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

## 2010 ANNUAL REPORT

Prepared by:

**Russell Porter**
Pacific States Marine Fisheries Commission

In Cooperation with:

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**2010 Executive Summary**
by

Russell G. Porter

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

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

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

In 1994, we investigated the use of trap nets and gillnets at specific locations where concentrations of northern pikeminnow were known or suspected to occur during the spring season (*i.e.*, March through early June). In addition, we initiated a concerted effort to increase public participation in the sport-reward fishery through a series of promotional and incentive activities.

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

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

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

Program cooperators include the Pacific States Marine Fisheries Commission (PSMFC), Oregon Department of Fish and Wildlife (ODFW), and Washington Department of Fish and Wildlife (WDFW). 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 2010 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 2010 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 174,289 northern pikeminnow $\geq$ 228 mm, and 6,777 pikeminnow < 228 mm were harvested during the 2010 NPSRF season. There were a total of 3,313 different anglers who spent 25,361 angler days participating in the fishery during the 2010 season.

3. Anglers submitted 213 northern pikeminnow with external spaghetti tags, all of which also had ODFW PIT tags. There were also 111 northern pikeminnow with ODFW PIT tags only, but missing spaghetti tags. An additional 109 PIT tags were recovered from juvenile salmonids ingested by northern pikeminnow received during the 2010 NPSRF.

**Report B**

***Northern Pikeminnow Sport-Reward Fishery Payments***

1. For 2010 the rewards paid to anglers were the same as in the 2009 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 2010, excluding tagged fish, rewards paid totaled $1,117,994 for 173,981 fish.

3. A total of 213 tagged fish vouchers were paid. The total season tag rewards paid totaled $106,500.

4. A total of 1,075 separate successful anglers caught one or more fish and received payments during the season. A total of 3,313 separate anglers registered to fish, of which two thirds were unsuccessful.

5. The total for all payments for non-tagged and tagged pikeminnows in 2010 was $1,224,494.

**Report C**

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

1. Our objectives in 2010 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 lower Snake River reservoirs, and 3) look for possible compensatory responses by these species.

2. System-wide exploitation in 2010 of northern pikeminnow 250 mm or greater in fork length was 18.8% which incorporated a tag loss of 5.1%.

3. The 2010 estimated reduction in potential predation was estimated at 35% of pre-program levels.

4. We conducted biological indexing in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs in 2010 as part of our predator community evaluation on the Snake River. Northern pikeminnow abundance indices in these reservoirs remained at low levels. Occurrence of salmonids in northern pikeminnow digestive tracts was high in Lower Granite Reservoir, and the relative weight of female northern pikeminnow in Lower Granite Reservoir has increased in recent years. Due to low catch rates, we were unable to calculate consumption or predation indices, as well as stock densities for northern pikeminnow for 2010.

5. The relative abundance of smallmouth bass observed in the tailrace area of Lower Monumental Reservoir during 2010 was higher than previous years; however, relative densities in most areas of the lower Snake River were similar to values observed in the past. Consumption indices for smallmouth bass remained unchanged while predation indices increased in the mid-reservoir area of Little Goose Reservoir. As with northern pikeminnow, the proportion of smallmouth bass stomach samples containing salmonids was highest in Lower Granite Reservoir. However, the prey fish most often consumed by smallmouth bass were *Percopsis* and *Cottus* spp. Proportional stock density values for smallmouth bass in the Snake River reservoirs continued to be less than those indicative of a balanced population, and relative weights appeared to be within the range of recent years.

6. We captured a walleye ($n$ = 1) for the first time in Ice Harbor Reservoir, and several walleye were found in Lower Monumental Reservoir, as in previous years. Thus, walleye densities were very low in the lower Snake pools indexed in 2010. Of the five walleye stomach content samples we collected and examined, one contained juvenile salmonid remains. Walleye relative weights were within the range of previous years, but our sample size was too small to calculate stock densities.

7. At this time, there does not appear to be a system-wide predator response to the NPMP. However, because responses to fisheries management programs may not be detected for several years, we recommend continued monitoring of predator populations in the Snake River.

**Report D**

***Dam angling at The Dalles and John Day dams***

1. The 16 week fishery took place at The Dalles and John Day dams from mid-May through the end of August, 2010.

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 two dams while collecting, compiling and reporting data on harvest, CPUE, gear/techniques and incidental catch of other species; c) scan all northern pikeminnow for the presence of consumed salmonid PIT tags and record any external spaghetti tags, fin-clips or signs of tag loss; and d) collect biological data on all northern pikeminnow and other fishes caught.

3. Harvests for the 16 week fishery at the two dams were 1,323 northern pikeminnow at The Dalles dam and 2,675 northern pikeminnow at John Day dam. The total fishing time at the two dams was 1,816.7 hours for a combined overall average catch per angler hour of 2.2 fish. The catch at The Dalles dam was 1.42 fish per angler hour and at John Day dam, 3.03 fish per angler hour.

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

5. Incidental species most frequently caught and released at both dams were smallmouth bass *Micropterus dolomieu,* walleye *Sander vitreus,* white sturgeon *Acipenser transmontanus* and sculpin *Cottus* spp.

6. The mean fork length of northern pikeminnow caught from the dams was larger than that from the sport reward fishery - 367mm vs. 282 mm respectively.

**REPORT A**

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

Prepared by

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

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, 2010. 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 fish species caught.

A total of 174,289 northern pikeminnow $\geq$ 228 mm, and 6,777 pikeminnow < 228 mm were harvested during the 2010 NPSRF season. There were a total of 3,313 different anglers who spent 25,361 angler days participating in the fishery during the 2010 season. Catch per unit effort for combined returning and non-returning anglers was 6.87 fish/angler day. The Oregon Department of Fish and Wildlife (ODFW) estimated that the northern pikeminnow harvest activities (from the 2010 NPSRF) reported on in this report, resulted in an overall exploitation rate of 18.8% (Report C, this document).

Anglers submitted 213 northern pikeminnow with external spaghetti tags, all of which also had ODFW PIT tags. There were also 111 northern pikeminnow with ODFW PIT tags only, but missing spaghetti tags. An additional 109 PIT tags were recovered from juvenile salmonids ingested by northern pikeminnow received during the 2010 NPSRF.

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

## INTRODUCTION

Mortality of juvenile salmonids *Oncorhynchus* spp. migrating through the Columbia River system is a major concern of the Columbia Basin Fish and Wildlife Program, and predation is an important component of mortality (NPPC 1987a). Northern pikeminnow *Ptychocheilus oregonensis*, formerly known as northern squawfish (Nelson et al. 1998), are the primary piscine predator of juvenile salmonids in the Lower Columbia and Snake River Systems (Rieman et al. 1991). Rieman and Beamesderfer (1990) predicted that predation on juvenile salmonids could be reduced by up to 50% with a sustained exploitation rate of 10-20% on northern pikeminnow > 275 mm FL (11 inches total length). The Northern Pikeminnow Management Program (NPMP) was created in 1990, with the goal of implementing fisheries to achieve the recommended 10-20% annual exploitation on northern pikeminnow >275 mm FL within the program area (Vigg and Burley 1989). In 2000, NPMP administrators reduced the minimum size for eligible (reward size) northern pikeminnow to 228 mm FL (9 inches total length) in response to recommendations contained in a review of NPMP justification, performance, and cost-effectiveness (Hankin and Richards 2000). Beginning in 1991, the Washington Department of Fish and Wildlife (WDFW) was contracted to conduct the NPSRF component of the NPMP (Burley et al. 1992). The NPSRF enlists recreational anglers to harvest reward sized ($\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 3.7 million reward sized northern pikeminnow and spent over 743,000 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 2010 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 2010 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.

## METHODS OF OPERATION

### Fishery Operation

### Boundaries and Season

The 2010 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, 2010. In addition, fifteen stations conducted a ten day "post-season extension" beginning on October 1, 2010 in order to take advantage of favorable river conditions and provide anglers with an extended opportunity to harvest northern pikeminnow.

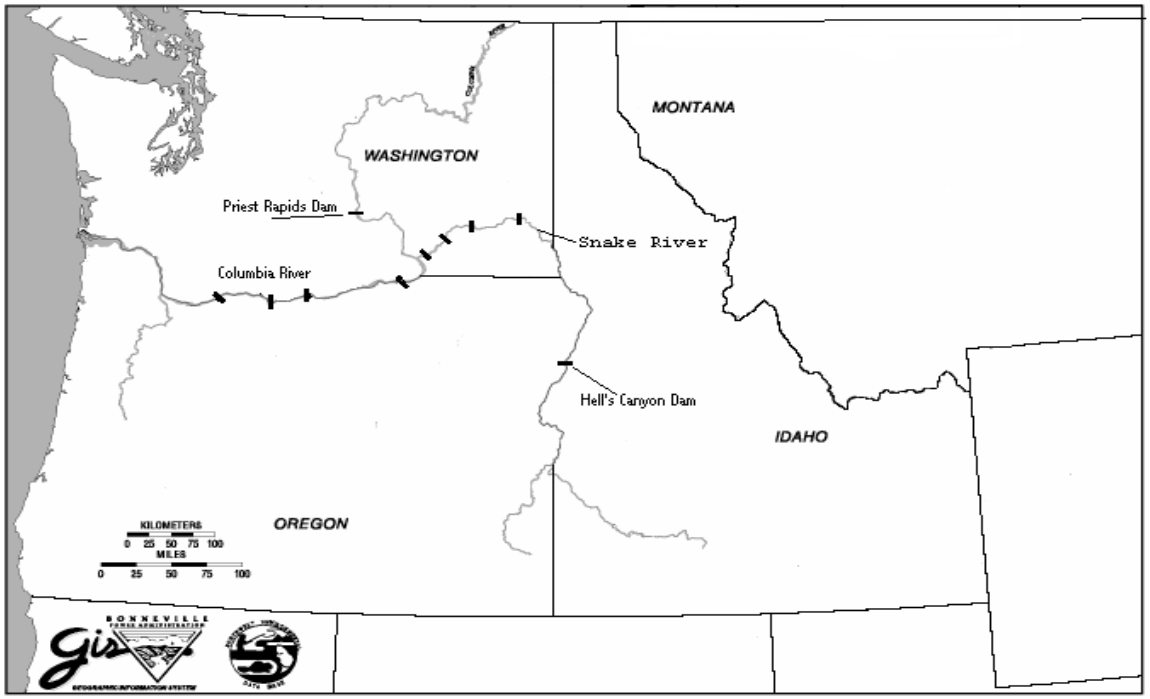



**Figure 1. Northern Pikeminnow Sport-Reward Fishery Program Area**

### 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 between two and eight hours per day during the season. Technicians registered anglers to participate in the NPSRF, collected angler creel information,

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


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

**Figure 2. 2010 Northern Pikeminnow Sport Reward Fishery Registration Stations**

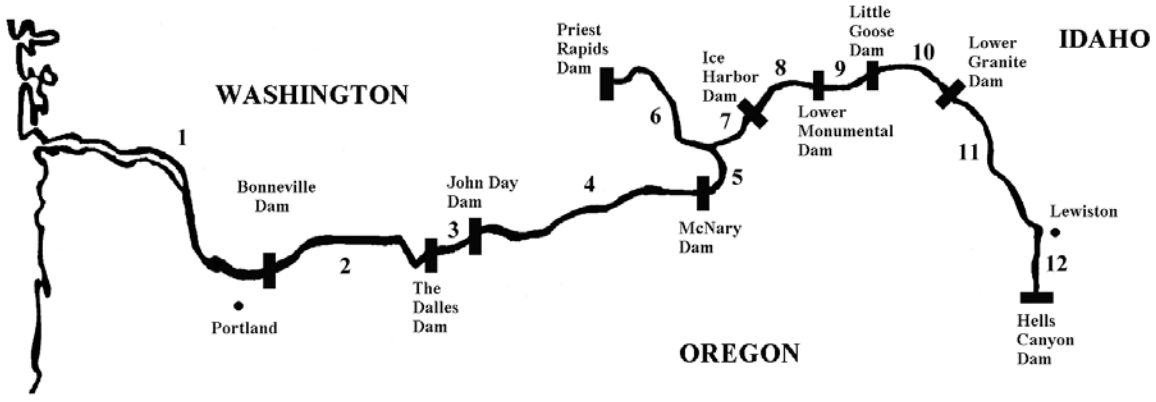
## Reward System

The 2010 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 2010 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".




Fishing Locations:

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

**Figure 3. Fishing location codes used for the 2010 Northern Pikeminnow Sport-Reward Fishery**

### Returning Anglers

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

### Non-Returning Anglers

Non-returning angler data were compiled from the pool of anglers who had registered for the NPSRF and targeted northern pikeminnow, but did not return to a registration station to participate in an exit interview. WDFW attempted to survey 20% of the NPSRF's non-returning anglers using a telephone survey in order to obtain creel data from that segment of the NPSRF's participants. To obtain the 20% sample, non-returning anglers were randomly selected from each registration station for each week. A technician called anglers from each random sample until the 20% sample was attained. Non-returning anglers were surveyed with the same exit interview questions used for returning anglers. Anglers were asked: "did you specifically fish for northern pikeminnow at any time during your fishing trip?" With a "Yes" response, anglers were asked to report the number and species of adult and/or juvenile salmonids and the number of reward size northern pikeminnow that were caught and harvested/released while they targeted northern pikeminnow. Angler catch and harvest data were not collected from non-returning anglers who did not target northern pikeminnow on their fishing trip. In addition, non-returning angler catch and harvest data for non-salmonid species were once again collected in 2010 to determine whether there was any variance from the consistent trends observed over the NPSRF's previous 19 year history (Winther et al. 1996), and/or from when this data was last obtained in 2005 (Bruce et al. 2005). These data will not be again collected until 2015 unless results indicate variance from non-returning angler trends observed to date within the Sport-Reward Fishery.

## Northern Pikeminnow Handling Procedures

### Biological Sampling

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

## PIT Tag Detection

All northern pikeminnow collected during the 2010 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 2010 were caudal clipped rather than eviscerated in order to facilitate more accurate recovery of PIT tags. Sampled northern pikeminnow were iced and transported to cold storage facilities from which they were ultimately delivered to rendering facilities for final disposal.

## RESULTS AND DISCUSSION

### Northern Pikeminnow Harvest

The NPSRF harvested a total of 174,289 reward size northern pikeminnow (≥ 228 mm TL) during the 2010 season, operating during 23 weeks, plus a 10 day extension (at limited stations). The 2010 NPSRF had one less day of fishing than the 2009 NPSRF (Hone et al. 2009), but 2010 harvest was 32,287 fish higher than 2009, and very near the mean 1991-2009 harvest of 176,062 fish (Figure 4). The 2010 NPSRF also achieved an exploitation rate of 18.8% (Report C, this document) which was near the upper end of the 10-20% exploitation goal of NPMP. In addition to harvesting 174,289 reward size northern pikeminnow, the 2010 NPSRF also harvested 6,777 northern pikeminnow < 228 mm TL.

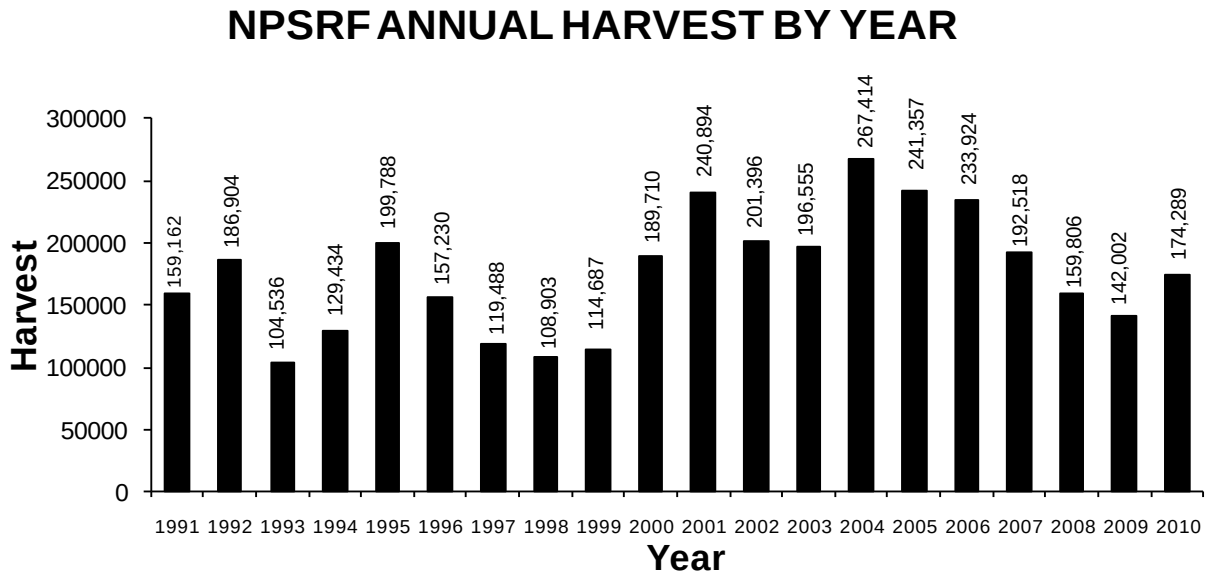



**Figure 4. Annual Harvest Totals for the Northern Pikeminnow Sport Reward Fishery**

### Harvest by Week

Peak weekly harvest for the 2010 NPSRF was 11,574 fish and occurred during week 27 of the season (Figure 5). Mean weekly harvest (regular season + extension) was 7,262 fish, even though the data week for the May 1st opener only included only 2 days and 1,561 fish. Both peak weekly harvest and peak mean harvest were well above 2009 levels (9,217 and 5,950 respectively). Peak harvest was two weeks later than 2009 and weekly harvest totals for the 2010 NPSRF were above the weekly totals for 2009 with the exception of 4 weeks (Figure 6). Peak harvest was one week later than the NPSRF's historical 1991-2009 peak in week 26 (Fox et al. 1999) and other than the second week of the season (week 19), weekly harvest for the 2010

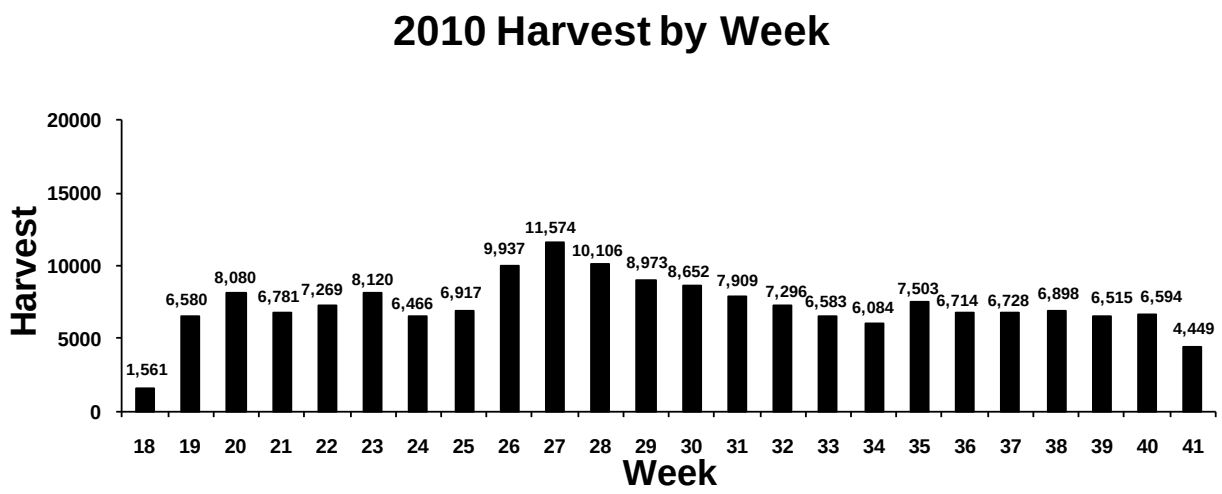



**Figure 5. 2010 Weekly Northern Pikeminnow Sport-Reward Fishery Harvest.**

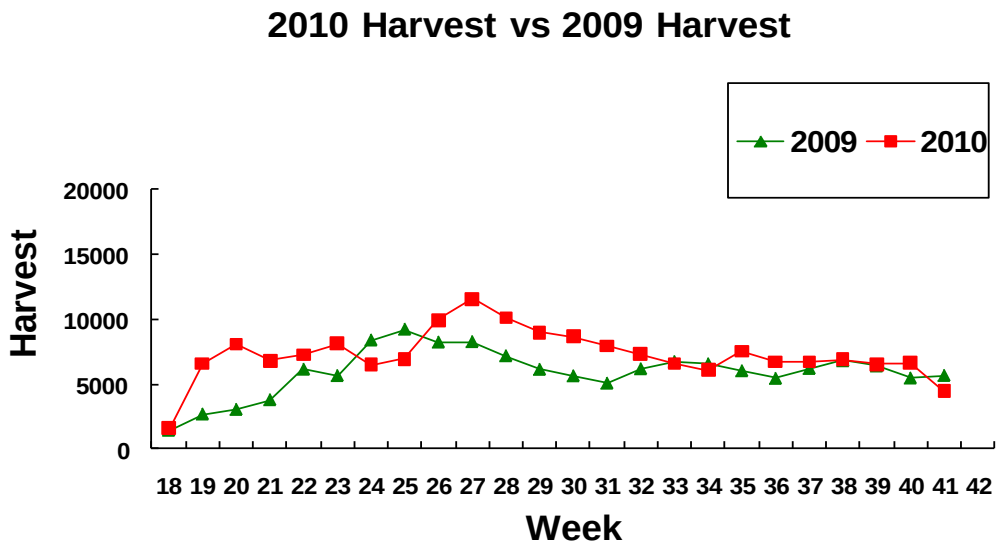



**Figure 6. 2010 Weekly NPSRF Harvest vs. 2009 Weekly Harvest.**

NPSRF was lower than mean 1991-2009 weekly harvest levels for the first half of the season (Figure 7). Weekly harvest then picked up right before the second half of the season and stayed at or above historical 1991-2009 weekly harvest levels for the remainder of the regular season and through the extension. If it were not for a two week downturn in harvest that coincided with high river flows during weeks 24 and 25, NPSRF harvest in 2010 would have almost exactly followed the seasonal harvest pattern typical for most of the previous 19 NPSRF seasons.

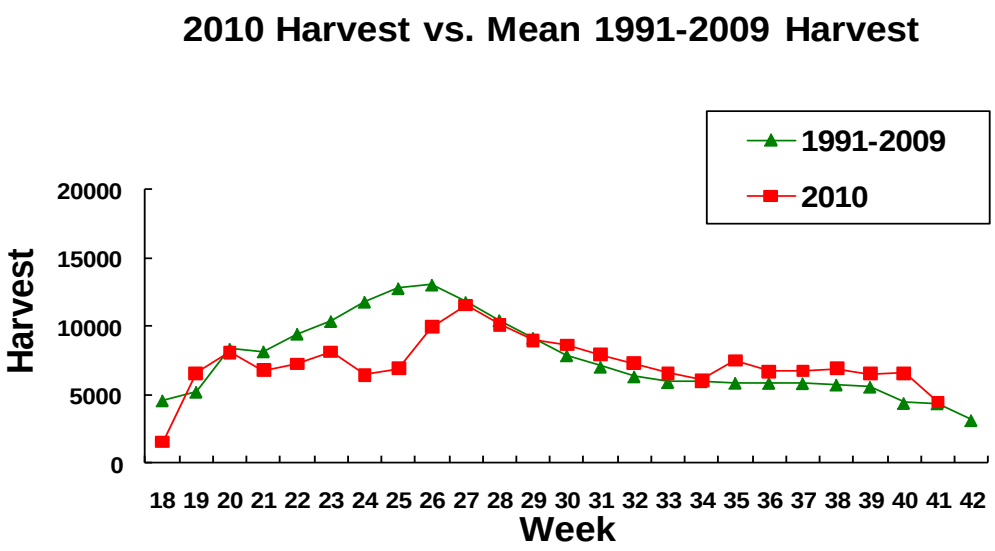



**Figure 7. Comparison of 2010 NPSRF Weekly Harvest to 1991-2009 Mean Weekly Harvest.**

## Harvest by Fishing Location

The mean harvest by fishing location for the 2010 NPSRF was 14,524 northern pikeminnow and ranged from 73,499 reward size northern pikeminnow in fishing location 01 (below Bonneville Dam) to 300 northern pikeminnow from fishing location 07 (Mouth of the Snake River to Lower Monumental Dam) (Figure 8). Harvest from Fishing Location 01 (the Columbia river below Bonneville Dam) accounted for 42% of total NPSRF harvest and was once again the highest producing area as it has been for each year since 1991. Fishing location 02 (Bonneville Reservoir) was the second best area (in terms of total harvest) accounting for 22% of total 2010 NPSRF harvest. Bonneville Pool (Fishing location 02) reclaimed the number two harvest position for the first time since 2007 returning to the high harvest levels first documented during the 2004 NPSRF (Hone et al. 2004). Once again, the primary area of harvest for this fishing location is in the tailrace area of The Dalles Dam, especially during the first 6 weeks of the season where NPSRF technicians recorded exceptionally large catches from anglers fishing exclusively in this area. The area immediately below Lower Granite Dam (Fishing location 10) also continued to be a top producer with 18% of total 2010 NPSRF harvest.

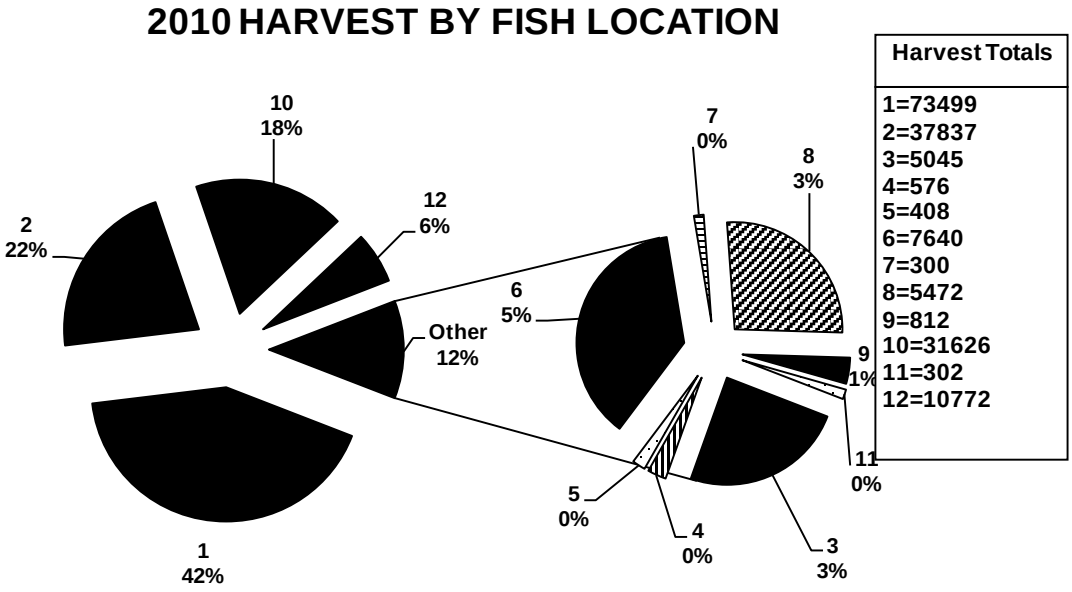



**Figure 8. 2010 Northern Pikeminnow Sport-Reward Fishery Harvest by Fishing Location.***
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the 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 2010 was up (from 2009 levels) at 10 of the 18 registration stations that were also operated during the 2009 NPSRF (there were 3 new stations in 2010). Boyer Park was the NPSRF's top producing station for the fourth consecutive season (Figure 9). Boyer Park anglers harvested 30,971 northern pikeminnow (up from 27,434 in 2009), equaling 17.8% of the total 2010 NPSRF harvest. The average harvest per registration station was 8,299 reward size northern pikeminnow, up from 7,889 per station in 2009. The registration station with the smallest harvest was the new station at Arlington where anglers harvested only 62 northern pikeminnow during the 2010 season. The Bingen and Lyon's Ferry registration stations showed the largest increase in harvest, more than doubling their harvest totals in 2010 (from 2,073 at Bingen and 1,961 at Lyon's Ferry in 2009).

