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

2012 ANNUAL REPORT

Prepared by:

Russell Porter
Pacific States Marine Fisheries Commission

In Cooperation with:

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2012 Executive Summary
by

Russell G. Porter

This report presents results for year twenty-two 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 long-line 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 long-line 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 long-line 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 long-line 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 trapnets 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 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

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

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). 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. 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. **WDFW (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 2012 by report are as follows:

Report A

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

1. The objectives of the 2012 NPSRF were to (1) implement a public fishery that rewards recreational anglers for harvesting northern pikeminnow $\geq$ 228 mm (9 inches) total length, (2) collect, compile, and report data on angler participation, catch and harvest of northern pikeminnow and other fish species, and success rates of participating anglers during the season, (3) examine collected northern pikeminnow for the presence of external tags, fin-clips, and signs of tag loss, (4) collect biological data on northern pikeminnow and other fish species returned to registration stations, (5) scan northern pikeminnow for the presence of Passive Integrated Transponder (PIT) tags implanted into northern pikeminnow by ODFW as secondary tags, and/or from northern pikeminnow containing consumed salmonids with PIT tags, and (6) survey non-returning fishery participants targeting northern pikeminnow in order to obtain catch and harvest data on fish species caught.

2. A total of 158,159 northern pikeminnow $\geq$ 228 mm were harvested during the 2012 NPSRF season. There were a total of 3,302 different anglers who spent 22,968 angler days participating in the fishery during the 2012 season.

3. Anglers submitted 189 northern pikeminnow with external spaghetti tags, 186 of which also had ODFW PIT tags. There were also 98 northern pikeminnow with ODFW PIT tags only, but missing spaghetti tags. An additional 103 PIT tags were recovered from juvenile salmonids ingested by northern pikeminnow received during the 2012 NPSRF.

Report B

Northern Pikeminnow Sport-Reward Fishery Payments

1. For 2012 the rewards paid to anglers were the same as in the 2011 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 2012, excluding tagged fish, rewards paid totaled $1,016,672 for 156,837 fish.

3. A total of 188 tagged fish vouchers were paid. The total season tag rewards paid totaled $94,000.

4. A total of 1,012 separate successful anglers caught one or more fish and received payments during the season. A total of 3,302 separate anglers registered to fish, of which two thirds were unsuccessful.

5. The total for all payments for non-tagged and tagged pikeminnows in 2012 was $1,117,502.

Report C

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

1. The objectives in 2012 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* downstream of Bonneville dam and in Bonneville reservoir, and 3) look for possible compensatory responses by smallmouth bass and walleye.

2. System-wide exploitation in 2012 of northern pikeminnow 250 mm or greater in fork length was 15.9% (95% confidence interval 10.6–21.2%) which incorporated a tag loss of 8.4%.

2. The 2012 estimated reduction in potential predation was estimated at 35% of pre-program levels.

3. Biological indexing was conducted downstream of Bonneville and in Bonneville reservoir in 2012 as part of our predator community evaluation. Consumption and/or predation indices for northern pikeminnow in all areas of both reservoirs were unable to be calculated due to limited sample sizes.

4. During both seasons sampled in 2012, smallmouth bass abundance was greatest in the middle reach of Bonneville Reservoir. Consumption index values in Bonneville Reservoir were similar in each indexed area during spring and summer. Among smallmouth bass containing fish, cottids were the most frequently occurring fish species; appearing in 43% and 59% of the diets containing fish for the area below Bonneville Dam and Bonneville Reservoir, respectively. Smallmouth bass stomach samples containing salmonids occurred between 4 and 10% of the time. Proportional stock density values for smallmouth bass were within the range of previous years. Relative weights in both areas have been between 94 and 99 since 2005.

5. In Bonneville Reservoir more walleye (n=22) were caught during 2012 than in previous years, but abundance continues to be far lower than that of northern pikeminnow and smallmouth bass. Salmonids continued to be the most prevalent prey fish observed in walleye stomachs. Cyprinids were the second most prevalent prey item observed in walleye samples.

6. Northern pikeminnow diet samples collected during angling at John Day and The Dalles in 2012 were evaluated. Fish were found to be the primary prey type consumed at The Dalles dam; however, other invertebrates were the primary prey type consumed at John Day Dam. Salmon and lamprey made up the highest percentage of prey fish species consumed by northern pikeminnow.

7. At this time, a predator response to the NPMP in the Columbia River downstream of Bonneville Dam and in Bonneville Reservoir does not seem apparent. However, because

responses to fisheries management programs may not be detected for several years, continued monitoring of predator populations in the Columbia River is recommended.

Report D

Dam angling at The Dalles and John Day dams

1. The 22 week fishery took place at The Dalles and John Day dams from May 3rd to October 4th, 2012.

2. The project objectives were to: a) implement a recreational-type hook and line fishery that harvests northern pikeminnow from the dam tailraces unavailable to the public fishing effort; b) allocate equal angler effort between The Dalles and John Day dams, based on angler CPUE in order to maximize harvest of northern pikeminnow, while collecting, compiling and reporting data on harvest, CPUE, gear/techniques and incidental catch of other species; c) scan record and report Passive

3. Integrated Transponder (PIT) tag data from all northern pikeminnow, smallmouth bass, walleye, and channel catfish caught by the angling crew; d) record the presence of any external spaghetti tags, fin-clips, or signs of tag loss; and e) collect biological data on all northern pikeminnow and other fishes caught.

4. Harvests for the 22 week fishery at the two dams were 3,122 northern pikeminnow at The Dalles dam and 2,361 northern pikeminnow at John Day dam. The total fishing time at the two dams was 2,200 hours for a combined overall average catch per angler hour of 2.49 fish. The catch at The Dalles dam was 2.69 fish per angler hour and at John Day dam, 2.27 fish per angler hour.

5. Back bouncing soft plastic lures were found to be the most effective method for harvesting northern pikeminnow from both dams.

6. Incidental species most frequently caught and released at both dams were smallmouth bass *Micropterus dolomieue,* white sturgeon *Acipenser transmontanus,* American shad *Alosa sapidissima,* and Sculpin *Cottus* spp.

7. The mean fork length of northern pikeminnow caught from The Dalles Dam was 343.8 mm and 374.8 mm at John Day dam.

REPORT A

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

2012 Annual Report

Prepared by

John D. Hone
Eric C. Winther
Paul V. Dunlap

Washington Department of Fish and Wildlife
600 Capital Way N
Olympia, WA 98501-1091

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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 30, 2012. The objectives of this project were to (1) implement a recreational fishery that rewards recreational anglers for harvesting northern pikeminnow $\geq$ 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 Passive Integrated Transponder (PIT) tags implanted into northern pikeminnow by ODFW as secondary tags, and/or from northern pikeminnow containing consumed salmonids with PIT tags, and (6) survey non-returning NPSRF participants targeting northern pikeminnow in order to obtain catch and harvest data on northern pikeminnow and other specified fish species.

A total of 158,159 northern pikeminnow $\geq$ 228 mm and 5,942 pikeminnow < 228 mm were harvested during the 2012 NPSRF season. There were a total of 3,302 different anglers who spent 22,968 angler days participating in the fishery during the 2012 season. Catch per unit effort for combined returning and non-returning anglers was 6.89 fish/angler day. The Oregon Department of Fish and Wildlife (ODFW) estimated that the northern pikeminnow harvest activities from the 2012 NPSRF resulted in an overall exploitation rate of 15.9% (E. Van Dyke, December Northern Pikeminnow Management Program (NPMP) coordination meeting).

Anglers submitted 189 northern pikeminnow with external spaghetti tags, 186 of which also had ODFW PIT tags. There were also 98 northern pikeminnow with ODFW PIT tags only, but missing spaghetti tags. An additional 103 PIT tags were recovered from juvenile salmonids ingested by northern pikeminnow received during the 2012 NPSRF.

Peamouth *Mylocheilus caurinus*, smallmouth bass *Micropterus dolomieue*, and sculpins *Cottus* spp, were the fish species most frequently caught by NPSRF anglers targeting northern pikeminnow. The incidental catch of salmonids *Oncorhynchus* spp, by participating anglers targeting northern pikeminnow continued to remain below established limits for the NPMP.

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 ($\geq$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 3.83 million reward sized northern pikeminnow and spent over 804,000 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 2012 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 2012 NPSRF were to (1) implement a public fishery that rewards recreational anglers for harvesting northern pikeminnow $\geq$ 228 mm (9 inches) total length, (2) collect, compile, and report data on angler participation, catch and harvest of northern pikeminnow and other fish species, and success rates of participating anglers during the season, (3) examine collected northern pikeminnow for the presence of external tags, fin-clips, and signs of tag loss, (4) collect biological data on northern pikeminnow and other fish species returned to registration stations, (5) scan northern pikeminnow for the presence of Passive Integrated Transponder (PIT) tags implanted into northern pikeminnow by ODFW as secondary tags, and/or from northern pikeminnow containing consumed salmonids with PIT tags, and (6) survey non-returning fishery participants targeting northern pikeminnow in order to obtain catch and harvest data on northern pikeminnow and other specified fish species.

METHODS OF OPERATION

Fishery Operation

Boundaries and Season

The 2012 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. The NPSRF was fully implemented, with all stations operating during a regular season from May 1 through September 30, 2012.

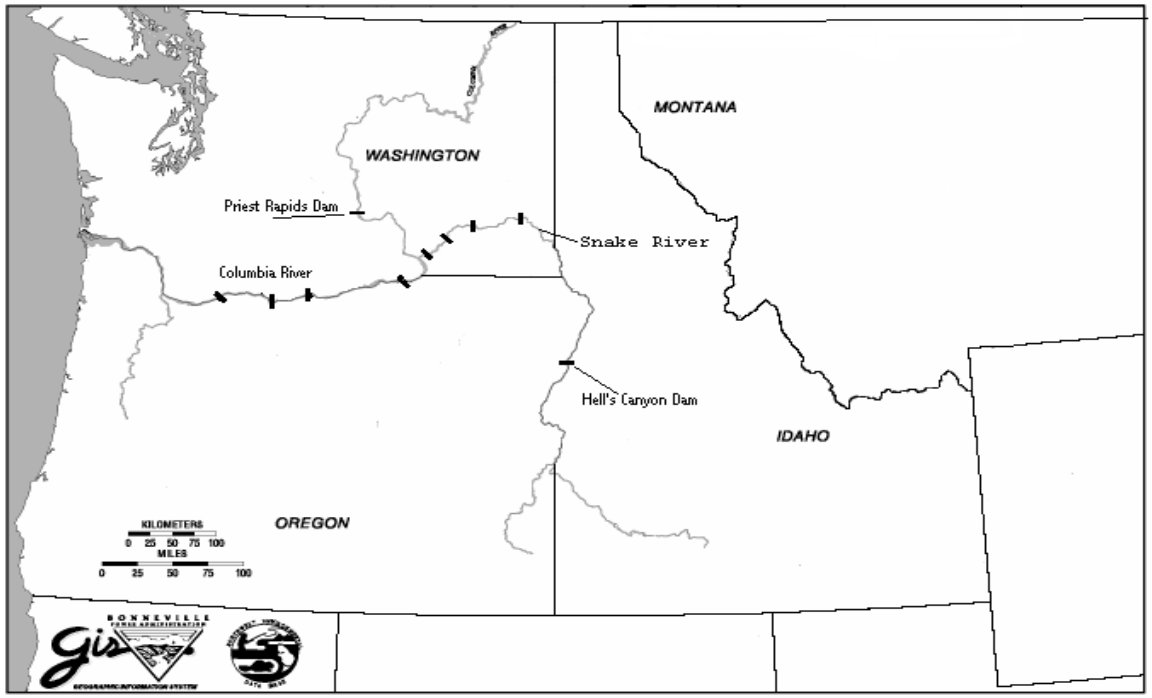

Figure 1. Northern Pikeminnow Sport-Reward Fishery Program Area

Registration Stations

Twenty-one 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 registration stations daily (seven days a week) at designated locations (normally public boat ramps or parks) which were available to anglers at specified times of between two and six 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.

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

Figure 2. 2012 Northern Pikeminnow Sport Reward Fishery Registration Stations

Reward System

The 2012 NPSRF rewarded anglers for harvesting northern pikeminnow $\geq$ 228mm TL (9 inches) and maintained the tiered angler reward system developed in 1995 (Hisata et al. 1995) which 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 2012 season, the NPSRF retained the pay levels first used in 2004 (Hone et al. 2004) 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".

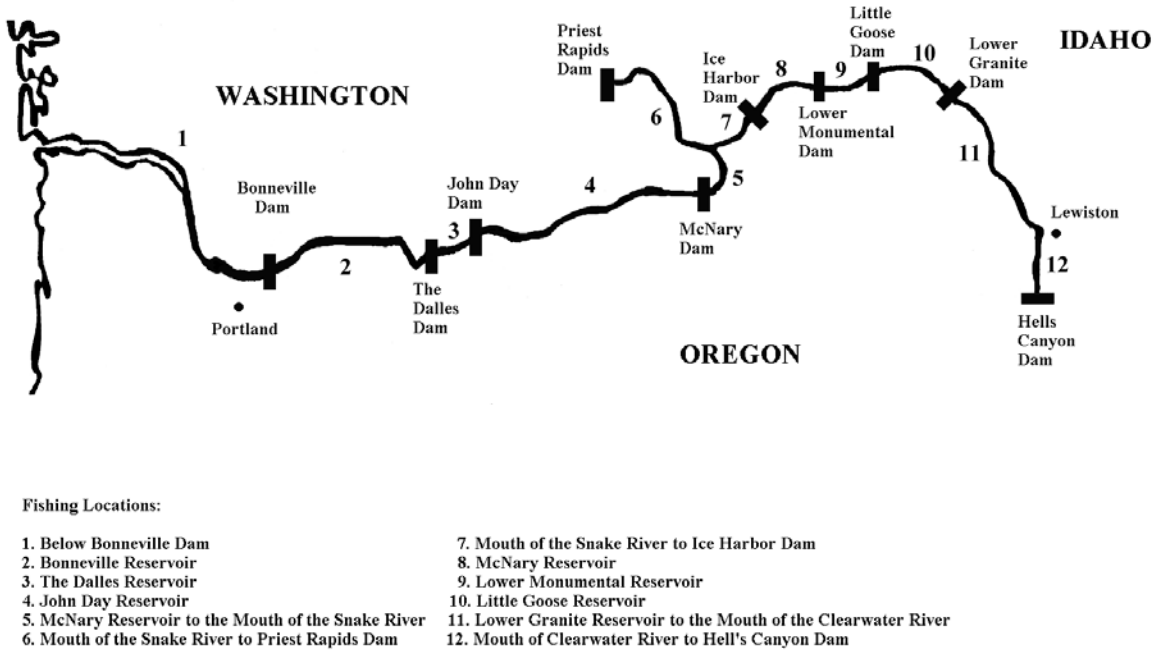

Figure 3. Fishing location codes used for the 2012 Northern Pikeminnow Sport-Reward Fishery

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 surveyed a minimum of 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. Non-returning angler catch and harvest data for non-salmonid species were not collected in 2012 because they

were collected in 2010 and trends for these species have remained consistent over the NPSRF's previous 20 year history (Winther et al. 1996, Bruce et al. 2005). These data will be collected again in 2015 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 (if specified). 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 2012 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 was intended to improve the NPSRF's estimate of tag loss, and result in a more accurate estimate of exploitation for the NPSRF. WDFW technicians were required to scan 100% of all northern pikeminnow returned to registration stations for PIT tags using one of two types of PIT tag "readers". Northern Pikeminnow submitted for payment to the NPSRF 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 Destron units 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 2012 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 22 week NPSRF harvested a total of 158,159 reward size northern pikeminnow (≥ 228 mm TL) during the 2012 season. Although the 2012 NPSRF had sixteen fewer days of fishing (no post season extension) than the 2011 NPSRF (Hone et al. 2011), harvest was 2,847 fish higher than 2011 harvest (Figure 4). Harvest remained lower than the mean 1991-2011 harvest of 174,989 fish, but was slightly above the season average for the five most recent years. The 2012 NPSRF harvest equated to an exploitation rate of 15.9% (E. VanDyke, ODFW personal communication), which was well within the 10-20% exploitation goal of NPMP. In addition to harvesting 158,159 reward size northern pikeminnow, the 2012 NPSRF also harvested 5,942 northern pikeminnow < 228 mm TL.

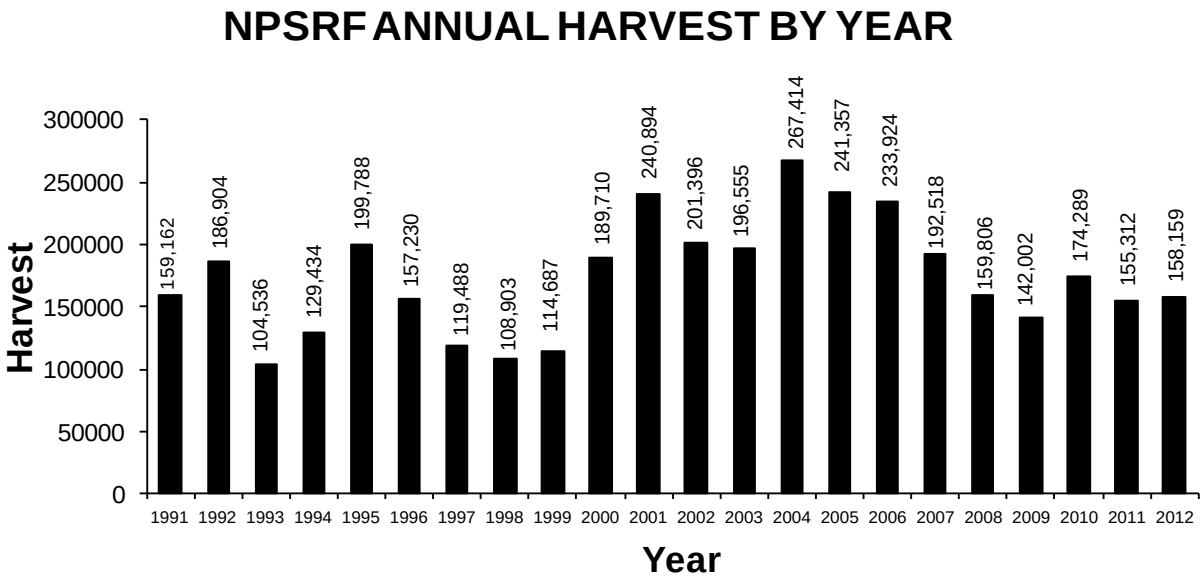

Figure 4. Annual Harvest Totals for the Northern Pikeminnow Sport Reward Fishery

Harvest by Week

Peak weekly harvest for the 2012 NPSRF of 10,163 fish was lower than the 2011 peak weekly harvest of 11,581 and occurred during week 26 of the season (Figure 5). Mean weekly harvest was 7,189 fish which was up from the 2011 mean of 6,212. Peak harvest was three weeks earlier than 2011 and weekly harvest totals for the 2012 NPSRF were higher than the weekly totals for 2011 with the exception of the time around the 2011 harvest peak (Figure 6). Peak harvest matched the NPSRF's historical 1991-2011 peak in week 26 (Fox et al. 1999) and for the first eleven weeks of the season (week 18- week 28), weekly harvest for the 2012 NPSRF was lower or nearly the same (week 18 & 19) as the mean 1991-2011 weekly harvest levels (Figure 7). Weekly harvest then increased and stayed at or above historical 1991-2011 weekly harvest levels

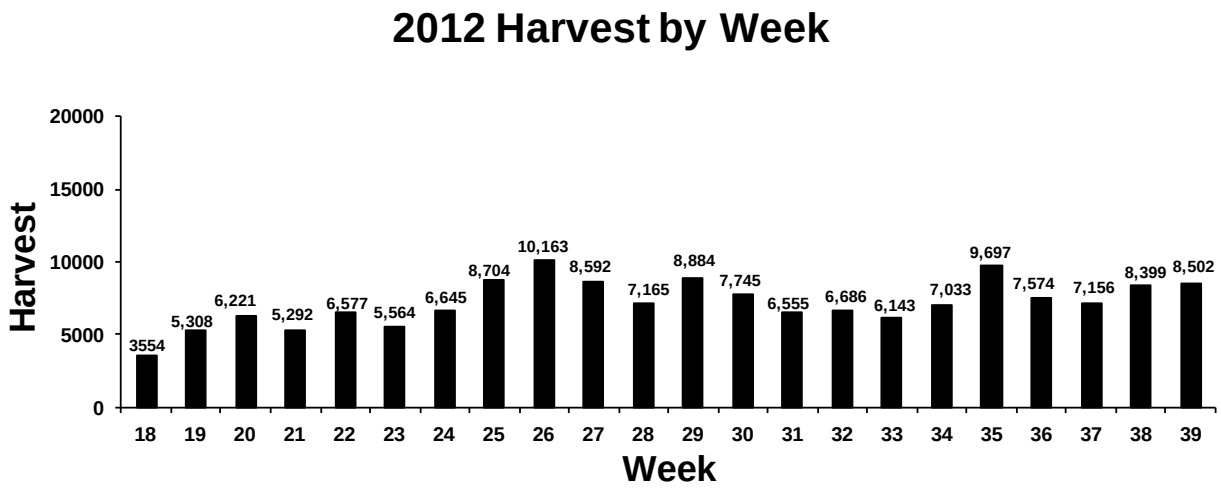

Figure 5. 2012 Weekly Northern Pikeminnow Sport-Reward Fishery Harvest.

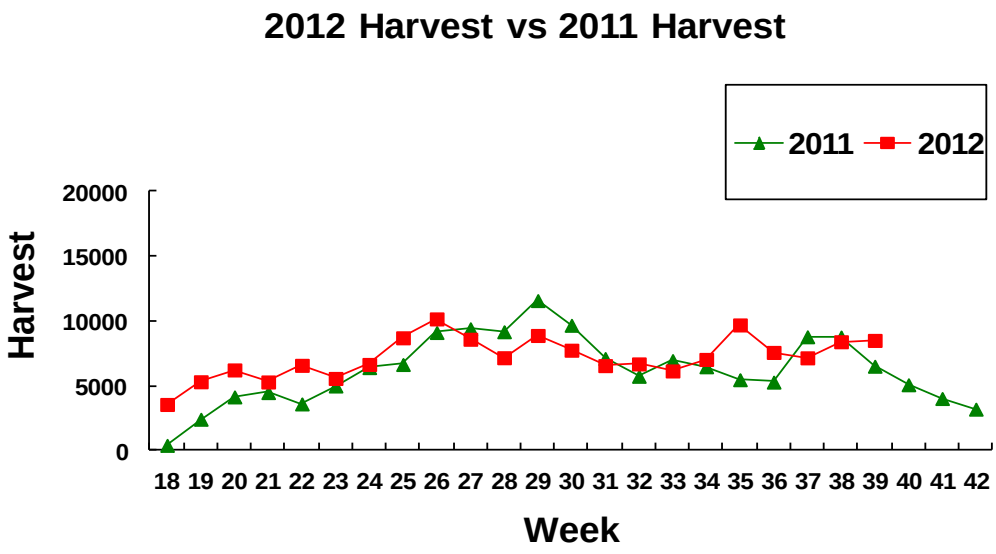

Figure 6. 2012 Weekly NPSRF Harvest vs. 2011 Weekly Harvest.

for the remainder of the season. Early harvest levels were well below the mean harvest levels of the previous 21 NPSRF seasons and can best be explained by high river flows (as a result of above average spring runoff) that typically cause lower harvest rates (Winther et al. 1996) .

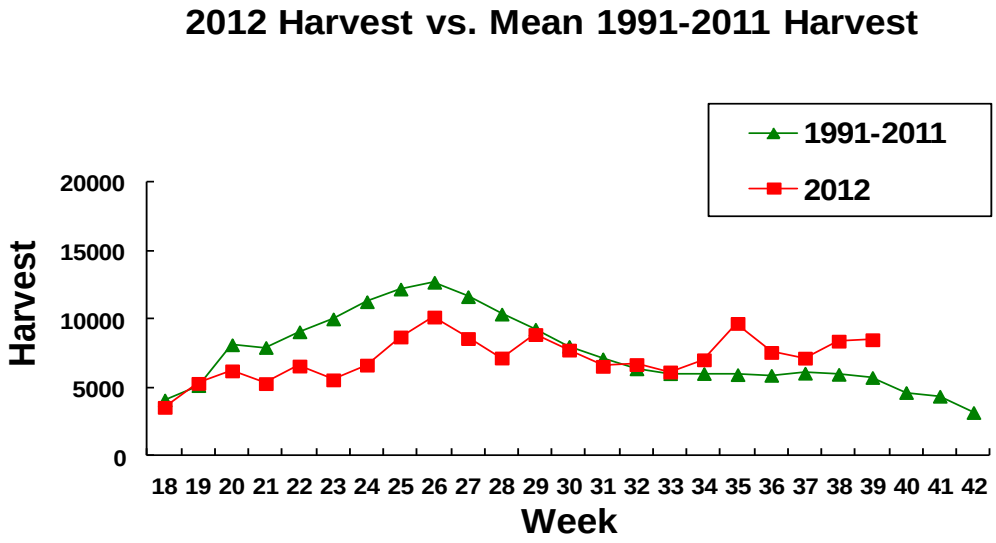

Figure 7. Comparison of 2012 NPSRF Weekly Harvest to 1991-2011 Mean Weekly Harvest.

Harvest by Fishing Location

The mean harvest by fishing location for the 2012 NPSRF was 13,180 northern pikeminnow and ranged from 52,837 reward size northern pikeminnow in fishing location 01 (Below Bonneville Dam) to 105 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 33% of the total NPSRF harvest and has been the highest producing location for all but one season since the NPSRF was implemented in 1991. Fishing location 02 (Bonneville Reservoir) accounted for 26% of the total 2012 NPSRF harvest. Fishing location 12 (Mouth of the Clearwater River to Hell's Canyon dam on the Snake River) accounted for 12% of the total 2012 NPSRF harvest, and Fishing location 6 (mouth of the Snake to Priest Rapids Dam) also continued to trend upwards as it had in 2011.

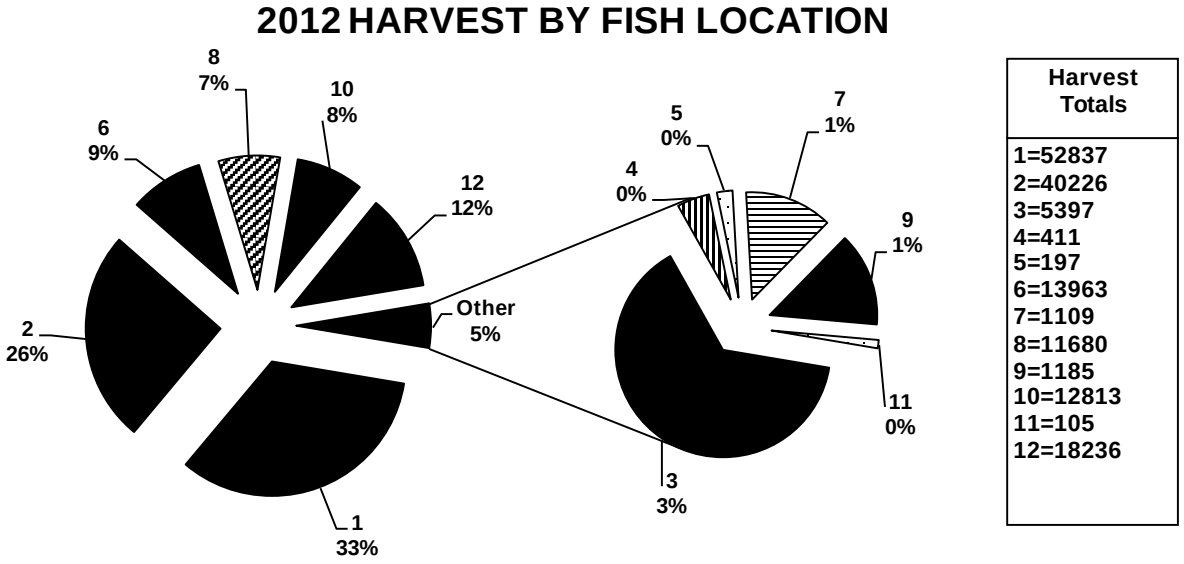

Figure 8. 2012 Northern Pikeminnow Sport-Reward Fishery Harvest by Fishing Location.*
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake 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 in 2012 was up (from 2011 levels) at 13 of the 21 registration stations operated during the 2012 NPSRF. The Dalles registration station retained the title of the NPSRF's top producing station for a second season as anglers harvested 24,661 northern pikeminnow, equaling 15.6% of the total 2012 NPSRF harvest (Figure 9). The Boyer Park station (which had been the #1 station for 4 of the past 5 years) fell to #4, behind Greenbelt and Columbia Point, with only 13,033 northern pikeminnow harvested in 2012. The average harvest per registration station was 7,531 reward size northern pikeminnow, up from 7,396 per station in 2011. The registration station with the smallest harvest was Umatilla where anglers harvested only 485 northern pikeminnow during the 2012 season. The Greenbelt registration station showed the largest increase in harvest with 18,404 reward size northern pikeminnow, up from 10,643 in 2011. The Columbia Point registration station harvest also deserves mention as it increased almost as much as Greenbelt with 16,698 northern pikeminnow up from 9,390 in 2011.

