REPORT ON THE PREDATION INDEX, PREDATOR CONTROL FISHERIES, AND PROGRAM EVALUATION FOR THE COLUMBIA RIVER BASIN EXPERIMENTAL NORTHERN PIKEMINNOW MANAGEMENT PROGRAM

2007 ANNUAL REPORT

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2007 Executive Summary
by
Russell G. Porter

This report presents results for year fifteen in the basin-wide Experimental Northern Pikeminnow Management Program to harvest northern pikeminnow[1] (Ptychocheilus oregonensis) in the Columbia and Snake Rivers. This program was started in an effort to reduce predation by northern pikeminnow on juvenile salmonids during their emigration from natal streams to the ocean. Earlier work in the Columbia River Basin suggested predation by northern pikeminnow on juvenile salmonids might account for most of the 10-20% mortality juvenile salmonids experience in each of eight Columbia River and Snake River reservoirs. Modeling simulations based on work in John Day Reservoir from 1982 through 1988 indicated that, if predator-size northern pikeminnow were exploited at a 10-20% rate, the resulting restructuring of their population could reduce their predation on juvenile salmonids by 50%.

To test this hypothesis, we implemented a sport-reward angling fishery and a commercial longline fishery in the John Day Pool in 1990. We also conducted an angling fishery in areas inaccessible to the public at four dams on the mainstem Columbia River and at Ice Harbor Dam on the Snake River. Based on the success of these limited efforts, we implemented three test fisheries on a system-wide scale in 1991—a tribal longline fishery above Bonneville Dam, a sport-reward fishery, and a dam-angling fishery. Low catch of target fish and high cost of implementation resulted in discontinuation of the tribal longline fishery. However, the sport-reward and dam-angling fisheries were continued in 1992 and 1993. In 1992, we investigated the feasibility of implementing a commercial longline fishery in the Columbia River below Bonneville Dam and found that implementation of this fishery was also infeasible.

Estimates of combined annual exploitation rates resulting from the sport-reward and dam-angling fisheries remained at the low end of our target range of 10-20%. This suggested the need for additional effective harvest techniques. During 1991 and 1992, we developed and tested a modified (small-sized) Merwin trapnet. We found this floating trapnet to be very effective in catching northern pikeminnow at specific sites. Consequently, in 1993 we examined a system-wide fishery using floating trapnets, but found this fishery to be ineffective at harvesting large numbers of northern pikeminnow on a system-wide scale.

In 1994, we investigated the use of trap nets and gillnets at specific locations where concentrations of northern pikeminnow were known or suspected to occur during the

[1] The common name of the northern squawfish was recently changed by the American Fisheries Society to northern pikeminnow at the request of the Confederated Tribes and Bands of the Yakama Indian Reservation.

spring season (*i.e.*, March through early June). In addition, we initiated a concerted effort to increase public participation in the sport-reward fishery through a series of promotional and incentive activities.

In 1995, 1996, and 1997, promotional activities and incentives were further improved based on the favorable response in 1994. Results of these efforts are subjects of this annual report.

Evaluation of the success of test fisheries in achieving our target goal of a 10-20% annual exploitation rate on northern pikeminnow is presented in Report C of this report. Overall program success in terms of altering the size and age composition of the northern pikeminnow population and in terms of potential reductions in loss of juvenile salmonids to northern pikeminnow predation is also discussed in Report C.

Program cooperators include the Pacific States Marine Fisheries Commission (PSMFC), Oregon Department of Fish and Wildlife (ODFW), and Washington Department of Fish and Wildlife (WDFW), and the U. S. Department of Agriculture (USDA), Animal Damage Unit as a contractor to test Dam Angling. The PSMFC was responsible for coordination and administration of the program; PSMFC subcontracted various tasks and activities to ODFW and WDFW based on the expertise each brought to the tasks involved in implementing the program and dam angling to the USDA. Objectives of each cooperator were as follows.

1. **WDFW (Report A)**: Implement a system-wide (*i.e.* Columbia River below Priest Rapids Dam and Snake River below Hells Canyon Dam) sport-reward fishery and operate a system for collecting and disposing of harvested northern pikeminnow.

2. **PSMFC (Report B)**: Provide technical, contractual, fiscal and administrative oversight for the program. In addition, PSMFC processes and provides accounting for the reward payments to participants in the sport-reward fishery.

3. **ODFW (Report C)**: Evaluate exploitation rate and size composition of northern pikeminnow harvested in the various fisheries implemented under the program together with an assessment of incidental catch of other fishes. Estimate reductions in predation on juvenile salmonids resulting from northern pikeminnow harvest and update information on year-class strength of northern pikeminnow.

4. **USDA (Report D)**: Dam angling at The Dalles and John Day dams.

Background and rationale for the Northern Pikeminnow Management Program can be found in Report A of our 1990 annual report (Vigg et al. 1990). Highlights of results of our work in 2007 by report are as follows:

Report A

Implementation of the Northern Pikeminnow Sport-Reward Fishery in the Columbia and Snake Rivers

1. Objectives for 2007 were to: (1) implement a recreational fishery that rewards recreational anglers for harvesting northern pikeminnow ≥ 228mm (9 inches) total length (TL), (2) collect, compile, and report data on angler participation, catch and harvest of northern pikeminnow and other fish species, as well as success rates of participants during the season, (3) examine collected northern pikeminnow for the presence of external tags, fin clips, and signs of tag loss, (4) collect biological data on northern pikeminnow and other fish species returned to registration stations, (5) scan northern pikeminnow for the presence of consumed salmonids containing Passive Integrated Transponder (PIT) tags, and (6) survey non-returning NPSRF participants targeting northern pikeminnow in order to obtain catch and harvest data on fish species caught, and (7) examine and process all northern pikeminnow caught by U.S. Department of Agriculture (USDA) angling crews operating at The Dalles and John Day dams to recover spaghetti and/or PIT tags.

2. The NPSRF was conducted from May 14 through October 14, 2007. Seventeen registration stations were operated throughout the lower Snake and Columbia rivers.

3. A total of 192,518 northern pikeminnow ≥ 9 inches in total length were harvested during the 2007 season with 26,942 angler days spent harvesting these fish. Catch-per-angler-day for all anglers during the season was 7.15 fish.

4. Anglers submitted 170 northern pikeminnow with external tags, and an additional 9 with what may be tag wounds, but no tag, fin clip or Pit Tag. A total of 102 salmonid PIT tags from consumed juvenile salmonids were detected in the pikeminnows caught, and the codes recorded for transmittal to the PITAGIS database.

Report B

Northern Pikeminnow Sport-Reward Fishery Payments

1. For 2007 the rewards paid to anglers were the same as in the 2006 season. Anglers were paid \$4, \$5, and \$8 per fish for the three payment tiers (up to 100 fish, 101-400 fish and 401 and up) during the season. The rewards for a tagged fish were \$500 per fish.

2. During 2007, excluding tagged fish, rewards paid totaled \$1,200,971 for 190,870 fish.

3. A total of 170 tagged fish vouchers were paid. The total season tag rewards paid totaled \$85,000.

4. A total of 1,177 separate successful anglers received payments during the season.

5. The total for all payments for non-tagged and tagged pikeminnows in 2007 was \$1,285,971.

Report C

Development of a Systemwide Predator Control Program: Indexing and Fisheries Evaluation

1. Objectives in 2007 were to (1) evaluate northern pikeminnow exploitation, potential predation, and tag loss, (2) define population parameters of northern pikeminnow, smallmouth bass *Micropterus dolomieu*, and walleye *Sander vitreus* in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs, and (3) look for possible compensatory responses by these species

2. System-wide exploitation in 2007 of northern pikeminnow 200 mm or greater in fork length was 15.3% which incorporated a tag loss of 5.3%. Sport-reward exploitation of fish $\geq$250 mm FL was 17.8%, the third highest exploitation rate since program inception.

3. The 2007 estimated reduction in potential predation (63% of pre-program levels) was based on an updated Friesen and Ward (1999) predation model (ODFW, unpublished data). This is a greater reduction than observed previously (75%; Jones et al. 2005), and is related to the updates we have made in the predation model.

4. We have not sampled in Ice Harbor Reservoir since 1991, the initial sampling year in the Snake River. Catches were low then and they are lower now. There were not enough samples to calculate a stock density in 2007, and the CPUE and abundance indices have also decreased. Northern pikeminnow abundance and stock density have been decreasing in Lower Monumental Reservoir since the program began in 1991. We have not been able to calculate a stock density since 1995 due to low sample sizes and the CPUE and abundance indices have decreased as well. In Little Goose Reservoir, stock density increased following initial sampling in 1991, and then decreased in 2004. We were unable to calculate the stock density in 2007 due to low sample sizes and therefore are uncertain if the decrease in 2004 has remained. Lower Granite Reservoir has been the one area in the Snake River with a consistent data set over the years. However, there has not been sufficient data to estimate stock density for northern pikeminnow since 1996.

5. Previous evaluations of the NPMP have not detected responses by the predator community to the sustained removal of northern pikeminnow (Ward et al. 1995; Ward and Zimmerman 1999; Zimmerman and Ward 1999). In 2007, we found some indications of possible localized responses to the removal program such as the change in age structure of northern pikeminnow and smallmouth bass, the slight increase in smallmouth bass consumption and predation indices, and the occurrence of walleye catch in Lower Monumental reservoir. However, whether these changes occurred due to reductions in the northern pikeminnow population or increases in the number of migrating smolts, or a combination of factors, is difficult to determine. Density dependent compensatory responses by fish populations can be hard to identify (Rose et al. 2001), and a system-wide response difficult to ascertain. Additionally, observable responses to fishery management programs have been known to lag by more than 15 years from project inception (Hilborn and Winton 1993; Beamesderfer et al. 1996).

Report D

Pilot studies for dam angling at The Dalles and John Day dams

1. A five man fishing crews was utilized to fish from May 14, 2006 through August 15, 2007 at The Dalles and John Day dams.

2. Fishing for 33 days for 952 hours at The Dalles dam resulted in 2,910 northern pikeminnow caught, of which 10 were tagged fish.

3. Fishing for 55 days for 1,695 hours at John Day dam resulted in 4,649 northern pikeminnow caught, of which 1 was a tagged fish.

4. John Day turbines had slowed by May 24th and fishing improved. Spill was occurring at the dam from around 6 P.M. to 7 A.M. and pikeminnow were congregating to feed on salmon smolt released during the nighttime spill. The first hours of the morning following the spill large numbers of predatory pikeminnow weighing three to seven pounds were caught.

5. At The Dalles, the trash sluice way produced a fair number of fish, as did the powerhouse deck. Fishing picks up as the pikeminnow congregate at the dam for the spawning period. As the shad start returning back downstream they are also concentrated by the dams and become available in abundance for the pikeminnow.

Report A

Implementation of the Northern Pikeminnow Sport-Reward Fishery in the Columbia and Snake Rivers

2007 Annual Report

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ABSTRACT

We are reporting on the progress of the Northern Pikeminnow *Ptychocheilus oregonensis* Sport-Reward Fishery (NPSRF) implemented by the Washington Department of Fish and Wildlife (WDFW) on the Columbia and Snake Rivers from May 14 through September 30, 2007. The objectives of this project were to (1) implement a recreational fishery that rewards recreational anglers for harvesting northern pikeminnow ≥ 228mm (9 inches) total length (TL), (2) collect, compile, and report data on angler participation, catch and harvest of northern pikeminnow and other fish species, as well as success rates of participants during the season, (3) examine collected northern pikeminnow for the presence of external tags, fin clips, and signs of tag loss, (4) collect biological data on northern pikeminnow and other fish species returned to registration stations, (5) scan northern pikeminnow for the presence of consumed salmonids containing Passive Integrated Transponder (PIT) tags, and (6) survey non-returning NPSRF participants targeting northern pikeminnow in order to obtain catch and harvest data on fish species caught, and (7) examine and process all northern pikeminnow caught by U.S. Department of Agriculture (USDA) angling crews operating at The Dalles and John Day dams to recover spaghetti and/or PIT tags.

A total of 192,518 northern pikeminnow ≥ 228 mm and 3,748 pikeminnow < 228 mm were harvested during the 2007 NPSRF season. There were a total of 3,814 different anglers who spent 26,924 angler days participating in the fishery. Catch per unit effort for combined returning and non-returning anglers was 7.15 fish/angler day. The Oregon Department of Fish and Wildlife (ODFW) estimated that the overall exploitation rate for the 2007 NPSRF was 17.8%.

Anglers submitted 170 northern pikeminnow with external spaghetti tags, of which there were 164 with both spaghetti and PIT tags, and 9 with possible tag wounds and/or fin clips, but without spaghetti or PIT tags. A total of 102 PIT tags from consumed juvenile salmonids were detected and interrogated from northern pikeminnow received during the 2007 NPSRF.

Peamouth *Mylocheilus caurinus*, smallmouth bass *Micropterus dolomieu*, walleye *Sander vitreus,* yellow perch *Perca flavescens*, and channel catfish *Ictalurus punctatus* were the fish species most frequently harvested by NPSRF anglers targeting northern pikeminnow. The incidental catch of salmonids *Oncorhynchus spp*, by participating anglers targeting northern pikeminnow remained below established limits for the Northern Pikeminnow Management Program.

INTRODUCTION

Mortality of juvenile salmonids *Oncorhynchus spp.* migrating through the Columbia River system is a major concern of the Columbia Basin Fish and Wildlife Program, and predation is an important component of mortality (NPPC 1987a). Northern pikeminnow *Ptychocheilus oregonensis*, formerly known as northern squawfish (Nelson et al. 1998), are the primary piscine predator of juvenile salmonids in the Lower Columbia and Snake River Systems (Rieman et al. 1991). Rieman and Beamesderfer (1990) predicted that predation on juvenile salmonids could be reduced by up to 50% with a sustained exploitation rate of 10-20% on northern pikeminnow > 275 mm FL (11 inches total length). The Northern Pikeminnow Management Program (NPMP) was created in 1990, with the goal of implementing fisheries which achieve the recommended 10-20% annual exploitation on northern pikeminnow >275 mm FL within the program area (Vigg and Burley 1989). In 2000, NPMP administrators reduced the minimum size for eligible (reward size) northern pikeminnow to 228 mm FL (9 inches total length) in response to recommendations contained in a review of NPMP justification, performance, and cost-effectiveness (Hankin and Richards 2000). Beginning in 1991, the Washington Department of Fish and Wildlife (WDFW) was contracted to conduct the NPSRF component of the NPMP (Burley et al. 1992). The NPSRF enlists recreational anglers to harvest reward sized (≥9" total length) northern pikeminnow from within program boundaries on the Columbia and Snake Rivers by using a monetary reward system. Since 1991, anglers participating in the NPSRF have harvested more than 3.04 million reward sized northern pikeminnow and spent more than 662,000 angler days of effort to become the NPMP's most successful component for achieving the annual 10-20% exploitation rate on northern pikeminnow within the program boundaries (Klaybor et al. 1993; Friesen and Ward 1999).

The 2007 NPSRF maintained the tiered angler reward system developed in 1995 (Hisata et al. 1995) which paid anglers higher rewards per fish based on achieving designated harvest levels and a separate bonus reward for returning northern pikeminnow spaghetti tagged by the Oregon Department of Fish and Wildlife (ODFW) as part of the NPSRF's biological evaluation. Catch and harvest data were collected from returning anglers, and non-returning anglers in order to monitor the effects of the NPSRF on other Columbia basin fishes.

The objectives of the 2007 NPSRF were to (1) implement a public fishery that rewards recreational anglers to harvest northern pikeminnow $\geq$ 228 mm (9 inches) total length, (2) collect, compile, and report data on angler participation, catch and harvest of northern pikeminnow and other fish species, and success rates of participating anglers during the season, (3) examine collected northern pikeminnow for the presence of external tags, fin-clips, and signs of tag loss, (4) collect biological data on northern pikeminnow and other fish species returned to registration stations, (5) scan northern pikeminnow for the presence of consumed salmonids containing Passive Integrated Transponder (PIT) tags, (6) survey non-returning fishery participants targeting northern pikeminnow in order to obtain catch and harvest data on fish species caught, and (7) examine and process all northern pikeminnow caught by U.S. Department of Agriculture (USDA) angling crews operating at The Dalles and John Day dams to recover spaghetti and/or PIT tags.

METHODS OF OPERATION

Fishery Operation

Boundaries and Season

The NPSRF was conducted on the Columbia River from the mouth to the boat-restricted zone below Priest Rapids Dam, and on the Snake River from the mouth to the boat-restricted zone below Hells Canyon Dam (Figure 1). In addition, anglers were allowed to harvest (and submit for payment) northern pikeminnow caught in backwaters, sloughs, and up to 400 feet from the mouth of tributaries within this area.

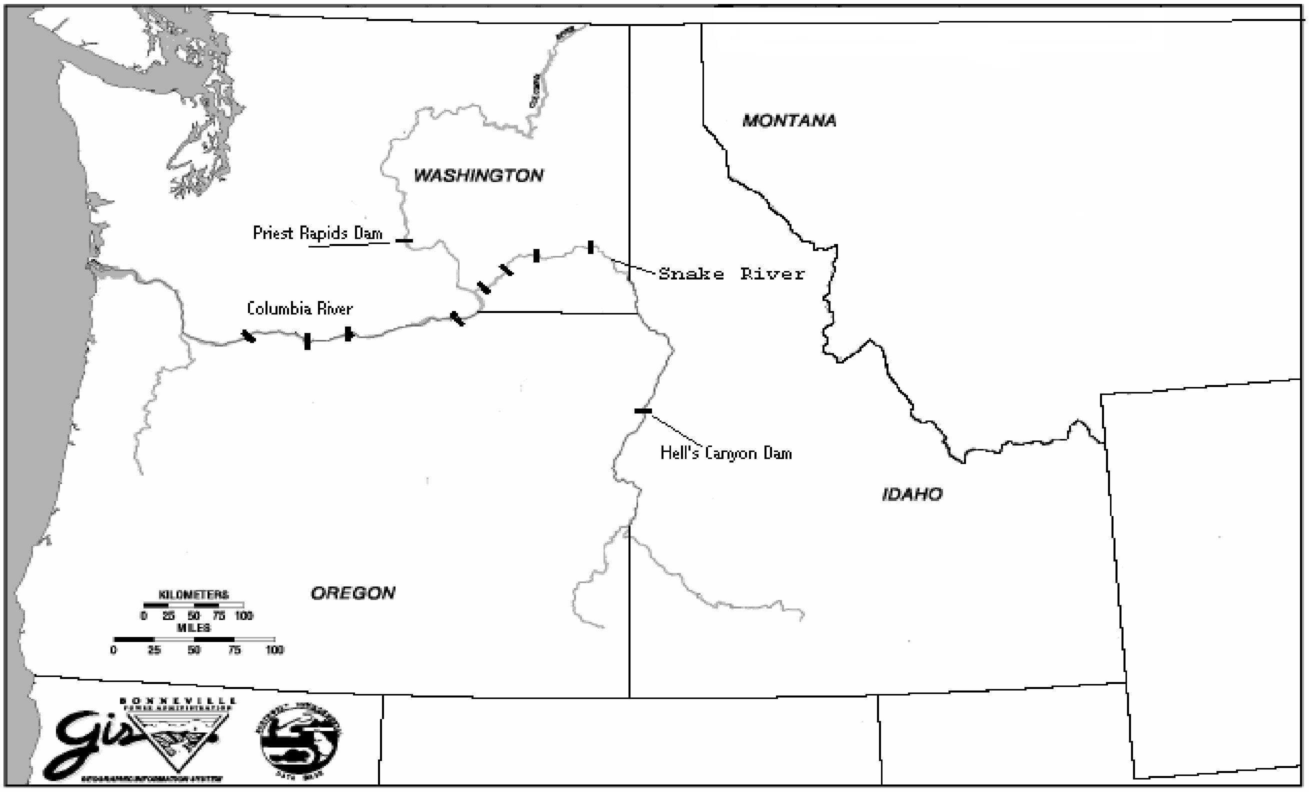


Figure 1. 2007 Northern Pikeminnow Sport-Reward Fishery Program Area

The NPSRF was fully implemented, with all stations operating from May 14 through September 30, 2007. In addition, thirteen stations conducted a two week long "post-season extension" beginning on October 1, 2007 in order to take advantage of favorable river conditions that provided anglers with an extended opportunity to harvest northern pikeminnow.

Registration Stations

Seventeen registration stations (Figure 2) were located on the Columbia and Snake Rivers to provide anglers with access to the Sport-Reward Fishery. WDFW technicians set up daily (seven days a week) registration stations at designated locations (normally public boat ramps or parks) which were available to anglers between two and eight hours per

1. Cathlamet Marina (11am-3 pm)
2. Willow Grove Boat Ramp (4-7 pm)
3. Rainier Marina (3-7:30 pm)
4. Kalama Marina (10:30am-2:30 pm)
5. M. James Gleason Boat Ramp (11am-7 pm)
6. Chinook Landing (7-10 am)
7. Washougal Boat Ramp (11am-7 pm)
8. Cascade Locks Boat Ramp (4-7 pm)
9. Bingen Marina (11am-3:00 pm)
10. The Dalles Boat Basin (11am-7 pm)
11. Giles French (11am-7 pm)
12. Umatilla Marina (4-6 pm)
13. Columbia Point Park (2-6:30 pm)
14. Vernita Bridge (10am-2:30 pm)
15. Lyon's Ferry (10:30am-12:30 pm)
16. Boyer Park (10:30 am-2 pm)
17. Greenbelt (3:30-6:30 pm)

Figure 2. 2007 Northern Pikeminnow Sport Reward Fishery Registration Stations

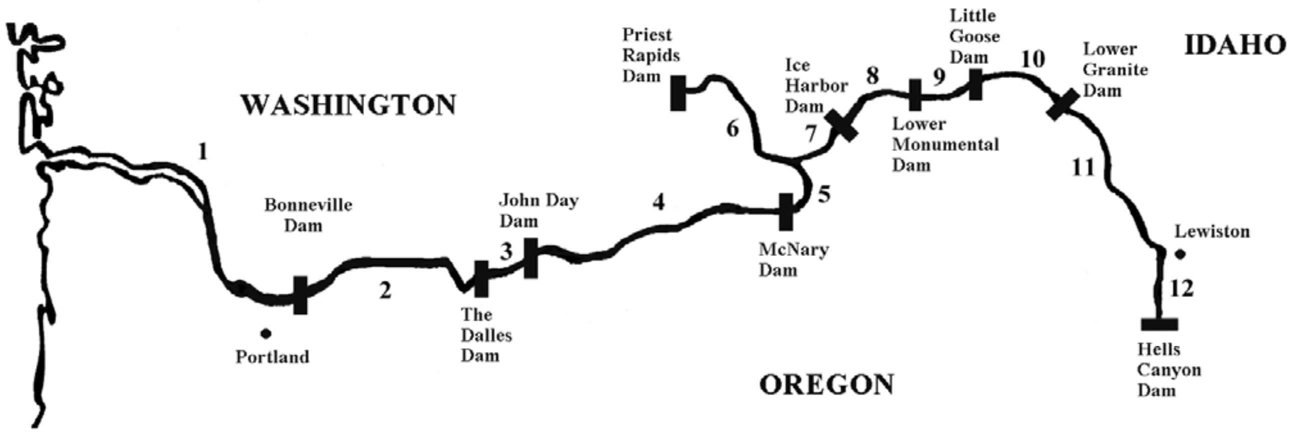
day during the season. Technicians registered anglers to participate in the NPSRF, collected angler creel information, issued pay vouchers to anglers returning with eligible northern pikeminnow, recorded biological data, scanned northern pikeminnow for the presence of PIT tags, and provided Sport-Reward Fishery information to the public. Self-registration boxes were located at each station so anglers could self register when WDFW technicians were not present.

Reward System

The 2007 NPSRF rewarded anglers for harvesting northern pikeminnow $\geq$ 228mm TL (9 inches). The 2007 NPSRF maintained the tiered angler reward system developed in 1995 (Hisata et al. 1995) that paid anglers a higher reward per fish once they had reached designated harvest levels over the course of the season. To receive payment, anglers returned their catch (daily) to the location where they had registered. WDFW technicians identified the angler's fish and issued a payment voucher for the total number of eligible northern pikeminnow. Anglers mailed payment vouchers to the Pacific States Marine Fisheries Commission (PSMFC) for redemption. Anglers returning with northern pikeminnow that were spaghetti-tagged by ODFW as part of the biological evaluation of the fishery (Vigg et al. 1990), were issued a separate tag payment voucher that was mailed to ODFW for tag verification before payment was made to the angler by PSMFC. During the 2007 season, the NPSRF retained the pay levels used in 2006 (Winther et al. 2006) which paid anglers $4 each for their first 100 northern pikeminnow, $5 each for numbers 101-400, and $8 each for all fish over 400. Anglers were also paid $500 for each northern pikeminnow they turned in which had been spaghetti-tagged by ODFW.

Angler Sampling

Angler data and creel data for the NPSRF were compiled from angler registration forms. One registration form represented one angler day. Angler data consisted of name, date, fishing license number, phone number, and city, state, zip code of participating angler. Creel data recorded by WDFW technicians included fishing location (Figure 3), and primary species targeted (Appendix B). Anglers were asked if they specifically fished for northern pikeminnow at any time during their fishing trip. A "No" response ended the exit interview. A "Yes" response prompted technicians to ask the angler (and record data), how many of each species of fish were caught, harvested or released while targeting northern pikeminnow. A fish was considered "caught" when the angler touched the fish, whether it was released or harvested. Fish returned to the water alive were defined as "released". Fish that were retained by the angler or not returned to the water alive were considered "harvested".



Fishing Locations:

1. Below Bonneville Dam
2. Bonneville Reservoir
3. The Dalles Reservoir
4. John Day Reservoir
5. McNary Reservoir to the Mouth of the Snake River
6. Mouth of the Snake River to Priest Rapids Dam
7. Mouth of the Snake River to Ice Harbor Dam
8. McNary Reservoir
9. Lower Monumental Reservoir
10. Little Goose Reservoir
11. Lower Granite Reservoir to the Mouth of the Clearwater River
12. Mouth of Clearwater River to Hell's Canyon Dam

Figure 3. Fishing location codes used for the 2007 Northern Pikeminnow Sport-Reward Fishery

Returning Anglers

Technicians interviewed all returning anglers at each registration station to obtain any missing angler data, and to record creel data from each participant's angling day. Creel data from caught and released fishes were recorded from angler recollection. Creel data from all harvested fish species were recorded from visual observation.

Non-Returning Anglers

Non-returning angler data was compiled from the pool of anglers who had registered for the NPSRF and targeted northern pikeminnow, but did not return to a registration station to participate in an exit interview. WDFW attempted to survey 20% of the NPSRF's non-returning anglers using a telephone survey in order to obtain creel data from that segment of the NPSRF's participants. To obtain the 20% sample, non-returning anglers were randomly selected from each registration station for each week. A technician called anglers from each random sample until the 20% sample was attained. Non-returning anglers were surveyed with the same exit interview questions used for returning anglers. Anglers were asked: "did you specifically fish for northern pikeminnow at any time during your fishing trip?" With a "Yes" response, anglers were asked to report the number and species of adult and/or juvenile salmonids and the number of reward size northern pikeminnow that were caught and harvested/released while they targeted northern pikeminnow. Angler catch and harvest data were not collected from non-returning anglers who did not target northern pikeminnow on their fishing trip. In addition, non-returning angler catch and harvest data for non-salmonid species were not collected in 2007 as it was last obtained in 2005 and trends for these species have remained consistent over the NPMP's 17 year history (Winther et al. 1996). These data will be again collected in 2010 to identify any variance from non-returning angler trends observed to date within the Sport-Reward Fishery.

Northern Pikeminnow Handling Procedures

Biological Sampling

Technicians examined all fishes returned to registration stations and recorded species as well as number of fish per species. Technicians checked all northern pikeminnow for the presence of external tags (spaghetti or dart), fin-clip marks, and signs of tag loss. Fork lengths (FL) and sex of northern pikeminnow as well as any other harvested fish species were recorded whenever possible. Complete biological data were collected from all tag-loss and spaghetti tagged northern pikeminnow including FL, sex (determined by evisceration), scale, and opercle samples. Spaghetti tagged and tag-loss northern pikeminnow carcasses were then labeled and frozen for data verification and/or tag recovery at a later date. Data from spaghetti tags were recorded on a tag envelope as well as on WDFW data forms. The spaghetti tag was then placed in the tag envelope, stapled to the tag payment voucher and given to the angler to submit to ODFW for verification.

PIT Tag Detection

All northern pikeminnow collected during the 2007 NPSRF were also scanned for passive integrated transponder (PIT) tags. Northern pikeminnow harvested by anglers participating in the NPSRF have been found to ingest juvenile salmonids which have been PIT tagged by other studies within the basin (Glaser et al. 2000). In addition, PIT tags have also been used by ODFW as a secondary mark (since 2003) in all northern pikeminnow fitted with spaghetti tags as part of the NPMP's biological evaluation activities. The use of PIT tags rather than fin clips as a secondary mark in northern pikeminnow should improve the NPSRF's estimate of tag loss, and result in a more accurate estimate of exploitation for the NPSRF. WDFW technicians scanned 100% of all northern pikeminnow returned to registration stations for PIT tags using two types of PIT tag "readers". Northern Pikeminnow were scanned using primarily Destron Fearing portable transceiver systems (model #FS2001F) to record information from PIT tag detections for submission to the Columbia Basin PIT tag information System (PTAGIS). The NPSRF also used Allflex ISO Compatible RF/ID Portable Readers (model #RS601) to scan northern pikeminnow and assist in recovery of initial PIT tag data when the Destrons were not available. Scanning began on the first day of the NPSRF season and continued at all stations throughout the rest of the year. Technicians individually scanned all reward sized northern pikeminnow for PIT tag presence and complete biological data were recorded from pikeminnow with positive readings. All PIT tagged northern pikeminnow were labeled and preserved for later dissection and tag recovery. All data were verified after recovery of PIT tags and all PIT tag recovery data were provided to ODFW and the Pit Tag Information System (PTAGIS) on a regular basis.

Northern Pikeminnow Processing

During biological sampling, all northern pikeminnow were eviscerated (to determine sex), or caudal clipped as an anti-fraud measure to eliminate the possibility of previously processed northern pikeminnow being resubmitted for payment. In 2007, most northern pikeminnow were caudal clipped rather than eviscerated in order to facilitate accurate recovery of PIT tags. Sampled northern pikeminnow were iced and transported to cold storage facilities from which they were ultimately delivered to rendering facilities for final disposal.

