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

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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

SECTION I: IMPLEMENTATION

2002 ANNUAL REPORT

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In Cooperation with:

Oregon Department of Fish and Wildlife
Washington Department of Fish and Wildlife
Confederated Tribes and Bands of the Yakama Indian Nation

Prepared for:

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2002 EXECUTIVE SUMMARY

by Russell G. Porter

This report presents results for year twelve in a basin-wide program to harvest northern pikeminnow[1] (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.

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

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

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

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 2002 by report are as follows:

Report A

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

1. Objectives for 2002 were to: (1) implement a recreational fishery that rewards anglers who harvest northern pikeminnow ≥ 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 April 29 through October 20, 2002 from the Dalles dam downstream and from May 13 through October 20, 2002 from the Dalles dam upstream. Nineteen registration stations were operated throughout the lower Snake and Columbia rivers.

3. A total of 201,396 northern pikeminnow ≥ 9 inches in total length were harvested during the 2002 season with 30,637 angler days spent harvesting these fish. Catch-per-angler-day for all anglers during the season was 6.57 fish.

4. Anglers submitted 160 northern pikeminnow with external tags, and an additional 22 with fin-clip marks, but no tag. A total of 190,631 northern pikeminnow were individually scanned for the presence of salmonid PIT tags in their gut. A total of 127 salmonid PIT tags were detected and the codes recorded for transmittal to the PITAGIS database.

Report B

Northern Pikeminnow Sport-Reward Fishery Payments

1. For 2002 the rewards paid to anglers returned to the traditional amounts for the three payment tiers. The Reward paid for the first 100 fish was $4 per fish. The reward for fish in the 101-400 fish range were $5 per fish and for all fish caught above 400 was $6 per fish. Rewards for tagged fish was $100 per fish.

2. During 2002, rewards excluding tagged fish totaled $1,029,827 were paid for 199,220 fish.

3. A total of 160 vouchers were paid for tagged fish at $100 per tag. The tagged rewards totaled $16,000.

4. A total of 2,001 promotional coupons were redeemed at $4 each for a total of $8,004.

5. A total of 2,465 separate successful anglers received payments during the season.

6. The total for all payments was $1,053,831.

Report C

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

1. Dam angling occurred at Bonneville and The Dalles dams on the lower Columbia River during 2002 by the Yakama Nation. This resulted in only a catch of 7 northern pikeminnow between June 26th and July 14th. This fishery was terminated after only three weeks on July 14, 2002 as a result of poor catches.

2. Overall catch per angler hour (CPAH) was 0.034 in 2002, compared to 1.79 the previous year..

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 at four locations in 2002 to catch 712 predator-size northern pikeminnow from May 13 to June 23, 2002 for catch-per-net-hour (CPNH) of 4.04. Most of the fish were caught at the Klickitat River (96.8%).

2. Incidental species composed 44.4% of the total catch in 2002.

3. The site-specific fishery was terminated in 2002 and will not be a component of the 2003 fishery.

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 2002, (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 10.6% for sport-reward, 3.4%for northern pikeminnow 200-249 mm FL, and 12.3% for northern pikeminnow equal to or greater than 250 mm FL. Exploitation rates for dam-angling and site-specific gill-net fisheries were 0.0%, as no tagged fish were caught in these fisheries. Incidental catch was 41.2% in the sport-reward fishery, 66.7% of the dam angling catch, and 19.5% 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 1996-2002 levels. It is estimated potential predation is currently 77% of pre-program levels, indicating this level of or reduction will remain relatively constant through 2006.

4. Within-season tag loss was estimated to be 3.8% for spaghetti tags. However because of possible errors in secondary mark identification, this estimate is uncertain. Mark loss will be estimated by use of PITTags in 2003.

5. Between-reader variation in the aging of northern pikeminnow scales and opercles was higher in 2002 than in the previous year. Ages assigned to opercles exactly matched ages assigned to scales from the same fish 27.1% of the time, however, agreement within one year was 65.9%. 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

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We are grateful to the City of Rainier for the use of the Rainier boat ramp; The City of Richland for the use of Columbia Point Park; the Cowlitz County Parks and Recreation Department for the use of Willow Grove Boat Ramp; the Port of Camas/Washougal for the use of the Camas/Washougal Boat Ramp; the Port of Cascade Locks for the use of Cascade Locks Marina; the Port of Cathlamet for the use of Cathlamet Marina; the Port of Hood River for the use of Hood River Marina; the Port of Kalama for the use of Kalama Marina; the Port of Klickitat for the use of Bingen Marina; the Port of St. Helens for the use of Scapoose Bay Marina; the Port of The Dalles for the use of The Dalles Boat Basin; the Port of Umatilla for the use of Umatilla Marina; the Portland Metro Regional Parks Department for the use of the M.J. Gleason Boat Ramp and Chinook Landing; the U.S. Army Corps of Engineers for the use of Giles French Park, and the Greenbelt Boat Ramp; the U.S. Forest Service for the use of Bonneville Trailhead; the Washington Department of Transportation for the use of the Vernita Rest Area; the Washington State Parks and Recreation Commission for the use of Lyon's Ferry State Park; and Sheila Cannon and Ken Beer for the use of The Fishery at Covert's Landing.

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We also recognize Diana Murillo for her excellent work in computer data entry and document verification, Fella Tanaka for her numerous phone survey interviews, Kathleen Moyer for serving as the lead technician for the PIT Tag recovery portion of the program, and Julie Memarian for producing our weekly field activity reports, overseeing the Sport-Reward hotline and operating a registration station throughout the season.

In memory of Nicholas "Nick" Yaksic, 1936-2002.

ABSTRACT

We are reporting on the progress of the Northern Pikeminnow *Ptychocheilus oregonensis* Sport-Reward Fishery (NPSRF) operated on the Columbia and Snake Rivers from April 29 through October 20, 2002. The objectives of this project were to (1) implement a recreational fishery that rewards anglers who harvest northern pikeminnow ≥228mm (9 inches) total length, (2) collect, compile, and report data on angler participation, catch and harvest of northern pikeminnow and other fish species, and success rates of participating anglers during the season (3) examine collected northern pikeminnow for the presence of external tags 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 consumed salmonids containing Passive Integrated Transponder (PIT) tags, and (6) obtain catch and harvest data on fish species caught by non-returning fishery participants who were targeting northern pikeminnow

A total of 201,396 northern pikeminnow ≥228mm (9 inches) and 6,876 pikeminnow <228 mm were harvested during the 2002 season. There were a total of 6,490 different anglers who spent 30,637 angler days participating in the fishery. Catch per unit of effort for combined returning and non-returning anglers was 6.57 fish/angler day. The overall exploitation rate for the NPSRF was 10.6%

Anglers submitted 157 northern pikeminnow with external spaghetti tags, 9 with fin-clip marks but no tag and 11 with possible tag wounds and no fin clip recorded. A total of 127 PIT tags were detected and interrogated (95% of available northern pikeminnow).

Peamouth *Mylocheilus caurinus*, smallmouth bass Micropterus dolomieui, and channel catfish *Ictalurus punctatus* 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 for the Northern Pikeminnow Management Program.

INTRODUCTION

Mortality of juvenile salmonids *Oncorhynchus spp.* Migrating through the Columbia River system is a major concern of the Columbia Basin Fish and Wildlife Program, and predation is an important component of mortality (NPPC 1987a). Northern pikeminnow *Ptychocheilus oregonensis*, formerly known as northern squawfish (Nelson et al. 1998), are the primary piscine predator of juvenile salmonids in the Lower Columbia and Snake River systems (Rieman et al. 1991). Rieman and Beamesderfer (1990) predicted that predation on juvenile salmonids could be reduced by up to 50% with a sustained exploitation rate of 10-20% on northern pikeminnow >275 mm (11 inches) 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. The Washington Department of Fish and Wildlife (WDFW) was enlisted to conduct the Sport-Reward Fishery (Burley et al. 1992) which provides monetary rewards to recreational anglers who harvest northern pikeminnow from within program boundaries on the Columbia and Snake rivers. Since 1991, the Northern Pikeminnow Sport-Reward Fishery (NPSRF) has been responsible for harvesting more than 1.9 million reward size northern pikeminnow and generating more than 500,000 angler days of effort in becoming the NPMP's most successful component for achieving the annual 10-20% exploitation rate on northern pikeminnow within the program boundaries (Klaybor et al. 1993; Friesen and Ward 1999). In 2000, NPMP administrators reduced the minimum size for eligible (reward size) northern pikeminnow to 228 mm (9 inches) in response to recommendations contained in a review of NPMP justification, performance, and cost-effectiveness (Hankin and Richards 2000).

The 2002 NPSRF continued to provide a tiered reward system that paid anglers a higher amount per fish based on achieving designated harvest levels and a separate bonus reward for returning northern pikeminnow that were spaghetti tagged by the Oregon Department of Fish and Wildlife (ODFW). All returning anglers, and 20% of non-returning anglers were surveyed in order to collect catch and harvest data needed to monitor the effect of the NPSRF on other fish species.

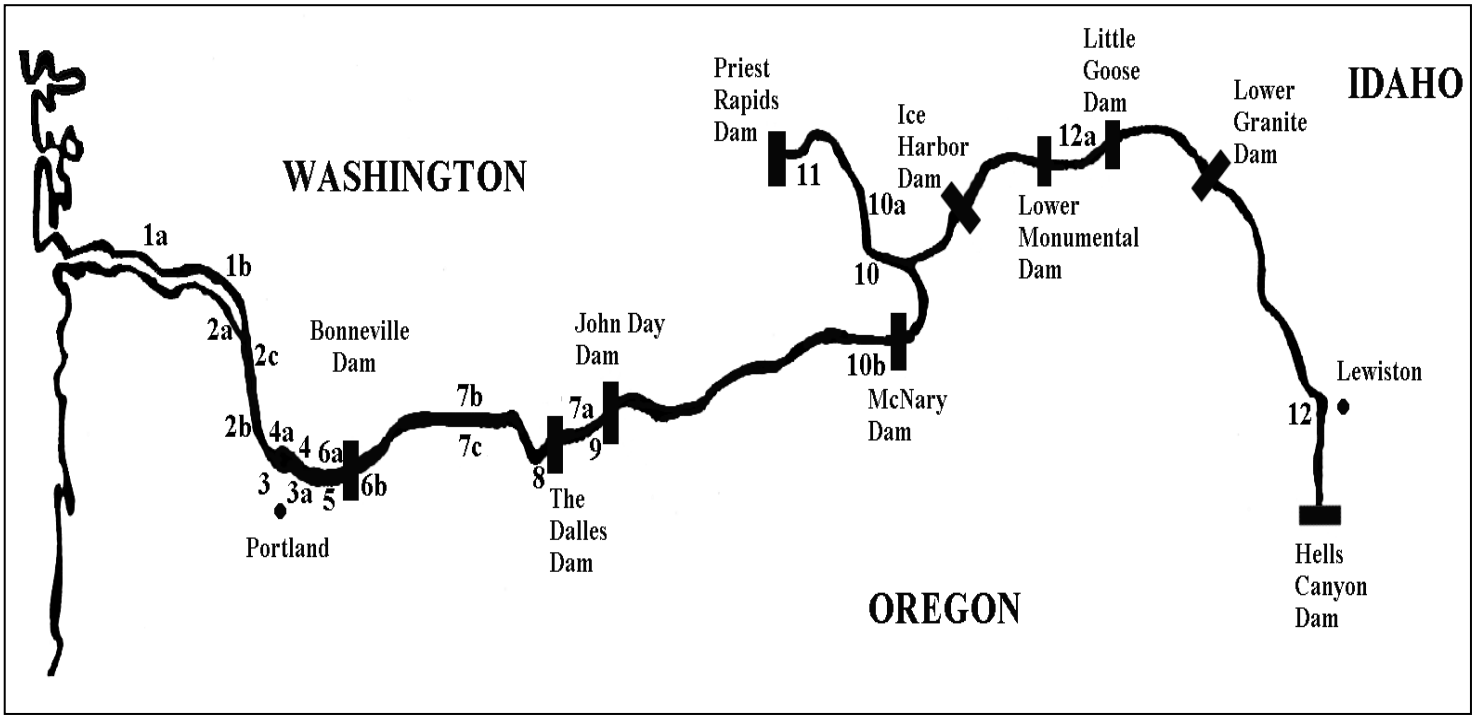
The objectives of the 2002 NPSRF were to (1) implement a recreational fishery that rewards anglers who harvest northern pikeminnow $\geq$228mm (9 inches) total length, (2) collect, compile, and report data on angler participation, catch and harvest of northern pikeminnow and other fish species, and success rates of participating anglers during the season (3) examine collected northern pikeminnow for the presence of external tags 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 consumed salmonids containing PIT tags, and (6) obtain catch and harvest data on fish species caught by non-returning fishery participants who were targeting northern pikeminnow.

METHODS OF OPERATION

FISHERY OPERATION

Boundaries and Season

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



Registration Stations	Registration Stations	Registration Stations
1a. Cathlamet Marina	5. The Fishery	10b. Umatilla Boat Ramp
1b. Willow Grove Boat Ramp	6a. Bonneville Trail Head	11. Vernita Bridge Rest Area
2a. Rainier Marina	6b. Cascade Locks Boat Ramp	12. Greenbelt
2b. Scapoose Bay Marina	7b. Bingen Marina*	12a. Lyon's Ferry
2c. Kalama Marina	7c. Hood River Marina*	
3. M. James Gleason Boat Ramp	8. The Dalles Boat Basin	
3a. Chinook Landing*	9. Giles French	4a. Marine Park (CLOSED
4. Washougal Boat Ramp	10. Columbia Point Park	7a. Maryhill Park (CLOSED)

Figure 1. 2002 Northern Pikeminnow Sport-Reward Fishery registration stations.

The NPSRF was fully implemented from May 13 through September 29, 2002. In addition, fourteen stations below The Dalles Dam conducted a two week long "pre-season"

beginning on April 29, 2002 in order to take advantage of favorable river conditions that provided anglers with an earlier opportunity to begin harvesting northern pikeminnow. Eleven registration stations also continued to operate during a three-week season extension from September 30 – October 20, 2002 for the same reasons. Implementing this type of 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 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 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, recorded biological data, scanned northern pikeminnow for the presence of PIT tags, and provided Sport-Reward Fishery information to the public. Self-registration boxes were located at each station so that anglers could self-register when WDFW technicians were not there.

Reward System

The 2002 NPSRF rewarded anglers for northern pikeminnow $\geq$ 228mm (9 inches) total length (TL). The 2002 NPSRF continued to use a tiered reward system developed in 1995 (Hisata et al. 1995) that paid anglers a higher reward per fish once they had reached designated harvest levels over the course of the season. To receive payment, anglers returned their catch (daily) to the location where they had registered. 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. The 2002 NPSRF returned to reward levels in place at the beginning of the 2001 NPSRF (Winther et. al, 2001) which paid anglers $4 each for their first 100 northern pikeminnow, $5 each for numbers 101 – 400, $6 each for all fish over 400. Anglers received $100 each for returning eligible spaghetti-tagged northern pikeminnow in 2002.

Angler Sampling

Angler data and creel data for the NPSRF were compiled from angler registration forms. One registration form represented one angler day. Angler data consisted of name, date, fishing license number, phone number, and city, state, zip code of participating angler. Creel data recorded by WDFW technicians included fishing location (Figure 2), and primary species targeted (Appendix B). Anglers were asked if they specifically fished for northern pikeminnow

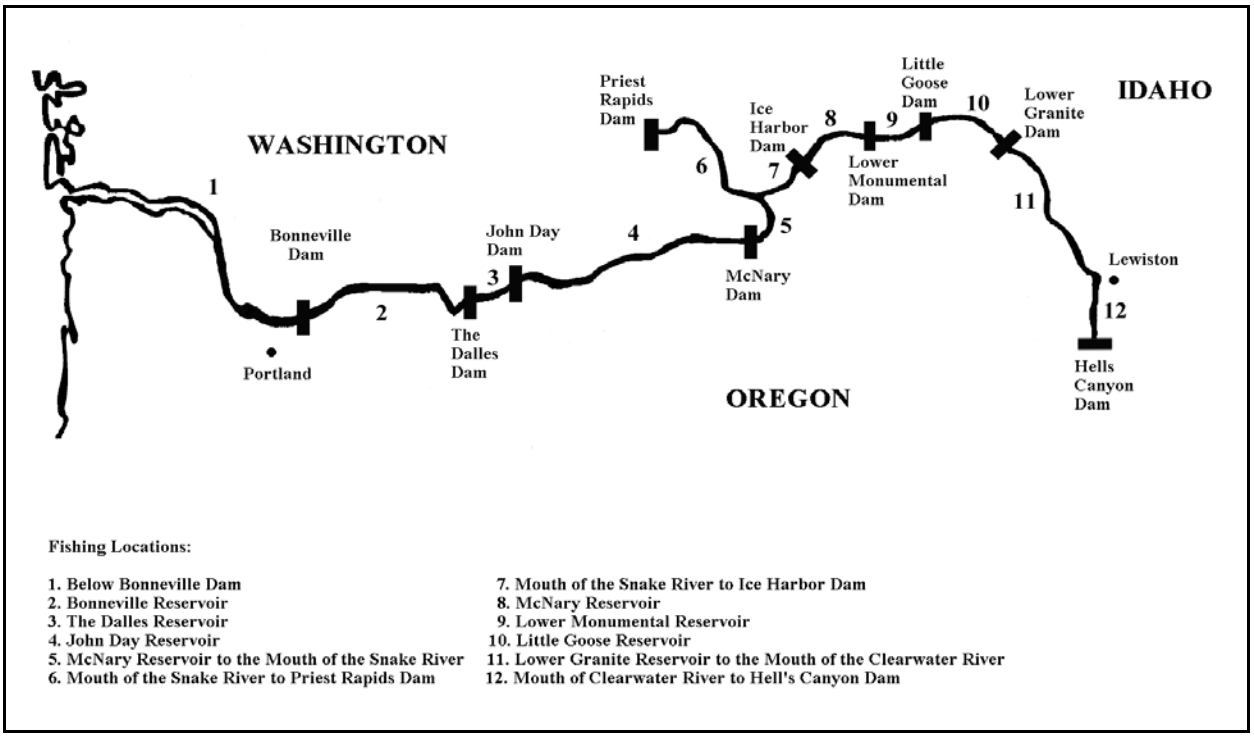


Figure 2. Fishing location codes used for the Northern Pikeminnow Sport-Reward Fishery

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 targeting northern pikeminnow. A fish was considered "caught" when the angler touched the fish, whether it was released or harvested. Fish returned to the water alive were defined as "released". Fish that were retained by the angler or not returned to the water alive were considered "harvested".

Returning Anglers

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

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, 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 2002 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 and harvest data for all other fish species (last obtained during the 2000 NPSRF) were not collected in 2002 since their catch and harvest rates tend to be less than 25% of the catch and harvest rates of returning anglers (Hisata et al. 1995). We anticipate collecting full creel data for all other fish species (in order to confirm this trend) again in 2005 per NPSRF protocol (Fox et al 1999).

