

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

Northern Pikeminnow Management Program

Annual Report
2000



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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

2000 ANNUAL REPORT

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2000 EXECUTIVE SUMMARY

by Russell G. Porter

This report presents results for year ten in a basin-wide program to harvest northern pikeminnow¹ (*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.

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 under Section I, Implementation.

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 Section II 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 under Section II.

Program cooperators include the Columbia Basin Fish and Wildlife Authority (Authority), Pacific States Marine Fisheries Commission (PSMFC), Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Columbia River Inter-Tribal Fish Commission (CRITFC), and two lower Columbia River treaty tribes; the Nez Perce Tribe, and the Yakama Indian Nation. The Authority and PSMFC were responsible for coordination and administration of the program; PSMFC subcontracted various tasks and activities to ODFW, WDFW, CRITFC, and two lower Columbia River treaty tribes 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):** Process and provide accounting for reward payments to participants in the sport-reward fishery.
3. **CRITFC (Report C):** Implement a system-wide angling fishery at mainstem dams on the Snake and Columbia rivers.
4. **CRITFC (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 2000 by report are as follows:

Report A

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

1. Objectives for 2000 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 May 15 through October 15, 2000. Twenty-two registration stations were operated throughout the lower Snake and Columbia rivers.
3. A total of 189,710 northern pikeminnow ≥ 9 inches in length were harvested during the 2000 season with 30,337 angler days spent harvesting these fish. Catch-per-angler-day for all anglers during the season was 6.25 fish, the highest in program history.
4. Anglers submitted 172 northern pikeminnow with external tags, and an additional 15 with fin-clip marks, but no tag. A total of 59 salmonid PIT tags were detected and interrogated in pikeminnow stomachs.

Report B

Northern Pikeminnow Sport-Reward Fishery Payments

1. During 2000, vouchers totaling \$961,050 were paid for 187,768 fish.
2. A total of 172 vouchers were paid for tagged fish at \$50 per tag for a total of \$8,600.
3. A total of 2,322 promotional coupons were redeemed at \$4 each for a total of \$9,288.
4. A total of 2,688 anglers received payments.
5. The total for all payments was \$978,938.

Report C

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

1. Dam angling at three dams on the lower Columbia river during 2000 by the Yakama Nation resulted in a catch of 423 northern pikeminnow from June 6 through October 5.
2. Overall catch per angler hour (CPAH) was 0.3 in 2000, compared to 1.1 the previous year. Relative to 1999, catch declined 89%, effort (as reported) declined 58% and CPAH declined 75%.
3. Incidental catch, primarily centrachids caught at The Dalles Dam was 6.6% of the total hook-and-line catch.

Report D

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

1. Small-meshed gillnets were used to catch 557 predator-size northern pikeminnow during 2000 for catch-per-net-hour (CPNH) of 2.2. Most of the fish were caught at locations in Bonneville Pool (94.4%). Drano Lake and the Klickitat River continued to be the most productive fishing location accounting for 89.8% of the catch.
2. Incidental species composed 51.6% of the total catch in 2000, a reduction from the 6.16% in 1999.
3. The future of site-specific fishing will be determined in 2002.

Report E

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

1. Objectives were to: (1) evaluate northern pikeminnow exploitation and compare catch rate of incidentally-harvested fishes among the three major management fisheries in 1997, (2) estimate reductions in predation on juvenile salmonids since implementation of the fisheries, and (3) update information on year-class strength of northern pikeminnow.

2. System-wide exploitation of northern pikeminnow 250 mm or greater in fork length was 11.9% for sport-reward, 0.0% for dam-angling, and 0.0% for site-specific gill-net fisheries. Incidental catch was 29.4% in the sport-reward fishery and 51.6% in the gill-net fishery.
3. If exploitation rates remains constant through 2006, we estimate that potential predation by northern pikeminnow on juvenile salmonids will be held to 77% of levels estimated prior to implementation of predator control fisheries.
4. Within-season tag loss was estimated to be 2.6% for spaghetti tags and 33.3% for dart tags. We concluded that spaghetti tags were a more effective means of tagging northern pikeminnow.

SECTION I. IMPLEMENTATION

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 City of Vancouver for the use of Marine 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 Maryhill State Park and Lyon's Ferry State Park; and Sheila Cannon and Ken Beer for the use of The Fishery at Covert's Landing.