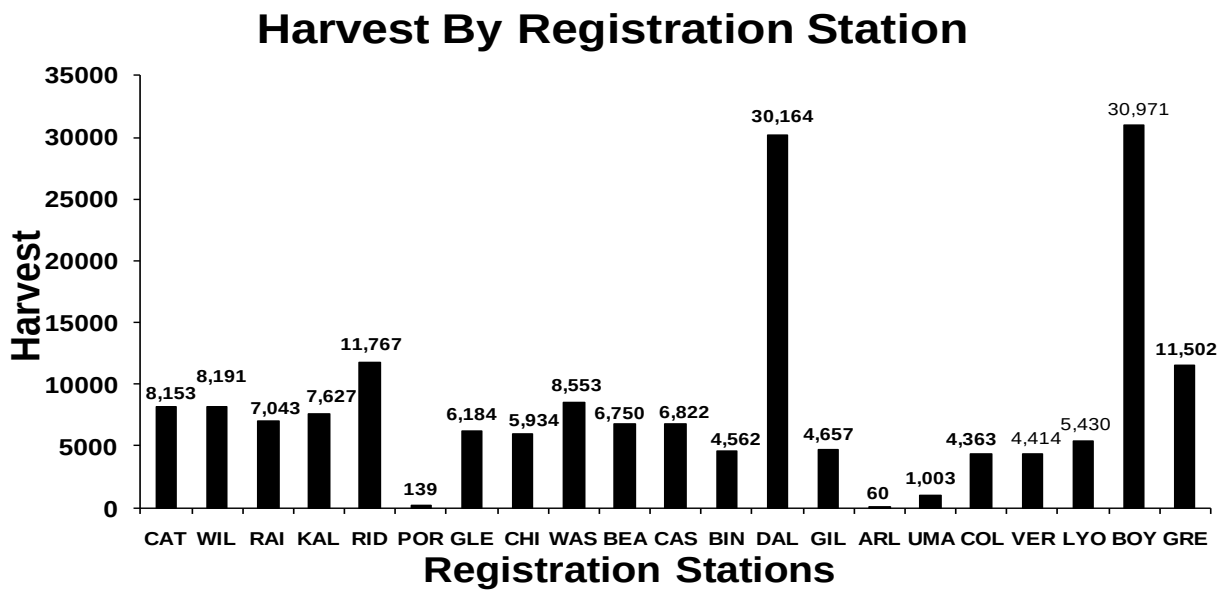



**Figure 9. 2010 Northern Pikeminnow Sport-Reward Fishery Harvest by Registration Station.**
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, POR-Portco, GLE-Gleason, CHI-Chinook, WAS-Washougal, BEA-Beacon Rock, CAS-Cascade Locks, BIN-Bingen, DAL- The Dalles, GIL-Giles, ARL- Arlington, 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 2010 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 2010.**

**Salmon**

| Species | Caught | Harvest | Harvest Percent |
|---|---|---|---|
| Chinook (Adult) | 33 | 4 | 12.12% |
| Chinook (Jack) | 14 | 7 | 50.00% |
| Chinook (Juvenile) | 282 | 0 | 0% |
| Coho (Adult) | 0 | 0 | 0 |
| Coho (Juvenile) | 3 | 0 | 0% |
| Cutthroat (Unknown) | 12 | 4 | 33.33% |
| Steelhead Adult (Hatchery) | 33 | 13 | 39.39% |
| Steelhead Adult (Wild) | 32 | 0 | 0% |
| Steelhead Juvenile (Hatchery) | 41 | 0 | 0% |
| Steelhead Juvenile (Wild) | 14 | 0 | 0% |

| | | | |
|---|---|---|---|
| Trout (Unknown) | 101 | 7 | 6.93% |

Anglers reported that all juvenile salmonids caught during the 2010 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 2010 NPSRF, but were only retained during legal salmonid fisheries. Instances where NPSRF anglers reported harvesting "trout" from the Snake River during a legal fishery are typically residualized hatchery steelhead smolts which are caught and kept by anglers, and misidentified as trout. Any NPSRF angler who reports illegally harvesting salmonids during the exit interview (whether juvenile or adult salmonids), are immediately reported to the appropriate enforcement entity by WDFW technicians.

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

**Table 2. Catch and Harvest of non-salmonids by Returning Anglers Targeting Northern Pikeminnow in 2010.**

**Non-Salmonid**

| Species | Caught | Harvest | Harvest Percent |
|---|---|---|---|
| Northern Pikeminnow ≥228mm | 174,309 | 174,289 | 99.99% |
| Northern Pikeminnow <228mm | 55,130 | 6,777 | 12.29% |
| Peamouth | 36,905 | 11,636 | 31.53% |
| Smallmouth Bass | 12,721 | 1,214 | 9.54% |
| Sculpin (unknown) | 8,408 | 4,270 | 50.78% |
| White Sturgeon | 3,691 | 49 | 1.33% |
| Yellow Perch | 3,518 | 733 | |
| Sucker (unknown) | 2,859 | 349 | 12.21% |
| Starry Flounder | 980 | 112 | 11.43% |
| Catfish (unknown) | 913 | 152 | 16.65% |
| Walleye | 791 | 456 | 57.65% |
| Carp | 543 | 109 | 20.07% |
| Chiselmouth | 500 | 54 | 10.80% |
| American Shad | 161 | 82 | 50.93% |
| Bullhead (unknown) | 144 | 21 | 14.58% |
| Redside Shiner | 131 | 0 | 0% |
| Sandroller | 116 | 0 | 0% |
| Pumpkinseed | 84 | 69 | 82.14% |
| Bluegill | 84 | 19 | 22.62% |
| Whitefish | 24 | 7 | 29.17% |
| Largemouth Bass | 21 | 3 | 14.29% |
| Crappie (unknown) | 12 | 0 | 0% |

*Non-returning Anglers Catch and Harvest Estimates*

We randomly surveyed 1,913 non-returning anglers (24% of all non-returning anglers) to record their catch and/or harvest of reward sized northern pikeminnow or any salmonid species. Catch and harvest data for other fish species caught by non-returning anglers were also collected in 2010 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 2010 NPSRF. A simple estimator (i.e., based on the subsample percentage) 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 2010 NPSRF. Estimated totals are listed in columns 4 and 5 of Table 3. Estimated catch for non-returning anglers participating in the 2010 NPSRF was higher for the 11 species highlighted below (compared to non-returning anglers from the 2005 NPSRF), although estimated harvest for those species was below 2005 levels for all species except yellow perch, suckers, and adult chinook salmon. Catch and harvest levels for all species by non-returning NPSRF anglers continued to remain low in 2010, illustrating once again that non-returning anglers are less proficient at catching fish than are returning anglers. We anticipate once again collecting full catch and harvest data for all species from surveyed non-returning anglers in 2015 to determine whether this trend has changed.

**Table 3. 2010 NPSRF Catch and Harvest for surveyed Non-returning Anglers and Estimated non-return angler catch and harvest totals. Note: highlighted values are species that had a higher catch in the 2010 than the 2005 NPSRF.**

| Species | Caught | Harvested | %Harvested | Estimated Total Catch | Estimated Total Harvest |
|---|---|---|---|---|---|
| Northern Pikeminnow ≥ 228 mm | 74 | 58 | 78.4 | 309 | 242 |
| Northern Pikeminnow < 228 mm | 1063 | 36 | 3.4 | 4433 | 150 |
| Peamouth | 1111 | 157 | 14.1 | 4633 | 655 |
| Smallmouth bass | 762 | 114 | 15.0 | 3178 | 475 |
| White Sturgeon | 185 | 0 | 0.0 | 771 | 0 |
| Yellow Perch | 179 | 6 | 3.4 | 746 | 25 |
| Bullhead | 177 | 11 | 6.2 | 738 | 46 |
| Sculpin (combined species) | 165 | 0 | 0.0 | 688 | 0 |
| Sucker (combined species) | 121 | 22 | 18.2 | 505 | 92 |
| Starry Flounder | 58 | 1 | 1.7 | 242 | 4 |
| Channel Catfish | 48 | 10 | 20.8 | 200 | 42 |
| Carp | 40 | 22 | 55.0 | 167 | 92 |
| Walleye | 23 | 17 | 73.9 | 96 | 71 |
| Chiselmouth | 12 | 7 | 58.3 | 50 | 29 |
| American Shad | 4 | 0 | 0.0 | 17 | 0 |
| Crappie | 2 | 0 | 0.0 | 8 | 0 |
| Trout, unknown | 37 | 0 | 0.0 | 154 | 0 |
| Steelhead (juvenile – adipose absent) | 12 | 0 | 0.0 | 50 | 0 |
| Steelhead (adult – adipose absent) | 3 | 0 | 0.0 | 13 | 0 |
| Chinook Salmon (adult) | 2 | 1 | 50.0 | 8 | 4 |
| Chinook Salmon (jack) | 1 | 0 | 0.0 | 4 | 0 |
| Chinook Salmon (juvenile) | 1 | 0 | 0.0 | 4 | 0 |
| Steelhead (adult - adipose present) | 1 | 0 | 0.0 | 4 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| Steelhead (juvenile - adipose present) | 1 | 0 | 0.0 | 4 | 0 |

**N = 7,972 n = 1,913**

*Fork Length Data*

The length frequency distribution of harvested northern pikeminnow ( ≥ 200 mm) from the 2010 NPSRF is presented in Figure 10. Fork length data for a total of 65,914 northern pikeminnow (38% of total) were taken during the 2010 NPSRF. The mean fork length for all measured northern pikeminnow (≥ 200 mm) in 2010 was 281.7 mm (SD= 70.6 mm), down from 291.4 in 2009.

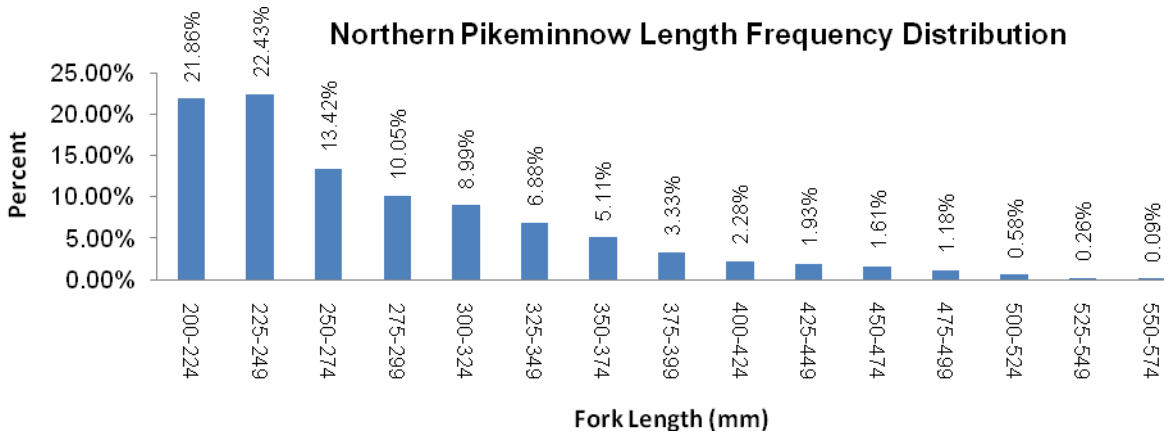



**Figure 10. Length frequency distribution of northern pikeminnow ≥ 200 mm FL from 2010 NPSRF.**

## Angler Effort

The 2010 NPSRF recorded total effort of 25,361 angler days spent during the season, a decrease of 3,751 angler days from the effort total of the previous year (Hone et al. 2009) (Figure 11). When total effort is divided into returning and non-returning angler days, 17,389 angler days (69%) were recorded by returning anglers, and 7,972 were non-returns. The percentage of returning anglers showed an increase from 2009 (66%) and returned to the upward trend that the NPSRF had seen prior to 2008. In addition, 69% of total effort, and 85% of returning angler effort (14,728 angler days), was attributed to successful anglers who harvested at least 1 northern pikeminnow in 2010.

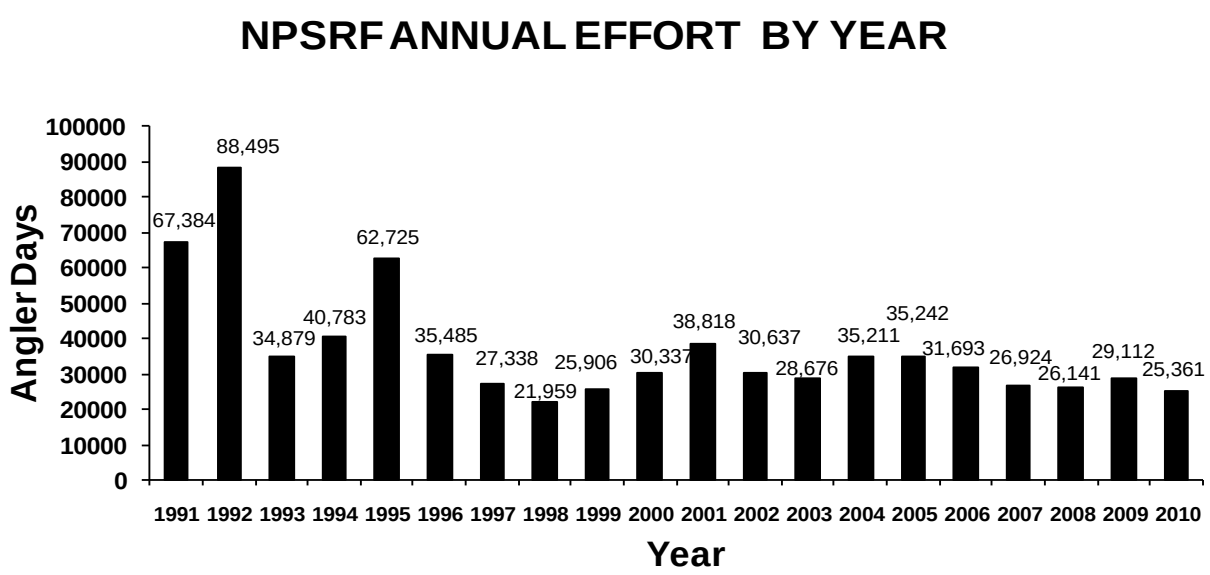



**Figure 11. Annual Northern Pikeminnow Sport-Reward Fishery Effort.**

### Effort by Week

Mean weekly effort for the 2010 NPSRF was 1,057 angler days during the season, with the peak occurring in the third week of the season and then spiking again in week 26 (Figure 12). Peak weekly effort typically occurs near peak weekly harvest in mid to late June, but this season there were two peaks as excellent angling success during the first three weeks of the season at The Dalles station resulted in an early surge of effort which was later followed by the traditional peak near the harvest peak. Overall mean weekly effort decreased from 1,213 in 2009 to 1,057 in 2010 (Winther et al. 2008). The weekly effort totals for the 2010 NPSRF generally followed the pattern of previous seasons although lower than historical 1991-2009 effort levels that were buoyed by heavy participation in the first few years of the NPSRF (Figure 13).

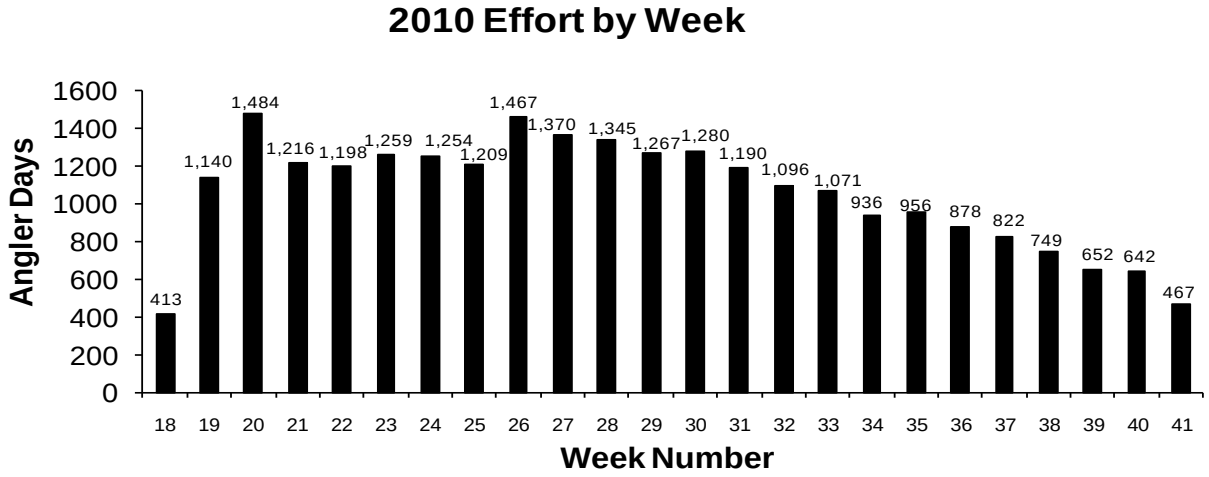



**Figure 12. 2010 Weekly Northern Pikeminnow Sport-Reward Fishery Effort vs 2009 Weekly Effort.**

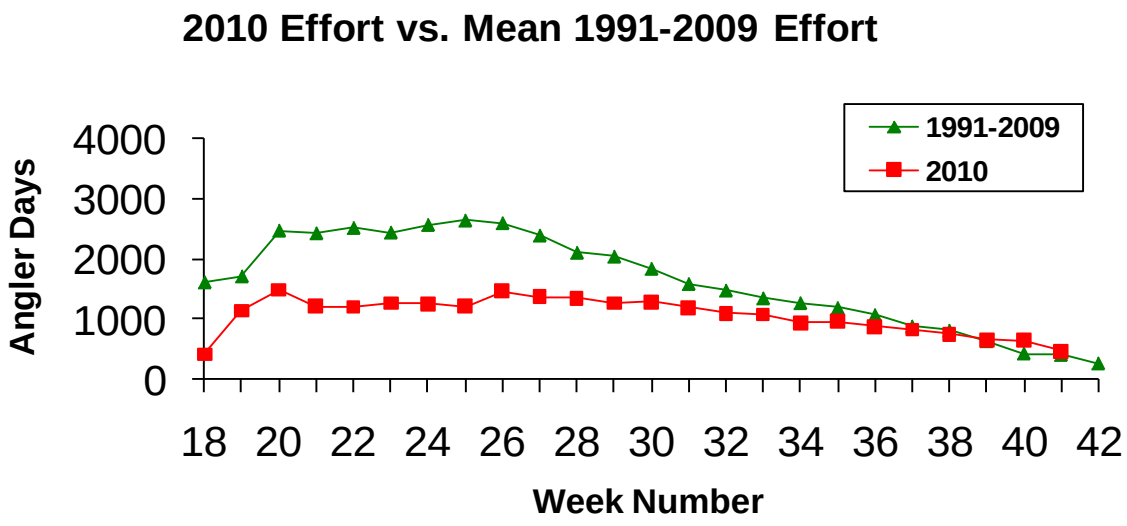



**Figure 13. 2010 NPSRF Weekly Effort vs. Mean 1991-2009 Effort.**

### Effort by Fishing Location

Mean annual effort by fishing location for the 2010 NPSRF (returning anglers only) was 1,449 angler days compared to 1,590 angler days in 2009. Effort totals ranged from 7,567 angler days recorded below Bonneville Dam (fishing location 01) to only 36 angler days spent in fishing location 07 on the Snake River (Mouth of the Snake River to Ice Harbor Dam) (Figure 14). A 23.8% increases in effort at fishing locations 02 (The Dalles Dam to John Day Dam) helped compensate for the fact that effort decreased at eight of the twelve NPSRF fishing locations.

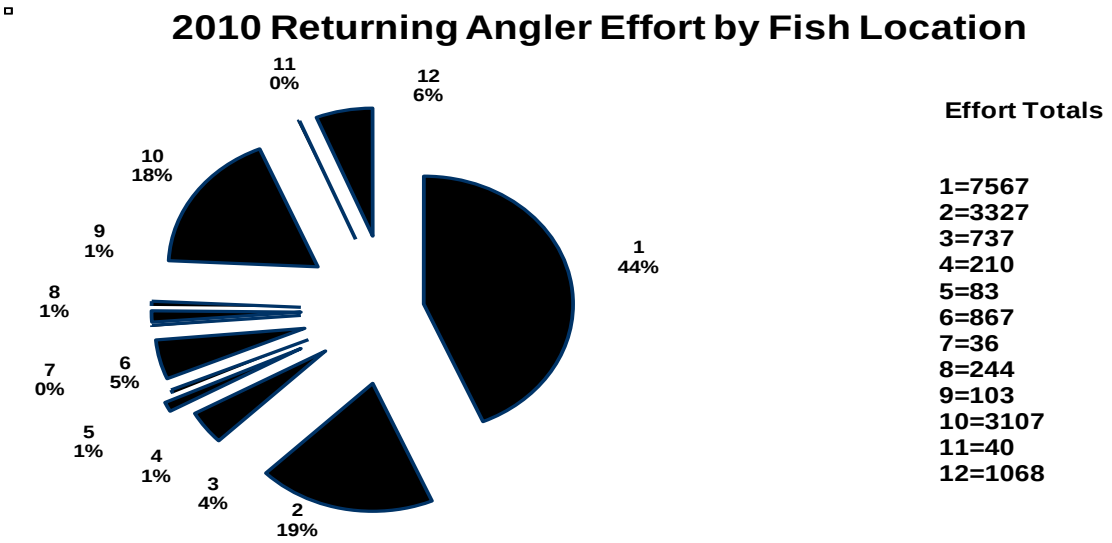



**Figure 14. 2010 NPSRF Angler Effort by Fishing Location (returning anglers only).***
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake 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 2010 NPSRF was 1,208 angler days compared to 1,617 angler days in 2009. Effort totals ranged from 3,932 angler days at The Dalles station to 39 angler days at the new Arlington station (Figure 15). Effort during the 2010 NPSRF decreased at fifteen of the eighteen registration stations that were also operated in 2009. Effort increased at three stations, most notably at the Bingen station where effort increased by 61% with an additional 311 angler days spent in 2010. We saw the largest decline in effort (from 2009) at the Cathlamet station where we lost 975 angler days of effort.

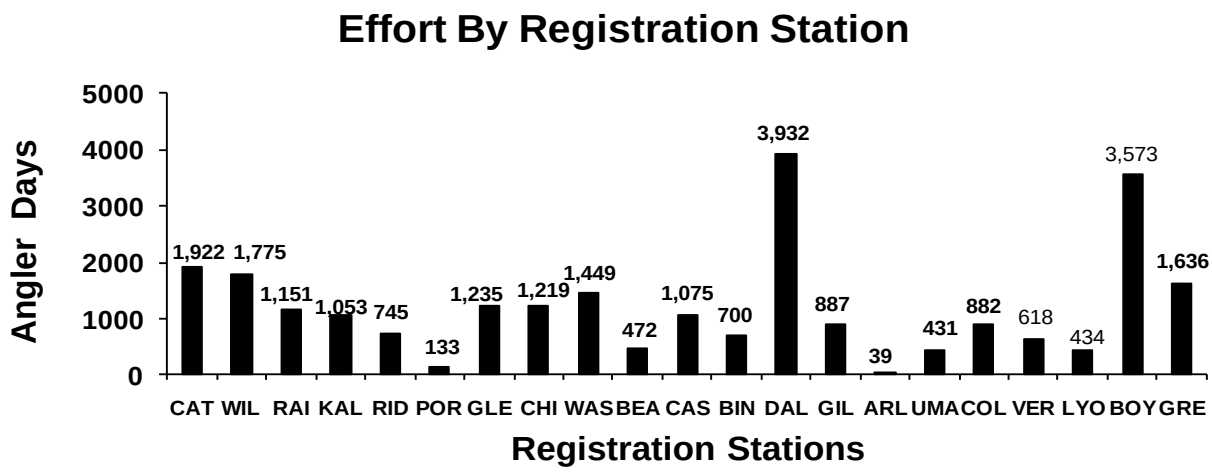



**Figure 15. 2010 Northern Pikeminnow Sport-Reward Fishery Angler Effort by Registration Station.**
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, POR-Portco, GLE-Gleason, CHI-Chinook, WAS-Washougal, BEA-Beacon Rock, CAS-Cascade Locks, BIN-Bingen, DAL-The Dalles, GIL-Giles, ARL-Arlington, UMA-Umatilla, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, BOY-Boyer Park, GRE-Greenbelt.

## Catch Per Angler Day (CPUE)

The 2010 NPSRF recorded an overall (returning + non-returning anglers) catch per unit of effort (CPUE) of 6.87 northern pikeminnow harvested per angler day during the 2010 season. This catch rate increased from 4.88 in 2009 (Hone et al. 2009) and was also higher than the 6.11 CPUE recorded during the 2008 NPSRF (Winther et al. 2008) (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 (Hone et al. 2009). The 2010 NPSRF was conducted without the use of any random drawings or other incentives attracting inexperienced anglers and angler CPUE rebounded to near pre-drawing (2007) levels. Returning angler CPUE during the 2010 NPSRF was 10.02 northern pikeminnow per angler day, up from both 2009 and 2008 (7.44 and 8.86 respectively), and near the 2007 level of 10.5. We estimate that CPUE for non-returning anglers is 0.03 reward sized northern pikeminnow per angler day based on 2010 NPSRF phone survey results.

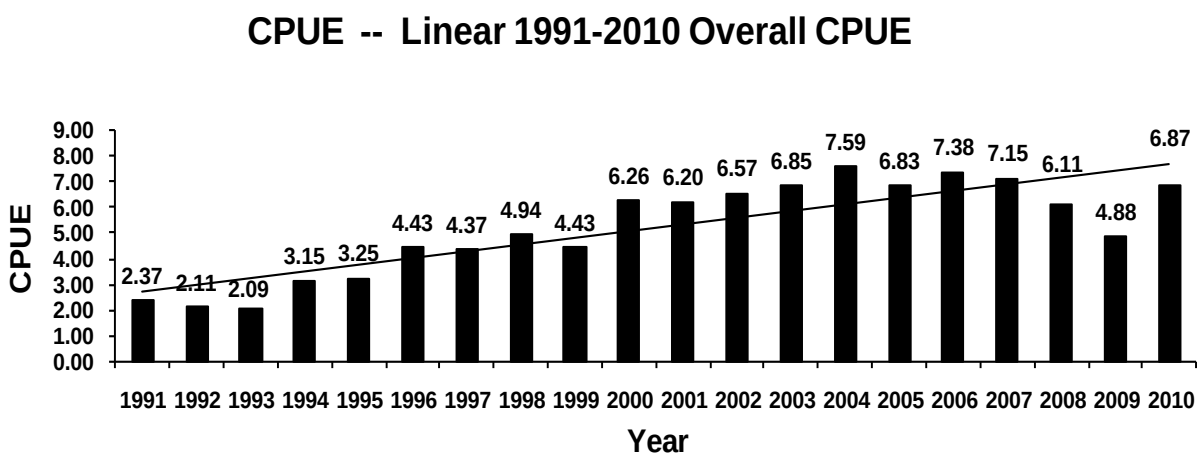



**Figure 16. Annual NPSRF CPUE (returning + non-returning anglers) for the years 1991-2010.**

## CPUE by Week

Mean angler CPUE by week for the 2010 NPSRF was 7.05 fish per angler day compared to 5.45 in 2009. CPUE ranged from 3.78 in week 18 (May 1-2) to a peak of 10.27 in week 40 (September 27-October 3) (Figure 17). As has historically been the case, weekly CPUE for the 2010 NPSRF followed the two peak pattern where catch rates spike upward near peak harvest (week 26) and then again late in the season.

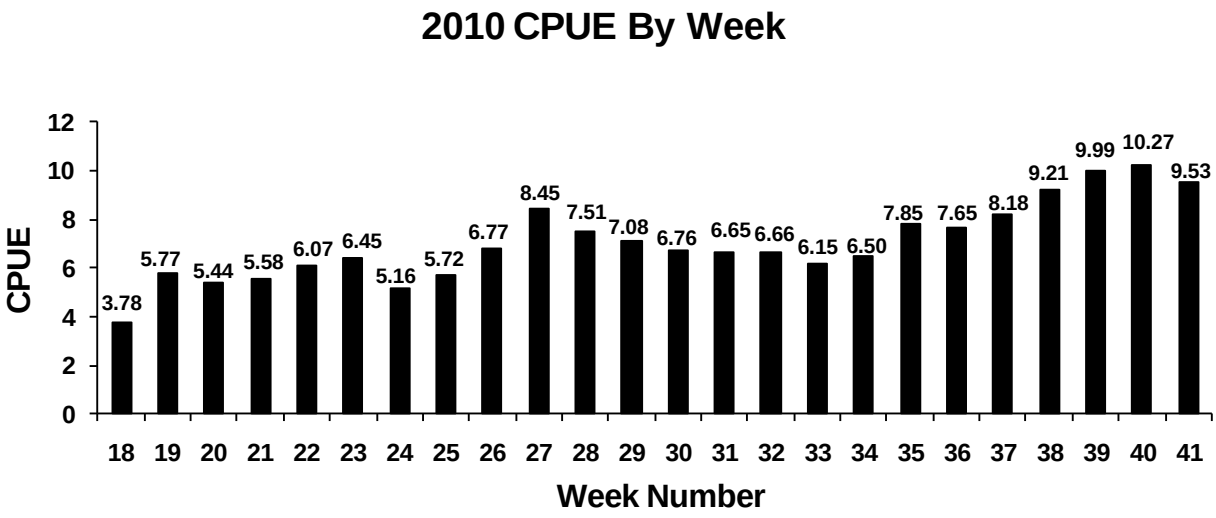



**Figure 17. 2010 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Week.**

## CPUE by Fishing Location

Angler success rates for the 2010 NPSRF, as indicated by CPUE, are available for returning anglers only and varied by fishing location. Success rates ranged from a high of 22.43 fish per angler day in fishing location 08 (Ice Harbor Reservoir) to 2.74 fish per angler per day in fishing location 04 (John Day Dam to McNary Dam) (Figure 18). Catch rates were up from 2009 at all fishing locations except The Dalles and John Day Pools (Fishing Locations 03 and 04 respectively) as well as fishing location 07 (the mouth of the Snake River to Ice Harbor Dam). The average CPUE by fishing location was 9.24 northern pikeminnow per angler day in 2010 compared to 7.52 in 2009.

