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

2009 ANNUAL REPORT

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In Cooperation with:

Oregon Department of Fish and Wildlife
Washington Department of Fish and Wildlife
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2009 Executive Summary
by

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This report presents results for year nineteen 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 spring season (*i.e.*, March through early June). In addition, we initiated a concerted effort

[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.

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 2009 by report are as follows:

Report A

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

1. The objectives for 2009 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.

2. A total of 142,002 northern pikeminnow ≥ 228 mm (total length), and 4,980 pikeminnow < 228 mm (total length) were harvested during the 2009 NPSRF season. With 29,112 angler days spent harvesting these fish in 2009.

3. Anglers submitted 180 northern pikeminnow with external spaghetti tags, 179 of which also had ODFW PIT tags. There were also 121 northern pikeminnow with ODFW PIT tags only, but missing spaghetti tags. An additional 100 PIT tags were recovered from juvenile salmonids ingested by northern pikeminnow received during 2009.

Report B

Northern Pikeminnow Sport-Reward Fishery Payments

1. For 2009 the rewards paid to anglers were the same as in the 2008 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 2009, excluding tagged fish, rewards paid totaled \$868,660 for 139,924 fish.

3. A total of 180 tagged fish vouchers were paid. The total season tag rewards paid totaled \$90,000.

4. A total of 1,215 separate successful anglers caught one or more fish and received payments during the season. A total of 4,479 separate anglers registered to fish, of which many were unsuccessful.

5. A special one-month tournament was held in August to promote more fishing effort. Sixty anglers received prizes of $1,000 each for a total payout of $60,000.

6. The total for all payments for tagged and non-tagged pikeminnows, coupons and drawings in 2009 was $1,025,100.

Report C

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

1. Our objectives in 2009 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 The Dalles and John Day reservoirs, and 3) look for possible compensatory responses by these species.

2. System-wide exploitation in 2009 of northern pikeminnow 250 mm or greater in fork length was 12.8% which incorporated a tag loss of 9.2%.

3. The 2009 estimated reduction in potential predation was estimated at 40% of pre-program levels.

4. Biological indexing was conducted in the The Dalles and John Day reservoirs as part of our predator community evaluation during 2009. Northern pikeminnow abundance indices continued a downward trend in both reservoirs. Of the 19 northern pikeminnow digestive tracts we collected, one contained a juvenile salmonid. Inadequate sample sizes precluded us from calculating consumption indices, predation indices, or proportional stock density and we were unable to complete year-class analysis for either reservoir. Relative weights of northern pikeminnow were within the range of previous years.

5. Of the 837 smallmouth bass stomach contents we collected, 8 contained juvenile salmonid remains. The prey fish most often consumed by smallmouth bass continued to be *Cottus* spp. Abundance, consumption and predation indices remain relatively static with previous years. The proportion of smallmouth bass composed of age-4 and age-5 was the largest relative percentage estimated in The Dalles and John Day reservoirs to date. Proportional stock density was within the generally expected range (score 30–60) for this species in both The Dalles and John Day reservoirs. Relative weights of smallmouth bass are within the range of previous years.

6. Estimates of relative density for walleye were on average less than 1 fish/500m^2 in both reservoirs during 2009. Of the 64 walleye stomach content samples we examined, 18 contained juvenile salmonid remains. Year-class analysis continued to show no discernable trend. Proportional and relative stock density values were within a range of a balanced population, while relative weights of walleye were within the range of previous years.

7. At this time, there does not appear to be a system-wide predator response to the NPMP. However, there may be some early signs of compensation by other piscivores fishes to the sustained removal of northern pikeminnow. These indicators are localized in small areas below Bonneville dam and in Bonneville and John Day reservoirs.

Report D

Dam angling at The Dalles and John Day dams

1. A five man fishing crews was utilized to fish from May 1, 2009 through August 14, 2009 at The Dalles and John Day dams.

2. Fishing for 1237 hours at The Dalles dam resulted in 1,380 northern pikeminnow caught, of which 0 were tagged fish.

3. Fishing for 1,221 hours at John Day dam resulted in 3,989 northern pikeminnow caught, of which 1 was a tagged fish.

Fishing success was best the first couple hours in the morning and some good success right before dark. Overall the spill at the dams had a considerable negative effect on fishing efforts this year. Cold water and high flows made fishing tough. Fishing times were adjusted to various periods, but the 24 hour spill made fishing hard.

Report A

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

2009 Annual Report

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We also recognize Diana Murillo for her excellent work in computer data entry and document verification, Fella Tanaka for her numerous phone survey interviews, Kathleen Moyer for serving as the lead technician for the PIT tag recovery portion of the program, as well as Melissa Dexheimer for producing our weekly field activity reports, overseeing the Sport-Reward hotline, and helping to keep the program operating smoothly throughout the season.

ABSTRACT

We are reporting on the progress of the Northern Pikeminnow Sport-Reward Fishery (NPSRF) implemented by the Washington Department of Fish and Wildlife (WDFW) on the Columbia and Snake Rivers from May 1 through September 27, 2009. 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 142,002 northern pikeminnow ≥ 228 mm, and 4,980 pikeminnow < 228 mm were harvested during the 2009 NPSRF season. There were a total of 4,479 different anglers who spent 29,112 angler days participating in the fishery during the 2009 season. Catch per unit effort for combined returning and non-returning anglers was 4.88 fish/angler day. The Oregon Department of Fish and Wildlife (ODFW) estimated that the overall exploitation rate for the 2009 NPSRF was 12.8%.

Anglers submitted 180 northern pikeminnow with external spaghetti tags, 179 of which also had ODFW PIT tags. There were also 121 northern pikeminnow with ODFW PIT tags only, but missing spaghetti tags. An additional 100 PIT tags were recovered from juvenile salmonids ingested by northern pikeminnow received during the 2009 NPSRF.

Peamouth *Mylocheilus caurinus*, smallmouth bass *Micropterus dolomieue*, sculpins *Cottus spp,* yellow perch *Perca flavescens*, white sturgeon *Acipenser transmontanus* and suckers *Catostomus spp.* 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 to 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 using a monetary reward system. Since 1991, anglers participating in the NPSRF have harvested more than 3.4 million reward sized northern pikeminnow and spent nearly 718,000 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 2009 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 2009 NPSRF were to (1) implement a public fishery that rewards recreational anglers for harvesting northern pikeminnow ≥ 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 2009 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.

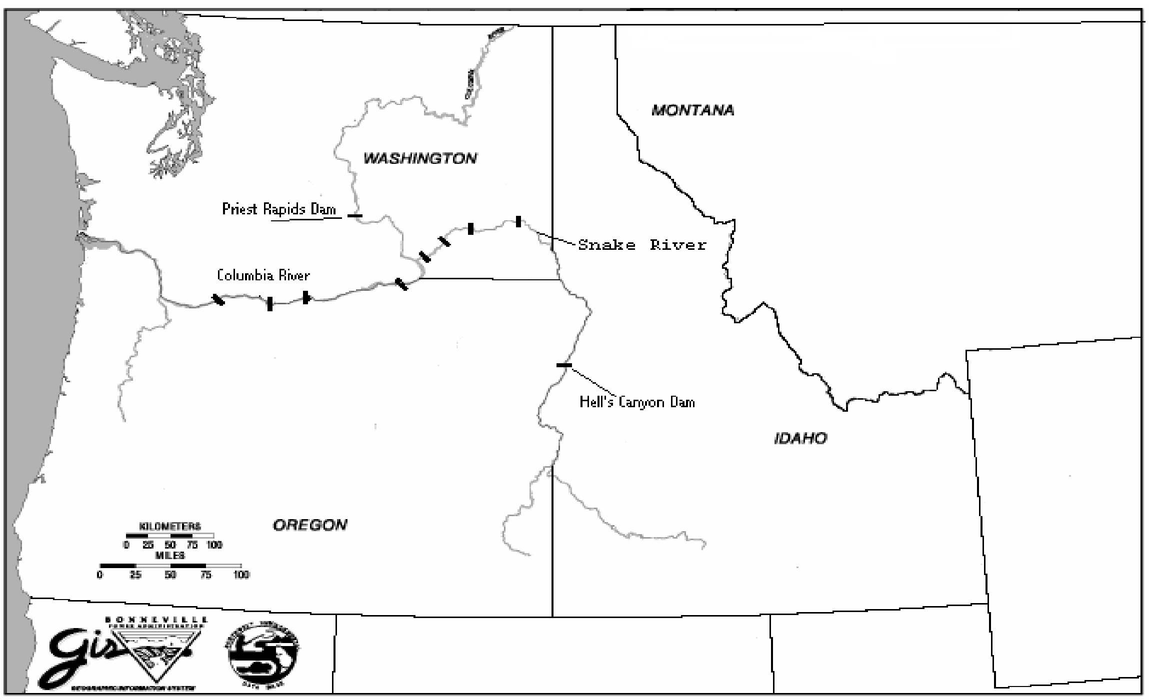
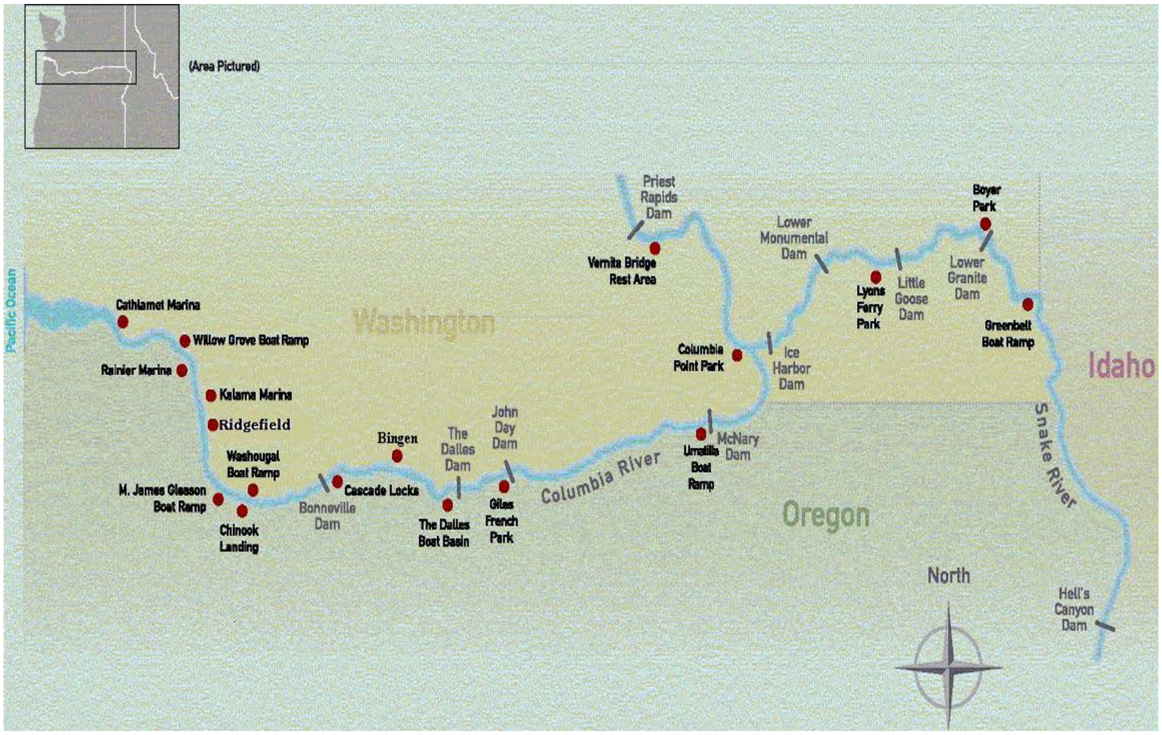


Figure 1. Northern Pikeminnow Sport-Reward Fishery Program Area

The NPSRF was fully implemented, with all stations operating from May 1 through September 27, 2009. In addition, fifteen stations conducted a fourteen day "post-season extension" beginning on September 28, 2009 in order to take advantage of favorable river conditions and provide anglers with an extended opportunity to harvest northern pikeminnow.

Registration Stations

Eighteen 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



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

Figure 2. 2009 Northern Pikeminnow Sport Reward Fishery Registration Stations

registration stations daily (seven days a week) at designated locations (normally public boat ramps or parks) which were available to anglers between two and eight hours per 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 2009 NPSRF rewarded anglers for harvesting northern pikeminnow $\geq$ 228mm TL (9 inches). The 2009 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 2009 season, the NPSRF retained the pay levels used in 2008 (Winther et al. 2008) 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 paid $500 for each northern pikeminnow which retained a valid spaghetti tag used by ODFW for the biological evaluation of the NPMP.

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. 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".

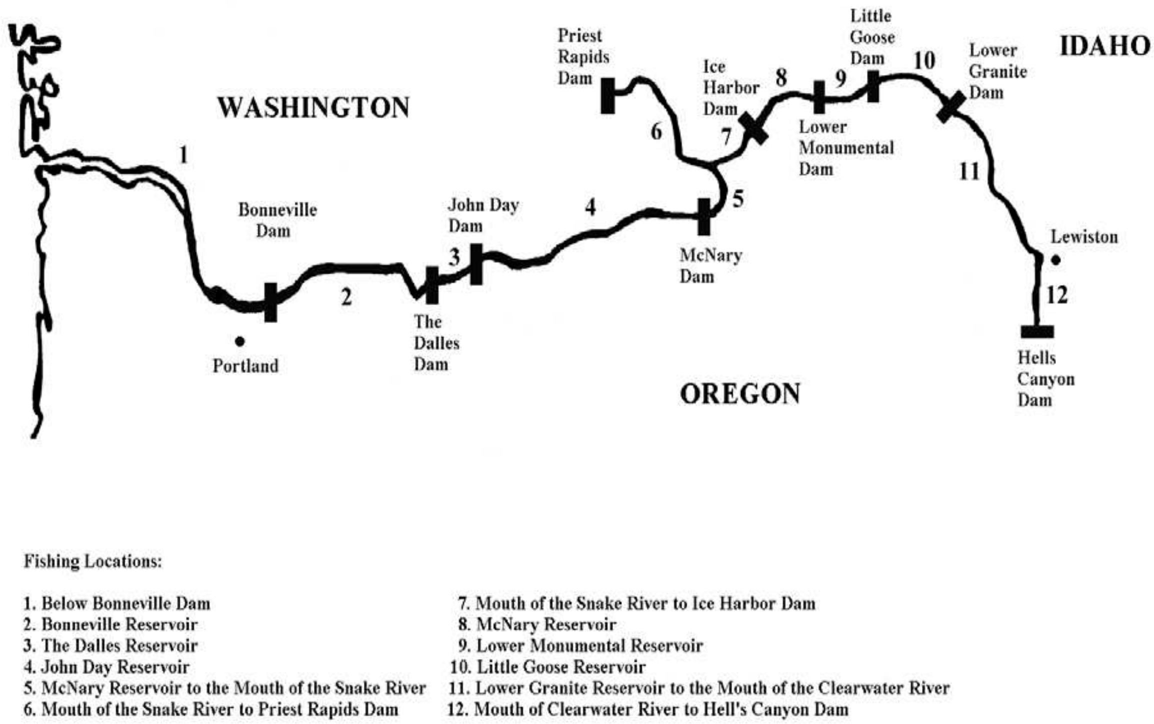


Figure 3. Fishing location codes used for the 2009 Northern Pikeminnow Sport-Reward Fishery

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 were 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 2009 as it was last obtained in 2005 and trends for these species have remained consistent over the NPMP's 19 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), and scale 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 2009 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 in all northern pikeminnow fitted with spaghetti tags (beginning in 2003) as part of the NPMP's biological evaluation activities (Takata and Koloszar 2004). The use of PIT tags rather than fin clips as a secondary mark in northern pikeminnow has improved the NPSRF's estimate of tag loss, and resulted 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 Dextrons were not available. Scanning began on the first day of the NPSRF season and continued at all stations throughout the rest of the season. Technicians individually scanned all reward sized northern pikeminnow for PIT tag presence, and complete biological data were recorded from all 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 either 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. As in recent years, most northern pikeminnow harvested in 2009 were caudal clipped rather than eviscerated in order to facilitate more 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 142,002 reward size northern pikeminnow ($\geq$ 228 mm TL) during the 2009 season, operating for a 21 week and 3 day regular season, plus a 2 week extension (at limited stations). The 2009 season was identical in length to the 2008 NPSRF which had a 3 day shorter regular season and a 3 day longer extension (Winther et al. 2008). Even with the same length season, 2009 harvest declined by 17,804 fish from 2008, and fell well below the mean 1991-2008 harvest of 177,954 fish (Figure 4). Despite below average harvest, the 2009 NPSRF did record an exploitation rate of 12.8% which falls within the 10-20% exploitation goal of NPMP. In addition to harvesting 142,002 reward size northern pikeminnow, the 2009 NPSRF also harvested 4,980 northern pikeminnow < 228 mm TL.

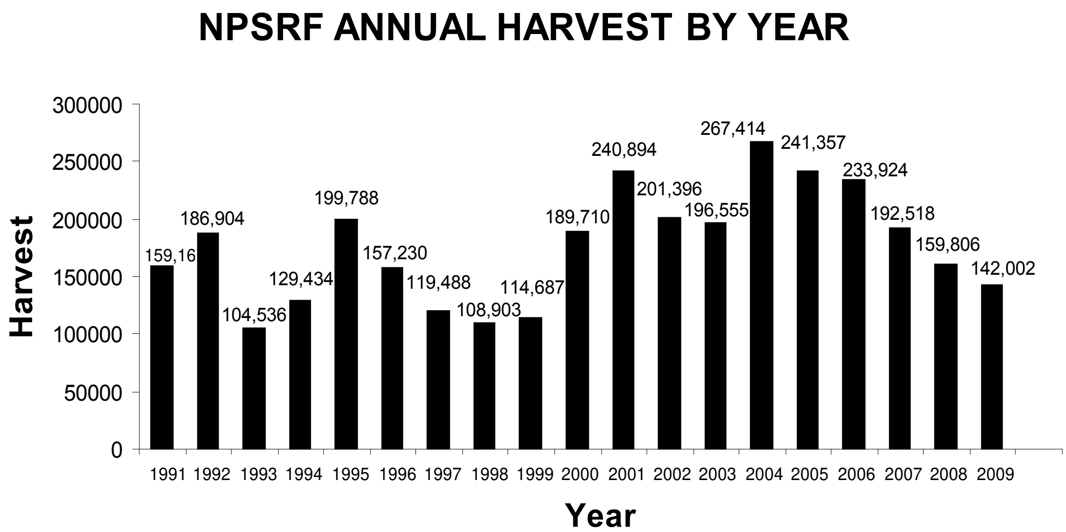


Figure 4. Annual Harvest Totals for the Northern Pikeminnow Sport Reward Fishery

Harvest by Week

Mean weekly harvest for the 2009 NPSRF was 5,950 fish during the regular season, 5,548 during the extension, and 5,917 overall (Figure 5). Weekly harvest totals for the 2009 NPSRF were similar to the totals in 2008 with the exception of weeks 26 to 31 and week 36 where the 2009 totals fell well below the 2008 totals (Figure 6). Weekly harvest for the 2009 NPSRF was lower than mean 1991-2008 weekly harvest levels for the first 14 weeks of the season (Figure 7), then stayed at or above historical 1991-2008 weekly harvest levels for the rest of the regular season and the extension. Peak harvest was 9,217 fish and occurred during the eighth week of the season (week 25), June 15-June 21. This peak was lower and one week earlier than the NPSRF's historical 1991-2008 peak in week 26 (Fox et al. 1999). The 2009 NPSRF mimicked previous seasons by acquiring a bulk of the overall harvest around week 26 which coincides with the northern pikeminnow spawn.

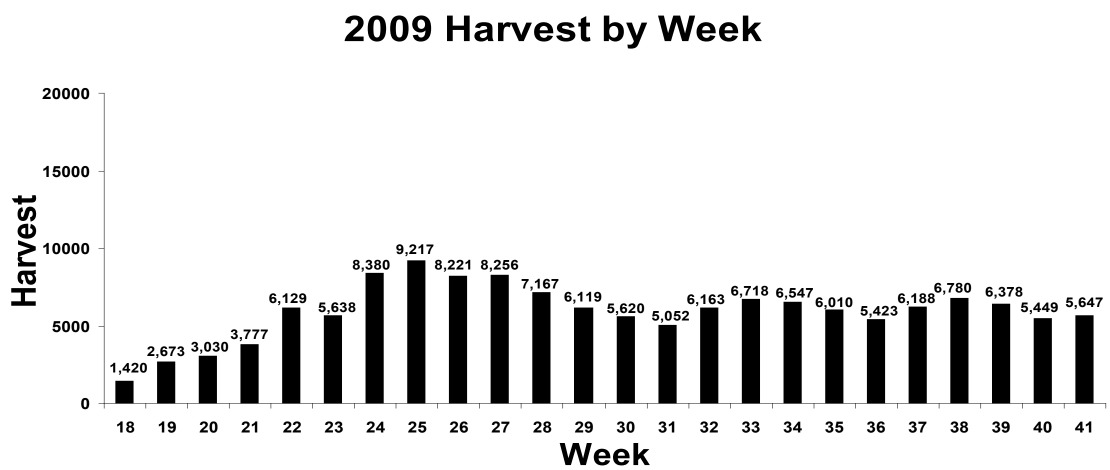


Figure 5. 2009 Weekly Northern Pikeminnow Sport-Reward Fishery Harvest.

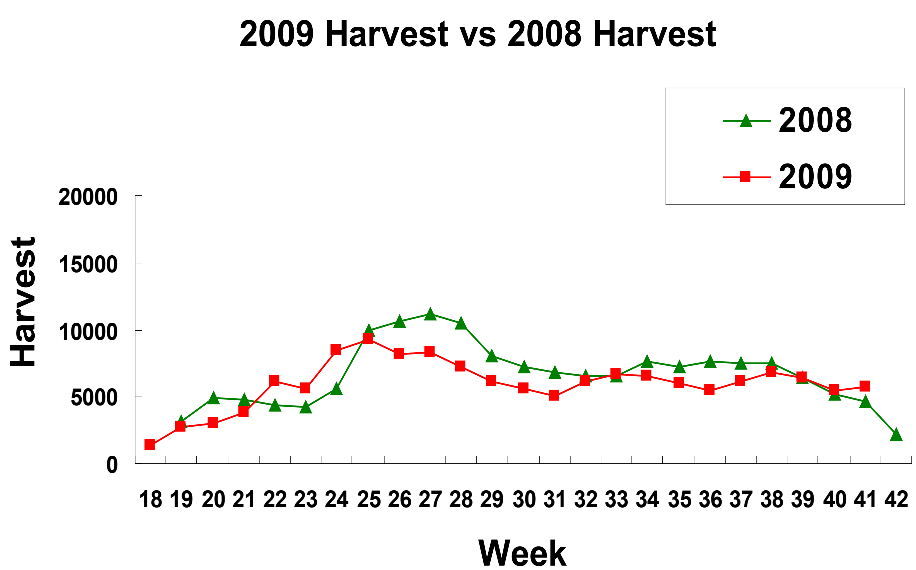


Figure 6. 2009 Weekly NPSRF Harvest vs. 2008 Weekly Harvest.

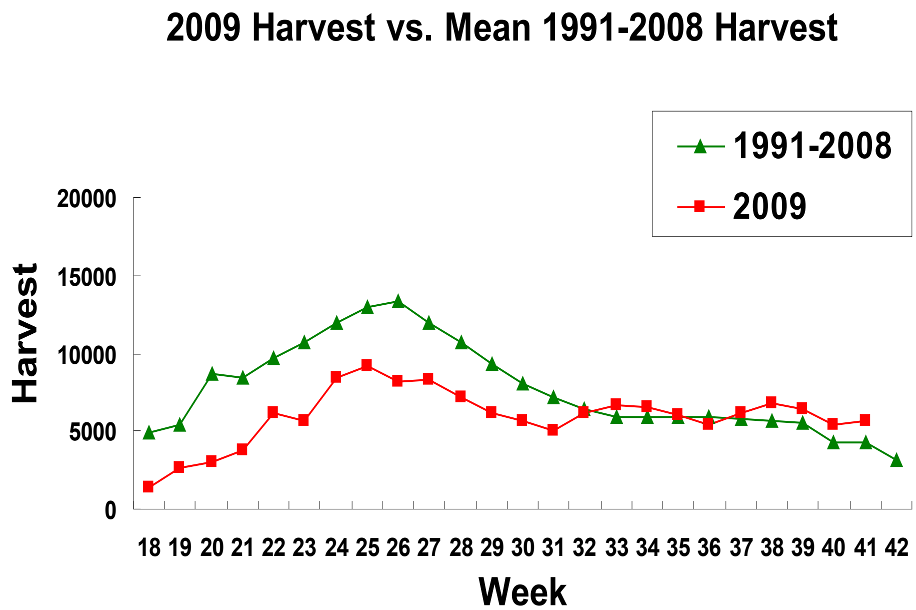


Figure 7. Comparison of 2009 NPSRF Weekly Harvest to 1991-2008 Mean Weekly Harvest.

