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US Army Corps of Engineers
Walla Walla District

SPORT FISHERY USE AND VALUE ON LOWER SNAKE RIVER RESERVOIRS

PHASE I REPORT : PART 1 RESERVOIR SPORT FISHERY DURING 1997

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PREPARED FOR:
Department of the Army
Corps of Engineers
Walla Walla District
201 North Third Avenue
Walla Walla, Washington 99362

PREPARED BY:
Normandeau Associates
1921 River Road, P.O. Box 10
Drumore, Pennsylvania 17518

University of Idaho
Department of Fish and Wildlife
Moscow, Idaho 83844

and

Agricultural Enterprises, Inc.
P.O. Box 120
Masonville, Colorado 80541

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EXECUTIVE SUMMARY

A creel survey of the sport fisheries in the four lower Snake River reservoirs was conducted from April through November 1997 as part of the *Lower Snake River Feasibility Study*. A combination of aerial flights and in-person interviews at access points throughout the nearly 140-mile reach was used to estimate angler effort, catch and harvest, catch and harvest rates, and various angler attributes. Interviewed anglers were also asked to participate in follow-up economic surveys that were used to determine the monetary worth of reservoir sport fishing.

During April and May, most fishing pressure occurred in backwater inlets and stocked mitigation ponds adjacent to the reservoirs. These side-channel areas received substantial pressure into June, but by the end of June, more anglers fished in the reservoirs. Angler counts peaked in late June and early July. Fishing pressure declined during August, and remained low until September 1, when steelhead harvest season opened. Angling pressure subsequently increased steadily from September through November, when the reservoir survey concluded. Occasional aerial flights during December through March observed angling at favored steelhead angling sites. By March, the cycle began to repeat itself, with anglers returning to side-channel areas.

A total of 111,461 angler trips produced an estimated 489,215 hours of effort on the four reservoirs. Lower Granite reservoir received the most fishing effort (220,605 hours), followed by Ice Harbor reservoir (106,281 hours), Lower Monumental reservoir (92,520), and Little Goose reservoir (69,809). Monthly angling use increased from 15,327 hours in April to 166,888 hours in November. Little Goose reservoir received the most use during the spring and summer, whereas Lower Granite reservoir experienced the most use from September through November. More than 70% as much effort was expended by boat anglers (308,546 hours) as shore anglers (180,669 hours). Ice Harbor reservoir supported the highest proportion of use by shore anglers (63,350 hours), whereas Lower Granite reservoir received the highest boat angling effort (181,544 hours).

Night angling occurred throughout the four reservoirs, although principally in Ice Harbor reservoir in the summer months and Lower Granite reservoir from mid-August through November. The focal point of night angling in Lower Granite reservoir was the Snake River-Clearwater River confluence area.

Reservoir anglers caught an estimated 140,358 fish, and harvested 83,066 (59.2%). Seasonally, catch and harvest were highest in July and lowest in October and November. The highest catch occurred in Lower Granite reservoir (41,941 fish), whereas the highest harvest occurred in Ice Harbor reservoir (29,128 fish). Shore anglers caught (58.5%) and harvested (63.5%) the majority of the fish.

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The highest catch and harvest during April through June occurred in Little Goose reservoir. During July and August, most fish caught and harvested were in Ice Harbor reservoir. From September through November, the highest catch and harvest occurred in Lower Granite reservoir, and comprised approximately 42% of the system-wide harvest during those months. Overall, the harvest of fish during April through June was nearly equal to the harvest from July through November.

Night anglers in Lower Granite reservoir caught an estimated 1,475 fish, and kept 853, from September through November. Night fishing yielded the most fish in October. We did not estimate night angler catch and harvest during spring and summer.

The catch of resident sport fish was dominated by three species. Crappie were the most abundant sport fish caught (34,072) and harvested (22,313) from the reservoir system during 1997. Most crappie were caught and harvested in Little Goose reservoir. Smallmouth bass ranked second among fish caught overall (25,042 fish), although less than 30% (7,152) were harvested. Lower Granite reservoir produced the highest smallmouth bass catch, but the highest harvest occurred in Lower Monumental reservoir, where more than 71% of bass caught were kept. Anglers caught an estimated 18,156 channel catfish, and harvested 73% (13,278) of those caught. Ice Harbor and Little Goose reservoirs yielded the majority of the catfish harvested.

Among other resident species, yellow perch, sunfish, and northern pikeminnow were the more prominent. Most yellow perch and sunfish were caught in Ice Harbor reservoir, whereas northern pikeminnow were caught principally in Lower Granite reservoir. Most of the estimated catch (718), and all of the quantifiable harvest (40) of white sturgeon came from Little Goose reservoir. Limited harvests of white sturgeon occurred in other reservoirs, but were not included in our estimates.

Stocked rainbow trout provided a substantial spring and early summer sport fishery in mitigation ponds associated with Ice Harbor and Lower Granite reservoirs. Although the magnitude of the catch in these reservoirs was comparable, most of the harvest (5,672 of 9,005 trout) occurred at sites associated with Ice Harbor reservoir.

We estimated 13,147 steelhead were caught and 9,541 harvested in the lower Snake River reservoirs during August through November. Most of the catch (8,429) and harvest (5,390) occurred in Lower Granite reservoir, principally by boat anglers. In contrast, the bulk of the steelhead harvest in Lower Monumental and Ice Harbor reservoirs was by shore anglers. The sport fishery for steelhead in Little Goose reservoir was comparatively poor (283 fish).

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The estimated yield of sport fish in the lower Snake River reservoirs ranged from 7.60 kg/ha in Lower Granite reservoir to 2.05 kg/ha in Little Goose reservoir. Steelhead ranked first in the yield of each reservoir except Little Goose, where channel catfish provided the highest yield.

Little Goose Reservoir experienced the highest total catch/harvest rates (0.442/0.278 fish/angler hour). The lowest catch rate occurred in Lower Monumental reservoir (0.119 fish/angler hour), whereas Lower Granite experienced the lowest harvest rate (0.067 fish/angler hour). Total catch and harvest rates were typically highest during May or June, and lowest in October or November. Catch and harvest rates were variable, but generally similar for boat and shore anglers in each reservoir except Lower Granite, where shore anglers experienced considerably better success rates than boat anglers.

Steelhead was the most frequently sought species throughout the lower Snake River reservoirs during 1997. The proportion of anglers seeking steelhead from April through November exceeded 72%. Boat angling for steelhead occurred principally in Lower Granite reservoir, whereas Ice Harbor and Lower Monumental reservoirs supported the most shore-oriented steelhead fishing. Other species pursued by Snake River reservoir anglers, in decreasing order of importance, were channel catfish, smallmouth bass, and stocked rainbow trout. Little Goose Reservoir supported the highest proportions of anglers seeking channel catfish and smallmouth bass. The highest proportion of anglers seeking crappie was in Lower Monumental reservoir. Anglers pursuing stocked rainbow trout fished mostly at the mitigation ponds associated with Lower Granite and Ice Harbor reservoirs.

Seasonal preferences were observed on most reservoirs. Anglers fished for resident fishes and stocked rainbow trout mainly during April through August. However, on September 1, when steelhead harvest season opened on the Snake River, anglers directed most of the effort towards steelhead on all reservoirs except Little Goose. Anglers on Little Goose reservoir continued to fish for resident fishes, principally channel catfish, during September. By October, anglers sought steelhead in Little Goose as well.

Directed catch and harvest rates (rates calculated for only those anglers seeking that species) were generally highest for crappie, smallmouth bass, rainbow trout, and steelhead in Lower Granite reservoir than other lower Snake River reservoirs. However, the harvest rates for smallmouth bass and steelhead were higher in Lower Monumental and/or Little Goose reservoirs. Boat anglers were generally more successful than shore anglers when seeking channel catfish, smallmouth bass, and white sturgeon; whereas shore anglers had higher success rates fishing for crappie and rainbow trout.

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Among the resident or stocked fishes, directed catch and harvest rates were typically highest during May or June for crappie and rainbow trout, and during the summer months for channel catfish and smallmouth bass. Catch and harvest rates for steelhead tended to be highest in either October or November.

Anglers from 19 states and Canada, in addition to the main states of Washington, Idaho, and Oregon, fished on the lower Snake River reservoirs in 1997. The large majority of anglers at Ice Harbor and Lower Granite reservoirs originated from nearby population centers of the Tri-Cities and Walla Walla, and Lewiston-Clarkston-Pullman-Spokane, respectively. Lower Monumental anglers resided principally in Walla Walla and vicinity or Tri-Cities. Anglers fishing Little Goose reservoir were about equally represented by Walla Walla and Tri-Cities residents and those from the Spokane-Moscow-Pullman areas. Participation in the reservoir fisheries by local anglers intensified during the steelhead season. The largest seasonal shift in anglers appeared to occur at Little Goose reservoir in the fall, when anglers from the Spokane-Moscow-Pullman areas apparently shifted their destination to either Lower Granite or Lower Monumental reservoirs, presumably to fish for steelhead.

Anglers visiting the lower Snake River reservoirs made mostly day trips. The highest proportion of day trips occurred in Ice Harbor and Lower Granite reservoirs. Little Goose and Lower Monumental reservoirs, both relatively isolated from population centers, received the most overnight visits. The use of paid lodging was notable only at Lower Granite reservoir, and was almost exclusively associated with steelhead angling during the fall.

Steelhead angler characteristics and fishing methods varied among reservoirs. Shore fisheries were predominant in all reservoirs except Lower Granite, where 90% of steelhead anglers used boats. Similarly, baited lures were the primary gear used for steelhead fishing in all reservoirs except Lower Granite, where most anglers used unbaited lures. Among anglers in Lower Granite reservoir, more anglers used an Idaho license (41.6%) than a Washington license (35.2%). Most of the remainder (23.1%) had purchased licenses from both states.

The temporal and spatial patterns of angler use in the lower Snake River reservoirs likely reflected the anglers' knowledge of where the best catch rates and best fishing conditions could be expected. Angling during April through June was focused in mitigation ponds and side-channel backwaters, where more than 70,000 catchable-sized rainbow trout were stocked, and more favorable angling conditions of higher water temperatures, shelter from the wind, less current velocity, and less runoff-borne debris occurred. By June, fishing conditions in the main channel portions of the reservoirs had improved, and most anglers utilized the main reservoirs during the summer months.

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Angler use of the main reservoirs intensified when steelhead season opened in September, but usage was focused at relatively discrete locations where anglers expected the best steelhead catch rates. These locations generally included tributary confluences (e.g., Clearwater and Tucannon Rivers) and sites that provided access near fishway entrances and exits (e.g., shoreline above Ice Harbor Dam, Little Goose "wall").

Our estimates of angler use are similar to the only known estimates of use for any reservoir on the lower Snake River. Previous estimates of angling effort in Little Goose reservoir for a comparable fishing period ranged from 45,752 to 79,605 angler hours, similar to our estimate in 1997 (69,809 hours). Our data indicated that sport angling in the lower Snake River reservoirs may be relatively static, and that anglers probably shift from Little Goose to adjacent reservoirs beginning in September to fish for steelhead.

Channel catfish, crappie, and smallmouth bass largely supported the resident sport fishery, with channel catfish the most preferred. Channel catfish accounted for more than 75% of the yield (biomass) of resident fish in Ice Harbor reservoir, and was also particularly sought by boat anglers in Little Goose and Lower Monumental reservoirs. Smallmouth bass ranked second among resident fishes sought, and was the target of a substantial catch-and-release fishery in Lower Granite reservoir. Although catch-and-release is common among smallmouth bass fisheries throughout its range, the high proportion of released fish in Lower Granite reservoir may be related to the small size of bass caught. In general, resident sport fishes have demonstrated slow growth and high mortality rates, a common feature of Northwest reservoirs, including those on the lower Snake River. Crappie fisheries spatially and temporally exist as found in earlier surveys.

Our data suggest a shift in angler preference among the resident fishes towards channel catfish, compared to that shortly after the impoundments were completed. Anglers probably target channel catfish due to their large average size, or perhaps increased abundance and distribution. Our angler catch and harvest data generally corroborate the reported spatial distribution and abundance surveys of resident fishes in the lower Snake River reservoirs.

The most intensive angling effort in the Snake River reservoirs occurred during the September through November period, when anglers targeted steelhead. Boat anglers expended more than 70% of the total effort during this time. Among the reservoirs, Lower Granite supported the bulk of boat angling effort, which was particularly focused at the Snake River-Clearwater River confluence area in Lewiston-Clarkston. Most shore angling for steelhead occurred at fishway exits or entrances in Ice Harbor and Lower Monumental reservoirs.

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Our current estimate of 192,000 angler hours for the September-November period in Lower Granite Reservoir indicates continued growth of the fishery in spite of fewer returning adult steelhead in recent years. A substantial night fishery directed at steelhead contributed nearly 9% of total effort for steelhead in Lower Granite reservoir. Historical estimates of steelhead angling effort in the lower Snake River reservoirs are limited to 3 years of data for Lower Granite reservoir - from 1984 through 1986. Angling effort increased (68,000 to 116,000 angler hours) during the 3 years, likely in response to increased returns of hatchery fish from enhanced stocking.

Our determined patterns of angling use in the lower Snake River reservoirs seem to be consistent from year to year. Although the reservoir survey concluded on November 30, we continued to make limited aerial observations of angler distribution throughout the reservoir system during December 1997 through March 1998. Angler use of favored steelhead fishing locations near the dams continued at a decreased intensity. By March many anglers were again observed fishing in adjacent side ponds and backwater areas.

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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, 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 system in 1975. Return to natural river 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 are to estimate reservoir fishery use in angler days or angler hours and determine the monetary value of the existing reservoir recreational fishery. The Phase II objectives are to determine 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. The Phase II study targeted recreational steelhead/salmon fishing, but also collected data on sport fisheries for resident species.

This report addresses the Phase I studies, and consists of two parts. Part 1 contains the entire Phase I sport fishing investigation. Part 2 includes the detailed economic report. Field work and analysis related to the Phase II study will be reported in subsequent volumes. A list of common and scientific names of fish discussed herein is shown in Table 1-1.

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

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

* Formerly northern squawfish.

1.1 Previous Investigations

Following the staged impoundment of the lower Snake River from 1960-1975, the resident fishery and the quality of the available fish habitat that developed in the four reservoirs were investigated by Bennett et al. (1983). Sport fishing use and angling characteristics were examined by Knox (1982) as part of the 1983 study. The investigation by Knox (1982) represents the only quantifiable estimate of sport fishing effort directed at resident fish populations in the lower Snake River. Knox (1982)

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reported the relative angler use among the reservoirs based on relative aerial counts, and a detailed analysis of the sport fishery in Little Goose Reservoir (Figure 1-1). Angler use in Little Goose Reservoir was estimated at 46,000 and 80,000 angler hours during 1979 and 1980, respectively, and was deemed comparable among the four reservoirs in the system except for Lower Monumental Reservoir, where angler use was less. Fishing success was described as "high" in Little Goose Reservoir, with anglers seeking mostly smallmouth bass, white sturgeon, channel catfish, and crappie and other panfish. Although angler success rates were high, anglers rated the sport fishery as only fair or poor, and yields, when compared to other reservoirs in the U.S., were low.

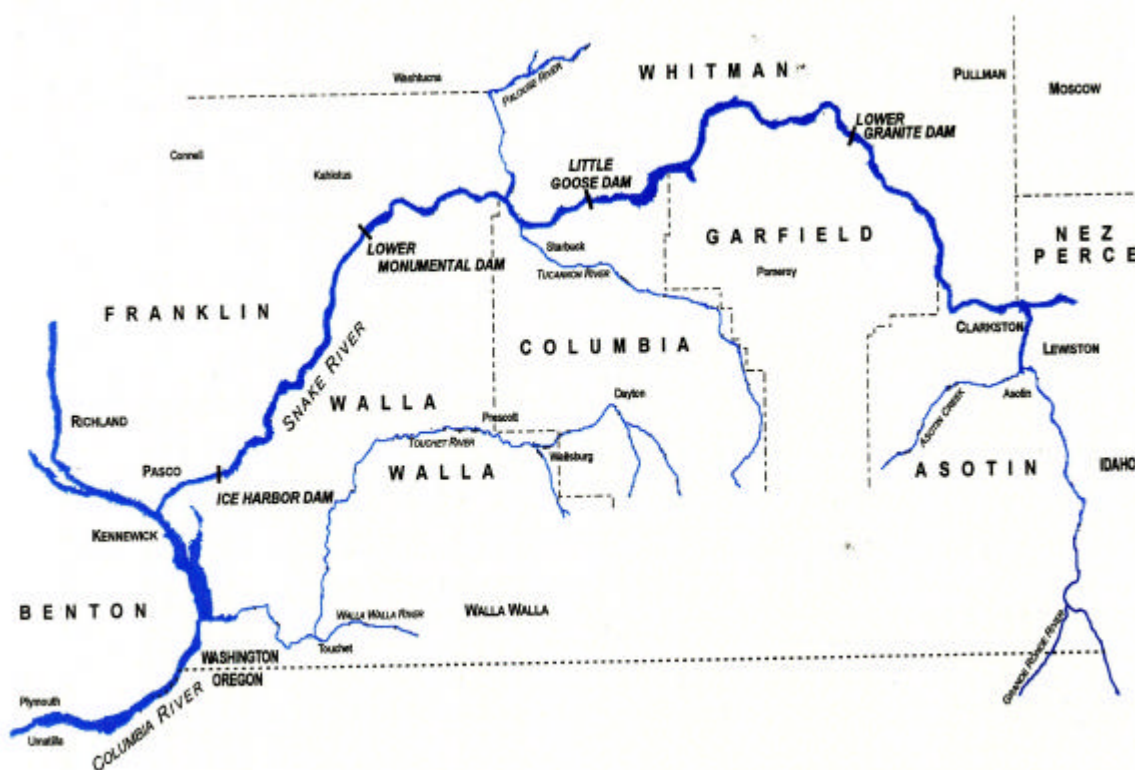


Figure 1-1. Location map of hydro dams and reservoirs on the lower Snake River and the mid-Snake River upstream of Asotin, Washington

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

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fall 1984. 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 just above the confluence with the Grande Ronde River (mid-Snake River). The Clearwater River arm of Lower Granite Reservoir was not included in the Washington surveys. Creel clerks also measured fish and examined them for tags and fin clips to determine origin (hatchery or wild).

Efforts to estimate angler use on the lower Snake River below Lower Granite Dam were abandoned after 2 years largely because insufficient use existed to document precisely with available manpower. However, angler counts and interviews were easier to obtain above Lower Granite Dam due to parallel road access, and 3 years of effort and catch data were obtained (Mendel and Aufforth 1985; Mendel et al. 1987, 1988). Data within these reports were recombined to permit comparison with effort estimates determined by the present study. Other, more management-oriented data are not discussed herein.

Following these surveys, the Washington Department of Fish and Wildlife continued to annually survey steelhead anglers at various sites of angler concentration along the Snake River reservoirs. Catch and harvest data are recorded, but the principal focus of their efforts is 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 to collect catch and angler data. The annual survey provides catch rates to evaluate run size for among-year comparisons, but is not designed to quantitatively estimate angler effort.

2.0 METHODS

A complemented aerial-access point survey design was developed to allow coverage of the large regional fishery (Pollock *et al.*, 1994). Aerial angler counts were used to determine effort, while ground interviewers obtained catch and angler characteristics. The overall design was conceptually similar to that conducted by Knox (1982). However, the present survey was planned to be able to estimate total angling effort and catch attributes for each reservoir and the overall lower Snake River reservoir system, and achieve a precision level of 20-25 % for the estimates of angler use.

2.1 Study Area

The Phase I field investigations were conducted from Ice Harbor Dam upstream to the headwaters of Lower Granite Reservoir (Figure 2-1). Upper study limits within Lower Granite Reservoir for the Snake River and tributary Clearwater River were defined as Chief Looking Glass Park in Asotin, WA and the Potlatch Paper Mill in Lewiston, ID, respectively. The length and surface area of each reservoir is shown in Table 2-1.

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Lower Granite is the longest pool, while Little Goose pool has the largest surface area. Lower Monumental pool is the smallest impoundment. The total surface area of all pools is 34,715 acres (14,049 hectares) for a combined total of 136.9 linear miles (220.3 km).

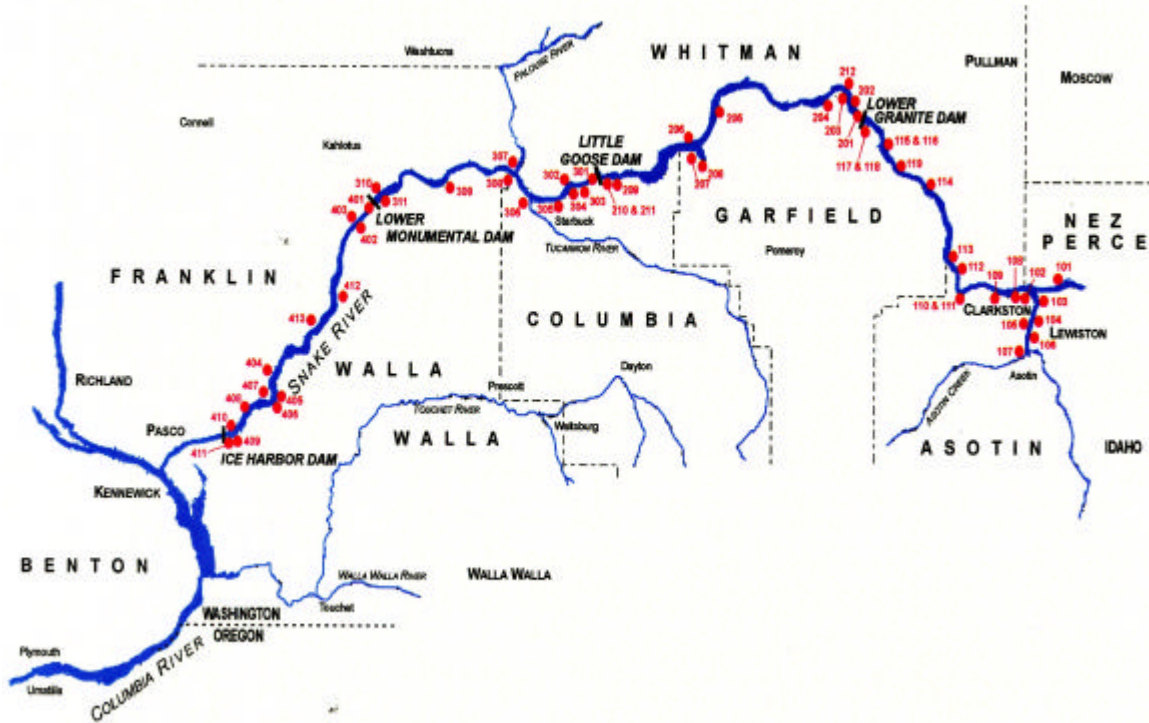


Figure 2-1. Access sites in the lower Snake River reservoir sportfishing study area. Numbers refer to access points listed in Appendix Table A-1.

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Table 2-1 Physical Data for Lower Snake River Reservoirs			
Reservoir	Length - Miles (km)	Surface Area Acres (hectares)	Percent of Surface Area
Ice Harbor	32.0 (51.5)	9,200 (3,723)	26.5
Lower Monumental	28.7 (46.2)	6,590 (2,667)	19.0
Little Goose	37.2 (59.9)	10,025 (4,057)	28.9
Lower Granite	39.0 (62.8)	8,900 (3,602)	25.6
Totals	136.9 (220.3)	34,715 (14,049)	

Initial aerial overflights identified several angling sites that were cut off from the mainstream reservoir body by railroad berms or dikes. Ground reconnaissance confirmed that most of these sites remained directly connected to the mainstream reservoir by culverts or, alternatively, were likely dependent upon reservoir level to maintain themselves by groundwater connection. These sidestream sites may have been old sloughs, backwaters, or mitigation ponds constructed as a result of impoundment, and were located principally in Ice Harbor and Lower Granite reservoirs. Because of their apparent dependence on reservoir water level, these sites were included within the overall study design during aerial angler counts and ground surveys.

2.2 Aerial Surveys

Aerial angler counts were conducted from fixed-wing aircraft flown out of Pullman, WA. Flight direction was randomized between upstream (starting at Ice Harbor Dam) and downstream (starting at Asotin, WA) directions, and between morning and afternoon strata. 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 2-2. Friday through Sunday were considered weekend days, while Monday through Thursday comprised the weekday strata (Knox 1982). Major holidays (e.g., Memorial Day, July 4th, Labor Day) were

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considered weekend days. The distribution of flights between weekend and weekday strata was based on reported angler distribution in 1979 and 1980 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).

Table 2-2 Distribution of Aerial Flight Among Monthly and Morning/Afternoon Strata					
Month	Weekend/ Holiday AM	Weekend/ Holiday PM	Weekday AM	Weekday PM	Total
April	2	2	1	2	7
May	3	3	1	3	10
June	7	2	1	3	13
July	4	3	1	2	10
August	5	2	1	2	10
September	3	5	2	2	12
October	4	4	2	2	12
November	4	4	2	3	13
Total	32	25	11	19	87

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, it became possible to only count identified fishing boats, as most anglers in a boat were hidden from view. Subsequently, ground survey data were utilized to determine a mean number of anglers per boat for these months, and this mean was applied to the number of boats counted to determine the number of boat anglers for a given aerial count.

2.3 Ground Surveys

Ground surveys were conducted based on stratified cluster sampling (Scheaffer *et al.*, 1996). Clusters were half-day periods of 6-8 h depending on day length, separated at 1300 h prevailing time. Ground surveys were scheduled each week for both morning and afternoon clusters on two weekdays and each weekend/holiday. Three creel clerks were used to cover the four reservoirs. The locations of ground surveys were assigned from the distribution of anglers observed during the most recent aerial counts. Thus,

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ground surveys were distributed among access sites by proportional use. The individual access points included in the survey design are listed in Appendix Table A-1, and shown in Figure 2-1. Access points in close proximity were typically surveyed together. For example, the Central Ferry/Port of Garfield/Dead Man's Bay area was easily visited within a survey cluster, as were the Lyons Ferry State Park/Lyons Ferry Marina sites.

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. Creel fish were counted and measured (total length for all species except steelhead, which were measured fork length).

Beginning in September, additional information about steelhead fishing was sought as a result of a cooperative effort and 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 creel and released fish.

2.4 Night Fishing

Night fishing during spring and summer months was investigated qualitatively. Anglers arriving to fish just before dark, or those fishing at the conclusion of an afternoon cluster, were asked how long they planned to continue fishing. The goal was to ascertain the proportion of anglers that engage in night fishing, the species sought, and the locations favored for this activity. Such a qualitative evaluation was preferred since most anglers who planned to fish all or part of a night arrived and began fishing well before dark. Thus, separating those fish caught after dark from those caught prior to dusk was usually not possible.

When steelhead season opened on September 1, night fishing became prominent, especially in Lower Granite Reservoir at the confluence of the Snake and Clearwater rivers. As a result, a separate survey stratum to measure night effort and catch in Lower Granite Reservoir was added. Night fishing effort was determined by boat trailer counts at six boat ramps (Clearwater Landing, Greenbelt, Lower Lewiston Landing, Clarkston Landing (Swallows Nest), Hells Gate, and Chief Looking Glass) in the confluence area during an hour-long circuit at a randomly selected hour within the night stratum. For example, the night stratum in early September was 2000-0100 h, during which the clerk would leave the assigned boat ramp for one hour (*e.g.*, 2100-2200 h), count trailers at

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all the ramps in the area, and return to the original ramp to resume interviews. These six ramps supported virtually all night fishing effort for steelhead. Night surveys continued at a frequency of once or twice each weekday period and twice each weekend from early September until the reservoir survey concluded November 30. Within the night stratum, Friday and Saturday nights were considered weekends, whereas Sunday through Thursday nights comprised the weekday period.

2.5 Computational Methods

Estimates of sport fishery use were determined for each reservoir in the lower Snake River, and for the entire lower Snake River system. Data collected from ground and aerial surveys were used to estimate angler use on a monthly basis, since monthly estimates are more useful to fisheries managers. Estimates of angler effort were measured in angler trips and angler-hours. Fishing pressure observed at access sites adjacent to the main channel of the Snake River and influenced by reservoir water levels (e.g., Dalton Lake in Ice Harbor Reservoir) was recorded as a proportion of each reservoir count. Methods of deriving angler characteristics and attributes were similar to those used by Knox (1982), although recent publications on creel survey techniques and analysis were consulted (Robson and Jones 1989; Pollock *et al.*, 1994; Jones *et al.*, 1995; Lockwood 1997; Pollock *et al.*, 1997).

2.5.1 Estimating Angler Effort

2.5.1.1 Estimating Total Angler Trips

The aerial counts provided excellent data during the angling time periods of approximately 8-10 AM and 5-7 PM. Although historical data showed that these time periods reflected maximum angling pressure during the respective AM or PM fishing periods (Knox, 1982), it was erroneous to assume 100% of the anglers present during the entire half-day period was observed. 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 sampled period. The sightability of anglers 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 and for each reservoir separately.

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Ratio estimators for shore anglers were derived when ground observations occurred simultaneously with aerial counts over a particular access site. The ratio estimator for shore anglers was calculated for 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):

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

where:

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

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where:

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

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

n = number of half-days observed,

μ_x^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:

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

Because boat anglers generally fished longer distances from their points of access, comparing aerial counts and ground observations was futile, as it was difficult to determine the access site of origin. As a result, ratio estimators for boat anglers could not be obtained in the same manner as for shore anglers. Rather, the ratio was derived using the mean number of anglers interviewed during the half-day period versus those that were present during the corresponding aerial count. The ratio estimator for boat anglers was calculated as:

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

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where:

\hat{R} = ratio estimator,

\bar{y} = mean number of observations (anglers interviewed) during half-day period,

\bar{x} = mean number of observations (anglers interviewed) present during the aerial count.

The variance of the ratio estimator was calculated for each stratum as in equations 2 and 3 (Schaeffer *et al.*, 1996).

Estimates of total angler trips for each reservoir 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):

$$\hat{T}_1 = (N_{11}\bar{y}_{11} + N_{12}\bar{y}_{12})\hat{R}$$

where:

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

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

y_{ii} = mean number of observations (shore/boat anglers) in stratum i (weekday/weekend),

\hat{R} = ratio estimator for the reservoir.

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

$$\hat{V}(\hat{T}) = \sum_i^L N_i(N_i - n_i) \left(\frac{s_{y_{li}}^2}{n_i} \right) \hat{R}^2$$

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where:

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

where:

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

$s_{y_{li}}^2$ = 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_{li} = the number of anglers observed in the i th instantaneous aerial count,

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

\hat{R} = the ratio estimator for the i th reservoir.

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):

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

Estimates of total angler trips for each reservoir were combined to estimate total angler trips for the entire reservoir system. The variance of the entire reservoir system was additive.

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2.5.1.2 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 time stratum and then combined to represent the entire reservoir system. For both weekdays and weekends, anglers interviewed during the PM stratum fished longer than those interviewed during the AM stratum. The strata were treated separately before being combined in the final analysis.

Average trip length was determined using data only 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:

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

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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 i th stratum,

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

b_i = the average trip length for stratum i ,

R_i = the ratio estimator for the i th reservoir.

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

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

where:

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

where:

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

$s_{y_{li}}^2$ = 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 i th 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.

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

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

Separate estimates of total hours were calculated for each reservoir and then summed to estimate angler hours for the entire lower Snake River system. The variance of the entire reservoir system was additive.

2.5.2 Estimates of Night Fishing Effort for Steelhead

Night fishing effort was quantified only for the upper portion of Lower Granite Reservoir, encompassing both river arms and the vicinity of the Snake River-Clearwater River confluence. Frequent observations at other sites indicated no use. Nightly boat trailer counts taken at the six primary boat access points provided an instantaneous count from which the distribution of anglers during the time strata could be obtained. It was assumed that all observed boat trailers represented fishing boats, as other types of recreation activity were observed to be non-existent at night. The mean number of anglers per boat was also determined from the access point surveys. Night anglers were defined as those that began their trip after sunset. Since a bus route was used, night hours and weekend/weekdays were used as strata for a month, and total effort was computed using this classification. Total angler hours for night fisherman were estimated as:

$$\hat{T}_3 = [N_1 (\bar{y}_{31})(d_1) + N_2 (\bar{y}_{32})(d_2)]$$

where:

\hat{T}_3 = estimated total number of nighttime angler hours,

N_i = total number of night hours in stratum i ,

\bar{y}_{3i} = mean number of boat trailers observed for each hour in stratum i ,

d_i = average anglers per boat for night stratum i .

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Variance of the estimated total number of night angler hours was calculated for each stratum as:

$$\hat{V}(\hat{T}_3) = \sum_{i=1}^L N_i(N_i - n_i) \left(\frac{s_{y_{3i}}^2}{n_i} \right) (d_i)^2$$

where:

$$s_{y_{3i}}^2 = \frac{\sum_{i=1}^{n_i} (y_{3i} - \bar{y}_3)^2}{n_i}$$

N_i = total number of night hours in stratum i ,

n_i = total number of night hours sampled in stratum i

\bar{y}_3 = mean boat trailers observed per hour,

y_{3i} = total number of boat trailers observed for each hour,

d_i = average anglers per boat for stratum i .

A bound on the error of estimation was calculated using the estimated variance as:

$$\hat{T}_3 \pm 2\sqrt{\hat{V}(\hat{T}_3)}$$

The total number of night anglers was estimated by multiplying the number of boat trailer hours from the bus route by the average number of anglers per boat, and dividing by the average night angler trip length determined from access point interviews. The total number of nighttime anglers was estimated as:

$$\hat{T}_4 = \sum_{i=1}^2 N_i \bar{y}_{4i}$$

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where:

$$\bar{y}_{4i} = \frac{(\bar{y}_{3i})(d_i)}{b_i}$$

where:

\hat{T}_4 = estimated total number of nighttime anglers,

N_i = total number of hours in the i th stratum,

y_{4i} = hourly estimates of boat anglers for the i th stratum,

\bar{y}_{3i} = mean number of boat trailers observed for each hour in stratum i ,

d_i = average anglers per boat for the i th stratum,

b_i = average trip length of the i th stratum.

Variance of the estimated total number of night anglers was calculated for each stratum as:

$$\hat{V}(\hat{T}_4) = \sum_{i=1}^L N_i (N_i - n_i) \left(\frac{s_{y3i}^2}{n_i} \right) \left(\frac{d_i^2}{b_i^2} \right)$$

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where:

$$s_{y_{3i}}^2 = \frac{\sum_{i=1}^{n_1} (y_{3i} - \bar{y}_3)^2}{n_i}$$

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

N_i = total number of hours in the i th stratum,

n_i = total number of night hours sampled in stratum i ,

y_{3i} = total number of boat trailers observed for each hour,

$\bar{y}_3 =$ mean number of boat trailers observed per hour i ,

d_i = average anglers per boat for the i th stratum,

b_i = average trip length of the i th stratum.

