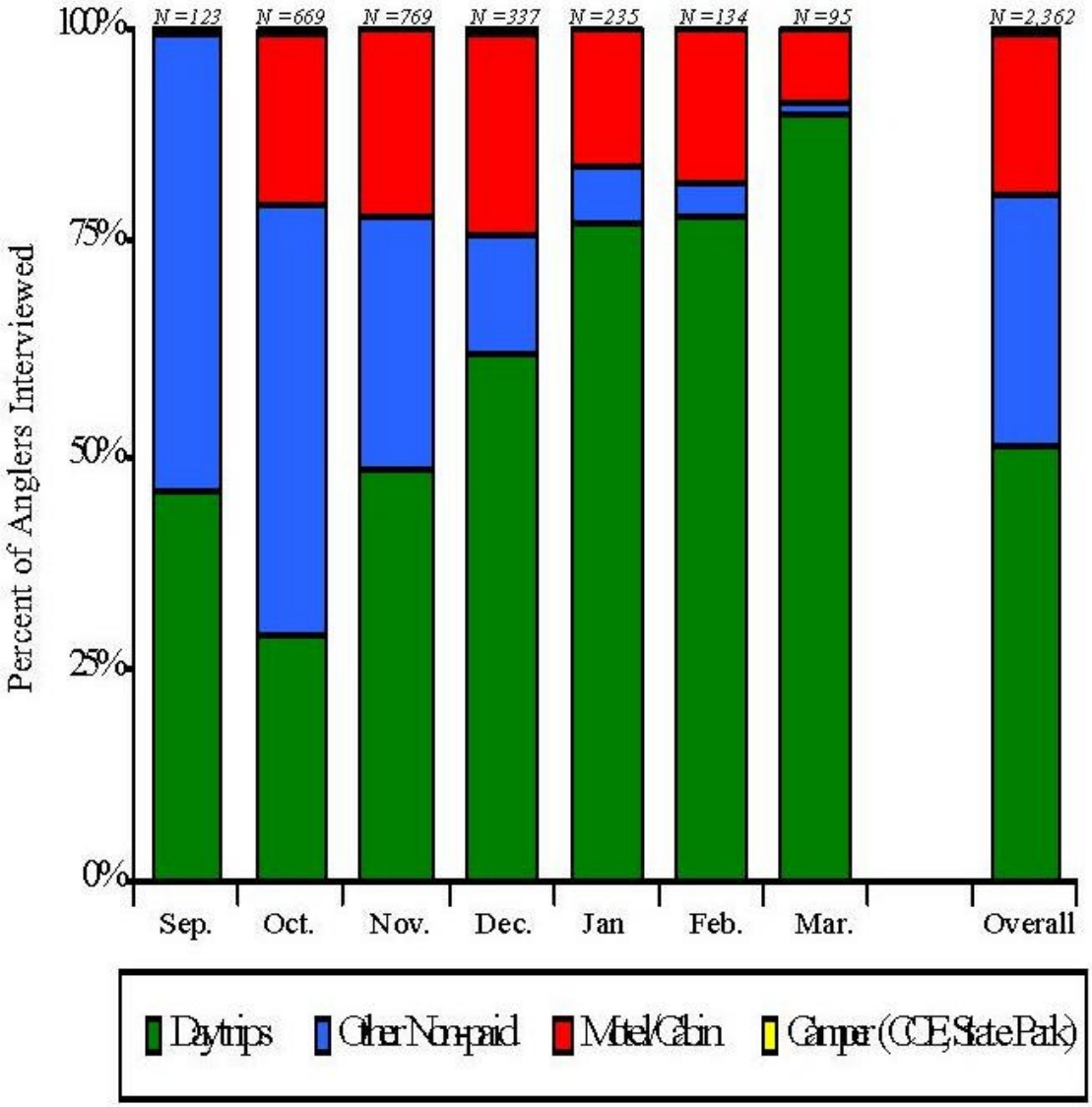

Figure 3.6-2. Visitor status of anglers in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

3.6.3 Characteristics and Methods of Steelhead Anglers

Steelhead angling in the flowing water reach above Asotin was primarily boat-based (Figure 3.6-3). More than two-thirds of all anglers fished from boats. Most boat angling was from private craft. However, 26.7% of all boat anglers fished with a guide. Guide use was reported each month except March, but was highest in October and November (more than 29% of all boat anglers). Among shore anglers, however, use of a guide was reported only twice.

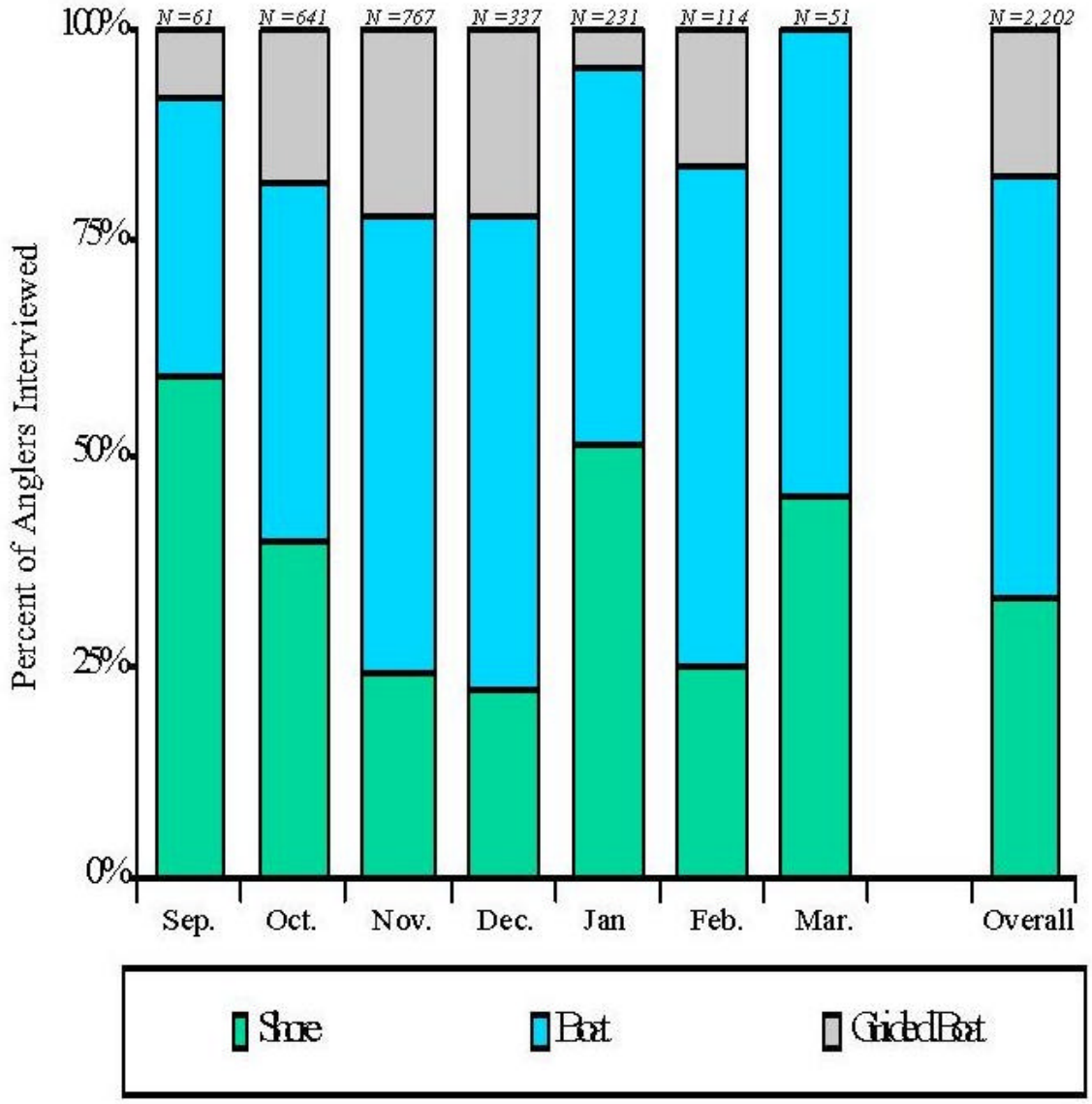

Figure 3.6-3. Fishing methods of steelhead anglers in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

The choice of bait, lures, or a combination of both was reported by more than 90% of all steelhead anglers, each in about equal proportion (range 28.9 to 32.9%; Figure 3.6-4). The use of lures tended to occur early in the season (September and October), whereas the use of bait or baited lures was more prevalent in the cooler months. Fly rod anglers formed about 9% of those interviewed, and were most common in October.