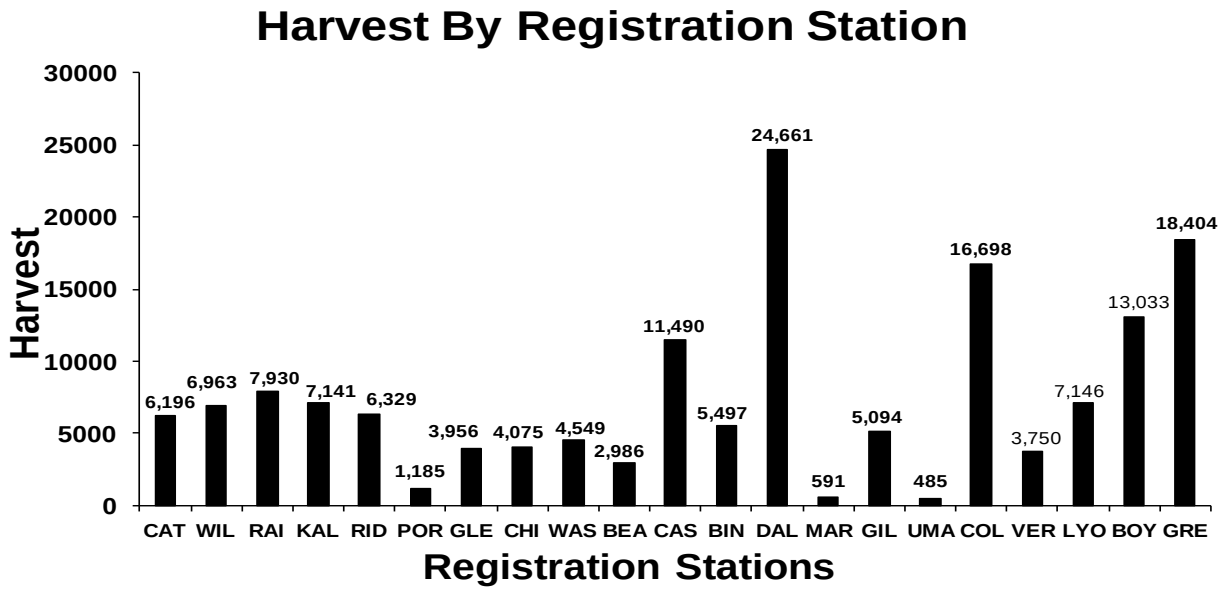

Figure 9. 2012 Northern Pikeminnow Sport-Reward Fishery Harvest by Registration Station.
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, POR-Portco, GLE-Gleason, CHI-Chinook, WAS-Washougal, BEA-Beacon Rock, CAS-Cascade Locks, BIN-Bingen, DAL- The Dalles, MAR-Maryhill, GIL-Giles, UMA - Umatilla, COL - Columbia Point, VER - Vernita, LYO - Lyon's Ferry, BOY-Boyer Park, GRE-Greenbelt.

Harvest by Species/ Incidental Catch

Returning anglers

In addition to northern pikeminnow, returning anglers participating in the 2012 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 unknown species of trout.

Table 1. Catch and Harvest of salmonids by Returning Anglers Targeting Northern Pikeminnow in 2012.

Salmon

Species	Caught	Harvest	Harvest Percent
Chinook (Juvenile)	117	0	0%
Trout (Unknown)	103	15	14.56%
Steelhead Juvenile (Hatchery)	58	0	0%
Steelhead Juvenile (Wild)	47	0	0%
Chinook (Jack)	30	6	20%
Chinook (Adult)	29	5	17.24%
Steelhead Adult (Hatchery)	26	4	15.38%
Cutthroat (Unknown)	20	8	40%
Steelhead Adult (Wild)	14	0	0%
Coho(Juvenile)	9	0	0%
Sockeye	7	2	28.57%
Bull Trout	4	0	0%

Anglers reported that all juvenile salmonids caught during the 2012 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 2012 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 identified 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.

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

Table 2. Catch and Harvest of non-salmonids by Returning Anglers Targeting Northern Pikeminnow in 2012.

Non-Salmonid

Species	Caught	Harvest	Harvest Percent
Northern Pikeminnow >228mm	158,205	158,159	99.97%
Northern Pikeminnow <228mm	50,450	5,942	11.78%
Peamouth	43,841	25,399	57.93%
Smallmouth Bass	9,246	1,002	10.84%
Sculpin (unknown)	8,571	5,444	63.52%
White Sturgeon	6,121	24	.39%
Yellow Perch	3,185	880	27.63%
Channel Catfish	2,699	479	17.75%
Sucker (unknown)	1,789	323	18.05%
Catfish (unknown)	1,084	698	64.39%
Chiselmouth	859	101	11.76%
Walleye	503	291	57.85%
Carp	339	38	11.21%
Bullhead (unknown)	248	70	28.23%
Starry Flounder	238	28	11.76%
Redside Shiner	100	0	0%
American Shad	63	38	60.32%
Bluegill	38	3	7.89%
Sandroller	28	0	0%
Pumpkinseed	12	1	8.33%
Crappie (unknown)	11	0	0%
Largemouth Bass	9	2	22.22%
Whitefish	7	0	0%

Non-returning Anglers Catch and Harvest Estimates

We randomly surveyed a total of 1,511 non-returning anglers (22% of all non-returning anglers) from participants at each of the NPSRF's 21 stations in order to survey and record their catch and/or harvest of reward sized northern pikeminnow and salmonid species only. We anticipate once again collecting full catch and harvest data for all species from surveyed non-retuning anglers in 2015 (full catch and harvest data were last collected 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 fish species listed in column 1 of Table 3 during the 2012 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 2012 NPSRF. Estimated totals are listed in columns 4 and 5 of Table 3.

Table 3. 2012 NPSRF Non-returning Angler phone survey Catch results, Estimated Harvest, and expanded Total Catch and Harvest estimates for all Non-returning anglers.

Species	Caught	Harvest	%Harvested*	Estimated Total Catch	Estimated Total Harvest
Northern Pikeminnow ≥ 228 mm	115	102	88.7%	531	471
Chinook Salmon (adult)	6	3	50%	28	14
Chinook Salmon (jack)	6	2	33.3%	28	9
Chinook Salmon (juvenile)	28	0	0%	129	0
Steelhead (adult)	5	0	0%	23	0
Steelhead (juvenile)	8	0	0%	37	0

N=6,977 n=1,511

Fork Length Data

The length frequency distribution of harvested northern pikeminnow (≥ 200 mm) from the 2012 NPSRF is presented in Figure 10. Fork length data for a total of 86,581 northern pikeminnow (55% of total) were taken during the 2012 NPSRF. The mean fork length for all measured northern pikeminnow (≥ 200 mm) in 2012 was 275.1 mm (SD= 64.8 mm), down from 276.0 in 2011.

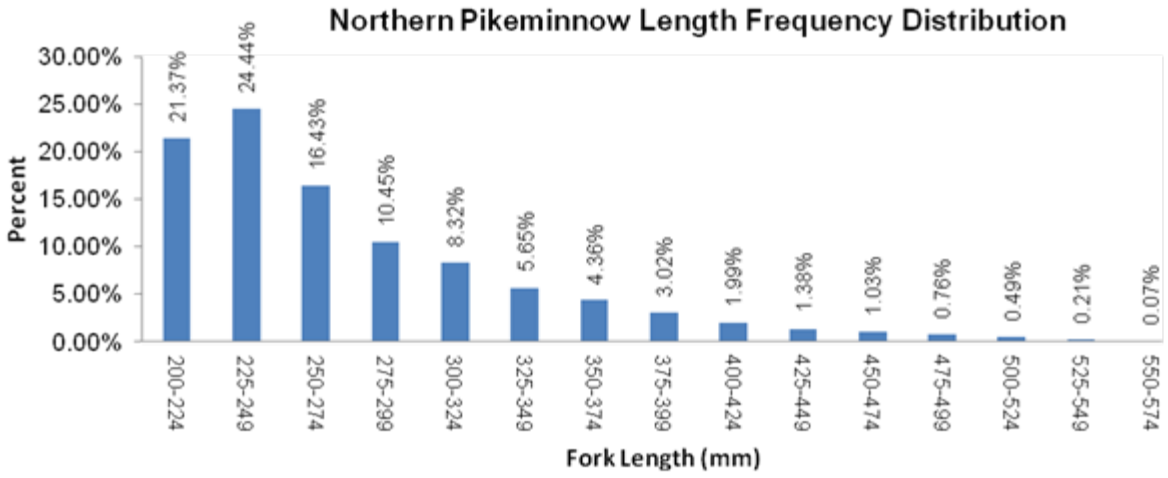

Figure 10. Length frequency distribution of northern pikeminnow ≥ 200 mm FL from 2012 NPSRF.

Angler Effort

The 2012 NPSRF recorded total effort of 22,968 angler days spent during the season, a decrease of 1,438 angler days from the effort total of the previous year (Hone et al. 2011) (Figure 11). When total effort is divided into returning and non-returning angler days, 15,991 angler days (70%) were recorded by returning anglers, and 6,977 were non-returns. The percentage of returning anglers showed a slight increase from 2011 (68%). In addition, 57% of total effort, and 82% of returning angler effort (13,144 angler days), was attributed to successful anglers who harvested at least 1 northern pikeminnow in 2012.

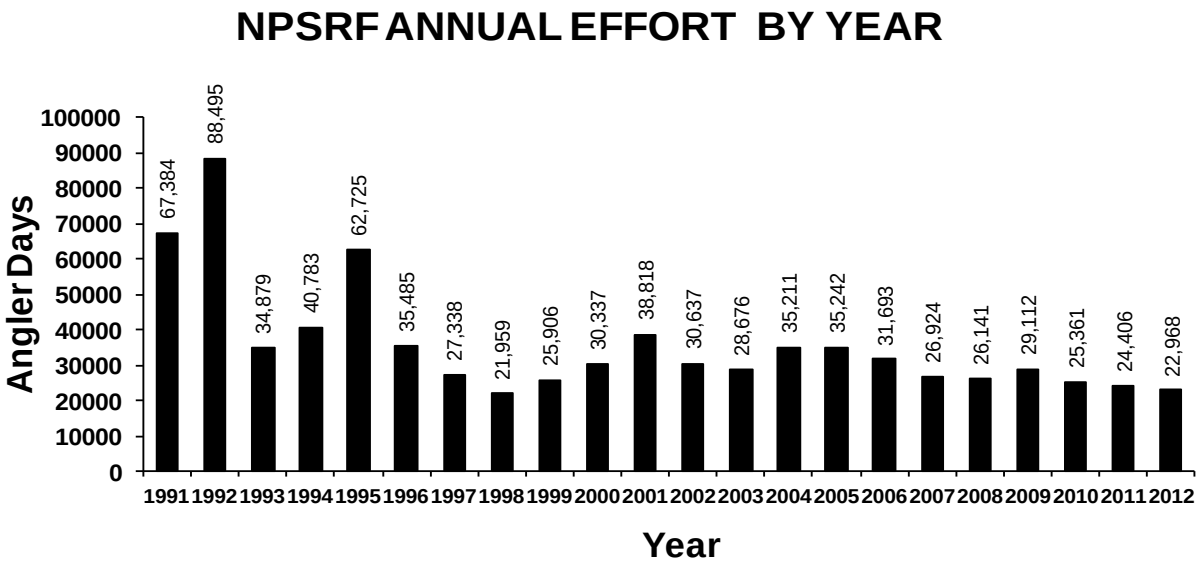

Figure 11. Annual Northern Pikeminnow Sport-Reward Fishery Effort.

Effort by Week

Mean weekly effort for the 2012 NPSRF was 1,044 angler days during the season, with the peak occurring in the eighth week of the season (Figure 12). As observed in previous seasons, the peak effort (week 25) occurred near the same week as peak harvest (week 26). Overall mean weekly effort increased from 976 in 2011 to 1,044 in 2012. The weekly effort totals for the 2012 NPSRF generally followed the pattern of previous seasons except that they were lower than historical 1991-2011 effort levels which were buoyed by heavy participation in the first few years of the NPSRF (Figure 13).

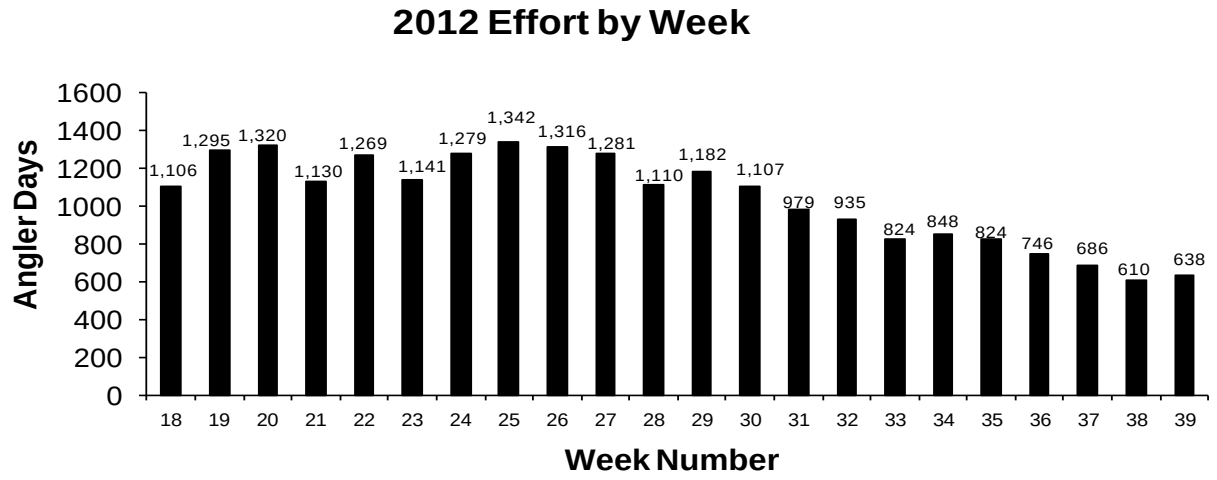

Figure 12. 2012 Weekly Northern Pikeminnow Sport-Reward Fishery Effort.

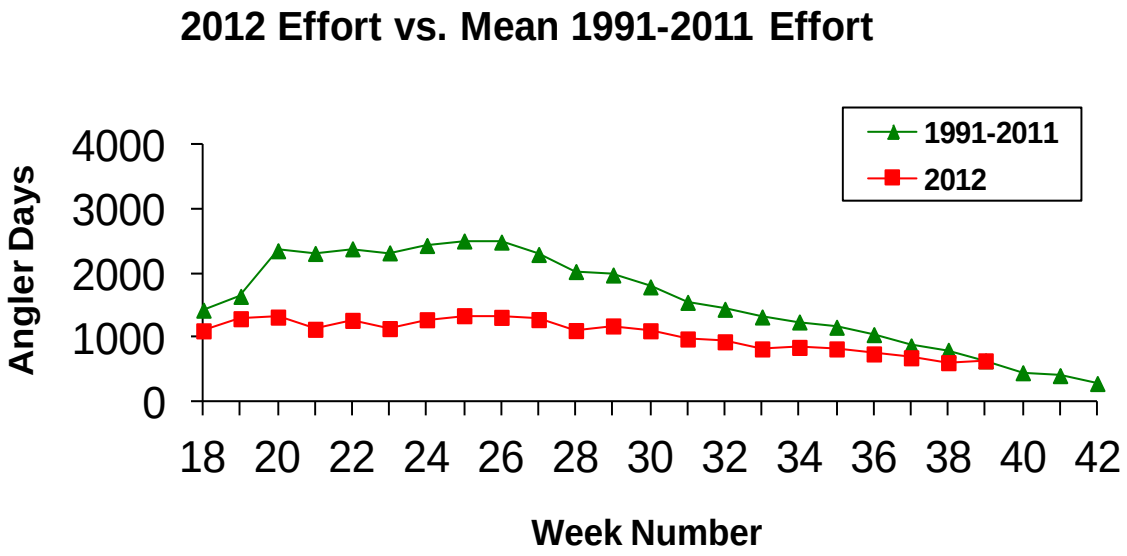

Figure 13. 2012 NPSRF Weekly Effort vs. Mean 1991-2011 Effort.

Effort by Fishing Location

Mean annual effort by fishing location for the 2012 NPSRF (returning anglers only) was 1,333 angler days compared to 1,387 angler days in 2011. Effort totals ranged from 5,673 angler days recorded below Bonneville Dam (fishing location 01) to only 22 angler days spent in fishing location 11 on the Snake River (Lower Granite Dam to the mouth of the Clearwater River) (Figure 14). Effort at half of the twelve NPSRF fishing locations increased in 2012 keeping the mean effort by fishing location near that of the 2011 NPSRF. The most noteworthy change in effort was a decrease at fishing location 10 (Little Goose Reservoir), 2,548 angler days in 2011 to 1,277 in 2012.

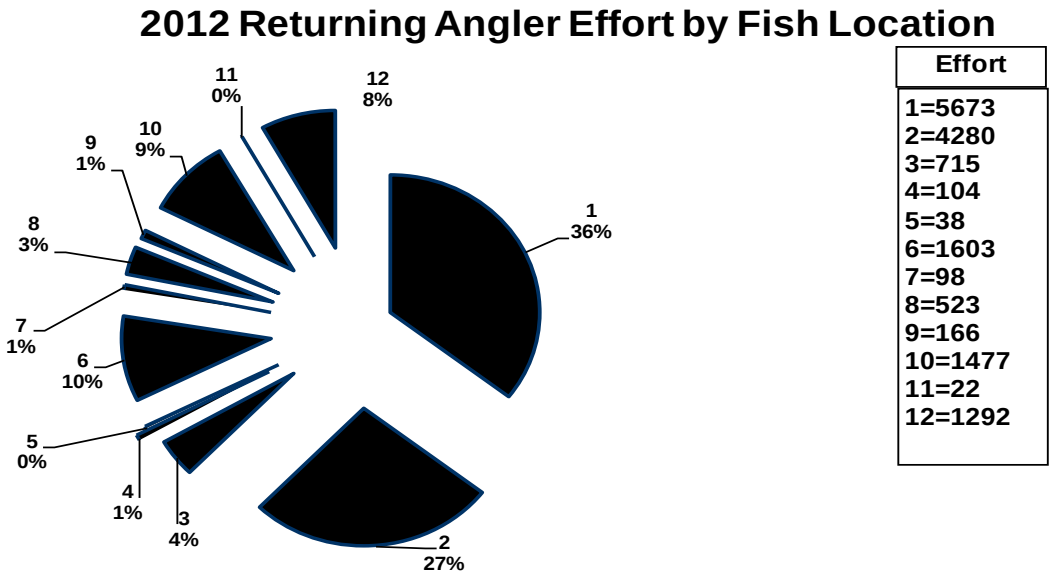

Figure 14. 2012 NPSRF Angler Effort by Fishing Location (returning anglers only).*
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake River 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 2012 NPSRF was 1,094 angler days compared to 1,162 angler days in 2011. Effort totals ranged from 3,917 angler days at The Dalles station to 111 angler days at the Portco station (Figure 15). Effort during the 2012 NPSRF decreased at thirteen of the twenty one registration stations, most notably at the Boyer Park station where effort dropped 1,190 angler days (41%) from the previous year. Effort increased at eight stations, most notably at the Columbia Point station where effort increased by 55% with an additional 816 angler days spent in 2012. As we have come to expect, the top 6 stations in terms of angler effort were also the top 6 harvest stations.

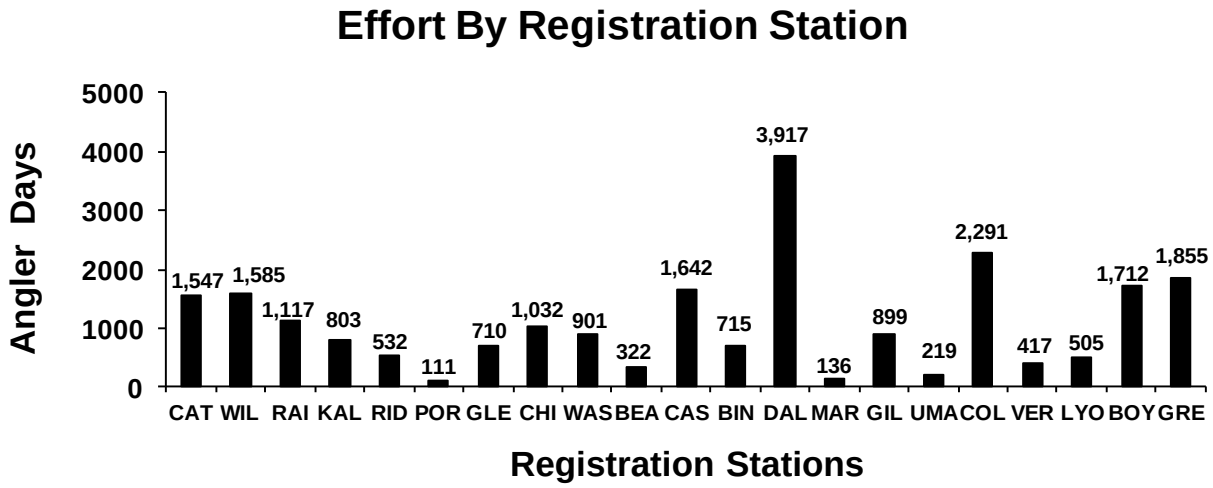

Figure 15. 2012 Northern Pikeminnow Sport-Reward Fishery Angler Effort by Registration Station.
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, POR-Portco, GLE-Gleason, CHI-Chinook, WAS-Washougal, BEA-Beacon Rock, CAS-Cascade Locks, BIN-Bingen, DAL-TheDalles, MAR-Maryhill, GIL-Giles, UMA-Umatilla, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, BOY-Boyer Park, GRE-Greenbelt.

Catch Per Angler Day (CPUE)

The 2012 NPSRF recorded an overall (returning + non-returning anglers) catch per unit of effort (CPUE) of 6.89 northern pikeminnow harvested per angler day during the season. This catch rate increased from 6.36 in 2011 (Hone et al. 2011) (Figure 16). Up through the 2007 season, angler CPUE had increased steadily throughout the NPSRF's history. During both the 2008 and 2009 NPSRF seasons, angler CPUE was considerably lower, most likely due to the influx of new or inexperienced anglers attracted to the NPSRF by the Pikeminnow Angler Random Drawing incentive (Winther et al. 2008, Hone et al. 2009). The 2012 NPSRF, like the 2011 and 2010 NPSRF, was conducted without the use of any random drawings or other incentives attracting inexperienced anglers and angler CPUE appears to have stabilized as a result. Returning angler CPUE during the 2012 NPSRF was 9.89 northern pikeminnow per angler day, up slightly from the 2011 CPUE of 9.33. We estimate that CPUE for non-returning anglers is 0.07 reward size northern pikeminnow per angler day based on 2012 NPSRF phone survey results.

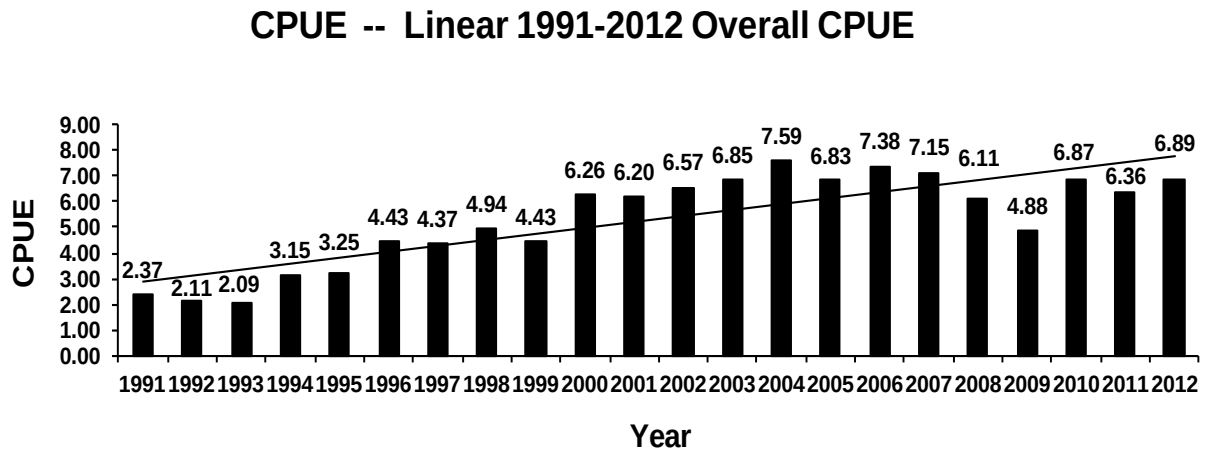

Figure 16. Annual NPSRF CPUE (returning + non-returning anglers) for the years 1991-2012.

CPUE by Week

Mean angler CPUE by week for the 2012 NPSRF was 7.40 fish per angler day compared to 6.55 in 2011. CPUE ranged from 3.21 in week 18 (May 1-May 6) to a peak of 13.77 in week 38 (September 17-September 23) (Figure 17). As has historically been the case, weekly CPUE for the 2012 NPSRF followed a two peak pattern with a high point near peak harvest (week 26) and then again late in the season (Winther et al. 2010).

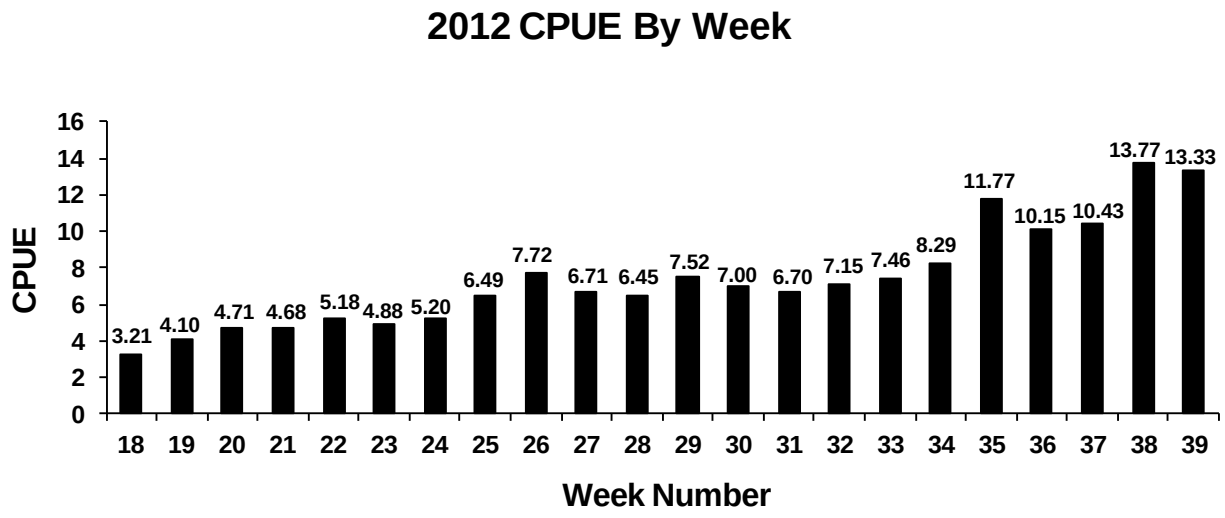

Figure 17. 2012 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Week.

CPUE by Fishing Location

Angler success rates for the 2012 NPSRF, as indicated by CPUE, are available for returning anglers only and varied by fishing location. Success rates ranged from a high of 22.33 fish per angler day in fishing location 08 (Ice Harbor Reservoir) to 3.95 fish per angler per day in fishing location 04 (John Day Reservoir) (Figure 18). Catch rates were up from 2011 at seven of the twelve fishing locations (01, 03, 07, 08, 09, 11, and 12). The average CPUE by fishing location was 9.37 northern pikeminnow per angler day in 2012 compared to 8.33 in 2011.

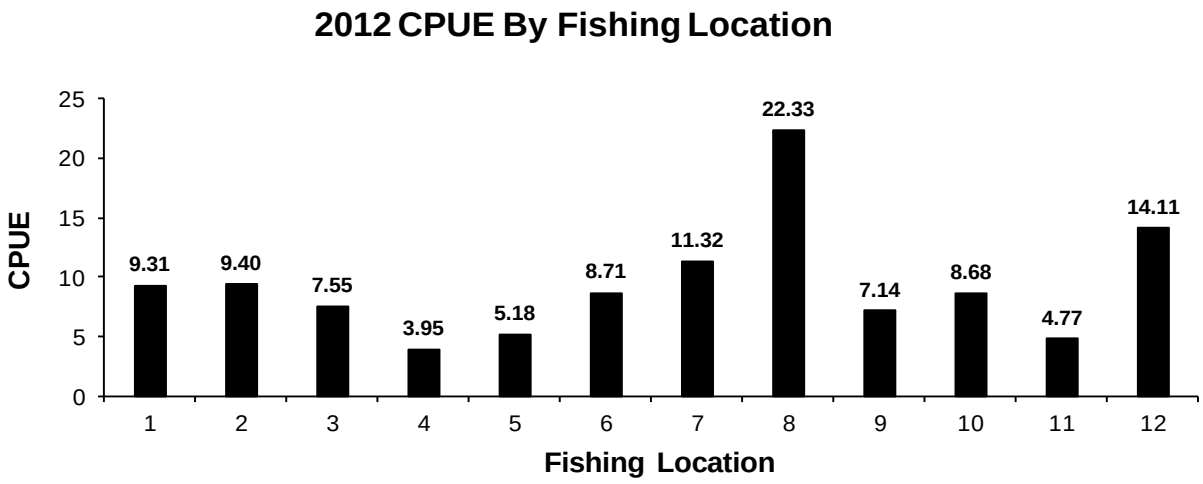

Figure 18. 2012 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Fishing Location.*
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the 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 2012 NPSRF was the Lyon's Ferry station where anglers averaged 14.15 northern pikeminnow per angler day (Figure 19). The registration station with the lowest CPUE was the Umatilla station with a CPUE of 2.21 northern pikeminnow per angler day. The station average for angler CPUE was 7.23, up from 5.91 in 2011. Angler CPUE by registration station increased at thirteen stations during the 2012 NPSRF. The largest change in CPUE occurred at Portco where the 2011 CPUE of 1.06 climbed to 10.68 in 2012.

