

# Development of a System-wide Predator Control Program: Stepwise Implementation of a Predation Index, Predator Control Fisheries, and Evaluation Plan in the Columbia River Basin

## Northern Pikeminnow Management Program

Annual Report  
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Bonneville Power Administration  
P.O. Box 3621  
Portland, OR 97208

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**DEVELOPMENT OF A SYSTEM-WIDE PREDATOR CONTROL  
PROGRAM: STEPWISE IMPLEMENTATION OF A PREDATION  
INDEX, PREDATOR CONTROL FISHERIES, AND EVALUATION  
PLAN IN THE COLUMBIA RIVER BASIN**

**2001 ANNUAL REPORT**

Prepared by:

Russell Porter  
Pacific States Marine Fisheries Commission

In Cooperation with:

Oregon Department of Fish and Wildlife  
Washington Department of Fish and Wildlife  
Yakama Indian Nation

Prepared for:

U.S. Department of Energy  
Bonneville Power Administration  
Environment, Fish and Wildlife  
P.O. Box 3621  
Portland, OR 97208-3621

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## 2001 EXECUTIVE SUMMARY

by Russell G. Porter

This report presents results for year eleven in a basin-wide program to harvest northern pikeminnow (*Ptychocheilus oregonensis*). 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 trapnets and gillnets at specific locations where concentrations of northern pikeminnow were known or suspected to occur during the spring season (*i.e.*, March through early June). In addition, we initiated a concerted effort to increase public participation in the sport-reward fishery through a series of promotional and incentive activities.

In 1995, 1996, and 1997, promotional activities and incentives were further improved 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. 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.

Program cooperators include the Pacific States Marine Fisheries Commission (PSMFC), Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), and the Yakama Indian Nation. The PSMFC was responsible for coordination and administration of the program; PSMFC subcontracted various tasks and activities to ODFW, WDFW, and the Yakama Indian Nation 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. **YIN (Report C):** Implement a system-wide angling fishery at mainstem dams on the Snake and Columbia rivers.
4. **YIN (Report D):** Implement a gillnet fishery for removing northern pikeminnow near hatchery release sites and at other specific locations where concentrations of northern pikeminnow are known or suspected to occur.
5. **ODFW (Report E):** 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.

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 2001 by report are as follows:

## **Report A**

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

1. Objectives for 2001 were to: (1) implement a recreational fishery that rewards anglers who harvest northern pikeminnow  $\geq 9$  inches total length, (2) obtain catch data on all fish species caught by fishery participants while targeting northern pikeminnow, (3) collect length data on the above-mentioned species which are returned to registration stations, (4) collect, monitor, and report data on angler participation and catch-per-angler-day during the season, and (5) evaluate promotional, fish handling, and cost-analysis aspects of the Northern Pikeminnow Sport Reward Fishery (NPSRF)
2. The NPSRF was conducted from May 14 through October 14, 2001. Twenty registration stations were operated throughout the lower Snake and Columbia rivers.
3. A total of 240,894 northern pikeminnow  $\geq 9$  inches in total length were harvested during the 2001 season with 38,818 angler days spent harvesting these fish. Catch-per-angler-day for all anglers during the season was 6.21 fish.
4. Anglers submitted 200 northern pikeminnow with external tags, and an additional 7 with fin-clip marks, but no tag. A total of 153,892 northern pikeminnow were individually scanned for the presence of salmonid PIT tags in their gut. A total of 58 salmonid PIT tags were detected and the codes recorded for transmittal to the PITAGIS database.

## **Report B**

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

1. In response to very low flows during 2001, there was a change in the reward amounts paid part way through the season. With increased travel time for salmonid smolts to transit the river, the increased rewards were designed to stimulate additional predator removal to curtail the expected additional salmonid losses during transit to the estuary. Bonneville Power Administration funded an increase in the reward payments commencing on July 10, 2001. Rewards paid for the first 100 fish were increased from \$4 per fish to \$5 per fish. Rewards for fish in the 101-400 fish range increased from \$5 per fish to \$6 per fish and for all fish caught above 400 from \$6 per fish to \$8 per fish. Rewards for tagged fish was increased from \$50 per fish to \$1000 per fish. This was designed to bring more effort to the sport reward zone in the mainstem Columbia River because of chances for this substantial reward if a tagged fish were caught. These changes resulted in the largest harvest of pikeminnow during the history of the program. It exceeded the previous high by over 40,000 fish.
2. During 2001, rewards excluding tagged fish totaled \$1,440,110 were paid for 237,950 fish.



3. A total of 200 vouchers were paid for tagged fish at \$50 per tag for 118 fish caught prior to July 10, 2001 and \$1000 per tag for 82 fish caught after July 10, 2001. The tagged rewards totaled \$87,900.
4. A total of 2,966 promotional coupons were redeemed at \$4 each for a total of \$11,984. This was the highest number of coupons utilized in one season since this promotional tool was implemented.
5. A total of 3,351 separate successful anglers received payments during the season.
6. The total for all payments was \$1,528,010.

## **Report C**

### ***Controlled Angling for Northern Pikeminnow at Bonneville, The Dalles, and John Day Dams***

1. Dam angling at three dams on the lower Columbia river during 2001 by the Yakama Nation resulted in a catch of 2,751 northern pikeminnow between May and August, 2001.
2. Overall catch per angler hour (CPAH) was 1.79 in 2001, compared to 0.3 the previous year. Relative to 2000, catch increased 650%, effort (as reported) increased 12% and CPAH.

## **Report D**

### ***Site-Specific Gillnetting for Northern Pikeminnow Concentrated to Feed on Hatchery-Released Juvenile Salmonids in the Lower Columbia River***

1. Small-meshed gillnets were used to catch 523 predator-size northern pikeminnow from March 25 to April 21, 2001 for catch-per-net-hour (CPNH) of 4.4. Most of the fish were caught at the Klickitat River (69%).
2. Incidental species composed 56.6% of the total catch in 2001.
3. The future of site-specific fishing will be determined in 2002.

## **Report E**

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

1. Objectives were to: (1) evaluate northern pikeminnow exploitation and compare catch rate of incidentally-harvested fishes among the three major management fisheries in 1997, (2) estimate reductions in predation on juvenile salmonids since implementation of the fisheries, and (3) estimated tag loss for spaghetti tags, and (4) validation of aging methodology for northern pikeminnow based on scale and opercula readings.
2. System-wide exploitation of northern pikeminnow 250 mm or greater in fork length was a record high of 16.2% for sport-reward, 0.0% for dam-angling, and 0.0% for site-specific gill-net fisheries. Incidental catch was 31.6% in the sport-reward fishery, 2.8% of the dam angling catch, and 56.6% in the gill-net fishery.
3. Although some modest reductions in predation have been achieved since 1999, further reductions are likely to be minimal if exploitation continues at mean 1995-2001 levels. Even if exploitation rates remain near the exceptionally high levels seen this year, relative predation will not decline to any significant extent. It probably will not be reduced much from 76% of the pre-program level.
4. Within-season tag loss was estimated to be 0% for spaghetti tags. However because an unknown proportion of harvested pikeminnows may not have been examined for tag loss, it is unknown if no tag loss fish were recovered. This study will be repeated in 2002.
5. Between-reader variation in the aging of northern pikeminnow scales and opercles tended to be high. Complete agreement ranged from only 22.6% for opercles to an average of 36.5% for scales. Ages for opercles tended to be greater than those for scales, suggesting that either scales underestimate ages or opercles overestimate ages of northern pikeminnow.

# **REPORT A**

## **IMPLEMENTATION OF THE NORTHERN PIKEMINNOW SPORT-REWARD FISHERY IN THE COLUMBIA AND SNAKE RIVERS**

**Prepared by:**

**Eric C. Winther  
Lyle G. Fox  
Mark L. Wachtel  
Bryce G. Glaser**

**Washington Department of Fish and Wildlife  
600 Capitol Way N., Olympia, WA 98501-1091**

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## ABSTRACT

The Northern Pikeminnow Sport-Reward Fishery (NPSRF) operated on the Columbia and Snake Rivers from April 30 through October 14, 2001. The objectives of this project were to (1) implement a recreational fishery that rewards anglers who harvest northern pikeminnow  $\geq$  228mm (9 inches) total length, (2) obtain catch data on fish species caught by fishery participants while targeting northern pikeminnow, (3) examine collected northern pikeminnow for the presence of external tags and fin-clip marks, (4) collect biological data on northern pikeminnow and other fish species returned to registration stations, (5) scan northern pikeminnow for the presence of PIT tags at select registration stations, and (6) collect, monitor, and report data on angler catch, participation, and success rates during the season.

A total of 240,894 northern pikeminnow  $\geq$ 228mm were harvested. Harvest was the highest in program history. Anglers spent 38,818 days participating in the fishery. Catch per unit of effort for combined returning and non-returning anglers was 6.21 fish/angler day. The overall exploitation rate for the NPSRF was X%. Cathlamet fraud total was 25.3% of station total.

Anglers submitted 200 northern pikeminnow with external tags and an additional 7 with fin-clip marks but no tag. A total of 58 PIT tags were detected and interrogated (95.87% of available northern pikeminnow).

Peamouth *Mylocheilus caurinus*, and smallmouth bass *Micropterus dolomieu* were the fish species most frequently harvested by NPSRF anglers targeting northern pikeminnow. The incidental catch of salmonids *Onchorhynchus spp.* by participating anglers targeting northern pikeminnow remained below limits established by the National Marine Fisheries Service (NMFS).

## INTRODUCTION

Northern pikeminnow *Ptychocheilus oregonensis*, formerly known as northern squawfish (Nelson et al. 1998), are the primary piscine predator of juvenile salmonids *Onchorhynchus spp.* in the Lower Columbia and Snake River systems (Rieman et al. 1988). 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 (fork length). The Northern Pikeminnow Management Program (NPMP) was formed in 1990 with the goal of implementing the recommended 10-20% annual exploitation on northern pikeminnow >275 mm (fork length) within the program area. In response to a review of NPMP justification, performance, and cost-effectiveness (Hankin and Richards 2000), NPMP administrators now include northern pikeminnow  $\geq 228$  mm (9 inches) total length in the NPSRF. The Sport-Reward Fishery on the Columbia and Snake rivers has been found to be the most effective method for achieving annual exploitation within the specified range.

The Northern Pikeminnow Sport-Reward Fishery (NPSRF) encourages recreational anglers to use hook and line to harvest northern pikeminnow  $\geq 9$  inches total length from within program boundaries on the Columbia and Snake rivers by offering monetary rewards. The 2001 NPSRF continued to provide a tiered reward system that paid anglers a higher amount per fish based on achieving designated harvest levels and that paid a bonus rate for returning northern pikeminnow that were spaghetti tagged by the Oregon Department of Fish and Wildlife (ODFW). Participating anglers were also surveyed in order to collect catch data needed to monitor the effect of the NPSRF on other fish species.

The objectives of the 2001 NPSRF were to (1) implement a recreational fishery that rewards anglers who harvest northern pikeminnow  $\geq 228$ mm (9 inches) total length, (2) obtain catch data on all fish species caught by fishery participants while targeting northern pikeminnow, (3) collect biological data on northern pikeminnow and other fish species returned to registration stations, (4) collect, monitor, and report data on angler catch, participation, and success rates during the season, (5) scan northern pikeminnow for the presence of PIT tags at select registration stations.

## **METHODS OF OPERATION**

### **FISHERY OPERATION**

#### **Boundaries and Season**

The NPSRF was conducted on the Columbia River from the mouth to the boat-restricted zone below Priest Rapids Dam, and on the Snake River from the mouth to the boat-restricted zone below Hells Canyon Dam (Figure 1). In addition, anglers were allowed to harvest northern pikeminnow from backwaters, sloughs, and 400 feet up tributaries within this area to submit for payment. Angler rules for participation in the NPSRF remain unchanged from 1995 (Hisata et al. 1995) and are listed in Appendix A.

The NPSRF was fully implemented from May 14 through September 30, 2001. Sixteen stations below The Dalles Dam opened two weeks earlier on April 30, 2001 for a “pre-season” in order to take advantage of favorable river conditions that provided anglers with an earlier opportunity to begin harvesting northern pikeminnow. Eight registration stations also continued to operate during the two-week extension from October 1-14, 2001 for the same reasons. Utilizing a limited schedule during non-core periods has been shown to allow significant pikeminnow harvest at a reduced program cost (Winther et al. 1996).

#### **Registration Stations**

Twenty-four registration stations (Figure 1) were located on the Columbia and Snake rivers to provide anglers with access to the Sport-Reward Fishery. Washington Department of Fish and Wildlife (WDFW) technicians set up daily (seven days a week) registration stations at designated locations (normally public boat ramps or parks) which were available to anglers between two and eight hours per day during the season. Technicians registered anglers to participate in the NPSRF, collected creel information, issued pay vouchers to anglers returning with eligible northern pikeminnow, and provided Sport-Reward Fishery information to the public. Self-registration boxes were located at each station so anglers could register themselves when WDFW technicians were not there.

#### **Reward System**

The 2001 NPSRF rewarded anglers for northern pikeminnow  $\geq 228\text{mm}$  (9 inches) total length (TL). The 2001 NPSRF continued to use a tiered reward system developed in 1995 (Hisata et al. 1995) which rewarded anglers for reaching designated harvest levels during the season. To receive payment, anglers returned their catch (daily) to the location where they had registered. Station technicians identified and measured 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 (Smith et al. 1994), were issued a separate tag payment voucher that was mailed to ODFW for tag verification before payment was made by PSMFC. Initially, the 2001 NPSRF continued to pay anglers \$4 each for their first 100 northern pikeminnow, \$5 each for numbers 101 – 400, \$6 each for all fish over 400 and \$50 each for tagged northern pikeminnow. On July 10, 2001 BPA increased the rewards paid for northern pikeminnow for the remainder of the season as an alternative for not fully implementing spill measures at Federal hydropower facilities during power emergencies the region experienced in 2001. The base reward increased to \$5 each for the first 100 northern pikeminnow, \$6 for 101-400 and \$8 each for catching over 400 northern pikeminnow. The reward for tagged pikeminnow increased to \$1000 for each tagged fish.

## **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 location fished (Figure 2), and primary species targeted Appendix B. Anglers were asked if they specifically fished for northern pikeminnow at any time during their fishing trip. A “No” response ended the exit interview. A “Yes” response prompted the technician to ask the angler, and record data on how many of each species of fish were caught, harvested or released while targetting 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”.

## **Returning Anglers**

Technicians interviewed all returning anglers at each registration station to obtain any missing angler data, and to record creel data relevant to their angling day. Creel data related to harvested fishes was recorded from visual observation.

## **Non-Returning Anglers**

Non-returning angler data was compiled from the pool of anglers who had registered for the NPSRF and targeted northern pikeminnow, but did not return to a registration station to participate in an exit interview. WDFW technicians surveyed 20% of the NPSRF’s non-returning anglers by telephone in order to obtain creel data from that segment of the NPSRF’s participants. To obtain the 20% sample, 50% of the registration forms from 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. For the 2001



season, catch and harvest data were only recorded for the number and species of adult and/or juvenile salmonids, the number of  $\geq 9$ " total length pikeminnow and the number of  $< 9$ " northern pikeminnow. Non-returning angler catch data for all other fish species (last obtained during the 2000 NPSRF) were not collected in 2001. We anticipate collecting full creel data for other fish species again in 2005 per NPSRF protocol (Fox et al 1999).