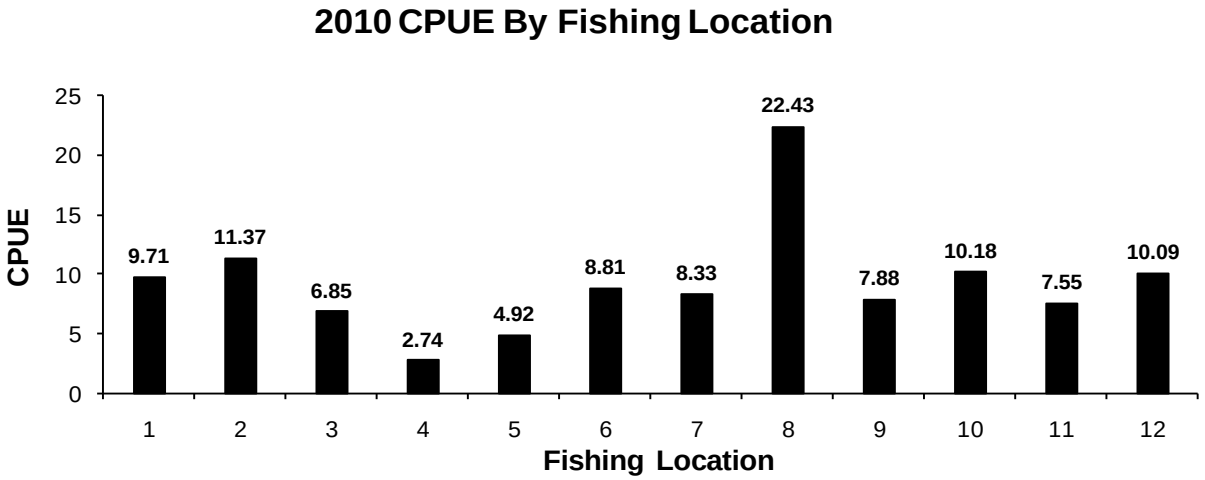



**Figure 18. 2010 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Fishing Location.***
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of 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

For the second consecutive year the registration Station with the highest CPUE during the 2010 NPSRF was the Ridgefield station where anglers averaged 15.79 northern pikeminnow per angler day (Figure 19). The registration station with the lowest CPUE was the new Portco station with a CPUE of 1.05 northern pikeminnow per angler day. The station average for angler CPUE was 6.62, up from 4.94 in 2009. Average angler CPUE by registration station increased at all but four stations during the 2010 NPSRF, and the four that did decline were down just slightly from 2009. The Lyon's Ferry station had the largest change in CPUE, more than doubling from 5.04 in 2009 to 12.51 in 2010.

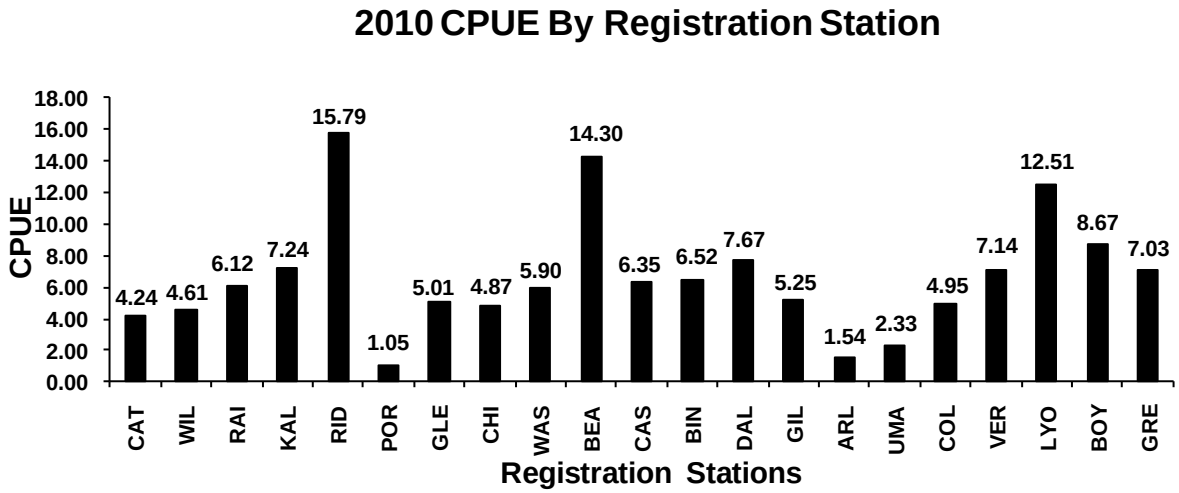



**Figure 19. 2010 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Registration Station.**
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, POR-Portco, GLE-Gleason, CHI-Chinook, WAS-Washougal, BEA-Beacon Rock, CAS-Cascade Locks, BIN-Bingen, DAL-The Dalles, GIL-Giles, ARL-Arlington, UMA-Umatilla, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, BOY-Boyer Park, GRE-Greenbelt.

## Angler Totals

There were 3,313 separate anglers who participated in the 2010 NPSRF, a decrease of 1,166 participants from 2009 (Hone et al. 2009). One thousand, three hundred and eleven of these anglers (39.6% of total vs 35.5% in 2010) were classified as successful since they harvested at least one reward size northern pikeminnow (for which a voucher was issued) during the 2010 season. Of the successful anglers, 82% (1,075 anglers) sent in their vouchers to PSMFC for payment (PSMFC personal communication). The average successful angler harvested 133 northern pikeminnow during the 2010 NPSRF, although when we break down the 1,311 successful anglers by tier, most anglers (1,091 anglers = 83%) harvested fewer than 100 northern pikeminnow and were classified as Tier 1 anglers (Figure 20). One hundred and eleven anglers (9%) reached Tier 2 status by harvesting between 101 and 400 northern pikeminnow, and 109 anglers (8%) reached Tier 3 status by harvesting more than 400 northern pikeminnow in 2010. The 109 anglers who reached Tier 3 also represent only 3.3% of all angler participants (both returning and non-returning anglers) during the 2010 NPSRF. The number of anglers reaching each of the three tiers during the 2010 NPSRF increased at Tier 3, was equal at Tier 2 and declined at Tier 1 compared to the previous year. The number of anglers at Tier 1 (<100 fish) during the 2010 NPSRF declined by 294 anglers from 2009 which was nearly the identical number of anglers gained in 2009 (281) from 2008 as a result of the random drawings (Winther et al 2008).

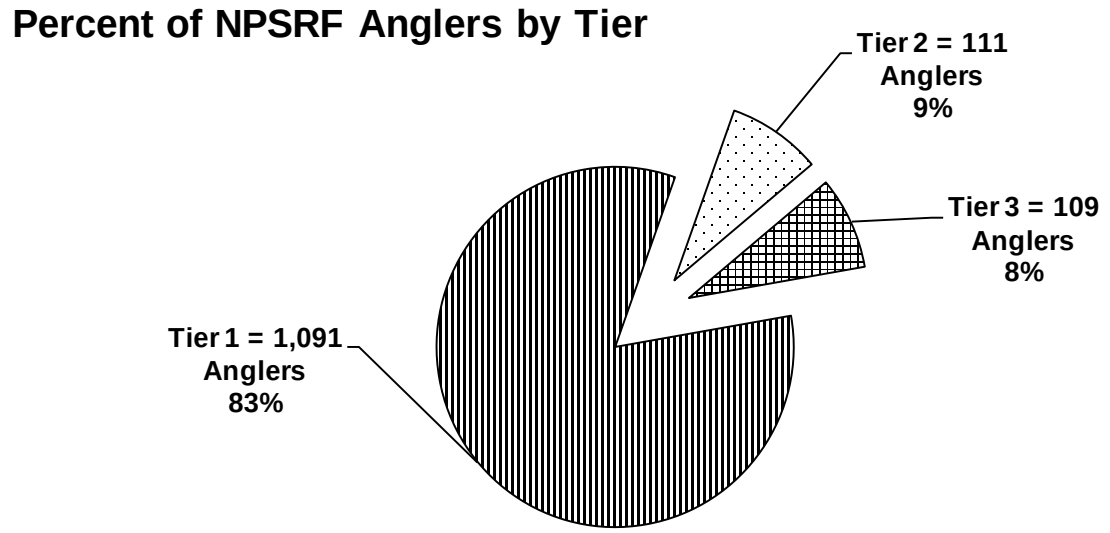



**Figure 20. 2010 NPSRF Anglers by tier (returning only) based on total # of fish harvested.**

While Tier 1 anglers made up more than 83% of all successful NPSRF participants in 2010, they only harvested 13,740 northern pikeminnow accounting for only 8% of total NPSRF harvest (Figure 21). This translated into an average of 13 fish per Tier 1 angler, per year. Tier 2 anglers harvested 22,429 northern pikeminnow equaling 13% of total 2010 NPSRF harvest and averaging 202 fish per Tier 2 angler, per year. Tier 3 anglers, also known as "highliners", harvested 138,120 northern pikeminnow equaling 79% of total 2010 NPSRF harvest and averaging 1,267 fish per Tier 3 angler, per year. The percentage of total harvest for Tier 3 anglers increased from 73% in 2009 to 79% in 2010, while the percentage of harvest for Tier 1 and Tier 2 anglers declined.

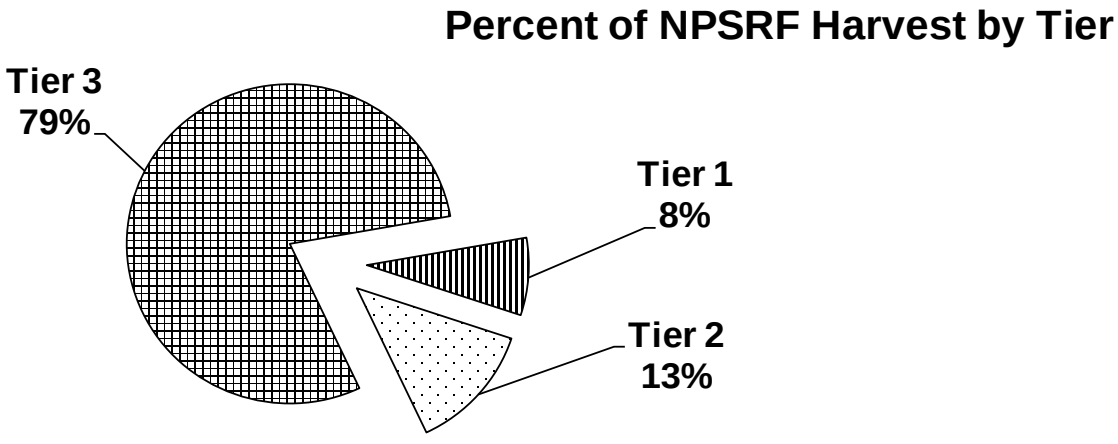



**Figure 21. 2010 NPSRF Harvest by Angler Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400).**

The average NPSRF participant (returning + non-returning anglers) expended more time (effort) pursuing northern pikeminnow during the 2010 season than in 2009 (7.67 vs. 6.50 angling days of effort). When we look at successful anglers only, Tier 1 anglers spent an average of 8 days fishing in the 2010 NPSRF compared to 7 days in 2009 (Figure 22). Tier 2 anglers spent an average of 41 days fishing for northern pikeminnow in 2010, down from 53 in 2009. Tier 3 anglers spent an average of 86 days fishing during the 2010 NPSRF, down from 91 days in 2009. The average number of days spent fishing by anglers at Tier 2 and 3 declined from the previous year, while the average number of days spent fishing by Tier 1 anglers increased by a day. As has been the trend in recent seasons, the NPSRF anglers who harvest the most fish (anglers from Tiers 3 and 2), also expend the most effort.

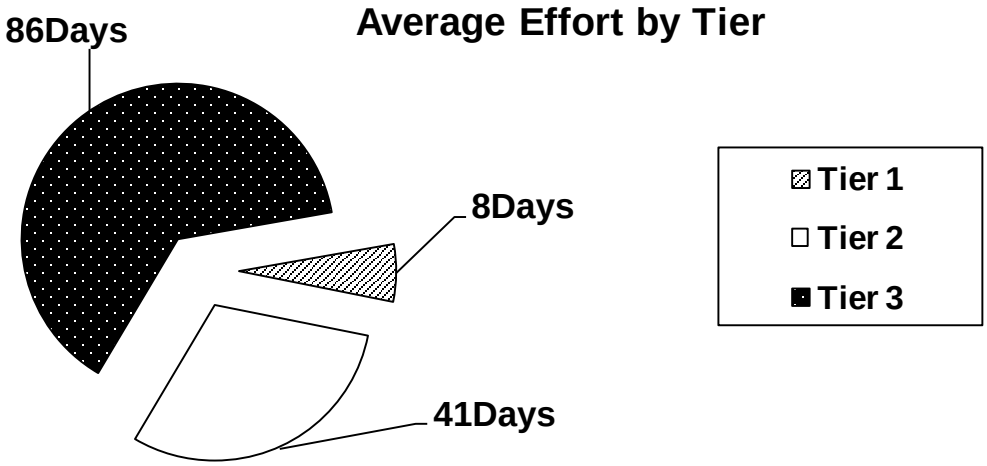



**Figure 22. Average Effort of 2010 NPSRF Anglers by Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400) .**

Overall angler CPUE for the 2010 NPSRF increased from 2009 and the fact that CPUE increased for all anglers at all tier levels (Figure 23) indicates that fishing conditions were more favorable than the previous year. CPUE for anglers at Tier 1 increased from 1.38 in 2009 to 1.64 in 2010. CPUE for Tier 2 anglers increased from 4.04 in 2009 to 4.91 in 2010, and CPUE for Tier 3 anglers jumped from 12.40 in 2009 to 14.77 in 2010.

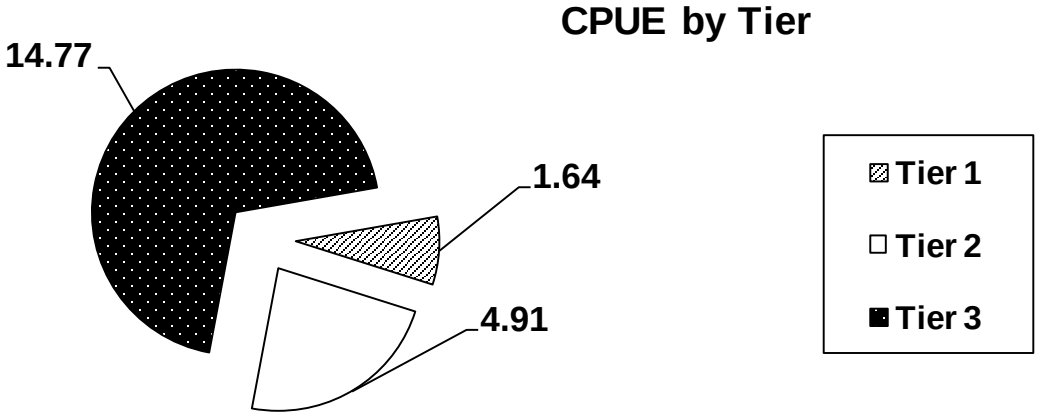



**Figure 23. Average CPUE of 2010 NPSRF Anglers by Tier (Tier 1 = <100, Tier 2 =101-400, Tier 3 = > 400).**

The top individual angler (based on number of fish caught) for the 2010 NPSRF harvested 9,519 northern pikeminnow and 13 spaghetti tagged northern pikeminnow worth for total earnings of $81,366 (Report B, this document). The 2010 top angler had a record breaking season catching 3,958 more fish than he had as the top angler in 2009, and over 3,700 more fish than the second place angler. The CPUE for this year's top angler (80.7 fish per angler day) was nearly double what he had as the top angler in 2009 (41.8 fish per angler day). The top angler for the 2010 season spent 16 fewer days (effort) fishing than he did as the 2009 top angler (134 days) but the effort accounted for a much higher total harvest. By comparison, the top angler (in terms of participation rather than harvest) for the 2010 NPSRF fished 150 days and harvested 1,209 northern pikeminnow.

## Tag Recovery

### Northern Pikeminnow Tags

Returning anglers harvested 213 northern pikeminnow tagged by ODFW with external spaghetti tags during the 2010 NPSRF compared to 180 spaghetti tags paid in 2009 (Hone et al., 2009). Tag recoveries peaked in week 23, four weeks earlier than peak NPSRF harvest (Figure 24). Of these spaghetti tagged northern pikeminnow, 212 had also been PIT tagged by ODFW as a secondary mark. WDFW technicians also recovered an additional 114 northern pikeminnow which had ODFW PIT tags and wounds and/or fin-clips indicating that the fish had "lost" an ODFW spaghetti tag. The recovered spaghetti and PIT tags, as well as the potential tag loss data was estimated by ODFW to equal a 18.8% exploitation rate for the 2010 NPSRF (Report C, this document).

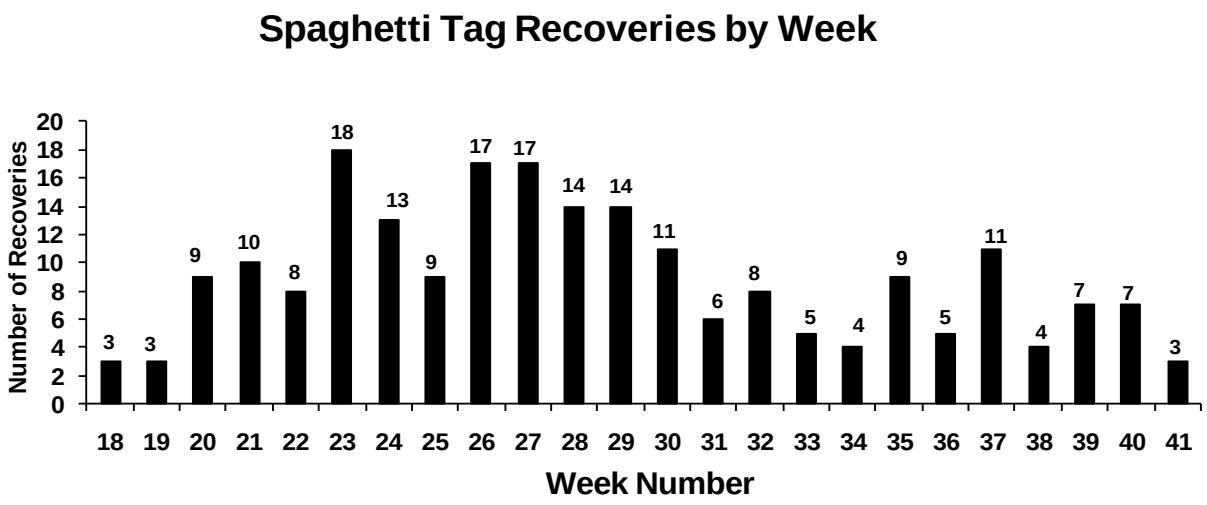



**Figure 24. 2010 NPSRF Spaghetti Tag Recoveries by Week.**

## Ingested Tags

A total of 174,289 northern pikeminnow were individually scanned for the presence of PIT tags. This represents 100% of the total harvest of reward-size fish for the 2010 NPSRF (northern pikeminnow not qualifying for rewards were also scanned whenever possible). We recovered a total of 109 PIT tags from consumed smolts that had been ingested by northern pikeminnow harvested during the 2010 NPSRF, an overall occurrence ratio of 1:1,599. Total ingested tag recoveries in 2010 were higher (9 more) than the previous year, however, with a higher season harvest there ended up being a lower a higher rate of occurrence (1:1,599 in 2010 versus 1:1,420 in 2009) (Hone et al., 2009). PIT tag recoveries of salmonid smolts ingested by northern pikeminnow peaked during the 3rd and 5th weeks of the season (where 19 ingested smolts were recovered) and didn't end until early September (Figure 25).

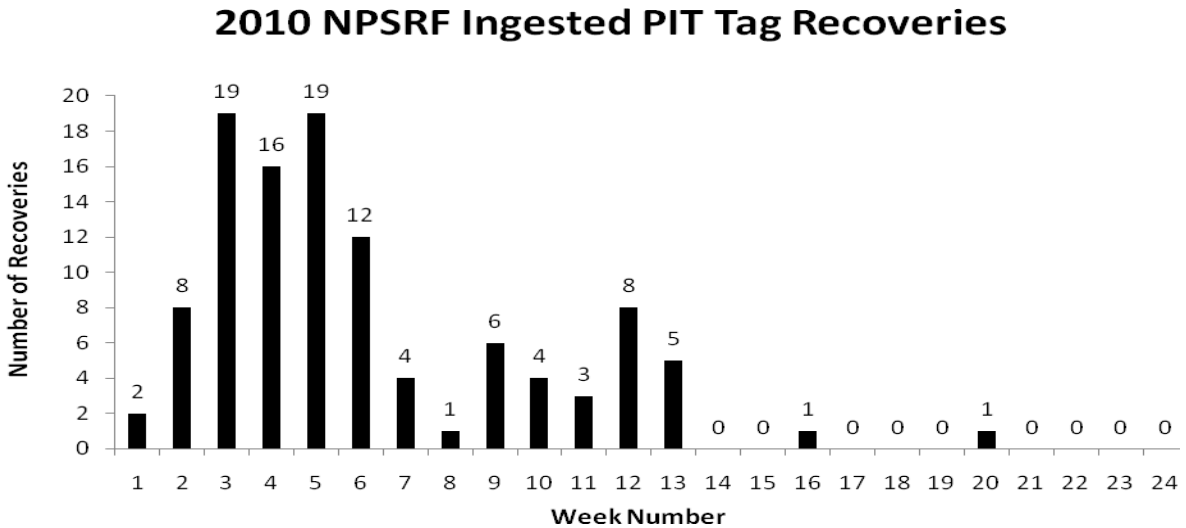



**Figure 25. 2010 NPSRF PIT Tag Recoveries by Date.**

Pit tag recoveries by fishing location during the 2010 NPSRF showed that northern pikeminnow harvested from Fishing locations 02 (Bonneville Reservoir) ingested the largest number of salmonid smolts containing PIT tags (Figure 26), compared to 25 each from both The Dalles and Little Goose Reservoirs in 2009.

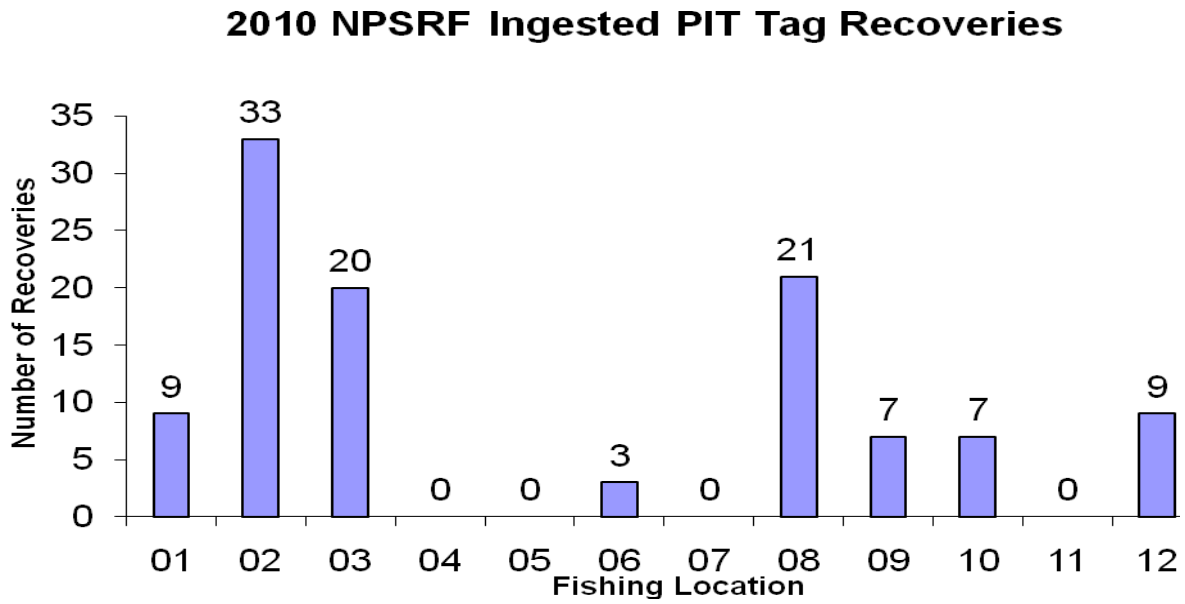



**Figure 26. 2010 NPSRF ingested PIT Tag Recoveries by Fishing Location.**
*Fishing Location Codes for Columbia River; 1 = Below Bonneville Dam, 2 = Bonneville Reservoir, 3 = The Dalles Reservoir, 4 = John Day Reservoir, 5 = McNary Dam to the mouth of the Snake River, 6 = Mouth of the Snake River to 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 2010 NPSRF was obtained from PTAGIS and indicated that ninety-five (87%) of the 109 ingested PIT tag recoveries were from chinook smolts. The other 14 PIT tags were from 3 sockeye, 3 steelhead and 8 unknown species accounting for the remaining 13% (Figure 27). The majority of chinook PIT tags these were recovered in May along with all the sockeye recoveries and one third of the steelhead recoveries. PTAGIS queries revealed that the PIT tag recoveries from chinook smolts consisted of 34 fall chinook, 32 spring chinook, 16 unknown chinook and 13 summer chinook). PIT tag queries of PTAGIS also indicated that 25 of the 109 recovered PIT tags (23%) were from salmonids of wild origin.

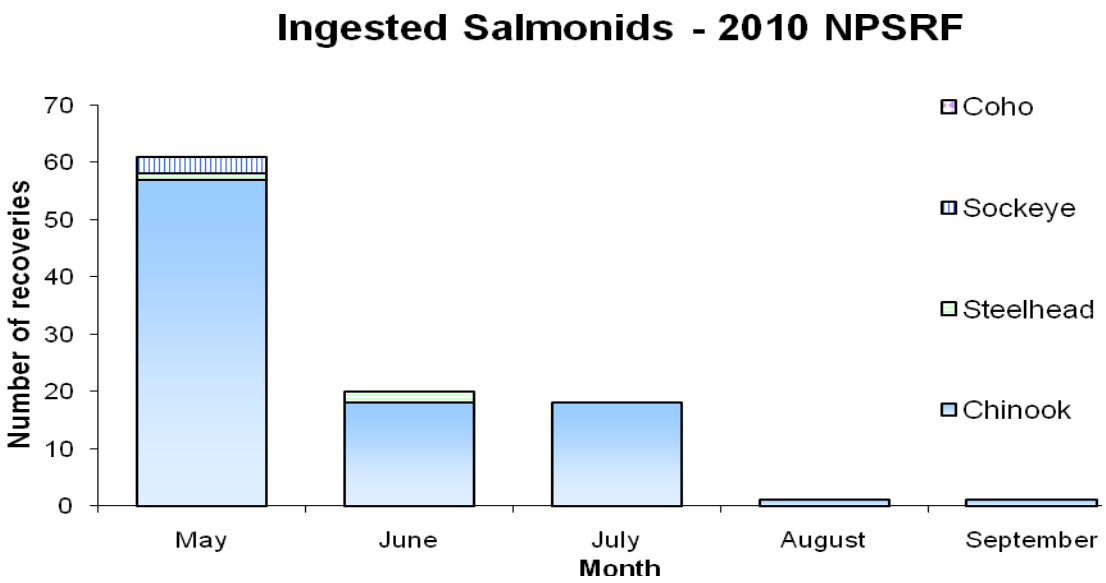



**Figure 27. Recoveries of ingested salmonid PIT Tags from the 2010 NPSRF.**

Analysis of PIT tag recovery data from the 2010 NPSRF continues to document northern pikeminnow predation on downstream migrating juvenile salmonids. Further data collection and analysis of PIT tag recoveries from juvenile salmonids consumed by northern pikeminnow harvested in the NPSRF may lead to a better understanding of northern pikeminnow predation on salmonid smolts and the factors affecting the vulnerability of smolts to predation while migrating through the Columbia River System.

## SUMMARY

The 2010 NPSRF succeeded in reaching the NPMP's 10-20% exploitation goal for the thirteenth consecutive year, achieving an estimated exploitation rate of 18.8%. NPSRF harvest rebounded to very near average 1991-2009 levels and if it were not for two weeks of high runoff in early June (just prior to the spawn) which caused angler harvest to steeply drop, overall harvest in 2010 may well have exceeded 200,000 fish. Angler effort dropped a little from 2009, but angler CPUE returned to the upward trending levels seen prior to 2008 and resulted in an increase in harvest from 2009 to 2010. The 2010 NPSRF saw a decrease in the number of individuals participating in the fishery, but CPUE bounced back upwards from a slump over the previous two years. One of the three new registration stations used during the 2010 NPSRF had exceptional effort and harvest (Beacon Rock), and one showed promise for future years (Portco). Finally, our top angler set a NPSRF record for both individual harvest (9,532 total northern pikeminnow) and payment received ($81,366; Report B, this document).

The NPSRF's top angler for the 2010 season caught 3,958 more fish than he did as the top angler in 2009. The top angler fished fewer days than he did as the top angler last season, but because his CPUE was nearly twice what it was in 2009, he harvested far more northern pikeminnow than he did in 2010. Because an increase in angler CPUE was recorded for the 2010 NPSRF overall and at all tier levels, more favorable fishing conditions were most likely the reason for higher harvest not only for the top angler, but for all 2010 NPSRF anglers.

Detection of PIT tags from juvenile salmonids ingested and retained in the gut of northern pikeminnow continues to yield valuable data about northern pikeminnow predation on juvenile salmonids. We recovered more ingested PIT tags than last year and peak recoveries occurred earlier in the season. Species composition of PIT tag recoveries from ingested juvenile salmonids again showed that they were primarily chinook smolts, mostly of hatchery origin. We also recovered a small number of PIT tags from steelhead, and sockeye smolts this season. Use of PIT tags by ODFW as a secondary mark in spaghetti tagged northern pikeminnow continues to work well and we look forward to the use of these tags producing more accurate estimates of spaghetti tag loss and overall pikeminnow exploitation by the NPMP. PIT tag recoveries also continue to serve as an effective 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 2011 NPSRF in order to enhance promotional opportunities, build angler familiarity, and ultimately to maximize predation reduction.