Harvest by Fishing Location

The mean harvest by fishing location was 11,834 northern pikeminnow and ranged from 63,984 reward size northern pikeminnow in fishing location 01 (below Bonneville Dam) to 210 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 45% of total NPSRF harvest and was once again the highest producing area as it has been for each year since 1991. Fishing location 10 (Little Goose Reservoir) was the second best area (in terms of total harvest) accounting for 20% of total 2009 NPSRF harvest. The five mile stretch of river immediately below Lower Granite Dam in fishing location 10 has been responsible for a significant portion of total NPSRF harvest in past years and has caused fishing location 10 to be the second best fishing location in terms of harvest for the past three seasons. Bonneville Pool (Fishing location 02) continued to show a slight decline in harvest from the high levels first documented during the 2004 NPSRF (Hone et al. 2004).

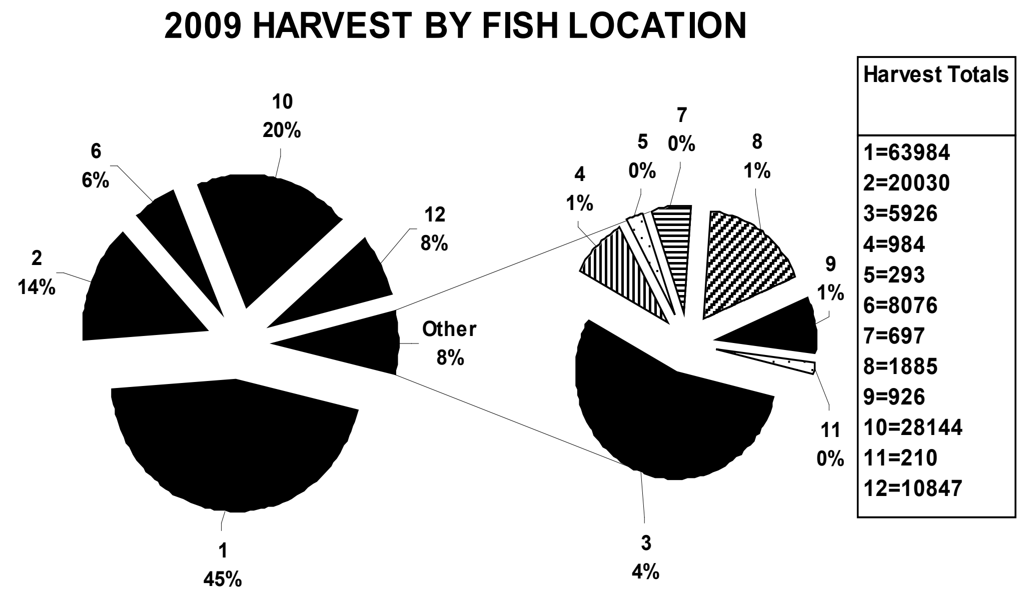


Figure 8. 2009 Northern Pikeminnow Sport-Reward Fishery Harvest by Fishing Location.*
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake 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

Harvest was down from 2008 levels at 11 of the 18 registration stations operated during the 2009 NPSRF. The Greenbelt registration station was one of six stations with improved harvest in 2009. Boyer Park was the NPSRF's top producing station for the third consecutive season. Boyer Park anglers harvested 27,434 northern pikeminnow (down from 36,368 in 2008), equaling 19.3% of the total 2009 NPSRF harvest (Figure 9). The average harvest per registration station was 7,889 reward size northern pikeminnow, down from 9,400 per station in 2008. The registration station with the smallest harvest was Umatilla where anglers harvested 1,287 northern pikeminnow. It should be noted however, that the three lowest producing stations were only open during very limited hours (2-3 hrs/day). The Willow Grove registration station showed the largest percent increase in harvest (up 40.2%) improving from 4,886 northern pikeminnow in 2008 to 6,848 in 2009. The Gleason station showed the largest decline, dropping from 14,589 fish in 2008 to 5,113 in 2009 (a 65% decrease).

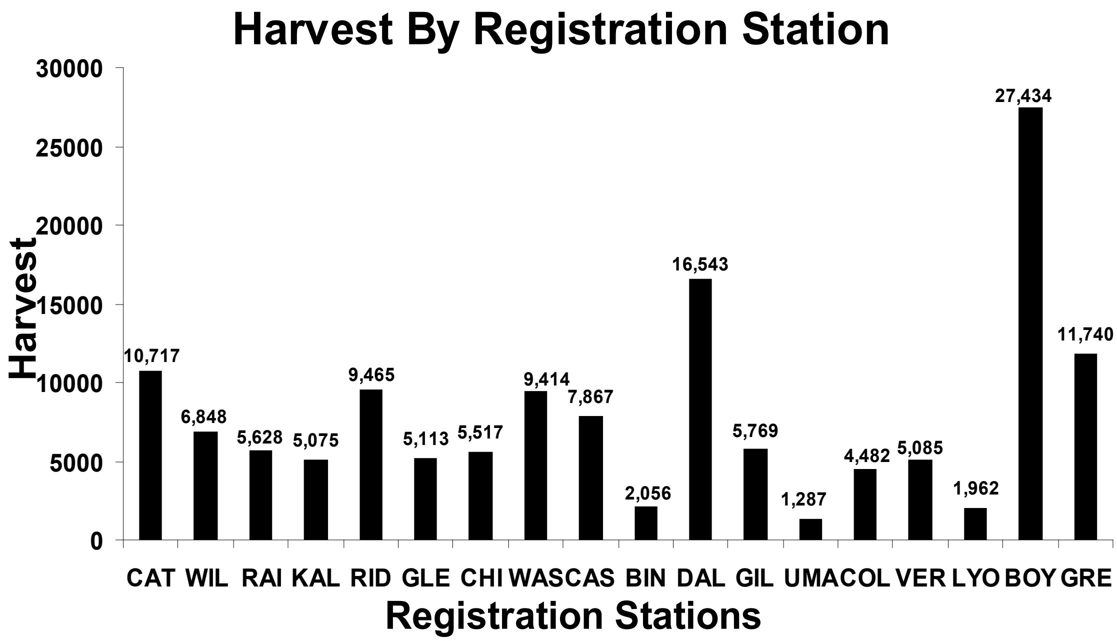


Figure 9. 2009 Northern Pikeminnow Sport-Reward Fishery Harvest by Registration Station. CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, GLE-Gleason, CHI-Chinook, WAS-Washougal, CAS-Cascade Locks, BIN-Bingen Marina, DAL-TheDalles, GIL-Giles French, UMA-Umatilla Marina, COL-Columbia 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 2009 NPSRF reported that they incidentally caught the salmonids listed in Table 1. Incidental salmonid catch by returning NPSRF anglers consisted mostly of juvenile chinook and juvenile hatchery steelhead. Anglers reported that all juvenile salmonids caught during the 2009 NPSRF were released. Technicians recorded all 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 2009 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 2009.

Salmon

Species	Caught	Harvest	Harvest Percent
Chinook (Adult)	28	3	10.71%
Chinook (Jack)	19	6	31.58%
Chinook (Juvenile)	71	0	0%
Coho (Adult)	5	1	20.00%
Coho (Juvenile)	16	0	0%
Cutthroat (Unknown)	31	9	29.03%
Steelhead Adult (Hatchery)	52	25	48.08%
Steelhead Adult (Wild)	28	0	0%
Steelhead Juvenile (Hatchery)	106	0	0%
Steelhead Juvenile (Wild)	28	0	0%
Trout (Unknown)	150	13	8.67%

Other fish species incidentally caught by returning NPSRF anglers targeting northern pikeminnow were most often peamouth, smallmouth bass, Sculpin, Yellow Perch, White Sturgeon, and Suckers (Table 2).

Table 2.
Catch and Harvest of non-salmonids by Returning Anglers Targeting Northern Pikeminnow in 2009.

Non-Salmonid

Species	Caught	Harvest	Harvest Percent
Northern Pikeminnow >228mm	142,055	142,002	99.96%
Northern Pikeminnow <228mm	57,330	4,980	8.69%
Peamouth	37,167	10,239	27.55%
Smallmouth Bass	15,142	1,447	9.56%
Sculpin (unknown)	9,369	3,880	41.41%
Yellow Perch	2,985	863	28.91%
White Sturgeon	2,972	45	1.51%
Sucker (unknown)	2,859	349	12.21%
Starry Flounder	980	112	11.43%
Catfish (unknown)	913	152	16.65%
Walleye	791	456	57.65%
Carp	543	109	20.07%
Chiselmouth	500	54	10.80%
American Shad	161	82	50.93%
Bullhead (unknown)	144	21	14.58%
Redside Shiner	131	0	0%
Sandroller	116	0	0%
Pumpkinseed	84	69	82.14%
Bluegill	84	19	22.62%
Whitefish	24	7	29.17%
Largemouth Bass	21	3	14.29%
Crappie (unknown)	12	0	0%

Non-returning Anglers Catch and Harvest Estimates

We randomly surveyed 2,221 non-returning anglers (22.13% 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 2009 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 2009 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 2009 NPSRF. Estimated totals are listed in columns 4 and 5 of Table 3.

Table 3. 2009 NPSRF Catch and Harvest for surveyed Non-returning Anglers and Estimated non-return angler catch and harvest totals.

Species	Caught	Harvested	%Harvested	Estimated Total Catch	Estimated Total Harvest
Northern Pikeminnow > 228 mm	46	39	84.78%	230	195
Steelhead (juvenile - Adipose absent)	34	0	0	170	0
Steelhead (juvenile – Adipose present)	23	0	0	115	0
Steelhead (adult – Adipose present)	3	0	0	15	0
Chinook (juvenile)	0	0	0	0	0
Chinook (adult)	4	0	0	20	0
Chinook (jack)	4	1	25%	20	5

N=10,037 n=2,221

Fork Length Data

The length frequency distribution of harvested northern pikeminnow (≥ 200 mm) from the 2009 NPSRF is presented in Figure 10. Fork length data for a total of 76,841 northern pikeminnow (54% of total) were taken during the 2009 NPSRF. The mean fork length for all measured northern pikeminnow (≥ 200 mm) in 2009 was 291.4 mm (SD= 72.7 mm), down from 295.1 in 2008.

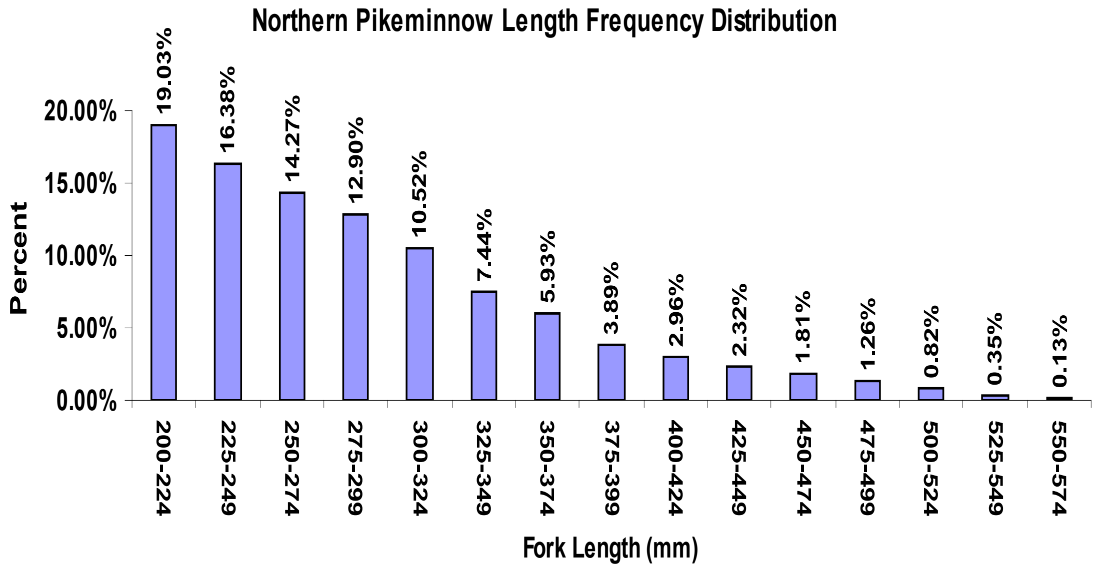


Figure 10. Length frequency distribution of northern pikeminnow > 200 mm FL from 2009 NPSRF.

Angler Effort

The 2009 NPSRF recorded total effort of 29,112 angler days spent during the season, an increase of 2,971 angler days from the effort total of the previous year (Winther et al. 2008) (Figure 11). Peak effort for the 2009 NPSRF once again occurred near peak harvest in mid to late June; however the addition of the Pikeminnow Angler Random Drawing incentive caused a second smaller peak in early August. This incentive, which was designed to increase angler participation, resulted in an increase in effort for the four week period it was in effect. When total effort is divided into returning and non-returning angler days, 19,075 angler days (66%) were recorded by returning anglers, and 10,037 were non-returns. The percentage of returning anglers showed a slight decrease from 2008 (69%), which is counter to the upward trend that the NPSRF has seen in recent years. In addition, 54% of total effort, and 82% of returning angler effort (15,636 angler days), was attributed to successful anglers who harvested at least 1 northern pikeminnow in 2009.

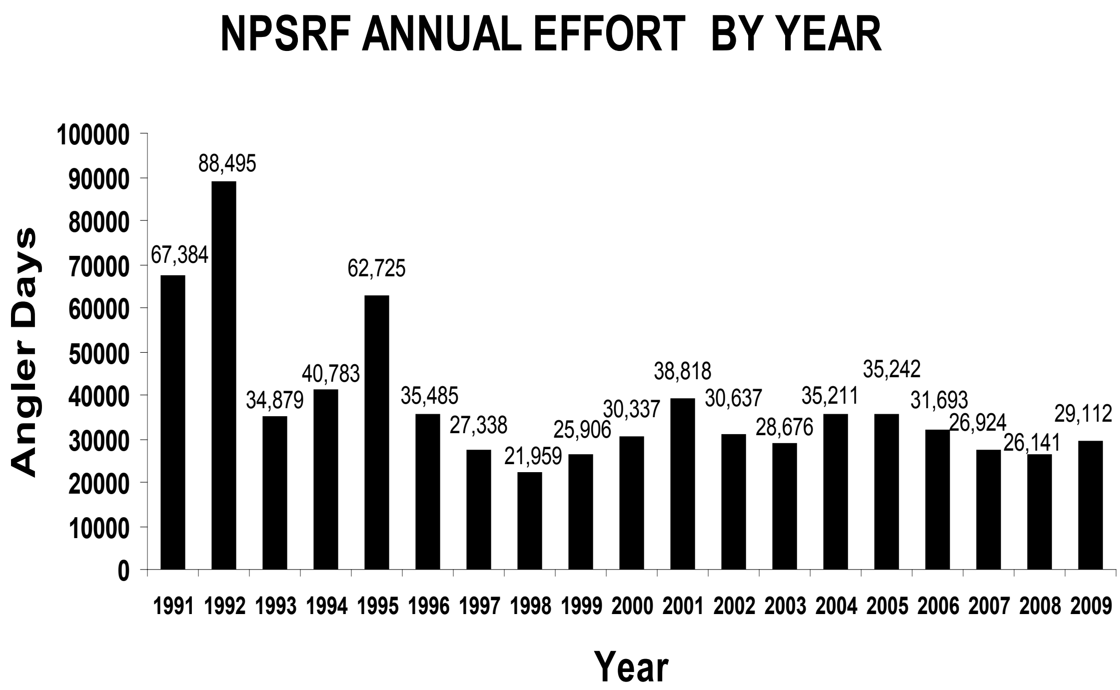


Figure 11. Annual Northern Pikeminnow Sport-Reward Fishery Effort.

Effort by Week

Mean weekly effort for the 2009 NPSRF was 1,279 angler days during the regular season, declining to 491 angler days during the extension, and 1,213 overall. Effort peaked during week 26 and then spiked upward again in week 32 as a result of starting the Pikeminnow Angler Random Drawing incentive (Figure 12). Peak weekly effort typically occurs near peak weekly harvest, although this season it peaked 1 week prior to the harvest peak. Overall mean weekly effort increased from 1,089 in 2008 to 1,213 in 2009 (Winther et al. 2008). The weekly effort totals for the 2009 NPSRF generally followed the pattern of previous seasons until week 32, when the Pikeminnow Angler Random Drawing incentive began (Figure 13). At that point, effort increased to historical levels and remained near those levels for the remainder of the season. Other than six weeks of the entire 2009 season (including the extension), effort fell below historical 1991-2008 effort levels, continuing a trend that the NPSRF has experienced since the first years of the program.

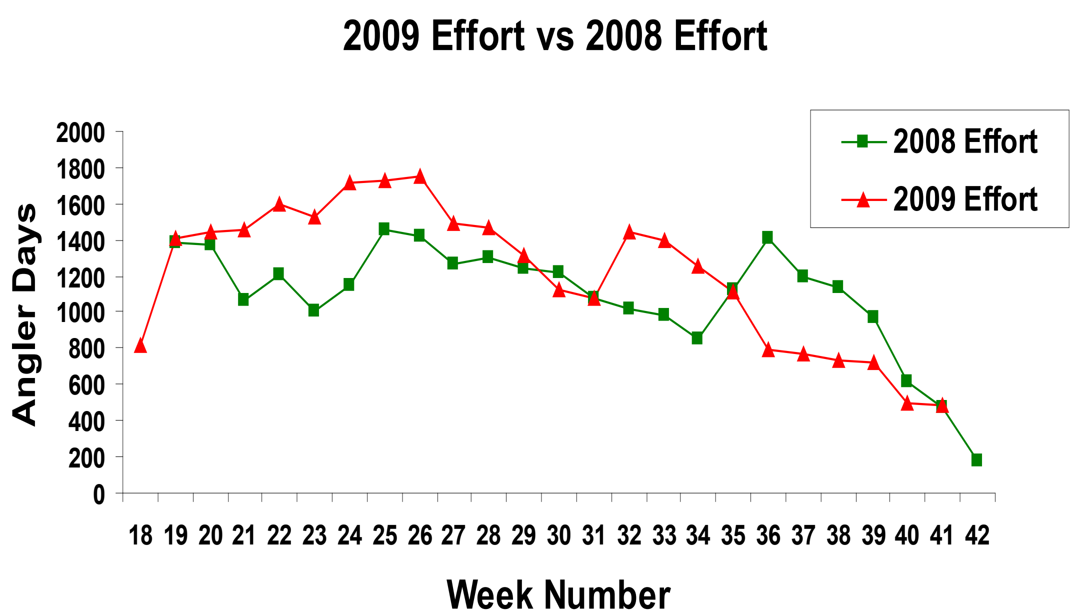


Figure 12. 2009 Weekly Northern Pikeminnow Sport-Reward Fishery Effort vs 2008 Weekly Effort.

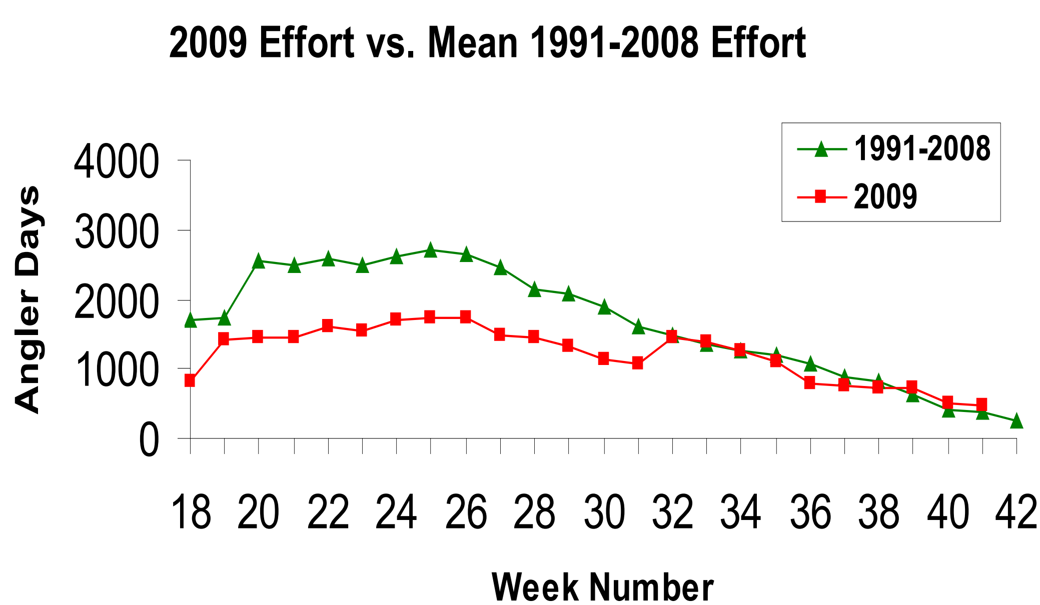


Figure 13. 2009 NPSRF Weekly Effort vs. Mean 1991-2008 Effort.

Effort by Fishing Location

Mean annual effort by fishing location for the 2009 NPSRF (returning anglers only) was 1,590 angler days compared to 1,503 angler days in 2008. Effort totals ranged from 8,957 angler days recorded below Bonneville Dam (fishing location 01) to only 37 angler days spent in fishing location 11 on the Snake River (Lower Granite Dam to the mouth of the Clearwater River) (Figure 14). Large increases in effort at fishing locations 01 and 12 (Mouth of the Clearwater River to Hell's Canyon Dam on the Snake River) more than compensated for the decrease in effort at five of the twelve NPSRF fishing locations. Fishing location 03 (The Dalles Dam to John Day Dam), had the next largest decrease in effort, losing 147 angler days from 2008.

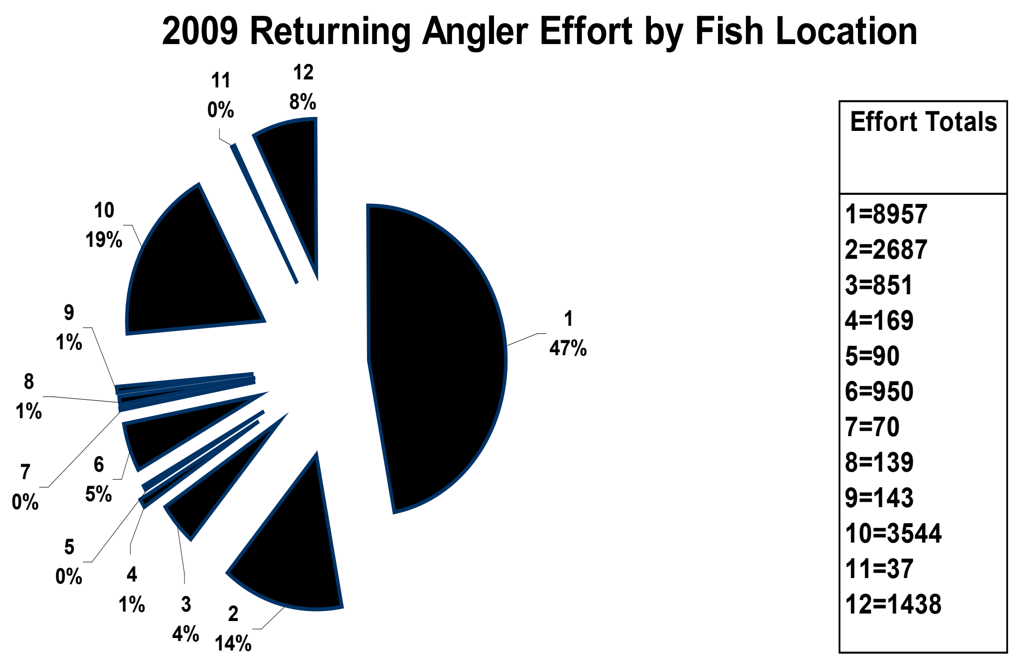


Figure 14. 2009 NPSRF Angler Effort by Fishing Location (returning anglers only).*
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake River 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 2009 NPSRF was 1,617 angler days compared to 1,452 angler days in 2008. Effort totals ranged from 4,174 angler days at the Boyer Part station to 389 angler days at the Lyons Ferry station (Figure 15). Effort during the 2009 NPSRF actually increased at thirteen of the eighteen registration stations, most notably at the Greenbelt, Willow Grove and Cathlamet stations. We saw the largest decline in effort (from 2008) at the Gleason station where we lost 421 angler days, most likely due to the addition of the new Ridgefield station.

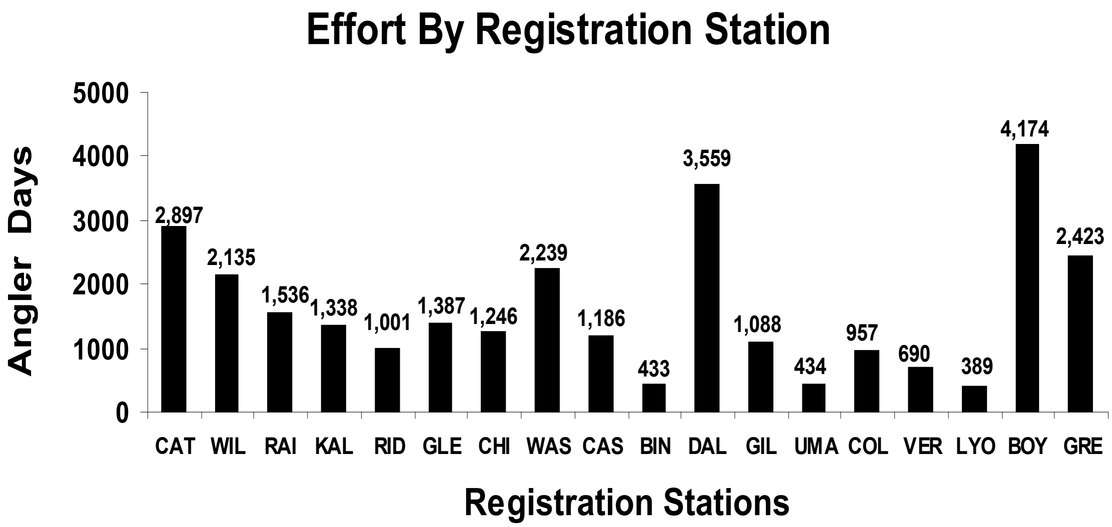


Figure 15. 2009 Northern Pikeminnow Sport-Reward Fishery Angler Effort by Registration Station. CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, GLE-Gleason, CHI-Chinook, WAS-Washougal, CAS-Cascade Locks, BIN-Bingen Marina, DAL-TheDalles, GIL-Giles French, UMA-Umatilla, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, GRE-Greenbelt, BOY-Boyer Park.