## **Non-Returning Angler Catch Estimates**

Total catch estimates for non-returning anglers were calculated for each species using simple estimators. Estimates were made for northern pikeminnow  $\geq 228$  mm total length, northern pikeminnow  $< 228$  mm total length and for adult and juvenile salmonids

## **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 examined all northern pikeminnow for the presence of external tags (spaghetti or dart), fin-clip marks, and signs of tag loss. Fork lengths and sex of northern pikeminnow (determined by evisceration) as well as fork lengths for other fish species were recorded whenever possible. All tagged northern pikeminnow and fin-clipped northern pikeminnow (which may have had missing tags) were measured for fork length, eviscerated to determine sex, and had scale and opercle samples taken. Data from tags, fin-clip marks or signs of tag loss were recorded on data forms and on a tag envelope. The tag was placed in the envelope, stapled to the tag payment voucher and given to the angler to submit to ODFW for verification.

### **PIT Tag Detection**

Northern pikeminnow harvested in the NPSRF have been found to ingest juvenile salmonids carrying passive integrated transponder (PIT) tags (Glaser et al. 2000). The Bonneville Power Administration (BPA) continued to provide the NPSRF with two PIT tag "readers" (Destron Fearing portable transceiver system – model # FS2001F) in order to scan pikeminnow and record information from PIT tag detections for submission to the Columbia Basin PIT Tag Information System (PTAGIS).

Logistical constraints limited us to scanning northern pikeminnow from less than 100% of the NPSRF area during the 2001 season. We therefore concentrated scanning activities at registration stations below John Day Dam since this area accounts for the majority of the NPSRF's harvest. Scanning began during the two week pre-season and was also continued during the season extension. Technicians individually scanned all northern pikeminnow for PIT tag readings and those with positive readings were labeled and frozen for future analysis and tag recovery. The PIT tag readers were downloaded regularly to a central computer and detection information was forwarded to PTAGIS via electronic mail.

## **Northern Pikeminnow Processing**

During biological sampling, all northern pikeminnow were either eviscerated (to determine sex), or caudal clipped as an anti-fraud measure intended to eliminate the possibility of previously processed northern pikeminnow being resubmitted for payment. In 2001, northern pikeminnow returned to stations below John Day Dam were caudal clipped rather than eviscerated in order to facilitate accurate scanning for 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 2001 NPSRF harvested 218,585 northern pikeminnow  $\geq 9$ " TL while fully implemented during the regular season. The NPSRF also harvested 10,224 eligible n. pikeminnow during the two week pre-season below The Dalles Dam and 12,085 eligible n. pikeminnow during the two week extension. The overall season total for the NPSRF was 240,894 northern pikeminnow  $\geq 9$ " TL. In addition, the 2001 NPSRF harvested 9,829 northern pikeminnow  $< 9$ " TL.

Mean weekly harvest for the regular season NPSRF was 10,929 northern pikeminnow  $\geq 9$ " TL. Peak weekly harvest occurred in week 23 (June 4-10) and totaled 13,425 northern pikeminnow  $\geq 9$ " TL (Figure 3). Mean weekly harvest prior to the BPA reward increase was 11,415 northern pikeminnow and 10,605 northern pikeminnow afterwards.

Fifty-four percent of the NPSRF's harvest of northern pikeminnow (130,600) came from fishing location 01 (below Bonneville Dam) (Figure 4) although the top registration station was Greenbelt in Clarkston, Washington with 34,392 northern pikeminnow received (Figure 5). Mean harvest per registration station was 10,950 northern pikeminnow. The registration station at Cathlamet received 16,664 northern pikeminnow during the 2001 season although 4,214 (25.3%) n. pikeminnow were received at Cathlamet by anglers disqualified from the NPSRF for illegally turning in northern pikeminnow caught outside the NPSRF's boundaries.

### **Incidental Catch/Harvest by Species**

Of the returning anglers targeting northern pikeminnow, peamouth *Mylocheilus caurinus* were the species most often caught other than northern pikeminnow. Sculpins (*Cottus* sp.) and smallmouth bass (*Micropterus dolomieu*) were also frequently caught (Table 1).

## **Angler Effort**

The 2001 NPSRF recorded 35,037 angler days (effort) while fully implemented during the regular season. The NPSRF also recorded 2,718 angler days during the pre-season and 1,063 angler days during the season extension for an overall effort level of 38,818 angler days in 2001. Returning angler days (22,625) comprised 58.3% of total overall effort.

Mean weekly effort for the regular season was 1,752 angler days. Mean weekly effort for the pre-season was 1,359 angler days, 532 angler days during the season extension and 1,617 angler days overall. Peak weekly effort occurred during week 29 (July 16-22) and totaled 2,586 angler days (Figure 6). Mean weekly effort prior to the BPA reward increase was 1,825 angler days and 1,703 angler days afterwards.

Returning anglers accounted for 22,625 angler days (58.3%) of effort during the 2001 NPSRF. This was an increase of 5,005 angler days from the 2000 NPSRF although the percentage of effort remained the same.

Thirty-seven percent of the NPSRF's effort (14,452 angler days) came from fishing location 01 (below Bonneville Dam) (Figure 7), highlighted by the Washougal registration station's total of 5,585 angler days (Figure 8). Average effort per registration station was 1,765 angler days. The Cathlamet registration station also recorded 96 angler days spent by anglers disqualified from the NPSRF for illegally turning in northern pikeminnow caught outside the NPSRF's boundaries.

## **Catch Per Angler Day**

The 2001 NPSRF recorded a catch per unit of effort (CPUE) of 6.24 northern pikeminnow harvested per angler day (returning + non-returning anglers) while fully implemented during the regular season. The NPSRF also recorded CPUE's of 3.76 fish/day during the pre-season, and 11.37 fish/day during the season extension. Overall CPUE for the 2001 NPSRF was 6.21 northern pikeminnow per angler day.

The highest CPUE area in the 2001 NPSRF was in fishing location 10 (Little Goose Dam to Lower Granite Dam) with 40.92 northern pikeminnow per angler day (Figure 9). The registration station that recorded the highest CPUE was at the Ringold registration station with 48.68 northern pikeminnow per angler day (Figure 10). Peak weekly CPUE occurred during week 39 (September 24-30) and was 7.96 northern pikeminnow per angler day. Returning angler CPUE was 10.65 northern pikeminnow per angler day.

## **Tag Recovery**

Anglers returned 200 northern pikeminnow tagged with external spaghetti tags, for an occurrence rate of .0008302. One hundred and eighteen tags were redeemed prior to July 10 and

were eligible for the NPMP's standard \$50 reward. An additional 82 spaghetti tags were redeemed from July 10<sup>th</sup> through the end of the season and were worth \$1000 each as part of BPA's northern pikeminnow reward increase. Station technicians identified an additional 7 northern pikeminnow with a fin-clip mark and/or wounds consistent with having lost a tag.

A total of 153,892 northern pikeminnow were individually scanned for the presence of PIT tags in their gut. This represents 95.87% of all northern pikeminnow handled below the John Day Dam. A total of 58 PIT tags were located and interrogated from these fish. The overall tag occurrence rate was .0003768.

Total harvest for 2001 was the highest in program history and exceeded the previous record of 199,600 northern pikeminnow harvested in 1995 (Hisata et al. 1995), as well as the mean 1991-2000 season harvest of 146,925. Effort increased by 8,481 angler days from the 2000 NPSRF (primarily after the BPA reward increase) but remained below the 1991-2000 average of 44,913. CPUE was down from 6.25 in 2000 to 6.21 in 2001. While the 2001 harvest of northern pikeminnow set a new high for the NPSRF, the potential for an even higher harvest was not realized. Peak harvest was three weeks earlier than the 1991-2000 mean peak mainly because the river warmed up to northern pikeminnow spawning temperature earlier due to drought conditions. Since the BPA reward increase came after the peak harvest, the participation spike that was generated came after the best fishing period had passed. In addition the increased reward generated additional concerns about fraud that was supported by the documentation of 25.3% of the northern pikeminnow harvested at the Cathlamet registration being fraudulently turned in during 2001.

Detection of PIT tags retained in the gut of northern pikeminnow continued to show promise as a way to obtain additional data on predation. Additional sampling should provide more relevant data on how to best utilize this opportunity.

## **RECOMMENDATIONS FOR THE 2002 SEASON**

1. Begin the 2002 NPSRF as early as possible in lower river areas where anglers successfully demonstrated that they can harvest worthwhile numbers of NPM.
2. Retain the option to extend the NPSRF season on a site-specific basis if harvest, angler effort and CPUE levels warrant.
3. Continue incentives designed to maintain the NPSRF's core angler group and to deter anglers from catching pikeminnow outside program boundaries.
4. Modify PIT tag scanning operations to include registration stations above John Day Dam.
5. Explore and develop additional measures to deter anglers from fraudulently submitting northern pikeminnow to the NPMP for payment.
6. Continue to survey 20% of non-returning anglers to calculate catch estimates for salmonids and NPM. Resample for all species in 2005 to verify that trends have not changed.

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## APPENDIX A

### NORTHERN PIKEMINNOW SPORT-REWARD FISHERY RULES AND REGULATIONS

**1. Each angler must:**

- a) **obtain an appropriate fishing license** (contact your local state fishery agency for information regarding fishing regulations and license requirements.)
- b) **adhere to state fishing regulations for the area in which they fish.**
- c) **register in person at one of the registration stations or authorized satellite stations each day prior to fishing** (anglers may self-register at any time when registration stations are closed. Self-registration facilities are provided at all registration stations).
- d) **mail in all reward vouchers within 30 days from the end of the season.**

**2. Ptychocheilus oregonensis submitted for reward payment must satisfy all of the following criteria:**

- a) **have been caught in the mainstem Columbia River from the mouth up to the boat restricted zone below Priest Rapids Dam, or in the Snake River from the mouth up to Hells Canyon Dam.** Also open are backwaters and sloughs as well as up to 400 feet into any tributaries within the area described above.
- b) **be live, or in fresh condition** (fish that are or have been frozen will not be accepted for payment). The technicians have authority to determine whether or not returned fish meet these standards.
- c) **be 9 inches or longer** [there is no reward for fish shorter than 228mm (9 inches)].
- d) be returned to the registration station the **same day** you registered (**within 24 hours**), in order to receive a reward payment.

**Violation of any of the above rules may result in disqualification from the Sport-Reward Fishery.**



# **REPORT B**

## **NORTHERN PIKEMINNOW SPORT REWARD PAYMENTS – 2001**

Prepared by  
Russell G. Porter

Pacific States Marine Fisheries Commission  
45 S.E. 82<sup>nd</sup> Drive, Suite 100  
Gladstone, OR 97027

March, 2002

## INTRODUCTION

The **Northern Pikeminnow Predator Control Program** was administered by PSMFC in 2001. The program is a joint effort between the fishery agencies of the states of Washington and Oregon, the Yakama Indian Nation, and the Pacific States Marine Fisheries Commission (PSMFC). Washington ran the sport-reward registration/creel check stations throughout the river and handled all fish checked in to the program. Oregon provided fish tagging services, population studies, food habit and reproductive studies, as well as exploitation rate estimates. PSMFC provided technical, fiscal and contractual oversight for all segments of the Program and processed all reward vouchers for the sport-reward anglers. The Yakama Indian Nation conducted angling at the dams and site-specific removals by means of gillnets at tributary mouths to aid salmonid downstream migrant survival.

## CATCH AND PAYMENTS

In 2001 a total of 239,964 fish were harvested in the sport-reward fishery. Vouchers for 238,150 fish were submitted for payment totaling rewards of \$1,528,010. There was a change in the reward payment amounts this season part way through the fishery. This was in response to the very low flows this season and resultant increased travel time of salmonids through the river system. This increased travel time subjected them to longer periods of predation in the river on their way out to sea. Bonneville Power Administration funded an increase in the reward payments commencing on July 10, 2001. The rewards paid from the beginning of the season up through July 9, 2001 were \$4 for the first 100 fish caught during the season, \$5 for fish in the 101-400 range, and \$6 for all fish caught by an angler above 400 fish, with tagged fish being paid at \$50 per tagged fish. Rewards were increased effective July 10, 2001. From that date forward fish were paid at \$5 for the first 100 fish caught during the season, \$6 for fish in the 101-400 range, and \$8 for all fish caught by an angler above 400 fish, with tagged fish being paid at \$1,000 per tagged fish. PSMFC maintained an accounting system during the season to determine the appropriate reward amount due each angler for particular fish. Coupons good for one free \$4 reward were issued again in 2001 as an incentive to stimulate angler participation. A total of 2,997 coupons were returned for payments of \$11,988. Anglers were able to use a coupon on a voucher when they caught one or more pikeminnows for the extra \$4 reward. A total of 3,354 anglers who registered were successful in catching one or more fish in 2001. The 2001 season ran from April 30, 2001 through October 14, 2001.

## TAGGED FISH PAYMENTS

A total of 200 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 \$50 or \$1,000 tagged fish reward depending on the date caught. This resulted in tag reward payments of \$87,900. A total of 118 tagged fish were paid at the \$50 reward for a total of \$5,900 up through July 9, 2001. A total of 82 tagged fish were paid at the \$1,000 reward amount for a total of \$82,000 from July 10, 2001 through October 14, 2001.

## **ACCOUNTING**

Total payments for the season of regular vouchers, tagged fish, coupons and tournaments totaled \$1,528,010. All IRS Form 1099 Mis. Statements were sent to the qualifying anglers for tax purposes in the third week of January, 2002. Appropriate reports and copies were provided to the IRS by the end of February, 2002.

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) 650-5400 or email at: russell\_porter@psmfc.org.