Non-Returning Angler Catch and Harvest Estimates

Total catch and/or harvest estimates for non-returning anglers were calculated for selected fish species using the creel data collected from our random sample of non-returning anglers and applying a simple estimator. Updated confidence intervals will be developed for 2003. For the 2002 NPSRF, estimates were only made for 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 (determined by evisceration) of northern pikeminnow as well as fork lengths for any other harvested fish species were recorded whenever possible. All tagged northern pikeminnow 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 NPSRF attempted to scan 100% of all northern pikeminnow returned to registration stations using PIT tag "readers". Northern pikeminnow were scanned using primarily Destron Fearing portable transceiver systems (model # FS2001F), to record information from PIT tag detections for submission to the Columbia Basin PIT Tag Information System (PTAGIS). In addition, WDFW acquired eight Allflex ISO Compatible RF/ID Portable Readers (model # RS601) to test for

scanning suitability in recovery of PIT tag data that may better enable the NPSRF to more efficiently scan 100% of the NPSRF's harvested northern pikeminnow.

The NPSRF attempted to scan 100% of all northern pikeminnow turned in during the 2002 season. Scanning began during the pre-season and was continued during the season extension. Technicians individually scanned all northern pikeminnow for PIT tag readings and those with positive readings were preserved for dissection and tag recovery. All data was verified and the PIT tag readers were downloaded regularly to a central computer from which detection information was forwarded to PTAGIS via electronic mail.

Northern Pikeminnow Processing

During biological sampling, all northern pikeminnow are to be 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 2002, most northern pikeminnow 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 NPSRF harvested a total of 201,396 reward-size northern pikeminnow ($\geq$ 228 mm TL) during the 2002 season. Of this total, 7,280 northern pikeminnow (4%) were caught during the two week pre-season which operated below The Dalles Dam from April 29 through May 12th and 12,323 northern pikeminnow (6%) were caught during the three week extension from September 30 through October 20th. Total harvest for the 2002 NPSRF was 16% lower than for the 2001 NPSRF (Winther et al 2001) that harvested a record 240,894 northern pikeminnow (Figure 3.). On the other hand, 2002 NPSRF total harvest was 30% higher than mean 1991-2001 harvests and the peak occurred during the traditional June peak

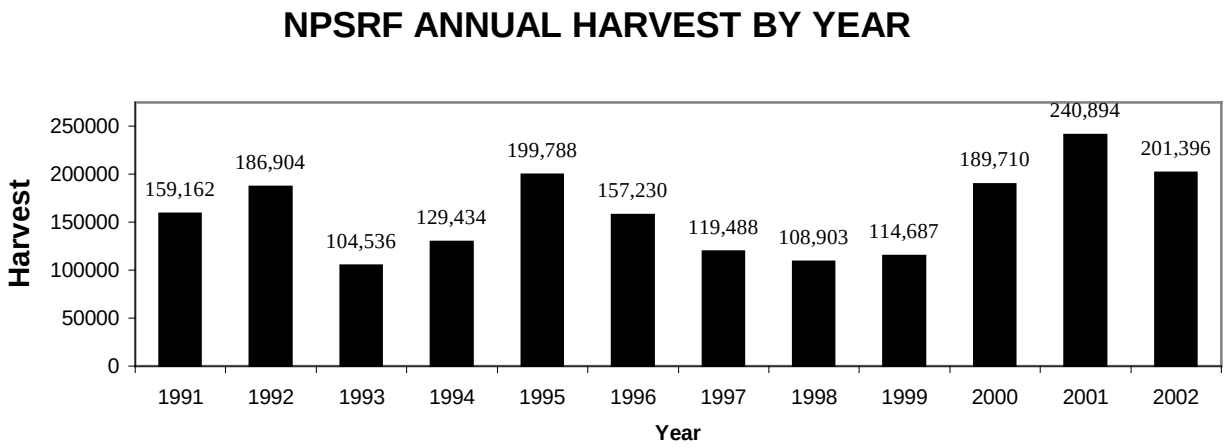


Figure 3. Annual Harvest totals for the Northern Pikeminnow Sport-Reward Fishery**.**

harvest period (Figure 4) seen from 1991-2001 (Fox et al. 1999). It should also be noted that in addition to reward size northern pikeminnow, the 2002 NPSRF also harvested 6,876 northern pikeminnow < 228 mm TL during the 2002 season.

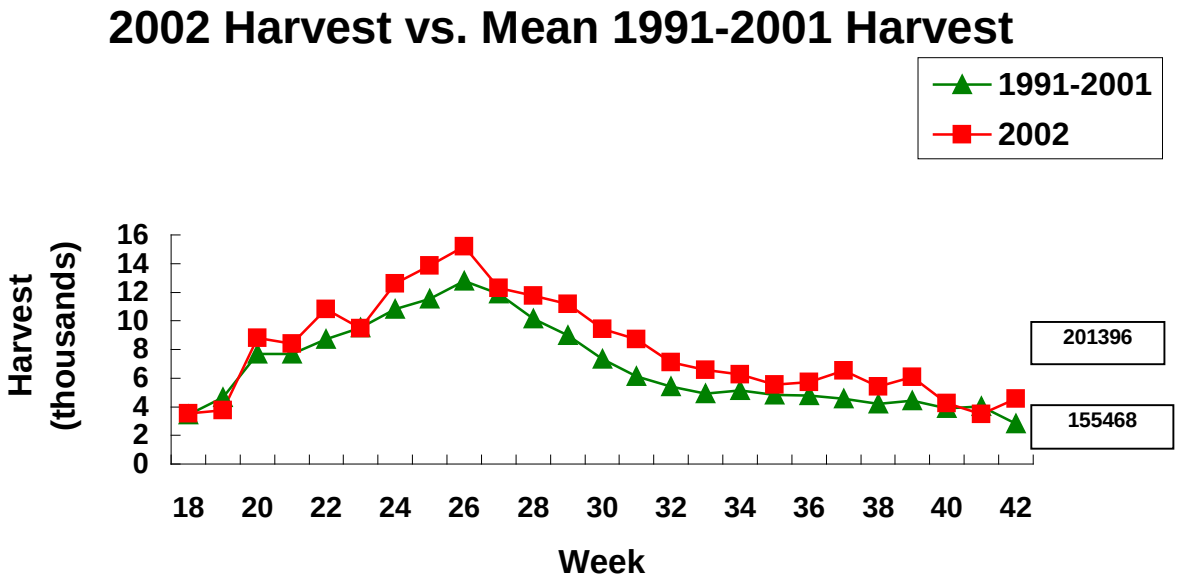


Figure 4. Comparison of 2002 NPSRF Harvest to Mean 1991-2001 NPSRF Harvest.

Mean weekly harvest for the 2002 NPSRF was 8,416 reward-size northern pikeminnow and ranged from 3,516 in week 18 (April 29 – May 5) to 15,203 in week 26 (June 24-30) (Figure 5). The 2002 NPSRF weekly mean harvest was 27% lower than the 2001 NPSRF

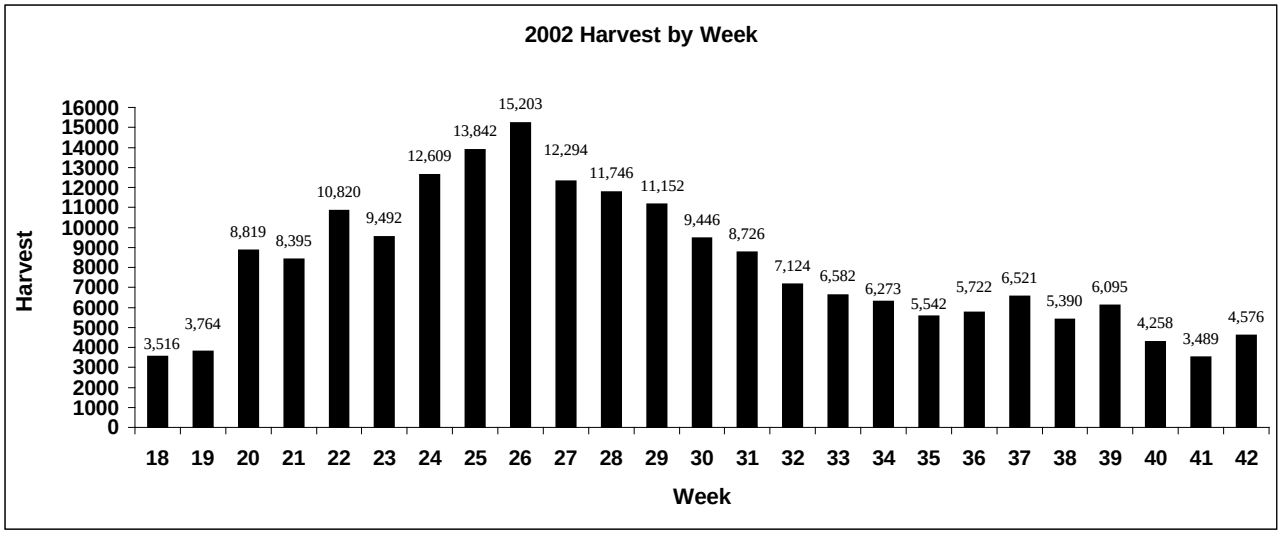


Figure 5. 2002 Northern Pikeminnow Sport-Reward Fishery Harvest by week**.**

Weekly mean harvest. Mean weekly harvest for the pre-season and for the extension was 3,640 NPM and 4,108 NPM respectively. Weekly harvest means for the 2002 NPSRF were consistently lower than for the 2001 NPSRF, except for during the usual peak harvest period in June (Figure 6).

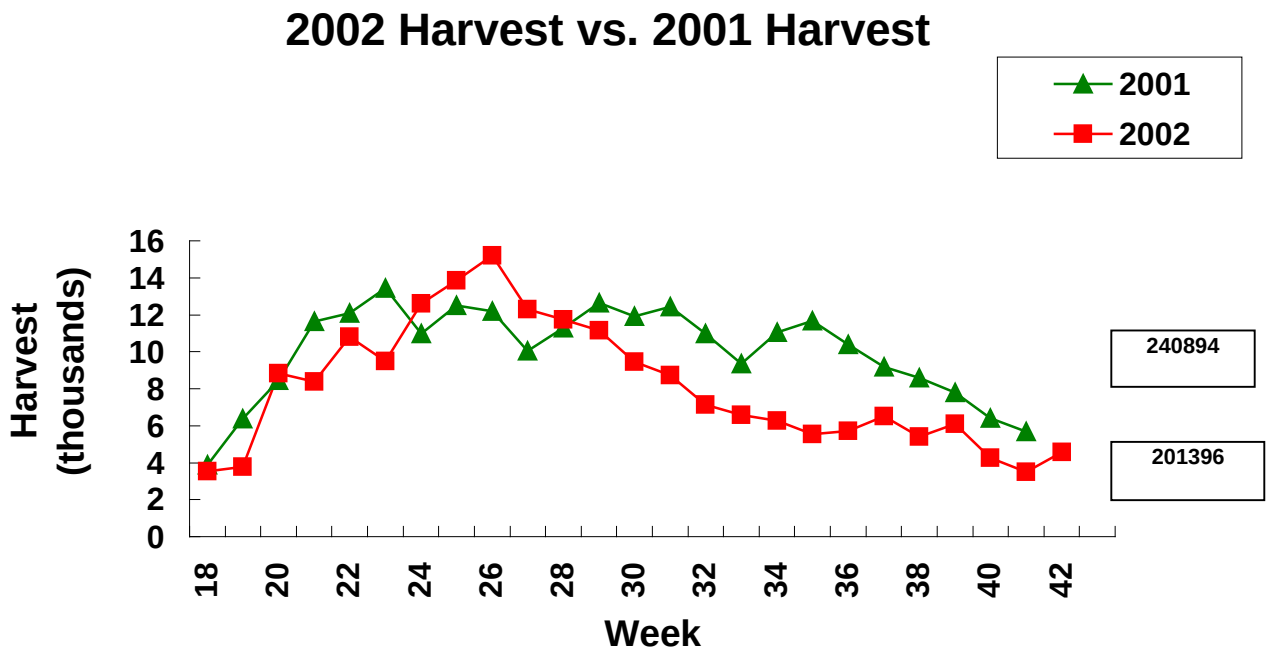


Figure 6. 2002 weekly Northern Pikeminnow Sport-Reward Fishery Harvest vs. 2001 weekly Harvest.

The mean harvest by fishing location was 16,783 northern pikeminnow and ranged from 71,264 reward size northern pikeminnow (36% of the total NPSRF season harvest) in fishing

location 01, (downstream of Bonneville Dam) to 740 northern pikeminnow from fishing location 5 (McNary Dam to mouth of the Snake River) (Figure 7). Fishing location 01 was the NPSRF's top producing location for the twelfth consecutive year although it was the smallest percentage of total NPSRF harvest since 1995.

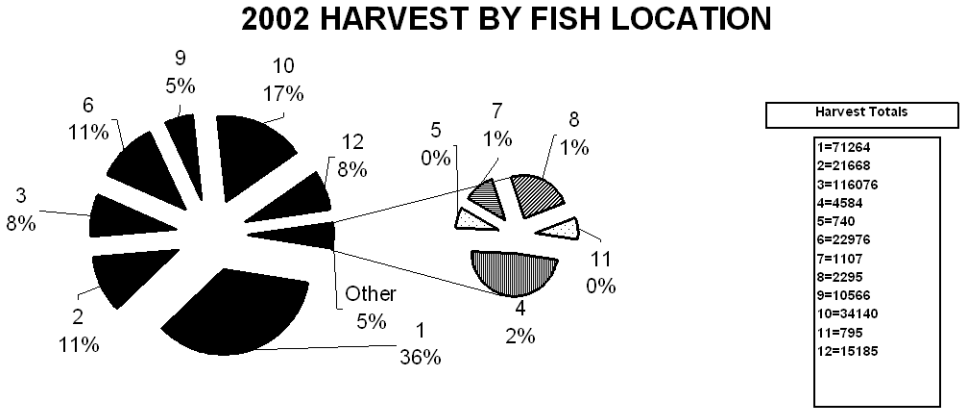


Figure 7. 2002 Northern Pikeminnow Sport-Reward Fishery Harvest by Fishing Location**.**

Mean harvest per registration station was 10,070 reward-size northern pikeminnow and ranged from 47,435 northern pikeminnow at the Greenbelt station (24% of total 2002 NPSRF harvest) to 1,762 northern pikeminnow at the Hood River station (Figure 8). Mean harvest per registration station was only down slightly from 2001 (10,950). The Greenbelt registration station was the top producing registration station for the second year in a row following the pattern of the Vernita station, which had been the top station for the preceding two years (Glaser et al. 2000; Winther et al. 2001).

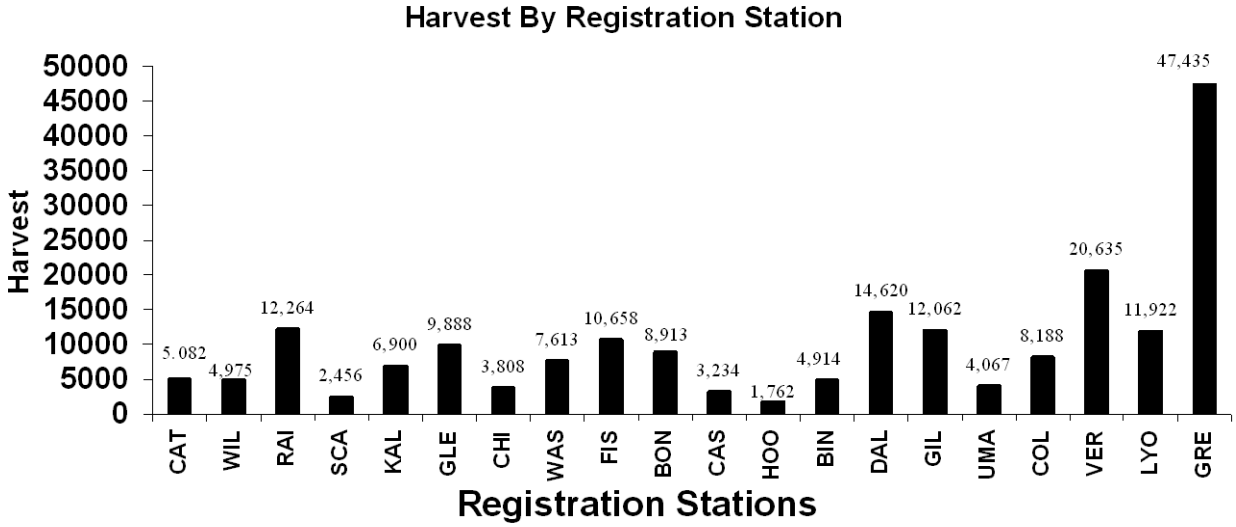


Figure 8. 2002 Northern Pikeminnow Sport-Reward Fishery Harvest by Registration station**.**

CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, SCA-Scappoose, KAL-Kalama, GLE-Gleason, CHI-Chinook, WAS-Washougal, FIS-The Fishery, BON-Bonneville Trailhead, CAS-Cascade Locks, HOO-Hood River, BIN-Bingen, DAL-The Dalles, GIL-Giles French, UMA-Umatilla, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, GRE-Greenbelt.

INCIDENTAL CATCH/HARVEST BY SPECIES

Returning Anglers

Returning anglers targeting northern pikeminnow mostly caught juvenile steelhead and steelhead when it came to incidental salmonid catch. Harvested salmonids are generally fish that are incidentally caught by anglers during a legal fishery. In instances where juvenile salmonids are listed as harvested, these are most often cases where the angler felt that they had fatally hooked the fish but had returned it to the water. Any angler choosing to keep such fish were reported to Enforcement personnel. During the 2002 NPSRF, returning anglers reported that they caught or harvested the following salmonid species while targeting northern pikeminnow (Table 1).

Table 1. Catch and harvest totals by returning anglers targeting northern pikeminnow during the 2002 Northern Pikeminnow Sport-Reward Fishery.

Salmonids				
Species		**Caught**	**Harvest**	**Harvest Percent**
Chinook (Adult)	*Oncorhynchus tshawytscha*	58	24	41.38%
Chinook (Jack)	*Oncorhynchus tshawytscha*	30	8	26.67%
Chinook (Juvenile)	*Oncorhynchus tshawytscha*	226	4	1.77%
Chum (Juvenile)	*Oncorhynchus keta*	3	0	0
Coastal Cutthroat	*Oncorhynchus clarki*	2	0	0
Coho (Adult)	*Oncorhynchus kisutch*	4	2	50.00%
Coho (Juvenile)	*Oncorhynchus kisutch*	17	3	17.65%
Cutthroat (unknown)	*Oncorhynchus clarki*	18	1	5.56%
Rainbow Trout	*Oncorhynchus mykiss*	46	11	23.91%
Salmon Pacific (unknown)	*Oncorhynchus spp.*	13	2	15.38%
Searun Cutthroat	*Oncorhynchus clarki*	7	3	42.86%
Steelhead Adult (Hatchery)	*Oncorhynchus mykiss*	92	42	45.65%
Steelhead Adult (Wild)	*Oncorhynchus mykiss*	62	0	0
Steelhead Juvenile (Hatchery)	*Oncorhynchus mykiss*	338	11	3.25%
Steelhead Juvenile (Wild)	*Oncorhynchus mykiss*	20	0	0
Trout (Unknown)		144	20	13.89%

The fish species most often incidentally caught by NPSRF anglers were peamouth, smallmouth bass, and channel catfish. This has been the case in each year that the NPSRF has been implemented. In addition to these three species, returning anglers targeting northern pikeminnow also reported that they caught or harvested the following non-salmonid species during the 2002 NPSRF (Table 2).