RESULTS AND DISCUSSION

Northern Pikeminnow Harvest

The NPSRF harvested a total of 192,518 reward size northern pikeminnow ($\geq$ 228 mm TL) during the 2007 season, achieving an estimated 17.8% exploitation rate (ODFW, personal communication). Despite a 41,406 drop in harvest from 2006, the 2007 season harvest was still well above the mean 1991-2006 season harvest of 178,211 (Figure 4). The 2007 NPSRF total annual harvest was higher than nine of the seventeen previous season harvest totals and remained comparable to the seasons that followed the boost in angler incentives that were implemented in the year 2000 (Glaser et al. 2000). In addition to reward size northern pikeminnow, the 2007 NPSRF also harvested 3,748 northern pikeminnow < 228 mm TL.

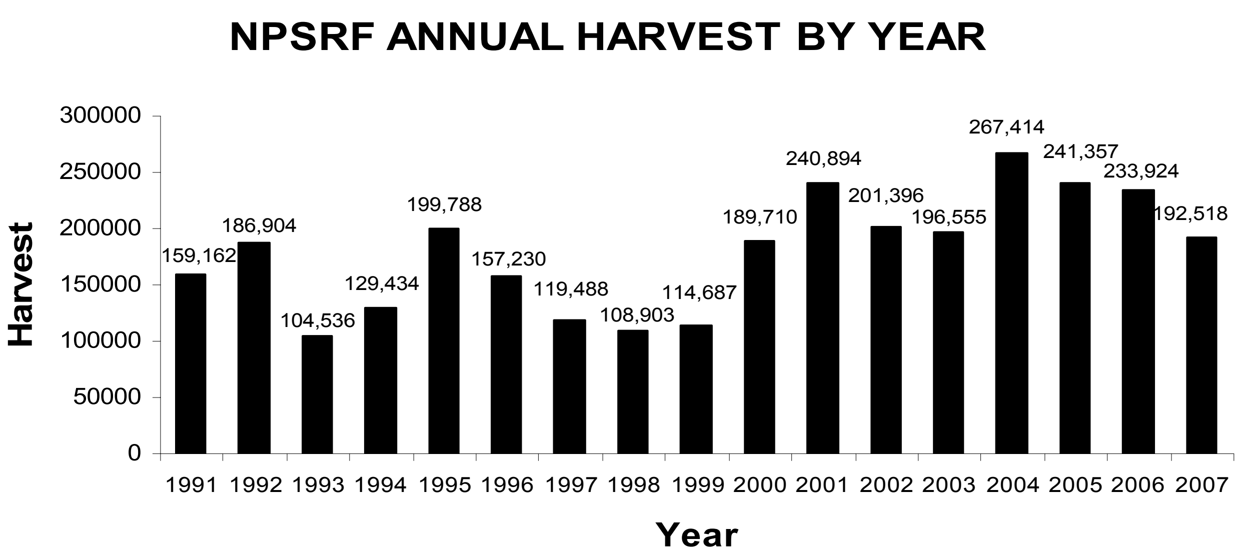


Figure 4. Annual Harvest Totals for the 2007 Northern Pikeminnow Sport Reward Fishery

Harvest by Week

The 2007 NPSRF operated for 22 weeks, with peak harvest occurring during the third week of the season (week 22), May 28-June 3 (Figure 5). The 2007 NPSRF started two weeks later than usual and mean weekly harvest was 8,750 fish. The 2007 NPSRF was also implemented for 2 weeks less than the 2006 NPSRF. Weekly harvest totals for most of the 2007 NPSRF were similar to 2006, except that the 2007 NPSRF did not see it's traditional harvest peak (near the third week of June) as seen in most years, including the 2006 NPSRF (Figure 6). Not only was the weekly harvest peak for the 2007 NPSRF much earlier than the 2006 peak, it was also much lower (13,999 versus 18,709). In fact, after the fifth week of the 2007 NPSRF, weekly harvest fell below the 2006 NPSRF levels through the end of the season (8,750 in 2007 versus 9,747 in 2006). With the strong early season harvest seen in 2007, an earlier start it may have resulted in an additional harvest of 15-20,000 fish, but it is unlikely that the 2007 NPSRF could have equaled 2006.

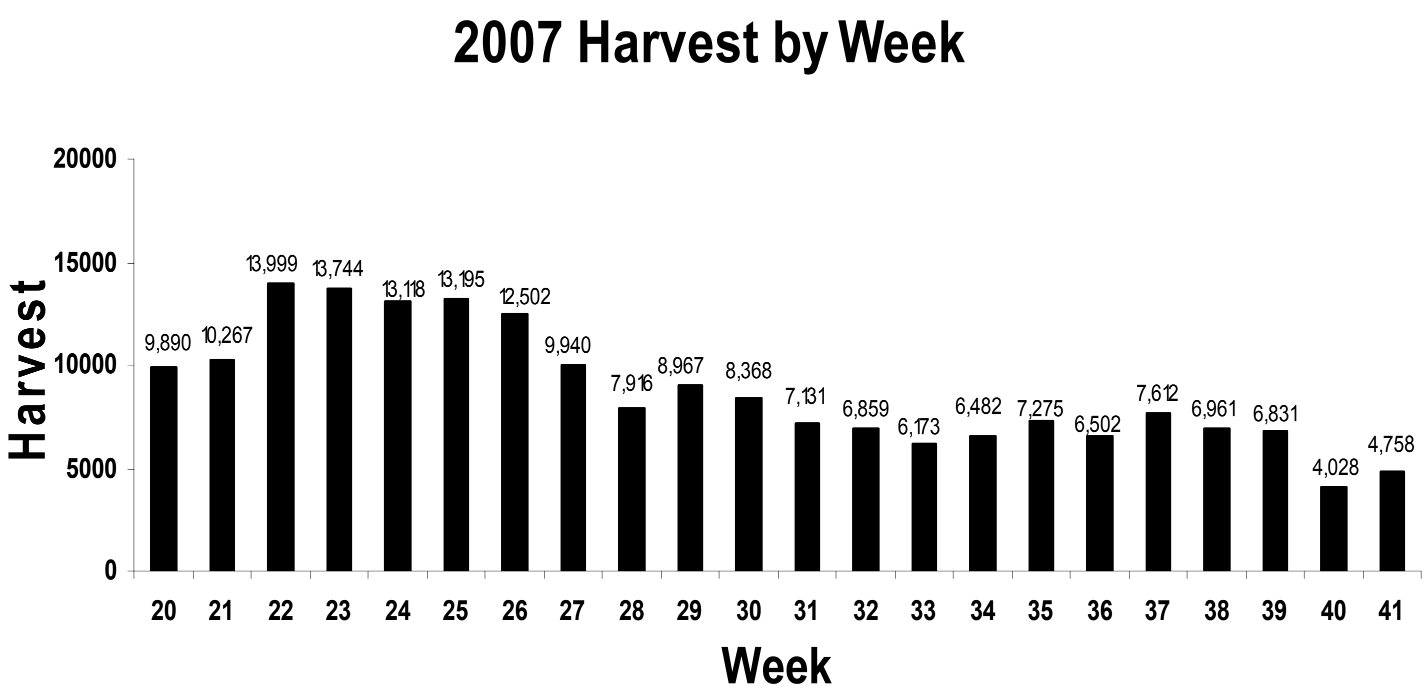


Figure 5. 2007 Weekly Northern Pikeminnow Sport-Reward Fishery Harvest.

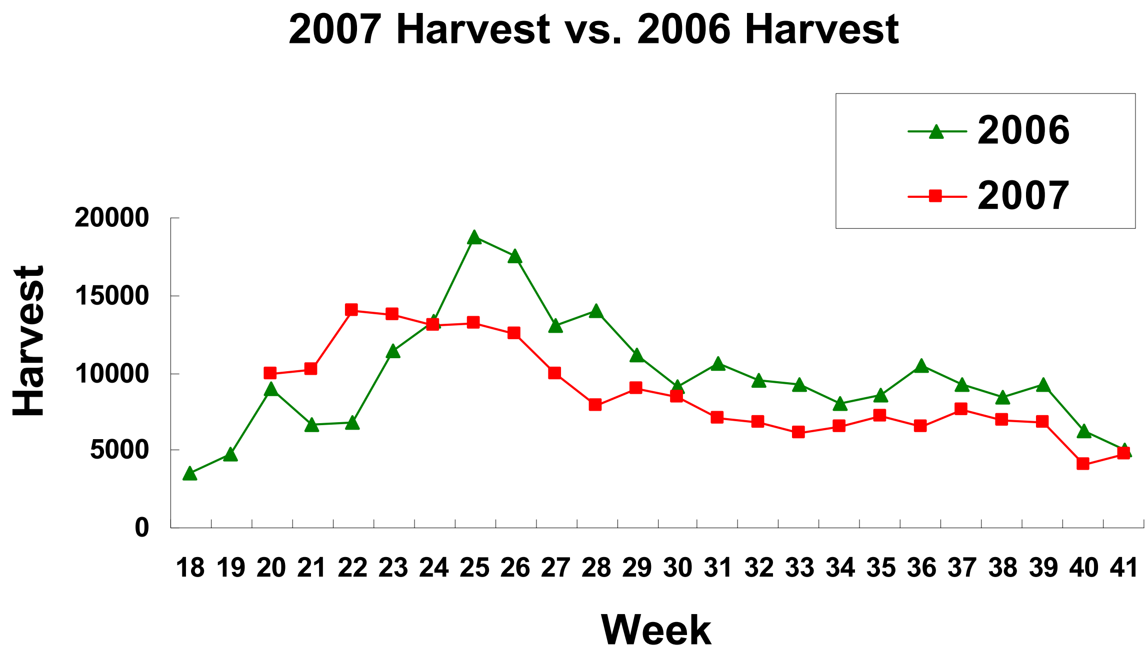


Figure 6. 2007 Weekly NPSRF Harvest vs. 2006 Weekly Harvest.

The 2007 NPSRF weekly harvest was lower than the mean 1991-2006 harvest for only four weeks (Figure 7). During the remainder of the season, harvest for the NPSRF was at or above the historical 1991-2006 harvest levels. In addition, peak weekly harvest for the 2007 NPSRF was slightly higher and occurred four weeks earlier than the NPSRF's historical 1991-2006 peak in week 26 (Fox et al. 1999).

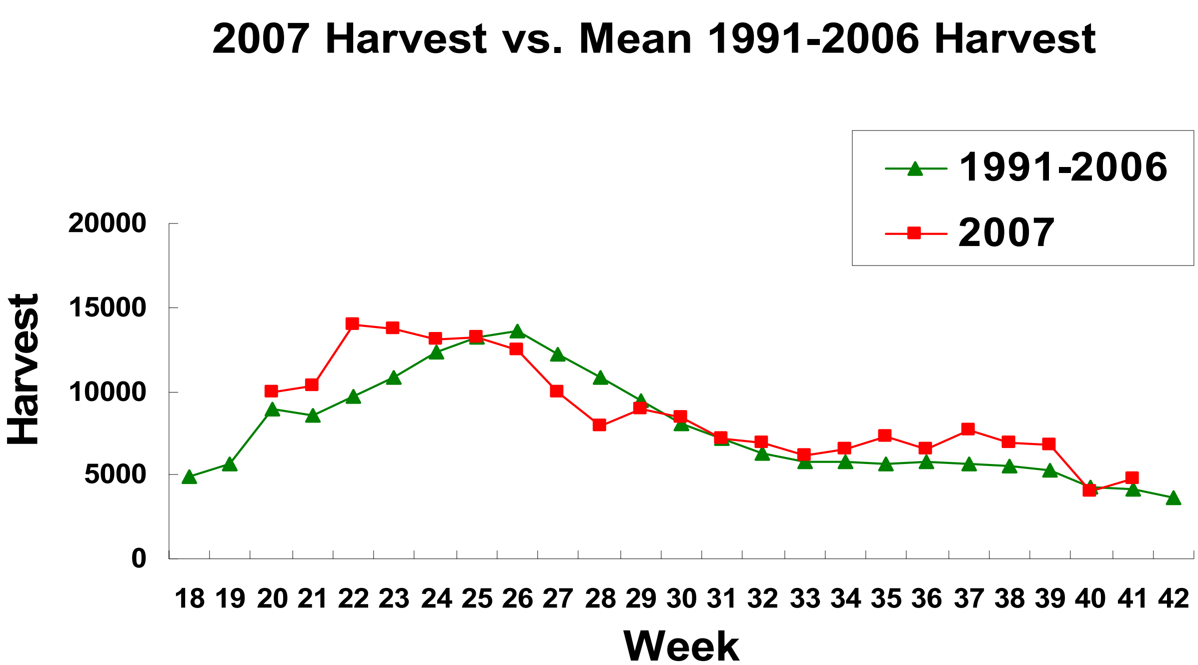


Figure 7. 2007 NPSRF Weekly Harvest versus 1991-2006 Mean Weekly Harvest.

Harvest by Fishing Location

The mean harvest by fishing location was 16,043 northern pikeminnow and ranged from 81,780 reward size northern pikeminnow in fishing location 01 (below Bonneville Dam) to 88 northern pikeminnow from fishing location 11 (Lower Granite Dam to the mouth of the Clearwater River) (Figure 8). Harvest from Fishing Location 01 (the Columbia river below Bonneville Dam) accounted for 42% of total NPSRF harvest and was once again the highest producing area as it has been for each year since 1991. For the fourth year in a row, a bulk of the total NPSRF harvest(17%) came from Bonneville Pool (Fishing location 02) as was first documented during the 2004 NPSRF (Hone et al. 2004). The primary area of harvest for this fishing location is in the tailrace area of The Dalles Dam where NPSRF technicians continue to record larger than usual catches from anglers fishing exclusively in this area. Fishing location 10 (Little Goose Reservoir) also made up 17% of the total NPSRF harvest. A five mile stretch of river below Lower Granite Dam in fishing location 10 has been responsible for a significant amount of the NPSRF harvest especially since the site at Boyer Park was reopened in 2004.

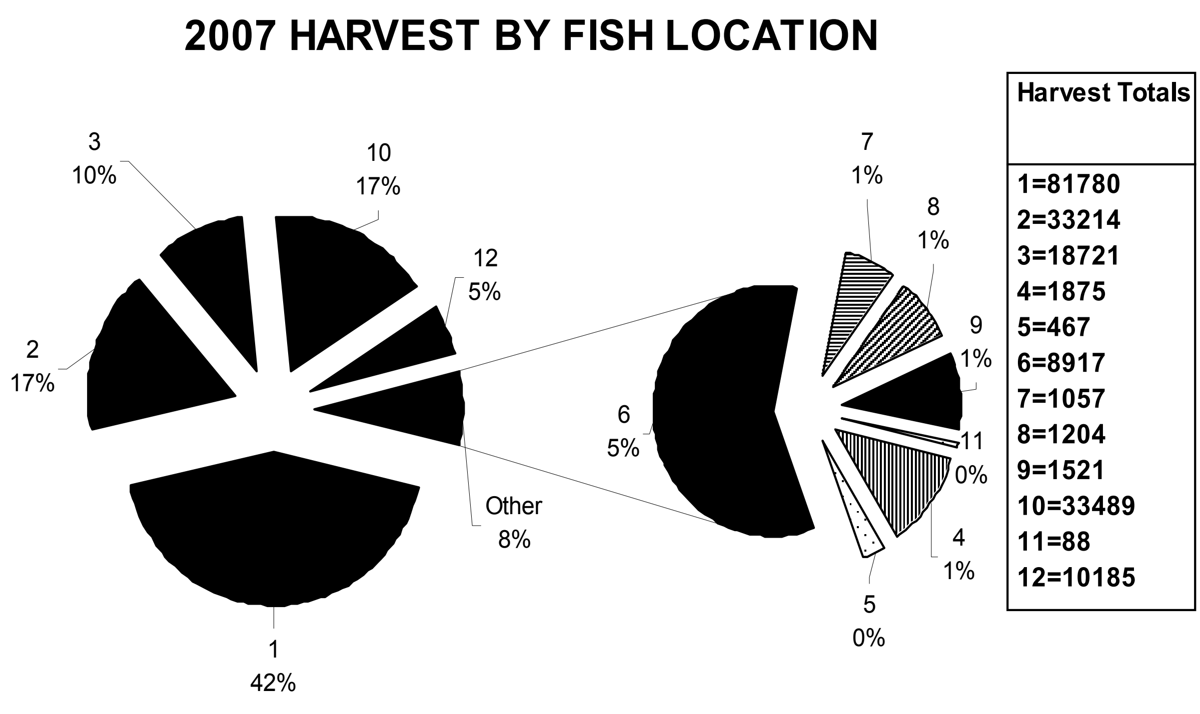


Figure 8. 2007 Northern Pikeminnow Sport-Reward Fishery Harvest by Fishing Location.*
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake River to Priest Rapids Dam. Fishing Location Codes for the Snake River; 7 = Mouth of the Snake River to Ice Harbor Dam, 8 = Ice Harbor Reservoir, 9 = Lower Monumental Reservoir, 10 = Little Goose Reservoir, 11 = Lower Granite Dam to the mouth of the Clearwater River, 12 = Mouth of the Clearwater River to Hell's Canyon Dam.

Harvest by Registration Station

The Boyer Park station was the top producing station where anglers harvested 32,717 northern pikeminnow equaling 17% of the total NPSRF harvest (Figure 9). Harvest at the Boyer Park station during the 2007 NPSRF exceeded harvest at The Dalles station which had been the top producing station for the past three seasons. The station with the smallest harvest was Bingen (in its first year of operation since 2003), where anglers harvested 1,636 northern pikeminnow. The average harvest per registration station was 11,325 reward size northern pikeminnow, down from 13,760 per station in 2006. It should be noted that one factor for below average harvest at some registration stations was that they were only open during limited hours. The Umatilla registration station showed the largest percent based increase in harvest improving from 1,570 northern pikeminnow in 2006 to 2,289 in 2007 (a 46% increase). The Dalles station showed the largest decline, dropping from 45,742 fish in 2006 to 29,463 in 2007 (a 36% decrease).

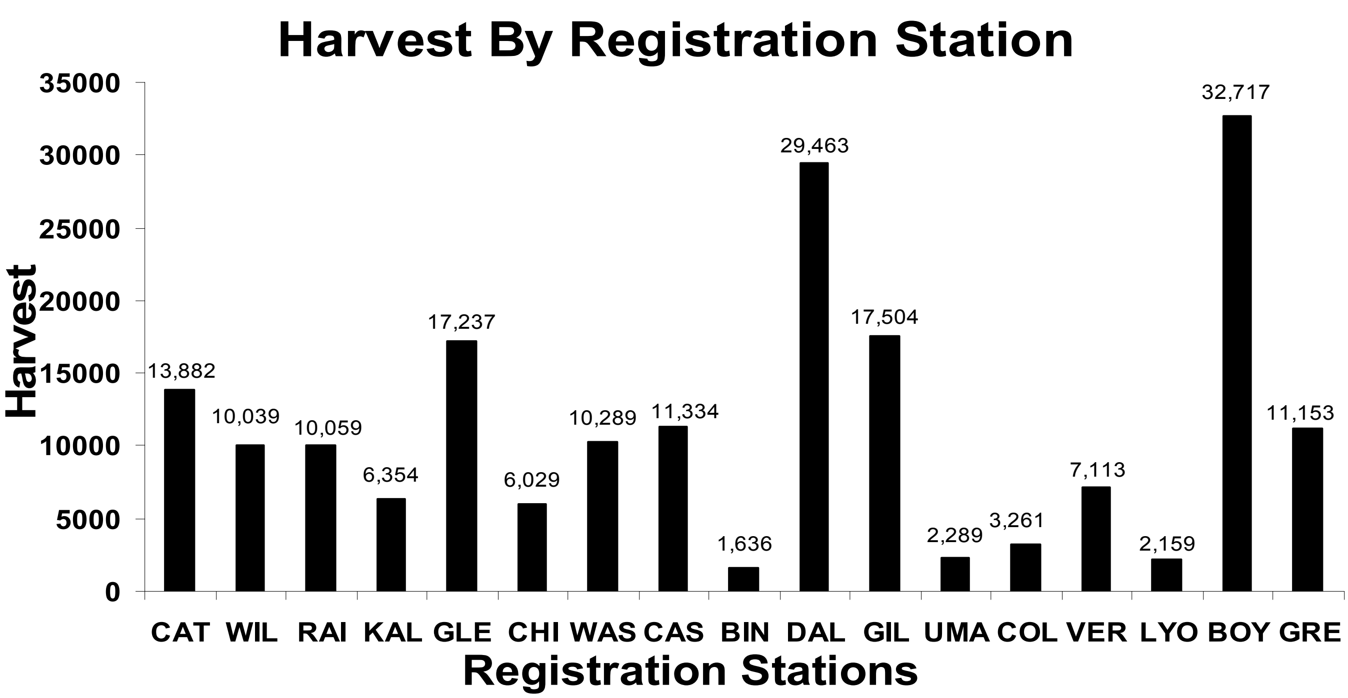


Figure 9. 2007 Northern Pikeminnow Sport-Reward Fishery Harvest by Registration Station. CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, GLE-Gleason, CHI-Chinook, WAS-Washougal, CAS-Cascade Locks, BIN-Bingen Marina, DAL-The Dalles, GIL-Giles French, UMA-Umatilla Marina, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, GRE-Greenbelt, BOY-Boyer Park.

Harvest by Species/ Incidental Catch

Returning anglers

In addition to northern pikeminnow, returning anglers participating in the 2007 NPSRF reported that they incidentally caught the salmonids listed in Table 1. Incidental salmonid catch by returning NPSRF anglers consisted mostly of juvenile hatchery steelhead and adult fin-clipped chinook. Anglers reported that all juvenile salmonids caught during the 2007 NPSRF were released. Technicians recorded any juvenile steelhead caught by NPSRF anglers (except those specifically reported as missing the adipose fin), as "wild". Harvested adult salmonids (hatchery fin-clipped chinook and steelhead with missing adipose fins) were caught incidentally during the 2007 NPSRF, but were only retained during legal salmonid fisheries. Instances where NPSRF anglers reported harvesting "trout" from the Snake River during a legal fishery are typically residualized hatchery steelhead smolts which are caught and kept by anglers, and misidentified as trout. Any NPSRF angler who reports illegally harvesting salmonids during the exit interview (whether juvenile or adult salmonids), are immediately reported to the appropriate enforcement entity by WDFW technicians.

Table 1. Catch and Harvest of salmonids by Returning Anglers Targeting Northern Pikeminnow in 2007.

Salmon

Species	Caught	Harvest	Harvest Percent
Chinook (Adult)	37	8	21.62%
Chinook (Jack)	41	15	36.59%
Chinook (Juvenile)	63	0	0%
Coho(Adult)	4	0	0%
Coho (Juvenile)	14	0	0%
Cutthroat (unknown)	24	4	16.67%
Steelhead Adult (Hatchery)	23	10	43.48%
Steelhead Adult (Wild)	26	0	0%
Steelhead Juvenile (Hatchery)	152	0	0%
Steelhead Juvenile (Wild)	27	0	0%
Trout (Unknown)	3357	187	5.57%

Other fish species incidentally caught by returning NPSRF anglers targeting northern pikeminnow were mostly peamouth, smallmouth bass, yellow perch, walleye, and channel catfish (Table 2).

Table 2. Catch and Harvest of non-salmonids by Returning Anglers Targeting Northern Pikeminnow in 2007.

Non-Salmonid

Species	Caught	Harvest	Harvest Percent
Northern Pikeminnow >228mm	192,583	192,518	99.97%
Peamouth	40,473	7,097	17.54%
Northern Pikeminnow <228mm	55,159	3,748	6.79%
Smallmouth Bass	19,042	1,333	7.00%
White Sturgeon	3,531	64	1.81%
Channel Catfish	5,765	1,123	19.48%
Sucker (unknown)	3,338	255	7.64%
Sculpin (unknown)	5,875	1,509	25.69%
Walleye	754	378	50.13%
American Shad	215	122	56.74%
Yellow Perch	3,353	463	13.81%
Starry Flounder	706	47	6.66%
Chiselmouth	319	54	16.93%
Carp	508	38	7.48%
Bullhead (unknown)	1,275	136	10.67%
Catfish (unknown)	304	53	17.43%
Crappie (unknown)	17	2	11.76%
Bluegill	94	13	13.83%
Redside Shiner	126	49	38.89%
Whitefish	13	1	7.69%
Largemouth Bass	29	0	0%
Pumpkinseed	41	0	0%
Sandroller	53	3	5.66%

Non-returning Anglers Catch and Harvest Estimates

We randomly surveyed 1,720 non-returning anglers (20.03% of all non-returning anglers) to record their catch and/or harvest of reward sized northern pikeminnow or any salmonid species. Catch and harvest data for other fish species caught by non-returning anglers were not collected in 2007 since harvest levels of those species by NPSRF anglers has been historically very low (Bruce et al. 2005), and was last obtained during the 2005 NPSRF. We anticipate once again collecting full catch and harvest data for all species from surveyed non-returning anglers in 2010 to determine whether this trend has changed per NPMP protocol (Fox et al. 1999). Surveyed non-returning anglers targeting northern pikeminnow reported that they caught and/or harvested the salmonid species listed in column 1 of Table 3 during the 2007 NPSRF. A simple estimator was applied to the catch and harvest totals obtained from the surveyed anglers to obtain Total Catch, and Total Harvest estimates for all non-returning anglers participating in the 2007 NPSRF. Estimated totals are listed in columns 4 and 5 of Table 3.

Table 3. 2007 NPSRF Catch and Harvest for surveyed Non-returning Anglers and Estimated non-return totals.

Species	Caught	Harvested	%Harvested	Estimated Total Catch	Estimated Total Harvest
Northern Pikeminnow > 228 mm	72	66	91.67%	360	330
Steelhead (juvenile - Adipose absent)	1	0	0	5	0
Steelhead (juvenile – Adipose present)	12	0	0	60	0
Steelhead (adult – Adipose present)	3	0	0	15	0
Chinook (juvenile)	4	0	0	20	0
Chinook (adult)	1	0	0	5	0
Chinook (jack)	9	1	11.11%	45	5

N=8,584 n=1,720

Fork Length Data

The length frequency distribution of harvested northern pikeminnow (≥ 200 mm) from the 2007 NPSRF is presented in Figure 10. A total of 50,598 northern pikeminnow were

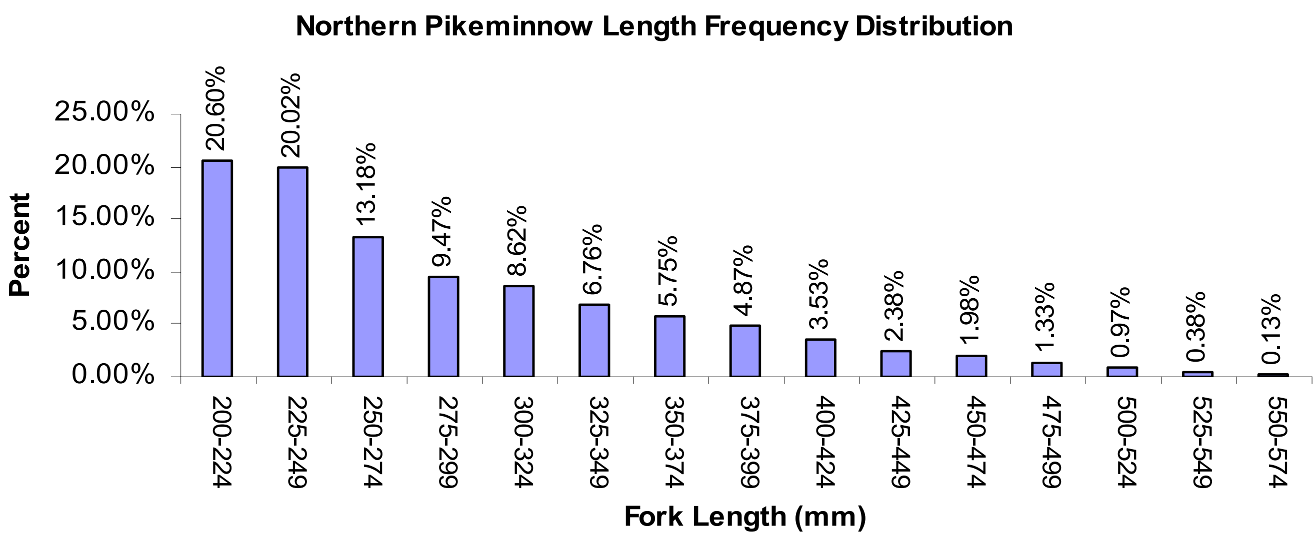


Figure 10. Length frequency distribution of northern pikeminnow ≥ 200 mm FL sampled in 2007.

eligible for reward payment, having a fork length > 209 mm (Glaser et al. 2000). The mean fork length for measured northern pikeminnow in 2007 was 290.4 mm (SD= 76.2 mm), down from 296.2 in 2006.

Angler Effort

The 2007 NPSRF recorded total effort of 26,924 angler days spent during the season, a drop of more than 15% from the effort total of the previous year (Figure 11). Unlike most years, peak effort occurred during the first week of the season (week 20), May 14-20, 2007. This is likely due to favorable river conditions combining with a two week late start which may have had anglers especially anxious to participate in the program. When total effort is divided into returning and non-returning angler days, 18,340 angler days (68.1%) were recorded by returning anglers, and 8,584 were non-returns. The percentage of returning anglers (67.6%), showed a slight increase from 2006 and is consistent with the upward trend seen in recent years. In addition, 60% of total effort, and 87% of returning angler effort (16,038 angler days), was attributed to successful anglers who harvested at least 1 northern pikeminnow in 2007.