We appreciate the efforts of Andrew Albrecht, Kathleen Byrd, Pam Carlson, Denise Cummings, Melissa Dexheimer, Bill Fleenor, Luke Flohr, Josh Hede, Maria Holmes, Sean Homestead, Kurt Hubbard, Jeff Lesselyoung, Derrick Meaghers, Eric Meyer, Linda Moore, Kim Motyka-Klundt, Jacob Mundt, Melissa Rogers, Bill Rogers, Tricia Shoblom, Troy Shumacher, Tracy Sobelman, Angela Stephani, Daniel Stief, Mark Thompson, Kelly Tkachenko, Ryan Tribble, Jeremy Trump, Alyce Wells, DJ Werlan, Nick Yaksic and Matt Zwolinski for operating the sport-reward fishery registration stations.

We also recognize Diana Murillo for her excellent work in computer data entry and document verification, Fella Tanaka for her numerous phone survey interviews and Kathleen Moyer for generating the weekly field activity reports and her assistance with many other projects throughout the season.

We are thankful to Jennifer Amren for her efforts in maintaining/staffing the sport-reward fishery hotline, her help in compiling this report, and her assistance in keeping the program running smoothly throughout the year.

ABSTRACT

The Northern Pikeminnow Sport-Reward Fishery (NPSRF) operated on the lower Columbia and Snake rivers, for its 10th consecutive year, from May 15 through October 15, 2000. The objectives of this project were to (1) implement a recreational fishery that rewards anglers who harvest northern pikeminnow $\geq 228\text{mm}$ (9 inches) total length, (2) obtain catch data on fish species caught by fishery participants while targeting northern pikeminnow, (3) examine northern pikeminnow collected for the presence of external tags and fin-clip marks, (4) collect biological data on northern pikeminnow and other fish species returned to registration stations, (5) scan northern pikeminnow for the presence of PIT tags at select registration stations, and (6) collect, monitor, and report data on angler catch, participation, and success rates during the season.

For the 2000 season, the minimum northern pikeminnow size required for reward was reduced from 279mm (11 inches) to 228mm (9 inches). A total of 189,710 northern pikeminnow $\geq 228\text{mm}$ were harvested, with an estimated 38.5% of this harvest attributable to fish in the 228 to 279mm size-class. Harvest was the second highest in program history. A total of 7,288 individual anglers spent 30,337 days participating in the fishery. Catch per unit of effort was 6.25 fish/angler day, the highest in program history. The overall exploitation rate for the NPSRF was 10.9%.

Anglers submitted 172 northern pikeminnow with external tags, and an additional 15 with fin-clip marks but no tag. A total of 59 PIT tags were detected and interrogated.

The incidental catch/harvest of salmonids and other fish species by fishery participants was found to be low when compared to the total northern pikeminnow harvest. Peamouth *Mylocheilus cauriius* was the species most frequently caught incidentally by program anglers.

INTRODUCTION

Northern pikeminnow *Ptychocheilus oregonensis*, formerly known as northern squawfish (Nelson et al. 1998), are the primary predator of juvenile salmonids *Onchorhynchus spp.* in the Lower Columbia and Snake River systems (Rieman et al. 1988). Rieman and Beamesderfer (1990) estimated that predation on juvenile salmonids could be reduced by up to 50% with a sustained exploitation rate of 10-20% on northern pikeminnow >275 mm (fork length). The Northern Pikeminnow Management Program (NPMP) was developed in 1990 with the goal of maintaining a 10-20% annual exploitation rate on northern pikeminnow ≥ 279 mm (11 inches) within the established program area. In response to an independent review of NPMP justification, performance, and cost-effectiveness (Ref? Hankin /Richards), NPMP administrators reduced the target size of northern pikeminnow from ≥ 279 mm (11 inches) to ≥ 228 mm (9 inches) total length beginning in 2000.