Non-Returning Anglers

We surveyed 2,321 non-returning anglers (19.26%) to record their catch and/or harvest of northern pikeminnow and salmonid species during the 2002 NPSRF. Catch and harvest data for all other fish species (last obtained during the 2000 NPSRF) were not recorded in 2002. We anticipate collecting full creel data for other fish species (to determine whether trends have changed) in 2005 per NPSRF protocol (Fox et al. 1999). Surveyed non-returning anglers targetting northern pikeminnow reported that they caught and/or harvested the northern pikeminnow and salmonid species listed in column one during the 2002 NPSRF (Table 3). We applied a simple estimator to the catch and harvest totals obtained from the surveyed anglers to obtain a total catch and harvest estimate for all non-returning anglers. Estimated total catch and harvest of northern pikeminnow and salmonids for all non-returning anglers participating in the 2002 NPSRF is listed in column two (Table 3).

Table 2. 2002 Catch and harvest totals of non-salmonids by returning anglers during the 2002 NPSRF.

Species	**Catch**	**Harvest**	**Percent Harvested**
Northern Pikeminnow ≥ 228 mm	200,533	200,445	99.96%
Northern Pikeminnow < 228 mm	51,929	6,876	13.24%
Peamouth *Mylocheilus cauriuus*	47,228	16,361	34.64%
White Sturgeon *Acipenser transmountanus*	4,557	71	1.56%
Smallmouth Bass *Micropterus dolomieui*	13,240	1,416	10.69%
Channel Catfish *Ictalurus punctatus*	5,931	1,057	17.82%
Walleye *Stizostedion vitreum*	510	347	68.04%
American Shad *Alosa sapidissima*	254	105	41.34%
Brown Bullhead *Ictalurus nebulosus*	88	15	17.05%
Black Crappie *Pomoxis nigromaculatus*	5	2	40.00%
Black Bullhead *Ictalurus melas*	4	0	0
Blue Catfish *Ictalurus punctatus*	11	3	27.27%
Bluegill *lepomis macrochirus*	74	13	17.57%
Bullhead *Ictalurus spp.*	1,175	159	13.53%
Pumpkinseed *Leomis gibbosus*			
Bridgelip Sucker *Catostomus columbianus*	138	13	9.42%
Crappie (Unknown) *Pomoxis spp.*	80	41	51.25%
Chiselmouth *Acrochilus alutaceus*	2,269	277	12.21%
Sculpin *Cottus spp.*	5,153	823	15.97%

Carp *Cyprinus carpio*	633	69	10.90%
Flathead Catfish *Pilodictis olivaris*	7	0	0
Largemouth Bass *Micropterus salmonids*	40	3	7.50%
Longnose Sucker *Catostomus catostomus*	20	1	5.00%
Largescale Sucker *Catostomus macrocheilus*	8	1	12.50%
Sucker (Unknown) *Catostomus spp.*	3,680	521	14.16%
Redside Shiner *Richarsonius balteatus*	423	20	4.73%
Starry Flounder *Platichthys stellatus*	321	26	8.10%
White Crappie *Promoxis annularis*	5	0	0
Mountain Whitefish *Prosopium williamsoni*	58	9	15.52%
Yellow Bullhead *Ictalurus natlis*	223	18	8.07%
Yellow Perch *Perea flauesceno*	1,218	253	20.77%

Table 3. Catch and harvest totals and Estimates of catch and harvest for non-returning anglers**.**

Species	**Caught**	**Harvested**	**% Harvested**	**Est. Catch**	**Est. Harvest**	**Conf. Interval**
Northern Pikeminnow < 228 mm	172	165	95.93%	893	856	*
Chinook (Adult)	1	0	0	5	0	*
Chinook (Jack)	3	1	33.33%	16	5	*
Chinook (Juvenile)	66	0	0	343	0	*
Steelhead Adult (Adipose absent)	8	1	12.50%	42	5	*
Steelhead Adult (Adipose present)	3	0	0	16	0	*
Steelhead Juv. (Adipose absent)	19	0	0	99	0	*
Steelhead Juv.(Adipose present)	42	0	0	218	0	*
Trout (Unknown)	12	0	0	62	0	*

N=12,054 n=2,321

Angler Effort

The NPSRF recorded total effort of 30,637 angler days spent during the 2002 season. Of this total, we noted that 2,405 angler days (8%) were spent during the pre-season and 951 angler days (3%) were spent during the season extension. Total effort declined 21% from the 2001 NPSRF, although a large portion of the decline can be attributed to the sharp upward spike in effort that the 2001 NPSRF received after the July 10th reward increase (Figure 9) and angler reaction to reward levels being returned to the May 2001 level ($4, $5, and $6) (Winther et al. 2001). When total effort is divided into returning and non-returning angler days, 18,583 angler days (61%) were recorded by returning anglers (up from 58.3% in 2001). Of the 18,587 returning angler days spent during the 2002 NPSRF, 16,990 angler days (91.4%) were designated successful since they resulted in harvested NPM.

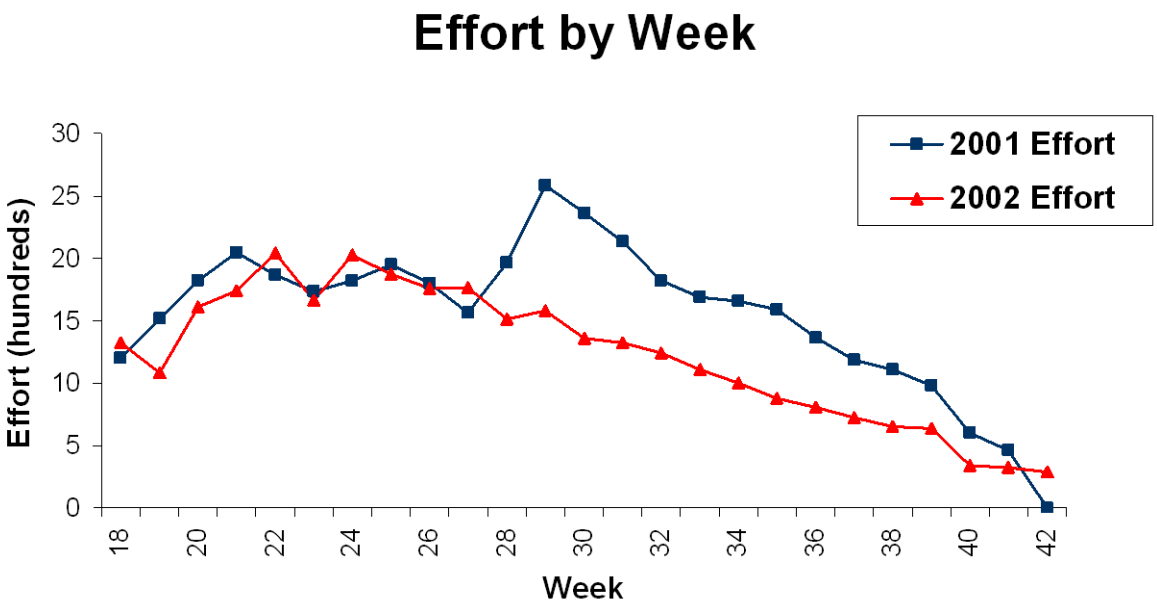


Figure 9. 2002 weekly Northern Pikeminnow Sport-Reward Fishery Effort vs 2001 weekly Effort.

Mean weekly effort for the 2002 NPSRF declined to 1,226 angler days (down 32% from 2001) and ranged from 285 in week 42 (October 14-20) to 2,040 during week 22 (May 26 – June 2) (Figure 10). Mean weekly effort for the pre-season and the extension was 1,203 angler days, and 317 angler days respectively. The effort peak returned to the usual end of May, early June time period seen from 1991-2001(Figure 11), as opposed to last season when the BPA reward increase caused peak effort to occur in the middle of July (Winther et al. 2001).

Mean annual effort (returning anglers only) by fishing location was 2,553 angler days and ranged from 9,298 (30% of NPSRF total) in fishing location 01 (below Bonneville Dam) to 60 in fishing location 5 (McNary Dam to mouth of the Snake River) (Figure 12).

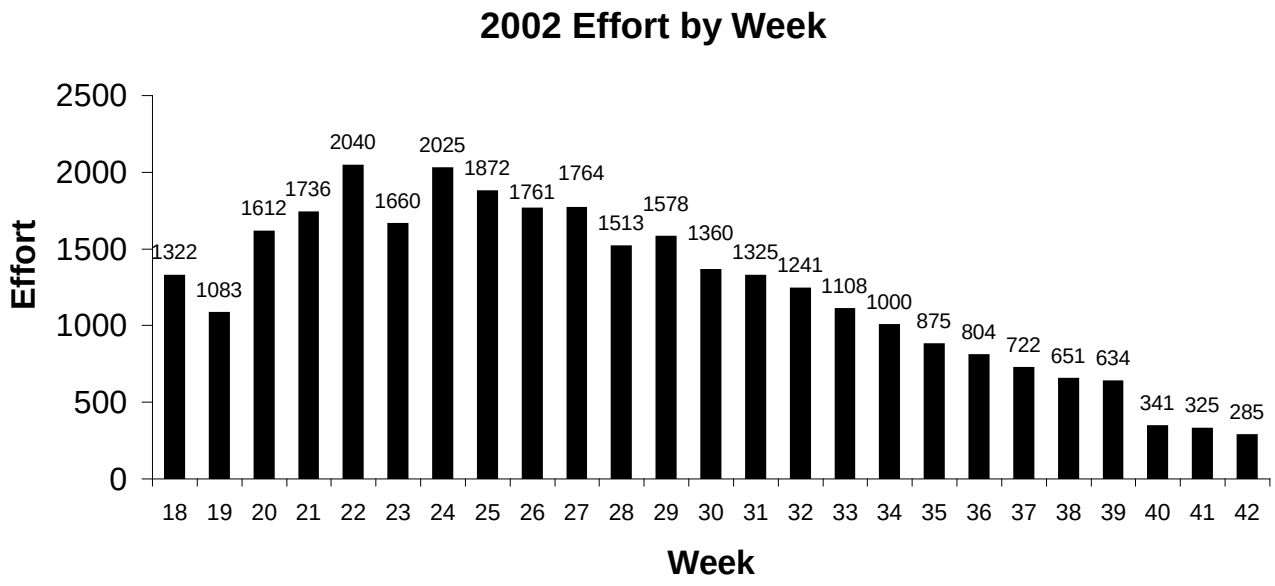


Figure 10. 2002 Northern Pikeminnow Sport-Reward Fishery Effort by week**.**

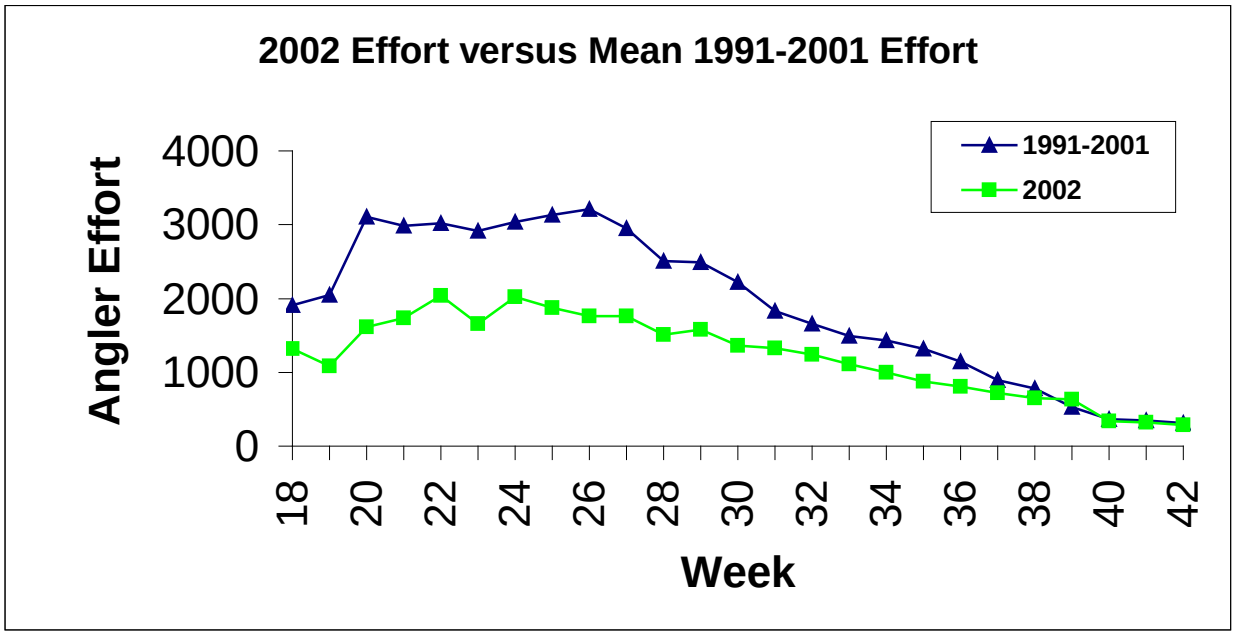


Figure 11. 2002 Northern Pikeminnow Sport-Reward Fishery weekly Effort vs. Mean 1991-2001 Effort.

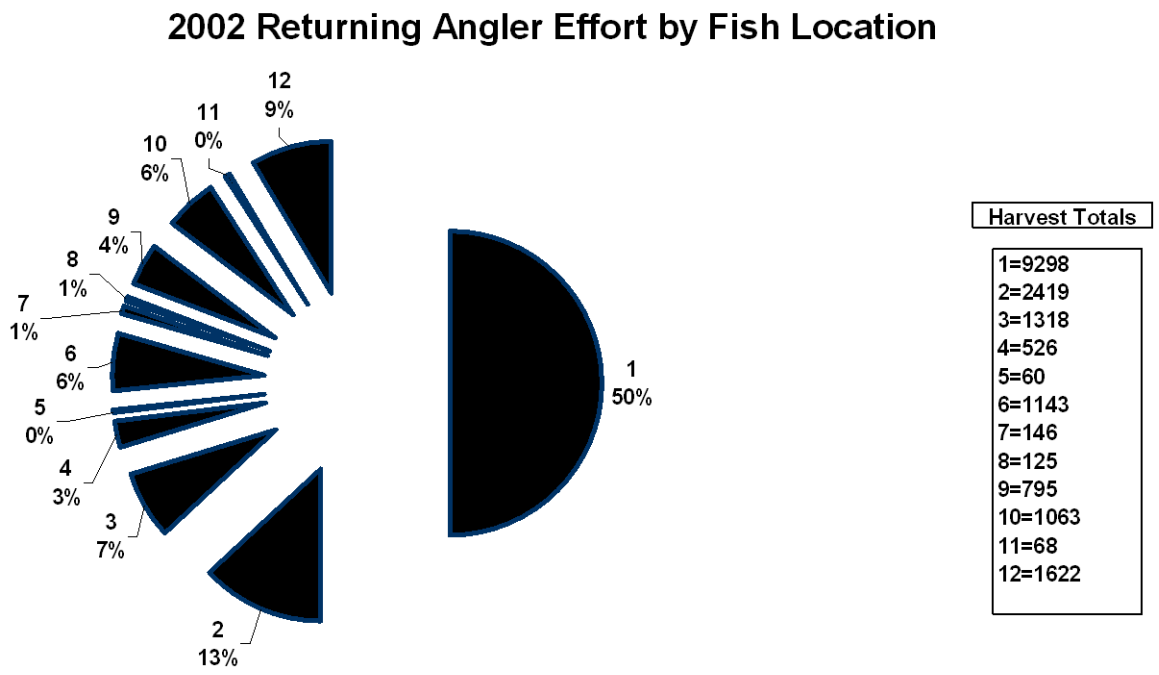


Figure 12. 2002 Northern Pikeminnow Sport-Reward Fishery Angler Effort by Fishing Location (Returning Anglers only).

Mean effort per registration station was 1,532 angler days and ranged from 4,327 angler days at Greenbelt to 222 angler days at Hood River (Figure 13). This continued a pattern that the NPSRF has seen for the past six years in which the Greenbelt and Washougal stations had split time as the NPSRF's leader in effort.

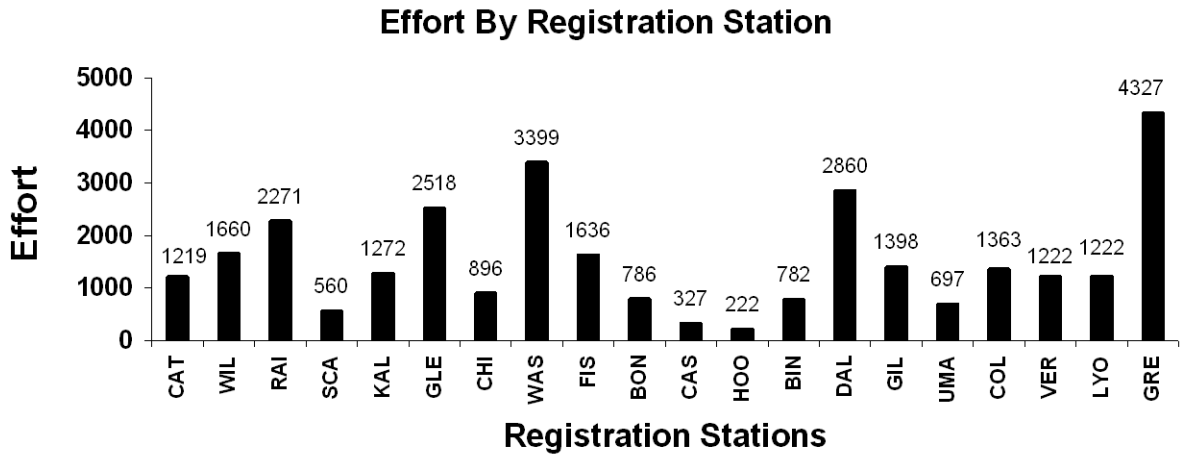


Figure 13. 2002 Northern Pikeminnow Sport-Reward Fishery Angler Effort by Registration Station
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, SCA-Scappoose, KAL-Kalama, GLE-Gleason, CHI-Chinook, WAS-Washougal, FIS-The Fishery, BON-Bonneville Trailhead, CAS-Cascade Locks, HOO-Hood River, BIN-Bingen, DAL-The Dalles, GIL-Giles French, UMA-Umatilla, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, GRE-Greenbelt.