2.) Continue to investigate and develop angler incentives designed to capitalize on, and retain new anglers recruited to the 2011 NPSRF.

   a) Review angler participation patterns and adjust NPSRF registration station times as needed to facilitate better angler usage, i.e discontinue Arlington station and relocate to Maryhill State Park near Biggs, OR.

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

   c) Continue to research feasibility of paying for tag-loss NPM retaining ODFW PIT tags.

   d) Continue use of coupons for successful anglers.

   e) Investigate use of internet for advertising NPSRF and/or 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 fish from outside NPSRF boundaries.

6.) Survey at least 20% of non-returning anglers to record non-returning angler catch of all salmonids and to estimate total non-returning angler catch and harvest of all salmonids per NPMP protocol, and to identify any changes in NPSRF 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 Arlington for the use of the Arlington 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 State Park; 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 – 2010

Prepared by

Russell G. Porter

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

March, 2011

## INTRODUCTION

The **Northern Pikeminnow Predator Control Program** was administered by PSMFC in 2010. The program is a joint effort between the fishery agencies of the states of Washington and Oregon, and the Pacific States Marine Fisheries Commission (PSMFC). Washington ran the sport-reward registration/creel check stations throughout the river and handled all fish checked in to the program. Oregon provided fish tagging services, population studies, 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 2010 a total of 173,981 fish were harvested in the sport-reward fishery. Of this total 213 were tagged fish and 173,768 were untagged. Vouchers for 173,113 of the untagged fish were submitted for payment totaling rewards of $1,117,994. 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 1,075 anglers who registered were successful in catching one or more fish in 2010. The 2010 season ran from May 1, 2010 through October 10, 2010. 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 2010 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 213 tagged fish were caught. Anglers were issued a special tagged fish voucher for all tagged fish brought to the registration station. The tag voucher was then sent in with the tag for verification and payment of the special $500 tagged fish reward. All 213 tagged vouchers were submitted for payment. This resulted in tag reward payments of $106,500 in addition to the regular reward payments above.

## ACCOUNTING

Total payments for the season of regular vouchers, coupons, and tagged fish, totaled $1,224,494. All IRS Form 1099-MISC Statements were sent to the qualifying anglers for tax purposes in the third week of January, 2011. Appropriate reports and copies were provided to the IRS by the end of February, 2011.

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.

## 2010 SPORT REWARD PAYMENTS SUMMARY

**The following is a summary of the vouchers received and paid as of November 16, 2010**

| | Fish | Incentives | $ Paid |
|---|---|---|---|
| Fish paid @ tier 1 ($4 each): | 34,723 | N/A | $138,892 |
| Fish paid @ tier 2 ($5 each): | 43,948 | N/A | $219,740 |
| Fish paid @ tier 3 ($8 each): | 94,229 | N/A | $753,832 |
| Tags paid (@ $500 each): | 213 | N/A | $106,500 |
| Coupons issued (@ $10 each) | N/A | 550 | $5,500 |
| **Total:** | **173,113** | **550** | **$1,224,464** |

| | | | | |
|---|---|---|---|---|
| Anglers @ tier 1 | 854 | | | |
| Anglers @ tier 2 | 112 | Anglers with 10 fish or less: | 550 | |
| Anglers @ tier 3 | 109 | Anglers with 2 fish or less: | 255 | |
| Number of separate anglers | 1,075 | | | |

| | *Top Twenty Anglers ** | TIER 1 | TIER 2 | TIER 3 | TAGS | TOTAL FISH | COUPONS | BALANCE |
|---|---|---|---|---|---|---|---|---|
| 1. | NIKOLAY N ZAREMSKIY | 99 | 300 | 9,120 | 13 | 9,532 | $10 | $81,366 |
| 2. | DAVID R VASILCHUK | 100 | 300 | 5,370 | 22 | 5,792 | $10 | $55,870 |
| 3. | VIKTOR M ORLOVSKIY | 100 | 300 | 4,392 | 2 | 4,794 | $10 | $38,046 |
| 4. | THOMAS H PAPST | 100 | 300 | 3,873 | 3 | 4,276 | $10 | $34,394 |
| 5. | IVAN R VASILCHUK | 98 | 300 | 3,198 | 11 | 3,607 | $10 | $32,986 |
| 6. | OLEG R VASILCHUK | 100 | 298 | 2,572 | 5 | 2,975 | $10 | $24,976 |
| 7. | EDWARD R WILLIAMS | 100 | 300 | 2,558 | 0 | 2,958 | $10 | $22,374 |
| 8. | STEVEN A WEBER | 100 | 300 | 2,455 | 0 | 2,855 | $10 | $21,550 |
| 9. | TIMOTHY L HISTAND | 100 | 300 | 2,392 | 0 | 2,792 | $10 | $21,046 |
| 10. | ANATOLIY A GUTSAL | 100 | 300 | 2,235 | 1 | 2,636 | $10 | $20,290 |
| 11. | DANIEL J GEIGER | 100 | 300 | 2,020 | 1 | 2,421 | $10 | $18,570 |
| 12. | DUANE P BLETH | 100 | 300 | 1,896 | 0 | 2,296 | $10 | $17,078 |
| 13. | WAYNE L POWELL SR | 100 | 300 | 1,209 | 7 | 1,616 | $10 | $15,082 |
| 14. | PETR S LYUBCHIK | 100 | 300 | 1,570 | 1 | 1,971 | $10 | $14,970 |
| 15. | ANATOLIY F MIKHAYLYUK | 100 | 300 | 1,561 | 1 | 1,962 | $10 | $14,898 |
| 16. | HOLLIE DARDEN JR | 100 | 300 | 1,427 | 3 | 1,830 | $10 | $14,826 |
| 17. | RALPH L FONTANA | 100 | 300 | 1,461 | 1 | 1,862 | $10 | $14,098 |
| 18. | MATTHEW R TENNISON | 100 | 300 | 1,427 | 0 | 1,827 | $10 | $13,326 |
| 19. | MARK A WATKINS | 100 | 300 | 1,350 | 1 | 1,751 | $10 | $13,210 |
| 20. | VERLON D MILLER | 100 | 300 | 1,373 | 0 | 1,773 | $10 | $12,894 |
| | * (by total fish caught) | 1,997 | 5,998 | 53,459 | 72 | 61,526 | $200 | $501,850 |

**REPORT C**

# System-wide Predator Control Program: Indexing and Fisheries Evaluation

Prepared by

Howard K. Takata
Aaron M. McAlexander
Michele Hughes Weaver
Jeremy D. Cameron
Peter A. McHugh

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

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## SUMMARY

The Northern Pikeminnow Management Program (NPMP), comprised of fisheries aimed at reducing predation on juvenile salmonids by northern pikeminnow *Ptychocheilus oregonensis* in the Columbia and Snake rivers, was assessed for the 2010 season (1 April–10 October 2010). 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 lower Snake River reservoirs, and 3) possible compensatory responses by these species.

To evaluate exploitation during 2010, we tagged and released 853 northern pikeminnow ≥200 mm fork length (FL) throughout the lower Columbia and Snake rivers. Of these fish, 640 were in the size group (≥250 mm FL) that we have used to monitor trends in system-wide exploitation. System-wide exploitation by the sport-reward fishery of northern pikeminnow ≥250 mm FL was 18.8% (95% confidence interval 14.5–23.1%). Exploitation rates were adjusted using an estimated tag loss of 5.1%. Based on sport-reward exploitation rates, we estimated that 2010 predation levels were 35% (range: 20–53%) lower than pre-program levels.

We conducted biological indexing in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs in 2010 as part of our predator community evaluation on the Snake River. Northern pikeminnow abundance indices in these reservoirs remained at low levels. Occurrence of salmonids in northern pikeminnow digestive tracts was high in Lower Granite Reservoir, and the relative weight of female northern pikeminnow in Lower Granite Reservoir has increased in recent years. Due to low catch rates, we were unable to calculate consumption or predation indices, as well as stock densities for northern pikeminnow for 2010.

The relative abundance of smallmouth bass observed in the tailrace area of Lower Monumental Reservoir during 2010 was higher than previous years; however, relative densities in most areas of the lower Snake River were similar to values observed in the past. Consumption indices for smallmouth bass remained unchanged while predation indices increased in the mid-reservoir area of Little Goose Reservoir. As with northern pikeminnow, the proportion of smallmouth bass stomach samples containing salmonids was highest in Lower Granite Reservoir. However, the prey fish most often consumed by smallmouth bass were *Percopsis* and *Cottus* spp. Proportional stock density values for smallmouth bass in the Snake River reservoirs continued to be less than those indicative of a balanced population, and relative weights appeared to be within the range of recent years.

We captured a walleye ($n$ = 1) for the first time in Ice Harbor Reservoir, and several walleye were found in Lower Monumental Reservoir, as in previous years. Thus, walleye densities were very low in the lower Snake pools indexed in 2010. Of the five walleye stomach content samples we collected and examined, one contained juvenile salmonid remains. Walleye relative weights were within the range of previous years, but our sample size was too small to calculate stock densities.

We evaluated northern pikeminnow diet samples collected during angling at John Day, The Dalles, and Bonneville dams from 2006-2010 and report the findings from this work for the first

time this year. We analyzed 2,441 samples and found fish to be the primary prey type consumed. The primary prey fish species consumed by pikeminnow was lamprey (23% of all stomachs examined), however, 13% of diets also contained salmonids.

At this time, there does not appear to be a system-wide predator response to the NPMP. However, because responses to fisheries management programs may not be detected for several years, we recommend continued monitoring of predator populations in the Snake River.

## INTRODUCTION

The Columbia and Snake rivers once supported large numbers of anadromous salmonids *Oncorhynchus* spp. Declines in adult returns have been attributed to many factors, including habitat degradation and overexploitation (Nehlsen et al. 1991; Wismar et al. 1994), hydroelectric and flood control activities during the 1970's (Raymond 1988), and predation (Rieman et al. 1991; Collis et al. 2002). The mean annual loss of juvenile salmonids to predators can be equivalent to mortality associated with dam passage (Rieman et al. 1991), which in the past could approach 30% at a single dam (Long and Ossiander 1974). The Northern Pikeminnow Management Program (NPMP) is a set of targeted fisheries aimed at reducing predation on juvenile salmonids by northern pikeminnow *Ptychocheilus oregonensis* in the lower Columbia and Snake rivers (Rieman and Beamesderfer 1990; Beamesderfer et al. 1996). The Oregon Department of Fish and Wildlife (ODFW) established baseline levels of predation and northern pikeminnow population characteristics prior to the implementation of the northern pikeminnow fisheries. Abundance, consumption, and predation were estimated in Columbia River reservoirs in 1990 and 1993, Snake River reservoirs in 1991, and the unimpounded lower Columbia River downstream from Bonneville Dam in 1992 (Ward et al. 1995). We continue to sample northern pikeminnow populations in standardized areas, and to compare relevant biological parameters between years when catch rates are adequate (Zimmerman and Ward 1999; Zimmerman et al. 2000; Takata et al. 2007). This report describes our activities and findings for 2010.

Our objectives in 2010 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 lower Snake River reservoirs, and 3) look for possible compensatory responses by these species.

## METHODS

### Fishery Evaluation, Predation Estimates, and Tag Loss

*Field Procedures*—We collected northern pikeminnow for tagging using electrofishing boats in the Columbia River from river kilometer (rkm) 76 (near Clatskanie, Oregon) upstream to rkm 639 (Priest Rapids Dam), and in the Snake River from rkm 112 (Little Goose Dam) to rkm 248 (Figure 1). To balance our system-wide tagging effort, we used two 15-minute electrofishing

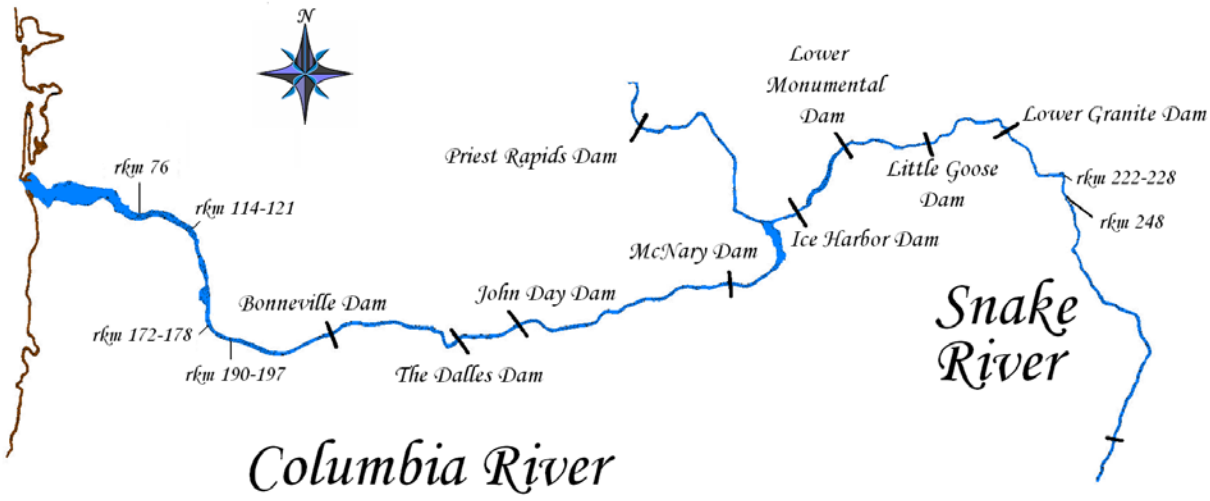


Figure 1. The lower Columbia and Snake rivers.

periods per river kilometer. We were unable to cover every river kilometer prior to the fisheries opener. With the exception of rkm 208–213, fish were tagged in the area below John Day Dam (rkm 227) before the beginning of the fisheries. River kilometers 208–213 were covered on 23 June. Fish were tagged upstream of rkm 227 concurrent with the fisheries. Sampling was conducted between 1 April and late May and between the hours of 1800 and 0200, except where river navigation necessitated daytime sampling.

We tagged and released northern pikeminnow ≥200 mm FL with uniquely numbered Floy FT-4 lock-on loop tags to estimate exploitation rates for the sport-reward and dam-angling fisheries (Report A, this report). Tags were inserted posterolaterally of the dorsal fin through the sub-dermal rays. To evaluate tag retention, we injected a passive integrated transponder (PIT) tag into the dorsal sinus of all loop tagged fish.

We worked in cooperation with 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 from 1 May to 10 October, 2010, during which participating anglers received payment for all harvested northern pikeminnow ≥228 mm (9 inches) in total length (TL). This size limit is approximately equivalent to the minimum size of northern pikeminnow we tagged (i.e., 200 mm FL [223 mm TL]). The payment schedule consisted of three tiers (Report B, this report), and anglers were also eligible for a $500 reward for each tagged fish

turned in at a participating station. The dam-angling fishery occurred from 19 May to 25 August 2010 and was confined to the accessible area directly off The Dalles and John Day dams. These anglers also removed northern pikeminnow ≥228 mm TL (9 inches) but were ineligible for rewards available under the public fishery payment schedule.

*Data Analysis*—We estimated the proportion of the northern pikeminnow population removed during program fisheries using mark-and-recapture data from the entire area fished (system-wide) and for continuous zones separated by dams (area-specific). We accounted for the change in minimum length of northern pikeminnow eligible for sport-reward payment being reduced from 11 inches (≥278 mm TL; equivalent ≥250 mm FL) to 9 inches TL (≥228 mm TL; equivalent ≥200 mm FL) in 2000, by calculating exploitation rates for all fish tagged (≥200 mm FL), the subset of fish from 200 to 249 mm FL, and the subset of fish ≥250 mm FL. We used the subset of fish ≥250 mm FL whenever comparing trends among years. In areas where tagging was completed prior to the start of the fishery, we estimated the rate of exploitation of the population using the Petersen method (Ricker 1975). This annual estimate was calculated using the equation

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

where

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

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

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

where

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

In addition, we calculated 2010 exploitation rates based on release and recovery information for all pikeminnow PIT tagged during 2003–2010 in the area below Bonneville Dam and in Bonneville Reservoir using the variable survival method (Everhart and Youngs 1981). This approach yields estimates based on annual mark and recapture (i.e., tag recoveries at angler check stations) efforts and a growing pool of marked fish, but accounts for inter-annual variation in mortality (natural or fishing-related). Year-specific estimates are obtained from the equation

$$f_i = \frac{R_i}{M_i} \cdot \frac{C_i}{T_i}, \tag{3}$$

where

$f_i$ = the minimum estimate of exploitation in year $i$,
$M_i$ = the number of fish that are tagged in year $i$,
$R_i$ = the number of recaptures from a particular cohort (tag year) year across recapture years,
$C_i$ = the number of recaptures from any cohort within sample year $i$, and
$T_i$ = $T_{i-1} + R_i - C_{i-1}$ where $T_1 \equiv R_1$ and is computed recursively thereafter

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 2010. We calculated 95% confidence intervals for each estimate using the formula

$$u \pm t\sqrt{ks}\,, \tag{4}$$

where

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

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

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

where

$L$ = tag loss rate,
$m$ = the number of northern pikeminnow recaptured with a PIT tag from the 2010 season and no loop tag, and
$r$ = the number of northern pikeminnow recaptured with 2010 loop tags intact.

We used a model based on Friesen and Ward (1999) to estimate predation on juvenile salmonids relative to predation before the implementation of the NPMP. The model estimates potential predation reduction from preprogram conditions using the parameters 1) population structure before removals by fisheries, 2) consumption of juvenile salmonids by northern pikeminnow, 3) fish length, 4) size-specific exploitation rates, and 5) annual mortality. We used a 10-year average age structure (based on catch curves) for a pre-exploitation base, and assumed constant recruitment. The model has been updated to include fork length increments 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, provided that all other variables held constant. We estimated the potential

predation during 2010 based on observed exploitation rates and predicted future predation rates using a mean level of exploitation observed during current program rules (2001; 2004–2010). See Friesen and Ward (1999) for additional model documentation.

## Biological Evaluation

*Field Procedures*—We used standardized electrofishing techniques described in Ward et al. (1995) and Zimmerman and Ward (1999) to evaluate northern pikeminnow, smallmouth bass, and walleye populations in Ice Harbor, Lower Monumental, Little Goose, and Lower Granite reservoirs on the Snake River during 2010. We conducted nighttime (0200-1200) sampling during spring (4–21 May) and summer (22 June–16 July) in three areas of Ice Harbor Reservoir (forebay, rkm 16–23; mid-reservoir, rkm 28–39; Lower Monumental Dam tailrace, rkm 60–67), Lower Monumental Reservoir (forebay, rkm 67–72; mid-reservoir, rkm 87–94; Little Goose Dam tailrace, rkm 105–112), and Little Goose Reservoir (forebay, rkm 112–120; mid-reservoir, rkm 128–136; Lower Granite Dam tailrace, rkm 165–172). In addition, one area was sampled twice each season in Lower Granite Reservoir (upper-reservoir, rkm 219–228). 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. Additionally, we sampled the northern pikeminnow collected during the dam angling portion of this project (see Report B of this report). We sampled the dam anglers catch twice a week throughout the season (May-Aug). Sampling days were chosen randomly and were distributed at each dam equally.

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 ≥200 mm FL. We removed scales from 25 fish per 25 mm FL size increment by species in each reservoir sampled. We sacrificed all untagged northern pikeminnow ≥200 mm FL to collect and preserve digestive tracts for diet analysis. We removed the digestive tract by securing both ends with hemostats and cutting free the connective tissue. We removed all external tissues prior to placing the digestive tract into a Whirl-pak bag for storage. Whenever possible, we noted gender and stage of maturity for each sacrificed fish. Stomach contents from smallmouth bass and walleye ≥200 mm FL were collected using a modified Seaburg sampler (Seaburg 1957), which used a jet of water to flush contents from the foregut of the fish (gastric lavage) without sacrificing the animal. We collected the lavaged contents in a 200 µm meshed container prior to transferring it to a Whirl-pak bag. All bags were kept on ice while in the field, and stored in a freezer prior to analysis in a laboratory.

*Laboratory Procedures.*—We examined digestive tract contents of northern pikeminnow, smallmouth bass, and walleye to measure relative consumption rates of juvenile salmonids. Each digestive sample was thawed in the laboratory and the contents were sorted into trays by prey category. 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; 8 X porcine digestive enzyme), 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.

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

*Data Analysis.*—We used catch per unit of effort (CPUE, fish per 900-second electrofishing run) and area-specific surface areas to calculate northern pikeminnow abundance indices (Ward et al. 1995). For smallmouth bass and walleye, we used log-transformed catch per unit of effort [$\log_{10}$ (CPUE + 1)] to assess trends in relative abundance.

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

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

and

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

where

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

The consumption index is not a direct estimate of the number of juvenile salmonids eaten per day by an average predator; however, it is linearly related to the consumption rate of northern pikeminnow (Ward et al. 1995) and smallmouth bass (Ward and Zimmerman 1999).

We 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) observed 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. However, to keep bass predation index computations consistent with those for pikeminnow, we used untransformed CPUE, scaled to surface area, for this assessment.

To evaluate age structure, we compared the frequency percentage by age and size of northern pikeminnow, smallmouth bass, and walleye collected in 2010 to previous years. To address differential vulnerability to the electrofisher associated with northern pikeminnow size, as well

as inter-annual variation in exploitation rates (Friesen and Ward 1999), we limited our comparisons to abundance of northern pikeminnow large enough to be effectively sampled and small enough to be excluded from the NPMP (ages 3–5). Based on electrofishing catch curves for smallmouth bass and walleye (ODFW, unpublished data), we limited our comparisons for those species to ages 4–5 and ages 5–6, respectively.

Northern pikeminnow exploitation rates are believed to be greater for larger fish than for smaller fish (Zimmerman et al. 1995); therefore, sustained fisheries should decrease the abundance of large fish relative to the abundance of smaller fish. We used proportional stock density (Anderson 1980) to compare the size structure of northern pikeminnow, smallmouth bass, and walleye populations among years. Proportional stock density (%) was calculated using the formula

$$PSD_i = 100 \cdot (FQ_i / FS_i), \quad (8)$$

where

$PSD_i$ = proportional stock density,
$FQ_i$ = 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 for smallmouth bass and walleye. Relative stock density (Gabelhouse 1984) was calculated using the formula

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

where

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

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

Changes in body condition may indicate a response to sustained exploitation. We used relative weight ($W_r$; Anderson and Neumann 1996) to compare the condition of northern pikeminnow, smallmouth bass, and walleye in 2010 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. We used analysis of variance to assess whether or not there was significant inter-annual variation in $W_r$, and visually contrasted specific years based on 95% confidence intervals around estimates where an overall difference was detected.

## RESULTS

### Fishery Evaluation, Predation Estimates, and Tag Loss

We tagged and released 853 northern pikeminnow ≥200 mm FL throughout the lower Columbia and Snake rivers during 2010, of which 640 were ≥250 mm FL (Table 1). In 2010, removal fisheries harvested 178,287 northern pikeminnow ≥200 mm. The sport-reward fishery harvested 174,289 of these fish and the dam-angling fishery removed 3,998 (Report A, this report). The sport-reward fishery recaptured a total of 112 northern pikeminnow tagged in 2010; none were recovered by dam anglers. Fish tagged and subsequently recaptured in 2010 were at-large from 0 to 168 days (average of 63 days). Of sport-reward fishery recaptures, 88% were ≥ 250 mm FL (Table 1). In the sport reward fishery, 56% of the measured harvest consisted of northern pikeminnow ≥250 mm FL, and the median fork length was 258 mm (J. Hone, WDFW, personal communication). A total of six northern pikeminnow were recaptured from the 2010 tagging season with a PIT tag present and loop tag absent. Exploitation was adjusted to reflect an estimated tag loss of 5.1%.

System-wide exploitation of northern pikeminnow ≥200 mm FL by the sport-reward fishery was 15.9% (95% confidence interval 12.4–19.5%; Appendix Tables B-1 and B-2). Area-specific exploitation estimates ranged from 9.2% in McNary Reservoir to 63.1% in Lower Granite reservoir. We did not calculate exploitation rates for The Dalles or John Day reservoirs due to an insufficient number of tag recoveries (Appendix Table B-2). When using catch information for all fish tagged 2003–2010, we estimated the exploitation rate to be 17.6% below Bonneville Dam and 11.0% in Bonneville Reservoir.

Table 1. Number of northern pikeminnow tagged and recaptured in the sport-reward fishery during 2010.

| | 200–249 mm FL | | ≥250 mm FL | | All combined | |
|---|---|---|---|---|---|---|
| Area | Tagged | Recaptured | Tagged | Recaptured | Tagged | Recaptured |
| Below Bonneville Dam | 78 | 3[a] | 440 | 83 | 518 | 86[a] |
| Bonneville | 17 | 0 | 56 | 7 | 73 | 7 |
| The Dalles | 7 | 0 | 11 | 0 | 18 | 0 |
| John Day | 11 | 2 | 6 | 0 | 17 | 2 |
| McNary | 57 | 4 | 91 | 3 | 148 | 7 |
| Little Goose | 28 | 2 | 9 | 3 | 37 | 5 |
| Lower Granite | 15 | 2 | 27 | 3 | 42 | 5 |
| All areas combined | 213 | 13[a] | 640 | 99 | 853 | 112[a] |

a) Includes fish recaptured in a different area than originally tagged. These fish were not included in area-specific exploitation rate calculations.

The system-wide exploitation rate of northern pikeminnow 200–249 mm FL was 7.6% for the sport-reward fishery (95% confidence interval 2.8–12.5%; Appendix Table B-2). The area-specific estimate for McNary Reservoir was 12.4%; the only area with sufficient numbers of recaptures to calculate an exploitation rate.

For northern pikeminnow ≥250 mm FL, system-wide exploitation was 18.8% (95% confidence interval 14.5–23.1%; Figure 2, Appendix Table B-2). Area-specific exploitation rates ranged from 13.1% in Bonneville Reservoir to 19.8% in the area below Bonneville Dam. An inadequate number of tag recoveries precluded estimation of exploitation for this size group in any other reservoir (Appendix Table B-2). When using catch information for all fish tagged 2003–2010, we estimated the exploitation rate to be 20.0% below Bonneville Dam and 14.3% in Bonneville Reservoir.

We acquired biological samples (i.e., diets, scales) from 835 northern pikeminnow caught in the dam-angling fishery, with 51% of the samples coming from John Day Dam. Median fork length of northern pikeminnow caught by dam anglers was 369 mm. Two tagged northern pikeminnow were recaptured at The Dalles Dam; however, neither was tagged in 2010.

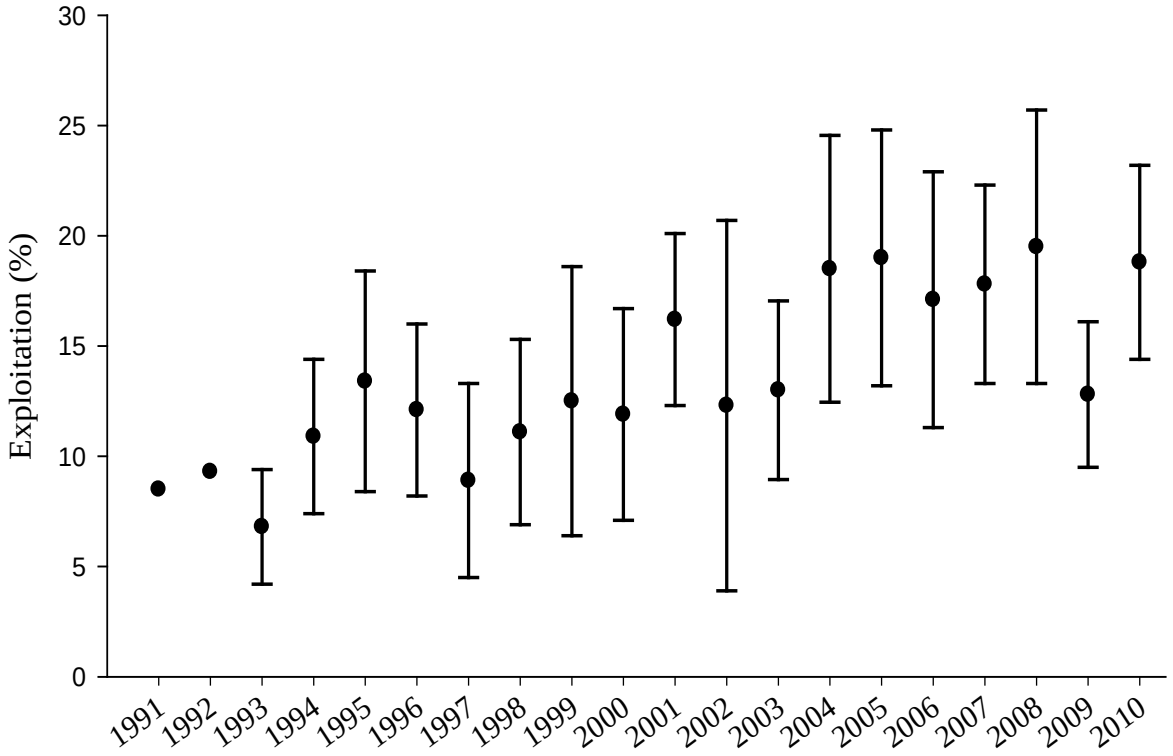


Figure 2. System-wide exploitation rates of northern pikeminnow ≥250 mm fork length for the sport-reward fishery, 1991–2010. Error bars denote the 95% confidence interval. Confidence intervals were not available for 1991–1992.