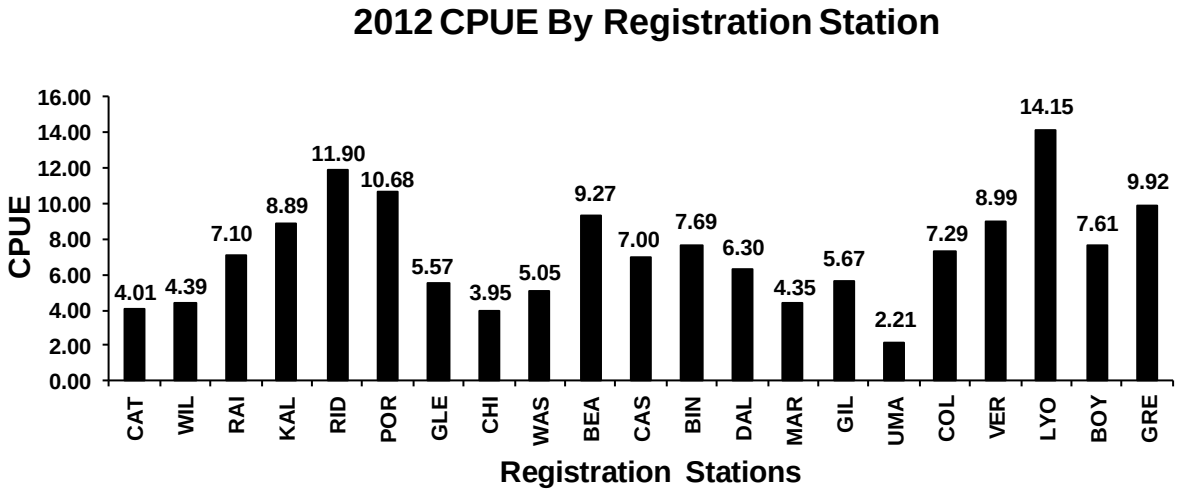

Figure 19. 2012 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Registration Station. CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, POR-Portco, GLE-Gleason, CHI-Chinook, WAS-Washougal, BEA-Beacon Rock, CAS-Cascade Locks, BIN-Bingen, DAL-The Dalles, MAR-Maryhill, GIL-Giles, UMA-Umatilla, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, BOY-Boyer Park, GRE-Greenbelt.

Angler Totals

There were 3,302 separate anglers who participated in the 2012 NPSRF, a decrease of 322 participants from 2011 (Hone et al. 2011). One thousand, two hundred and eighty five of these anglers (38.9% of total vs. 39.3% in 2011) were classified as successful since they harvested at least one reward size northern pikeminnow (for which a voucher was issued) during the 2012 season. Of the successful anglers, 79% (1,012 anglers) sent in their vouchers to PSMFC for payment (PSMFC 12/13/12 Payment Summary) while 273 anglers (21%) did not. The average successful angler harvested 123 northern pikeminnow during the 2012 NPSRF, although when we break down the 1,285 successful anglers by tier, 85% (1,097 anglers) harvested fewer than 100 northern pikeminnow and were classified as Tier 1 anglers (Figure 20). Ninety anglers (7%) reached Tier 2 status by harvesting between 101 and 400 northern pikeminnow, and 98 anglers (8%) reached Tier 3 status by harvesting more than 400 northern pikeminnow in 2012. The 98 anglers who reached Tier 3 represented only 3% of all participants (both returning and non-returning anglers) during the 2012 NPSRF. The number of anglers reaching each of the three tiers during the 2012 NPSRF decreased for both Tier 1 and 2, but increased for Tier 3 when compared to 2011. Since Tier 3 are the NPSRF's most proficient anglers, the increased number of Tier 3 anglers (from 87 anglers in 2011 to 98 anglers in 2012) was likely the primary factor in the improved NPSRF harvest seen in 2012 (Hone et al. 2003).

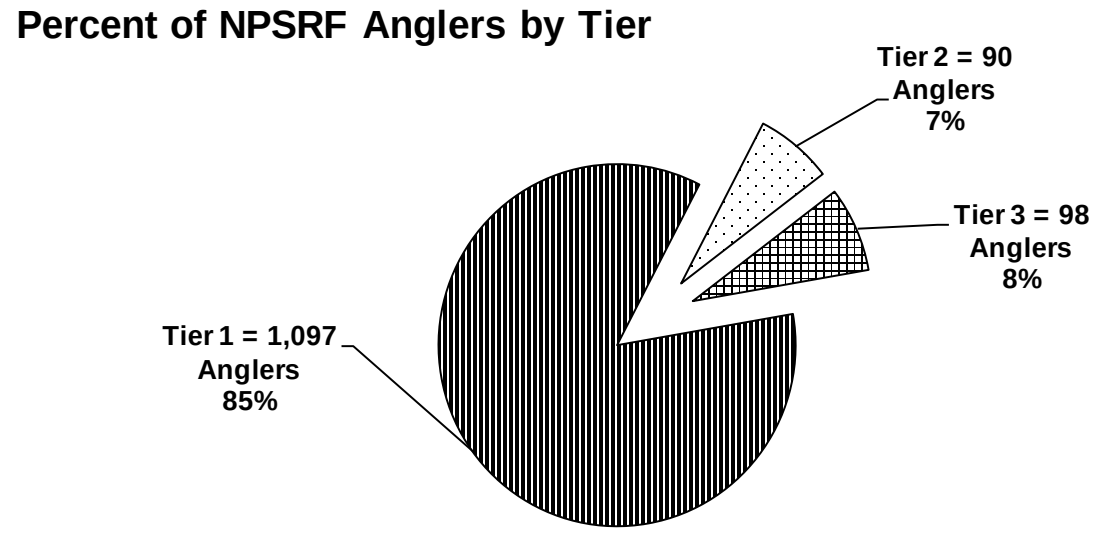

Figure 20. 2012 NPSRF Anglers by tier (returning only) based on total # of fish harvested.

While Tier 1 anglers made up 85% of all successful NPSRF participants in 2012, they accounted for only 8% of total NPSRF harvest (13,000 northern pikeminnow) (Figure 21). This translates to an average harvest of 12 fish per Tier 1 angler, per year. Tier 2 anglers harvested 18,190 northern pikeminnow equaling 12% of total 2012 NPSRF harvest and averaging 202 fish per Tier 2 angler, per year. Tier 3 anglers, (known as "highliners"), harvested 126,969 northern

pikeminnow equaling 80% of total 2012 NPSRF harvest and averaging 1,296 fish per angler, per year. The percentage of total NPSRF harvest for Tier 3 anglers increased from 74% in 2011 to 80% in 2012, while the percentage of harvest for Tier 1 and Tier 2 anglers each decreased slightly.

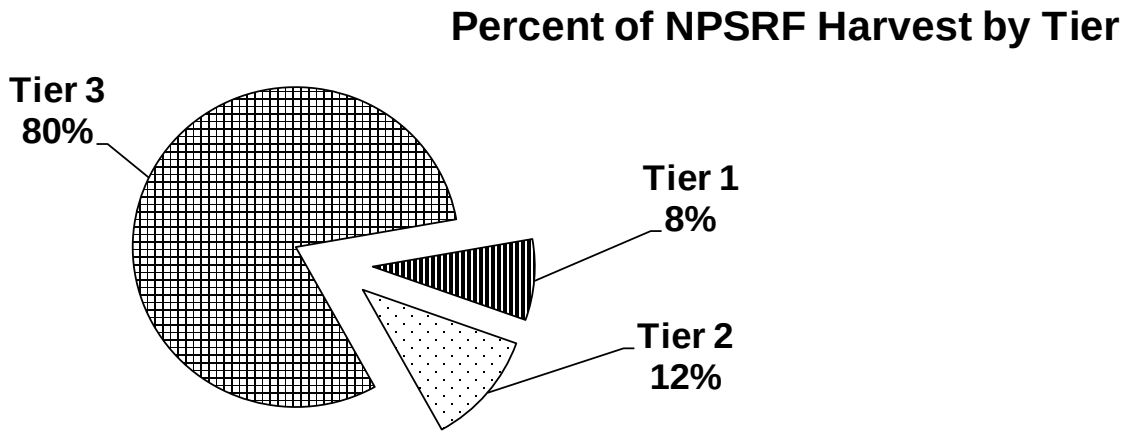

Figure 21. 2012 NPSRF Harvest by Angler Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400).

The average NPSRF participant (returning + non-returning anglers) expended slightly more effort pursuing northern pikeminnow during the 2012 season than in 2011 (6.96 vs. 6.73 angling days of effort). When we look at successful anglers only, the overall average successful angler expended 10.23 angler days of effort during the 2012 NPSRF compared to 9.67 days in 2011. It should be noted that just as was first documented in 2002 (Winther et al. 2002), individual Tier 3 anglers expend more effort (on average) than individual Tier 2 anglers. Individual Tier 2 anglers also expend more effort (on average) than individual Tier 1 anglers. In 2012, Tier 3 anglers spent an average of 82 days fishing (down from 85 days in 2011), Tier 2 anglers spent an average of 43 days fishing (down from 45 in 2011), and Tier 1 anglers spent an average of only 7 days fishing, just as they had done in 2011 (Figure 22).

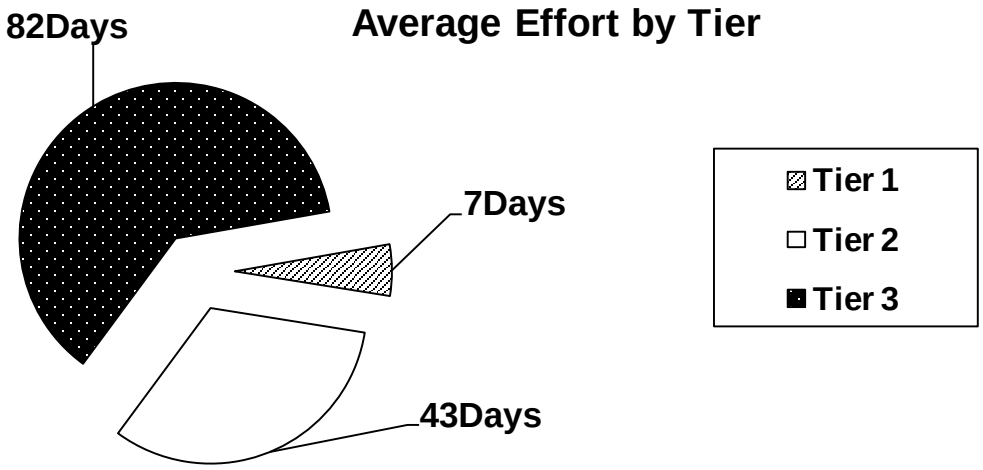

Figure 22. Average Effort of 2012 NPSRF Anglers by Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400) .

Overall angler CPUE for the 2012 NPSRF increased from 2011, however, CPUE decreased slightly for anglers at Tiers 1 and 2 while CPUE for anglers at Tier 3 increased a small amount indicating that overall fishing success was fairly similar to the previous season for successful anglers. CPUE for anglers at Tier 1 decreased from 1.76 in 2011 to 1.68 in 2012 (Figure 23). CPUE for Tier 2 anglers decreased from 4.98 in 2011 to 4.66 in 2012, and CPUE for Tier 3 anglers went up from 15.56 in 2011 to 15.78 in 2012.

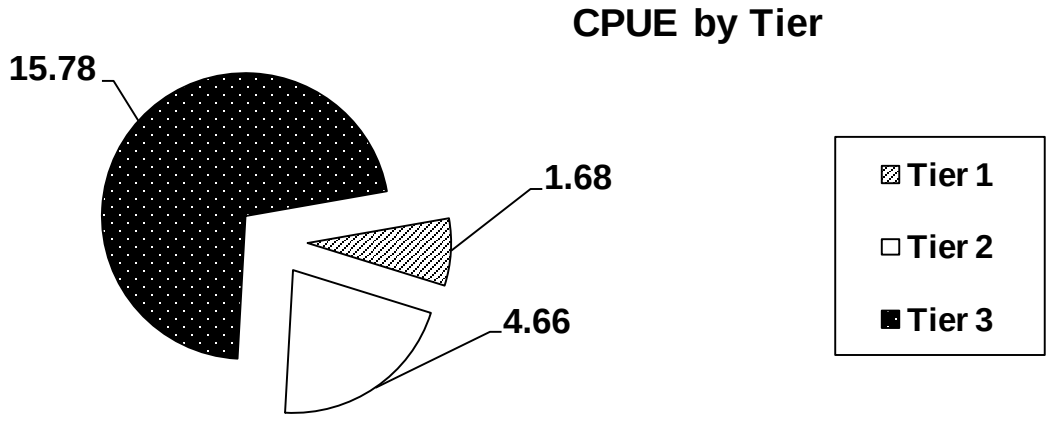

Figure 23. Average CPUE of 2012 NPSRF Anglers by Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400).

The top individual angler (based on number of fish caught) for the 2012 NPSRF harvested 9,324 northern pikeminnow with 8 spaghetti tagged northern pikeminnow worth a total earnings of $77,238 (PSMFC 12/13/2012 Sport Reward Payment Summary). The 2012 top angler caught 352 more fish than he did as the top angler in 2011 and more than twice the number of fish that the 2012 second place angler caught. The CPUE for this year's top angler (74.6 fish per angler day) was down from what he had as the top angler in 2011 (86.3 fish per angler day). The top

angler for the 2012 season spent 21 more days (effort) fishing than he did in 2011 (as the top angler when he fished 104 days) and his increased effort in 2012 solely accounted for more than half the increase (1,567 fish) in harvest totals this year's NPSRF when compared to 2011. By comparison, the top angler (in terms of participation rather than harvest) for the 2012 NPSRF fished 144 days and harvested 614 northern pikeminnow.

Tag Recovery

Northern Pikeminnow Tags

Returning anglers harvested 189 northern pikeminnow tagged by ODFW with external spaghetti tags during the 2012 NPSRF compared to 155 spaghetti tags paid in 2011 (Hone et al., 2011). Tag recoveries peaked in week 24, two weeks earlier than peak NPSRF harvest (Figure 24). Of these spaghetti tagged northern pikeminnow, 186 had also been PIT tagged by ODFW as a secondary mark. WDFW technicians also recovered an additional 98 northern pikeminnow which had ODFW PIT tags with wounds and/or fin-clips indicating that the fish had "lost" an ODFW spaghetti tag. The recovered spaghetti and PIT tags, as well as the potential tag loss data was estimated by ODFW to equal a 15.9% exploitation rate for the 2012 NPSRF (E. VanDyke, ODFW personal communication).

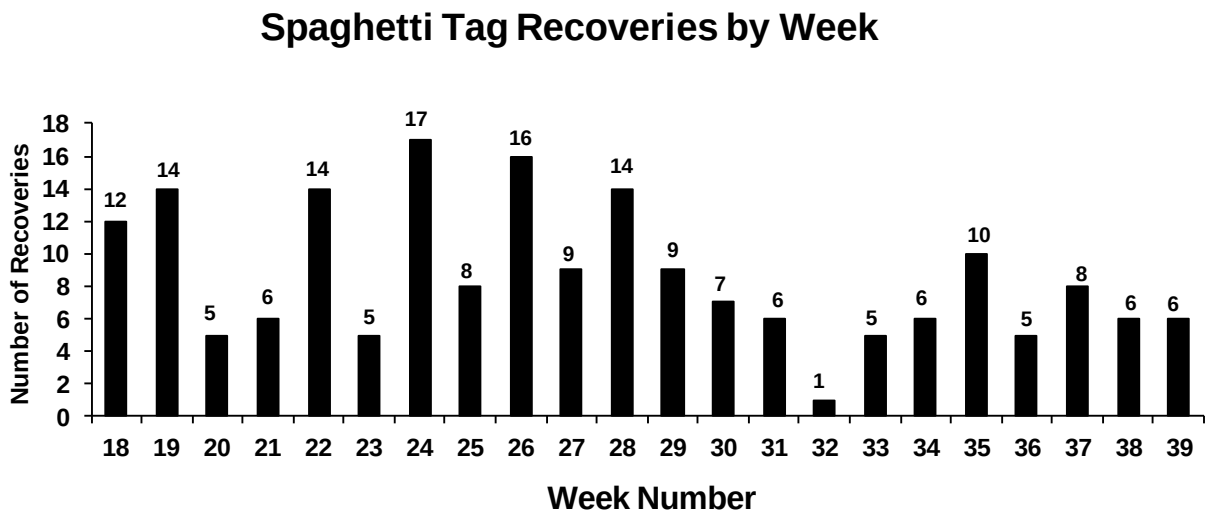

Figure 24. 2012 NPSRF Spaghetti Tag Recoveries by Week.

Ingested PIT Tags

A total of 158,159 northern pikeminnow were individually scanned for the presence of PIT tags. This represents 100% of the total harvest of reward-size fish for the 2012 NPSRF (northern pikeminnow not qualifying for rewards were also scanned whenever possible). Technicians recovered a total of 103 PIT tags from consumed smolts that had been ingested by northern pikeminnow harvested during the 2012 NPSRF, an overall occurrence ratio of 1:1,536. Total ingested PIT tag recoveries in 2012 were quite a bit higher (41 more) than the previous year and given that total harvest levels were similar, there ended up being a higher rate of occurrence (1:1,536 in 2012 versus 1:2,501 in 2011) (Hone et al., 2011) as well. PIT tag recoveries of salmonid smolts ingested by northern pikeminnow peaked during weeks 26 and 28 of the season (where 19 ingested smolts were recovered) and didn't conclude until week 35 near the end of August (Figure 25).

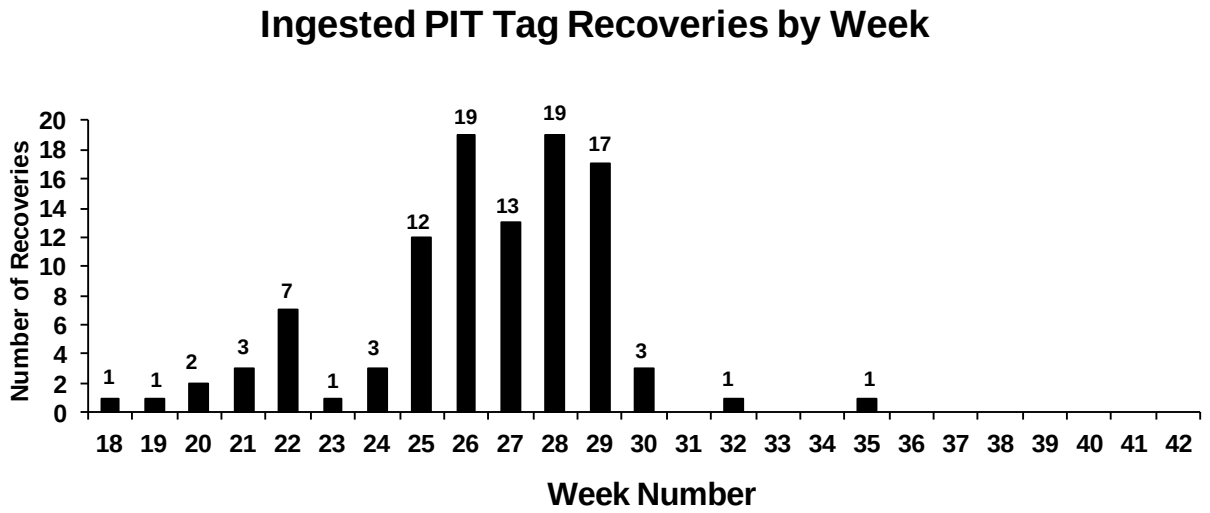

Figure 25. 2012 NPSRF PIT Tag Recoveries by Date.

Pit tag recoveries by fishing location during the 2012 NPSRF showed that northern pikeminnow harvested from Fishing locations 08 (Ice Harbor Reservoir) ingested the largest number of salmonid smolts containing PIT tags (Figure 26).

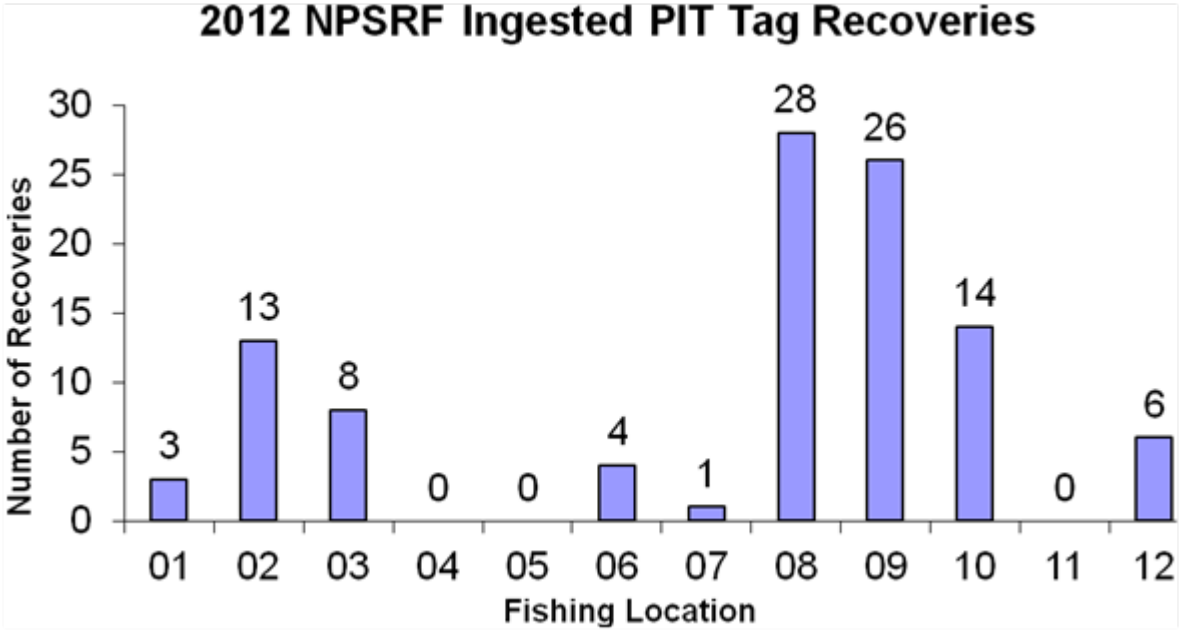

Figure 26. 2012 NPSRF ingested PIT Tag Recoveries by Fishing Location.
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake River to Priest 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.

Species composition of PIT tagged smolts (recovered from northern pikeminnow harvested in the 2012 NPSRF) was obtained from PTAGIS and indicated that ninety-six (93%) of the 103 ingested PIT tag recoveries were from chinook smolts. The other 7 PIT tags were from 3 sockeye, 1 coho, 2 steelhead, and 1 unknown species accounting for the remaining percentage (Figure 27). Nearly half of the chinook PIT tags were recovered in July, while the coho and steelhead recoveries occurred primarily in May and June. Two of the 3 Sockeye PIT tags were also recovered in May with the other one recovered in June. PTAGIS queries revealed that the PIT tag recoveries from chinook smolts consisted of 83 fall chinook, 3 spring chinook, 5 unknown chinook and 5 summer chinook). PIT tag queries of PTAGIS also indicated that 9 of the 103 recovered PIT tags (9%) were from salmonids of wild origin.

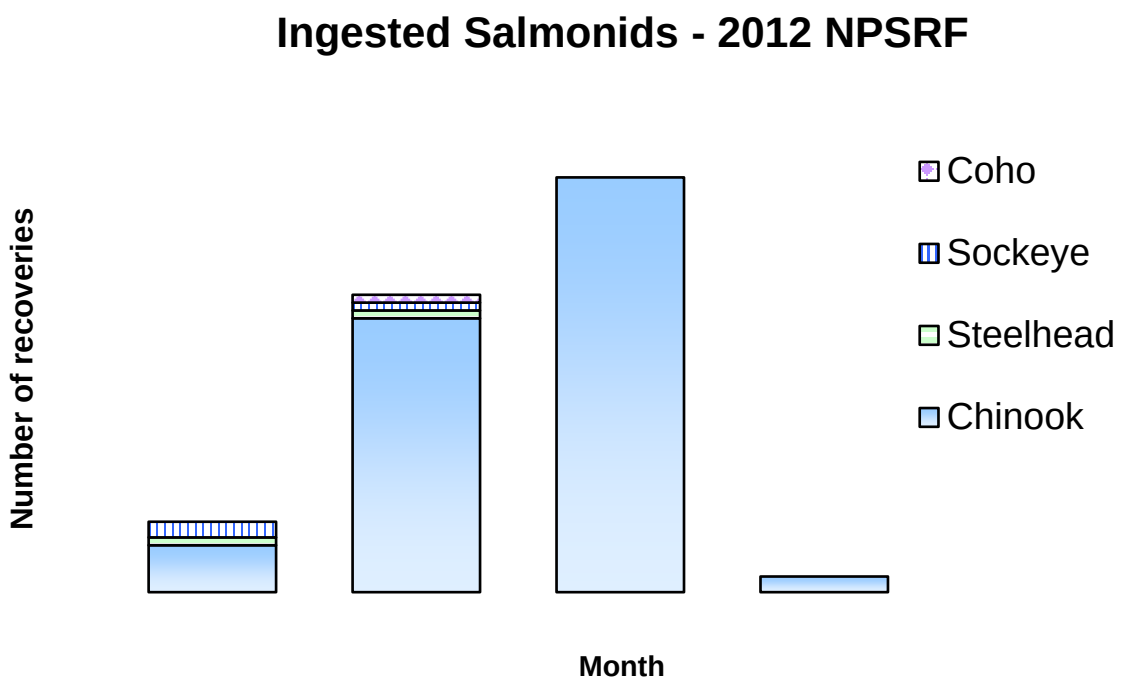

Figure 27. Recoveries of ingested salmonid PIT Tags from the 2012 NPSRF.

Analysis of PIT tag recovery data from the 2012 NPSRF continues to document actual 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 2012 NPSRF succeeded in reaching the NPMP's 10-20% exploitation goal for the fifteenth consecutive year, achieving an estimated exploitation rate of 15.9%. NPSRF harvest in 2012 was up from 2011 and effort was down causing an increase in overall CPUE. Peak weekly harvest was three weeks earlier than the 2011 peak, corresponding to the 1991-2011 average peak week. For the second consecutive year, The Dalles registration station was the SRF's top producing station in terms of harvest, and the Boyer Park station had the largest drop in participation (effort). We recovered 189 northern pikeminnow spaghetti tagged by ODFW and an additional 98 which were missing spaghetti tags but retaining ODFW PIT tags. Mean fork length (FL) for northern pikeminnow harvested in the 2012 NPSRF was 275.1 mm, down from 276.0 mm in 2011. Incidental catch consisted primarily of peamouth, smallmouth bass and sculpin, most of which were released and juvenile Chinook (for salmonids), all of which were released.

The 2012 NPSRF continued to provide excellent harvest opportunities for anglers program wide, but certain areas stuck out as "Hot Spots" as indicated by high CPUE or harvest rates. These areas included Fishing location 08 (Ice Harbor Reservoir) on the Snake River where angler CPUE was 22.33 fish per angler day, the Lyon's Ferry and Ridgefield registration stations were angler CPUE was 14.15 and 11.90 fish per angler day respectively, and the NPSRF's top station (The Dalles) where anglers harvested more than 24,000 fish. The top angler during the 2012 NPSRF caught 352 more fish than the top angler in 2011 earning $77,238 in reward payments. The second place angler harvested less than half the number northern pikeminnow turned in by the top angler during the 2012 NPSRF.

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 more PIT tags from ingested salmonids than last year (103 vs. 62). Species composition of recovered PIT tags again showed that they were primarily from chinook smolts (96), mostly fall chinook of hatchery origin. We also recovered a small number of PIT tags from steelhead (2), sockeye (3), and coho (1), as well as 1 of unknown origin (according to PTAGIS). We continue to consider the use of PIT tag recovery data as a way to identify and document angler fraud from northern pikeminnow tagged outside NPSRF boundaries.

RECOMMENDATIONS

1.) Continue use of standardized season dates (May 1st-Sept 30th) for implementation of the 2013 NPSRF in order to enhance promotional opportunities, build angler familiarity, and ultimately to optimize removal of predatory northern pikeminnow from the NPMP program area.

2.) Continue to investigate and develop angler incentives designed to improve returning angler effectiveness during, and recruit new, and preferably experienced anglers to the 2013 NPSRF.

   a) Review angler participation patterns and adjust NPSRF registration stations and/or times as needed to encourage angler participation.

   b) Review NPSRF station times and routes for efficiencies which may allow adding additional stations or provide additional angler opportunities for participation.

   c) Continue to pursue feasibility of paying for tag-loss NPM retaining ODFW PIT tags in response to repeated angler requests and to improve NPSRF public relations.

   d) Continue use of angler clinics, coupons, and sport show booths as tools to recruit new anglers and promote NPSRF awareness.

   e) Investigate use of internet and social media for advertising NPSRF and for angler recruitment and education.

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 PIT tagged northern pikeminnow coming from outside NPSRF boundaries.

6.) Survey a minimum of 20% of non-returning NPSRF anglers to record non-returning angler catch of northern pikeminnow and all salmonids and estimate total catch and harvest of northern pikeminnow and all salmonids per NPMP protocol. Analyze and monitor this data to identify any changes in non-returning angler catch trends.