Catch Per Angler Day (CPUE)

The 2009 NPSRF recorded an overall (returning + non-returning anglers) catch per unit of effort (CPUE) of 4.88 northern pikeminnow harvested per angler day during the 2009 season. This catch rate declined from 6.11 in 2008, (Winther et al. 2008) and was the NPSRF's third consecutive year of declining CPUE (Figure 16). Angler CPUE had increased steadily throughout the NPSRF's history from 1991-2006, but 2009 CPUE is lower than any year since 1999. Part of this decline may be due to an influx of new or inexperienced anglers attracted to the SRF by reinstituting the Extra $10 Coupon for turning in pikeminnow, or later in August by the Pikeminnow Angler Random Drawing incentive. Since new and/or inexperienced anglers are less proficient at catching northern pikeminnow (Hisata et al. 1995), their addition to the 2009 NPSRF helped cause overall CPUE rates to decline. Returning angler CPUE during the 2009 NPSRF was 7.44 northern pikeminnow per angler day, down from 8.86 in 2008. We estimate that CPUE for non-returning anglers is 0.02 reward sized northern pikeminnow per angler day based on 2009 NPSRF phone survey results.

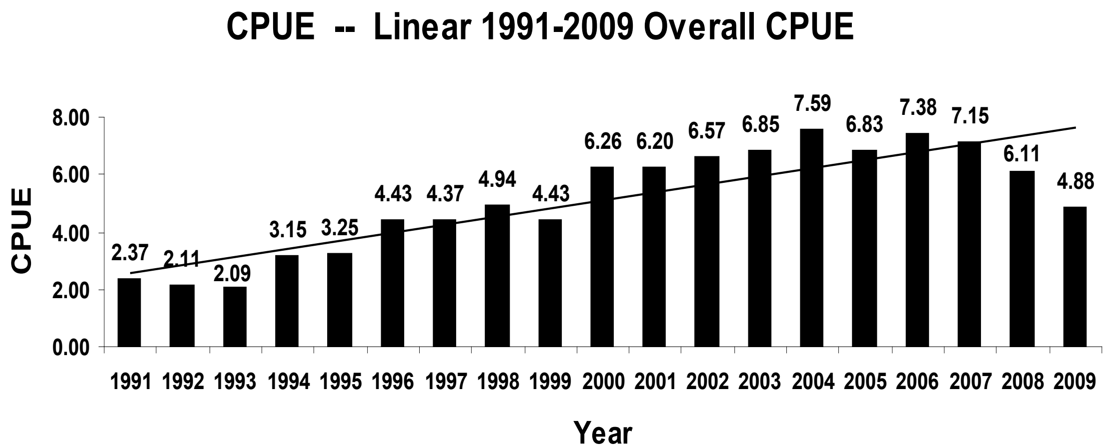


Figure 16. Annual NPSRF CPUE (returning + non-returning anglers) for the years 1991-2009.

CPUE by Week

Mean angler CPUE by week for the 2009 NPSRF was 5.45 fish per angler day compared to 6.49 in 2008. CPUE ranged from 1.73 in week 18 (May 1-3) to a peak of 11.64 in week 41 (October 5-11) (Figure 17). As expected, catch rates (CPUE) dropped in week 32 when the special Pikeminnow Angler Random Drawing incentive began as new or less experienced anglers entered or returned to the NPSRF. Once the drawings were completed (week 35), CPUE again spiked upward for the rest of the season and through the extension.

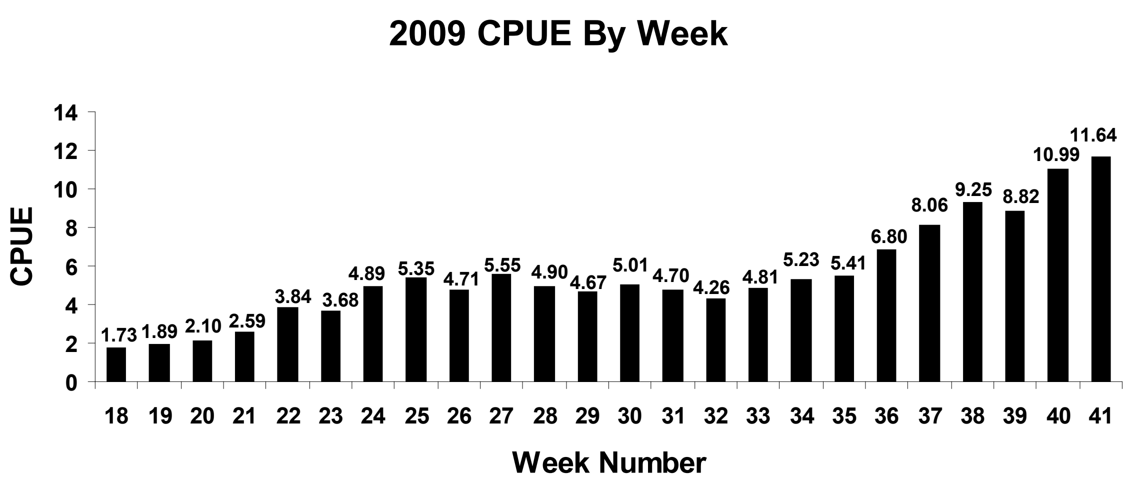


Figure 17. 2009 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Week.

CPUE by Fishing Location

Angler success rates for the 2009 NPSRF, as indicated by CPUE, are available for returning anglers only and varied by Fishing Location. Success rates ranged from a high of 13.56 fish per angler day in Fishing Location 08 (Ice Harbor Reservoir) to 3.26 fish per angler per day in fishing location 5 (McNary Dam to the mouth of the Snake River) (Figure 18). Catch rates were up from 2008 at Fishing locations 04, 07, 08, 09 and 11 while rates dropped at the remaining seven fishing locations. The average CPUE by fishing location was 7.52 northern pikeminnow per angler day.

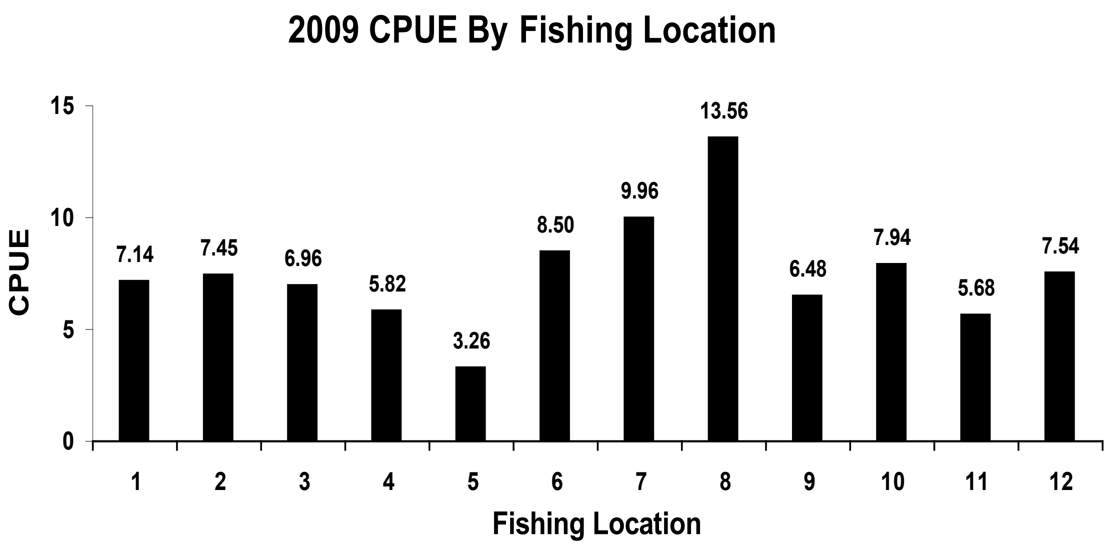


Figure 18. 2009 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Fishing Location.*
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the 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 Registration Station

The registration Station with the highest CPUE during the 2009 NPSRF was the new station at Ridgefield with 9.46 northern pikeminnow per angler day (Figure 19). The registration station with the lowest CPUE was the Umatilla station with a CPUE of 2.97 northern pikeminnow per angler day. The station average for angler CPUE was 4.94. Anglers at fifteen of the eighteen registration stations had lower CPUE during the 2009

NPSRF than they did in 2008. The Gleason station had the largest change in CPUE dropping 54% to 3.69 (down from 8.07 in 2008).

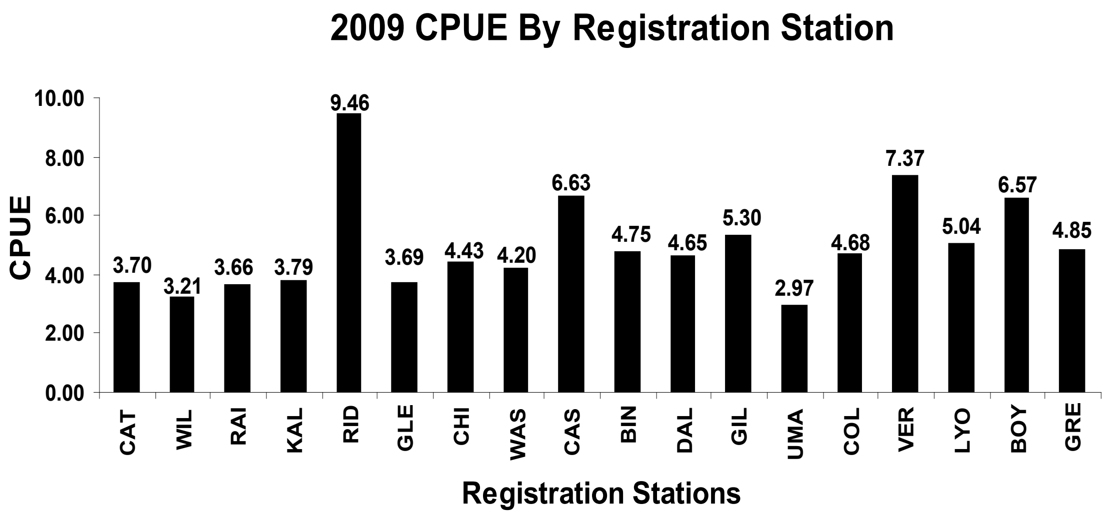


Figure 19. 2009 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Registration Station. CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, GLE-Gleason, CHI-Chinook, WAS-Washougal, CAS-Cascade Locks, BIN-Bingen, DAL-TheDalles, GIL-Giles French, UMA-Umatilla Marina, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, GRE-Greenbelt, BOY-Boyer Park.

Angler Totals

There were 4,479 separate anglers who participated in the 2009 NPSRF, an increase of 869 participants from 2008 (Winther et al. 2008), and the first increase in anglers that the NPSRF has seen since 2004. One thousand, five hundred and eighty eight of these anglers (35.5%) were classified as successful since they harvested at least one reward size northern pikeminnow (for which a voucher was issued) during the 2009 season. Of the successful anglers, 76.5% (1,215 anglers) sent in their vouchers to PSMFC for payment (Craig Miller, PSMFC personal communication). The average successful angler harvested 89 northern pikeminnow during the 2009 NPSRF, although when we break down the 1,588 successful anglers by tier, most anglers (87% = 1,385 anglers) harvested fewer than 100 northern pikeminnow and were classified as Tier 1 anglers (Figure 20). One hundred and eleven anglers (7%) reached Tier 2 status by harvesting between 101 and 400 northern pikeminnow, and 92 anglers (6%) reached Tier 3 status by harvesting more than 400 northern pikeminnow in 2009. The 92 anglers who reached Tier 3 also represent only 2.1% of all angler participants (both returning and non-returning anglers) during the 2009 NPSRF. The number of anglers reaching each of the three tiers during the 2009 NPSRF was up at two of the three levels when compared to the previous year. The number of anglers at Tier one (<100 fish) increased by 281 anglers, Tier 2 gained 1 angler, and Tier 3 lost 12 anglers.

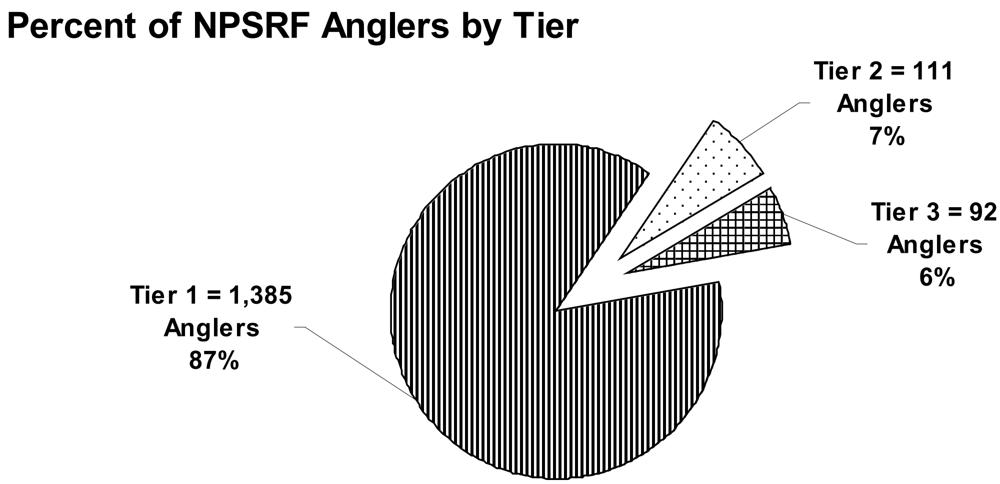


Figure 20. 2009 NPSRF Anglers by tier (returning only) based on total # of fish harvested.

While Tier 1 anglers made up more than 85% of all successful NPSRF participants in 2009, they only harvested an average of 10 fish per angler, per year, accounting for only 10% (14,165 northern pikeminnow) of total NPSRF harvest (Figure 21). Tier 2 anglers harvested an average of 213 fish per year, equaling 17% (23,623 northern pikeminnow) of total 2009 NPSRF harvest. Tier 3 anglers, also known as "highliners", harvested an average of 1,133 fish per year equaling 73% (104,214 northern pikeminnow) of total 2009 NPSRF harvest. The percentage of total harvest for Tier 3 anglers declined slightly from 2008, while the percentage for Tier 1 and Tier 2 anglers improved.

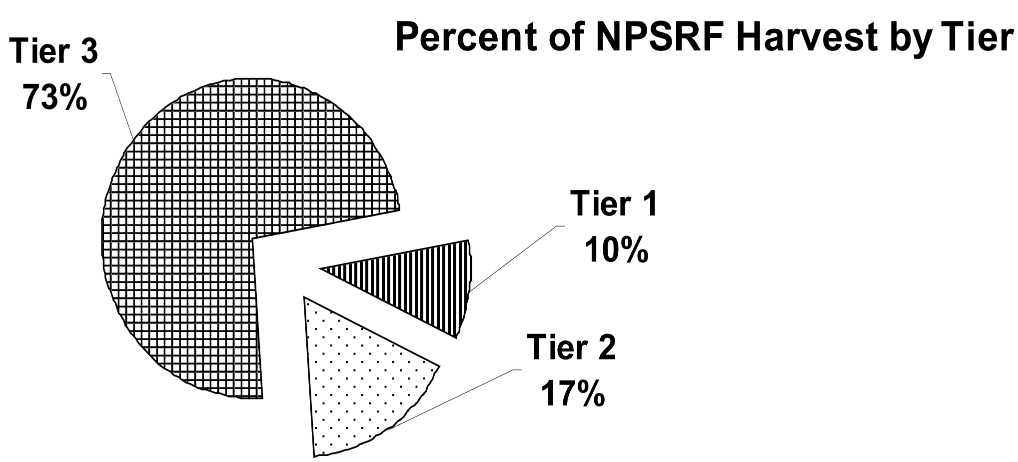


Figure 21. 2009 NPSRF Harvest by Angler Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400).

The average NPSRF participant (returning + non-returning anglers) expended less time (effort) pursuing northern pikeminnow during the 2009 season than in 2008 (6.50 vs. 7.24 angling days of effort). When we look at successful anglers only, Tier 1 anglers spent the same average number of days fishing in the 2009 NPSRF (7 days) as in 2008 (Figure 22). Tier 2 anglers increased the average number of days that they spent fishing for northern pikeminnow from 46 in 2008 to 53 in 2009. Tier 3 anglers slightly increased their average number of days spent fishing during the 2009 NPSRF, going from 90 days in 2008 to 91 days in 2009. This continues the trend seen in recent seasons where the NPSRF anglers who harvest the most fish (Tier 2 and 3 anglers), also expend the most effort.

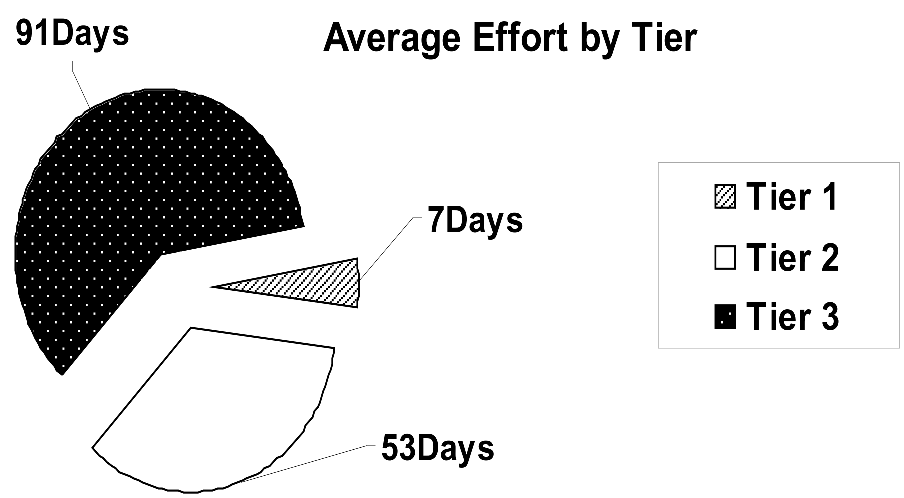


Figure 22. Average Effort of 2009 NPSRF Anglers by Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400) .

Although overall angler CPUE for the 2009 NPSRF decreased from 2008, the fact that CPUE decreased for all anglers at all tier levels (Figure 23) suggests that fishing conditions were less favorable than the previous year. CPUE for anglers at Tier 1 decreased from 1.68 in 2008 to 1.38 in 2009. CPUE for Tier 2 anglers decreased from 4.72 in 2008 to 4.04 in 2009. CPUE for Tier 3 anglers decreased from 13.04 in 2008 to 12.40 in 2009.

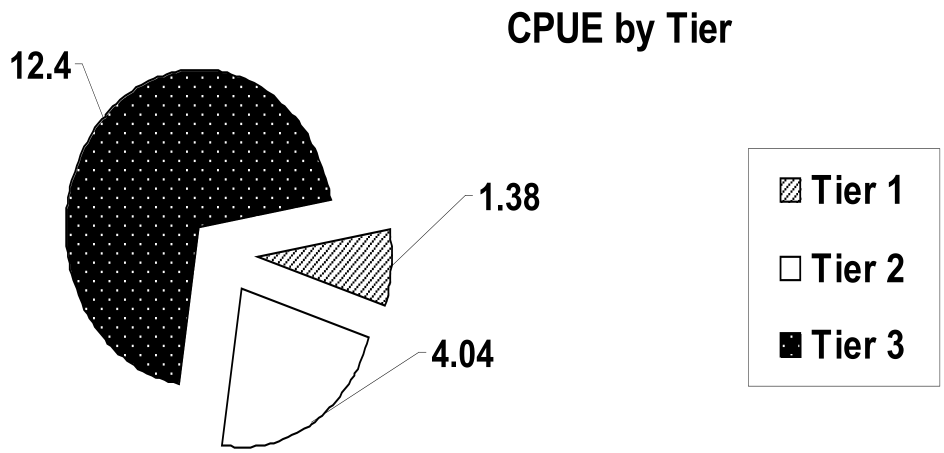


Figure 23. Average CPUE of 2009 NPSRF Anglers by Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400).

The top individual angler (based on number of fish caught) for the 2009 NPSRF harvested 5,561 NPM worth an estimated $48,137. This total included 8 spaghetti tagged northern pikeminnow and a $1000 prize from the Pikeminnow Angler Random Drawing Incentive in August. The 2009 top angler caught only 260 more fish than the second place angler who happened to be the top angler from 2008. The total harvest by the top angler for the 2009 NPSRF was 1,454 fewer fish than the top angler's harvest in 2008. The CPUE for this year's top angler was 41.8 fish per angler day (down from the 2008 top angler's CPUE of 52.4). The top angler for the 2009 season spent the same amount of days (effort) fishing as the 2008 top angler (134 days) but accounted for a lower total harvest. By comparison, the top angler (in terms of participation rather than harvest) for the 2009 NPSRF fished 164 days and harvested 187 northern pikeminnow.

Tag Recovery

Northern Pikeminnow Tags

Returning anglers harvested 180 northern pikeminnow tagged by ODFW with external spaghetti tags during the 2009 NPSRF compared to 167 spaghetti tags paid in 2008 (Winther et al., 2008). Tag recoveries peaked in week 25, the same week as peak NPSRF harvest (Figure 24). Of these spaghetti tagged northern pikeminnow, 179 had also been PIT tagged by ODFW as a secondary mark (1fish did not receive a PIT tag when it was spaghetti tagged by ODFW). WDFW technicians also recovered an additional 121 northern pikeminnow which had ODFW PIT tags and 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 12.8% exploitation rate for the 2009 NPSRF (ODFW, personal communication).

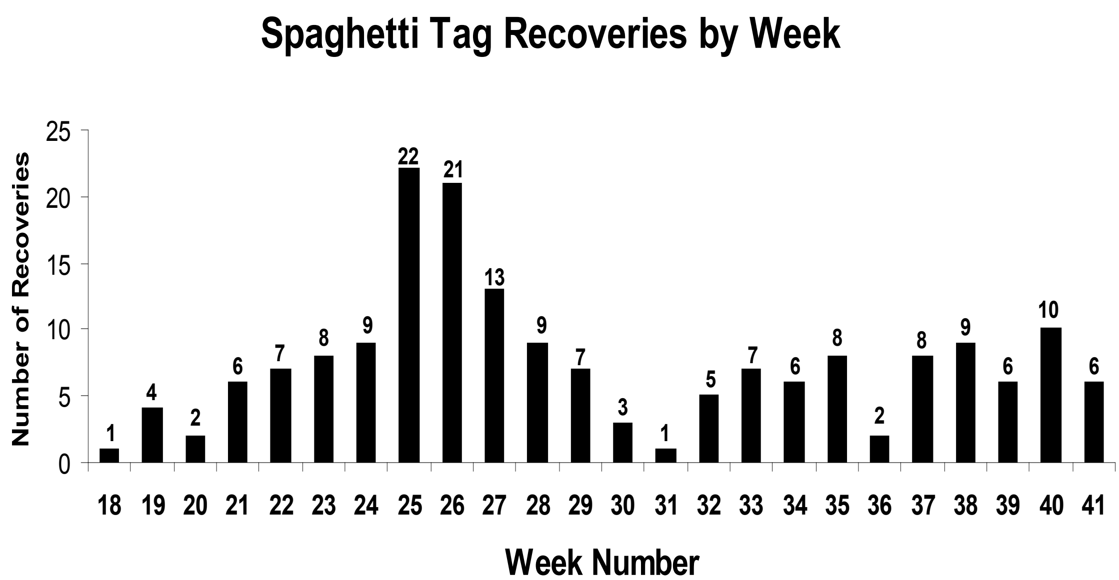


Figure 24. 2009 NPSRF Spaghetti Tag Recoveries by Week.

Ingested Tags

A total of 142,002 northern pikeminnow were individually scanned for the presence of PIT tags. This represents 100% of the total harvest of reward-size fish for the 2009 NPSRF (northern pikeminnow not qualifying for rewards were also scanned whenever possible). We recovered a total of 100 PIT tags from consumed smolts that had been ingested by northern pikeminnow harvested during the 2009 NPSRF, an overall occurrence ratio of 1:1,420. Total ingested tag recoveries in 2009 were lower (7 less) than the previous year, however, with a lower season harvest there was a higher rate of occurrence (1:1,420 in 2009 versus 1:1,494 in 2008) (Winther et al., 2008). PIT tag recoveries of salmonid smolts ingested by northern pikeminnow peaked during mid June (week 25) in 2009 and ended by mid August (Figure 25).