## 2001 SPORT REWARD PAYMENTS SUMMARY

The following is a summary of the vouchers received and paid as of November 27, 2001

**TOTAL FISH PAID: 237,938**

**TOTAL REWARD DOLLARS PAID: \$1,527,046**

TOTAL IF REWARD HAD NOT CHANGED: \$1,239,060

ADDITIONAL DOLLARS PAID AT NEW REWARD TIER: \$287,986

	Tier Fish	If paid at old tier	Additional at new tier	Total	Tagged Fish	Old Tier	New Tier	Total
Tier 1	71,813	\$287,252	N/A			(\$50)	(\$1,000)	
Tier 2	65,726	\$328,630	N/A		118	\$5,900	N/A	\$5,900
Tier 3	100,199	\$601,194	N/A		82	N/A	\$82,000	\$82,000
	237,738	\$1,217,076	\$210,086	<b>\$1,427,162</b>	200	\$5,900	\$82,000	\$87,900

Coupons returned (\$4):    2,996            **\$11,984**

Number of anglers @ Tier 1	<b>2,971</b>	Number of anglers with 10 fish or less:	<b>2,143</b>
Number of anglers @ Tier 2	<b>241</b>	Number of anglers with 2 fish or less:	<b>1,157</b>
Number of anglers @ Tier 3	<b>139</b>		
Number of separate anglers	<b>3,351</b>	Number of Predacards ordered and/or Issued:	<b>967</b>

	<i>Top Twenty Anglers *</i>					Total Fish Caught	Total Paid if tier had not changed	Additional paid @ new tier	Total Reward Paid
	TIER 1	TIER 2	TIER 3	Coupons	Tags				
#1 MCDONALD, ROBERT E	99	300	4,473	1	1	4,873	\$28,788	\$6,558	\$35,346
#2 WILLIAMS, EDWARD R	99	300	3,876	1	0	4,275	\$25,156	\$5,866	\$31,022
#3 KENDALL, ROY G	100	299	3,767	1	3	4,169	\$24,651	\$10,506	\$35,157
#4 SCHWARTZ, DWAYNE W	99	300	3,678	1	6	4,083	\$24,268	\$6,858	\$31,126
#5 MILLER, EARL D	99	300	3,401	1	5	3,805	\$22,556	\$6,713	\$29,269
#6 GARRICK, TERRY W	99	299	3,274	1	8	3,680	\$21,939	\$12,546	\$34,485
#7 NIXON, STEVE W	99	300	2,995	1	0	3,394	\$19,870	\$3,442	\$23,312
#8 HASKETT, SHIRLEY M	99	300	2,232	1	4	2,635	\$15,492	\$1,264	\$16,756
#9 WEARSTLER, ZACHARY A	99	300	2,195	1	0	2,594	\$15,070	\$3,208	\$18,278
#10 BROWN, JOHN G	99	300	2,071	1	7	2,477	\$14,676	\$3,316	\$17,992
#11 SHROCK, WALTER W JR	99	300	1,955	1	0	2,354	\$13,630	\$3,922	\$17,552
#12 STEVENS, TODD G	99	300	1,899	1	2	2,300	\$13,394	\$5,907	\$19,301
#13 BARANOVICH, ROMAN H	99	300	1,872	1	0	2,271	\$13,132	\$470	\$13,602
#14 JENSEN, TED A JR	98	299	1,795	1	3	2,195	\$12,811	\$4,424	\$17,235

<i>Top Twenty Anglers *</i>									
	TIER 1	TIER 2	TIER 3	Coupons	Tags	Total Fish Caught	Total Paid if tier had not changed	Additional paid @ new tier	Total Reward Paid
#15 SMITH, DEAN M	99	299	1,795	1	1	2,194	\$12,715	\$2,642	\$15,357
#16 MUCK, JAMES E	99	299	1,738	1	4	2,140	\$12,523	\$4,584	\$17,107
#17 PAPST, THOMAS H	99	300	1,740	1	1	2,140	\$12,390	\$2,990	\$15,380
#18 WYATT, JAMES R	99	300	1,736	1	0	2,135	\$12,316	\$3,638	\$15,954
#19 VANDENBERGHE, OLIVER P	100	300	1,627	1	0	2,027	\$11,666	\$2	\$11,668
#20 PICARD, LOUIS A	99	300	1,579	1	0	1,978	\$11,374	\$2,932	\$14,306
<i>*(by total fish caught)</i>	1,981	5,995	49,698	20	45			\$91,788	\$430,205

## **REPORT C**

# **CONTROLLED ANGLING FOR NORTHERN PIKEMINNOW AT LOWER COLUMBIA RIVER DAMS IN 2001**

Prepared by

George Lee

Fisheries Resource Management  
Confederated Tribes and Bands  
Yakama Nation  
Post Office Box 151  
Toppenish, WA  
98948

## **ACKNOWLEDGEMENTS**

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Funding for this work was provided by the Bonneville Power Administration (John Skidmore, COTR) through the Pacific States Marine Fisheries Commission (Russell Porter, Program Manager).

## **ABSTRACT**

In 2001, the Yakama Nation crew angled for Northern pikeminnow (Npm) at Bonneville, The Dalles and John Day Dams during the months between May and August. Angling and data collection methods were the same as in 2000, where the crew measured its effort generally as time spent on the dam rather than as time spent actively angling.

The crew caught 2,751 Npm > 200mm FL in 1530.5 angling hours, for a seasonal catch per angler hour (CPAH) of 1.79. Relative to 2000, catch increased 650% and effort increased by 12% as well. Increase in catch can be attributed a longer angling season and to the low water year and throughout the lower Columbia River the Corp was not spilling water over the dams.

## INTRODUCTION

The hydroelectric dams and reservoirs on the lower Columbia River provide predatory fishes with favorable conditions for feeding on juvenile salmonids (Raymond 1979; Rieman et al 1991), many populations of which are now protected by Endangered Species Act listings. A principal predator, the northern pikeminnow (NPM) *Ptychocheilus oregonensis*, is being targeted for control in the lower Columbia River by fisheries implemented through the Northern Pikeminnow Management Program.

Angling at mainstem dams by fishery technicians has been one of the control fisheries since the program's inception in 1990 (Vigg et al. 1990; Beaty et al. 1993; Parker et al. 1993; CRITFC 1994, 1995; Collis et al. 1997; Beaty 1999, 2000) although originally implemented at all eight federal dams on the lower Columbia and Snake rivers, the dam angling fishery has continually been reduced in scope over the years and focused on the most productive locations. Other existing fisheries include the sport reward fishery, conducted by the Washington Department of Fish and Wildlife, and the gillnet fishery implemented by the Yakama Nation which is done at selected sites and is primarily in the Bonneville reservoir. The continuing mission of the dam angling fishery is to efficiently remove NPM from areas near dams using hook and line angling, while keeping the catch of incidental species, particularly salmonids, at a minimum.

## METHODS

In 2001, dam angling was conducted only at Bonneville, The Dalles and John Day dams on the lower Columbia River. Effort was focused on tailraces. No angling was done within the boat restricted zones (BRZ) of the dams.

Angling began in April and ended in September. Hours and times fished on each dam were varied to maximize catch and utilize resource most efficiently. The Yakama Nation employed one crew on this project and fished at the three lower Columbia River dams. Angling was terminated when funding was exhausted.

The field crew rotated between the Bonneville, The Dalles and John Day Dams, fishing the most favorable times as determined by angling success and past experience. It was found that the most successful baits/lures were the grubs, but anglers tried various lures.

Data was recorded on paper forms and faxed to the office at Toppenish, WA and entered onto a computer. This data was then summarized and reported weekly to the PSMFC office in Gladstone, OR.





**Figure 1.** Locations of Bonneville, The Dalles and John Day Dams

## RESULTS AND DISCUSSION

Angling for 2001 resulted in 2,751 northern pikeminnow being caught in 1,530.5 angler hours of effort (Table 1). This results in an average catch per angler hour (CPAH) of 1.79 overall. . At Bonneville dam 213 NPM were caught in 95 hours of effort, and the CPAH was 2.24. There were a total of 1425 NPM caught at The Dalles dam with 1005.5 hours of effort and this resulted in a CPAH at The Dalles Dam of 1.41. At John Day dam 1113 NPM were caught in 430 hours of effort, and the CPAH was 2.58

The catch of adult and juvenile salmonids was zero, and sturgeon and gamefish was held to a low number. There were no non-game fish caught (Table 1). All incidental fish caught were released in excellent condition because anglers cut the line as soon as a hooked fish was recognized to be a non-target species.

**Table 1.** Effort and Numbers of NPM and other fishes caught during angling in 2001 at Bonneville, The Dalles and John Day dams.

<b>LOCATION</b>	<b>EFFORT</b>	<b>NPM</b>	<b>ADULT SALMONID</b>	<b>JUVENILE SALMONID</b>	<b>STURGEON</b>	<b>GAMEFISH</b>	<b>NON-GAME</b>
<b>Bonneville</b>	95.0	213	0	0	2	2	0
<b>The Dalles</b>	1,005.5	1425	0	0	12	35	0
<b>John Day</b>	430.0	1113	0	0	9	19	0
<b>TOTALS:</b>	1530.5	2751.0	0	0	23	56	0

There was a high peak point within the weekly reports and this was week 25 and also week 29. During these two weeks 501 NPM were caught during week 25 and the CPAH was the highest weekly average during the week 29 (Table 2).

**Table 2.** Statistical weeks effort, catch and CPAH

<b>Statistical Week</b>	<b>Effort</b>	<b>NPM</b>	<b>CPAH</b>
<b>Dates</b>			
Week 17: 4/22/01 to 4/28/01	<b>165.0</b>	<b>51</b>	<b>0.31</b>
Week 18 : 4/29/01 to 5/5/01	<b>70.0</b>	<b>15</b>	<b>0.21</b>
Week 19 : 5/6/01 to 5/12/01	<b>64.0</b>	<b>31</b>	<b>0.48</b>
Week 20 : 5/13/01 to 5/19/01	<b>38.5</b>	<b>23</b>	<b>0.60</b>
Week 21 : 5/20/01 to 5/26/01	<b>27.0</b>	<b>26</b>	<b>0.96</b>
Week 22 : 5/27/01 to 6/2/01	<b>8.1</b>	<b>9</b>	<b>1.11</b>
Week 23 : 6/3/01 to 6/9/01	<b>120.5</b>	<b>117</b>	<b>0.97</b>
Week 24 : 6/10/01 to 6/13/01	<b>150.0</b>	<b>152</b>	<b>1.01</b>
Week 25 : 6/17/01 to 6/23/01	<b>187.5</b>	<b>501</b>	<b>2.67</b>
Week 26 : 6/24/01 to 6/30/01	<b>111.5</b>	<b>165</b>	<b>1.48</b>
Week 27 : 7/01/01 to 7/07/01	<b>105.0</b>	<b>326</b>	<b>3.10</b>
Week 28 : 7/08/01 to 7/14/01	<b>142.5</b>	<b>380</b>	<b>2.67</b>
Week 29 : 7/15/01 to 7/21/01	<b>80.5</b>	<b>252</b>	<b>3.13</b>
Week 30 : 7/22/01 to 7/28/01	<b>126.5</b>	<b>353</b>	<b>2.79</b>
Week 31 : 7/29/01 to 8/04/01	<b>76.5</b>	<b>223</b>	<b>2.92</b>
Week 32 : 8/05/01 to 8/11/01	<b>57.5</b>	<b>127</b>	<b>2.21</b>

The CPAH in 2001 was higher than in past years (Table 3). The CPAH has not been this high since 1993 when angling first began. This could be because of the low water throughout the

Columbia River basin. As a result there was no spill during the times that the crew was out on the dams fishing. The juveniles salmonids forced to pass through the by-pass system or the powerhouses brought the NPM within casting range of the anglers as the predators are within the tailrace areas. Experience has shown that spilling at the dams allow more of the juveniles salmonids to pass over the spills where they are relatively protected from predators. NPM tend to be held out of casting range of the anglers by both the high water velocities and difficult foraging conditions in the splash pool below the dam.

**Table 3.** Northern pikeminnow (NPM) catch, effort (angler hours),and catch per angler hour(CPAH) for hook and line angling at Columbia River dams.

		COLUMBIA RIVER DAMS				
		Bonneville	The Dalles	John Day	McNary	Season
1991	NPM	8,131	3,674	5,004	8,348	25,157
	Effort	2,621	1,333	2,816	3,416	10,186
	<b>CPAH</b>	<b>3.1</b>	<b>2.8</b>	<b>1.8</b>	<b>2.4</b>	<b>2.5</b>
1992	NPM	4,814	7,561	3,427	7,297	23,099
	Effort	1,781	2,496	2,775	2,523	9,575
	<b>CPAH</b>	<b>2.7</b>	<b>3.0</b>	<b>1.2</b>	<b>2.9</b>	<b>2.4</b>
1993	NPM	5,836	2,712	2,509	5,148	16,205
	Effort	1,991	1,992	1,561	2,780	8,324
	<b>CPAH</b>	<b>2.9</b>	<b>1.4</b>	<b>1.6</b>	<b>1.9</b>	<b>1.9</b>
1994	NPM	5,238	4,393	3,083	2,556	15,270
	Effort	2,232	2,064	1,649	2,966	8,910
	<b>CPAH</b>	<b>2.3</b>	<b>2.1</b>	<b>1.9</b>	<b>.9</b>	<b>1.7</b>
1995	NPM	2,422	409	950	1,002	4,783
	Effort	2,823	920	777	1,670	6,190
	<b>CPAH</b>	<b>.9</b>	<b>.4</b>	<b>1.2</b>	<b>.6</b>	<b>.8</b>
1996	NPM	1,135	623	1,278	2,184	5,220
	Effort	693	338	618	1,372	3,022
	<b>CPAH</b>	<b>1.6</b>	<b>1.8</b>	<b>2.1</b>	<b>1.6</b>	<b>1.7</b>
1997	NPM	1,086	1,084	1,086	263	3,519
	Effort	784	826	857	746	3,214
	<b>CPAH</b>	<b>1.4</b>	<b>1.3</b>	<b>1.3</b>	<b>.4</b>	<b>1.1</b>
1998	NPM	829	800	945	1,106	3,680
	Effort	538	758	902	1,356	3,554
	<b>CPAH</b>	<b>1.5</b>	<b>1.1</b>	<b>1.0</b>	<b>.8</b>	<b>1.0</b>
1999	NPM	1,926	506	853	452	3,737
	Effort	1,249	540	726	691	3,206
	<b>CPAH</b>	<b>1.5</b>	<b>.9</b>	<b>1.2</b>	<b>.7</b>	<b>1.2</b>

<b>2000</b>	NPm	107	289	27	–	423
	Effort	327	832	197	0	1,356
	<b>CPAH</b>	<b>.3</b>	<b>.3</b>	<b>.1</b>	–	<b>.3</b>
<b>2001</b>	<b>NPm</b>	<b>213</b>	<b>1425</b>	<b>1113</b>		<b>2751</b>
	<b>Effort</b>	<b>95</b>	<b>1005.5</b>	<b>430</b>	<b>0</b>	<b>1530.5</b>
	<b>CPAH</b>	<b>2.2</b>	<b>1.4</b>	<b>2.6</b>		<b>1.8</b>
Total	NPm	31,737	23,476	20,275	28,356	103,844
	Effort	15,134	13,105	13,308	17,520	59,068
	<b>CPAH</b>	<b>2.1</b>	<b>1.8</b>	<b>1.5</b>	<b>1.6</b>	<b>1.8</b>

Again angling was measured as time spent on the dam rather than as the time spent actively angling, as in the previous years prior to 2000. Recording of the time was kept as the angler changed from site to site, changing lures/gear, detangle fishing lines from bird wires, etc. This results in a higher effort but reduces the CPAH. No changes to the submitted data were made in an attempt to correct this.