ACKNOWLEDGEMENTS

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We are grateful to the City of Rainier for the use of the Rainier boat ramp; The City of Richland for the use of Columbia point Park; The City of Vancouver Parks and Recreation Department for the use of the Marine Park (PORTCO) boat ramp; the Cowlitz County Parks and Recreation Department for the use of the Willow Grove boat ramp; the Port of Bingen for the use of Bingen Marina; The Port of Camas/Washougal for the use of the Camas/Washougal boat ramp; the Port of Cascade Locks for the use of Marine Park; the Port of Cathlamet for the use of the Cathlamet Marina; the Port of Kalama for the use of the Kalama Marina; the Port of Ridgefield for the use of the Ridgefield boat ramp; the Port of The Dalles for the use of The Dalles Boat Basin; the Port of Umatilla for the use of the Umatilla Marina; the Portland Metro Regional Parks Department for the use of the M.J. Gleason Boat Ramp and Chinook Landing; the U.S. Army Corps of Engineers for the use of Giles French Park and the Greenbelt Boat Ramp; The Washington Department of Transportation for the use of the Vernita Bridge Rest Area; Washington State Parks for the use of Beacon Rock and Maryhill State Parks; Jim MacArthur for the use of Lyon's Ferry Marina; and Dave and Linda Petersen for the use of Boyer Park.

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REPORT B

Northern Pikeminnow Sport Reward Payments – 2012

Prepared by

Russell G. Porter

Pacific States Marine Fisheries Commission
205 S.E. Spokane St. Suite 100
Portland, OR 97202

March, 2013

INTRODUCTION

The **Northern Pikeminnow Predator Control Program** was administered by PSMFC in 2012. 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, handled all fish checked in to the program and conducted dam angling at John Day Dam and The Dalles Dam. Oregon provided fish tagging services, population studies, and food habit 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 2012 a total of 158,159 fish were harvested in the sport-reward fishery. Of this total 189 were tagged fish and 157,970 were untagged. Vouchers for 156,837 of the untagged fish were submitted for payment totaling rewards of $1,016,672. 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 1,285 anglers who registered were successful in catching one or more fish in 2011. The 2012 season ran from May 1, 2012 through September 30, 2012. 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 2012 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 189 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. Of this total, 188 tagged vouchers were submitted for payment. This resulted in tag reward payments of $94,000 in addition to the regular reward payments above.

ACCOUNTING

Total payments for the season of regular vouchers, coupons, and tagged fish, totaled $1,117,502. All IRS Form 1099-MISC Statements were sent to the qualifying anglers for tax purposes in the fifth week of January, 2013. Appropriate reports and copies were provided to the IRS by the end of February, 2013.

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: rporter@psmfc.org.

2012 SPORT REWARD PAYMENTS SUMMARY

The following is a summary of all vouchers received and paid in 2012.

	Fish	Incentives	$ Paid
Fish paid @ tier 1 ($4 each):	30,556	N/A	$122,224
Fish paid @ tier 2 ($5 each):	38,600	N/A	$193,000
Fish paid @ tier 3 ($8 each):	87,681	N/A	$701,448
Tags paid (@ $500 each):	188	N/A	$94,000
Coupons issued (@ $10 each)	N/A	683	$6,830
Total:	**157,025**	**683**	**$1,117,502**

Anglers @ tier 1	824
Anglers @ tier 2	90
Anglers @ tier 3	98
Total	1,012

Anglers with 10 fish or less:	530
Anglers with 2 fish or less:	273

Top Twenty Anglers (by total fish caught)

	TIER 1	TIER 2	TIER 3	TAGS	TOTAL FISH	COUPONS	BALANCE
1.	100	300	8,916	8	9,324	$10	$77,238
2.	100	300	4,204	13	4,617	$10	$42,042
3.	100	300	4,200	2	4,602	$10	$36,510
4.	100	299	3,050	2	3,451	$10	$27,305
5.	100	300	2,945	3	3,348	$10	$26,970
6.	100	300	2,739	2	3,141	$10	$24,822
7.	100	300	2,714	5	3,119	$10	$26,122
8.	100	300	2,525	7	2,932	$10	$25,610
9.	100	300	2,302	0	2,702	$10	$20,326
10.	100	298	2,277	3	2,678	$10	$21,616
11.	100	300	2,250	4	2,654	$10	$21,910
12.	100	300	2,089	2	2,491	$10	$19,622
13.	100	300	2,018	0	2,418	$10	$18,054
14.	100	300	1,922	2	2,324	$10	$18,286
15.	100	300	1,854	0	2,254	$10	$16,742
16.	100	300	1,800	0	2,200	$10	$16,310
17.	99	300	1,776	8	2,183	$10	$20,114
18.	100	300	1,628	2	2,030	$10	$15,934
19.	100	300	1,625	1	2,026	$10	$15,410
20.	100	300	1,489	2	1,891	$10	$14,822
	1,999	5,997	54,323	66	62,385	$200	$505,765

Report C

System-wide Predator Control Program: Indexing and Fisheries Evaluation

Prepared by

Matthew Gardner
Eric Tinus
Michele Hughes Weaver
Christine Mallette
Erick S. Van Dyke

Oregon Department of Fish and Wildlife
Columbia River Coordination Program
17330 S.E. Evelyn Street
Clackamas, Oregon 97015

March 2013

SUMMARY

The Northern Pikeminnow Management Program (NPMP), with its fisheries aimed at reducing predation on juvenile Pacific salmon *Oncorhychus spp.* by northern pikeminnow *Ptychocheilus oregonensis* in the Columbia and Snake rivers, was assessed for the 2012 season (1 May–30 September 2012). 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 to the sustained removal of northern pikeminnow by these species.

To evaluate exploitation during 2012, we tagged and released 1,675 northern pikeminnow 200 mm fork length (FL) and greater throughout the lower Columbia and Snake rivers. Of these fish, 806 were in the size group (≥250 mm FL) that we have used to monitor trends in system-wide exploitation and predation reduction since the start of this program in 1990. System-wide exploitation by the sport-reward fishery of northern pikeminnow greater than or equal to 250 mm FL was 15.9% (95% confidence interval 10.6–21.2%). Exploitation rates were adjusted using an estimated tag loss of 8.4%. Using the model of Friesen and Ward (1999), we estimated that 2012 predation levels were 35% (range: 19–53%) lower than pre-program levels.

Our biological evaluation was conducted in The Dalles and John Day Reservoirs during 2012. Northern pikeminnow abundance index values in these two reservoirs ranged from 0.1 to 0.9, whereas abundance index values were between 1.4 and 5.1 during the first year of the NPMP in 1990. The occurrence of juvenile salmon in northern pikeminnow digestive tracts was higher in The Dalles Reservoir (three of 22 samples) than in John Day Reservoir (zero of 18 samples). Lamprey *Lampetra spp.* occurred in two of the 22 samples in The Dalles Reservoir and zero of 18 samples in John Day Reservoir. As in 2009, we were unable to calculate consumption indices for northern pikeminnow in all areas of both reservoirs, and subsequently predation indices, because fewer than seven samples contained fish.

Smallmouth bass abundance indices were greatest in the mid-reservoir areas of The Dalles and John Day reservoirs in both spring and summer 2012. In John Day Reservoir during the summer, the mid-reservoir abundance index for smallmouth bass was the highest we have calculated since 1990. Smallmouth bass consumption indices for The Dalles and John Day reservoirs were similar to those observed in previous years. The most frequently occurring prey fish observed in smallmouth diets was sculpin *Cottus spp.*, and juvenile salmon were observed in between two and seven percent of the smallmouth bass diets sampled. Despite diet composition and consumption index values being relatively consistent with previous years, the predation index calculated for smallmouth bass in John Day mid-reservoir area during the summer season was the highest calculated since monitoring began in 1990. Consumption index values for smallmouth bass in this area were not noticeably elevated above previous years estimates, therefore, this increase in predation index is directly associated with a higher than usual abundance estimate for this location.

Spring and summer walleye abundance indices for the John Day Reservoir tailrace area were the second highest they have been since monitoring began in 1990. Juvenile Pacific Salmon continued to be among the most prevalent prey fish observed in walleye diet samples. The

frequency of occurrence of juvenile salmon in walleye diet was highest in the John Day Reservoir tailrace area. Cyprinids were the second most prevalent prey item observed in walleye diet samples.

During 2012, we evaluated 275 and 479 northern pikeminnow diet samples collected during angling at The Dalles and John Day dams, respectively. We found fish to be the primary prey type consumed by northern pikeminnow captured from The Dalles Dam, while non-crayfish invertebrates were the primary prey type consumed by northern pikeminnow captured from John Day Dam. As in previous years, juvenile salmon and lamprey made up the highest percentage of prey fish species consumed by northern pikeminnow captured near these dams.

Higher than earlier observed abundance index values for non-native piscivores in some areas of The Dalles and John Day reservoirs might be an early indication of compensation occurring in localized areas. However, in the absence of system wide compensatory patterns of change, we recommend monitoring efforts continue to assess future trends of localized predator populations throughout the Columbia and Snake rivers.

INTRODUCTION

The Columbia and Snake rivers once supported large numbers of naturally produced anadromous Pacific salmon *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 (Raymond 1988), and predation (Rieman et al. 1991; Collis et al. 2002). The mean annual loss of juvenile salmon to predators can be equivalent to mortality associated with dam passage (Rieman et al. 1991), which historically 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 salmon 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) quantified 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 2012, and wherever possible, evaluates changes from previous years.

Our objectives in 2012 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) assess evidence of possible compensatory responses by these predators in relation to the sustained removal of northern pikeminnow.

METHODS

Fishery Evaluation, Predation Estimates, and Tag Loss

Field Procedures—In order to meet our first objective, we tagged northern pikeminnow and estimated exploitation rates with tag recovery data that was received from the Sport-Reward fishery. We collected northern pikeminnow using boat electrofishing 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). We performed four, 15-minute electrofishing transects in each river mile (i.e., 1.6 river kilometers). Sampling was conducted between 2 April and 21 June 2012 between the hours of 1800 and 0400, except in the Hanford Reach (rkm 557–639) where river navigation necessitated daytime sampling.

We tagged and released northern pikeminnow that were 200 mm FL and greater with uniquely numbered Floy FT-4 lock-on loop tags. Each loop tag was inserted through the pterygiophores of the fish's dorsal fin. We were unable to tag fish in every river kilometer prior to the start of the Sport-Reward and Dam Angling fisheries. All fish captured downstream of The Dalles Dam (rkm 306) were tagged before the start of these fisheries, whereas all tagging conducted up stream of The Dalles dam was performed concurrently with these fisheries. To evaluate tag retention, we secondarily marked all loop tagged fish with a passive integrated transponder (PIT) tag inserted into the dorsal sinus.

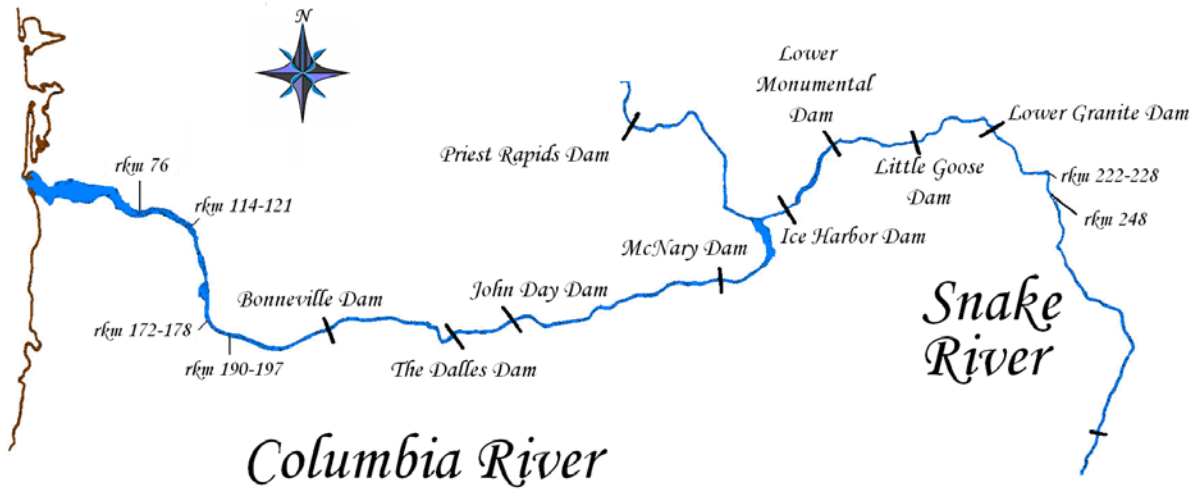

Figure 1. Study area on the Columbia and Snake rivers.

We worked in cooperation with the Washington Department of Fish and Wildlife (WDFW) to acquire tag recovery information from the sport-reward and dam-angling fisheries. The sport-reward fishery occurred between 1 May and 30 September 2012 (Report A, Hone et al. 2013, this report). Participating anglers received payment for all harvested northern pikeminnow that are 230 mm (9 inches) in total length (TL) and greater. This size limit corresponds to the minimum size (200 mm FL) of northern pikeminnow we tagged. The payment schedule

consisted of three tiers (Report B, Porter 2013, this report), and anglers were eligible for a $500 reward for each loop-tagged fish that was returned to a check station.

In addition to the Sport Reward fishery, a NPMP-administered dam-angling fishery (Report D Dunlap et al. 2013, this report) was conducted between 3 May and 4 October in the powerhouse tailraces at The Dalles and John Day dams. For this effort, a team of anglers used hook and line to remove northern pikeminnow that were 230 mm TL and greater. These anglers were not eligible for monetary rewards offered through the NPMP Sport Reward fishery. Loop-tagged fish that were captured by the dam anglers were excluded when estimating exploitation rates for the Sport Reward fishery.

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 1) all fish tagged (≥200 mm FL); 2) the subset of fish from 200 to 249 mm FL; and 3) the subset of fish 250 mm FL and greater. We used the subset of fish 250 mm FL and greater whenever comparing trends among years. In areas where tagging was completed prior to the start of the fishery, we calculated the annual rate of exploitation, u, of the population using the Petersen method (Ricker 1975) as

$$u = R / M, \tag{1}$$

where

R = the number of tagged fish that are recaptured in a season and
M = the number of fish that are tagged in a season.

We calculated 95% confidence intervals for exploitation estimates, when R is greater than three using the formula

$$u \pm \frac{z\sqrt{R}}{M}, \tag{2}$$

where

z = the multiplier from the standard normal distribution.

We also 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 2012. For areas where four tags or more were recovered we calculated 95% confidence intervals for each estimate using the formula

$$u \pm t\sqrt{ks}\,, \tag{3}$$

where

t = the multiplier from the Student's t-distribution for k - 1,
k = the number of weeks in the fishing season, and
s = the standard deviation of the weekly exploitation estimates (Styer 2003).

We did not calculate exploitation when the number of recaptures was less than four (Styer 2003). We adjusted exploitation estimates and confidence intervals for tag loss. An estimate of the annual tag loss rate, L, was calculated using the formula

$$L = [m / (m + r)]\,, \tag{4}$$

where

m = the number of northern pikeminnow recaptured with a PIT tag from the 2012 season and no loop tag, and
r = the number of northern pikeminnow recaptured with 2012 loop tags intact.

We used a model based on Friesen and Ward (1999) to estimate predation on juvenile salmon 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 salmon 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 derived from annual mark-recapture growth observations rather than growth estimates obtained from length and age data. Given these inputs, the model predicts changes in potential predation that were directly related to removals, if all other variables held constant. We estimated the potential predation during 2012 based on observed exploitation rates and predicted future predation rates using a mean level of exploitation observed during current program rules (2001; 2004–2012). See Friesen and Ward (1999) for additional model documentation.

Biological Evaluation

Field Procedures—We used standardized boat 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 2012. We conducted early morning (0200–1200) sampling during spring (7 May–2 June) and summer (25 June–20 July) in three areas (forebay, mid-reservoir, and tailrace) each of The Dalles and John Day reservoirs. Each area contained 24 transects approximately 500 m long that occurred along both shores of the river. 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 sampling. We measured fork length (nearest mm) on all fish captured and total body weight (nearest 10 g) for fish that were 200 mm FL and greater. We removed scales from 25 fish per 25-mm FL increment for each species in both reservoirs and seasons. We sacrificed all untagged northern pikeminnow that were 200 mm FL and greater to collect and preserve digestive tracts for diet analysis. We removed the digestive tract by securing both ends with hemostats and pulling free the connective tissue. We removed all external tissues prior to placing the digestive tract into a Whirl-Pak® bag for storage. Whenever possible, we recorded gender and stage of maturity for each sacrificed fish. Stomach contents from smallmouth bass and walleye 200 mm FL and greater were collected using a modified Seaburg sampler (Seaburg 1957) that uses a jet of water to flush contents from the foregut of the fish (gastric lavage) without sacrificing the animal. We collected the 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.

Using the same diet collection protocol discussed above, we also sampled northern pikeminnow captured during the dam angling portion of the NPMP (Report D, Dunlap et al. 2013, this report). We sampled the dam anglers' catch one to four days per week during July and August 2012.

Laboratory Procedures.—We examined digestive tract contents of northern pikeminnow, smallmouth bass, and walleye to measure their relative consumption rates of juvenile salmon. Each digestive sample was thawed in the laboratory and the contents sorted into trays by prey category. Stomach contents were weighed to the nearest 0.01 g before being returned to the original Whirl-Pak® bag for chemical digestion of the soft tissues. We added a solution of lukewarm tap water, pancreatin (2% wet weight), and sodium sulfide nonahydrate (1% wet weight) to each bag. Bags were sealed and placed in a desiccating oven at approximately 48°C for 24 h. After removal from the oven, a solution of tap water and sodium hydroxide (3% wet weight) was added to the bag to dissolve any remaining fats. 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.

Data Analysis.—Following the methods of Ward et al. (1995), we calculated abundance index values for each predator species by multiplying catch per unit of effort (CPUE; # of fish/900 second electrofishing run) by the surface area of specific sampling locations in each reservoir by season. We used the following formulas from Ward et al. (1995) to calculate consumption indices for northern pikeminnow (CI_{NPM}) and smallmouth bass (CI_{SMB}; Ward and Zimmerman 1999)

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

and

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

where

T = water temperature (^{o}C),
W = mean predator weight (g),
S = mean number of juvenile salmon per predator, and
GW = mean gut weight (g) per predator.

The consumption index is not a direct estimate of the number of juvenile salmon 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 used the product of annual abundance and seasonal consumption indices to generate predation indices for northern pikeminnow during spring and summer periods. Ward and Zimmerman (1999) reported that smallmouth bass densities varied seasonally in the Columbia and Snake rivers; therefore, we calculated predation indices for smallmouth bass using seasonal abundance and consumption indices.

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 characterize the trend in size structure for northern pikeminnow, smallmouth bass, and walleye populations. Proportional stock density, PSD_i, was calculated using the formula

$$PSD_i = 100 \cdot (FQ_i / FS_i), \tag{8}$$

where

FQ_i = number of fish ≥ quality length for species i, and
FS_i = number of fish ≥ stock length for species i.

In addition to calculating proportional stock densities for all three species, we also calculated relative stock densities, *RSD-P*, for smallmouth bass and walleye (Gabelhouse 1984) using the formula

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

where

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, 280, and 350 mm TL, respectively. For walleye, stock, quality, and preferred minimum length categories were 250, 380, 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 $TL_{WAL} = FL_{WAL} \cdot 1.060$.

Beyond a shifting size structure, changes in body condition may indicate a response by remaining predators to the sustained exploitation of pikeminnow. We used relative weight (W_r; Anderson and Neumann 1996) to compare the condition of northern pikeminnow, smallmouth bass, and walleye in 2012 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 percent 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.

RESULTS

Fishery Evaluation, Predation Estimates, and Tag Loss

We tagged and released 1,675 northern pikeminnow 200 mm FL and greater throughout the lower Columbia and Snake rivers during 2012, of which 806 were 250 mm FL and greater (Table 1). Removal fisheries harvested 163,642 northern pikeminnow 200 mm and greater during 2012. The sport-reward fishery harvested 158,159 (Report A, Hone et al. 2013, this report) of these fish and the dam-angling fishery removed 5,483 (Report D, Dunlap et al. 2013, this report). The sport-reward fishery recaptured 131 northern pikeminnow tagged in 2012 and two were recovered in the dam angling fishery. Fish tagged in 2012 that were subsequently recaptured in the sport reward fishery were at large from zero to 162 days (average of 59 days). Seventy three percent of Sport-Reward Fishery recaptures were 250 mm FL and greater (Table 1), whereas 53.8% of the total measured harvest (tagged and untagged) consisted of northern pikeminnow 250 mm FL and greater. The median fork length of the sport-reward fishery catch was 254 mm (J. Hone, WDFW, personal communication). Twelve of the northern pikeminnow tagged (PIT tag and spaghetti tag) and recaptured in the 2012 sport-reward fishery had a PIT tag present and loop tag absent. Exploitation was adjusted to reflect an estimated tag loss of 8.4%.

System-wide exploitation of northern pikeminnow 200 mm FL and greater by the sport-reward fishery was 11.0% (95% confidence interval 7.4–14.6%; Appendix Tables B-1 and B-2). Tag returns were sufficient (N>3) to calculate area-specific exploitation estimates for the Columbia River below Bonneville Dam, as well as Bonneville and McNary reservoirs. Exploitation estimates for these areas were 15.4, 8.6, and 8.8, respectively (≥200 mm FL, Appendix B-2).

The system-wide exploitation rate of northern pikeminnow 200–249 mm FL was 6.0% for the sport-reward fishery (95% confidence interval 3.4–8.6%; Appendix Table B-2). Tag returns were sufficient to calculate area-specific exploitation rates for the Columbia River below Bonneville Dam, as well as Bonneville and McNary reservoirs. Exploitation estimates for these areas were 7.8, 5.8, and 4.5%, respectively (Appendix Tables B-2).

For northern pikeminnow 250 mm FL and greater, system-wide exploitation was 15.9% (95% confidence interval 10.6–21.2%; Figure 2; Appendix Table B-2). For this size class, tag returns

were sufficient to calculate area specific exploitation rates for the Columbia River below Bonneville Dam as well as, Bonneville and McNary reservoirs. Exploitation estimates for these areas were 17.4, 13.5, and 17.6%, respectively.

Table 1. Number of northern pikeminnow tagged and recaptured in the sport-reward fishery during 2012 that were used to calculate exploitation rates.

	200–249 mm FL		≥ 250 mm FL		All combined	
Area	Tagged	Recaptured	Tagged	Recaptured	Tagged	Recaptured
Below Bonneville Dam	84	6	326	52	411[a]	58
Bonneville	188	12	105	13	293	25
The Dalles	105	0	108	2	213	2
John Day	9	0	7	0	17[a]	0
McNary	321	13	214	26	535	39
Little Goose	15	1	5	1	20	2
Lower Granite	145	2	41	1	186	3
All areas combined	867	36	806	95	1,675	131[b]

a) Count is one fish greater than the sum of both size intervals combined because the fork length of one fish was not recorded before release.

b) All areas combined recapture count is two fish greater than the sum of all seven area-specific counts combined because two fish were not included in the area-specific exploitation calculations because they were captured in a different reservoir than they were released.

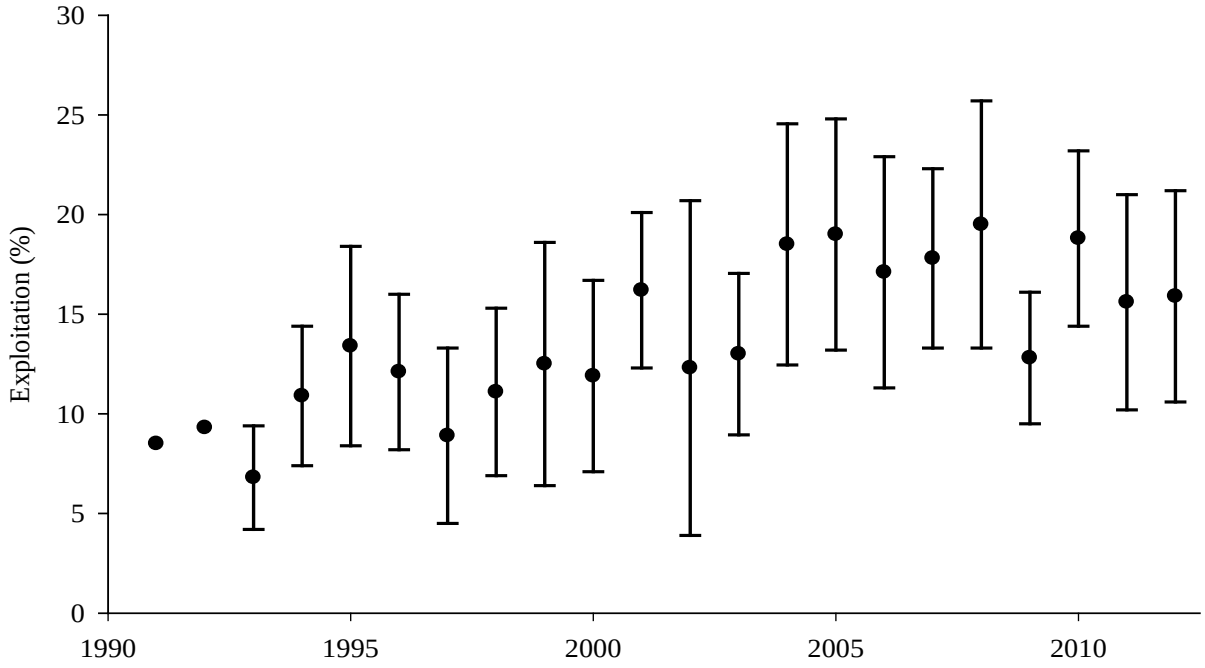

Figure 2. System-wide exploitation rates of northern pikeminnow(≥250 mm FL) for the sport-reward fishery, 1991–2012. Error bars denote the 95% confidence interval. Confidence intervals were not available for 1991–1992.

Based on our 2012 estimate of exploitation, our predation model predicted a 35% (range: 19–53%) reduction in northern pikeminnow consumption of juvenile salmon relative to pre-program levels (Figure 3). Projections based on the current fishery and population structure imply predation by northern pikeminnow may remain static through 2016.

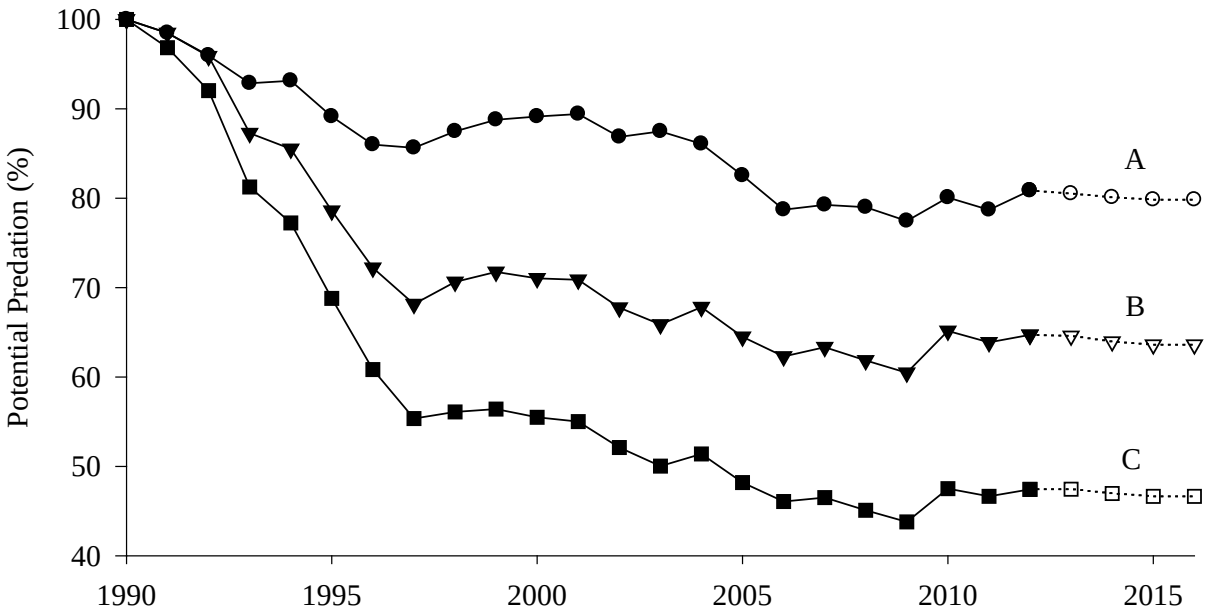

Figure 3. Maximum (A), median (B), and minimum (C) levels of potential predation estimated for northern pikeminnow on juvenile salmon relative to predation prior to implementation of the Northern Pikeminnow Management Program. Estimates of predicted predation after 2012 are based on 9-year average values.

Biological Evaluation

We conducted 65 to 78 electrofishing runs in each sampling area to collect fish for biological evaluation (Appendix Table A-2). The dates of our indexing samples tended to coincide with the peaks of juvenile salmon migration through McNary and John Day dams (Figure 4). Across all sample sites, spring CPUE ranged from 0.00 to 0.11 for northern pikeminnow, 0.45 to 5.34 for smallmouth bass, and 0.00 to 0.29 for walleye (Table 2). Summer CPUE ranged from 0.00 to 0.11 for northern pikeminnow, 1.27 to 7.35 for smallmouth bass, and 0.00 to 1.05 for walleye. Across areas, catch rates for northern pikeminnow were the greatest in The Dalles forebay and John Day tailrace areas during spring and summer, respectively. For smallmouth bass, CPUE was highest in the John Day mid-reservoir area during both spring and summer seasons, with the greatest CPUE occurring during the summer. Walleye CPUE was highest in John Day reservoir in the tailrace of McNary Dam during both spring and summer.