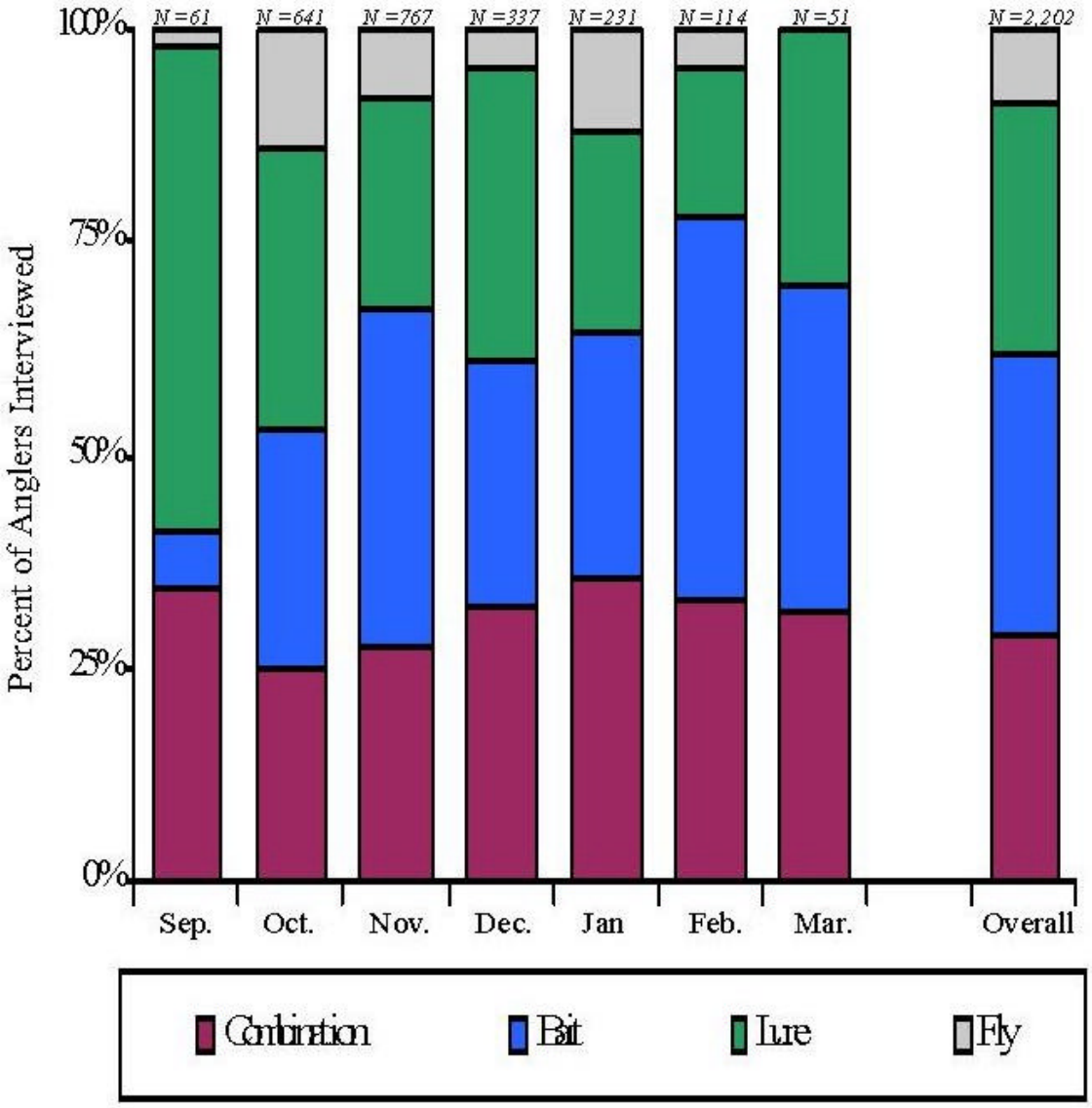

Figure 3.6-4. Fishing methods of steelhead anglers in the unimpounded Snake River from Asotin, Washington, to the Oregon/Washington border, September through March 1997-1998.

Anglers in the mid-Snake River above Asotin were queried about their license purchases. Nearly half (49.6%) of those interviewed fished with a Washington license, while 28.8% fished with an Idaho license. The proportion of anglers with both licenses was 21.6%.

4.0 DISCUSSION

The September 1997 through March 1998 creel survey of the designated 48 km reach of unimpounded Snake River was clearly dominated by the steelhead sport fishery. Steelhead anglers were present for the duration, and accounted for over 93% of the total anglers interviewed by creel clerks. In contrast, the amount of directed effort towards resident fishes in the sample reach was comparatively small, and occurred primarily during early September and late March. Angling pressure for steelhead peaked during October and November, based on estimates of maximum angler use. It is likely the second largest run of adult steelhead since 1992 (85,917; Corps of Engineers data) contributed to the high interest in the steelhead fishery. This large number of fish combined with the general popularity of steelhead fishing and the perceived high success rates generally associated with the unimpounded Snake River probably contributed to the preponderance of steelhead anglers in the study area.

The initial angling effort for steelhead during September was slightly higher for shore anglers. Subsequently, boat anglers dominated the fishery until January when angling effort for steelhead became evenly distributed between shore and boat anglers. Overall, boat anglers accounted for the most intensive steelhead angling effort in the unimpounded Snake River. From October to December, when 98% of the anglers were seeking steelhead, boat anglers accounted for over 86% of the angler effort in the study reach. In December, total boat angler hours were about half that in November, which largely contributed to the overall decline in angling pressure. Although 100% of the boat anglers interviewed were seeking steelhead in December, lower catch rates, colder air temperatures, and adverse weather conditions likely contributed to the reduction in boat anglers. Boat angler pressure continued to decline through March, despite the improved catch rates experienced by the low number of steelhead anglers in February.

The number of shore anglers seeking steelhead remained relatively stable throughout the sampling period, except during the peak month of October. When shore angler hours tripled from September to October, more than 96% were seeking steelhead. By November, shore angler hours began to decline, and shore effort remained stable until March. Higher catch rates by shore anglers seeking steelhead in January and February likely contributed to their persistence. In March, relatively few shore anglers were observed as a result of poor fishing conditions. High, turbid flows and relatively low catch rates probably discouraged most shore anglers.