Based on our 2010 estimate of exploitation, our predation model predicted a 35% (range: 20–53%) reduction in northern pikeminnow consumption of juvenile salmonids relative pre-program levels (Figure 3). Projections based on the current fishery and population structure predict predation reduction by northern pikeminnow to remain static through 2014.

## Biological Evaluation

Across all lower Snake River areas sampled in 2010, spring CPUE (fish per 900 s electrofishing run) ranged from 0.0 to 0.3 for northern pikeminnow, 0.4 to 5.1 for smallmouth bass, and 0.0 to 0.1 for walleye (Table 2). Summer CPUE ranged from 0.0 to 0.3 for northern pikeminnow, 2.0 to 15.5 for smallmouth bass, and 0.0 to 0.2 for walleye. Catch rates for smallmouth bass were always higher than for northern pikeminnow and walleye, and most areas had higher catch rates in summer than in spring.

Annual abundance indices for northern pikeminnow in the lower Snake River reservoirs were generally low, with no northern pikeminnow ≥250 mm FL captured in Ice Harbor Reservoir (Appendix Table C-1). Abundance indices were very similar to those observed during the last sampling event (2007).

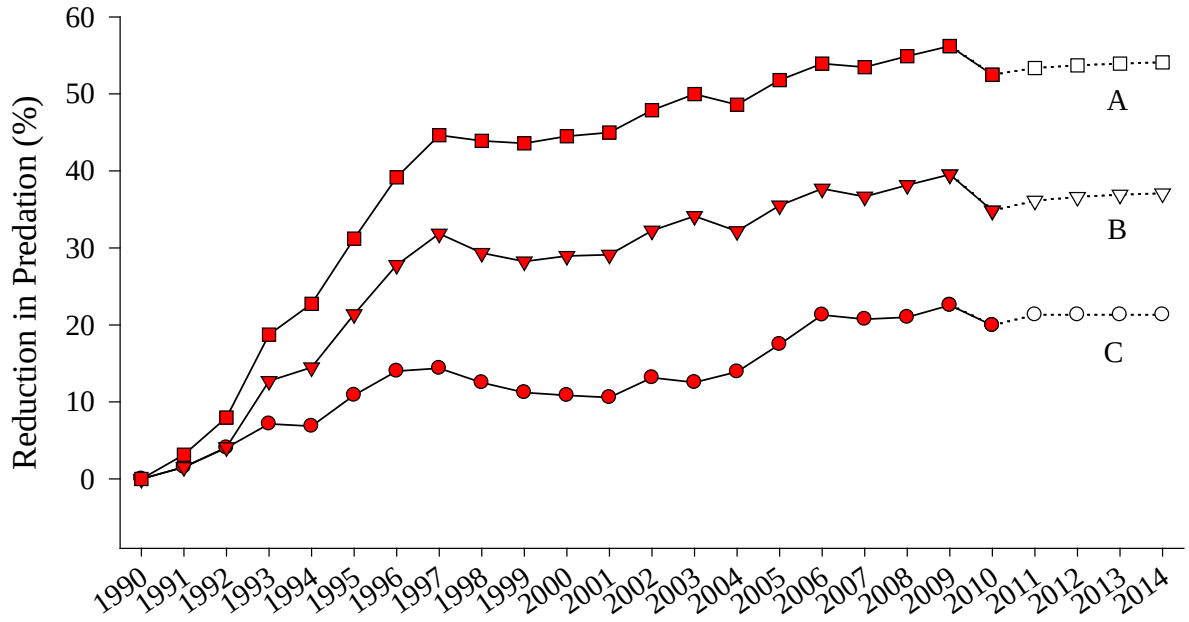


Figure 3. Maximum (A), median (B), and minimum (C) estimates of predation reduction by northern pikeminnow on juvenile salmonids relative to predation prior to implementation of the Northern Pikeminnow Management Program. Estimates of predicted predation after 2010 are based on average values for post-program model inputs for the most recent seven years.

Smallmouth bass were captured in all Snake River sampling areas, with relative abundance [i.e., $\log_{10}$(CPUE+1)] ranging from 0.1 to 0.6 during spring and 0.3 to 1.2 during summer (Appendix Table C-2). Relative abundance was highest in Lower Monumental Reservoir, particularly in the tailrace area of the reservoir. However, in most areas, values were similar to those observed in 2007.

Walleye were captured in both Ice Harbor and Lower Monumental reservoirs; however, all fish ≥200 mm FL were from Lower Monumental Reservoir (Appendix Table C-3). Walleye relative abundance was less than 0.1, and much lower than it was for either northern pikeminnow or smallmouth bass.

We examined a total of 98 northern pikeminnow digestive tracts from the lower Snake River in 2010, of which 87% contained food items (e.g. crayfish, insects, and fish). Seventeen percent of the samples contained fish and 7% contained remains identified as salmonid (*Oncorhynchus*) species (Table 3). The proportion of northern pikeminnow digestive tracts containing salmonids was highest in Lower Granite Reservoir. For samples where prey fish could be identified, northern pikeminnow consumed salmonids most frequently in Lower Granite and Lower Monumental reservoirs (Table 4).

Table 2. Catch per 15-minute electrofishing run (CPUE) for northern pikeminnow (≥250 mm FL), smallmouth bass (≥200 mm FL), and walleye (≥200 mm FL) that were captured during indexing in the lower Snake River reservoirs during spring and summer 2010. FB = Forebay, Mid = Mid-reservoir, TR = Tailrace.

| Species, | Ice Harbor | | | Lower Monumental | | | Little Goose | | | Lower Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| Season | FB | Mid | TR | FB | Mid | TR | FB | Mid | TR | Upper |
| Northern pikeminnow | | | | | | | | | | |
| Spring | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.1 | <0.1 |
| Summer | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | 0.3 | 0.3 |
| Smallmouth bass | | | | | | | | | | |
| Spring | 0.8 | 2.5 | 5.1 | 1.5 | 4.2 | 4.8 | 2.0 | 3.1 | 0.4 | 1.7 |
| Summer | 2.7 | 2.3 | 4.2 | 3.3 | 4.3 | 15.5 | 2.0 | 3.2 | 3.0 | 3.9 |
| Walleye | | | | | | | | | | |
| Spring | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Summer | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 |

We also examined 1,370 smallmouth bass stomach samples, of which 90% contained identifiable prey, 19% contained fish, and 4% contained salmonid remains (Table 3). The proportion of smallmouth bass stomach samples containing salmonids was highest in Lower Granite Reservoir. Percopsids were the most frequently found prey fish in Little Goose and Lower Granite reservoirs, while cottids were prominent in samples from Ice Harbor and Lower Monumental reservoirs (Table 4).

Due to their relatively low abundance in the Snake River, we only obtained five stomach content samples from walleye in 2010. All samples came from Lower Monumental Reservoir. Eighty percent of the walleye samples contained identifiable prey, 20% had fish remains, and 20% contained salmonids (Table 3). The one walleye sample that contained identifiable fish remains had both a cottid and salmonid in it (Table 4).

Table 3. Number (*N*) of northern pikeminnow, smallmouth bass, and walleye digestive tracts examined from the lower Snake River reservoirs in 2010, and percent that contained food (i.e., non-empty), fish, and salmonid remains (Sal).

| Season, | Northern pikeminnow | | | | Smallmouth bass | | | | Walleye | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area | *N* | Food | Fish | Sal | *N* | Food | Fish | Sal | *N* | Food | Fish | Sal |
| Spring | | | | | | | | | | | | |
| Ice Harbor | 15 | 93 | 20 | 0 | 150 | 97 | 21 | 3 | 0 | 0 | 0 | 0 |
| Lower Monumental | 16 | 88 | 13 | 0 | 215 | 94 | 9 | 3 | 1 | 100 | 0 | 0 |
| Little Goose | 6 | 83 | 33 | 17 | 88 | 92 | 20 | 3 | 0 | 0 | 0 | 0 |
| Lower Granite | 4 | 25 | 50 | 25 | 79 | 94 | 37 | 22 | 0 | 0 | 0 | 0 |
| All areas | 41 | 83 | 22 | 5 | 532 | 95 | 18 | 6 | 1 | 100 | 0 | 0 |
| Summer | | | | | | | | | | | | |
| Ice Harbor | 7 | 71 | 0 | 0 | 180 | 92 | 16 | 0 | 0 | 0 | 0 | 0 |
| Lower Monumental | 14 | 100 | 7 | 7 | 353 | 84 | 10 | 0 | 4 | 75 | 25 | 25 |
| Little Goose | 18 | 89 | 11 | 0 | 145 | 85 | 24 | 3 | 0 | 0 | 0 | 0 |
| Lower Granite | 18 | 89 | 33 | 28 | 160 | 93 | 39 | 8 | 0 | 0 | 0 | 0 |
| All areas | 57 | 89 | 16 | 11 | 838 | 87 | 19 | 2 | 4 | 75 | 25 | 25 |
| All combined | 98 | 87 | 18 | 8 | 1,370 | 90 | 19 | 4 | 5 | 80 | 20 | 20 |

In addition to diet samples acquired during indexing, we collected a total of 2,441 northern pikeminnow digestive tracts from dam angling activities occurring between 2006 and 2010. These fish ranged in size from 185 to 575 mm FL and had an average length of 368 mm FL (Appendix Table D-1). Sample origin was split evenly between The Dalles and John Day dams, with the exception of John Day Dam in 2008 where catch rates were lower. The overall percent of samples with food was 60% and ranged from 36% to 82% (Appendix Table D-2). The prey type most often found was fish (42%) and the fish most often consumed was lamprey (23%) The percent of samples containing salmon remains ranged from 4% to 36%. The primary prey fish found in May and June was lamprey, in July was salmonid, and in August was clupeid (Appendix Table D-4).

In 2010, the only areas that had sufficient sample sizes to calculate consumption indices for northern pikeminnow were the mid-reservoir area of Lower Monumental Reservoir during spring and the upper reservoir area of Lower Granite Reservoir during summer, where values were 0.0 and 1.7, respectively (Appendix Table C-4). Northern pikeminnow predation indices for those areas were 0.0 and 0.2, respectively (Appendix Table C-5).

Consumption indices for smallmouth bass ranged from 0.0 to 0.1 during both spring and summer seasons (Appendix Table C-6). Consumption indices in the lower Snake River have remained relatively low, with only minor fluctuations, since sampling began in 1991. Smallmouth bass predation indices ranged from 0.0 to 0.2 during spring and 0.0 to 0.6 during summer (Appendix Table C-7). Predation indices were highest in the mid-reservoir area of Little Goose Reservoir during both seasons; however, for most areas, predation indices were lower than they were in 2007.

In 2010, we aged 47 northern pikeminnow from Ice Harbor Reservoir, 51 from Lower Monumental Reservoir, 62 from Little Goose Reservoir, and 34 from Lower Granite Reservoir. The proportion of age-5 fish decreased from previous years in all reservoirs except Lower Granite Reservoir. However, even in Lower Granite Reservoir, age-3 and age-4 fish dominated within the 3–5 year age range (Figure 5).

Table 4. Percent frequency of occurrence of prey fish families consumed by northern pikeminnow, smallmouth bass, and walleye in the lower Snake River reservoirs in 2010 (only includes samples containing identifiable fish). IH = Ice Harbor, LM = Lower Monumental, LGO = Little Goose, and LGR = Lower Granite. Reservoir totals may exceed 100% when samples contain multiple families of prey fish. See Table 3 for sample sizes.

| | Northern pikeminnow | | | | Smallmouth bass | | | | Walleye | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Family | IH | LM | LGO | LGR | IH | LM | LGO | LGR | IH | LM | LGO | LGR |
| Catostomidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| Centrarchidae | 0 | 0 | 0 | 0 | 5 | 8 | 0 | 4 | 0 | 0 | 0 | 0 |
| Cottidae | 100 | 0 | 33 | 0 | 48 | 44 | 21 | 0 | 0 | 100 | 0 | 0 |
| Cyprinidae | 0 | 0 | 33 | 0 | 16 | 3 | 3 | 0 | 0 | 0 | 0 | 0 |
| Ictaluridae | 0 | 0 | 0 | 0 | 14 | 23 | 5 | 0 | 0 | 0 | 0 | 0 |
| Percopsidae | 0 | 0 | 0 | 17 | 11 | 13 | 62 | 58 | 0 | 0 | 0 | 0 |
| Salmonidae | 0 | 100 | 33 | 100 | 11 | 21 | 18 | 41 | 0 | 100 | 0 | 0 |

For smallmouth bass, we aged 110 fish from Ice Harbor Reservoir, 102 from Lower Monumental Reservoir, 122 from Little Goose Reservoir, and 119 from Lower Granite Reservoir. The proportion of age-4 bass was greater than the proportion of age-5 bass in all reservoirs. For Ice Harbor and Lower Monumental reservoirs, this marked a reversal of proportions in 2007 (Figure 6).

We aged one walleye from Ice Harbor Reservoir and seven from Lower Monumental Reservoir. Sample sizes were inadequate for an analysis of age composition.

In 2010, we were unable to calculate *PSD* for northern pikeminnow in any of the lower Snake River reservoirs due to inadequate sample sizes (Appendix Table C-8).

Smallmouth bass *PSD* ranged from 8 to 23 in the Snake River reservoirs (Appendix Table C-8). Compared to 2007, *PSD* values were higher in all reservoirs except Lower Monumental Reservoir. *PSD* has declined in Lower Monumental Reservoir since 1999. The other Snake River reservoirs showed no trend in *PSD*. Smallmouth bass *RSD-P* was relatively low, with values ranging from 1 to 7 (Appendix Table C-8). *RSD-P* was also lowest in Lower Monumental Reservoir.

We were unable to calculate stock densities for walleye as only six stock size fish was captured in 2010 (Appendix Table C-8).

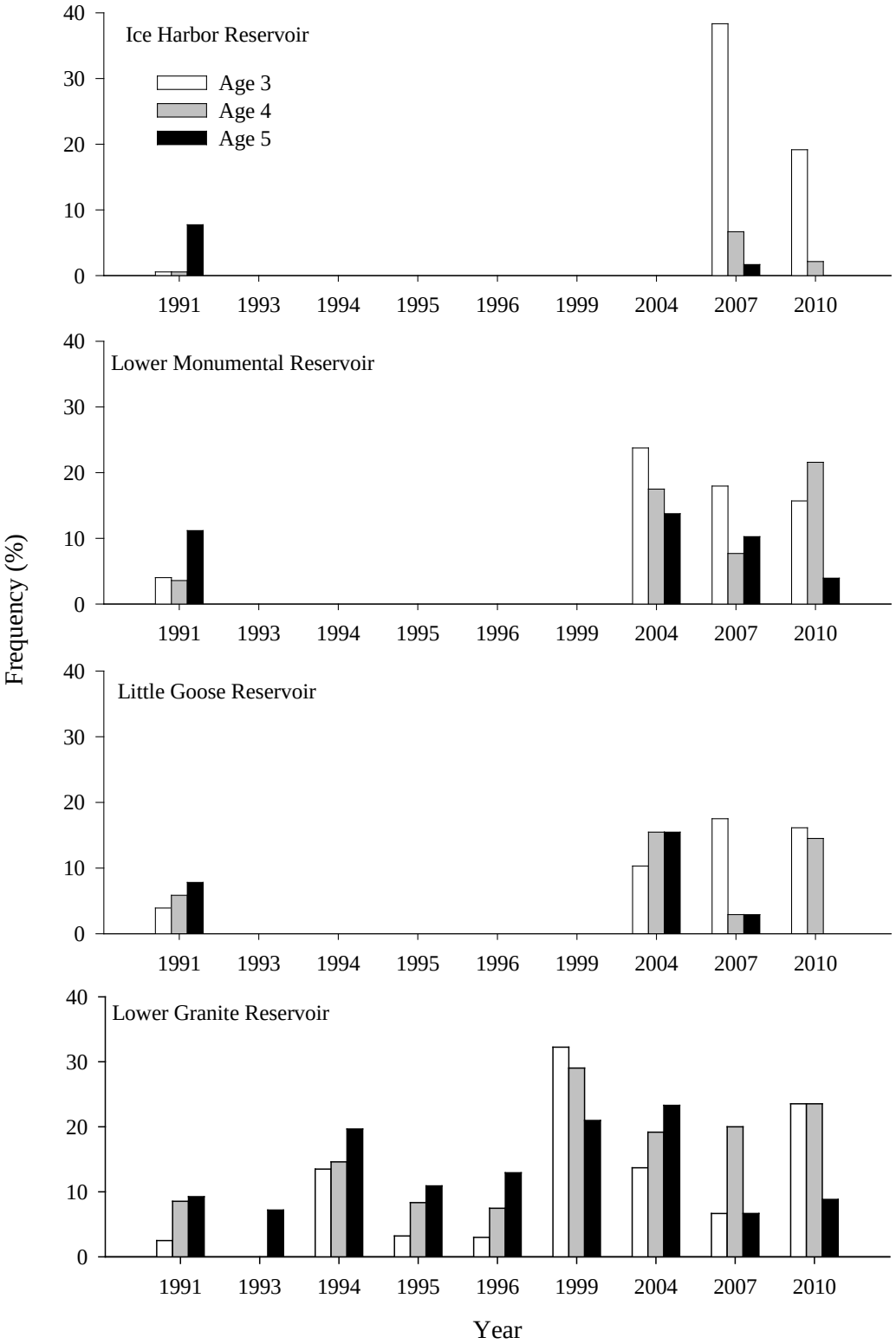


Figure 5. Percent composition of age 3–5 northern pikeminnow, relative to the total sample of fish ≥250 mm FL, in the lower Snake River reservoirs for sampling years 1991 to 2010. Years with blanks indicate either no sampling or insufficient sample size.

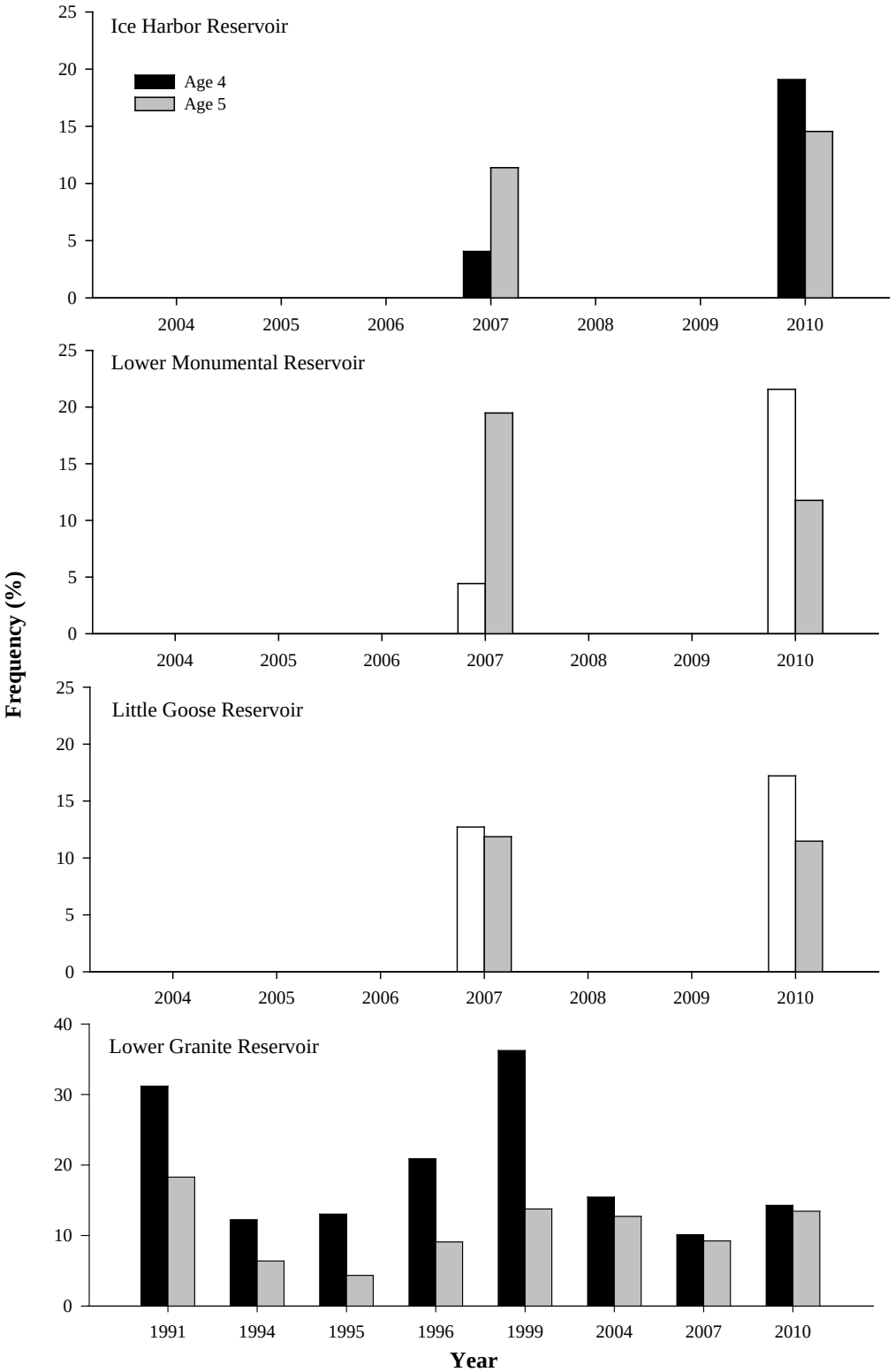


Figure 6. Percent composition of age 4–5 smallmouth bass, relative to the total sample of fish ≥200 mm FL, in the lower Snake River reservoirs for sampling years between 1991 and 2010. Years with blanks indicate either no sampling or insufficient sample size.

Median $W_r$ for male northern pikeminnow during 2010 ranged from 88 to 110 in Lower Monumental, Little Goose, and Lower Granite reservoirs (Appendix Table C-9). No male northern pikeminnow were captured in Ice Harbor Reservoir (Figure 7A). Median $W_r$ for female northern pikeminnow ranged from 93 to 115 across all Snake River reservoirs. An analysis of variance indicated that there was a significant difference in relative weight ($P$ <0.001) among years for both male and female northern pikeminnow in Lower Granite Reservoir (Figure 7B), with $W_r$ being higher in 1999 and 2007 than in earlier sampling years.

Median $W_r$ for smallmouth bass ranged from 92 to 97 in the lower Snake River reservoirs (Appendix Table C-9). We found that for smallmouth bass, all reservoirs had some years that were significantly different in relative weight ($P$ <0.001), with later years typically having higher $W_r$ than earlier years (Figure 8).

The median $W_r$ for walleye captured in Lower Monumental Reservoir was 100 (Appendix Table C-9). Relative weights for Lower Monumental walleye have only been calculated in three years, and we did not find any significant difference among years ($P$ = 0.255) (Figure 9).

## DISCUSSION

In 2010, system-wide exploitation of northern pikeminnow ≥200 mm FL (15.9%) increased from 2009 (8.8%). In addition, the system-wide exploitation rate for northern pikeminnow ≥250 mm FL (18.8%) increased from 2009 (12.0%). Overall exploitation for the sport-reward fishery continued to achieve the targeted range of 10–20% (Rieman and Beamesderfer 1990). Exploitation rates have been on the upper end of the 10–20% target range in 2004, 2005, 2008, and 2010 with results ranging from 18.5–19.5% for fish ≥250 mm FL. However, the upper bounds on uncertainty around these point estimates have exceeded the target range for these years. If exploitation rates continue to rise, it may be necessary assess the consequences of exploitation beyond the target range.

The majority (91%) of recaptures of fish ≥250 mm FL came from Bonneville Reservoir and the area below Bonneville Dam. No fish were recaptured from The Dalles Reservoir and only two fish were recaptured from John Day Reservoir, but few fish were tagged in either of these reservoirs (i.e., they accounted for a combined total of 4% of 2010 tags). The highest exploitation rate in 2010 was estimated in Lower Granite Reservoir at 63% and for fish ≥200 mm FL. However, this exceptionally high rate was artificially inflated due to a single fish being recaptured while there were only two tags at large (i.e., prior to the completion of our tagging in that reservoir). In full-season terms, Lower Granite Reservoir had five recaptures for 2010, comprising less than 1% of system-wide recaptures.

The 2010 dam-angling fishery accounted for 2.3% of the total northern pikeminnow harvested, a slight decrease from 3.7% during 2009 (Weaver et al. 2010). Only two tagged northern pikeminnow were recovered by dam anglers, neither of which was tagged in 2010. As in previous years, northern pikeminnow collected during the 2010 dam-angling fishery were consistently larger (median: 369 mm FL) than those collected in the 2010 sport-reward fishery (median: 258 mm FL). Past studies have also noted that dam anglers may have a better opportunity to harvest larger, mature northern pikeminnow than sport anglers (Martinelli and Shively 1997). In addition, dam anglers harvested fish from the boat restricted zones, which were not accessible to sport-anglers. Considering these observations and the fact that larger northern pikeminnow typically consume more smolts than smaller northern pikeminnow (Vigg et al. 1991), we support continued angling from the dams, and will continue to monitor dam-angling activities during 2011. Additionally, the high occurrence of lamprey in dam-angled pikeminnow diets is a noteworthy finding that we will closely track in future years.

Annual abundance indices for northern pikeminnow ≥250 mm FL in the lower Snake River reservoirs are much lower now than when sampling first began in 1991. Unfortunately, such low catch rates result in sample sizes that are insufficient for calculating consumption and predation indices. Therefore, it is difficult to assess long-term trends for those indices at the present time. Age histograms show that the proportion of age-5 northern pikeminnow has decreased in recent years relative to the proportions of age-3 and age-4 fish. This may indicate a population shift towards younger fish; however, Lower Granite Reservoir is the only Snake River reservoir where long-term aging data are available, so additional data are needed to confirm this trend in other reservoirs. Salmonids were found most frequently in northern pikeminnow digestive tracts from Lower Granite Reservoir, where the occurrence of salmonids in gut samples was also high in

2007. In addition, median relative weights for female northern pikeminnow in Lower Granite Reservoir appear to have increased slightly since sampling began in 1991. However, due to sparse consumption data for northern pikeminnow in the Snake River, we are unable to determine if improved fish condition is a result of higher salmonid consumption at the present time.

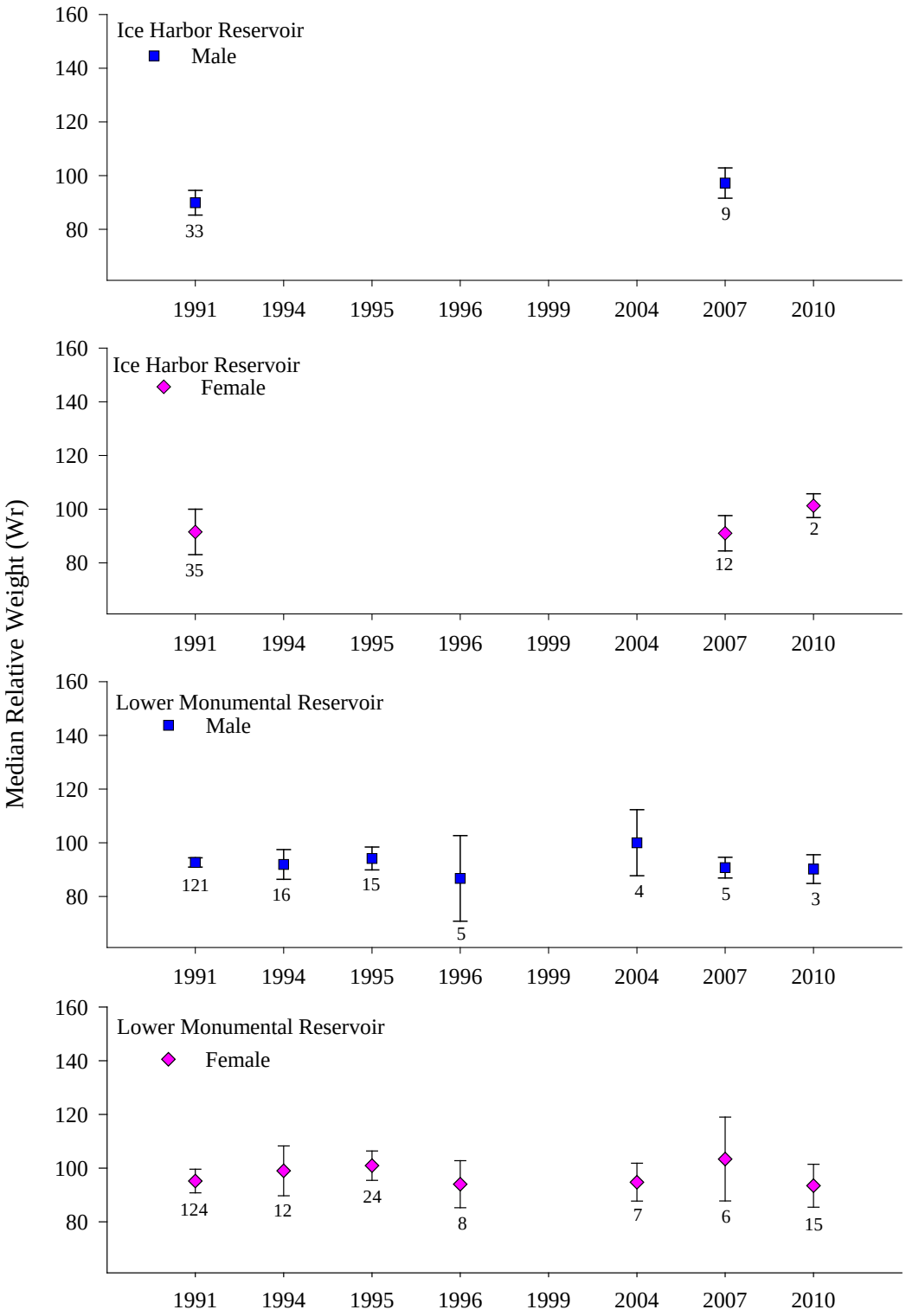


Figure 7A. Relative weight of male and female northern pikeminnow in Ice Harbor and Lower Monumental reservoirs, 1991- 2010. Numbers below the bars are the sample size. Years with blanks indicate either no sampling or no fish caught. Error bars correspond to 95% confidence intervals.