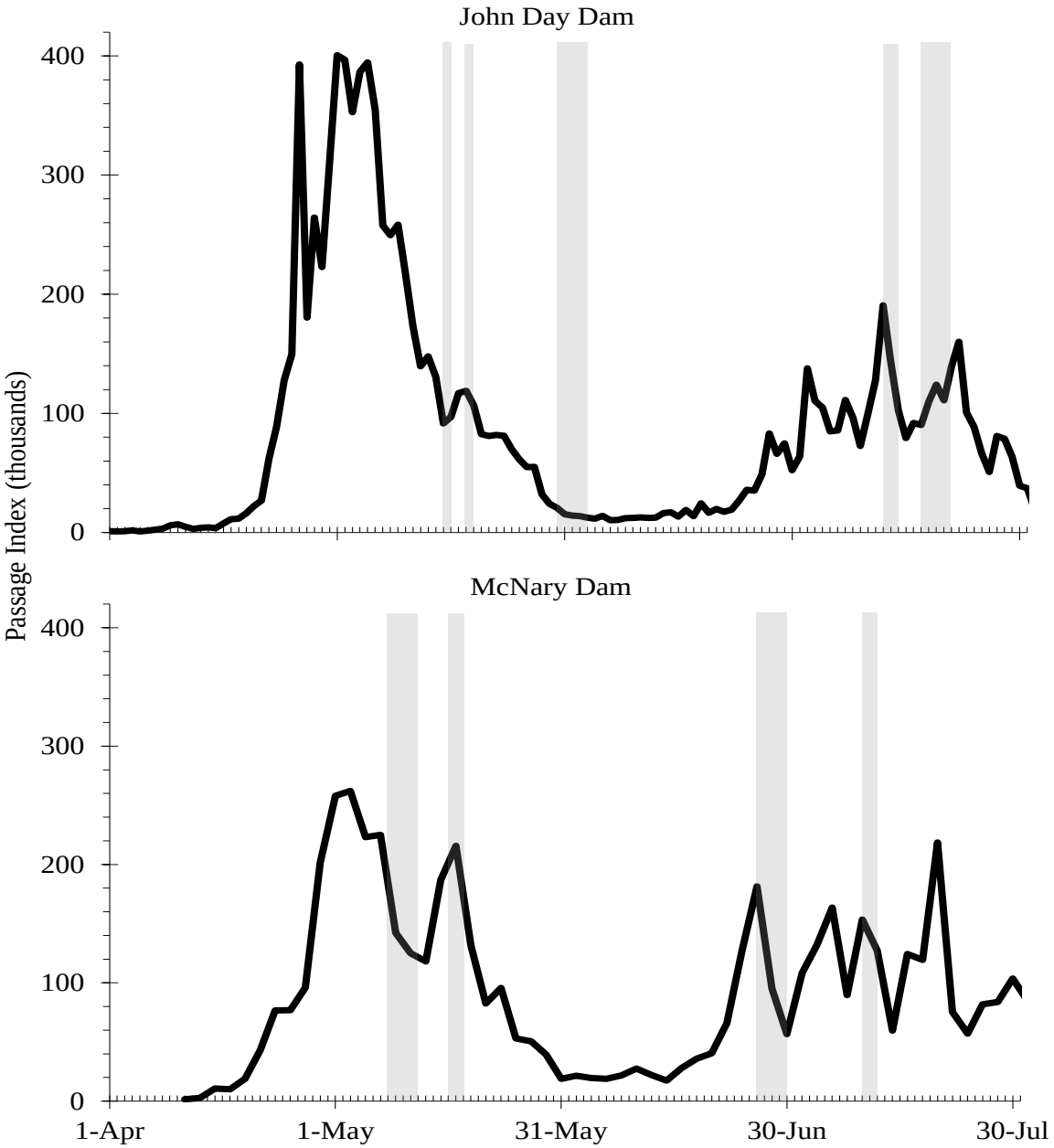

Figure 4. Periods of index sampling (shaded bars) and a smolt index of juvenile salmon (all species) passing through John Day and McNary dams 1 April–31 July 2012 (Source: Fish Passage Center, unpublished data).

The CPUE values for northern pikeminnow at all indexing sites in The Dalles and John Day Reservoirs were 0.1 fish/electrofishing run or less during 2012 (Appendix Table C-1). Alternatively stated, we encountered approximately one northern pikeminnow (>250 mm FL) for every ten electrofishing runs conducted. Abundance indices calculated for northern pikeminnow during 2012 ranged between 0.1 and 0.3 in The Dalles Reservoir and 0.1 and 0.9 in John Day Reservoir (Appendix Table C-2). Across sites, CPUE and abundance indices continue to remain far lower than those calculated during the early 1990's, which have shown a decreasing trend over time (Figure 5).

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 three areas of The Dalles and John Day Reservoirs during spring and summer 2012.

Species, Season	The Dalles Reservoir			John Day Reservoir		
	Forebay	Mid-Reservoir	Tailrace	Forebay	Mid-Reservoir	Tailrace
Northern pikeminnow,						
Spring	0.11	0.09	0.09	0.04	0.09	0.00
Summer	0.00	0.06	0.06	0.08	0.00	0.11
Smallmouth bass,						
Spring	5.18	5.07	2.14	3.59	5.34	0.45
Summer	1.27	3.76	2.00	4.55	7.35	1.43
Walleye,						
Spring	0.03	0.04	0.29	0.00	0.13	1.20
Summer	0.00	0.03	0.14	0.00	0.06	1.05

Across all areas sampled during 2012, smallmouth bass abundance indices were greatest in the mid-reservoir area of John Day Reservoir in both spring and summer and lowest in the John Day tailrace area during the spring season (Appendix Table C-3). Within reservoirs and in both seasons, smallmouth bass abundance indices were greatest at the mid-reservoir locations. During the summer season, abundance index values at the mid-reservoir sites in both reservoirs were the highest we have reported since monitoring began in 1990.

Abundance indices for walleye sampled during 2012 were greatest in John Day Reservoir during both spring and summer indexing seasons, with the greatest value for John Day Reservoir being roughly eight times that found in The Dalles (Appendix Table C-3). The greatest abundance indices were found in the tailrace and mid-reservoir areas of both reservoirs, with the lowest values occurring in the forebay areas.

We examined a combined total of 40 northern pikeminnow digestive tracts from The Dalles (n=22) and John Day reservoirs (n=18) to describe consumption (Table 3). Across reservoirs and seasons, between 50 and 100% of the digestive tracts that we examined contained food items (e.g., crayfish, insects, and fish). During the summer season, a slightly higher percentage of the digestive tracts contained fish. Among northern pikeminnow, only stomach samples collected in The Dalles reservoir contained juvenile salmon. When prey fish could be identified, salmonidae was the most common fish family identified in northern pikeminnow diets (Table 4).

During the spring and summer of 2012, we collected 749 and 663 smallmouth bass diet samples, respectively; nearly all of these contained food (Table 3). Across reservoirs and seasons, approximately 15 to 20% of the smallmouth bass diets we collected included fish contents. The proportion of smallmouth bass stomach samples containing salmon tended to be low (<7%) in both seasons and reservoirs (Table 3). In both reservoirs sampled, the most frequently occurring

prey fish family observed in smallmouth bass diets was Cottidae, followed by salmonidae (Table 4).

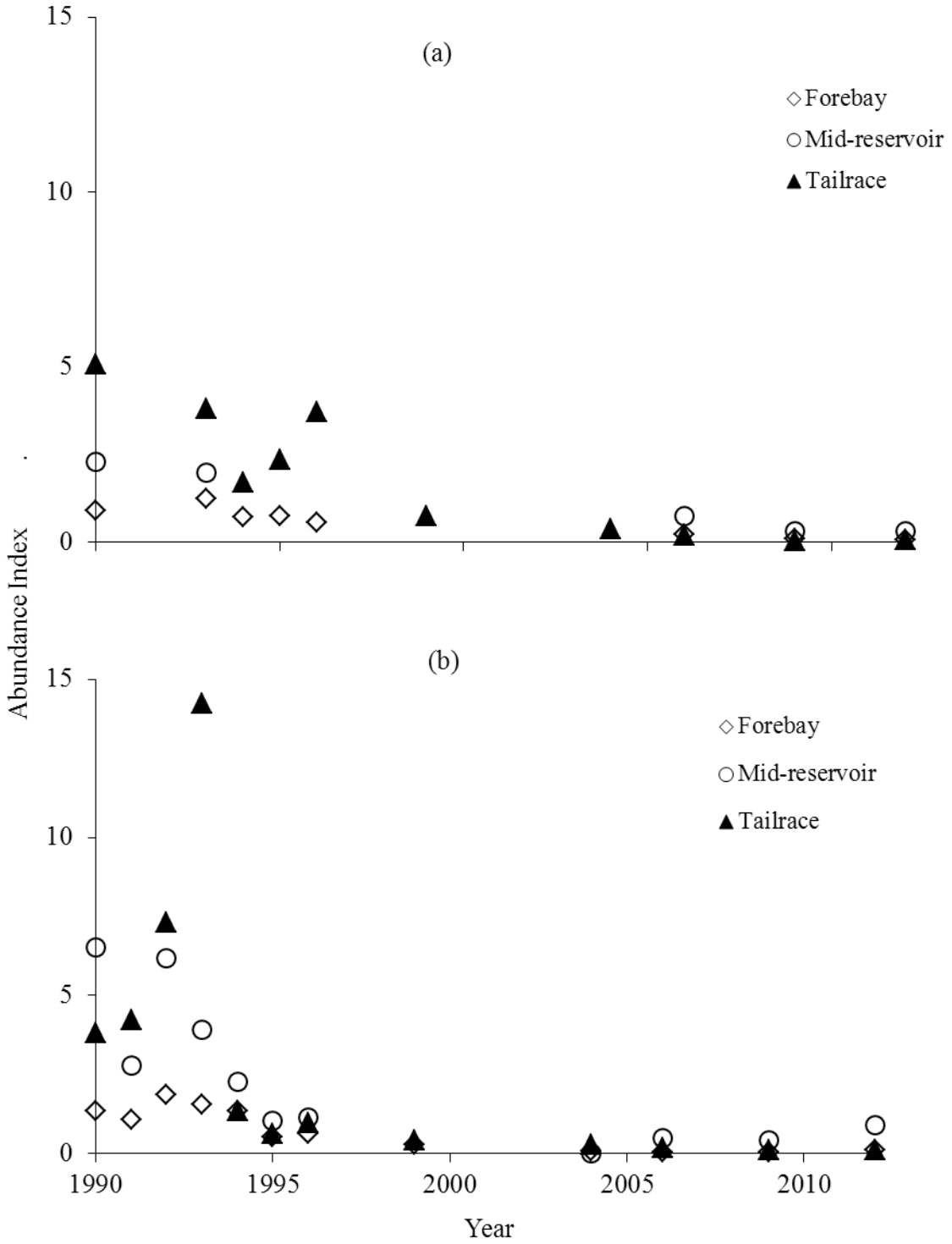

Figure 5: Abundance indices for northern pikeminnow from a) The Dalles and b) John Day reservoirs, 1990-2012.

During the spring and summer seasons of 2012, we collected 51 and 40 walleye diet samples, respectively; nearly all of which contained food (Table 3). In both seasons and reservoirs, between 64 and 83% of the samples we examined contained fish. Among the predacious fishes we sampled, walleye digestive tracts exhibited the highest percentage of both fish and juvenile salmon remains. Approximately one third to one half of the walleye diet samples contained juvenile salmon, with the exception of those collected in The Dalles Reservoir during summer where no salmon remains were observed. Salmonidae was the most frequently occurring prey fish family observed in walleye diets in John Day Reservoir (Table 4). Salmonidae and Cyprinidae were observed at same percentage in samples from The Dalles reservoir.

Table 3. Number (*N*) of northern pikeminnow, smallmouth bass, and walleye digestive tracts examined from The Dalles (TDA) and John Day (JDA) reservoirs and both areas combined (ALL) in 2012, and the percent of fish that contained food (i.e., non-empty), fish, and juvenile salmon remains (Sal).

Season,	Northern pikeminnow				Smallmouth bass				Walleye			
Area	*N*	% Food	% Fish	% Sal	*N*	% Food	% Fish	% Sal	*N*	% Food	% Fish	% Sal
Spring,												
TDA	17	88	12	12	472	98	21	7	11	100	64	36
JDA	8	50	13	0	277	99	20	3	40	98	80	47
ALL	25	100	100	8	749	98	21	6	51	98	80	47
Summer,												
TDA	5	60	20	20	213	96	17	2	6	100	83	0
JDA	10	100	20	0	483	97	13	5	34	97	68	38
ALL	15	87	20	7	696	97	15	4	40	98	70	33

Table 4. Frequency of occurrence (%) of fish families identified in northern pikeminnow, smallmouth bass, and walleye (≥200 mm FL) digestive tract samples containing fish remains and collected from The Dalles (TDA) and John Day (JDA) reservoirs during 2012. Some samples contained multiple families.

	Northern pikeminnow		Smallmouth bass		Walleye	
Common name (Family)	TDA	JDA	TDA	JDA	TDA	JDA
Lampreys (Petromyzontidae)	67	0	1	0	0	0
Salmon and Trout (Salmonidae)	100	0	28	28	33	56
Mountain Whitefish (Salmonidae)	0	0	0	0	0	4
Minnows (Cyprinidae)	0	0	1	0	33	4
Suckers (Catostomidae)	0	0	1	3	0	2
Sun fishes (Centrarchidae)	0	0	0	1	0	0
Yellow perch (Percidae)	0	0	2	0	0	0
Sculpin (Cottidae)	0	0	41	31	17	12
Unidentified	0	33	21	23	17	23

In 2012, we were unable to calculate consumption and predation indices values for northern pikeminnow due to an insufficient sample size ($n < 6$) from each sampling area during each season (Appendix Table C-4 and C-5). While these results may not assist us in characterizing the relative contribution of northern pikeminnow to salmonid predation, they are noteworthy as we were also unable to collect a sufficient number of samples from The Dalles and John Day reservoirs in 2009 for the same analysis.

Consumption indices for smallmouth bass ranged from zero to 0.1 in 2012 (Appendix Table C-4). The highest smallmouth bass consumption indices were observed in The Dalles Reservoir forebay and tailrace areas during the spring. Within John Day reservoir, consumption indices did not differ between sample locations or seasons. Between reservoirs, predation indices were greatest in both seasons at the John Day mid-reservoir location (Appendix Table C-5). The spring and summer predation indices calculated for this location are the highest we have found to date. Despite the fact that diet composition and consumption were fairly consistent with previous years, the predation index calculated for smallmouth bass in the mid-reservoir area of John Day Reservoir during the summer season was the highest we have reported. Consumption index values for smallmouth bass in this area were not drastically elevated above previous years, therefore this increase in predation index is likely due to the near record abundance we observed at this location during 2012. It is noteworthy that the smallmouth bass predation index observed at the John Day mid-reservoir site is higher than that observed for northern pikeminnow at any location in John Day Reservoir between 1990 and the present.

We were unable to calculate proportional stock density (PSD) for northern pikeminnow and walleye in The Dalles reservoir and pikeminnow in John Day reservoir due to insufficient sample sizes ($n < 20$) (Appendix Table C-6). Similarly, biological indexing conducted in The Dalles and John Day reservoirs during 2009 did not yield a sufficient sample size to calculate stock indices for northern pikeminnow. Walleye PSD and RSD-P for John Day Reservoir were 81 and 28, respectively (Appendix Table C-6). For smallmouth bass, PSD values for The Dalles and John Day reservoirs were 40 and 22, respectively (Appendix Table C-6). Smallmouth bass RSD-P was 16 and 5 in The Dalles and John Day reservoirs, respectively (Appendix Table C-6). In all cases that allowed us to calculate stock density indices during 2012, our observations were consistent with previous sampling years in The Dalles and John Day reservoirs.

During 2012, median W_r for male and female northern pikeminnow in the Dalles and John Day reservoirs was 102 and 120 (Figure 6) and 97 and 116 (Figure 7), respectively (Appendix Table C-7). Within reservoirs, female northern pikeminnow exhibited greater W_r values than males. Female W_r values during the last four indexing seasons have tended to be greater than those observed in the years initially following implementation of the NPMP (Figures 6 and 7). These results may indicate a positive trend in female W_r among northern pikeminnow in The Dalles and John Day reservoirs, although it is important to note that sample sizes have been small (averaging between five and twelve fish/sex/reservoir) during the last four seasons of indexing (Appendix Table C-7).

Median W_r for smallmouth bass in The Dalles and John Day reservoirs was 96 and 94, respectively. The 2012 values are similar to W_r estimates we have reported in previous years since the initial implementation of the NPMP (Figure 8, Appendix Table C-7).

Median W_r for walleye in The Dalles and John Day reservoirs was 89 and 94, respectively (Appendix Table C-9). The 2012 values are similar to W_r estimates we have reported in previous years since the initial implementation of the NPMP in 1990 (Figure 9, Appendix Table (C-7).

In addition to northern pikeminnow diets collected during biological indexing, we examined the diets of northern pikeminnow collected by a dam angling fishery that is a separate component of the Northern Pikeminnow Management Program (Report D, Dunlap et al. 2013, this report). During the months of July and August 2012, we collected a total of 816 northern pikeminnow digestive tracts from fish removed by the dam angling fishery at The Dalles and John Day dams. All samples collected during August were taken from the John Day tailrace. All angling was conducted in the tailraces of the dams. These fish ranged in size from 210 to 545 mm FL and had an average length of 339 mm FL (Appendix Table D-1). During 2012 at both dams, 77 percent of the digestive tracts we examined contained food (Appendix Table D-2). At The Dalles Dam, fish were observed in a higher percentage of diets than other prey types, whereas this was true of invertebrates at John Day Dam. Overall, juvenile salmon and lamprey were the most frequently occurring prey fish types (Appendix Table D-3). Juvenile salmon were the primary prey fish observed in July and occurred in equal frequency to lamprey during August. Additionally, American shad *Alosa sapidissima* became an important component of northern pikeminnow diets at John Day Dam during August, nearly equaling the frequency of occurrence of juvenile salmon and lamprey.

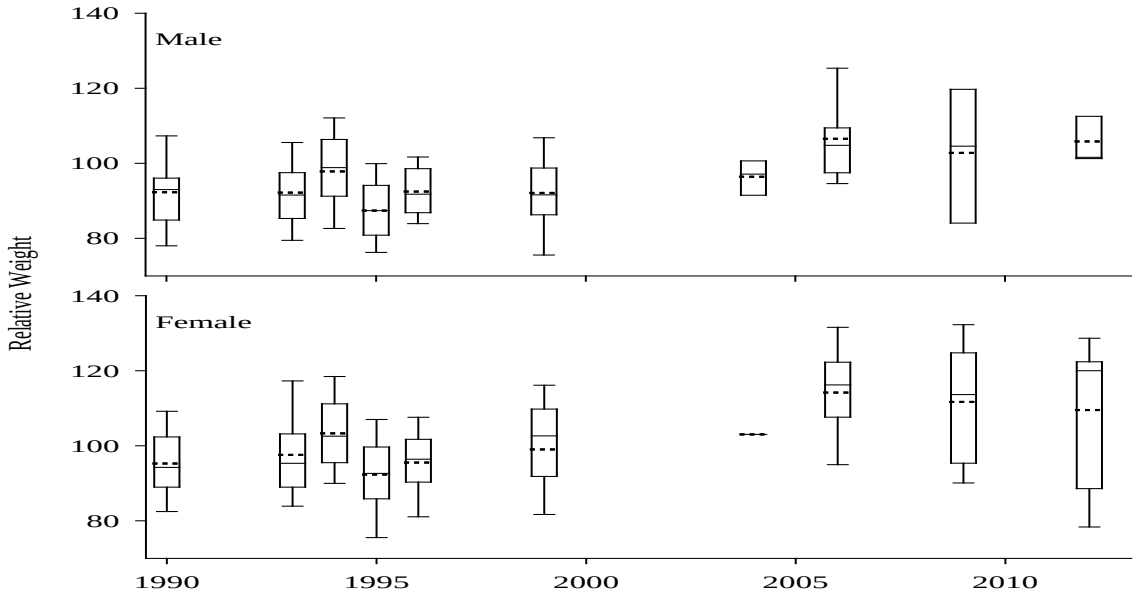

Figure 6. Median relative weight (W_r) for male and female northern pikeminnow in The Dalles Reservoir. The upper and lower boundaries of the box indicate the 75th and 25th percentiles, the solid center line is the median, the dotted line is the mean, and the whiskers indicate the 10th and 90th percentiles. Years with blanks indicate either no sampling or no fish caught.

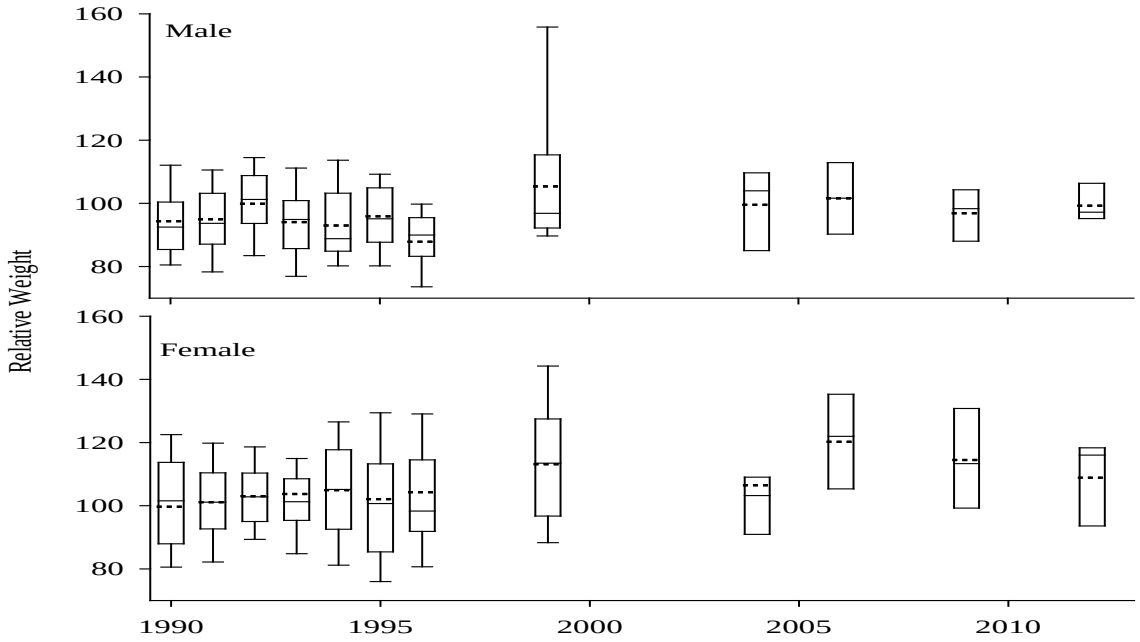

Figure 7. Median relative weight (W_r) for male and female northern pikeminnow in John Day Reservoir. The upper and lower boundaries of the box indicate the 75th and 25th percentiles, the solid center line is the median, the dotted line is the mean, and the whiskers indicate the 10th and 90th percentiles. Years with blanks indicate either no sampling or no fish caught.

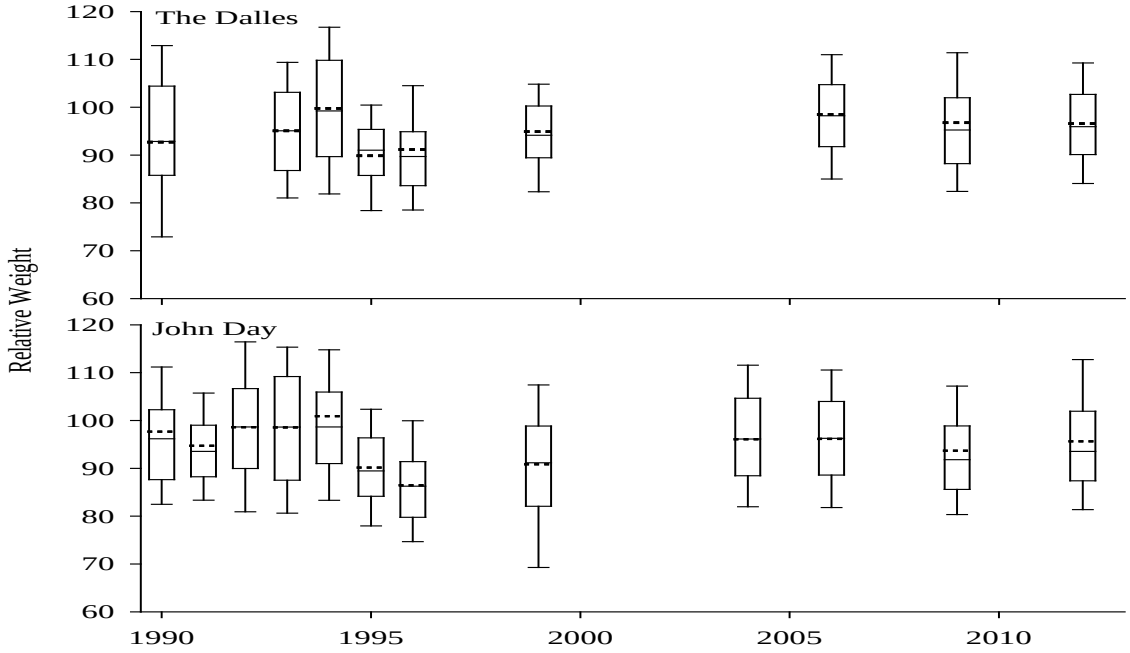

Figure 8. Median relative weight (W_r) for smallmouth bass (SMB) in The Dalles and John Day reservoirs. The upper and lower boundaries of the box indicate the 75th and 25th percentiles, the solid center line is the median, the dotted line is the mean, and the whiskers indicate the 10th and 90th percentiles. Years with blanks indicate either no sampling or no fish caught.

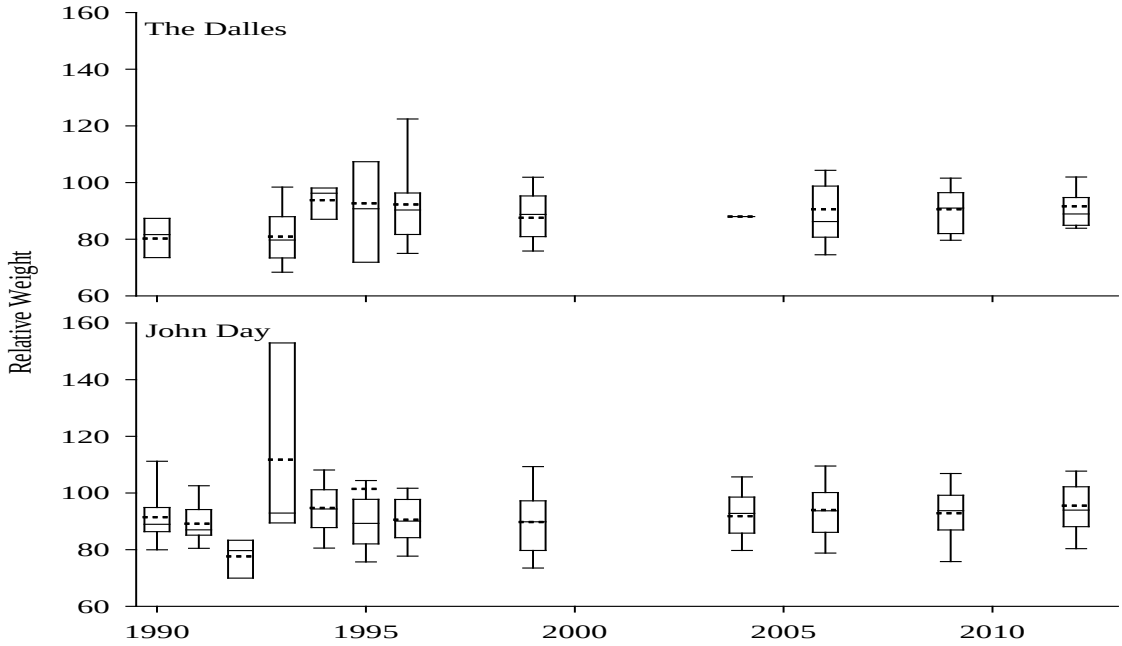

Figure 9. Median relative weight (W_r) for walleye in The Dalles and John Day reservoirs. The upper and lower boundaries of the box indicate the 75th and 25th percentiles, the solid center line is the median, the dotted line is the mean, and the whiskers indicate the 10th and 90th percentiles. Years with blanks indicate either no sampling or no fish caught.

DISCUSSION

Our estimate of the system-wide exploitation rate (15.9% ± 5.3, 95% C.I.) for the NPMP is similar to estimates reported during the past ten years of sampling (Figure 2). Overall, the exploitation rate for the 2012 sport-reward fishery falls towards the middle of the target range of 10–20% required to maintain reduced predation on juvenile salmon (Rieman and Beamesderfer 1990). In recent years, exploitation rates have approached the upper end of the 10–20% target range (2004, 2005, 2008, and 2010), ranging from 18.5–19.5% and with the upper bounds of uncertainty on these estimates exceeding the target range.

Recaptures of northern pikeminnow 200–249 mm FL were inadequate (≤ 3 tagged fish) to calculate area-specific rates of exploitation in all but three areas during 2012 (the Columbia River below Bonneville Dam, as well as Bonneville and McNary reservoirs) (Appendix Table B-2). 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 greater or equal to 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 greater or equal to 250 mm FL when comparing between or among years of program fisheries.