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# **REPORT D**

## **SITE-SPECIFIC GILLNETTING FOR NORTHERN PIKEMINNOW IN THE LOWER COLUMBIA RIVER IN 2002**

Prepared by

George Lee

Fisheries Resource Management  
Confederated Tribes and Bands  
Yakama Nation  
Post Office Box 151  
Toppenish, WA 98948

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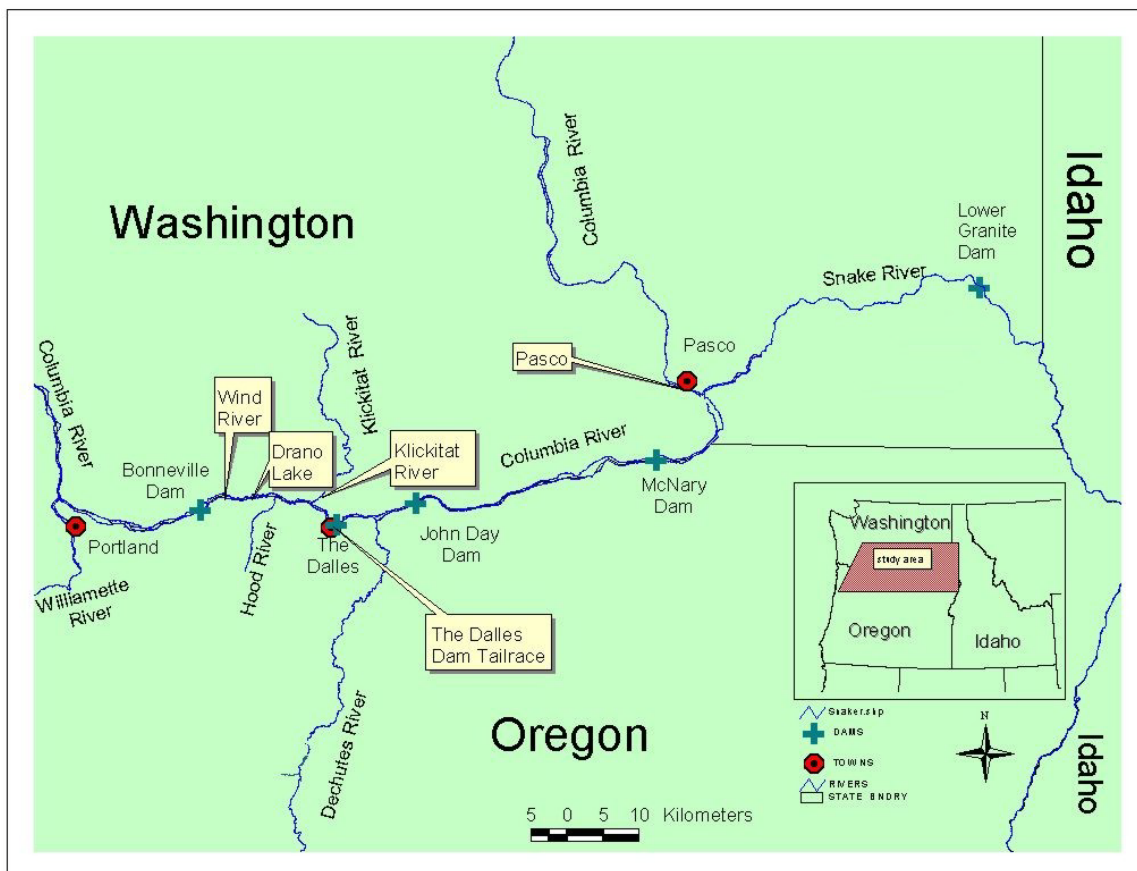


## ABSTRACT

The Yakama Nation crew used small meshed gillnets at two locations in the lower Columbia River, Bonneville Pool (Figure 1). The site-specific gillnet fishery is part of the on going program to control the abundance of northern pikeminnow (NPM) and their predation on juvenile salmonids *Oncorhynchus* spp.

The crew fished with gillnets from March 25 to April 21 and caught 523 NPM in a total of 120 net-hours of effort, for a catch per net hour (CPNH) of 4.4. Compared to the past years effort was down due to problems with our boat. The Klickitat River was the most productive and resulted in 69% or 362 NPM of the catch.

**Figure 1.** Bonneville Pool, site of the Site-specific work on the Columbia River.



## INTRODUCTION

Implemented in 1990, the Northern Pikeminnow Management Program seeks to increase survival of juvenile salmonids by controlling the abundance of northern pikeminnow (*tychocheilichthys oregonensis*) (NPM) of predaceous or nearly predaceous size in the lower Columbia River. This component of the program was tested in 1993 and since then has been employed to target predators where they are known to concentrate, such as near hatchery release points in Bonneville Reservoir (Collis et al. 1995). The objective of the fishery again in 2001 was to catch NPM as efficiently as possible while keeping incidental impacts to salmonids to a minimum. The Yakama Nation was contracted to perform this activity.

## METHODS

Small meshed gillnets were used in the lower Columbia River, mainly in the Bonneville reservoir. Effort was focused in the most productive location in Bonneville Reservoir. In past years work was discontinued once a sockeye salmon (*Oncorhynchus nerka*) was caught.

Essentially the same operational criterion was used as had been used in previous years to reduce impacts to salmonids (Collis et al. 1995; Hatch et al. 1998). For example, fishing was conducted only at night, and nets were fished only about 45 minutes so that incidentally caught salmonids could be quickly found and released. At times the crew tried to limit the time to 30 minutes. The crew fished three to five nets simultaneously, pulling, checking and resetting the nets in a regular rotation.

Fishing effort for each net was measured from the time the net was set until it was pulled. Fork lengths were recorded on up to three NPM taken from each net. Numbers of salmonids (by species for adults) and white sturgeon (*Acipenser transmontanus*) were recorded for each net set based on the condition of the fish at release. Numbers (but not condition) of other game fishes were recorded by species, and numbers of non-game fishes (e.g., “suckers” for *Catostomus* spp.) of non-game fishes were recorded

Data were recorded on paper forms that were faxed to our office in Toppenish, Wa. And were then entered into the computer files and summarized for weekly reports that were submitted to the Program Coordinator.

## RESULTS & DISCUSSION

The crew fished four weeks in the Bonneville pool, from March 25 to April 21 and caught 523 NPM in 120 hours (See chart 1) of effort. This is a catch per net hour (CPNH) of 4.4. Compared

to 2000 site specific work performed by the Yakama Nation crew three less fish were caught and 61 less hours of effort (See Chart 2).

The Klickitat River was the site, which the most NPm were caught. There were 362 NPm caught which is 69% of the total. Drano Lake is the other of two sites, which were fished during 2001 and 161 NPm, or 31% of the fish were caught there.

Generally the site-specific fishing is completed when a sockeye salmon is caught, however the fishing was completed before a sockeye was caught.

**Chart 1.** Weekly catch, effort and Northern Pikeminnow (NPm) caught during 2001 gillnet season.

	Effort	NPm	Adult Salmonids	Juvenile Salmonids	Sturgeon	Gamefish	Non Gamefish
Week 13: 3/25/01 to 3/31/01	20.0	81	0	0	3	0	135
Week 14: 4/1/01 to 4/7/01	54.2	194	3	0	15	9	244
Week 15: 4/8/01 to 4/14/01	54.2	385	19	0	93	19	444
Week 16: 4/15/01 to 4/21/01	120.0	523	25	0	106	19	532

**Chart 2.** Annual catches within selected pools during the years 1993-2001.

		Blw Bonn	Bonneville	The Dalles	John Day	McNary	Season
<b>1993</b>	NPm	0	1,772	0	0	0	1,772
	Effort (h)	0	394	0	0	0	394
	CPAH	--	4.5	--	--	--	4.5
<b>1994</b>	NPm	0	8,890	5	42	10	8,947
	Effort (h)	0	1,195	18	43	67	1,323
	CPAH	--	7.4	0.3	1.0	0.1	6.8
<b>1995</b>	NPm	263	8,668	25	136	57	9,149
	Effort (h)	166	1,844	19	139	45	2,213
	CPAH	1.6	4.7	1.3	1.0	1.3	4.1
<b>1996</b>	NPm	38	5,822	232	63	11	6,166
	Effort (h)	35	2584	121	91	47	2,878
	CPAH	1.1	2.3	1.9	0.7	0.2	2.1
<b>1997</b>	NPm	1	2,538	226	35	23	2,823
	Effort (h)	4	1296	172	84	28	1,584
	CPAH	0.3	2.0	1.3	0.4	0.8	1.8
<b>1998</b>	NPm	76	2847	111	1	0	3,035
	Effort (h)	28	1119	108	15	0	1,270
	CPAH	2.7	2.5	1.0	0.1	--	2.4

<b>1999</b>	NPm	186	1672	33	0	0	1,891
	Effort (h)	94	970	46	0	0	1,110
	CPAH	2.0	1.7	0.7	--	--	1.7
<b>2000</b>	NPm	0	526	0	0	7	533
	Effort (h)	0	181	0	0	49	230
	CPAH	--	2.9	--	--	0.1	2.3
<b>2001</b>	NPm	0.0	523.0	0.0	0.0	0.0	523
	Effort (h)	0.0	120.0	0.0	0.0	0.0	120
	CPAH	0.0	4.4	0.0	0.0	0.0	4.4
<b>Total</b>	NPm	564	33,258	632	277	108	34,839
	Effort (h)	327	9,703	484	372	236	11,122
	CPAH	1.7	3.4	1.3	0.7	0.5	3.1

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# **REPORT E**

## **DEVELOPMENT OF A SYSTEM-WIDE PREDATOR CONTROL PROGRAM: FISHERIES EVALUATION**

Prepared by

Howard K. Takata  
David L. Ward

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

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## ABSTRACT

Predator control fisheries aimed at reducing predation on juvenile salmonids by northern pikeminnow *Ptychocheilus oregonensis* were implemented for the eleventh consecutive year in the mainstem Columbia and Snake rivers. We report on (1) exploitation rates of northern pikeminnow and catch rates of incidental fishes among the three management fisheries in 2001, (2) estimated reductions in predation on juvenile salmonids since implementation of the fisheries, (3) estimated tag loss for spaghetti tags, and (4) validation of aging methodology for northern pikeminnow based on scale and opercula readings.

For the sport-reward fishery, system-wide exploitation of northern pikeminnow  $\geq 250$  mm fork length (FL) was a record high of 16.2%, 10.6% for northern pikeminnow 200-249 mm FL, and 15.5% for all northern pikeminnow  $\geq 200$  mm FL. Although northern pikeminnow were harvested by dam angling and site-specific gillnet fisheries, no fish tagged in 2001 were recovered by either of these fisheries; therefore, exploitation rates were 0%. Among reservoirs/river areas, exploitation of northern pikeminnow  $\geq 200$  mm by the sport-reward fishery was highest in McNary Reservoir (including the Hanford Reach) and the area downstream of Bonneville Dam. The exceptionally high exploitation rates in 2001 may be the result of low river flows that improved angler success rates, or from increased catch and effort due to an increase in rewards paid to anglers participating in the sport-reward fishery.

Incidental fish comprised 31.6% of the catch by sport-reward anglers targeting northern pikeminnow, 2.8% of the dam angling catch, and 56.6% of the site-specific gillnet catch. The proportion of the northern pikeminnow catch consisting of predator-sized ( $\geq 200$  mm FL) fish was 82.7% in the sport-reward fishery. The incidental catch of salmonids by all fisheries combined comprised 1.0% of the total catch, a three-fold increase over previous years.

Although some modest reductions in predation have been achieved since 1999, further reductions are likely to be minimal if exploitation continues at mean 1995-2001 levels. Even if exploitation rates remain near the exceptionally high levels seen in 2001, relative predation will not decline to any significant extent. We estimate that juvenile salmonid predation will probably not change much from 76% of the pre-program level.

Within-year tag loss was estimated to be 0% for spaghetti tags. However, because an unknown proportion of harvested northern pikeminnow may not have been examined for fin marks and tag loss scars, we cannot confidently conclude that no tag loss fish were recovered. Therefore, we will need to repeat the tag loss study in 2002.

Between-reader variation in the aging of northern pikeminnow scales and opercles tended to be high with complete agreement ranging from only 22.6% for opercles to an average of 36.5% for scales. There appeared to be no clear pattern to the variation between readers. An assessment of the precision of our aging over time showed that complete agreement occurred 40.5% of the time--similar to our results in 2000. Ages assigned to opercles were the same as ages assigned to scales from the same fish only 27.7% of the time. Overall, ages for opercles

tended to be greater than those for scales, suggesting that either scales underestimate ages or opercles overestimate ages of northern pikeminnow.



## INTRODUCTION

The goal of the Northern Pikeminnow Management Program (NPMP) is to reduce mainstem mortality of juvenile salmonids attributed to predation by northern pikeminnow *Ptychocheilus oregonensis* in the lower Columbia River Basin. We established baseline levels of predation and described northern pikeminnow population characteristics prior to the implementation of sustained predator control fisheries by estimating abundance, consumption, and predation 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). From 1994 to 1996, we sampled in areas where sufficient numbers of northern pikeminnow could be collected to compare changes in predation among years (Zimmerman and Ward 1999). Ward (1998) provided a comprehensive summary of NPMP evaluation from 1990 to 1996. In this report, we describe our activities and findings for 2001, and wherever possible, evaluate changes from previous years.

Our objectives in 2001 were to (1) evaluate the relative efficiency of each northern pikeminnow fishery by comparing exploitation rates and incidental catches, (2) estimate reductions in predation on juvenile salmonids since implementation of the NPMP, (3) estimate the tag loss rate for spaghetti tags, and (4) validate aging methods through collection and reading of scale and opercula samples from tagged and recaptured northern pikeminnow. The later two objectives were first implemented in 2000 based on the recommendations of an independent review of the NPMP (Hankin and Richards 2000).

## METHODS

### FISHERY EVALUATION, PREDATION ESTIMATES, AND TAG LOSS

#### Field Procedures

Three northern pikeminnow fisheries were conducted in 2001. The sport-reward fishery was implemented by the Washington Department of Fish and Wildlife (WDFW) from April 30 (May 14 for areas upstream of The Dalles Dam) to October 14 throughout the lower Columbia and Snake rivers. For the second consecutive year, northern pikeminnow as small as 9 inches (230 mm) total length (TL) (approximately equivalent to 200 mm fork length) were eligible for a reward. The dam angling fishery was implemented by the Yakama Nation from April 23 to August 12 at Bonneville, The Dalles, and John Day dams (fishing primarily on the tailrace side of the dams). A site-specific gillnet fishery was also implemented by the Yakama Nation from March 26 to April 22 in Bonneville Reservoir. Both the dam angling and site-specific gillnet fisheries also targeted northern pikeminnow  $\geq 230$  mm TL.

We tagged and released northern pikeminnow  $\geq 200$  mm fork length (FL) to estimate exploitation rates for each fishery. We used electrofishing boats and bottom gillnets to collect northern pikeminnow from April 4 to June 14. A detailed description of sampling gears and methods is given in Parker et al. (1995). With few exceptions, we allocated equal sampling effort in all sampled river kilometers (Rkm). On the Columbia River, we sampled from Rkm 78 (near Clatskanie, Oregon) upstream to Rkm 634 (Priest Rapids Dam). In 2001, we sampled only about half of John Day Reservoir due to historically low numbers of tagged fish in that reservoir. In addition, approximately 18 river kilometers in various areas of the Columbia could not be sampled due to high winds. On the Snake River, we only sampled above Lower Granite Dam from Rkm 190 (approximately 20 kilometers downstream of Lewiston, Idaho) to Rkm 246 (near the mouth of the Grande Ronde River). Sampling in Lower Monumental and Little Goose reservoirs was discontinued in 2001 due to historically low numbers of tagged fish in those reservoirs. Northern pikeminnow  $\geq 200$  mm FL were tagged with a serially-numbered spaghetti tag. To evaluate tag loss, we clipped the right ventral fin on all tagged fish.

## Data Analysis

We used mark-and-recapture data to compare exploitation rates of northern pikeminnow  $\geq 200$  mm FL among fisheries and reservoirs in 2001. Weekly estimates of exploitation for each fishery were calculated by dividing the number of tagged northern pikeminnow recovered (including fish tagged in 2001 that had lost their tags) by the number of tagged fish at large and summed to yield total exploitation rates (Beamesderfer et al. 1987).

We calculated 95% confidence intervals for each weekly exploitation estimate. We calculated confidence intervals for variables distributed in a Poisson distribution from Ricker (1975) for weeks when tagging and fishing occurred simultaneously. After tagging was complete, we calculated weekly confidence intervals using the formula

$$m \pm 1.96 \sqrt{m/n} \quad (\text{if } mn > 30),$$

where

$m$  = the mean number of tagged fish recovered per week (Elliott 1977), and  
 $n$  = the number of sampling weeks remaining.

We summed estimates for each week to give overall confidence limits.

We compared incidental catch among fisheries by calculating the percent of the total catch comprised of fish other than northern pikeminnow  $\geq 200$  mm FL. We also estimated the proportion of predator-sized northern pikeminnow ( $\geq 200$  mm FL) relative to the total northern pikeminnow catch, and the catch rate of salmonids in each fishery.