Catch Per Angler Day

The NPSRF recorded an overall catch per unit of effort (CPUE) of 6.57 northern pikeminnow harvested per angler day (returning + non-returning anglers) during the 2002 season. This catch rate was up from 6.21 in 2001 and once again set the standard for the highest CPUE in NPSRF history. The steady increase in CPUE from year to year is also consistent with the upward trend in CPUE seen in the NPSRF from 1991-2001 (Fox et al, 1999) (Figure 14). Returning angler CPUE was 10.84 northern pikeminnow per angler day and also set a NPSRF record.

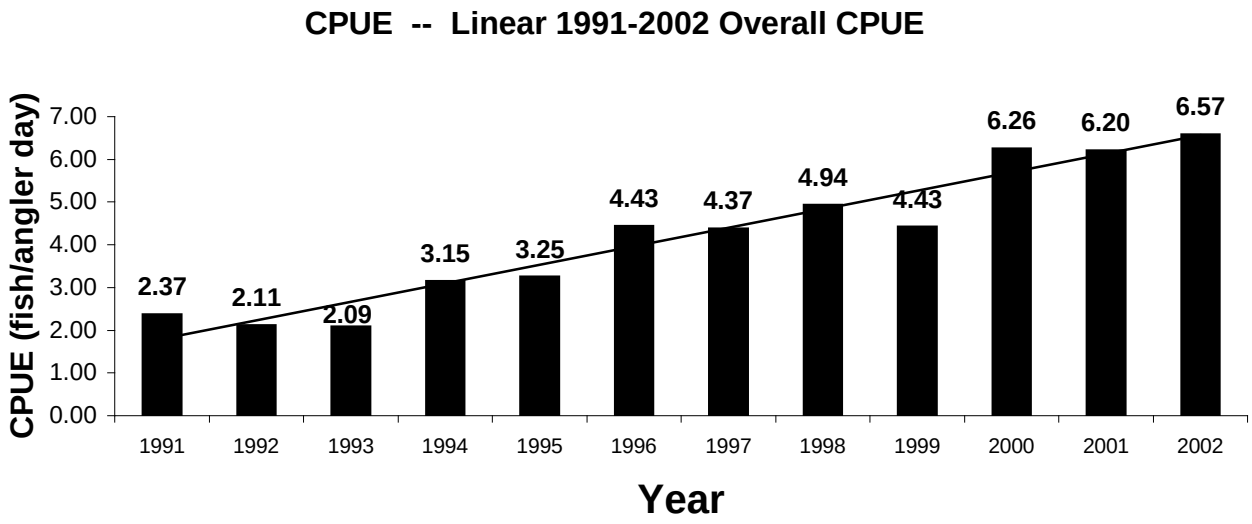


Figure 14. Annual CPUE totals for the Northern Pikeminnow Sport-Reward Fishery.

Mean weekly CPUE was 7.31 and ranged from 2.66 in week 18 (April 29 – May 5) to a peak of 16.06 at the end of the season in week 42 (October 14-20) (Figure 15). The NPSRF also recorded mean CPUE of 3.71 fish/day during the pre-season, and 9.72 fish/day during the season extension.

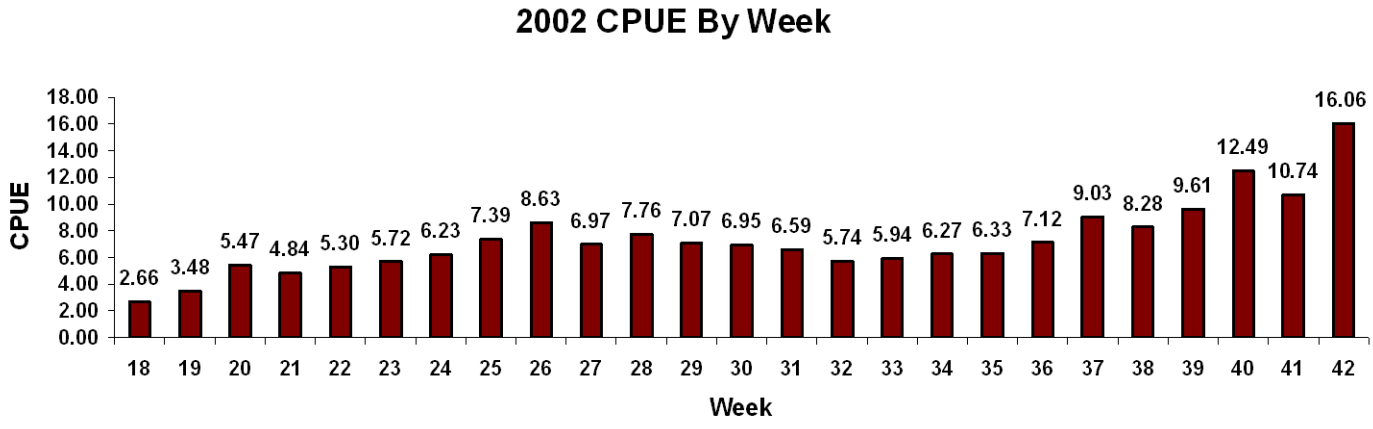


Figure 15. 2002 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Week**.**

The CPUE by fishing location during the 2002 NPSRF ranged from 32.12 northern pikeminnow per day in fishing location 10 (Little Goose Reservoir) to 7.58 in fishing location 7 (Snake River from mouth to Ice Harbor Dam) (Figure 16). Fishing locations on the Snake River and near the Vernita registration station showed the largest increases from 2001.

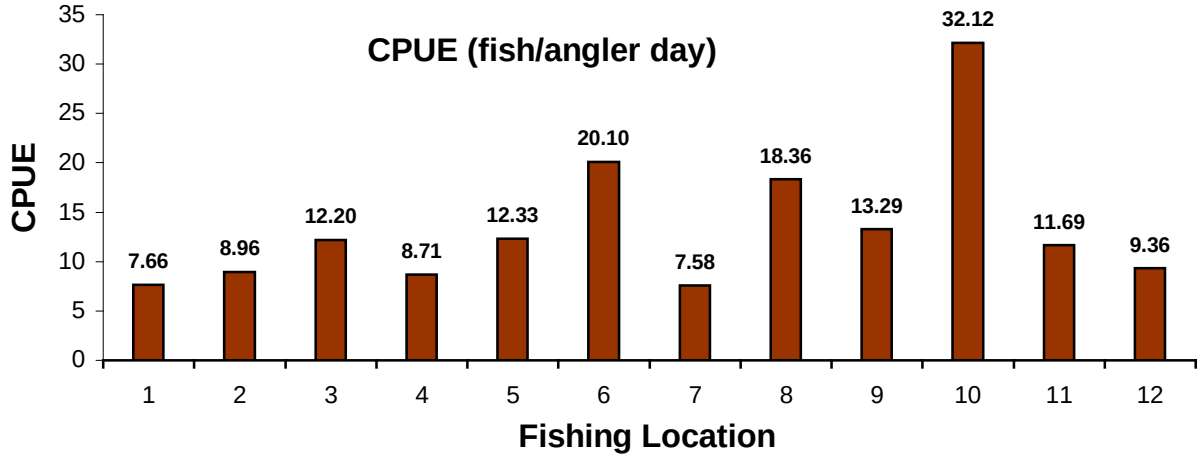


Figure 16. 2002 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Fishing Location.

The registration station that recorded the highest CPUE was Vernita with 16.89 northern pikeminnow per angler day (Figure 17). The registration station with the lowest CPUE was Washougal.

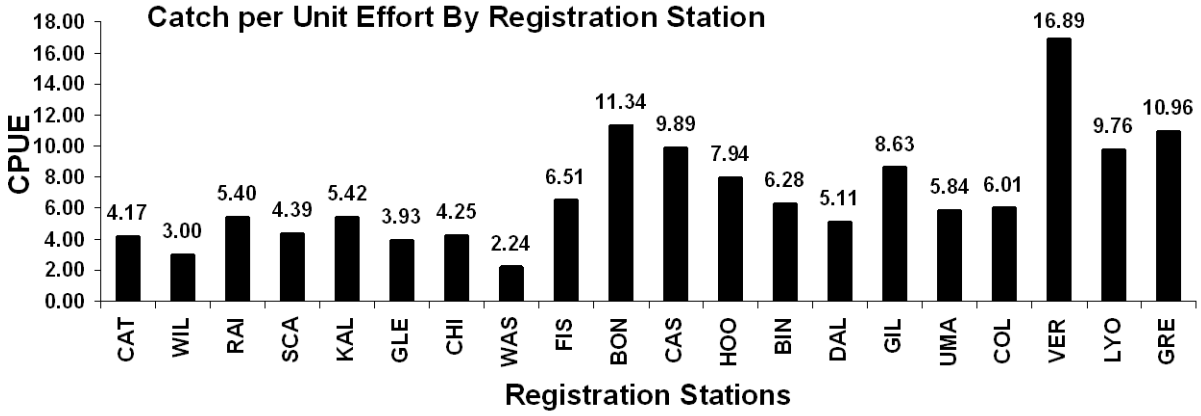


Figure 17. 2002 Northern Pikeminnow Sport-Reward Fishery Angler CPUE by Registration Station
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, SCA-Scappoose, KAL-Kalama, GLE-Gleason, CHI-Chinook, WAS-Washougal, FIS-The Fishery, BON-Bonneville Trailhead, CAS-Cascade Locks, HOO-Hood River, BIN-Bingen, DAL-The Dalles, GIL-Giles French, UMA-Umatilla, COL-Columbia Point, VER-Vernita, LYO-Lyon's Ferry, GRE-Greenbelt.

Angler Totals

There were 6,490 separate anglers who participated in the 2002 NPSRF. Two thousand, nine hundred and ninety-four of these anglers (46%) were classified as successful since they harvested at least one northern pikeminnow during the 2002 season. The average annual harvest of reward size northern pikeminnow per successful angler was 67.27 northern pikeminnow per season. When we break down the 2,994 successful anglers by tier, 90% (2,692 anglers) harvested less than 100 northern pikeminnow (Tier 1) during the 2002 season (Figure 18), with an average harvest of 10). Six percent (178 anglers) harvested between 101 and 400 northern pikeminnow (Tier 2) during the 2002 season with an average harvest of 204. Four percent (124 anglers) caught more than 400 northern pikeminnow (Tier 3) during the 2002 season and averaged 1,112 NPM.

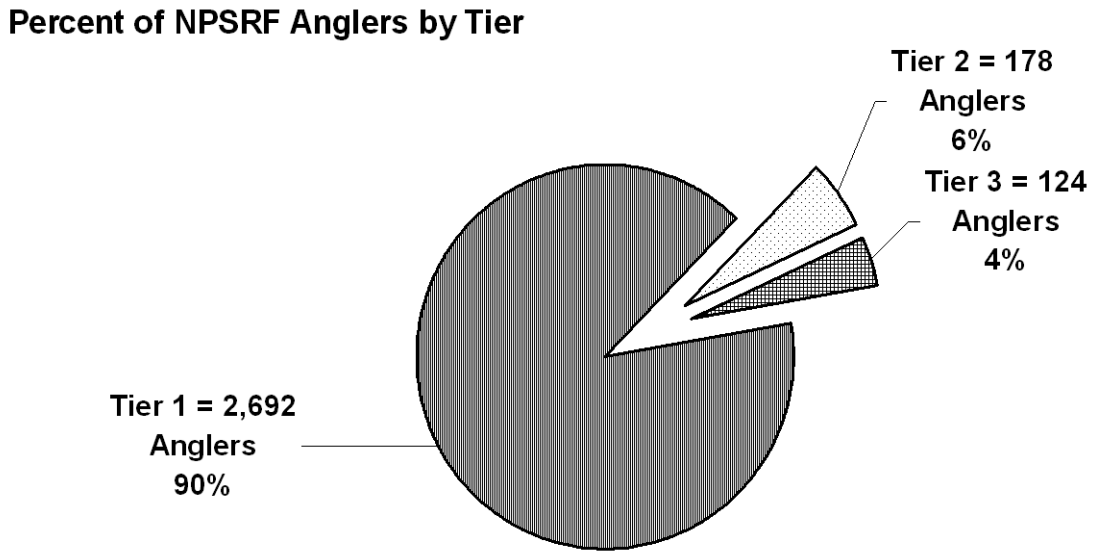


Figure 18. 2002 Northern Pikeminnow Sport-Reward Fishery Anglers based on number of fish harvested. Tier 1 anglers harvested < 100 fish, Tier 2 anglers harvested 101-400 fish, and Tier 3 anglers harvested >400 fish during the 2002 Sport-Reward Fishery season.

Cumulative 2002 NPSRF harvest by angler tier was as follows. Tier 1 anglers caught 13.3% (26,786 northern pikeminnow) of the total 2002 NPSRF harvest (Figure 19). Tier 2 anglers caught 18.2% (36,654 northern pikeminnow) of the total harvest. Tier 3 anglers caught a whopping 68.5% (137,956 northern pikeminnow) of the total 2002 NPSRF harvest.

The average angler spent five days participating in the NPSRF during the 2002 season which was the same as the average number of days spent by Tier 1 anglers (Figure 20). Tier 2 anglers spent an average of 28 days participating in the NPSRF, while Tier 3 anglers spent 58 days. Angler effort by tier level has not varied much since last reported from those in the 2000 NPSRF (Glaser et al 2000).

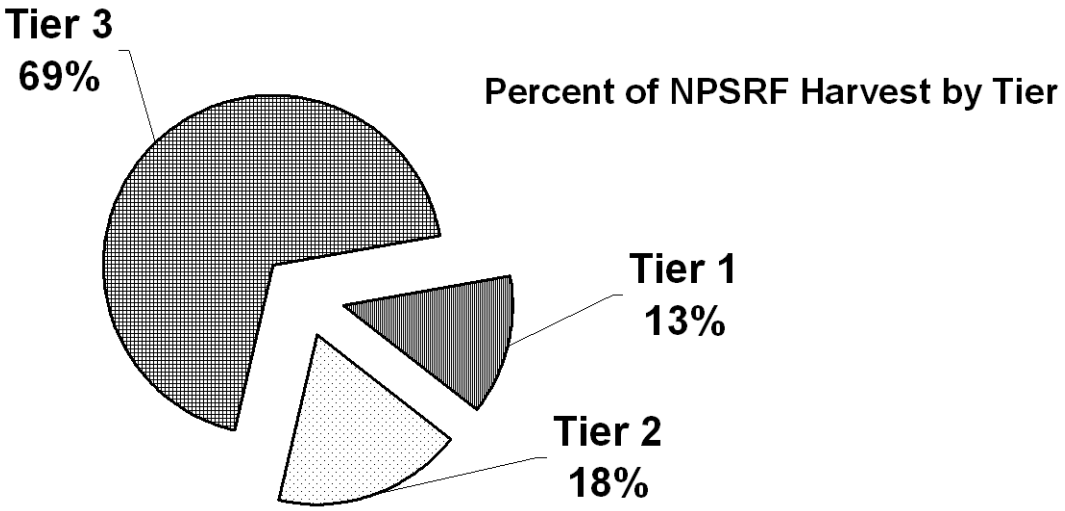


Figure 19. Percentage of 2002 Northern Pikeminnow Sport-Reward Fishery Harvest by Angler Tier. Tier 1 anglers harvested < 100 fish, Tier 2 anglers harvested 101-400 fish, and Tier 3 anglers harvested >400 fish during the 2002 Sport-Reward Fishery season.

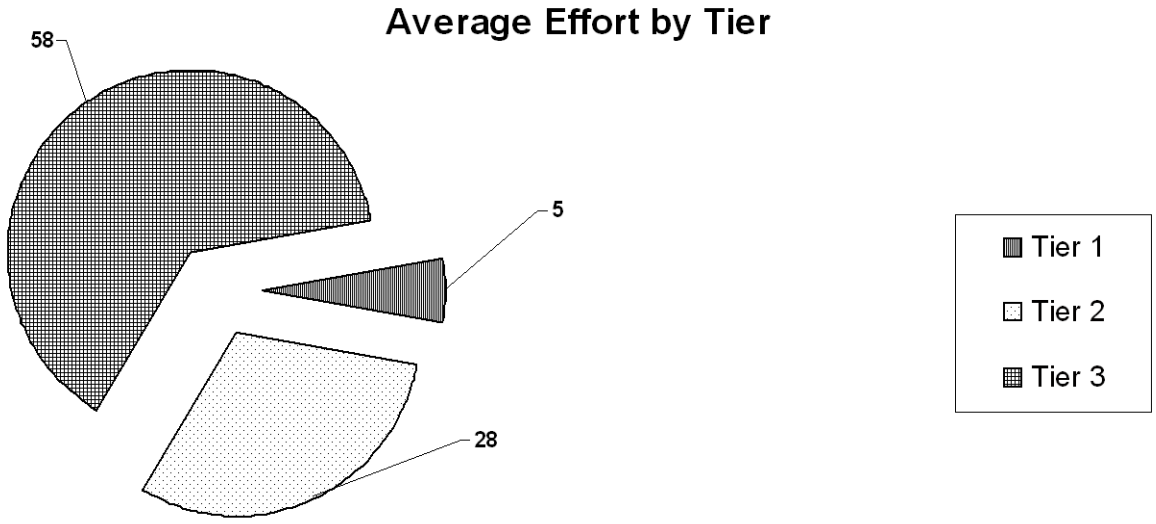


Figure 20. Average Effort of 2002 Northern Pikeminnow Sport-Reward Fishery Anglers by Tier. Tier 1 anglers harvested < 100 fish, Tier 2 anglers harvested 101-400 fish, and Tier 3 anglers harvested >400 fish during the 2002 Sport-Reward Fishery season.

The average Tier 1 angler harvested 2.03 northern pikeminnow per trip during the 2002 NPSRF (Figure 21). Tier 2 anglers harvested an average of 7.21 northern pikeminnow per trip, and Tier 3 anglers harvested an average of 19.05 northern pikeminnow per trip during the 2002 NPSRF.

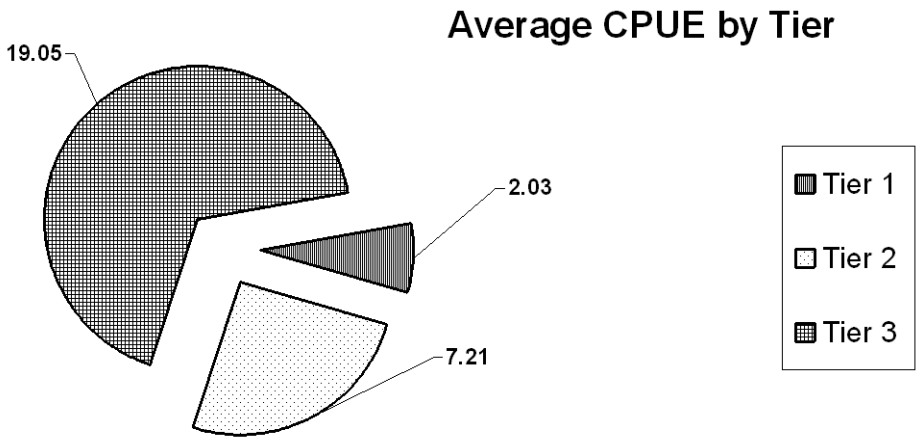


Figure 21. Average CPUE of 2002 Northern Pikeminnow Sport-Reward Fishery Anglers by Tier. Tier 1 anglers harvested < 100 fish, Tier 2 anglers harvested 101-400 fish, and Tier 3 anglers harvested >400 fish during the 2002 Sport-Reward Fishery season.