The 2012 dam-angling fishery accounted for 3.5% of the total northern pikeminnow harvested, which is slightly higher than 2.9% for 2011 (Weaver et al. 2012). Thirteen tagged northern pikeminnow were recovered by dam anglers, two of them were tagged in 2012. As in previous years, northern pikeminnow collected during the 2012 dam-angling fishery were considerably larger (median = 330 and 350 mm FL at The Dalles and John Day dams, respectively) than those collected in the 2012 sport-reward fishery (median; 254 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). Additionally, dam anglers harvested fish from the boat restricted zones, which were not accessible to sport-anglers. For these reasons, we support continued angling from the dams, as long it is accompanied by concurrent monitoring during future dam-angling activities.

Reductions in the northern pikeminnow population may improve survival among migrating juvenile salmon if an equal compensatory response by the remaining northern pikeminnow or other predators does not minimize the benefits (Beamesderfer et al. 1996; Friesen and Ward 1999). Potential signs of a compensatory response by predators may be indicated by increased abundance, condition factor, consumption and predation indices, or a shift in population size structure toward larger individuals (Knutsen and Ward 1999). Sustained exploitation should decrease the proportion of large fish and increase the proportion of small fish (Zimmerman et al. 1995), and smaller northern pikeminnow consume fewer juvenile salmon than their larger counterparts (Vigg et al. 1991). Continued monitoring of the fisheries should provide the program with the information needed to assess the status of any compensatory responses being expressed by these predator fish populations.

The CPUE and abundance index information that we report for 2012 are indicative of a continued and persistent decrease in the number of northern pikeminnow $\geq$ 250 mm in The Dalles and John Day reservoirs since the early 1990s when the NPMP was implemented (Appendix Tables C-1 and C-2). This basic trend is also reflected in the total number of stock size northern pikeminnow we encounter during indexing years to calculate PSD values (Appendix Table C-6). During the last two periods of indexing in these reservoirs, we have been unable to calculate PSD for northern pikeminnow due to insufficient sample sizes ($n \leq 20$). Rieman and Beamesderfer (1990) suggested that a decreasing trend in proportional stock density may predict the effect of the sport-reward fishery by qualifying the direction of change in the size structure of northern pikeminnow. Neumann and Allen (2007) indicate that proportional stock density can be high in low density populations. Proportional stock density values can be related to lower abundance index values. Everhart and Youngs (1981) found that overexploited fish populations may show oscillating patterns of year class strength. Changes in northern pikeminnow abundance and size structure may be related to exploitation, thus continued monitoring is needed to better understand 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 salmon comprised a small but consistent portion of smallmouth bass diets in the Columbia River. Our observations for 2012 are consistent with these findings (Table 3), although the primary prey fish species consumed by smallmouth bass continued to be sculpin (Table 4). Ward and Zimmerman (1999) suggested the first evidence of any response by smallmouth bass would likely be a change in diet. While we did not observe an increase in the proportion of smallmouth bass diets containing juvenile salmon, smallmouth bass abundance indices at several locations we indexed during 2012 were the highest or among the highest we have observed since monitoring began in 1990. The elevated abundance indices we observed for smallmouth bass during 2012 provide the greatest contribution to the record predation index we observed in John Day Reservoir. We advocate for continued monitoring of smallmouth bass abundance to identify any evidence of a compensatory response.

The abundance of walleye, as indicated by the abundance index, tends to be similar to that of northern pikeminnow in The Dalles Reservoir and is greater than that of northern pikeminnow in John Day Reservoir (Appendix Tables C-2 and C-3). We were unable to determine PSD for walleye in The Dalles Reservoir, while in John Day Reservoir there does not appear to be an apparent increase or decrease in PSD or RSD over the period of monitoring (Appendix Table C-6). Similarly, there does not appear to be a positive or negative trend in walleye relative weight for The Dalles and John Day Reservoirs (Figure 9). Juvenile salmon have been identified as an important diet component for walleye in the lower Columbia River (Poe et al. 1991; Vigg et al. 1991; Zimmerman 1999). Takata et al. (2007) found juvenile salmon most often in walleye digestive tracts in The Dalles and John Day reservoirs. In 2012, juvenile salmon and cyprinids were the primary fish identified in the walleye diets from The Dalles Reservoir, while juvenile salmon predominated in John Day Reservoir (Table 4). While walleye abundance indices for The Dalles and John Day Reservoir may appear far greater than those of northern pikeminnow, it is important to note that they remain lower than those of northern pikeminnow in other areas of the lower Columbia River, such as the reach below Bonneville Dam. Therefore, the impact that walleye predation has on salmonid populations can be highly variable among areas. Further monitoring of walleye population parameters and diets would be prudent.

Previous evaluations of the NPMP have not detected responses by the predator community to the sustained removal of northern pikeminnow (Ward et al. 1995; Ward and Zimmerman 1999; Zimmerman and Ward 1999). However, 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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APPENDIX TABLES A

Sampling Effort and Timing in the Lower Columbia and Snake Rivers

Appendix Table A-1. Dates of sampling weeks with range of days in 2012.

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

Appendix Table A-2. Number of 15-minute electrofishing runs conducted by ODFW for biological indexing in The Dalles and John Day reservoirs for all sampling years. Dashes (—) indicate no sampling conducted.

Year	The Dalles Reservoir			John Day Reservoir		
	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace
1990	38	12	30	35	36	30
1991	—	—	—	37	35	35
1992	—	—	—	44	38	40
1993	49	50	42	30	20	17
1994	92	—	48	91	43	74
1995	62	—	35	74	94	82
1996	59	—	31	54	52	71
1999	—	—	71	52	—	62
2004	—	—	16	28	17	68
2006	77	95	74	75	78	74
2009	76	60	76	65	95	70
2012	65	78	75	67	66	77

APPENDIX TABLES B

Exploitation Rates for Northern Pikeminnow, 1991–2012

Appendix Table B-1. System-wide weekly exploitation rates of northern pikeminnow (≥200 mm FL) for the sport-reward fishery in 2012. Dashes (—) indicate: no tagging effort, no recapture effort, or no exploitation calculated.

Sampling Week	Tagged	Recaptured	At-Large	Exploitation[a] (%)
15	19	—	0	—
16	144	—	19	—
17	231	—	163	—
18	310	—	394	—
19	213	9	704	1.4
20	35	12	908	1.4
21	395	4	931	0.5
22	9	6	1,322	0.5
23	8	11	1,325	0.9
24	105	3	1,322	0.2
25	186	13	1,424	1.0
26	20	5	1,597	0.3
27	—	7	1,611	0.5
28	—	4	1,603	0.3
29	—	8	1,599	0.5
30	—	5	1,591	0.3
31	—	6	1,585	0.4
32	—	3	1,577	0.2
33	—	1	1,574	0.1
34	—	3	1,573	0.2
35	—	6	1,570	0.4
36	—	8	1,564	0.6
37	—	4	1,556	0.3
38	—	4	1,552	0.3
39	—	4	1,548	0.3
40	—	5	1,544	0.4
Total	1,675	131	1,539	11.0

a) Exploitation rates adjusted for tag loss (8.4%).

Appendix Table B-2. Exploitation rates (%) of northern pikeminnow, grouped by fork length and area, in the sport-reward fishery. *a* = no exploitation rate calculated (n<4) and — = 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
2010	17.2	10.1	*a*	*a*	9.2	15.0	63.1	15.9
2011	14.9	9.1	*a*	*a*	14.8	*a*	*a*	13.5
2012	15.4	8.6	*a*	*a*	8.8	*a*	*a*	11.0
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
2010	*a*	*a*	*a*	*a*	12.4	*a*	*a*	7.6
2011	17.9	*a*	*a*	*a*	11.0	*a*	*a*	9.8
2012	7.8	5.8	*a*	*a*	4.5	*a*	*a*	6.0
≥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

Appendix Table B-2. Continued.

Group, Year	Below Bonneville	Bonneville	The Dalles	John Day	McNary	Little Goose	Lower Granite	All areas
≥250 mm cont.								
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
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
2010	19.8	13.1	*a*	*a*	*a*	*a*	*a*	18.8
2011	14.5	10.4	*a*	*a*	17.8	*a*	*a*	15.6
2012	17.4	13.5	*a*	*a*	17.6	*a*	*a*	15.9

APPENDIX TABLES C

Biological Evaluation of Northern Pikeminnow, Smallmouth Bass, and Walleye in The Dalles and John Day reservoirs, 1990–2012

Appendix Table C-1. Catch per 15-minute electrofishing run (CPUE) of northern pikeminnow (≥250 mm fork length) captured during ODFW biological indexing in three areas of The Dalles and John Day reservoirs in 1990–1996, 1999, 2004, 2006, 2009 and 2012. — = 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
2012	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 three areas of The Dalles and John Day reservoirs, 1990–1996, 1999, 2004, 2006, 2009 and 2012. — = 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
2012	0.1	0.3	0.1	0.1	0.9	0.1

Appendix Table C-3. Annual abundance indices for smallmouth bass and walleye (>200 mm FL) that were captured during indexing years in The Dalles and John Day reservoirs by season and area, 1990-2012. — = no sampling conducted.

Species, Season, Year	The Dalles Reservoir			John Day Reservoir		
	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace
Smallmouth bass,						
Spring						
1990	1.0	—	1.5	4.7	69.8	0.2
1991	—	—	—	2.3	79.4	0.5
1992	—	—	—	—	—	—
1993	3.8	18.0	2.8	—	—	—
1994	1.8	—	—	3.1	38.4	1.1
1995	5.3	—	—	4.8	51.9	0.5
1996	4.1	—	—	2.3	71.3	0.3
1999	—	—	1.1	1.1	—	0.3
2004	—	—	—	22.0	58.8	1.0
2006	6.4	20.7	2.9	5.4	120.5	3.3
2009	1.9	5.3	1.5	3.0	84.9	0.6
2012	6.7	20.1	2.5	7.0	104.7	0.9
Summer,						
1990	0.6	2.0	0.4	4.8	14.7	0.6
1991	—	—	—	2.2	9.1	1.2
1992	—	—	—	3.7	24.1	1.1
1993	2.2	8.3	1.7	5.2	40.2	2.5
1994	1.6	—	1.2	6.2	22.1	1.3
1995	3.1	—	0.7	4.3	77.6	1.2
1996	1.1	—	1.2	2.3	44.4	0.5
1999	—	—	2.3	3.6	—	0.9
2004	—	—	—	17.3	—	5.6
2006	3.8	12.1	5.6	5.8	133.4	5.1
2009	1.1	8.8	1.1	8.2	60.9	1.6
2012	1.7	14.9	2.0	8.9	144.1	2.9

Species, Season, Year	The Dalles Reservoir			John Day Reservoir		
	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace
Walleye,						
Spring,						
1990	0.0	—	0.6	0.0	0.0	0.7
1991	—	—	—	0.0	2.0	0.4
1992	—	—	—	—	—	—
1993	0.5	2.8	1.8	—	—	—
1994	0.0	—	—	0.0	0.0	1.9
1995	0.1	—	—	0.1	0.0	1.2
1996	0.2	—	—	0.0	0.0	1.8
1999	—	—	0.7	0.0	—	1.0
2004	—	—	0.0	0.0	5.8	1.6
2006	0.1	0.4	0.6	0.0	0.0	4.1
2009	0.2	0.7	0.5	0.0	2.0	1.2
2012	0.0	0.2	0.3	0.0	2.5	2.4
Summer,						
1990	0.0	0.0	0.3	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	0.0	0.0	0.0	0.4
1994	0.1	—	0.2	0.0	0.0	0.5
1995	0.1	—	0.1	0.0	2.1	1.1
1996	0.1	—	0.6	0.0	1.3	1.5
1999	—	—	0.3	0.0	—	0.7
2004	—	—	0.1	0.1	—	1.8
2006	0.0	0.1	0.2	0.0	1.3	2.2
2009	0.0	0.1	0.0	0.0	0.0	0.8
2012	0.0	0.1	0.2	0.0	1.2	2.1

Appendix Table C-4. Spring and summer consumption indices for northern pikeminnow (≥250 mm FL) and smallmouth bass (≥200 mm FL) in four areas of The Dalles and John Day reservoirs in 1990–1996, 1999, 2004, 2006, 2009, and 2012. BRZ = Tailrace Boat Restricted Zone, *a* = no consumption index calculated (*N* <6), *b* = included in Tailrace calculation, *c* = no smallmouth bass samples collected, and — = area not sampled.

Species, Season, Year	The Dalles Reservoir				John Day Reservoir			
	Forebay	Mid-reservoir	Tailrace	BRZ	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	—
2009	*a*	*a*	*a*	—	*a*	*a*	*a*	—
2012	*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*	—
2012	*a*	*a*	*a*	—	*a*	*a*	*a*	—

Species, Season, Year	The Dalles Reservoir				John Day Reservoir			
	Forebay	Mid-reservoir	Tailrace	BRZ	Forebay	Mid-reservoir	Tailrace	BRZ
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	—
2012	0.1	<0.1	0.1	—	<0.1	<0.1	<0.1	—
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	—	—	—	—	<0.1	—	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	—
2012	<0.1	<0.1	0.0	—	<0.1	<0.1	<0.1	—

Appendix Table C-5. Spring and summer predation indices for northern pikeminnow (≥250 mm FL) in The Dalles and John Day reservoirs, 1990–1996, 1999, 2004, 2006, 2009 and 2012, and for smallmouth bass (≥200 mm FL) 2004, 2006, 2009 and 2012. — = 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*
2012	*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*
2012	*a*	*a*	*a*	*a*	*a*	*a*

Species, Season, Year	The Dalles Reservoir			John Day Reservoir		
	Forebay	Mid-reservoir	Tailrace	Forebay	Mid-reservoir	Tailrace
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
2012	0.8	0.4	0.1	0.2	1.6	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
2012	0.0	1.1	0.0	0.8	7.7	0.3

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 (1990–2012). — = 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
2012	11	*a*	915	40	16	16	*a*	*a*
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
2012	15	*a*	1,070	22	5	89	81	28

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 (1990–2012). — = not sampled.

Reservoir,	Northern pikeminnow						Smallmouth bass			Walleye		
	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
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
2012	5	102	5.6	11	120	11.1	734	96	0.7	19	89	4.2
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
2012	7	97	4.1	8	116	10.4	763	94	1.0	93	94	2.6

APPENDIX TABLES D

Diets of Northern Pikeminnow Captured While Dam Angling at Bonneville, The Dalles, and John Day Dams, 2006–2012

Appendix Table D-1. Number (*N*) and fork length description of northern pikeminnow collected for digestive tract evaluation from Bonneville, The Dalles, and John Day dams during 2006–2012. — = not sampled.

Dam,	Northern pikeminnow			
Year	*N*	FL-range	Mean	Median
Bonneville				
2006	22	267–544	425	438
2007	—	—	—	—
2008	—	—	—	—
2009	—	—	—	—
2010	—	—	—	—
2011	—	—	—	—
2012	—	—	—	—
The Dalles				
2006	129	212–549	360	342
2007	340	229–550	343	333
2008	209	200–518	356	350
2009	223	187–545	377	370
2010	395	185–545	366	364
2011	326	219–574	367	370
2012	324	210–525	332	314
John Day				
2006	—	—	—	—
2007	453	230–553	366	358
2008	64	265–550	377	365
2009	224	251–572	403	394
2010	382	233–575	376	376
2011	288	230–515	362	363
2012	492	230–545	344	320
Combined totals	3,871	185–575	368	361

Appendix Table D-2. Number (*N*) of northern pikeminnow digestive tracts examined from Bonneville, The Dalles, and John Day dams in 2006–2012, and percent of prey items contained. — = not sampled, SAL=salmonid, LAM=lamprey, ASH=American shad.

Dam, Year	*N*	Food	Fish	Crayfish	Other Invert	Misc.	SAL	LAM	ASH	Other fish
Bonneville										
2006	22	82	41	9	23	23	36	0	0	9
2007	—	—	—	—	—	—	—	—	—	—
2008	—	—	—	—	—	—	—	—	—	—
2009	—	—	—	—	—	—	—	—	—	—
2010	—	—	—	—	—	—	—	—	—	—
2011	—	—	—	—	—	—	—	—	—	—
2012	—	—	—	—	—	—	—	—	—	—
The Dalles										
2006	129	36	21	8	4	11	4	17	0	5
2007	340	61	40	4	22	9	13	31	0	6
2008	209	63	44	4	33	5	11	31	0	12
2009	223	70	64	6	19	10	9	50	1	14
2010	395	62	49	6	14	17	16	18	15	18
2011	329	66	44	7	19	17	36	9	0	8
2012	275	77	57	9	19	25	15	18	0	0
John Day										
2006	—	—	—	—	—	—	—	—	—	—
2007	453	58	37	2	27	3	13	8	11	21
2008	64	81	36	3	69	11	9	23	0	8
2009	224	61	56	8	31	4	11	40	0	14
2010	382	55	29	7	34	25	16	10	2	7
2011	283	70	22	6	56	4	15	7	0	2
2012	479	77	39	13	48	9	15	12	4	0

Appendix Table D-3. Frequency of occurrence (%) of fish families identified in northern pikeminnow digestive tract samples containing fish remains and collected from The Dalles and John Day dams by dam angling in 2012. Some samples contained multiple families. August samples were only collected at John Day dam.

Family	July	August	Total
Lampreys (Petromyzontidae)	49	29	43
Shad (Clupeidae)	0	26	7
Salmon and trout (Salmonidae)	54	29	47
Mountain Whitefish (Salmonidae)	1	0	0
Minnows (Cyprinidae)	0	1	0
Suckers (Catostomidae)	1	0	0
Walleye (Percidae)	0	1	1
Sculpin (Cottidae)	1	1	1
Unidentified	18	16	17

Northern Pikeminnow Dam Angling on the Columbia River

2012 Annual Report

Prepared by

Eric C. Winther
Paul V. Dunlap
John D. Hone

Washington Department of Fish and Wildlife
600 Capital Way N
Olympia, WA 98501-1091

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CONTENTS

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We appreciate the efforts of Dennis Werlau, our Dam Angling crew leader, along with the efforts of Kyle Beckley, Spencer Black, Rick Farris, Ray Lais, and Scott Mengis who made up our 2012 dam angling crew.

We also recognize Diana Murillo and Dennis Werlau for their work in data entry and document verification, and Melissa Dexheimer for producing our weekly field activity reports throughout the season.

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ABSTRACT

We are reporting on the 2012 Northern Pikeminnow Dam Angling component of the Northern Pikeminnow Management Program (NPMP) as implemented by the Washington Department of Fish and Wildlife (WDFW). Angling took place within the boat restricted tailrace areas of The Dalles and John Day dams for 22 weeks from May 3rd to October 4th. The objectives of the project were to (1) implement a recreational-type hook and line fishery that harvests northern pikeminnow from within the boat restricted areas (BRZ) unavailable to the public at The Dalles and John Day dams, (2) allocate Dam Angler effort between the The Dalles and John Day dams based on angler CPUE in order to maximize harvest of northern pikeminnow, (3) collect, compile and report data on angler harvest, CPUE, gear/techniques, and incidental catch for each project, (4) scan, record and report Passive Integrated Transponder (PIT) tag data from all northern pikeminnow, smallmouth bass, walleye, and channel catfish caught by the angling crew and record with the presence of any external spaghetti tags, fin-clips, or signs of tag loss from these fishes for use in coordination with other Oregon Department of Fish and Wildlife (ODFW) predation studies, (5) collect relevant biological data on all northern pikeminnow and other fishes caught by the 2012 Dam Angling crew.

A Dam Angling crew of four anglers harvested 3,122 northern pikeminnow at The Dalles Dam and 2,361 northern pikeminnow at the John Day Dam for a total northern pikeminnow harvest of 5,483 in 2012. The crew fished a total of 2,200 hours during the 22 week fishery for a combined overall average catch per angler hour of 2.49, and the crew's average catch per angling week equaling 249.2 fish. At The Dalles Dam, crew members averaged 2.69 fish per angler hour (CPUE), and cumulatively 76.15 northern pikeminnow per day. At the John Day Dam, crew member CPUE was 2.27 (fish per angler hour) with a cumulative crew total of 48.18 fish per day.

Based on the knowledge gained from implementing the Dam Angling project in 2010 and 2011, back bouncing soft plastic lures was the primary angling method used by the Dam Angling crew for harvesting northern pikeminnow from The Dalles and John Day dams in 2012. Incidental species most frequently caught and released by the Dam Angling crew in 2012 were smallmouth bass *Micropterus dolomieue*, white sturgeon *Acipenser transmontanus*, American shad *Alosa sapidissima*, and sculpin *Cottus* spp.

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). The primary component of the NPMP is the Northern Pikeminnow Sport-Reward Fishery (NPSRF) implemented by the Washington Department of Fish and Wildlife (WDFW) (Burley et al. 1992). Beginning in 2010, WDFW was also contracted to conduct the Dam Angling component of the NPMP (Dunlap et al. 2011, Hone et al. 2010) and 2012 marks the third consecutive year that WDFW has implemented this component. The Dam Angling component of the NPMP utilized a four person crew of experienced anglers to harvest northern pikeminnow from within the boat restricted zones (BRZ's) of The Dalles and John Day dams on the Columbia River using recreational-type hook and line angling techniques.

The objectives of the 2012 Dam Angling component of the NPMP were to (1) implement a recreational-type hook and line fishery that harvests northern pikeminnow from within the boat restricted areas (BRZ) unavailable to the public at The Dalles and John Day dams, (2) allocate Dam Angler effort between the The Dalles and John Day dams based on angler CPUE in order to maximize harvest of northern pikeminnow, (3) collect, compile and report data on angler harvest, CPUE, gear/techniques, and incidental catch for each project, (4) scan, record and report Passive Integrated Transponder (PIT) tag data from all northern pikeminnow, smallmouth bass, walleye, and channel catfish caught by the angling crew and record the presence of any external spaghetti tags, fin-clips, or signs of tag loss from these fishes for use in coordination with other Oregon Department of Fish and Wildlife (ODFW) predation studies, and (5) collect biological data on all northern pikeminnow and other fishes caught by the 2012 Dam Angling crew.

METHODS

Project Area

In 2012, northern pikeminnow removal activities utilizing a Dam Angling crew were once again conducted by WDFW at The Dalles and John Day Dams on the Columbia River as a supplemental component to the NPMP (Figure 1). Dam Angling activities in 2012 were planned for a four month period originally scheduled to be from May 3rd (week 18) through the end of August (week 36). At both The Dalles, and John Day Projects, all angling activities were conducted within the tailrace boat restricted zones where no public angling was permitted. At The Dalles Dam, the Dam Angling crew fished primarily along the turbine wall and near the ice-trash sluiceway as indicated in Figure 2. At the John Day Dam, the crew fished exclusively along the turbine wall (Figure 3).

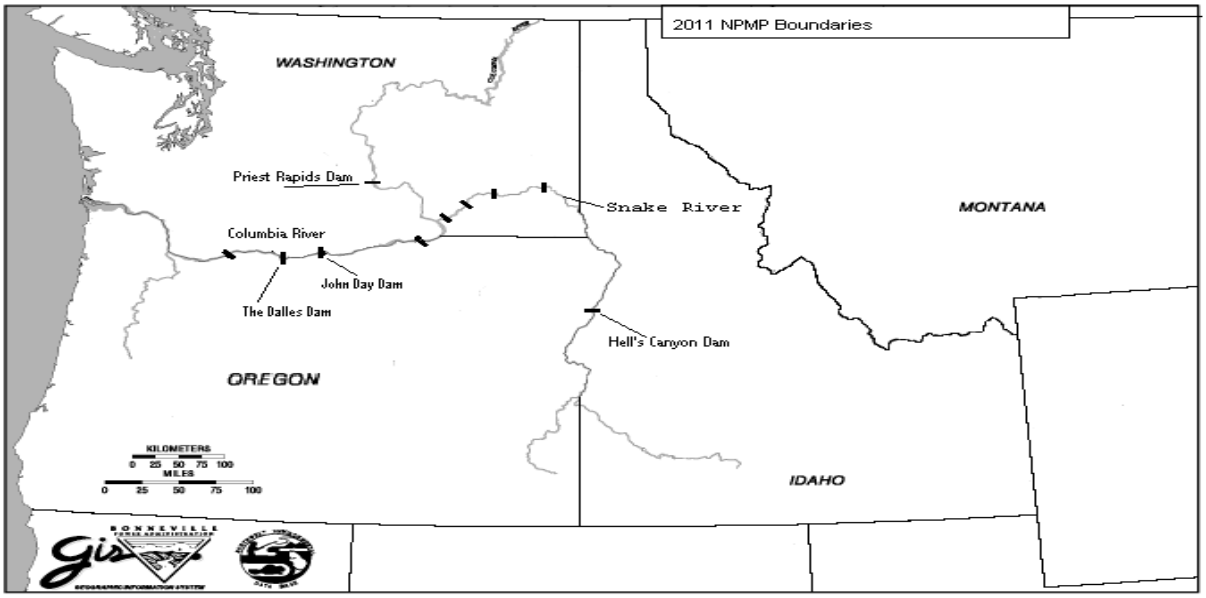

Figure 1. Northern Pikeminnow Management Program boundaries, including 2012 Dam Angling sites.

Figure 2. Angling locations for the 2012 Dam Angling crew at The Dalles Dam.

Figure 3. Angling locations for the 2012 Dam Angling crew at the John Day Dam.

The Dam Angling Season

In order to achieve the primary project objective of maximizing harvest of predatory northern pikeminnow, WDFW used the experience and knowledge gained from two previous seasons of conducting the Dam Angling component of the NPMP to formulate a Defined Angling Strategy to use in implementing the 2012 Dam Angling season. The strategy consisted of two parts; (1) a defined CPUE goal (fish/angler hour) at which the Dam Angling crew would conduct full scale angling activities, and (2) a defined protocol for allocating Dam Angler effort in order to search for, and obtain the CPUE goal throughout the season. Based on data from the 2010-11 Dam Angling seasons (Dunlap et al. 2011, Hone et al 2010), the 2012 CPUE goal was set at 2.0

fish/angler hour. The protocol for allocating Dam Angler effort consisted of alternating the crew's angling days between The Dalles and John Day dams until the CPUE goal was met, and then concentrating all angling activities at that location. When CPUE slips below the goal, the crew's alternating location pattern would be resumed until the goal was reacquired. If angling conditions are such (at both projects) that the CPUE goal cannot be met with reasonable effort, angling activities may be scaled back or suspended by the Project Leader until conditions improve. The missed effort would then be added to the end of the scheduled season.

The Dam Angling Crew

The four member angling crew typically worked four ten hour days a week, (usually Tuesday - Friday) during the 2012 fishery (Figure 4). Shift start times (on site, actually fishing) varied from approximately 4:30 am to 6:00 am at The Dalles Dam and from 5:00 am to 6:00 am at the John Day Dam. We also conducted a limited number of supplemental angling shifts in the evening at the John Day Dam (approximately 6:00 pm – 10:00 pm) during the 2012 fishery in order to determine if evening hours could be productive. In addition to the three or four person angling crew, a crew leader was also present each day for angler safely and supervision, to collect and record and compile data on northern pikeminnow harvest, other fish species caught, and to ensure that project protocols were adhered to.

Figure 4. The Dam Angling crew at The Dalles Dam.

Angling Gear

Dam anglers used Berkley Air IM8 Graphite 10'6" (2-8 oz. extra heavy casting) rods equipped with either Daiwa TD Luna 253 or Shimano Calcutta 400 series reels. Each reel was spooled with a 20# test braided main line (Power Pro), tied to a size 7 barrel swivel and a 24"-30" monofilament leader of 15-20# Maxima (Figure 5). For weight, a cannonball sinker was attached to the swivel using four to six inch dropper line of 12# monofilament leader. The cannonball sinker varied in weight from one to six ounces depending on river flow. Terminal gear consisted primarily of assorted soft plastic lures rigged with two octopus style hooks (size 1 to 1/0 Gamakatsu hooks) spaced 1 1/8" apart (Figure 6). Hook size varied in order to match the

size of the soft plastic bait, with the soft plastic lure most preferred by the crew being a 3-5” tube bait. Other effective soft plastics were flukes, grubs and sassy shad in similar 3”-5” sizes.

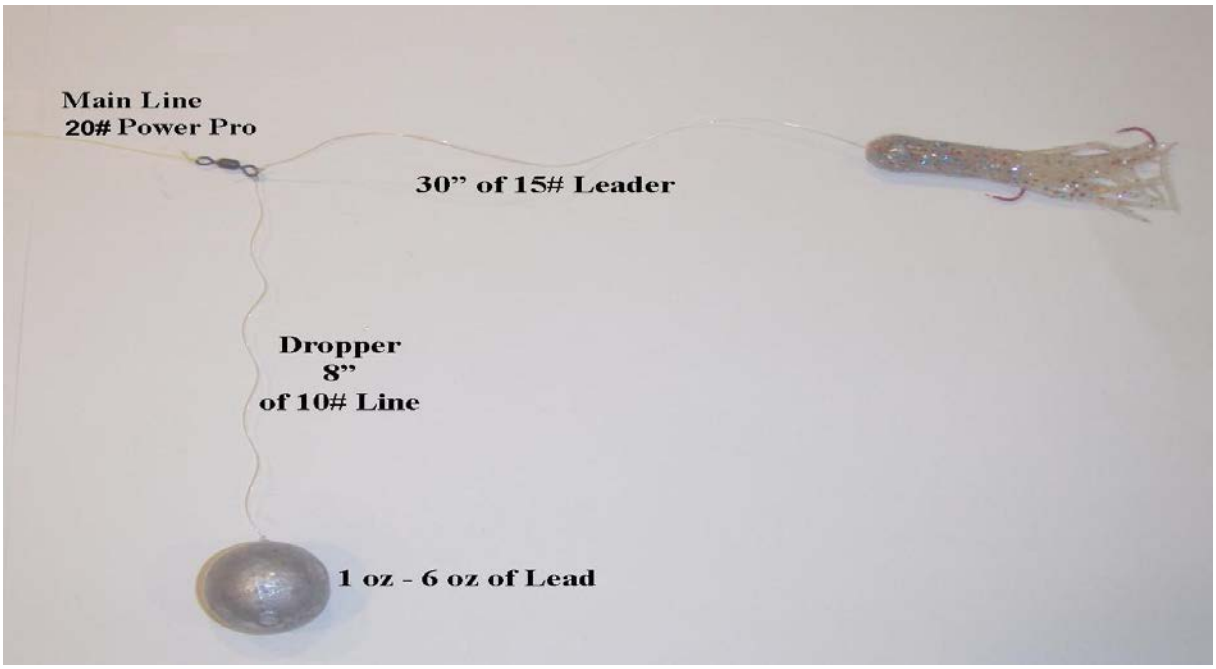

Figure 5. Example of typical rigging used by 2012 NPMP Dam Anglers.