2.5.3 Catch and Harvest Rates

Catch rates were calculated using creel 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 a specific fish species (e.g., white sturgeon or steelhead). Only creel fish were used to calculate harvest rates. Mean catch and harvest rates were compared between boat and shore anglers and among months in each reservoir. Catch and harvest rates were calculated for all anglers as well as those targeting a specific fish species (directed rates).

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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 was 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 i th party $i=1, \dots, n$,

c_i = the total angler hours expended by the i th 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):

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

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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 i th party $i=1, \dots, n$,

$c_i =$ the total angler hours expended by the i th 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 for each reservoir were combined to an annual estimate of catch and harvest rates for each reservoir 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 , $i=1, \dots, L$,

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

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

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

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 , $i=1, \dots, L$,

$\hat{V}(\bar{x}_i)$ = 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:

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

2.5.4 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, individual months, and each reservoir. Ground surveys began too late to develop catch/harvest rate data for April. As a result, May catch rates were used to calculate April catch and harvest.

The biomass of creel 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 for individual species and for each reservoir was estimated by dividing the biomass of harvested fish by the respective reservoir surface area.

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2.5.5 Angler Characteristics

Angler characteristics that were assessed included angler residence, visitor status, and species sought. Whereas mean length of a fishing trip and catch and harvest rates were calculated using only completed trip data, other angler characteristics were derived from 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 reservoirs, 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 each reservoir were calculated for the full season and for two seasonal periods (April through August and September through November) from individual angler zip codes. Logical geographic regions were used to aggregate zip codes (Appendix Table A-3). Those regions represented by 2% or more of a reservoir's sampled angling population 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)

Seasonal trends in angler distribution throughout the four lower Snake River reservoirs were observed from aerial surveys beginning in April 1997. During April through May most angling pressure was observed away from the main channel in backwaters and stocked mitigation ponds adjacent to the Snake River. Three stocked mitigation ponds were located near Lower Granite Reservoir, one near Little Goose Reservoir, three near Lower Monumental Reservoir, and three near Ice Harbor Reservoir. Backwaters were more prominently found in Little Goose Reservoir (*e.g.*, Dead Man's Bay) and in Lower Monumental Reservoir (*e.g.*, Lyon's Ferry). These areas received substantial angling pressure through June, although by the end of June a higher number of anglers was observed using the main channel waters of the lower Snake River impoundments. The number of anglers observed from aerial counts peaked during late June and early July, and declined during the early weeks of August. Angling pressure remained low in the reservoirs until the first of September with the advent of steelhead season. A notable increase in angling pressure was observed from September through November, especially in the upper portion of Lower Granite Reservoir at the Snake River-Clearwater River confluence, in Lower Monumental Reservoir at the Snake River-Tucannon River confluence, and at those access sites in close proximity to mainstream hydroelectric dams.

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The importance of the stocked mitigation ponds and backwater inlets to anglers early in the year was apparent from the aerial angler counts. A total of 1,347 anglers was counted during April through May 1997, of which 60% were located in areas away from the main channel of the Snake River. Shore anglers comprised 81% of those counted in off-channel areas while the remaining 19% were boat anglers. In June, 38% of 1,587 anglers counted during aerial flights were located in off-channel areas, with the remaining anglers utilizing main channel reaches of the reservoirs. During July through August, 21% of 2,519 anglers were observed in areas away from the main channel of the Snake River. From September through November, stocked mitigation ponds and backwater inlets received minimal fishing effort.

Following the conclusion of the reservoir study on November 30, occasional aerial counts were made of the entire lower Snake River reservoir system through March 1998, as part of a follow-up investigation to qualitatively assess the extent of angler use during the winter months. Seven flights were made. Initially, anglers in December continued to concentrate at many of the preferred steelhead angling sites near mainstream hydroelectric dams, such as the shoreline above Ice Harbor Dam. However, by March most anglers were once again observed primarily in adjacent side ponds and backwater inlets.

3.1.2 Estimates of Angler Effort

A total of 111,461 angler trips accounting for 489,215 angler hours was estimated for the lower Snake River reservoir system from April through November 1997 (Appendix Table B-1). Lower Granite Reservoir received the highest proportion of angler use (220,605 hours), followed by Ice Harbor Reservoir (106,281 hours), while Lower Monumental (92,520 hours) and Little Goose reservoirs (69,809 hours) supported considerably less effort. The 95% confidence limits on individual reservoir effort estimates ranged from $\pm 6.4\%$ to $\pm 12.4\%$.

Monthly estimates of angler use demonstrated a general increase in angling effort throughout the 1997 season (Figure 3.1-1). November received the highest amount of angler use (166,888 hours), and April received the least angler use (15,327 hours). Effort reached a plateau during the mid-summer months, then increased steadily through November. Estimates of angler use and bounds of error of estimation are contained in Appendix Table B-1. Confidence limits around monthly estimates of system-wide angler effort ranged from 6.2% to 23.3%. Precision of the monthly estimates of use was highest in fall when daily effort was the most consistent.

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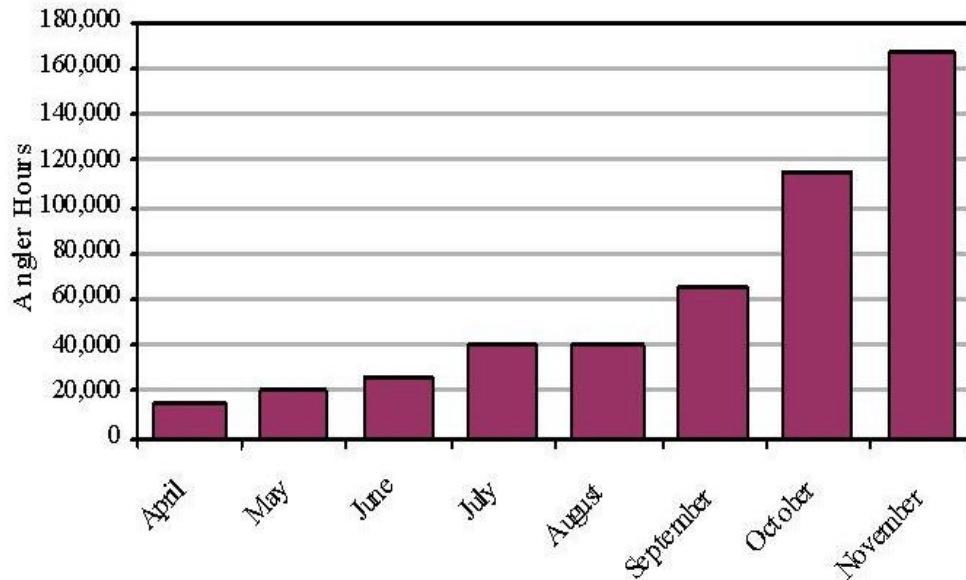


Figure 3.1-1. Estimated total angler hours, by month, combined for the lower Snake River reservoirs, April through November 1997.

Monthly trends in angler use patterns are shown in Figure 3.1-2, while proportional use among reservoirs is compared in Figure 3.1-3. Monthly variation in angler use was substantial among the lower Snake River reservoirs (Appendix Table B-1). During April through May, a total of 36,884 angler hours was estimated with Little Goose Reservoir receiving the highest angler use (12,625 hours) while Lower Granite Reservoir received the least (5,033 hours). Similarly, during June through August estimated use among reservoirs was highest in Little Goose Reservoir (35,371 hours). Summer angler use was least in Lower Monumental Reservoir. However, a major increase in effort occurred at all reservoirs except Little Goose beginning in late summer. Of the system-wide total of 347,651 angler hours estimated for September through November (71% of the survey total), Lower Granite Reservoir received 191,899 angler hours, followed by Ice Harbor (68,330 hours), Lower Monumental Reservoir (65,608 hours), and Little Goose Reservoir (21,814 hours).

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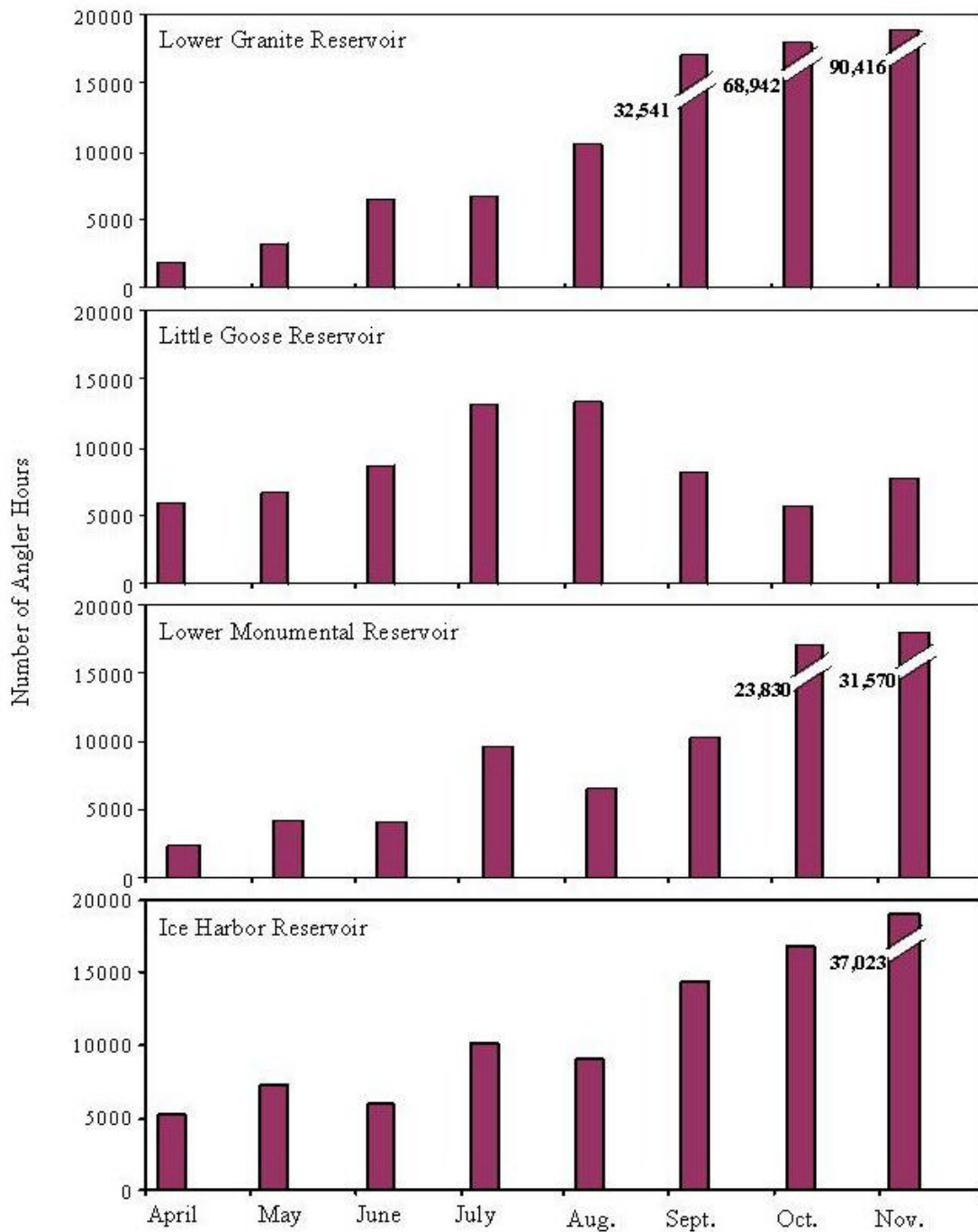


Figure 3.1-2. Estimated monthly total angler hours for the lower Snake River reservoirs, April through November 1997.

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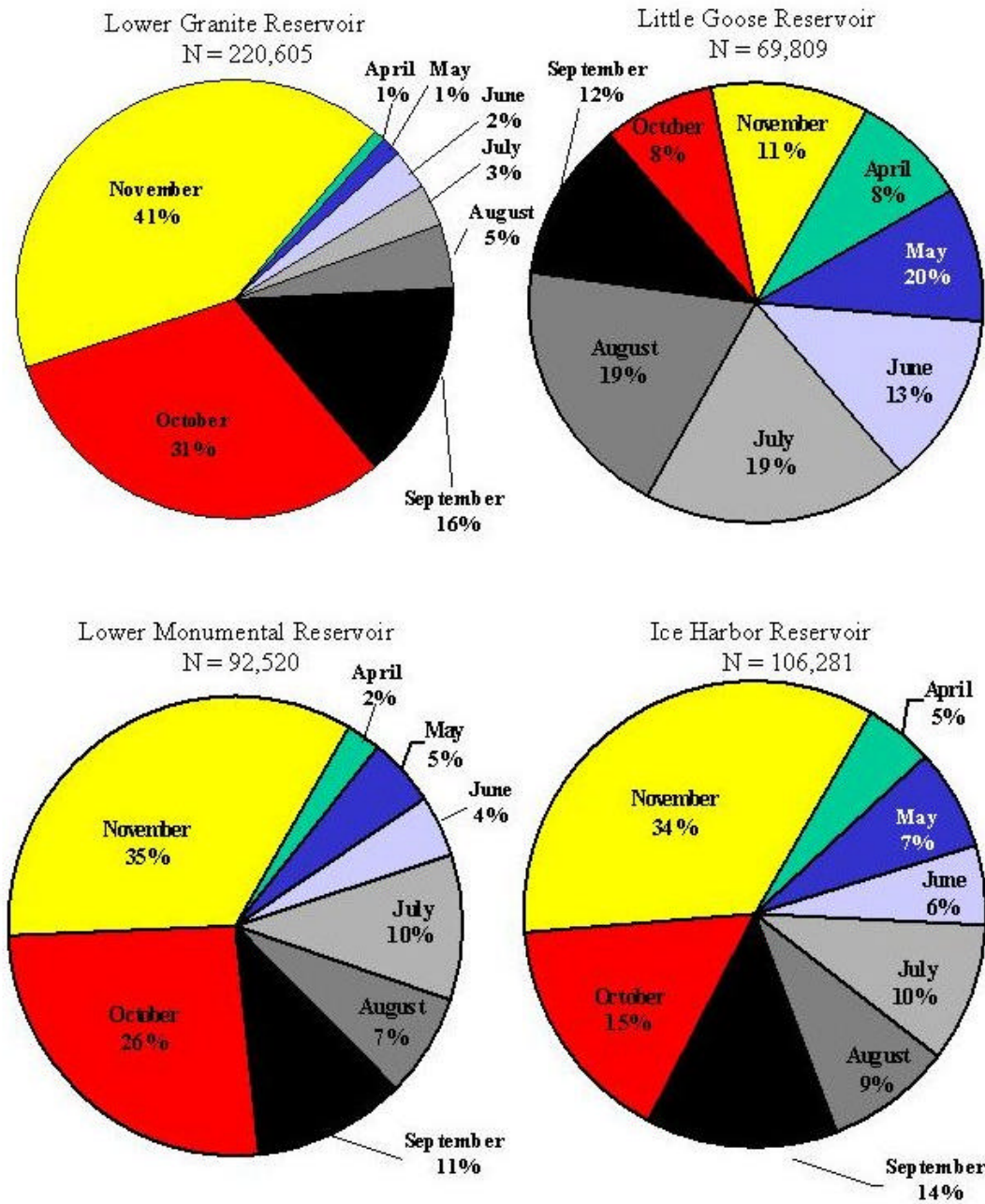


Figure 3.1-3. Monthly proportions of estimated total angler use (hours) for lower Snake River reservoirs, April through November 1997.

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Overall, 180,669 shore angler hours and 308,546 boat angler hours were estimated for the entire lower Snake River reservoir system (Appendix Table B-2). Ice Harbor Reservoir received the highest proportion of shore angler use (63,350 hours), and Lower Granite Reservoir received the highest proportion of boat angler use (181,544 hours). Both shore and boat angling effort peaked during November except in Little Goose Reservoir. Both shore and boat angling were least in April. Effort also varied among reservoirs with respect to boat and shore angling. In general, boat anglers were most abundant in Lower Granite Reservoir while shore angler abundance was highest in Ice Harbor Reservoir (Figure 3.1-4; Appendix Table B-2). Early in the year, shore angler abundance was highest in Ice Harbor Reservoir, whereas Little Goose Reservoir received the greatest amount of boat angler use. During July through August, boat angler use generally exceeded shore angler use in all reservoirs, and accounted for 65.5% of the estimated 79,221 angler hours. After August, shore anglers predominated in Ice Harbor Reservoir and Lower Monumental Reservoir, whereas boat anglers predominated in Lower Granite reservoir. During these months, Ice Harbor Reservoir received the highest amount of shore angler use (40,164 hours) and Lower Granite Reservoir received the highest amount of boat angler use (165,966 hours).

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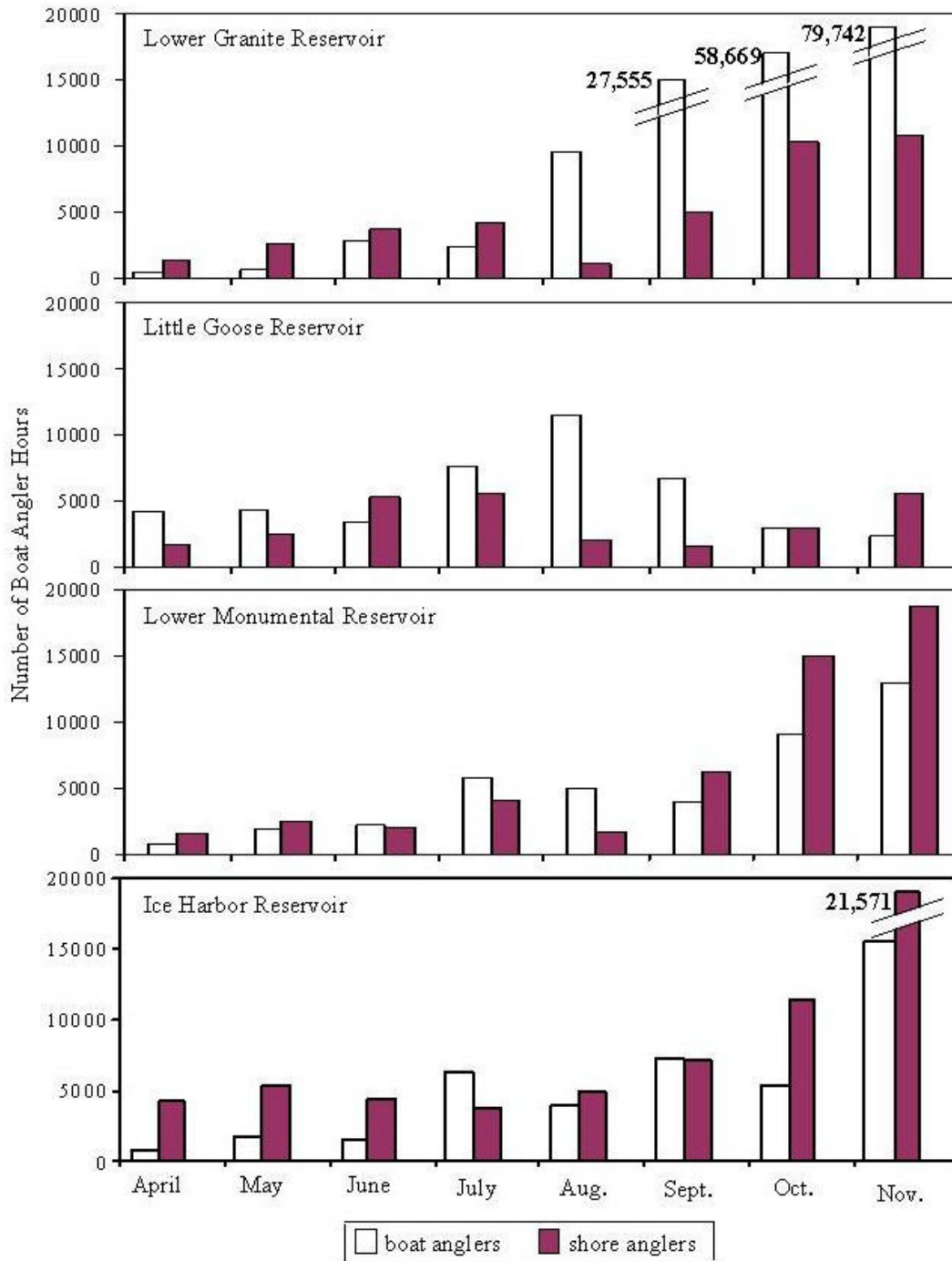


Figure 3.1-4. Estimated monthly total boat and shore angler hours for the lower Snake River reservoirs, April through November 1997.

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3.1.3 Night Fishing Effort

Night fishing during the spring and summer predominantly occurred on weekends in July and August. A total of 173 anglers planning to fish after dark throughout the lower Snake River reservoir system were interviewed during these months. In July, 71 anglers were interviewed, of which 68% occurred at Ice Harbor Reservoir, primarily on a small point immediately upstream of Ice Harbor Dam. In August, a total of 102 night anglers was interviewed, of which 70% were evenly distributed between Lower Granite and Ice Harbor Reservoirs. Night fishing in Lower Granite Reservoir was observed primarily near the Snake River-Clearwater River confluence in late August.

In addition, 629 boat angler interviews were conducted in upper Lower Granite Reservoir from September through November. Night angler effort was estimated at 16,520 angler hours. Night fishing for steelhead in the Lewiston/Clarkston reach amounted to 4.8% of the total angler hours estimated for all reservoirs during September through November. October received the highest amount of night angler use (6,207 hours), followed by September (5,856 hours), and November (4,457 hours). The Greenbelt access site in Clarkston, Washington, supported a substantially higher proportion of angler use than the other five access points surveyed for night activity.

3.2 Catch and Harvest

3.2.1 Total Catch and Harvest

Anglers caught an estimated 140,358 fish and harvested 59.2% (83,066) of those caught in the lower Snake River reservoir system from April through November 1997 (Appendix Table B-3). Total angler catch and harvest (C/H) were highest in the lower Snake River reservoir system in July (29,512/17,142 fish), and lowest in November (6,106/4,990 fish) (Figure 3.2-1). Lower Granite Reservoir contributed the largest proportion of angler catch (29.9%-41,941 fish) and Lower Monumental Reservoir the lowest (13.9%-19,530 fish) (Table 3.2-1). In contrast, Ice Harbor Reservoir contributed the largest angler harvest (35.0%-29,128 fish) whereas Lower Granite Reservoir produced the smallest harvest (16.7%-13,855 fish). Total harvest estimates for the lower Snake River reservoirs ranged from 33-75% of the catch. Fish harvest was highest in Ice Harbor (75%) and Lower Monumental (71%) reservoirs, and lowest in Lower Granite Reservoir (33%). Total angler catch was distributed unevenly between boat anglers (41.5%-58,264 fish) and shore anglers (58.5%-82,094 fish) (Appendix Table B-4). Shore anglers also removed a higher proportion of fish (63.5%-52,785) than boat anglers (36.5%-30,281) (Appendix Table B-4). Lower Granite Reservoir provided the highest boat angler catch (19,862 fish) while Ice Harbor Reservoir provided the highest shore angler catch (26,300 fish) (Table 3.2-1). The highest shore angler harvest occurred in Ice Harbor Reservoir (22,150 fish) while the highest boat harvest occurred

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in Little Goose Reservoir (9,490 fish). Total catch was distributed evenly between fishing methods in Lower Granite and Little Goose reservoirs, but favored shore anglers in Lower Monumental Reservoir and, especially, Ice Harbor Reservoir. Boat anglers harvested substantially more fish than shore anglers only in Lower Granite Reservoir.

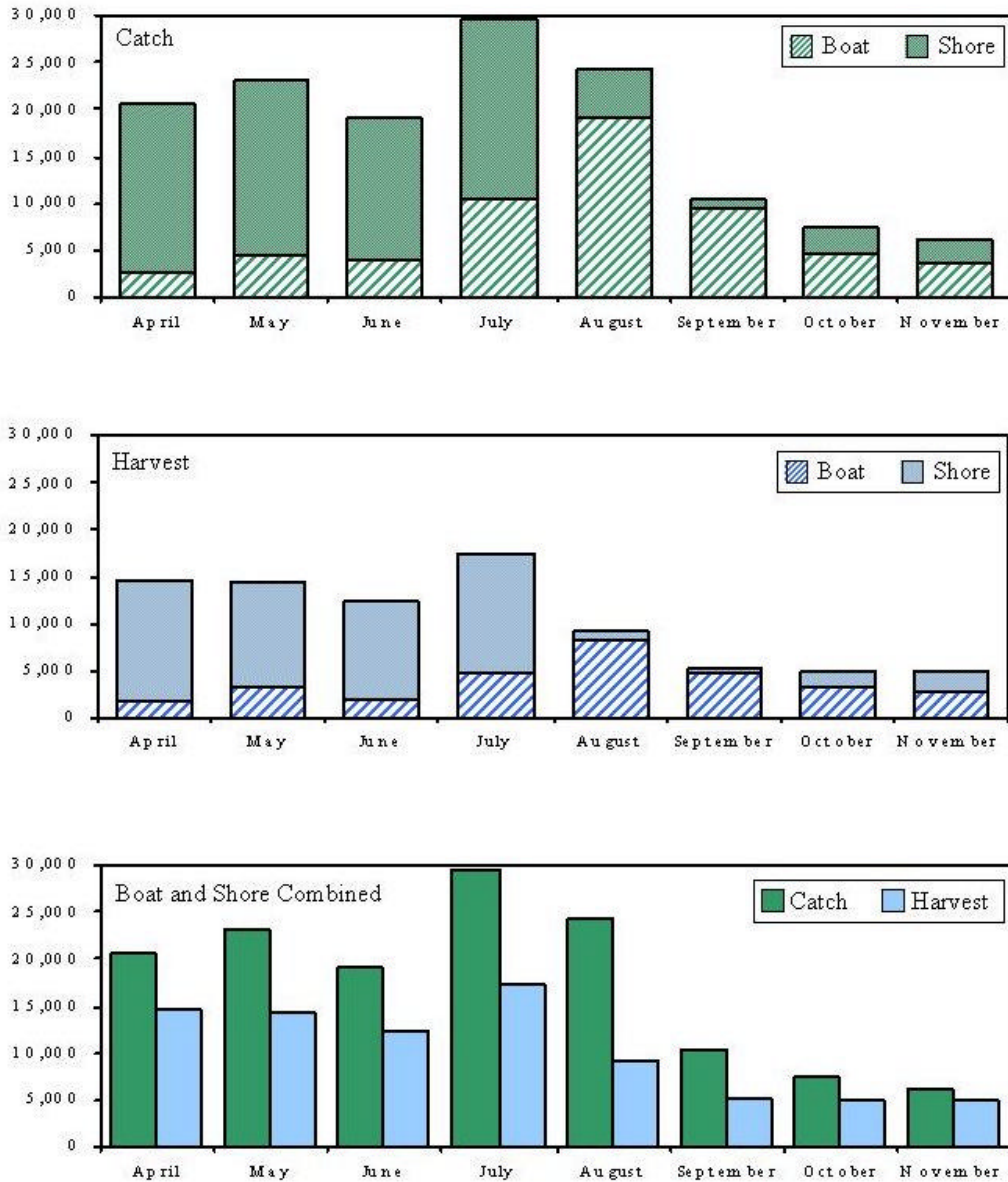


Figure 3.2-1. Estimated total monthly catch and harvest by boat, shore, and all anglers combined for lower Snake River reservoirs, April through November 1997.

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**Table 3.2-1
Estimated Total Catch and Harvest by Boat, Shore, and All Anglers for Lower
Snake River Reservoirs
April through November 1997
(Numbers in parentheses represent 95-percent confidence intervals)**

	Lower Granite		Little Goose		Lower Monumental		Ice Harbor	
	Catch	Harvest	Catch	Harvest	Catch	Harvest	Catch	Harvest
Boat	19,862 (1,160)	7,092 (495)	18,046 (2,997)	9,490 (1,898)	7,676 (510)	6,721 (360)	12,680 (1,366)	6,979 (833)
Shore	22,080 (3,756)	6,763 (1,512)	21,860 (2,193)	16,686 (1,315)	11,855 (1,156)	7,185 (873)	26,300 (1,264)	22,150 (945)
Total	41,941 (2,526)	13,855 (1,043)	39,906 (3,706)	26,176 (2,283)	19,530 (1,371)	13,906 (1,000)	38,980 (1,796)	29,128 (1,265)

3.2.2 Monthly Catch and Harvest

Angler catch and harvest varied among months and reservoirs in 1997 (Figure 3.2-2; Appendix Table B-3). During April through June, the highest combined angler catch occurred in Little Goose Reservoir (23,352 fish) while the lowest occurred in Lower Monumental Reservoir (10,954 fish). Estimated combined angler catch was similar from April through June in Lower Granite Reservoir (14,579 fish) and Ice Harbor Reservoir (13,748 fish). Total combined angler catch for all reservoirs was highest during July through August (53,738 fish). In July and August, Ice Harbor Reservoir contributed the highest proportion to the overall angler catch (33.7%-18,121 fish) followed by Lower Granite (30.2%-16,242 fish), Little Goose (26.2%-14,067 fish), and Lower Monumental reservoirs (9.9%-5,308 fish). During September through November, angler catch was highest in Lower Granite Reservoir (46.4%-11,120 fish) followed by Ice Harbor Reservoir (29.6%-7,111 fish). Angler catches from September through November were similar between Lower Monumental (13.6%-3,268 fish) and Little Goose reservoirs (10.4%-2,487 fish).

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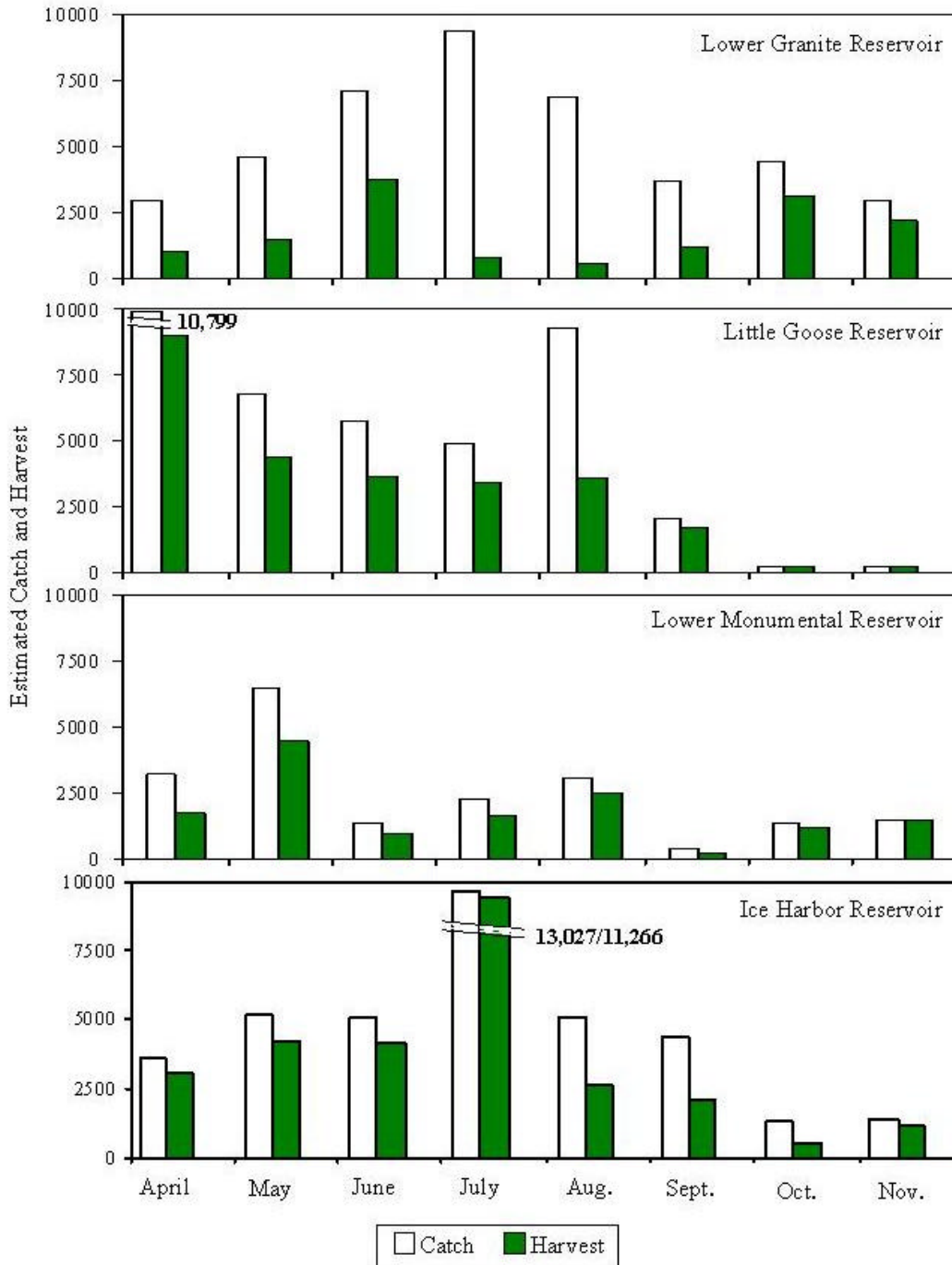


Figure 3.2-2. Monthly angler catch and harvest for individual lower Snake River reservoirs, April through November 1997.

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During April through June, total angler harvest (41,567 fish) represented 66.3% of the total angler catch from the lower Snake River reservoirs. Total angler harvest from July and August (26,264) was 48.8% of the total catch, and 63.1% of the total catch from September through November (15,137). Overall, the number of fish harvested in April through June nearly equaled the harvest from July through November.

Seasonally, the largest harvest during April through June occurred in Little Goose Reservoir (Figure 3.2-2). During July through August, the overall angler harvest of fish was the highest in Ice Harbor Reservoir (13,930 fish) while harvests were considerably lower in the other reservoirs (range 1,338 to 6,961 fish). During September through November, total angler harvest was highest in Lower Granite Reservoir (6,392 fish), and accounted for 42.2% of the total harvest throughout the lower Snake River reservoir system during the fall.

Boat and shore angler catches for the lower Snake River system varied seasonally (Figure 3.2-1). The highest shore angler catch occurred in July (18,988 fish), however shore angler catches during April through June were also substantial (Appendix Table B-4). The highest boat angler catch occurred in August (19,007 fish). Boat angler catches in most other months were less than 5,000 fish.

Monthly harvest estimates also varied considerably between shore and boat anglers (Figure 3.2-1). The highest shore angler harvests occurred in April (12,823) and July (12,406), and the highest boat angler harvest occurred in August (8,088). Boat anglers accounted for 70.3% of the total fish harvest during September through November.

Shore anglers harvested the highest number of fish from Ice Harbor Reservoir during June and July, and during April and May in Little Goose and Lower Monumental reservoirs (Figure 3.2-3). Boat angler harvest was highest in Little Goose, Lower Monumental, and Ice Harbor reservoirs in August. In contrast, the largest harvest by boat anglers in Lower Granite Reservoir occurred in October and November (Figure 3.2-4).