The top angler for the 2002 NPSRF harvested 6,811 NPM, which was 2,636 more fish than the number two angler harvested and over 1,900 more fish than any other individual had harvested in the eleven previous years of the NPSRF. His CPUE was 68.8 northern pikeminnow and he spent 99 angler days of effort during the 2002 season. By comparison, the top participating angler spent 167 days and harvested 2,725 northern pikeminnow.

Tag Recovery

Returning anglers recovered and turned in 157 northern pikeminnow tagged with external spaghetti tags during the 2002 NPSRF. This compares to the 2001 total of 200 tags turned in by NPSRF anglers (Winther et al., 2001). Station technicians identified an additional 22 northern pikeminnow with a fin-clip mark and/or wounds consistent with having lost a tag. The recovered tags and potential tag loss data was estimated by ODFW to equal a 10.6% exploitation rate for the 2002 NPSRF (2002 ODFW unpublished data).

A total of 190,631 northern pikeminnow were individually scanned for the presence of PIT tags in their gut. This represents 95% of all northern pikeminnow handled by NPSRF technicians. A total of 127 PIT tags were located and interrogated from these fish. This compares to 2001 when the NPSRF had 58 PIT tag recoveries (Winther et al, 2001).

SUMMARY

The 2002 NPSRF succeeded in reaching the NPMP's 10-20% exploitation goal with a season that was slightly above average in terms of harvest. Given that 2002 reward levels were lowered back to $4, $5, and $6 per northern pikeminnow in effect prior to the 2001 BPA reward increases (Winther et al, 2001), we expected to see effort decrease and were thus prepared for a decrease in harvest. Fortunately, the increase in angler catch rate (CPUE) from 6.24 in 2001 to 6.57 in 2002 was able to overcome the NPSRF's decrease in participation. While the increased catch rate seen during the 2002 NPSRF can most likely be attributed to the continued evolution of our core anglers to a more efficient level, it must also be noted that there were a small number of participants with high catch rates who were disqualified from the NPSRF for breaking program rules. Given that the NPSRF also had a documented fraud issue (25% at the Cathlamet station) in 2001 (Winther et al. 2001), additional attention should be given to this matter in 2003. In order for the NPSRF to minimize these issues in future seasons, a review and update of the program's rules, and modification of WDFW procedures should be implemented prior to the start of the 2003 season. Detection of PIT tags retained in the gut of northern pikeminnow has continued to show promise as a way to obtain additional data on predation. Since WDFW will be scanning 100% of northern pikeminnow for PIT tags, perhaps we can utilize this technology as a deterrent to this type of activity in the future. The NPSRF may also address uncertainty associated with northern pikeminnow tag loss by using PIT tags in conjunction with ODFW spaghetti tags. Additional options for sampling PIT tagged fishes may be available which could provide additional relevant data on how to best utilize this technology.

RECOMMENDATIONS FOR THE 2003 SEASON

Utilize a two-week pre-season (in early May) for the 2003 NPSRF for areas where anglers have successfully demonstrated that they can harvest worthwhile numbers of NPM.

Review and revise WDFW procedures and NPSRF Rules as needed to ensure consistency with NPMP mandates and maintain integrity of the program.

Continue to develop incentives designed to maintain and encourage the NPSRF's core angler group and provide additional information to increase the effectiveness of novice anglers so that the NPSRF can continue to consistently meet the NPMP's 10-20% exploitation goal.

Retain the option to extend the NPSRF season on a site-specific basis if harvest, angler effort and CPUE levels warrant.

Continue to scan all northern pikeminnow for PIT tags from consumed smolts.

Explore and develop additional measures to deter anglers from fraudulently submitting northern pikeminnow to the NPMP for payment.

Continue to survey 20% of non-returning anglers to calculate total non-returning angler catch and harvest estimates.

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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.

APPENDIX B

SPECIES CODES

LMB	Bass, Largemouth
RKB	Bass, Rock
BG	Bluegill
BH	Bullhead (Unknown)
YBH	Bullhead, Yellow
BBH	Bullhead, Brown
BLB	Bullhead, Black
CP	Carp
BCF	Catfish, Blue
CC	Catfish, Channel
FCF	Catfish, Flathead
CMO	Chiselmouth
CRC**	Columbia River Chub
C	Crappie (Unknown)
BC	Crappie, Black
WC	Crappie, White
SF	Flounder, Starry
PMO	Peamouth
YP	Perch, Yellow
PS	Pumpkinseed
CK	Salmon, Chinook
CH	Salmon, Chum
CO	Salmon, Coho
K	Salmon, Kokanee
PK	Salmon, Pink
SO	Salmon, Sockeye
JAK	Salmon, Chinook (Jack)
JCK	Salmon, Chinook (Juvenile)
JCH	Salmon, Chum (Juvenile)
JCO	Salmon, Coho (Juvenile)
JPK	Salmon, Pink (Juvenile)
JSO	Salmon, Sockeye (Juvenile)
SAN	Sandroller
COT	Sculpin, (General)
AMS	Shad, American
RS	Shiner, Redside
NPM	Pikeminnow, Northern
SHP*	Steelhead (Adipose Present)
SHA*	Steelhead (Adipose Absent)
JSP	Steelhead, Juvenile (Adipose Present)
JSA	Steelhead, Juvenile (Adipose Absent)
GRS	Sturgeon, Green
WS	Sturgeon, White
SK	Sucker (Unknown)
BRS	Sucker, Bridgelip
LRS	Sucker, Largescale
S	Sunfish, (Unknown)
TNC	Tench
CT	Trout, Cutthroat (Unknown)
CCT	Trout, Cutthroat Coastal
SCT	Trout, Cutthroat Searun
LCT	Trout, Cutthroat Lahontan
DB	Trout, Dolly/Bull (Unknown)
BLC	Trout, Bull (Char)
DVC	Trout, Dolly Varden (Char)
RB	Trout, Rainbow (Resident)
RU	Trout, Rainbow (Unknown)
TR	Trout, (Unknown)
WAL	Walleye
WM	Warmouth
WF	Whitefish, Mountain

** Conventional naming for NPM Sport-Reward Program

REPORT B

NORTHERN PIKEMINNOW SPORT REWARD PAYMENTS – 2002

Prepared by
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March, 2003

INTRODUCTION

The **Northern Pikeminnow Predator Control Program** was administered by PSMFC in 2002. 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 2002 a total of 201,396 fish were harvested in the sport-reward fishery. Vouchers for 199,220 fish were submitted for payment totaling rewards of $1,029,827. The rewards paid this season 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 $100 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 2002 as an incentive to stimulate angler participation. A total of 160 fish were submitted that were tagged. These rewards totaled $16,000. A total of 2,001 coupons were returned for payments of $8,004. Anglers were able to use a coupon on a voucher when they caught one or more pikeminnows for the extra $4 reward. Total reward payment for regular vouchers, tagged fish vouchers and coupons totaled $1,053,831. A total of 2,465 anglers who registered were successful in catching one or more fish in 2002. The 2002 season ran from May 13, 2002 through September 29, 2002. The season was extended three additional weeks to October 20, 2002 at selected stations that were still productive at the end of the regular season.

TAGGED FISH PAYMENTS

A total of 160 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 $100 tagged fish reward.

PREDACARDS

A few years ago a special plastic credit card type identification was issued to anglers to facilitate them checking in fish and providing for clarity of angler information on the vouchers issued. In 2002 a total of 529 anglers requested to be issued a “predacard.” Returning anglers

use their previously issued cards each year unless they have an address change or need a replacement card. This process has greatly aided receipt of legible vouchers from the more avid anglers so that data entry for the vouchers and timely processing of reward payments can proceed uninterrupted. Anglers usually receive their reward payments within 4-5 days after receipt of their voucher(s) at PSMFC. It is estimated that about 75-80 % of the program's anglers use predacards to check in fish.

FRAUD

It is apparent that some fraudulent submission of fish exists in the program. Fraud is something that the Pikeminnow Program takes very seriously. It is believed this is primarily submission of fish caught outside of the reward program boundaries or in other river systems than the Columbia and Snake rivers and usually may also entail registration violations. The Pikeminnow Sport Reward Program rules allow for exclusion from the program for anyone found to be in violation of those rules. PSMFC and WDFW continue to explore means to expose this fraud and exclude those participating in it. This process involves at times both ODFW and WDFW fishery agency enforcement officers as well as program supervisors. The registration process is designed to bring angling into the program area by requiring daily registration and submission of fish at the various stations in the reward program area. During 2002 seven anglers were permanently banned from further participation in the reward program for violation of program rules. Three of these were for violations during the 2001 season that either went to court or were a result of investigations finishing during 2002 prior to the season opening. This brings to eight the number of anglers banned permanently from the program. A total of three additional anglers were banned from participation for the remainder of the 2002 season for minor program rule violations and four more anglers were issued letters of warning that any further irregularities would result in exclusion for the 2002 season. Changes in the daily registration process are being implemented for the 2003 season to further tighten the process for those who would violate the program rules. It is felt it will also assist in furthering the intent of the program to concentrate on rewards for removal of fish from only the mainstem Columbia and Snake Rivers and deter fraud.

ACCOUNTING

Total payments for the season of regular vouchers, tagged fish, coupons and tournaments totaled $1,053,831. All IRS Form 1099 Misc. 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.

Table 1.

2002 SPORT REWARD PAYMENTS SUMMARY

The following is a summary of the vouchers received and paid as of December 7, 2002

TOTAL REWARD DOLLARS PAID:		**$1,053,831**
TOTAL FISH PAID:		**199,380**
		$ Amount
Number of fish paid @ Tier 1 ($4.00):	54,903	$219,612
Number of fish paid @ Tier 2 ($5.00):	55,687	$278,435
Number of fish paid @ Tier 3 ($6.00):	88,630	$531,780
Tags returned:	**160**	**$16,000**
Coupons returned:	2,001	$8,004

Number of anglers @ Tier 1	**2,153**	Number of anglers with 10 fish or less:	**1,536**
Number of anglers @ Tier 2	**187**	Number of anglers with 2 fish or less:	**636**
Number of anglers @ Tier 3	**125**		
Number of separate anglers	**2,465**	Number of Predacards ordered and/or Issued:	**529**

Top Twenty Anglers *	TIER 1	TIER 2	TIER 3	COUPON	TAGS	TOTAL FISH (not including coupon)	BALANCE
1 KENDALL, ROY G	99	300	6,412	1	2	6,813	$40,572
2 WILLIAMS, EDWARD R	99	300	3,776	1	0	4,175	$24,556
3 SCHWARTZ, DWAYNE W	99	297	2,730	1	9	3,135	$19,165
4 SMITH, THOMAS M	99	300	2,683	1	0	3,082	$17,998
5 ESSEX, JEAN E	100	300	2,609	0	0	3,009	$17,554
6 PAPST,THOMAS H	99	300	2,510	1	3	2,912	$17,260
7 MUCK,JAMES E	99	299	2,328	1	3	2,729	$16,163
8 HIEBERT,LEE J	100	300	2,324	0	0	2,724	$15,844
9 SMITH, DEAN M	99	300	2,161	1	6	2,566	$15,466
10 GARRICK, TERRY W	99	300	2,072	1	1	2,472	$14,432
11 ZAREMSKIY, NIKOLAY N	99	300	1,903	1	1	2,303	$13,418
12 OWRE, STEVEN H	99	300	1,853	1	6	2,258	$13,618
13 MINGS, LYNN E	99	300	1,822	1	0	2,221	$12,832
14 JENSEN, TED A JR	99	300	1,741	1	1	2,141	$12,446
15 MCDONALD,ROBERT E	99	300	1,551	1	0	1,950	$11,206
16 HISTAND,TIMOTHY L	99	300	1,549	1	1	1,949	$11,294
17 MINGS, GLEN E	99	300	1,540	1	0	1,939	$11,140
18 HOLSCHER,ERIC G	99	300	1,386	1	1	1,786	$10,316
19 DARDEN, HOLLIE	99	300	1,375	1	1	1,775	$10,250
20 WEARSTLER,ZACHARY A	99	300	1,350	1	2	1,751	$10,200
* (by total fish caught)	1,982	5,996	45,675	18	37	53,690	$315,730

REPORT C

CONTROLLED ANGLING FOR NORTHERN PIKEMINNOW AT LOWER COLUMBIA RIVER DAMS IN 2002

Prepared by

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For

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Since this component of the Northern Pikeminnow Management Program ended prematurely this year because of poor catch rates, this report was prepared by Russell Porter of the Pacific States Marine Fisheries Commission (PSMFC).

ABSTRACT

In 2002, the Yakama Nation crew angled for Northern pikeminnow (NPm) at Bonneville and The Dalles dams during three weeks from June 26, 2002 through July 14, 2002. All data collection methods were the same as in 2001, where the crew measured its effort generally as time spent on the dam rather than as time spent actively angling.

The crew caught 7 NPm > 230mm FL during 205.0 angling hours for a seasonal catch per angler hour (CPAH) of 0.034. Relative to 2001 the catch decreased many magnitudes from the catch rate in 2001 of 1.79 fish per angler hour. Because of this extremely low success rate this fishery was terminated after three weeks by agreement of the YIN and PSMFC. Therefore, this abstract constitutes this years report for this program task. This abstract comprises the complete report.

REPORT D

CONTROLLED ANGLING FOR NORTHERN PIKEMINNOW AT LOWER COLUMBIA RIVER DAMS IN 2002

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Since the YIN component of the Northern Pikeminnow Management Program ended prematurely this year because of poor catch rates, this report was prepared by Russell Porter of the Pacific States Marine Fisheries Commission (PSMFC).

ABSTRACT

In 2002, the Yakama Nation crew used small meshed gillnets at four locations in the lower Columbia River with the same methods used in 2001. The locations fished were all in Bonneville pool and included: Herman Creek, Drano Lake, Bingen Marina and the Klickitat River.

The crew fished with gillnets from May 13, 2002 to June 23, 2002 and caught 712 NPm in a total of 176 net-hours of effort, for a catch per net hour (CPNH) of 4.04. This compared with a CPNH of 4.4in 2001. The Klickitat River was the most productive and resulted in 96.8% (689 NPm) of the catch during 144 net-hours. This was followed by Drano Lake with 15 NPm in 11 net-hours, Herman Creek with 5 NPm in 11 net-hours, and Bingen Marina with 3 NPm in 11 net-hours.

A total of 141 sturgeon, 19 game fish, and 411 non-game fish were caught incidental to the fishery for Northern Pikeminnow. A total of 137 sturgeon were caught at the Klickitat River and 4 in Drano Lake with none from the other two locations. A total of 15 game fish were caught at Klickitat River and 4 in Drano Lake with none from the other two locations. The 411 non-game fish caught resulted from 240 from Klickitat River, 70 from Drano Lake, 58 from Bingen Marina and 43 from Herman Creek. This abstract comprises the complete report.

REPORT E

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

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ABSTRACT

Predator control fisheries aimed at reducing predation on juvenile salmonids by northern pikeminnow *Ptychocheilus oregonensis* were implemented for the twelfth 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 2002, (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 all northern pikeminnow ≥ 200 mm fork length (FL) was 10.6%, 3.4% for northern pikeminnow 200-249 mm FL, and 12.3% for northern pikeminnow ≥ 250 mm FL. Although northern pikeminnow were harvested by dam angling and site-specific gillnet fisheries, no fish tagged in 2002 were recovered by either of these fisheries; therefore, exploitation rates were 0.0%. Among reservoirs/river areas, exploitation of northern pikeminnow ≥ 200 mm by the sport-reward fishery was highest in Lower Granite Reservoir. Despite the unusually low exploitation rate for smaller northern pikeminnow, the exploitation rate for larger fish (≥ 250 mm FL) was very similar to the average rate for the past five years.

Incidental fish comprised 41.2% of the catch by sport-reward anglers targeting northern pikeminnow, 66.7% of the dam angling catch, and 19.5% of the site-specific gillnet catch. The proportion of the northern pikeminnow catch consisting of predator-sized fish (≥ 200 mm FL) was 79.4% in the sport-reward fishery. Incidental catch of salmonids by all fisheries combined was 0.3% of the total catch.

Although modest reductions in potential predation have been achieved since 1999, further reductions are likely to be minimal if exploitation continues at mean 1996-2002 levels. We estimate potential predation is currently 77% of pre-program levels; extrapolation indicates this level of reduction will remain relatively constant through 2006.

Within-year tag loss was estimated to be 3.8% for spaghetti tags. However, because of possible errors in secondary mark identification, this estimate is uncertain. The true tag loss rate could have been lower than 3.8%, or as high as 5.7%. In 2003 we plan to conduct a double-tagging experiment to improve estimates of tag loss.

Between-reader agreement in aging of northern pikeminnow scales and opercles was higher in 2002 than in the previous year, suggesting as readers gain experience working together, they begin to interpret annuli in a similar manner. Agreement between tagging and recapture ages and time at-large was higher for scale samples collected in the same year compared to those collected in different years.

Ages assigned to opercles exactly matched ages assigned to scales from the same fish 27.1% of the time; however, agreement within ± one year was 65.9%. Overall, ages for opercles tended to be greater than those for scales, suggesting that either scales underestimate or opercles overestimate ages of northern pikeminnow. Opercles from northern pikeminnow injected with

oxytetracycline exhibited fluorescent marks of variable quality. Although most marks were relatively poor, further experimentation with different dosages may improve mark quality.

INTRODUCTION

The goal of the Northern Pikeminnow Management Program (NPMP) is to reduce mortality of juvenile salmonids attributed to predation by northern pikeminnow *Ptychocheilus oregonensis* in the lower Columbia and Snake rivers. Prior to the implementation of predator control fisheries, the Oregon Department of Fish and Wildlife (ODFW) established baseline levels of predation and described northern pikeminnow population characteristics. We estimated 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 predation levels 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 2002, and wherever possible, evaluate changes from previous years.

Our objectives in 2002 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. Objectives (3) and (4) 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 operated in 2002. The Washington Department of Fish and Wildlife (WDFW) administered the sport-reward fishery from April 29 (May 13 for areas upstream of The Dalles Dam) to October 20 throughout the lower Columbia and Snake rivers. Participating anglers received payment for northern pikeminnow 9 inches (230 mm) total length (TL) (approximately equivalent to 200 mm fork length) and larger. The Yakama Nation implemented the dam angling fishery from June 24 to July 14 at Bonneville and The Dalles dams (fishing primarily on the tailrace side of the dams). They also fished with gillnets from May 13 to June 23 in Bonneville Reservoir. The dam angling and site-specific gillnet fisheries both targeted northern pikeminnow ≥ 230 mm TL.