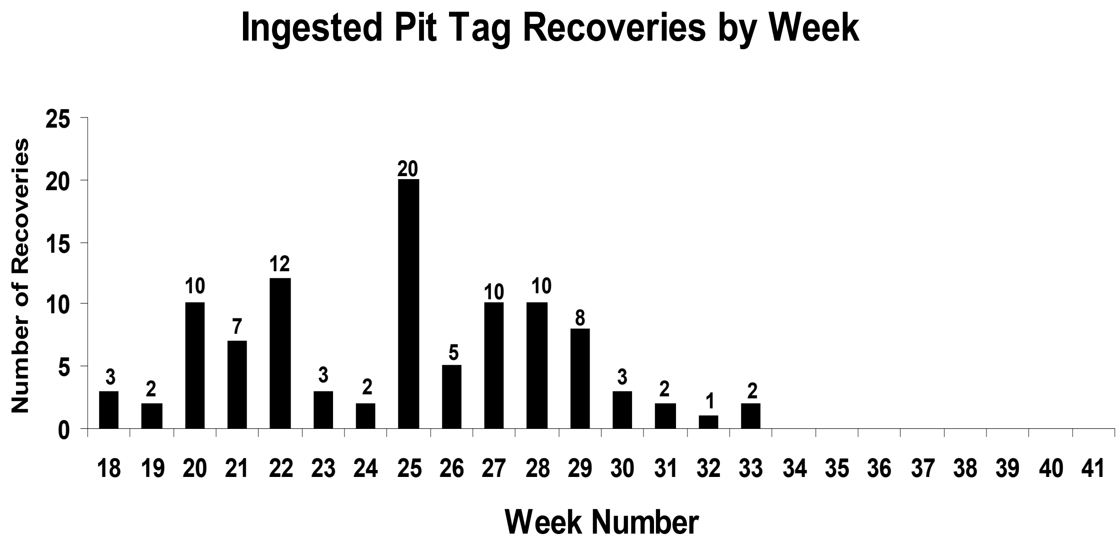


Figure 25. 2009 NPSRF PIT Tag Recoveries by Date.

Pit tag recoveries by fishing location during the 2009 NPSRF showed that northern pikeminnow harvested from Fishing locations 03 (The Dalles Reservoir) and 10 (Little Goose Reservoir) ingested the largest number of salmonid smolts containing PIT tags (Figure 26). The Little Goose reservoir had the highest number of recoveries in 2008 as well.

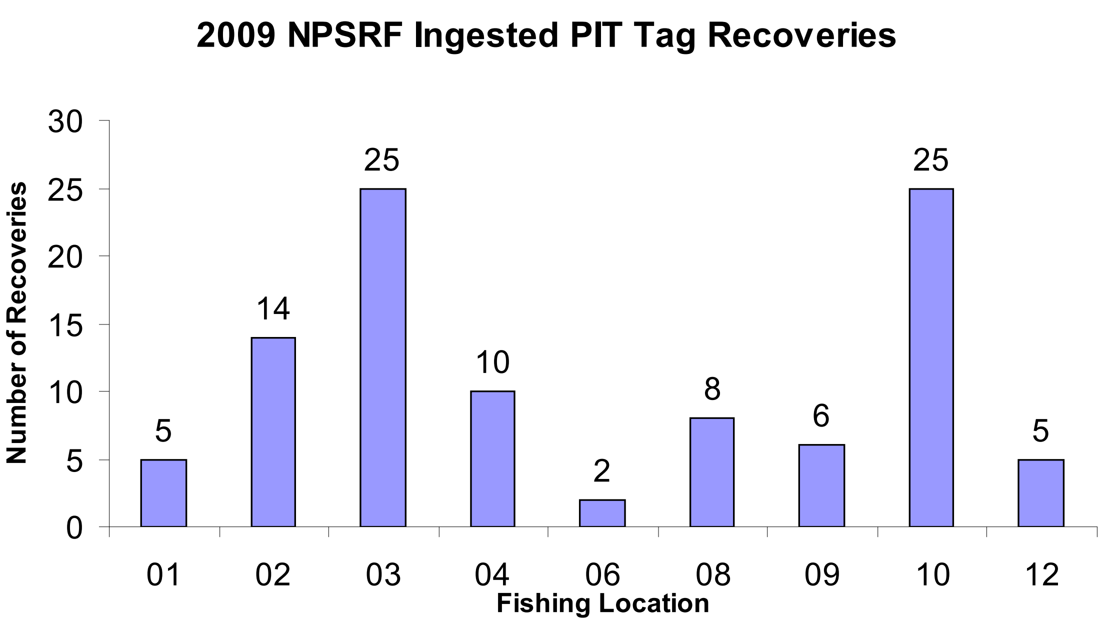


Figure 26. 2009 NPSRF ingested PIT Tag Recoveries by Fishing Location.

Species composition of PIT tagged smolts recovered from northern pikeminnow harvested in the 2009 NPSRF indicated that they were overwhelmingly chinook smolts (primarily fall chinook) (Figure 27). Eighty seven of the 100 ingested PIT tag recoveries (87%) were from chinook smolts. The other 13 PIT tags were from 3 coho, 3 sockeye, 3 steelhead and 4 unknown species accounting for the remaining 13%. PIT tag queries of PTAGIS also indicated that 7 of the 87 chinook smolts (8%) were of wild origin.

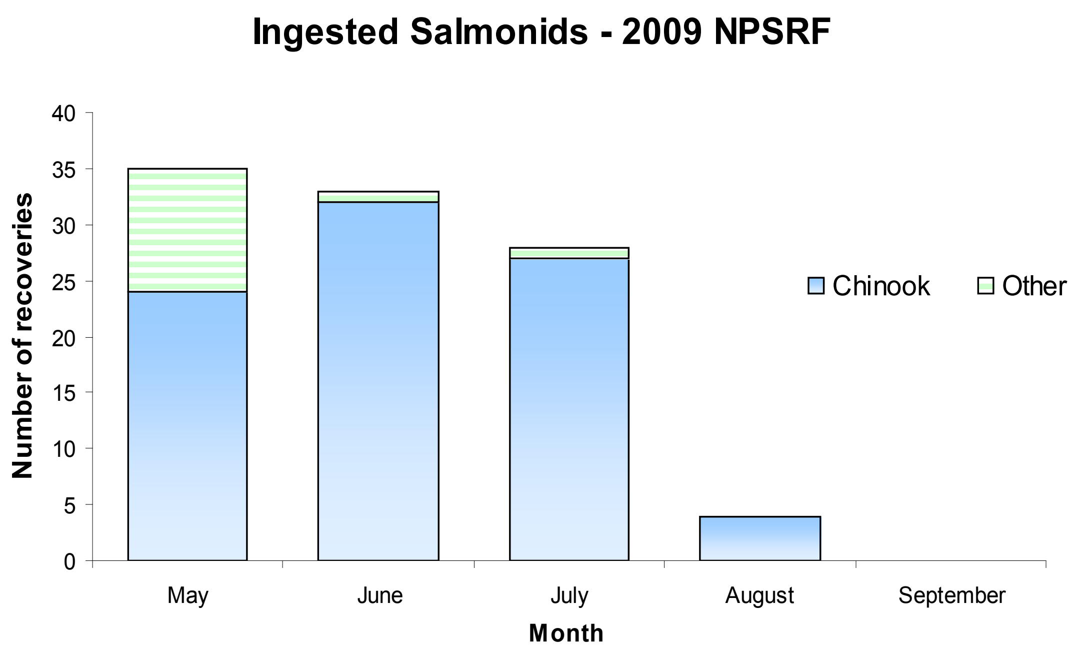


Figure 27. Recoveries of ingested salmonid PIT Tags from the 2009 NPSRF.

Analysis of PIT tag recovery data from the 2009 NPSRF continues to document northern pikeminnow predation on downstream migrating juvenile salmonids. 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

The 2009 NPSRF succeeded in reaching the NPMP's 10-20% exploitation goal for the twelfth consecutive year, achieving an estimated exploitation rate of 12.8%. Despite NPSRF harvest falling to its lowest level since 1999, the exploitation rate was within the 10-20% target range needed to ensure program success. Effort increased by 2,971 angler days from 2008, breaking the downward trend in effort the NPSRF has followed the past three seasons. The 2009 NPSRF also saw an increase in the number of individuals participating in the fishery for the first time since 2004. The Pikeminnow Angler Random Drawing incentive coupled with the ten dollar coupons helped attract new anglers to the 2009 NPSRF and likely kept harvest from being lower than it was.

The NPSRF's top angler for the 2009 season caught 1,454 fewer fish than the 2008 top angler. The top angler fished the same number of days as last season's top angler but with a decrease in harvest the result was a drop in CPUE of over 10 fish per trip. Because a drop in CPUE was evident for the NPSRF overall and at all tier levels, less favorable fishing conditions were most likely cause of lower harvest not only for this angler, but for all 2009 NPSRF anglers.

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 salmonids. We recovered fewer ingested PIT tags than last year and peak recoveries occurred earlier in the season. Species composition of PIT tag recoveries from ingested juvenile salmonids again showed that they were primarily chinook smolts, mostly of hatchery origin. We also recovered a small number of PIT tags from steelhead, coho, and sockeye this season. Use of PIT tags by ODFW as a secondary mark in spaghetti tagged northern pikeminnow continues to go smoothly and we look forward to 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 2010 SEASON

1.) Continue use of standardized season dates (May 1st-Sept 30th) for implementation of the 2010 NPSRF in order to enhance promotional opportunities and maximize predation reduction.

2.) Develop angler incentives designed to capitalize on, and retain new anglers recruited to the NPSRF in 2009.

   a) Review angler participation patterns and adjust NPSRF registration station times as needed to conform with angler usage.

   b) Review NPSRF station times and routes for efficiencies which may allow adding additional stations.

   c) Review NPSRF tiered reward structure for adjustments which may stimulate angler participation and harvest.

   d) Review NPSRF tag reward incentive to determine feasibility of paying for tag-loss NPM which have retained ODFW PIT tags.

   e) Continue use of coupons for successful anglers.

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

5.) 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.

6.) 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, and other species to identify any changes in NPSRF catch trends.

REFERENCES

Bruce, R.C., E.C. Winther, J.D. Hone, and P.V. Dunlap. 2005. Implementation of the northern pikeminnow sport-reward fishery in the Columbia and Snake Rivers. *In* Development of a system-wide predator control program: stepwise mplementation of a predator index, predator control fisheries, and evaluation plan in the Columbia River Basin (Northern Pikeminnow Management Program). 2005 Annual Report, project number 90-077. Contract DE-B179-90BP07084, Bonneville Power Administration, Portland, OR.

Burley, C.C., D.C. Klaybor, G.W. Short, and G.J. Hueckel. 1992. Evaluation of the northern squawfish sport-reward fishery in the Columbia and Snake Rivers. Report B *in* C.F. Willis and A.A. Nigro, editors. Development of a system-wide predator control program: stepwise implementation of a predator index, predator control fisheries, and evaluation plan in the Columbia River Basin (Northern Pikeminnow Management Program). 1991 Annual Report. Contract DE-B179 -90-BP07084, Bonneville Power Administration, Portland, Oregon.

Fox, L.G., J.J. Amren, B.G. Glaser, M.L. Wachtel, and E.C. Winther. 1999. Implementation of the northern pikeminnow sport-reward fishery in the Columbia and Snake Rivers. *In* Development of a system-wide predator control program: stepwise implementation of a predator index, predator control fisheries, and evaluation plan in the Columbia River Basin (Northern Pikeminnow Management Program). 1999 Annual Report, project number 90-007. Bonneville Power Administration, Portland, Oregon.

Friesen, T.A., and D.L. Ward 1999. Management of northern pikeminnow and implications for juvenile salmonid survival in lower Columbia and Snake Rivers. North American Journal of Fisheries Management 19:406-420.

Glaser, B.G., J.J. Amren, L.G. Fox., M.L. Wachtel, and E.C. Winther. 2000. Implementation of the northern pikeminnow sport-reward fishery in the Columbia and Snake Rivers. *In* Development of a system-wide predator control program: stepwise implementation of a predator index, predator control fisheries, and evaluation plan in the Columbia River Basin (Northern Pikeminnow Management Program). 2000 Annual Report, project number 90-077. Bonneville Power Administration, Portland, Oregon.

Hankin, D.G., and J. Richards. 2000. The northern pikeminnow management program: an independent review of program justification, performance, and cost effectiveness. Report to the Pacific Northwest Electric Power and Conservation Planning Council, Portland, Oregon.

Hisata, J.S., M.R. Peterson, D.R. Gilliland, E.C. Winther, S.S. Smith, and J. Saurez-Pena. 1995. Implementation of the northern squawfish sport-reward fishery in the Columbia and Snake Rivers. Report A *in* Development of a system-wide predator control program: stepwise implementation of a predator index, predator control fisheries, and evaluation plan in the Columbia River Basin (Northern Squawfish Management Program). 1995 Annual Report, project number 90-077. Contract DE-B179-90BP07084, Bonneville Power Administration, Portland, Oregon.

Hone, J.D., R. Bruce, J. Memarian, and E.C. Winther. 2004. Implementation of the northern pikeminnow sport-reward fishery in the Columbia and Snake Rivers. *In* Development of a system-wide predator control program: stepwise implementation of a predator index, predator control fisheries, and evaluation plan in the Columbia River Basin (Northern Pikeminnow Management Program). 2004 Annual Report, project number 90-077. Contract DE-B179-90BP07084, Bonneville Power Administration, Portland, Oregon.

Klaybor, D.C., C.C. Burley, S.S. Smith, E.N. Mattson, E.C. Winther, P. E. DuCommun, H.R. Bartlett, and S,L. Kelsey. 1993. Evaluation of the northern squawfish sport-reward fishery in the Columbia and Snake Rivers. Report B in C.F. Willis and D. L. Ward, editors. Development of a system-wide predator control program: stepwise implementation of a predator index, predator control fisheries, and evaluation plan in the Columbia River Basin. 1993 Annual Report, Volume 1. Contract DE-B179-90BP07084, Bonneville Power Administration, Portland, Oregon.

Nelson, J. S. and five co-authors. 1998. Recommended changes in common fish names: pikeminnow to replace squawfish. Fisheries 23(9):37.

Northwest Power Planning Council. 1987a. Columbia River Basin Fish and Wildlife Program. Northwest Power Planning Council. Portland, Oregon.

Rieman, B.E., R. C. Beamsderfer, S. Vigg, and T.P. Poe. 1991. Predation by resident fish on juvenile salmonids in a mainstem Columbia reservoir: Part IV. Estimated total loss and mortality of juvenile salmonids to northern squawfish, walleye, and smallmouth bass. T. P. Poe, and B.E. Rieman editors. Resident fish predation on juvenile salmonids in John Day Reservoir, 1983-1986. Final Report (Contracts DE-A179-82 BP34796 and DE-A179-82BP35097) to Bonneville Power Administration, Portland, Oregon.

Rieman, B.E., and R.C. Beamesderfer. 1990. Dynamics of a northern squawfish population and the potential to reduce predation on juvenile salmonids in a Columbia River reservoir. North American Journal of Fisheries Management 10:228-241.

Takata, H. K., and J. A. Koloszar. 2004. Development of a system-wide predator control program: fisheries evaluation. Oregon Department of Fish and Wildlife, Contract Number DE-B1719-94BI24514. 2003 Annual Report to the Bonneville Power Administration, Portland, Oregon.

Vigg, S. and C.C. Burley. 1989. Developing a predation index and evaluating ways to reduce salmonid losses to predation in the Columbia Basin. Report A in A.A. Nigro, editor. Developing a predation index and evaluating ways to reduce losses to predation in the Columbia Basin. Oregon Department of Fish and Wildlife, Contract Number DE-A179-88BP92122. Annual Report to Bonneville Power Administration, Portland, Oregon.

Vigg, S., C.C. Burley, D.L. Ward, C. Mallette, S. Smith, and M. Zimmerman. 1990. Development of a system-wide predator control program: Stepwise implementation of a predation index, predator control fisheries, and evaluation plan in the Columbia River Basin. Oregon Department of Fish and Wildlife, Contact number DE-B179-90BP07084. 1990 Annual Report to the Bonneville Power Administration, Portland, Oregon.

Winther, E.C., J.S. Hisata, M.R. Peterson, M.A. Hagen and R. C. Welling. 1996. Implementation of the northern squawfish sport-reward fishery in the Columbia and Snake Rivers. *In* Development of a system-wide predator control program: stepwise implementation of a predator index, predator control fisheries, and evaluation plan in the Columbia River Basin (Northern Squawfish Management Program). 1996 Annual Report, project number 90-077. Contract DE-B179-90BP07084, Bonneville Power Administration, Portland, Oregon.

Winther, E.C., J.D. Hone, P.V. Dunlap, and K.C. Moyer. 2008. Implementation of the northern pikeminnow sport-reward fishery in the Columbia and Snake Rivers. *In* Development of a system-wide predator control program: stepwise implementation of a predator index, predator control fisheries, and evaluation plan in the Columbia River Basin (Northern Pikeminnow Management Program). 2006 Annual Report, project number 90-077. Contract DE-B179-90BP07084, Bonneville Power Administration, Portland, Oregon.

Report B

Northern Pikeminnow Sport Reward Payments – 2009

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March, 2010

INTRODUCTION

The Northern Pikeminnow Predator Control Program was administered by PSMFC in 2009. 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 into the program. Oregon provided fish tagging services, population studies, food habit and reproductive studies, as well as exploitation rate estimates. PSMFC provided technical administration, and the fiscal and contractual oversight for all segments of the Program and processed all reward vouchers for the sport-reward anglers.

CATCH AND PAYMENTS

In 2009 a total of 142,002 fish were harvested in the sport-reward fishery. Of this total 180 were tagged fish and 141,822 were untagged. Vouchers for 139,924 of the untagged fish were submitted for payment totaling rewards of $868,660. 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 1,215 anglers who registered were successful in catching one or more fish in 2009. The 2009 season ran from May 1, 2009 through October 11, 2009. At the beginning of the season, coupons were issued to all anglers in the pikeminnow database and to those who signed up for our mailing list at the various sportsmen's shows. In addition, all the newspaper ads announcing the opening of the season contained the coupon. The 2009 Coupon was worth a $10 bonus when attached to a voucher for a qualifying pikeminnow caught and turned in for the reward payment.

TAGGED FISH PAYMENTS

A total of 180 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 180 tagged vouchers were submitted for payment. This resulted in tag reward payments of $90,000 in addition to the regular reward payments above.

TOURNAMENT DRAWINGS

A one month tournament was held this season. Each week all anglers who had turned in a voucher for that week were eligible for a weekly drawing. Fifteen angler names were drawn each week for a prize of $1,000. One entry into the weekly drawing was issued for each angler on each day they turned in fish. The tournament drawings took place in

August. A total of $60,000 was paid to the sixty anglers drawn in August for the four weekly drawings.

ACCOUNTING

Total payments for the season of regular vouchers, coupons, drawings and tagged fish, totaled $1,025,100. All IRS Form 1099 Mis. Statements were sent to the qualifying anglers for tax purposes in the third week of January, 2010. Appropriate reports and copies were provided to the IRS by the end of February, 2010.

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.

2009 SPORT REWARD PAYMENTS SUMMARY

The following is a summary of the vouchers received and paid as of November 19, 2009

	Fish	$ Paid
Fish paid @ tier 1 ($4 each):	32,779	$131,116
Fish paid @ tier 2 ($5 each):	39,872	$199,360
Fish paid @ tier 3 ($8 each):	67,273	$538,184
Tags paid (@ $500 each):	180	$90,000
Coupons issued (@ $10 each)	644	$6,440
August drawing winners (@ $1,000 each)	60	$60,000
Total:	**140,104**	**$1,025,100**

Anglers @ tier 1	1,012		
Anglers @ tier 2	111	Anglers with 10 fish or less:	710
Anglers @ tier 3	92	Anglers with 2 fish or less:	336
Number of separate anglers	1,215		

	*Top Twenty Anglers **	TIER 1	TIER 2	TIER 3	TAGS	TOTAL FISH	COUPONS	WEEKLY DRAWING	BALANCE
1.	DAVID R VASILCHUK	100	299	5,154	8	5,561	10	$1,000	$48,137
2.	NIKOLAY N ZAREMSKIY	100	300	4,894	7	5,301	10	$1,000	$45,562
3.	EDWARD R WILLIAMS	100	299	2,687	2	3,088	10	$0	$24,401
4.	THOMAS H PAPST	100	300	2,189	2	2,591	10	$0	$20,422
5.	TIMOTHY L HISTAND	100	300	2,044	2	2,446	10	$1,000	$20,262
6.	VIKTOR M ORLOVSKIY	100	300	1,971	0	2,371	10	$0	$17,678
7.	DUANE P BLETH	100	300	1,601	0	2,001	10	$0	$14,718
8.	IVAN R VASILCHUK	100	300	1,546	3	1,949	0	$0	$15,768
9.	VASILIY G LEVCHENKOV	100	300	1,485	0	1,885	10	$1,000	$14,790
10.	OLEG R VASILCHUK	98	299	1,445	3	1,845	10	$1,000	$15,957
11.	DANIEL J GEIGER	100	299	1,428	2	1,829	10	$1,000	$15,329
12.	VERLON D MILLER	100	300	1,261	1	1,662	10	$0	$12,498
13.	STEVEN A WEBER	100	300	1,194	0	1,594	10	$0	$11,462
14.	PETER F WAHL	100	300	1,146	1	1,547	10	$0	$11,578
15.	KENNETH W HUNTER	100	300	1,131	0	1,531	10	$1,000	$11,958
16.	JAMES E MUCK	100	300	1,041	1	1,442	10	$0	$10,738
17.	MARK A WATKINS	100	300	1,015	0	1,415	10	$1,000	$11,030
18.	RALPH L FONTANA	100	300	994	4	1,398	10	$0	$11,862
19.	BRUCE OLIVER	100	300	941	4	1,345	10	$0	$11,438
20.	JAMES R WYATT	100	300	933	0	1,333	10	$0	$9,374
	* (by total fish caught)	1,998	5,996	36,100	40	44,134	190	$8,000	$354,962

Report C

System-wide Predator Control Program: Indexing and Fisheries Evaluation

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SUMMARY

The Northern Pikeminnow Management Program (NPMP), comprised of fisheries aimed at reducing predation on juvenile salmonids by northern pikeminnow *Ptychocheilus oregonensis* in the Columbia and Snake rivers, was assessed for the 2009 season (1 April–16 October 2009). We report on 1) northern pikeminnow exploitation rates, predation estimates, and tag loss, 2) population parameters of northern pikeminnow, smallmouth bass *Micropterus dolomieu*, and walleye *Sander vitreus* in The Dalles and John Day reservoirs, and 3) possible compensatory responses by these species.

To evaluate exploitation during 2009, we tagged and released 1,803 northern pikeminnow ≥ 200 mm fork length (FL) throughout the lower Columbia and Snake rivers in 2009. Of these fish, 1,112 were in the size group (≥250 mm FL) we have used to monitor trends in system-wide exploitation. System-wide exploitation by the sport-reward fishery of northern pikeminnow ≥ 250 mm FL was 12.8% (95% confidence interval 9.5–16.1%). The 2009 exploitation calculations were adjusted using an estimated tag loss of 9.2%. Based on sport-reward exploitation rates, we estimated that 2009 predation levels were 40% (range: 23–56%) lower than pre-program levels.

We conducted biological indexing in The Dalles and John Day reservoirs as part of our predator community evaluation during 2009. Northern pikeminnow abundance indices continued a decreasing trend in both reservoirs. Of the 19 northern pikeminnow digestive tracts we collected, one contained a juvenile salmonid. Inadequate sample sizes precluded us from calculating consumption indices, predation indices, or proportional stock density and we were unable to complete year-class analysis for either reservoir. Relative weights of northern pikeminnow were within the range of previous years.

Of the 837 smallmouth bass stomach contents we collected, 8 contained juvenile salmonid remains. The prey fish most often consumed by smallmouth bass continued to be *Cottus* spp. Abundance, consumption and predation indices remain relatively static with previous years. The proportion of smallmouth bass composed of age-4 and age-5 was the largest relative percentage estimated in The Dalles and John Day reservoirs to date. Proportional stock density was within the generally expected range (score 30–60) for this species in both The Dalles and John Day reservoirs. Relative weights of smallmouth bass are within the range of previous years.

Estimates of relative density for walleye were on average less than 1 fish/500m^2 in both reservoirs during 2009. Of the 64 walleye stomach content samples we examined, 18 contained juvenile salmonid remains. Year-class analysis continued to show no discernable trend. Proportional and relative stock density values were within a range of a balanced population, while relative weights of walleye were within the range of previous years.

At this time, there does not appear to be a system-wide predator response to the NPMP. However, there may be some early signs of compensation by other piscivores fishes to

the sustained removal of northern pikeminnow. These indicators are localized in small areas below Bonneville dam and in Bonneville and John Day reservoirs.

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 1970's (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 to sample northern pikeminnow populations in standardized areas, and to compare results among years when sample sizes are adequate to avoid biasing estimates (Zimmerman and Ward 1999; Zimmerman et al. 2000; Takata et al. 2007). This report describes our activities and findings for 2009, and wherever possible, evaluates changes from previous years.

Our objectives in 2009 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 The Dalles and John Day reservoirs, and 3) look for possible compensatory responses by these species.

METHODS

Fishery Evaluation, Predation Estimates, and Tag Loss

Field Procedures

We collected northern pikeminnow for tagging using electrofishing boats in the Columbia River from river kilometer (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). To balance our system-wide tagging effort, we used two 15-minute electrofishing periods per river kilometer. We were unable to cover every river kilometer prior to the fisheries opener. Therefore, we tagged fish in the area below John Day dam (rkm 227) before the beginning of the fisheries. Fish were tagged upstream of rkm 227 concurrent with the fisheries.