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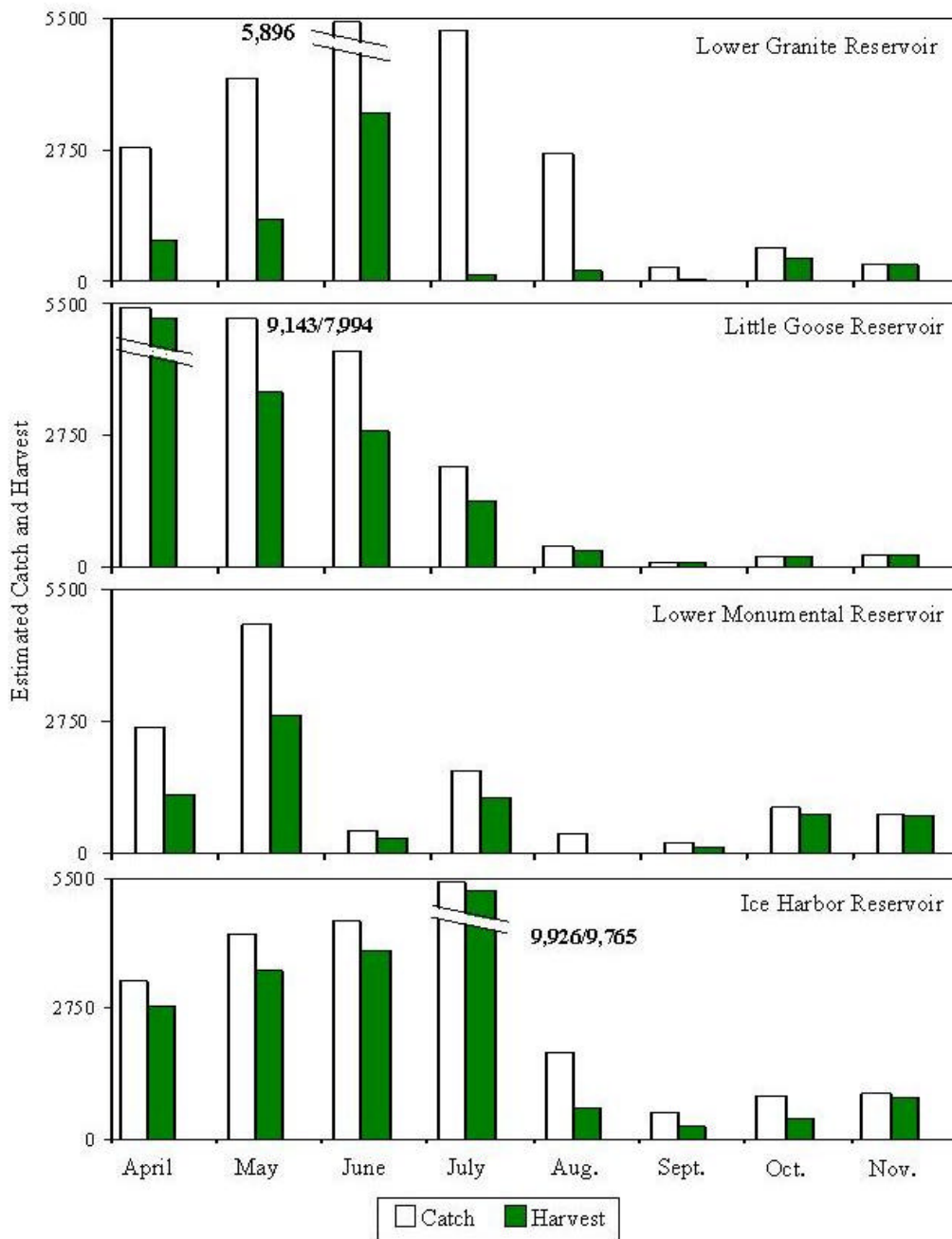


Figure 3.2-3. Shore angler catch and harvest for the lower Snake River reservoirs, April through November 1997.

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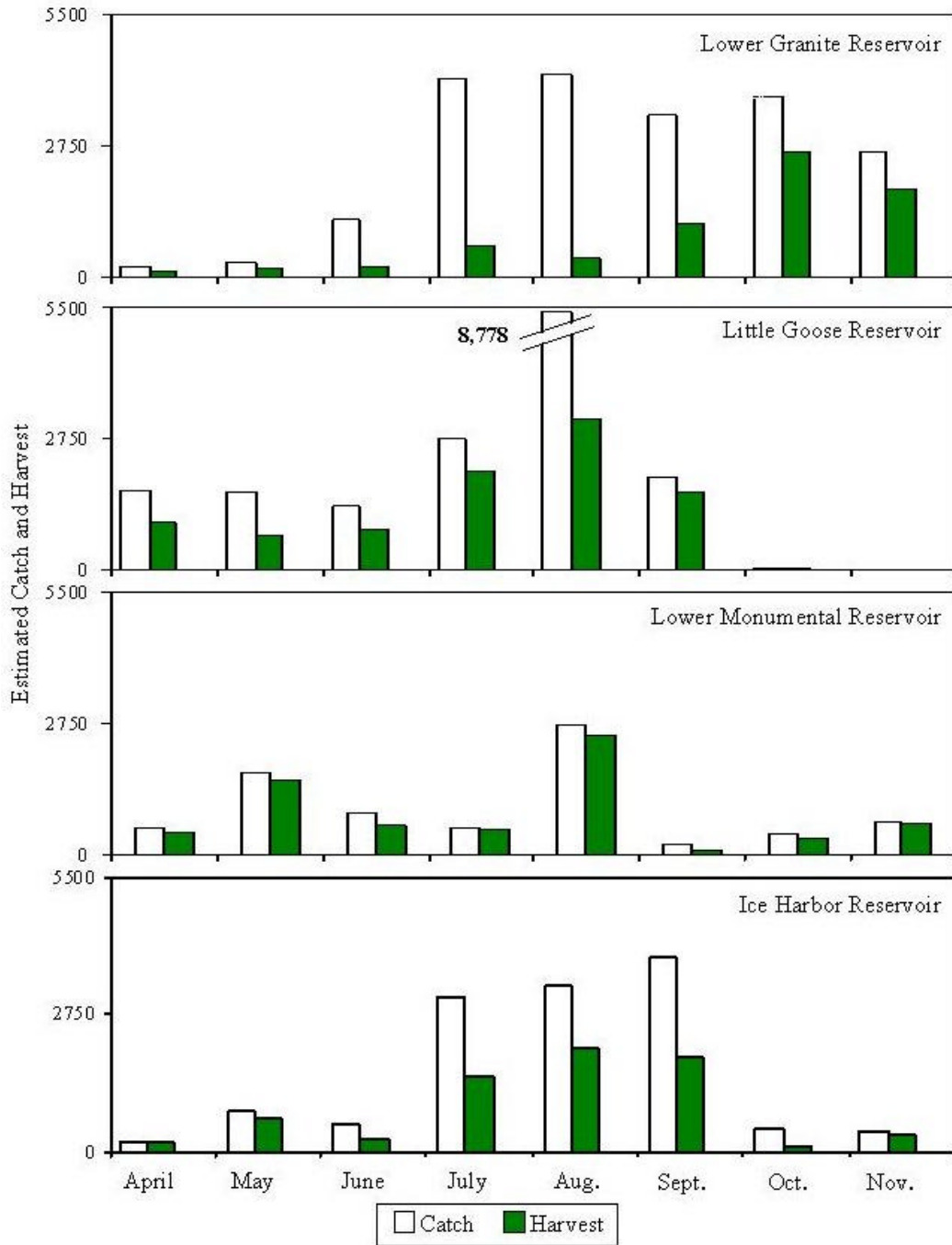


Figure 3.2-4. Boat angler catch and harvest for the lower Snake River reservoirs, April through November 1997.

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3.2.3 Night Fishing Catch and Harvest

Night anglers fishing in upper Lower Granite Reservoir near the Snake River-Clearwater River confluence caught an estimated 1,475 fish and harvested 853 fish during September through November 1997. The highest angler catch and harvest (C/H) occurred in October (634/359), followed by September (452/308), and November (389/187).

3.3 Individual Species Catch, Harvest, and Yield

3.3.1 Catch and Harvest

The catch and harvest of sport fish for the entire lower Snake River reservoir system is shown in Table 3.3-1. Comparisons of the proportional catch and harvest among the four reservoirs are depicted in Figures 3.3-1 and 3.3-2. The numerical catch and harvest of the three principal resident sport species plus steelhead are compared in Figure 3.3-3. All catch and harvest data are listed in Appendix Tables B-5 through B-8. The mean lengths of individual species by reservoir and length frequency histograms of the most important species are included in Appendix C, but are not discussed herein.

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**Table 3.3-1
Catch and Harvest of Sport Fishes in the Lower Snake River Reservoirs
April through November 1997**

Species	Total Catch	Percent of Total	Total Harvest	Percent of Total
Crappie spp. ¹	34,072	24.3%	22,313	26.9%
Sunfish ²	7,415	5.3%	5,573	6.7%
Smallmouth bass	25,042	17.8%	7,152	8.6%
Yellow perch	14,993	10.7%	13,037	15.7%
Channel catfish	18,156	12.9%	13,278	16.0%
Bullhead ³	2,227	1.6%	897	1.1%
Northern pikeminnow	5,704	4.1%	2,031	2.4%
Rainbow trout	15,770	11.2%	9,005	10.8%
Steelhead	13,147	9.4%	9,541	11.5%
White sturgeon	718	0.5%	40	0.0%
Other	3,232	2.3%	430	0.5%
All species⁴	140,358		83,066	

¹Includes black and white crappie.

²Includes bluegill and pumpkinseed.

³Includes brown and yellow bullhead.

⁴May include species not listed (e.g., common carp, chiselmouth, peamouth, largescale sucker). Individual species totals may not sum to "all species" totals due to differences in calculating respective catch and harvest rates.

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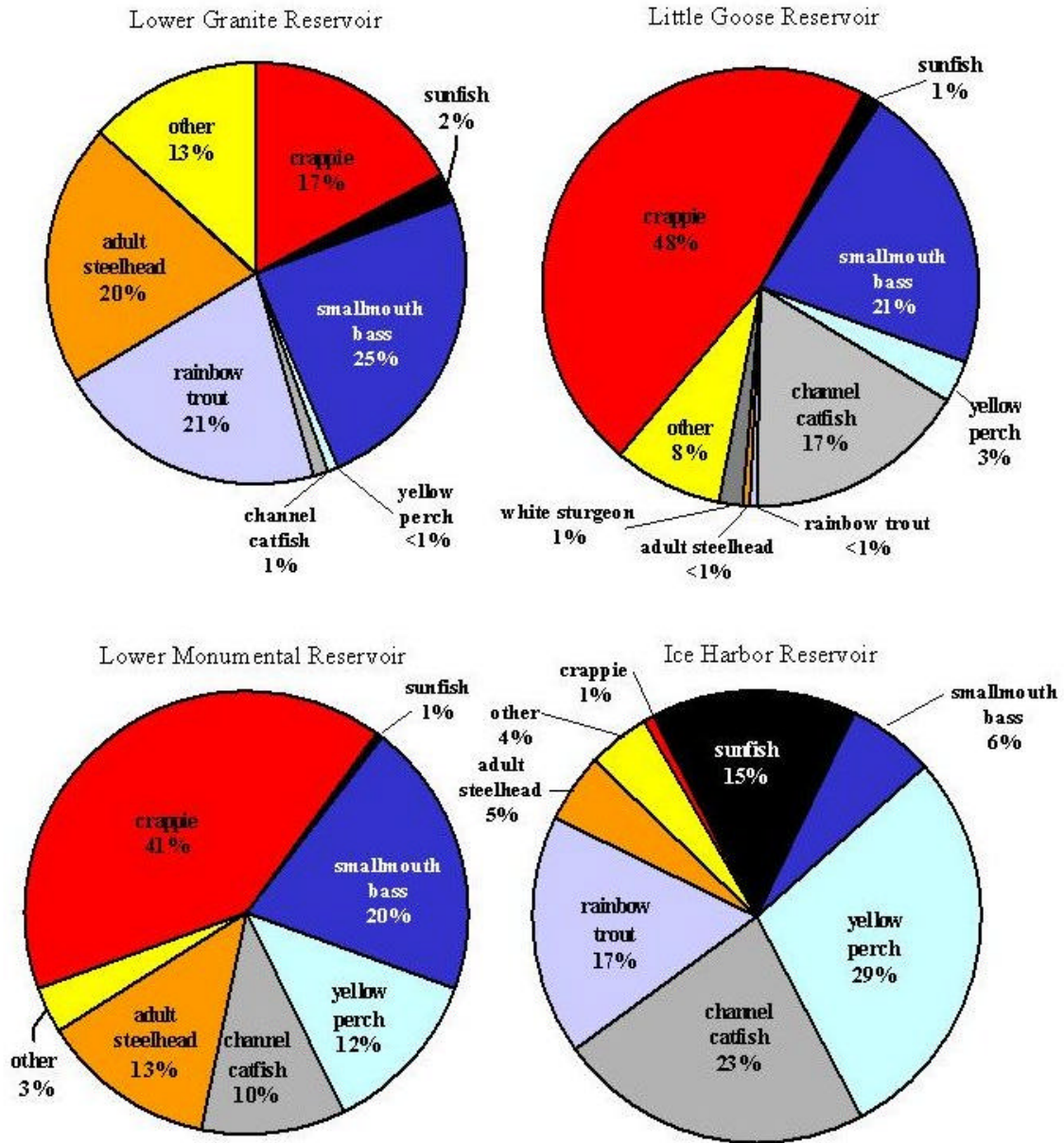


Figure 3.3-1. Composition of angler catch from lower Snake River reservoirs, April through November 1997.

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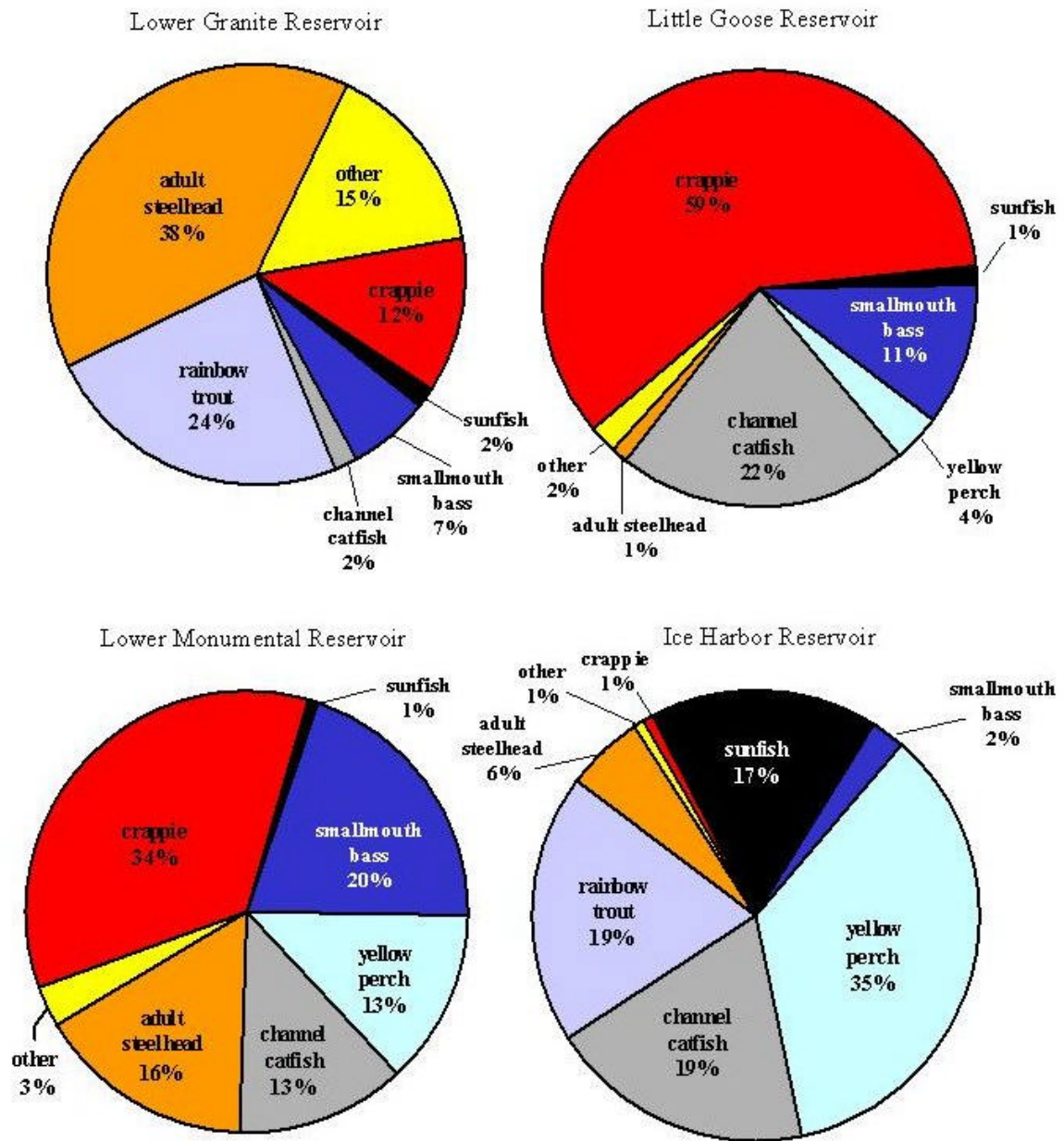


Figure 3.3-2. Composition of angler harvest from lower Snake River reservoirs, April through November 1997.

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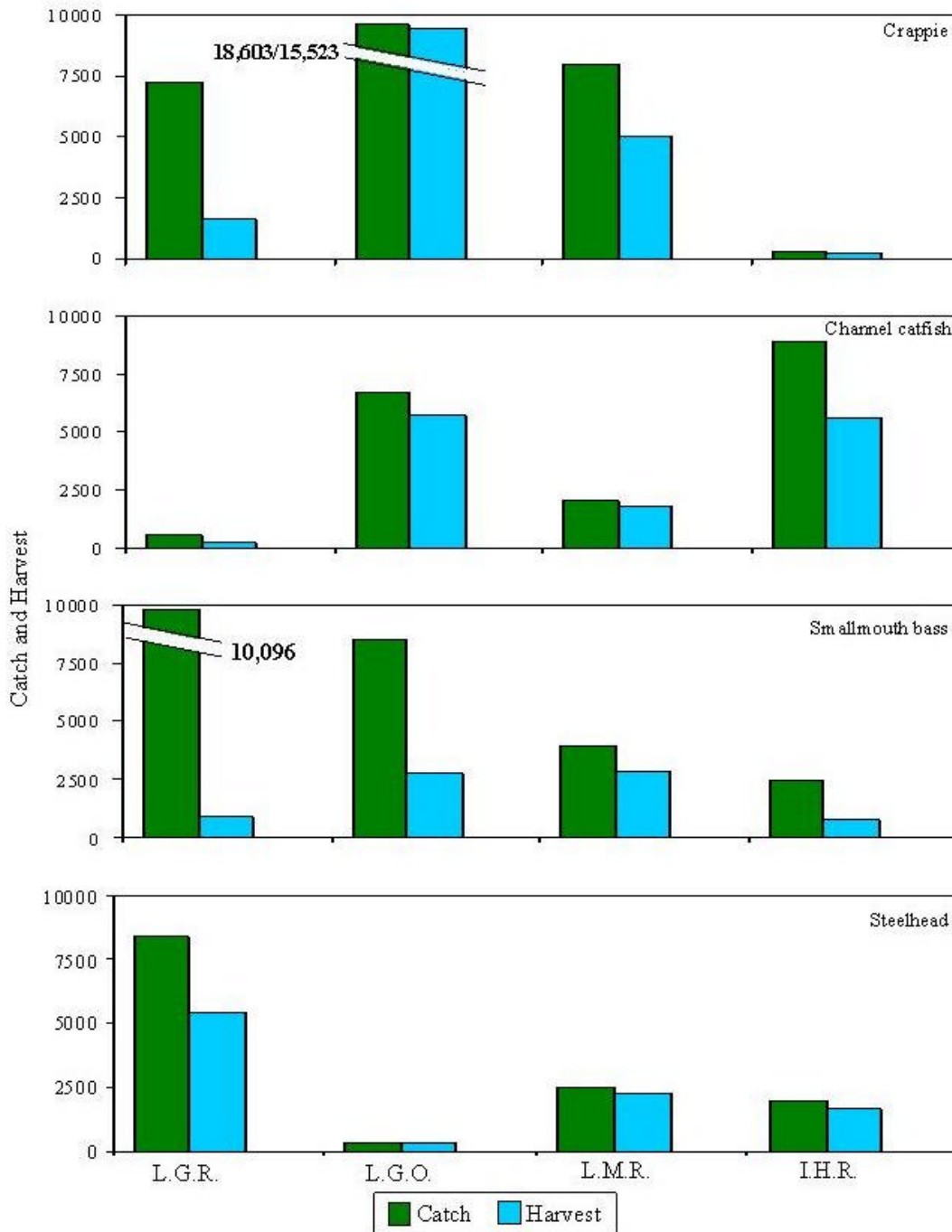


Figure 3.3-3. Total angler catch and harvest for crappie, channel catfish, smallmouth bass, and adult steelhead for Lower Granite reservoir, Little Goose reservoir, Lower Monumental reservoir, and Ice Harbor reservoir April through November 1997.

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Overall, black and white crappie accounted for the highest proportion of total catch (24.3%-34,072) and harvest (26.9%-22,313) throughout the entire reservoir system (Table 3.3-1). Anglers in Little Goose Reservoir caught the most crappie (18,603), of which 83.4% (15,523) were harvested (Figure 3.3-1 to 3.3-3). Crappie were the most numerous sport fish harvested in Little Goose and Lower Monumental reservoirs.

The fewest crappie were taken from Ice Harbor Reservoir. Anglers caught an estimated 25,042 smallmouth bass in the lower Snake River system, although considerably less (28.6%-7,152) were harvested (Table 3.3-1). The highest catch of smallmouth bass occurred in Lower Granite Reservoir (10,096), but anglers kept less than 9% of those caught. The largest harvest occurred in Lower Monumental Reservoir (2,802), where anglers retained more than 71% of smallmouth bass caught. The harvest of smallmouth bass ranked second to crappie among all creel fish in Lower Monumental Reservoir.

Anglers caught an estimated 18,156 channel catfish, and harvested 73.1% (13,278) in the lower Snake River system. The largest channel catfish catch and harvest (C/H) occurred in Ice Harbor Reservoir (8,897/5,607) and Little Goose Reservoir (6,687/5,654; Figure 3.3-3). Channel catfish ranked second among all harvested fish in each of the latter reservoirs.

Estimates of angler catch and harvest for other resident fish species are contained in Appendix Tables B-5 and B-8. Yellow perch, sunfish, and northern pikeminnow were the most prominent resident species caught after crappie, smallmouth bass, and channel catfish (Table 3.3-1). The largest catch and harvest of yellow perch and sunfish were in Ice Harbor Reservoir, principally from the off-channel Dalton Lake site. The largest catch and harvest of northern pikeminnow occurred in Lower Granite Reservoir.

An estimated 718 white sturgeon were caught, but only 40 were harvested in the lower Snake River reservoirs. Most of the catch and all of the harvest came from Little Goose Reservoir. A limited number of sturgeon were harvested in other reservoirs, but they were observed during incomplete trip interviews and thus were not included in the estimates. Anglers caught an estimated 15,770 rainbow trout, and harvested 57.1% (9,005) of those caught (Table 3.3-1). Catch of rainbow trout was largely limited to stocked, off-channel sites adjacent to Lower Granite Reservoir (8,768) and Ice Harbor Reservoir (6,750). However, the harvest of rainbow trout (5,672 fish) was highest from the two off-channel sites on Ice Harbor Reservoir, and was nearly twice the harvest (3,320) from the Lower Granite off-channel sites.

Anglers caught an estimated 13,147 adult steelhead during August--November in the lower Snake River reservoir system, and harvested 72.5% (9,541) of those (Table 3.3-1). Additionally, juvenile steelhead (likely residual smolts) were caught sporadically during the year, and are lumped under "other" species. Anglers in Lower Granite

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Reservoir had the highest catch (8,429) and harvest (5,390) of adult steelhead among reservoirs (Figure 3.3-3). Steelhead ranked first among all harvested fish in Lower Granite Reservoir (Figure 3.3-2). In contrast, anglers in Little Goose Reservoir accounted for the fewest adult steelhead caught (283) and harvested (283).

The distribution of catch and harvest of the major sport species between boat and shore anglers is shown in Figures 3.3-4 and 3.3-5. Boat anglers accounted for most of the catch and harvest of channel catfish and smallmouth bass, whereas most crappie were taken by bank anglers (except in Lower Granite Reservoir). Similarly, shore anglers caught the majority of steelhead in all reservoirs except Lower Granite.

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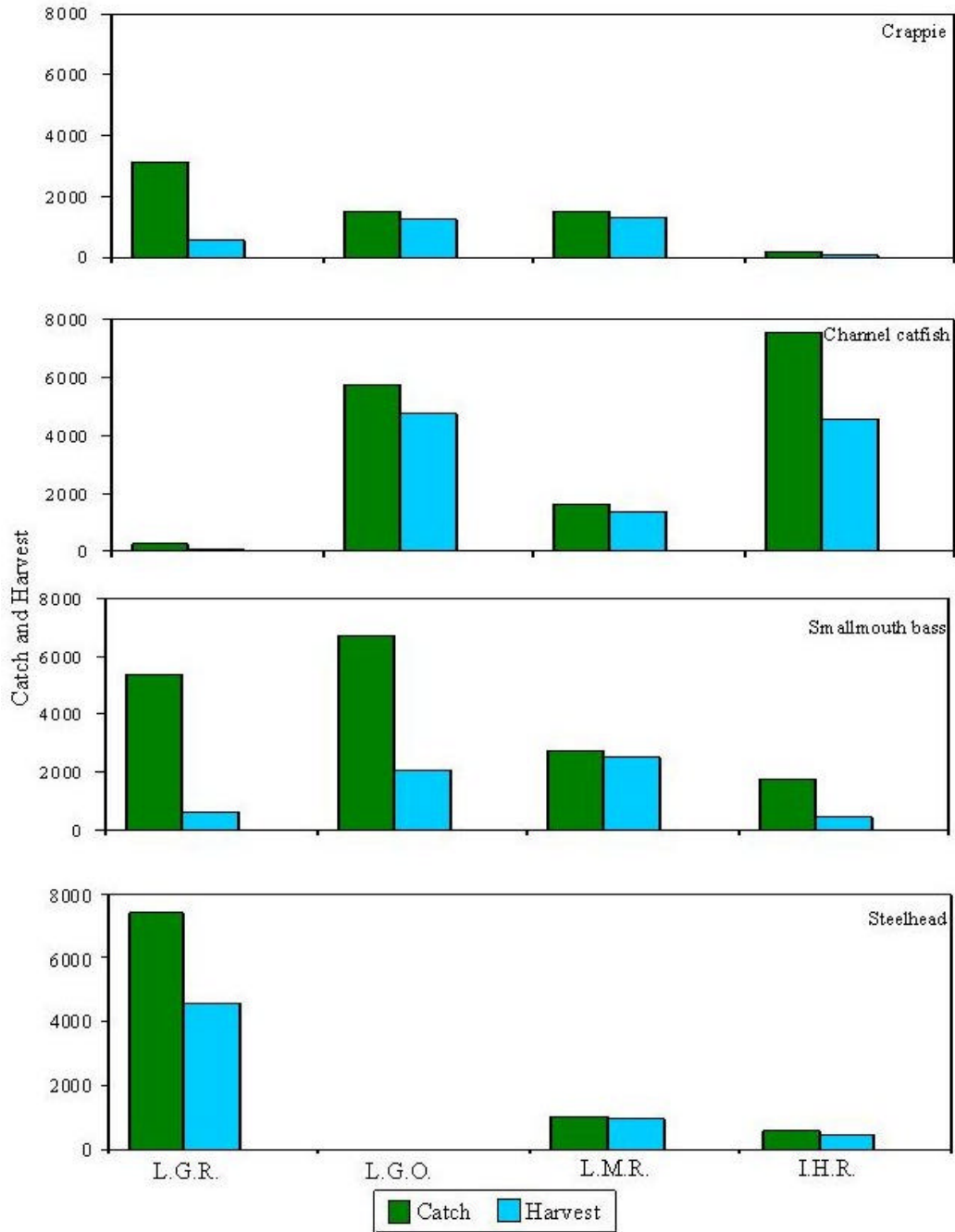


Figure 3.3-4. Boat angler catch and harvest for crappie, channel catfish, smallmouth bass, and adult steelhead for Lower Granite reservoir, Little Goose reservoir, Lower Monumental reservoir, and Ice Harbor reservoir April through November 1997.

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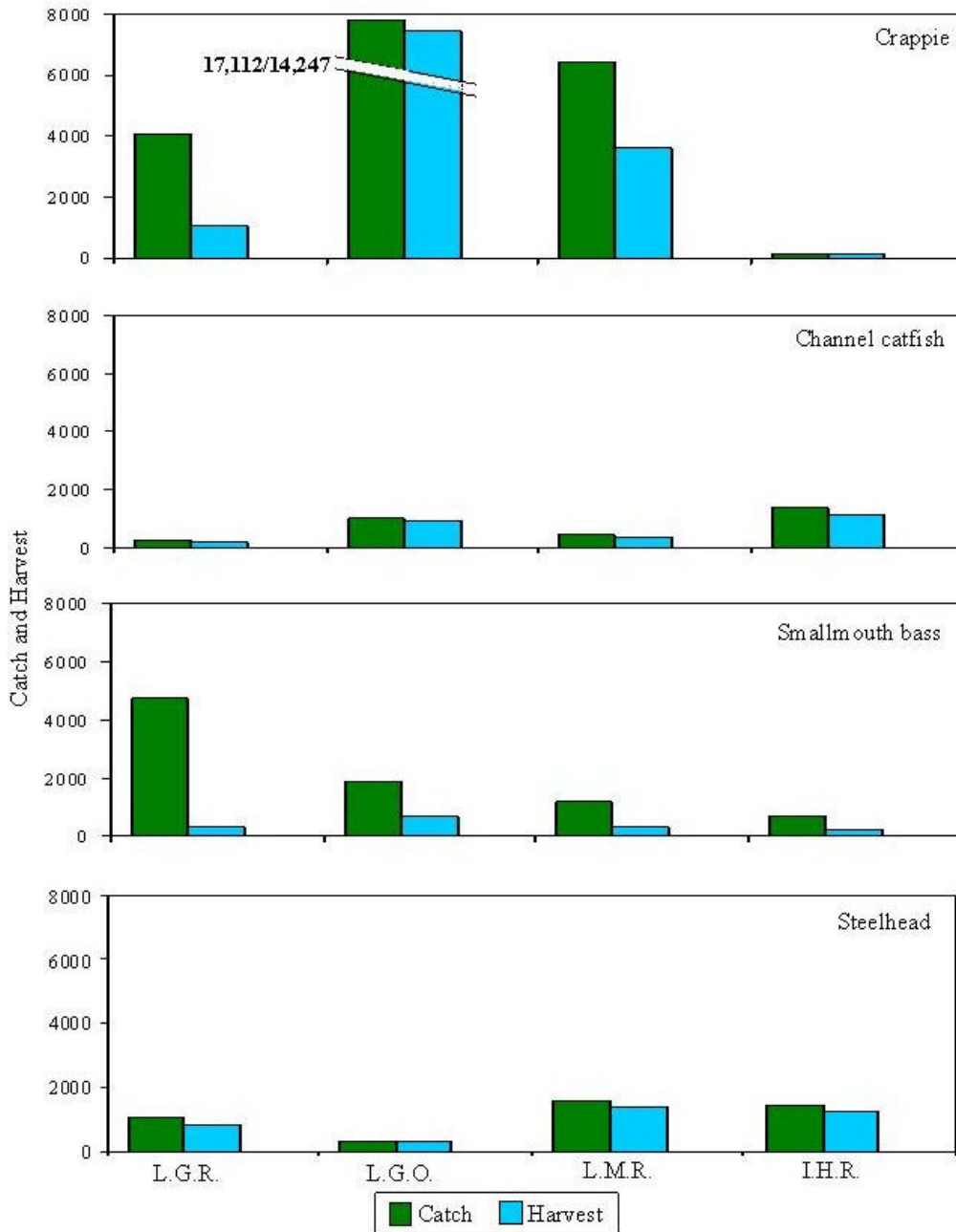


Figure 3.3-5. Shore angler catch and harvest for crappie, channel catfish, smallmouth bass, and adult steelhead for Lower Granite reservoir, Little Goose reservoir, Lower Monumental reservoir, and Ice Harbor reservoir April through November 1997.

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3.3.2 Yield

Harvest (number/unit surface area) and yield (biomass/unit surface area) are listed for the lower Snake River reservoirs in Table 3.3-2 and compared among reservoirs in Figure 3.3-6. The values shown omit steelhead, which are anadromous and not linked to reservoir production. Similarly, rainbow trout were omitted since trout provide a put-and-take fishery based on hatchery production. However, the bulk of the biomass harvested was steelhead, particularly in Lower Granite and Lower Monumental reservoirs.