We tagged and released northern pikeminnow ≥ 200 mm fork length (FL) to estimate exploitation rates for each fishery. We used electrofishing boats and bottom gillnets to collect

northern pikeminnow from March 28 to June 28. Parker et al. (1995) provides a detailed description of sampling gears and methods. With few exceptions, we allocated equal 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 2002, we again sampled only about half of John Day Reservoir due to historically low numbers of tagged and recaptured fish in that reservoir. We did not sample 22 rkm in various areas of the Columbia River due to inclement weather and mechanical problems. On the Snake River, we sampled above Lower Granite Dam from rkm 211 (approximately 11 rkm downstream of Lewiston, Idaho) to rkm 246 (near the mouth of the Grande Ronde River). Mechanical problems prevented us from sampling 21 rkm in various areas of the Snake River. Sampling in Lower Monumental and Little Goose reservoirs was discontinued in 2001 due to historically low numbers of tagged and recaptured fish in those reservoirs. We inserted serially numbered spaghetti tags in northern pikeminnow ≥ 200 mm FL. To evaluate tag loss, we clipped the left pectoral fin on all tagged fish.

Data Analysis

We used mark-and-recapture data to compare exploitation rates of northern pikeminnow ≥ 200 mm FL, 200-249 mm FL, and ≥ 250 mm FL among fisheries and reservoirs in 2002. Weekly estimates of exploitation for each fishery were calculated by dividing the number of tagged northern pikeminnow recovered by the number of tagged fish at large. We then summed the weekly exploitation rates to yield total exploitation rates for the season (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 completed, 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.

Weekly exploitation estimates were adjusted using these confidence intervals, and the results were summed to give overall 95% confidence bounds. We also plotted annual sport-reward exploitation rate versus mean Columbia River stage (May-September; below Bonneville Dam) to explore the effect of river flow on northern pikeminnow harvest

We compared incidental catch among fisheries by calculating the percent of the total catch comprised of fish other than northern pikeminnow ≥ 200 mm FL. We also estimated the proportion of predator-sized northern pikeminnow (≥ 200 mm FL) relative to the total northern pikeminnow catch, as well as 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 (Knutsen and Ward 1998). The model therefore estimates changes in potential predation related directly to removals, allowing us to estimate the effects of removals if all variables except exploitation were held constant.

We estimated the potential relative predation in 2002 based on observed exploitation rates, and the eventual minimum potential predation assuming continuing exploitation at mean 1996-2002 levels. Because inputs to the model included three potential relationships between age of northern pikeminnow and consumption, as well as three estimates of exploitation (point estimate and 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 a secondary mark (left pectoral fin clip) and no spaghetti tag, and
r = number of northern pikeminnow recaptured with year 2002 tags intact.

Age Validation

Field and Laboratory Procedures

We collected scale samples from all northern pikeminnow we tagged in 2002. In addition, each fish was injected with a solution of oxytetracycline (OTC) at a dosage of 35 mg OTC per kg fish weight (McFarlane and Beamish 1987) to leave a fluorescent mark on aging structures. 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. Parker et al. (1995) described methods of age determination in northern pikeminnow. Two experienced readers independently aged the scale samples. When the readers disagreed on an age, they reviewed 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. We then removed the tissue using a pair of tweezers and a 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 (Scoppettone 1988). Readers examined each opercle 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. The same two readers who had aged the scales also read the opercles. We resolved age differences in the same way that we had done for the scales. In addition, we checked opercles from fish tagged in 2002 for fluorescent OTC marks. Each opercle was examined in a dark room under a dissecting microscope using a desk lamp fitted with a "black light".

Data Analysis

Continuing an age validation study initiated in 2000 (Takata and Ward 2001), we evaluated between-reader variation in ages assigned to both scales and opercles from northern pikeminnow. Aging discrepancies were 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 (e.g. -2 years, - 1 year, 0 years, + 1 year, etc), so we could determine if differences were systematic. We then calculated the percentage of samples in each discrepancy category as a measure of between-reader agreement.

We also sought to validate yearly annulus formation. We compared final ages (agreed upon by both readers) assigned to scales collected at recapture to those for scales collected from the same fish at tagging. We used the formula

$$D = (A_R - A_T) - (Y_R - Y_T),$$

where

D = age discrepancy,
A_R = age assigned to a scale at recapture,
A_T = age assigned to a scale at tagging,
Y_R = recapture year, and
Y_T = tagging year

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

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_O = age assigned to an opercle at recapture, and
A_S = age assigned to a scale at recapture.

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

Opercles from pikeminnow tagged in 2002 were checked for OTC marks and the marks were scored for quality. An easily observed, relatively wide fluorescent band along all or most of the opercle's edge was scored as a '3' (good mark). If the fluorescent band was thin but still went around ½ or more of the opercle's edge, it was scored as a '2' (fair mark). If there was fluorescent marking along less than half of the opercle's edge then it was considered a '1' (poor mark).

RESULTS

Fishery Evaluation, Predation Estimates, and Tag Loss

We tagged and released 1,097 northern pikeminnow throughout the lower Columbia and Snake rivers in 2002. Of these fish, 214 were 200-249 mm FL and 883 were ≥ 250 mm FL. A total of 100 northern pikeminnow tagged in 2002 were recaptured in 2002, all in the sport-reward fishery. Seven of the recaptures were 200-249 mm and 93 were ≥ 250 mm.

The management fisheries harvested 201,164 northern pikeminnow ≥ 200 mm FL in 2002. System-wide exploitation of northern pikeminnow ≥ 200 mm by all fisheries combined was 10.6% (95% confidence interval 5.8% - 19.6%). Reservoir/area-specific exploitation rates ranged from 0.0% in John Day Reservoir to 11.6% in Lower Granite Reservoir. The system-wide exploitation rate of northern pikeminnow 200-249 mm by all fisheries was 3.4% (confidence interval not available because mn < 30), and ranged from 0.0% in Bonneville, The Dalles, and John Day reservoirs to 5.3% in McNary Reservoir. For northern pikeminnow ≥ 250 mm, the system-wide exploitation rate for all fisheries combined was 12.3% (95% confidence interval 6.5% - 23.2%), ranging from 0.0% in John Day Reservoir to 14.3% in Lower Granite Reservoir (Figure 1; Appendix Table A-1).

The sport-reward fishery harvested 200,445 northern pikeminnow ≥ 200 mm FL. Based on sampled catch proportions, an estimated 120,267 of these fish were ≥ 250 mm FL and 80,178 were 200-249 mm FL. Mean fork length of northern pikeminnow harvested in the sport-reward fishery was 281 mm (J. Hone, WDFW, personal communication). Because all tag recoveries occurred in the sport-reward fishery, exploitation estimates for this fishery are the same as for all fisheries combined (Figure 1; Appendix Table A-2). Only 22 northern pikeminnow were tagged in John Day Reservoir; none were recovered by the sport-reward fishery.

For larger northern pikeminnow (≥ 250 mm), we identified a significant inverse relationship (r^2 = 0.76; P < .05) between sport-reward exploitation rate and mean Columbia River stage below Bonneville Dam during the sport-reward season (Figure 2).

Only 719 northern pikeminnow ≥ 200 mm FL were harvested in the dam angling (7) and site-specific gillnet (712) fisheries in 2002, and none of these fish were tagged. Thus, exploitation for these fisheries was 0.0% (Figure 1; Appendix Tables A-3 and A-4). Northern pikeminnow were not measured in either fishery during 2002 (G. Lee, Yakama Nation, personal communication); therefore, catch proportions for the size groups (≥ 250 mm FL and 200-249 mm FL) and the mean size of harvested fish were unknown. System-wide weekly exploitation rates for all fisheries are tabulated in Appendix Tables A-5 to A-7.

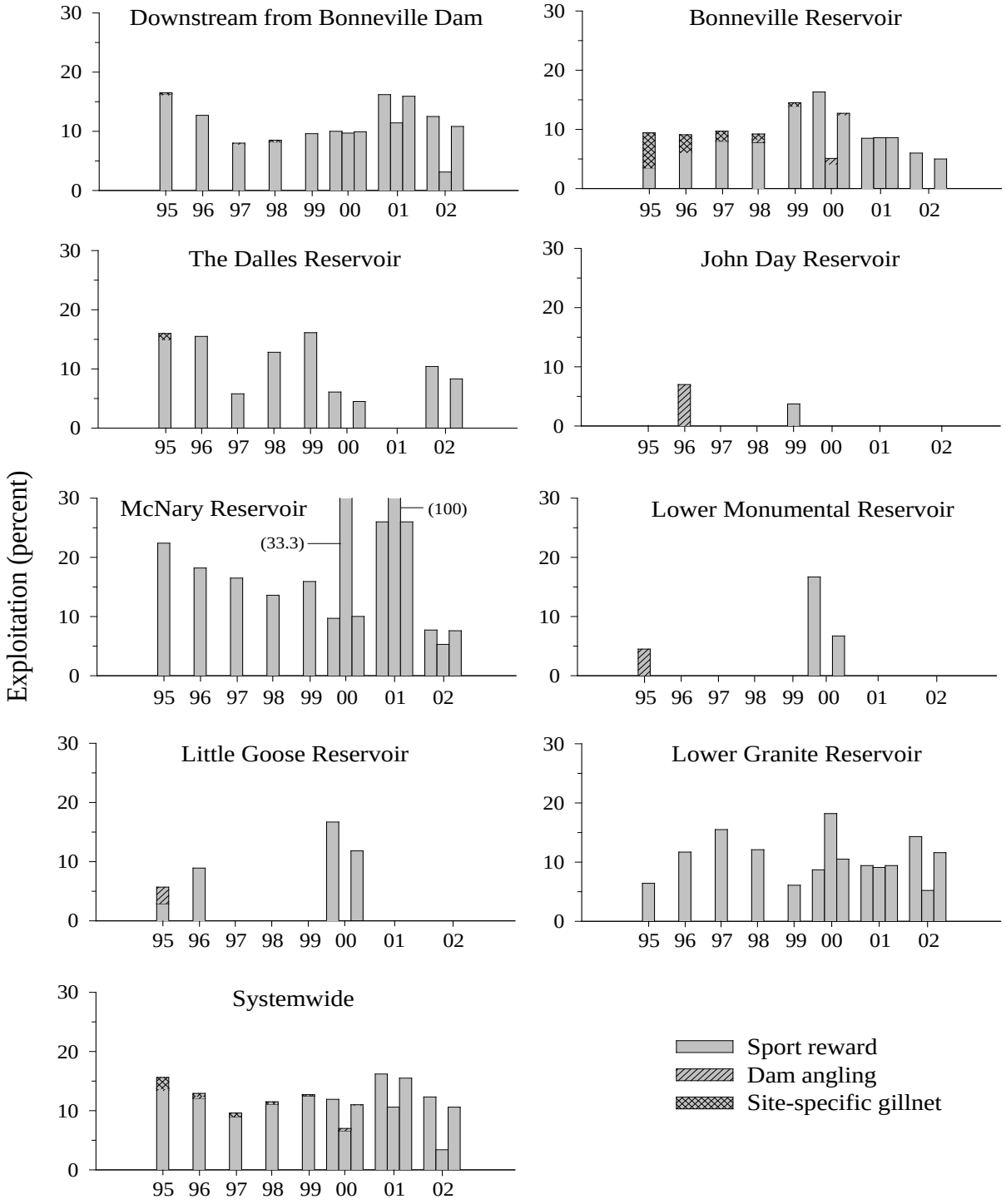

Figure 1. Exploitation of northern pikeminnow ≥ 250 mm fork length (FL) by reservoir/area and fishery, 1995-2002. For 2000-2002, vertical bars, from left to right, show exploitation for northern pikeminnow ≥ 250 mm FL, 200-249 mm FL, and ≥ 200 mm FL. Exploitation rates were not corrected for tag loss in 2000-2002.

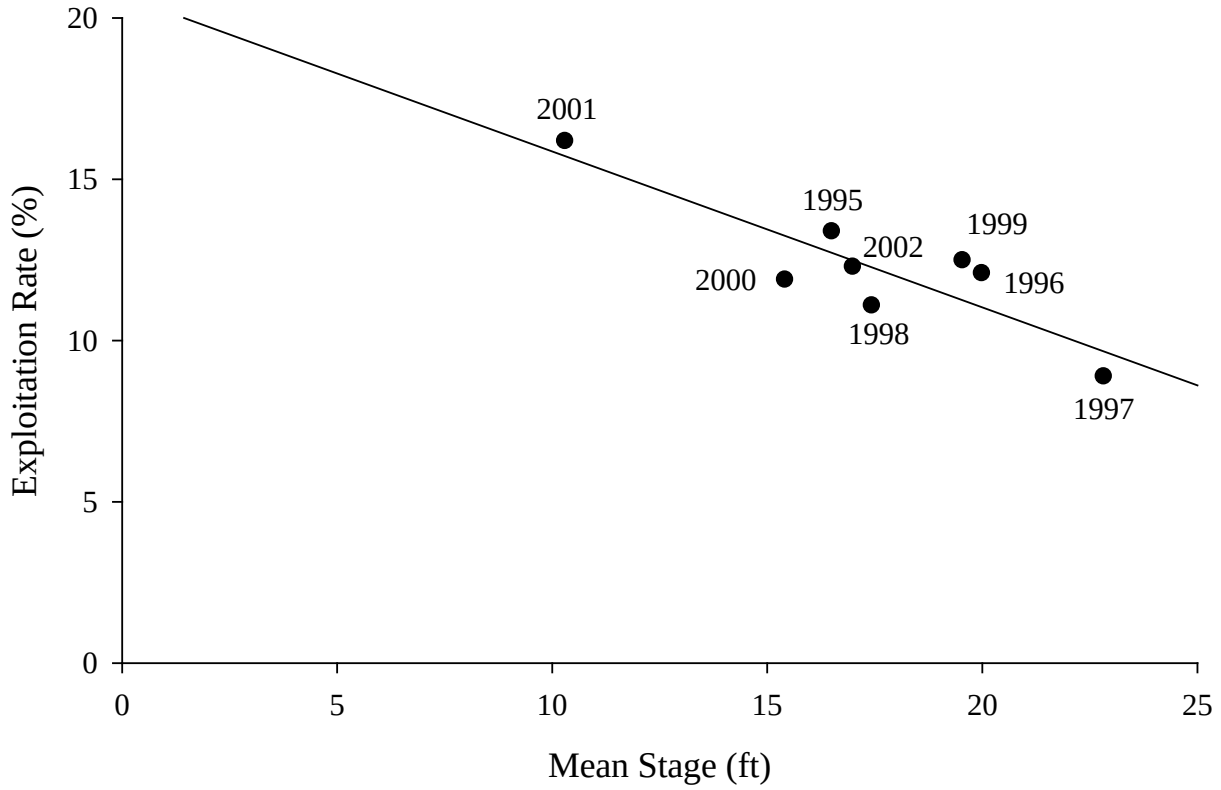

Figure 2. Relationship between sport-reward exploitation of northern pikeminnow ≥ 250 mm FL and mean Columbia River stage (gage height below Bonneville Dam) during the sport-reward season (May-September) for the period 1995-2002.

In 2002, the three management fisheries reported a total incidental catch of 140,577 fish, including northern pikeminnow < 200 mm FL (Table 1). The incidental catch rate for all fisheries combined was 41.1%. The most common incidental fishes were northern pikeminnow < 200 mm, other cyprinids, and small mouth bass. The incidental catch rate was 41.2% for anglers who targeted northern pikeminnow in the sport-reward fishery, 66.7% in the dam angling fishery, and 19.5% in the site-specific gillnet fishery. For the sport-reward fishery, the proportion of the northern pikeminnow catch consisting of fish $\geq$ 200 mm was 79.4%. The proportions for the dam angling and site-specific gillnet fisheries are unknown (G. Lee, Yakama Nation, personal communication). In the sport-reward fishery, 0.3% of the total catch consisted of salmonids. Salmonids made up 1.4% of the total catch in the site-specific gillnet fishery, and no salmonids were caught in the dam angling fishery. For all fisheries combined, salmonids comprised 0.3% of the total catch.

Table 1. Catch of northern pikeminnow and incidental fishes in each fishery in 2002. 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	200,533	7	712
< 200 mm FL	51,929	[a]	[a]
Salmonidae			
Chinook (adult/jack)	88	0	[a]
Coho (adult/jack)	4	0	[a]
Sockeye (adult)	0	0	[a]
Steelhead (adult)	154	0	[a]
Cutthroat trout	27	0	[a]
Juvenile salmon/steelhead	617	0	[a]
All other salmonids[b]	248	0	12
White sturgeon	4,557	13	141
Walleye	510	[a]	[a]
Smallmouth bass	13,240	[a]	[a]
Yellow perch	1,218	[a]	[a]
American shad	254	[a]	[a]
Cyprinidae[c]	50,553	[a]	[a]
Catostomidae	3,846	[a]	[a]
Ictaluridae	7,439	[a]	[a]
Centrarchidae[d]	233	[a]	[a]
Other/unidentified	5,474	1	19
Total (all species)	340,924	21	884
Percent incidental catch	41.2	66.7	19.5

[a] Catch unknown. Counts included in "Other/unidentified".
[b] Includes juvenile and adult *Oncorhynchus* spp., and mountain whitefish *Prosopium williamsoni*.
[c] Excluding northern pikeminnow.
[d] Excluding smallmouth bass.

Modeling results indicated potential predation by northern pikeminnow on juvenile salmonids in 2002 ranged from 63% to 89% of pre-program levels, with a median estimate of 77% (Figure 3). Extrapolation through 2006 indicated continued harvest at mean 1996-2002 exploitation levels will result in minimal additional reductions in predation.

Four northern pikeminnow with a left pectoral fin clip and a missing tag were reported recovered in the sport-reward fishery, yielding a tag loss estimate of 3.8% (96.2% retention). Fish tagged and recaptured in 2002 were at-large from 3 to 180 days.

AGE VALIDATION

We aged a total of 293 scale and 136 opercle samples from tagged and recaptured northern pikeminnow in 2002. For scales collected at tagging, complete agreement (i.e. zero discrepancy) on ages assigned by the two readers was 53.8%, with 90.3% agreement within ± one year (Figure 4). For scales collected at recapture, both complete agreement and agreement within ± one year was slightly lower at 41.2% and 82.4%, respectively. Complete agreement was lowest for opercles collected at recapture at 33.8%. Nevertheless, agreement within ± one year was relatively high (80.1%). For scales, there did not appear to be any pattern to aging discrepancies. However, for the opercle samples, Reader 1 tended to age older than Reader 2 (Figure 4). The largest age discrepancy between the two readers was 7 years.

When final ages assigned to scales collected at tagging in 2000 were compared to final ages assigned to scales collected from the same fish at recapture in 2002, the ages accounted exactly for the time at-large only 22.2% of the time (Figure 5, panel A). However, agreement within ± one year was 72.2%. Ages assigned to scales collected at recapture were usually not old enough to account for the two years that the fish were at-large.