Limited comparative estimates of steelhead angling effort are available for the designated 48 km Snake River section. In fall 1984, the Washington Department of Fish and Wildlife began a survey of steelhead anglers along a comparable reach of the mid-Snake River from Asotin to near the Oregon border that continued for three seasons (September through March). From 1984-85 to 1986-87, angler effort for steelhead increased from 26,852 (1984-85) to 68,682 (1986-87) angler hours (Mendel and Aufforth, 1985; Mendel *et al.*, 1987, 1988). This rapid growth in angler effort in the mid-1980's was likely a response to larger steelhead runs past Lower Granite Dam, largely a result of enhanced hatchery output (Mark Schuck, Washington Department of Fish and Game, personal communication). In comparison, 1997 estimated effort for the same 7

month period was approximately 89,000 angler hours. In spite of reduced hatchery production and relatively fewer returning adults in recent years compared to 1984-85 through 1986-87 (Lower Granite passage ranged from 99,000 to 133,000 steelhead for run years 1984 to 1986), the steelhead fishery has continued to develop in popularity.

Catch rates for steelhead anglers were similar in October and November, and were considerably higher than those observed during other months. Steelhead anglers attributed their high success rates to favorable river conditions beginning in mid-October as a result of reduced outflow from Hells Canyon Dam. Releases from Hells Canyon Dam were sustained at 9,000 cfs from mid-October through early December, compared to more than 20,000 cfs in mid-September through mid-October (Rick Bobier, Idaho Power Company, personal communication). Further, except in September, boat anglers consistently had better success rates for steelhead than shore anglers. Many boat anglers attributed their high angling success to the mobility associated with fishing from a boat and being able to fish river sections not accessible from shore. Use of a guide also produced higher steelhead success rates for boat anglers. In February, both boat and shore anglers experienced higher catch rates for steelhead when compared to January. As weather conditions generally improve in February, steelhead become more active prior to spawning, which probably contributed to better catch rates (Ted Bjornn, University of Idaho, personal communication).

Catch rates observed by steelhead anglers in the mid-Snake River above Asotin compared favorably with other regional steelhead fisheries in 1997. During the comparable October through November period of maximum use, steelhead anglers in Lower Granite Reservoir observed a mean catch rate of 0.044 fish/angler hour (Normandeau Associates et al. 1998), whereas steelhead anglers in the flowing water section observed a mean catch rate about four times higher (0.172 fish/angler hour). Similar results were found when steelhead catch rates were compared to those in Little Goose Reservoir (mean of 0.030 fish/angler hour), Lower Monumental Reservoir (0.048 fish/angler hour) and Ice Harbor Reservoir (0.353 fish/angler hour) from the corresponding time period.

Steelhead anglers on the mid-Snake River above Asotin also enjoyed higher catch rates than steelhead anglers on a comparable length of the mainstem Clearwater River from Lewiston to Orofino, ID. A comparison of monthly catch rates (CPE) for steelhead during October 1997 through March 1998 revealed that Clearwater River CPE ranged from 0.071 to 0.042 fish/hour (Kent Ball, Idaho Department of Fish and Game, personal communication), whereas monthly CPE in the unimpounded Snake river generally exceeded 0.10 fish/hour (Figure 3.5-6).

Comparisons of monthly catch rates with another regional tributary steelhead fishery were more variable. During September through December 1997, anglers in the Grand Ronde River observed a mean catch rate for steelhead of 0.127 fish/angler hour (Flesher *et al.*, 1998), compared to a mean of 0.163 fish/angler hour in the study area during the same period. However by January through March, catch rates for steelhead

in the Grande Ronde River (0.174 fish /angler hour) exceeded those for steelhead anglers in the unimpounded Snake River (0.105 fish/angler hour). Differences in monthly catch rates between adjacent fisheries were likely attributable to variations in angling methods (fewer jet boats and more fly fishing on the Grande Ronde River) and seasonal differences in the movement and activity levels of steelhead.

The sport fishery for resident species in the 48 km riverine section was largely supported by smallmouth bass (44% of anglers seeking resident fishes), northern pikeminnow (24%) and white sturgeon (20%). Other resident species contributed minimally to the sport fishery. Non-sport fishes (suckers, peamouth, and chiselmouth) were also caught throughout the sampling period, although they were rarely harvested, except for bait. Channel catfish were exclusively caught in fall, and were largely an incidental catch while steelhead fishing. A small number of anglers sought channel catfish in the spring but were unsuccessful.

Smallmouth bass was the most highly sought resident species in the free flowing Snake River during September to March. In particular, boat anglers accounted for 87.5% of the effort directed towards smallmouth bass. Many of these anglers seeking bass favored the upper river section between the confluence of the Grand Ronde River and the Oregon border because of better success rates. Smallmouth bass were mainly caught in September, although directed angling effort continued for bass in October. Boat anglers seeking smallmouth bass consistently had higher catch rates than shore anglers, possibly why more boat anglers sought smallmouth bass than did shore anglers.

The majority of smallmouth bass caught in the mid-Snake River were released (69%), although at a lower rate than determined for smallmouth bass in Lower Granite Reservoir from April to November (91% released; Normandeau Associates *et al.* 1999). Catch and release of smallmouth bass is common in many sport fisheries throughout the United States (Graff, 1987). However, the low retention rates observed in the mid-Snake River may reflect the small average size of bass typically caught. Limited information is available on the current status of the smallmouth bass population in the sample reach. Length frequency data collected by electrofishing indicated that smallmouth bass in the Snake River corridor from Asotin, Washington to the Oregon border were generally smaller in length than bass collected further upstream in the Hells Canyon reach (Cochnauer *et al.*, 1996). No size comparisons of smallmouth bass caught among upper and lower access sites from the creel data were made, as the number of bass measured by creel clerks was low.

Northern pikeminnow ranked second among resident species sought. Specifically, northern pikeminnow were sought in September and October by anglers participating in the "Sport Reward Program" coordinated by the Bonneville Power Administration, Portland, Oregon. This program rewards anglers with a tiered bounty system worth $3-5 for each pikeminnow (11 inches or greater) returned to a registration station. Between September 1 through October 17, 1997, as part of the reward program, anglers removed 3,905 qualifying (>11 inches) northern pikeminnow from the Snake River from the Clearwater River confluence to Hells Canyon Dam. The Snake River corridor

between Asotin, Washington, and the Oregon border, in particular, was a popular area for pikeminnow anglers (Mark Wachtel, Washington Department of Fish and Wildlife, personal communication). The high harvest rate of northern pikeminnow observed during September and October likely reflects those fish kept for bounty.

The seasonal and spatial trends in angler distribution largely reflect the shift from anglers seeking resident sport fishes to those seeking steelhead. Initially, angler distribution in September was fairly uniform along Asotin County Road 209, when about half (49.5%) of all anglers interviewed were seeking resident fishes (*i.e.*, smallmouth bass, northern pikeminnow, and white sturgeon). The shift to steelhead in October (97.5% of anglers interviewed sought steelhead) redistributed angling pressure to the upper river section near the Grand Ronde River confluence and to the lower river section adjacent to the town of Asotin. Steelhead typically concentrate in these areas and provide high catch rates that concentrate anglers (Art Viola, Washington Department of Fish and Game, personal communication). In March, anglers seeking resident species once again accounted for about half (46.3%) of the anglers interviewed, and these anglers were evenly distributed along the length of Asotin County Road 209.

Factors other than seasonality in angler preference also influenced the distribution of boat and shore anglers. In September, shore angler distribution throughout the 48 km river section also seemed to be a function of accessibility. Most shore anglers accessed the river from more than a dozen large pullout areas along Asotin County Road 209. These areas were often associated with trails that provided a convenient walk to the river. Privately owned sections of riverbank located in the middle of the sample area prevented some access by shore anglers, although these areas were comparatively small.