<p align="center">Table 3.3-2 Total Harvest (Number/Acre or Number/Hectare) and Yield (Pounds/Acre or Kilograms/Hectare) Estimates of Resident Fish From the Lower Snake River Reservoirs April through November 1997 (Totals do not include steelhead and stocked rainbow trout)</p>				
Reservoir	Harvest		Yield	
	No./Acre	No./Hectare	lb/Acre	kg/Hectare
Lower Granite	0.58	1.43	0.37	0.40
Little Goose	2.59	6.38	1.55	1.72
Lower Monumental	1.81	4.46	0.76	0.85
Ice Harbor	2.37	5.83	1.34	1.50

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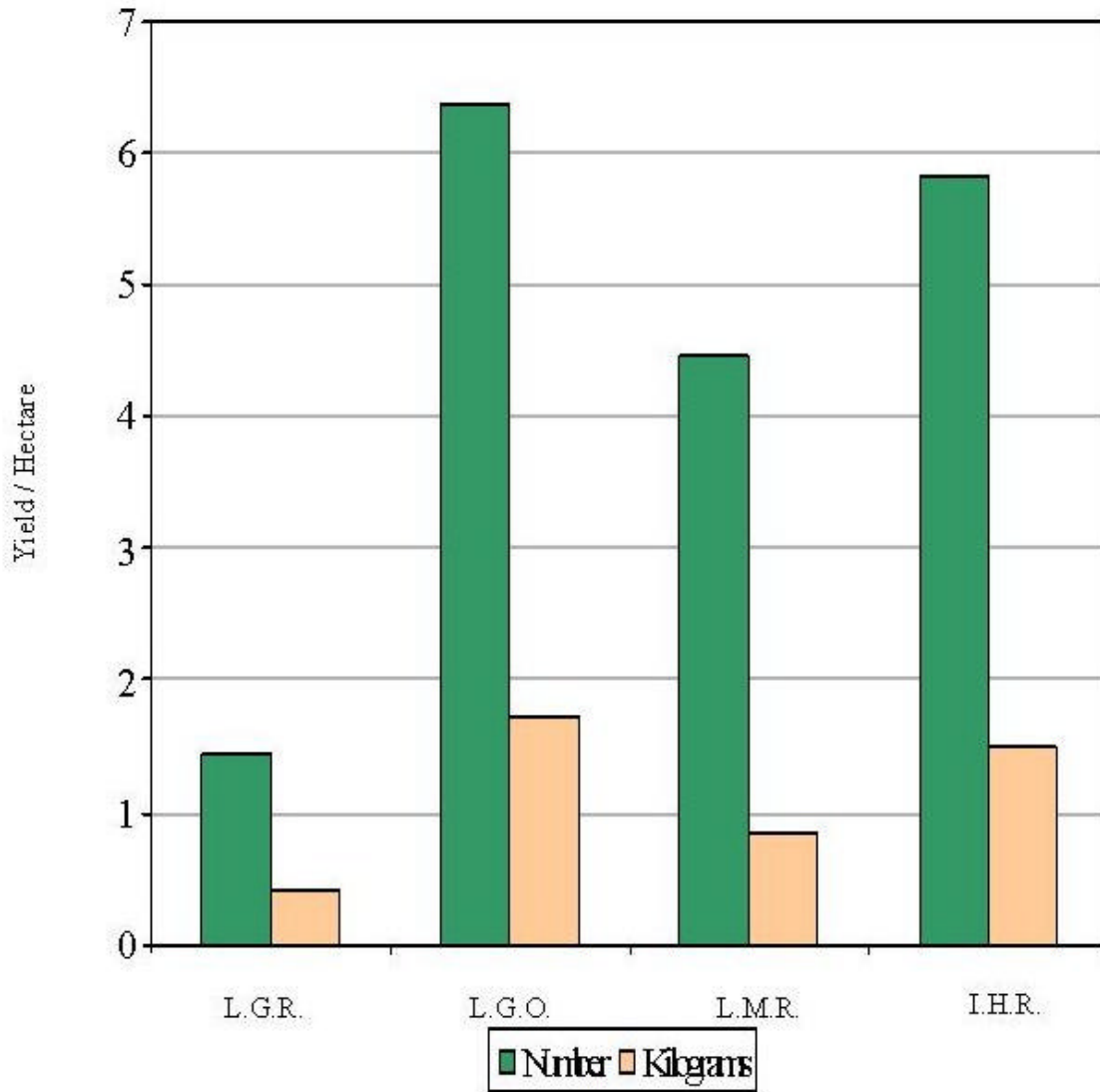


Figure 3.3-6. Estimates of angler harvest and yield of resident fish for Lower Granite reservoir, Little Goose reservoir, Lower Monumental reservoir, and Ice Harbor reservoir
During April through November 1997.

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Little Goose Reservoir produced the highest harvest and yield of resident fishes (6.38 fish/ha and 1.72 kg/ha), followed by Ice Harbor Reservoir. Harvest and yield in Lower Granite Reservoir (1.43 fish/ha and 0.40 kg/ha) were substantially lower than the other reservoirs.

Yield estimates for individual resident fishes in each reservoir are provided in Appendix Tables B-5 through B-8. Channel catfish ranked first in the yield of resident fishes in all reservoirs except for Lower Granite Reservoir. The largest yield of channel catfish was from Ice Harbor Reservoir (1.13 kg/ha). Northern pikeminnow ranked first among the yield of fishes in Lower Granite Reservoir (0.17 kg/ha).

3.4 Catch and Harvest Rates

3.4.1 All Species Combined

Catch and harvest rates for each reservoir are shown in Table 3.4-1. Total catch rates were highest in Little Goose Reservoir (0.442 fish/angler hour), followed by Ice Harbor Reservoir (0.197 fish/angler hour), Lower Granite Reservoir (0.162 fish/angler hour), and Lower Monumental Reservoir (0.119 fish/angler hour). Total harvest rates were also highest in Little Goose Reservoir (0.278 fish/angler hour), followed by Ice Harbor Reservoir (0.137 fish/angler hour), Lower Monumental (0.087 fish/angler hour) and Lower Granite reservoirs (0.067 fish/angler hour).

Table 3.4-1 Estimated Catch (CPE) and Harvest Rates for Boat and Shore Anglers for Lower Snake River Reservoirs April through November 1997								
	Lower Granite		Little Goose		Lower Monumental		Ice Harbor	
	CPE	HPE	CPE	HPE	CPE	HPE	CPE	HPE
Boat	0.089	0.038	0.445	0.282	0.134	0.094	0.221	0.135
Shore	0.670	0.270	0.439	0.264	0.108	0.082	0.185	0.138
Total	0.162	0.067	0.442	0.278	0.119	0.087	0.197	0.137

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Monthly variations in angler catch rates were observed among reservoirs within a general seasonal pattern (Figure 3.4-1; Appendix Tables B-9 and B-10). Catch rates for all reservoirs were highest during May (ranging 1.482 to 0.812 fish/angler hour) and lowest during November (ranging 0.049 to 0.038 fish/angler hour). Catch rates in Lower Granite Reservoir remained high through July but declined after May in the other reservoirs. The largest discrepancy in monthly catch rates among reservoirs occurred during July between Lower Granite Reservoir (1.183 fish/angler hour) and Lower Monumental Reservoir (0.117 fish/angler hour); however, catch rates among reservoirs during August were more comparable. Catch rates among reservoirs were quite similar during October and November, ranging between 0.067 and 0.038 fish/angler hour.

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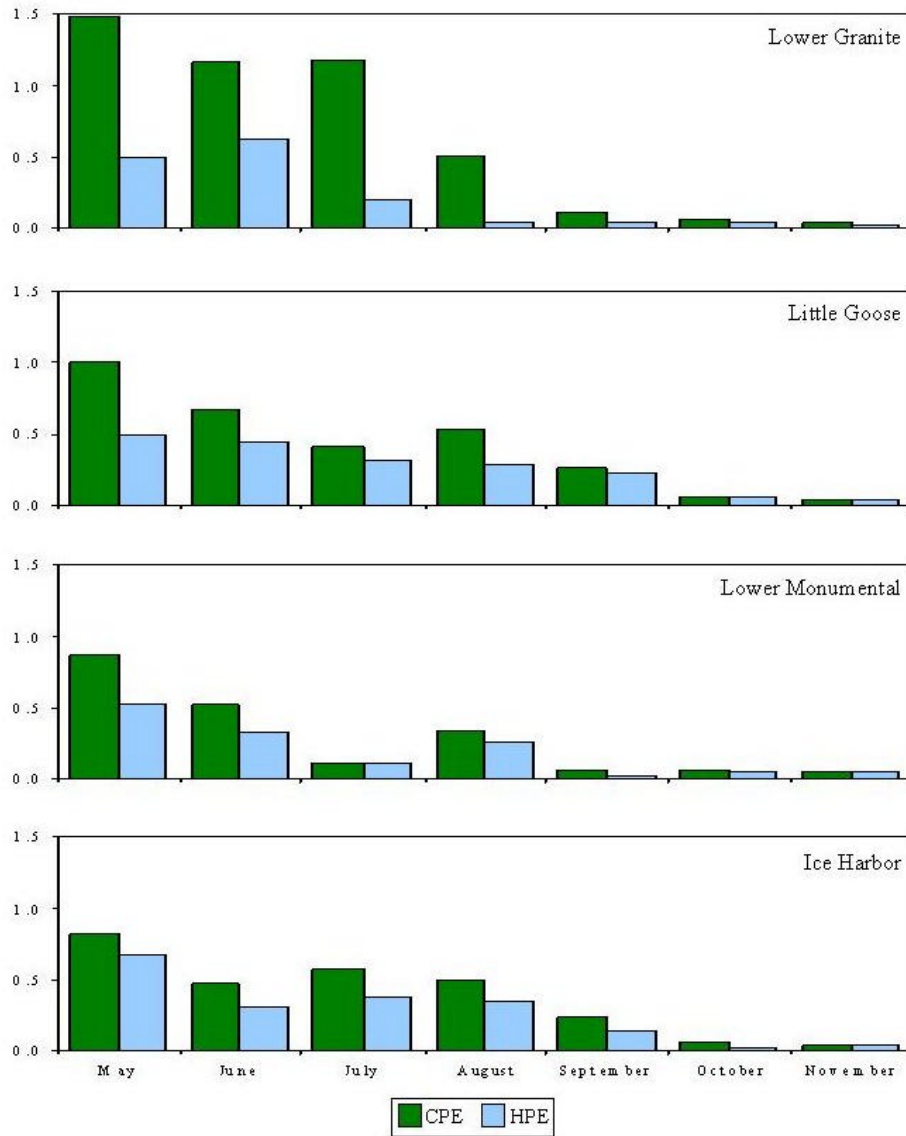


Figure 3.4-1. Estimated monthly angler catch and harvest rates for Each lower Snake River reservoir May through November 1997.

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Harvest rates exhibited a similar seasonal pattern (Figure 3.4-1). In all reservoirs, harvest rates were highest during May or June (ranging 0.665 to 0.313 fish/angler hour), and lowest during October and November (ranging 0.055 to 0.025 fish/angler hour). Anglers in Ice Harbor Reservoir during May experienced the highest harvest rate among reservoirs during the spring and summer months (0.665 fish/angler hour), whereas those in Little Goose Reservoir in October experienced the highest harvest rate among reservoirs during the fall (0.055 fish/angler hour).

Catch rates varied considerably among reservoirs between boat and shore anglers (Table 3.4-1). In Lower Granite Reservoir, shore anglers exhibited the highest catch rates (0.670 fish/angler hour) while boat anglers exhibited the lowest catch rates (0.089 fish/angler hour) among all reservoirs. In contrast, catch rates for boat anglers (0.445 fish/angler hour) were comparable with shore anglers (0.439 fish/angler) in Little Goose Reservoir. Estimated catch rates for shore and boat anglers were also similar in Ice Harbor and Lower Monumental reservoirs, although lower than in Little Goose Reservoir.

Shore and boat angler harvest rates were similar within each reservoir except Lower Granite Reservoir, where harvest rates for shore anglers (0.270 fish/angler hour) greatly exceeded those of boat anglers (0.038 fish/angler hour) (Table 3.4-1). Harvest rates by shore anglers were highest in Lower Granite Reservoir (0.270 fish/angler hour) while those by boat anglers were highest in Little Goose Reservoir (0.282 fish/angler hour).

In all reservoirs except Lower Granite, the highest catch rates for shore anglers occurred during May (Figure 3.4-2). In contrast, the highest catch rates for shore anglers in Lower Granite Reservoir occurred in August (1.798 fish/angler hour). The peak catch rates for boat anglers varied from May to August in each reservoir, with the highest catch rate (2.384 fish/angler hour) observed in Lower Granite Reservoir during July. However, catch rates for shore and boat anglers in all reservoirs were generally lowest during September through November.

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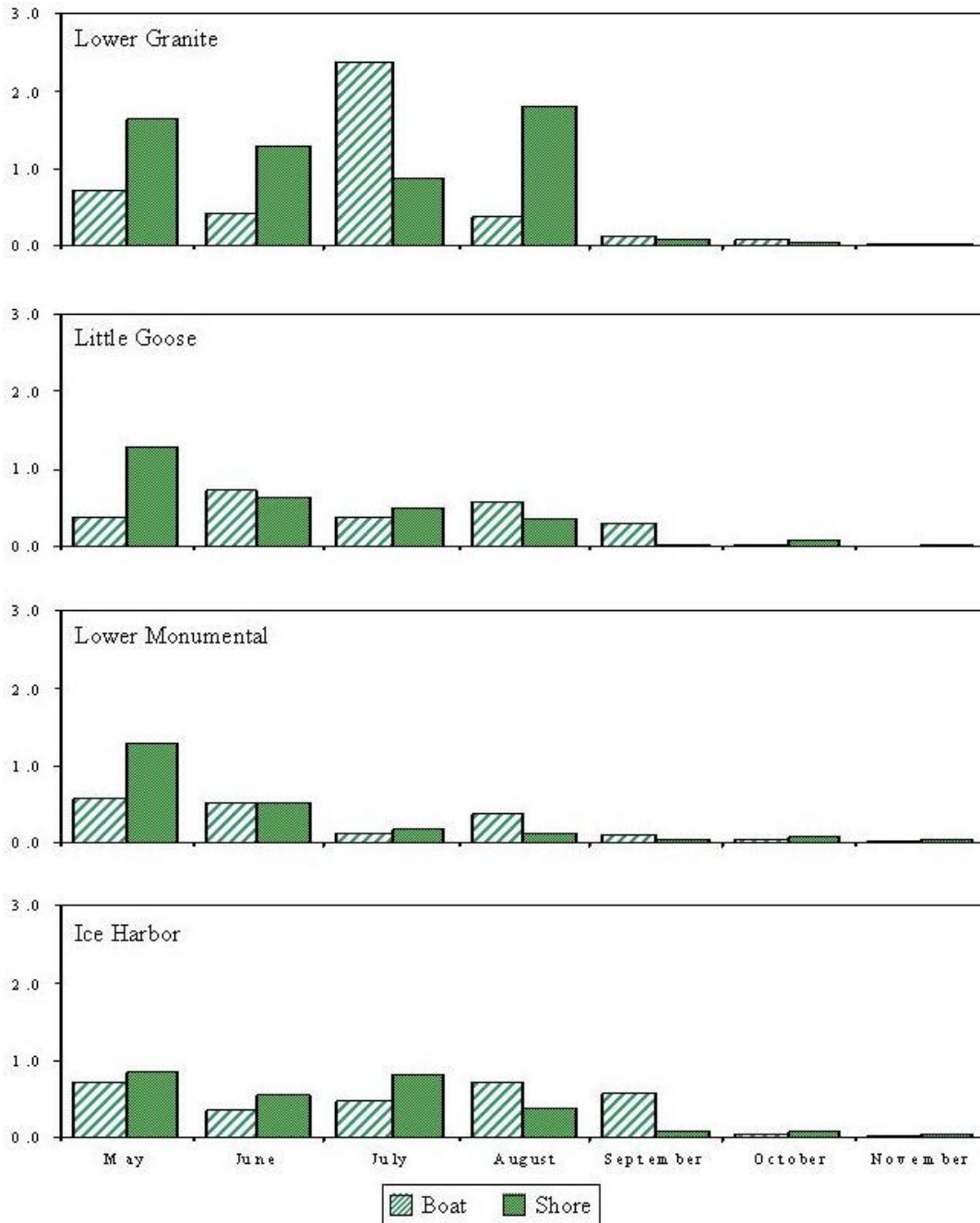


Figure 3.4-2. Estimated monthly catch rates for boat and shore anglers for Each lower Snake River reservoir May through November 1997.

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Monthly harvest rates for shore and boat anglers were typically higher during May through July (Figure 3.4-3). The lowest harvest rates were experienced in September through November by both shore and boat anglers. During May through June, harvest rates for shore anglers exceeded those for boat anglers in all reservoirs, except in Little Goose Reservoir during June when harvest rates for boat anglers were higher.

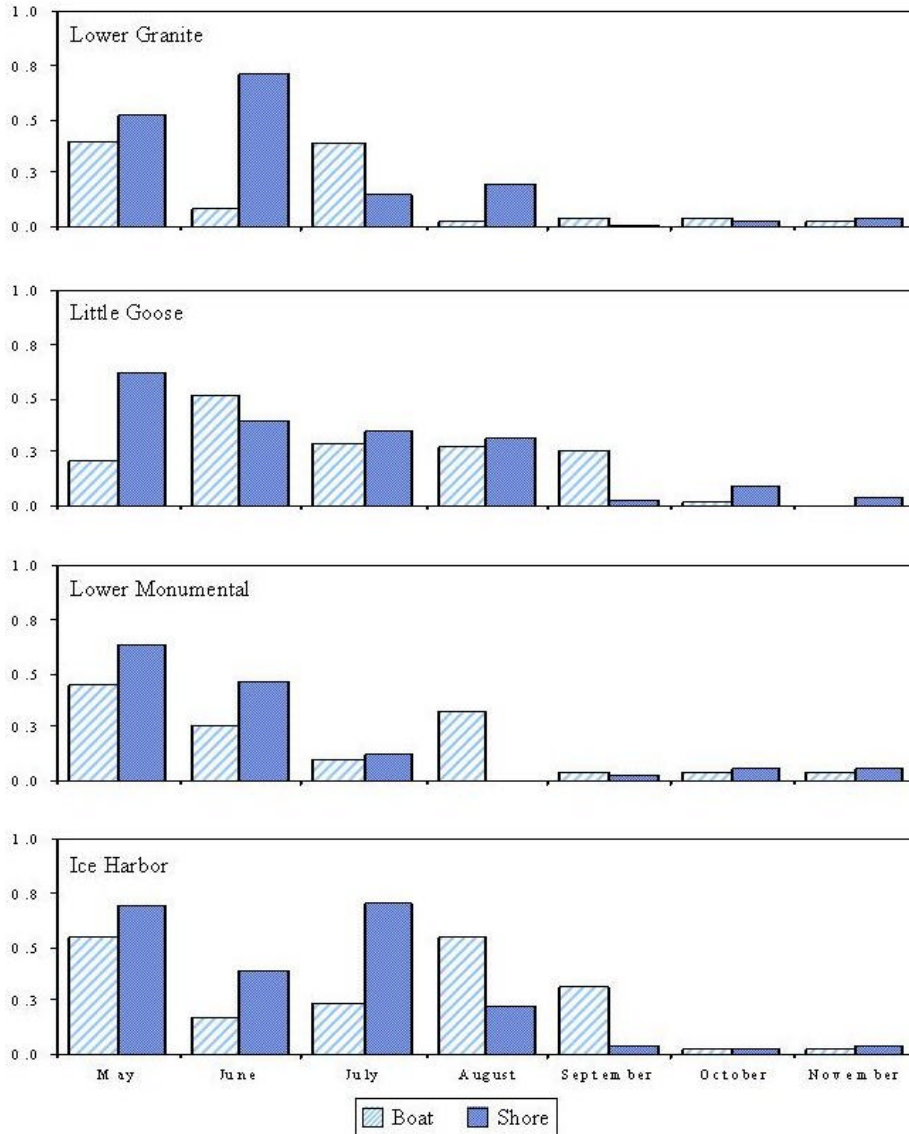


Figure 3.4-3. Estimated monthly harvest rates for boat and shore anglers for each lower Snake River reservoir May through November 1997.

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3.4.2 Individual Species

The catch and harvest rates for individual species in the creel are shown in Appendix Tables B-11 through B-14. As shown they reflect the disproportionate amount of total effort directed at steelhead throughout the lower Snake River reservoirs, and thus do not accurately portray the catch and harvest rates for species other than steelhead. As a result, they are provided in Appendix B for reference, but trends in catch and harvest rates among reservoirs and months and between shore and boat anglers are discussed only for those anglers specifically seeking those species (see Section 3.5.2). This presents the most useful data for most types of comparisons.

3.5 Directed Fisheries

3.5.1 Species Preferences

The relative proportions of interviewed anglers seeking a particular species are shown by reservoir for all anglers and for boat and shore anglers in Figures 3.5-1 through 3.5-3. Steelhead was the most frequently sought species in the lower Snake River reservoir system (Table 3.5-1). Nearly 4,500 interviewed anglers (72% of the total) sought steelhead between August and November. Lower Granite Reservoir supported the highest number and proportion of anglers seeking steelhead (85.9% of the reservoir total) followed by Lower Monumental Reservoir (73.3%) and Ice Harbor Reservoir (67.3%; Figure 3.5-1). The smallest fishery for steelhead was in Little Goose Reservoir, where 20.5% of those interviewed during 1997 sought steelhead.

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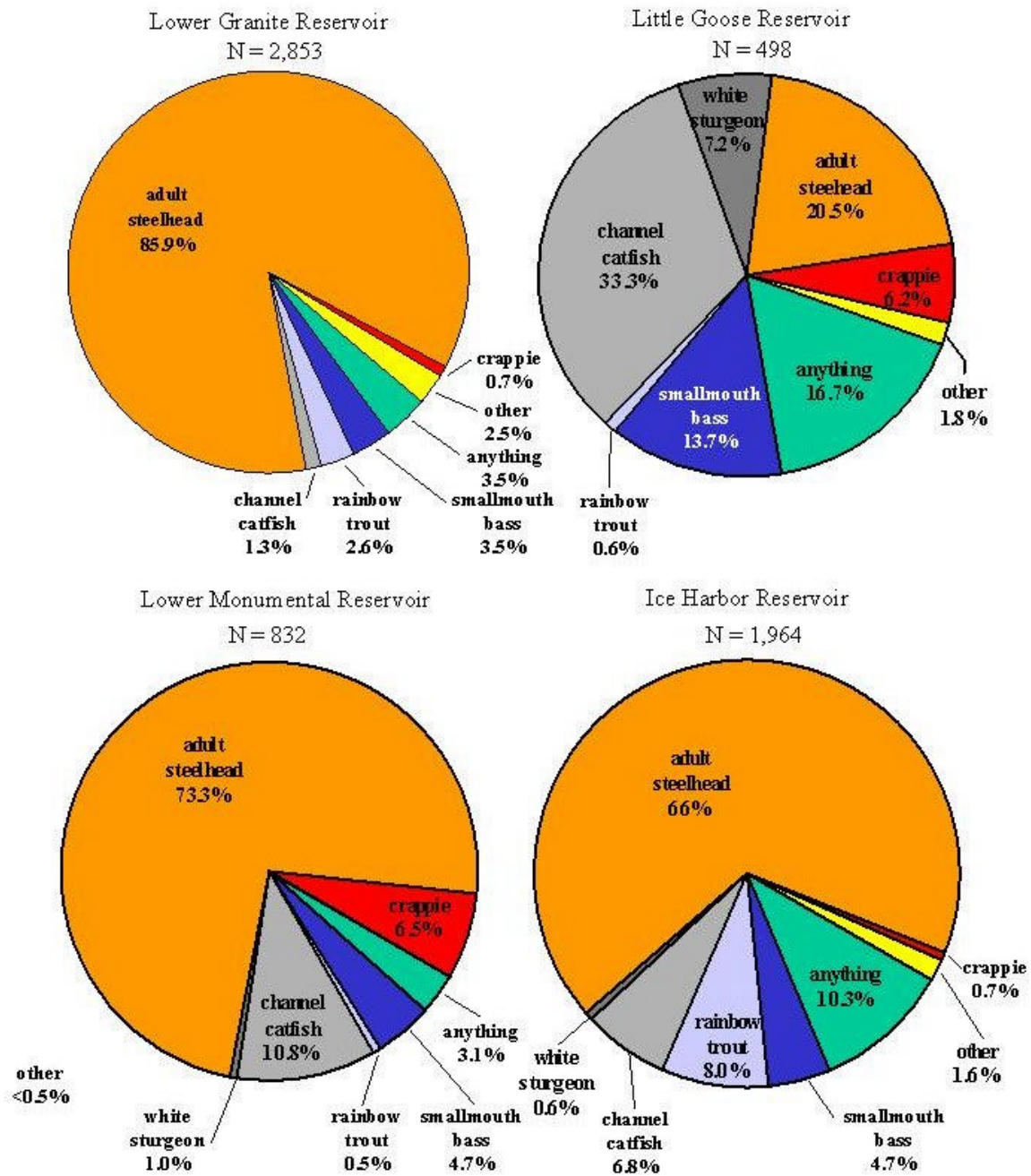


Figure 3.5-1. Species preference for all interviewed anglers in lower Snake River reservoirs
May through November 1997.

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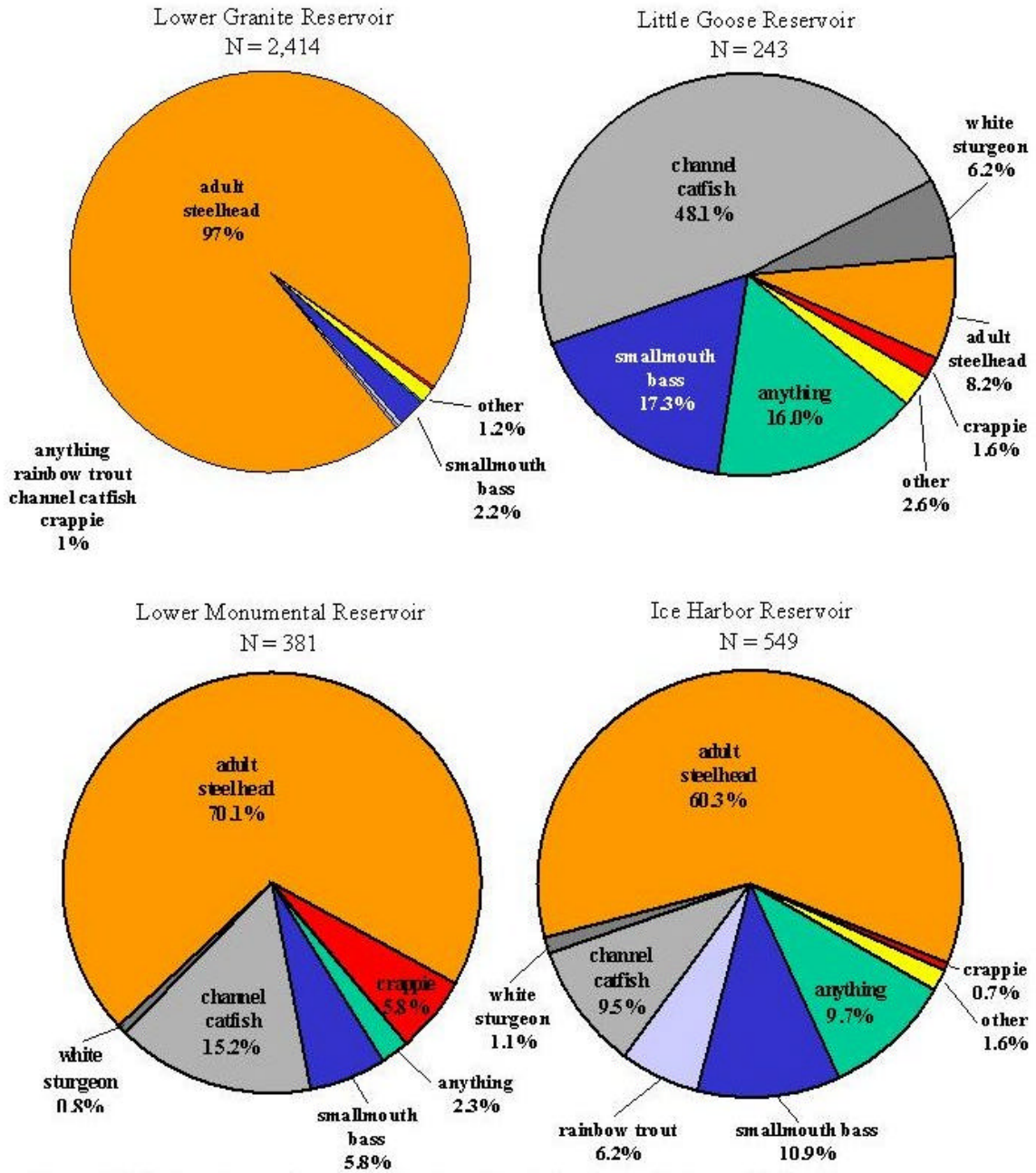


Figure 3.5-2. Species preference for boat anglers interviewed in lower Snake River reservoirs
May through November 1997.

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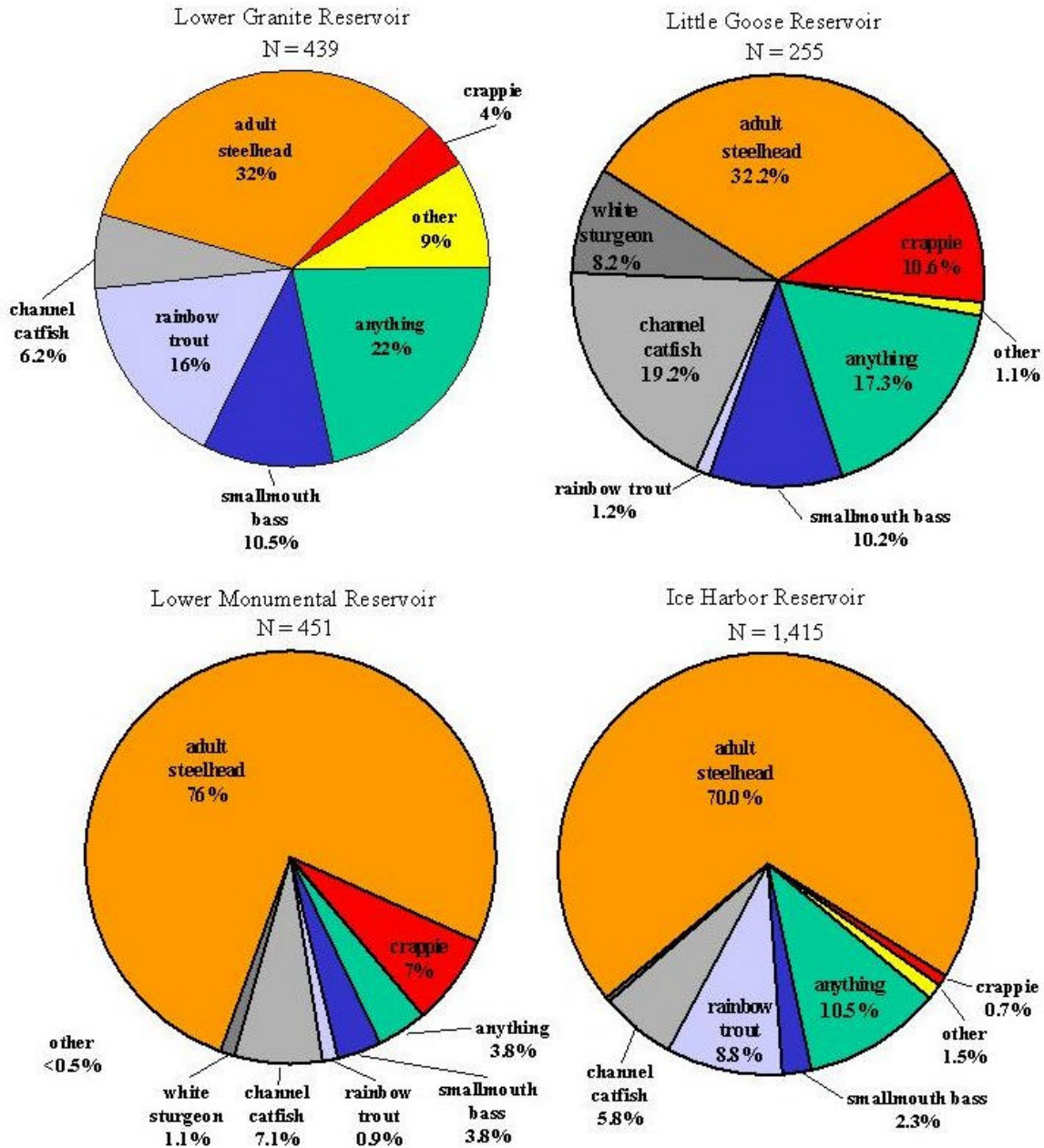


Figure 3.5-3. Species preference for shore anglers interviewed in lower Snake River reservoirs
May through November 1997.

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<p align="center">Table 3.5-1 Overall Species Preferences of Interviewed Anglers Throughout the Lower Snake River Reservoirs May through November 1997</p>		
Species	Number of Anglers	Percent
Steelhead	4,484	72.3
Channel catfish	426	6.9
Smallmouth bass	298	4.8
Rainbow trout	239	3.9
White sturgeon	55	0.9
Other species	112	1.8
Anything	415	7.5
Total	6,147	100.0

The proportion of all boat anglers seeking steelhead ranged from 8.2% at Little Goose Reservoir to 97% at Lower Granite Reservoir (Figure 3.5-2), but only at Little Goose was the proportion less than 60%. Pursuit of steelhead by shore anglers was highest at Lower Monumental and Ice Harbor reservoirs, where at least 70% of all shore anglers sought steelhead (Figure 3.5-3). In contrast, the proportion of shore anglers fishing for steelhead in the other reservoirs was 32%.

Seasonally, an abrupt shift away from resident species occurred in all reservoirs except Little Goose on September 1 when steelhead season opened in Washington and Idaho (Figures 3.5-4 and 3.5-5). However, boat anglers began to target steelhead even earlier (mid-August) in the Clearwater River arm of Lower Granite Reservoir. Anglers in Little Goose Reservoir, and to a lesser extent in Ice Harbor Reservoir, were the exception, and continued to fish primarily for channel catfish during September. By October, however, virtually all Snake River anglers except those fishing from shore in Little Goose Reservoir were focused on steelhead.

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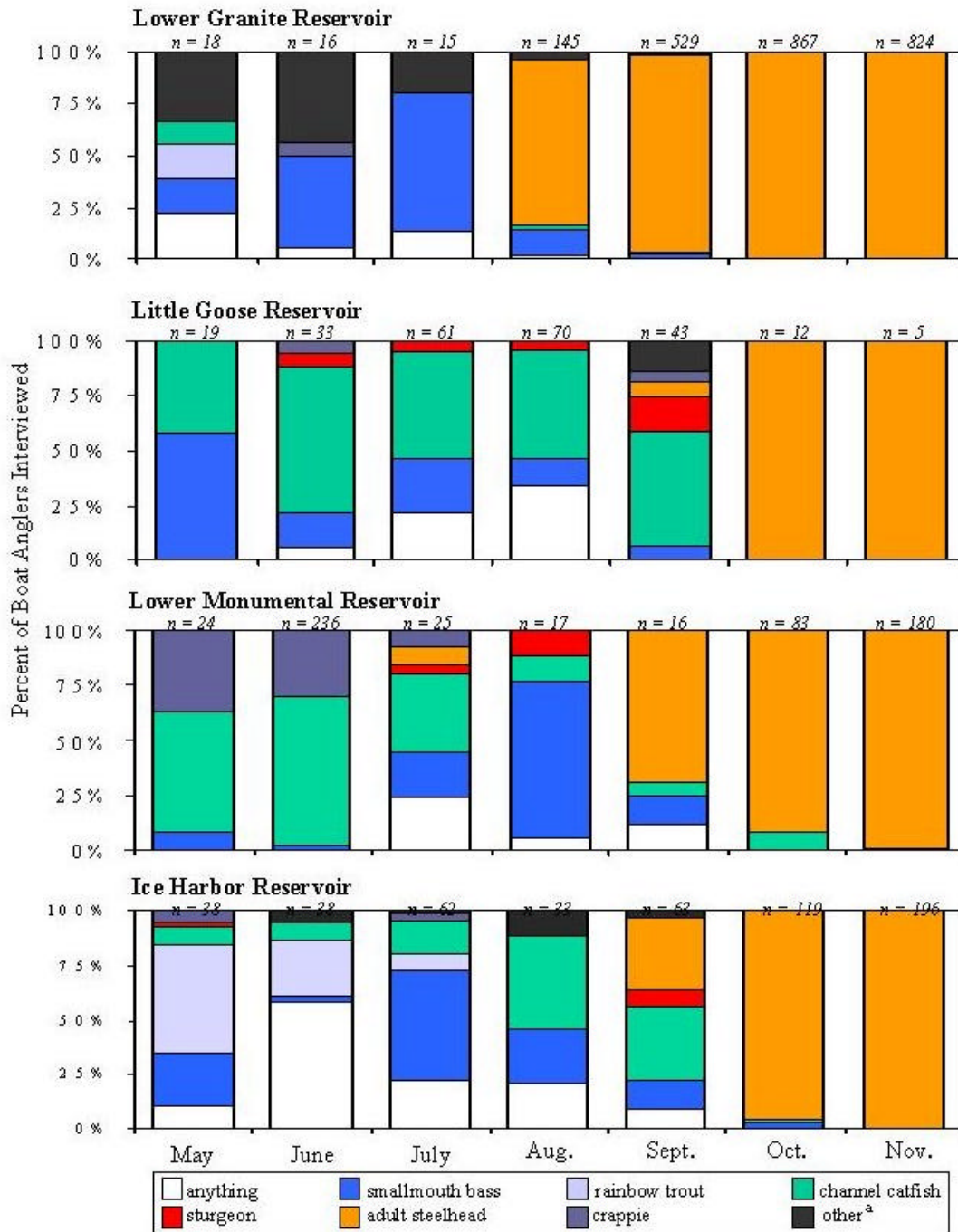


Figure 3.5-4. Species sought by boat anglers at the lower Snake River reservoirs May through November 1997.