Figure 6. Examples of soft Plastic lures and tube baits used by 2012 NPMP Dam Anglers.

Data collection

Creel data were recorded for each individual angler for their day of angling and then the combined crew totals were summarized on a weekly basis with totals for either The Dalles Dam or the John Day Dam. Collected data included total hours of effort per angler, northern pikeminnow harvest per angler, incidental catch per angler, location and hour of all caught fishes by angler, as well as specific terminal gear (lure) used (and fish caught with that lure) by angler. Weekly catch and harvest totals (by project) for Dam Anglers were submitted to PSMFC using a Weekly Field Activity Report (WFAR) as is done for the NPSRF.

Biological Sampling

Fork lengths (FL) of all northern pikeminnow harvested by the Dam Angling crew were recorded on biological data sheets provided by the NPSRF. Technicians also examined all northern pikeminnow for the presence of external tags (spaghetti or dart), fin-clip marks, and signs of tag loss. Complete biological data were collected from all tag-loss and spaghetti tagged northern pikeminnow including FL, sex (determined by evisceration), and scale samples if specified. Spaghetti tagged and tag-loss northern pikeminnow carcasses were labeled and frozen for data verification and/or tag recovery at a later date. Spaghetti tags from harvested northern pikeminnow along with biological data were recorded on a tag envelope provided by the NPSRF and were submitted to ODFW for verification.

PIT Tag Detection

All northern pikeminnow collected by Dam Anglers during 2012 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). Dam Angling technicians were required to scan 100% of all harvested northern pikeminnow for PIT tags using Destron Fearing portable transceiver systems (model #FS2001F). Technicians were also asked to scan incidental catch for PIT tags whenever possible and 100% of all incidentally caught smallmouth bass (for coordination with concurrent ODFW bass study). Scanning began on the first day of angling and continued throughout the duration of Dam Angling activities. Technicians individually scanned all northern pikeminnow for PIT tag presence, and complete biological data were recorded from all pikeminnow with positive readings. All northern pikeminnow with PIT tags were labeled and preserved for later dissection and tag recovery. All PIT tag data were verified after recovery of PIT tags by WDFW personnel and all data were provided to ODFW and the Pit Tag Information System (PTAGIS) once verified.

Northern Pikeminnow Processing

During biological sampling, all northern pikeminnow were caudal clipped as an anti-fraud measure to eliminate the possibility of previously processed northern pikeminnow being resubmitted to the Sport-Reward Fishery for payment. 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

Combined John Day/Dalles Dam Findings

2012 Dam Angling Season

Dam Angling activities for the 2012 season had been planned to occur over a four month period from the first week of May through the end of August. The Dam Angling crew fished one day during week 18 (May 3rd), achieving a CPUE of 0.3 fish/angler hour (Figure 7), well below the CPUE goal of 2.0 fish/angler hour established in our Defined Angling Strategy. Angling conditions deteriorated the next week and the Project Leader made the decision to suspend dam angling activities until river conditions became more suitable. From Week 18 through Week 21 (with limited effort), the crew's CPUE remained well below our 2.0 fish/angler hour CPUE goal, only approaching it in Week 22, and finally achieving the CPUE goal in week 23. The crew's most experienced and productive angler (from 2010-11) also abruptly resigned at the end of June, leaving the crew shorthanded for much of the remaining season. Due to the missed angling time in May and the reduced crew size, five additional weeks of angling time were added to the end of the 2012 season, extending dam angling activities to October 4th (week 40). Despite these difficulties, the 2012 Dam Angling crew fished 22 weeks between the two dams and harvested an average of 249 northern pikeminnow per week.

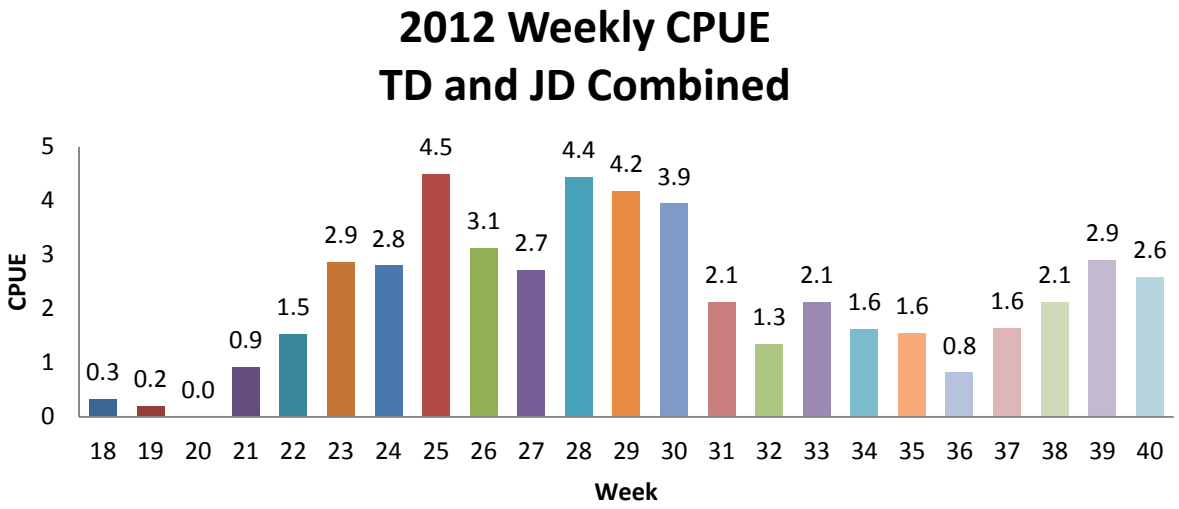

Figure 7. 2012 Weekly CPUE (fish/angler hour) of The Dalles (TD) and John Day (JD) dams combined.

Angling Gear and Technique

Using the knowledge obtained during the two previous seasons in which WDFW had conducted the Dam Angling Project, the 2012 Dam Angling crew targeted fishing areas at each dam that had been productive in the past (Dunlap et al. 2011, Hone et al. 2010). Since the majority of our angling success in previous years had come off the turbine decks, the back bouncing technique (using soft plastic lures) developed in 2010, and further refined in 2011, was once again the primary angling method used in 2012. Using this method, the 3.75" Smoke/Black Copper Glitter

and the Grey Shad Gitzit tube baits were the top two producers used by the Dam Angling crew in 2012 (Table 1). Other productive soft plastics that were new to the top 10 compared to previous seasons were two of the 2.75" Dry Creek tubes (Perk's Delight, and Shimmer Shad), and an experimental 3.5" custom tube (Grey/Silver Hologram) provided by top SRF angler Tim Histand.

Table 1. Top 10 Northern Pikeminnow Lures used by 2012 WDFW Dam Angling Crew.

Northern Pikeminnow Lures

Brand/style	Size	Color	# N. Pikeminnow Caught
Gitzit/ tube bait	3.75"	Smoke/Black Copper Glitter	1,734
Gitzit/ tube bait	3.75"	Grey Shad	1,182
Gitzit/ tube bait	3.75"	Smoke Silver Glitter	695
Gitzit/ tube bait	3.75"	Dark Smoke Hologram	573
Dry Creek/ tube bait	2.75"	Perk's Delight	159
Gitzit/ tube bait	3.75"	Rainbow Trout	156
Gitzit/ tube bait	3.75"	Bluegill	148
Dry Creek/ tube bait	2.75"	Shimmer Shad	146
Histand custom tube	3.5"	Grey/Silver Hologram	95
Gitzit/ tube bait	3.75"	Pearl White	67

Angling Times

Time of day continued to make a difference when it came to Dam Angler harvest success during the 2012 season. Fishing results from the two previous Dam Angling seasons conducted by WDFW had indicated that morning hours (prior to 11 a.m.) were typically the most productive times for harvesting northern pikeminnow (Dunlap et al. 2011, Hone et al 2010). When we look at the combined results for 2012 (The Dalles and John Day projects), a majority of the harvest (66%) once again occurred prior to 11:00 am (Table 2). In a change from previous years however, there were also a sizable percentage (13%) of northern pikeminnow harvested after 1:00 pm during the 2012 fishery. When we break out the hourly harvest for each individual project in 2012, it is obvious that there were productive evening harvest times at the John Day Dam in 2012 which were not available at The Dalles Dam (Table 3).

Table 2. Combined 2012 WDFW Dam Angler Hourly Harvest Totals for The Dalles (TD) and John Day (JD) dams.

Hourly Northern Pikeminnow Harvest (combined TD and JD totals)

Time of day	Harvest	% of Harvest
Prior to 6:00 a.m	606	11%
6:00 a.m - 7:00 a.m	624	11%
7:00 a.m. - 8:00 a.m.	666	12%
8:00 a.m. - 9:00 a.m	684	12%
9:00 a.m - 10:00 a.m	626	11%
10:00 a.m - 11:00 a.m.	518	9%
11:00 a.m. - 12:00 p.m.	553	10%
12:00 p.m. - 1:00 p.m.	468	9%
After 1 p.m.	738	13%
Total	5,483	100%

Table 3. 2012 WDFW Dam Angler Hourly Northern Pikeminnow Harvest Comparison (TD vs JD).

	The Dalles Dam		John Day Dam	
Time of day	Harvest	% of Harvest	Harvest	% of Harvest
5:00 a.m. - 6:00 a.m	461	15%	145	6%
6:00 a.m - 7:00 a.m	454	15%	170	7%
7:00 a.m. - 8:00 a.m.	462	15%	204	9%
8:00 a.m. - 9:00 a.m	422	14%	262	11%
9:00 a.m - 10:00 a.m	369	12%	257	11%
10:00 a.m - 11:00 a.m.	288	9%	230	10%
11:00 a.m. - 12:00 p.m.	317	10%	236	10%
12:00 p.m. - 1:00 p.m.	282	9%	186	8%
1:00 p.m. - 6:00 p.m.	67	2%	84	3.5%
6:00 p.m. - 7:00 p.m.	0	0%	171	7%
7:00 p.m. – 8:00 p.m.	0	0%	164	7%
8:00 p.m. – 9:00 p.m.	0	0%	83	3.5%
9:00 p.m. – 10:00 p.m.	0	0%	62	2.5%
10:00 p.m. – 2:00 a.m.	0	0%	107	4.5%
Total	**3,122**	**100%**	**2,361**	**100%**

Incidental Catch

The Dam Angling crew incidentally caught and released the fish species listed in Table 4 while targeting northern pikeminnow at The Dalles and John Day dams in 2012. Incidental species most often caught were smallmouth bass *Micropterus dolomieue*, white sturgeon *Acipenser transmontanus*, and American shad *Alosa sapidissima*. In addition, the Dam Angling crew once again noted large numbers of juvenile lamprey *Entosphenus* spp. and/or *Lampetra* spp. regurgitated by northern pikeminnow caught at The Dalles Dam in May and June.

Table 4. 2012 WDFW Dam Angler Incidental Catch by project.

Incidental Catch		
Species	**The Dalles Dam**	**John Day Dam**
Smallmouth Bass	59	115
White Sturgeon	9	63
American Shad	4	31
Walleye	0	28
Sculpin	51	25
Peamouth	0	23
Channel Catfish	0	18
Chinook Salmon (adult)	1	0

Tag Recovery

All northern pikeminnow harvested by Dam Anglers in 2012 were examined for the presence of external spaghetti tags and individually scanned for the presence of PIT tags. Five northern pikeminnow with external ODFW spaghetti tags were recovered by the Dam Angling crew at The Dalles Dam in 2012, while no spaghetti tagged northern pikeminnow were caught at the John Day Dam. In addition, there were eleven northern pikeminnow recovered that had lost spaghetti tags, but retained PIT tags implanted by ODFW as a secondary tag mark. Eight of these PIT tagged fish were caught by the Dam Angling crew at The Dalles Dam and three at the John Day Dam. The 2012 Dam Angling crew also recovered PIT tags from fourteen salmonid smolts that had been ingested by northern pikeminnow harvested at The Dalles and John Day dams, an occurrence ratio of one (ingested PIT tagged salmonid) for every 392 scanned northern pikeminnow (1:392), more than three times last year's Dam Angling ratio (1:1,333) and almost four times the (1:1,536) ratio of the 2012 Sport-Reward Fishery (Hone et al. 2012). The Dam Angling crew also caught and scanned thirteen smallmouth bass (in 2012) with PIT tags (likely from an affiliated ODFW predation study), and these data were later provided to ODFW.

The Dalles Dam

Harvest

The Dam Angling crew fished sixteen weeks at The Dalles Dam in 2012 and harvested 3,122 northern pikeminnow in that time. The 2012 harvest total for The Dalles Dam more than doubled the harvest of either of the two previous seasons (1,323 in 2010 and 1,204 in 2011). The crew harvested an average of 195 northern pikeminnow per week in 2012 and harvest ranged from a high of 699 in week 25(June 19-22) to a low of 12 fish in the abbreviated second week of the season when angling conditions were very poor (Figure 8). Poor harvest at the start of the season may have

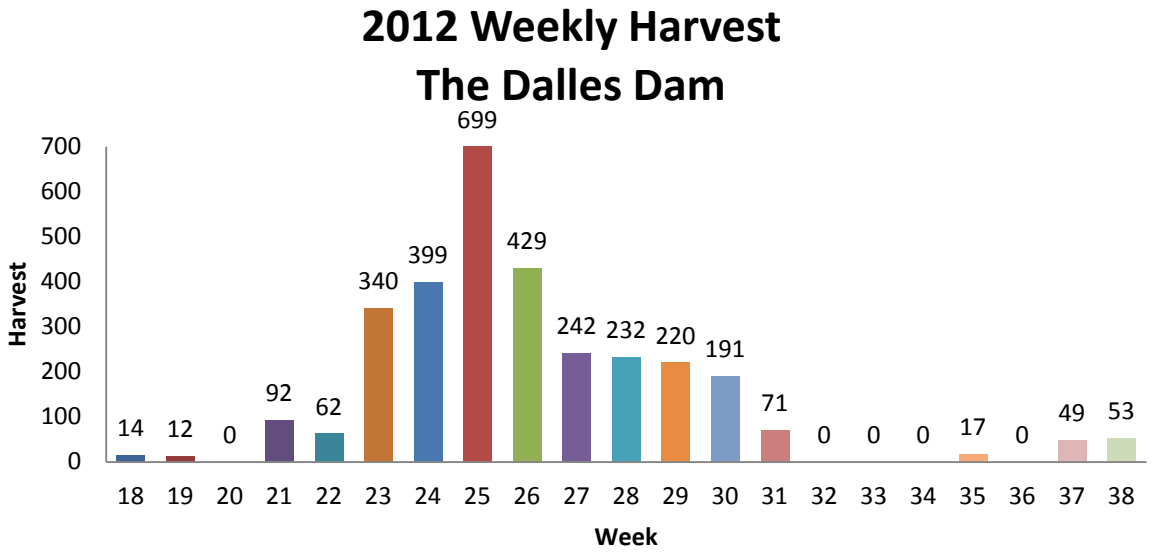

Figure 8. 2012 Weekly Dam Angler Harvest of Northern Pikeminnow at The Dalles Dam.

been due to high river conditions present for the first four weeks of the season as indicated in Figure 9. Harvest was so poor at The Dalles Dam during the first three weeks of the season (weeks 18-20), that the crew did not conduct full time angling activities during the first two weeks, and did not fish at all in the third week based on our Defined Angling Strategy protocol (described earlier in this report). Test fishing was conducted during weeks 21 and 22 due to improving river conditions, and the Dam Angling crew achieved some moderate success at The Dalles Dam with 154 northern pikeminnow harvested in that period. Harvest really increased in week 23, and peaked in week 25 which was one week earlier than peak harvest for the Sport Reward Fishery (Hone et al. 2012). The 2012 peak weekly harvest of 699 northern pikeminnow was nearly three times higher than the previous weekly record of 236 fish harvested at The Dalles Dam in week 20 of the 2011 season (Dunlap et al. 2011). Good river conditions continued at The Dalles Dam through week 30, but fell to unproductive levels after August 1st (week 31) when spill ended.

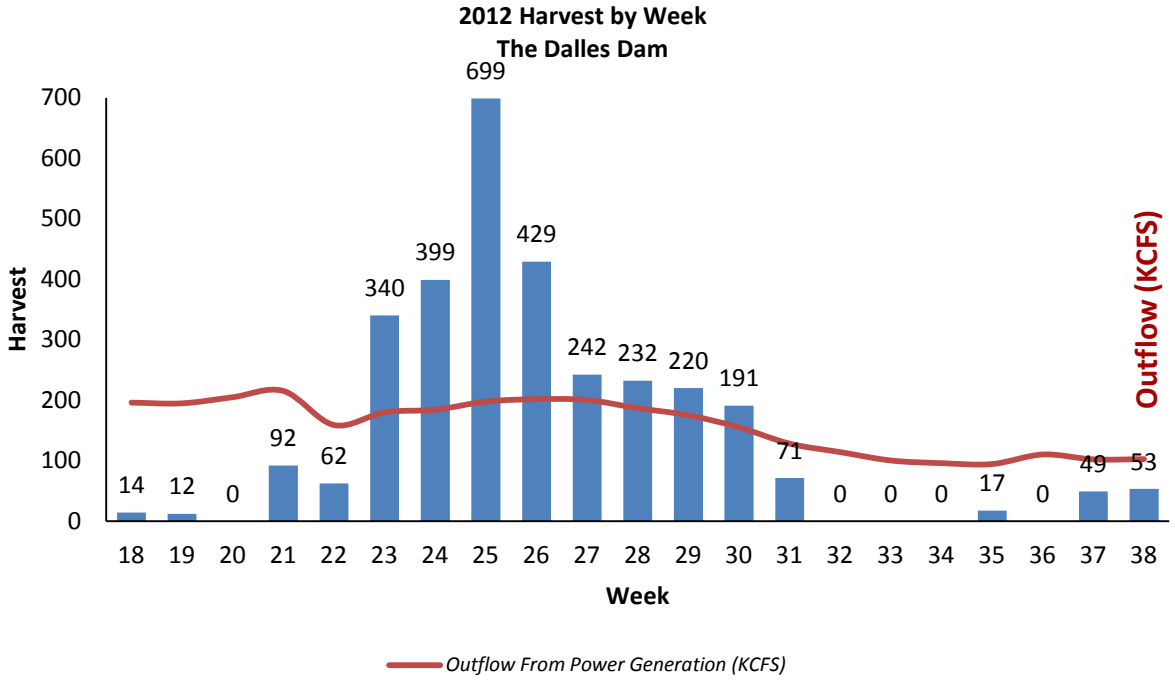

Figure 9. 2012 Weekly Northern Pikeminnow Harvest Compared to Outflow.

As was the case in the previous two seasons, certain areas and/or turbines at The Dalles Dam produced better harvest than others. Turbine 13 (T13) was the top producing angling location at The Dalles Dam in 2012 with 23% of total harvest (Figure 10) compared to only 6% in 2011. In fact, the whole area between T10 and T14 was very productive, accounting for more than 70% of total harvest at The Dalles Dam in 2012. Our data had indicated that the other turbines in this vicinity may also be productive as T12 had been the top producing turbine in 2011 (17% of harvest), or T13 with 18% in 2010 (and another 18% between T11 and T14). In addition, we once again recorded good harvest of northern pikeminnow (12% of TD total) off the gravel bank area upstream of the Ice/Trash Sluiceway in 2012 (this area had accounted for 27% of TD

harvest in 2011). T1, near the Fishway was also productive, but nowhere near the top angling location it was in 2010 with 24% of TD harvest that season.

Figure 10. 2012 Overall Percent of Northern Pikeminnow Harvest by Area (T=turbine #, F = fishway).

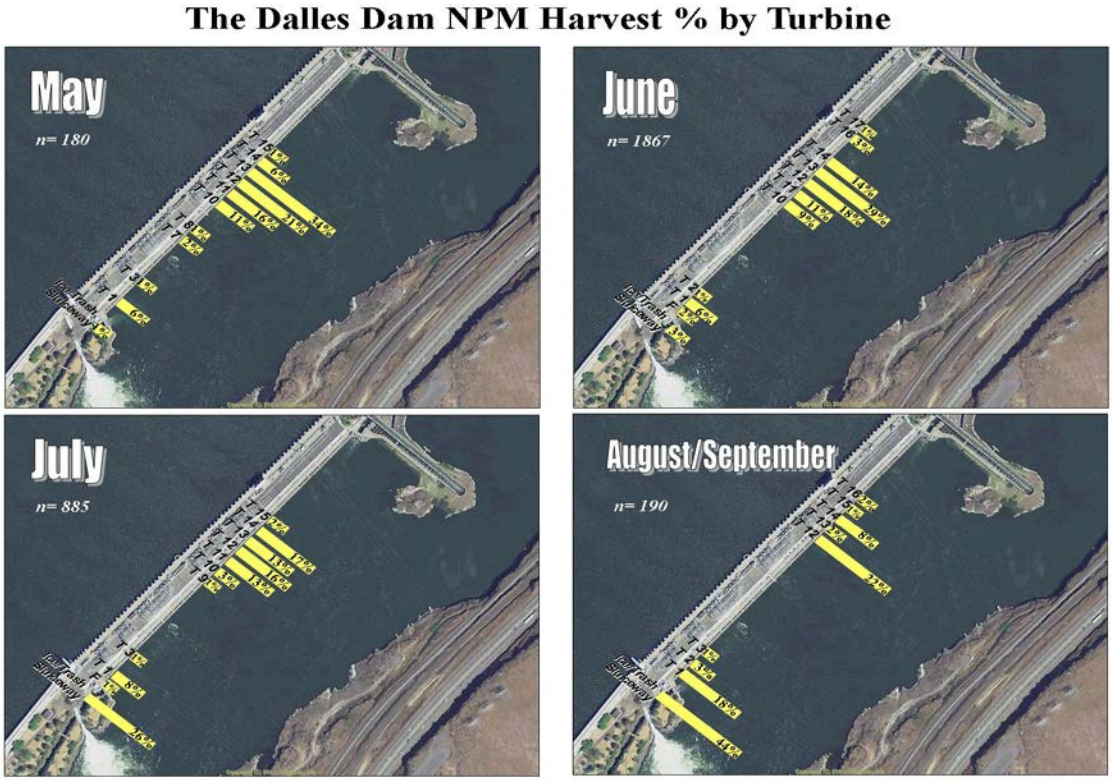

Figure 11. 2012 Monthly Harvest Percent by area (T=turbine# , F = fishway) at The Dalles Dam.

When we look at northern pikeminnow harvest at The Dalles Dam over the course of the 2012 Dam Angling season, our harvest data does not indicate much of a shift in the location of harvest as we had documented in 2010 and 2011 (Figure 11). Our data does show some harvest shifting to the ice/trash sluiceway location in July, but good, consistent harvest occurred at all of the angling locations between T10-14 over the course of the season until water conditions changed at the beginning of August. After that point, what little harvest occurred was mainly near the sluiceway.

Incidental Catch

While the Dam Angling crew did not target other fish species in their angling activities during 2012, smallmouth bass (smb) were the most common species incidentally caught at The Dalles Dam. The Dam Angling crew caught 59 smallmouth bass at The Dalles Dam in 2012, compared to 79 in 2011 and 92 in 2010. The decline in the number of smallmouth bass caught by the Dam Angling crew at The Dalles Dam over the past three seasons is to be expected as the crew's angling techniques, and locations fished evolve to target northern pikeminnow rather than smallmouth bass according to project objectives. Most smallmouth bass were caught near the Ice/Trash sluiceway in July (Figure 12) when northern pikeminnow harvest was shifting to that area as discussed previously. As was the case in 2010 and 2011, all smallmouth bass caught by the Dam Angling crew in 2012 were released.

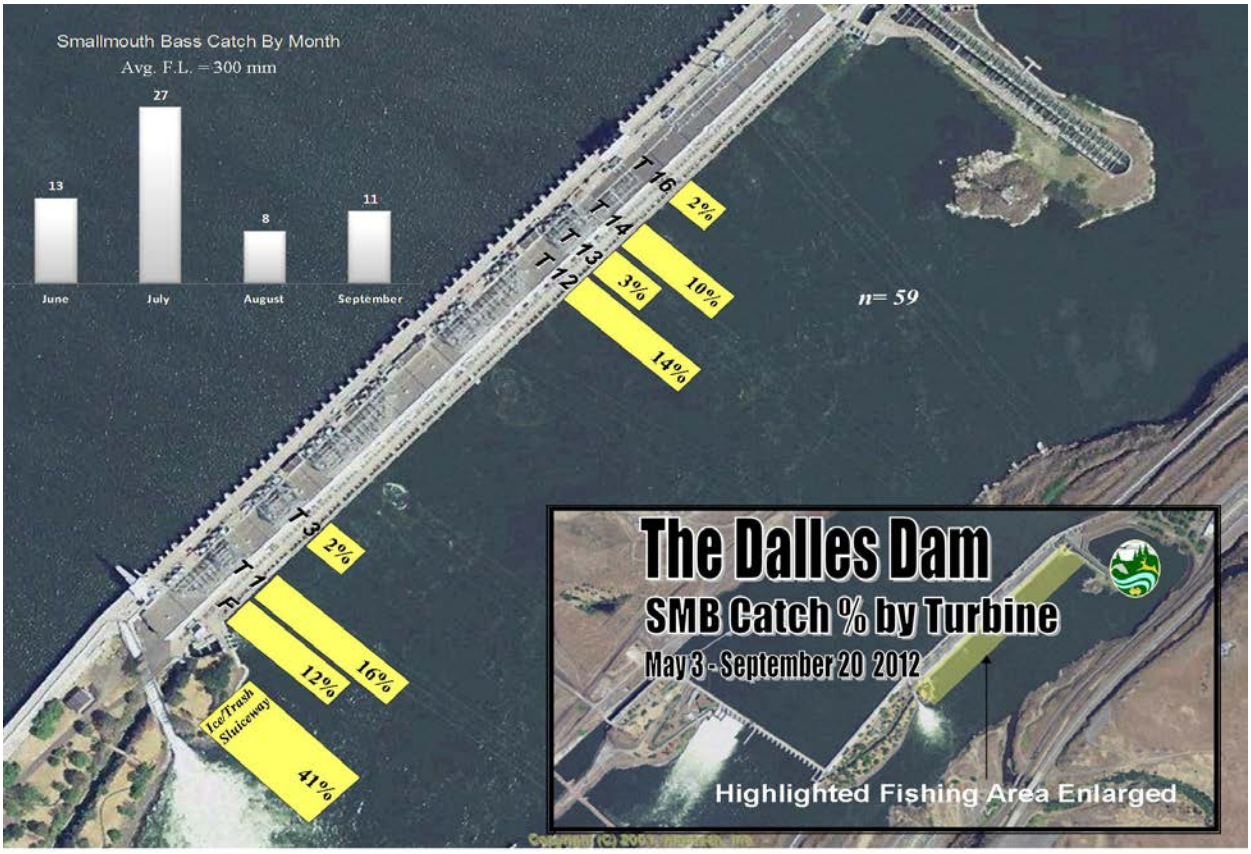

Figure 12. 2012 Incidental catch of smallmouth bass by Dam Angling crew at The Dalles Dam.

EFFORT

Total angler hours of effort spent at The Dalles Dam in 2012 was 1,161.05 hours (up from 754.4 hours in 2011), equaling 52.8% of total overall effort spent by the Dam Angling crew in 2012. To achieve that level of effort, the Dam Angling crew fished 41 days in 16 weeks at The Dalles Dam in 2012, compared to 33 days in 17 weeks in 2011. The 2012 Dam Angling crew also averaged a combined 72.56 angler hours of effort per week or 28.32 angler hours of effort per day.

CPUE

The Dam Angling crew harvested 3,122 northern pikeminnow in 1,161.05 angler hours at The Dalles Dam in 2012 for an overall average CPUE of 2.69 fish/angler hour. This rate was an improvement from 2010 (1.42 fish per angler hour) and 2011 (1.60 fish/angler hour). Weekly CPUE ranged from 0.2 fish/angler hour in week 19 to 4.5 fish/angler hour in week 25 (no angling activities were conducted during weeks labeled with zero) (Figure 13). Peak weekly CPUE for the Dam Angling crew occurred one week earlier than that of the Sport Reward Fishery (week 26). Despite experiencing low CPUE rates for the first five weeks of the season (and after August 1st), the Dam Angling crew was able to exceed our overall CPUE goal of 2.0 fish/angler hour at The Dalles Dam by implementing the Defined Angling Strategy we developed for the 2012 Dam Angling season (as described earlier in this report).