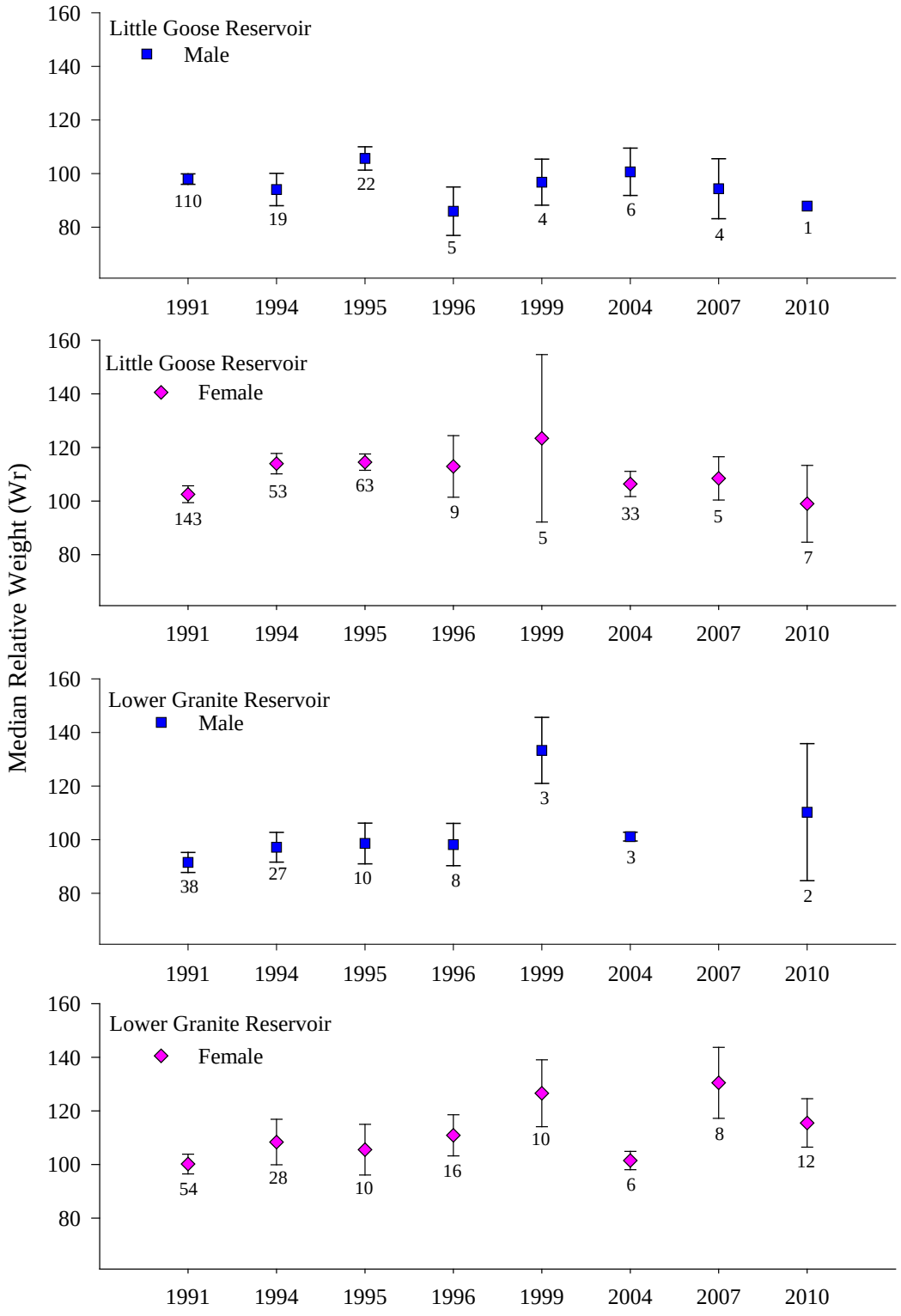


Figure 7B. Relative weight of male and female northern pikeminnow in Little Goose and Lower Granite reservoirs, 1991-2010. Numbers below the bars are the sample size. Years with blanks indicate either no sampling or no fish caught. Error bars correspond to 95% confidence intervals.

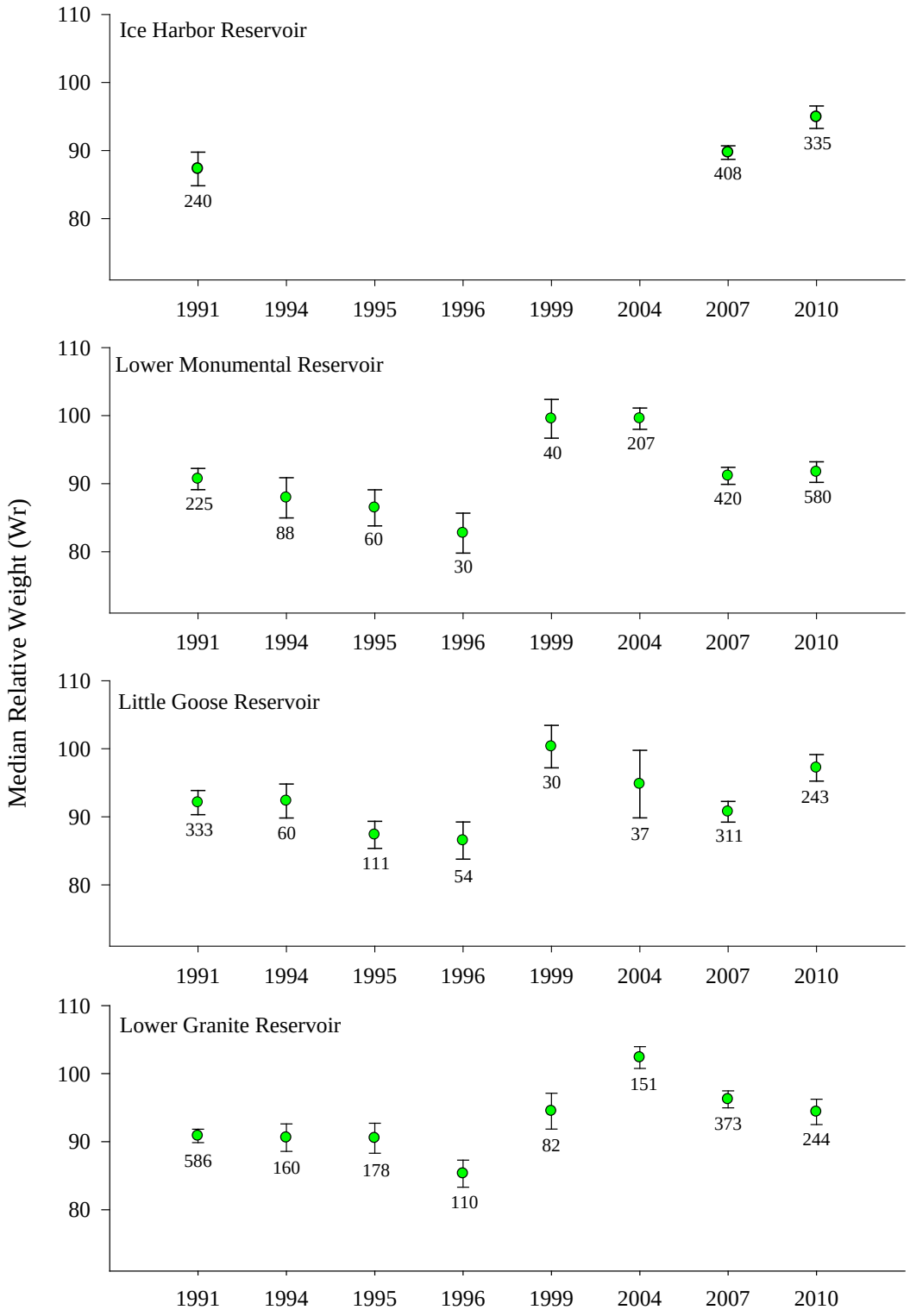


Figure 8. Relative weight of smallmouth bass in the lower Snake River 1991-2010. Numbers below the bars are the sample size. Years with blanks indicate either no sampling or no fish caught. Error bars correspond to 95% confidence intervals.

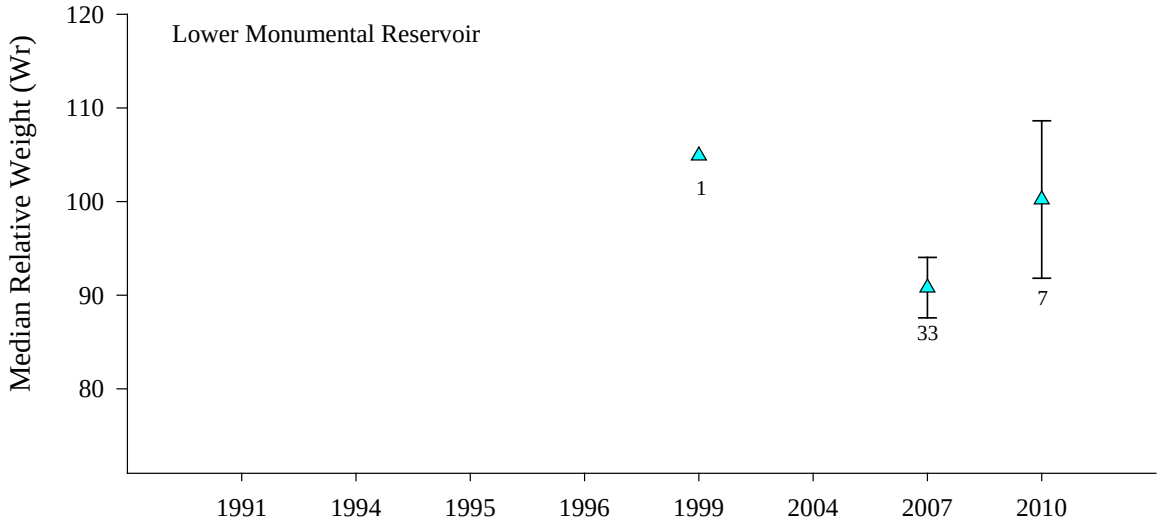


Figure 9. Relative weight of walleye in Lower Monumental Reservoir, 1991-2010. Numbers below the bars are the sample size. Years with blanks indicate either no sampling or no fish caught. Error bars correspond to 95% confidence intervals.

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). The relative abundance of smallmouth bass in the lower Snake River is greater than for northern pikeminnow and walleye, and although increases in abundance do periodically occur in some localized areas (e.g., the tailrace area of Lower Monumental Reservoir), relative abundance in most sampling areas has not changed since the NPMP was implemented. In both 2007 and 2010, smallmouth bass *PSD* values in all lower Snake River reservoirs were well below the threshold for a balanced population (*PSD*: 30–60; Anderson and Weithman 1978), and age compositions in 2010 showed higher proportions of age-4 fish relative to age-5 fish, possibly indicating an abundance of smaller and younger fish. We also found that median relative weights for smallmouth bass during sampling years from 1999 to 2010 were significantly higher than they were during sampling years from 1991 to 1996. However, improved condition of smallmouth bass in recent years did not appear to be reflected in increased consumption of juvenile salmonids, as both consumption and predation indices remained static. As documented in earlier work (Poe et al. 1991; Zimmerman 1999; Naughton et al. 2004), juvenile salmonids comprised a small but consistent portion of smallmouth bass diets in the Snake River. The proportion of stomach samples containing salmonids was slightly lower for smallmouth bass compared to northern pikeminnow; however, as with northern pikeminnow, the proportion was highest in Lower Granite Reservoir. This has been the case in the last three sampling years. Ward and Zimmerman (1999) suggested the first evidence of any response by smallmouth bass would likely be a change in diet. Although salmonids were often found in bass stomachs in Lower Granite Reservoir, non-salmonids such as percopsids and cottids were more prevalent in smallmouth bass diets in all reservoirs.

In contrast to smallmouth bass, and to a lesser extent northern pikeminnow, the relative abundance of walleye in the Snake River is extremely low. We continue to find small numbers of walleye in Lower Monumental Reservoir, and we captured a walleye for the first time in Ice

Harbor Reservoir in 2010. Although sample sizes have been small, diet analyses indicate that walleye in Lower Monumental Reservoir do consume juvenile salmonids. Given that diet analyses for walleye in other areas of the lower Columbia Basin have shown that juvenile salmonids can be found in a high proportion of walleye stomachs at certain times (Weaver et al. 2009; Weaver et al. 2010), we should continue to monitor the Snake River walleye population.

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). As of 2010, we have not yet found clear evidence of compensation by remaining predators in the lower Snake River. However, given recent trends towards higher condition among smallmouth bass, and the long-term needs for pikeminnow program evaluation (e.g., Beamesderfer et al. 1996), it is critical to continue monitoring the impact of the NPMP on Columbia and Snake river predator communities.

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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 2010.

| Sampling Week | Dates | |
|---|---|---|
| 14 | 29 Mar | – 4 Apr |
| 15 | 5 Apr | – 11 Apr |
| 16 | 12 Apr | – 18 Apr |
| 17 | 19 Apr | – 25 Apr |
| 18 | 26 Apr | – 2 May |
| 19 | 3 May | – 9 May |
| 20 | 10 May | – 16 May |
| 21 | 17 May | – 23 May |
| 22 | 24 May | – 30 May |
| 23 | 31 May | – 6 Jun |
| 24 | 7 Jun | – 13 Jun |
| 25 | 14 Jun | – 20 Jun |
| 26 | 21 Jun | – 27 Jun |
| 27 | 28 Jun | – 4 Jul |
| 28 | 5 Jul | – 11 Jul |
| 29 | 12 Jul | – 18 Jul |
| 30 | 19 Jul | – 25 Jul |
| 31 | 26 Jul | – 1 Aug |
| 32 | 2 Aug | – 8Aug |
| 33 | 9 Aug | – 15 Aug |
| 34 | 16 Aug | – 22 Aug |
| 35 | 23 Aug | – 29 Aug |
| 36 | 30 Aug | – 5 Sep |
| 37 | 6 Sep | – 12 Sep |
| 38 | 13 Sep | – 19 Sep |
| 39 | 20 Sep | – 26 Sep |
| 40 | 27 Sep | – 3 Oct |
| 41 | 4 Oct | – 10 Oct |
| 42 | 11 Oct | – 17 Oct |

Appendix Table A-2. Number of 15-minute (900 second) electrofishing runs conducted for biological indexing in the lower Snake River reservoirs for all sampling years. FB = Forebay, Mid = Mid-reservoir, TR = Tailrace. rkm = river kilometer and — = not sampled.

| | Ice Harbor | | | Lower Monumental | | | Little Goose | | | Lower Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | FB | Mid | TR | FB | Mid | TR | FB | Mid | TR | rkm 222–228 |
| 1991 | 57 | 59 | 67 | 66 | 61 | 56 | 61 | 55 | 57 | 55 |
| 1994 | — | — | — | — | — | 44 | — | — | 39 | 85 |
| 1995 | — | — | — | — | — | 46 | — | — | 40 | 89 |
| 1996 | — | — | — | — | — | 32 | — | — | 37 | 89 |
| 1999 | — | — | — | — | — | 14 | — | — | 29 | 75 |
| 2004 | — | — | — | — | — | 30 | — | — | 30 | 34 |
| 2007 | 37 | 40 | 40 | 40 | 36 | 37 | 40 | 24 | 20 | 96 |
| 2010 | 36 | 39 | 40 | 44 | 48 | 30 | 35 | 35 | 41 | 91 |

## APPENDIX TABLES B

## Exploitation Rates for Northern Pikeminnow, 1991–2010

Appendix Table B-1. System-wide weekly exploitation rates of northern pikeminnow ≥200 mm FL for the sport-reward fishery in 2010. Dashes indicate either no tagging effort, no recapture effort, or no exploitation calculated.

| Sampling Week | Tagged | Recaptured | At-Large | Exploitation[a] (%) |
|---|---|---|---|---|
| 14 | 7 | — | — | — |
| 15 | 57 | — | 7 | — |
| 16 | 28 | — | 64 | — |
| 17 | 330 | — | 92 | — |
| 18 | 181 | 1 | 422 | 0.2 |
| 19 | 4 | 1 | 602 | 0.2 |
| 20 | 13 | 4 | 605 | 0.7 |
| 21 | 29 | 3 | 614 | 0.5 |
| 22 | 51 | 5 | 640 | 0.8 |
| 23 | 39 | 8 | 686 | 1.2 |
| 24 | 40 | 7 | 717 | 1.3 |
| 25 | 68 | 4 | 748 | 0.6 |
| 26 | 6 | 7 | 812 | 1.0 |
| 27 | — | 8 | 810 | 1.0 |
| 28 | — | 9 | 802 | 1.2 |
| 29 | — | 8 | 793 | 1.1 |
| 30 | — | 2 | 785 | 0.5 |
| 31 | — | 3 | 780 | 0.5 |
| 32 | — | 5 | 776 | 0.7 |
| 33 | — | 4 | 771 | 0.5 |
| 34 | — | 3 | 767 | 0.4 |
| 35 | — | 6 | 764 | 0.8 |
| 36 | — | 2 | 758 | 0.3 |
| 37 | — | 5 | 756 | 0.7 |
| 38 | — | 3 | 751 | 0.4 |
| 39 | — | 4 | 748 | 0.6 |
| 40 | — | 2 | 744 | 0.3 |
| 41 | — | 2 | 742 | 0.3 |
| 42 | — | — | 739 | — |
| Total | 853 | 112 | 739 | 15.9 |

a) Exploitation rates adjusted for tag loss (5.1%).

Appendix Table B-2. Exploitation rates (%) of northern pikeminnow fork length groups 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 |
| 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 |
| ≥250 mm | | | | | | | | |
| 1991 | 7.6 | 10.9 | 23.6 | 2.8 | 5.3 | 2.4 | 20.0 | 8.5 |
| 1992 | 11.4 | 4.0 | 6.2 | 3.4 | 5.6 | 11.9 | 15.0 | 9.3 |
| 1993 | 6.0 | 2.1 | 7.0 | 2.4 | 15.9 | 3.3 | 12.5 | 6.8 |
| 1994 | 13.6 | 2.2 | 9.8 | 3.2 | 14.0 | 6.1 | 8.7 | 10.9 |
| 1995 | 16.1 | 3.5 | 14.9 | 0.0 | 22.4 | 2.9 | 6.4 | 13.4 |
| 1996 | 12.7 | 6.1 | 15.5 | 0.0 | 18.2 | 8.9 | 11.7 | 12.1 |
| 1997 | 7.8 | 8.0 | 5.8 | 0.0 | 16.5 | 0.0 | 15.5 | 8.9 |
| 1998 | 8.2 | 7.8 | 12.8 | 0.0 | 13.6 | 0.0 | 12.1 | 11.1 |
| 1999 | 9.6 | 13.9 | 16.1 | 3.7 | 15.9 | 0.0 | 6.1 | 12.5 |
| 2000 | 10.0 | 16.3 | *a* | *a* | 9.7 | *a* | 8.7 | 11.9 |
| 2001 | 16.2 | 8.5 | *a* | *a* | 26.0 | — | *a* | 16.2 |
| 2002 | 12.6 | 6.0 | *a* | *a* | 7.7 | — | 14.3 | 12.3 |

Appendix Table B-2. Continued.

| Group, Year | Below Bonneville | Bonneville | The Dalles | John Day | McNary | Little Goose | Lower Granite | All areas |
|---|---|---|---|---|---|---|---|---|
| ≥250 mm cont. | | | | | | | | |
| 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 |

## APPENDIX TABLES C

**Biological Evaluation of Northern Pikeminnow, Smallmouth Bass, and Walleye in the Lower Snake River Reservoirs, 1991–2010**

Appendix Table C-1. Annual abundance index values (catch per 15-minute electrofishing run, scaled to surface area) for northern pikeminnow ≥ 250 mm fork length in the lower Snake River reservoirs during all sampling years. FB = Forebay, Mid = Mid-reservoir, TR = Tailrace. — = not sampled.

| | Ice Harbor | | | Lower Monumental | | | Little Goose | | | Lower Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | FB | Mid | TR | FB | Mid | TR | FB | Mid | TR | Upper |
| 1991 | 0.1 | 1.0 | 0.3 | 0.5 | 2.9 | 1.3 | 1.2 | 1.7 | 0.7 | 1.6 |
| 1994 | — | — | — | — | — | 0.3 | — | — | 0.2 | 0.5 |
| 1995 | — | — | — | — | — | 0.1 | — | — | <0.1 | 0.2 |
| 1996 | — | — | — | — | — | 0.1 | — | — | 0.1 | 0.2 |
| 1999 | — | — | — | — | — | 0.0 | — | — | 0.1 | 0.3 |
| 2004 | — | — | — | — | — | 0.1 | — | — | 0.1 | 0.1 |
| 2007 | <0.1 | 0.0 | 0.1 | <0.1 | 0.3 | 0.0 | <0.1 | 0.0 | <0.1 | 0.1 |
| 2010 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | <0.1 | 0.1 |

Appendix Table C-2. Spring and summer relative abundance of smallmouth bass ≥ 200 mm fork length in the lower Snake River reservoirs during all sampling years. FB = Forebay, Mid = Mid-reservoir, TR = Tailrace. — = not sampled. Relative abundance is expressed as mean transformed catch ($\log_{10}$(catch+1)) per 15-minute electrofishing run.

| Season, | Ice Harbor | | | Lower Monumental | | | Little Goose | | | Lower Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | FB | Mid | TR | FB | Mid | TR | FB | Mid | TR | Upper |
| Spring | | | | | | | | | | |
| 1991 | 0.3 | 0.4 | 0.7 | 0.4 | 0.3 | 0.6 | 0.6 | 0.7 | — | — |
| 1994 | — | — | — | — | — | 0.4 | — | — | 0.7 | 0.6 |
| 1995 | — | — | — | — | — | 0.2 | — | — | 0.4 | 0.3 |
| 1996 | — | — | — | — | — | 0.1 | — | — | 0.4 | 0.3 |
| 1999 | — | — | — | — | — | 0.5 | — | — | 0.4 | 0.3 |
| 2004 | — | — | — | — | — | 0.0 | — | — | 0.0 | 0.2 |
| 2007 | 0.2 | 0.3 | 0.6 | 0.4 | 0.4 | 0.7 | 0.6 | 0.3 | 0.2 | 0.5 |
| 2010 | 0.2 | 0.5 | 0.6 | 0.3 | 0.6 | 0.6 | 0.3 | 0.4 | 0.1 | 0.3 |
| Summer | | | | | | | | | | |
| 1991 | 0.1 | 0.3 | 0.3 | 0.2 | 0.2 | 0.3 | 0.4 | 0.4 | 0.5 | 0.6 |
| 1994 | — | — | — | — | — | 0.5 | — | — | 0.4 | 0.3 |
| 1995 | — | — | — | — | — | 0.2 | — | — | 0.3 | 0.4 |
| 1996 | — | — | — | — | — | 0.3 | — | — | 0.2 | 0.1 |
| 1999 | — | — | — | — | — | — | — | — | — | 0.0 |
| 2004 | — | — | — | — | — | 1.0 | — | — | 0.2 | 0.3 |
| 2007 | 0.5 | 0.5 | 0.7 | 0.6 | 0.4 | 0.6 | 0.6 | 0.4 | 0.2 | 0.4 |
| 2010 | 0.4 | 0.4 | 0.7 | 0.5 | 0.6 | 1.2 | 0.4 | 0.4 | 0.3 | 0.6 |

Appendix Table C-3. Spring and summer relative abundance of walleye ≥ 200 mm fork length in the lower Snake River reservoirs during selected sampling years[1]. FB = Forebay, Mid = Mid-reservoir, TR = Tailrace. — = not sampled. Relative abundance is expressed as mean transformed catch ($log_{10}$ (catch+1)) per 15-minute electrofishing run.

| Season, | Ice Harbor | | | Lower Monumental | | | Little Goose | | | Lower Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | FB | Mid | TR | FB | Mid | TR | FB | Mid | TR | Upper |
| Spring | | | | | | | | | | |
| 1999 | — | — | — | — | — | <0.1 | — | — | 0.0 | 0.0 |
| 2007 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2010 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Summer | | | | | | | | | | |
| 1999 | — | — | — | — | — | — | — | — | — | 0.0 |
| 2007 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2010 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |

[1] Years when walleye were not captured during indexing were omitted to simplify this table.

Appendix Table C-4. Spring and summer consumption indices for northern pikeminnow ≥ 250 mm fork length in the lower Snake River reservoirs during all sampling years. FB = Forebay, Mid = Mid-reservoir, TR = Tailrace. — = not sampled, *a* = no consumption index calculated (n ≤ 5), and *b* = no stomach data collected.

| Season, | Ice Harbor | | | Lower Monumental | | | Little Goose | | | Lower Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | FB | Mid | TR | FB | Mid | TR | FB | Mid | TR | Upper |
| Spring | | | | | | | | | | |
| 1991 | 0.0 | 0.4 | 0.5 | 0.0 | 0.0 | 0.6 | 0.8 | 0.0 | 0.7 | 0.3 |
| 1994 | — | — | — | — | — | 0.8 | — | — | 2.0 | 1.1 |
| 1995 | — | — | — | — | — | *b* | — | — | *b* | 1.2 |
| 1996 | — | — | — | — | — | *a* | — | — | 0.7 | 0.3 |
| 1999 | — | — | — | — | — | *a* | — | — | *a* | 2.0 |
| 2004 | — | — | — | — | — | *a* | — | — | *a* | *a* |
| 2007 | *a* | *a* | *a* | *a* | *a* | *a* | *a* | *a* | *a* | 1.0 |
| 2010 | *a* | *a* | *a* | *a* | 0.0 | *a* | *a* | *a* | *a* | *a* |
| Summer | | | | | | | | | | |
| 1991 | *b* | *b* | *b* | *b* | *b* | *b* | *b* | *b* | *b* | *b* |
| 1994 | — | — | — | — | — | *a* | — | — | *a* | *b* |
| 1995 | — | — | — | — | — | *a* | — | — | *a* | *a* |
| 1996 | — | — | — | — | — | *a* | — | — | *a* | *a* |
| 1999 | — | — | — | — | — | — | — | — | *a* | *a* |
| 2004 | — | — | — | — | — | *a* | — | — | 0.0 | *a* |
| 2007 | *a* | *a* | 2.0 | *a* | *a* | *a* | *a* | *a* | *a* | *a* |
| 2010 | *a* | *a* | *a* | *a* | *a* | *a* | *a* | *a* | *a* | 1.7 |

Appendix Table C-5. Spring and summer predation indices for northern pikeminnow ≥ 250 mm fork length in the lower Snake River reservoirs during all sampling years. FB = Forebay, Mid = Mid-reservoir, TR = Tailrace. — = not sampled, *a* = no predation index calculated (n ≤ 5), and *b* = no stomach data collected.

| Season, | Ice Harbor | | | Lower Monumental | | | Little Goose | | | Lower Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | FB | Mid | TR | FB | Mid | TR | FB | Mid | TR | Upper |
| Spring | | | | | | | | | | |
| 1991 | 0.0 | 0.4 | 0.2 | 0.0 | 0.0 | 0.5 | 1.3 | 0.0 | 0.7 | 0.3 |
| 1994 | — | — | — | — | — | 0.2 | — | — | 0.3 | 0.5 |
| 1995 | — | — | — | — | — | *b* | — | — | *b* | 0.2 |
| 1996 | — | — | — | — | — | *a* | — | — | 0.1 | 0.1 |
| 1999 | — | — | — | — | — | *a* | — | — | *a* | 0.5 |
| 2004 | — | — | — | — | — | *a* | — | — | *a* | *a* |
| 2007 | *a* | *a* | *a* | *a* | *a* | *a* | *a* | *a* | *a* | 0.1 |
| 2010 | *a* | *a* | *a* | *a* | 0.0 | *a* | *a* | *a* | *a* | *a* |
| Summer | | | | | | | | | | |
| 1991 | *b* | *b* | *b* | *b* | *b* | *b* | *b* | *b* | *b* | *b* |
| 1994 | — | — | — | — | — | *a* | — | — | *a* | *b* |
| 1995 | — | — | — | — | — | *a* | — | — | *a* | *a* |
| 1996 | — | — | — | — | — | *a* | — | — | *a* | *a* |
| 1999 | — | — | — | — | — | — | — | — | *a* | *a* |
| 2004 | — | — | — | — | — | *a* | — | — | 0.0 | *a* |
| 2007 | *a* | *a* | 0.2 | *a* | *a* | *a* | *a* | *a* | *a* | *a* |
| 2010 | *a* | *a* | *a* | *a* | *a* | *a* | *a* | *a* | *a* | 0.2 |

Appendix Table C-6. Spring and summer consumption indices for smallmouth bass ≥ 200 mm fork length in the lower Snake River reservoirs during all sampling years. FB = Forebay, Mid = Mid-reservoir, TR = Tailrace. — = not sampled, *a* = no consumption index calculated (n ≤ 5), and *b* = no stomach data collected.

| Season, | Ice Harbor | | | Lower Monumental | | | Little Goose | | | Lower Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | FB | Mid | TR | FB | Mid | TR | FB | Mid | TR | Upper |
| Spring | | | | | | | | | | |
| 1991 | 0.0 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | <0.1 | <0.1 | <0.1 | 0.1 |
| 1994 | — | — | — | — | — | 0.1 | — | — | 0.1 | 0.2 |
| 1995 | — | — | — | — | — | 0.0 | — | — | 0.0 | 0.1 |
| 1996 | — | — | — | — | — | 0.0 | — | — | <0.1 | <0.1 |
| 1999 | — | — | — | — | — | <0.1 | — | — | <0.1 | 0.1 |
| 2004 | — | — | — | — | — | *a* | — | — | *a* | 0.2 |
| 2007 | 0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | 0.1 | 0.1 | 0.0 | 0.1 |
| 2010 | 0.1 | 0.0 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 | 0.1 |
| Summer | | | | | | | | | | |
| 1991 | *b* | *b* | *b* | *b* | *b* | *b* | *b* | *b* | *b* | *b* |
| 1994 | — | — | — | — | — | *b* | — | — | *b* | *b* |
| 1995 | — | — | — | — | — | 0.0 | — | — | 0.0 | 0.0 |
| 1996 | — | — | — | — | — | 0.0 | — | — | 0.0 | 0.0 |
| 1999 | — | — | — | — | — | — | — | — | *a* | 0.2 |
| 2004 | — | — | — | — | — | *b* | — | — | *b* | 0.2 |
| 2007 | <0.1 | 0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.2 |
| 2010 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 | 0.0 | 0.0 | 0.1 | <0.1 | 0.1 |

Appendix Table C-7. Spring and summer predation indices for smallmouth bass ≥ 200 mm fork length in the lower Snake River reservoirs during selected sampling years[1]. FB = Forebay, Mid = Mid-reservoir, TR = Tailrace. — = not sampled, *a* = no predation index calculated (n ≤ 5), and *b* = no stomach data collected.

| Season, | Ice Harbor | | | Lower Monumental | | | Little Goose | | | Lower Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | FB | Mid | TR | FB | Mid | TR | FB | Mid | TR | Upper |
| Spring | | | | | | | | | | |
| 2004 | — | — | — | — | — | *b* | — | — | *b* | 0.2 |
| 2007 | 0.1 | 0.2 | 0.0 | 0.2 | 0.2 | 0.2 | 0.5 | 0.4 | 0.0 | 0.3 |
| 2010 | 0.1 | 0.0 | 0.1 | 0.1 | 0.1 | <0.1 | 0.1 | 0.2 | 0.0 | 0.2 |
| Summer | | | | | | | | | | |
| 2004 | — | — | — | — | — | *b* | — | — | *b* | 0.4 |
| 2007 | 0.2 | 0.6 | 0.1 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.5 |
| 2010 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.6 | <0.1 | 0.4 |

[1] Years when predation indices were not calculated were omitted to simplify this table.