The fishing methods pursued by shore anglers also contributed to their distribution along the unimpounded Snake River. Among shore anglers, two separate groups were observed, those that preferred fly fishing and those that used spinning tackle. Each group seemed to choose different river sections based on river morphology and flow. Fly fishermen preferred areas where flow was parallel and close to the riverbank, while anglers fishing with spinning tackle preferred areas where river flow did not parallel the shore and created slack backwater pools. Further, most shore anglers along Asotin County Road 209 avoided fishing in large groups, and generally fished in small parties or individually even during the peak steelhead season. These anglers were "nomadic," and would travel the length of Asotin County Road 209, stopping frequently to fish secluded river sections. The exception were shore anglers observed at Heller Bar, often in large groups concentrated immediately downstream of the Grand Ronde River confluence. Such groups would generally remain in the Heller Bar area for the duration of their fishing trip.

Boat angler distribution in the unimpounded Snake River was concentrated at both ends of the sampling area. Most boat anglers were observed in the upper river section near the Grand Ronde River confluence and in the lowermost river section adjacent to Asotin, Washington. Developed boat launching facilities in Lower Granite Reservoir

closest to the lowermost river section in Lewiston (Hells Gate), Clarkston (Swallows Nest Park) and Asotin (Chief Looking Glass Park), and in the upper river section (Heller Bar) contributed to the high boater usage in these areas. The four undeveloped boat launches along Asotin County Road 209 were most frequently used in September by boat anglers seeking resident fishes, but received only minimal use later in fall and winter by steelhead anglers. Boat anglers that launched from these undeveloped boat launches generally used small craft, were less mobile, and fished in the immediate area of the boat launch.

River morphology and flow had less of an effect on distribution of boat anglers than shore anglers. Boat anglers would typically seek areas below rapids or large pools where flow was more consistent. However, many boat anglers were also observed drifting in long river sections and fishing in all types of river habitats. Decreased river flows beginning in mid-October seemed to have little effect on boat angler distribution in the study area.

The survey results are considered to be precise with relatively small confidence intervals, and aerial observations are predicted to be within 95% of the actual number of anglers. The aerial survey provided an excellent means to quickly assess angler distribution throughout the unimpounded Snake River, and to maximize the efficiency and focus of the ground survey effort. The combined aerial and ground surveys worked well. Sample sizes were generally large enough to provide good precision and represent the angler populations. The development and use of a modified phone survey greatly increased sampling efficiency for completed trip information, particularly from the more "nomadic" anglers at undeveloped access sites along Asotin County Road 209. Anglers readily cooperated with the phone survey even though many anglers were contacted more than once. Anglers did not likely inflate their reports of success, although no effort was made to verify the accuracy of the phone data.

The estimates of angler effort are considered slightly conservative because ratio estimators were used to adjust aerial counts. Ideally, aerial counts should have been made during all hours in a stratum, although the cost would have been unrealistically high. As it was, flights occurred during the peak periods and, consequently, data were adjusted for non-flight hours. Simultaneous counts of aerial and ground observations were taken for both A.M. and P.M. time intervals for certain days of each month. Because of differences in sightability of shore and boat anglers, separate ratio estimators were needed. However, ratios derived for both A.M. and P.M. periods and for weekends and weekdays were consistent and, therefore, combined. Aerial counts were generally higher than the corresponding ground counts, probably because of better sightability from the air or uncooperativeness of anglers during ground surveys.

Care must be taken when evaluating results for the resident species sport fishery. The unimpounded Snake River angler survey was intended to assess the recreational sport fishery that exists during the fall and winter months for steelhead. Thus, the sport fishery observed in the mid-Snake River was characterized predominantly by steelhead

angling. The results, while accurately portraying the resident species fishery, are limited to the September- March time frame. However, the sport fishery in the mid-Snake River typically supports the largest amount of angler effort for resident fishes during the months of April through July (Larry Barrett, Idaho Department of Fish and Game, personal communication).

5.0 Estimate of Recreational Steelhead Angling Use and Value In A Restored Lower Snake River

The natural river alternative proposed by the U.S. Army Corps of Engineers (Corps) as a part of the *Lower Snake River Juvenile Salmon Migration Feasibility Study* would return the areas currently encompassed by the four lower Snake River reservoirs to an unimpounded river channel. Adoption of this alternative would eliminate all existing reservoir fisheries, including those for steelhead, that have developed during more than three decades. The immediate and long-term effects of dam breaching on the resulting steelhead fishery and corresponding angler use are largely unknown. As a result, both quantitative and observational data collected in the 48-km unimpounded "surrogate" reach were applied to evaluate the potential recreational steelhead fishery use that will develop if the lower Snake River reservoirs were returned to a riverine condition. The predicted use estimate was then combined with the "willingness-to-pay" (WTP) value determined for a steelhead angler in the accompanying economic report (Part 2 of the Phase II study) to estimate the potential monetary worth of the steelhead sport fishery in a restored lower Snake River.

This section briefly reviews and compares the steelhead sport fisheries and corresponding angler use determined during the Phase I and Phase II studies, and addresses those assumptions needed to predict future angler use. The Phase I (lower Snake River reservoirs) investigations are reported in the initial section of the overall UVS. The short-term and long-term angler use and monetary worth expected with adoption of the natural river alternative are then projected based on the current recreational steelhead fishery characteristics determined for the designated "surrogate" reach. The subsequent discussion of these estimates addresses those factors expected to influence the amount of fishing in the restored reach and potential success rates.

5.1 Comparative Angler Use- Reservoir versus Unimpounded Snake River

Angler use estimates for September through November 1997 were comparable between the reservoir system and the unimpounded Snake River when standardized by respective reach length (1,578 versus 1,473 hours/km), but not when based on surface area (Table 5-1). On an area basis, use in the flowing water section was about 2.8 times (68.4 versus 24.7 hours/ha) that observed in the reservoirs. Anglers fishing for steelhead in the reservoirs concentrated in a relatively few distinct areas, usually

immediately above or below a hydroelectric dam or near a river confluence. Other, more expansive areas along the reservoir corridor were virtually unused. Steelhead anglers in the unimpounded Snake River, while also concentrated in some areas, were generally distributed more evenly along the entire length of the study area and fished more secluded river sections. This difference in angler distribution probably reflects the greater diversity of steelhead fishing opportunities in the flowing river section.

Table 5-1
Comparison of Angler Use, Catch Rates (CPE), and Harvest Rates (HPE), Between Lower Snake River Reservoirs and the Unimpounded Snake River During September through November 1997

Reservoir	Angler Hours	Percent of Seasonal Total*	Surface Area (ha)	Hours/ha	Reach Length (km)	Hours/km	CPE (Catch/ Hour)	HPE (Harvest/ Hour)
Ice Harbor	68,330	64.3	3,723	18.4	51.5	1,327	0.032	0.027
Lower Monumental	65,608	70.9	2,667	24.6	46.2	1,420	0.046	0.041
Little Goose	21,814	31.2	4,057	5.4	59.9	364	0.028	0.028
Lower Granite	191,899	87.0	3,602	53.3	62.8	3,056	0.04	0.027
Reservoirs Combined	347,651	71.1	14,049	24.7	220.3	1,578	0.039	0.030
Unimpounded Reach	70,695	79.5	1,033	68.4	48.0	1,473	0.1690	0.1037

*Reservoir fishing season is April through November. Unimpounded reach fishing season is September through March.

Angler success for steelhead was considerably higher in the unimpounded Snake River than in the reservoirs. Catch and harvest rates of steelhead anglers in the unimpounded reach were about 4.3 and 3.4 times better, respectively, than those determined for reservoir anglers (Table 5-1). One possible reason for improved angler success in the flowing water reach compared to the reservoirs may be the density of fish. The flowing river section surface area was about 14 times smaller than the combined reservoir surface area, thus steelhead were in higher concentration and easier for anglers to locate and catch. Another reason for higher catch and harvest rates may be related to the use of guides by anglers in the unimpounded river. It was found during October and November that more than 29% of all boat anglers in the "surrogate" reach used a guide, while the use of guides by reservoir anglers was negligible. Boat anglers that used guides experienced up to three times higher catch and harvest rates than anglers fishing from private craft.