We tagged and released northern pikeminnow ≥ 200 mm FL with uniquely numbered Floy FT-4 lock-on loop tags to estimate exploitation rates for the sport-reward (Winther et al. 2010, this report) and dam-angling fisheries (USDA 2010, this report). To evaluate tag retention, we also injected a passive integrated transponder (PIT) tag into the dorsal sinus of all loop-tagged fish.

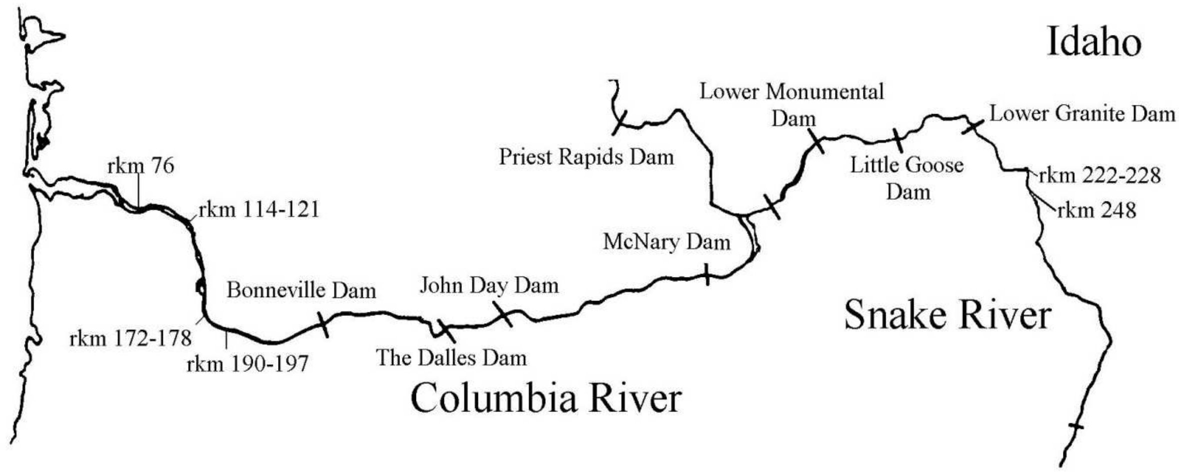

Figure 1. The lower Columbia and Snake rivers.

We worked in cooperation with Washington Department of Fish and Wildlife (WDFW) and the United States Department of Agriculture (USDA) to acquire tag recovery information from the sport-reward and dam-angling fisheries, respectively. The sport-reward fishery occurred from 1 May to 11 October 2009 at which time participating anglers received payment for northern pikeminnow ≥ 230 mm (9 inches) in total length (TL). This size limit is approximately equivalent to the minimum size (200 mm FL) of northern pikeminnow we tagged. The payment schedule continued to consist of three tiers (Porter 2010, this report), and anglers received $500 reward for each fish with a loop tag turned in at a participating station. The dam-angling fishery occurred from 11 May to 15 August 2009, and was confined to the accessible area directly off The Dalles and John Day dams. These anglers also removed northern pikeminnow ≥ 230 mm TL (9 inches), but did not follow a payment schedule.

Data Analysis

We estimated the proportion of the northern pikeminnow population removed during program fisheries using mark-and-recapture data from the entire area fished (system-wide) and for continuous zones separated by dams (area-specific). We accounted for the change in minimum length of northern pikeminnow eligible for sport-reward payment being reduced from 11 inches (≥278 mm TL; equivalent ≥250 mm FL) to 9 inches TL (≥230 mm TL; equivalent ≥200 mm FL) in 2000, by calculating exploitation rates for all fish tagged (≥200 mm FL), the subset of fish from 200 to 249 mm FL, and the subset of fish ≥ 250 mm FL. We used the subset of fish ≥ 250 mm FL whenever comparing trends among years. In areas where tagging was completed prior to the start of the fishery, we estimated the rate of exploitation of the population annually using the Petersen method (Ricker 1975). This annual estimate was calculated using the equation

$$u = R/M, \qquad (1)$$

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.

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

$$(R \pm z*R^{0.5})/M, \qquad (2)$$

where

z = the multiplier from the standard normal distribution,
M = the number of fish that are tagged in a season, and
R = the number of tagged fish that are recaptured in a season (Styer 2003).

In addition, we calculated exploitation rates in 2009 for northern pikeminnow (≥200 mm FL) PIT tagged 2003–2009 in the areas below Bonneville Dam and in Bonneville Reservoir using the variable survival method (Everhart and Youngs 1981). This is given by the equation

$$f_i = R_i/M_i * C_i/T_i, \qquad (3)$$

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 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 system-wide exploitation rates to account for tagging and fishing that 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 summed weekly rates to estimate system-wide exploitation for the season (Styer 2003). Appendix Table A-1 shows sampling weeks used in 2009. We calculated 95% confidence intervals for each estimate using the formula

$$u \pm t(k*s)^{0.5}, \quad (4)$$

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 the rate when the number of recaptures was less than four (Styer 2003). Exploitation estimates from previous years with fewer than four tag recoveries 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

$$L = [m / (m + r)] * 100, \quad (5)$$

where

- L = tag loss rate,
- m = the number of northern pikeminnow recaptured with a PIT tag from the 2009 season and no loop tag, and
- r = the number of northern pikeminnow recaptured with 2009 loop tags intact.

We used a model based on Friesen and Ward (1999) to estimate predation on juvenile salmonids relative to predation before the implementation of the NPMP. The model estimates potential predation reduction from preprogram conditions using the parameters 1) population structure before removals by fisheries, 2) consumption of juvenile salmonids by northern pikeminnow, 3) fish length, 4) size-specific exploitation rates, and 5) annual mortality. We used a 10-year average age structure (based on catch curves) for a pre-exploitation base, and assumed constant recruitment. The model has been updated to include fork length increments with measured growth instead of age increments and estimated growth. We changed age increments to fork length increments by calculating the intervals on measured annual growth from mark-and-recapture information. The model predicts changes in potential predation that were directly related to removals, provided that all other variables held constant. We estimated the potential predation during 2009 based on observed exploitation rates and predicted future predation rates using a mean level of exploitation observed during current program rules (2002–2009).

Biological Evaluation

Field Procedures

We used standardized electrofishing techniques described in Ward et al. (1995) and Zimmerman and Ward (1999) to evaluate northern pikeminnow, smallmouth bass, and walleye populations in The Dalles and John Day reservoirs during 2009. We conducted sampling during spring (4–22 May) and summer (22 June–17 July) in three areas of The Dalles (forebay; rkm 307–313, mid-reservoir; rkm 329–334, and John Day Dam tailrace; rkm 341–347) and John Day reservoirs (forebay; rkm 347–354, mid-reservoir; rkm 387–394, and McNary Dam tailrace; rkm 461–469). Each area contained 24 transects approximately 500m long that occurred along both shores of the river, or along both sides of major islands (e.g. Miller Island in The Dalles mid-reservoir). Effort at each transect consisted of a 15-min electrofishing period with continuous output of approximately 4 amperes.

We recorded catch and biological data for all northern pikeminnow, smallmouth bass, and walleye collected during 2009. We measured fork length (nearest mm) and total body weight (nearest g) for each fish captured. We removed scales from 25 fish per 25 mm FL size increment by species in each reservoir sampled. Walleye scales collected during 2009 tagging operations were used to supplement those collected during the indexing season. We sacrificed all untagged northern pikeminnow to collect and preserve digestive tracts for diet analysis. We removed digestive tract by securing both ends with hemostats and cutting free the connective tissue. We removed all external tissues prior to placing the digestive tract into a Whirl-pak bag for storage. We noted gender and stage of maturity for each sacrificed fish. Smallmouth bass and walleye (≥200 mm FL) stomach contents were collected using a modified Seaburg sampler (Seaburg 1957), which used a jet of water to flush contents from the foregut of a fish (gastric lavage) without sacrificing the animal. We collected the lavaged contents in a 200 μm meshed container prior to transferring it to a Whirl-pak bag. All bags were kept on ice while in the field, and stored in a freezer prior to analysis in a laboratory.

Laboratory Procedures

We examined digestive tract contents of northern pikeminnow, smallmouth bass, and walleye to measure relative consumption rates of juvenile salmonids. Each digestive sample was thawed in the laboratory and the contents were sorted into trays by prey category. Each tray was weighed to the nearest 0.01 g before being returned to the original Whirl-pak bag for chemically digesting the soft tissue contents from the bones. We added a solution of lukewarm tap water, pancreatin (2% wet weight; 8 X porcine digestive enzyme), and sodium sulfide nonahydrate (1% wet weight) to each bag. Each bag was sealed and placed in a desiccating oven at approximately 48°C for 24 h. After removing from the oven, a solution of tap water and sodium hydroxide (3% wet weight) was added to the bag to digest any remaining tissues. The contents that remained in the bag were poured into a 425 μm sieve and rinsed with tap water. The remaining bones were identified to the lowest possible taxon (Hansel et al. 1988, Frost 2000, and Parrish et al. 2006) using a dissecting microscope.

Scales were cleaned and mounted for pressing into acetate using a heated hydraulic press. We viewed the scale impressions with a microfiche reader. We assigned ages using standard methods described by DeVries and Frie (1996).

Data Analysis

We used catch per unit of effort (CPUE) and area-specific surface areas to calculate northern pikeminnow abundance indices (Ward et al. 1995). We compared abundance indices of northern pikeminnow in 2009 with those from previous years. We used transformed catch [$\log_{10}$ (catch + 1)] as an index of smallmouth bass and walleye relative densities (fish/500m^2).

We used the following formulas to calculate consumption indices for northern pikeminnow (Ward et al. 1995) and smallmouth bass (Ward and Zimmerman 1999)

$$CI_{NPM} = 0.0209 \cdot T^{1.60} \cdot W^{0.27} \cdot (S \cdot GW^{-0.61}), \qquad (6)$$

and

$$CI_{SMB} = 0.0407 \cdot e^{(0.15)(T)} \cdot W^{0.23} \cdot (S \cdot GW^{-0.29}), \qquad (7)$$

where

CI_{NPM} = consumption index for northern pikeminnow,
CI_{SMB} = consumption index for smallmouth bass,
T = water temperature (^oC),
W = 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 and summer consumption indices for 2009 to those from previous years.

We used the product of abundance and consumption indices to generate an index of predation for northern pikeminnow during spring and summer periods. The index was used to compare relative predation among years that data were collected. The daily juvenile salmonid passage indices at The Dalles and McNary dams were plotted to verify timing of index sampling with concentrations of juvenile salmonids. We started calculating a predation index for smallmouth bass in 2004 as a response to reports of increased abundance in some areas. Ward and Zimmerman (1999) observed that smallmouth bass densities (fish/500m) varied seasonally in the Columbia and Snake rivers; we therefore calculated predation indices using spring and summer CPUE and area-specific surface area as the season-specific relative abundance index. We multiplied the abundance index by its corresponding consumption index to obtain a season-specific predation index.

To evaluate age structure, we examined the change in frequency percentage by age and size of northern pikeminnow, smallmouth bass, and walleye collected in 2009 to previous years. To address differential vulnerability associated with northern pikeminnow FL (50-mm groups) and exploitation rates 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). Based on electrofishing catch curves for smallmouth bass and walleye (ODFW, unpublished data), we limited our comparisons for these species to age 4–5 and age 5–6, respectively.

Northern pikeminnow exploitation rates are believed to be greater for larger fish than for smaller fish (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 (Anderson 1980) to compare the size structure of northern pikeminnow, smallmouth bass, and walleye populations among years. Proportional stock density was calculated using the formula

$$PSD = 100 \cdot (FQ_i/FS_i), \qquad (8)$$

where

PSD = proportional stock density,
FQ_i = number of fish ≥ quality length, and
FS_i = number of fish ≥ stock length.

In addition to calculating proportional stock densities for all three species, we calculated relative stock density to examine smallmouth bass and walleye populations. Relative stock density (Gabelhouse 1984) was calculated using the formula

$$RSD\text{-}P = 100 \cdot (FP_i/FS_i), \qquad (9)$$

where

$RSD\text{-}P$ = relative stock density of preferred size fish,
FP_i = number of fish ≥ preferred length, and
FS_i = number of fish ≥ stock length.

Stock and quality minimum length categories used for northern pikeminnow were 250 and 380 mm FL, respectively (Beamesderfer and Rieman 1988; Parker et al. 1995). Stock, quality and preferred minimum length categories for smallmouth bass were 180 mm, 280 mm, and 350 mm TL, respectively. For walleye, stock, quality, and preferred minimum length categories were 250 mm, 380 mm, and 510 mm TL, respectively (Willis et al. 1985). We converted fork length to total length for smallmouth bass and walleye to conform to the established standards for each species. The conversion for smallmouth was $TL_{SMB} = FL_{SMB} \cdot 1.040$, and the conversion for walleye was $TL_{WAL} = FL_{WAL} \cdot 1.060$.

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 2009 with previous years. We used the length-specific standard weight—predicted by a weight–length regression [$log_{10}W_s=a'+b \cdot log_{10}(L)$]—for northern pikeminnow (Parker et al. 1995), smallmouth bass (Kolander et al. 1993), and walleye (Murphy et al. 1990) to calculate relative weight [$W_r = 100 \cdot (W/W_s)$]. We calculated median 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 used the analysis of variance to detect a significant difference and calculated the 95% confidence intervals.

RESULTS

Fishery Evaluation, Predation Estimates, and Tag Loss

We tagged and released 1,803 northern pikeminnow ≥ 200 mm FL throughout the lower Columbia and Snake rivers during 2009 of which 1,112 were ≥ 250 mm FL (Table 1). In 2009, removal fisheries harvested 147,014 northern pikeminnow ≥ 200 mm. The sport-reward fishery harvested 141,645 of these fish (Winther et al. 2010, this report) while the dam-angling fishery removed 5,369 (USDA 2010, this report). The sport-reward fishery recaptured a total of 128 tagged northern pikeminnow, and the dam-angling fishery recaptured one tagged fish. Fish tagged and subsequently recaptured in 2009 were at-large from 0 to 168 days (average of 81 days). Of all recaptures, 91% were ≥ 250 mm FL (Table 1). In the sport reward fishery, 65% of the harvest consisted of northern pikeminnow ≥ 250 mm FL, and the median fork length was 275 mm (J. Hone, WDFW, personal communication). The fishery recaptured a total of 13 northern pikeminnow that contained 2009 PIT tags, but were missing loop tags. Exploitation was adjusted to reflect an estimated tag loss of 9.2%.

Table 1. Number of northern pikeminnow tagged and recaptured in the sport reward fishery during 2009.

	200–249 mm FL		≥250 mm FL		All combined	
Area	Tagged	Recaptured	Tagged	Recaptured	Tagged	Recaptured
Below Bonneville Dam	286	3	713	74	1,003	77
Bonneville	12	1	103	14	115	15
The Dalles	10	0	28	2	38	2
John Day	17	0	11	1	28	1
McNary	57	0	168	16	225	16
Little Goose	185	6	41	7	226	13
Lower Granite	120	1	48	2	168	3
All areas combined	691	11	1,112	117[a]	1,803	128[a]

a) Includes fish recaptured in a different area than originally tagged. The value is not included in area-specific exploitation rate calculations.

System-wide exploitation of northern pikeminnow ≥ 200 mm FL by the sport-reward fishery was 8.8% (95% confidence interval 6.4–11.2%; Appendix Tables B-1 and B-2). Area-specific exploitation estimates ranged from 8.4% in McNary Reservoir and the area below Bonneville Dam to 15.2% in Bonneville Reservoir. We did not calculate exploitation rates for The Dalles, John Day, or Lower Granite reservoirs due to an insufficient number of tag recoveries (Appendix Table B-2). When using catch information for all fish tagged 2003–2009, we estimated the exploitation rate to be 8.4% below Bonneville Dam and 14.8% in Bonneville Reservoir.

The system-wide exploitation rate of northern pikeminnow 200–249 mm FL was 1.8% for the sport-reward fishery (95% confidence interval 0.3–3.4%; Appendix Table B-2). The area-specific estimate for Little Goose Reservoir was 5.6%; the only area with sufficient numbers of recaptures to calculate an exploitation rate.

For northern pikeminnow ≥ 250 mm FL, system-wide exploitation was 12.8% (95% confidence interval 9.5–16.1%; Figure 2, Appendix Table B-2). Area-specific exploitation rates ranged from 11.3% for the area below Bonneville Dam to 25.8% in Little Goose Reservoir. As with system wide exploitation estimates, insufficient number of tag recoveries precluded estimates of exploitation for The Dalles, John Day, or Lower Granite reservoirs (Appendix Table B-2).

We sampled 767 northern pikeminnow caught in the dam-angling fishery, with 54% of the samples coming from The Dalles Dam. Median fork length of northern pikeminnow caught by dam anglers was 375 mm. One tagged northern pikeminnow was recaptured at The Dalles Dam; however, this was not an adequate sample size to calculate an unbiased exploitation estimate for this fishery.

Our Model predicted a 40% (23–56%) reduction in predation by northern pikeminnow on juvenile salmonids from pre-program levels (Figure 3). Projections using the current fishery structure predict predation reduction by northern pikeminnow to remain static through 2012.

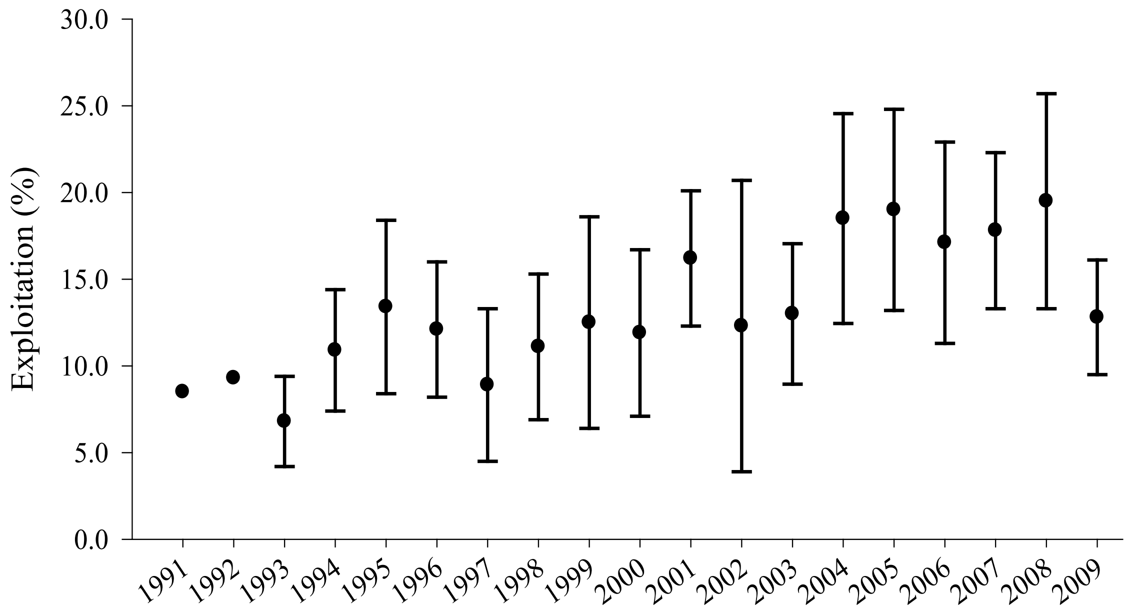

Figure 2. System-wide exploitation rates of northern pikeminnow ≥ 250 mm fork length for the sport-reward fishery, 1991–2009. Error bars denote the 95% confidence interval. Confidence intervals were not available for 1991–1992.

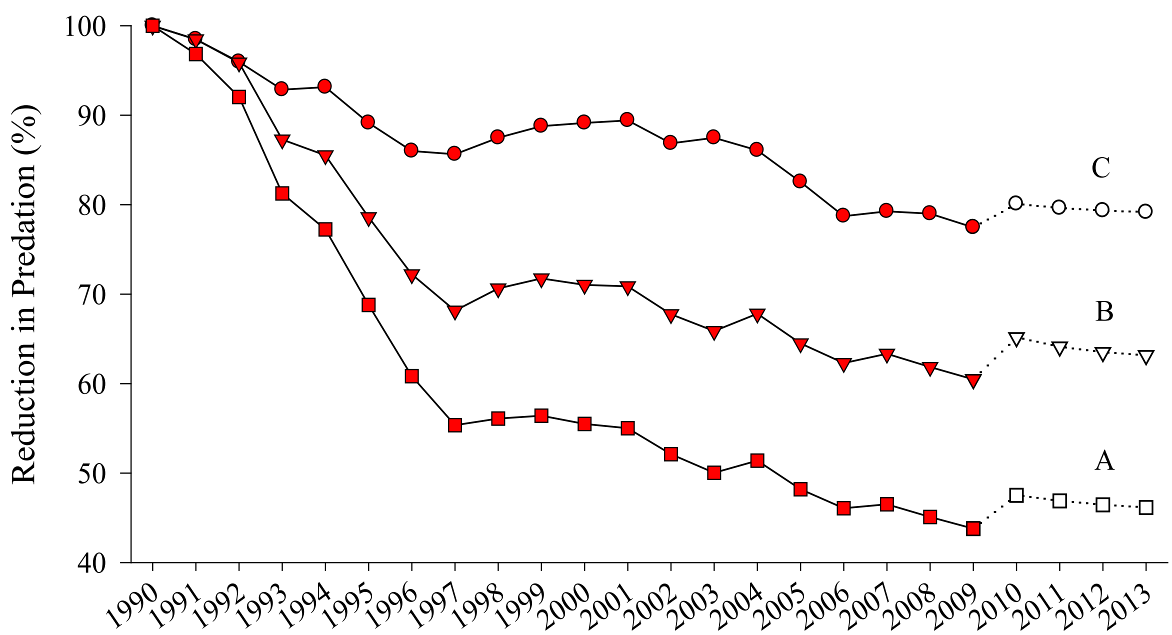

Figure 3. Maximum (A), median (B), and minimum (C) estimates of predation reduction by northern pikeminnow on juvenile salmonids relative to predation prior to implementation of the Northern Pikeminnow Management Program. Estimates of predicted predation after 2009 are based on 7-year average values.

Biological Evaluation

We were not able to sample in The Dalles mid-reservoir or John Day Dam forebay for a second time during summer because of boat malfunctions and extreme wind. Therefore, our summer estimate for these two areas was calculated with one sampling event.

As in past years, sampling during 2009 occurred while juvenile salmonids were actively passing through The Dalles and McNary dams (Figure 4). Northern pikeminnow CPUE for both seasons combined in The Dalles and John Day reservoirs did not exceed 0.1 in any area sampled during 2009 (Appendix Table C-1). Spring CPUE ranged from 0.0 to 0.2 for northern pikeminnow, 0.3 to 4.3 for smallmouth bass, and 0.0 to 0.6 for walleye (Table 2). Summer CPUE ranged from 0.0 to 0.1 for northern pikeminnow, 0.8 to 4.2 for smallmouth bass, and 0.0 to 0.4 for walleye.

Abundance index values for northern pikeminnow ranged from less than 0.1 to 0.3 in The Dalles Reservoir, and from less than 0.1 to 0.4 in John Day Reservoir during 2009 (Appendix Table C-2). Area-specific index values were the lowest estimated in all cases but John Day Mid-reservoir since 1990, and continued to follow a decreasing trend.

Relative densities of smallmouth bass during spring were 0.3 in all three areas of The Dalles Reservoir, and ranged from 0.1 to 0.6 in John Day Reservoir during 2009 (Appendix Table C-3). Relative densities for the species during summer ranged from 0.2 to 0.4 in The Dalles Reservoir, and from 0.2 to 0.6 in John Day Reservoir (Appendix Table C-3). Relative densities vary among years and areas showing no consistent trend or pattern.

Relative densities for walleye ranged from 0.0 to 0.1 in both The Dalles and John Day reservoirs regardless of the season during 2009 (Appendix Table C-3). Since sampling began in the early 1990's relative densities have not exceeded 0.3 walleye/500m^2. Walleye captured during 2009 indexing were primarily in tailrace areas with 57% and 87% of the total walleye collected in the tailraces of the John Day and McNary dams, respectively.

We examined 19 northern pikeminnow digestive tracts in 2009, of which 95% contained food items (e.g. crayfish, insects, and fish). In the digestive tracts with food items, three contained fish remains of which one had salmon (Table 3). Of the three samples containing fish remains, we were able to identify the prey fish in two (Table 4). One sample contained a *Micropterus* species, one contained *Oncorhynchus* species, and the other could not be identified.

We examined 837 smallmouth bass stomach samples of which 96% contained food items. Of the samples with food items, 99 contained fish remains of which eight had salmon (Table 3). The predominant fish consumed by smallmouth bass was *Cottus* species in both The Dalles (71%) and John Day (60%) reservoirs during 2009 (Table 4).

We examined 64 walleye stomach samples of which 89% contained food items. Of the samples that contained food items, 69% contained prey fish and 30% contained salmonids (Table 3). We found fish remains in 44 of the samples, of which 26 contained prey fish species. Salmon was the most common fish identified with 67% and 70% of the identified samples from The Dalles and John Day reservoirs, respectively (Table 4).