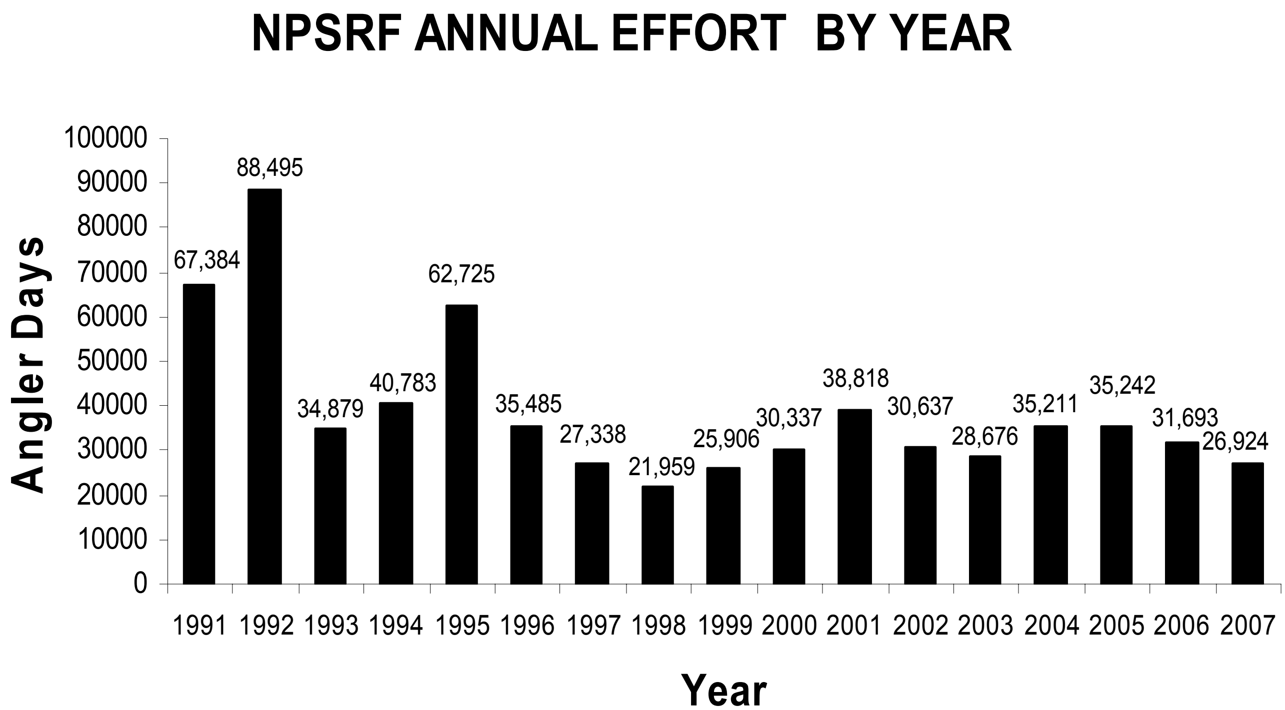


Figure 11. Annual Northern Pikeminnow Sport-Reward Fishery Effort.

Effort by Week

Mean weekly effort for the 2007 NPSRF was 1,224 angler days, down from 1,321 in 2006. The weekly effort totals of 2007 NPSRF did not follow the usual pattern of previous seasons. Instead, the 2007 peak in effort occurred immediately (week 20) and then trended downward for the remainder of the season. A small upturn in effort did occur during week 25 (which typically corresponds with peak NPSRF harvest and the northern pikeminnow spawn), but other than the final three weeks of the 2007 season, effort tracked well below mean 1991-2006 effort levels (Figure 13), continuing a trend that the NPSRF has experienced since the first years of the program.

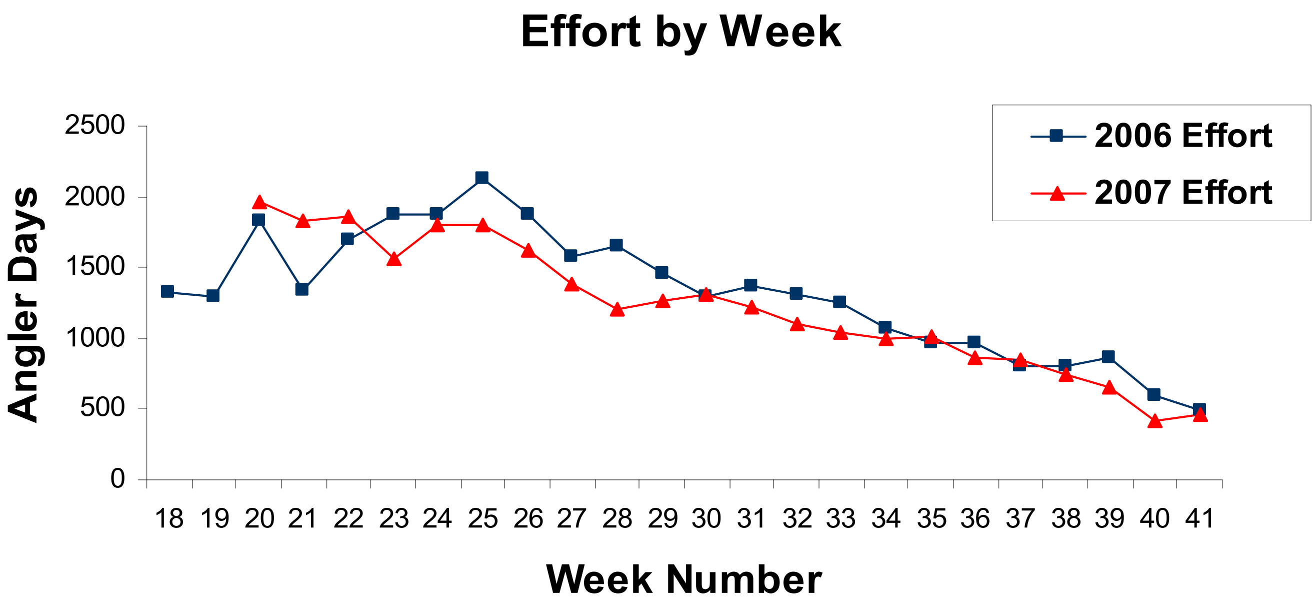


Figure 12. 2007 Weekly Northern Pikeminnow Sport-Reward Fishery Effort vs 2006 Weekly Effort.

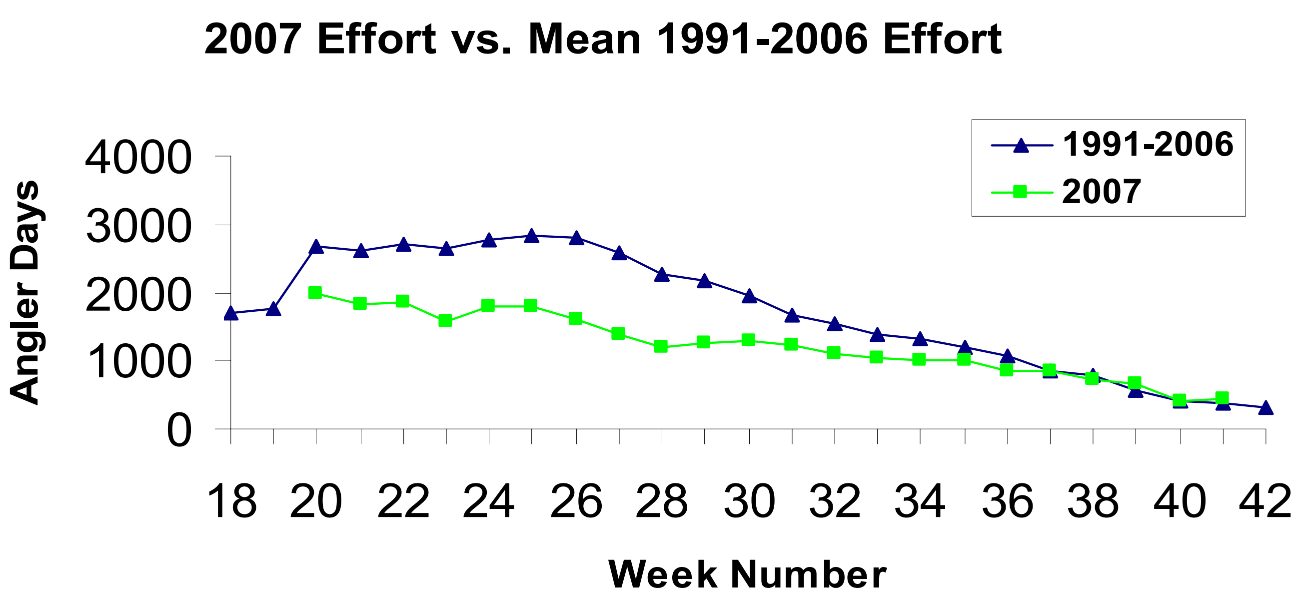


Figure 13. 2007 NPSRF Weekly Effort vs. Mean 1991-2006 Effort.

Effort by Fishing Location

Mean annual effort by fishing location for the 2007 NPSRF (returning anglers only) was 1,528 angler days compared to 1,786 angler days in 2006. Effort totals ranged from 8,576 angler days recorded below Bonneville Dam (fishing location 01) to only 19 angler days spent in fishing location 11 on the Snake River (Lower granite Dam to the mouth of the Clearwater River) (Figure 14). We did notice a small shift of effort from fishing locations 2 and 3 to fishing location 1, for the second year in a row, whereas effort totals in the remaining fishing locations were similar to 2006.

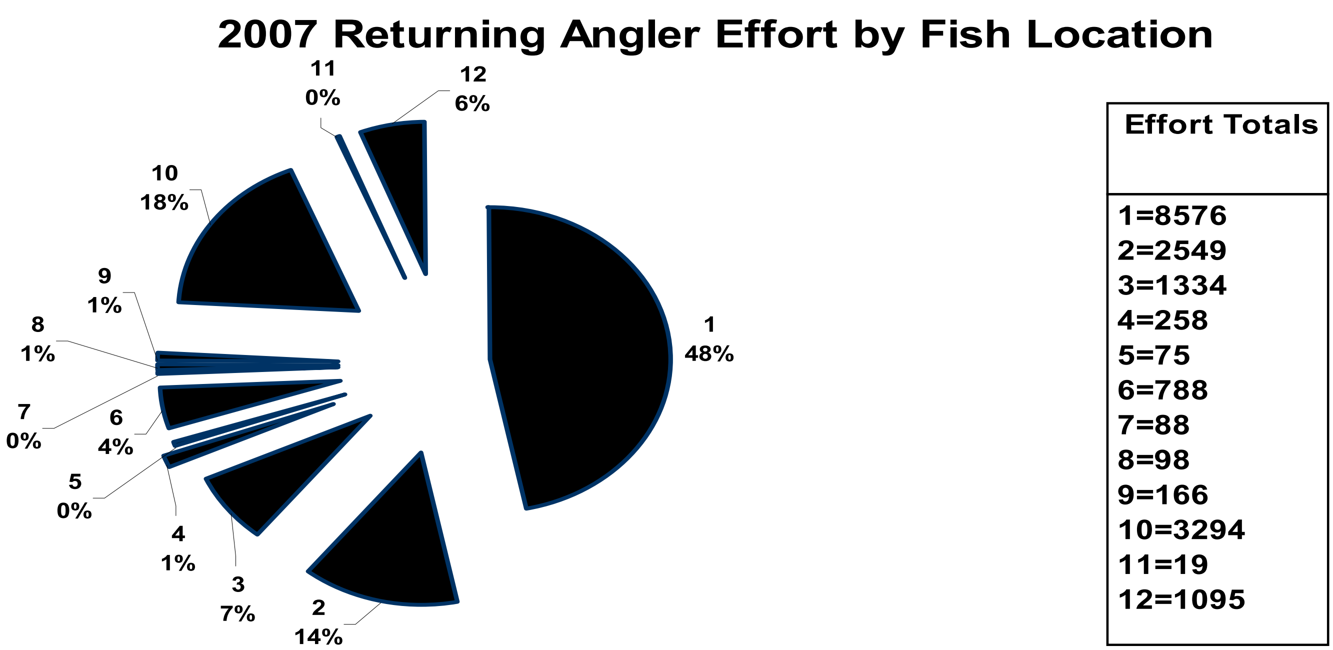


Figure 14. 2007 NPSRF Angler Effort by Fishing Location (returning anglers only).*
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake River to Priest Rapids Dam. Fishing Location Codes for the Snake River; 7 = Mouth of the Snake River to Ice Harbor Dam, 8 = Ice Harbor Reservoir, 9 = Lower Monumental Reservoir, 10 = Little Goose Reservoir, 11 = Lower Granite Dam to the mouth of the Clearwater River, 12 = Mouth of the Clearwater River to Hell's Canyon Dam.

Effort by Registration Station

Mean effort per registration station during the 2007 NPSRF was 1,584 angler days compared to 1,864 angler days in 2006. Effort totals ranged from 3,639 angler days at the Boyer Park station to 351 angler days at the Lyons Ferry station (Figure 15). Effort during the 2007 NPSRF declined at the majority of registration stations, especially at The Dalles station. We did however see an increase in angler effort at the Cascade Locks, Umatilla, and Cathlamet registration stations.

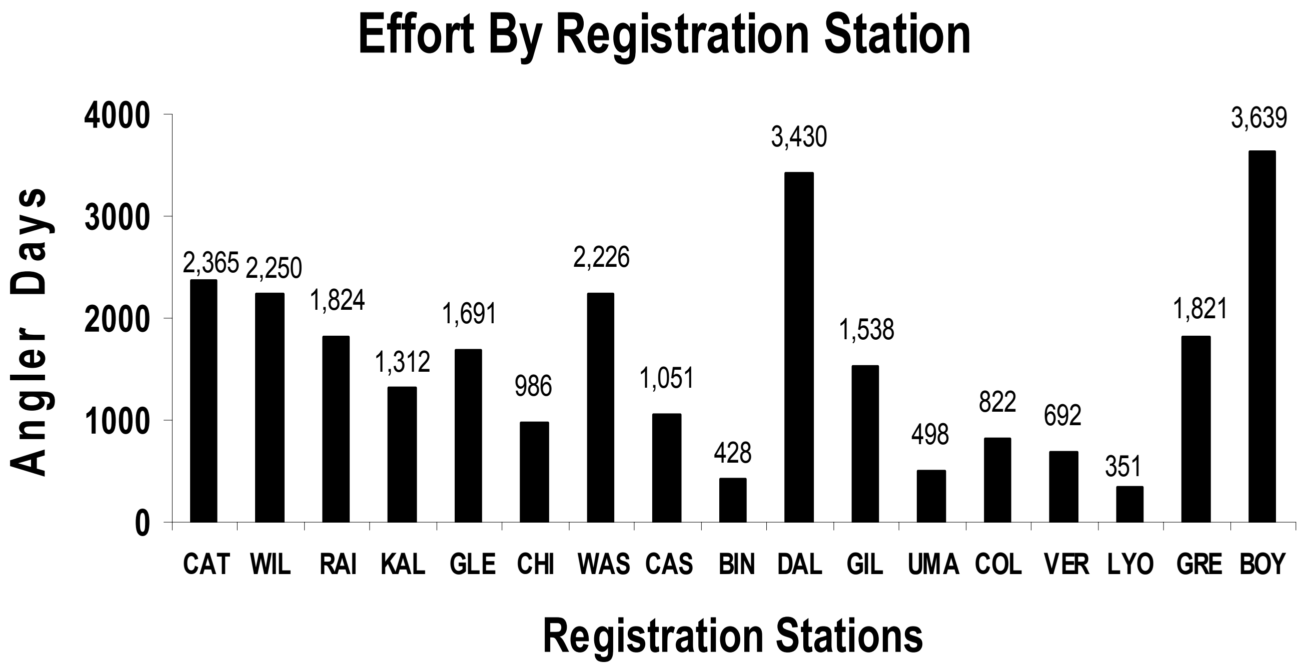


Figure 15. 2007 Northern Pikeminnow Sport-Reward Fishery Angler Effort by Registration Station. CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, GLE-Gleason, CHI-Chinook, WAS-Washougal, CAS-Cascade Locks, BIN-Bingen Marina, DAL-TheDalles, GIL-Giles French, UMA-Umatilla, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, GRE-Greenbelt, BOY-Boyer Park.

Catch Per Angler Day (CPUE)

The NPSRF recorded an overall (returning + non-returning anglers) catch per unit of effort (CPUE) of 7.15 northern pikeminnow harvested per angler day during the 2007 NPSRF. This catch rate declined slightly from 7.38 in 2006, but was still the third best CPUE in program history (Figure 16). Angler CPUE has increased steadily throughout the period from 1991-2006, and although CPUE in 2007 declined from 2006, the general trend continues. Returning angler CPUE during the 2007 NPSRF was 10.50 northern pikeminnow per angler day, down from 10.91 in 2006. Our most recent estimate of CPUE for non-returning anglers is 0.04 reward sized northern pikeminnow per angler day based on 2007 NPSRF phone survey results.

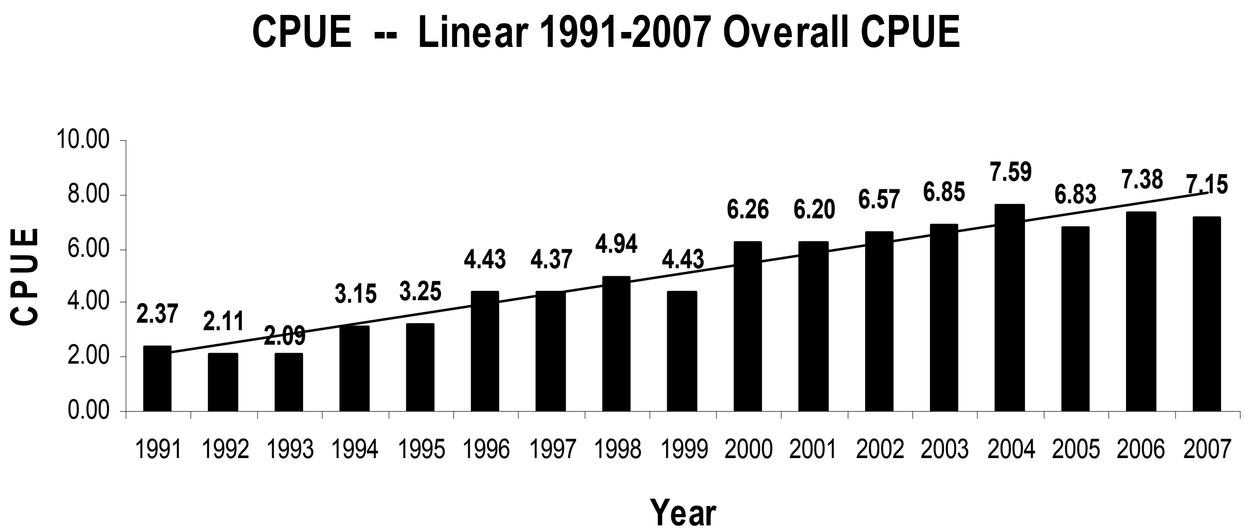


Figure 16. Annual NPSRF CPUE (returning + non-returning anglers) for the years 1991-2007.

CPUE by Week

Mean angler CPUE by week for the 2007 NPSRF was 7.49 fish per angler day compared to 7.76 in 2006. CPUE ranged from 5.02 in week 20 (May 14-May 20) to a peak of 10.46 in week 39 (September 24-30) (Figure 17). Highest catch rates occurred during the last half of September and the first two weeks of October.

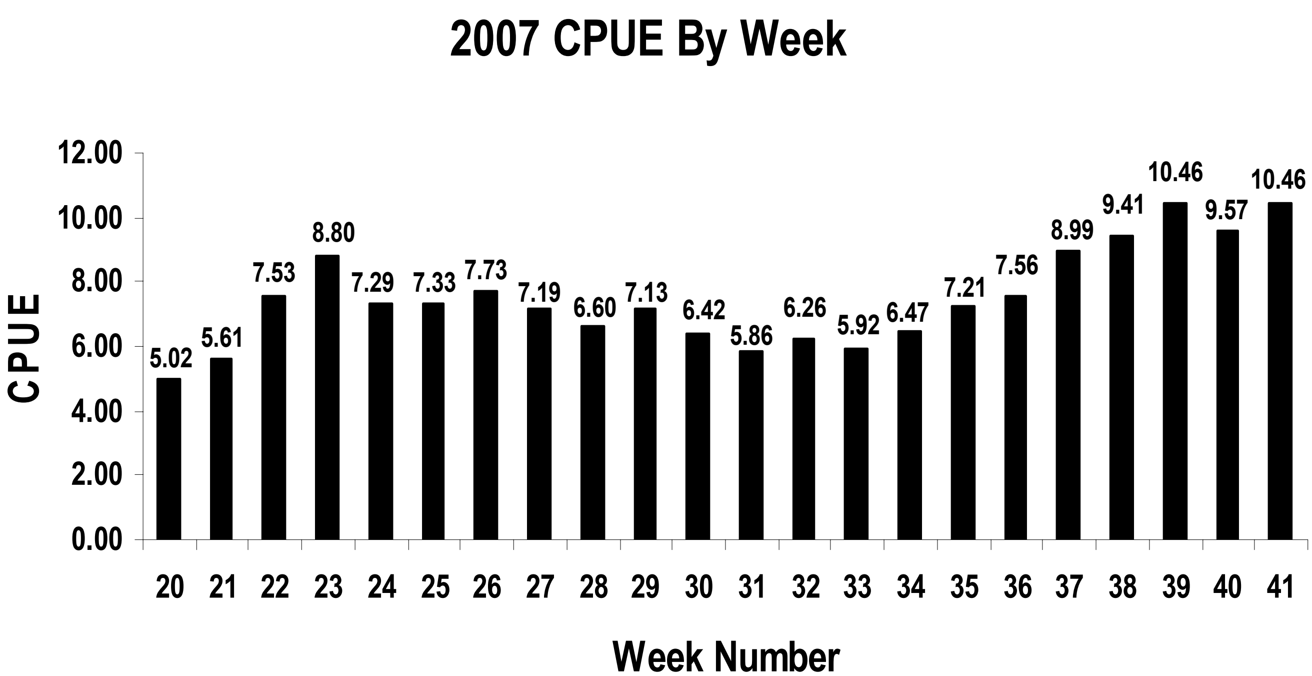


Figure 17. 2007 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Week.

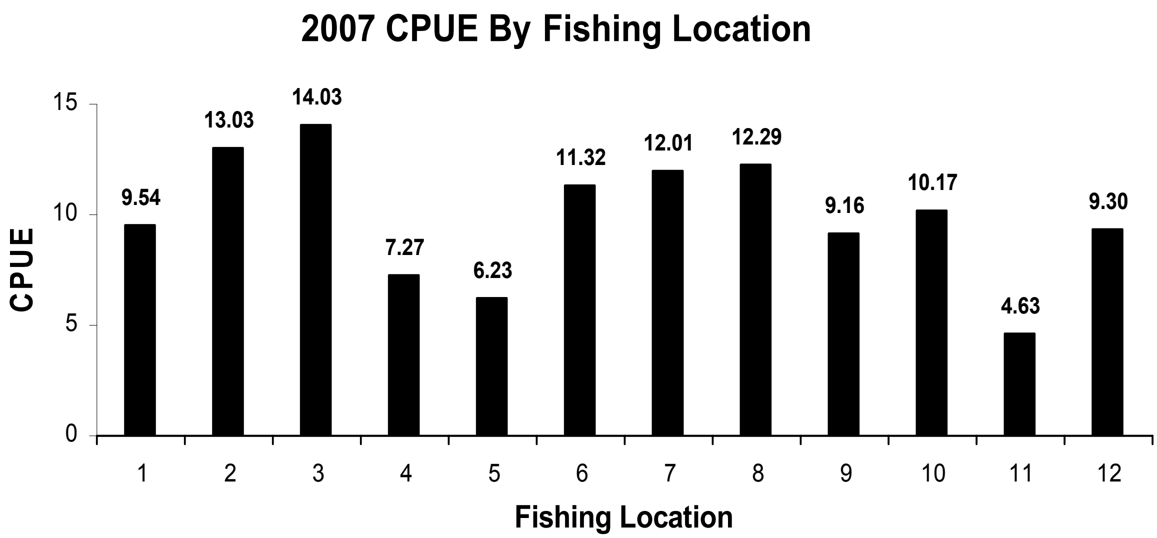


Figure 18. 2007 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Fishing Location.*
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake River to Priest Rapids Dam. Fishing Location Codes for the Snake River; 7 = Mouth of the Snake River to Ice Harbor Dam, 8 = Ice Harbor Reservoir, 9 = Lower Monumental Reservoir, 10 = Little Goose Reservoir, 11 = Lower Granite Dam to the mouth of the Clearwater River, 12 = Mouth of the Clearwater River to Hell's Canyon Dam.

CPUE by Fishing Location

Harvest rates for the 2007 NPSRF varied by Fishing Location and ranged from 4.63 fish per angler per day in fishing location 11 on the Snake River (Lower Granite Dam to the mouth of the Clearwater River), to 14.03 fish per angler day in Fishing Location 3, The Dalles Reservoir (Figure 18). The average CPUE by fishing location was 9.92 northern pikeminnow per angler day.

CPUE by Registration Station

The registration Station with the highest CPUE during the 2007 NPSRF was Giles French with 11.38 northern pikeminnow per angler day (Figure 19). The registration station with the lowest CPUE was the Bingen station with 3.82 northern pikeminnow per angler day. The station average for angler CPUE was 6.84. Seven of the 17 registration stations had higher CPUE during the 2007 NPSRF than they did in 2006. The Giles French station also had the largest change in CPUE with an increase from 6.92 in 2006 to 11.38 in 2007.

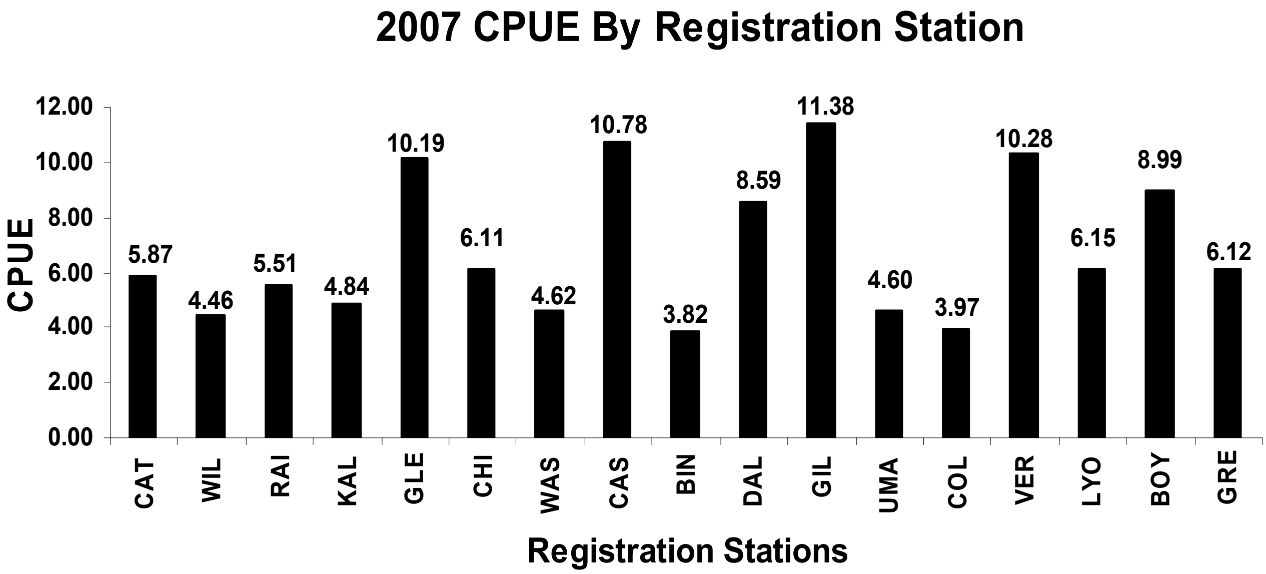


Figure 19. 2007 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Registration Station. CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, GLE-Gleason, CHI-Chinook, WAS-Washougal, CAS-Cascade Locks, BIN-Bingen, DAL-TheDalles, GIL-Giles French, UMA-Umatilla Marina, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, GRE-Greenbelt, BOY-Boyer Park.

Angler Totals

There were 3,814 separate anglers who participated in the 2007 NPSRF, a decline of more than 650 participants from 2006. One thousand, five hundred and forty one of these anglers (40%) were classified as "successful" since they harvested at least one reward size northern pikeminnow during the 2007 season. The average successful angler harvested 125 northern pikeminnow during the 2007 NPSRF, although when we break down the 1,541 successful anglers by tier, most anglers (82% = 1,264 anglers) harvested fewer than 100 northern pikeminnow and were classified as Tier 1 anglers (Figure 20). One hundred and fifty four anglers (10%) reached Tier 2 status by harvesting between 101 and 400 northern pikeminnow, and only eight percent of all NPSRF participants (123 anglers) reached the Tier 3 level by harvesting more than 400 northern pikeminnow in 2007. The number of anglers participating in the 2007 NPSRF was down at all three tier levels although the percentage of anglers at each tier level remained similar to previous years. The number of people at Tier one (<100 fish) declined by 325 anglers, while both Tier 2 and Tier 3 each lost 24 anglers.

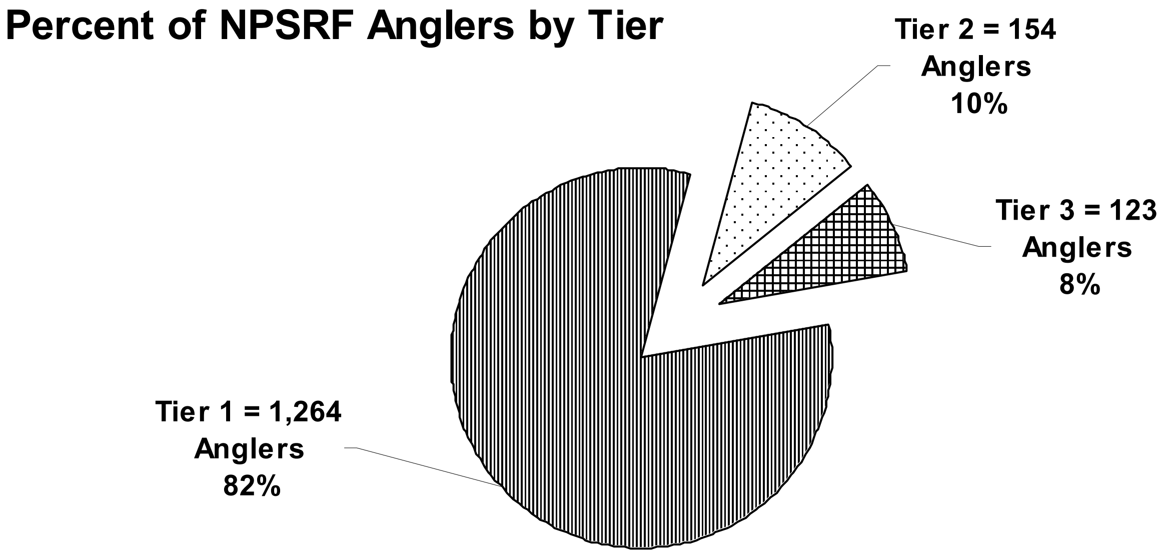


Figure 20. 2007 NPSRF Anglers by tier (returning only) based on total # of fish harvested.

While Tier 1 anglers made up more than 80% of all successful NPSRF participants in 2007, they only harvested an average of 13 fish per year accounting for only 9% (16,672 northern pikeminnow) of total NPSRF harvest (Figure 21). Tier 2 anglers harvested an average of 196 fish per year, equaling 16% (30,167 northern pikeminnow) of total 2007 NPSRF harvest. Tier 3 anglers, also known as "highliners", harvested an average of 1,184 fish per year equaling 75% (145,679 northern pikeminnow) of total 2007 NPSRF harvest. The harvest rates for both Tier 1 and Tier 3 anglers declined from 2006, while Tier 2 harvest rates improved.