Along with higher use of guides, anglers from a wider geographic area participated in the steelhead fishery in the "surrogate" section. During the peak of steelhead season, anglers traveling from outside the immediate region accounted for 70% of angler use in the unimpounded Snake River, whereas the reservoir sections consisted of primarily local anglers. Among steelhead anglers that participated in guided trips, 93.3% traveled

to the flowing water reach from outside the immediate areas of central Idaho and southeastern Washington. Most prominently, anglers traveled from the population centers north of the area such as Spokane, Coeur d'Alene, and Moscow-Pullman, and from the Seattle-Tacoma metropolitan areas west of the Cascades. Additionally, the unimpounded section probably provided a more aesthetically pleasing experience for anglers along with higher catch and harvest rates. Anglers in the unimpounded section also participated in a more "traditional" riverine fishery for steelhead than in the reservoirs. For example, anglers using fly rods formed about 9% of those interviewed in the flowing water section, while fly fishing in the reservoirs was virtually absent.

Another difference between steelhead fisheries related to techniques was that night steelhead fishing was virtually absent on the unimpounded Snake River. Only a few shore anglers, primarily early in the season, and no boat anglers fished for steelhead at night. In contrast, a substantial night steelhead fishery flourished in the reservoirs, principally in Lower Granite Reservoir, where 9.1% (16,520 hours) of angler effort during September through November was at night. Anglers in the reservoir night fishery also experienced higher catch and harvest rates than steelhead anglers fishing during daylight.

5.2 Assumptions for Estimating Angler Use

The variability associated with dam breaching, such as potential changes in access to the river and annual differences in run size and timing, make any projection of angler use in a normative lower Snake River difficult. At a minimum, uncertainty related to these two factors appears critical to any prediction of future angler behavior. Therefore, before a valid, meaningful projection of angler use could be achieved, two assumptions were made.

The first assumption was that yearly adult run sizes remain at least similar to those observed since the early 1980's when hatchery steelhead supplementation was initiated. In theory, the natural river alternative would increase smolt survival during out-migration by eliminating juvenile salmonid mortality associated with passage through the series of lower Snake River hydroelectric dams and reservoirs.

Given these assumptions, it was considered whether steelhead angling in the unimpounded Snake River has reached equilibrium, and whether there is potential for additional growth in the restored, normative river. From 1984-85 to 1986-87, steelhead angling use in the unimpounded reach above Asotin increased at a rate of nearly 21,000 angler hours per season (September-March; Mendel and Aufforth, 1985; Mendel *et al.*, 1987, 1988). Such rapid growth in angler use during the mid-1980s was likely a response to larger steelhead runs over Lower Granite Dam, largely a result of enhanced hatchery output (Mark Schuck, Washington Department of Fish and Wildlife, personal communication). Comparing the 1997 angler use estimates with those estimated during the mid-1980s, estimated angler use has continued to increase over the past 12 years, but at a mean rate of only about 1,800 angler hours per season. These results,

combined with field observations of high angler density in many areas, suggest that current angler use has probably reached saturation in the study reach above Asotin. It is unlikely that significant numbers of additional anglers could be accommodated. Using the flowing water reach as a surrogate, current use levels may also represent the potential saturation point, in terms of hours/km, for predicting angler use in a restored lower Snake River.

5.3 Predicted Angler Use in a Restored Lower Snake River

The maximum predicted usage of the steelhead sport fishery in a normative lower Snake River for the September to November peak fishing period is estimated at 324,060 hours, based on an effort density of 1,473 hours/km. The predicted usage is 6.8% less than the 1997 reservoir-wide effort estimate of 347,651 hours for a comparable fishing period (Table 5-1). Over a full steelhead season (September to March) predicted usage may exceed 407,600 hours if temporal patterns of usage determined above Asotin during winter were maintained in the restored river section. The predictions assume that the current density of steelhead anglers above Asotin has reached saturation. However, there are no other recent, quantitative use estimates available to frame inter-annual variability in participation, which is dependent on annual run size as well as river and weather conditions.

The predicted use estimate was based on angling, primarily for steelhead, during the September to March time period. Angler density estimates forming the basis of projections include some fishing directed at resident species such as smallmouth bass, although it is likely interest in smallmouth bass angling had largely waned by September when the survey began. There are no data available for the unimpounded reach above Asotin to enable projections of the amount of angling that will take place for species other than steelhead in the restored reach during other times of the year (*i.e.*, during April through August). However, available unpublished information suggests that smallmouth bass fishing is popular in the unimpounded reach during spring and summer (Larry Barrett, Idaho Department of Fish and Game, personal communication). Moreover, the Sport Reward Program stimulates effort upstream of Asotin that targets northern pikeminnow. The amount of use directed at resident species during April through August in 140 miles of restored river could be substantial.

5.4 Predicted Sport Fishery Value in a Restored Lower Snake River

The final objective of the Phase II study is to predict the monetary worth of the salmonid sport fishery in a restored lower Snake River. The individual economic or trip-related values utilized to calculate the predicted worth are provided in Part 2 of the Phase II report, along with methods of calculation. The number of unique anglers (regardless of repeat trips) is determined by dividing the predicted use estimated in Section 5.3 (above) by the "hours fished per season," or 407,600 hours/96.24 hours per season per angler. The resultant value is 4,235 unique anglers. The number of unique anglers (4,235), when multiplied by the WTP determined for a unique angler ($442), yields $1,871,870, the estimated monetary worth of the sport fishery, targeting principally steelhead from September through March, expected to develop in a restored lower

Snake River. By comparison, the estimated worth of the existing reservoir sport fishery is $1,956,560 (Part 2 of Phase I report). Although there are differences between the discrete time frames (months) represented by these two worth estimates, the overlap during September through November in the respective peak period of use for each fishery is sufficient to suggest that the potential value of the sport fishery in a restored lower Snake River would be at least comparable to that of the current reservoir sport fishery. The additional worth represented by spring/summer angling for resident fish enhances the potential value of the restored lower Snake River.

5.5 Discussion

Angler use on a linear basis (hours/km) in the restored lower Snake River may eventually closely resemble angler use estimates in the "surrogate" free flowing reach. However, both initial and long-term angler use may further depend on the response of current and future anglers to a restored Snake River. Implementing the natural river alternative will alter existing river morphology. Such a dramatic change will present an assortment of new angling opportunities for some, while creating a significant challenge for others. For example, anglers that have developed and learned techniques to maximize their success catching steelhead in the reservoirs may be unwilling or unable to adapt to fishing conditions in the riverine environment. Concurrently, extending the unimpounded Snake River 220 km downstream will likely attract anglers that prefer fishing for steelhead in a more natural setting. Future steelhead angling would be greatly influenced by angler response to new conditions, however predicting the degree to which either of these scenarios occurs is difficult.

Initially, several factors will depress angler use in the recreational steelhead fishery in a normative river. In particular, reduced access and unstable river conditions are likely to have the most immediate and detrimental effects on angler use. In 1992, during the test drawdown of Lower Granite and Little Goose reservoirs, shorelines that accumulated sediment were exposed to the air resulting in riverbank slumping and turbid flows. Also during the drawdown, close access to the main river channel was difficult because developed boat-launching facilities constructed after impoundment were unusable as a result of the lower water level. Similar adverse conditions would persist for several years and deter potential angler use immediately after dam breaching if the natural river alternative were implemented.