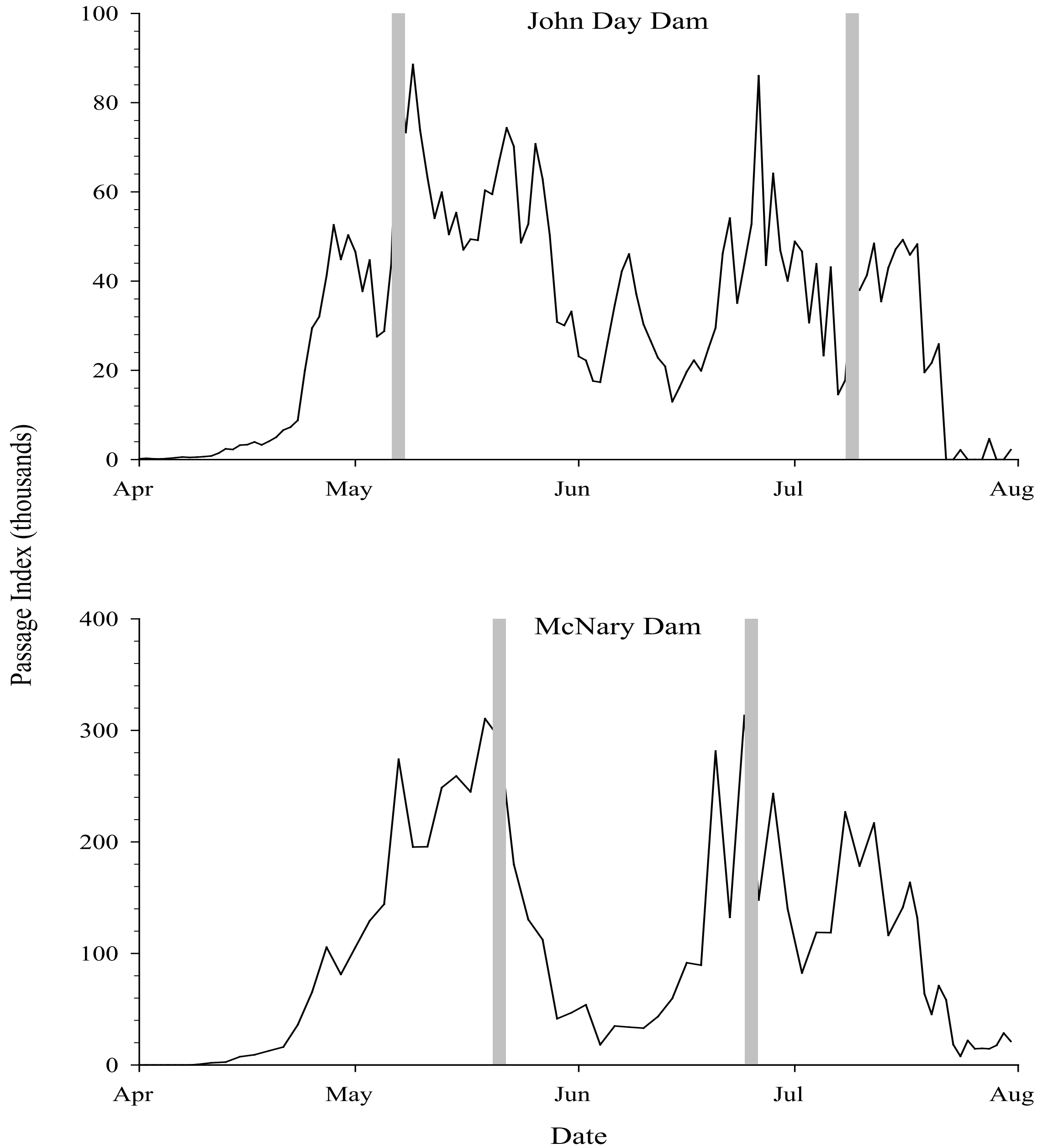

Figure 4. Periods of index sampling (shaded bars) and a smolt index of juvenile salmonids (all species) passing though John Day and McNary dams 1 April– 31 July 2009 (Columbia River Data Access in Real Time (DART), unpublished metadata).

Shaded areas indicate dates of sampling in the vicinity of the dams. The passage index is estimated fish per volume of water, and is adjusted for river flow (FPC 2005).

Table 2. Catch per 15-minute electrofishing run (CPUE) for northern pikeminnow (≥250 mm FL), smallmouth bass (≥200 mm FL), and walleye (≥200 mm FL) that were captured during indexing in The Dalles and John Day Reservoirs during spring and summer 2009.

Species, Reservoir, Season	Forebay	Mid-reservoir	Tailrace
Northern pikeminnow,			
The Dalles Reservoir,			
Spring	0.1	0.2	0.0
Summer	<0.1	<0.1	0.1
John Day Reservoir,			
Spring	<0.1	<0.1	0.1
Summer	0.0	<0.1	0.0
Smallmouth bass,			
The Dalles Reservoir,			
Spring	1.5	1.3	1.3
Summer	0.9	2.2	0.9
John Day Reservoir,			
Spring	1.5	4.3	0.3
Summer	4.2	3.1	0.8
Walleye,			
The Dalles Reservoir,			
Spring	0.1	0.2	0.4
Summer	<0.1	<0.1	0.0
John Day Reservoir,			
Spring	0.0	0.1	0.6
Summer	0.0	0.0	0.4

Due to the low northern pikeminnow catch during 2009, we were unable to calculate consumption index values in The Dalles and John Day reservoirs in spring or summer (Appendix Table C-4). Consumption index values for smallmouth bass in 2009 ranged from 0.0 to 0.1 and remain similar to past years (Appendix Table C-4).

Our inability to calculate consumption indices precluded us from calculating northern pikeminnow predation indices during 2009 (Appendix Table C-5). Smallmouth bass predation index values ranged from 0.0 to 1.5 during 2009 (Appendix Table C-5). During summer 2009, mid-reservoir index values were generally largest in both The Dalles and John Day reservoirs.

We aged 26 northern pikeminnow from The Dalles Reservoir, and 7 from John Day Reservoir during 2009. In the 3–5 year age range, there was one fish from The Dalles and two fish from

Table 3.—Number (*N*) of northern pikeminnow, smallmouth bass, and walleye digestive tracts examined from The Dalles and John Day reservoirs in 2009, and percent that contained food, fish, and salmonid remains (Sal).

Season,	Northern pikeminnow				Smallmouth bass				Walleye			
Area	*N*	Food	Fish	Sal	*N*	Food	Fish	Sal	*N*	Food	Fish	Sal
Spring												
The Dalles Reservoir	8	88	13	0	137	94	19	1	25	80	44	12
John Day Reservoir	6	100	33	17	285	98	9	0	25	96	84	44
All areas	14	93	21	7	422	97	13	1	50	88	64	28
Summer												
The Dalles Reservoir	4	100	0	0	150	91	13	0	2	100	100	50
John Day Reservoir	1	100	0	0	265	97	10	2	12	92	83	33
All areas	5	100	0	0	415	95	11	1	14	93	86	36
All Combined	19	95	16	5	837	96	12	1	64	89	69	30

Table 4. Percent family composition of fish consumed by northern pikeminnow, smallmouth bass, and walleye in The Dalles and John Day Reservoirs, 2009. TDA = The Dalles Reservoir, JDY = John Day Reservoir, and (n = the number of samples containing identifiable fish).

	Northern pikeminnow		Smallmouth bass		Walleye	
Family	TDA	JDY	TDA	JDY	TDA	JDY
Catostomidae	0	0	13 (4)	6 (2)	17 (1)	0
Centrarchidae	100 (1)	0	13 (4)	6 (2)	0	0
Cottidae	0	0	71 (22)	60 (21)	0	20 (4)
Cyprinidae	0	0	0	6 (2)	33 (2)	10 (2)
Gasterosteidae	0	0	0	0	0	0
Ictaluridae	0	0	0	3 (1)	0	0
Percopsidae	0	0	0	0	0	0
Petromyzontidae	0	0	0	6 (2)	0	0
Salmonidae	0	100 (1)	6 (2)	17 (6)	67 (4)	70 (14)

John Day Reservoir (Figure 5). Sample size was inadequate to complete a year-class analysis for northern pikeminnow during 2009.

We collected smallmouth bass scales in The Dalles Reservoir for the second time in 2009. A total of 137 scales were aged, 13.9% of which were age-4 fish and 13.1% age-5 fish (Figure 6). In John Day Reservoir we aged 94 smallmouth bass, 25.5% of which were age-4 and 17.0% were age-5. Both age-4 and age-5 fish had the largest proportion measured to date in John Day Reservoir. Age-4 smallmouth bass continue to predominate within the age 4–5 group in John Day Reservoir.

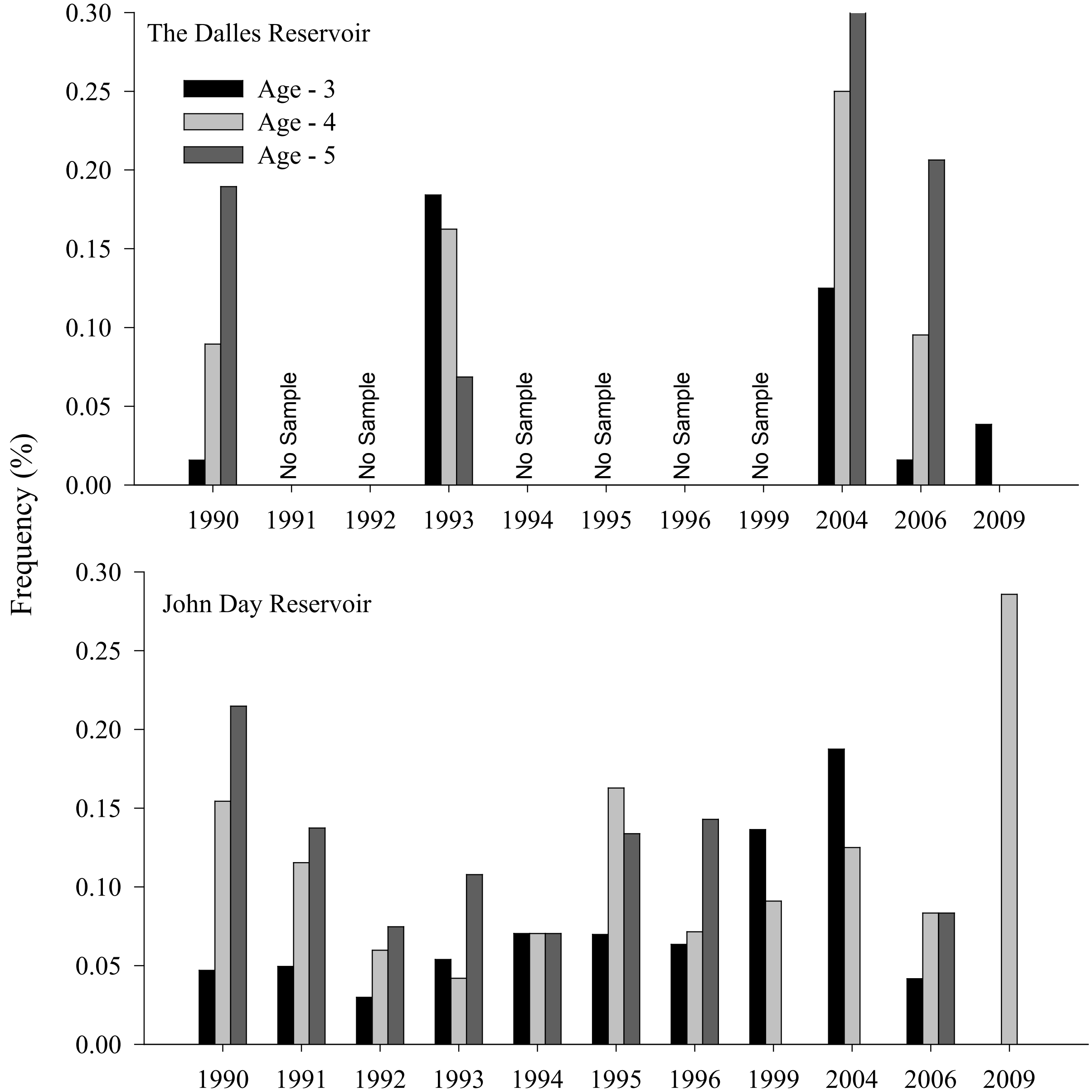

Figure 5. Percent composition of age 3-5 northern pikeminnow, relative to the total sample, The Dalles and John Day Reservoirs 1990–1996, 1999, 2004, 2006, and 2009.

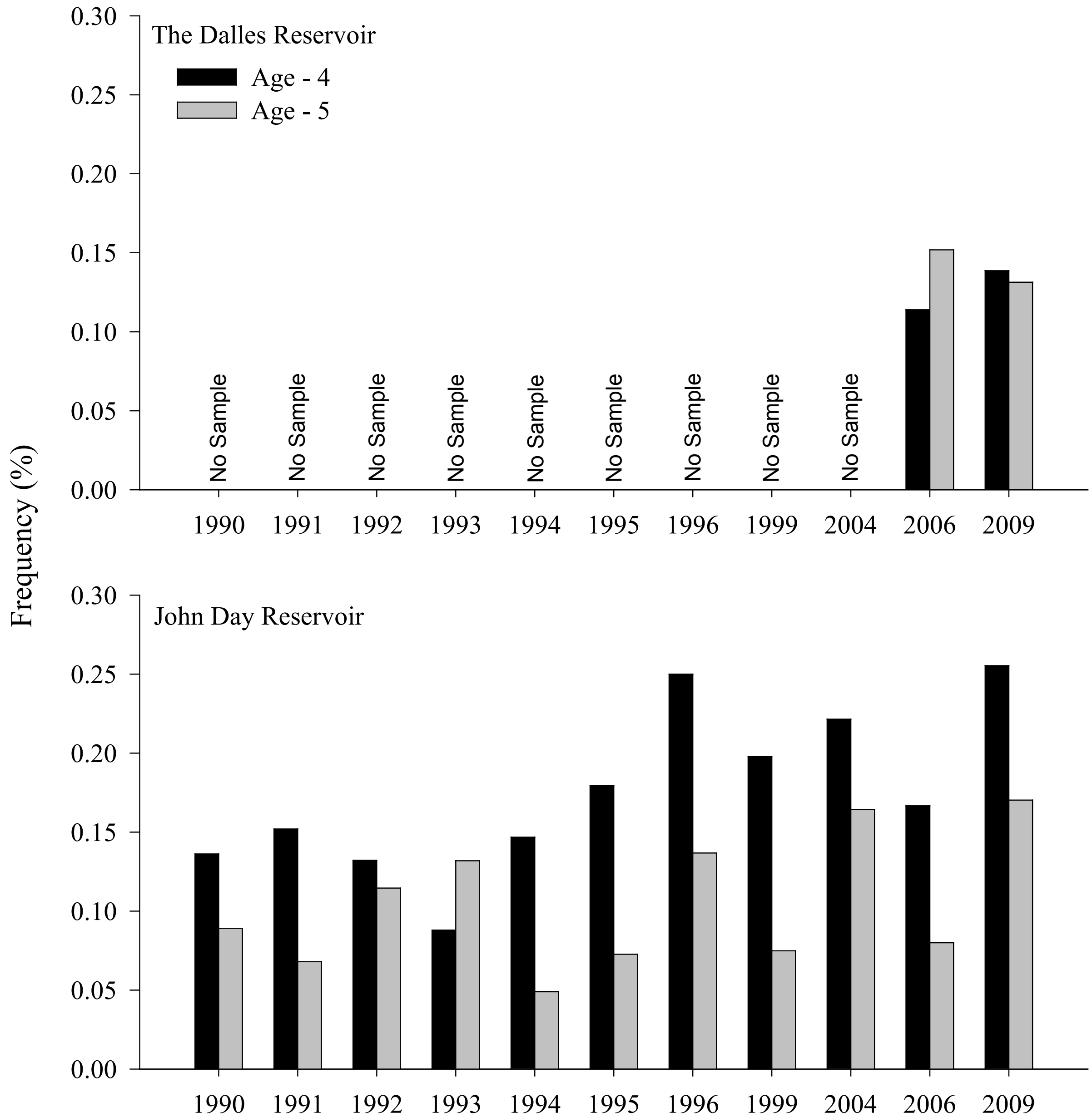

Figure 6. Percent composition of age 4-5 smallmouth bass, relative to the total sample, The Dalles and John Day Reservoirs 1990–1996, 1999, 2004, 2006, and 2009.

During 2009 we aged 31 walleye in The Dalles Reservoir, 9.7% of which were age-5 and 3.2% were age-6 (Figure 7). Age-5 walleye continued to predominate the age grouping. The proportion of this age grouping continued to show an inconsistent pattern among years. We aged 33 walleye in John Day Reservoir. The percent of each age was 9.1%. The combined proportion of the age 5–6 group was down in 2009 relative to 2006.

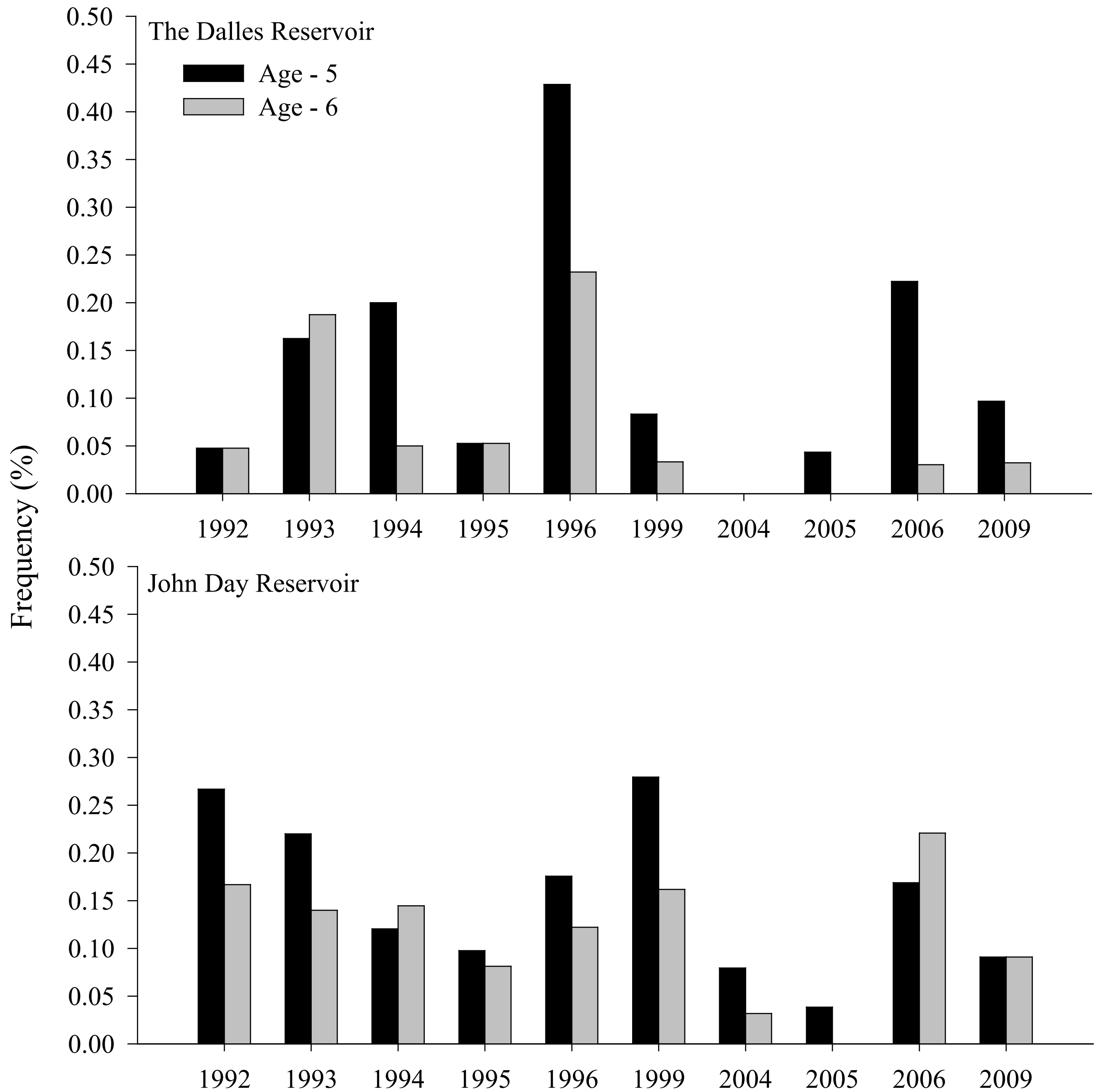

Figure 7. Percent composition of age 5-6 walleye, relative to the total sample, The Dalles and John Day Reservoirs 1990–1996, 1999, 2004, 2006, and 2009.

Sample sizes fewer than 20 stock size fish (250 mm FL) precluded calculating PSD values for northern pikeminnow during 2009 in both The Dalles and John Day reservoirs (Appendix Table C-6). Inadequate sample sizes have kept us from calculating PSD for two of the last four sampling years in The Dalles Reservoir, and three of the last four sampling years in John Day Reservoir.

During 2009, smallmouth bass in The Dalles Reservoir had a PSD of 59 while RSD-P was 16. Both of these values are the highest calculated to date (Appendix Table C-6). In

John Day Reservoir smallmouth bass PSD was 33, which was within the range observed during previous years. The RSD-P was 3, which was lower than all other years (Appendix Table C-6).

The PSD calculated for walleye in 2009 was 52, and the RSD-P was 26 in The Dalles Reservoir. Both were the lowest values of the four calculated to date (Appendix Table C-6). In John Day Reservoir, the PSD value was 41 (the lowest calculated to date), while the RSD-P value of 23 was similar to 2004 and 2006 values (Appendix Table C-6).

The median W_r for northern pikeminnow was 104.6 for males and 113.6 for females in The Dalles Reservoir, and 98.3 for males and 113.3 for females in John Day Reservoir (Appendix Table C-7). Analysis of variance determined there was a significant difference (P <0.01) among years for male and female northern pikeminnow in both The Dalles and John Day reservoirs (Figure 8).

Median W_r for smallmouth bass was 95.3 in The Dalles Reservoir and 91.8 in John Day Reservoir (Appendix Table C-7). Analysis of variance determined that there was a significant difference (P <0.001) among years in both reservoirs (Figure 9).

The median W_r calculated in 2009 for walleye was 91.0 in The Dalles Reservoir and 93.7 in John Day Reservoir (Appendix Table C-7). The analysis of variance indicated the difference among years was significant (P <0.001) in The Dalles Reservoir, and not significant (P = 0.109) in John Day Reservoir (Figure 10).

DISCUSSION

In 2009, system-wide exploitation of northern pikeminnow ≥ 200 mm FL (8.8%) was the lowest since the 200 mm size limit was implemented in 2000. In addition, the system-wide exploitation rate for northern pikeminnow ≥ 250 mm FL (12.8%) was the lowest since 2002. Even though overall exploitation decreased during 2009, the sport-reward fishery continued to achieve the targeted range of 10–20% (Rieman and Beamesderfer 1990).

Recaptures of northern pikeminnow 200–249 mm FL were inadequate (≤ 4 tagged fish) to calculate area-specific rates of exploitation in all areas but Little Goose Reservoir during 2009 even though they comprised from 10% to 71% of total fish tagged (Table 1). Ricker (1975) identified differential mortality and behavioral differences between marked and unmarked fish as violations of the assumptions of the Petersen mark-recapture methodology. Although we were able to calculate a system-wide estimate for this subset of the population, their disproportionate representation among areas within the system could influence the efficacy of our evaluation (Styer 2003). Since these smaller fish are also included in estimating exploitation rates for all northern pikeminnow ≥ 200 mm FL, they could be reducing the estimated proportion being exploited by NPMP fishery activities. Our evaluation has documented these concerns in previous reports (Takata and

Koloszar 2004; Weaver et al. 2008; Weaver et al. 2009). For this reason, we continue to recommend using exploitation rates for northern pikeminnow ≥ 250 mm FL when comparing between or among years of program fisheries.