Appendix Table C-8. 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 lower Snake River reservoirs during all sampling years. — = not sampled, and *a* = no stock density index calculated ($N \leq 20$).

| Area, | Northern Pikeminnow | | Smallmouth Bass | | | Walleye | | |
|---|---|---|---|---|---|---|---|---|
| Year | *N* | PSD | *N* | PSD | RSD-P | *N* | PSD | RSD-P |
| Ice Harbor | | | | | | | | |
| 1991 | 49 | 37 | 269 | 17 | 2 | 0 | *a* | *a* |
| 1994 | — | — | — | — | — | — | — | — |
| 1995 | — | — | — | — | — | — | — | — |
| 1996 | — | — | — | — | — | — | — | — |
| 1999 | — | — | — | — | — | — | — | — |
| 2004 | — | — | — | — | — | — | — | — |
| 2007 | 8 | *a* | 662 | 13 | 3 | 0 | *a* | *a* |
| 2010 | 0 | *a* | 485 | 15 | 2 | 0 | *a* | *a* |
| Lower Monumental | | | | | | | | |
| 1991 | 143 | 16 | 248 | 17 | 3 | 0 | *a* | *a* |
| 1994 | 19 | *a* | 167 | 7 | 1 | 0 | *a* | *a* |
| 1995 | 35 | 23 | 74 | 12 | 3 | 0 | *a* | *a* |
| 1996 | 12 | *a* | 39 | 10 | 0 | 0 | *a* | *a* |
| 1999 | 0 | *a* | 42 | 62 | 2 | 1 | *a* | *a* |
| 2004 | 8 | *a* | 253 | 15 | 1 | 0 | *a* | *a* |
| 2007 | 7 | *a* | 533 | 14 | 3 | 25 | 20 | 8 |
| 2010 | 12 | *a* | 780 | 8 | 1 | 6 | *a* | *a* |
| Little Goose | | | | | | | | |
| 1991 | 143 | 36 | 405 | 20 | 3 | 0 | *a* | *a* |
| 1994 | 70 | 64 | 159 | 6 | 1 | 0 | *a* | *a* |
| 1995 | 84 | 60 | 129 | 13 | 5 | 0 | *a* | *a* |
| 1996 | 13 | *a* | 55 | 18 | 5 | 0 | *a* | *a* |
| 1999 | 9 | *a* | 30 | 70 | 0 | 0 | *a* | *a* |
| 2004 | 30 | 53 | 48 | 35 | 13 | 0 | *a* | *a* |
| 2007 | 2 | *a* | 513 | 18 | 5 | 0 | *a* | *a* |
| 2010 | 6 | *a* | 338 | 23 | 7 | 0 | *a* | *a* |
| Lower Granite | | | | | | | | |
| 1991 | 35 | 43 | 828 | 8 | 2 | 0 | *a* | *a* |
| 1994 | 45 | 33 | 436 | 9 | 2 | 0 | *a* | *a* |
| 1995 | 20 | *a* | 270 | 17 | 6 | 0 | *a* | *a* |

Appendix Table C-8. Continued.

| Area, Year | Northern Pikeminnow *N* | Northern Pikeminnow PSD | Smallmouth Bass *N* | Smallmouth Bass PSD | Smallmouth Bass RSD-P | Walleye *N* | Walleye PSD | Walleye RSD-P |
|---|---|---|---|---|---|---|---|---|
| 1996 | 26 | 38 | 132 | 29 | 11 | 0 | *a* | *a* |
| 1999 | 17 | *a* | 83 | 37 | 6 | 0 | *a* | *a* |
| 2004 | 5 | *a* | 298 | 12 | 2 | 0 | *a* | *a* |
| 2007 | 11 | *a* | 517 | 14 | 3 | 0 | *a* | *a* |
| 2010 | 14 | *a* | 451 | 16 | 6 | 0 | *a* | *a* |

Appendix Table C-9. Sample size (*N*), median relative weight (Wr), and 95% confidence interval (CI) of northern pikeminnow ≥ 200 mm FL, smallmouth bass ≥ 200 mm TL, and walleye ≥ 200 mm TL in the lower Snake River reservoirs during all sampling years. — = not sampled..

| Area, | Northern pikeminnow | | | | | | Smallmouth bass | | | Walleye | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | | | Female | | | | | | | | |
| Year | *N* | Wr | CI | *N* | Wr | CI | *N* | Wr | CI | *N* | Wr | CI |
| Ice Harbor | | | | | | | | | | | | |
| 1991 | 33 | 90 | 4.6 | 35 | 92 | 8.5 | 240 | 87 | 2.5 | 0 | 0 | 0.0 |
| 1994 | — | — | — | — | — | — | — | — | — | — | — | — |
| 1995 | — | — | — | — | — | — | — | — | — | — | — | — |
| 1996 | — | — | — | — | — | — | — | — | — | — | — | — |
| 1999 | — | — | — | — | — | — | — | — | — | — | — | — |
| 2004 | — | — | — | — | — | — | — | — | — | — | — | — |
| 2007 | 9 | 97 | 5.7 | 12 | 91 | 6.6 | 408 | 90 | 1.0 | 0 | 0 | 0.0 |
| 2010 | 0 | 0 | 0.0 | 2 | 101 | 4.4 | 335 | 95 | 1.6 | 0 | 0 | 0.0 |
| Lower Monumental | | | | | | | | | | | | |
| 1991 | 121 | 93 | 1.7 | 124 | 95 | 4.4 | 225 | 91 | 1.6 | 0 | 0 | 0.0 |
| 1994 | 16 | 92 | 5.6 | 12 | 99 | 9.3 | 88 | 88 | 3.0 | 0 | 0 | 0.0 |
| 1995 | 15 | 94 | 4.3 | 24 | 101 | 5.5 | 60 | 86 | 2.7 | 0 | 0 | 0.0 |
| 1996 | 5 | 87 | 15.9 | 8 | 94 | 8.8 | 30 | 83 | 2.9 | 0 | 0 | 0.0 |
| 1999 | 0 | 0 | 0.0 | 0 | 0 | 0.0 | 40 | 100 | 2.8 | 1 | 105 | 0.0 |
| 2004 | 4 | 100 | 12.3 | 7 | 95 | 7.0 | 207 | 100 | 1.6 | 0 | 0 | 0.0 |
| 2007 | 5 | 91 | 3.9 | 6 | 103 | 15.6 | 420 | 91 | 1.3 | 33 | 91 | 3.2 |
| 2010 | 3 | 90 | 5.4 | 15 | 93 | 8.0 | 580 | 92 | 1.5 | 7 | 100 | 8.4 |
| Little Goose | | | | | | | | | | | | |
| 1991 | 110 | 98 | 2.0 | 143 | 103 | 3.1 | 333 | 92 | 1.8 | 0 | 0 | 0.0 |
| 1994 | 19 | 94 | 6.0 | 53 | 114 | 3.8 | 60 | 92 | 2.5 | 0 | 0 | 0.0 |

Appendix Table C-9. Continued

| Area, Year | Northern pikeminnow | | | | | | Smallmouth bass | | | Walleye | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | | | Female | | | | | | | | |
| | *N* | Wr | CI | *N* | Wr | CI | *N* | Wr | CI | *N* | Wr | CI |
| 1995 | 22 | 106 | 4.4 | 63 | 115 | 3.1 | 111 | 87 | 2.0 | 0 | 0 | 0.0 |
| 1996 | 5 | 86 | 9.0 | 9 | 113 | 11.5 | 54 | 87 | 2.7 | 0 | 0 | 0.0 |
| 1999 | 4 | 97 | 8.6 | 5 | 123 | 31.2 | 30 | 100 | 3.1 | 0 | 0 | 0.0 |
| 2004 | 6 | 101 | 8.8 | 33 | 106 | 4.7 | 37 | 95 | 5.0 | 0 | 0 | 0.0 |
| 2007 | 4 | 94 | 11.2 | 5 | 108 | 8.1 | 311 | 91 | 1.5 | 0 | 0 | 0.0 |
| 2010 | 1 | 88 | 0.0 | 7 | 99 | 14.3 | 243 | 97 | 2.0 | 0 | 0 | 0.0 |
| Lower Granite | | | | | | | | | | | | |
| 1991 | 38 | 92 | 3.7 | 54 | 100 | 3.7 | 586 | 91 | 1.0 | 0 | 0 | 0.0 |
| 1994 | 27 | 97 | 5.6 | 28 | 108 | 8.5 | 160 | 91 | 2.0 | 0 | 0 | 0.0 |
| 1995 | 10 | 99 | 7.6 | 10 | 106 | 9.5 | 178 | 91 | 2.2 | 0 | 0 | 0.0 |
| 1996 | 8 | 98 | 7.9 | 16 | 111 | 7.7 | 110 | 85 | 2.0 | 0 | 0 | 0.0 |
| 1999 | 3 | 133 | 12.3 | 10 | 127 | 12.5 | 82 | 94 | 2.6 | 0 | 0 | 0.0 |
| 2004 | 3 | 101 | 1.6 | 6 | 101 | 3.4 | 151 | 102 | 1.6 | 0 | 0 | 0.0 |
| 2007 | 0 | 0 | 0.0 | 8 | 130 | 13.2 | 373 | 96 | 1.2 | 0 | 0 | 0.0 |
| 2010 | 2 | 110 | 25.6 | 12 | 115 | 9.0 | 244 | 94 | 1.9 | 0 | 0 | 0.0 |

## APPENDIX TABLES D

## Diets of Northern Pikeminnow Captured While Dam Angling at Bonneville, The Dalles, and John Day Dams, 2006–2010

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 2006-2010. — = not sampled.

| Dam, | Northern pikeminnow | | | |
|---|---|---|---|---|
| Year | *N* | FL-range | Mean | Median |
| Bonneville | | | | |
| 2006 | 22 | 267-544 | 425 | 438 |
| 2007 | — | — | — | — |
| 2008 | — | — | — | — |
| 2009 | — | — | — | — |
| 2010 | — | — | — | — |
| 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 |
| 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 |
| Combined totals | 2441 | 185-575 | 368 | 360 |

Appendix Table D-2. Number (*N*) of northern pikeminnow digestive tracts examined from Bonneville, The Dalles, and John Day dams in 2006-2010, and percent of prey items contained. — = not sampled, SAL=salmonid, LAM=lamprey, ASH=American shad.

| Dam, | Northern pikeminnow | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | — | — | — | — | — | — | — | — | — | — |
| 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 |
| 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 |
| Totals | 2441 | 60 | 42 | 5 | 25 | 11 | 13 | 23 | 5 | 13 |

Appendix Table D-3. Percent of prey fish families identified from northern pikeminnow digestive tract samples collected from Bonneville, The Dalles, and John Day dams during 2006-2010 that contained fish remains.

| Family | May | June | July | August | Total |
|---|---|---|---|---|---|
| Catostomidae | 0 | 0 | 0 | 3 | 1 |
| Centrarchidae | 0 | 0 | 1 | 22 | 4 |
| Clupeidae | 0 | 0 | 0 | 76 | 12 |
| Cottidae | 0 | 2 | 1 | 3 | 2 |
| Cyprinidae | 0 | 0 | 1 | 5 | 1 |
| Ictaluridae | 0 | 0 | 0 | 1 | 0 |
| Percidae | 1 | 0 | 0 | 1 | 0 |
| Petromyzontidae | 78 | 81 | 38 | 7 | 56 |
| Pleuronectidae | 0 | 0 | 0 | 1 | 0 |
| Salmonidae | 28 | 26 | 54 | 8 | 32 |

**REPORT D**

# Northern Pikeminnow Dam Angling on the Columbia River

Prepared by

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

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

March 2011

# ABSTRACT

We are reporting on the 2010 Northern Pikeminnow Dam Angling component of the Northern Pikeminnow Management Program (NPMP) as implemented by the Washington Department of Fish and Wildlife (WDFW). The angling took place within the tailraces areas of The Dalles and John Day dams for 16 weeks from mid May to the end of August. 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 equal Dam Angler effort between the The Dalles and John Day dams while collecting, compiling and reporting data on angler harvest, CPUE, gear/techniques, and incidental catch for each project, (3) scan all northern pikeminnow for the presence of consumed salmonids containing Passive Integrated Transponder (PIT) tags and record the presence of any external spaghetti tags, fin-clips, or signs of tag loss, (4) collect biological data on all northern pikeminnow and other fishes caught by 2010 Dam Angling crew.

A Dam Angling crew of four anglers harvested 1,323 northern pikeminnow at The Dalles Dam and 2,675 pikeminnow at John Day Dam for a total of 3,998 pikeminnow. The crew fished a total of 1,816.7 hours during the 16 week fishery for a combined overall average catch per angler hour of 2.20, while the crew's average catch per week was 249.86 fish. At The Dalles Dam, crew members averaged 1.42 fish per angler hour (CPUE), and cumulatively 41.34 northern pikeminnow per day. At John Day Dam, crew member CPUE was 3.03 (fish per angler hour) with a cumulative total of 83.59 fish per day.

Back bouncing soft plastic lures was found to be the most effective method for harvesting northern pikeminnow from The Dalles and John Day dams. Incidental species most frequently caught and released by the Dam Angling crew in 2010 were smallmouth bass *Micropterus dolomieu*, walleye *Sander vitreus*, white sturgeon *Acipenser transmontanus* 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). Beginning in 2010, WDFW was also contracted to conduct the Dam Angling component of the NPMP. 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 2010 Dam Angling component of the NPMP were to (1) implement a recreational-type hook and line fishery that harvests northern pikeminnow from within areas closed to public access at The Dalles and John Day Dams, (2) allocate equal Dam Angler effort between the The Dalles and John Day Dams while collecting, compiling and reporting data on angler harvest, CPUE, gear/techniques, and incidental catch for each project, (3) scan all northern pikeminnow for the presence of consumed salmonids containing Passive Integrated Transponder (PIT) tags and record the presence of any external spaghetti tags, fin-clips, or signs of tag loss, (4) collect biological data on all northern pikeminnow and other fishes caught by 2010 Dam Angling crew.

# METHODS

## Project Area

Dam angling activities for the 2010 NPMP were conducted at The Dalles and John Day Dams on the Columbia River from May 11, 2010 (week 20) through August 29, 2010 (week 35). At both projects, all fishing was conducted within the boat restricted zone where no public angling was permitted. At The Dalles Dam, the Dam Angling crew fished along the turbine wall, throughout the cul-de-sac area, at the ice-trash sluiceway and along the North side of the bank below the spillway (Figure 2). At the John Day Dam, the Dam Angling crew fished exclusively along the turbine wall (Figure 3).

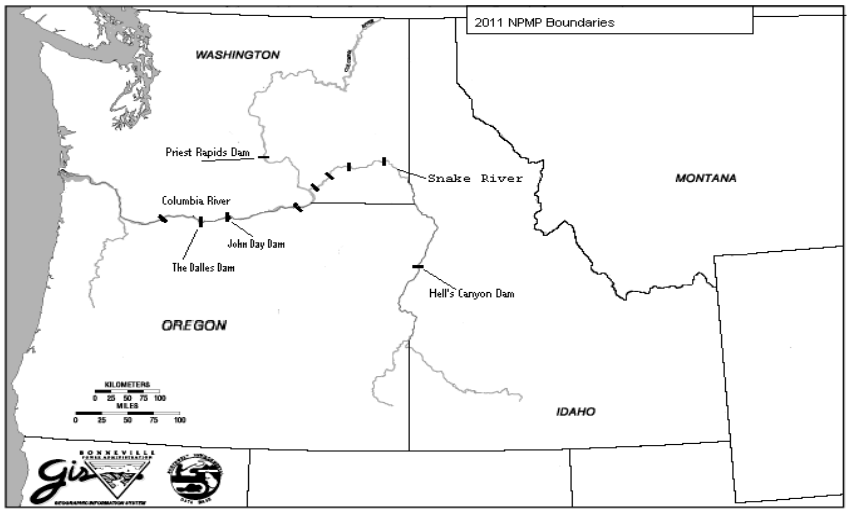


**Figure 1. Northern Pikeminnow Management Program boundaries, including Dam Angling sites.**

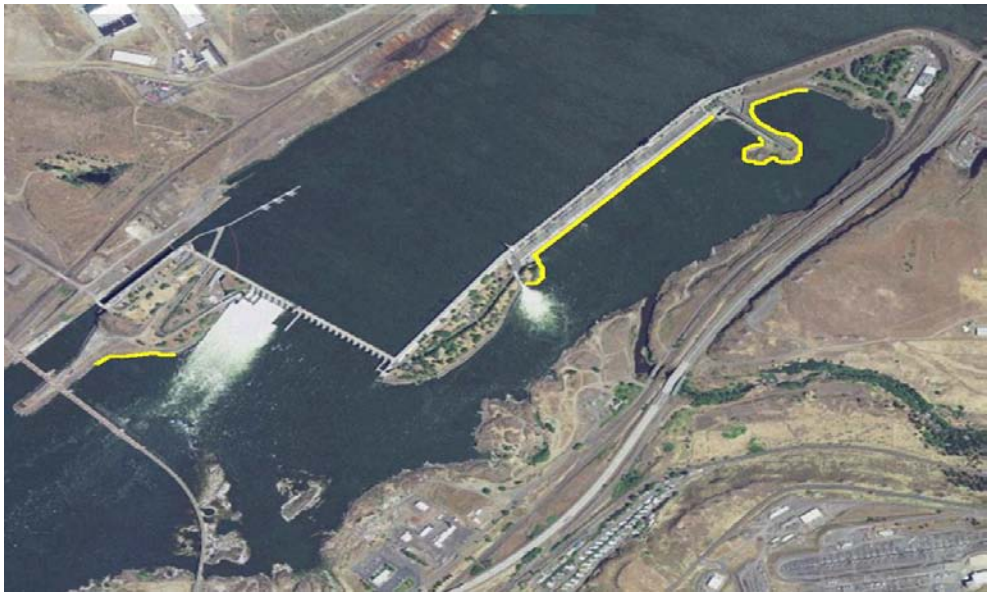

**Figure 2. Angling locations for the 2010 Dam Angling crew at The Dalles Dam.**

**Figure 3. The John Day Dam.**

## The Dam Angling Crew

A four person angling crew worked four ten hour days a week, typically Tuesday thru Friday alternating days between projects. Shift hours (on site, actually fishing) were from approximately 4:30 am to 1:00 pm at The Dalles Dam and 5:00 am to 12:30 pm at the John Day Dam. In addition to the four man angling crew, a crew leader was also present each day for angler safety and supervision, to collect and record data on northern pikeminnow harvest as well as biological data on other fish species, and to ensure that project protocols were adhered to.

**Figure 4. The Dam Angling crew at The Dalles Dam 2010.**

## Angling Gear

Dam anglers used Berkley Air im8 Graphite 10'6" (2-8 oz. extra heavy casting) rods equipped with Shimano Calcutta 400 series reels. Each reel was spooled with a 30# test braided main line (Power Pro), tied to a size 10 barrel swivel and a 30" monofilament leader of 15-20# Maxima (Figure 5). For weight, a cannonball sinker was attached to the swivel using six to eight inch dropper line of 12# monofilament leader. The cannonball sinker varied in weight from three 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) at one end of the monofilament leader and spaced 1 1/8" apart (Figure 6). Hook size varied in order to match the size of the soft plastic bait, and the soft plastic preferred by most of the crew was a 3" to 5" tube bait. Other effective soft plastics were worms, grubs and flukes in similar 3"-5" sizes.

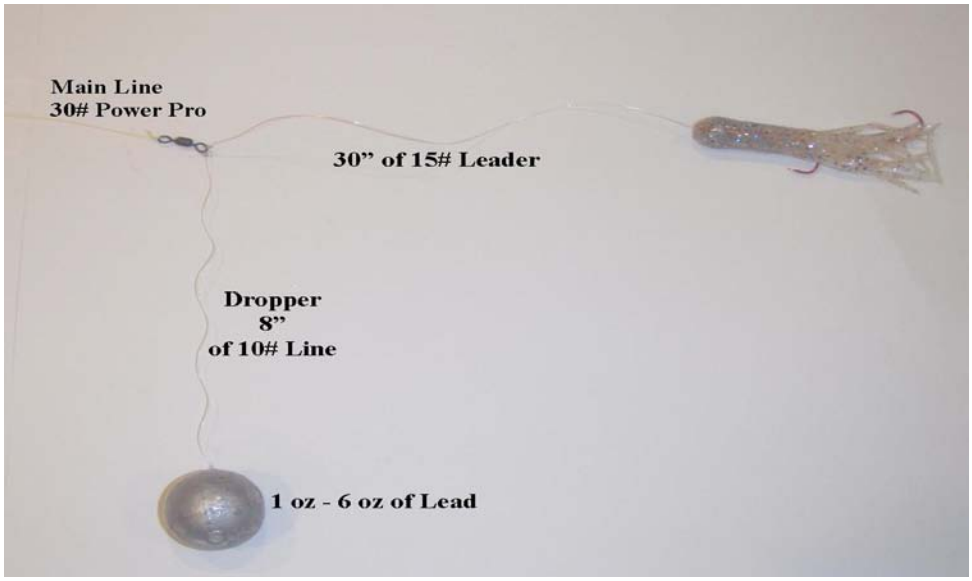


**Figure 5. Example of typical rigging used by 2010 NPMP Dam Anglers.**

**Figure 6. Examples of soft Plastic lures and tube baits used by 2010 NPMP Dam Anglers.**

## Data collection

Creel-type data were recorded for each angler day of angling and then were summarized for either The Dalles Dam or the John Day Dam. Collected data included hours of effort per angler, northern pikeminnow harvest per angler, incidental catch per angler, location of all caught fishes by angler, terminal gear used 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) and sex 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. Spaghetti tagged and tag-loss northern pikeminnow carcasses were then labeled and frozen for data verification and/or tag recovery at a later date. Spaghetti tags 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 2010 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). Scanning began on the first day of angling and continued throughout the duration of Dam Angling activities. 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 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 Dam Angling Findings

### Angling Gear and Technique

Likely fishing areas on and close to each dam were test fished throughout the season and it was quickly learned that fishing in the current created by the turbines was most productive. Because the crew almost exclusively fished from the face of the dam, a back bouncing technique best presented the terminal gear as in most cases, maintaining contact with the bottom was critical for maximum pikeminnow harvest. Both lures and bait were tested throughout the season to determine effectiveness and time and time again, plastic tube baits proved to be the most effective terminal gear, accounting for the vast majority of northern pikeminnow harvest. Tube baits resemble a squid and come in a variety of colors with those patterns that imitate salmon smolt or juvenile lamprey working the best (Table 1). We also found that dark colors were very effective in low light conditions and that increasing the size of the tube bait when water clarity was poor tended to increase harvest.

**Table 1. Top 10 Northern Pikeminnow Lures used by 2010 WDFW Dam Angling Crew.**

**Northern Pikeminnow Lures**

| Brand/style | Size | Color | # N. Pikeminnow Caught |
|---|---|---|---|
| Gitzit/ tubebait | 3.75” | Smoke Silver | 328 |
| Gitzit/ tubebait | 3.75” | Black Copper | 320 |
| Gitzit/ tubebait | 3.75” | Bluegill | 285 |
| Gitzit/ tubebait | 5” | Dark Smoke Hologram | 276 |
| Gitzit/ tubebait | 5” | Bluegill | 232 |
| Gitzit/ tubebait | 3.75” | Dark Smoke Hologram | 230 |
| Gitzit/ tubebait | 3.75” | Smoke Blue Glitter | 228 |
| Dry Creek/ tubebait | 2.75” | Flash Minnow | 189 |
| Gitzit/ tubebait | 3.75” | Smoke Green/Gold | 171 |
| Gitzit/ tubebait | 5” | Smoke Green/Gold | 155 |

### Angling Times

Time of day also made a difference when it came to Dam Angler harvest success during the 2010 season. At the start of the season, WDFW Dam Anglers conducted test fishing during times most likely to be conducive to angling success, including mornings, afternoons, evenings and nights. Test fishing indicated that morning hours were consistently the most productive times, although evenings and night also showed some potential, especially later in the season. As was expected, afternoons were the least productive angling times. Based on the results of our test fishing, we scheduled our Dam Angler work shifts between the hours of 4:00 am and 2:00 pm. Table 2 indicates the combined hourly harvest results for our Dam Angling crew during the 2010 season. The hours spent fishing early in the morning were the most productive and 80% of the northern pikeminnow harvested by the Dam Angling crew was before 11:00 am.

**Table 2. 2010 WDFW Dam Angler Harvest of Northern Pikeminnow by hour (TD and JD combined).**

**Hourly Northern Pikeminnow Harvest**

| Time of day | Harvest | % of Harvest |
|---|---|---|
| Prior to 6:00 am | 593 | 17% |
| 6:00 am – 7:00 am | 545 | 16% |
| 7:00 am – 8:00 am | 454 | 13% |
| 8:00 am – 9:00 am | 433 | 13% |
| 9:00 am – 10:00 am | 341 | 10% |
| 10:00 am – 11:00 am | 376 | 11% |
| 11:00 am – 12:00 pm | 359 | 10% |
| 12:00 pm – 1:00 pm | 268 | 8% |
| 1:00 pm – 2:00 pm | 12 | 2% |
| Total | 3,441 | 100% |

## Incidental Catch

The Dam Angling crew incidentally caught and released the fish species listed on Table 3 while targeting northern pikeminnow from The Dalles and John Day hydroelectric projects. Incidental species most often caught were smallmouth bass *Micropterus dolomieue,* and white sturgeon *Acipenser transmontanus*. In addition, the Dam Angling crew noted large numbers (estimated as hundreds) of juvenile lamprey *Entosphenus* spp. and/or *Lampetra* spp. that were regurgitated by northern pikeminnow caught at The Dalles Dam during May and June, although totals were not enumerated in 2010.

**Table 3. 2010 WDFW Dam Angler Incidental Catch (TD and JD totals ).**

**Incidental Catch**

| Species | The Dalles Dam | John Day Dam |
|---|---|---|
| Smallmouth Bass | 92 | 195 |
| White Sturgeon | 65 | 82 |
| Walleye | 8 | 60 |
| Sculpin | 33 | 44 |
| Peamouth | 0 | 26 |
| Chinook (adult) | 0 | 2 |
| Steelhead (adult) | 0 | 1 |
| American Shad | 1 | 0 |

## Tag Recovery

All northern pikeminnow harvested by Dam Anglers in 2010 were examined for the presence of external spaghetti tags and individually scanned for the presence of PIT tags. Two northern pikeminnow with external spaghetti tags were recovered by the Dam Angling crew at The Dalles Dam in 2010. In addition, there were six northern pikeminnow recovered that had lost spaghetti tags, but retained PIT tags implanted by the Oregon Department of Fish and Wildlife (ODFW) as a secondary tag mark. Four of these PIT tagged fish were caught by the Dam Angling crew at the John Day Dam and two at The Dalles Dam. The Dam Angling crew also recovered three PIT tags from salmonid smolts that were ingested by northern pikeminnow for an occurrence rate of 1:1,333 compared to 1:599 for the Sport-Reward Fishery (Winther et al 2010).