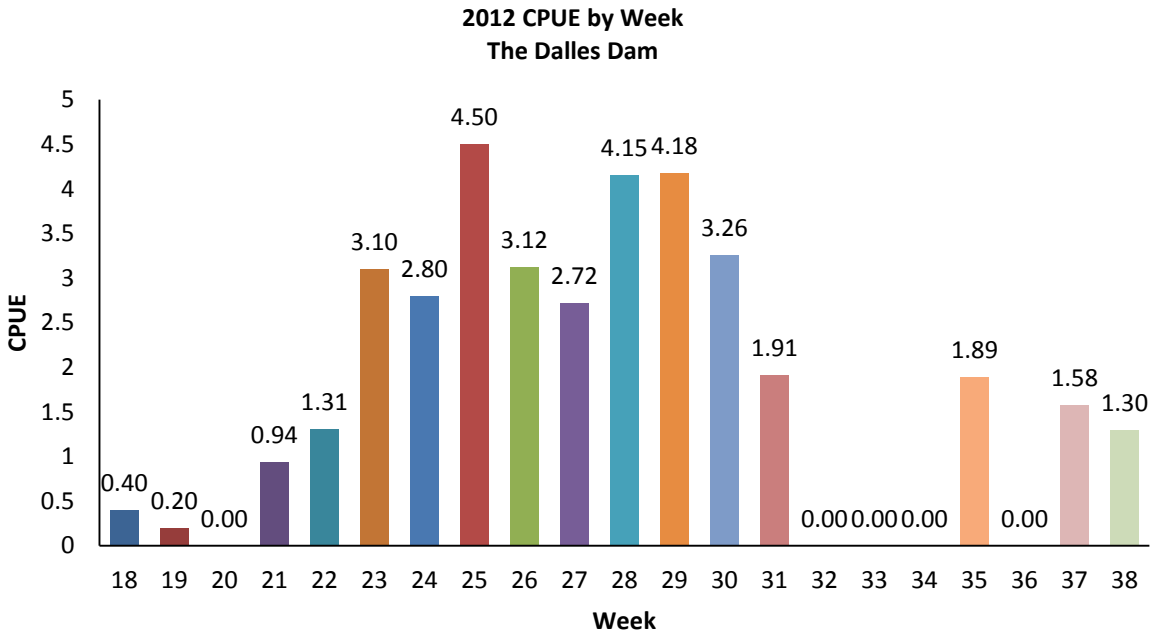

Figure 13. 2012 Weekly Dam Angler CPUE at The Dalles Dam.

Fork Length Data

Fork lengths were taken from 100% of all northern pikeminnow harvested at The Dalles Dam during the 2012 Dam Angling Season. The length frequency distribution of harvested northern pikeminnow from The Dalles Dam in 2012 is presented in Figure 14. Mean fork length for all measured northern pikeminnow at The Dalles Dam in 2012 was 343.8 mm compared to 361.0 mm in 2011 and 365.5 mm in 2010.

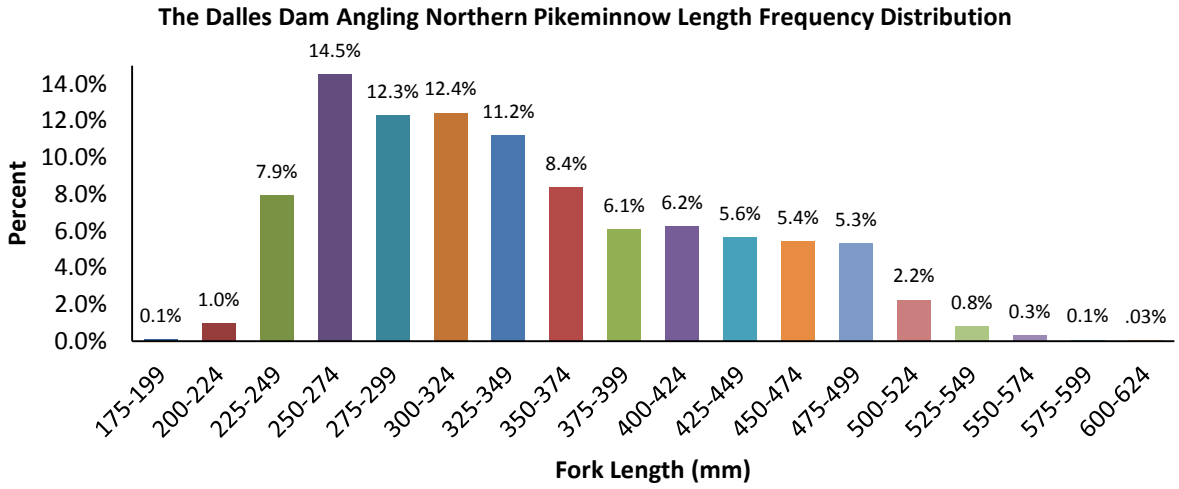

Figure 14. Northern pikeminnow Length Frequency Distribution at The Dalles dam in 2012 (N=3,122).

John Day Dam

Harvest

The Dam Angling crew harvested 2,361 northern pikeminnow during the 16 weeks that they fished at the John Day Dam in 2012 compared to 3,322 in 2011 and 2,675 in 2010. Weekly harvest (for the combined crew) averaged 148 fish per week in 2012 versus 185 fish/week in 2011, and 167 fish/week in 2010. Weekly harvest ranged from 13 northern pikeminnow in week 21 to 339 in week 39 (September 24-30) (Figure 15). Other than at the start of the 2012 season (weeks 21-23), when the Dam Angling crew was conducting test fishing at the John Day Dam attempting to reach our CPUE goal of 2.0 fish/angler hour (as described earlier in this report as our Defined Angler Strategy), the crew did not fish at the John Day Dam until week 28.

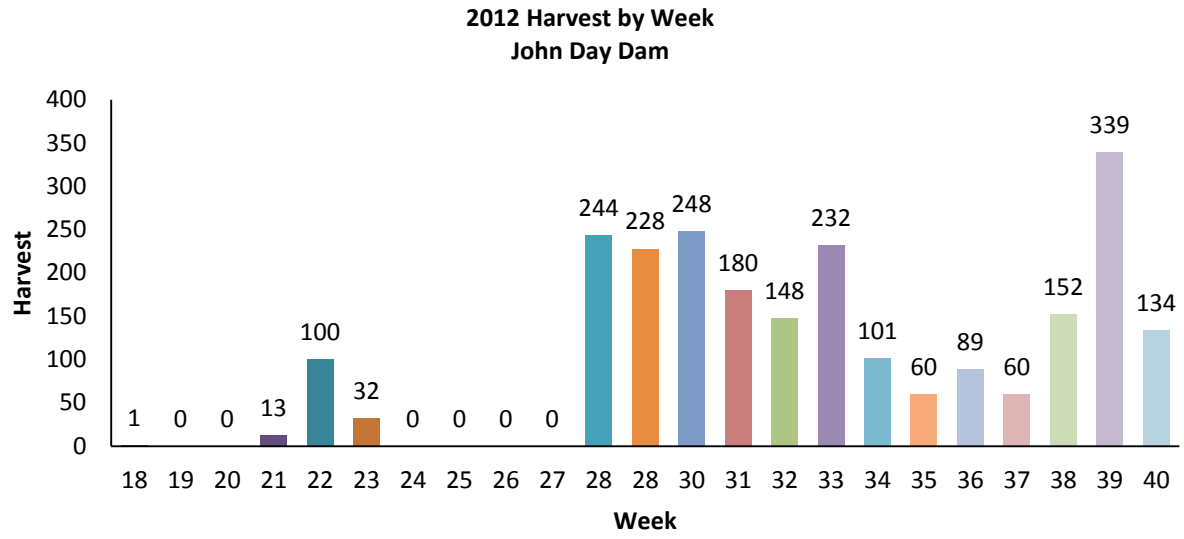

Figure 16. 2012 Weekly Dam Angler Harvest of Northern Pikeminnow at the John Day Dam.

While part of the decision (not to fish at JD) was due to high river levels and poor angling conditions at the John Day Dam (Figure 17), the most important reason was that from week 23-27, harvest was much better at The Dalles Dam. Fortunately, when an August 1st change in river conditions at The Dalles Dam (week 31), caused harvest there to plummet, positive river conditions at the John Day Dam allowed harvest there to remain productive.

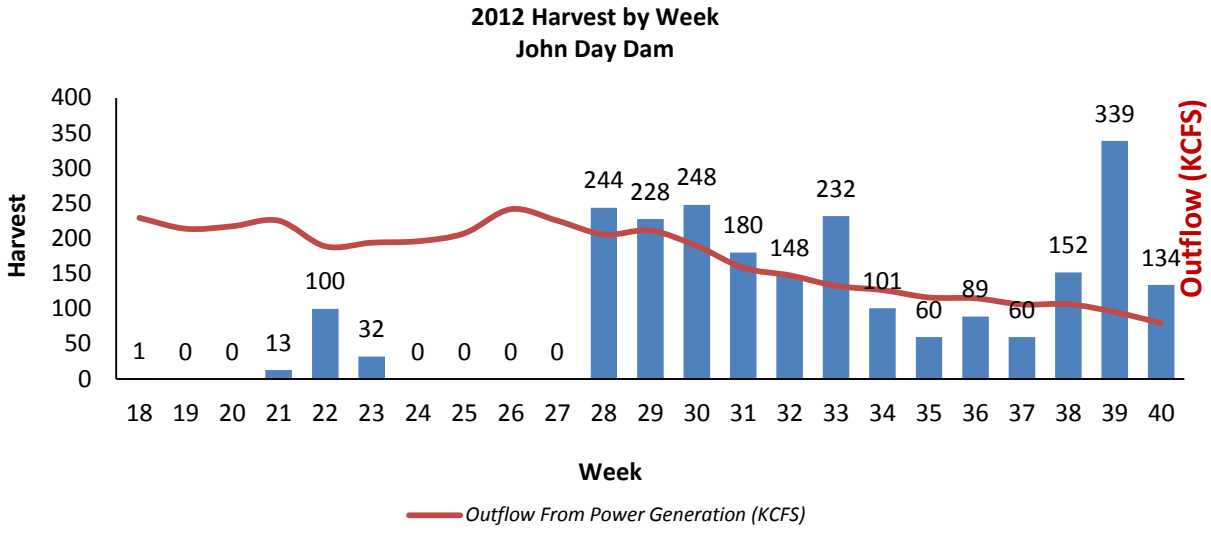

Figure 17. 2012 Weekly Dam Angler Harvest of Northern Pikeminnow at the John Day Dam vs Outflow.

As documented in previous Dam Angling Reports (Dunlap et al. 2011, Hone et al. 2010), certain turbines at the John Day Dam created water flow conditions more favorable for harvesting

northern pikeminnow than others. Of the total pikeminnow harvest at the John Day Dam in 2012, turbine #10 (T10) was the single best producing area with 24% of the total documented harvest (Figure 18). Turbine 3 (T3) had been the best angling location in 2011 with 20% of total harvest, while T5 had been tops in 2010 with 22% of harvest.

Figure 18. 2012 Overall Percent of Northern Pikeminnow Harvest by Area (T=turbine#)

Similar to what we documented in our 2010 and 2011 Dam Angling reports, harvest once again shifted away from the spillway and towards the Oregon shore over the course of the 2012 Dam Angling season (Figure 19). One element of difficulty that the Dam Angling crew experienced with this shift in 2012 was that the number of productive turbines available (from a harvest point of view) late in the year was very limited. What this typically meant was that only one or two members of a three or four member Dam Angling crew were able to fish effectively at any one time. In an effort to deal with this phenomenon, the crew was compelled to experiment with fishing some evening hours during times of limited productivity in the past (6-10:00 p.m.). We discovered that there were some very productive harvest opportunities during these evening times (especially at turbines 3 and 5), which we were able to exploit using resources that could not be productive in the mornings.

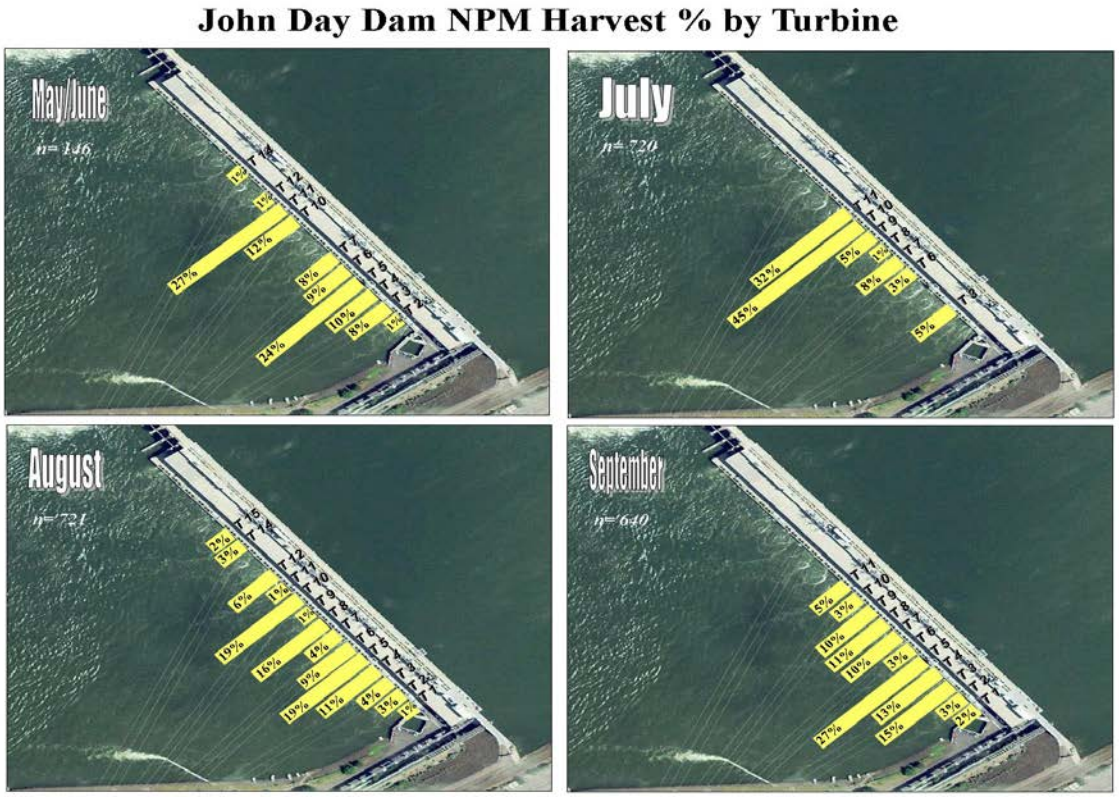

Figure 19. 2012 Monthly Percent of Northern Pikeminnow Harvest by area (T=turbine#)

Incidental Catch

While the Dam Angling crew did not target other fish species in their angling activities, smallmouth bass (smb) were the most common species incidentally caught in 2012 at the John Day Dam, just as they were at The Dalles Dam. The Dam Angling crew caught 115 smallmouth bass at the John Day Dam in 2012, compared to 283 in 2011 and 195 in 2010. The decline in the number of smallmouth bass caught by the Dam Angling crew at the John Day Dam over the past three seasons is to be expected as the crew's angling techniques, and fishing locations evolve to target northern pikeminnow rather than smallmouth bass according to project objectives. Most smallmouth bass were caught between turbines 2-5 as they had been in 2011, although T10 was also productive (Figure 20). Most smallmouth bass were caught in August and as was the case at The Dalles Dam, all smallmouth bass caught by the Dam Angling crew in 2012 were released. The Dam Angling crew only caught 28 walleye at the John Day Dam in 2012 (Figure 21), most commonly between turbines 5-10 (compared to 125 caught in 2011 and 60 caught in 2010). Walleye were mostly caught in August and September as the inset in the upper right corner of Figure 21 shows. As was also the case at The Dalles Dam, walleye and other incidental species caught by the Dam Angling crew at the John Day Dam in 2012 were released.

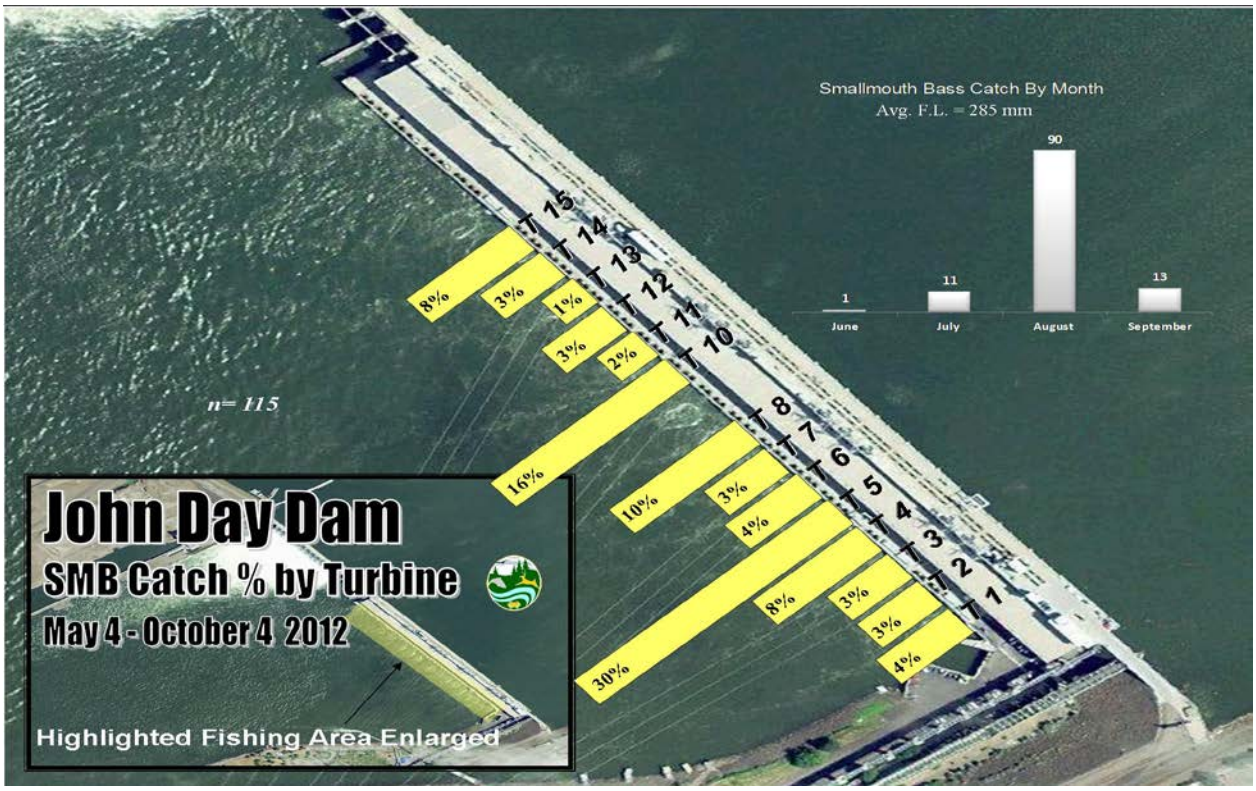

Figure 20. 2012 Incidental catch of smallmouth bass by Dam Angling crew at the John Day Dam.

Figure 21. 2012 Incidental catch of walleye by Dam Angling crew at the John Day Dam.

EFFORT

Total angler hours of effort spent at the John Day Dam in 2012 was 1,038.75 hours (down from 1,296.1 hours in 2011), equaling 47.2% of total overall effort spent by the Dam Angling crew in 2012. To achieve that level of effort, the Dam Angling crew fished 49 days in 17 weeks at The Dalles Dam in 2012, compared to 55 days in 18 weeks in 2011. The 2012 Dam Angling crew also averaged a combined 61.10 angler hours of effort per week or 21.19 angler hours of effort per day.

CPUE

The Dam Angling crew harvested 2,361 northern pikeminnow in 1,038.75 angler hours at the John Day Dam in 2012 for an overall average CPUE of 2.27 fish/angler hour. This rate was below both the rates from 2011 (2.56 fish/angler hour) and 2010 (3.03fish/angler hour). Weekly CPUE ranged from .08 fish/angler hour in week 18 to 4.74 fish/angler hour in week 28 (no angling activities were conducted during weeks labeled with zero) (Figure 22). Peak weekly CPUE at the John Day Dam occurred three weeks later than at The Dalles Dam, and two weeks later than for the Sport Reward Fishery (week 26). Despite experiencing low CPUE rates during the early season test fishing, and then having all angling activity shift to The Dalles Dam during a four week period (July), the Dam Angling crew was also able to exceed our overall CPUE goal of 2.0 fish/angler hour at the John Day Dam by implementing the Defined Angling Strategy we developed for the 2012 Dam Angling season (as described earlier in this report).

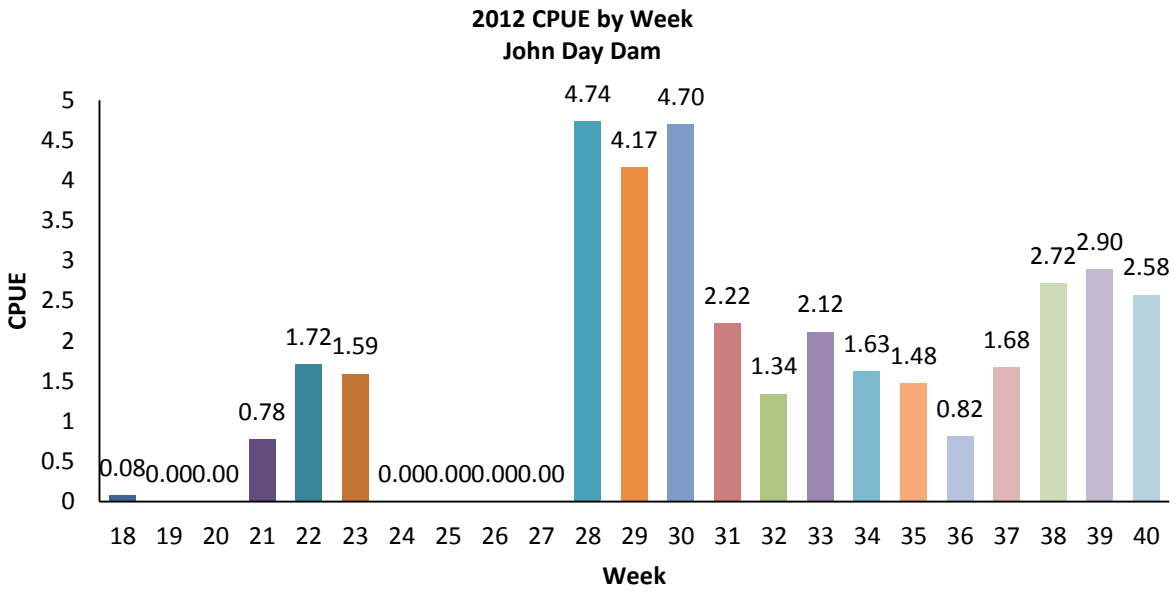

Figure 22. 2012 Weekly Dam Angling CPUE at John Day Dam.

Fork Length Data

Fork lengths were taken from 100% of all northern pikeminnow harvested at the John Day Dam during the 2012 Dam Angling Season. The length frequency distribution of harvested northern pikeminnow from the John Day Dam in 2012 is presented in Figure 23. The mean fork length for all measured northern pikeminnow harvested from the John Day Dam in 2012 was 374.8 mm compared to 380.0 mm in 2011, and 368.9 mm in 2010.

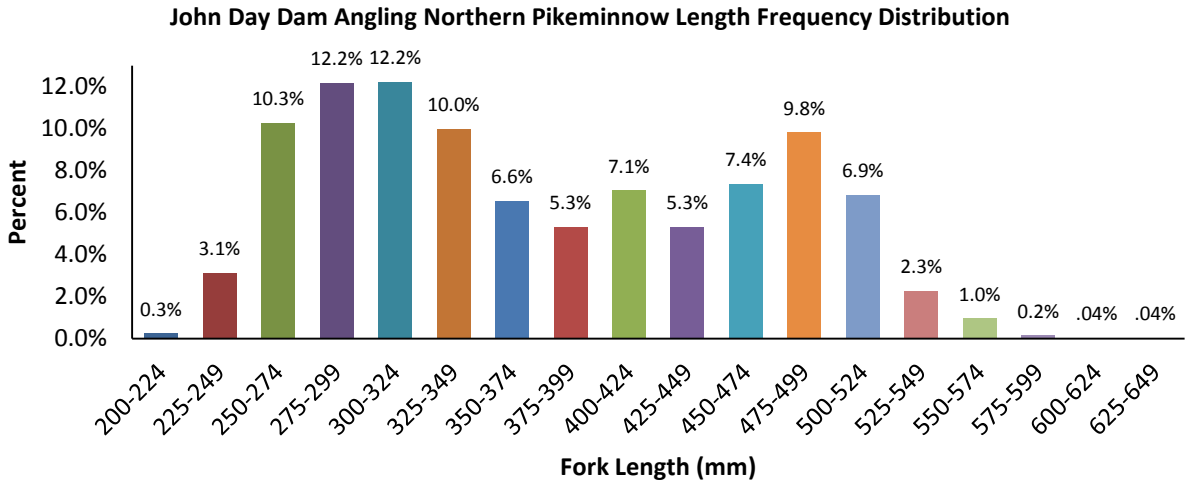

Figure 23. Northern pikeminnow Length Frequency Distribution at the John Day Dam in 2012 (N=2,361).

SUMMARY

The third year of WDFW implementing the Dam Angling component of the NPMP at The Dalles and John Day dams was our most successful season to date in terms of overall harvest (5,483), and overall CPUE (2.49). In addition, at The Dalles Dam, totals for northern pikeminnow harvest (3,122), and CPUE (2.69) were also higher than the totals the Dam Angling crew had achieved in either of the two preceding seasons. We utilized the data and angling experience that we had acquired from Dam Angling in 2010 and 2011 to develop a Defined Angling Strategy (DAS) protocol for use in allocating angling effort between the two projects so that we could maximize harvest of northern pikeminnow in 2012. The CPUE goal used for implementing our DAS protocol (initially set at 2.0 fish/angler hour) proved to be more than adequate for allocating Dam Angler effort in a manner that resulted in record setting harvest in 2012. Given that the 2012 Dam Angling crew had to deal with high water levels and poor angling conditions early in the season (as well as with the resignation of our most productive angler), the ability to add the missed time to the end of the season was once again an important aspect to our success in 2012.

Fork length data from northern pikeminnow harvested by the Dam Angling component of the NPMP continued to document that mean fork lengths of northern pikeminnow harvested at both The Dalles and John Day dams were considerably larger than the mean fork length of northern pikeminnow harvested in the Sport-Reward Fishery (343.8mm at The Dalles, 374.8 mm John Day and 275.1 mm in the SRF). Tag recovery data indicated that five spaghetti tagged northern pikeminnow were recovered by the Dam Angling crew at The Dalles Dam (0 at John Day), and that 11 additional northern pikeminnow with PIT tags and lost spaghetti tags were also recovered between the two projects. Finally, the Dam Angling crew also recovered 14 PIT tags from juvenile salmonids that had been ingested by northern pikeminnow which was our highest occurrence rate to date (1:392), and well above the 2012 SRF rate of 1:1,536.

The 2012 Dam Angling crew incidentally caught 174 smallmouth bass, 76 sculpin, 72 white sturgeon, and 28 walleye between the two projects while attempting to harvest northern pikeminnow. Total incidental catch for all non-northern pikeminnow species continues to decline and reflects the Dam Angling crew's ability to evolve and refine their angling techniques to better target northern pikeminnow, and minimize catch of other species. As has been the case for all years that WDFW has conducted the Dam Angling component of the NPMP. all incidental species caught by the Dam Angling crew were released.

RECOMMENDATIONS FOR 2013

1.) Continue to implement Dam Angling component the NPMP in order to remove predatory northern pikeminnow from the Boat Restricted Zones in the tailrace areas of The Dalles and John Day dams where participants in the Northern Pikeminnow Sport-Reward Fishery are not able to access.

2.) Plan for Dam Angling activities to occur during similar times of year as the 2012 NPSRF in order to take advantage of fishery knowledge gained during over the 2010-2012 Dam Angling seasons as related to maximizing harvest.

3.) Continue to utilize (and modify as needed) the Defined Angling Strategy (DAS) protocol developed in 2012 which uses a minimum CPUE goal for determining where to allocate Dam Angler effort in order to maximize harvest of northern pikeminnow.

4.) Continue to improve data collection in the area of PIT tag scanning other incidentally caught predator fishes, and in enumerating juvenile lamprey regurgitated by northern pikeminnow caught by Dam Anglers in 2012.

5.) Continue to investigate and further develop northern pikeminnow angling techniques in 2013 that will improve Dam Angler CPUE and/or allow exploitation of northern pikeminnow in areas not currently fishable.

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APPENDIX A
Terminal lures used by 2012 Dam Angler crew

Bluegill
Gitzit Tube 3.75" & 5"

Smoke/Black Copper
Gitzit Tube 3.75" & 5"

Dark Smoke Hologram
Gitzit Tube 3.75" & 5"

Pearl White
Gitzit Tube 3.75" & 5"

Smoke/Green & Gold Glitter
Gitzit Tube 3.75" & 5"

Clear Pepper
Gitzit Tube 3.75" & 5"

Pumpkin/Black & Green Glitter
Gitzit Tube 3.75" & 5"

Grey Shad
Gitzit Tube 3.75" & 5"

Hologram Shad
Gitzit Tube 3.75" & 5"

Smoke/Silver Glitter
Gitzit Tube 3.75" & 5"

Rainbow Trout
Gitzit Tube 3.75" & 5"

Brown Melon/Black & Purple Glitter
Gitzit Tube 3.75" & 5"

Zoom Fluke *Smokin Shad 3"*- 5"

Zoom Fluke *Houdini 3"* - 5"

Zoom Fluke *Smokin Silver 3"* - 5"

Zoom Fluke *White Pearl 3"* - 5"

Sassy Shad *Pearl* 4"

Zoom Fluke *Baby Bass 3"* - 5"

Perks Delight
Dry Creek 2 3/4"

Roboworm 5" & 6"

Shimmer Shad
Dry Creek 2 3/4"