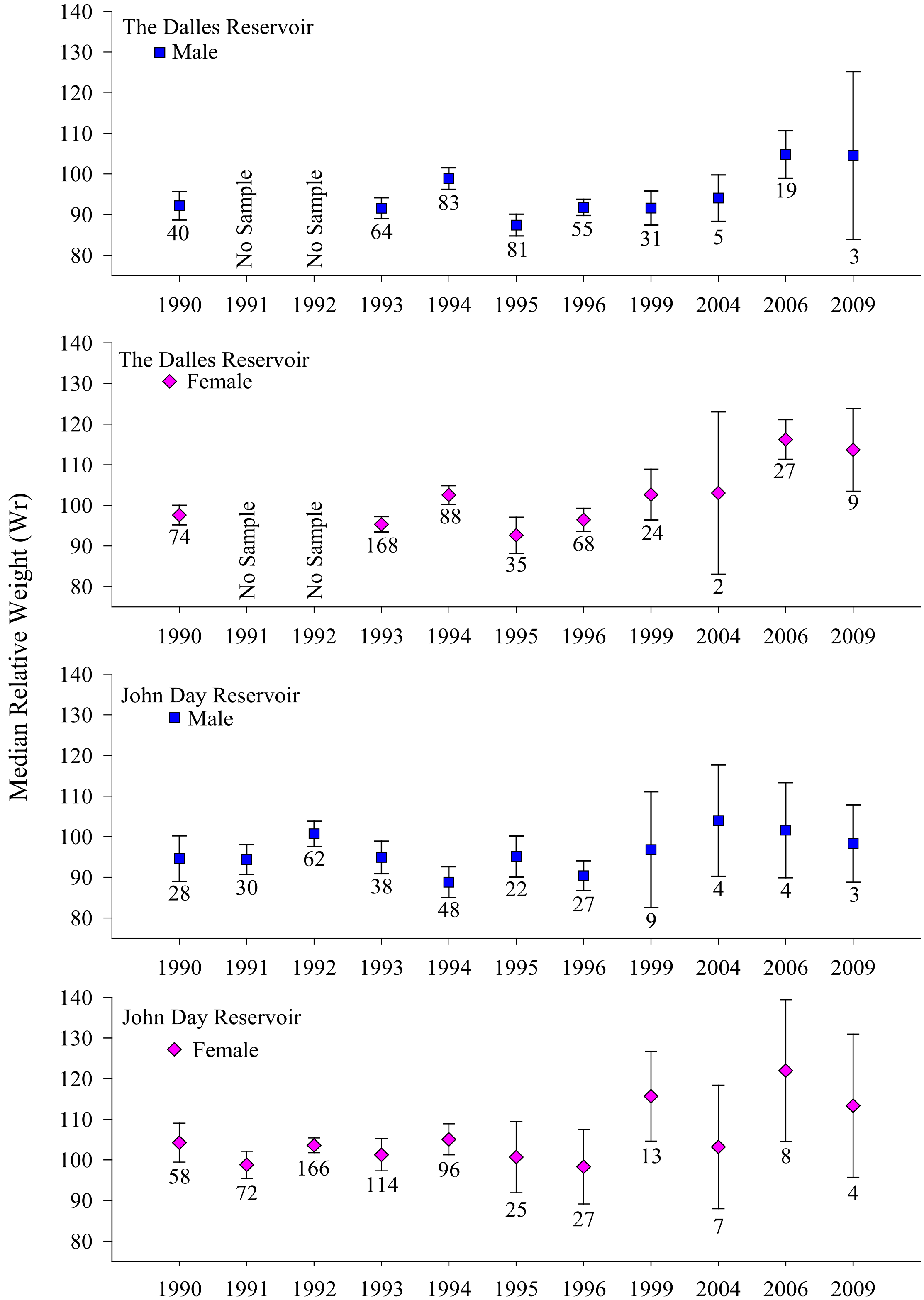

Figure 8. Relative weight of male and female northern pikeminnow in The Dalles and John Day Reservoirs, 1990–1996, 1999, 2004, 2006, and 2009. Numbers below the bars are the sample size.

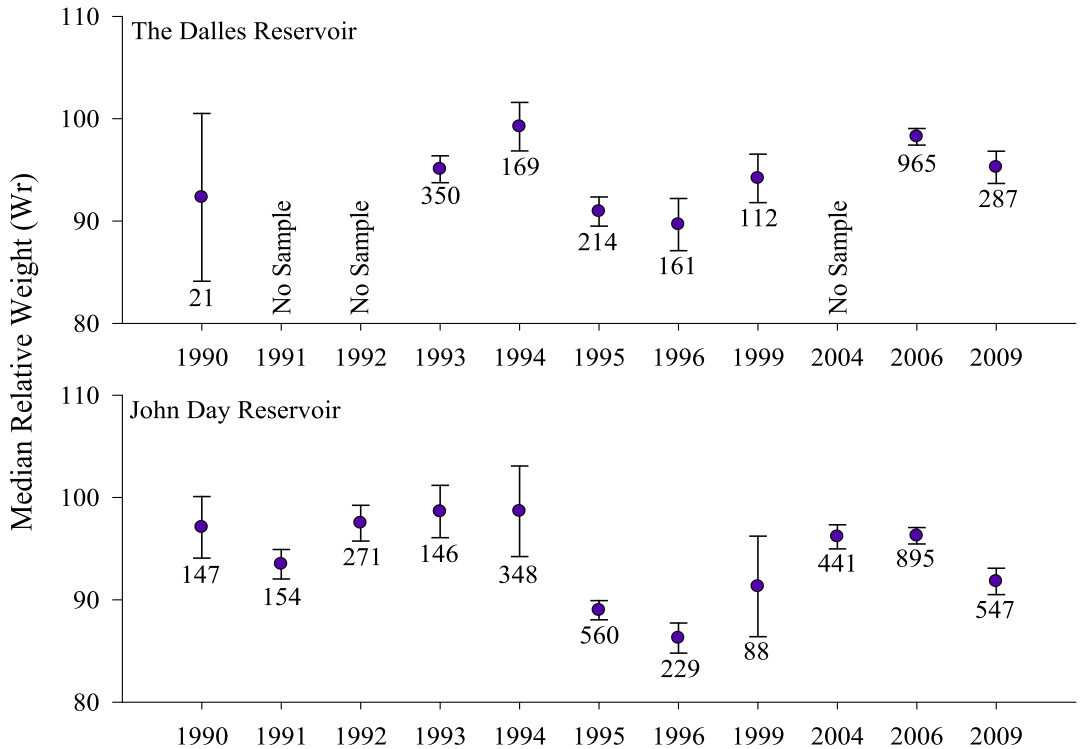

Figure 9. Relative weight of smallmouth bass in The Dalles and John Day reservoirs, 1990–1996, 1999, 2004, 2006, and 2009. Numbers below the bars are the sample size.

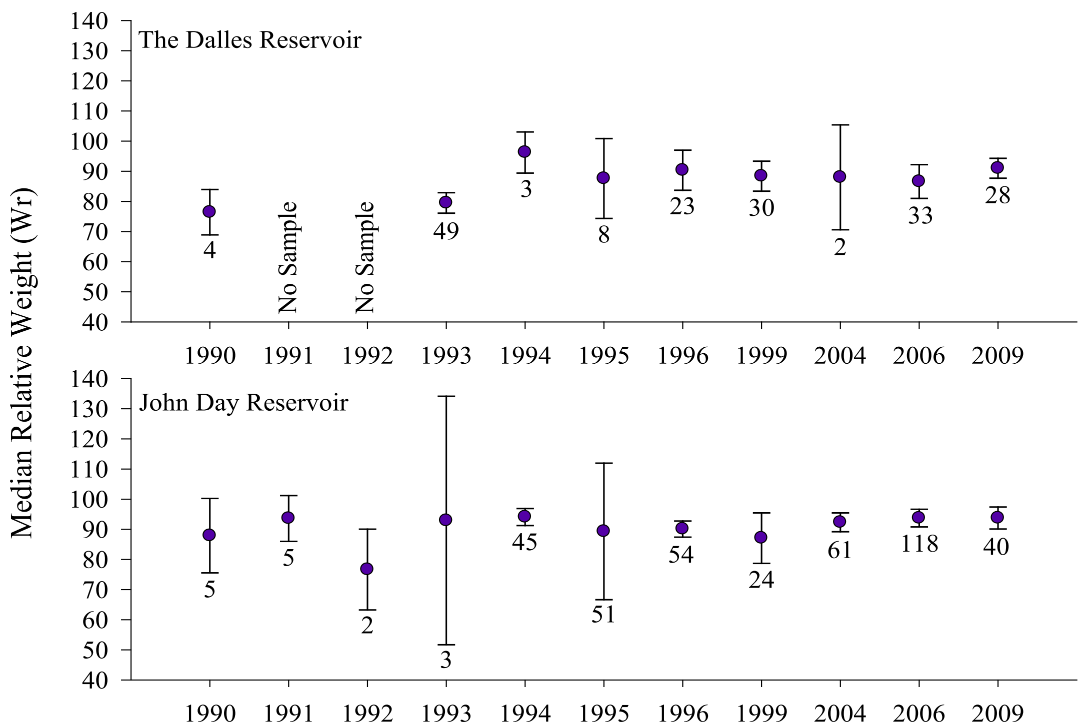

Figure 10. Relative weight of walleye in The Dalles and John Day reservoirs, 1990–1996, 1999, 2004, 2006, and 2009. Numbers below the bars are the sample size.

The 2009 dam-angling fishery accounted for 3.7% of the total northern pikeminnow harvested, a slight increase from 2.4% during 2008 (Weaver et al. 2009). Only one tagged northern pikeminnow was recovered by dam anglers; therefore, an exploitation rate was not calculated for this fishery. As in previous years, northern pikeminnow collected during the 2009 dam-angling fishery were larger (median; 375 mm FL) than those collected in the 2009 sport-reward fishery (median; 275 mm FL). Vigg et al. (1991) found that larger northern pikeminnow consumed more smolts than smaller northern pikeminnow. On average, dam anglers may have a better opportunity for harvesting larger mature northern pikeminnow than sport anglers (Martinelli and Shively 1997). In addition, dam-anglers harvested fish from the boat restrict zones, which were not accessible to sport-anglers. For these reasons we support continued angling from the dams, and will continue to monitor dam-angling activities during 2010.

Abundance index values for northern pikeminnow in both The Dalles and John Day reservoirs during 2009 continued to show a decreasing trend from early 1990's levels. The decreased catch of northern pikeminnow in recent years has been comprised of sample sizes, which have precluded us from estimating many metrics for the species in these areas. Everhart and Youngs (1981) found that overexploited fish populations may show-up as oscillating patterns of year class strength. Recognizing overexploitation of northern pikeminnow populations may require sampling these areas annually rather than continuing to sample on a three year cycle. Changes in northern pikeminnow abundance, year class strength, and size structure may be related to exploitation, thus continued and more regular monitoring may be needed to better evaluate the fisheries association with the functional dynamics of the population.

The efficacy of the NPMP depends on the lack of response by other piscivores in the Columbia Basin to the sustained removal of northern pikeminnow (Ward and Zimmerman 1999). As reported in earlier work (Poe et al. 1991; Zimmerman 1999; Naughton et al. 2004), juvenile salmonids comprised a small but consistent portion of smallmouth bass diets in the Columbia River during 2009. Ward and Zimmerman (1999) suggested the first evidence of any response by smallmouth bass would likely be a change in diet. Consumption indices for smallmouth bass in The Dalles and John Day reservoirs remained static, and *cottus* spp. continued to make-up a large proportion of their diet. Additionally, stock density values of smallmouth bass from The Dalles and John Day reservoirs were in the range expected for a balanced population (PSD 30–60; Anderson and Weithman 1978). This was consistent with past years results in The Dalles Reservoir, but was only the third time since the program began that stock density measures indicated a balanced population in John Day Reservoir. Carline and Johnson (1984) cautioned against using stock density values alone to evaluate populations, and recommended using relative weight in conjunction with stock density values. Relative weight values during 2009 were within the range of previous years, showing a fluctuating but stable size structure since the program began. Therefore, we should continue to monitor smallmouth bass population structure to identify any compensatory response related to northern pikeminnow fisheries.

In both The Dalles and John Day reservoirs, *Oncorhynchus* spp. was the most common fish species found in walleye digestive tract samples during 2009. Earlier research (Poe et al. 1991; Vigg et al. 1991; Zimmerman 1999) also identified juvenile salmonids as an important component of walleye diets. However, the relative density of walleye during 2009 remained as low as past years in The Dalles and John Day reservoirs. For the first time since the program began, PSD for walleye in both The Dalles and John Day reservoirs was within the range indicative of a balanced population (PSD 30–60; Anderson and Weithman 1978). This may be due to improved recruitment of stock-size fish in recent years. On average, relative weight of walleye has remained relatively consistent among years in The Dalles and John Day reservoirs. Given the observed changes for walleye populations during 2009, we recommend that walleye population parameters and diets continue to be monitored.

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). During 2009, we found some indications of possible localized responses to the removal program. Fishery management programs have been described as needing sustained annual sampling to effectively evaluate if a response has occurred (Beamesderfer et al. 1996). Therefore, it is critical to continue monitoring to assess the impact of the NPMP.

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REFERENCES

Anderson, R. O. 1980. Proportional stock density (PSD) and relative weight (Wr): interpretive indices for fish populations and communities. Pages 27–33 in S. Gloss and B. Shupp, editors. Practical fisheries management: more with less in the 1980s. New York Chapter American Fisheries Society, Bethesda, MD.

Anderson, R. O., and R. M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447–482 in B. R. Murphy and D. W. Willis, editors. Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Anderson, R. O., and A. S. Weithman. 1978. The concept of balance for coolwater fish populations. American Fisheries Society Special Publication 11:371–381.

Beamesderfer, R. C., and B. E. Rieman. 1988. Size selectivity and bias in estimates of population statistics of smallmouth bass, walleye, and northern squawfish in a Columbia River reservoir. North American Journal of Fisheries Management 8:505–510.

Beamesderfer, R. C., D. L. Ward, and A. A. Nigro. 1996. Evaluation of the biological basis for a predator control program on northern squawfish (Ptychocheilus oregonensis) in the Columbia and Snake rivers. Canadian Journal of Fisheries and Aquatic Sciences 53:2898–2908.

Byorth, P. A., and J. P. Magee. 1998. Competitive interactions between arctic grayling and brook trout in the Big Hole River drainage, Montana. Transactions of the American Fisheries Society 127:921–931.

Carline, R. F., and B. L. Johnson 1984. Estimation and Interpretation of Proportional Stock Density for Fish Populations in Ohio Impoundments. North American Journal of Fisheries Management 4(2):139–154

Collis, K., D. D. Roby, D. P. Craig, S. Adamany, J. Y. Adkins, and D. E. Lyons. 2002. Colony size and diet composition of piscivorous water birds on the Lower Columbia River: Implications for losses of juvenile salmonids to avian predation. Transactions of the American Fisheries Society 131:537–550.

Crowder, L. B. 1990. Community ecology. Pages 609–632 in C. B. Schreck and P. B. Moyle, editors. Methods for Fish Biology. American Fisheries Society, Bethesda, Maryland.

DeVries, D. R., and R. V. Frie. 1996. Determination of age and growth. Pages 483–512 in B. R. Murphy and D. W. Willis, editors. Fisheries Techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Everhart, W. H., and W. D. Youngs. 1981. Principles of fishery science, 2nd edition. Cornell University Press, Ithaca, New York.

FPC (Fish Passage Center). 2005. Smolt Monitoring Program Metadata. Available: www.fpc.org/documents/metadata/FPC_SMP_Metadata.html (May 2005)

FPC (Fish Passage Center). 2009. Daily passage data for the smolt monitoring project, March – October 1990–2009. Fish Passage Center. Available: www.fpc.org/smolt/SMP_queries.html. (December 2009).

Friesen, T. A., and D. L. Ward. 1999. Management of northern pikeminnow and implications for juvenile salmonid survival in the lower Columbia and Snake rivers. North American Journal of Fisheries Management 19:406–420.

Frost, Conrad N. 2000. A key for identifying prey fish in the Columbia River based on diagnostic bones. U.S. Geological Survey Western fisheries Research Center, Cook WA. USA 50p.

Gabelhouse, D. W., Jr. 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273–285.

Hansel, H. C., S. D. Duke, P. T. Lofty, and G. A. Gray. 1988. Use of diagnostic bones to identify and estimate original lengths of ingested prey fishes. Transactions of the American Fisheries Society 117:55–62.

Jones, T. A., J. A. Koloszar, M. J. Reesman, T. A. Friesen, and H. K. Takata. 2005. Development of a system-wide predator control program: fisheries evaluation. Oregon Department of Fish and Wildlife, Contract Number DE-B1719-94BI24514. 2003 Annual Report to the Bonneville Power Administration, Portland, Oregon.

Knutsen, C. J., and D. L. Ward. 1999. Biological characteristics of northern pikeminnow in the Lower Columbia and Snake Rivers before and after sustained exploitation. Transactions of the American Fisheries Society 128:1008–1019.

Kolander, C. J., D. W. Willis, and B. R. Murphy. 1993. Proposed revision of the standard weights (Ws) equation for smallmouth bass. North American Journal of Fisheries Management 13:398–400.

Liao, H., C. L. Pierce, and D. H. Wahl. 1995. Relative Weight (Wr) as a field assessment tool: Relationships with growth, prey biomass, and environmental conditions. Transactions of the American Fisheries Society 124:387–400.

Long, C. W., and F. J. Ossiander. 1974. Survival of coho salmon fingerlings passing through a perforated bulkhead in an empty turbine bag and through flow deflectors (with and without dentates) on the spillways of Lower Monumental Dam, Snake River, April–May 1973. Final Report (Contract DACW68-84-H-0034) to U.S. Army Corps of Engineers, Portland, Oregon.

Martinelli, T. L., and R. S. Shively. 1997. Seasonal distribution, movements and habitat associations of northern squawfish in two lower Columbia River reservoirs. Regulated Rivers: Research and Management 6, pp 543–556, Nov–Dec 1997.

Miranda, L. E., and W. D. Hubbard. 1994. Length-dependent winter survival and lipid composition of Age-0 largemouth bass in Bay Springs Reservoir, Mississippi. Transactions of the American Fisheries Society 123:80–87.

Murphy, B. R., M. L. Brown, and T. A. Springer. 1990. Evaluation of the relative weight (Wr) index, with new applications to walleye. North American Journal of Fisheries Management 10:85–97.

Naughton, G. P., D. H. Bennet, and K. B. Newman. 2004. Predation on juvenile salmonids by smallmouth bass in the Lower Granite Reservoir system, Snake River. North American Journal of Fisheries Management 24:534–544.

Nehlsen, W., J. E. Williams, and J. A. Lichatowich. 1991. Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16:4–21.

Neumann, R. S. and M. S. Allen. 2007. Size structure. Pages 375–421 in C. S. Guy and M. L. Brown, editors. Analysis and interpretation of freshwater fisheries data. American fisheries Society, Bethesda, Maryland.

Parrish, J.K., K. Haapa-aho, W. Walker, M. Stratton, J. Walsh, H. Ziel. 2006. Small-bodied and juvenile fishes of the Mid-Columbia Region including keys to diagnostic otoliths and cranial bones. Draft Version, March 2006. University of Washington, Seattle WA. USA 137p.

Parker, R. M., M. P. Zimmerman, and D. L. Ward. 1995. Variability in biological characteristics of northern squawfish in the lower Columbia and Snake rivers. Transactions of the American Fisheries Society 124:335–346.

Poe, T. P., H. C. Hansel, S. Vigg, D. E. Palmer, and L. A. Prendergast. 1991. Feeding of predaceous fishes on out-migrating juvenile salmonids in the John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:405–420.

Raymond, H. L. 1988. Effects of hydroelectric development and fisheries enhancement on spring and summer Chinook salmon and steelhead in the Columbia River basin. North American Journal of Fisheries Management 8:1–24.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 191.

Rieman, B. E., and R. C. Beamesderfer. 1990. Dynamics of a northern squawfish population and the potential to reduce predation on juvenile salmonids in a Columbia River reservoir. North American Journal of Fisheries Management 10:228–241.

Rieman, B. E., R. C. Beamesderfer, S. Vigg, and T. P. Poe. 1991. Estimated loss of juvenile salmonids to predation by northern squawfish, walleyes, and smallmouth bass in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:448–458.

Rose, K. A., J. H. Cowan, K. O. Winemiller, A. Ransom, and R. Hilborn. 2001. Compensatory density dependence in fish populations: importance, controversy, understanding, and prognosis. Fish and Fisheries, Vol. 2 Issue 4, p. 293–327.

Seaburg, K. G. 1957. A stomach sampler for live fish. Progressive fish-Culturist 19:137–139.

Styer, P. 2003. Statistical consulting report to review computational methods in the northern pikeminnow management program. Report to the Oregon Department of Fish and Wildlife, Clackamas.

Takata, H. K., and J. A. Koloszar. 2004. Development of a system-wide predator control program: fisheries evaluation. Oregon Department of Fish and Wildlife, Contract Number DE-B1719-94BI24514. 2003 Annual Report to the Bonneville Power Administration, Portland, Oregon.

Takata, H. K., M. J. Reesman, G. E. Reed, L. D. Layng, and T. A. Jones. 2007. Development of a system-wide predator control program: indexing and fisheries evaluation. Oregon Department of Fish and Wildlife, Contract Number DE-B1719-94BI24514. 2006 Annual Report to the Bonneville Power Administration, Portland, Oregon.

USDA (United States Department of Agriculture) 2010. 2009 Dam Angling Season Report. Annual report to the Bonneville Power Administration, Project 199007700, Portland, Oregon.

Van Den Avyle, M. J., and R. S. Hayward. 1999. Dynamics of exploited fish populations. Pages 127–166 in C. C. Kohler and W. A. Hubert, editors. Inland Fisheries Management in North America, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Vigg, S., T. P. Poe, L. A. Prendergast, and H. C. Hansel. 1991. Rates of consumption of juvenile salmonids and alternative prey fish by northern squawfish, walleyes, smallmouth bass, and channel catfish in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:421–438.

Ward, D. L., J. H. Petersen, and J. J. Loch. 1995. Index of predation on juvenile salmonids by northern squawfish in the lower and middle Columbia River and in the lower Snake River. Transactions of the American Fisheries Society 124:321–334.

Ward, D. L., and M. P. Zimmerman. 1999. Response of smallmouth bass to sustained removals of northern pikeminnow in the lower Columbia and Snake Rivers. Transactions of the American Fisheries Society 128:1020–1035.

Weaver, M. H., H. K. Takata, M. J. Reesman, L. D. Layng, G. E. Reed, and T. A. Jones. 2008. Development of a system-wide predator control program: fisheries evaluation. Oregon Department of Fish and Wildlife, Contract Number DE-B1719-94BI24514. 2007 Annual Report to the Bonneville Power Administration, Portland, Oregon.

Weaver, M. H., H. K. Takata, M. J. Reesman, and E. S. Van Dyke. 2009. Development of a system-wide predator control program: fisheries evaluation. Oregon Department of Fish and Wildlife, Contract Number DE-B1719-94BI24514. 2008 Annual Report to the Bonneville Power Administration, Portland, Oregon.

Willis, D. W., K. D. McCloskey, and D. W. Gabelhouse, Jr. 1985. Calculation of stock density indices based on adjustments for efficiency of gill-net mesh size. North American Journal of Fisheries Management 5:126–137.

Winther, E. C., J. D. Hone, P. V. Dunlap, and K. C. Moyer. 2010. Implementation of the Northern Pikeminnow Sport-Reward Fishery in the Columbia and Snake Rivers. Annual report to the Bonneville Power Administration, Project 199007700, Portland, Oregon.

Wismar, R. C., J. E. Smith, B. A. McIntosh, H. W. Li, G. H. Reeves, and J. R. Sedell. 1994. A history of resource use and disturbance in riverine basins of eastern Oregon and Washington (early 1800s–1900s). Northwest Science 68 (Special Issue):1–35.

Zimmerman, M. P. 1999. Food habits of smallmouth bass, walleyes, and northern pikeminnow in the lower Columbia River Basin during outmigration of juvenile anadromous salmonids. Transactions of the American Fisheries Society 128:995–1007.

Zimmerman, M. P., C. Knutsen, D. L. Ward, and K. Anderson. 1995. Development of a system-wide predator control program: Indexing and fisheries evaluation. Oregon Department of Fish and Wildlife, Contract number DE-AI79-90BP07084. 1993 Annual Report to the Bonneville Power Administration, Portland, Oregon.

Zimmerman, M. P., and D. L. Ward. 1999. Index of predation on juvenile salmonids by northern pikeminnow in the lower Columbia River basin, 1994–1996. Transactions of the American Fisheries Society 128:995–1007.

Zimmerman, M.P., T. A. Friesen, D. L. Ward, and H. K. Takata. 2000. Development of a system-wide predator control program: indexing and fisheries evaluation. Oregon Department of Fish and Wildlife, Contract Number DE-B1719-94BI24514. 1999 Annual Report to the Bonneville Power Administration, Portland, Oregon.

APPENDIX TABLES A

Sampling Effort and Timing in the Lower Columbia and Snake River

Appendix Table A-1. Dates of sampling weeks with range of days in 2009.

Sampling Week	Dates
14	30 Mar – 5 Apr
15	6 Apr – 12 Apr
16	13 Apr – 19 Apr
17	20 Apr – 26 Apr
18	27 Apr – 3 May
19	4 May – 10 May
20	11 May – 17 May
21	18 May – 24 May
22	25 May – 31 May
23	1 Jun – 7 Jun
24	8 Jun – 14 Jun
25	15 Jun – 21 Jun
26	22 Jun – 28 Jun
27	29 Jun – 5 Jul
28	6 Jul – 12 Jul
29	13 Jul – 19 Jul
30	20 Jul – 26 Jul
31	27 Jul – 2 Aug
32	3 Aug – 9 Aug
33	10 Aug – 16 Aug
34	17 Aug – 23 Aug
35	24 Aug – 30 Aug
36	31 Aug – 6 Sep
37	7 Sep – 13 Sep
38	14 Sep – 20 Sep
39	21 Sep – 27 Sep
40	28 Sep – 4 Oct
41	5 Oct – 11 Oct

Appendix Table A-2. Number of 15-minute electrofishing runs conducted for biological indexing below Bonneville Dam and in Bonneville Reservoir 1990, 1992–1996, 1999, 2004–2005, and 2008. rkm = river kilometer and — = area not sampled.

	Below Bonneville Dam				Bonneville Reservoir		
Year	rkm 114–121	rkm 172–178	rkm 190–197	Tailrace	Forebay	Mid-reservoir	Tailrace
1990	—	—	—	39	47	52	52
1992	68	65	64	60	—	—	—
1993	—	—	—	25	35	28	31
1994	36	33	43	35	97	84	68
1995	45	36	40	24	79	45	80
1996	43	35	40	31	80	57	69
1999	44	47	40	29	62	57	71
2004	22	31	32	55	35	35	43
2005	48	48	48	82	101	58	74
2008	48	48	48	78	87	69	73

Appendix Table A-3. Number of 15-minute electrofishing runs conducted for biological indexing in The Dalles and John Day reservoirs 1990–1996, 1999, 2004, 2006, and 2009. rkm = river kilometer and — = area not sampled.