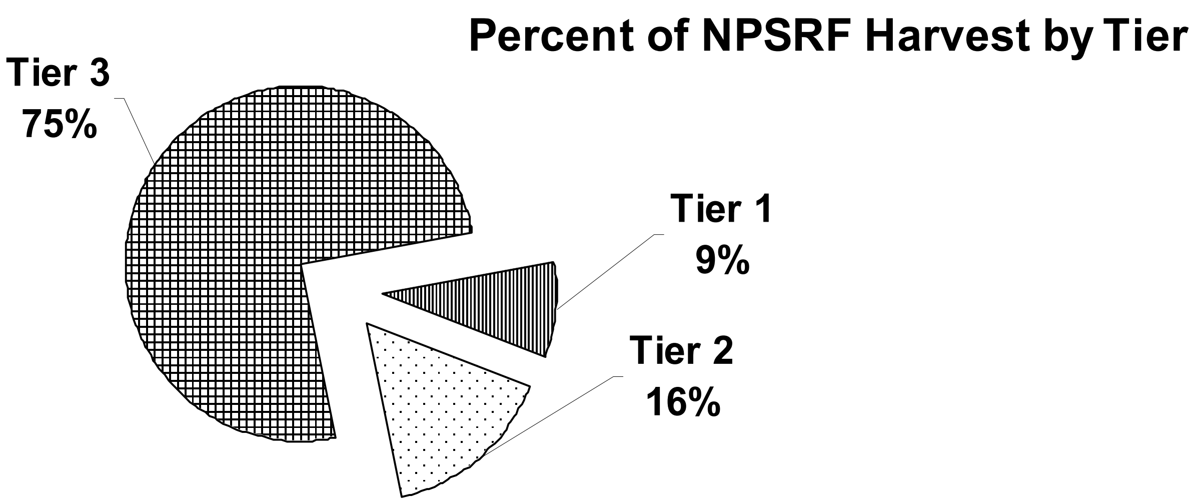


Figure 21. 2007 NPSRF Harvest by Angler Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400).

The average NPSRF participant expended the same amount of time (effort) pursuing northern pikeminnow during the 2007 season as in 2006 (7.1 angling days of effort). Tier 1 anglers spent the same average number of days fishing in the 2007 NPSRF (7 days) as in 2006 (Figure 22). Tier 2 anglers averaged three days more than in 2006 (35 days in 2007 versus 32 days in 2006). Tier 3 anglers increased their average number of days spent fishing during the 2007 NPSRF to 79 days (up from 78 days in 2006). This continues the trend seen in recent seasons where the NPSRF anglers who harvest the most fish (Tier 3 anglers), also expend the most effort.

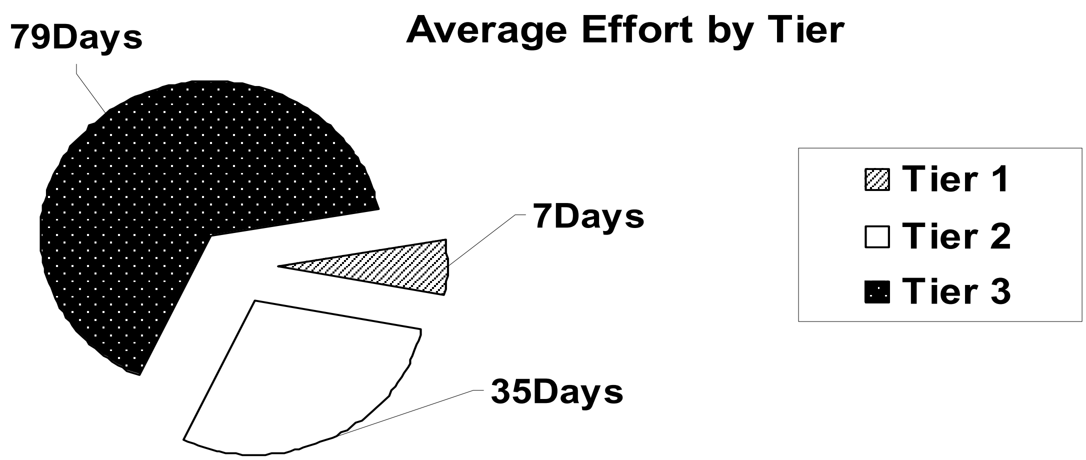


Figure 22. Average Effort of 2007 NPSRF Anglers by Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400) .

Just as overall angler CPUE for the 2007 NPSRF decreased from 2006, CPUE decreased slightly for all anglers at all tier levels (Figure 23). CPUE for anglers at Tier 1 decreased from 2.16 in 2006 to 2.00 in 2007, CPUE for Tier 2 anglers decreased from 5.87 in 2006 to 5.62 in 2007, and CPUE for Tier 3 anglers declined from 15.52 in 2006 to 14.95 in 2007 (Figure 23).

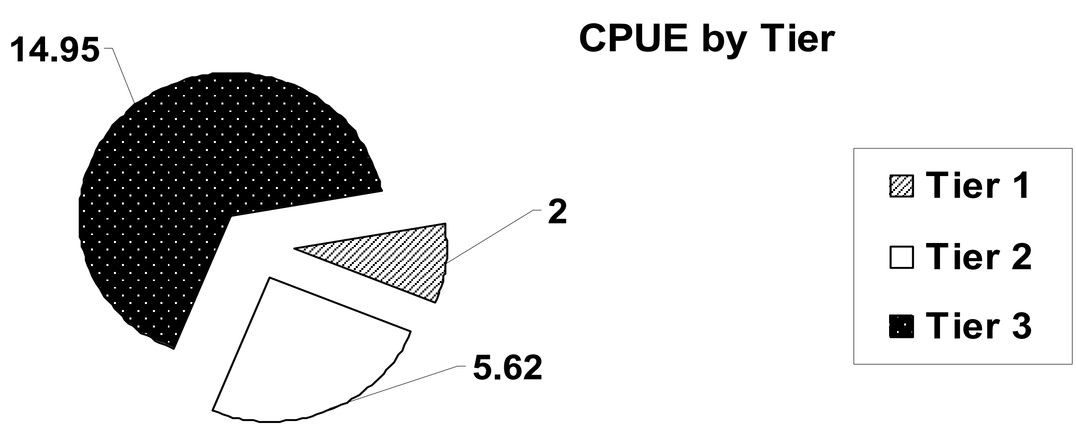


Figure 23. Average CPUE of 2007 NPSRF Anglers by Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400).

The top angler (based on number of fish caught) for the 2007 NPSRF harvested 5,778 NPM worth an estimated $46,400. This total included 3 spaghetti tagged northern pikeminnow and was 187 more fish than the number two angler harvested. It was also only 47 more fish than last years top angler harvest of 5,731 northern pikeminnow. The number two angler actually made more money than the top angler by harvest because he caught 8 spaghetti tagged northern pikeminnow for a total of $47,364. The CPUE for this year's top angler was 57.2 fish per day (up from the 2006 top angler's CPUE of 43.4), and he spent 101 angler days of effort during the 2007 season (versus 132 days by the top angler in 2006). By comparison, the two anglers who participated the most in 2007 each fished 152 days and harvested 948 and 183 northern pikeminnow.

Tag Recovery

Northern Pikeminnow Tags

Returning anglers harvested 170 northern pikeminnow tagged by ODFW with external spaghetti tags during the 2007 NPSRF for which the NPSRF paid $500 each to the anglers who caught them. This compares to 177 spaghetti tags paid in 2006 (Winther et al., 2006). Of these spaghetti tagged northern pikeminnow, 164 had also been PIT tagged by ODFW as a secondary mark. WDFW technicians recovered an additional 108 northern pikeminnow having PIT tags with wounds and/or fin-clips indicating that the fish had "lost" an ODFW spaghetti tag. The recovered spaghetti and PIT tags, as well as the potential tag loss data was estimated by ODFW to equal a 17.8% exploitation rate for the 2007 NPSRF (ODFW, personal communication).

Ingested Tags

A total of 192,518 northern pikeminnow were individually scanned for the presence of PIT tags. This represents 100% of the total harvest of reward-size fish for the 2007 NPSRF (northern pikeminnow not qualifying for rewards were also scanned whenever possible). We recovered a total of 102 PIT tags from consumed smolts that had been ingested by northern pikeminnow harvested during the 2007 NPSRF, an overall occurrence ratio of 1:1,887. This total is 66 less than the number of recoveries during the 2006 NPSRF (Winther et al., 2006). PIT tag recoveries of salmonid smolts ingested by northern pikeminnow peaked during the first week of the 2007 season (May 14-20), declining after that until late June when recoveries briefly edged upwards. As in previous years, recoveries of PIT tags from ingested smolts ended by August (8/5/07) (Figure 24).

Pit tag recoveries by fishing location showed that northern pikeminnow harvested from The Dalles Pool (fishing location 03) during the 2007 NPSRF, had ingested the largest number of salmonid smolts containing PIT tags (Figure 25). This is a change from 2006 when the highest number of recoveries came from the Bonneville Pool (fishing location 02). It is also of note that fishing location 09 (Lower Monumental Pool) had a large increase in the number of PIT tag recoveries from ingested smolts, more than doubling the 2006 total.

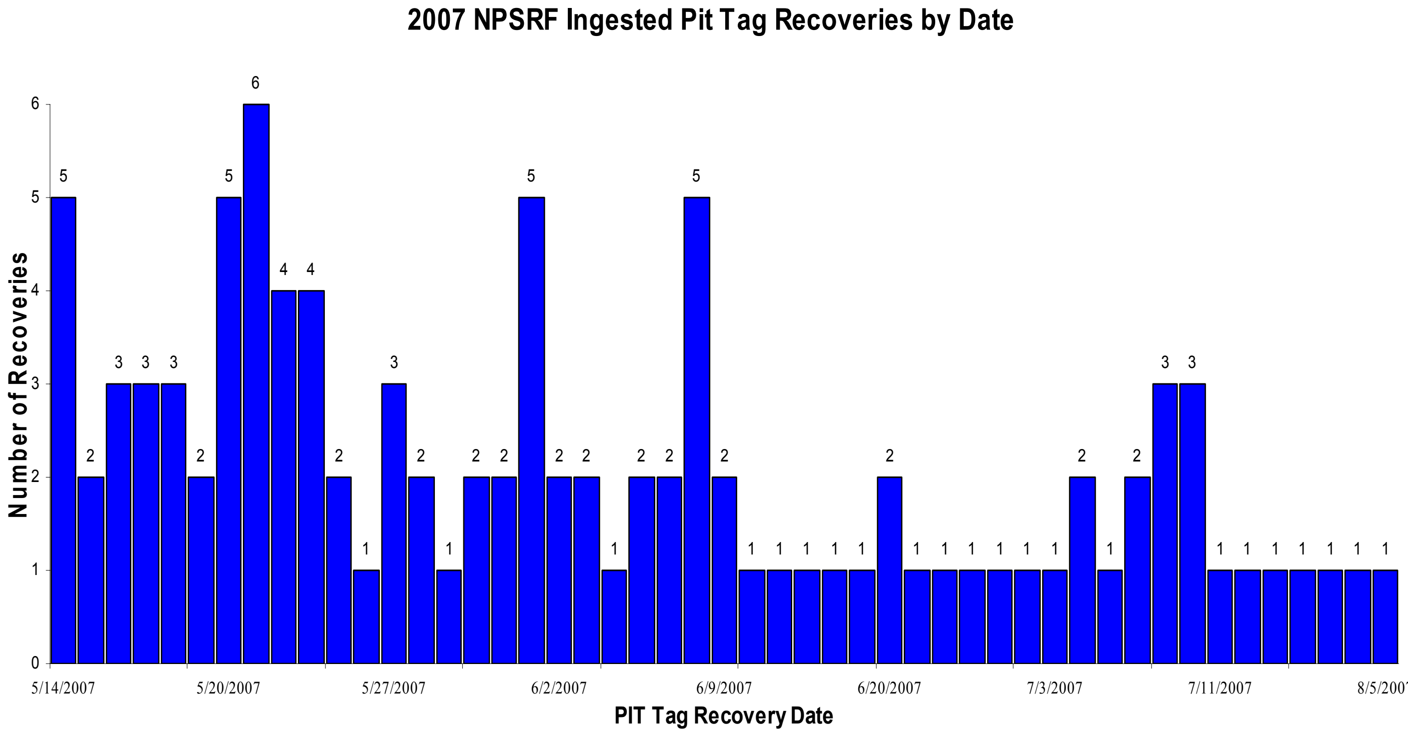


Figure 24. 2007 NPSRF PIT Tag Recoveries by Date.

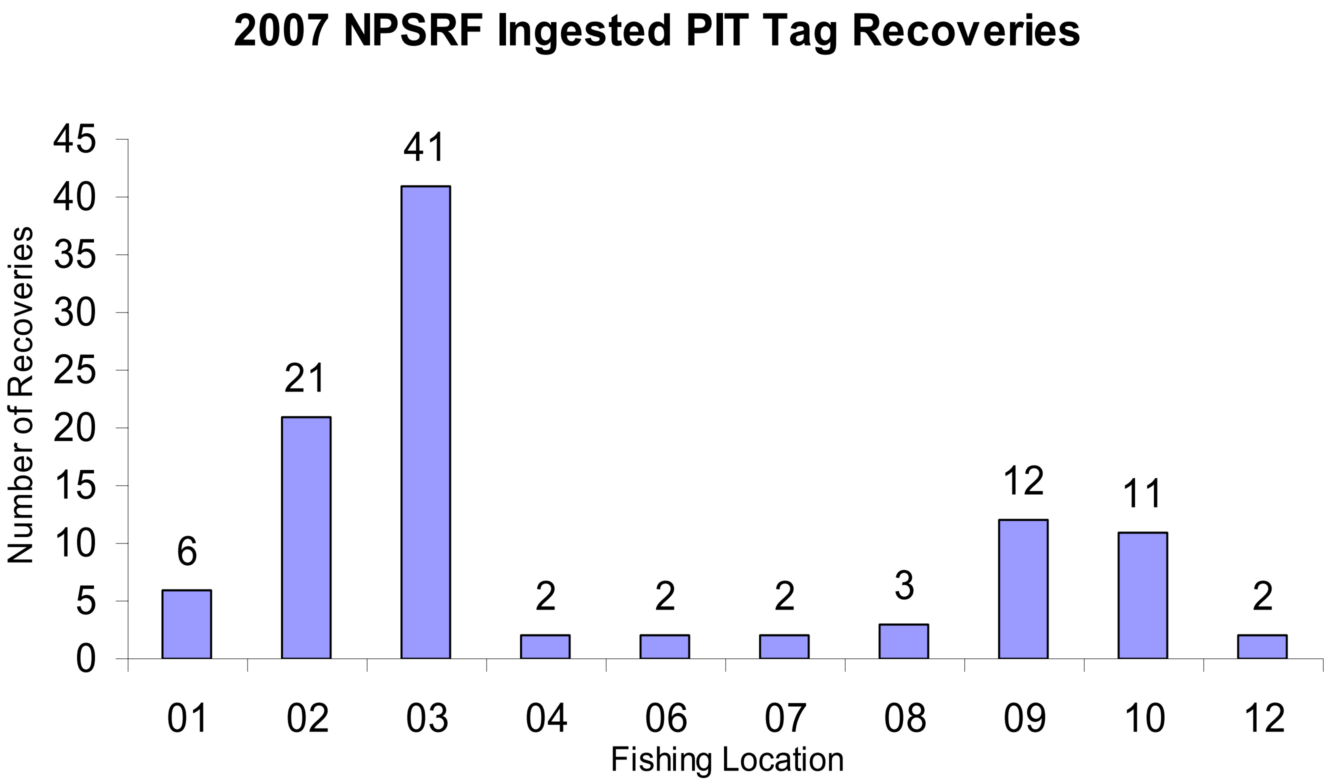


Figure 25. 2007 NPSRF ingested PIT Tag Recoveries by Fishing Location

All 102 PIT tag recoveries from ingested smolts were queried through the PTAGIS database and those queries yielded the following results. The mean fork length of smolts consumed by northern pikeminnow harvested during the 2007 NPSRF (based on FL at release from PTAGIS) was 111.46, considerably larger than the 2006 mean of 89.47 mm, and also larger than the 2005 mean of 100.17 mm. Mean fork length for northern pikeminnow found with ingested PIT tags from salmonid smolts was 361.6 mm, also larger than the mean for 2006 (352.9 mm). The mean fork length of northern pikeminnow found to have consumed PIT tagged smolts during the 20076 NPSRF was once again much larger than the overall mean fork length for all reward-size northern pikeminnow harvested during the 2007 NPSRF (290.4 mm).

Species composition of PIT tagged smolts recovered from northern pikeminnow harvested in the 2007 NPSRF indicated that they were overwhelmingly chinook smolts (primarily fall chinook) (Figure 26). 90 of the 102 ingested PIT tag recoveries (88%) were from chinook smolts, 4 (4%) were from steelhead smolts, 3 (3%) were from coho smolts, 2 from sockeye smolts (2%) and 3 PIT tags were listed as “not given species” in PTAGIS accounting for the remaining 3%. PIT tag queries of PTAGIS also indicated that 8 of the 90 chinook smolts (8.89%) were of wild origin, 1 of the 4 PIT tagged steelhead (25%) were of wild origin, and 1 of the 2 sockeye smolts (50%) was of wild origin.

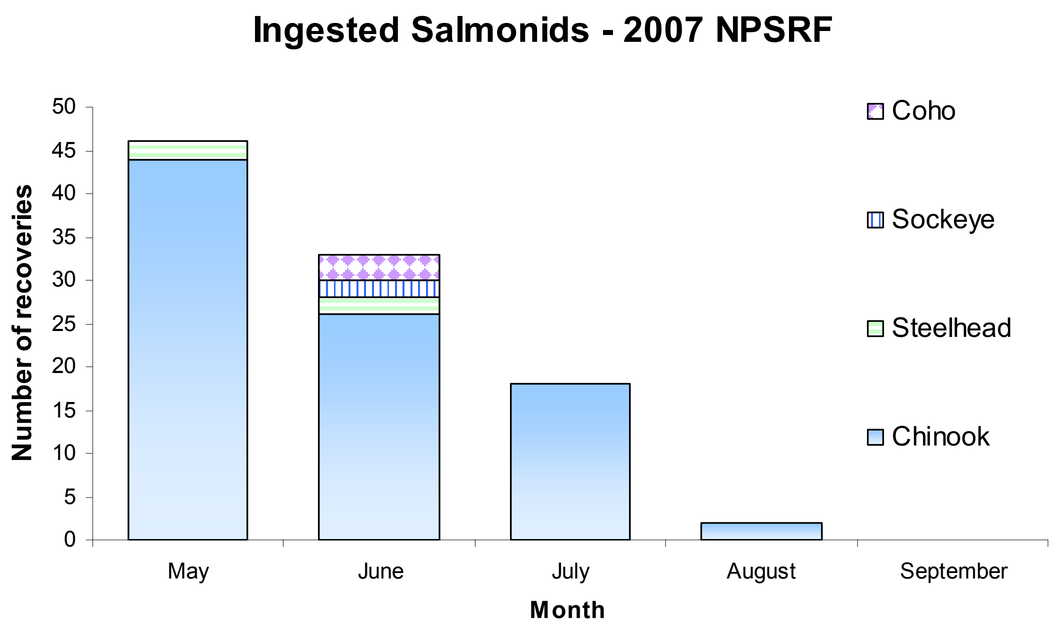


Figure 26. Recoveries of ingested salmonid PIT Tags from the 2007 NPSRF.

Analysis of PIT tag recovery data from the 2007 NPSRF continues to document northern pikeminnow predation on downstream migrating juvenile salmonids, mainly Chinook salmon and primarily fall Chinook salmon. Our PIT tag recovery data also confirms that northern pikeminnow consume smolts (including Snake River fish) most heavily during the peak smolt migration month of May, and ending in August. Further data collection and analysis of PIT tag recoveries from juvenile salmonids consumed by northern pikeminnow harvested in the NPSRF may lead to a better understanding of northern pikeminnow predation on salmonid smolts and the factors affecting the vulnerability of smolts to predation while migrating through the Columbia River System.

SUMMARY

Despite starting the 2007 season two weeks later than usual, strong early season harvest, a solid overall season, and a two week extension resulted in an above average NPSRF season which harvested nearly 200,000 fish. The 2007 NPSRF also succeeded in reaching the NPMP's 10-20% exploitation goal for the tenth consecutive year, achieving an estimated exploitation rate of 17.8%. While harvest was down from last year, it was still comparable to high NPSRF harvest levels recorded since the NPMP began aggressively increasing rewards in 2001. Effort declined by 4,769 angler days from 2006 and the number of different individuals participating declined by 654 people. Angler CPUE did not change much from 2006, but was slightly lower for all anglers (regardless of tier level), indicating poorer fishing conditions. Since participation peaked in the first week of the season and weekly harvest exceeded 10,000 fish, it is probable that an earlier start date for the 2007 NPSRF would have greatly boosted the season's harvest and effort totals. We estimate that perhaps as many as 3,000-4,000 angler days of effort, and 15,000-20,000 northern pikeminnow (based on early season effort and harvest rates) may have been lost with the two week late start date.

The NPSRF's top angler caught more northern pikeminnow in 2007 that the top angler from 2006, although he did not earn as much in reward money (the top angler in 2006 had more tagged fish worth $500). The top angler participated less in 2007 than in 2006 and also thus had higher CPUE, contrary to the overall trend, but consistent with the pattern of increasing angling effectiveness observed in highliner anglers. Successful anglers caught an average of 3 more fish per year in 2007 than in 2006, and also fished more days. In the end, the increased effort expended by the NPSRF's most proficient anglers (Tiers 2 & 3) was able to compensate for a two week later start date and slightly poorer fishing (CPUE) and achieve the 2007 NPSRF's estimated 17% exploitation rate.

Detection of PIT tags from juvenile salmonids ingested and retained in the gut of northern pikeminnow, continues to yield valuable data about northern pikeminnow predation on juvenile salmonid smolts. We recovered less PIT tags than last year with peak recoveries occurring in the typical late May and early June period. Species composition of PIT tag recoveries from ingested juvenile salmonids showed that the majority of predation was on chinook smolts, mostly of hatchery origin. We also recovered PIT tags from steelhead, coho, and two sockeye smolts consumed by northern pikeminnow. Use of PIT tags by ODFW as a secondary mark in spaghetti tagged northern pikeminnow continues to go smoothly and we look forward more accurate estimates of tag loss and overall pikeminnow exploitation by the NPSRF. PIT tag recoveries also continued to be monitored to identify and document angler fraud from northern pikeminnow tagged outside NPSRF boundaries.

RECOMMENDATIONS FOR THE 2008 SEASON

1.) Begin implementation of the 2008 NPSRF for all registration stations on May 5th in order to maximize predation reduction by beginning removals earlier in the period of smolt outmigration.

2.) Adjust registration station locations and times as needed, adjusting to the dynamics of the fishery and fishery participants, in order to increase angler participation and/ or NPSRF efficiency.

3.) Review NPSRF Rules of participation as needed, adjusting to the dynamics of the fishery and fishery participants, in order to maintain NPSRF integrity.

4.) Develop angler education materials designed to recruit new anglers to NPSRF, and to improve the angling efficiency of current participants in order to achieve the NPMP's 10-20% exploitation goal.

5.) Retain the option to extend the NPSRF season on a site-specific basis if warranted by high harvest, angler effort, and/or CPUE levels.

6.) Continue to scan all northern pikeminnow for PIT tags from ingested juvenile salmonids, from northern pikeminnow tagged by ODFW as part of the biological evaluation of the NPMP, and as a way to deter fraud by identifying fish from outside NPSRF boundaries.

7.) Survey 20% of non-returning anglers to record total non-returning angler catch of all salmonids to estimate total non-returning angler catch and harvest per NPMP protocol.

8.) Continue to investigate additional incentives for anglers to harvest northern pikeminnow from within NPSRF boundaries, i.e., spaghetti tagged fish.

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Report B

Northern Pikeminnow Sport Reward Payments – 2007

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March, 2008

INTRODUCTION

The **Northern Pikeminnow Predator Control Program** was administered by PSMFC in 2007. The program is a joint effort between the fishery agencies of the states of Washington and Oregon, and the Pacific States Marine Fisheries Commission (PSMFC). Washington ran the sport-reward registration/creel check stations throughout the river and handled all fish checked in to the program. Oregon provided fish tagging services, population studies, food habit and reproductive studies, as well as exploitation rate estimates. PSMFC provided technical administration, fiscal, and contractual oversight for all segments of the program and processed all reward vouchers for the sport-reward anglers.

CATCH AND PAYMENTS

In 2007 a total of 191,154 fish were harvested in the sport-reward fishery. Of this total 170 were tagged fish and 190,984 were untagged. Vouchers for 190,870 of the untagged fish were submitted for payment totaling rewards of $1,200,971. Rewards were paid at $4 for the first 100 fish caught during the season, $5 for fish in the 101-400 range, and $8 for all fish caught by an angler above 400 fish. PSMFC maintained an accounting system during the season to determine the appropriate reward amount due each angler for particular fish. A total of 1,177 anglers who registered were successful in catching one or more fish in 2007. The 2007 season ran from May 14, 2007 through October 14, 2007.

TAGGED FISH PAYMENTS

A total of 170 tagged fish were caught. Anglers were issued a special tagged fish voucher for all tagged fish brought to the registration station. The tag voucher was then sent in with the tag for verification and payment of the special $500 tagged fish reward. All 170 tagged vouchers were submitted for payment This resulted in tag reward payments of $85,000 in addition to the regular reward payments above.

ACCOUNTING

Total payments for the season of regular vouchers and tagged fish, totaled $1,285,971. All IRS Form 1099 Mis. Statements were sent to the qualifying anglers for tax purposes in the third week of January, 2008. Appropriate reports and copies were provided to the IRS by the end of February, 2008.

A summary of the catch and rewards paid is provided in Table 1. For further information contact Russell Porter, PSMFC, Field Programs Administrator at (503) 595-3100 or email at: russell_porter@psmfc.org.

Table 1. 2007 SPORT REWARD PAYMENTS SUMMARY

The following is a summary of the vouchers received and paid as of December 6, 2007

	Fish	$ Paid
Fish paid @ tier 1 ($4.00 each):	42,660	$170,640
Fish paid @ tier 2 ($5.00 each):	51,783	$258,915
Fish paid @ tier 3 ($8.00 each):	96,427	$771,416
Tags paid (@ $500.00 each):	170	$85,000
Total:	**191,040**	**$1,285,971**

Anglers @ tier 1	902
Anglers @ tier 2	152
Anglers @ tier 3	123
Number of separate anglers	1,177

Anglers with 10 fish or less:	533
Anglers with 2 fish or less:	210

	Top Twenty Anglers *	TIER 1	TIER 2	TIER 3	TAGS	TOTAL FISH	BAL
1.	ZAREMSKIY, NIKOLAY N	100	300	5,375	3	5,778	$46,400
2.	VASILCHUK, DAVID R	100	300	5,183	8	5,591	$47,364
3.	HISTAND,TIMOTHY L	100	300	3,985	5	4,390	$36,280
4.	WILLIAMS, EDWARD R	100	300	3,166	1	3,567	$27,728
5.	VASILCHUK, IVAN R	100	300	3,053	11	3,464	$31,824
6.	BROWN, JOHN G	100	300	3,034	4	3,438	$28,172
7.	PAPST,THOMAS H	100	300	2,992	3	3,395	$27,336
8.	ORLOVSKIY, VIKTOR M	100	300	2,594	0	2,994	$22,652
9.	ZAGORODNY, IOSIF P	100	300	2,290	1	2,691	$20,720
10.	MILLER, EARL D	100	300	1,873	3	2,276	$18,384
11.	GLASPIE, ROBERT R	100	300	1,785	0	2,185	$16,180
12.	LEVCHENKOV, VASILIY G	100	300	1,754	0	2,154	$15,932
13.	SMITH, LARRY L	100	300	1,623	1	2,024	$15,384
14.	KEILWITZ,DANIEL D	100	300	1,624	0	2,024	$14,892
15.	CAGLE, CARL D	100	300	1,561	2	1,963	$15,388
16.	GEIGER, DANIEL J	100	300	1,559	1	1,960	$14,872
17.	WEBER, STEVEN A	100	300	1,451	0	1,851	$13,508
18.	MUCK,JAMES E	100	300	1,369	0	1,769	$12,852
19.	JONES, JOHN A	100	300	1,367	0	1,767	$12,836
20.	OLIVER, BRUCE	100	300	1,348	1	1,749	$13,184
	* (by total fish caught)	2,000	6,000	48,986	44	57,030	$451,888

Report C

Development of a System-wide Predator Control Program: Indexing and Fisheries Evaluation

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Summary

The Northern Pikeminnow Management Program (NPMP), a fishery aimed at reducing predation on juvenile salmonids by northern pikeminnow *Ptychocheilus oregonensis*, was implemented for the 17th consecutive year in the mainstem Columbia and Snake rivers. We report on (1) northern pikeminnow exploitation rates, predation estimates, and spaghetti tag loss rates, (2) population parameters of northern pikeminnow, smallmouth bass *Micropterus dolomieu*, and walleye *Sander vitreus* in four Snake River reservoirs (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite), and (3) possible compensatory responses by these species.

To evaluate exploitation, we tagged and released 575 northern pikeminnow ≥ 200 mm fork length (FL) throughout the lower Columbia and Snake rivers in 2007. Of these, 469 were ≥ 250 mm FL. System-wide exploitation of northern pikeminnow ≥ 200 mm FL by the sport-reward fishery was 15.3% (95% confidence bounds 11.6% - 19.0%), which incorporated a tag loss estimate of 5.0%. Sport-reward exploitation of fish ≥ 250 mm FL was 17.8% (13.4% - 22.3%), the third highest exploitation rate since program inception. Based on sport-reward exploitation rates and using our current model, we estimated that 2007 predation levels were 37% (21% - 54%) lower than pre-program levels.

We continued biological indexing in the lower Snake River as part of our predator community evaluation. Northern pikeminnow abundance indices are low in the Snake River reservoirs, and 2007 was the lowest observed to date. Although 28% of northern pikeminnow stomachs were empty, 21% contained identifiable fish remains, of which 64% were identified as juvenile salmonids. While the stomach analysis shows that consumption of juvenile salmonids by northern pikeminnow does occur, our sample sizes were inadequate to calculate a consumption index in the majority of the areas we sampled. Predation indices were similar to or lower than previous years. Relative weight of northern pikeminnow in the four lower Snake River Reservoirs has fluctuated since initial sampling in 1991 with a slight increasing trend. Year-class analysis indicated that northern pikeminnow in the lower Snake River may be getting younger, with the proportion of the population consisting of age-3 fish substantially higher then when initially sampled in 1991. Although this is a desired outcome of the removal program, whether it can be attributed to the NPMP is unclear.