We used the model of Friesen and Ward (1999) to estimate predation on juvenile salmonids relative to predation prior to implementation of the NPMP. The model incorporates age-specific exploitation rates on northern pikeminnow and resulting changes in age structure to

estimate changes in predation. We used a 10-year “average” age structure (based on catch curves) for a pre-exploitation base, and assumed constant recruitment. Age-specific consumption was incorporated; however, potential changes in consumption, growth, and fecundity due to removals were not considered likely. The model therefore estimates changes in potential predation related directly to removals. This, in effect, allowed us to estimate the effects of removals if all variables except exploitation were held constant.

We estimated the potential relative predation in 2001 based on observed exploitation rates, and the eventual minimum potential predation assuming continuing exploitation at mean 1995-2001 levels. Because inputs to the model included three potential relationships between age of northern pikeminnow and consumption, and three estimates of exploitation (point estimate plus confidence limits), we computed nine estimates of relative predation for each year (Friesen and Ward 1999). We report the maximum, median, and minimum estimates.

To estimate tag loss, we used the formula

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

where

L = percent tag loss,

m = number of northern pikeminnow recaptured with missing tags and right ventral fin clips, and

r = number of northern pikeminnow recaptured with year 2001 tags intact.

## **AGE VALIDATION**

### **Field and Laboratory Procedures**

We collected scale samples from all northern pikeminnow that we tagged in 2001. In addition, WDFW personnel collected scale and opercle samples from each tagged northern pikeminnow recaptured in the sport-reward fishery. Scales were cleaned, mounted on cards, and pressed onto acetate sheets for viewing on a microfiche reader. Methods of age determination were described by Parker et al. (1995). Scales were read independently by two people and we kept track of the number of times that the readers disagreed on an age. Age differences were resolved by the two readers re-viewing the scale in question together until they agreed on a final age.

Opercula were placed in a bowl of water and heated in a microwave oven at high temperature for approximately 5 minutes to soften the tissue and skin covering the opercular bone. The skin and any remaining tissue was then removed using a pair of tweezers and/or toothbrush. A thickened “ridge” radiating from the focus on the concave side of each opercle was ground down with a small handheld grinder to enhance viewing of potential annuli near the

focus. The opercle was then examined under a digital video microscope at 10x magnification using light transmitted from either above or below the opercle (whichever gave the best view of the annuli on a particular sample). Opercular images from the microscope were viewed on a computer monitor. Each opercle sample was read independently by the same two readers that had aged the corresponding scale samples. Again, we kept track of aging discrepancies between readers and differences were resolved in a manner similar to that for the scales to obtain a final opercle age.

## Data Analysis

In a continuation of an age validation study initiated in 2000 (Takata and Ward 2001), we looked at between-reader variation in ages assigned to both scales and opercles from northern pikeminnow. An aging discrepancy was calculated as

$$d = a_2 - a_1,$$

where

$d$  = age discrepancy,

$a_1$  = age assigned to a scale or opercle by Reader 1, and

$a_2$  = age assigned to a scale or opercle by Reader 2.

This indicated both the magnitude and direction of the discrepancy (-2 years, - 1 year, 0 years, + 1 year, etc). We then calculated the percentage of samples in each discrepancy category as a measure of between-reader variation.

We also assessed the precision of our aging over time. We compared final ages (agreed upon by both readers) assigned to scales collected at the time of recapture to those for scales collected from the same fish at the time of tagging. We used the formula

$$D = (A_2 - A_1) - (Y_2 - Y_1),$$

where

$D$  = age discrepancy,

$A_1$  = final age assigned to a scale at tagging,

$A_2$  = final age assigned to a scale at recapture,

$Y_1$  = tagging year, and

$Y_2$  = recapture year

to calculate aging discrepancies. We then calculated the percent of samples in each discrepancy category as we had done for the between-reader assessment.

Finally, to evaluate the potential use of opercula for aging northern pikeminnow, we compared the final age assigned to an opercle with the final age assigned to a scale collected from the same fish at the same time. We calculated discrepancies using the formula

$$D = A_O - A_S,$$

where

D = age discrepancy,  
A<sub>O</sub> = final age assigned to an opercle at recapture, and  
A<sub>S</sub> = final age assigned to a scale at recapture.

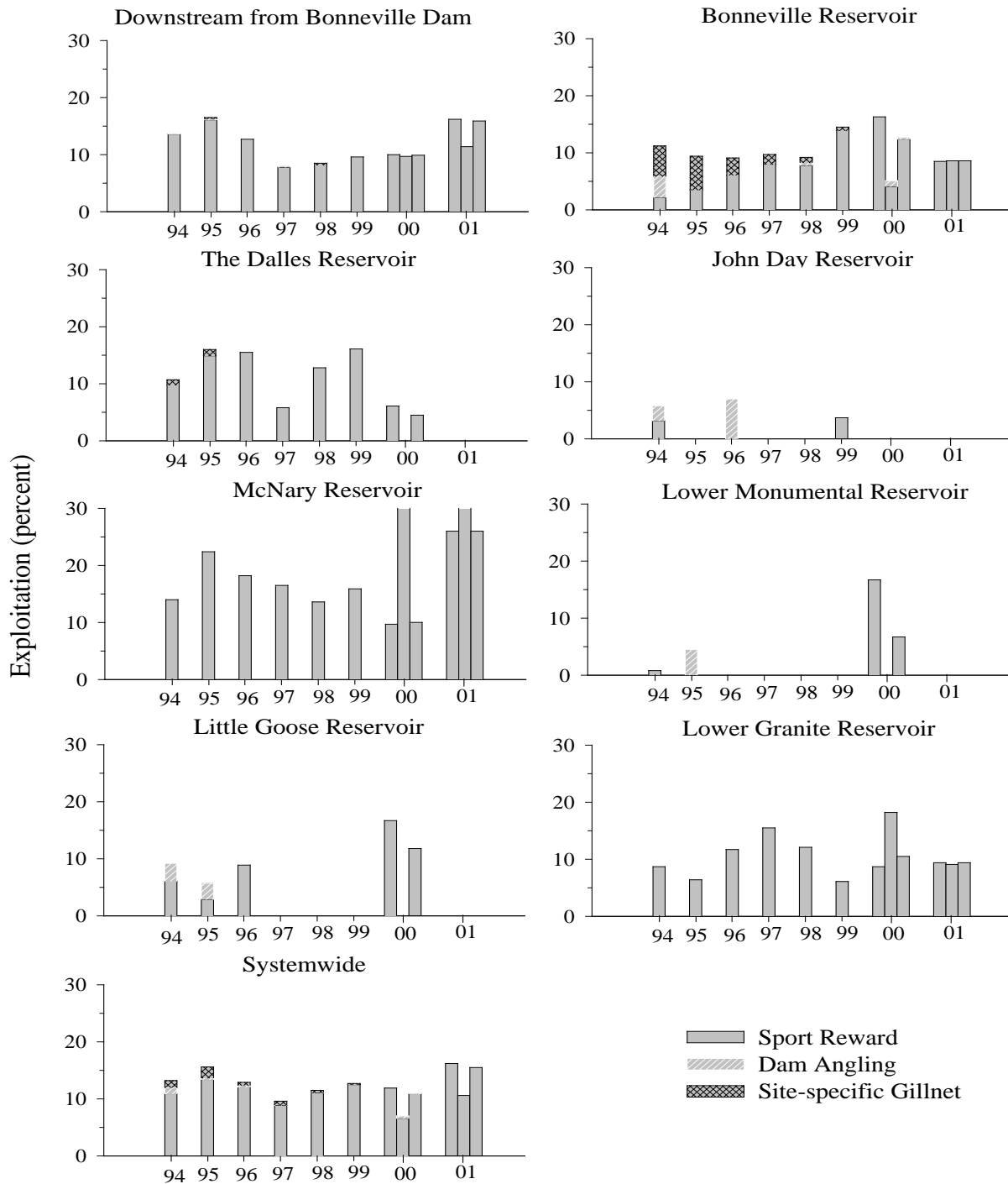
We also directly compared opercle ages to corresponding scale ages from the same fish.

## RESULTS

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

We tagged and released 786 northern pikeminnow throughout the lower Columbia and Snake rivers in 2001. Eighty-five of these fish were 200 to 249 mm FL and 701 were  $\geq 250$  mm FL. A total of 110 northern pikeminnow tagged in 2001 were recaptured in 2001; all in the sport-reward fishery. Of these recaptures, 8 were 200-249 mm and 102 were  $\geq 250$  mm.

**A TOTAL OF 244,168 NORTHERN PIKEMINNOW  $\geq 200$  MM FL  
WERE HARVESTED BY THE MANAGEMENT FISHERIES IN 2001.  
SYSTEM-WIDE EXPLOITATION OF NORTHERN PIKEMINNOW**



**Figure 1.** Exploitation of northern pikeminnow  $\geq 250$  mm fork length (FL) by reservoir/area and fishery, 1994-2001. For 2000 and 2001, vertical bars, from left to right, show exploitation for northern pikeminnow  $\geq 250$  mm FL, 200-249 mm FL, and  $\geq 200$  mm FL. In McNary Reservoir, 2001 sport-reward exploitation for northern pikeminnow 200-249 mm was 100%.

$\geq 200$  mm by all fisheries combined was 15.5% (95% confidence interval of 10.0% to 25.0%).

Reservoir/area-specific exploitation rates ranged from a high of 26.0% in McNary Reservoir to a low of

0.0% in The Dalles and John Day reservoirs. The system-wide exploitation rate on northern pikeminnow 200-249 mm by all fisheries was 10.6% (confidence interval not available due to  $n < 30$ ), and ranged from 100% in McNary Reservoir to 0.0% in The Dalles and John Day reservoirs. For northern pikeminnow

$\geq 250$  mm, all fisheries combined had a system-wide exploitation rate of 16.2% (95% confidence interval of 10.3% to 23.1%), ranging from 26.0% in McNary Reservoir to 0.0% in The Dalles and John Day reservoirs (Figure 1; Appendix Table A-1).

The sport-reward fishery harvested 240,894 northern pikeminnow  $\geq 200$  mm FL. Based on sampled catch proportions, an estimated 138,273 of these fish were  $\geq 250$  mm FL and 102,621 were in the 200-249 mm FL range. Mean fork length of northern pikeminnow harvested in the sport-reward fishery was 276 mm (M. Wachtel, WDFW, personal communication). Because all tag recoveries occurred in the sport-reward fishery, exploitation estimates for this fishery are the same as that for all fisheries combined (Figure 1; Appendix Table A-2). The Dalles and John Day reservoirs were the only reservoirs in which northern pikeminnow were tagged in 2001 but no tagged fish were recaptured by the sport-reward fishery.

Although 2,751 northern pikeminnow  $\geq 200$  mm FL were harvested in the dam angling fishery in 2001, none of these fish were tagged. Thus, exploitation for this fishery was calculated as 0.0% (Figure 1; Appendix Table A-3). Northern pikeminnow were not measured in the dam angling fishery in 2001 (G. Lee, Yakama Nation, personal communication); therefore, catch proportions for fish  $\geq 250$  mm and those in the 200-249 mm size class, as well as the mean size of harvested fish, were unknown.

A total of 523 northern pikeminnow  $\geq 200$  mm FL were harvested by the site-specific gillnet fishery in 2001; however, none of these fish were tagged. Therefore, exploitation for this fishery was also calculated as 0% (Figure 1; Appendix Table A-4). Northern pikeminnow were not measured in the gillnet fishery in 2001 (G. Lee, Yakama Nation, personal communication); therefore, catch proportions for fish  $\geq 250$  mm and those in the 200-249 mm size class, as well as the mean size of harvested fish, were unknown.

System-wide weekly exploitation rates for the management fisheries are shown in Appendix Tables A-5 through A-7. In addition, Appendix Table A-8 shows the week-by-week exploitation rates for northern pikeminnow 200-249 mm in McNary Reservoir, where total exploitation on these fish was unusually high at 100%.

In 2001, the three management fisheries reported a total incidental catch of 109,975 fish, including northern pikeminnow  $< 200$  mm FL (Table 1). The incidental

**Table 1.** Catch of northern pikeminnow and incidental fishes in each fishery in 2001. Northern pikeminnow < 200 mm fork length (FL) are considered incidental catch. Sport-reward catches of incidentals are estimates based upon exit surveys of anglers who targeted northern pikeminnow.

Species or family	Sport-reward	Dam angling	Gillnet
Northern pikeminnow			
≥ 200 mm FL	240,894	2,751	523
< 200 mm FL	50,202	<sup>a</sup>	<sup>a</sup>
Salmonidae			
Chinook (adult/jack)	131	0	<sup>a</sup>
Coho (adult/jack)	6	0	<sup>a</sup>
Sockeye (adult)	7	0	<sup>a</sup>
Steelhead (adult)	187	0	<sup>a</sup>
Cutthroat trout	57	0	<sup>a</sup>
Juvenile salmon/steelhead	679	0	<sup>a</sup>
All other salmonids <sup>b</sup>	2,375	0	<sup>a</sup>
White sturgeon	4,461	23	106
Walleye	364	<sup>a</sup>	<sup>a</sup>
Smallmouth bass	6,020	<sup>a</sup>	<sup>a</sup>
Yellow perch	1,094	<sup>a</sup>	<sup>a</sup>
American shad	413	<sup>a</sup>	<sup>a</sup>
Cyprinidae <sup>c</sup>	26,169	<sup>a</sup>	<sup>a</sup>
Catostomidae	2,831	<sup>a</sup>	<sup>a</sup>
Ictaluridae	4,642	<sup>a</sup>	<sup>a</sup>
Centrarchidae <sup>d</sup>	271	<sup>a</sup>	<sup>a</sup>
Other/unidentified	10,677	56	576
Total (all species)	350,108	2,830	1,205
Percent incidental catch	31.6	2.8	56.6

<sup>a</sup> Catch unknown. Counts included in “Other/unidentified”.

<sup>b</sup> Includes juveniles and adults of *Oncorhynchus* spp., *Salvelinus* spp., and mountain whitefish *Prosopium williamsoni*.

<sup>c</sup> Excluding northern pikeminnow.

<sup>d</sup> Excluding smallmouth bass.

catch rate for all fisheries combined was 31.1%. The most common incidental fishes were northern pikeminnow < 200 mm, other cyprinids, and unidentified fishes. The incidental catch rate was 31.6% for anglers who targeted northern pikeminnow in the sport-reward fishery, 2.8%



in the dam angling fishery, and 56.6% in the site-specific gillnet fishery. For the sport-reward fishery, the proportion of the northern pikeminnow catch consisting of predator-sized ( $\geq 200$  mm) fish was 82.7%. The proportions for the dam angling and site-specific gillnet fisheries are unknown (G. Lee, Yakama Nation, personal communication). In the sport-reward fishery, 1.0% of the total catch consisted of salmonids. Salmonids made up 4.3% of the total catch in the site-specific gillnet fishery. No salmonids were caught in the dam angling fishery. For all fisheries combined, salmonids made up 1.0% of the total catch.

Modeling results indicate that potential predation by northern pikeminnow on juvenile salmonids in 2001 ranged from 63% to 88% of pre-program levels, with a median estimate of 76% (Figure 2). Continued harvest at mean 1995-2001 exploitation levels will result in minimal additional reductions in predation.