Several years may be required for the river channel to stabilize and in-river conditions improve (Michael Falter, University of Idaho, personal communication). Meanwhile, steelhead anglers that traditionally fished in the lower Snake River reservoirs may, in response to the limited access and poor fishing conditions, temporarily transfer their effort to other regional steelhead fisheries (*i.e.*, mid and upper Snake River, Grande Ronde River, Clearwater River, Tucannon River, Salmon River). However, it is likely that some steelhead angling use will occur relatively soon in the restored Snake River,

and that it will be primarily by shore anglers in areas with suitable shoreline access. Boat angling will likely respond more slowly, due to the time required to restore boat ramps and for anglers to become familiar with navigating a new channel configuration. Regardless, angler use in a restored lower Snake River would probably be initially low until suitable river conditions occur.

Exacerbating the initial decline in angler use will likely be a substantial reduction in night fishing for steelhead in a restored Lower Snake River; navigating an unimpounded river at night is hazardous. However, some amount of night fishing for steelhead may continue in the well-illuminated areas near the Clearwater River-Snake River confluence near the towns of Lewiston, Idaho, and Clarkston, Washington. This area is expected to retain a high concentration of usable boat landings (Brown, 1997). However, nighttime use in this area will ultimately depend on the number and extent of navigable pools suitable for boating.

As the river channel stabilizes and angler access improves, steelhead angler use in the normative Snake River will increase. Initially, anglers may be reluctant to venture into the more remote reaches of the newly-restored, unimpounded river, and will likely concentrate in areas previously popular during the reservoir fishery (*i.e.*, tributary confluences). In particular, the Lewiston/Clarkston area will probably receive the most intensive angler use, as it does today (Table 5-1). Secondarily, the restored river nearest the Tri-Cities will support substantial steelhead angling due to the proximity of a regional population center. Eventually, as anglers learn where fish concentrate and develop techniques to maximize their steelhead fishing success, angler use will become more evenly distributed throughout the restored Snake River.

Based on observations of use patterns in the free flowing study area, shore anglers will likely concentrate in areas with road access. Unlike the 48-km flowing water section, however, good road access near steelhead holding areas may be limited or unavailable. Thus, shoreline angling will likely remain discontinuous, or clumped. In contrast, boat anglers will be less confined and may travel to sections inaccessible from shore, as they do now to river reaches upstream of Heller Bar. Therefore, given the limited road access expected after dam breaching in many areas of the lower Snake River, the steelhead fishery in the restored Snake River is expected to be primarily boat-based.

A greater diversity of anglers and angling opportunities will develop in the lower Snake River if the natural river alternative were implemented. Extending the unimpounded Snake River 220 km downstream will likely attract anglers that prefer steelhead fishing in a more natural system. Specifically, the number of fly fishermen seeking steelhead should increase, as will the development or extension downstream of guide services. An increase in such "traditional" angling opportunities associated with the normative river will likely also attract anglers from a wider geographic area than presently use the

reservoirs. In particular, the availability of a large, traditional steelhead fishery on an unimpounded river less than a one-half day drive from the Portland and Seattle-Tacoma metropolitan centers west of the Cascades will attract anglers similar to the current attraction of Spokane anglers to the Snake River above Asotin. However, development of these more specialized steelhead fisheries will likely come at the expense of the more easily accessed, widely available, reservoir fisheries.

Anglers in a restored lower Snake River will likely experience higher catch and harvest rates than before dam breaching. The principal reason for this will be that the reduced surface area of the restored river should facilitate locating and catching steelhead. Also, the harassment factor associated with high angler concentrations observed in the reservoir fishery (*i.e.*, at the Snake River-Clearwater River confluence) should be minimized, as anglers would be more dispersed throughout a restored lower Snake River. Furthermore, use of guides may also contribute to improved success rates.

As angler use increases in the restored lower Snake River, a reduction of use may occur along sections of the river upstream from the reservoirs. Angler use upstream of Asotin may decline if current anglers shift some of their effort to the restored lower sections. In addition, improved steelhead fishing success by downstream anglers may reduce the number of fish available in the upper river reaches, potentially leading to reduced catch and harvest rates.

In summary, a substantial steelhead sport fishery with approximately 407,600 angler hours of effort and a monetary worth of $1,871,870 will eventually develop in response to restoring the lower Snake River to an unimpounded condition. However, the immediate effects of unstable river banks, turbid water conditions, and lack of suitable access related to dam breaching may initially reduce angler use to below that observed in the current reservoir fishery. Only when river conditions improve and anglers learn how and where to maximize their success catching steelhead in the restored Snake River will angler use increase and approach current levels. As angler use in the restored lower river section becomes established, usage in other river sections will probably decrease. The net result of dam breaching on the steelhead sport fishery would be a wider distribution of anglers throughout the 220 km restored section, a fishery of higher aesthetic quality and diversity with greater appeal to non-local anglers, and potentially higher catch and harvest rates.

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APPENDIX A

Appendix Table A-1
Access Points Used By Anglers to Fish the Snake River Above Asotin, Washington

Lower Granite Reservoir

- Swallows Nest Park - ACOE access, Clarkston, Washington
- Hells Gate Park - State Park, Lewiston, Idaho
- Chief Looking Glass Park, Asotin, Washington

These three developed launches represent the only sites on upper Lower Granite reservoir used by anglers to access the free-flowing Snake River.

Free-Flowing Snake River

- Heller Bar - large developed site near the Snake River-Grande Ronde River confluence

There are four informal, undeveloped boat launches used by boat and shore anglers along County Road 209. The names reflect those of nearby landmarks, as the sites have no formal names.

- Asotin ramp - located at the south end of Asotin next to the baseball field.
- Couse Creek ramp - located at the confluence of Couse Creek, about midway between Asotin and Heller Bar.
- Coral Run ramp - located 0.25 mile upriver from Buffalo Rapids (named by fly anglers).
- Idaho Fish and Game House ramp - located opposite the Idaho Fish and Game House, about 2 miles upstream of Coral Run.

Appendix Table A-2
Length-Weight Equations Used to Calculate Fish Weights in Lower Snake River Reservoirs

Species	Length-Weight Equations	Source
Smallmouth bass	log wt. = -5.843 + 3.239*log (length)	Knox (1982)
Channel catfish	log wt. = -5.510 + 3.202*log (length)	Knox (1982)
Common carp	log wt. = -4.489 + 2.875*log (length)	Knox (1982)
Largescale sucker*	log wt. = -5.341 + 3.126*log (length)	Knox (1982)
Bridgelip sucker*	log wt. = -5.341 + 3.126*log (length)	Knox (1982)
Chiselmouth*	log wt. = -5.341 + 3.126*log (length)	Knox (1982)
Peamouth*	log wt. = -5.341 + 3.126*log (length)	Knox (1982)
Northern pikeminnow	log wt. = -5.341 + 3.126*log (length)	Knox (1982)
Rainbow trout	log wt. = -4.149 + 2.621*log (length)	Knox (1982)
Adult steelhead	log wt. = -5.057 + 3.063*log (length)	Carlander (1969)

Appendix Table A-3
Geographic Regions and Cities Used in Analysis of Angler Zip Codes

Zip Codes	Geographic Region	Prominent Cities
832,833,834,836,837	Southern Idaho	Boise, Twin Falls, Pocatello
835,994	Central Idaho, Southeast Washington	Lewiston, Idaho; Clarkston, Asotin, Washington
838,990-992	Northern Idaho, Northeast Washington	Coeur d'Alene, Idaho; Spokane, Washington, and vicinity
980-986	Western Washington	Seattle, Tacoma, Olympia, Vancouver
988,989	Central Washington	Wenatchee, Yakima
993 only	Southeast Washington	Tri-Cities, Walla Walla, Pullman, Colfax
970-977	Central, Western Oregon	Portland, Eugene, Corvallis
978-979	Eastern, Northeast Oregon	Pendleton, Milton-Freewater
All other US zip codes	Montana, California, other states	--
Canadian Postal Codes	Canada	--