Smallmouth bass relative densities in the lower Snake River reservoirs have fluctuated over the past 15 years, while northern pikeminnow abundance has declined. Relative weights for smallmouth bass have increased over the same time period. Smallmouth bass proportional stock density (PSD) and relative stock density (RSD-P) in the lower Snake River reservoirs indicate potentially unstable populations with higher than optimal recruitment to the stock. Smallmouth bass consumption and predation indices were generally low and stable, with salmonid predation highest in the middle of Ice Harbor Reservoir. Juvenile salmonids were found in 23% of the samples that contained identifiable fish remains; however *Cottus* spp. was most commonly consumed by smallmouth bass.

This is the second year walleye have been captured during indexing in the Snake River reservoirs since the program began. Both occurrences were in the Lower Monumental Reservoir indicating the walleye population may be increasing. Compared to smallmouth bass, walleye stomachs contained a higher proportion of juvenile salmonids, but not as high as northern pikeminnow. Walleye abundance is low compared to northern pikeminnow and smallmouth bass.

Although there are some signs of possible compensation by predators to the sustained removal of northern pikeminnow by the NPMP, the indicators are localized, and other density- independent factors can have similar effects. At this time, there does not appear to be a system-wide predator response to the removal program; however, continued monitoring is necessary to assess potential long-term impacts of localized changes.

Introduction

The Columbia and Snake rivers once supported large numbers of anadromous salmonids *Oncorhynchus* spp. Declines in adult returns have been attributed to many factors, including habitat degradation and overexploitation (Nehlsen et al. 1991; Wismar et al. 1994), hydroelectric and flood control activities during the 1970s (Raymond 1988), and predation (Rieman et al. 1991; Collis et al. 2002). The mean annual loss of juvenile salmonids to predators can be equivalent to mortality associated with dam passage (Rieman et al. 1991), which in the past could approach 30% at a single dam (Long and Ossiander 1974). The Northern Pikeminnow Management Program (NPMP) is a set of targeted fisheries aimed at reducing predation on juvenile salmonids by northern pikeminnow *Ptychocheilus oregonensis* in the lower Columbia and Snake rivers (Rieman and Beamesderfer 1990; Beamesderfer et al. 1996). The Oregon Department of Fish and Wildlife (ODFW) established baseline levels of predation and northern pikeminnow population characteristics prior to the implementation of the northern pikeminnow fisheries. Abundance, consumption, and predation were estimated in Columbia River reservoirs in 1990 and 1993, Snake River reservoirs in 1991, and the unimpounded lower Columbia River downstream from Bonneville Dam in 1992 (Ward et al. 1995). We continue sampling the northern pikeminnow populations in standardized areas, and made comparisons among years when there were adequate sample sizes (Zimmerman and Ward 1999; Zimmerman et al. 2000; Jones et al. 2005). In addition we increased sampling in 2007 to include sections of Ice Harbor, Lower Monumental, and Little Goose reservoirs that had not been sampled since the baselines were established (Appendix Table A-1). This report describes our activities and findings for 2007, and wherever possible, evaluates changes from previous years.

Our objectives in 2007 were to (1) evaluate northern pikeminnow exploitation, potential predation, and tag loss, (2) define population parameters of northern pikeminnow, smallmouth bass *Micropterus dolomieu*, and walleye *Sander vitreus* in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs, and (3) look for possible compensatory responses by these species.

Objective (1) was modified in 2006 to include evaluation of a dam-angling fishery at Bonneville and The Dalles dams. The tag loss and an age validation portion of objective (1) were implemented in 2000 based on recommendations from an independent review of the NPMP (Hankin and Richards 2000). We continue to evaluate tag loss; however we discontinued the age validation portion in 2007. We conducted the age validation evaluation from 2000-2006 and we hope to report the results in a journal article this year. Objectives (2) and (3) are a continuation of population monitoring studies conducted in 1990-1996, 1999, and 2004-2005.

Methods

Fishery Evaluation, Predation Estimates, and Tag Loss

Field Procedures.—The Washington Department of Fish and Wildlife (WDFW) administered the sport-reward fishery from 14 May to 15 October 2007 throughout the lower Columbia and Snake rivers. Participating anglers received payment for northern pikeminnow ≥ 230 mm (9 inches) total length (TL). This size limit is approximately equivalent to 200 mm fork length (FL). The payment schedule for 2007 consisted of three tiers: US$4 per fish for "Tier 1" anglers (<100 fish caught), $5 per fish for "Tier 2" anglers (100-400 fish caught), and $8 per fish for "Tier 3" anglers (>400 fish caught) (WDFW 2007). Rewards for spaghetti-tagged fish remained at $500.

The U.S. Department of Agriculture (USDA) Wildlife Services Division conducted dam-angling fisheries at The Dalles and John Day dams from 14 May to 28 August 2007. This was a removal fishery designed to further decrease predation in the immediate tailrace area of the dams. To collect biological data from northern pikeminnow caught in this fishery, we sub-sampled the dam-angling catch twice weekly between May and August.

We tagged and released northern pikeminnow ≥ 200 mm FL with uniquely numbered spaghetti tags to estimate exploitation rates for the sport-reward and dam-angling fisheries. To evaluate spaghetti tag retention, we also injected a passive integrated transponder (PIT) tag into the dorsal sinus of all spaghetti-tagged fish. We used electrofishing boats to collect northern pikeminnow from 22 March to 22 June 2007 (detailed methods are given in Friesen and Ward 1999). Though we attempted to allocate equal sampling effort in all river kilometers (rkm), some deviation was necessary due to sampling logistics and river flow in the Hanford Reach of the Columbia River and in the Snake River near Asotin, Washington. We sampled in the Columbia River from rkm 76 (near Clatskanie, Oregon) upstream to rkm 639 (Priest Rapids Dam) and in the Snake River from rkm 112 (Little Goose Dam) to rkm 248 (Figure 1).

We completed northern pikeminnow tagging below Bonneville Dam and in Bonneville, The Dalles, and Little Goose reservoirs before the start of the sport-reward fishery. Tagging operations ran concurrently with the fishery in John Day, McNary, and Lower Granite reservoirs.

Data Analysis.—We used mark-and-recapture data to compare exploitation rates of northern pikeminnow ≥ 200 mm FL, 200-249 mm FL, and ≥ 250 mm FL among reservoirs. In areas where tagging was completed prior to the start of the fishery, we used a simple Peterson method (Ricker 1975) to calculate annual exploitation rates. This is given by the equation

$$u = R/M,$$

where

u = annual exploitation estimate,
M = the number of fish that are tagged in a season, and
R = the number of tagged fish that are recaptured in a season.

z = the multiplier from the standard normal distribution,
M = the number of fish that are tagged in a season, and

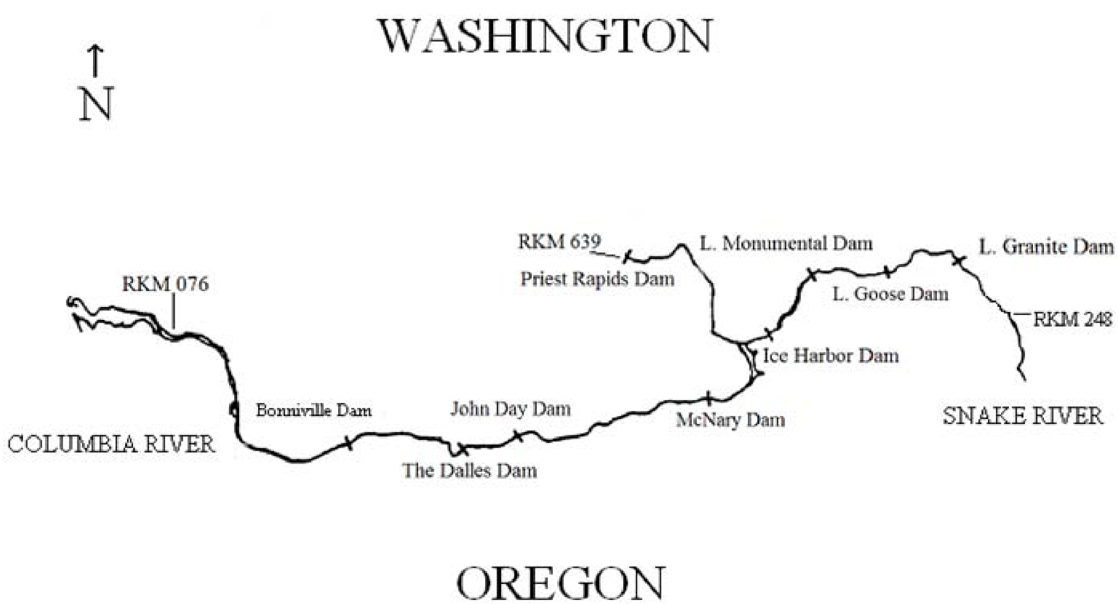

FIGURE 1.—The lower Columbia and Snake rivers. Northern pikeminnow were tagged from river kilometer (rkm) 76 to Priest Rapids Dam in the lower Columbia River and from Little Goose Dam forebay to rkm 248 on the Snake River. Biological indexing was conducted in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs during the spring and summer of 2007.

We calculated 95% confidence intervals for exploitation estimates using the formula

$$(R \pm z^*R^{0.5})/M,$$

where

R = the number of tagged fish that are recaptured in a season (Styer 2003).

We calculated multi-year exploitation rates in 2007 from 2003 – 2007 PIT tag return data for the area below Bonneville Dam and in Bonneville Reservoir. We used a variable survival method (Everhart and Youngs 1981) to calculate multi-year exploitation rates for northern pikeminnow ≥ 200 mm FL. This is given by the equation

$$f_i = R_i/M_i * C_i/T_i ,$$

where

f_i = the minimum estimate of exploitation in year i,
M_i = the number of fish that are tagged in year i,
R_i = the total number of recaptures from a particular tagging release,
C_i = the total number of fish that are recaptured in any particular sample year,
and
$T_i = T_{i-1} + R_i - C_{i-1}$ where $T_1 \equiv R_1$.

We used a multiple sample approach to compute exploitation rates in areas where tagging and fishing occurred concurrently (Styer 2003). Weekly estimates of exploitation were calculated by dividing the number of tagged northern pikeminnow recovered by the number of tagged fish at-large. We then summed the weekly exploitation rates to yield total exploitation rates for the season (Styer 2003).

We calculated 95% confidence intervals for exploitation estimates obtained by the multiple sample method by using the formula

$$u \pm t(k^*s)^{0.5},$$

where

u = the annual exploitation estimate,
t = the multiplier from the Student's t-distribution,
k = the number of weeks in the fishing season, and
s = the standard deviation of the weekly exploitation estimates (Styer 2003).

We did not calculate exploitation rates for areas where the number of recaptures was less than four (Styer 2003), and exploitation estimates from previous years where fewer than four tags were recovered were excluded from this report. We adjusted exploitation estimates and confidence intervals for tag loss. An annual tag loss estimate was calculated using the formula

$$L = [m / (m + r)] * 100,$$

where

L = tag loss rate,
m = the number of northern pikeminnow recaptured with a secondary mark (PIT tag)
and no spaghetti tag, and
r = the number of northern pikeminnow recaptured with year 2007 spaghetti tags intact.

We used a model based on Friesen and Ward (1999), updated to include fork length increments with measured growth instead of age increments and estimated growth, to estimate predation on juvenile salmonids relative to predation prior to implementation of the NPMP. The model incorporates size-specific exploitation rates on northern pikeminnow and resulting changes in size structure to estimate changes in predation. We used a 10-year "average" age structure (based on catch curves) for a pre-exploitation base, and assumed constant recruitment. We changed the age increments to fork length increments by using the same starting and stopping points and basing the length interval on measured annual growth calculated from mark and recapture information. Size-specific consumption was incorporated; however, potential changes in consumption, growth, and fecundity due to removals were not considered likely (Knutsen and Ward 1999). The model therefore estimates changes in potential predation related directly to removals, allowing us to estimate the effects of removals if all variables except exploitation were held constant. We estimated the potential relative predation in 2007 based on observed exploitation rates and the eventual minimum potential predation assuming continuing exploitation at mean levels from recent years.

To explore the effect of river flow on northern pikeminnow harvest, we plotted the log transformed annual (1995 - 2007) system-wide sport-reward exploitation rate for fish ≥ 250 mm FL versus mean Columbia River stage below Bonneville Dam (site number 14128870; USGS 2007) for the period May – September (May – October since 2006). Additionally, because the reward structure of the sport-reward fishery has been modified to increase effort and catch in recent years, we also analyzed two reward structure variables (pay at the Tier 3 level and the number of Tier 3 anglers) to determine their effects on system-wide exploitation rates for northern pikeminnow ≥ 250 mm FL during 2000-2007. We used both simple linear and multiple linear regressions of these variables as well as t-tests to conduct this analysis.

Biological Evaluation

Field Procedures.—We used standardized electrofishing to evaluate changes in northern pikeminnow and smallmouth bass relative abundance, consumption and predation indices, population size and age structure, condition, and feeding habits. We also analyzed relative abundance, population size and age structure, condition, and feeding habits of walleye. Biological data were collected in spring (7 - 25 May) and summer (25 June - 17 July) 2007 in Ice Harbor Dam forebay (rkm 16-23), Ice Harbor mid-reservoir (rkm 28-39), Lower Monumental Dam tailrace (rkm 60-67), Lower Monumental Dam forebay (rkm 67-72), Lower Monumental mid-reservoir (rkm 387-394), Little Goose Dam tailrace (rkm 105-112), Little Goose Dam forebay (rkm 112-120), Little Goose mid-reservoir (rkm 128-136), Lower Granite Dam tailrace (rkm 165-172), and Lower Granite upper-reservoir (rkm 219-228) (Figure 1). Sampling methods and gear specifications have been previously described (Ward et al. 1995; Zimmerman and Ward 1999).

We recorded biological data from all northern pikeminnow, smallmouth bass, and walleye collected by electrofishing. We measured all fish collected (mm FL) and recorded total body weight (g) from fish ≥ 200 mm. We collected scales in each reservoir we sampled from 25 smallmouth bass per 25 mm FL size increment, and from all northern pikeminnow and walleye. In addition, northern pikeminnow ≥ 425 mm FL and walleye scales collected during tagging operations in 2006 were used to supplement those collected during the indexing season. We collected and preserved digestive tract contents from northern pikeminnow, smallmouth bass, and walleye ≥ 200 mm FL using methods described by Ward et al. (1995). Northern pikeminnow ≥ 200 mm FL were sacrificed to remove their digestive tract; this also enabled us to establish sex (male, female, or undetermined) and maturity (undetermined, immature, developing, ripe, or spent).

Laboratory Procedures.—We examined digestive tract contents of northern pikeminnow, smallmouth bass, and walleye to measure relative consumption rates of juvenile salmonids. Details of laboratory methods are given in Ward et al. (1995). Standard methods of determining ages from scales were used (DeVries and Frie 1996).

Data Analysis.—We used catch per unit effort (CPUE) (Appendix Table C-1) to calculate northern pikeminnow abundance indices. Abundance indices were calculated as the product of CPUE and reservoir or area-specific surface area (Ward et al. 1995). We compared abundance indices of northern pikeminnow in 2007 with those from 1991, 1994-1996, 1999, and 2004 for sampling areas in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs. We used transformed catch ($\log_{10}$ (catch + 1)) as an index of smallmouth bass and walleye relative densities.

We used the following formulas to calculate consumption indices (CI) for northern pikeminnow and smallmouth bass:

$$CI_{NPM} = 0.0209 \cdot T^{1.60} \cdot MW^{0.27} \cdot (S \cdot GW^{-0.61})$$ (Ward et al. 1995),

and

$$CI_{SMB} = 0.0407 \cdot e^{(0.15)(T)} \cdot MW^{0.23} \cdot (S \cdot GW^{-0.29})$$ (Ward and Zimmerman 1999),

where

CI_{NPM} = consumption index for northern pikeminnow,
CI_{SMB} = consumption index for smallmouth bass,
T = water temperature (^oC),
MW = mean predator weight (g),
S = mean number of salmonids per predator, and
GW = mean gut weight (g) per predator.

The consumption index is not a direct estimate of the number of juvenile salmonids eaten per day by an average predator; however, it is linearly related to the consumption rate of northern pikeminnow (Ward et al. 1995) and smallmouth bass (Ward and Zimmerman 1999). We compared spring (May) and summer (June-July) consumption indices for 2006 to those from 1990-1996, 1999, and 2004.

We used the product of abundance and consumption indices to calculate predation indices for northern pikeminnow for spring and summer periods, and compared northern pikeminnow predation among years when data were collected. The daily juvenile salmonid passage indices at Lower Monumental, Little Goose, and Lower Granite dams were plotted to compare timing of index sampling with concentrations of juvenile salmonids (FPC 2007; Appendix Figure A-1). As in 2004, 2005, and 2006 we calculated a predation index for smallmouth bass in response to reports of increased abundance in some areas. Ward and Zimmerman (1999) observed that smallmouth bass densities varied seasonally in the Columbia and Snake rivers; we therefore calculated predation indices using CPUE (Appendix Table C-3) as a season-specific relative abundance index. We multiplied the product of the season-specific CPUE and reservoir or area-specific surface area by its corresponding consumption index to obtain a season-specific predation index.

To evaluate age structure, we examined the change in frequency of age 3-5 northern pikeminnow and age 4-5 smallmouth bass from previous years. Because the relative abundances of northern pikeminnow year classes in electrofishing catches were biased by exploitation rates that varied among years (Friesen and Ward 1999), we limited our comparisons to abundance of northern pikeminnow large enough to be effectively sampled and small enough to be excluded from the NPMP (ages 3-5). We constructed smallmouth bass electrofishing catch curves (ODFW, unpublished data) and concluded that younger smallmouth bass (ages 1-3) were not sampled in proportion to their abundance. We therefore limited our comparisons to age 4-5 smallmouth bass. Due to their low abundance in the Snake River system, we did not evaluate walleye age structure this year.

Northern pikeminnow exploitation rates are greater for larger fish than for smaller ones (Zimmerman et al. 1995); therefore, sustained fisheries should decrease the abundance of large fish relative to the abundance of smaller fish. We used proportional stock density (PSD; Anderson 1980), where PSD = 100 • (number of fish ≥ quality length / number of fish ≥ stock length) to compare size structure of northern pikeminnow, smallmouth bass, and walleye populations among years. Stock and quality sizes for northern pikeminnow are 250 and 380 mm FL, respectively (Beamesderfer and Rieman 1988; Parker et al. 1995). We also used relative stock density (RSD-P) indices to examine smallmouth bass and walleye populations. Stock, quality, and preferred size classes for smallmouth bass are 180 mm, 280 mm, and 350 mm TL where RSD-P = 100 • (number of fish ≥ preferred length / number of fish ≥ stock length) (Gabelhouse 1984). For walleye, stock, quality, and preferred lengths are 250 mm, 380 mm, and 510 mm TL, respectively (Willis et al. 1985).

Changes in body condition may indicate a response to sustained exploitation. We used relative weight (W_r; Anderson and Neumann 1996) to compare the condition of northern pikeminnow, smallmouth bass, and walleye in 2006 with previous years. We used the standard weight (W_s) equations for northern pikeminnow (Parker et al. 1995), smallmouth bass (Kolander et al. 1993), and walleye (Murphy et al. 1990) to calculate relative weight (W_r = 100[weight]/W_s). We calculated mean W_r for male and female northern pikeminnow and all smallmouth bass and walleye, which were not sexed. To compare W_r among years, we calculated the 95% confidence intervals and concluded the there was a significant difference where the intervals did not overlap.

Results

Fishery Evaluation, Predation Estimates, and Tag Loss

We tagged and released 575 northern pikeminnow ≥ 200 mm FL throughout the lower Columbia and Snake rivers in 2007; 468 were ≥ 250 mm FL (Appendix Table B-1). In 2007, removal fisheries harvested 198,770 northern pikeminnow ≥ 200 mm; 191,154 in the sport-reward fishery (PSMFC 2007) and 7,616 in the dam-angling fishery (J. Zierenberg, USDA, personal communication). A total of 73 tagged northern pikeminnow were recaptured; 71 in the sport-reward fishery and two in the dam-angling fishery. Fish tagged and recaptured in 2007 were at-large from 10 to 193 days, and 94% of the recaptures were ≥ 250 mm FL (Appendix Table B-1). Only 63% of the overall sport-reward harvest consisted of northern pikeminnow ≥ 250 mm FL. Median fork length of northern pikeminnow harvested in the sport-reward fishery was 272 mm (J. Hone, WDFW, personal communication). Four northern pikeminnow with 2007 PIT tags and missing spaghetti tags were recaptured in the sport-reward fishery, yielding a tag loss estimate of 5.3%; we adjusted exploitation rates accordingly.

System-wide exploitation of northern pikeminnow ≥ 200 mm FL by the sport-reward fishery was 15.3% (95% confidence bounds 11.6% - 19.0%; Appendix Table B-2). Reservoir/area-specific exploitation rates ranged from 5.9% in McNary Reservoir to 35.0% in Little Goose Reservoir. We did not calculate exploitation rates for The Dalles and John Day reservoirs due to an insufficient number of tag recoveries in these reservoirs (n < 4; Appendix Table B-2; Styer 2003). We calculated multi-year exploitation estimates of 18.5% below Bonneville Dam and 11.7% in Bonneville Reservoir using PIT tag data from the last four years; these were slightly higher than the single year estimates of 18.4% and 9.6% for fish ≥ 200 mm.

The system-wide exploitation rate of northern pikeminnow 200 – 249 mm FL was 4.0% for the sport-reward fishery (95% confidence bounds 0.4% - 7.7%; Appendix Table B-3). We did not have sufficient recaptures to calculate reservoir/area-specific exploitation rates for this size class.

For northern pikeminnow ≥ 250 mm FL, system-wide exploitation was 17.8% (95% confidence bounds 13.4% - 22.3%; Appendix Table B-4). Exploitation rates ranged from 7.5% in McNary Reservoir to 19.4% in the area below Bonneville Dam (Figure 2). In The Dalles, John Day, and Little Goose reservoirs, not enough fish were recaptured to estimate exploitation rates for these larger fish. Weekly system-wide exploitation estimates for the sport-reward fishery are given in Appendix Table B-5.

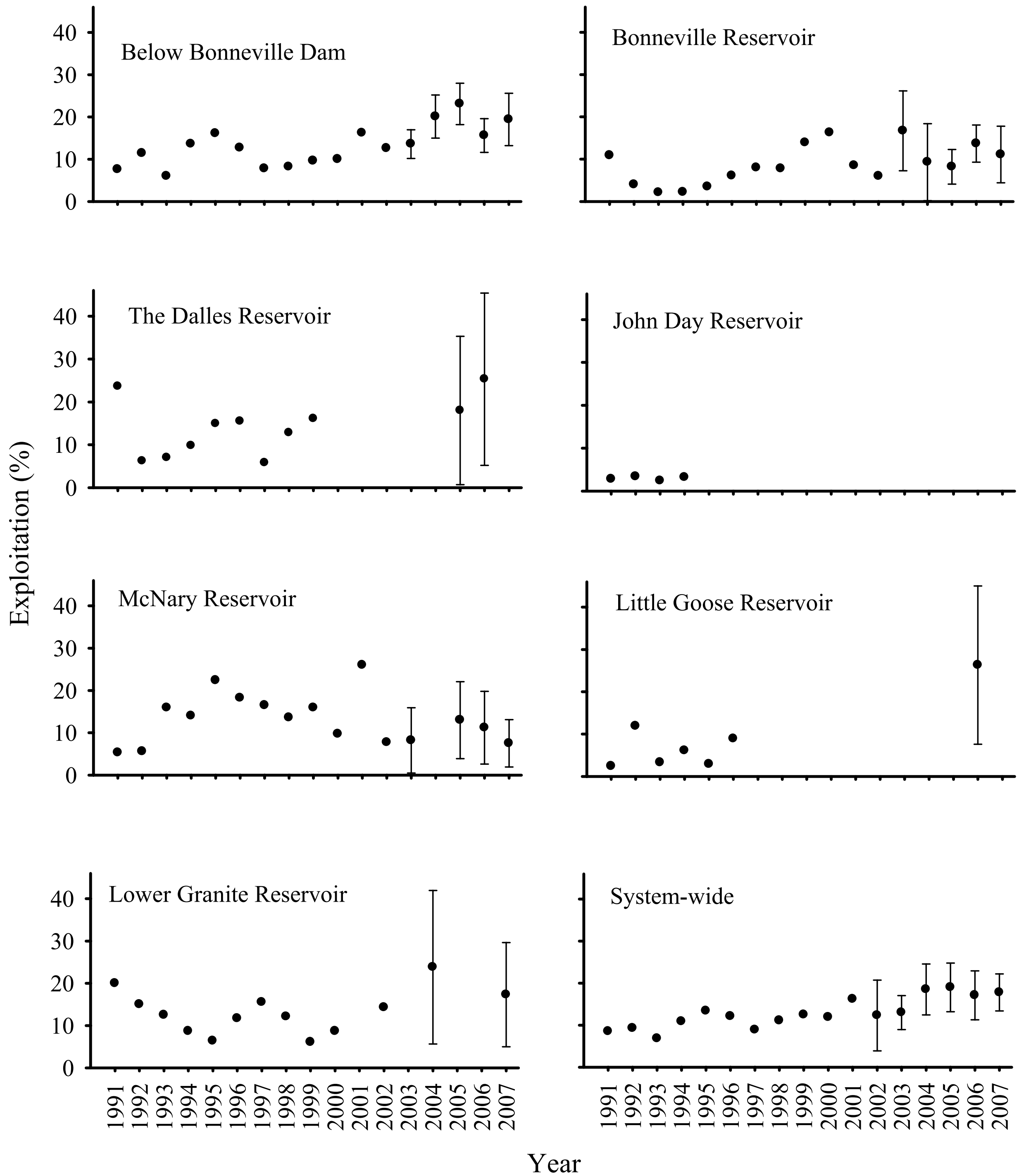

FIGURE 2.—Exploitation rates of northern pikeminnow ≥ 250 mm fork length in each reservoir or area, 1991 – 2007. Exploitation rates were not calculated where the number of recaptured tags was low ($n < 4$). Exploitation rates for 2000 – 2002 were not adjusted for tag loss. Error bars denote the 95% confidence interval.

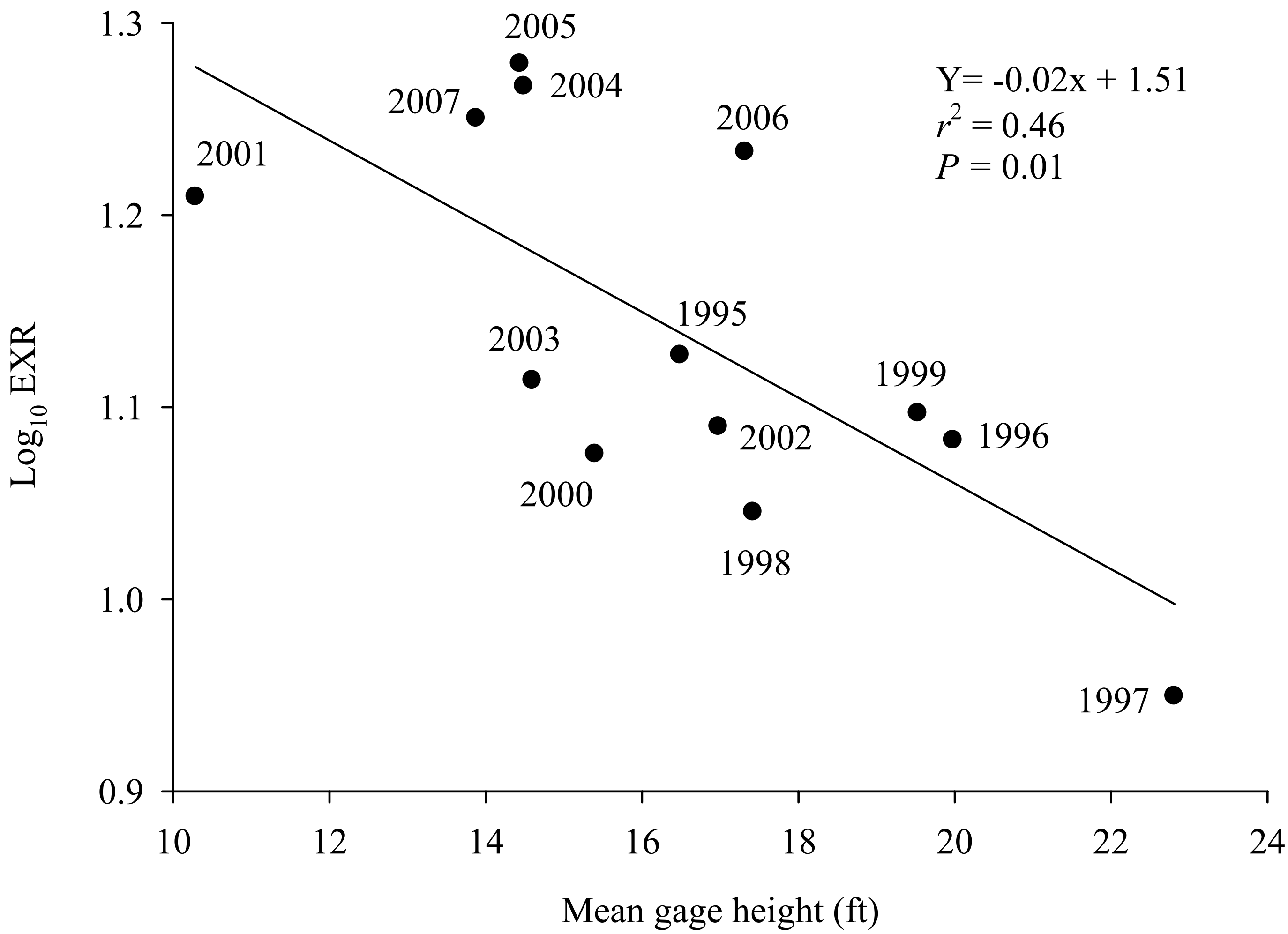

FIGURE 3.—Relationship between system-wide sport-reward exploitation rate (Log_{10} EXR) of northern pikeminnow ≥ 250mm FL and mean Columbia River gage height (ft) below Bonneville Dam during the sport-reward season (May – September 1995 – 2005 and May – October 2006 – 2007).

In 2007, we continued to find a significant relationship between the system-wide sport-reward exploitation rate for northern pikeminnow ≥ 250 mm FL and mean Columbia River gage height measured below Bonneville Dam during the sport-reward season ($r^2 = 0.46$; $P < 0.05$; Figure 3). We also found that a combination of Tier 3 pay and the number of Tier 3 anglers explained 92% of the variation in exploitation of northern pikeminnow ≥ 250 mm FL during 2000 – 2007 ($r^2 = 0.92$; $P < 0.001$). Tier 3 pay alone accounted for 89% of the variation in exploitation rates ($r^2 = 0.89$; $P < 0.001$).