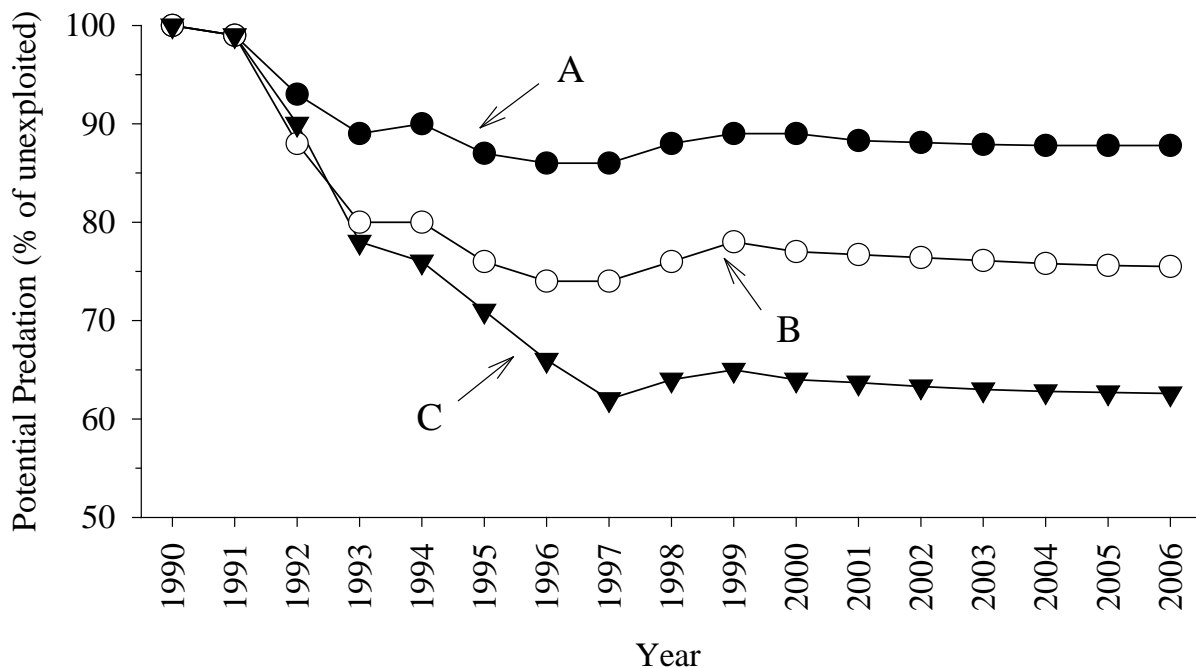


Figure 2. Maximum (A), median (B), and minimum (C) estimates of potential predation on juvenile salmonids by northern pikeminnow relative to predation prior to implementation of the Northern Pikeminnow Management Program. Trends after 2001 indicate predicted predation in future years if exploitation is maintained at mean 1995-2001 levels.

No northern pikeminnow with a right ventral fin clip and a missing tag were reported recovered in any of the management fisheries. Thus, within-year tag loss was calculated as 0% for northern pikeminnow tagged with spaghetti tags in 2001.

## Age Validation

We aged a total of 302 scale and opercle samples from tagged and recaptured northern pikeminnow in 2001. Ninety-nine of these fish were tagged in 2001 and 13 were tagged in 2000. For scales collected at tagging, complete agreement (i.e. zero discrepancy) on ages assigned by the two readers was 35.4%, with 75.6% agreement within  $\pm$  one year (Figure 3). For scales collected at recapture, complete agreement was slightly higher at 37.6%. Agreement within  $\pm$  one year for this group of scales was also higher at 78.2%. Complete agreement was lowest for opercles collected at recapture at 22.6%. The readers agreed within  $\pm$  one year 62.8% of the time. Reader 1 tended to age a little higher than Reader 2 on scales collected at recapture, while Reader 2 tended to age higher on scales collected at tagging and on opercles collected at recapture (Figure 3). The largest age discrepancy between the two readers was 5 years.

When final ages assigned to scales collected at tagging in 2000 were compared to final ages assigned to scales collected at recapture in 2001 for the same fish, the ages agreed only 15.4% of the time (Figure 4). However, agreement within  $\pm$  one year occurred with 69.2% of the samples. Ages assigned to scales collected at recapture were usually the same or actually younger than ages assigned to scales from the same fish at tagging even though a year had elapsed between tagging and recapture.

When final ages assigned to scales collected at tagging in 2001 were compared to final ages assigned to scales collected at recapture in 2001 for the same fish, complete agreement was higher at 40.5% (Figure 4). Agreement within  $\pm$  one year was also higher at 78.5%. However, when there was a discrepancy, ages assigned to scales collected at recapture were actually younger than ages assigned to scales from the same fish at tagging.

Final ages assigned to scales matched exactly with final ages assigned to opercles from the same fish 27.7% of the time (Figure 5). Agreement within  $\pm$  one year was 66.0%. The majority (54.2%) of the samples had an opercle age that was greater than the scale age. Scale ages ranged from 3 to 13 years while opercle ages ranged from 4 to 17 years. Ages for opercles tended to be greater than scale ages throughout the entire range of age classes in the sample (Figure 5).

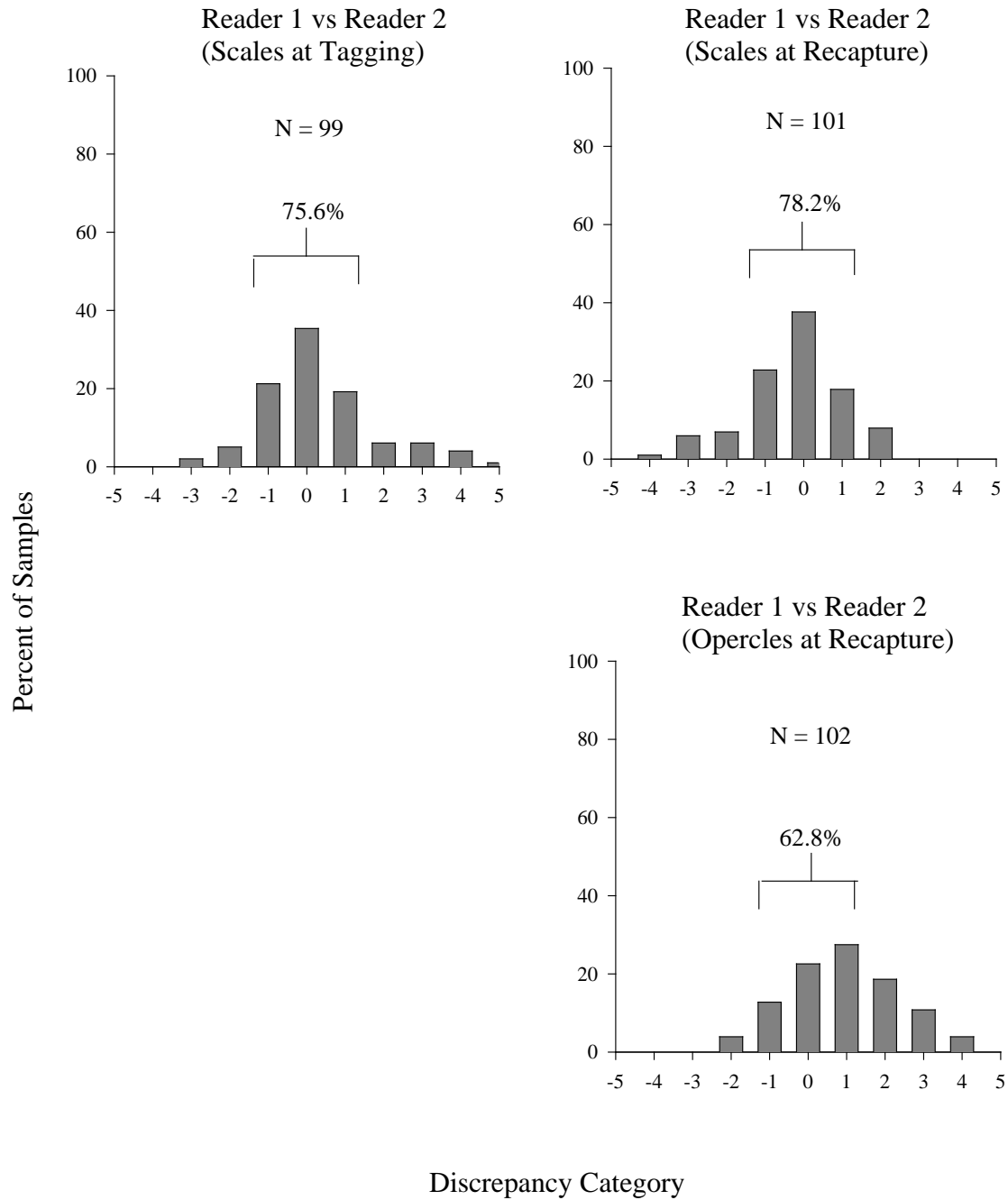


Figure 3. Distribution of reader aging discrepancies for northern pikeminnow scales and opercles collected at tagging and recapture in 2001. A potential aging discrepancy is defined as the Reader 1 age subtracted from the Reader 2 age.

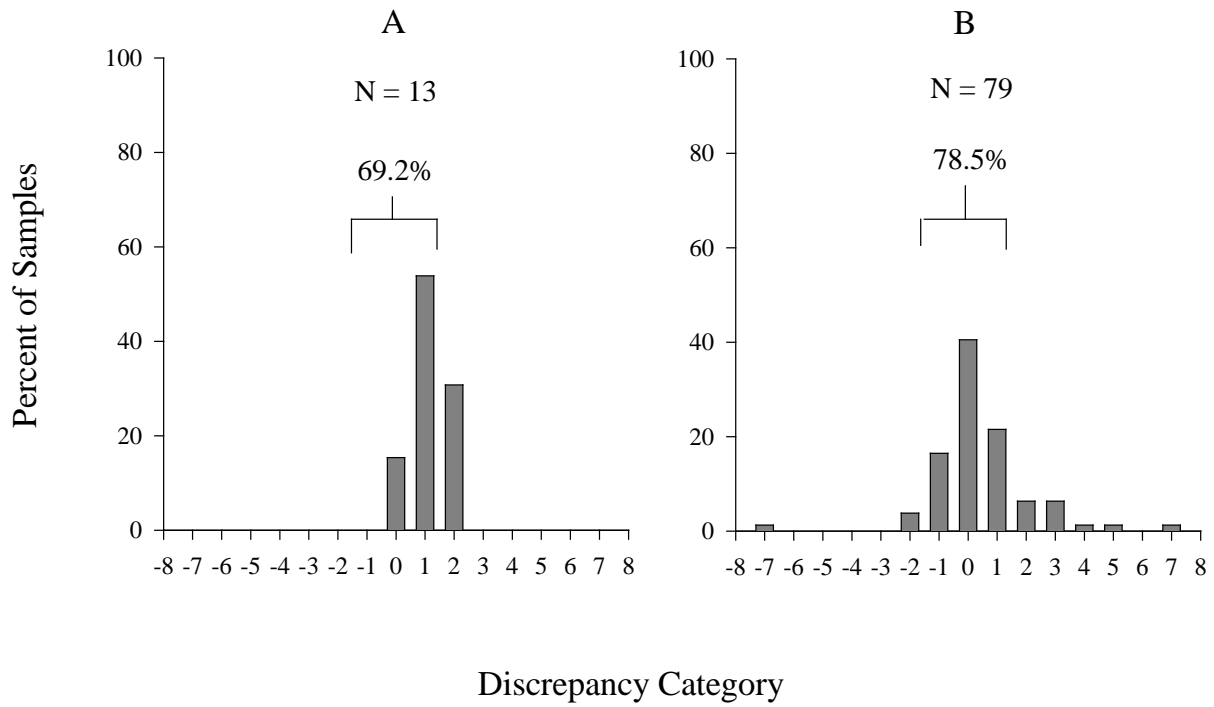


Figure 4. Panel A shows aging discrepancies for scales taken from fish during tagging in 2000 and at recapture in 2001. Panel B shows aging discrepancies for scales taken from fish during tagging in 2001 and at recapture in 2001. A potential discrepancy is defined as the difference between recapture age minus tagging age and recapture year minus tagging year.

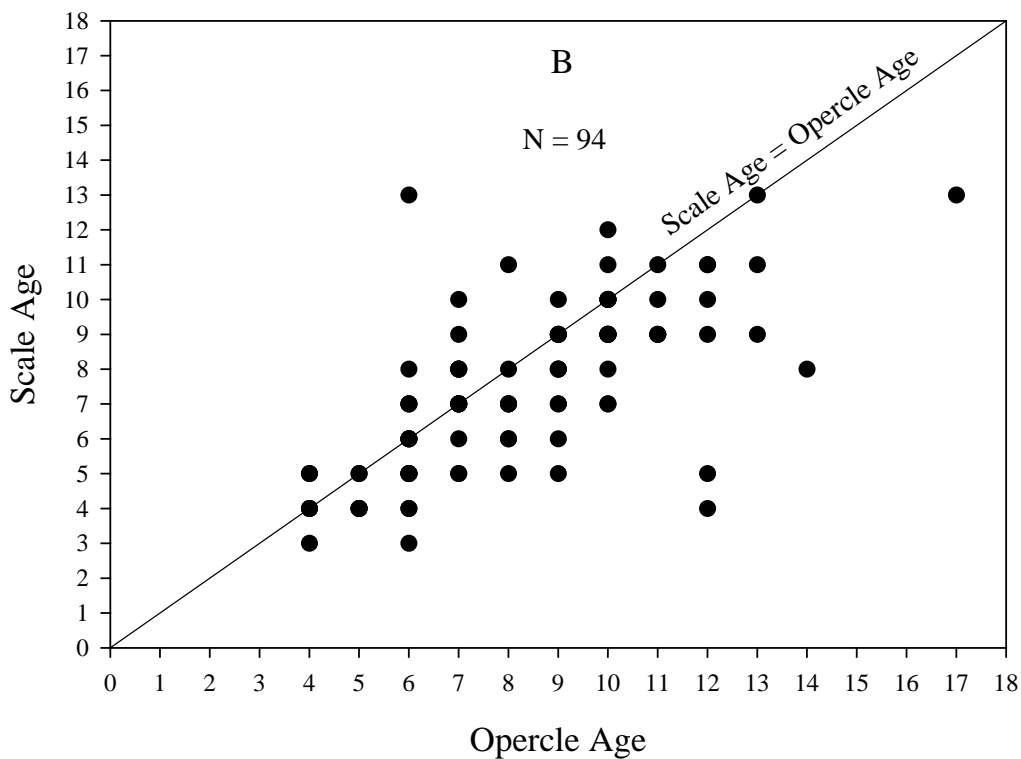
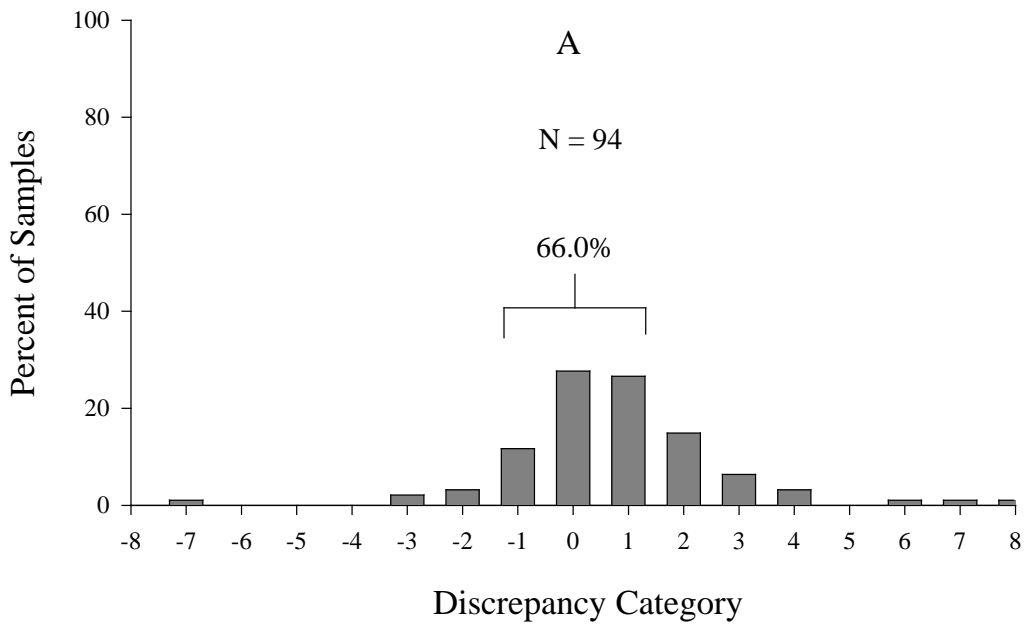


Figure 5. Comparison of ages assigned to scales and opercles from northern pikeminnow recaptured in 2001. Panel A shows aging discrepancies between scales and opercles taken from the same fish. A potential discrepancy is defined as the scale age subtracted from the opercle age. Panel B shows scale ages plotted against corresponding opercle ages.