APPENDIX B - Data Tables

Appendix Table B-1
Estimated Monthly Angler Hours and 95-Percent Confidence Intervals in the Unimpounded Snake River
From Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Month	Shore Anglers		Boat Anglers		Combined Anglers	
	Total Angler Hours	95% CI (+/-)	Total Angler Hours	95% CI (+/-)	Total Angler Hours	95% CI (+/-)
September	1,846	805	3,158	172	5,004	823
October	5,660	1,823	20,722	4,050	26,382	4,441
November	3,361	1,320	35,948	3,115	39,309	3,384
December	1,268	939	10,491	1,002	11,759	1,373
January	1,679	1,059	2,727	398	4,407	1,131
February	577	157	882	216	1,459	267
March	267	242	353	229	620	333
Total	**14,658**	**2,792**	**74,281**	**5,234**	**88,940**	**5,933**

Appendix Table B-2
Estimated Monthly Total Angler Catch and Harvest with 95-Percent Confidence Intervals
For the Unimpounded Snake River from Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Month	Shore Anglers				Boat Anglers				Total Anglers			
	Angler Catch	95% CI (+/-)	Angler Harvest	95% CI (+/-)	Angler Catch	95% CI (+/-)	Angler Harvest	95% CI (+/-)	Angler Catch	95% CI (+/-)	Angler Harvest	95% CI (+/-)
September	444	192	169	66	3,268	173	1,621	89	3,712	688	1,790	349
October	892	286	606	195	6,094	1,170	3,766	733	6,987	1,132	4,372	719
November	279	110	105	46	6,959	676	4,217	393	7,239	677	4,322	386
December	137	100	49	39	1,606	155	1,118	104	1,743	203	1,166	130
January	253	125	41	26	302	45	200	25	555	131	242	52
February	46	8	38	4	218	48	77	19	264	53	115	21
March	60	37	0	4	33	27	19	9	92	43	19	10
Total	**2,111**	**360**	**1,008**	**165**	**18,481**	**1,345**	**11,018**	**780**	**20,592**	**1,376**	**12,026**	**771**

Appendix Table B-3
Estimated Catch and Harvest of the Principal Sport Fishes
In the Unimpounded Snake River from Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Month	Shore Anglers				Boat Anglers				Combined Anglers			
	Total Catch	Percent of Total	Total Harvest	Percent of Total	Total Catch	Percent of Total	Total Harvest	Percent of Total	Total Catch	Percent of Total	Total Harvest	Percent of Total
Smallmouth bass	57	2.7%	6	0.6%	1,480	8.0%	471	4.3%	1,537	7.5%	477	4.0%
Channel catfish	23	1.1%	0	0.0%	156	0.8%	43	0.4%	179	0.9%	43	0.4%
Sucker spp.*	202	9.6%	19	1.9%	762	4.1%	1	0.0%	965	4.7%	22	0.2%
Northern pikeminnow	323	15.3%	217	21.5%	2,907	15.7%	2,310	21.0%	3,230	15.7%	2,527	21.0%
Rainbow trout	34	1.6%	0	0.0%	64	0.3%	6	0.1%	99	0.5%	6	0.05%
Adult steelhead	1,430	67.7%	748	74.2%	12,669	68.6%	8,187	74.3%	14,099	68.5%	8,935	74.3%
White sturgeon	0	0.0%	0	0.0%	122	0.7%	0	0.0%	122	0.6%	0	0.0%
Other	42	2.0%	18	1.8%	321	1.7%	0	0.0%	361	1.8%	16	0.1%
All species**	**2,111**		**1,008**		**18,481**		**11,018**		**20,592**		**12,026**	

*Includes largescale and bridgelip sucker.
**May include species not listed (*i.e.*, common carp, chiselmouth, peamouth, crappie).

Appendix Table B-4
Harvest (Number/Unit) and Yield (Biomass/Unit) Estimates of Sport Fishes
In the Unimpounded Snake River from Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Species	Harvest				Yield			
	No./km	No./hectare	No./mile	No./acre	kg/km	kg/hectare	lb/mile	lb/acre
Smallmouth bass	9.9	0.5	15.9	0.2	2.51	0.12	8.86	0.10
Channel catfish	0.9	0.0	1.4	0.0	1.60	0.07	5.64	0.07
Sucker spp.*	0.5	0.0	0.7	0.0	0.05	0.02	1.79	0.02
Northern pikeminnow	52.7	2.5	84.2	1.0	29.01	1.35	102.32	1.20
Rainbow trout	0.1	0.0	0.2	0.0	0.02	0.001	0.06	0.001
Adult steelhead	186.2	8.7	297.8	3.5	--	--	--	--
White sturgeon	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00
Other	0.3	0.0	0.5	0.0	0.08	0.004	0.30	0.003
All species**	**250.2**	**11.7**	**400.3**	**4.7**	**33.73**	**1.57**	**118.97**	**1.39**

*Includes largescale and bridgelip sucker.
**May include species not listed (*i.e.*, common carp, chiselmouth, peamouth).

Appendix Table B-5
Monthly Catch and Harvest Rates for Boat, Shore, and Combined Anglers
For the Unimpounded Snake River from Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Month	Shore Anglers		Boat Anglers		Total Anglers	
	Catch Rate	Harvest Rate	Catch Rate	Harvest Rate	Catch Rate	Harvest Rate
September	0.239 (0.016)	0.082 (0.025)	1.005 (0.009)	0.520 (0.011)	0.836 (0.005)	0.424 (0.006)
October	0.157 (0.004)	0.107 (0.005)	0.289 (0.001)	0.181 (0.001)	0.255 (0.001)	0.162 (0.001)
November	0.083 (0.005)	0.035 (0.006)	0.217 (0.000)	0.126 (0.000)	0.200 (0.000)	0.114 (0.000)
December	0.107 (0.012)	0.042 (0.011)	0.155 (0.002)	0.104 (0.005)	0.148 (0.001)	0.095 (0.001)
January	0.118 (0.005)	0.025 (0.008)	0.114 (0.005)	0.062 (0.005)	0.116 (0.002)	0.046 (0.002)
February	0.051 (0.065)	0.026 (0.079)	0.221 (0.005)	0.086 (0.005)	0.198 (0.004)	0.077 (0.004)
March	0.154 (0.084)	0.015 (0.138)	0.116 (0.046)	0039 (0.057)	0.129 (0.021)	0.031 (0.027)
Total	**0.129 (0.011)**	**0.059 (0.016)**	**0.257 (0.003)**	**0.149 (0.003)**	**0.225 (0.005)**	**0.126 (0.006)**