	The Dalles Reservoir			John Day Reservoir		
Year	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace
1990	62	—	56	56	61	55
1991	—	—	—	61	58	59
1992	—	—	—	68	62	64
1993	31	—	26	44	43	46
1994	92	—	48	91	43	74
1995	62	—	35	75	94	80
1996	59	—	31	75	94	80
1999	—	—	71	52	—	62
2004	—	—	5	28	15	51
2006	78	95	74	75	80	76
2009	76	60	79	65	95	70

Appendix Table A-4. Number of 15-minute electrofishing runs conducted for biological indexing in Ice Harbor, Lower Monumental, Little Goose and Lower Granite reservoirs 1991,1994–1996, 1999, 2004, and 2007. rkm = river kilometer and — = area not sampled.

	Ice Harbor			Lower Monumental			Little Goose			Lower Granite
Year	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace	rkm 222–228
1991	57	59	67	66	61	56	61	55	57	55
1994	—	—	—	—	—	44	—	—	39	85
1995	—	—	—	—	—	46	—	—	40	89
1996	—	—	—	—	—	32	—	—	37	89
1999	—	—	—	—	—	14	—	—	29	75
2004	—	—	—	—	—	30	—	—	30	34
2007	37	40	40	40	36	37	40	24	20	96

APPENDIX TABLES B

Exploitation Rates for Northern Pikeminnow

Appendix Table B-1. System-wide weekly exploitation rates of northern pikeminnow ≥ 200 mm FL for the sport-reward fishery in 2009. Dashes indicate either no tagging effort, no recapture effort, or no exploitation calculated.

Sampling Week	Tagged	Recaptured	At-Large	Exploitation[a] (%)
14	21	—	—	—
15	85	—	21	—
16	66	—	106	—
17	627	—	172	—
18	355	2	799	0.3
19	—	2	1,152	0.2
20	25	2	1,150	0.2
21	3	3	1,173	0.3
22	125	3	1,173	0.3
23	99	5	1,295	0.4
24	249	5	1,389	0.4
25	145	16	1,633	1.1
26	3	14	1,762	0.9
27	—	8	1,751	0.5
28	—	7	1,743	0.4
29	—	4	1,736	0.3
30	—	3	1,732	0.2
31	—	1	1,729	0.1
32	—	4	1,728	0.3
33	—	4	1,724	0.3
34	—	4	1,720	0.3
35	—	5	1,716	0.3
36	—	2	1,711	0.1
37	—	8	1,709	0.5
38	—	9	1,701	0.6
39	—	5	1,692	0.3
40	—	7	1,687	0.5
41	—	5	1,680	0.3
Total	1,803	128	1,675	8.8

a) Exploitation rates adjusted for tag loss (9.2%).

Appendix Table B-2. Exploitation rates (%) of northern pikeminnow fork length groups in the sport-reward fishery, 2000–2009. *a* = no exploitation rate calculated (n<4) and "—" = area not sampled.

Group, Year	Below Bonneville	Bonneville	The Dalles	John Day	McNary	Little Goose	Lower Granite	All areas
≥200 mm								
2000	9.9	12.4	*a*	*a*	10.2	*a*	10.5	10.9
2001	15.9	8.6	*a*	*a*	26.0	—	9.4	15.5
2002	10.8	5.0	*a*	*a*	7.6	—	11.6	10.6
2003	11.8	11.0	*a*	*a*	6.6	—	*a*	10.5
2004	18.8	11.7	*a*	*a*	*a*	—	19.6	17.0
2005	21.6	8.0	14.9	*a*	9.6	—	*a*	16.3
2006	14.6	10.5	22.4	*a*	10.7	20.0	*a*	14.6
2007	18.4	9.6	*a*	*a*	5.9	35.0	11.8	15.3
2008	20.6	9.6	13.8	*a*	14.1	8.3	4.1	14.8
2009	8.4	15.2	*a*	*a*	8.4	9.0	*a*	8.8
200–249 mm								
2000	9.7	4.1	*a*	*a*	*a*	*a*	*a*	6.6
2001	*a*	*a*	*a*	*a*	*a*	—	*a*	10.6
2002	3.1	*a*	*a*	*a*	*a*	—	*a*	3.4
2003	*a*	*a*	*a*	*a*	*a*	—	*a*	*a*
2004	*a*	13.5	*a*	*a*	*a*	—	*a*	10.9
2005	*a*	*a*	*a*	*a*	*a*	—	*a*	*a*
2006	9.6	6.7	*a*	*a*	*a*	17.4	*a*	9.9
2007	*a*	*a*	*a*	*a*	*a*	*a*	*a*	*a*
2008	4.6	5.8	10.5	*a*	4.9	4.8	1.3	5.7
2009	*a*	*a*	*a*	*a*	*a*	5.6	*a*	1.8
≥250 mm								
1991	7.6	10.9	23.6	2.8	5.3	2.4	20.0	8.5
1992	11.4	4.0	6.2	3.4	5.6	11.9	15.0	9.3
1993	6.0	2.1	7.0	2.4	15.9	3.3	12.5	6.8
1994	13.6	2.2	9.8	3.2	14.0	6.1	8.7	10.9
1995	16.1	3.5	14.9	0.0	22.4	2.9	6.4	13.4
1996	12.7	6.1	15.5	0.0	18.2	8.9	11.7	12.1
1997	7.8	8.0	5.8	0.0	16.5	0.0	15.5	8.9
1998	8.2	7.8	12.8	0.0	13.6	0.0	12.1	11.1
1999	9.6	13.9	16.1	3.7	15.9	0.0	6.1	12.5
2000	10.0	16.3	*a*	*a*	9.7	*a*	8.7	11.9
2001	16.2	8.5	*a*	*a*	26.0	—	*a*	16.2
2002	12.6	6.0	*a*	*a*	7.7	—	14.3	12.3

2003	13.6	16.7	*a*	*a*	8.2	—	*a*	13.0
2004	20.1	9.3	*a*	*a*	*a*	—	23.8	18.5

Appendix Table B-2. Continued.

Group, Year	Below Bonneville	Bonneville	The Dalles	John Day	McNary	Little Goose	Lower Granite	All areas
≥250 mm cont.								
2005	23.1	8.2	18.0	*a*	13.0	—	*a*	19.0
2006	15.6	13.7	25.3	*a*	11.2	26.3	*a*	17.1
2007	19.4	11.1	*a*	*a*	7.5	*a*	17.3	17.8
2008	22.2	10.5	15.0	*a*	16.8	21.7	9.2	19.5
2009	11.3	15.9	*a*	*a*	11.6	25.8	*a*	12.8

APPENDIX TABLES C

Biological Evaluation of Northern Pikeminnow, Smallmouth Bass, and Walleye in The Dalles and John Day reservoirs

Appendix Table C-1. Catch per 15-minute electrofishing run (CPUE) of northern pikeminnow (≥250 mm fork length) captured during biological indexing of in The Dalles and John Day reservoirs in 1990–1996, 1999, 2004, 2006, and 2009. — = area not sampled.

	The Dalles Reservoir			John Day Reservoir		
Year	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace
1990	1.1	0.6	2.8	0.7	0.3	0.8
1991	—	—	—	0.7	0.2	0.8
1992	—	—	—	1.3	0.3	0.1
1993	1.2	0.5	0.7	0.6	0.2	0.5
1994	0.6	—	0.7	0.7	0.1	0.3
1995	0.6	—	1.6	0.3	0.1	0.3
1996	0.4	—	3.7	0.3	0.1	0.5
1999	—	—	0.8	0.2	—	0.2
2004	—	—	0.4	<0.1	0.0	0.1
2006	0.2	0.2	0.2	<0.1	<0.1	0.1
2009	0.1	0.1	<0.1	<0.1	<0.1	0.1

Appendix Table C-2. Abundance index values for northern pikeminnow (≥250 mm fork length) in The Dalles and John Day reservoirs, 1990–1996, 1999, 2004, 2006, and 2009. — = not sampled.

	The Dalles Reservoir			John Day Reservoir		
Year	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace
1990	1.4	2.4	2.7	1.4	5.1	1.4
1991	—	—	—	1.3	4.7	1.4
1992	—	—	—	2.4	6.7	0.2
1993	1.6	2.0	0.7	1.2	3.1	0.9
1994	0.7	—	0.6	1.4	2.4	0.5
1995	0.5	—	1.5	0.5	1.0	0.6
1996	0.6	—	3.6	0.6	1.1	1.0
1999	—	—	0.8	0.3	—	0.4
2004	—	—	0.4	0.1	0.0	0.3
2006	0.2	0.7	0.2	<0.1	0.5	0.2
2009	0.1	0.3	<0.1	<0.1	0.4	0.1

Appendix Table C-3. Spring and summer relative density of smallmouth bass (≥200 mm fork length) and walleye (≥200 mm fork length) in The Dalles and John Day reservoirs, 1990–1996, 1999, 2004, and 2006. — = not sampled. Relative density is mean transformed catch ($\log_{10}$ (catch+1)) per 15-minute electrofishing run.

Species,	The Dalles Reservoir			John Day Reservoir		
Season, Year	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace
Smallmouth bass,						
Spring						
1990	0.2	—	0.2	0.5	0.5	<0.1
1991	—	—	—	0.3	0.6	0.1
1992	—	—	—	0.4	0.2	0.2
1993	0.5	0.6	0.4	—	—	—
1994	0.3	—	—	0.3	0.3	0.1
1995	0.6	—	—	0.4	0.4	0.1
1996	0.5	—	—	0.3	0.5	<0.1
1999	—	—	0.2	0.1	—	<0.1
2004	—	—	0.0	1.0	0.5	<0.1
2006	0.7	0.7	0.4	0.5	0.8	0.3
2009	0.3	0.3	0.3	0.3	0.6	0.1
Summer,						
1990	0.1	0.1	0.1	0.4	0.2	0.1
1991	—	—	—	0.3	0.1	0.1
1992	—	—	—	0.3	0.3	0.1
1993	0.3	0.4	0.3	0.4	0.4	0.3
1994	0.3	—	0.2	0.5	0.2	0.1
1995	0.4	—	0.1	0.4	0.6	0.1
1996	0.2	—	0.2	0.3	0.4	0.1
1999	—	—	0.4	0.4	—	0.1
2004	—	—	0.0	0.9	—	0.3
2006	0.5	0.5	0.6	0.4	0.8	0.4
2009	0.2	0.4	0.2	0.6	0.5	0.2
Walleye,						
Spring,						
1990	0.0	—	0.1	0.0	0.0	0.1
1991	—	—	—	0.0	<0.1	0.1
1992	—	—	—	0.0	0.0	<0.1
1993	0.1	0.1	0.2	—	—	—
1994	0.0	—	—	0.0	0.0	0.2
1995	<0.1	—	—	<0.1	0.0	0.1
1996	<0.1	—	—	0.0	0.0	0.2

Appendix Table C-3. Continued.

Species, Season, Year	The Dalles Reservoir Forebay	Mid-reservoir	Tailrace	John Day Reservoir Forebay	Mid-reservoir	Tailrace
Walleye cont.,						
Spring cont.,						
1999	—	—	0.1	0.0	—	0.1
2004	—	—	0.0	0.0	<0.1	0.2
2006	<0.1	<0.1	0.1	0.0	0.0	0.3
2009	<0.1	<0.1	0.1	0.0	<0.1	0.1
Summer,						
1990	0.0	0.0	<0.1	0.0	0.0	<0.1
1991	—	—	—	0.0	0.0	0.0
1992	—	—	—	0.0	0.0	<0.1
1993	0.0	<0.1	<0.1	0.0	0.0	<0.1
1994	<0.1	—	<0.1	0.0	0.0	0.1
1995	<0.1	—	<0.1	0.0	<0.1	0.1
1996	<0.1	—	0.1	0.0	<0.1	0.1
1999	—	—	0.1	0.0	—	0.1
2004	—	—	<0.1	<0.1	—	0.2
2006	0.0	<0.1	<0.1	0.0	<0.1	0.2
2009	<0.1	<0.1	0.0	0.0	0.0	0.1

Appendix Table C-4. Spring and summer consumption indices for northern pikeminnow (≥250 mm fork length) and smallmouth bass (≥200 mm fork length) in The Dalles and John Day reservoirs in 1990–1996, 1999, 2004, 2006 and 2009. BRZ = Tailrace Boat Restricted Zone, *a* = no consumption index calculated (n ≤ 5), *b* = included in Tailrace calculation, *c* = no smallmouth bass samples collected, and — = area not sampled.

Species, Season, Year	The Dalles Reservoir Forebay	Mid-reservoir	Tailrace	BRZ	John Day Reservoir Forebay	Mid-reservoir	Tailrace	BRZ
Northern pikeminnow								
Spring								
1990	0.8	—	0.7	0.9	1.5	0.0	1.5	2.5
1991	—	—	—	—	1.9	0.5	0.9	1.5
1992	—	—	—	—	1.9	0.0	0.0	0.9
1993	0.1	—	0.0	*a*	1.5	*a*	2.0	—
1994	0.1	—	—	—	1.0	*a*	0.3	0.7
1995	0.0	—	—	—	1.7	*a*	0.8	—
1996	0.0	—	—	—	*a*	*a*	0.5	—
1999	—	—	0.5	—	1.2	—	1.7	—
2004	—	—	*a*	—	*a*	*a*	0.0	—
2006	0.0	0.5	*a*	—	*a*	*a*	0.3	—

Appendix Table C-4. Continued.

Species, Season, Year	The Dalles Reservoir				John Day Reservoir			
	Forebay	Mid-reservoir	Tailrace	BRZ	Forebay	Mid-reservoir	Tailrace	BRZ
Northern pikeminnow cont.								
Spring cont.								
2009	*a*	*a*	*a*	—	*a*	*a*	*a*	—
Summer								
1990	1.0	—	0.0	6.4	2.4	0.9	2.6	11.7
1991	—	—	—	—	3.1	*a*	0.0	2.8
1992	—	—	—	—	0.7	0.0	*a*	4.6
1993	0.0	—	0.0	0.5	0.6	0.6	0.0	0.6
1994	0.0	—	0.8	1.2	1.2	0.6	*a*	1.9
1995	0.0	—	0.0	2.2	2.0	*a*	0.6	—
1996	0.0	—	0.7	*a*	0.4	*a*	0.3	—
1999	—	—	0.0	—	*a*	—	0.0	—
2004	—	—	5.5	—	*a*	—	*a*	—
2006	*a*	*a*	5.7	—	*a*	*a*	*a*	—
2009	*a*	*a*	*a*	—	*a*	*a*	*a*	—
Smallmouth bass								
Spring								
1990	0.6	0.0	0.0	*b*	0.1	0.0	*c*	*b*
1991	—	—	—	—	0.0	0.0	*a*	*b*
1992	—	—	—	—	0.1	0.0	*a*	*b*
1993	0.0	<0.1	0.0	*b*	—	—	—	—
1994	0.0	—	—	—	0.1	0.0	0.0	*b*
1995	<0.1	—	—	—	0.0	0.0	0.0	—
1996	0.0	—	—	—	0.0	0.0	0.0	—
1999	—	—	0.0	—	<0.1	—	0.0	—
2004	—	—	—	—	0.1	<0.1	*c*	—
2006	0.0	<0.1	0.0	—	0.0	<0.1	<0.1	—
2009	<0.1	<0.1	0.0	—	0.0	<0.1	0.0	—
Summer								
1990	0.0	0.0	0.2	*b*	0.3	0.3	0.0	*b*
1991	—	—	—	—	0.6	0.0	0.1	*b*
1992	—	—	—	—	0.2	0.0	0.0	*b*
1993	0.0	0.0	0.0	*b*	0.1	0.0	0.0	*b*
1994	0.0	—	0.0	*b*	0.2	0.0	0.0	*b*
1995	0.0	—	0.0	*b*	0.3	0.0	0.0	—
1996	0.0	—	0.0	*b*	0.1	0.0	0.0	—
1999	—	—	0.0	—	0.1	—	0.0	—
2004	—	—	0.0	—	<0.1	—	0.2	—
2006	0.0	<0.1	<0.1	—	0.1	<0.1	<0.1	—
2009	0.0	0.0	0.0	—	<0.1	<0.1	0.1	—

Appendix Table C-5. Spring and summer predation indices for northern pikeminnow (≥250 mm fork length) in The Dalles and John Day reservoirs, 1990–1996, 1999, 2004, 2006 and 2009, and for smallmouth bass (≥200 mm fork length) 2004, 2006 and 2009. — = not sampled, a = no predation index calculated (n ≤ 5) and b = no northern pikeminnow collected.

Species, Season, Year	The Dalles Reservoir			John Day Reservoir		
	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace
Northern pikeminnow						
Spring						
1990	1.1	—	1.9	2.1	0.0	2.2
1991	—	—	—	2.5	2.4	1.3
1992	—	—	—	4.7	0.0	0.0
1993	0.2	—	0.0	1.9	*a*	1.8
1994	0.1	—	—	1.3	*a*	0.2
1995	0.0	—	—	0.9	*a*	0.5
1996	0.0	—	—	*a*	*a*	0.3
1999	—	—	0.4	0.4	—	0.7
2004	—	—	*a*	*b*	*b*	0.0
2006	0.0	0.4	*a*	*a*	*a*	0.1
2009	*a*	*a*	*a*	*a*	*a*	*a*
Summer						
1990	1.4	—	0.0	3.4	4.6	3.7
1991	—	—	—	4.0	*a*	0.0
1992	—	—	—	1.7	0.0	*a*
1993	0.0	—	0.0	0.7	1.9	0.4
1994	0.0	—	0.5	1.6	1.4	*a*
1995	0.0	—	0.0	1.0	*a*	0.4
1996	0.0	—	2.5	0.2	*a*	0.2
1999	—	—	0.0	*a*	—	0.0
2004	—	—	2.0	*a*	—	*a*
2006	*a*	*a*	1.1	*b*	*b*	*a*
2009	*a*	*a*	*a*	*a*	*a*	*a*
Smallmouth bass						
Spring						
2004	—	—	0.0	—	—	2.0
2006	0.0	0.3	0.0	0.0	0.4	0.1
2009	0.1	0.1	0.0	0.0	0.0	0.0
Summer						
2004	1.6	2.3	0.0	0.8	0.0	0.5
2006	0.0	1.1	0.1	0.4	2.8	0.2
2009	0.0	0.3	0.0	0.1	1.5	0.1

Appendix Table C-6. Number of stock sized fish (N), proportional stock density (PSD), and relative stock density (RSD-P) of northern pikeminnow, smallmouth bass, and walleye in The Dalles and John Day reservoirs (1990–2009). — = not sampled; *a* = Number (stock sized fish) ≤ 20, no stock density index calculated.

Reservoir,	Northern Pikeminnow		Smallmouth bass			Walleye		
Year	*N*	PSD	*N*	PSD	RSD-P	*N*	PSD	RSD-P
The Dalles								
1990	189	43	66	35	11	7	*a*	*a*
1993	208	71	409	31	8	17	*a*	*a*
1994	121	42	201	42	8	10	*a*	*a*
1995	105	17	218	40	9	7	*a*	*a*
1996	123	34	168	51	14	23	91	39
1999	55	29	139	29	3	25	68	44
2004	7	*a*	—	—	—	2	*a*	*a*
2006	47	45	1,135	33	15	26	88	46
2009	12	*a*	301	59	16	27	52	26
John Day								
1990	93	60	211	20	8	5	*a*	*a*
1991	99	69	175	38	11	4	*a*	*a*
1992	232	65	324	23	6	2	*a*	*a*
1993	149	64	156	28	9	3	*a*	*a*
1994	133	71	427	22	6	54	91	22
1995	51	43	625	26	8	48	75	50
1996	55	53	234	41	12	58	97	59
1999	21	62	106	29	9	24	92	88
2004	11	*a*	581	29	10	55	78	25
2006	12	*a*	1,055	25	8	91	65	20
2009	7	*a*	724	33	3	39	41	23

Appendix Table C-7. Sample size (*N*), median relative weight (W_r), and 95% confidence interval (CI) of northern pikeminnow ≥ 200 mm FL, smallmouth bass ≥ 200 mm TL, and walleye ≥ 200 mm TL in The Dalles and John Day reservoirs (1990–2009). — = not sampled.

	Northern pikeminnow						Smallmouth bass			Walleye		
Reservoir,	Male			Female								
Year	*N*	W_r	CI	*N*	W_r	CI	*N*	W_r	CI	*N*	W_r	CI
The Dalles												
1990	40	92	3.5	74	98	2.4	21	92	8.2	4	76	7.5
1993	64	92	2.6	168	95	1.9	350	95	1.3	49	80	3.4
1994	83	99	2.7	88	103	2.3	169	99	2.4	3	96	6.8
1995	81	87	2.7	35	93	4.4	214	91	1.4	8	88	13.2
1996	55	92	2.0	68	96	2.8	161	90	2.6	23	90	6.7
1999	31	92	4.2	24	103	6.2	112	94	2.4	30	88	5.0
2004	5	94	5.7	2	103	20.0	—	—	—	2	88	17.4

Appendix Table C-7. Continued.

Reservoir, Year	Northern pikeminnow						Smallmouth bass			Walleye		
	Male			Female								
	N	W_r	CI	*N*	W_r	CI	*N*	W_r	CI	*N*	W_r	CI
The Dalles cont.												
2006	19	105	5.8	27	116	4.9	965	98	0.8	33	87	5.6
2009	3	105	20.7	9	114	10.2	28	95	1.6	28	91	3.3
John Day												
1990	28	95	5.6	58	104	4.8	147	97	3.0	5	88	12.4
1991	30	94	3.7	72	99	3.3	154	94	1.4	5	94	7.6
1992	62	101	3.1	166	104	1.8	271	98	1.7	2	77	13.4
1993	38	95	4.0	114	101	4.0	146	99	2.6	3	93	41.2
1994	48	89	3.8	96	105	3.8	348	99	4.4	45	94	2.8
1995	22	95	5.1	25	101	8.8	560	89	0.9	51	89	22.6
1996	27	90	3.7	27	98	9.2	229	86	1.5	54	90	2.7
1999	9	97	14.2	13	116	11.1	88	91	4.9	24	87	8.4
2004	4	104	13.7	7	103	15.2	441	96	1.2	61	92	3.1
2006	4	102	11.7	8	122	17.4	895	96	0.8	118	94	2.9
2009	3	98	9.5	4	113	17.6	547	92	1.3	40	94	3.7

Report D

Dam Angling – The Dalles & John Day Dams

Conducted By

U.S. Department of Agriculture
Animal Damage Unit

Prepared by

Russell Porter

March, 2010

Dam Angling 2009 Season Report

Methods

Manpower used

A five person angling crew working 40 hrs a week plus administrative oversight was utilized to conduct the dam angling at the two hydroelectric projects.

Fishing locations

John Day and The Dalles tailraces were fished during this season with efforts split 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 utilized methods and their results.

Natural Baits of worms, dead minnows, and crickets were used in the fishery. 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 artificial baits were also used. 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. When properly rigged this type of bait is good for several fish without needed to be re-rigged, which saves angling time. It doesn't produce as well as the naturals if the fish are lethargic. In an active bite it will out fish the naturals.

Soft plastic worm baits were also employed. These are just like the name implies, they 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 snag the angler if a fish is thrashing about. A single hooked tube will outperform a worm generally, due to the bait being in the water a greater percentage of time. This lure does not work well for non aggressive fish or in times of colder water temperatures.

Artificial soft plastic swim baits were also tested. These can come in any variety of shapes and resemble swimming vertebrates and invertebrates alike, such as fish, salamanders, frogs and leaches. Some may have a hard lip to impart action but many do not. Limited experimentation with different shapes yielded no greater success than with the soft plastic tubes or worms. Most experimentation focused on minnow-like baits. They seem to tear more easily and lose there functionality earlier than other plastic 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 worked the best for us.

Wooden plugs 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 get finicky. Due to cost they are not economically feasible as a mainstay. They are also difficult to fish deep for midday fish.

Metal spoons and spinners were also tried. Both produced well on surface fish mid-season, but using them at depth was hard. They are a variety lure used as catch rates slow in a given area and the fish need a change of pace. Not a “go to” lure but did have times where it was an effective alternative. Spinners worked better than spoons.

Results

The Dalles

1. Fishing Effort – 1237 hours
2. Catch- 1380 Pikeminnow
3. By catch – 103 fish (see table for species breakdown)
4. Tagged Fish- 0
5. Size Data-Refer to ODFW data

Location	Hours	# of Pikeminnow	By-catch total	Tagged Fish
The Dalles	1237	1380	103	0

By catch Species	Sturgeon	Game Fish	Non-Game		
N=103	42	48	13		

John Day

1. Fishing Effort – 1221 hours
2. Catch- 3989Pikeminnow
3. By catch – 68 fish (see table for species breakdown)
4. Tagged Fish-1
5. Size Data- Refer to ODFW data

Location	Hours	# of Pikeminnow	By-catch total	Tagged Fish
John Day	1221	3989	68	1

Species	Sturgeon	Game Fish	Non-Game		
N=68	33	30	5		