## DISCUSSION

At 16.2%, system-wide exploitation of northern pikeminnow  $\geq 250$  mm by the management fisheries in 2001 was the highest since inception of the program in 1991. It far exceeded the 11.7% mean exploitation rate for the 5-year period 1996-2000. The exploitation rates for northern pikeminnow 200-249 mm (10.6%) and for all northern pikeminnow  $\geq 200$  mm (15.5%) also increased from rates for these fish in 2000 (the first year northern pikeminnow 200-249 mm FL were targeted) (Figure 1).

There are two possible explanations for the exceptionally high exploitation rates observed in 2001. One factor that may have contributed to high exploitation is river level/flow. The mean river stage at the gauging station below Bonneville Dam (USGS site number 14128870) during the sport-reward season (May through September, 2001) was the lowest in the past decade (U.S. Geological Service unpublished data). Using mean stage (ft) as an index of river level/flow and sport-reward exploitation data from 1995 through 2001, there was a significant inverse relationship ( $r^2 = 0.76$ ;  $P < .05$ ) between the sport-reward exploitation rate on northern pikeminnow  $\geq 250$  mm and mean stage during the season (Figure 6). Low river levels may concentrate northern pikeminnow in certain areas (e.g. dam tailrace reaches or tributary mouths), possibly improving angling success rates in those areas. Concentrations of fish would also increase the likelihood of catching a tagged fish, thereby potentially increasing exploitation rates.

The second factor that may have contributed to higher exploitation rates in 2001 was the change in rewards paid out to anglers participating in the sport-reward fishery. On July 10, 2001, mid-way through the season, rewards for northern pikeminnow  $\geq 200$  mm FL increased to \$5, \$6, and \$8 per fish for the three tier levels in the program. In addition, rewards for tagged northern pikeminnow were raised substantially from \$50 to \$1,000 per fish. This increased both catch and effort to levels above what is normally seen during the later half of the season (L. Fox, WDFW, personal communication). This may have led to more tagged fish being recovered during the second half of the season than is usually the case. In 2000, about 30% of the year's tag recoveries occurred during the second half of the season. In 2001, this proportion increased to 50%. The greater proportion of tag recoveries in the later part of the season may help explain the higher exploitation rates.

Exploitation of all northern pikeminnow  $\geq 200$  mm by all fisheries combined increased from 2000 levels in the area below Bonneville Dam and in McNary Reservoir. On the other hand, exploitation rates dropped in Bonneville, The Dalles, and Lower Granite Reservoirs. For the first time since inception of the program, the exploitation rate in The Dalles Reservoir was 0.0%. In contrast, John Day reservoir has had an exploitation rate of 0.0% in five of the last eight years.

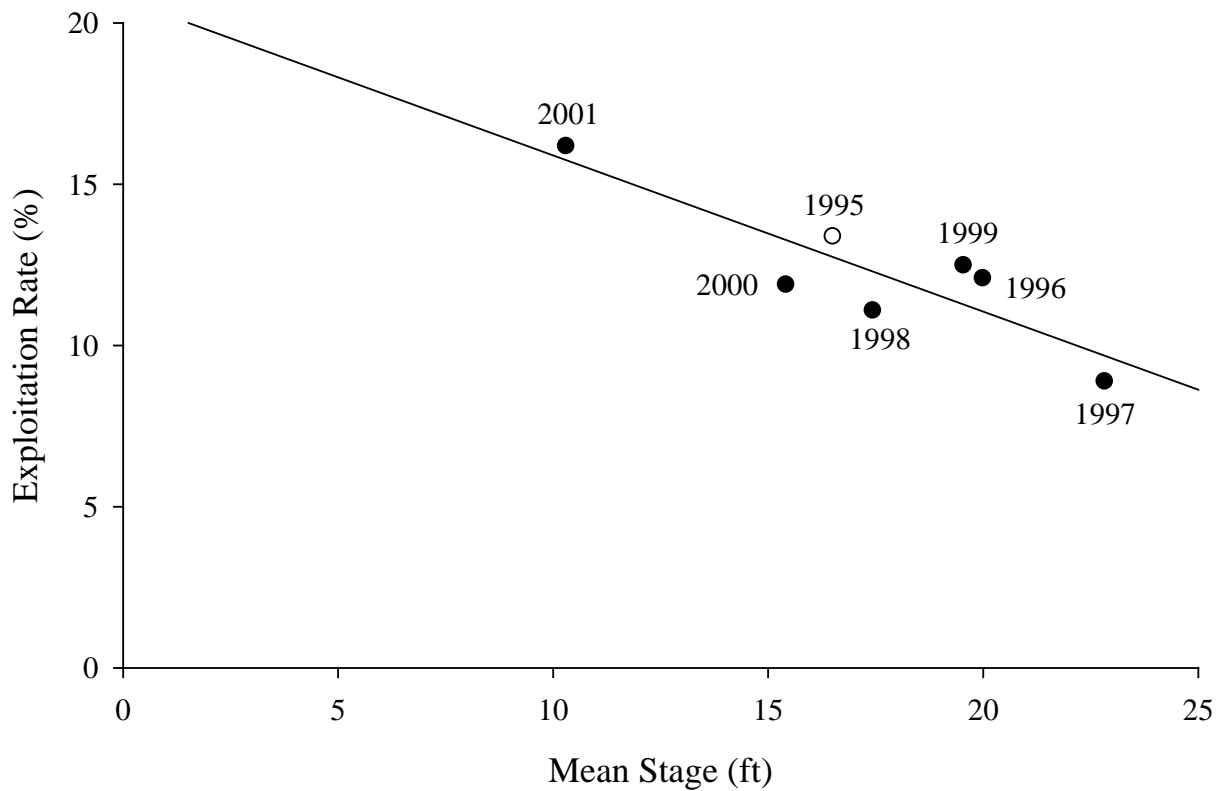


Figure 6. Relationship between sport-reward exploitation of northern pikeminnow greater than or equal to 250 mm FL and mean Columbia River stage (gauge height in feet below Bonneville Dam) during the sport-reward season (May-September) for the period 1995-2001.

Among reservoirs/areas, McNary Reservoir had by far the highest exploitation rate for all size classes of northern pikeminnow. In addition to the increased catch and effort due to the new reward system, another factor that may have played a role is the possible shift in distribution of northern pikeminnow within the Hanford Reach (defined as the Columbia River from the confluence of the Yakima River to Priest Rapids Dam). Data from 2000 and 2001 indicate that a larger proportion of the tagged northern pikeminnow within the Hanford Reach were tagged in the upper half of the reach in 2001 compared to the previous year (Figure 7). This concentration of fish in the Priest Rapids tailrace may have been the result of very low river flow in 2001. Whether this apparent shift occurred due to feeding opportunities, spawning, or some other reason is unclear. In McNary Reservoir, 78% of the recaptured tagged fish were turned

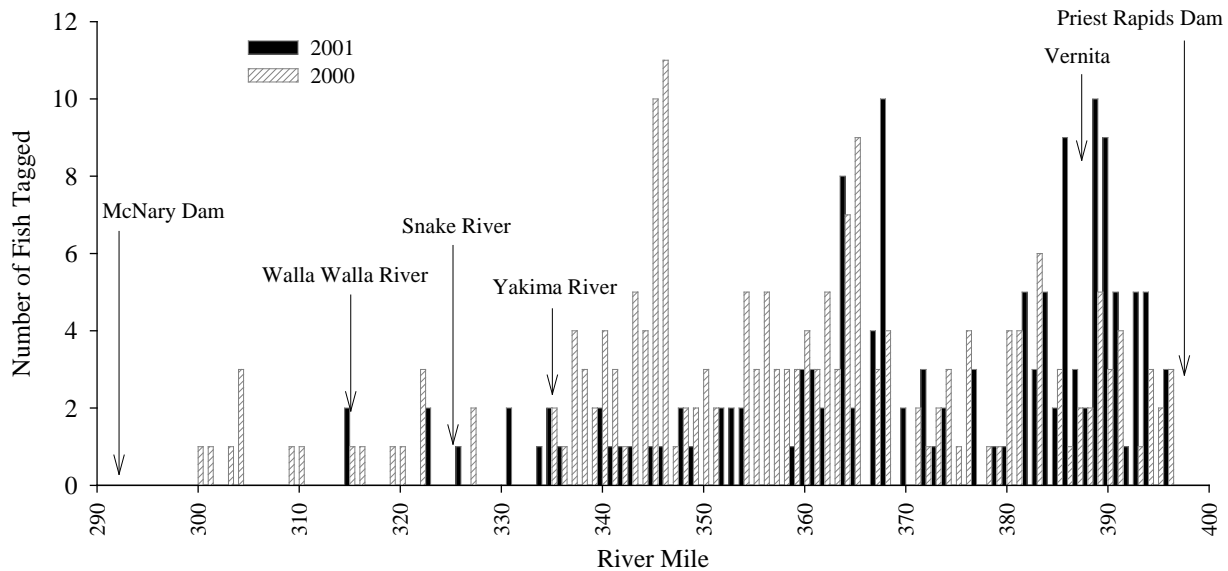


Figure 7. Distribution of northern pikeminnow tagged in 2000 and 2001 in the Columbia River in McNary Reservoir (including Hanford Reach).

in at the Vernita Bridge Rest Area check station within the tailrace area of Priest Rapids Dam, presumably indicating that those anglers had fished in the general vicinity of Vernita. Therefore, it is possible that anglers had exceptional success catching northern pikeminnow, including tagged fish, that had concentrated in this area.

The 100% exploitation rate on northern pikeminnow 200-249 mm in McNary Reservoir was an artifact of small sample size and coincidence. Appendix Table A-8 shows that during Sampling Week 20 only one tagged northern pikeminnow in this size class was at large; however, it just happened to get caught that same week. This resulted in a weekly exploitation rate of 100%. Since total exploitation for the season is a sum of weekly exploitation rates, the final exploitation on these fish in McNary Reservoir was also 100%. Although we try to minimize the amount of overlap between the tagging and sport-reward seasons, some overlap is unavoidable due to budgetary and sampling constraints. If the 200-249 mm tagged fish had not been recaptured until after all tagging in McNary Reservoir had been completed, the exploitation rate would have been 20%--probably a more realistic estimate. In the future, we will continue to try and reduce overlap between the tagging and sport-reward seasons and seek to complete tagging in a given reservoir within one week whenever possible.

As in 2000, system-wide exploitation of northern pikeminnow 200-249 mm was lower than that for fish  $\geq 250$  mm. The exploitation rate on the smaller fish will probably always be relatively low; however, harvest of these fish will prevent them from reaching the size of maximum predation on juvenile salmonids.



The dam angling and site-specific gillnet fisheries accounted for only 1.1% and 0.2%, respectively, of the total northern pikeminnow harvest and did not recapture any tagged fish, resulting in exploitation rates of 0.0% in 2001. However, these fisheries do harvest concentrations of northern pikeminnow in areas that sport-reward anglers cannot access (e.g. boat-restricted zones near dams) or are unwilling to target (Beamesderfer and Rieman 1991; Poe et al. 1991; Collis et al. 1995). Therefore, there may be some value in continuing them, particularly the dam angling fishery which appears to catch more northern pikeminnow with very little incidental catch.

Incidental catch rates for the management fisheries have been very stable over the past several years. This year's rates were very close to the average incidental catch rates for the 5-year period 1996-2000 of 30% in the sport-reward fishery, 5% in the dam angling fishery and 57.3% in the site-specific gillnet fishery. Incidental catch rates have consistently been highest for the gillnet fishery and lowest for the dam angling fishery. In 2001, there was a three-fold increase in the catch rate of salmonids compared to the 5-year average of 0.3%. This is probably due to both increased effort by sport-reward anglers and the record numbers of spring chinook and summer steelhead that returned to the Columbia River in 2001. Nevertheless, for the second consecutive year, the dam angling fishery did not catch any salmonids.

Potential predation has slightly decreased in the past two years. This reverses a modest increasing trend from 1997 to 1999 (Figure 2). However, it appears that most of the reduction in predation has been realized in the first seven years of the NPMP. If exploitation rates remain similar to mean 1995-2001 levels, further reductions in potential predation are likely to be minimal. Even if exploitation continues near the record-high level observed in 2001, potential predation probably will not decline significantly. Therefore, maintaining potential predation near the current level of 76% may be a more realistic goal for the future rather than trying to gain additional large reductions in predation.

In accordance with recommendations made in the audit of the NPMP (Hankin and Richards 2000), we are currently working on an updated predation model. We plan to use this new model once our aging and tag loss assessments are completed.

Although no tag loss fish were reported captured by any of the management fisheries in 2001, a within-year tag loss rate of 0.0% seems unlikely. In 2000, tag loss for spaghetti tags was estimated to be 2.6%, with the potential of being as high as 6.6% (Takata and Ward 2001). Due to the larger than usual catches of northern pikeminnow in this year's sport-reward fishery, some fish may not have been examined for fin marks and tag loss scars. This may especially be the case for fish turned in at the end of the sampling day (L. Fox, WDFW, personal communication). Therefore, we will conduct the tag loss study again in 2002.

We found that both absolute agreement and agreement within  $\pm$  one year between readers for ages assigned to scales were lower in 2001 than in 2000. This could be due to a variety of reasons, from differing experience levels of readers to changes in the quality of prepared samples. However, it may also be a reflection of the inherent difficulty in aging northern pikeminnow scales. This may be especially true for older fish where later annuli are very difficult to identify.

Absolute agreement and agreement within  $\pm$  one year for ages assigned to opercles was even lower than it was for scales. Opercles have many opaque lines that may or may not be true annuli. This could easily lead to different counts between readers. Overall, there appeared to be no clear trend in discrepancies between the readers; that is, one reader did not consistently age higher than the other reader for all groups of samples.

Both complete agreement and agreement within  $\pm$  one year were higher for scales from northern pikeminnow tagged in 2001 and recaptured the same year compared to scales from fish tagged in 2000 and recaptured in 2001. It is possible that the relatively small sample size for the later set of scales (Figure 4) may have contributed to these differences. Interestingly, complete agreement and agreement within  $\pm$  one year for the scales from fish tagged in 2001 and recaptured that year were similar to results for scales taken from northern pikeminnow tagged in 2000 and recaptured in 2000 (Takata and Ward 2001), even though the readers themselves were different.

Final ages assigned to opercles were frequently different than final ages assigned to scales from the same fish. In general, opercle ages tended to be older than scale ages. This is similar to the findings of Campbell and Babaluk (1979) who aged scales and opercles from walleye, and aging by the Washington Department of Fish and Wildlife of northern pikeminnow from the Columbia River (J. Sneva, WDFW, personal communication). Both of these studies concluded that ages derived from opercula may be more accurate than those from scales, particularly for older fish. If scales do underestimate the ages of northern pikeminnow, we may be overestimating natural mortality rates which can affect our assessment of population structure and predation. Although opercles may provide more accurate ages than scales, our findings indicate that between-reader variability appears to be higher for opercles (see above). We will continue to evaluate the potential of using opercula to age northern pikeminnow.