Furthermore, exploitation rates differed significantly at Tier 3 pay levels of \$6 and \$8 ($t = 7.56$, $P < 0.001$).

We sampled 813 northern pikeminnow caught in the dam-angling fishery, with 56% of the samples coming from John Day Dam. Median fork length of northern pikeminnow caught by dam anglers was 348 mm. One tagged northern pikeminnow was recovered at The Dalles Dam and another at John Day Dam. We were unable to calculate an exploitation rate for the dam-angling fishery due to the low number of recaptures. However, we included these fish in our calculation of total system-wide exploitation, increasing the estimate from 15.3% to 15.7% for fish ≥ 200 mm.

Biological Evaluation

Predator sampling near lower Snake River dams in 2007 generally occurred close to the peaks in juvenile salmonid passage indices for spring sampling, however there were no large peaks in juvenile salmonid passage during summer months (Appendix Figure A-1). The abundance index values for northern pikeminnow in all areas of Ice Harbor Reservoir were lower in 2007 than when previously sampled in 1991 (Appendix Table C-5). The forebay and mid-reservoir areas of Lower Monumental and Little Goose reservoirs were sampled for the first time since 1991 and the abundance indices were lower in all areas. Abundance index values for tailrace areas of Lower Monumental and Little Goose reservoirs continue to be low. The Lower Granite reservoir abundance index is unchanged from 2004, and remains at the programmatic low for this impoundment.

In spring 2007, smallmouth bass relative densities were lower in Ice Harbor Reservoir then when previously sampled in 1991 (Appendix Table C-6). Lower Monumental and Little Goose reservoir forebay and mid-reservoir areas, the other areas sampled for the first time since 1991, showed no change in the densities for the forebay areas, however, the mid-reservoir area increased in Lower Monumental Reservoir and decreased in Little Goose Reservoir. The tailrace section of Lower Monumental reservoir and the Lower Granite upper reservoir area both showed declining smallmouth bass relative densities from 1991 - 2004; however in 2007 they increased. The little Goose tailrace section continued to show a decline from 1991, but was higher than 2004.

Summer smallmouth bass relative densities in 2007 were higher in all areas of Ice Harbor Reservoir, the forebay and mid-reservoir section of Lower Monumental Reservoir, and the forebay section of Little Goose Reservoir than in 1991 (Appendix Table C7). The mid-reservoir section of Little Goose Reservoir showed no change from 1991. Smallmouth bass relative densities in the tailrace section of Lower Monumental Reservoir were lower than in 2004; however they were still higher than all other years sampled. Densities in the tailrace section of Little Goose Reservoir have remained the same for the last couple of years, while densities in the upper reservoir area of Lower Granite Reservoir continue to show an increase.

Relative densities for walleye were calculated in the Snake River reservoirs for the first time in 2007 (Appendix Table C-8). Since sampling began in the early 1990s, we have only captured walleye in 1991 and 2007. All walleye were captured in Lower Monumental Reservoir, and based on the data for this year, the relative density is increasing.

We examined 67 northern pikeminnow digestive tracts, 72% contained food (e.g. crayfish, insects, and fish) (Appendix Table C-10). In Lower Monumental and Lower Granite reservoirs, all identifiable fish remains found in northern pikeminnow digestive tracts were *Oncorhynchus* spp. (Appendix Table C-11). In Ice Harbor Reservoir we found both *Oncorhynchus* spp. and *Micropterus* spp. in the digestive tracts and in Little Goose Reservoir all identifiable fish remains were non-salmonids.

We examined 1,515 smallmouth bass stomach samples; 82% contained food, 20% contained fish, and 4% of the samples contained *Oncorhynchus* spp. (Appendix Table C-9). Smallmouth bass consumed *Oncorhynchus* spp. in all areas and seasons with the exception of Lower Monumental Reservoir in summer (Appendix Table C-10). In Lower Granite Reservoir *Oncorhynchus* spp. were identified most often (50%), in Ice Harbor Reservoir *Cottus* spp. were identified most often (42%), in Lower Monumental Reservoir catfishes (*Ameiurus spp.* and *Ictalurus spp*) were identified most often (31%), and in Little Goose Reservoir sandrollers (*Percopsis transmontanus*) were identified most often in smallmouth bass stomach samples (34%) (Appendix Table C-10).

Walleye were only found in Lower Monumental Reservoir. We examined 33 walleye stomach samples; 94% contained food, 82% contained fish, and 9% of the samples contained *Oncorhynchus* spp. (Appendix Table C-9). Walleye consumption of *Oncorhynchus* spp. was limited to spring. Peamouth (*Mylocheilus caurinus*) were identified most often (70%) in Walleye stomach samples, followed by suckers (*Catostomus* spp.) (20%) (Appendix Table C-10).

During spring 2007 the consumption index (CI) value for northern pikeminnow in Lower Granite upper reservoir was 1.0 (Appendix Table C-11). Summer CI value was 2.0 in Ice Harbor Reservoir tailrace area (Appendix Table C-12). We were unable to calculate spring or summer CI values in the remainder of the Snake River reservoirs, due to low catches ($n \leq 5$) of northern pikeminnow or sampling did not occur.

Spring CI values for smallmouth bass in the lower Snake River reservoirs remain low but showed a slight increase in 2007 from initial values calculated during baseline sampling (Appendix table C-13). The summer CI value for Lower Granite upper reservoir was the same as 1999 and 2004 values (0.2) (Appendix Table C-14). In all other years and areas, the summer CI values were ≤0.1 or the area was not sampled.

The spring predation index (PI) value in Lower Granite Reservoir for northern pikeminnow was 0.1, the same as it was in 1996, but lower than all other years (Appendix Table C-15). The summer PI value for northern pikeminnow in Ice Harbor Reservoir tailrace was 0.2, and is the first PI value we have calculated for northern pikeminnow in that area and season (Appendix Table C-16). No other PI values were calculated for northern pikeminnow due to low sample sizes ($n \leq 5$).

The summer PI value for smallmouth bass in Ice Harbor mid reservoir was 0.6, the highest value for the Snake River in 2007 (Appendix Table C-17). Spring and summer PI values for smallmouth bass in Lower Granite Reservoir were 0.3 and 0.5 respectively, up from 2004. The PI value for smallmouth bass in Lower Granite Reservoir during the spring was higher than the spring PI value for northern pikeminnow in Lower Granite Reservoir (Appendix Table C-18).

Northern pikeminnow year-class analysis in the lower Snake River reservoirs showed that age-5 fish made up a larger percentage of the population than did age-3 or age-4 fish when initial sampling occurred in 1991 (Figure 4). In Lower Granite Reservoir, the only area with a consistent data set, age-5 fish tended to predominate within the age 3-5 group for the next four years sampled (1993, 1994, 1995, and 1996). However, in 1999 and again this year, the proportion of age-5 fish decreased substantially (Figure 4). In Ice Harbor, Lower Monumental, and Little Goose reservoirs age-3 fish are now the most predominate in the age 3-5 group.

Year-class analysis in Lower Granite Reservoir indicated that in 2007 the percentage of age 4-5 smallmouth bass in the population was lower than 2004, continuing the downward trend following a peak in 1999 (Figure 5). Age-4 smallmouth bass continued to predominate within the age 4-5 group in Lower Granite Reservoir although to a lesser degree than in past years. We collected scales from smallmouth bass in Ice Harbor, Lower Monumental, and Little Goose reservoirs for the first time in 2007. A total of 354 scales were read from these areas, 7.1% of which were age-4 fish and 14.1% age-5 fish (Figure 6).

We were unable to calculate a northern pikeminnow PSD in 2007 due to inadequate sample sizes ($n < 20$ for stock size fish) (Table 1). We have not calculated northern pikeminnow PSD in the Snake River reservoirs we sample consistently due to inadequate sample sizes in recent years.

Smallmouth bass PSD in 2007 was slightly lower than the average for all previous years while RSD-P was similar or higher (Table 2). Stock densities in the Snake River reservoirs we sampled appeared to vary randomly with no apparent trends.

We report walleye PSD and RSD-P in Lower Monumental Reservoir, the only Snake River Reservoir where we have captured walleye while indexing, for the first time in 2007 (Table 3). We will use this data as a baseline and compare it to what we find next time we work in that area, which is scheduled for 2010.

Mean relative weights for male and female northern pikeminnow were not significantly different in 2007 than in previous years for all reservoirs sampled, except for female northern pikeminnow in Lower Granite Reservoir (Figures 7 and 8). Female northern pikeminnow in Lower Granite Reservoir in 2007, while having the highest mean relative weight to date, were only significantly different from 2004 and 1991 ($P < 0.05$). Both sexes have decreasing sample sizes in the last 10 years and there were no relative weight samples for male northern pikeminnow in Lower Granite Reservoir in 2007.

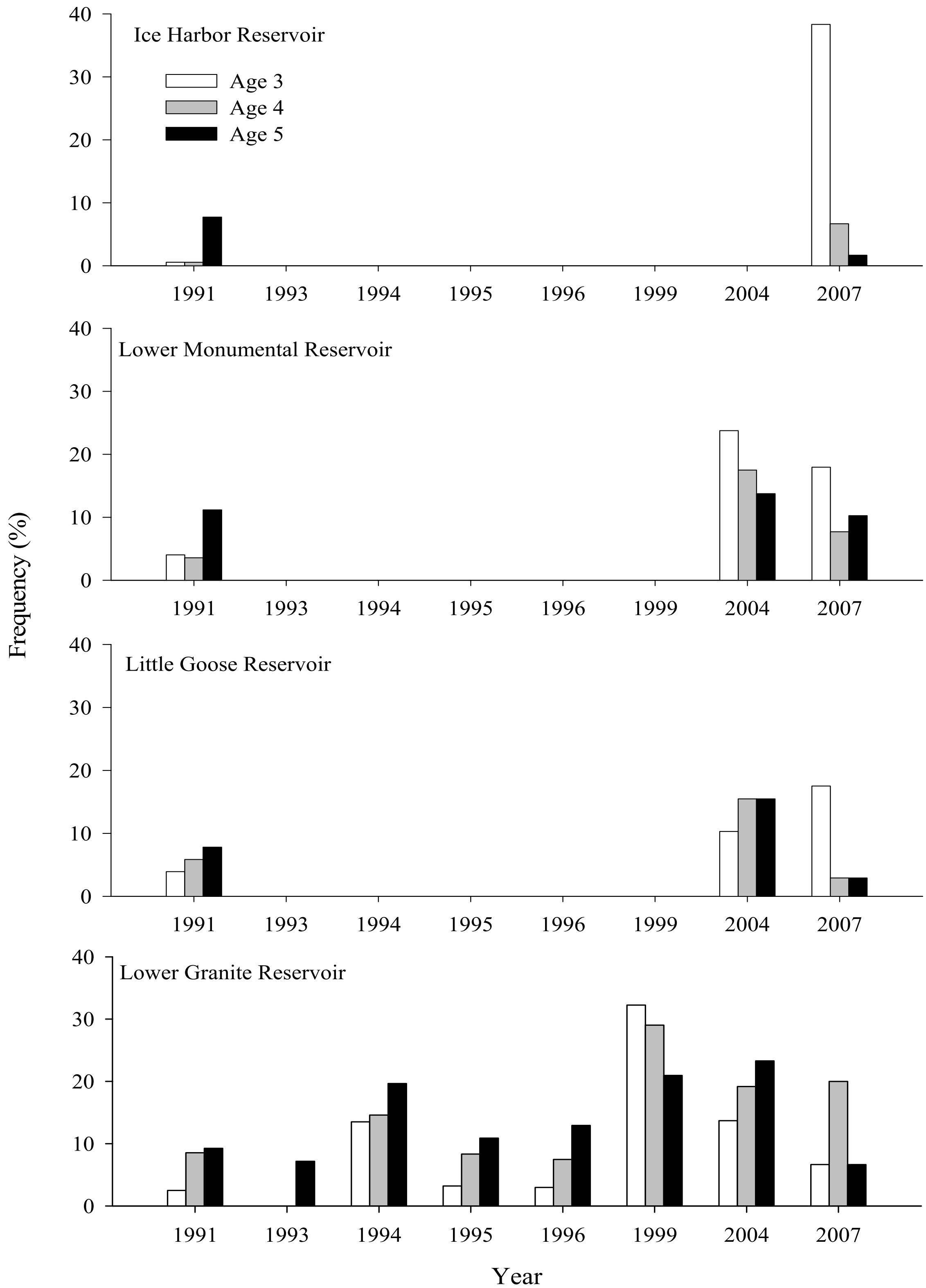
Ice Harbor Reservoir
Age 3
Age 4
Age 5
Lower Monumental Reservoir
Little Goose Reservoir
Lower Granite Reservoir
Frequency (%)
Year
0
10
20
30
40
1991
1993
1994
1995
1996
1999
2004
2007

FIGURE 4.—Percent composition of age 3-5 northern pikeminnow, relative to the total sample, in the four Snake River reservoirs, 1991, 1993-1996, 1999, 2004, and 2007.

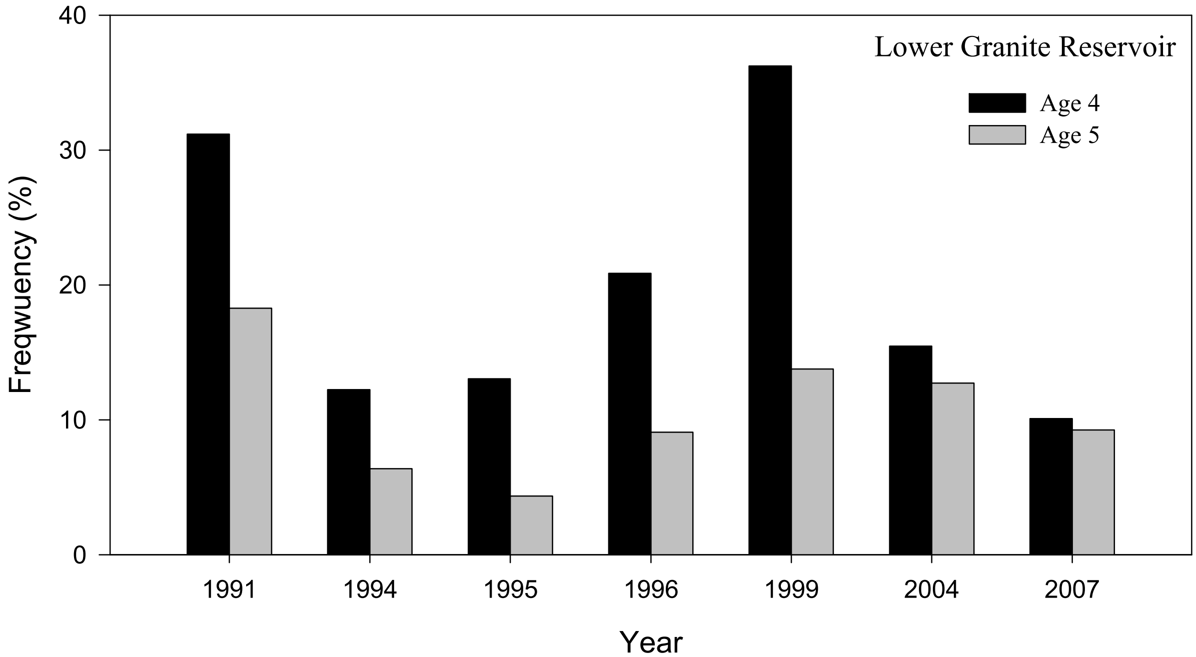

FIGURE 5.—Percent composition of age 4-5 smallmouth bass, relative to the total sample, in Lower Granite Reservoir, 1991, 1994-1996, 1999, 2004, and 2007.

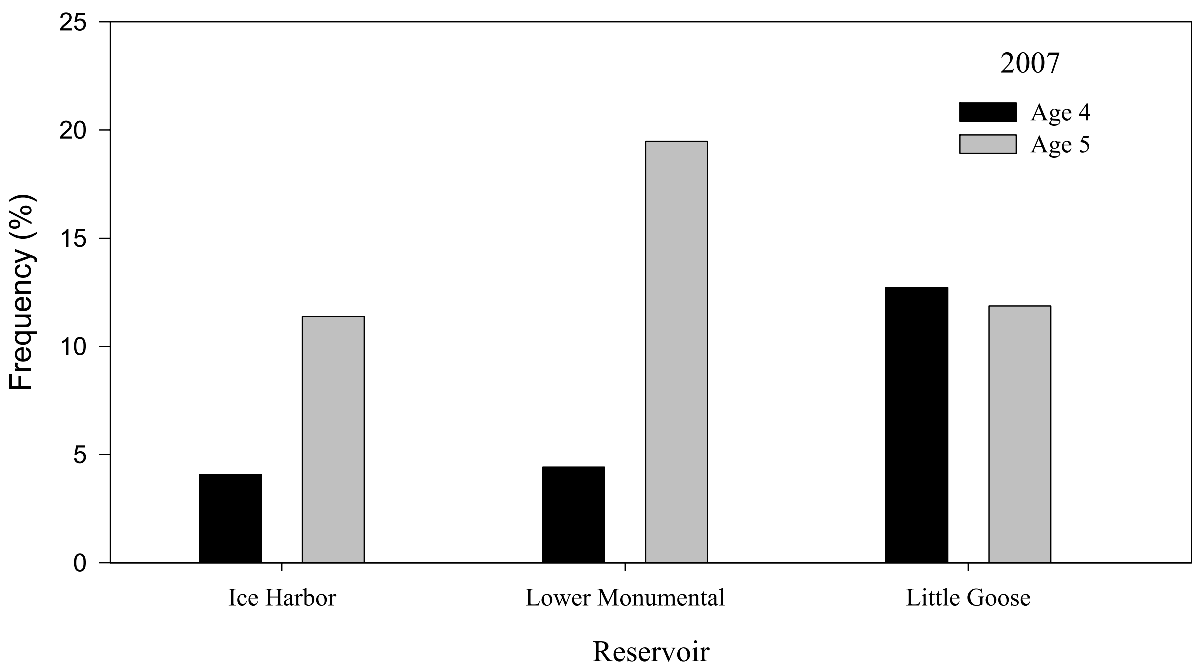

Figure 6. —Percent composition of age 4-5 smallmouth bass, relative to the total sample, in Ice Harbor, Lower Monumental, and Little Goose reservoirs, 2007.

TABLE 1. —Proportional stock density (PSD) and number of stock sized fish (*N*) of northern pikeminnow in the lower Snake River (1991, 1994-1996, 1999, 2004, and 2007). -- = not sampled; X = Number (stock sized fish) ≤ 20, no stock density index calculated.

Location, Parameter	1991	1994	1995	1996	1999	2004	2007
Ice Harbor Reservoir							
PSD	37	--	--	--	--	--	X
(*N*)	(49)	--	--	--	--	--	(8)
Lower Monumental Reservoir							
PSD	16	X	23	X	X	X	X
(*N*)	(143)	(19)	(35)	(12)	(0)	(8)	(7)
Little Goose Reservoir							
PSD	36	64	60	X	X	53	X
(*N*)	(143)	(70)	(84)	(13)	(9)	(30)	(2)
Lower Granite Reservoir							
PSD	43	33	X	38	X	X	X
(*N*)	(35)	(45)	(20)	(26)	(17)	(5)	(11)

TABLE 2.—Proportional stock density (PSD), relative stock density (RSD-P), and number of stock sized fish (*N*) of smallmouth bass in the lower Snake River (1991, 1994-1996, 1999, 2004, and 2007). -- = not sampled; X = Number (stock sized fish) ≤ 20, no stock density index calculated.

Location, Parameter	1991	1994	1995	1996	1999	2004	2007
Ice Harbor Reservoir							
PSD	17	--	--	--	--	--	13
RSD-P	2	--	--	--	--	--	3
(*N*)	(269)	--	--	--	--	--	(662)
Lower Monumental Reservoir							
PSD	17	7	12	10	62	15	14
RSD-P	3	1	3	0	2	1	3
(*N*)	(248)	(167)	(74)	(39)	(42)	(253)	(533)
Little Goose Reservoir							
PSD	20	6	13	18	70	35	18
RSD-P	3	1	5	5	0	13	5
(*N*)	(405)	(159)	(129)	(55)	(30)	(48)	(513)
Lower Granite Reservoir							

PSD	8	9	17	29	37	12	14
RSD-P	2	2	6	11	6	2	3
(*N*)	(828)	(436)	(270)	(132)	(83)	(298)	(517)

TABLE 3. —Proportional stock density (PSD), relative stock density (RSD-P), and number of stock sized fish (*N*) of Walleye in the lower Snake River (1991, 1994-1996, 1999, 2004, and 2007). -- = not sampled; X = Number (stock sized fish) ≤ 20, no stock density index calculated.

Location, Parameter	1991	1994	1995	1996	1999	2004	2007
Ice Harbor Reservoir							
PSD	X	--	--	--	--	--	X
RSD-P	X	--	--	--	--	--	X
(*N*)	(0)	--	--	--	--	--	(0)
Lower Monumental Reservoir							
PSD	X	X	X	X	X	X	20
RSD-P	X	X	X	X	X	X	8
(*N*)	(0)	(0)	(0)	(0)	(1)	(0)	(25)
Little Goose Reservoir							
PSD	X	X	X	X	X	X	X
RSD-P	X	X	X	X	X	X	X
(*N*)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Lower Granite Reservoir							
PSD	X	X	X	X	X	X	X
RSD-P	X	X	X	X	X	X	X
(*N*)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

Relative weights for smallmouth bass appear to fluctuate moderately in Lower Monumental and Little Goose reservoirs (Figure 9). In both reservoirs, relative weights were lowest in 1996 and highest in 1999 and 2004. While relative weights of smallmouth bass are significantly lower in 2007 compared to 1999 and 2004 ($P < 0.05$), they are not significantly different than the years previous to 1999 and 2004. Smallmouth bass relative weights in Lower Granite reservoir also fluctuate with the lowest in 1996, and while not significantly different than the previous two sampling years ($P < 0.05$), 2007 is the highest point value to date. The relative weights of smallmouth bass in Ice Harbor Reservoir are not significantly different in 2007 than they were in the previous year sampled ($P > 0.05$).

We report walleye relative weights in Lower Monumental Reservoir, the only Snake River reservoir where we have captured walleye while indexing, for the first time in 2007. The relative weight (104.9) of the single walleye captured in 1999 was significantly higher ($P < 0.05$) than the mean relative weight (90.8) of the walleye captured in 2007 (Figure 10). However, the 1999 sample was within the range (57.3-112.0) of relative weights measured in the 2007 samples.

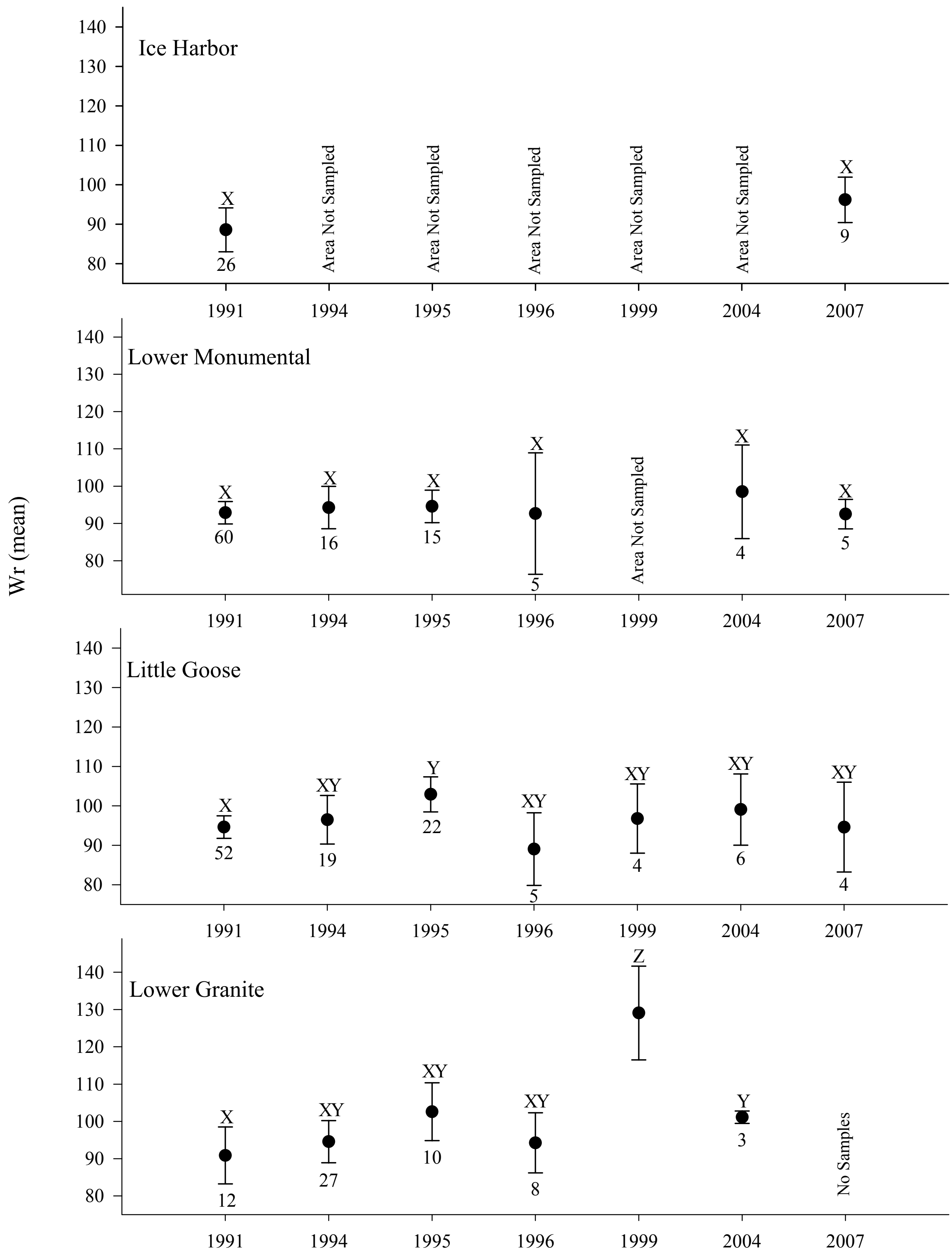

FIGURE 7.—Relative weight of male northern pikeminnow in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs in 1991, 1994-1996, 1999, 2004, and 2007. Bars without a letter in common differ significantly ($P < 0.05$); numbers below the bars are the sample size.

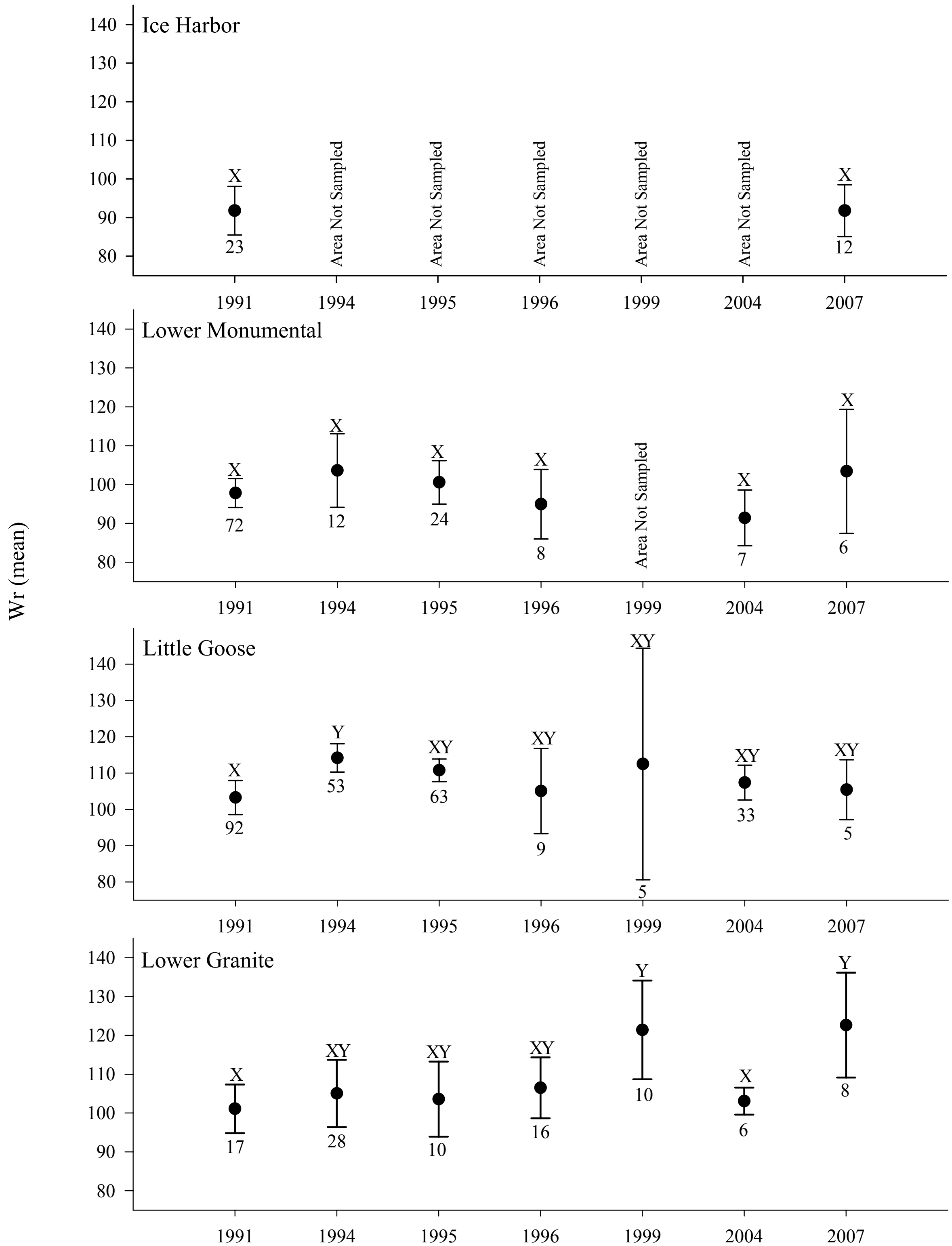

FIGURE 8.—Relative weight of female northern pikeminnow in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs in 1991, 1994-1996, 1999, 2004, and 2007. Bars without a letter in common differ significantly ($P < 0.05$); numbers below the bars are the sample size.