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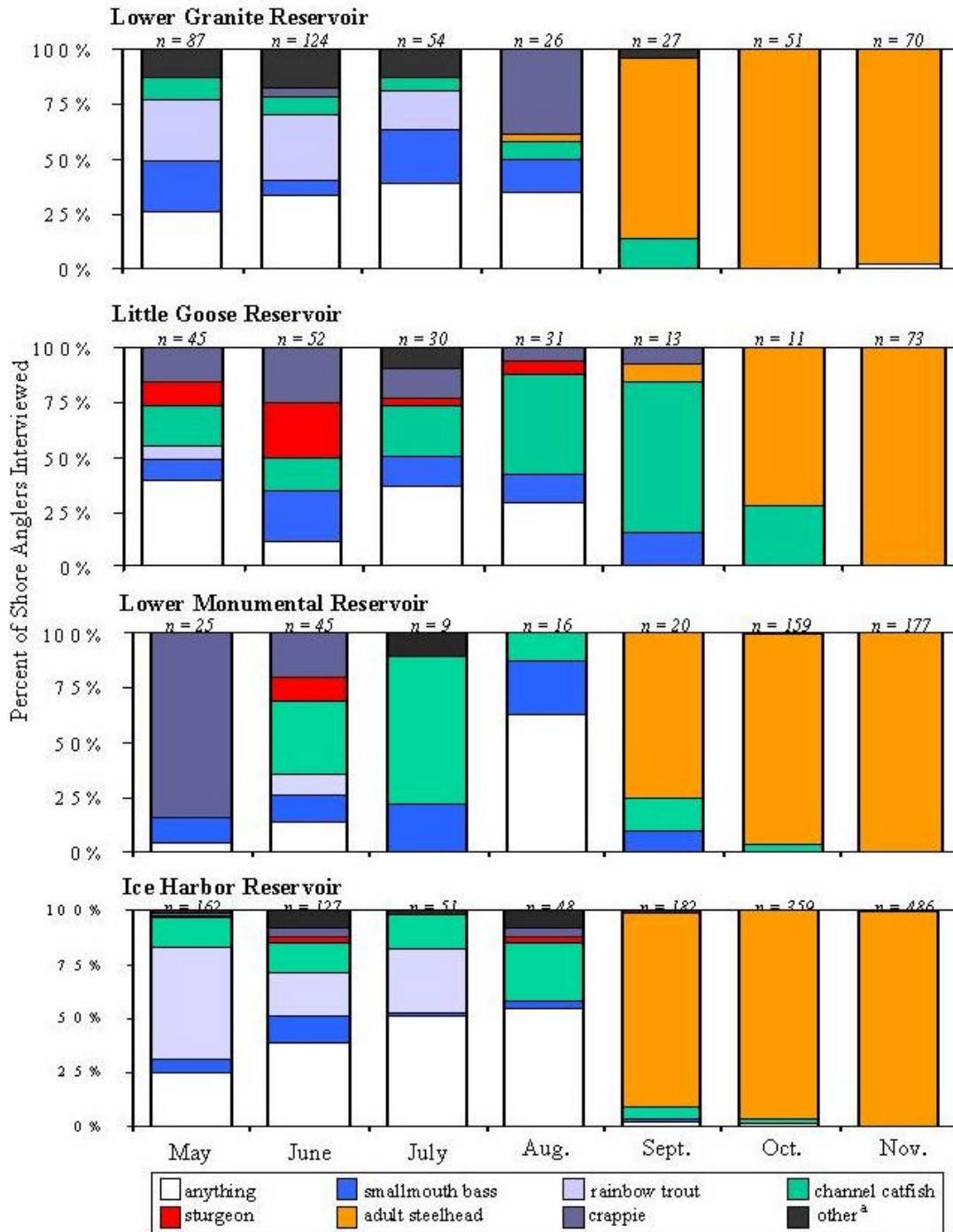


Figure 3.5-5. Species sought by shore anglers at the lower Snake River reservoirs May through November 1997.

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The resident fish most frequently sought by anglers interviewed throughout the lower Snake River reservoirs during 1997 included: channel catfish (6.9% of those interviewed), smallmouth bass (4.8%), crappie (1.9%), and white sturgeon (0.9%) (Table 3.5-1). Additionally, 3.9% of those interviewed sought stocked rainbow trout. Overall, 7.5% of the anglers contacted (range among reservoirs was 3.4% to 16.7%) had no species preference (*i.e.*, sought "anything").

Channel catfish was the most frequently sought resident fish in the lower Snake River system in 1997 (Figure 3.5-1). Little Goose Reservoir supported the largest number and highest proportion (33.3%) of anglers seeking channel catfish, whereas the lowest number of catfish anglers was in Lower Granite Reservoir. The proportion of anglers seeking channel catfish within most reservoirs remained relatively stable during May through August, then declined abruptly in all reservoirs except Little Goose when anglers turned to steelhead (Figures 3.5-4 and 3.5-5).

The largest proportion of anglers seeking smallmouth bass occurred in Little Goose Reservoir (13.7%), although more smallmouth bass anglers were interviewed in both Ice Harbor and Lower Granite reservoirs (Figure 3.5-1). The largest proportions of boat anglers seeking smallmouth bass occurred in Little Goose and Lower Granite reservoirs (Figure 3.5-2). However, the largest shore fishery for smallmouth bass was in Ice Harbor Reservoir (Figure 3.5-3). Seasonally, the largest proportion of anglers seeking smallmouth bass was in July in each reservoir except Little Goose, when the largest percentage occurred in May (Figures 3.5-4 and 3.5-5).

The largest proportion of crappie anglers was interviewed in Lower Monumental Reservoir (6.5% of the total) followed by Little Goose Reservoir (6.2%)(Figure 3.5-1). The crappie fishery in each of these reservoirs had a large shore component, and occurred principally in May and June (Figures 3.5-3 and 3.5-5).

Anglers seeking white sturgeon comprised less than 1% of all anglers interviewed. Most anglers seeking white sturgeon were contacted in Little Goose Reservoir directly downstream of Lower Granite Dam or in Lower Monumental Reservoir directly downstream of Little Goose Dam. Most sturgeon fishing took place from shore during May through July (Figures 3.5-3 and 3.5-5).

Stocked rainbow trout were sought by 3.9% of all interviewed anglers. The largest fishery for stocked trout occurred in Dalton Lake and Fish Hook Pond, off-channel sites adjacent to Ice Harbor Reservoir. Stocked rainbow trout were the second most targeted species after steelhead within Ice Harbor Reservoir (Figure 3.5-1). The other important put-and-take trout fishery was focused at several ponds adjacent to Lower Granite Reservoir along Highway 12 in Clarkston. All stocked trout fisheries were shore oriented and extended from April into July (Figures 3.5-4 and 3.5-5).

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3.5.2 Directed Catch and Harvest Rates

The catch and harvest rates for the principal directed fisheries are shown for each reservoir in Table 3.5-2. Lower Granite Reservoir exhibited the highest directed catch rates for crappie, smallmouth bass, rainbow trout, and steelhead. Although fewer anglers targeted crappie in Lower Granite Reservoir than elsewhere, success rates in backwater inlets and marinas of the Snake River arm were at least as good or better than those for crappie fisheries in the Dead Man's Bay and Lyons Ferry areas of Little Goose and Lower Monumental reservoirs, respectively, where more anglers sought crappie. Among all the directed fisheries, crappie had the most consistently high catch rates across all reservoirs. Catch rates for smallmouth bass were highest in Lower Granite Reservoir, whereas harvest rates were higher in Little Goose and Lower Monumental reservoirs. Similarly, the catch rate for steelhead in Lower Monumental Reservoir was equal to that in Lower Granite Reservoir, but the harvest rate in Lower Monumental Reservoir was the highest among all reservoirs. Catch-and-release of steelhead was only prominent in Lower Granite Reservoir, as evidenced by the substantial difference between catch and harvest rates.

<p align="center">Table 3.5-2 Total Angler Directed Catch (CPE) and Harvest (HPE) Rates for Lower Snake River Reservoirs During 1997 Confidence Intervals are Listed in Appendix Tables B-11 to B-14 N Represents the Number of Anglers Seeking a Species</p>												
Species Sought	Lower Granite Reservoir			Little Goose Reservoir			Lower Monumental Reservoir			Ice Harbor Reservoir		
	N	CPE	HPE	N	CPE	HPE	N	CPE	HPE	N	CPE	HPE
Crappie spp.*	19	2.760	2.204	31	2.691	1.611	54	0.995	0.666	14	1.445	0.144
Smallmouth bass	99	0.771	0.101	68	0.542	0.177	39	0.142	0.142	92	0.220	0.039
Channel catfish	36	0.075	0.059	166	0.240	0.223	90	0.178	0.147	134	0.355	0.290
Rainbow trout	74	3.249	1.328	3	1.129	0.000	4	0.000	0.000	158	0.752	0.623
Steelhead	2,450	0.046	0.028	102	0.028	0.028	610	0.046	0.041	1,322	0.033	0.028
White sturgeon	0	0.000	0.000	36	0.038	0.007	8	0.026	0.000	11	0.018	0.000

*Includes black and white crappie.

The highest catch and harvest rates among catfish anglers were observed in Ice Harbor Reservoir, followed by Little Goose Reservoir (Table 3.5-2). The catch and harvest rates for catfish anglers in Lower Granite Reservoir were substantially less than in the other three reservoirs.

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White sturgeon anglers experienced the best catch and harvest rates in Little Goose Reservoir (Table 3.5-2). Although sturgeon harvested from the other reservoirs were observed, they were apparently seen during incomplete trip interviews and thus did not enter into the rate calculations.

The variation in directed catch and harvest rates between boat and shore anglers for the major species is depicted in Figures 3.5-6 to 3.5-8. Boat anglers generally experienced higher success rates for channel catfish, smallmouth bass, and white sturgeon, whereas shore anglers had the highest rates for crappie and rainbow trout. An exception occurred in Lower Granite Reservoir, where angler success for crappie was highest among boat anglers. The catch and harvest rates of smallmouth bass anglers in Lower Granite and Little Goose reservoirs generally exceeded those of all smallmouth bass anglers in Lower Monumental and Ice Harbor reservoirs.

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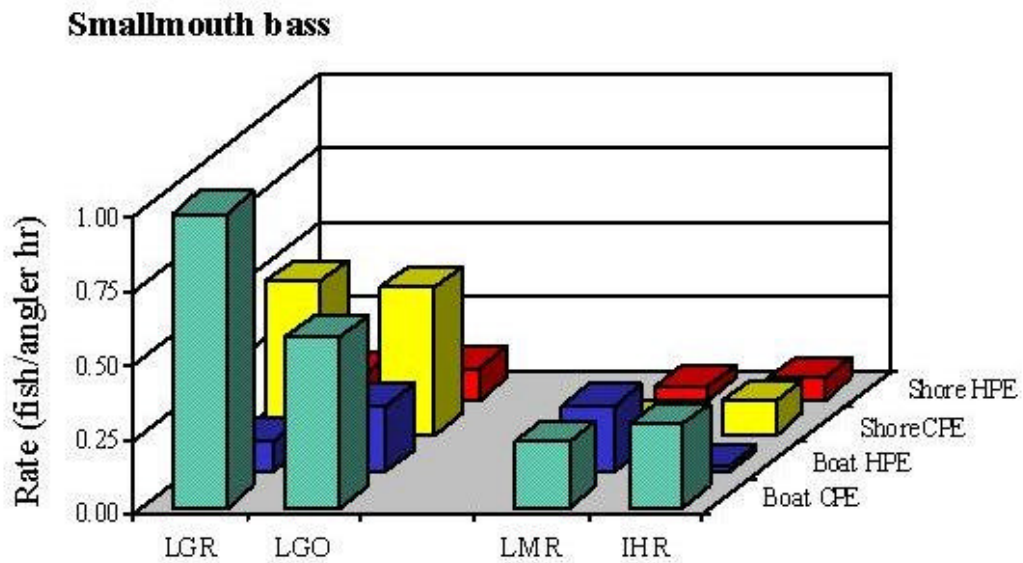
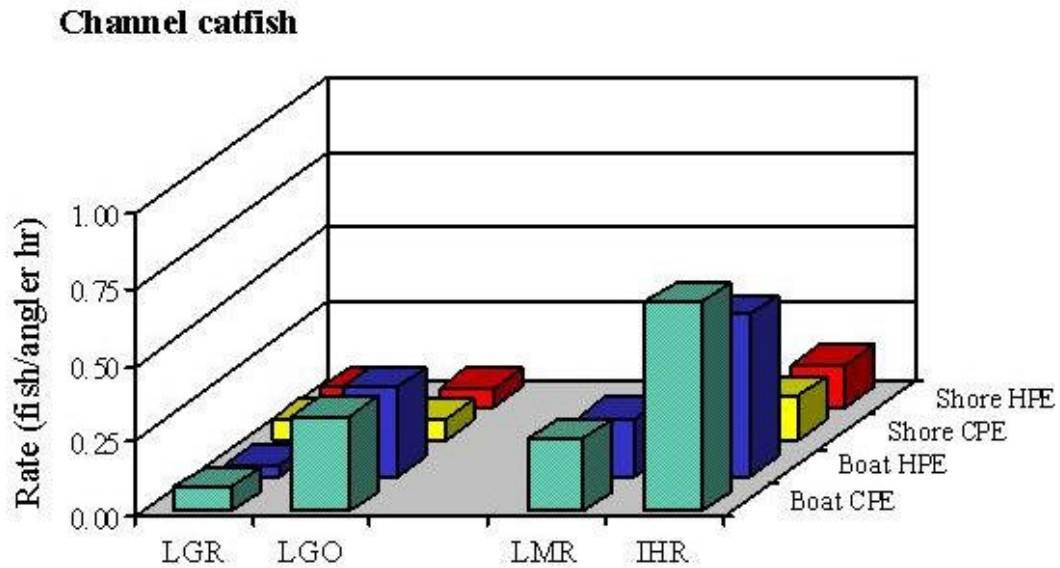
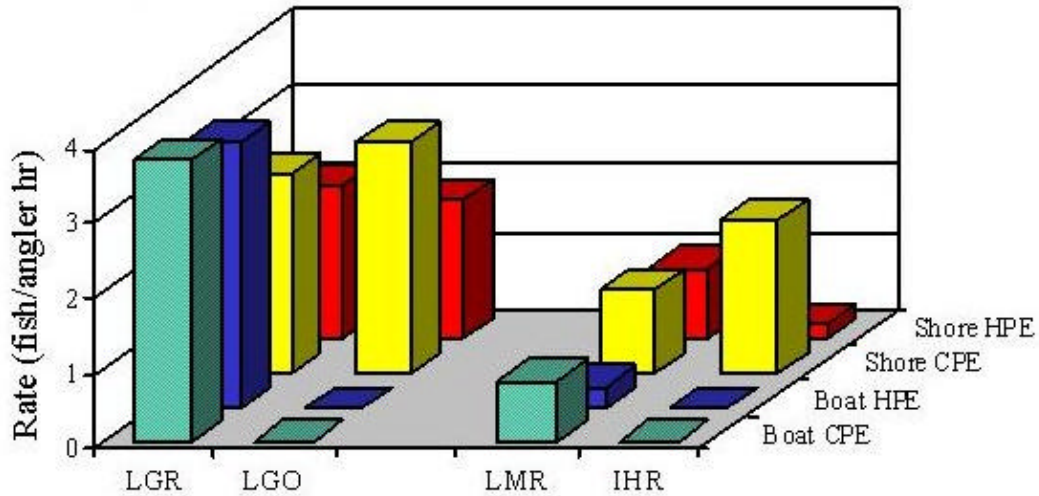


Figure 3.5-6. Directed catch and harvest rates for channel catfish and smallmouth bass
boat and shore anglers
in the lower Snake River reservoirs
May through November 1997.

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Crappie sp.



Rainbow Trout

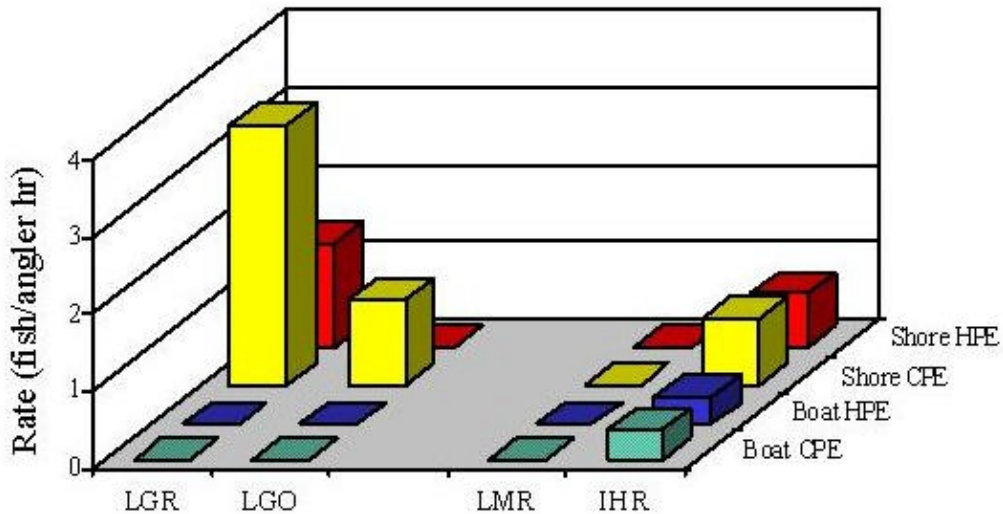


Figure 3.5-7. Directed catch and harvest rates for crappie and rainbow trout boat and shore anglers in the lower Snake River reservoirs May through November 1997.

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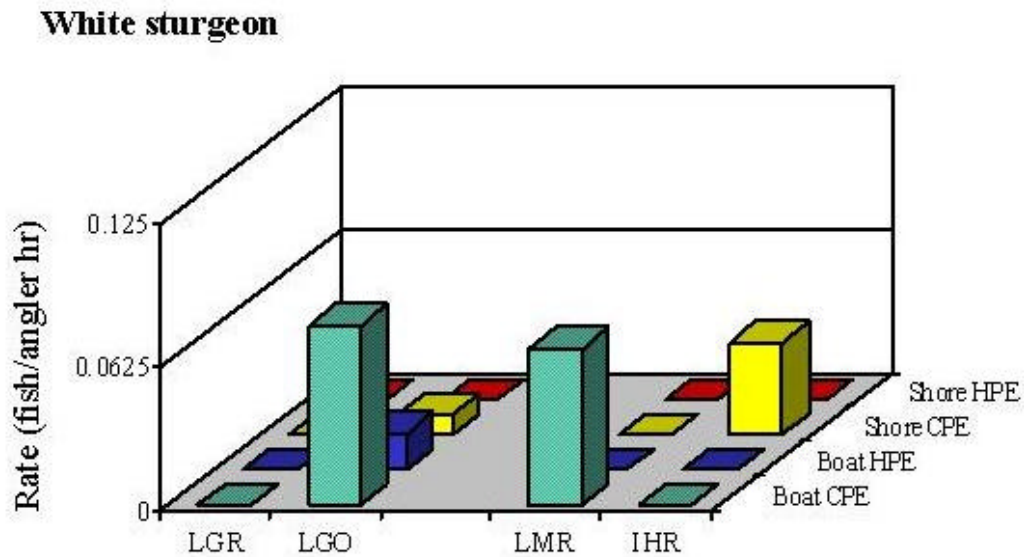
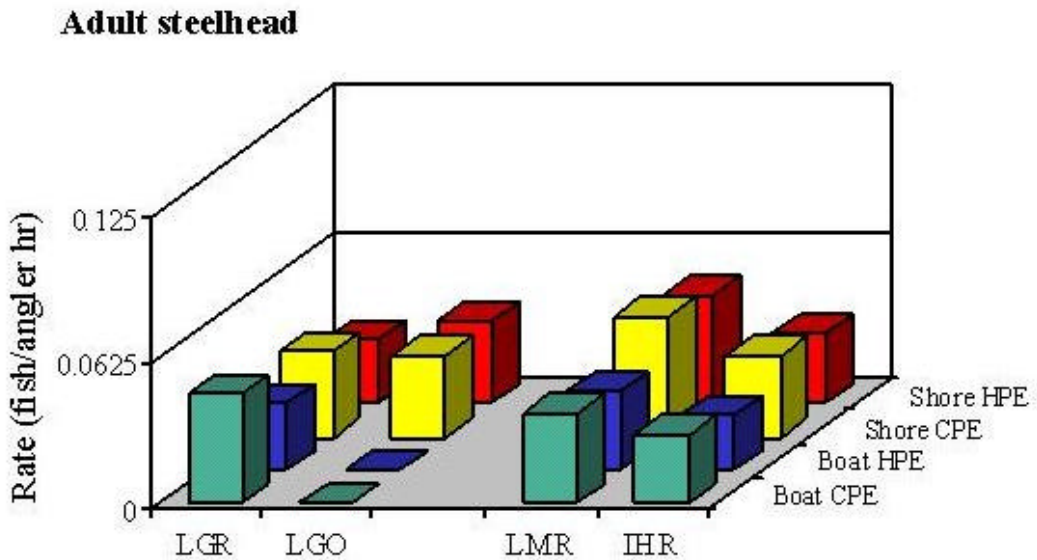


Figure 3.5-8. Directed catch and harvest rates for adult steelhead and white sturgeon
boat and shore anglers
in the lower Snake River reservoirs
May through November 1997.

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Seasonal trends in directed catch and harvest rates for steelhead, channel catfish, smallmouth bass, and crappie are shown in Figures 3.5-9 to 3.5-12. Steelhead catch and harvest rates during the harvest season (September 1 and thereafter) tended to be best in either October or November (Figure 3.5-9). However, the best catch rate (0.193 fish/angler hour) was for the catch-and-release fishery in upper Lower Granite Reservoir during August. The major channel catfish fisheries in Little Goose and Ice Harbor reservoirs experienced the best catch and harvest rates in either June through August or July through September, respectively (Figure 3.5-10). The small difference between catch and harvest rates in each reservoir suggests that most catfish caught were kept.

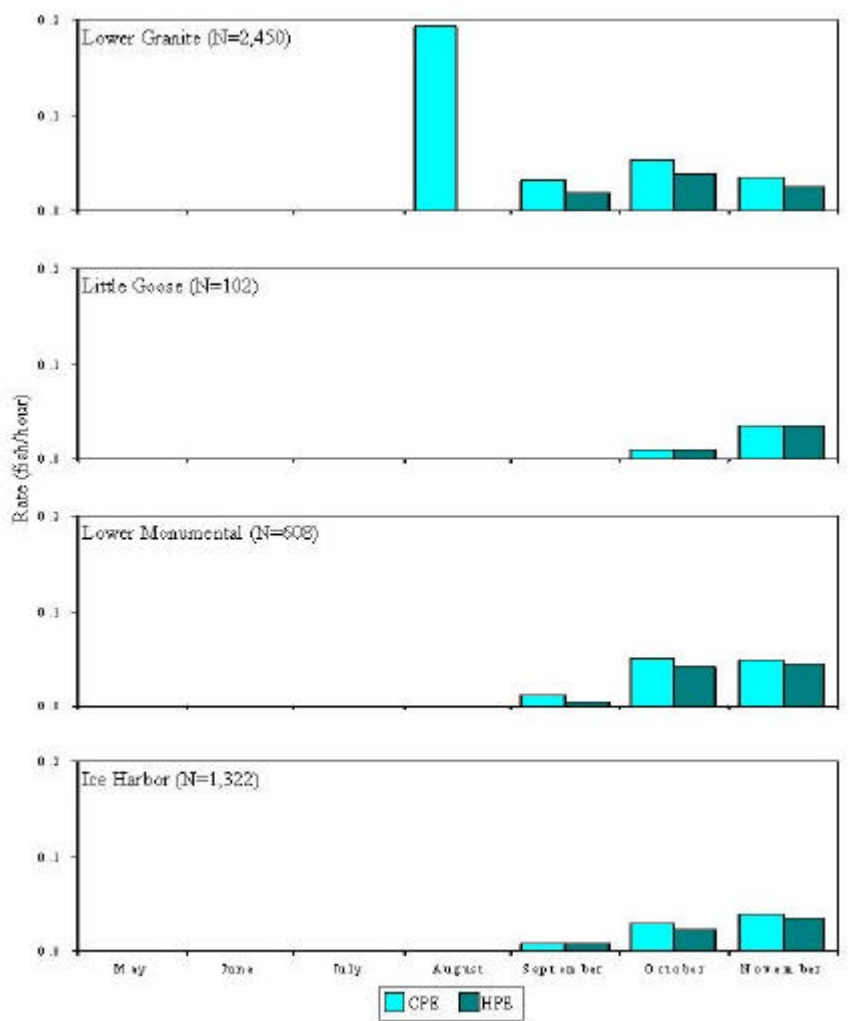


Figure 3.5-9. Monthly directed catch and harvest rates for steelhead in the lower Snake River reservoirs August through November 1997.

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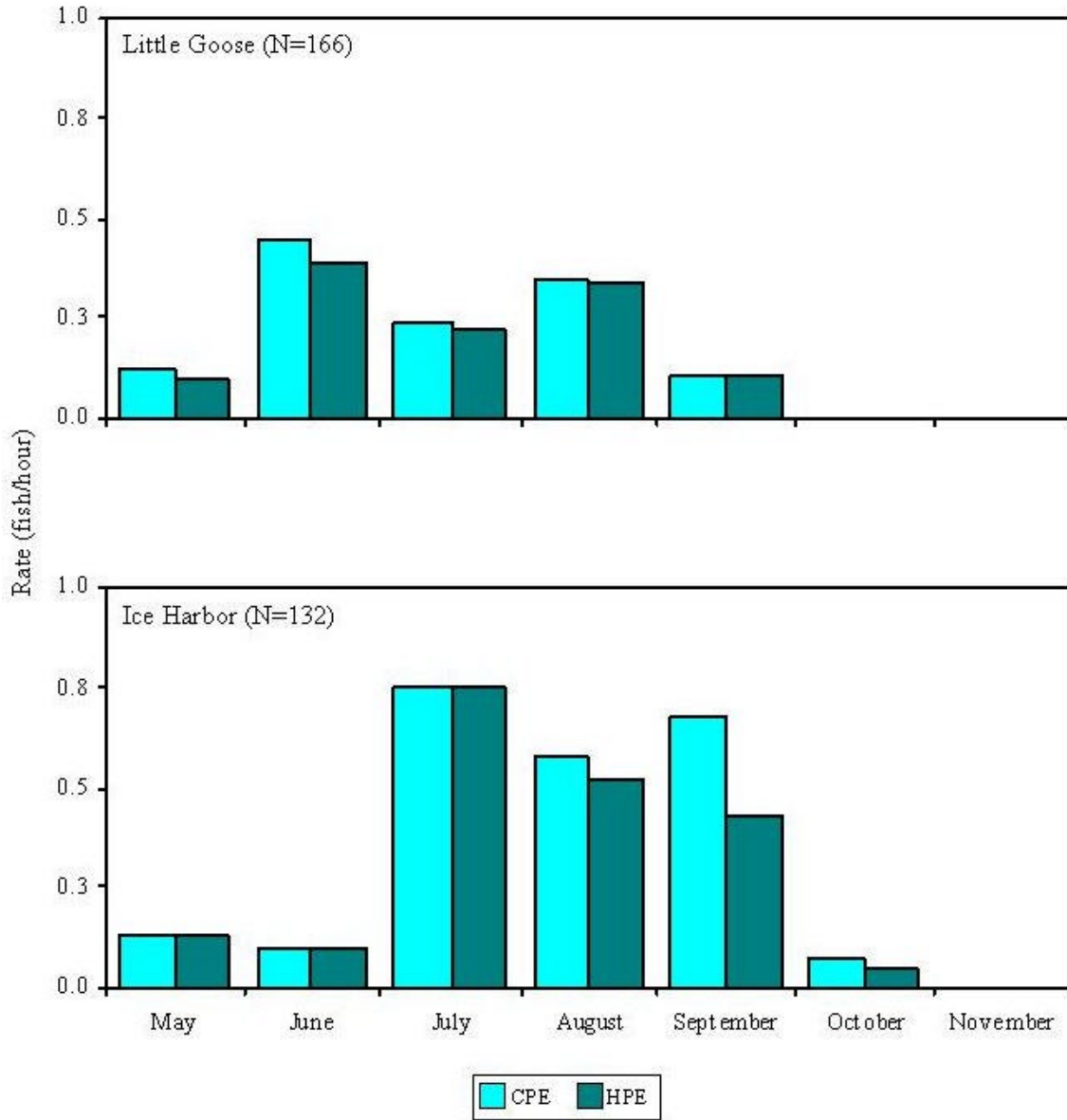


Figure 3.5-10. Monthly directed catch and harvest rates for channel catfish in selected lower Snake River reservoirs August through November 1997.

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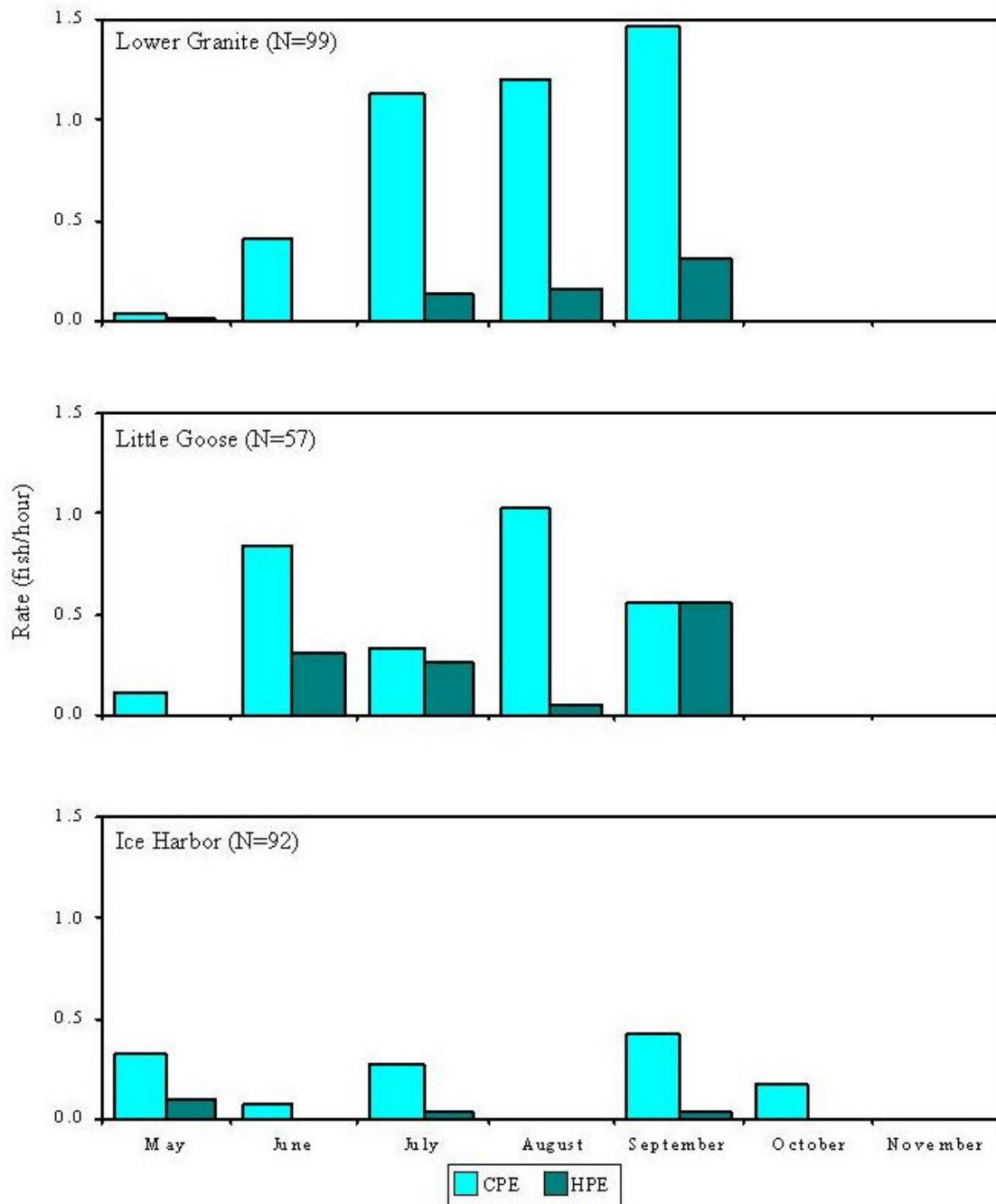


Figure 3.5-11. Monthly directed catch and harvest rates for smallmouth bass in selected lower Snake River reservoirs August through November 1997.