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## **APPENDIX A**

**EXPLOITATION OF NORTHERN PIKEMINNOW, 1996-2001**

**Appendix Table A-1.** Exploitation rates (%) of northern pikeminnow  $\geq 250$  mm fork length (FL) for all fisheries combined, 1996-2001.

Area or Reservoir	1996	1997	1998	1999	2000 <sup>a</sup>	2001 <sup>a</sup>				
Downstream of										
Bonneville Dam	12.7	8.0	8.4	9.6	10.0	(9.7) <sup>a1</sup>	(9.9) <sup>a2</sup>	16.2	(11.4) <sup>a1</sup>	(15.9) <sup>a2</sup>
Bonneville	9.1	9.7	9.2	14.5	16.3	(5.2) <sup>a1</sup>	(12.7) <sup>a2</sup>	8.5	(8.6) <sup>a1</sup>	(8.6) <sup>a2</sup>
The Dalles	15.5	5.8	12.8	16.1	6.1	(0.0 <sup>c</sup> ) <sup>a1</sup>	(4.5) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>
John Day	7.0	0.0 <sup>c</sup>	0.0 <sup>c</sup>	3.7	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>
McNary	18.2	16.5	13.6	15.9	9.7	(33.3) <sup>a1</sup>	(10.2) <sup>a2</sup>	26.0	(100.0) <sup>a</sup>	(26.0) <sup>a2</sup>
Ice Harbor	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>			-- <sup>b</sup>		
Lwr Monumental	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	16.7	(0.0 <sup>c</sup> ) <sup>a1</sup>	(6.7) <sup>a2</sup>	-- <sup>b</sup>		
Little Goose	8.9	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	16.7	(0.0 <sup>c</sup> ) <sup>a1</sup>	(11.8) <sup>a2</sup>			
Lower Granite	11.7	15.5	12.1	6.1	8.7	(18.2) <sup>a1</sup>	(10.5) <sup>a2</sup>	9.4	(9.1) <sup>a1</sup>	(9.4) <sup>a2</sup>
System-wide	12.9	9.6	11.5	12.7	11.9	(7.1) <sup>a1</sup>	(11.0) <sup>a2</sup>	16.2	(10.6) <sup>a1</sup>	(15.5) <sup>a2</sup>

<sup>a</sup> Rewards were paid for northern pikeminnow  $\geq 200$  mm FL. Figures in parentheses indicate the exploitation rate for northern pikeminnow 200-249 mm FL ( )<sup>a1</sup> and the total exploitation rate for northern pikeminnow  $\geq 200$  mm FL ( )<sup>a2</sup>.

<sup>b</sup> No northern pikeminnow tagged.

<sup>c</sup> Northern pikeminnow harvested, but no tags recovered.

**Appendix Table A-2.** Exploitation rates (%) of northern pikeminnow  $\geq 250$  mm fork length (FL) for the sport-reward fishery, 1996-2001.

Area or Reservoir	1996	1997	1998	1999	2000 <sup>a</sup>	2001 <sup>a</sup>				
Bonneville Dam	12.7	7.8	8.2	9.6	10.0	(9.7) <sup>a1</sup>	(9.9) <sup>a2</sup>	16.2	(11.4) <sup>a1</sup>	(15.9) <sup>a2</sup>
Bonneville	6.1	8.0	7.8	13.9	16.3	(4.1) <sup>a1</sup>	(12.4) <sup>a1</sup>	8.5	(8.6) <sup>a1</sup>	(8.6) <sup>a2</sup>
The Dalles	15.5	5.8	12.8	16.1	6.1	(0.0 <sup>c</sup> ) <sup>a1</sup>	(4.5) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>
John Day	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	3.7	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>
McNary	18.2	16.5	13.6	15.9	9.7	(33.3) <sup>a1</sup>	(10.2) <sup>a2</sup>	26.0	(100.0) <sup>a1</sup>	(26.0) <sup>a2</sup>
Ice Harbor	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>		
Lwr Monumental	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	16.7	0.0 <sup>c</sup>	(6.7) <sup>a2</sup>	-- <sup>b</sup>		
Little Goose	8.9	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	16.7	(0.0 <sup>c</sup> ) <sup>a1</sup>	(11.8) <sup>a2</sup>	-- <sup>b</sup>		
Lower Granite	11.7	15.5	12.1	6.1	8.7	(18.2) <sup>a1</sup>	(10.5) <sup>a2</sup>	9.4	(9.1) <sup>a1</sup>	(9.4) <sup>a2</sup>
System Wide	12.1	8.9	11.1	12.5	11.9	(6.6) <sup>a1</sup>	(10.9) <sup>a2</sup>	16.2	(10.6) <sup>a1</sup>	(15.5) <sup>a2</sup>

<sup>a</sup> Rewards were paid for northern pikeminnow  $\geq 200$  mm FL. Figures in parentheses indicate the exploitation rate for northern pikeminnow 200-249 mm FL ( )<sup>a1</sup> and the total exploitation rate for northern pikeminnow  $\geq 200$  mm FL ( )<sup>a2</sup>.

<sup>b</sup> No northern pikeminnow tagged.

<sup>c</sup> Northern pikeminnow harvested, but no tags recovered.

**Appendix Table A-3.** Exploitation rates (%) of northern pikeminnow  $\geq 250$  mm fork length (FL) for the dam-angling fishery, 1996-2001.

Area or Reservoir	1996	1997	1998	1999	2000 <sup>a</sup>	2001 <sup>a</sup>				
Bonneville Dam	0.0 <sup>c</sup>	0.2	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>
Bonneville	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.5	0.0 <sup>c</sup>	0.0 <sup>c</sup>	(1.0) <sup>a1</sup>	(0.3) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>
The Dalles	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>
John Day	7.0	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>	-- <sup>d</sup>		
McNary	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	-- <sup>d</sup>	-- <sup>d</sup>			-- <sup>d</sup>		
Ice Harbor	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>			-- <sup>b</sup>		
Lwr	0.0 <sup>c</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>			-- <sup>b</sup>		
Monumental										
Little Goose	0.0 <sup>c</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>			-- <sup>b</sup>		
Lower Granite	0.0 <sup>c</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>			-- <sup>d</sup>		
System Wide	0.3	0.1	0.1	0.0 <sup>c</sup>	0.0 <sup>c</sup>	(0.4) <sup>a1</sup>	(0.1) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>

<sup>a</sup> Rewards were paid for northern pikeminnow  $\geq 200$  mm FL. Figures in parentheses indicate the exploitation rate for northern pikeminnow 200-249 mm FL ( )<sup>a1</sup> and the total exploitation rate for northern pikeminnow  $\geq 200$  mm FL ( )<sup>a2</sup>.

<sup>b</sup> No northern pikeminnow tagged.

<sup>c</sup> Northern pikeminnow harvested, but no tags recovered.

<sup>d</sup> No fishing effort.

**Appendix Table A-4.** Exploitation rates (%) of northern pikeminnow  $\geq 250$  mm fork length (FL) for the site-specific gillnet fishery, 1996-2001.

Area or Reservoir	1996	1997	1998	1999	2000 <sup>a</sup>	2001 <sup>a</sup>				
Bonneville Dam	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.3	0.0 <sup>c</sup>	-- <sup>d</sup>			-- <sup>d</sup>		
Bonneville	3.0	1.7	0.9	0.6	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>
The Dalles	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	-- <sup>d</sup>			-- <sup>d</sup>		
John Day	0.0 <sup>c</sup>	0.0 <sup>c</sup>	0.0 <sup>c</sup>	-- <sup>d</sup>	-- <sup>d</sup>			-- <sup>d</sup>		
McNary	0.0 <sup>c</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>	-- <sup>d</sup>		
Ice Harbor	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>	-- <sup>b</sup>			-- <sup>b</sup>		
Lwr	-- <sup>d</sup>	0.0 <sup>c</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>			-- <sup>b</sup>		
Monumental										
Little Goose	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>			-- <sup>b</sup>		
Lower Granite	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	-- <sup>d</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>	-- <sup>d</sup>		
System Wide	0.5	0.6	0.3	0.2	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>	0.0 <sup>c</sup>	(0.0 <sup>c</sup> ) <sup>a1</sup>	(0.0 <sup>c</sup> ) <sup>a2</sup>

<sup>a</sup> Rewards were paid for northern pikeminnow  $\geq 200$  mm FL. Figures in parentheses indicate the exploitation rate for northern pikeminnow 200-249 mm FL ( )<sup>a1</sup> and the total exploitation rate for northern pikeminnow  $\geq 200$  mm FL ( )<sup>a2</sup>.

<sup>b</sup> No northern pikeminnow tagged.

<sup>c</sup> Northern pikeminnow harvested, but no tags recovered.

<sup>d</sup> No fishing effort.



**Appendix Table A-5.** Weekly exploitation of northern pikeminnow  $\geq 200$  mm fork length system-wide in 2001.

Sampling Week	Tagged	Recaptures				Exploitation (%)		
		Sport	Dam	Net	At Large	Sport	Dam	Net
14	22	--	--	--	--	--	--	--
15	129	--	--	--	22	--	--	--
16	124	--	--	--	151	--	--	--
17	106	--	--	--	275	--	--	--
18	190	2	--	--	381	0.5	--	--
19	120	2	--	--	569	0.4	--	--
20	44	3	--	--	687	0.4	--	--
21	20	6	--	--	728	0.8	--	--
22	18	7	--	--	742	0.9	--	--
23	5	7	--	--	753	0.9	--	--
24	8	5	--	--	751	0.7	--	--
25	--	10	--	--	754	1.3	--	--
26	--	5	--	--	744	0.7	--	--
27	--	8	--	--	739	1.1	--	--
28	--	7	--	--	731	1.0	--	--
29	--	3	--	--	724	0.4	--	--
30	--	6	--	--	721	0.8	--	--
31	--	--	--	--	715	--	--	--
32	--	2	--	--	715	0.3	--	--
33	--	5	--	--	713	0.7	--	--
34	--	1	--	--	708	0.1	--	--
35	--	3	--	--	707	0.4	--	--
36	--	8	--	--	704	1.1	--	--
37	--	3	--	--	696	0.4	--	--
38	--	8	--	--	693	1.2	--	--
39	--	5	--	--	685	0.7	--	--
40	--	3	--	--	680	0.4	--	--
41	--	1	--	--	677	0.1	--	--
Total	786	110	0	0	--	15.5	0.0	0.0

**Appendix Table A-6.** Weekly exploitation of northern pikeminnow 200-249 mm fork length system-wide in 2001.

Sampling Week	Tagged	Recaptures				Exploitation (%)		
		Sport	Dam	Net	At Large	Sport	Dam	Net
14	1	--	--	--	--	--	--	--
15	3	--	--	--	1	--	--	--
16	14	--	--	--	4	--	--	--
17	36	--	--	--	18	--	--	--
18	9	--	--	--	54	--	--	--
19	1	--	--	--	63	--	--	--
20	11	1	--	--	64	1.6	--	--
21	2	2	--	--	74	2.7	--	--
22	3	1	--	--	74	1.4	--	--
23	2	--	--	--	76	--	--	--
24	3	--	--	--	78	--	--	--
25	--	--	--	--	81	--	--	--
26	--	1	--	--	81	1.2	--	--
27	--	--	--	--	80	--	--	--
28	--	--	--	--	80	--	--	--
29	--	--	--	--	80	--	--	--
30	--	2	--	--	80	2.5	--	--
31	--	--	--	--	78	--	--	--
32	--	--	--	--	78	--	--	--
33	--	--	--	--	78	--	--	--
34	--	--	--	--	78	--	--	--
35	--	--	--	--	78	--	--	--
36	--	--	--	--	78	--	--	--
37	--	--	--	--	78	--	--	--
38	--	1	--	--	78	1.3	--	--
39	--	--	--	--	77	--	--	--
40	--	--	--	--	77	--	--	--
41	--	--	--	--	77	--	--	--
<b>Total</b>	<b>85</b>	<b>8</b>	<b>0</b>	<b>0</b>	<b>--</b>	<b>10.6</b>	<b>0.0</b>	<b>0.0</b>

**Appendix Table A-7.** Weekly exploitation of northern pikeminnow  $\geq 250$  mm fork length system-wide in 2001.

Sampling Week	Tagged	Recaptures				Exploitation (%)		
		Sport	Dam	Net	At Large	Sport	Dam	Net
14	21	--	--	--	--	--	--	--
15	126	--	--	--	21	--	--	--
16	110	--	--	--	147	--	--	--
17	70	--	--	--	257	--	--	--
18	181	2	--	--	327	0.6	--	--
19	119	2	--	--	506	0.4	--	--
20	33	2	--	--	623	0.3	--	--
21	18	4	--	--	654	0.6	--	--
22	15	6	--	--	668	0.9	--	--
23	3	7	--	--	677	1.0	--	--
24	5	5	--	--	673	0.7	--	--
25	--	10	--	--	673	1.5	--	--
26	--	4	--	--	663	0.6	--	--
27	--	8	--	--	659	1.2	--	--
28	--	7	--	--	651	1.1	--	--
29	--	3	--	--	644	0.5	--	--
30	--	4	--	--	641	0.6	--	--
31	--	--	--	--	637	--	--	--
32	--	2	--	--	637	0.3	--	--
33	--	5	--	--	635	0.8	--	--
34	--	1	--	--	630	0.2	--	--
35	--	3	--	--	629	0.5	--	--
36	--	8	--	--	626	1.3	--	--
37	--	3	--	--	618	0.5	--	--
38	--	7	--	--	615	1.1	--	--
39	--	5	--	--	608	0.8	--	--
40	--	3	--	--	603	0.5	--	--
41	--	1	--	--	600	0.2	--	--
Total	701	102	0	0	--	16.2	0.0	0.0

**Appendix Table A-8.** Weekly exploitation of northern pikeminnow 200-249 mm fork length in McNary Reservoir in 2001.

Sampling Week	Tagged	Recaptures				Exploitation (%)		
		Sport	Dam	Net	At Large	Sport	Dam	Net
14	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--
16	--	--	--	--	--	--	--	--
17	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--
19	1	--	--	--	--	--	--	--
20	--	1	--	--	1	100.0	--	--
21	--	--	--	--	0	--	--	--
22	3	--	--	--	0	--	--	--
23	1	--	--	--	3	--	--	--
24	--	--	--	--	4	--	--	--
25	--	--	--	--	4	--	--	--
26	--	--	--	--	4	--	--	--
27	--	--	--	--	4	--	--	--
28	--	--	--	--	4	--	--	--
29	--	--	--	--	4	--	--	--
30	--	--	--	--	4	--	--	--
31	--	--	--	--	4	--	--	--
32	--	--	--	--	4	--	--	--
33	--	--	--	--	4	--	--	--
34	--	--	--	--	4	--	--	--
35	--	--	--	--	4	--	--	--
36	--	--	--	--	4	--	--	--
37	--	--	--	--	4	--	--	--
38	--	--	--	--	4	--	--	--
39	--	--	--	--	4	--	--	--
40	--	--	--	--	4	--	--	--
41	--	--	--	--	4	--	--	--
Total	5	1	--	--	--	100.0	--	--

## **APPENDIX B**

### **DATES OF SAMPLING IN 2001**

**Appendix Table B-1.** Dates of each sampling week in 2001.

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