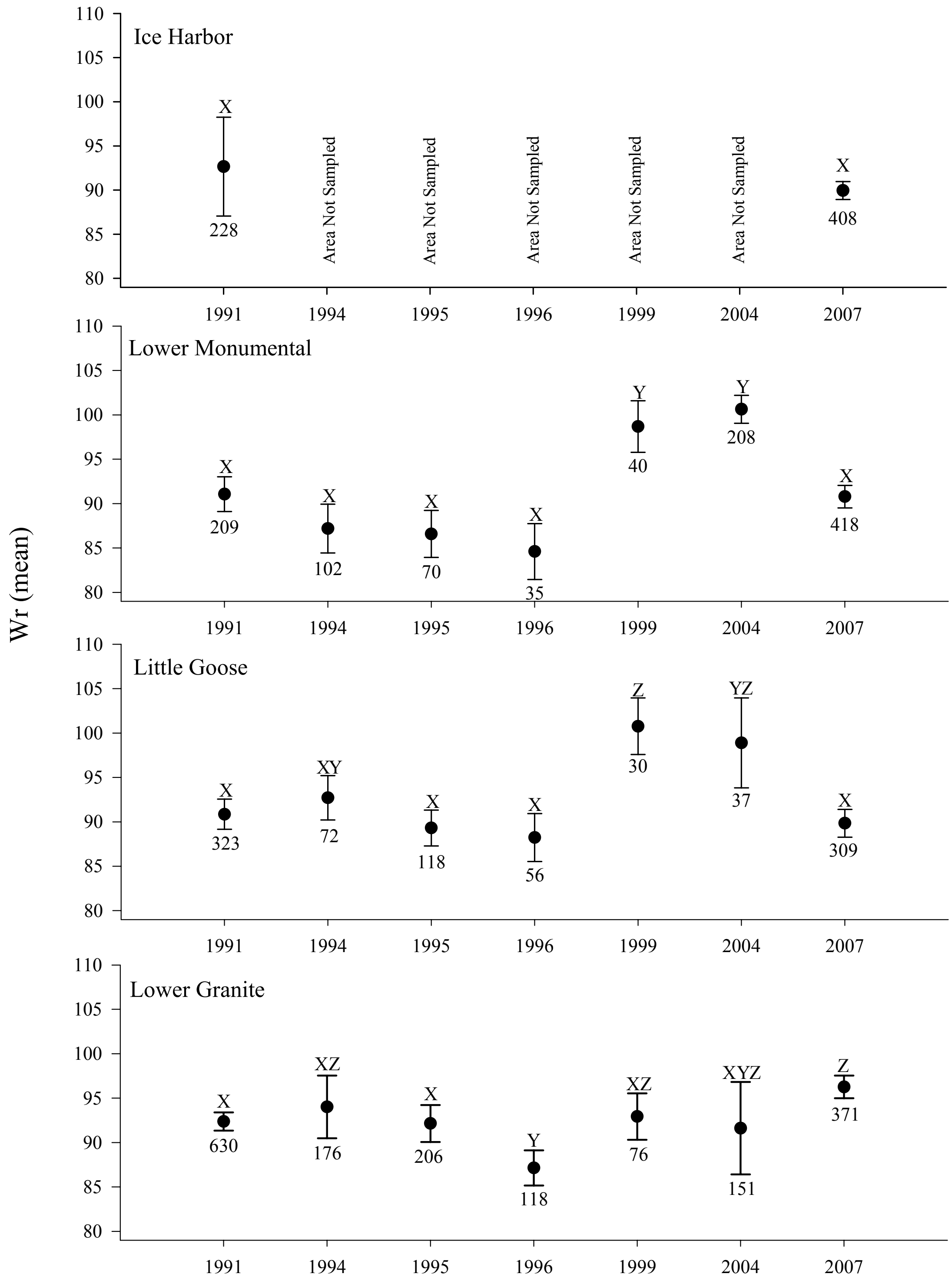

FIGURE 9.— Relative weight of smallmouth bass in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs in 1991, 1994-1996, 1999, 2004, and 2007. Bars without a letter in common differ significantly ($P < 0.05$); numbers below the bars are the sample size.

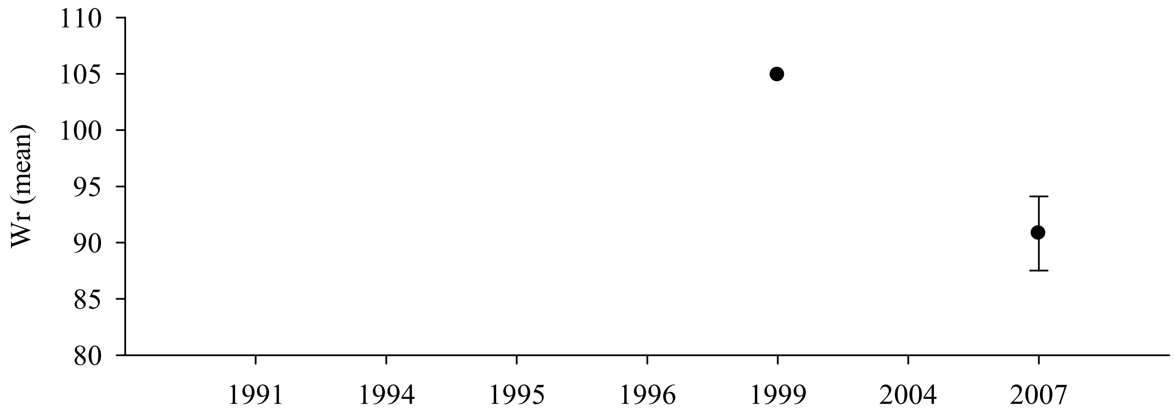

FIGURE 10.—Relative weight of walleye in Lower Monumental Reservoir in 1999 and 2007. Bars without a letter in common differ significantly ($P < 0.05$); numbers below the bars are the sample size.

Discussion

Fishery Evaluation, Predation Estimates, and Tag Loss

In 2007, system-wide exploitation of northern pikeminnow ≥ 250 mm FL by the sport-reward fishery (17.8%) was the third highest in program history. Total system-wide exploitation has been within the target range of 10-20% (Rieman and Beamesderfer 1990) in 15 of 17 years. The general trend since program inception has been of increasing exploitation, and the four highest exploitation rates, near the upper end of the 10-20% range, have occurred in the last four years.

The 35% exploitation rate calculated in Little Goose Reservoir is confounded by sample size issues, and had confidence limits that ranged from 1.5% to 68.5%. In 2007, we only tagged 12 northern pikeminnow in Little Goose Reservoir compared to 125 in 2006. However, the 2007 sport-reward catch per angler day (CPUE = 9.0) in that reservoir was similar to 2006 (CPUE = 10.2; PSMFC 2007). This combination of low sample size and high sport-reward harvest contributed to a high exploitation rate point estimate with a wide confidence interval.

Previous reports have documented the problem of northern pikeminnow tagged in the 200-249 mm FL class being caught at a lower rate than untagged fish of the same size and larger tagged fish (Takata and Koloszar 2004; Takata et al. 2007). In 2007, this discrepancy was especially large as 37% of the sport-reward catch consisted of fish 200-249 mm FL, but only 4% of the tag recoveries were from this size class. These smaller fish comprised about 19% of the northern pikeminnow tagged and released this year. Because there were so few recaptures of these small fish, we were not able to calculate any area or reservoir-specific exploitation rates for this group, and barely had a large enough sample size to derive a system-wide estimate. Higher mortality or other factors may prevent smaller fish from being recaptured in the fishery at a rate more consistent with their share of the overall catch (Takata and Koloszar 2004). We may need to re-assess our current practice of tagging fish in this size category as differential mortality or behavior between marked and unmarked fish violates central assumptions of the Petersen mark-recapture protocol (Ricker 1975).

We continue to observe variability in both system-wide and area-specific exploitation rates. Sport-reward exploitation of northern pikeminnow ≥ 250 mm FL appears to be influenced by river flow to some degree, with exploitation increasing as river levels decrease. However, the amount of variability explained by river flow has decreased in recent years, suggesting that other factors also contribute to exploitation of northern pikeminnow (Takata et al. 2007). Our analysis in 2007 indicated that there was a strong relationship between reward structure variables such as Tier 3 pay and the number of Tier 3 anglers and exploitation rates during 2000-2007. In fact, Tier 3 pay appeared to have a particularly strong relationship with exploitation rates during this time period, and exploitation rates differed significantly at the two pay levels examined. However, these results should be interpreted cautiously as there may not necessarily be a cause-and-effect relationship between the amount of money offered at the Tier 3 level and exploitation rates. First, there have only been two different pay levels offered to Tier 3 anglers--$6 and $8. We would probably have greater confidence in the strength of this relationship if the dataset included a greater variety of pay levels. Secondly, and perhaps more importantly, changes to the reward structure in recent years have coincided with improvements in angler skill during the same time frame. For example, the percentage of anglers catching fewer than 10 northern pikeminnow during the season decreased every year between 2000 and 2006. Also, the percentage of anglers at the Tier 3 level increased annually from 4.1% in 2001 to 10.5% in 2007 despite fluctuations in Tier 3 pay. There are likely several factors that influence exploitation rates, some of which may confound each other, so it may be difficult to identify a variable or variables that can reliably predict exploitation.

The 2007 dam-angling fishery accounted for 3.8% of the northern pikeminnow harvest, compared to 1.4% in 2006 (Takata et al. 2007) and 11.2% during 1991-1996 (Friesen and Ward 1999). Although the dam-angling fishery's contribution to program harvest was higher than last year, it was still well below what it was in the program's early years. This might be explained by several developments. First, tagging data as well as anecdotal information suggest that there are probably fewer northern pikeminnow in areas immediately adjacent to the dams than there were in the early 1990s. Secondly, as demonstrated by increasing catches and exploitation rates, the sport-reward fishery has become far more effective than it was 10 to 15 years ago. Finally, the dam-angling fishery used to operate at several dams; however, in recent years it has been scaled back to only two dams. Although the dam-angling fishery only recaptured two tagged northern pikeminnow in 2007, the percentage of the catch comprised of tagged fish (0.03%) was very similar to the sport-reward fishery (0.04%). Northern pikeminnow sampled from the dam-angling fishery in 2007 were larger (348 mm vs. 272 mm) than those sampled in the sport-reward fishery. Dam anglers may be harvesting more of the larger mature northern pikeminnow that have been reported to move upstream toward dam tailraces during the spawning season (Martinelli and Shively 1997). We will continue to monitor dam-angling activities in 2008, scheduled this year at The Dalles and John Day dams.

Our 2007 estimated reduction in potential predation (63% of pre-program levels) was based on an updated Friesen and Ward (1999) predation model (ODFW, unpublished data). This is a greater reduction than observed previously (75%; Jones et al. 2005), and is related to the updates we have made in the predation model. The Friesen and Ward (1999) model is based on the average pre-program northern pikeminnow population age structure, and suffers from age validation related issues. We have developed an updated model based on fish size and annual growth rather than age, and though preliminary results from this updated model indicate that actual reductions may be higher than previously thought, it has not yet been subject to peer review.

Biological Evaluation

Reductions in the northern pikeminnow population may improve outmigrating salmonid survival if an equal compensatory response by the remaining northern pikeminnow or other predators does not minimize the benefits (Beamesderfer et al. 1996; Friesen and Ward 1999). An increase in the abundance, population size structure, condition factor, or consumption and predation indices of remaining predators might indicate such a response (Knutsen and Ward 1999). Sustained exploitation should decrease the proportion of large (older) fish to small (younger) fish (Zimmerman et al. 1995), and smaller northern pikeminnow consume fewer salmonids than their larger counterparts (Vigg et al. 1991).

We have not sampled in Ice Harbor Reservoir since 1991, the initial sampling year in the Snake River. Catches were low then and they are lower now. There were not enough samples to calculate a stock density in 2007, and the CPUE and abundance indices have also decreased. Northern pikeminnow relative weights in Ice Harbor Reservoir have increased slightly since 1991, however, the difference is not significant and probably due to small sample sizes. Age composition data from Ice Harbor Reservoir indicates that the population may be getting younger. In 1991, the majority of the fish in the age 3-5 group were age 5. In 2007 the majority of the fish in the age 3-5 group were age 3. While these changes are a desired outcome of the program, there have not been significant removals from this area; therefore other factors may be driving these changes.

Northern pikeminnow abundance and stock density have been decreasing in Lower Monumental Reservoir since the program began in 1991. We have not been able to calculate a stock density since 1995 due to low sample sizes and the CPUE and abundance indices have decreased as well. Relative weights of northern pikeminnow in Lower Monumental Reservoir have varied over the years with no significant difference between years. The fluctuating relative weights are likely a result of low sample sizes, especially in recent years. The age data for Lower Monumental Reservoir indicate a shift in age composition. When we first sampled in 1991, age 5 fish dominated the age 3-5 group, however age 3 fish have been dominant since 2004.

In Little Goose Reservoir, stock density increased following initial sampling in 1991, and then decreased in 2004. We were unable to calculate the stock density in 2007 due to low sample sizes and therefore are uncertain if the decrease in 2004 has remained. A lower abundance index and CPUE in recent years along with the low sample size in 2007 indicate the population may be declining. Relative weights of northern pikeminnow in Little Goose Reservoir went up in 1994 and 1995, however since then have fluctuated slightly with no significant differences among the other years. While an improved condition in northern pikeminnow could be a sign of a density dependent response to exploitation (Sass et al. 2004), Reesman et al. (2006) suggested that density independent factors such as prey availability could also affect condition. Age data for northern pikeminnow in Little Goose Reservoir show a shift in age composition. In the age 3-5 group of fish, age 5 was most abundant in 1991, the baseline sampling year. Since then, there has been a shift and age 3 fish are now the most abundant.

Lower Granite Reservoir has been the one area in the Snake River with a consistent data set over the years. However, there has not been sufficient data to estimate stock density for northern pikeminnow since 1996. Both abundance index and CPUE trends show a decreasing population. The relative weights for northern pikeminnow in Lower Granite Reservoir have fluctuated over the years with some years showing significant differences. The age composition data in Lower Granite Reservoir has also fluctuated for age 3-5 northern pikeminnow. In 1991, and continuing until 1996 age 5 fish dominated our samples. The age 3 fish dominated the 1999 samples, however, age 5 continued to dominate in 2004. In 2007, age 4 fish dominate the age 3-5 group with age 3 and age 5 fish having equal representation. While a shift to a younger population is a desired outcome of the program, the fluctuating age composition leads to the possibility that other factors may be affecting the age structure of northern pikeminnow in Lower Granite Reservoir.

Increased northern pikeminnow consumption and predation indices might also be signs of compensation by remaining northern pikeminnow to prolonged exploitation by the NPMP (Zimmerman and Ward 1999). In 2007, we collected very few northern pikeminnow in the lower Snake River reservoirs (n = 67). Of the 72% of northern pikeminnow stomachs collected that contained food items, only 31% contained fish. Of the identifiable fish remains, 64% were salmonids. While the stomach analysis shows that northern pikeminnow are consuming juvenile salmonids, we did not catch a sample size adequate enough to calculate area or season specific consumption and predation indices in the majority of the areas we sampled, however, in the two areas of the Snake River that we were able to make calculations, they remain unchanged from earlier work.

The efficacy of the NPMP also depends, in part, on the lack of response by other piscivores in the Columbia Basin to the sustained removal of northern pikeminnow

(Ward and Zimmerman 1999). Smallmouth bass relative densities in the Snake River reservoirs have increased slightly, with minor fluctuations since sampling began in 1991, especially during spring sampling. The PDS values for smallmouth bass in the Snake River reservoirs have fluctuated since 1991. They started out relatively low and then increased until 1999 where they were reaching the upper end of what would be considered a balanced population in waters managed for warmwater species (Green 1989). In 2007 the PSD values decreased to below 30%, potentially a sign of an unstable population experiencing higher than optimal recruitment to the stock (Anderson and Weithman 1978). The relative weights of smallmouth bass have also fluctuated in Snake River reservoirs. Relative weights decreased after initial sampling in 1991, increased in 1999 and 2004, and then decreased again in 2007. Because the abundance of smallmouth bass have has not changed much, the relative weight fluctuations are likely due to some density independent factor such as prey availability. In the past, juvenile salmonids have composed small but consistent portions of smallmouth bass diets in the Columbia and Snake River (Poe et al. 1991; Zimmerman 1999; Naughton et al. 2004). This was true again in 2007; however, the fish primarily consumed by smallmouth bass were sculpins. Smallmouth bass consumption and predation indices show a slight increase in the lower Snake River in 2007. We have not consistently sampled in the Snake River reservoirs like we have in other areas and consequently have gaps in our data set. Ward and Zimmerman (1999) suggested the first evidence of any response by smallmouth bass would likely be a change in diet; therefore, smallmouth bass should continue to be monitored.

The abundance of walleye in the Snake River reservoirs is negligible compared to other predators such as northern pikeminnow and smallmouth bass, but the fact that we caught some this year warrants a mention. Since 1991 there has only been one other year we have captured walleye during biological indexing in Snake River reservoirs. In Lower Monumental Reservoir we captured a single walleye in the tailrace section in 1999. In Lower Monumental Reservoir in 2007 we captured 21 walleye in the tailrace section and 12 walleye in the mid-reservoir section. The average relative weight for walleye in 2007 was 90.8; this is the low end of the range considered to be "ideal" for walleye (SDGFP 2007; TWRA 2007). Juvenile salmonids have been found to be an important component of lower Columbia River walleye diets (Poe et al. 1991; Vigg et al. 1991; Zimmerman 1999) and Takata et al. (2007) found *Oncorhynchus* spp. most often in walleye digestive tracts in The Dalles and John Day reservoirs. We did not find similar results in Lower Monumental reservoir however. The majority of fish eaten by walleye in 2007 were peamouth chub. Although walleye abundance in the lower Snake River is low, other areas such as the McNary Dam tailrace have relatively high concentrations of walleye. Therefore, the impact of walleye predation on salmonid populations likely varies from area to area, and further monitoring of walleye population parameters and diets would be prudent.

Previous evaluations of the NPMP have not detected responses by the predator community to the sustained removal of northern pikeminnow (Ward et al. 1995; Ward and Zimmerman 1999; Zimmerman and Ward 1999). In 2007, we found some indications of possible localized responses to the removal program such as the change in age structure of northern pikeminnow and smallmouth bass, the slight increase in smallmouth bass consumption and predation indices, and the occurrence of walleye catch in Lower Monumental reservoir. However, whether these changes occurred due to reductions in the northern pikeminnow population or increases in the number of migrating smolts, or a combination of factors, is difficult to determine. Density dependent compensatory responses by fish populations can be hard to identify (Rose et al. 2001), and a system-wide response difficult to ascertain. Additionally, observable responses to fishery management programs have been known to lag by more than 15 years from project inception (Hilborn and Winton 1993; Beamesderfer et al. 1996). It is possible that, although we are seeing potential localized responses, not enough time has elapsed for a system-wide response to be detected. Therefore, it is critical to continue monitoring to properly assess the impact of the NPMP.

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Appendix A

Sampling Effort and Timing in the Lower Columbia and Snake Rivers

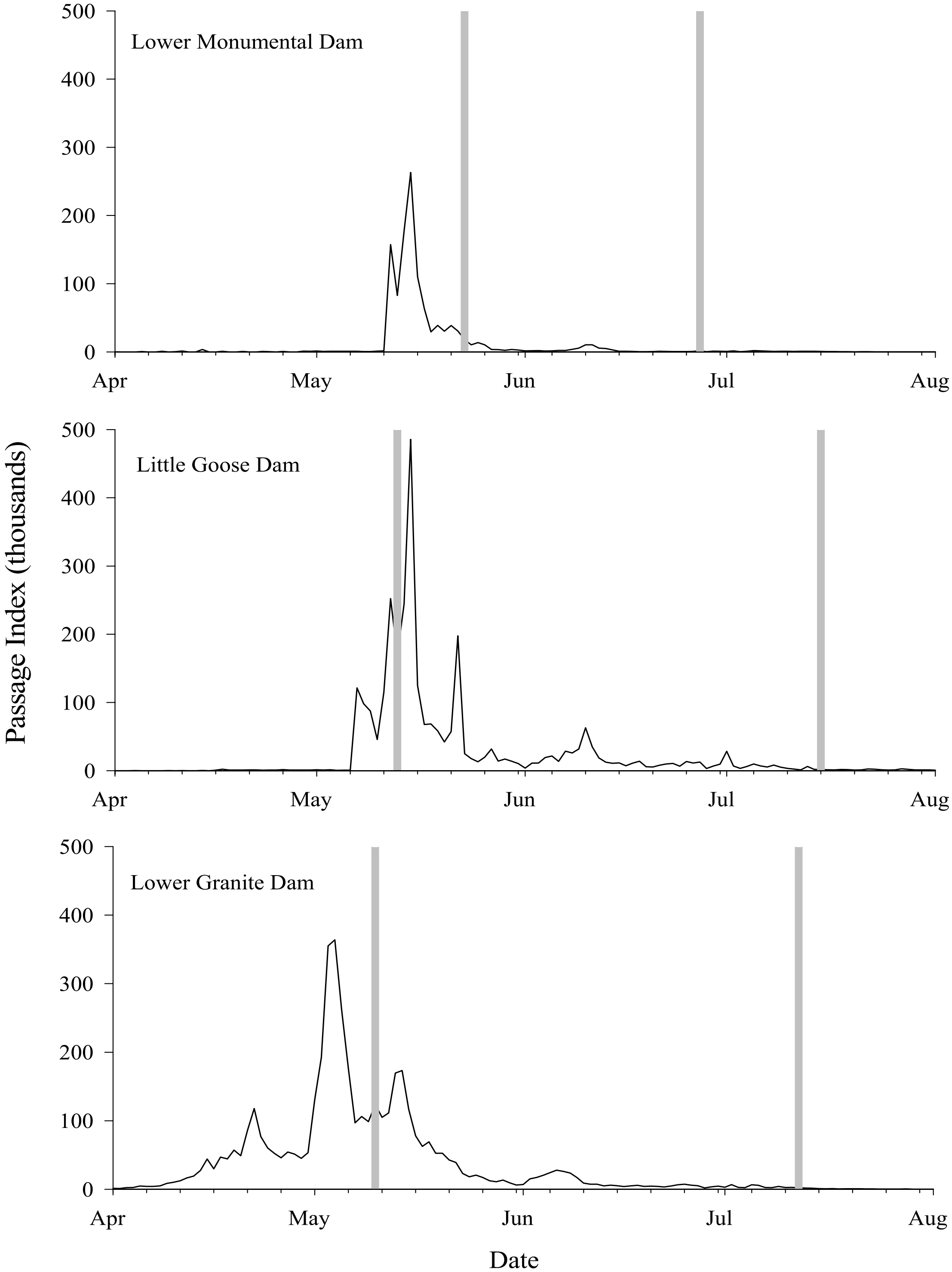
APPENDIX TABLE A-1.—Dates of 2007 sampling weeks.

Sampling Week	Dates
12	19 March - 25 March
13	26 March - 1 April
14	2 April - 8 April
15	9 April - 15 April
16	16 April - 22 April
17	23 April - 29 April
18	30 April - 6 May
19	7 May - 13 May
20	14 May - 20 May
21	21 May - 27 May
22	28 May - 3 June
23	4 June - 10 June
24	11 June - 17 June
25	18 June - 24 June
26	25 June - 1 July
27	2 July - 8 July
28	9 July - 15 July
29	16 July - 22 July
30	23 July - 29 July
31	30 July - 5 August
32	6 August - 12 August
33	13 August - 19 August
34	20 August - 26 August
35	27 August - 2 September
36	3 September - 9 September
37	10 September - 16 September
38	17 September - 23 September
39	24 September - 30 September
40	1 October - 7 October
41	8 October - 14 October

APPENDIX TABLE A-2. —Sampling effort (number of 15-minute electrofishing runs) for biological indexing in the lower Columbia and Snake rivers, 1990-1996, 1999, and 2004-2007. rkm = river kilometer and -- = area not sampled.

Reservoir/area reach	1990	1991	1992	1993	1994	1995	1996	1999	2004	2005	2006	2007
Below Bonneville Dam												
rkm 114-121	--	--	68	--	36	45	43	44	22	48	--	--
rkm 172-178	--	--	65	--	33	36	35	47	31	48	--	--
rkm 190-197	--	--	64	--	43	40	40	40	32	48	--	--
Tailrace	39	--	60	25	35	24	31	29	55	82	--	--
Bonneville												
Forebay	47	--	--	35	97	79	80	62	35	101	--	--
Mid-reservoir	52	--	--	28	84	45	57	57	35	58	--	--
Tailrace	52	--	--	31	68	80	69	71	43	74	--	--
The Dalles												
Forebay	62	--	--	31	92	62	59	--	--	--	78	--
Mid-reservoir	--	--	--	--	--	--	--	--	--	--	95	--
Tailrace	56	--	--	26	48	35	31	71	5	--	74	--
John Day												
Forebay	56	61	68	44	91	75	75	52	28	--	75	--
Mid-reservoir	61	58	62	43	43	94	94	–	15	--	80	--
Tailrace	55	59	64	46	74	80	80	62	51	--	76	--
Ice Harbor												
Forebay	--	57	--	--	--	--	--	--	--	--	--	37
Mid-reservoir	--	59	--	--	--	--	--	--	--	--	--	40
Tailrace	--	67	--	--	--	--	--	--	--	--	--	40
Lower Monumental												
Forebay	--	66	--	--	--	--	--	--	--	--	--	40
Mid-reservoir	--	61	--	--	--	--	--	--	--	--	--	36
Tailrace	--	56	--	--	44	46	32	14	30	--	--	37
Little Goose												
Forebay	--	61	--	--	--	--	--	--	--	--	--	40
Mid-reservoir	--	55	--	--	--	--	--	--	--	--	--	24
Tailrace	--	57	--	--	39	40	37	29	30	--	--	20

Lower Granite rkm 222-228	--	55	--	--	85	89	89	75	34	--	--	96



APPENDIX FIGURE A-1. –Timing of index sampling in 2007 with respect to juvenile salmonid passage (all species) at Lower Monumental, Little Goose, and Lower Granite dams. Shaded areas indicate dates of sampling in the vicinity of each dam. The passage index is the number of fish passing the dam, adjusted for river flow.

Appendix B

Exploitation Rates for Northern Pikeminnow

APPENDIX TABLE B-1.—Number of northern pikeminnow tagged and recaptured in the sport- reward fishery during 2007.

Area or reservoir	≥ 200 mm FL		200 - 249 mm FL		≥ 250 mm FL	
	Tagged	Recaptured	Tagged	Recaptured	Tagged	Recaptured
Below Bonneville Dam	205	37[a]	16	1	189	36[a]
Bonneville	120	12[a]	24	1	95	11[a]
The Dalles	31	3	5	0	26	3
John Day	18	1	5	0	13	1
McNary	133	7	30	0	103	7
Little Goose	12	4	9	2	3	2
Lower Granite	56	7[a]	17	0	39	7[a]
All areas	575	71	106	4	468	67

[a]Includes fish recaptured in a different area or reservoir than originally tagged and not included in area or reservoir-specific exploitation rate calculations.

APPENDIX TABLE B-2.—Exploitation rates (%) of northern pikeminnow ≥ 200 mm FL for the sport-reward fishery, 2002 – 2007. Exploitation rates were not corrected for tag loss in 2002. X = no exploitation rate calculated ($n < 4$) and "–" = area not sampled.

Area or reservoir	2002	2003	2004	2005	2006	2007
Below Bonneville Dam	10.8	11.8	18.8	21.6	14.6	18.4
Bonneville	5.0	11.0	11.7	8.0	10.5	9.6
The Dalles	X	X	X	14.9	22.4	X
John Day	X	X	X	X	X	X
McNary	7.6	6.6	X	9.6	10.7	5.9
Little Goose	–	–	–	–	20.0	35.0
Lower Granite	11.6	X	19.6	X	X	11.8
All areas	10.6	10.5	17.0	16.3	14.6	15.3

APPENDIX TABLE B-3.—Exploitation rates (%) of northern pikeminnow 200 - 249 mm FL for the sport-reward fishery, 2002 – 2007. Exploitation rates were not corrected for tag loss in 2002. X = no exploitation rate calculated (*n* < 4) and "–" = area not sampled.

Area or reservoir	2002	2003	2004	2005	2006	2007
Below Bonneville Dam	3.1	X	X	X	9.6	X
Bonneville	X	X	X	X	6.7	X
The Dalles	X	X	X	X	X	X
John Day	X	X	X	X	X	X
McNary	X	X	X	X	X	X
Little Goose	–	–	–	–	17.4	X
Lower Granite	X	X	X	X	X	X
All areas	3.4	X	10.9	X	9.9	X

APPENDIX TABLE B-4.—Exploitation rates (%) of northern pikeminnow ≥ 250 mm FL for the sport-reward fishery, 2002 – 2007. Exploitation rates were not corrected for tag loss in 2002. X = no exploitation rate calculated (*n* < 4) and "–" = area not sampled.

Area or reservoir	2002	2003	2004	2005	2006	2007
Below Bonneville Dam	12.6	13.6	20.1	23.1	15.6	19.4
Bonneville	6.0	16.7	9.3	8.2	13.7	11.1
The Dalles	X	X	X	18.0	25.3	X
John Day	X	X	X	X	X	X
McNary	7.7	8.2	X	13.0	11.2	7.5
Little Goose	–	–	–	–	26.3	X
Lower Granite	14.3	X	23.8	X	X	17.3
All areas	12.3	13.0	18.5	19.0	17.1	17.8

APPENDIX TABLE B-5.—System-wide weekly exploitation rates of northern pikeminnow ≥ 200 mm FL for the sport-reward fishery in 2007. Dashes indicate either no tagging effort, no recapture effort, or no exploitation calculated.

Sampling Week	Tagged	Recaptured	At-Large	Exploitation[a] (%)
12	7	–	–	–
13	5	–	7	–
14	18	–	12	–
15	16	–	30	–
16	159	–	46	–
17	101	–	205	–
18	50	–	306	–
19	20	–	356	–
20	5	2	376	0.6
21	3	2	379	0.6
22	15	3	380	0.8
23	3	4	392	1.1
24	94	5	391	1.3
25	79	3	480	0.7
26	–	6	556	1.1
27	–	2	549[b]	0.4
28	–	6	547	1.2
29	–	4	541	0.8
30	–	3	537	0.6
31	–	3	534	0.6
32	–	5	531	1.0
33	–	0	526	0.0
34	–	3	525[b]	0.6
35	–	3	522	0.6
36	–	2	519	0.4
37	–	4	517	0.8
38	–	2	513	0.4
39	–	5	511	1.0
40	–	2	506	0.4
41	–	2	504	0.4
42	–	–	502	–

Total	575	71	502	15.3

[a] Exploitation rates adjusted for tag loss (5.0%).
[b] Additional fish subtracted from at-large pool due to removal by other fisheries.