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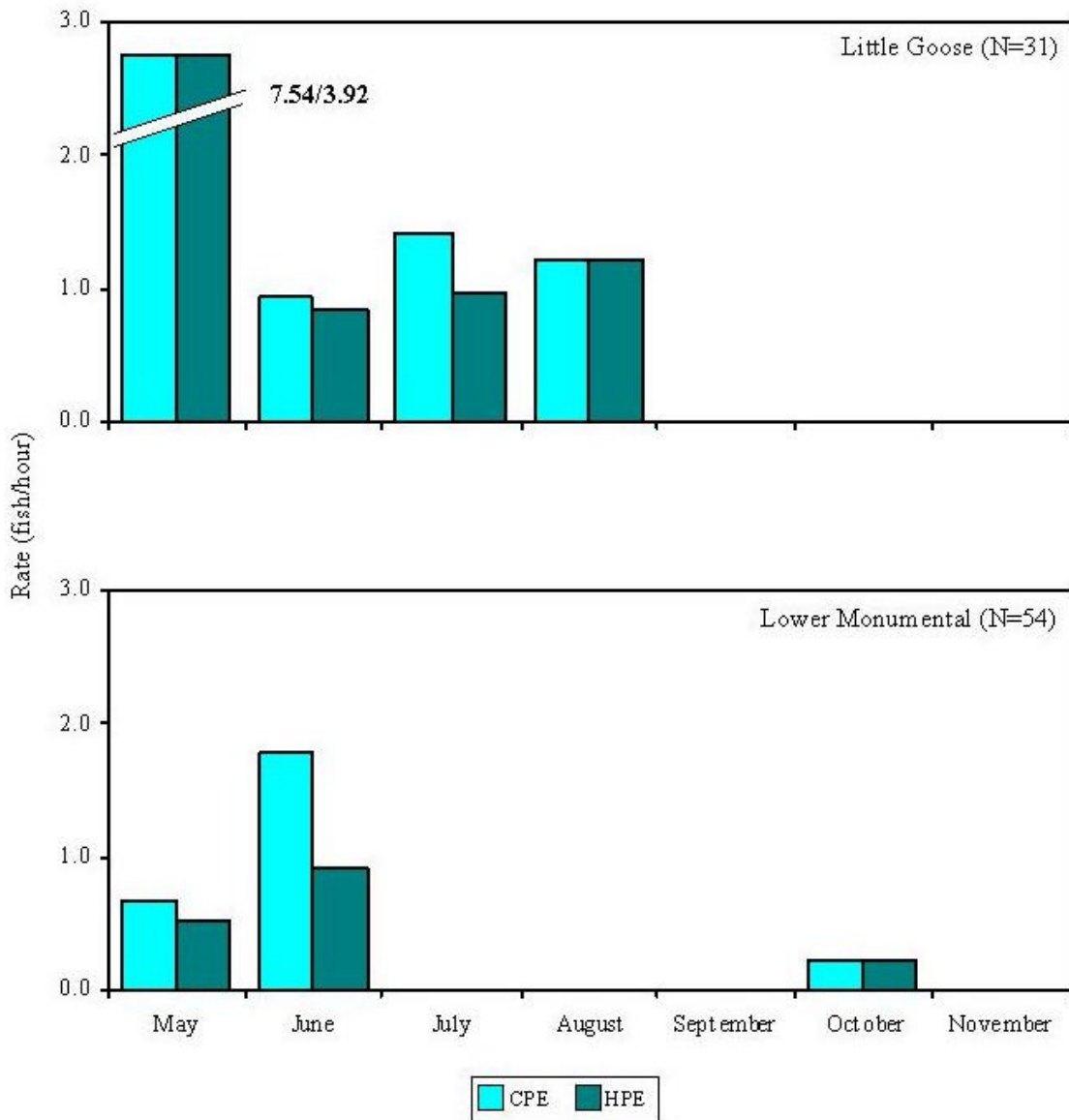


Figure 3.5-12. Monthly directed catch and harvest rates for crappie in selected lower Snake River reservoirs August through November 1997.

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Seasonal trends in catch/harvest rates among the smallmouth bass fisheries in Lower Granite, Little Goose, and Ice Harbor reservoirs tended to be quite variable (Figure 3.5-11). Sustained high catch rates were observed in Lower Granite Reservoir in July through September although harvest rates were 20% or less of catch rates. No consistent monthly trends in catch/harvest rates were apparent for smallmouth bass anglers in either Little Goose or Ice Harbor reservoirs. In fact, the catch rate in Ice Harbor Reservoir during August was <0.001 when the highest catch rate was observed in Little Goose Reservoir.

Catch/harvest rates for most crappie anglers were generally highest in May or June (Figure 3.5-12). However, a small number of anglers continued to pursue crappie in Little Goose reservoir in July (4) and August (2) and experienced catch rates exceeding 1.2 fish/angler hour.

3.6 Angler Characteristics

3.6.1 Angler Origin

Anglers from 19 states and Canada plus those from the principal catchment states of Washington, Idaho, and Oregon fished the Snake River reservoirs. Anglers visiting Ice Harbor and Lower Granite reservoirs clearly reflected the proximity of the major regional population centers (Figure 3.6-1). More than 89% of sport anglers at Ice Harbor Reservoir originated from one of the Tri-Cities or, secondarily, Walla Walla and vicinity (Waitsburg, Dayton, Pomeroy). Anglers from central Washington (*e.g.*, Yakima and Wenatchee) and areas west of the Cascades (*e.g.*, Seattle-Tacoma) each represented less than 4% of those interviewed. At the opposite end of the reservoir system, two-thirds of the anglers contacted at Lower Granite Reservoir resided in the Lewiston, ID vicinity or Clarkston, WA, while another quarter of those interviewed were from the Spokane, WA vicinity and Moscow-Pullman-Colfax areas. Anglers from other areas throughout the region comprised less than 9% of those interviewed at Lower Granite Reservoir.

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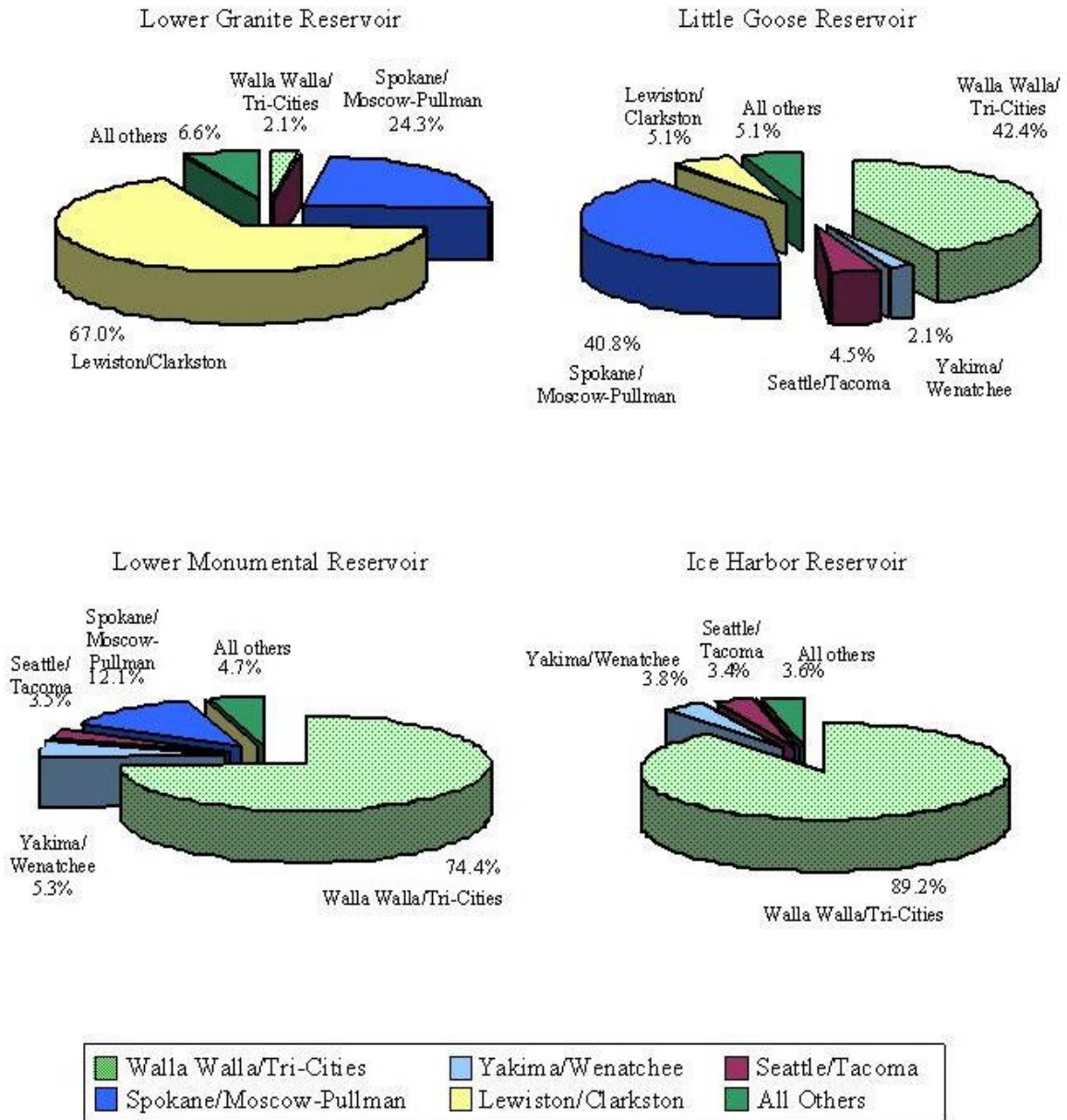


Figure 3.6-1. Origin of Snake River reservoir anglers interviewed during 1997 creel survey.

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Nearly 75% of anglers fishing Lower Monumental Reservoir resided in either Walla Walla and vicinity or, secondarily, one of the Tri-Cities (Figure 3.6-1). Residents of the Spokane and Moscow-Pullman-Colfax vicinities comprised most of the remaining Lower Monumental anglers. Anglers at Little Goose Reservoir were about equally represented from the Walla Walla and vicinity-Tri-Cities areas (42.4%) and the Spokane-Moscow-Pullman corridor (40.8%).

Anglers from Alaska, Montana and California were the most prevalent from states other than Washington, Idaho, and Oregon. Most Canadian anglers were from the province of Alberta.

When examined seasonally, the proportion of local anglers at Ice Harbor, Lower Monumental, and Little Goose reservoirs increased during the September through November period (Figure 3.6-2). At least for Ice Harbor and Lower Monumental reservoirs, the increased proportion of local anglers (those residing in the Tri-Cities or Walla Walla and vicinity) may have been partly due to a large number of repeat trips to fish for steelhead in lower Ice Harbor Reservoir and at the Little Goose Wall. In addition to higher participation by local anglers in Lower Monumental Reservoir, the proportion travelling to fish from the Spokane area and Moscow-Pullman also increased. However, the largest changes in angler residence between the spring-summer and fall periods occurred in Little Goose Reservoir. The representation by local (i.e., Walla Walla, Dayton, and vicinity) anglers more than doubled, while the proportion of anglers from the Spokane area and Moscow-Pullman declined from 48% to less than 20%.

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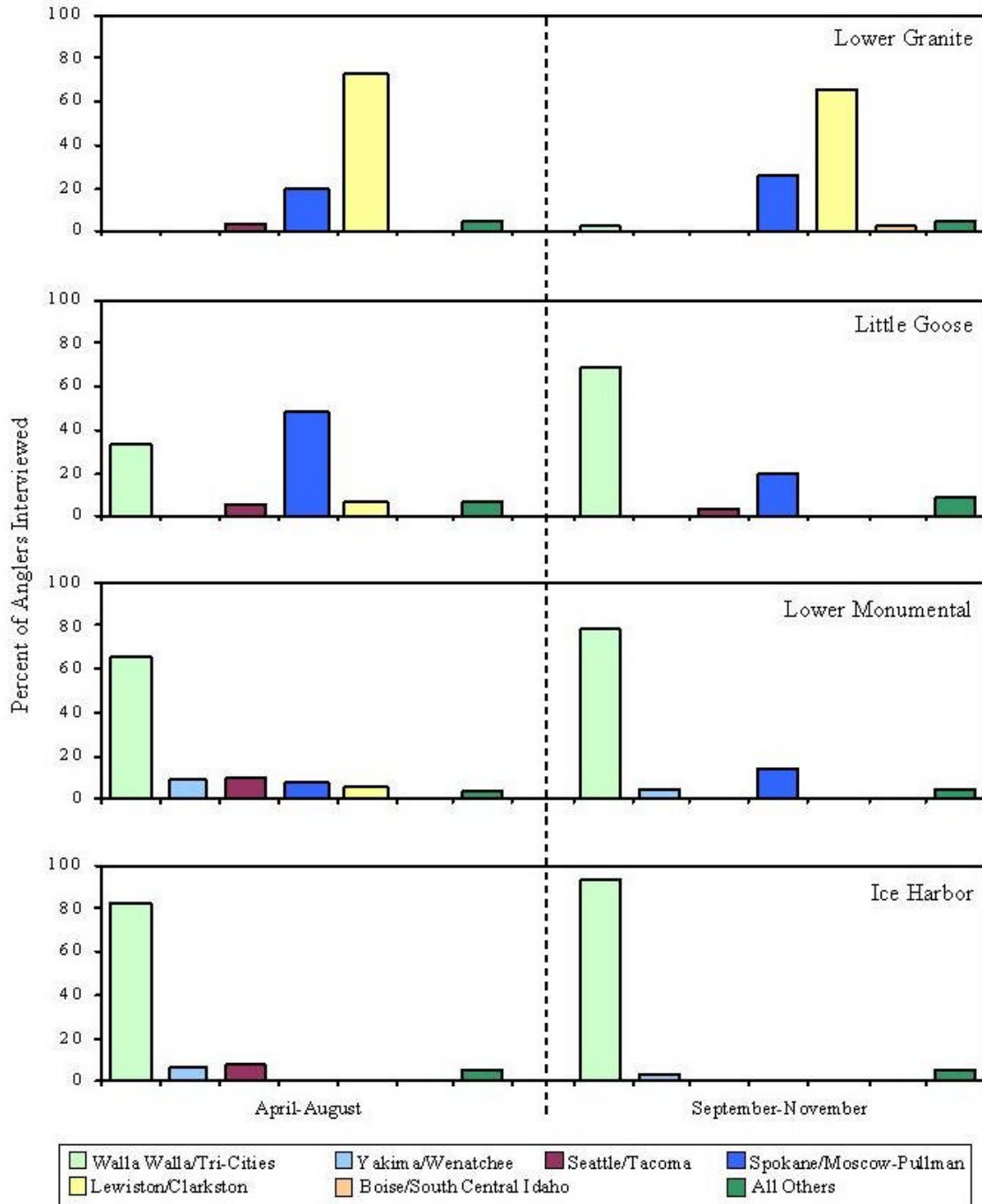


Figure 3.6-2. Origin of Snake River reservoir anglers during the April through August and September through November fishing season, 1997.

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At Lower Granite Reservoir, anglers from the Lewiston and Clarkston areas predominated during each seasonal period (Figure 3.6-2). However, the influx of anglers travelling longer distances such as from the Spokane area and Boise and other towns in south central Idaho was higher during September through November.

3.6.2 Visitation Status

Anglers visiting the lower Snake River reservoirs made primarily day trips that comprised 49% to 88% of individual reservoir visitation (Figure 3.6-3). The highest proportion of day trips occurred in Ice Harbor and Lower Granite reservoirs, each near a major population center. In contrast, camping was much more prevalent at the more isolated reservoirs. Anglers using either Corps, State Park or commercial camping facilities comprised 40% and 34% of those interviewed at Little Goose and Lower Monumental reservoirs, respectively. The proportion of anglers camping at Little Goose and Lower Monumental reservoirs generally increased during the fishing season. Proportional use of Lower Monumental campgrounds (Lyons Ferry area) was highest in August and in September-October at Little Goose campgrounds (Central Ferry area). Campground use by anglers was lowest in Lower Granite Reservoir.

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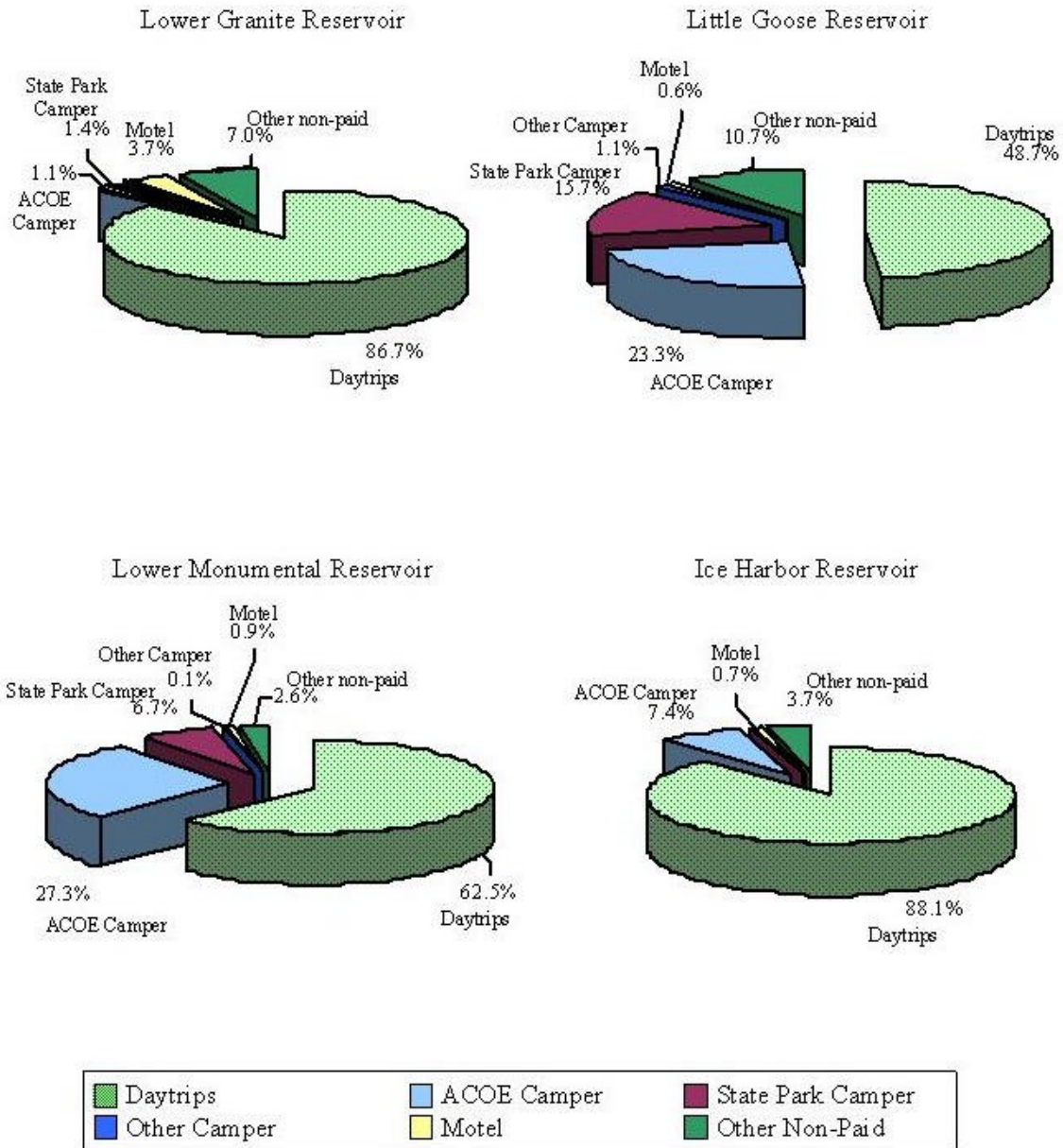


Figure 3.6-3. Visitor status of Snake River reservoir anglers interviewed during 1997 creel survey.

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Most other anglers were visiting friends or relatives and stayed with them. The use of paid lodging was notable only at Lower Granite Reservoir, where nearly 4% of the anglers stayed at motels. Use of motels by Lower Granite anglers occurred almost exclusively in October and November during steelhead fishing season.

3.6.3 Characteristics and Methods of Steelhead Anglers

Steelhead fishing throughout the Snake River reservoirs during September through November was pursued primarily by bank anglers except in Lower Granite Reservoir (Figure 3.6-4). The proportion of bank steelhead anglers among the three lowermost reservoirs ranged from 71% to 81%. In Ice Harbor Reservoir, the steelhead fishery was focused along the shoreline from the Charbonneau Park boat launch downstream to the Ice Harbor Dam. Charbonneau Road parallels the reservoir for much of this distance and offers easy, direct access for bank anglers. In Lower Monumental Reservoir the steelhead fishery occurred mainly in the Little Goose Dam tailrace at a developed area below the powerhouse known as the "Little Goose Wall." The relatively limited amount of steelhead angling in Little Goose Reservoir occurred immediately upstream of the Little Goose Dam.

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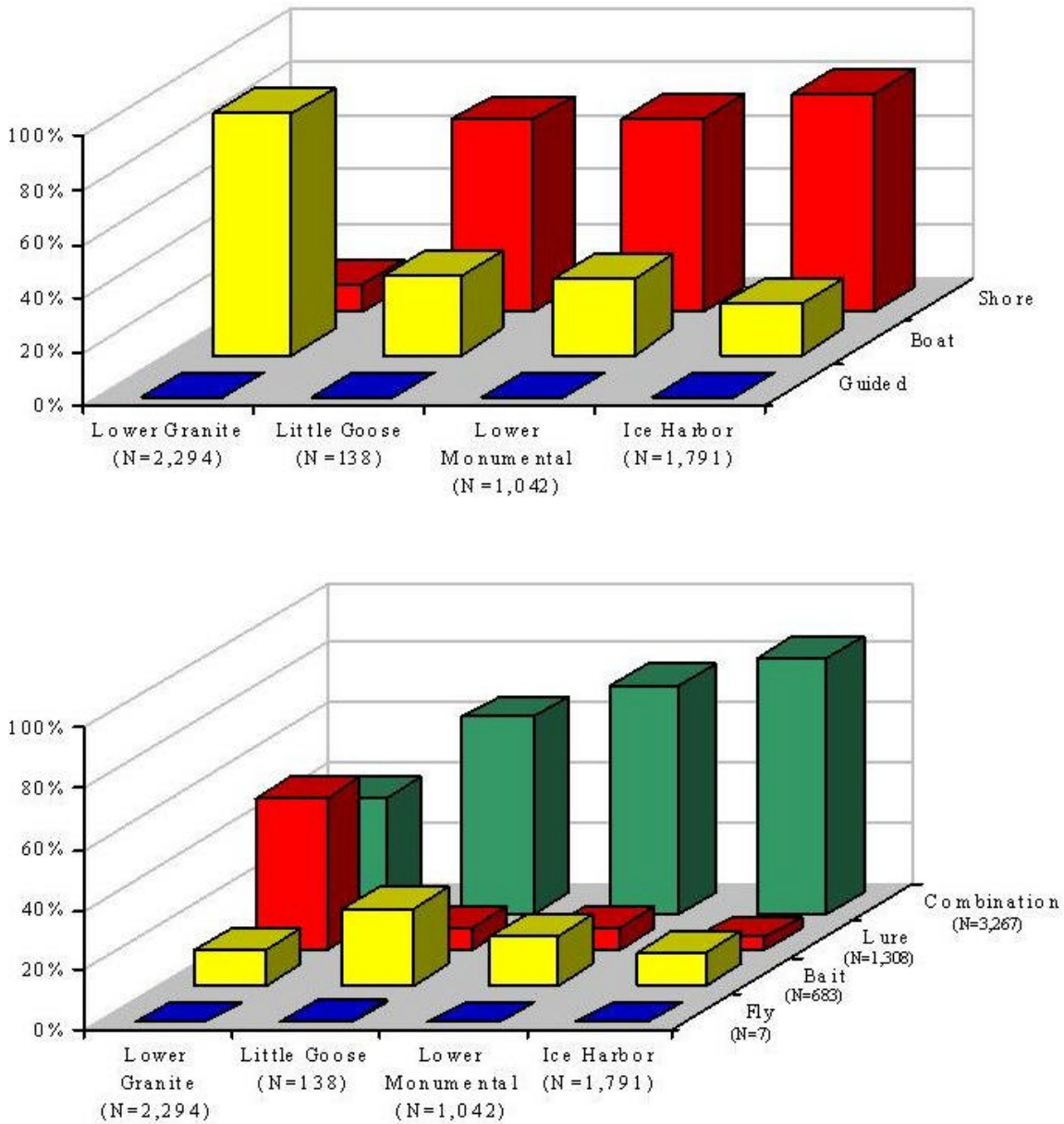


Figure 3.6-4. Methods used by Snake River steelhead anglers during the period of September through November 1997.

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In contrast to the other reservoirs, 90% of the steelhead anglers in Lower Granite Reservoir fished from a boat (Figure 3.6-4). Most of the boat effort emanated from launches in Lewiston or Clarkston that provided access to the Snake River-Clearwater River confluence area favored by anglers. Of the six boat access sites in the Lewiston-Clarkston area, the Greenbelt ramp supported the most use. The limited shore angling that did occur in Lower Granite Reservoir was focused in the downstream portions of the reservoir along the shoreline from Offield Landing to Lower Granite Dam. Virtually all steelhead boat angling in the reservoirs was from private craft, as little use of guides was reported.

A combination of a lure with bait was the primary method used to catch steelhead in each reservoir except Lower Granite (Figure 3.6-4). Typically, shore and boat anglers fished their baited lure combinations below bobbers. In contrast, more than 50% of steelhead anglers in Lower Granite Reservoir fished with an unbaited lure while nearly 38% reported using a lure with bait combination.

Anglers in Lower Granite Reservoir were queried about their fishing license purchases. Slightly more anglers fished with an Idaho license (41.6%) than a Washington license (35.2%). The proportion of anglers with licenses from both states was 23.1%. Only three anglers (0.1%) had purchased an Oregon license.

4.0 DISCUSSION

Highest angling effort throughout the lower Snake River reservoir system changed from side ponds and backwater areas in April and May to main channel areas in June through November 1997, and then returned to off-channel sites and backwaters in March 1998. The earliest angling effort was observed in 1997 in backwater inlets and side mitigation ponds. These areas were created when either a road or railroad bed was constructed adjacent to the reservoir (e.g., West Evans Pond along Lower Granite Reservoir), or resulted from an elevated water table induced by reservoir construction (e.g., Fishhook Ponds adjacent to Ice Harbor Reservoir). Backwater inlets were created either when tributary streams or low lying areas adjacent to the Snake River were flooded by reservoir construction (e.g., Dead Man's Bay in Little Goose Reservoir), or during construction of public access and use facilities (e.g., Ayer Landing in Lower Monumental Reservoir).

These side-channel locations were very attractive in the spring because of the higher catch rates. Beginning in February and continuing through May 1997, the Washington Department of Fish and Wildlife stocked a total of 71,441 (20,661 lbs.) hatchery-reared rainbow trout in ponds associated with the reservoirs of the lower Snake River. Ponds near Lower Granite Reservoir (41,942) and Ice Harbor Reservoir (22,952) received most of the trout. The catch rate for stocked rainbow trout was especially high in the

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ponds adjacent to Lower Granite Reservoir (3.2 fish/angler hour). As many as 40 shore anglers were observed surrounding the ponds along Highway 12 during a single aerial count. More than 80% of the estimated total catch (7,508 fish) in Lower Granite Reservoir, and 78% of the estimated total catch (8,668 fish) in Ice Harbor Reservoir during April and May consisted of stocked rainbow trout. The overall estimated catch for rainbow trout (15,770) is likely an underestimation of the total catch because most ponds were initially stocked nearly 3 months prior to the start of ground surveys. The actual catch may approximate two to three times the estimate herein.

Backwater inlets also supported more favorable fishing conditions than the main channel of the Snake River early in the year. Water temperature noted by creel clerks was often several degrees warmer in backwater areas than the main river channel. Crappie, smallmouth bass, and channel catfish were among the more highly sought fish in the more prominent backwater inlets in all the reservoirs, and during April and May comprised 97.1% and 94.1% of the total angler catch of Little Goose and Lower Monumental reservoirs, respectively.

Also, low angling pressure in the main river channel during spring 1997 was probably a result of near record water flows from early spring rains and substantial snowmelt. High, turbid flows and rafts of floating woody debris probably prevented many anglers from accessing the main river channel. The creel clerks noted several instances where boat launches were unusable as a result of high amounts of woody debris.

Angler use of the main channel of the Snake River reservoirs increased as boating and access conditions improved during June. Overall angling effort increased by 55.9% from June to July. Resident fish such as smallmouth bass and channel catfish became highly sought by anglers in the main river channel once water temperatures warmed and boating conditions improved. Lower flows coincided with an increase in the number of anglers seeking white sturgeon, particularly in the tailrace areas of Lower Granite and Little Goose reservoirs.

In August, overall angling pressure declined in the lower Snake River system as a result of fewer shore anglers. The number of shore anglers at stocked mitigation ponds and backwater inlets decreased; less than 10% of the anglers observed were located in these off-channel areas while the majority was found in the main river channel. Also, an increase in night fishing occurred in July and August, possibly an attempt to avoid the high air temperatures or other types of recreational activities during the day. Night anglers typically sought channel catfish and reported better fishing success after dark. Conflicting interests between anglers and recreationists (e.g., water skiing) may have also contributed to decreased shore angling.

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Beginning in September, the observed 76.4% increase in angling effort from August coincided with the opening of steelhead season in the lower Snake River system. From September to November, 95.8% of the total anglers interviewed were seeking steelhead. However, this large increase in angling pressure was not directed at the entire lower Snake River system, but occurred in a few key locations or "hot spots." In particular, anglers would concentrate at sites near the confluence of the Snake River with other tributaries (e.g., Clearwater or Tucannon Rivers), and at sites in close proximity to the hydroelectric dams. Sites near the dams focused on fishway entrances (e.g., Little Goose Wall) and exits (e.g., left descending shoreline above Ice Harbor and Lower Granite dams). According to steelhead biologists with Washington Department of Fish and Game, steelhead typically concentrate in these areas and often support high catch rates which attract anglers (Art Viola and Mark Schuck, Washington Department of Fish and Wildlife, personal communication).

Little trend information can be constructed on overall angling effort. The only known comparative study that quantified sport fishing effort for resident fish on Snake River reservoirs was conducted in 1979 and 1980 by Knox (1982). Effort in Little Goose Reservoir during 1997 (69,809 hours) for a comparable fishing period was within the range of effort (45,752 and 79,605 angler hours) reported by Knox (1982).

The resident sport fishery was largely supported by channel catfish, crappie, and smallmouth bass. Channel catfish was the most preferred, particularly in Little Goose, Lower Monumental, and Ice Harbor reservoirs. Channel catfish accounted for more than 45% of the yield of resident fish in the three lower most reservoirs, and was particularly important among boat anglers in Little Goose and Lower Monumental reservoirs. Moreover, the channel catfish caught were relatively large (see Appendix Figure C-1), which many "long time" anglers of the Snake River attributed to reduced angling pressure. Channel catfish comprised 16.9% of the total catch and accounted for 51.1% of the yield (excluding steelhead) in Little Goose Reservoir. In comparison, Knox (1982) reported that channel catfish in Little Goose Reservoir accounted for less than 4% of the angler catch and 13% of yield. Harvest rates for channel catfish also improved markedly as Knox (1982) found less than 0.10 fish/angler hour compared to 0.25 fish per angler hour in 1997.

Smallmouth bass ranked second among resident fish sought throughout the lower Snake River system. In particular, a substantial catch and release fishery existed for smallmouth bass in Lower Granite Reservoir, where anglers kept 8.8% of the estimated (10,096) bass catch. In comparison, anglers in the other three reservoirs harvested more than 27.9% of the smallmouth bass caught. Boat anglers seeking bass

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consistently had higher catch rates than shore anglers; higher catch rates may be why more boat anglers sought smallmouth bass than shore anglers. The total harvest rate for smallmouth bass anglers in Little Goose Reservoir (0.19 fish/angler hour) was less than that for shore or boat anglers in either 1979 (0.20 and 0.34 fish/angler hour) or 1980 (0.20 and 0.45 fish/angler hour) (Knox 1982).

Catch and release of smallmouth bass is common in many sport fisheries throughout the U.S. (Graff 1987). However, the low retention rates observed, especially in Lower Granite Reservoir, may reflect the small size of bass typically caught (see Appendix Table C-2). Bennett *et al.* (1991) examined population characteristics of smallmouth bass in the lower Snake River relative to other geographic regions and found that low numbers of quality-sized fish are prevalent throughout the lower Snake River and other northwest reservoirs. Growth rates are slow and replacement of larger individuals is slow compared to areas within the natural range.

Both white and black crappie comprised another important component of the resident sport fishery. Most of the crappie fishing occurred in backwater inlets in primarily Little Goose and Lower Monumental reservoirs in April through June. Crappie contributed more than 30% of the overall angler catch of resident fish, and provided anglers with the highest catch rates for resident species in the Snake River system (ranging up to 2.8 fish/angler hour). However, crappie caught and kept by anglers were typically small, accounting for less than 15% of the total yield within the lower Snake River reservoirs. Despite their small size, anglers kept 67.2% of the crappie caught. The results for 1997 are similar to those of Knox (1982) for Little Goose Reservoir during 1979 and 1980 when crappie comprised 10-15% of the yield (biomass).

Among the species-specific fisheries assessed by Knox (1982), crappie anglers in this study fished in the same locations and experienced the best catch rates. However, the crappie fishery is of relatively short duration and focused in primarily the backwater areas. The data suggest a shift in preference among anglers towards pursuit of channel catfish. More anglers sought channel catfish than any other species in Little Goose Reservoir in 1997, in contrast to 1979-1980 when most anglers sought smallmouth bass. The reasons for the suggested decline in the smallmouth bass sport fishery in Little Goose Reservoir, based on 1 year of comparative data, remain unclear but are probably related to catch rates and fish size. Anglers now may target channel catfish due to relatively high catch rates or superior size, or switched to catfish due to poorer success seeking smallmouth bass. Also, local anglers may target smallmouth bass more in Lower Granite Reservoir, where catch rates were higher for smallmouth bass and actual abundance is considerably higher (Bennett *et al.*, 1997).

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Two known surveys have been conducted on the distribution and abundance of resident fish throughout the lower Snake River reservoirs, and the catch and harvest data reflect similar trends as those surveys. In 1979 and 1980, Bennett *et al.* (1983) conducted the first comprehensive survey of fish in Little Goose Reservoir and seasonally in the other lower Snake River reservoirs. Their data showed that channel catfish were abundant in main channel areas and crappie were abundant in backwaters of Little Goose Reservoir. More recently, Zimmerman and Parker (1995) determined relative abundance and distribution by electrofishing and gill netting. They found the relative abundance of smallmouth bass was highest in Lower Granite Reservoir, which may explain the determination that the best catch rates occurred there. Similarly, the density and relative abundance of channel catfish was highest in Ice Harbor Reservoir, where the largest catch, harvest, and the highest catch rates for channel catfish among the four reservoirs was observed. Further, the relative lack of interest in channel catfish fishing in Lower Granite Reservoir parallels their finding that the lowest densities of channel catfish occurred there. The reported relative abundances of resident fish by Zimmerman and Parker (1995) were supported in Lower Granite Reservoir by more intensive sampling by Bennett *et al.* (1997) over a 10 year period.