Appendix Table B-6
Overall Catch and Harvest Rates for the Principal Sport Fish
From the Unimpounded Snake River from Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Month	Shore Anglers (N=504)				Boat Anglers (N=1,513)				Total Anglers (N=2,017)			
	Catch Rate (CPE)	95% CI (+/-)	Harvest Rate (HPE)	95% CI (+/-)	Catch Rate (CPE)	95% CI (+/-)	Harvest Rate (HPE)	95% CI (+/-)	Catch Rate (CPE)	95% CI (+/-)	Harvest Rate (HPE)	95% CI (+/-)
Smallmouth bass	0.0033	0.0033	0.0004	0.0008	0.0228	0.0170	0.0070	0.0059	0.0187	0.0135	0.0056	0.0047
Channel catfish	0.0012	0.0018	0.0000	0.0000	0.0023	0.0011	0.0006	0.0006	0.0020	0.0009	0.0005	0.0005
Sucker spp.*	0.0128	0.0071	0.0012	0.0014	0.0110	0.0041	0.0003	0.0006	0.0113	0.0036	0.0005	0.0006
Northern pikeminnow	0.0194	0.0254	0.0132	0.0249	0.0480	0.0235	0.0379	0.0218	0.0421	0.0194	0.0328	0.0181
Rainbow trout	0.0025	0.0023	0.0000	0.0000	0.0012	0.0008	0.0001	0.0002	0.0015	0.0008	0.0001	0.0000
Adult steelhead	0.0868	0.0176	0.0459	0.0100	0.1665	0.0183	0.1037	0.0101	0.1501	0.0151	0.0917	0.0084
White sturgeon	0.0000	0.0000	0.0000	0.0000	0.0024	0.0013	0.0000	0.0000	0.0019	0.0010	0.0000	0.0000
Other	0.0025	0.0043	0.0004	0.0008	0.0045	0.0052	0.0000	0.0000	0.0024	0.0027	0.0001	0.0002
Total	**0.1285**	**0.0618**	**0.0611**	**0.0379**	**0.2587**	**0.0713**	**0.1496**	**0.0392**	**0.2300**	**0.0570**	**0.1314**	**0.0325**

*Includes largescale and bridgelip suckers.

Appendix Table B-7
Directed Catch (CPE) and Harvest (HPE) Rates For Selected Species
In the Unimpounded Snake River from Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Species Sought	Shore Anglers					Boat Anglers					Total Anglers				
	N*	Catch Rate (CPE)	95% CI (+/-)	Harvest Rate (HPE)	95% CI (+/-)	N	Catch Rate (CPE)	95% CI (+/-)	Harvest Rate (HPE)	95% CI (+/-)	N	Catch Rate (CPE)	95% CI (+/-)	Harvest Rate (HPE)	95% CI (+/-)
Smallmouth bass	5	0.442	0.724	0.000	0.000	28	1.155	0.996	0.378	0.361	33	1.047	0.955	0.321	0.306
Channel catfish	2	0.000	0.000	0.000	0.000	2	0.000	0.000	0.000	0.000	4	0.000	0.000	0.000	0.000
Northern pikeminnow	0	0.000	0.000	0.000	0.000	18	1.861	0.624	1.763	0.586	18	1.861	0.624	1.763	0.586
Adult steelhead	491	0.088	0.018	0.047	0.010	1436	0.175	0.019	0.109	0.010	1927	0.153	0.019	0.093	0.010
White sturgeon	3	0.000	0.000	0.000	0.000	12	0.050	0.050	0.000	0.000	15	0.040	0.040	0.000	0.000

*The number of anglers seeking a particular species.

Appendix Table B-8
Monthly Directed Catch (CPE) and Harvest (HPE) Rates for Smallmouth Bass, Northern Pikeminnow, and Adult Steelhead
In the Unimpounded Snake River From Asotin, Washington, to the Oregon/Washington Border
September through March 1997-1998

Months		Smallmouth Bass			Northern Pikeminnow			Adult Steelhead		
		Shore Anglers	Boat Anglers	Combined Anglers	Shore Anglers	Boat Anglers	Combined Anglers	Shore Anglers	Boat Anglers	Combined Anglers
September	CPE	1.030	1.170	1.160	0.000	1.654	1.654	0.188	0.017	0.109
	HPE	0.000	0.383	0.355	0.000	1.530	1.530	0.086	0.008	0.050
October	CPE	0.000	0.000	0.000	0.000	2.358	2.358	0.100	0.199	0.170
	HPE	0.000	0.000	0.000	0.000	2.318	2.318	0.070	0.113	0.100
November	CPE	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.196	0.173
	HPE	0.000	0.000	0.000	0.000	0.000	0.000	0.033	0.126	0.111
December	CPE	0.000	0.000	0.000	0.000	0.000	0.000	0.092	0.148	0.137
	HPE	0.000	0.000	0.000	0.000	0.000	0.000	0.034	0.104	0.091
January	CPE	0.000	0.000	0.000	0.000	0.000	0.000	0.090	0.101	0.096
	HPE	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.062	0.044
February	CPE	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.129	0.115
	HPE	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.087	0.076
March	CPE	0.000	0.000	0.000	0.000	0.000	0.000	0.041	0.071	0.060
	HPE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.035	0.023

APPENDIX C - Length Data

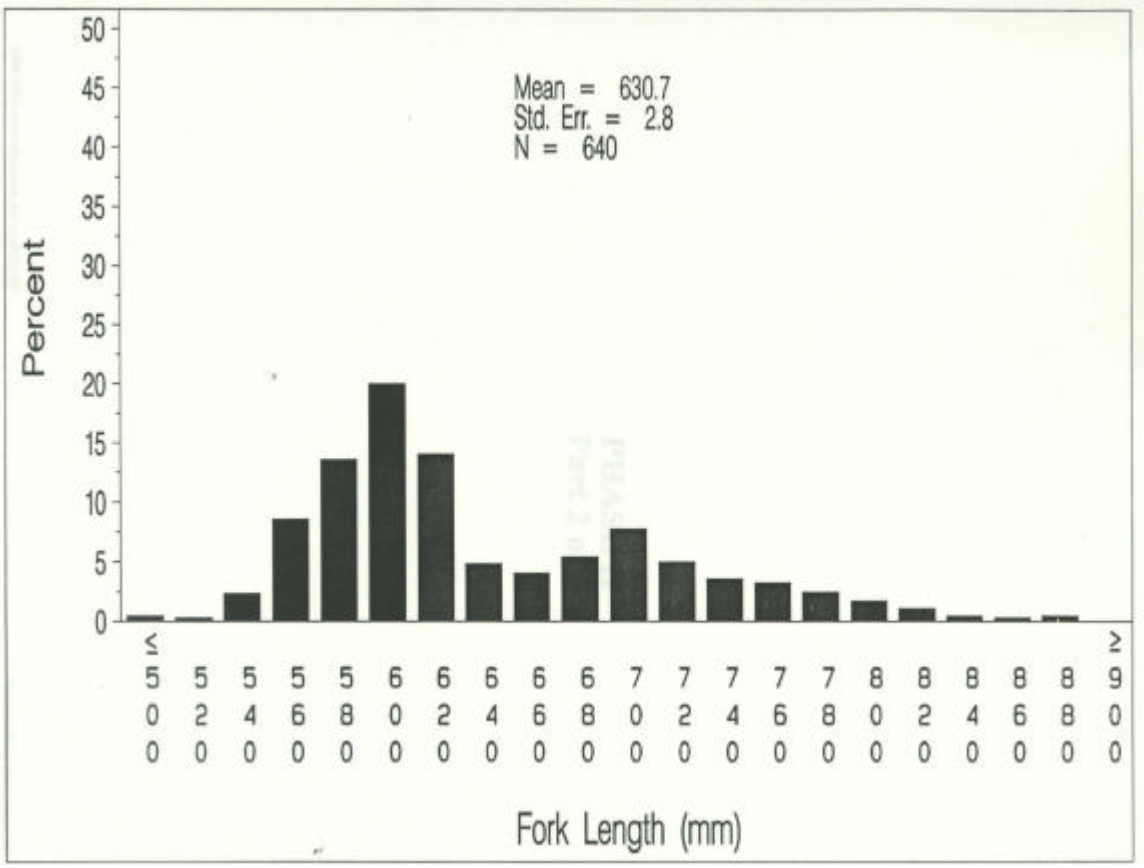

Figure C-1. Length frequency distribution of adult steelhead kept by anglers.