Appendix C

Biological Evaluation of Northern Pikeminnow, Smallmouth Bass, and Walleye in the Lower Snake Rivers

APPENDIX TABLE C-1.—Catch per 15-minute electrofishing run (CPUE) of northern pikeminnow ≥ 250 mm fork length captured during biological indexing of the lower Snake River in 1991, 1994-1996, 1999, 2004, and 2007. "--" = area not sampled.

Reservoir or Reach	CPUE						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	<0.1	--	--	--	--	--	<0.1
Mid-reservoir	0.3	--	--	--	--	--	0.0
Tailrace	0.5	--	--	--	--	--	0.2
Tailrace BRZ	4.2	--	--	--	--	--	--
Lower Monumental							
Forebay	0.5	--	--	--	--	--	<0.1
Mid-reservoir	1.9	--	--	--	--	--	0.2
Tailrace	1.5	0.3	0.1	0.2	0.0	0.1	0.0
Tailrace BRZ	16.3	1.2	3.9	1.0	0.0	0.8	--
Little Goose							
Forebay	0.8	--	--	--	--	--	<0.1
Mid-reservoir	0.5	--	--	--	--	--	0.0
Tailrace	1.6	0.5	0.1	0.3	0.3	0.3	<0.1
Tailrace BRZ	28.3	6.4	10.3	1.0	0.0	3.3	--
Lower Granite							
Upper reservoir	1.9	0.5	0.2	0.3	0.2	0.1	0.1

APPENDIX TABLE C-2. — Spring and summer catch per 15-minute electrofishing run (CPUE) of northern pikeminnow ≥ 250 mm FL captured in 2007 during biological indexing in the lower Snake River.

Reservoir or Reach	CPUE	
Area	Spring	Summer
Ice Harbor		
Forebay	0.00	0.06
Mid-reservoir	0.00	0.00
Tailrace	0.00	0.35
Lower Monumental		
Forebay	0.05	0.00
Mid-reservoir	0.08	0.21
Tailrace	0.00	0.00
Little Goose		
Forebay	0.05	0.00
Mid-reservoir	0.00	0.00
Tailrace	0.00	0.05
Lower Granite		
Upper Reservoir	0.23	0.00

APPENDIX TABLE C-3. — Spring and summer catch per 15-minute electrofishing run (CPUE) of smallmouth bass ≥ 200 mm FL captured in 2007 during biological indexing in the lower Snake River.

Reservoir or Reach	CPUE	
Area	Spring	Summer
Ice Harbor		
Forebay	1.25	3.53
Mid-reservoir	1.81	3.13
Tailrace	5.70	5.55
Lower Monumental		
Forebay	2.55	3.65
Mid-reservoir	3.50	2.21
Tailrace	5.94	5.35
Little Goose		
Forebay	4.60	4.30
Mid-reservoir	1.63	2.58
Tailrace	0.95	0.85
Lower Granite		
Upper Reservoir	4.50	3.29

APPENDIX TABLE C-4. — Spring and summer catch per 15-minute electrofishing run (CPUE) of walleye ≥ 200 mm FL captured in 2007 during biological indexing in the lower Snake River.

Reservoir or Reach	CPUE	
Area	Spring	Summer
Ice Harbor		
Forebay	0.00	0.00
Mid-reservoir	0.00	0.00
Tailrace	0.00	0.00
Lower Monumental		
Forebay	0.00	0.00
Mid-reservoir	0.58	0.21
Tailrace	0.41	0.70
Little Goose		
Forebay	0.00	0.00
Mid-reservoir	0.00	0.00
Tailrace	0.00	0.00
Lower Granite		
Upper Reservoir	0.00	0.00

APPENDIX TABLE C-5.—Abundance index values for northern pikeminnow ≥ 250 mm fork length in the lower Snake River, 1991, 1994-1996, 1999, 2004, and 2007. "--" = not sampled.

Reservoir or Reach	Abundance Index						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	0.1	--	--	--	--	--	<0.1
Mid-reservoir	1.0	--	--	--	--	--	0.0
Tailrace	0.3	--	--	--	--	--	0.1
Tailrace BRZ	0.2	--	--	--	--	--	--
Lower Monumental							
Forebay	0.5	--	--	--	--	--	<0.1
Mid-reservoir	2.9	--	--	--	--	--	0.3
Tailrace	1.3	0.3	0.1	0.1	0.0	0.1	0.0
Tailrace BRZ	0.8	0.1	0.2	0.1	0.0	<0.1	--
Little Goose							
Forebay	1.2	--	--	--	--	--	<0.1
Mid-reservoir	1.7	--	--	--	--	--	0.0
Tailrace	0.7	0.2	<0.1	0.1	0.1	0.1	<0.1
Tailrace BRZ	1.7	0.4	0.6	0.1	0.0	0.2	--
Lower Granite							
Upper reservoir	1.6	0.5	0.2	0.2	0.3	0.1	0.1

APPENDIX TABLE C-6.—Spring relative density of smallmouth bass ≥ 200 mm fork length in the lower Snake River, 1991, 1994-1996, 1999, 2004, and 2006. "--"= not sampled. Relative density is mean transformed catch ($\log_{10}$ (catch+1)) per 15-minute electrofishing run

Reservoir or Reach	Relative Density						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	0.3	--	--	--	--	--	0.2
Mid-reservoir	0.4	--	--	--	--	--	0.3
Tailrace	0.7	--	--	--	--	--	0.6
Tailrace BRZ	0.1	--	--	--	--	--	--
Lower Monumental							
Forebay	0.4	--	--	--	--	--	0.4
Mid-reservoir	0.3	--	--	--	--	--	0.4
Tailrace	0.6	0.4	0.2	0.1	0.5	0.0	0.7
Tailrace BRZ	0.6	0.3	0.2	0.0	0.3	0.0	--
Little Goose							
Forebay	0.6	--	--	--	--	--	0.6
Mid-reservoir	0.7	--	--	--	--	--	0.3
Tailrace	--	0.7	0.4	0.4	0.4	0.0	0.2
Tailrace BRZ	--	0.1	0.4	--	0.3	0.0	--

Lower Granite							
Upper reservoir	--	0.6	0.3	0.3	0.3	0.2	0.5

APPENDIX TABLE C-7.—Summer relative density of smallmouth bass ≥ 200 mm fork length in the lower Snake River, 1991, 1994-1996, 1999, 2004, and 2006. "--"= not sampled. Relative density is mean transformed catch ($\log_{10}$ (catch+1)) per 15-minute electrofishing run

Reservoir or Reach	Relative Density						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	0.1	--	--	--	--	--	0.5
Mid-reservoir	0.3	--	--	--	--	--	0.5
Tailrace	0.3	--	--	--	--	--	0.7
Tailrace BRZ	0.7	--	--	--	--	--	--
Lower Monumental							
Forebay	0.2	--	--	--	--	--	0.6
Mid-reservoir	0.2	--	--	--	--	--	0.4
Tailrace	0.3	0.5	0.2	0.3	--	1.0	0.6
Tailrace BRZ	0.2	0.4	0.5	0.2	--	0.6	--
Little Goose							
Forebay	0.4	--	--	--	--	--	0.6
Mid-reservoir	0.4	--	--	--	--	--	0.4
Tailrace	0.5	0.4	0.3	0.2	--	0.2	0.2
Tailrace BRZ	0.3	0.5	0.5	0.2	0.0	0.6	--
Lower Granite							
Upper reservoir	0.6	0.3	0.4	0.1	0.0	0.3	0.4

APPENDIX TABLE C-8.—Relative density of walleye ≥ 200 mm fork length in Lower Monumental Reservoir, 1999 and 2007. "--"= not sampled. Relative density is mean transformed catch ($\log_{10}$ (catch+1)) per 15-minute electrofishing run

Reservoir or Reach[a]	Relative Density			
	1999[a]		2007	
Area	Spring	Summer	Spring	Summer
Lower Monumental				
Forebay	--	--	0.0	0.0
Mid-reservoir	--	--	0.4	0.4
Tailrace	0.3	--	0.4	0.6
Tailrace BRZ	0.0	--	--	--

[a] Walleye have been captured during 1999 and 2007 indexing seasons in Lower Monumental Reservoir only, other areas and years were omitted to simplify this table.

APPENDIX TABLE C-9.—Number (*N*) of northern pikeminnow, smallmouth bass, and walleye digestive tracts examined from the Snake River in 2007, and percent that contained food, fish, and *Oncorhynchus* spp. (Sal).

Season, reservoir	Northern pikeminnow *N*	Northern pikeminnow Percent Food	Fish	Sal	Smallmouth bass *N*	Smallmouth bass Percent Food	Fish	Sal	Walleye *N*	Walleye Percent Food	Fish	Sal
Spring												
Ice Harbor	3	33	0	0	166	79	27	2	0	0	0	0
Lower Monumental	5	80	40	40	189	83	21	5	14	93	86	21
Little Goose	7	57	14	0	148	74	34	8	0	0	0	0
Lower Granite	13	62	38	38	212	86	15	9	0	0	0	0
All reservoirs	28	61	29	25	715	81	23	6	14	93	86	21
Summer												
Ice Harbor	22	82	14	9	244	84	15	2	0	0	0	0
Lower Monumental	10	60	0	0	234	84	14	0	19	95	79	0
Little Goose	7	100	57	0	165	84	25	1	0	0	0	0
Lower Granite	0	0	0	0	157	80	20	6	0	0	0	0
All reservoirs	39	79	18	5	800	83	18	2	19	95	79	0

APPENDIX TABLE C-10.—Percent species composition of fish consumed by northern pikeminnow, smallmouth bass, and walleye in the Snake River, 2007. ICH = Ice Harbor Reservoir, LMO = Lower Monumental Reservoir, LGO = Little Goose Reservoir, LGR = Lower Granite Reservoir and number of samples containing identifiable fish are in parenthesis.

	Northern pikeminnow				Smallmouth bass				Walleye
Taxa	ICH (3)	LMO (2)	LGO (4)	LGR (5)	ICH (70)	LMO (62)	LGO (75)	LGR (58)	LMO (24)
Lepomis spp.	0	0	0	0	0	3	1	0	0
Micropterus spp.	33	0	0	0	5	9	16	3	1
Oncorhynchus spp.	67	100	0	100	10	14	16	50	3
Lampetra spp.	0	0	20	0	0	0	0	2	0
Cyprinidae	0	0	20	0	0	0	0	2	0
Acrocheilus alutaceus	0	0	0	0	0	2	0	0	1
Mylocheilus caurinus	0	0	60	0	4	6	2	10	70
Ptylocheilus oregonensis	0	0	0	0	0	2	0	2	2
Catostomus spp.	0	0	0	0	4	6	1	5	20
Ictalardae*	0	0	0	0	28	31	8	16	0
Percopsis transmontana	0	0	0	0	8	9	34	3	3
Cottus spp.	0	0	0	0	42	18	20	7	1
Centrachidae	0	0	0	0	0	0	1	0	0

* Both *Ameiurus spp.* and *Ictalurus spp.* are included in this category

APPENDIX TABLE C-11.—Spring consumption indices for northern pikeminnow ≥ 250 mm fork length in the Snake River, 1991, 1994-1996, 1999, 2004, and 2007. BRZ = boat-restricted zone and "--" = area not sampled.

Reservoir or Reach	Consumption index						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	0.0	--	--	--	--	--	X[b]
Mid-reservoir	0.4	--	--	--	--	--	X[b]
Tailrace	0.5	--	--	--	--	--	X[b]
Tailrace BRZ	1.1	--	--	--	--	--	--
Lower Monumental							
Forebay	0.0	--	--	--	--	--	X[a]
Mid-reservoir	0.0	--	--	--	--	--	X[a]
Tailrace	0.6	0.8	X[a]	X[a]	X[b]	X[b]	X[b]
Tailrace BRZ	0.6	X[b]	1.3	X[a]	X[b]	X[b]	--
Little Goose							
Forebay	0.8	--	--	--	--	--	X[a]
Mid-reservoir	0.0	--	--	--	--	--	X[b]
Tailrace	0.7	2.0	X[a]	0.7	X[a]	X[a]	X[b]
Tailrace BRZ	0.8	2.6	1.6	X[c]	--	X[a]	--
Lower Granite							
Upper reservoir	0.3	1.1	1.2	0.3	2.0	X[a]	1.0

[a] No stomach data collected.
[b] No northern pikeminnow collected.

APPENDIX TABLE C-12.—Summer consumption indices for northern pikeminnow ≥ 250 mm fork length in the Snake River 1991, 1994-1996, 1999, 2004, and 2007. BRZ = boat-restricted zone and "--" = area not sampled.

Reservoir or Reach	Consumption index						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	X[a]	--	--	--	--	--	X[b]
Mid-reservoir	X[a]	--	--	--	--	--	X[c]
Tailrace	X[a]	--	--	--	--	--	2.0
Tailrace BRZ	X[a]	--	--	--	--	--	--
Lower Monumental							
Forebay	X[a]	--	--	--	--	--	X[c]
Mid-reservoir	X[a]	--	--	--	--	--	X[b]
Tailrace	X[a]	X[b]	X[b]	X[b]	--	X[b]	X[c]
Tailrace BRZ	X[a]	0.0	0.0	0.0	--	1.9	--
Little Goose							
Forebay	X[a]	--	--	--	--	--	X[a]
Mid-reservoir	X[a]	--	--	--	--	--	X[a]
Tailrace	X[a]	X[b]	X[c]	X[b]	X[b]	0.0	X[b]
Tailrace BRZ	X[a]	1.2	0.4	X[b]	X[c]	0.0	--
Lower Granite							
Upper reservoir	X[a]	X[a]	X[b]	X[b]	X[b]	X[b]	X[c]

[a] No stomach data collected.
[b] No consumption index calculated ($N \leq 5$).
[c] No northern pikeminnow collected.

APPENDIX TABLE C-13.—Spring consumption indices for smallmouth bass ≥ 200 mm fork length in the Snake River 1991, 1994-1996, 1999, 2004, and 2007. BRZ = boat-restricted zone and "--" = area not sampled.

Reservoir or Reach	Consumption index						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	0.0	--	--	--	--	--	0.1
Mid-reservoir	<0.1	--	--	--	--	--	<0. 1
Tailrace	0.0	--	--	--	--	--	<0.1
Tailrace BRZ	0.0	--	--	--	--	--	--
Lower Monumental							
Forebay	<0.1	--	--	--	--	--	0.1
Mid-reservoir	0.0	--	--	--	--	--	<0.1
Tailrace	0.0	0.1	0.0	0.0	<0.1	X[b]	<0.1
Tailrace BRZ	0.0	X[a]	X[a]	X[b]	X[a]	X[b]	--
Little Goose							
Forebay	<0.1	--	--	--	--	--	0.1
Mid-reservoir	<0.1	--	--	--	--	--	0.1
Tailrace	<0.1	0.1	0.0	<0.1	<0.1	X[b]	0.0
Tailrace BRZ	<0.1	X[a]	<0.1	--	X[a]	X[b]	--
Lower Granite							
Upper reservoir	0.1	0.2	0.1	<0.1	0.1	0.2	0.1

[a] No consumption index calculated ($n \leq 5$).
[b] No smallmouth bass collected.

APPENDIX TABLE C-14.—Summer consumption indices for smallmouth bass ≥ 200 mm fork length in the Snake River 1991, 1994-1996, 1999, 2004, and 2007. BRZ = boat-restricted zone "--" = area not sampled.

Reservoir or Reach	Consumption index						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	X[a]	--	--	--	--	--	<0.1
Mid-reservoir	X[a]	--	--	--	--	--	0.1
Tailrace	X[a]	--	--	--	--	--	<0.1
Tailrace BRZ	X[a]	--	--	--	--	--	--
Lower Monumental							
Forebay	X[a]	--	--	--	--	--	0.0
Mid-reservoir	X[a]	--	--	--	--	--	0.0
Tailrace	X[a]	X[a]	0.0	0.0	--	X[a]	0.0
Tailrace BRZ	X[a]	X[a]	0.0	X[b]	--	X[a]	--
Little Goose							
Forebay	X[a]	--	--	--	--	--	0.1
Mid-reservoir	X[a]	--	--	--	--	--	0.0
Tailrace	X[a]	X[a]	0.0	0.0	X[c]	X[a]	0.1
Tailrace BRZ	X[a]	X[a]	0.0	X[b]	--	X[a]	--
Lower Granite							
Upper reservoir	X[a]	X[a]	0.0	0.0	0.2	0.2	0.2

[a] No stomach data collected.
[b] No consumption index calculated ($n \leq 5$).
[c] No smallmouth bass collected.

APPENDIX TABLE C-15.—Spring predation indices for northern pikeminnow ≥ 250 mm fork length in the Snake River, 1991, 1994-1996, 1999, 2004, and 2007. BRZ = boat-restricted zone and "--" = area not sampled.

Reservoir or Reach	Predation Index						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	0.0	--	--	--	--	--	X[c]
Mid-reservoir	0.4	--	--	--	--	--	X[c]
Tailrace	0.2	--	--	--	--	--	X[c]
Tailrace BRZ	0.2	--	--	--	--	--	--
Lower Monumental							
Forebay	0.0	--	--	--	--	--	X[b]
Mid-reservoir	0.0	--	--	--	--	--	X[b]
Tailrace	0.5	0.2	X[b]	X[b]	X[c]	X[c]	X[c]
Tailrace BRZ	0.8	X[c]	0.3	X[b]	X[c]	X[c]	--
Little Goose							
Forebay	1.3	--	--	--	--	--	X[b]
Mid-reservoir	0.0	--	--	--	--	--	X[c]
Tailrace	0.7	0.3	X[b]	0.1	X[b]	X[b]	X[c]
Tailrace BRZ	0.8	1.0	1.0	X[c]	--	X[b]	--
Lower Granite							
Upper reservoir	0.3	0.5	0.2	0.1	0.5	X[b]	0.1

[a] No stomach data collected.
[b] No predation index calculated ($N \leq 5$).
[c] No northern pikeminnow collected.

APPENDIX TABLE C-16.—Summer predation indices for northern pikeminnow ≥ 250 mm fork length in the Snake River, 1991, 1994-1996, 1999, 2004, and 2007. BRZ = boat-restricted zone and "--" = area not sampled.

Reservoir or Reach	Predation Index						
Area	1991	1994	1995	1996	1999	2004	2007
Ice Harbor							
Forebay	X[a]	--	--	--	--	--	X[b]
Mid-reservoir	X[a]	--	--	--	--	--	X[c]
Tailrace	X[a]	--	--	--	--	--	0.2
Tailrace BRZ	X[a]	--	--	--	--	--	--
Lower Monumental							
Forebay	X[a]	--	--	--	--	--	X[c]
Mid-reservoir	X[a]	--	--	--	--	--	X[b]
Tailrace	X[a]	X[b]	X[b]	X[b]	--	X[b]	X[c]
Tailrace BRZ	X[a]	0.0	0.0	0.0	--	0.1	--
Little Goose							
Forebay	X[a]	--	--	--	--	--	X[a]
Mid-reservoir	X[a]	--	--	--	--	--	X[a]
Tailrace	X[a]	X[b]	X[c]	X[b]	X[b]	0.0	X[b]
Tailrace BRZ	X[a]	0.5	0.2	X[b]	X[c]	0.0	--
Lower Granite							
Upper reservoir	X[a]	X[a]	X[b]	X[b]	X[b]	X[b]	X[c]

[a] No stomach data collected.
[b] No predation index calculated ($N \leq 5$).
[c] No northern pikeminnow collected.

APPENDIX TABLE C-17.—Spring and summer predation indices for smallmouth bass ≥ 200 mm fork length in the Snake River, 2004 and 2007. BRZ = boat-restricted zone and "--" = area not sampled

Reservoir or Reach	Predation Index			
	2004		2007	
Area	Spring	Summer	Spring	Summer
Ice Harbor				
Forebay	--	--	0.1	0.2
Mid reservoir	--	--	0.2	0.6
Tailrace	--	--	0.0	0.1
Tailrace BRZ	--	--	--	--
Lower Monumental				
Forebay	--	--	0.2	0.0
Mid reservoir	--	--	0.2	0.0
Tailrace	X[a]	X[a]	0.2	0.0
Tailrace BRZ	X[a]	X[a]	--	--
Little Goose				
Forebay	--	--	0.5	0.3
Mid reservoir	--	--	0.4	0.0
Tailrace	X[a]	X[a]	0.0	0.0
Tailrace BRZ	X[a]	X[a]	--	--
Lower Granite				
Upper reservoir	0.2	0.4	0.3	0.5

[a] No stomach data collected.
[b] no predation index calculated ($n \leq 5$).
[c] No smallmouth bass collected

APPENDIX TABLE C-18.—Spring and summer predation indices for northern pikeminnow ≥ 250 and smallmouth bass ≥ 200 mm fork length in the Snake River, 2007. BRZ = boat-restricted zone and "--" = area not sampled.

Reservoir or Reach	Predation Index			
	Northern pikeminnow		Smallmouth bass	
Area	Spring	Summer	Spring	Summer
Ice Harbor				
Forebay	X[b]	X[a]	0.1	0.2
Mid reservoir	X[b]	X[a]	0.2	0.6
Tailrace	X[b]	0.2	0.0	0.1
Tailrace BRZ	--	--	--	--
Lower Monumental				
Forebay	X[a]	X[b]	0.2	0.0
Mid reservoir	X[a]	X[a]	0.2	0.0
Tailrace	X[a]	X[b]	0.2	0.0
Tailrace BRZ	--	--	--	--
Little Goose				
Forebay	X[b]	X[b]	0.5	0.3
Mid reservoir	X[b]	X[b]	0.4	0.0
Tailrace	X[b]	X[a]	0.0	0.0
Tailrace BRZ	--	--	--	--
Lower Granite				
Upper reservoir	0.1	X[b]	0.3	0.5

[a] No predation index calculated ($n \leq 5$).
[b] No northern pikeminnow or smallmouth bass collected

Report D

2007 Dam Angling Season Report

Prepared by

U.S. Department of Agriculture
Animal & Plant Health Inspection Service
Wildlife Services

March, 2008

Methods

Manpower used -We utilized a 5 person angling crew 40 hrs a week for 16 weeks + administrative oversight

Fishing locations -John Day and The Dalles dam tailraces were fished during this season with efforts split unequally between the two projects.

Angling techniques/gear -A variety of baits, lures and techniques were used in an effort to maximize catch rates. The following is a brief list of some of the methods tried and the results.

Natural Baits- Worms, dead minnows, crickets. These baits were moderately successful all season long and in periods of sluggish fish behavior they outshined artificial baits. Keeping the bait fresh and on the hook was difficult when summer temperatures rose and fish became aggressive. Natural bait involved rigging time between fish resulting in time out of the water. Worms and minnows worked best early and late in the season.

Soft Plastic Tube Baits- These baits are a soft plastic in the shape of a tube. The tube is closed on one end and open on the other with fingers cut into the open end. They look like a squid and come in a variety of colors. They can be weighted with the addition of an egg sinker inside the tube or a sinker on a dropper line to get them down to the level of the fish. These baits were most effective during an active or wide open bite when the fish were aggressively feeding. A variety of colors were tried with the favorite colors being greens, reds, and off color browns all with some degree of metallic flake in them. As the fish stack up behind the dams they can be caught on the surface early and late in the day, but tended to go deeper as the sun rose. This type of bait once rigged is good for several fish without needed to be re-rigged, which saves angling time. It doesn't produce as well as the natural baits if the fish are lethargic. In an active bite it can out fish the natural baits.

Soft Plastic Worm Baits- These are soft plastic worm like baits. We had success similar to the tube baits with these. They tend to be a little longer and a double hook set up is needed to optimize their fish catching abilities. This can be detrimental in active bite conditions as it takes longer to tie up two hooks and there is a slight chance the extra hook could catch the angler if a fish is thrashing about. It takes a little extra time and caution to unhook a worm with two hooks. A single hooked tube will outperform a worm generally, due to the bait being in the water a greater percentage of time. This lure doesn't work well for non aggressive fish or in times of colder water temperatures.

Soft Plastic Swim baits- These can come in any variety of shapes and resemble swimming vertebrates and invertebrates, such as fish, salamanders, frogs and leaches. Some may have a hard lip to impart action but many don't. Limited experimentation with different shapes yielded no greater success than with the soft plastic tubes or worms.

Most experimentation focused on minnow-like baits. The minnow-like baits seem to tear more easily and lose their functionality earlier than other plastic lures which still perform okay with a lost finger/tentacle. A good application of this lure may be when the "resident" fish are wise to a heavily fished pattern or lure. Casting in a new look or look similar to natural bait may trigger reaction strikes. Salmon/shad colors appeared to work best for us.

Wooden plugs- These balsa wood plugs imitate a wounded minnow. These worked well on surface fish during warmer periods of the season. They are easily suspended for a pause and retrieve technique which triggered strikes when fish got finicky. Due to cost they are not economically feasible as a mainstay. They are also hard to fish deep for midday fish.

Metal Lures- We tried spoons and spinners in this category. Both produced well on surface fish mid-season, but using them at depth was hard. They are a variety of lure used as catch rates slow in a given area and the fish need a change of pace. Not generally a "go to" lure but there were times where it was an effective alternative. Spinners appeared to work better than spoons.

I. Results

A. The Dalles

1. Fishing Effort – 952 hours and 33 days fished (Table 1
2. Catch- 2910 northern pikeminnow *Ptychocheilus oregonensis*
3. Bycatch – 86 fish (Table 2)
4. Tagged Fish- 10
5. Size Data-Refer to ODFW data

Table 1. Catch statistics of USDA dam angling activities at The Dalles Dam, 2007.

Location	Hours	Days	# of Pikeminnow	By-catch total	Tagged Fish
The Dalles	952	33	2910	86	10

Table 2. Summary of bycatch associated with USDA dam angling acitivies at The Dalles Dam, 2007

Bycatch Species	Smallmouth Bass	Sturgeon	Walleye	Catfish	Other
N=86	63	21	0	2	0

B. John Day
1. Fishing Effort – 1695 hours and 55 days fished (Table 3)
2. Catch- 4649 Pikeminnow
3. Bycatch – 167 fish (Table 4)
4. Tagged Fish
5. Size Data- Refer to ODFW data

Table 3. Catch statistics of USDA dam angling activities at John Day Dam, 2007.

Location	Hours	Days	# of Pikeminnow	By-catch total	Tagged Fish
John Day	1695	55	4649	167	1

Table 4. Summary of bycatch associated with USDA dam angling acitivies at John Day Dam, 2007

Species	Smallmouth Bass	Sturgeon	Walleye	Catfish	Other
N=167	129	25	9	1	3

Discussion

John Day- The first week of the season the turbines where running so strong we could not effectively get to the bottom of the river, where the fish were hanging out, with even four ounce sinkers. As a result the first week we fished at The Dalles Dam. Our next try at fishing John Day was May 24th, 2007. Power generation at this project had decreased by this time and with 3-4 oz of weight we could effectively catch fish. The entire crew fished there until the June 6th, 2007 when the crews split to give some effort to figuring out The Dalles. Three of the five fisherman remained at John Day to capitalize on the fish there. During this time spill was occurring from around 6p.m to 7 a.m. and northern pikeminnow were congregating to feed on salmon smolt released during the nighttime spill. The first hours of the morning following the spill we were able to catch large numbers of very large northern pikeminnow weighing 1.4 to 3.2 Kg. We often observed these fish coughing up salmon smolt as they were being brought in. By midmorning this congregation of fish seemed to disperse and traditional areas picked up again. On, June 29th, 2008 the entire crew went to The Dalles Dam to help even out the time spent at each dam. A three person crew returned July 9th,2008 to John Day Dam and had very high catches. The other two crew members from The Dalles rejoined them to maximize the effort, the crew remained together during the rest of the season at John Day Dam except for the occasional day at The Dalles Dam. By mid-August the fishing slowed apparently due to the abundant forage in the river system as the juvenile American shad *Alosa sapidissima* smolt began to filter back downstream. The last two weeks of August became decreasingly productive. Post spawn dispersal of northern pikeminnow may have also contributed to the decrease.

The Dalles - This year the fishing started off at a moderate pace from the beginning due to increased fish activity brought on warmer water temperatures in the second week of May. The first week the entire crew fished this dam due to un-fishable conditions at John Day Dam. After a brief exploratory foray to John Day Dam, two of the fisherman fished The Dalles Dam through the June and the first part of July 2008, after which they helped out at John Day. The ice and trash sluiceway produced a fair number of fish, as did the powerhouse deck. Fish tend to congregate for the spawn at the dams and fishing really picks up at these times. As the American shad start returning back downstream they are also concentrated by the dams and become available in abundance for potential northern pikeminnow consumption.

Suggestions for future operations

In order to capitalize on the most productive fishing times it is recommended that the removal season starts May 15th and goes through August 15th, with some time given before and after these dates for training, security clearance issues, project clean-up, etc.

An additional fisherman should be added to the crew, for safety reasons and ease of splitting the crews and effort between the dams.

Spinning rods have been suggested for fishing in areas not easily covered with the bait casting rods. These will be a supply item in 2008 from USDA.

As of August 1st the spill went from a night time spill to a daytime spill. Due to spill location and the turbulence caused fishing became impossible in some high productive areas, namely the last three gates on the north side of the dam. While changing this is probably not feasible shifting the spill over three gates to the south for the last two weeks of the season would be advantageous for the removal effort.

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A standardized data collection form should be generated to avoid discrepancies and minimize error. See comment below.

A lot of time was donated by our crews to drop off fish after shift hours in order to maximize fishing time at the project. A suggestion would be to work out a more efficient system for fish drop off next year.

Other comments

The numbers used in this report were generated from John Vickrey's journal entries which he recorded in our information management system (MIS). The numbers reflected slight differences from PSMFC's reports as outlined below.

John Day

	Total Angler Hours	Northern Pikeminnow Caught	Sturgeon Caught	Game Fish(including sturgeon)
Miller report	1759	4710	27	168
USDA MIS	1695	4649	25	167
Difference(Miller is…)	64 hours higher	61 fish higher	2 fish higher	1 fish higher

The Dalles

	Total Angler Hours	Northern Pikeminnow Caught	Sturgeon Caught	Game Fish
Miller report	977	2842	24	70
USDA MIS	952	2910	21	86
Difference(Miller is…)	25 hours higher	-68 fish lower	3 fish higher	-16 fish lower

Possible Explanations:

Hours- John may have reported Time Sheet hours a few times to Craig instead of angling hours.

Northern Pikeminnow Caught: The total sum of the two projects are within 7 fish. Reporting or recording error by project name possible.

Sturgeon Caught: Close but something was lost or added in the transfer of information.

Game Fish: John has recorded carp, sculpin and unknown's in his non target fish counts, whereas Craig may not have these.

Suggestion:

These differences could be minimized with a data form that John faxes to Craig rather than calls in. It could have everything John needs to record for us plus all the totals Craig needs for his weekly reports.