The most intensive angling effort in the lower Snake River reservoirs occurred during the September through November, 1997 period for steelhead. Both boat and shore anglers fished at fairly specific locations throughout the reservoir system. Boat anglers expended more than 70% of the total angler effort in the lower Snake River system from September through November. During this period, boat anglers in Lower Granite Reservoir contributed 72% of the total boat angler hours for the entire reservoir system. Further, more fishing pressure was consistently exerted in the upper portion of Lower Granite Reservoir near the confluence of the Clearwater and Snake rivers than elsewhere. Boat anglers are attracted to this area because it traditionally serves as an overwintering area for migrating steelhead and requires little boating skill or special equipment (Mendel and Aufforth 1985). The number of anglers seeking steelhead in Lower Granite Reservoir peaked during mid-November. Boat anglers remained highly abundant when the reservoir survey concluded November 30, 1997.

Shore anglers also contributed to the abundance of angling effort in September through November, especially in Lower Monumental and Ice Harbor reservoirs where they together accounted for 69.0% of the total angler hours expended. Also, the number of anglers seeking steelhead in these reservoirs peaked in November. Anglers mainly concentrated along the Charbonneau Road upstream of Ice Harbor Dam and near the

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entrance of the fish ladder below Little Goose Dam. These areas provided easy access to the river, and along with the perceived concentrated abundance of fish, contributed to the large concentration of shore anglers and also accounted for repeated use of these areas by the same anglers or angler groups. Additionally, both shore fishing locations were easily accessible from the population centers of Tri-Cities and Walla Walla.

This survey represents the only comprehensive, quantitative, precise estimate of angler effort directed at steelhead for the lower Snake River reservoirs. Earlier attempts to estimate effort in all four reservoirs were abandoned largely due to poor precision of estimates from inconsistent fishing pressure directed at relatively new, developing fisheries for reservoirs downstream of Lower Granite Dam (Mendel *et al.*, 1987). Anglers now have developed and learned the techniques to maximize their success catching steelhead in "flatwater" reaches (Mark Schuck, Washington Department of Fish and Wildlife, personal communication).

Estimated angler effort was relatively precise for steelhead in Lower Granite Reservoir from 1984 to 1986 during the comparable September through November period of maximum use (Mendel and Aufforth 1985; Mendel *et al.*, 1987, 1988). Angler effort estimated during this period increased from 68,000 to 116,000 angler hours. The rapid growth of steelhead fishing in Lower Granite Reservoir during the mid-1980's was likely a response to increased runs of steelhead past Lower Granite Dam, a result of enhanced hatchery output (Mark Schuck, Washington Department of Fish And Wildlife, personal communication). In comparison, the 1997 estimated effort for these 3 months was approximately 192,000 angler hours. In spite of reduced hatchery production overall and fewer returning adults in recent years, the steelhead fishery has continued to develop in popularity and area based on these comparisons of use.

Catch rates for steelhead anglers varied little among reservoirs in the lower Snake River system, except in Little Goose Reservoir where effort and subsequent sample sizes were relatively small during the study. However, anglers in Lower Granite Reservoir caught 64.1% of the estimated 13,147 total steelhead landed in the lower Snake River reservoirs, largely due to the intensive angling pressure and high angling success directed at steelhead in Lower Granite Reservoir. Anglers in Lower Granite Reservoir accounted for 55.1% of total angler effort for the reservoir system from September through November. A substantial night fishery for steelhead existed in Lower Granite Reservoir, compared to other reservoirs, that contributed to the high angling pressure.

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Night anglers seeking steelhead accounted for 8.6% (16,520 angler hours) of the angler effort expended in Lower Granite Reservoir during September through November. In addition, catch rates for night anglers seeking steelhead were generally higher than for anglers in daylight hours. One possible reason for improved angling success at night may be the large numbers of boats and heavy activity on the river during daylight hours may bother the steelhead and lead to reduced catch rates. Another reason may be that more skilled anglers fish at night.

The survey results are precise as indicated by relatively narrow confidence intervals. The aerial observations are predicted to be within 95% of the actual number of anglers. The aerial surveys provided an excellent means to quickly assess angler distribution throughout the lower Snake River system, and to maximize the efficiency and focus of the ground survey effort. The low density of riparian canopy along the shoreline and the relatively remote access sites characteristic of the lower Snake River minimized visual bias associated with aerial counts (Pollock *et al.*, 1994). The technique used to collect angler creel data worked well. Sample sizes were generally large enough to provide good precision, and anglers readily cooperated with the survey even though in certain instances fish handling prolonged interview time.

The estimates of shore angler effort are slightly conservative because use ratio estimators to adjust aerial counts had to be used. Simultaneous counts of aerial and ground observations were taken for both A.M. and P.M. time intervals for certain days of each month. Differences in sightability were found among reservoirs, and therefore ratio estimators for each reservoir were computed. However, the ratios derived for both A.M. and P.M. periods and for weekends and weekdays were consistent and could be combined within each reservoir. Further analysis indicated that the aerial counts were generally higher than the corresponding ground counts. This was probably the result of better sightability from the air or uncooperativeness of anglers during access point surveys. Ideally, aerial counts should have been made during all hours for each reservoir stratum, although the cost would have been unrealistically high. As it was, flights occurred during the peak periods and consequently were adjusted for non-flight hours using the ratios.

Angler effort was derived differently for boat anglers than shore anglers. The half-day access site counts were divided by peak period aerial counts. The mobility of boat anglers and the problem of counting anglers during steelhead season affected the accuracy of aerial counts for boat anglers. By using the half-day access count data, the number of boat anglers may be slightly inflated.

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A modified bus route survey described by Pollock *et al.* (1994) was used to estimate the night fishing effort during September through November in the upper portion of Lower Granite Reservoir. The hours in which the creel clerk would sample varied and therefore the distribution of angler use for the entire strata was more accurately estimated.

The estimates of angler catch during April were largely based on May catch data as a result of the time the survey was initiated. April catch was computed as the product of estimated angler effort, determined by aerial counts, and catch rates observed for anglers in May. Potential bias associated with use of possibly higher catch rates in May could have inadvertently inflated catch estimates for April. For example, unusually high angler catch was observed in Little Goose Reservoir during April. This could be attributed to the combination of high angler use during a couple of warm weekends in April combined with relatively high catch rates in May. Conversely, in other reservoirs it is likely that potentially higher catch rates due to recently stocked rainbow trout in April were not sampled due to the later start of the ground survey. Thus, the estimated catch of stocked trout in those reservoirs may be conservative.

Special events such as bass tournaments or holidays that directly influence catch rates were not taken into consideration in the design, and therefore contributed to a large variance. However, the intensive sampling quantified these events as well as possible.

The continued sampling effort throughout the winter provided additional information on angler use and distribution. Limited aerial surveys indicated angler distribution was similar in the winter, concentrating in preferred steelhead angling sites near mainstream hydroelectric dams, such as the shoreline above Ice Harbor Dam, although by March, most anglers were observed primarily in adjacent side ponds and backwater inlets.

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APPENDIX A

Appendix Table A-1 Access Points on Lower Snake River Reservoirs (Codes correspond to map in Figure 2-1)							
Lower Granite Reservoir (LGR)		Little Goose Reservoir (LGO)		Lower Monumental Reservoir (LMR)		Ice Harbor Reservoir (IHR)	
Code	Access Point	Code	Access Point	Code	Access Point	Code	Access Point
101	Clearwater Landing						
102	Greenbelt**						
103	Levy Ponds, Lewiston	201	Directly below LGR Dam			401	Directly Below LMR Dam
104	Lower Lewiston Landing**	202	Boyer Park*	301	Directly Below LGO Dam	402	Matthews Landing**
105	Swallows Nest**	203	Illia Landing**	302	Riparia Landing**	403	Windust Landing*
106	Hells Gate***	204	Illia Landing (undeveloped)	303	McGuide Shoal Road	404	Emma Lake
107	Chief Looking Glass Park			304	Texas Rapids Landing**	405	Fish Hook Landing*
108	Red Wolf Landing	205	Willow Bar Landing**	305	Choke Cherry Road	406	Fish Hook Landing
109	Hwy 12 Fishing Ponds	206	Central Ferry Landing (both)***	306	Tucannon River Confluence	407	Pond
110	Shore Ramp, Chief Timothy HMU	207	Port of Garfield Landing			408	Dalton Lake**
111	Chief Timothy Landing***	208	Dead Man's Bay Access	307	Lyon's Ferry Landing***	409	Levey Park Landing**
112	Steptoe Gulch	209	Little Goose Landing**	308	Lyon's Ferry Marina*		Charbonneau Landing*
113	Nisqually John Landing**	210	Pond Directly Above LGO Dam	309	Ayer Landing**	410	Ice Harbor Boat Ramp**
114	Blyton Landing**			310	Devil's Bench Landing**	411	Directly Above IHR Dam
115	Wawawai Landing**	211	Directly Above LGO Dam	311	Directly Above LMR Dam		
116	Wawawai Pond****	212	Almota			412	Walker Landing**
117	Offield Landing**					413	McCoy Canyon
118	Directly above LGR Dam						

* ACOE Campground
 ** Other ACOE Access
 *** State Park
 **** Other Fee Site

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

Species	Length-Weight Equation	Source
Crappie*	$\log \text{ wt.} = -4.273 + 2.744 * \log (\text{length})$	Knox (1982)
Bluegill	$\log \text{ wt.} = -4.800 + 3.062 * \log (\text{length})$	Knox (1982)
Pumpkinseed	$\log \text{ wt.} = -4.352 + 2.863 * \log (\text{length})$	Knox (1982)
Smallmouth bass	$\log \text{ wt.} = -5.843 + 3.239 * \log (\text{length})$	Knox (1982)
Largemouth bass	$\log \text{ wt.} = -5.483 + 3.239 * \log (\text{length})$	Carlander (1977)
Yellow perch	$\log \text{ wt.} = -5.275 + 3.177 * \log (\text{length})$	Knox (1982)
Channel catfish	$\log \text{ wt.} = -5.510 + 3.202 * \log (\text{length})$	Knox (1982)
Bullheads**	$\log \text{ wt.} = -3.768 + 2.558 * \log (\text{length})$	Knox (1982)
Common carp	$\log \text{ wt.} = -4.489 + 2.875 * \log (\text{length})$	Knox (1982)
Largescale sucker***	$\log \text{ wt.} = -5.341 + 3.126 * \log (\text{length})$	Knox (1982)
Bridgelip sucker***	$\log \text{ wt.} = -5.341 + 3.126 * \log (\text{length})$	Knox (1982)
Chiselmouth***	$\log \text{ wt.} = -5.341 + 3.126 * \log (\text{length})$	Knox (1982)
Peamouth***	$\log \text{ wt.} = -5.341 + 3.126 * \log (\text{length})$	Knox (1982)
Northern pikeminnow	$\log \text{ wt.} = -5.341 + 3.126 * \log (\text{length})$	Knox (1982)
Rainbow trout	$\log \text{ wt.} = -4.149 + 2.621 * \log (\text{length})$	Knox (1982)
Chinook salmon	$\log \text{ wt.} = -5.230 + 3.148 * \log (\text{length})$	Haukenes (1995)
Juvenile steelhead****	$\log \text{ wt.} = -4.149 + 2.621 * \log (\text{length})$	Knox (1982)
Adult steelhead	$\log \text{ wt.} = -5.057 + 3.063 * \log (\text{length})$	Carlander (1969)
White sturgeon	$\log \text{ wt.} = -6.122 + 3.248 * \log (\text{length})$	Knox (1982)

* Includes black and white crappie
 ** Includes brown and yellow bullheads
 *** Used L-W equation for northern pikeminnow
 **** Used L-W equation for rainbow trout

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Appendix Table A-3 Geographic Regions and Cities Used in Analysis of Angler Zip Codes		
Zip Codes	Geographic Region	Prominent Cities
832,833,834,836,837 835,994 838,990-992 980-986 988,989 993 only 970-977 978, 979 All other US zip codes Canadian Postal Codes	Southern Idaho Central Idaho, SE Washington Northern Idaho, NE Washington Western Washington Central Washington SE Washington Central, Western Oregon Eastern, NE Oregon Montana, California, other states Canada	Boise, Twin Falls, Pocatello Lewiston, Idaho; Clarkston, Asotin, Washington Coeur d'Alene, Idaho; Spokane, Washington, and vicinity Seattle, Tacoma, Olympia, Vancouver Wenatchee, Yakima Tri-Cities, Walla Walla, Pullman, Colfax Portland, Eugene, Corvallis Pendleton, Milton-Freewater -- --

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APPENDIX B

Appendix Table B-1 Estimated Monthly Angler Hours, Along With 95-Percent Confidence Intervals for Lower Snake River Reservoirs April through November 1997										
Month	Lower Granite Reservoir		Little Goose Reservoir		Lower Monumental Reservoir		Ice Harbor Reservoir		Total	95% CI (+/-)
	Total Angler Hours	95% CI (+/-)	Total Angler Hours	95% CI (+/-)	Total Angler Hours	95% CI (+/-)	Total Angler Hours	95% CI (+/-)		
April	1,806	1,129	5,887	1,463	2,299	542	5,336	1,038	15,328	2,307
May	3,227	1,827	6,738	1,561	4,336	1,115	7,256	1,510	21,557	3,207
June	6,547	1,105	8,792	1,918	4,043	1,265	6,077	1,869	25,459	3,210
July	6,605	4,006	13,162	5,000	9,707	4,148	10,226	5,175	39,700	9,258
August	10,521	6,235	13,417	4,951	6,527	1,793	9,057	3,162	39,522	8,978
September	32,541	3,934	8,224	3,342	10,208	2,324	14,420	3,469	65,393	6,457
October	68,942	5,897	5,711	702	23,830	2,859	16,887	2,015	115,370	7,100
November	90,416	9,428	7,879	1,378	31,570	9,695	37,023	5,040	166,888	14,190
Total	220,605	14,133	69,810	8,386	92,520	11,446	106,282	9,207	489,217	22,030

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Appendix Table B-2 Estimated Monthly Boat and Shore Angler Hours, Along With 95-Percent Confidence Intervals For Lower Snake River Reservoirs April through November 1997										
Angler	Lower Granite Reservoir		Little Goose Reservoir		Lower Monumental Reservoir		Ice Harbor Reservoir		Total	95% CI (+/-)
	Total Angler Hours	95% CI (+/-)	Total Angler Hours	95% CI (+/-)	Total Angler Hours	95% CI (+/-)	Total Angler Hours	95% CI (+/-)		
April										
Boat	412	230	4,215	679	778	164	919	138	6,324	669
Shore	1,394	1,038	1,672	816	1,521	392	4,416	831	9,003	1,671
May										
Boat	595	545	4,320	1,169	1,851	620	1,849	635	8,615	1,579
Shore	2,632	1,744	2,418	1,034	2,485	920	5,407	1,370	12,942	2,792
June										
Boat	2,767	962	3,417	578	2,139	1,141	1,560	1,007	9,883	1,880
Shore	3,780	543	5,375	1,829	1,904	542	4,517	1,575	15,576	2,602
July										
Boat	2,390	768	7,566	2,719	5,740	@,065	1,560	1,007	9,883	1,880
Shore	4,215	3,931	5,596	4,196	3,967	3,570	4,517	1,575	15,576	2,602
August										
Boat	9,415	6,185	11,506	4,931	4,873	1,657	4,087	2,072	29,881	8,627
Shore	1,106	785	1,911	443	1,654	681	4,970	2,389	9,641	2,488
September										
Boat	27,555	3,369	6,656	3,308	3,948	946	7,290	3,279	45,449	5,614

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Shore	4,987	1,144	1,568	475	6,260	2,106	7,130	1,132	19,945	2,620
October										
Boat	58,669	5,073	2,865	418	8,992	755	5,424	1,070	75,950	5,452
Shore	10,273	2,023	2,846	564	14,838	2,736	11,463	1,708	39,420	3,841
November										
Boat	79,742	8,977	2,321	618	12,884	2,093	15,452	2,317	110,399	9,910
Shore	10,674	2,361	5,558	1,232	18,686	9,393	21,571	4,476	56,489	9,997
Total										
Boat	181,545	12,972	42,866	6,736	41,205	3,817	42,931	6,168	308,547	16,591
Shore	39,061	5,609	26,944	4,994	51,315	10,708	63,349	6,853	180,669	14,494

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Appendix Table B-3 Estimated Monthly Total Angler Catch With 95-Percent Confidence Intervals for Lower Snake River Reservoirs April through November 1997									
Lower Granite Reservoir		Little Goose Reservoir		Lower Monumental Reservoir		Ice Harbor Reservoir		Total Catch (95% CI)	Total Harvest 95% CI
Total Catch (95% CI)	Total Harvest (95% CI)	Total Catch (95% CI)	Total Harvest (95% CI)	Total Catch (95% CI)	Total Harvest (95% CI)	Total Catch (95% CI)	Total Harvest (95% CI)		
April									
2,965 (1,673)	960 (564)	10,799 (1,477)	8,975 (728)	3,165 (466)	1,668 (285)	3,537 (843)	3,029 (691)	20,467 (2,279)	14,632 (1,337)
May									
4,543 (2,709)	1,425 (912)	6,761 (1,576)	4,344 (777)	6,486 (960)	4,431 (586)	5,131 (1,226)	4,233 (1,005)	22,921 (3,169)	14,433 (1,858)
June									
7,071 (1,284)	3,740 (676)	5,792 (1,271)	3,673 (847)	1,303 (663)	905 (407)	5,080 (886)	4,185 (585)	19,246 (2,308)	12,502 (1,372)
July									
9,353 (4,740)	787 (801)	4,856 (2,046)	3,424 (1,504)	2,277 (484)	1,665 (430)	13,027 (2,971)	11,266 (1,891)	29,512 (4,981)	17,142 (2,591)
August									
6,889 (3,186)	551 (236)	9,211 (2,627)	3,537 (1,380)	3,031 (585)	2,469 (455)	5,094 (1,581)	2,664 (1,087)	24,226 (4,479)	9,122 (1,892)
September									
3,680 (466)	1,148 (153)	1,996 (852)	1,732 (753)	429 (127)	213 (64)	4,402 (834)	2,109 (463)	10,507 (1,000)	5,202 (489)
October									
4,464 (394)	3,072 (163)	237 (39)	237 (39)	1,344 (182)	1,144 (150)	1,328 (132)	492 (56)	7,373 (466)	4,945 (303)

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November									
2,976 (356)	2,172 (237)	254 (52)	254 (52)	1,495 (476)	1,412 (447)	1,381 (200)	1,152 (173)	6,106 (578)	4,990 (467)
Total									
2,965 (1,673)	960 (564)	10,799 (1,477)	8,975 (728)	3,165 (466)	1,668 (285)	3,537 (843)	3,029 (691)	20,467 (2,279)	14,632 (1,337)

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Appendix Table B-4 Estimated Monthly Total Catch and Harvest By Boat and Shore Anglers 95-Percent Confidence Intervals for Lower Snake Reservoirs April through November 1997			
Lower Granite Reservoir			
Month	Angler Type	Total Catch (95% CI)	Total Harvest (95% CI)
April	Boat Shore	201 (163) 2,765 (1,706)	122 (92) 838 (540)
May	Boat Shore	298 (388) 4,245 (2,866)	165 (218) 1,239 (907)
June	Boat Shore	1,175 (415) 5,896 (707)	217 (78) 3,522 (387)
July	Boat Shore	4,137 (1,832) 5,216 (3,364)	658 (299) 128 (584)
August	Boat Shore	4,246 (2,316) 2,643 (1,412)	363 (129) 188 (155)
September	Boat Shore	3,378 (405) 302 (101)	1,124 (138) 24 (9)
October	Boat Shore	3,792 (344) 672 (104)	2,611 (231) 462 (55)
November	Boat Shore	2,635 (339) 341 (90)	1,831 (214) 341 (90)
Totals	Boat Shore	19,862 (1,160) 22,080 (3,756)	7,082 (495) 6,763 (1,512)

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Little Goose Reservoir			
Month	Angler Type	Total Catch (95% CI)	Total Harvest (95% CI)
April	Boat Shore	1,656 (262) 9,143 (1,047)	981 (143) 7,994 (509)
May	Boat Shore	1,602 (451) 5,159 (1,327)	709 (246) 3,636 (645)
June	Boat Shore	1,314 (418) 4,478 (1,140)	848 (297) 2,825 (722)
July	Boat Shore	2,738 (1,034) 2,118 (2,069)	2,063 (777) 1,361 (1,445)
August	Boat Shore	8,778 (2,765) 433 (155)	3,194 (1,347) 343 (138)
September	Boat Shore	1,907 (956) 89 (13)	1,643 (844) 89 (13)
October	Boat Shore	51 (8) 186 (50)	51 (8) 186 (50)
November	Boat Shore	0 (0) 254 (49)	0 (0) 254 (49)
Totals	Boat Shore	18,046 (2,997) 21,860 (2,193)	9,490 (1,898) 16,686 (1,315)

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Lower Monumental Reservoir			
Month	Angler Type	Total Catch (95% CI)	Total Harvest (95% CI)
April	Boat Shore	563 (92) 2,602 (499)	492 (72) 1,176 (252)
May	Boat Shore	1,716 (347) 4,770 (1,170)	1,563 (273) 2,868 (591)
June	Boat Shore	861 (597) 442 (285)	597 (284) 307 (252)
July	Boat Shore	549 (225) 1,728 (636)	513 (210) 1,152 (424)
August	Boat Shore	2,676 (622) 355 (95)	2,469 (531) 0 (0)
September	Boat Shore	220 (94) 209 (87)	88 (38) 125 (50)
October	Boat Shore	427 (39) 917 (184)	350 (28) 794 (156)
November	Boat Shore	664 (84) 831 (539)	649 (79) 763 (508)
Totals	Boat Shore	7,676 (510) 11,855 (1,156)	6,721 (360) 7,185 (873)

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Ice Harbor Reservoir			
Month	Angler Type	Total Catch (95% CI)	Total Harvest (95% CI)
April	Boat Shore	214 (97) 3,324 (699)	214 (76) 2,815 (577)
May	Boat Shore	809 (444) 679 (349)	679 (349) 3,553 (952)
June	Boat Shore	518 (349) 4,562 (856)	233 (177) 3,951 (610)
July	Boat Shore	3,101 (1,866) 9,926 (2,810)	1,502 (925) 9,765 (2,398)
August	Boat Shore	3,307 (1,482) 1,787 (875)	2,061 (1,125) 602 (525)
September	Boat Shore	3,882 (1,849) 520 (78)	1,878 (1,034) 231 (42)
October	Boat Shore	437 (57) 890 (121)	88 (22) 403 (53)
November	Boat Shore	412 (77) 969 (191)	323 (67) 828 (166)
Totals	Boat Shore	12,680 (1,366) 26,300 (1,264)	6,979 (833) 22,150 (945)

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Totals			
Month	Angler Type	Total Catch (95% CI)	Total Harvest (95% CI)
April	Boat Shore	2,634 (406) 17,833 (1,932)	1,808 (288) 12,823 (1,058)
May	Boat Shore	4,425 (959) 18,496 (3,226)	3,117 (680) 11,316 (1,767)
June	Boat Shore	3,867 (960) 15,378 (2,142)	1,896 (518) 10,606 (1,339)
July	Boat Shore	10,524 (2,660) 18,988 (5,769)	4,736 (1,180) 12,406 (3,045)
August	Boat Shore	19,007 (4,021) 5,219 (1,591)	8,088 (1,482) 1,133 (5211)
September	Boat Shore	9,332 (976) 1119 (174)	4,732 (458) 470 (84)
October	Boat Shore	4,708 (352) 2,665 (263)	3,100 (228) 1,845 (149)
November	Boat Shore	3,711 (369) 2,395 (452)	2,803 (369) 2,187 (452)
Totals	Boat Shore	58,264 (2,296) 82,094 (4,039)	30,281 (1,252) 52,785 (2,366)

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**Appendix Table B-5
Catch, Harvest, and Yield of Sport Fishes From Lower Granite Reservoir
April through November 1997**

Species	Total Catch	Percent of Total	Total Harvest	Percent of Total	Yield/Hectare		Yield/Acre	
					Number	Kilograms	Number	Pounds
Crappie spp. ¹	7,209	17.19%	1,634	11.79%	0.450	0.040	0.180	0.040
Sunfish ²	952	2.27%	226	1.63%	0.060	0.004	0.030	0.003
Smallmouth bass	10,096	24.07%	897	6.47%	0.250	0.050	0.100	0.048
Yellow perch	322	0.77%	55	0.40%	0.020	0.001	0.010	0.001
Channel catfish	515	1.23%	228	1.65%	0.060	0.090	0.030	0.080
Bullheads ³	1,395	3.33%	475	3.43%	0.130	0.020	0.050	0.017
Northern pikeminnow	2,385	5.69%	1,512	10.91%	0.420	0.170	0.170	0.150
Rainbow trout	8,768	20.91%	3,320	23.96%	--	--	--	--
Steelhead	8,429	20.10%	5,390	38.90%	--	--	--	--
White sturgeon	18	0.04%	0	0.00%	0.000	0.000	0.000	0.000
Other	1,733	1.733	4.13%	113	0.82%	0.030	0.010	0.030
All species^{4,5,6}	41,941		13,855		1.420	0.405	0.580	0.369

¹Includes black and white crappie.

²Includes bluegill and pumpkinseed.

³Includes brown and yellow bullhead.

⁴May include species not listed (e.g., common carp, chiselmouth, peamouth, largescale sucker).

⁵Catch and harvest totals may not equal sum of species totals due to different calculation methods.

⁶Steelhead and rainbow trout omitted from yield (number and biomass) totals.

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**Appendix Table B-6
Catch, Harvest, and Yield of Sport Fishes from Little Goose Reservoir
April through November 1997**

Species	Total Catch	Percent of Total	Total Harvest	Percent of Total	Yield/Hectare		Yield/Acre	
					Number	Kilograms	Number	Pounds
Crappie spp. ¹	18,603	46.62%	15,523	59.30%	3.830	0.390	1.550	0.350
Sunfish ²	578	1.45%	370	1.41%	0.090	0.012	0.040	0.008
Smallmouth bass	8,531	21.38%	2,762	10.55%	0.680	0.140	0.280	0.130
Yellow perch	1,171	2.93%	948	3.62%	0.230	0.022	0.090	0.019
Channel catfish	6,687	16.76%	5,654	21.60%	1.390	0.880	0.560	0.790
Bullheads ³	664	1.66%	287	1.10%	0.070	0.018	0.030	0.016
Northern pikeminnow	1,747	4.38%	161	0.62%	0.040	0.010	0.020	0.004
Rainbow trout	195	0.49%	0	0.00%	--	--	--	--
Steelhead	283	0.71%	283	1.08%	--	--	--	--
White sturgeon	598	1.50%	40	0.15%	0.010	0.200	0.004	0.180
Other	864	2.17%	159	0.61%	0.040	0.050	0.020	0.050
All species^{4,5,6}	39,906		26,176		6.380	1.722	2.594	1.547

¹Includes black and white crappie.

²Includes bluegill and pumpkinseed.

³Includes brown and yellow bullhead.

⁴May include species not listed (e.g., common carp, chiselmouth, peamouth, largescale sucker).

⁵Catch and harvest totals may not equal sum of species totals due to different calculation methods.

⁶Steelhead and rainbow trout omitted from yield (number and biomass) totals.

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**Appendix Table B-7
Catch, Harvest, and Yield of Sport Fishes from Lower Monumental Reservoir
April through November 1997**

Species	Total Catch	Percent of Total	Total Harvest	Percent of Total	Yield/Hectare		Yield/Acre	
					Number	Kilograms	Number	Pounds
Crappie spp. ¹	7,937	40.64%	4,952	35.61%	1.860	0.200	0.750	0.180
Sunfish ²	145	0.74%	125	0.90%	0.050	0.010	0.020	0.010
Smallmouth bass	3,943	20.19%	2,802	20.15%	1.050	0.130	0.430	0.120
Yellow perch	2,371	12.14%	1,789	12.86%	0.670	0.060	0.270	0.060
Channel catfish	2,058	10.54%	1,789	12.86%	0.670	0.390	0.270	0.350
Bullheads ³	135	0.69%	135	0.97%	0.050	0.010	0.020	0.010
Northern pikeminnow	439	2.25%	256	1.84%	0.100	0.030	0.040	0.030
Rainbow trout	58	0.30%	14	0.10%	--	--	--	--
Steelhead	2,513	12.87%	2,242	16.12%	--	--	--	--
White sturgeon	66	0.34%	0	0.00%	0.000	0.000	0.000	0.000
Other	132	0.68%	50	0.36%	0.020	0.020	0.010	0.010
All species^{4,5,6}	19,530		13,906		4.470	0.850	1.810	0.770

¹Includes black and white crappie.

²Includes bluegill and pumpkinseed.

³Includes brown and yellow bullhead.

⁴May include species not listed (e.g., common carp, chiselmouth, peamouth, largescale sucker).

⁵Catch and harvest totals may not equal sum of species totals due to different calculation methods.

⁶Steelhead and rainbow trout omitted from yield (number and biomass) totals.

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**Appendix Table B-8
Catch, Harvest, and Yield of Sport Fishes from Ice Harbor Reservoir
April through November 1997**

Species	Total Catch	Percent of Total	Total Harvest	Percent of Total	Yield/Hectare		Yield/Acre	
					Number	Kilograms	Number	Pounds
Crappie spp. ¹	323	0.83%	204	0.70%	0.050	0.010	0.020	0.010
Sunfish ²	5,739	14.72%	4,852	16.66%	1.300	0.070	0.530	0.060
Smallmouth bass	2,472	6.34%	691	2.37%	0.190	0.060	0.080	0.050
Yellow perch	11,129	28.55%	10,244	35.17%	2.750	0.190	1.110	0.170
Channel catfish	8,897	22.82%	5,607	19.25%	1.510	1.130	0.610	1.010
Bullheads ³	32	0.08%	0	0.00%	0.000	0.000	0.000	0.000
Northern pikeminnow	1,133	2.91%	102	0.35%	0.003	0.003	0.010	0.003
Rainbow trout	6,750	17.32%	5,672	19.47%	--	--	--	--
Steelhead	1,922	4.93%	1,627	5.59%	--	--	--	--
White sturgeon	37	0.009%	0	0.00%	0.000	0.000	0.000	0.000
Other	502	1.29%	108	0.37%	0.030	0.040	0.010	0.040
All species^{4,5,6}	38,980		29,128		5.833	1.503	2.370	1.343

¹Includes black and white crappie.

²Includes bluegill and pumpkinseed.

³Includes brown and yellow bullhead.

⁴May include species not listed (e.g., common carp, chiselmouth, peamouth, largescale sucker).

⁵Catch and harvest totals may not equal sum of species totals due to different calculation methods.

⁶Steelhead and rainbow trout omitted from yield (number and biomass) totals.

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**Appendix Table B-9
Estimated Monthly Angler Catch Rates (CPE) and Harvest Rates (HPE) for Lower Snake River
Reservoirs
May through November 1997**

Month	Lower Granite Reservoir		Little Goose Reservoir		Lower Monumental Reservoir		Ice Harbor Reservoir	
	CPE	HPE	CPE	HPE	CPE	HPE	CPE	HPE
May	1.482	0.499	1.010	0.498	0.860	0.526	0.812	0.665
June	1.163	0.612	0.663	0.442	0.524	0.322	0.474	0.313
July	1.183	0.200	0.409	0.301	0.117	0.104	0.574	0.365
August	0.511	0.038	0.531	0.279	0.326	0.254	0.500	0.344
September	0.118	0.039	0.255	0.225	0.055	0.027	0.240	0.133
October	0.067	0.044	0.055	0.055	0.064	0.052	0.066	0.028
November	0.038	0.025	0.038	0.038	0.049	0.046	0.040	0.034
Total	0.162	0.067	0.442	0.278	0.119	0.087	0.197	0.137

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Appendix Table B-10 Estimated Monthly Catch Rates (CPE) and Harvest Rates (HPE) for Boat and Shore Anglers for Lower Snake River Reservoirs May through November 1997								
Angler Type	Lower Granite Reservoir		Little Goose Reservoir		Lower Monumental Reservoir		Ice Harbor Reservoir	
	CPE	HPE	CPE	HPE	CPE	HPE	CPE	HPE
May								
Boat	0.711	0.400	0.386	0.210	0.560	0.441	0.699	0.549
Shore	1.643	0.520	1.283	0.623	1.272	0.642	0.841	0.695
June								
Boat	0.431	0.081	0.723	0.514	0.523	0.249	0.347	0.176
Shore	1.302	0.712	0.623	0.395	0.525	0.466	0.544	0.387
July								
Boat	2.384	0.389	0.380	0.286	0.109	0.102	0.481	0.239
Shore	0.856	0.149	0.493	0.344	0.178	0.119	0.820	0.700
August								
Boat	0.374	0.021	0.561	0.273	0.376	0.321	0.715	0.543
Shore	1.798	0.197	0.349	0.312	0.139	0.000	0.366	0.220

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September								
Boat	0.120	0.041	0.289	0.255	0.100	0.040	0.564	0.315
Shore	0.089	0.008	0.028	0.028	0.041	0.024	0.069	0.037
October								
Boat	0.068	0.045	0.019	0.019	0.052	0.038	0.054	0.020
Shore	0.051	0.027	0.088	0.088	0.067	0.057	0.071	0.031
November								
Boat	0.038	0.024	0.000	0.000	0.040	0.038	0.033	0.029
Shore	0.038	0.038	0.039	0.039	0.057	0.054	0.043	0.037
Total								
Boat	0.089	0.038	0.445	0.282	0.134	0.094	0.221	0.135
Shore	0.670	0.270	0.439	0.263	0.108	0.082	0.185	0.138

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Appendix Table B-11 Overall Angler Catch Rates (CPE) and Harvest Rates (HPE) With 95-Percent Confidence Intervals In Lower Granite Reservoir, 1997												
Species	Shore Anglers				Boat Anglers				Total Anglers			
	CPE	95% CI (+/-)	HPE	95% CI (+/-)	CPE	95% CI (+/-)	HPE	95% CI (+/-)	CPE	95% CI (+/-)	HPE	95% CI (+/-)
Crappie spp.*	0.115	0.090	0.048	0.069	0.009	0.008	0.002	0.003	0.022	0.013	0.005	0.009
Sunfish**	0.027	0.021	0.010	0.015	0.000	0.000	0.000	0.000	0.003	0.002	0.001	0.002
Smallmouth bass	0.066	0.037	0.011	0.009	0.018	0.010	0.002	0.002	0.024	0.010	0.003	0.002
Yellow perch	0.008	0.008	0.002	0.003	0.001	0.001	0.0002	0.0003	0.002	0.001	0.0004	0.0004
Channel catfish	0.012	0.006	0.007	0.005	0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.001
Bullheads***	0.030	0.019	0.008	0.011	0.003	0.004	0.001	0.003	0.002	0.004	0.006	0.003
Northern pikeminnow	0.034	0.028	0.028	0.027	0.008	0.007	0.005	0.005	0.011	0.007	0.008	0.005
Rainbow trout	0.331	0.125	0.138	0.051	0.0002	0.0002	0.000	0.000	0.042	0.015	0.017	0.006
Steelhead	0.019	0.011	0.014	0.009	0.046	0.006	0.027	0.004	0.042	0.006	0.026	0.003
White sturgeon	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.0001	0.0002	0.000	0.000
Other	0.028	--	0.004	--	0.005	--	0.0003	--	0.008	--	0.001	--
Total	0.670	--	0.270	--	0.089	--	0.038	--	0.162	--	0.067	--

* Includes black and white crappie.
 ** Includes bluegill and pumpkinseed.
 *** Includes yellow and brown bullhead.