**The Dalles Dam**

**Harvest**

The four man angling crew harvested 1,323 northern pikeminnow from The Dalles Dam during their sixteen week season. Harvest averaged 83 fish per week and ranged from 1 fish in week 25 (June 7-13) to 236 fish in the first week of the season (week 20). Although harvest at The Dalles dam was highest during week 20 (5/10-5/16), it should be noted that because it was a training week, the crew fished all four days of the work week at The Dalles Dam instead of the normal two day weeks during the rest of the season (Figure 7). In a normal two-day work week, weeks 22 (5/24-5/30) and 23 (5/31-6/6) had the highest harvest when comparing the remaining weeks fished at The Dalles Dam. Weeks 24 through 26 (6/7-6/27) produced the lowest harvest of northern pikeminnow in 2010 and may be explained by high river flows and the poor water visibility associated with such flows as seen in Figure 8.

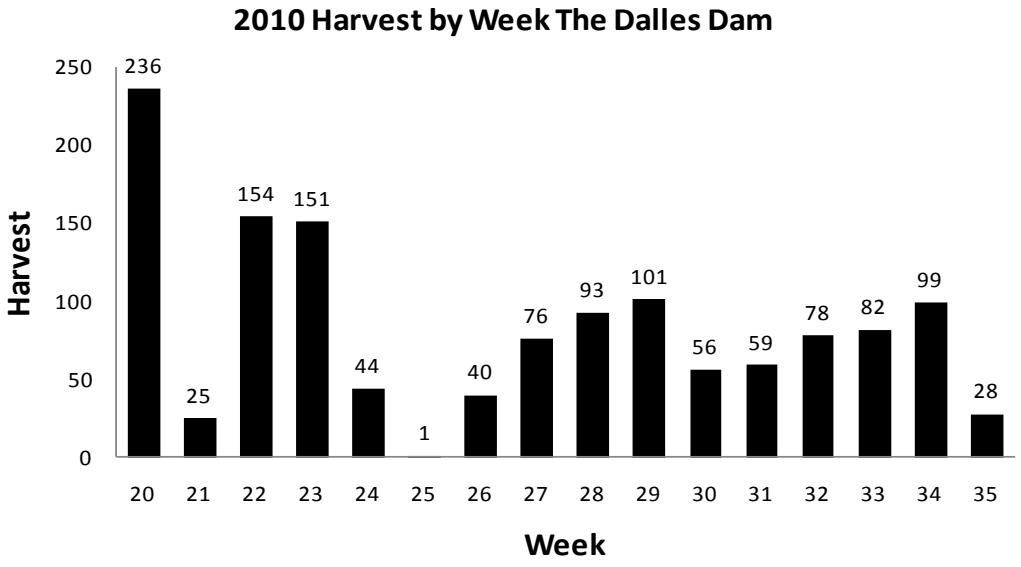


**Figure 7. 2010 Weekly Dam Angler Harvest of Northern Pikeminnow at The Dalles Dam.**

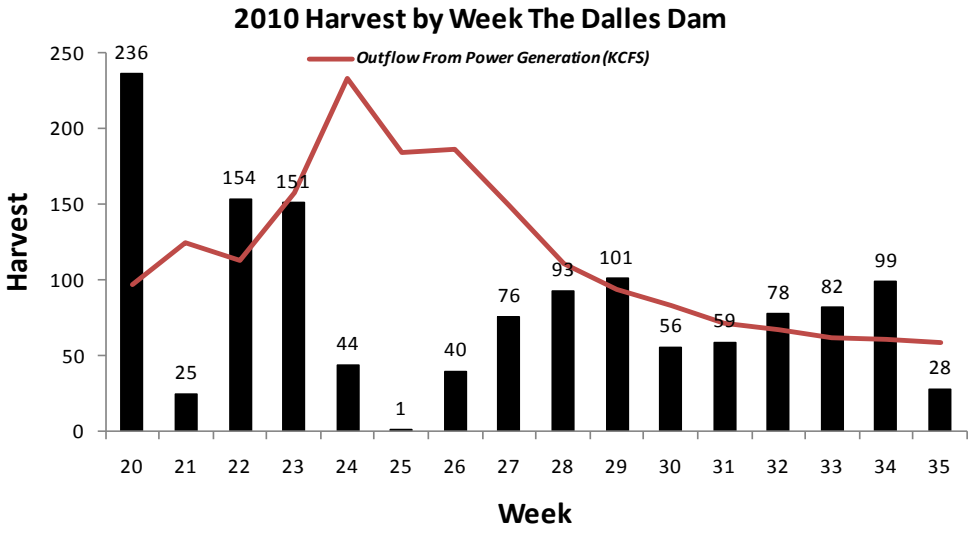


**Figure 8. 2010 Weekly Northern Pikeminnow Harvest Compared to Outflow.**

When we look at overall harvest of northern pikeminnow at The Dalles Dam it is apparent that certain areas and/or turbines produced better than others (Figure 9). The area between turbines 10-16 produced 53% of the total northern pikeminnow harvest at The Dalles Dam in 2010, and turbine thirteen (T13) was the single highest producing turbine during the season. The crew also harvested 32% of their total season harvest from the area between the fish ladder (F) and the Ice-Trash Sluiceway. While Figure 9 gives a general picture of where the best harvest areas were in 2010, when we break down harvest by month, our harvest data reveals that there was a dramatic

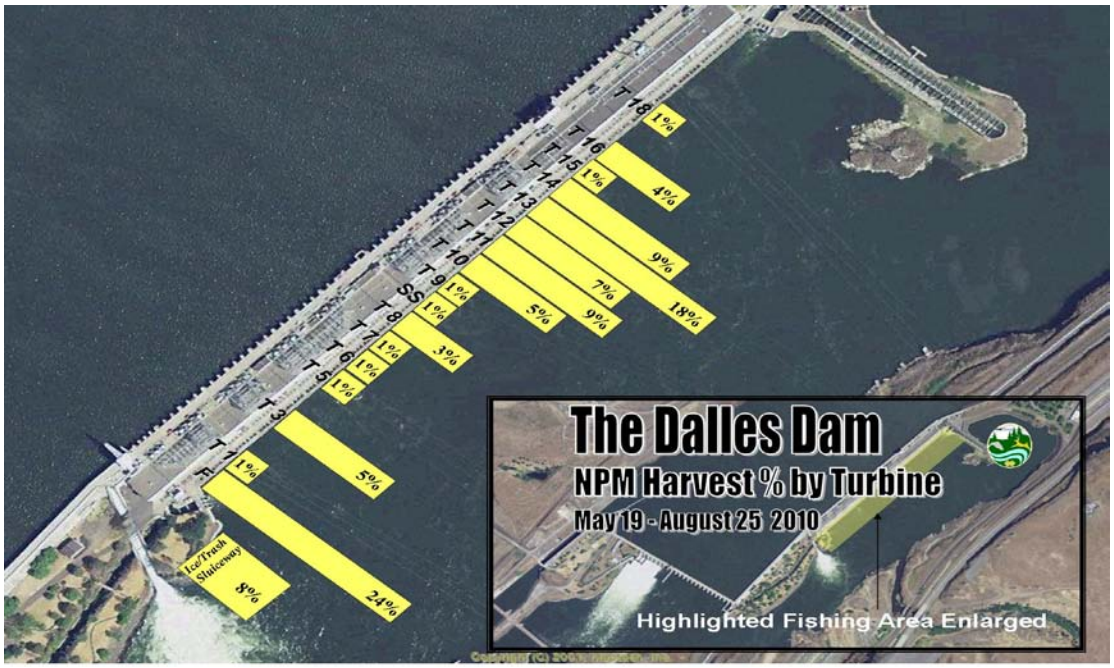


**Figure 9. 2010 Overall Percent of Northern Pikeminnow Harvest by Area (T=turbine# , F = fish ladder)**

shift in harvest over the course of the season (Figure 10). Early in the year (May and June) nearly all harvest occurred between turbines 10-16 and there was no harvest around the fish ladder. In July, harvest started to shift to the area around the fish ladder, and in August the majority of harvest was near the fish ladder and there was no harvest from turbines 10-16.

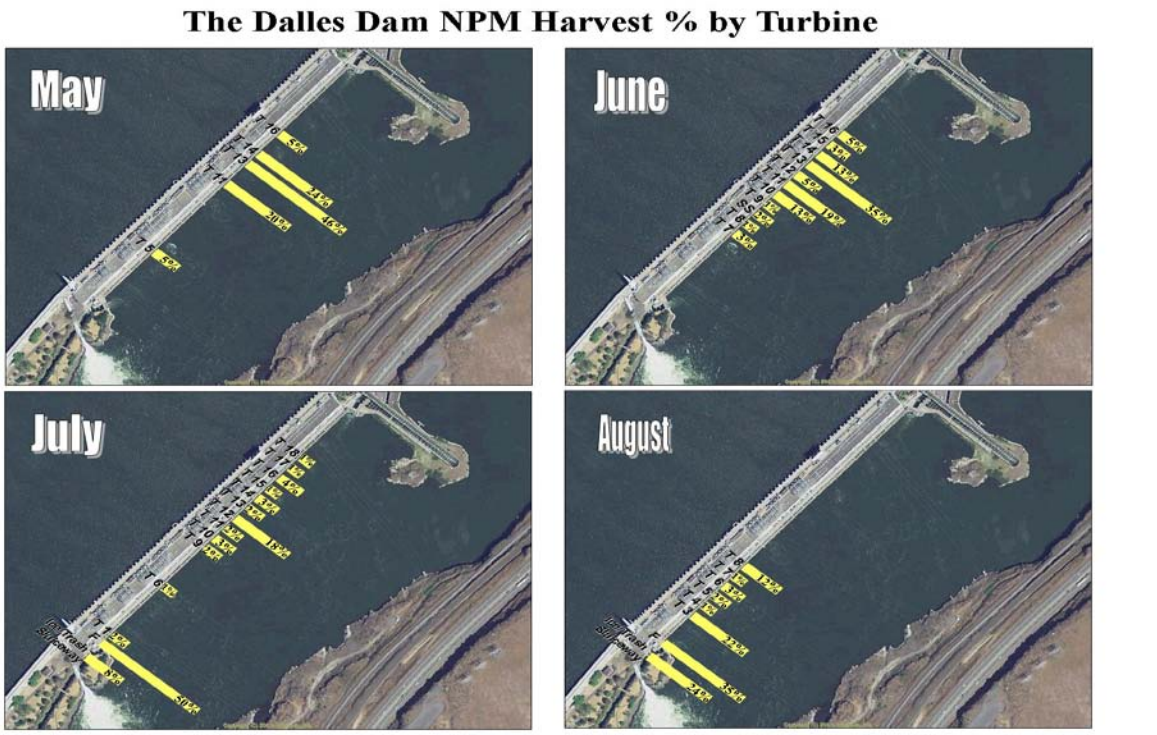


**Figure 10. 2010 Monthly Percent of Northern Pikeminnow Harvest by area (T=turbine# , F = fish ladder)**

**CPUE**

During the sixteen weeks that the Dam Angling crew operated, the anglers fished 33 days at The Dalles Dam, expending 934.3 total hours of effort for an average catch rate (CPUE) of 1.42 fish per angler per hour. Weekly CPUE (fish per hour) ranges from a high in week 23 (May 31 – June 6) with 2.5 fish per angler hour (Figure 11) to a low of zero fish in week 25. The poor fishing during week 25 corresponded with high flows which also negatively affected harvest in the Northern Pikeminnow Sport-Reward Fishery (Winther et al. 2010). It is also interesting to note that when we divide the total hours of effort at The Dalles by the number of weeks fished (16), and then the number of days per week spent fishing at The Dalles Dam (2) by the four person angling crew, we get an average number of fish per angler per day (10.37) which is comparable to returning angler CPUE from the Sport-Reward Fishery (10.02).

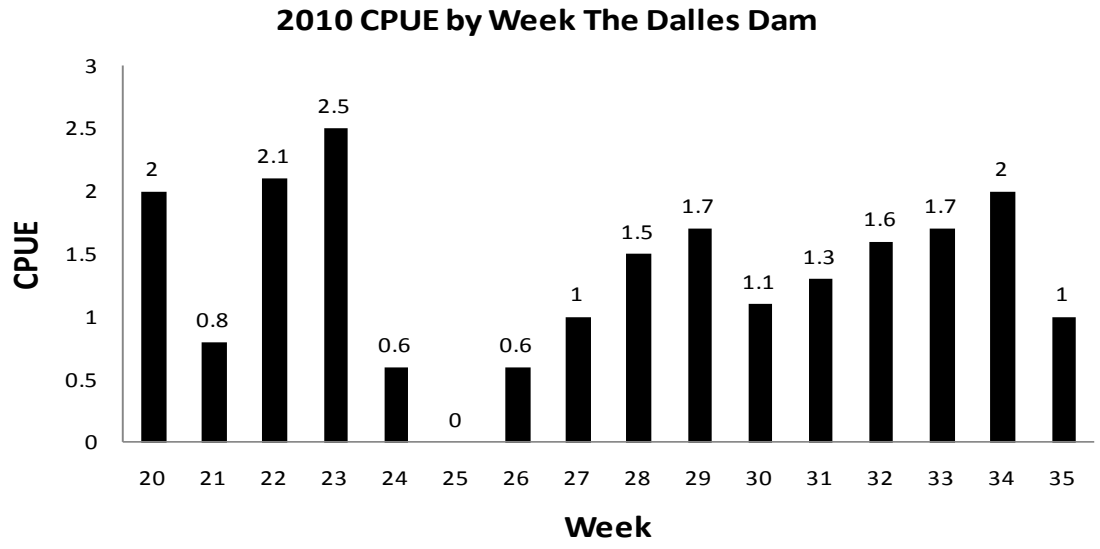


**Figure 11. 2010 Weekly angler CPUE at The Dalles Dam.**

## Fork Length Data

Fork lengths were taken from 98% of all northern pikeminnow harvested during the 2010 Dam Angling Season. The length frequency distribution of harvested northern pikeminnow from The Dalles Dam is presented in Figure 12. The mean fork length for all measured northern pikeminnow harvested from The Dalles Dam in 2010 was 365.5mm.

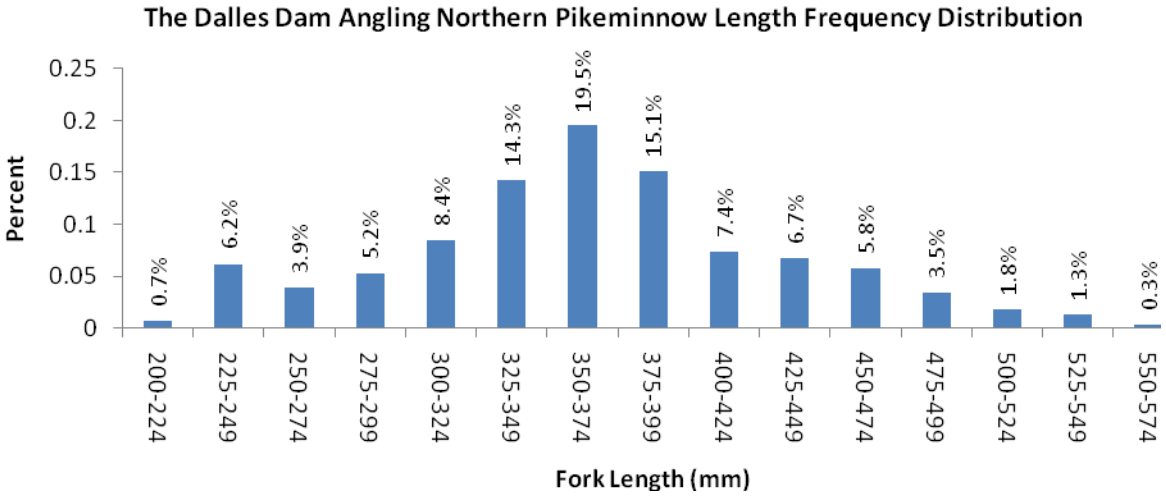


**Figure 12. Length Frequency Distribution of Harvested pikeminnow at The Dalles dam.**

## John Day Dam

### Harvest

The four man angling crew harvested 2,675 northern pikeminnow from the John Day Dam during their 16 week season. Harvest averaged 167 fish per week and ranged from a peak of 471 fish in week 32 (August 2-8) to zero fish in week 25 (June 7-13) (Figure 13). As was the case at The Dalles Dam, low catch during weeks 24 and 25 corresponded to high river levels caused by spring runoff (Figure 14).

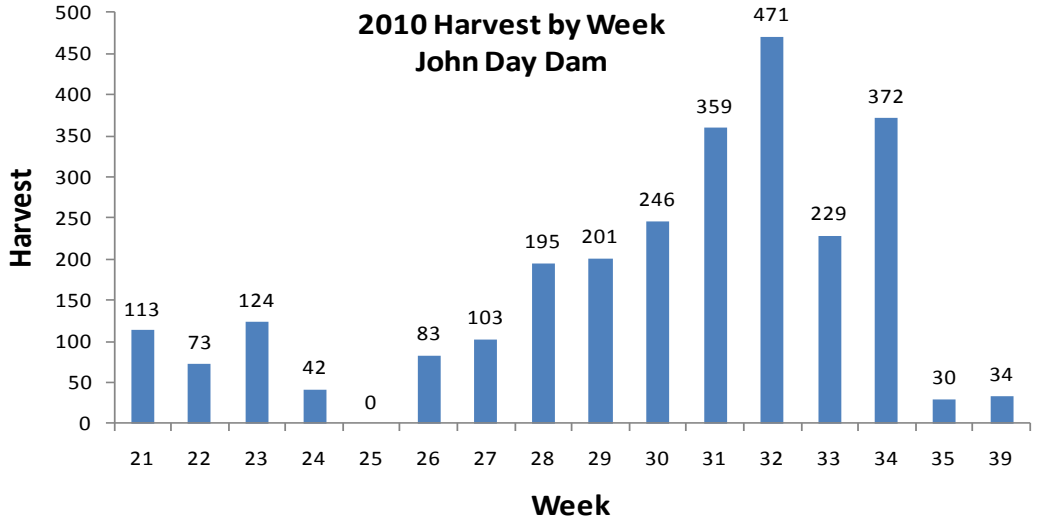


**Figure 13. 2010 Weekly Dam Angler Harvest of Northern Pikeminnow at the John Day Dam.**

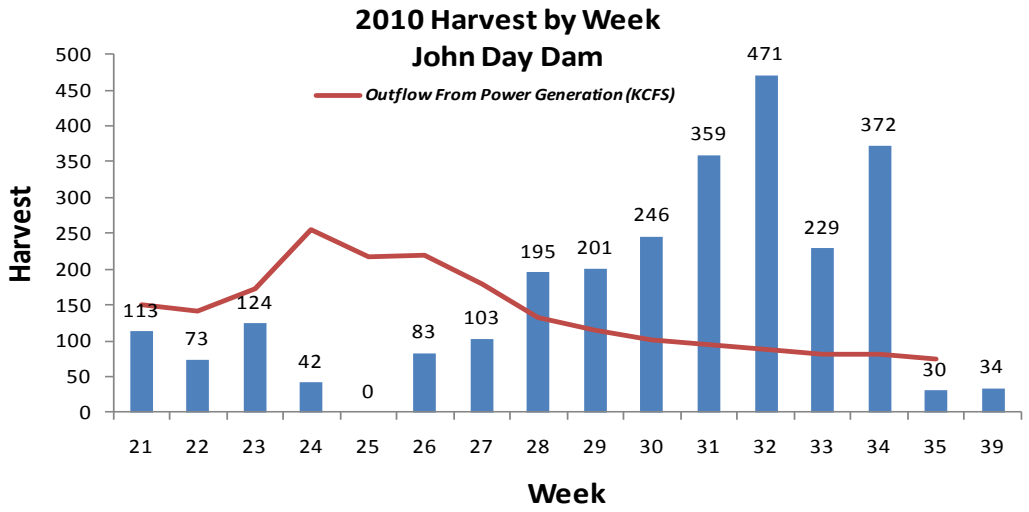


**Figure 14. 2010 Weekly Dam Angler Harvest of Northern Pikeminnow at the John Day Dam vs Outflow.**

Just like at The Dalles dam, certain turbines on John Day dam created water flow most favorable for northern pikeminnow harvest. Of the total pikeminnow harvest at the John Day Dam in 2010, turbine #5 (T5) was the single best producing turbine with 22% of the total documented harvest (Figure 15). If we look at northern pikeminnow harvest by turbine over the course of the


**Figure 15. 2010 Overall Percent of Northern Pikeminnow Harvest by Area (T=turbine#)**

four month Dam Angling season, we can see that the Dam Angling crew also experienced a dramatic shift in productive harvest areas as was also the case at The Dalles Dam. Early in the season (May), the best turbines for catching northern pikeminnow at the John Day Dam were turbines 14 and 15 with little harvest at turbines 2-5 (Figure 16). In June harvest started to shift toward the Oregon shore, highlighted by excellent harvest at turbine #8. July was our top month for harvest and good fishing was widely spread across the entire turbine wall. By the time we got to August, nearly all of our harvest was from the corner area (turbines 2-5), with virtually no harvest from turbines 14 and 15.

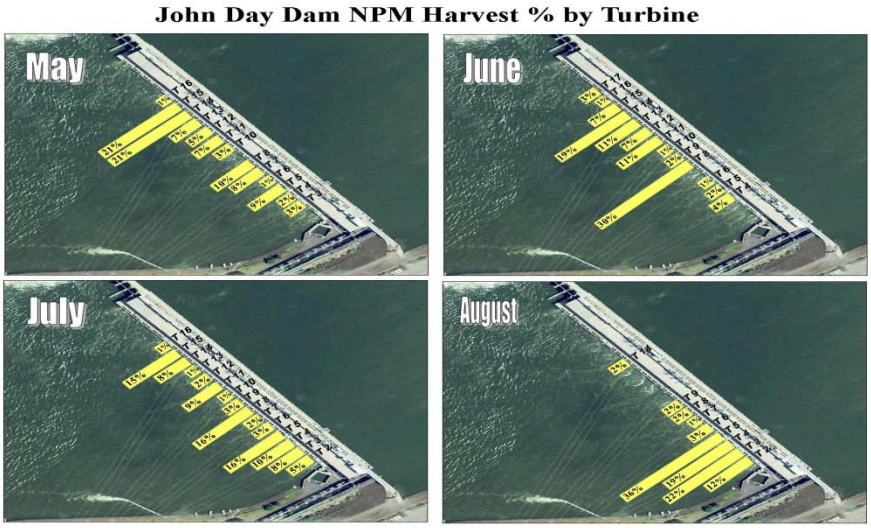


**Figure 16. 2010 Monthly Percent of Northern Pikeminnow Harvest by area (T=turbine#)**

## CPUE

During the sixteen weeks that the Dam Angling crew operated, they fished 31 days from the John Day Dam and expended 882.4 total hours of effort for a CPUE of 3.03 northern pikeminnow per angler hour. Weekly CPUE ranged from a high of 8.0 in week 32 (August 2-8) to zero in week 25 (June 7-13) (Figure 17). The poor fishing (as indicated by low CPUE) in weeks 24 and 25 was likely due to high river flows and the associated drop in water temperature and water clarity. Inserting the above data for the John Day Dam into the same calculation described earlier in this report under "The Dalles CPUE" we calculate an average of 20.89 fish per angler day in 2010 compared to 10.37 at The Dalles Dam and 10.02 for the SRF.

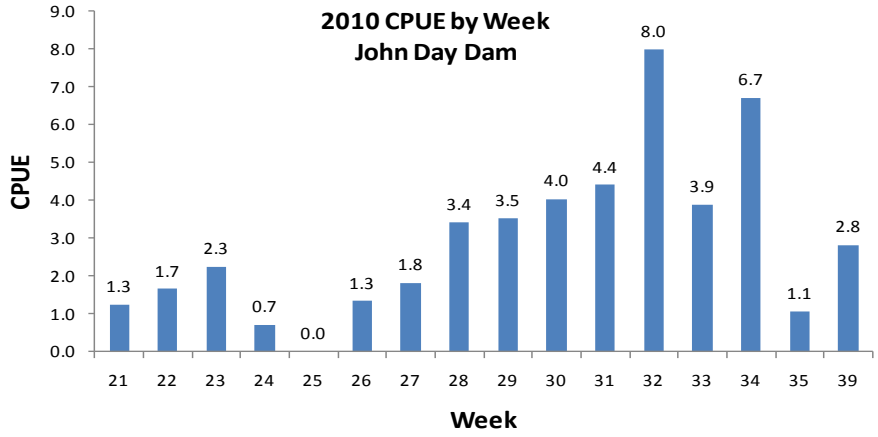


**Figure 17. 2010 Weekly Dam Angling CPUE at John Day Dam.**

## Fork Length Data

Fork lengths were taken from 98% of all northern pikeminnow harvested during the 2010 Dam Angling Season. The length frequency distribution of harvested northern pikeminnow from the John Day Dam is presented in Figure 18. The mean fork length for all measured northern pikeminnow harvested from the John Day Dam in 2010 was 368.9 mm.

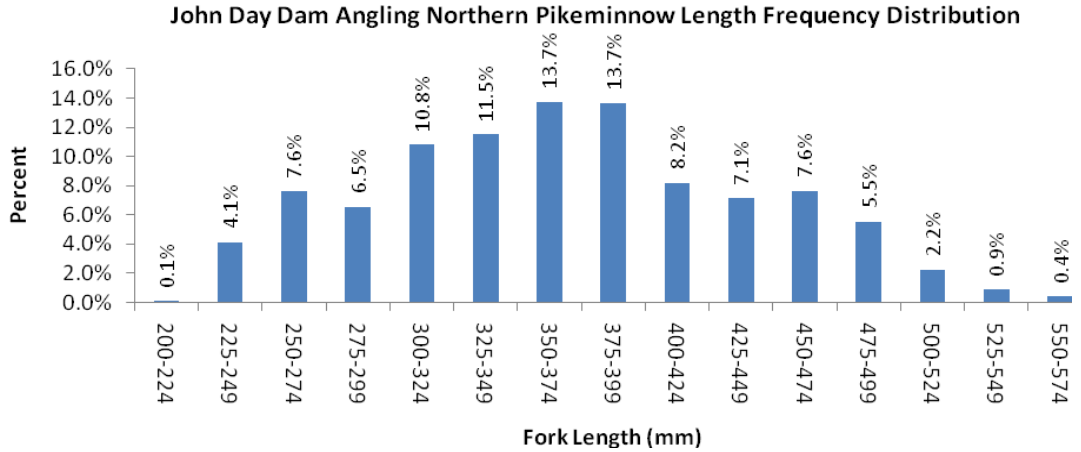


**Figure 18. Length Frequency Distribution of Harvested pikeminnow at John Day Dam.**

## SUMMARY

The Dam Angling component of the NPMP at The Dalles and John Day dams was a first time implementation for WDFW in 2010. Given the steep learning curve for mastering this fishery due to a scarcity of solid angling data from previous Dam Angling seasons, and given that only one member of our Dam Angling crew had any direct northern pikeminnow angling experience, harvesting 3,998 northern pikeminnow in 2010 exceeded our expectations. An overall CPUE of 2.20 northern pikeminnow per angler hour when considering the learning curve associated with a new project was a great accomplishment, especially if you factor in the poor water conditions in early June that plagued the crew for 2-3 weeks. Average daily catch of northern pikeminnow in the BRZ's of The Dalles and John Day dams by the Dam Angling crew was equal to or better than that of experienced SRF anglers (returning anglers) in 2010. The Dam Angling component of the NPMP also documented seasonal fluctuations in harvest and CPUE related to turbine power generating activity, river flow and availability of prey species such as juvenile lamprey at The Dalles Dam which will be used to improve Dam Angling effectiveness in 2011.

Adhering to project protocols which required crews to alternate angling days between the two projects and to expend equal amounts of effort at each project undoubtedly had a negative effect on total harvest of northern pikeminnow in 2010. However, these steps were necessary in order to obtain baseline data and meet project objectives. The time the crew spent collecting creel data related to all aspects of dam angling also helped satisfy a major objective of the program, although there is room for additional improvement.

Fork length data and PIT tag scanning of northern pikeminnow harvested by the Dam Angling component of the NPMP provided useful data for use in comparing the harvest results of this project with the Sport-Reward Fishery also implemented by the NPMP. For instance, the mean fork length of northern pikeminnow harvested by Dam Anglers in 2010 was considerably larger than the FL of Sport-Reward caught fish 365.5-368.9 mm vs 281.7 mm. The recovery ratio of spaghetti tagged northern pikeminnow to untagged northern pikeminnow by the Dam Angling crew was lower than that of the SRF (1:1,999 vs 1:818), however occurrence rates of ingested salmonids in northern pikeminnow harvested by the Dam Angling crew was higher (1:1,333 vs 1:1,599) than for those harvested by SRF anglers.

## RECOMMENDATIONS FOR 2011

1.) Continue to implement Dam Angling component of the NPMP in order to remove predatory northern pikeminnow from the Boat Restricted Zones of The Dalles and John Day dams during similar times of year as the 2011 NPSRF in order to further enhance knowledge of northern pikeminnow predation, increase exploitation and maximize fish handling and manpower efficiencies.

2.) 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 2011.

3.) Continue to investigate and develop northern pikeminnow angling techniques in 2011 that will improve Dam Angler CPUE and/or allow exploitation of northern pikeminnow in areas not currently fishable.

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