Final ages assigned to scales collected at tagging in 2001 and recaptured in 2002 accounted exactly for the time at-large 29.0% of the time (Figure 5, panel B). Agreement within ± one year occurred with 67.7% of the samples. Ages assigned to scales collected at recapture were usually not old enough to account for the one year that the fish were at-large.

Ages assigned to scales collected at tagging and recaptured in 2002 accurately accounted for time at-large 51.1% of the time (Figure 5, panel C). Agreement within ± one year occurred in 89.8% of the samples. Unlike the 2000 and 2001 samples, differences in 2002 did not appear to be systematic.

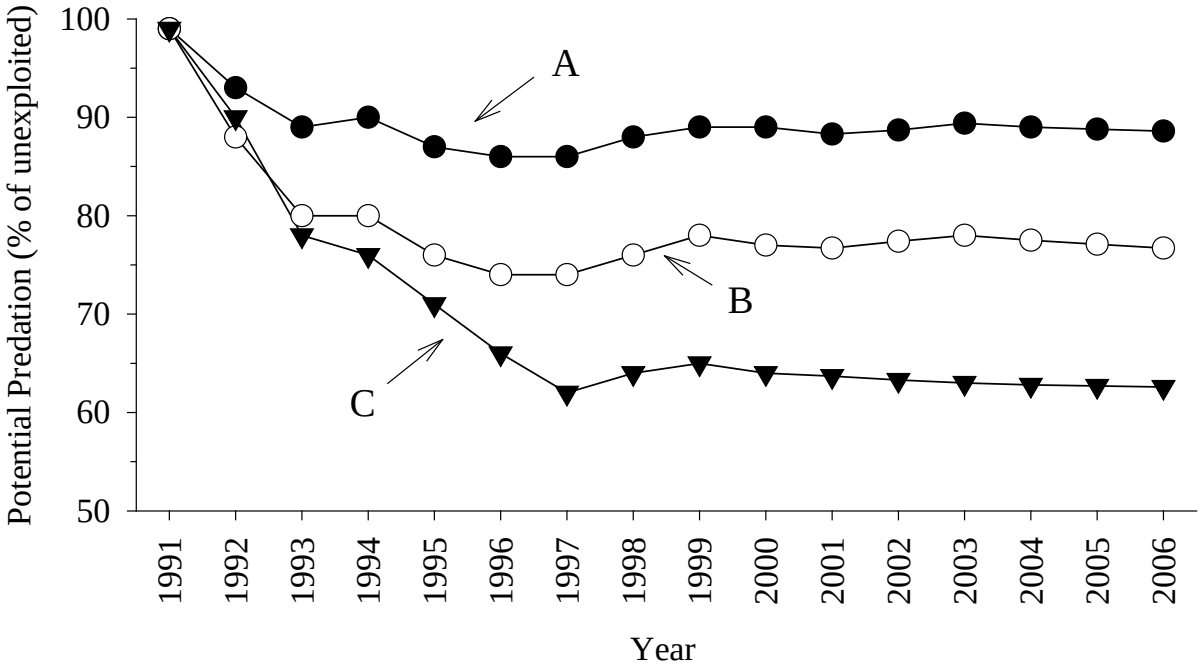

Figure 3. Maximum (A), median (B), and minimum (C) estimates of potential predation on juvenile salmonids by northern pikeminnow relative to predation prior to implementation of the Northern Pikeminnow Management Program. Trends after 2002 indicate predicted predation in future years if exploitation is maintained at mean 1996-2002 levels.

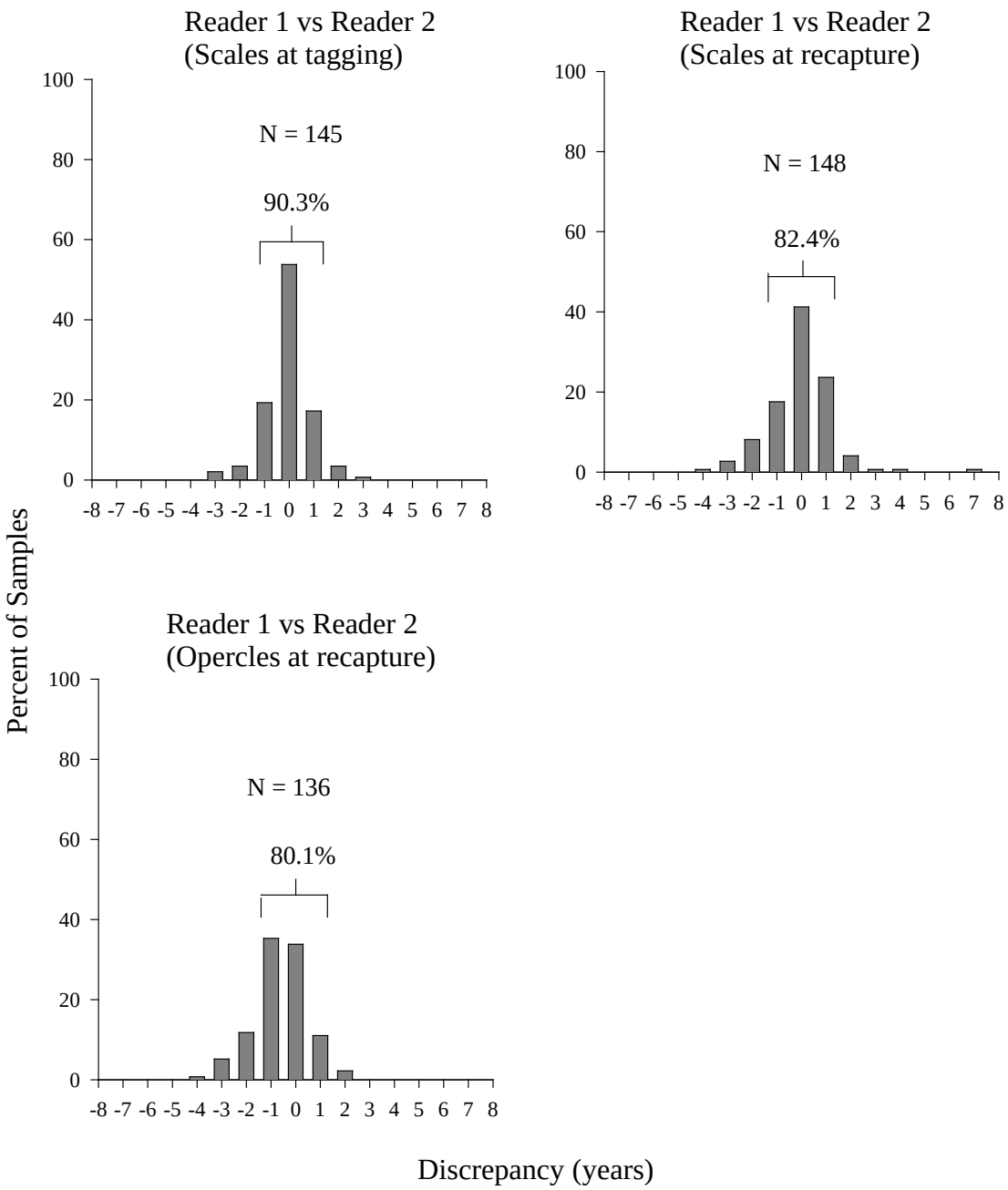

Figure 4. Distribution of reader aging discrepancies for northern pikeminnow scales and opercles collected at tagging and recapture in 2002. A potential aging discrepancy is defined as the Reader 1 age subtracted from the Reader 2 age.

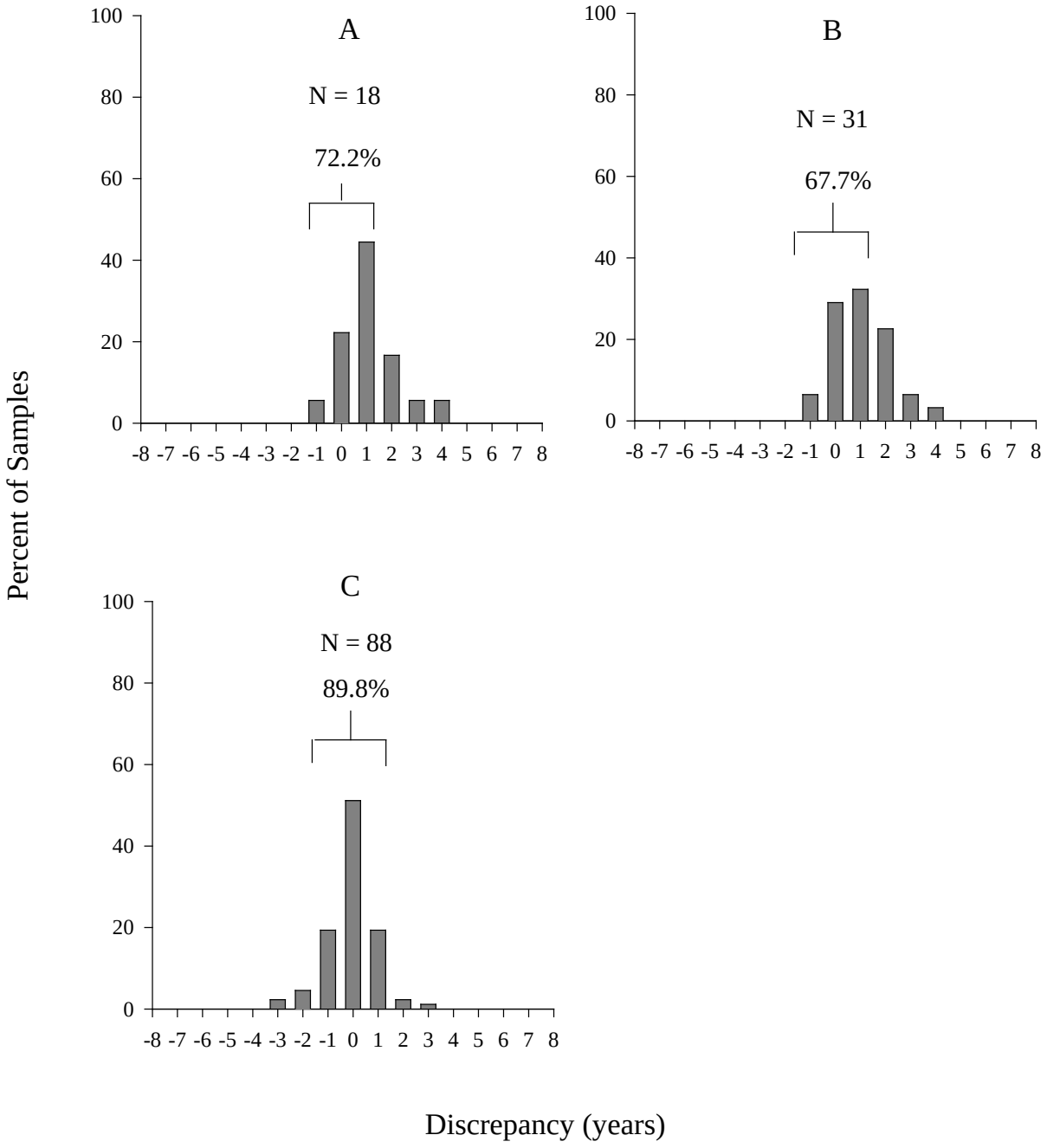

Figure 5. Panel A: aging discrepancies for scales collected from northern pikeminnow during tagging in 2000 and at recapture in 2002. Panel B: discrepancies for scales taken at tagging in 2001 and at recapture in 2002. Panel C: discrepancies for scales taken at both tagging and recapture in 2002. A potential discrepancy is defined as the difference between recapture age minus tagging age and recapture year minus tagging year.

Final ages assigned to scales matched exactly with final ages assigned to opercles from the same fish 27.1% of the time (Figure 6, panel A). Agreement within ± one year was 65.9%. The largest discrepancy between scale and opercula ages was five years, and differences were significant ($P < 0.001$). The majority (51.2%) of the paired samples had an opercle age that was greater than the scale age. Scale ages ranged from 3 to 15 years while opercle ages ranged from 4 to 15 years. Through age 9, scale and opercle ages were almost equally likely to be younger, older, or the same age. However, after age 9, opercles tended to be aged older than scales (Figure 6, panel B).

A total of 85 opercle samples from northern pikeminnow tagged and recaptured in 2002 were examined for OTC mark quality. According to our criteria, most (52%) marks were of poor quality, 34% were fair, and 14% were good.

DISCUSSION

At 12.3%, system-wide exploitation of northern pikeminnow ≥ 250 mm by the management fisheries in 2002 was the same as the mean exploitation rate for the 5-year period 1997-2001. However, the exploitation rate for northern pikeminnow 200-249 mm (3.4%) was the lowest since these smaller fish were first targeted in 2000. This reduced the exploitation rate for all northern pikeminnow ≥ 200 mm (10.6%) to the lowest level since 2000. Although exploitation rates on smaller fish are typically lower than those for larger fish, we cannot explain the unusually low exploitation rates for northern pikeminnow 200-249 mm in 2002. Sport-reward harvest of large (≥ 250 mm) northern pikeminnow appears to be driven by river flow, with exploitation increasing as river levels decrease.

Exploitation rate of northern pikeminnow ≥ 200 mm declined from 2001 in all areas except The Dalles and Lower Granite reservoirs. Among reservoirs/areas, Lower Granite Reservoir had the highest exploitation rate. Bonneville, The Dalles, and John Day reservoirs had no northern pikeminnow 200-249 mm recaptured in 2002. Also, for the sixth time in nine years, John Day Reservoir had an overall exploitation rate of 0.0%. This is likely due to a number of factors, including the large size of the reservoir, light fishing pressure, and low densities of northern pikeminnow (resulting in a relatively small number of tagged fish).

The dam angling and site-specific gillnet fisheries accounted for only 0.003% and 0.4%, respectively, of the total northern pikeminnow harvest and did not recapture any tagged fish, resulting in exploitation rates of 0.0% in 2002. The dam angling fishery has not recaptured a tagged northern pikeminnow since 2000 and the site-specific gillnet fishery has not recaptured one since 1999. Both effort and catch were slightly higher for the gillnet fishery in 2002 compared to 2001; however, effort in the dam angling fishery decreased by 87% and the catch of northern pikeminnow decreased by more than 99% to a mere seven fish. .

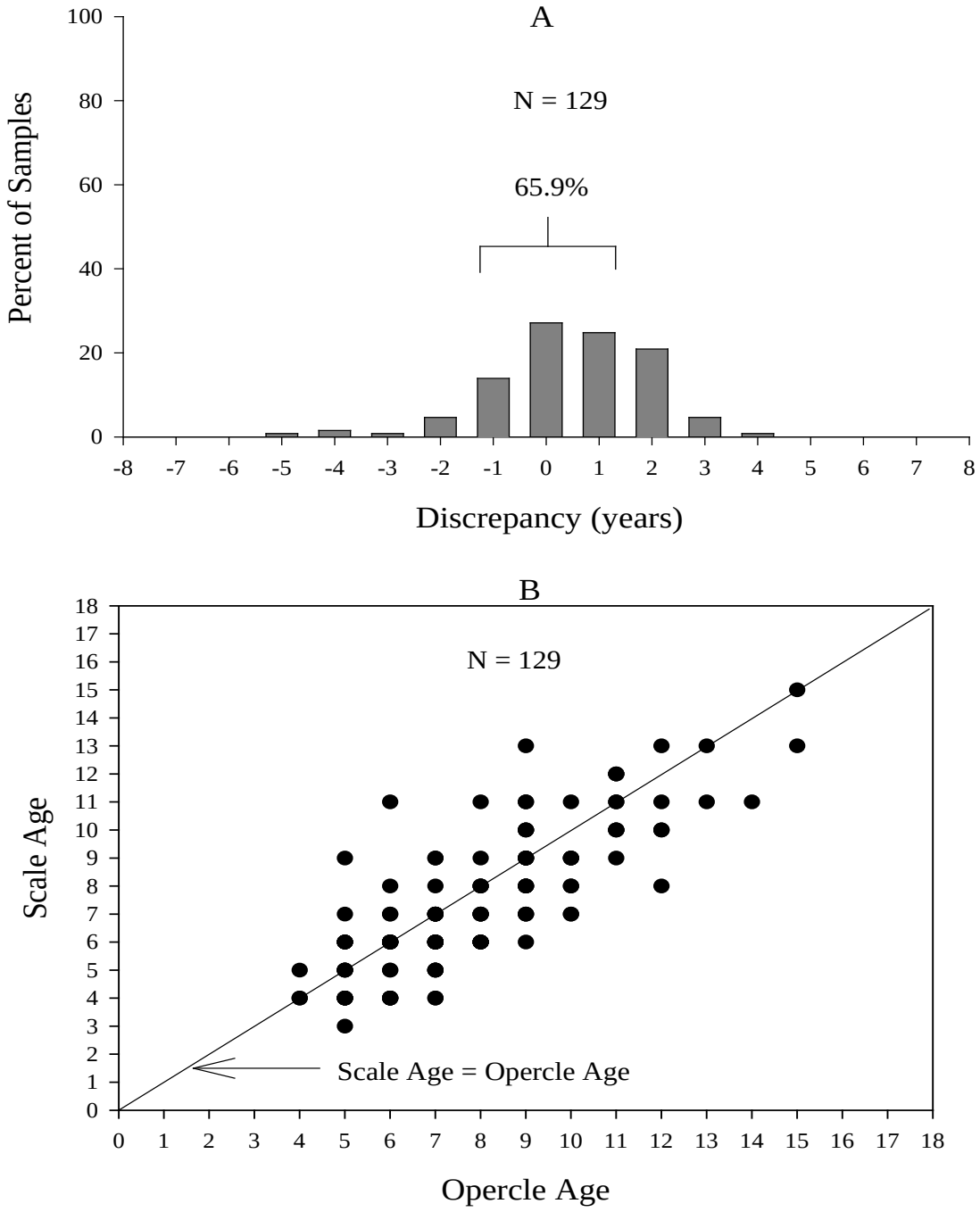

Figure 6. Comparison of ages assigned to scales and opercles from northern pikeminnow recaptured in 2002. Panel A: aging discrepancies between scales and opercles taken from the same fish. A potential discrepancy is defined as the scale age subtracted from the opercle age. Panel B: scale ages plotted against corresponding opercle ages.

Incidental catch rates for the management fisheries had been very stable over the past several years (approximately 30% for the sport-reward fishery, 5% for the dam angling fishery, and 55-60% for the site-specific gillnet fishery). However, 2002 incidental catches were over 10% higher in the sport-reward fishery and over ten times higher in the dam angling fishery. The high incidental catch rate in the dam angling fishery is undoubtedly a result of the extremely low northern pikeminnow catch. The lower than usual incidental catch rate in the site-specific gillnet fishery may be attributed to different fishing locations, random variation in catch composition, or incomplete catch data. After an increase in the catch rate of salmonids in 2001 (due to high angler effort and record runs of salmon and steelhead), the catch rate returned to its historical average of 0.3% in 2002.