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Appendix Table B-12 Overall Angler Catch Rates (CPE) and Harvest Rates (HPE) With 95-Percent Confidence Intervals In Little Goose Reservoir, 1997												
Species	Shore Anglers				Boat Anglers				Total Anglers			
	CPE	95% CI (+/-)	HPE	95% CI (+/-)	CPE	95% CI (+/-)	HPE	95% CI (+/-)	CPE	95% CI (+/-)	HPE	95% CI (+/-)
Crappie spp.*	0.284	0.235	0.176	0.154	0.024	0.024	0.014	0.090	0.142	0.108	0.088	0.070
Sunfish**	0.021	0.018	0.013	0.014	0.004	0.005	0.002	0.004	0.011	0.009	0.007	0.007
Smallmouth bass	0.059	0.052	0.028	0.036	0.146	0.077	0.062	0.032	0.106	0.048	0.046	0.024
Yellow perch	0.012	0.010	0.006	0.008	0.027	0.024	0.025	0.024	0.020	0.014	0.017	0.13
Channel catfish	0.028	0.013	0.023	0.012	0.185	0.049	0.161	0.049	0.114	0.029	0.099	0.029
Bullheads***	0.003	0.003	0.001	0.002	0.014	0.009	0.009	0.008	0.009	0.005	0.006	0.004
Northern pikeminnow	0.004	0.004	0.002	0.002	0.018	0.018	0.003	0.006	0.012	0.010	0.002	0.003
Rainbow trout	0.007	0.014	0.000	0.000	0.004	0.007	0.000	0.000	0.005	0.008	0.000	0.000
Steelhead	0.015	0.009	0.015	0.009	0.000	0.000	0.000	0.000	0.007	0.004	0.007	0.004
White sturgeon	0.005	0.009	0.000	0.000	0.004	0.005	0.001	0.001	0.004	0.005	0.0004	0.001
Other	0.002	--	0.000	--	0.019	--	0.004	--	0.010	--	0.002	--
Total	0.439	--	0.263	--	0.445	--	0.282	--	0.442	--	0.272	--

* Includes black and white crappie.
 ** Includes bluegill and pumpkinseed.
 *** Includes yellow and brown bullhead.

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Appendix Table B-13 Overall Angler Catch Rates (CPE) and Harvest Rates (HPE) With 95-Percent Confidence Intervals In Lower Monumental Reservoir, 1997												
Species	Shore Anglers				Boat Anglers				Total Anglers			
	CPE	95% CI (+/-)	HPE	95% CI (+/-)	CPE	95% CI (+/-)	HPE	95% CI (+/-)	CPE	95% CI (+/-)	HPE	95% CI (+/-)
Crappie spp.*	0.038	0.029	0.025	0.023	0.031	0.044	0.011	0.011	0.035	0.025	0.019	0.014
Sunfish**	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Smallmouth bass	0.004	0.003	0.001	0.001	0.019	0.018	0.016	0.017	0.010	0.008	0.007	0.007
Yellow perch	0.005	0.005	0.003	0.003	0.007	0.007	0.004	0.006	0.006	0.004	0.004	0.003
Channel catfish	0.005	0.003	0.005	0.003	0.038	0.024	0.030	0.021	0.019	0.010	0.015	0.009
Bullheads***	0.000	0.000	0.000	0.000	0.004	0.009	0.004	0.009	0.002	0.004	0.002	0.004
Northern pikeminnow	0.005	0.007	0.004	0.005	0.002	0.003	0.002	0.003	0.004	0.004	0.003	0.003
Rainbow trout	0.000	0.000	0.000	0.000	0.001	0.001	0.0005	0.001	0.0004	0.0005	0.0002	0.0004
Steelhead	0.047	0.009	0.042	0.009	0.028	0.011	0.025	0.010	0.039	0.007	0.035	0.007
White sturgeon	0.001	0.001	0.000	0.000	0.0005	0.001	0.000	0.000	0.001	0.001	0.000	0.000
Other	0.001	--	0.0003	--	0.001	--	0.0005	--	0.001	--	0.0004	--
Total	0.108	--	0.082	--	0.134	--	0.094	--	0.120	--	0.087	--

* Includes black and white crappie.
 ** Includes bluegill and pumpkinseed.
 *** Includes yellow and brown bullhead.

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Appendix Table B-14 Overall Angler Catch Rates (CPE) and Harvest Rates (HPE) With 95-Percent Confidence Intervals In Ice Harbor Reservoir, 1997												
Species	Shore Anglers				Boat Anglers				Total Anglers			
	CPE	95% CI (+/-)	HPE	95% CI (+/-)	CPE	95% CI (+/-)	HPE	95% CI (+/-)	CPE	95% CI (+/-)	HPE	95% CI (+/-)
Crappie spp.*	0.003	0.005	0.003	0.005	0.003	0.003	0.002	0.003	0.003	0.004	0.003	0.004
Sunfish**	0.030	0.018	0.023	0.018	0.006	0.008	0.0004	0.001	0.022	0.013	0.015	0.012
Smallmouth bass	0.008	0.005	0.002	0.002	0.042	0.028	0.013	0.016	0.019	0.010	0.006	0.005
Yellow perch	0.029	0.016	0.024	0.015	0.029	0.024	0.023	0.022	0.029	0.014	0.024	0.013
Channel catfish	0.015	0.007	0.011	0.006	0.089	0.046	0.062	0.039	0.040	0.017	0.028	0.014
Bullheads***	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.0004	0.001	0.000	0.000
Northern pikeminnow	0.007	0.005	0.001	0.001	0.005	0.005	0.000	0.000	0.007	0.004	0.0004	0.0004
Rainbow trout	0.062	0.022	0.051	0.018	0.022	0.014	0.019	0.014	0.048	0.015	0.040	0.013
Steelhead	0.027	0.005	0.023	0.005	0.019	0.006	0.015	0.006	0.024	0.004	0.021	0.004
White sturgeon	0.0002	0.0004	0.000	0.000	0.000	0.000	0.000	0.0000	0.0001	0.0002	0.000	0.000
Other	0.003	--	0.001	--	0.006	--	0.001	--	0.004	--	0.001	--
Total	0.185	--	0.138	--	0.221	--	0.135	--	0.195	--	0.137	--

* Includes black and white crappie.
 ** Includes bluegill and pumpkinseed.
 *** Includes yellow and brown bullhead.

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**Appendix Table B-15
Directed Catch Rates (CPE) and Harvest Rates (HPE)
With 95-Percent Confidence Intervals For Selected Species In Lower Granite Reservoir
May through November 1997
(N represents the number of anglers seeking a particular species)**

Species	Shore Anglers					Boat Anglers					Total Anglers				
	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)
Crappie spp.*	17	2.640	0.167	2.046	0.130	2	3.780	2.278	3.543	2.762	19	2.780	0.110	2.230	0.128
Smallmouth bass	46	0.517	0.016	0.096	0.003	53	0.992	0.064	0.106	0.007	99	0.751	0.021	0.101	0.003
Channel catfish	27	0.075	0.015	0.065	0.016	9	0.078	0.005	0.039	0.003	36	0.076	0.001	0.057	0.001
Rainbow trout	71	3.367	0.069	1.376	0.050	3	0.000	0.000	0.000	0.000	74	3.249	0.023	1.328	0.000
Steelhead	143	0.037	0.0007	0.027	0.000	2307	0.047	0.0001	0.028	0.000	2450	0.046	0.0001	0.028	0.000
White sturgeon	0	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000

*Includes black and white crappie.

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Appendix Table B-16 Directed Catch Rates (CPE) and Harvest Rates (HPE) With 95-Percent Confidence Intervals For Selected Species In Little Goose Reservoir May through November 1997 (N represents the number of anglers seeking a particular species)															
Species	Shore Anglers					Boat Anglers					Total Anglers				
	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)
Crappie spp.*	27	3.089	1.165	1.849	1.161	4	0.000	0.000	0.000	0.000	31	2.926	1.157	1.752	1.146
Smallmouth bass	26	0.494	0.066	0.104	0.014	42	0.572	0.025	0.222	0.022	68	0.549	0.210	0.187	0.069
Channel catfish	49	0.071	0.002	0.059	0.005	117	0.311	0.005	0.292	0.004	166	0.265	0.043	0.247	0.041
Rainbow trout	3	1.129	1.302	0.000	0.000	0	0.000	0.000	0.000	0.000	3	1.129	1.994	0.000	0.000
Steelhead	82	0.035	0.0001	0.035	0.0001	20	0.000	0.000	0.000	0.000	102	0.030	0.002	0.030	0.002
White sturgeon	21	0.009	0.001	0.000	0.000	15	0.001	0.001	0.016	0.002	36	0.034	0.017	0.006	0.006

*Includes black and white crappie.

Appendix Table B-17 Directed Catch Rates (CPE) and Harvest Rates (HPE) With 95-Percent Confidence Intervals For Selected Species In Lower Monumental Reservoir May through November 1997 (N represents the number of anglers seeking a particular species)															
Species	Shore Anglers					Boat Anglers					Total Anglers				
	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)
Crappie spp.*	32	1.113	0.033	0.929	0.022	22	0.824	0.074	0.282	0.113	54	0.828	0.035	0.462	0.047
Smallmouth bass	17	0.040	0.007	0.040	0.007	22	0.221	0.006	0.221	0.006	39	0.175	0.005	0.175	0.005
Channel catfish	32	0.077	0.030	0.068	0.030	58	0.233	0.043	0.191	0.045	90	0.192	0.038	0.158	0.041
Rainbow trout	4	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	4	0.000	0.000	0.000	0.000
Steelhead	343	0.051	0.000	0.046	0.000	267	0.038	0.000	0.034	0.000	610	0.047	0.000	0.042	0.000
White sturgeon	5	0.000	0.000	0.000	0.000	3	0.068	0.075	0.000	0.000	8	0.031	0.016	0.000	0.000

*Includes black and white crappie.

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**Appendix Table B-18
Directed Catch Rates (CPE) and Harvest Rates (HPE)
With 95-Percent Confidence Intervals For Selected Species In Ice Harbor Reservoir
May through November 1997
(N represents the number of anglers seeking a particular species)**

Species	Shore Anglers					Boat Anglers					Total Anglers				
	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)	N	CPE	95% CI (+/-)	HPE	95% CI (+/-)
Crappie spp.*	10	2.022	0.381	2.022	0.381	4	0.000	0.000	0.000	0.000	14	0.389	0.389	0.167	0.167
Smallmouth bass	32	0.111	0.010	0.074	0.011	60	0.279	0.008	0.021	0.001	92	0.237	0.034	0.015	0.015
Channel catfish	82	0.144	0.001	0.136	0.001	52	0.687	0.037	0.532	0.027	134	0.433	0.347	0.081	0.081
Rainbow trout	124	0.863	0.008	0.710	0.011	34	0.408	0.025	0.353	0.007	158	0.752	0.623	0.073	0.073
Steelhead	991	0.035	0.0003	0.030	0.0002	331	0.029	0.0001	0.233	0.0001	1322	0.033	0.028	0.0002	0.0002
White sturgeon	5	0.040	0.007	0.000	0.000	6	0.000	0.000	0.000	0.000	11	0.018	0.000	0.000	0.000

*Includes black and white crappie.

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APPENDIX C

Appendix Table C-1 Mean, Minimum, and Maximum Length of Fish Measured During Lower Snake River Sportfishing Survey, 1997 (N = Not Measured)					
Species	N	Mean	SD	Minimum	Maximum
Lower Granite					
White sturgeon	0				
Rainbow trout	306	231	22	170	300
Steelhead (residual smolt)	1	220		220	220
Adult steelhead	336	710	105	486	919
Common carp	3	582	6	575	585
Brown bullhead	23	209	46	111	288
Channel catfish	25	501	63	373	620
Pumpkinseed	17	136	14	109	165
Bluegill	19	148	19	105	173
Smallmouth bass	37	261	49	173	407
Largemouth bass	0				
Crappie	96	186	21	148	287
Yellow perch	8	183	26	160	230
Chinook salmon	0				
Chiselmouth	2	246	6	242	251
Peamouth	3	299	8	290	305
Northern pikeminnow	33	346	131	130	574
Bridgelip sucker	0				
Largescale sucker	3	477	8	470	485

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Little Goose					
White sturgeon	7	1,508	229	1,321	1,975
Rainbow trout	12	215	7	205	225
Steelhead (residual smolt)	0				
Adult steelhead	17	701	86	531	835
Common carp	6	536	54	479	620
Brown bullhead	22	264	43	213	356
Channel catfish	260	395	93	100	603
Pumpkinseed	6	165	6	158	173
Bluegill	14	185	24	141	220
Smallmouth bass	126	257	46	125	335
Largemouth bass	1	228		228	228
Crappie	208	195	18	125	316
Yellow perch	27	190	18	125	215
Chinook salmon	0				
Chiselmouth	0				
Peamouth	1	323		323	323
Northern pikeminnow	14	238	63	172	403
Bridgelip sucker	0				
Largescale sucker	2	501	11	493	509

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Lower Monumental					
White sturgeon	4	1,263	287	1,016	1,626
Rainbow trout	1	273		273	273
Steelhead (residual smolt)	3	343	41	297	375
Adult steelhead	296	689	100	420	908
Common carp	4	536	179	381	736
Brown bullhead	18	237	112	150	490
Channel catfish	162	384	100	178	786
Pumpkinseed	0				
Bluegill	11	184	11	171	203
Smallmouth bass	49	219	41	181	322
Largemouth bass	0				
Crappie	148	198	18	123	253
Yellow perch	35	191	23	105	210
Chinook salmon	1	515		515	515
Chiselmouth	0				
Peamouth	0				
Northern pikeminnow	29	317	49	254	458
Bridgelip sucker	0				
Largescale sucker	1	455		455	455

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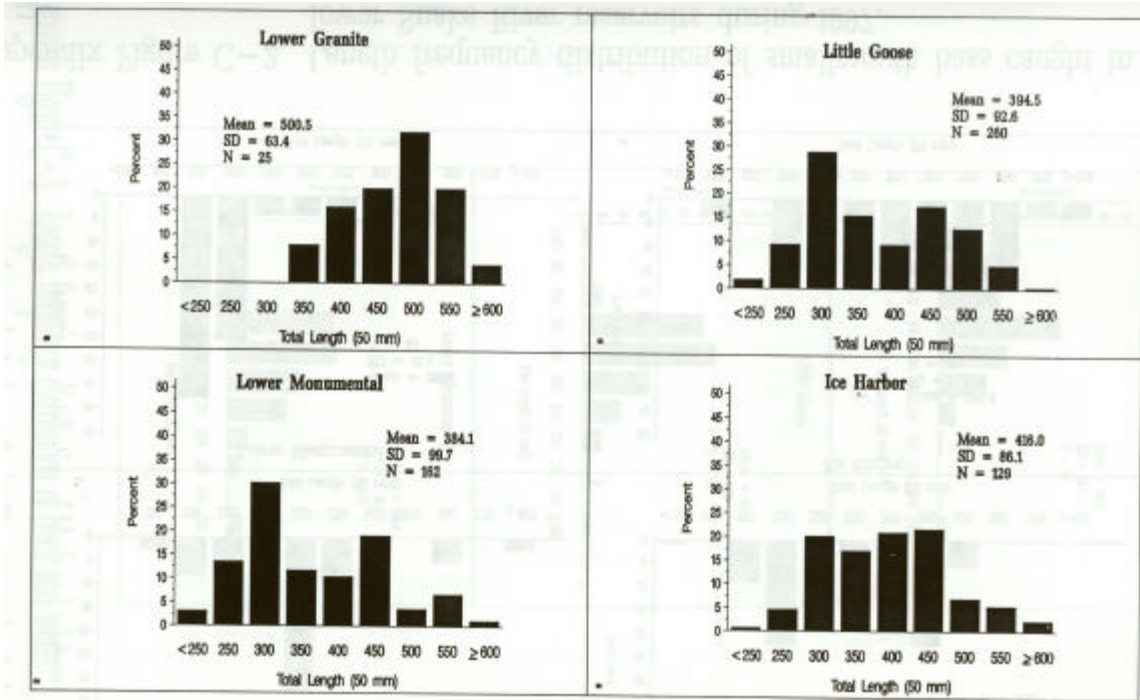
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Ice Harbor

White sturgeon	3	1,251	219	1,003	1,420
Rainbow trout	324	232	23	150	334
Steelhead (residual smolt)	0				
Adult steelhead	230	678	96	512	915
Common carp	2	584	1	584	585
Brown bullhead	3	189	27	172	220
Channel catfish	129	416	86	197	695
Pumpkinseed	19	129	20	103	205
Bluegill	75	137	14	115	189
Smallmouth bass	28	291	61	150	403
Largemouth bass	3	306	54	252	360
Crappie	5	205	73	74	242
Yellow perch	138	172	18	66	261
Chinook salmon	0				
Chiselmouth	1	304		304	304
Peamouth	0				
Northern pikeminnow	3	233	45	204	285
Bridgelip sucker	1	418		418	418
Largescale sucker	0				

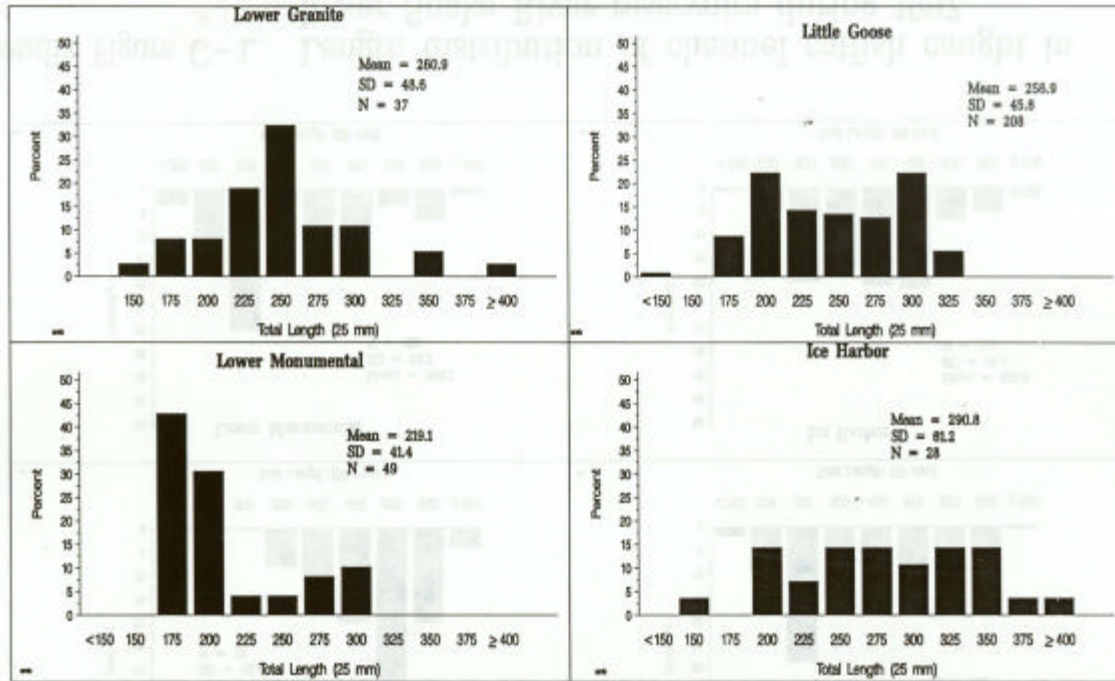
All lengths total length in mm except for steelhead (fork length mm).

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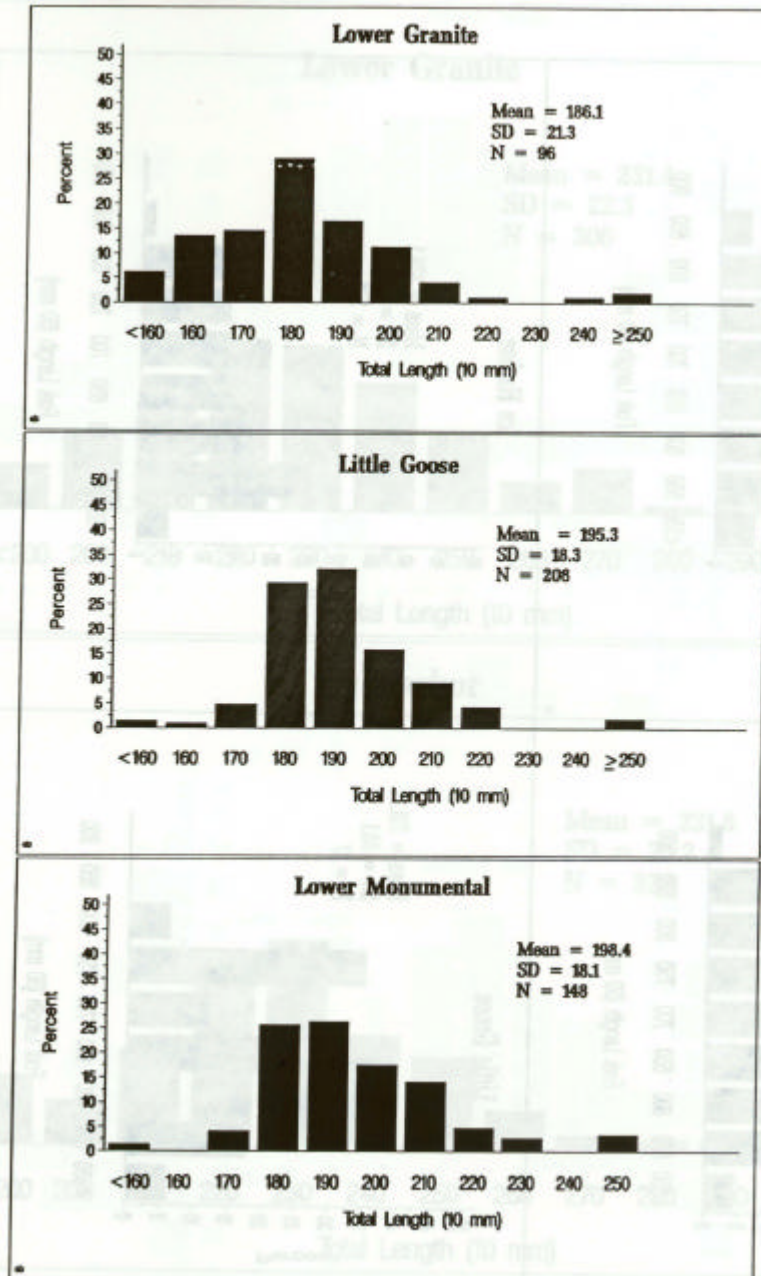
Appendix Figure C-1. Length distribution of channel catfish caught in lower Snake River reservoirs during 1997.

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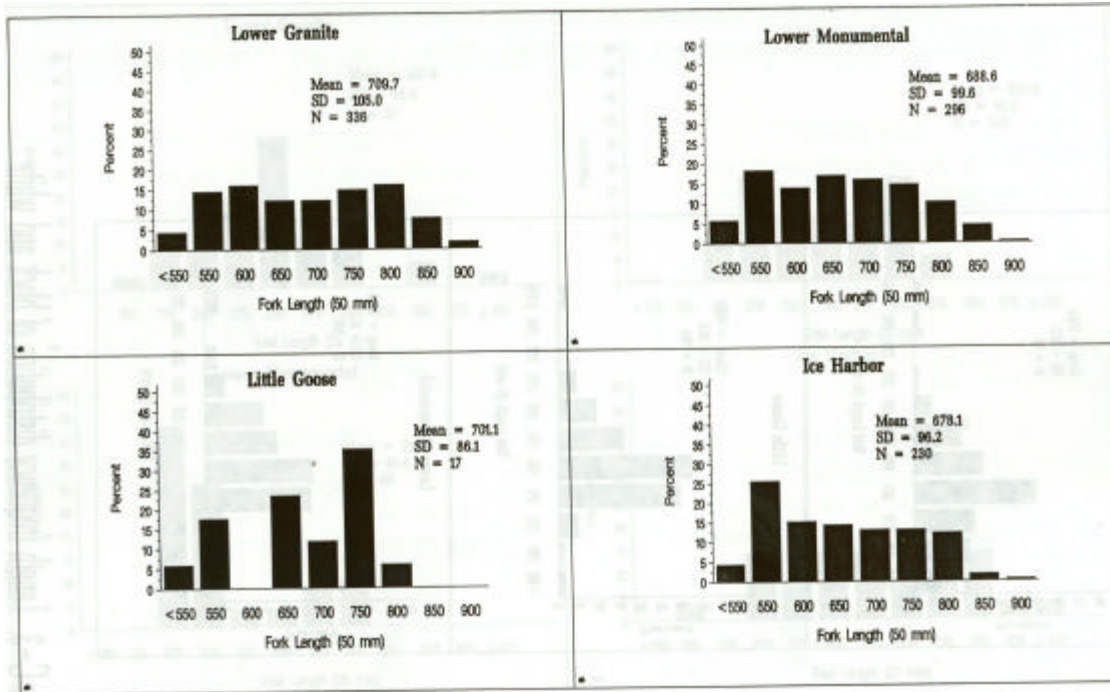
Appendix Figure C-2. Length frequency distribution of smallmouth bass caught in lower Snake River reservoirs during 1997.

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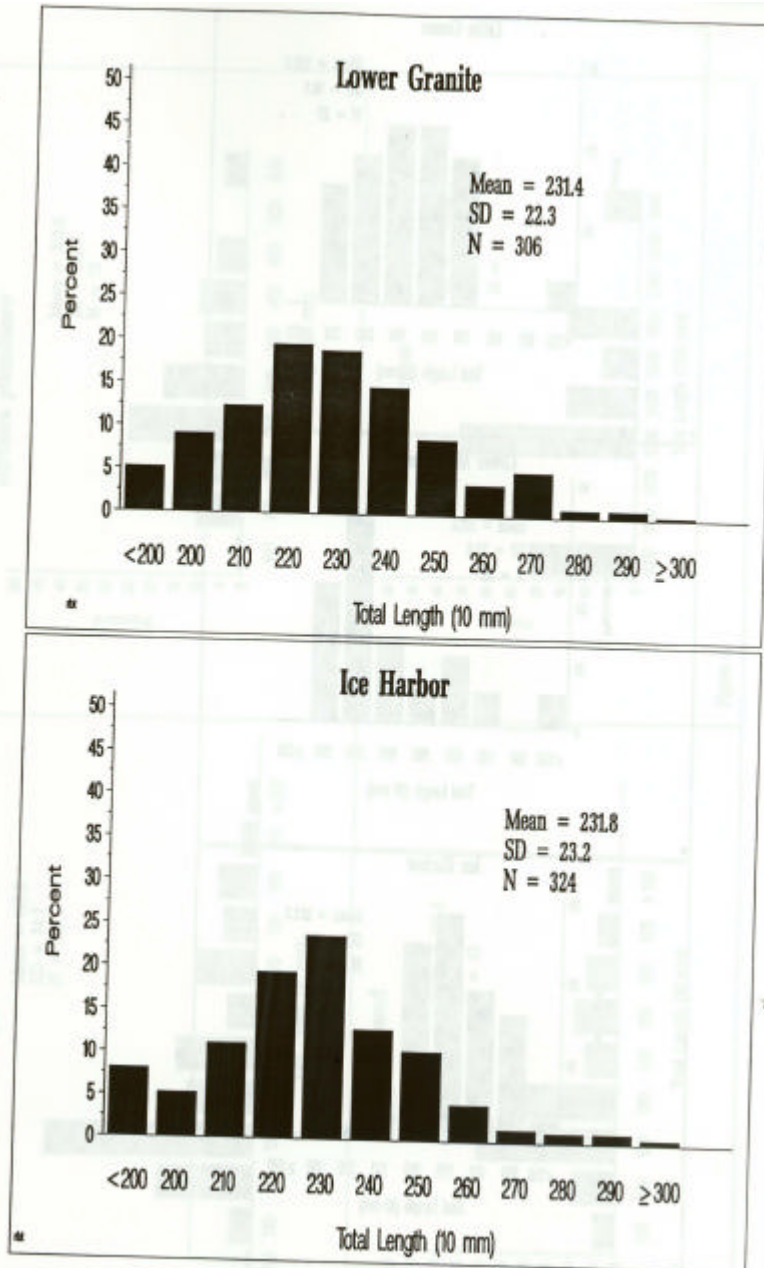
Appendix Figure C-3. Length frequency distribution of black and white crappie caught in lower Snake River reservoirs during 1997.

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Appendix Figure C-4. Length frequency distribution of adult steelhead kept by anglers fishing in lower Snake River reservoirs during 1997.

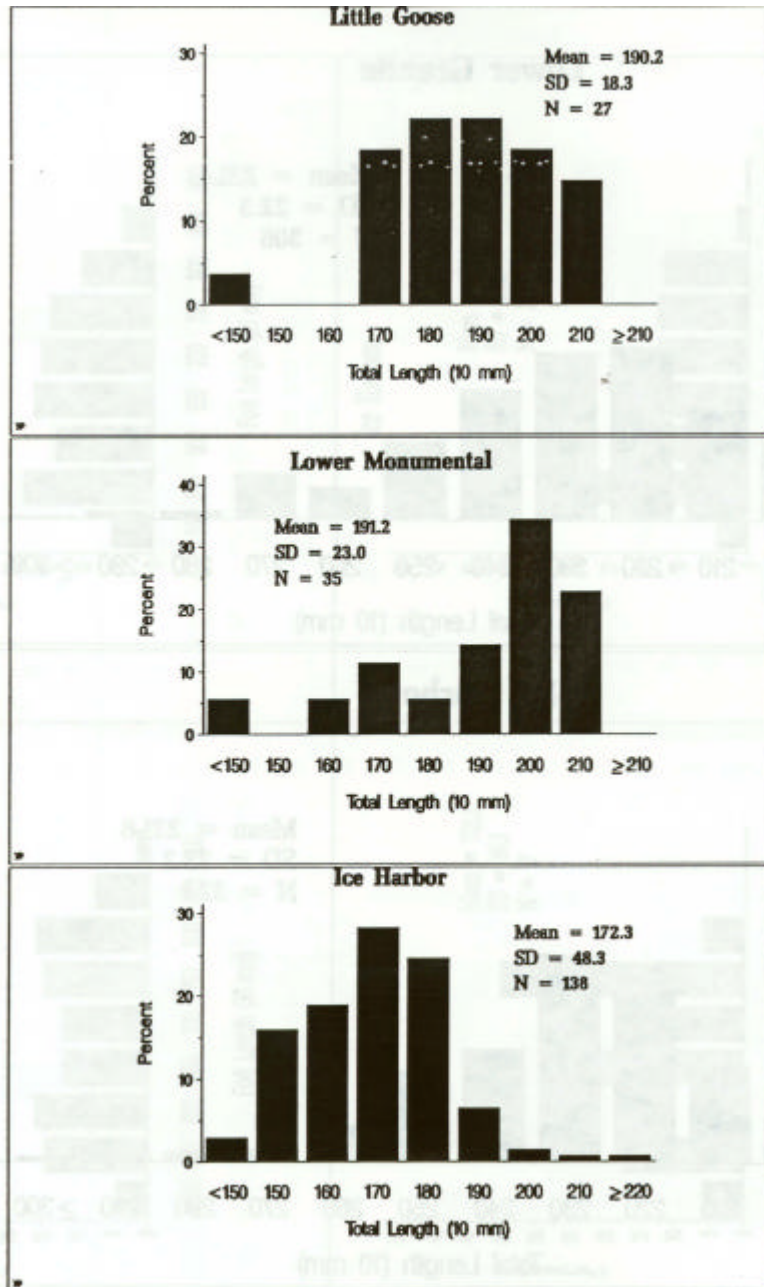
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Appendix Figure C-5. Length frequency distribution of rainbow trout caught in lower Snake River reservoirs during 1997.

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Appendix Figure C-6. Length frequency distribution of yellow perch caught in lower Snake River reservoirs during 1997.

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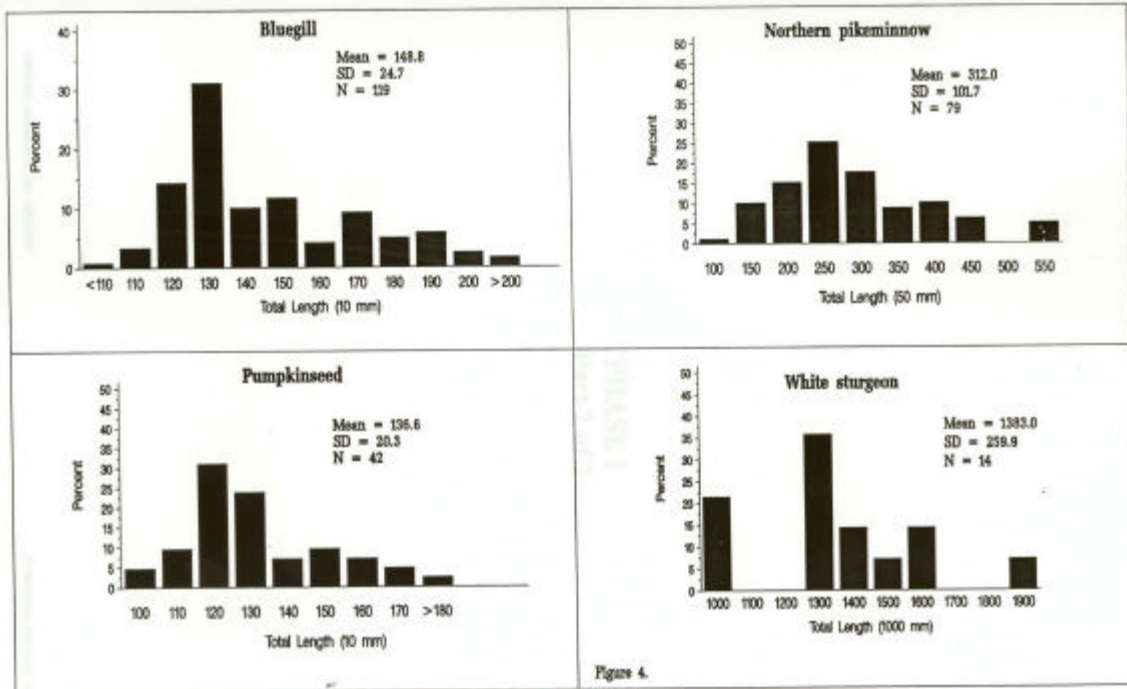


Figure 4.

Appendix Figure C-7. Length frequency distribution of bluegill, pumpkinseed, and white sturgeon caught in the lower Snake River reservoirs (combined) during 1997.