It appears most of the reduction in potential predation has been realized in the first seven years of the NPMP. After slight increases in 1998 and 1999, potential predation has stabilized at approximately 75- 80% of pre-program levels. If exploitation rates remain similar to mean 1996-2002 levels, further reductions in potential predation are likely to be minimal. Therefore, maintaining potential predation near the current level of 77% 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 an audit of the NPMP (Hankin and Richards 2000), we are currently working on an updated predation model. We plan to use the new model once our aging and tag loss assessments are completed.

Although four northern pikeminnow with missing tags and left pectoral fin clips were reported in 2002, we had serious concerns regarding the accuracy of fin mark identification. Seventeen percent of the fish with year 2002 tags were reported with fin marks other than a left pectoral clip. This would imply that a very high percentage of northern pikeminnow might have been incorrectly marked at tagging. However, due to close supervision during tagging operations and the manner in which fish are processed, a mark error rate of 17% is unreasonably high. It is more likely that some unknown number of northern pikeminnow had their fin marks incorrectly identified at the time of their recapture in the sport-reward fishery. This leads to some uncertainty about the correct number of tag loss fish with left pectoral clips. Therefore, actual tag loss in 2002 may have ranged from 0.0 to 5.7%. Because of this uncertainty, we did not adjust exploitation rates for tag loss in 2002. Prior to 2000, an annual tag loss rate of 4.2% was used to adjust exploitation rates (Zimmerman et al. 1999). If this tag loss rate were applied to 2002 exploitation estimates, it would have increased exploitation rates from 0.2 to 0.5% (depending on location). We are considering a double tagging experiment using passive integrated transponder (PIT) tags in 2003 to better assess tag loss rate.

In our aging study, we found both absolute agreement and agreement within ± one year between readers for ages assigned to scales and opercles were higher in 2002 than in 2001. Readers in both years were the same individuals; therefore, the additional year of experience working together on the project probably led to greater similarities in interpretation of annuli.

Compared to scales, ages assigned to opercles had lower levels of precision. This is similar to our results in 2001, and may be an indication of greater difficulty identifying annuli on opercles. Opercles have many translucent lines that may or may not be true annuli. This could easily lead to different counts between readers. We are attempting to address this problem

through our OTC marking experiments to help identify annuli on opercles.

Our age validation results in 2002 were also similar to our findings in 2001. Agreement between tagging and recapture ages and the time at-large was higher for samples taken from fish tagged and recaptured in the same year compared to those tagged and recaptured in different years. Because the most frequent discrepancy for scale samples collected in different years was underestimation of the recapture age by one year, we may be having difficulties detecting newly formed annuli on scales.

Our comparison of scale and opercle ages in 2002 yielded results almost identical to those in 2001. However, the magnitude of differences between scale and opercle ages was slightly smaller in 2002 compared to the previous year. Studies by Campbell and Babaluk (1979), Scoppettone (1988), Donald et al. (1992), and the Washington Department of Fish and Wildlife (J. Sneva, WDFW, personal communication) also found that ages derived from opercles tended to be older than those from scales. For this reason, some investigators have suggested that opercles may provide more accurate ages than scales, particularly for older fish (Donald et al. 1992). If scales do underestimate the ages of northern pikeminnow, we may be overestimating growth and natural mortality rates, which can affect our modeling of population structure and predation. Although opercles may provide more accurate ages than scales, our findings indicate between-reader variability is higher for opercles. Therefore, we will continue to evaluate the potential of using opercula to age northern pikeminnow.

Although some fluorescence was detected on virtually all opercles examined for OTC marks, the majority of opercle samples had poor quality marks. There are several possible explanations for this. First, the dosage used (35 mg OTC/kg fish weight) might have been too low to produce a satisfactory mark in northern pikeminnow opercles. McFarlane and Beamish (1987) noted that OTC mark intensity was a function of the dosage administered; however, high dosages (e.g. over 100 mg/kg) could lead to mortality. In 2002 we chose to use a conservative dosage, and three northern pikeminnow injected with OTC were held for six months in a tank to test for mortality. None of the injected fish died, nor did the two control fish that were not injected. The poor OTC marks may also be the result of administering the OTC at a time when northern pikeminnow are close to forming an annulus. Conover and Sheehan (1999) believed that better quality marks might be achieved if the OTC was administered during a period of rapid fish growth. However, since we must tag northern pikeminnow in the spring, and they are thought to form an annulus in the late spring or early summer, it is difficult for us to administer the OTC during another time of the year. Finally, fish at-large for less than a year before recapture (3-180 days in 2002) may not have sufficient time to grow after OTC marking to produce a well-defined fluorescent band. Most of the opercles examined had only a very thin fluorescent line on the edge of the opercle with no apparent growth beyond it.

Due in part to the qualitative nature of the mark scoring criteria, we did not find any relationships between mark quality and variables such as time at-large, tagging date, or amount of OTC administered. We will continue with our OTC experiments in 2003.

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APPENDIX A

EXPLOITATION OF NORTHERN PIKEMINNOW, 1998-2002

Appendix Table A-1. Exploitation rates (%) of northern pikeminnow ≥ 250 mm fork length (FL) for all fisheries combined, 1998-2002. Exploitation rates were not corrected for tag loss in 2000-2002.

Area or Reservoir	1998	1999	2000[a]	2001[a]	2002[a]
Downstream of Bonneville Dam	8.4	9.6	10.0 (9.7)[a1] (9.9)[a2]	16.2 (11.4)[a1] (15.9)[a2]	12.6 (3.1)[a1] (10.8)[a2]
Bonneville	9.2	14.5	16.3 (5.2)[a1] (12.7)[a2]	8.5 (8.6)[a1] (8.6)[a2]	6.0 (0.0)[a1] (5.0)[a2]
The Dalles	12.8	16.1	6.1 (0.0[c])[a1] (4.5)[a2]	0.0[c] (0.0[c])[a1] (0.0[c])[a2]	10.4 (0.0)[a1] (8.3)[a2]
John Day	0.0[c]	3.7	0.0[c] (0.0[c])[a1] (0.0[c])[a2]	0.0[c] (0.0[c])[a1] (0.0[c])[a2]	0.0 (0.0)[a1] (0.0)[a2]
McNary	13.6	15.9	9.7 (33.3)[a1] (10.2)[a2]	26.0 (100.0)[a1] (26.0)[a2]	7.7 (5.3)[a1] (7.6)[a2]
Ice Harbor	--[b]	--[b]	--[b]	--[b]	--[b]
Lower Monumental	0.0[c]	0.0[c]	16.7 (0.0[c])[a1] (6.7)[a2]	--[b]	--[b]
Little Goose	0.0[c]	0.0[c]	16.7 (0.0[c])[a1] (11.8)[a2]	--[b]	--[b]
Lower Granite	12.1	6.1	8.7 (18.2)[a1] (10.5)[a2]	9.4 (9.1)[a1] (9.4)[a2]	14.3 (5.2)[a1] (11.6)[a2]
System-wide	11.5	12.7	11.9 (7.1)[a1] (11.0)[a2]	16.2 (10.6)[a1] (15.5)[a2]	12.3 (3.4)[a1] (10.6)[a2]

[a] Rewards were paid for northern pikeminnow ≥ 200 mm FL. Figures in parentheses indicate the exploitation rate for northern pikeminnow 200-249 mm FL ( )[a1] and the total exploitation rate for northern pikeminnow ≥ 200 mm FL ( )[a2].
[b] No northern pikeminnow tagged.
[c] Northern pikeminnow harvested, but no tags recovered.

Appendix Table A-2. Exploitation rates (%) of northern pikeminnow ≥ 250 mm fork length (FL) for the sport-reward fishery, 1998-2002. Exploitation rates were not corrected for tag loss in 2000-2002.

Area or Reservoir	1998	1999	2000[a]	2001[a]	2002[a]
Downstream of Bonneville Dam	8.2	9.6	10.0 (9.7)[a1] (9.9)[a2]	16.2 (11.4)[a1] (15.9)[a2]	12.6 (3.1)[a1] (10.8)[a2]
Bonneville	7.8	13.9	16.3 (4.1)[a1] (12.4)[a2]	8.5 (8.6)[a1] (8.6)[a2]	6.0 (0.0)[a1] (5.0)[a2]
The Dalles	12.8	16.1	6.1 (0.0[c])[a1] (4.5)[a2]	0.0[c] (0.0[c])[a1] (0.0[c])[a2]	10.4 (0.0)[a1] (8.3)[a2]
John Day	0.0[c]	3.7	0.0[c] (0.0[c])[a1] (0.0[c])[a2]	0.0[c] (0.0[c])[a1] (0.0[c])[a2]	0.0 (0.0)[a1] (0.0)[a2]
McNary	13.6	15.9	9.7 (33.3)[a1] (10.2)[a2]	26.0 (100.0)[a1] (26.0)[a2]	7.7 (5.3)[a1] (7.6)[a2]
Ice Harbor	--[b]	--[b]	--[b]	--[b]	--[b]
Lower Monumental	0.0[c]	0.0[c]	16.7 (0.0[c])[a1] (6.7)[a2]	--[b]	--[b]
Little Goose	0.0[c]	0.0[c]	16.7 (0.0[c])[a1] (11.8)[a2]	--[b]	--[b]
Lower Granite	12.1	6.1	8.7 (18.2)[a1] (10.5)[a2]	9.4 (9.1)[a1] (9.4)[a2]	14.3 (5.2)[a1] (11.6)[a2]
System-wide	11.1	12.5	11.9 (6.6)[a1] (10.9)[a2]	16.2 (10.6)[a1] (15.5)[a2]	12.3 (3.4)[a1] (10.6)[a2]

[a] Rewards were paid for northern pikeminnow ≥ 200 mm FL. Figures in parentheses indicate the exploitation rate for northern pikeminnow 200-249 mm FL ( )[a1] and the total exploitation rate for northern pikeminnow ≥ 200 mm FL ( )[a2].
[b] No northern pikeminnow tagged.
[c] Northern pikeminnow harvested, but no tags recovered.

Appendix Table A-3. Exploitation rates (%) of northern pikeminnow ≥ 250 mm fork length (FL) for the dam-angling fishery, 1998-2002. Exploitation rates were not corrected for tag loss in 2000-2002.

Area or Reservoir	1998	1999	2000[a]	2001[a]	2002[a]
Downstream of Bonneville Dam	0.0[c]	0.0[c]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]
Bonneville	0.5	0.0[c]	0.0[c] (1.0)[a1] (0.3)[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]
The Dalles	0.0[c]	0.0[c]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]
John Day	0.0[c]	0.0[c]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	--[d]	--[d]
McNary	0.0[c]	--[d]	--[d]	--[d]	--[d]
Ice Harbor	--[b]	--[b]	--[b]	--[b]	--[b]
Lower Monumental	--[d]	--[d]	--[d]	--[b]	--[b]
Little Goose	--[d]	--[d]	--[d]	--[b]	--[b]
Lower Granite	--[d]	--[d]	--[d]	--[d]	--[d]
System-wide	0.1	0.0[c]	0.0[c] (0.4)[a1](0.1)[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]

[a] Rewards were paid for northern pikeminnow ≥ 200 mm FL. Figures in parentheses indicate the exploitation rate for northern pikeminnow 200-249 mm FL ( )[a1] and the total exploitation rate for northern pikeminnow ≥ 200 mm FL ( )[a2].
[b] No northern pikeminnow tagged.
[c] Northern pikeminnow harvested, but no tags recovered.
[d] No fishing effort.

Appendix Table A-4. Exploitation rates (%) of northern pikeminnow ≥ 250 mm fork length (FL) for the site-specific gillnet fishery, 1998-2002. Exploitation rates were not corrected for tag loss in 2000-2002.

Area or Reservoir	1998	1999	2000[a]	2001[a]	2002[a]
Downstream of Bonneville Dam	0.3	0.0[c]	--[d]	--[d]	--[d]
Bonneville	0.9	0.6	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]
The Dalles	0.0[c]	0.0[c]	--[d]	--[d]	--[d]
John Day	0.0[c]	--[d]	--[d]	--[d]	--[d]
McNary	--[d]	--[d]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	--[d]	--[d]
Ice Harbor	--[b]	--[b]	--[b]	--[b]	--[b]
Lower Monumental	--[d]	--[d]	--[d]	--[b]	--[b]
Little Goose	--[d]	--[d]	--[d]	--[b]	--[b]
Lower Granite	--[d]	--[d]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	--[d]	--[d]
System-wide	0.3	0.2	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]	0.0[c] (0.0[c])[a1](0.0[c])[a2]

[a] Rewards were paid for northern pikeminnow ≥ 200 mm FL. Figures in parentheses indicate the exploitation rate for northern pikeminnow 200-249 mm FL ( )[a1] and the total exploitation rate for northern pikeminnow ≥ 200 mm FL ( )[a2].
[b] No northern pikeminnow tagged.
[c] Northern pikeminnow harvested, but no tags recovered.
[d] No fishing effort.

Appendix Table A-5. Weekly exploitation of northern pikeminnow ≥ 200 mm fork length system-wide in 2002.

Sampling Week	Tagged	Recaptures			At Large	Exploitation (%)		
		Sport	Dam	Net		Sport	Dam	Net
13	4	--	--	--	--	--	--	--
14	34	--	--	--	4	--	--	--
15	45	--	--	--	38	--	--	--
16	153	--	--	--	83	--	--	--
17	269	--	--	--	236	--	--	--
18	169	3	--	--	505	0.6	--	--
19	118	2	--	--	671	0.3	--	--
20	52	8	--	--	787	1.0	--	--
21	137	5	--	--	831	0.6	--	--
22	23	7	--	--	963	0.7	--	--
23	37	3	--	--	979	0.3	--	--
24	33	8	--	--	1013	0.8	--	--
25	9	6	--	--	1038	0.6	--	--
26	14	11	--	--	1041	1.1	--	--
27	--	9	--	--	1044	0.9	--	--
28	--	6	--	--	1035	0.6	--	--
29	--	5	--	--	1029	0.5	--	--
30	--	1	--	--	1024	0.1	--	--
31	--	5	--	--	1023	0.5	--	--
32	--	--	--	--	1018	0.0	--	--
33	--	1	--	--	1018	0.1	--	--
34	--	1	--	--	1017	0.1	--	--
35	--	4	--	--	1016	0.4	--	--
36	--	2	--	--	1012	0.2	--	--
37	--	2	--	--	1010	0.2	--	--
38	--	3	--	--	1008	0.3	--	--
39	--	1	--	--	1005	0.1	--	--
40	--	2	--	--	1004	0.2	--	--
41	--	2	--	--	1002	0.2	--	--
42	--	3	--	--	1000	0.3	--	--
Total	1,097	100	0	0	997	10.6	0.0	0.0

Appendix Table A-6. Weekly exploitation of northern pikeminnow 200-249 mm fork length system-wide in 2002.

Sampling Week	Tagged	Recaptures			At Large	Exploitation (%)		
		Sport	Dam	Net		Sport	Dam	Net
13	--	--	--	--	--	--	--	--
14	2	--	--	--	--	--	--	--
15	11	--	--	--	2	--	--	--
16	30	--	--	--	13	--	--	--
17	36	--	--	--	43	--	--	--
18	41	--	--	--	79	--	--	--
19	22	--	--	--	120	--	--	--
20	1	--	--	--	142	--	--	--
21	39	--	--	--	143	--	--	--
22	2	1	--	--	182	0.5	--	--
23	7	--	--	--	183	--	--	--
24	16	--	--	--	190	--	--	--
25	2	--	--	--	206	--	--	--
26	5	1	--	--	208	0.5	--	--
27	--	1	--	--	212	0.5	--	--
28	--	--	--	--	211	--	--	--
29	--	--	--	--	211	--	--	--
30	--	--	--	--	211	--	--	--
31	--	1	--	--	211	0.5	--	--
32	--	--	--	--	210	--	--	--
33	--	--	--	--	210	--	--	--
34	--	--	--	--	210	--	--	--
35	--	--	--	--	210	--	--	--
36	--	1	--	--	210	0.5	--	--
37	--	1	--	--	209	0.5	--	--
38	--	--	--	--	208	--	--	--
39	--	--	--	--	208	--	--	--
40	--	1	--	--	208	0.5	--	--
41	--	--	--	--	207	--	--	--
42	--	--	--	--	207	--	--	--
Total	214	7	0	0	207	3.4	0.0	0.0

Appendix Table A-7. Weekly exploitation of northern pikeminnow ≥ 250 mm fork length system-wide in 2002.

Sampling Week	Tagged	Recaptures				Exploitation (%)		
		Sport	Dam	Net	At Large	Sport	Dam	Net
13	4	--	--	--	--	--	--	--
14	32	--	--	--	4	--	--	--
15	36	--	--	--	36	--	--	--
16	123	--	--	--	72	--	--	--
17	232	--	--	--	195	--	--	--
18	128	3	--	--	427	0.7	--	--
19	96	2	--	--	552	0.4	--	--
20	51	9	--	--	646	1.4	--	--
21	97	5	--	--	688	0.7	--	--
22	21	5	--	--	780	0.6	--	--
23	30	3	--	--	796	0.4	--	--
24	17	8	--	--	823	1.0	--	--
25	7	6	--	--	832	0.7	--	--
26	9	10	--	--	833	1.2	--	--
27	--	8	--	--	832	1.0	--	--
28	--	6	--	--	824	0.7	--	--
29	--	5	--	--	818	0.6	--	--
30	--	1	--	--	813	0.1	--	--
31	--	4	--	--	812	0.5	--	--
32	--	--	--	--	808	0.0	--	--
33	--	1	--	--	808	0.1	--	--
34	--	1	--	--	807	0.1	--	--
35	--	4	--	--	806	0.5	--	--
36	--	1	--	--	802	0.1	--	--
37	--	1	--	--	801	0.1	--	--
38	--	3	--	--	800	0.4	--	--
39	--	1	--	--	797	0.1	--	--
40	--	1	--	--	796	0.1	--	--
41	--	2	--	--	795	0.3	--	--
42	--	3	--	--	793	0.4	--	--
Total	883	102	0	0	790	12.3	0.0	0.0

APPENDIX B

DATES OF SAMPLING IN 2002

Appendix Table B-1. Dates of each sampling week in 2002.

Sampling Week	Dates	Sampling Week	Dates
13	March 25 – March 31	28	July 8 - July 14
14	April 1 - April 7	29	July 15 - July 21
15	April 8 - April 14	30	July 22 - July 28
16	April 15 - April 21	31	July 29 - August 4
17	April 22 - April 28	32	August 5 - August 11
18	April 29 - May 5	33	August 12 - August 18
19	May 6 - May 12	34	August 19 - August 25
20	May 13 - May 19	35	August 26 - September 1
21	May 20 - May 26	36	September 2 - September 8
22	May 27 – June 2	37	September 9 - September 15
23	June 3 - June 9	38	September 16 - September 22
24	June 10 - June 16	39	September 23 - September 29
25	June 17 - June 23	40	September 30 - October 6
26	June 24 - June 30	41	October 7 - October 13
27	July 1 - July 7	42	October 14 – October 20