One component of the Northern Pikeminnow Management Program is the Northern Pikeminnow Sport-Reward Fishery (NPSRF). In its 10th year of operation, the NPSRF continued to offer monetary rewards to recreational anglers for harvesting northern pikeminnow. In 2000, the objectives of the NPSRF were to; (1) implement a recreational fishery that rewards anglers who harvest northern pikeminnow ≥ 228 mm (9 inches) total length, (2) obtain catch data on fish species caught by fishery participants while targeting northern pikeminnow, (3) examine collected northern pikeminnow for the presence of external tags and fin-clip marks, (4) collect biological data on northern pikeminnow and other fish species returned to registration stations, (5) scan northern pikeminnow for the presence of PIT tags at select registration stations, and (6) collect, monitor, and report data on angler catch, participation, and success rates during the season.

METHODS OF OPERATION

FIELD PROCEDURES

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, northern pikeminnow harvested from backwaters, sloughs, and 400 feet up the mouths of tributaries within this area were also eligible for reward payment. Rules and regulations for participation in the NPSRF are listed in Appendix A. The 2000 NPSRF was fully implemented from May 15 (week 20) through September 24 (week 38). Based on acceptable harvest, effort, and catch per unit of effort (CPUE) levels, favorable river and weather conditions, and as a reward to dedicated NPSRF anglers, the season was extended through October 15, 2000 (week 41) at select registration stations.

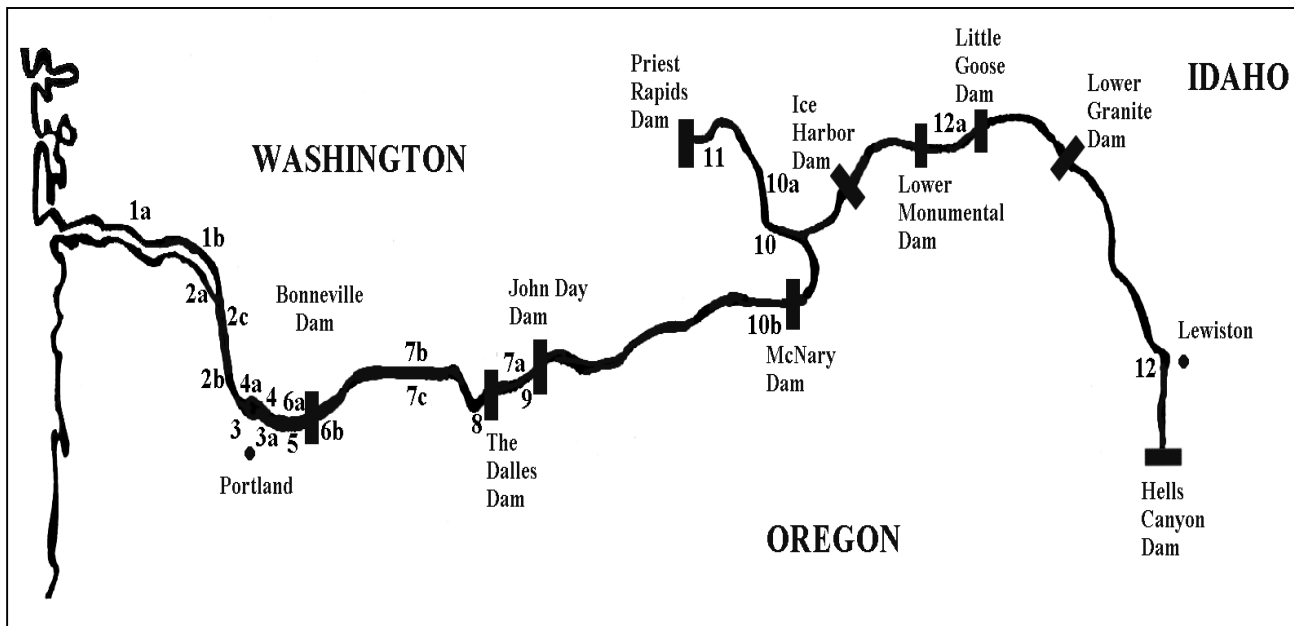


Figure 1. 2000 Northern Pikeminnow Sport-Reward Fishery registration stations.

Main Stations (Noon – 8:00 P.M.)	Hybrid Stations	Satellite Stations
3. M. James Gleason Boat Ramp*	1a. Cathlamet Marina* (Noon – 4:30 P.M.)	2c. Kalama Marina (7:00 – 10:00 A.M.) (Opened 7/31/00)
4. Washougal Boat Ramp/ Port of Camas*	1b. Willow Grove Park* (5:00 – 8:00 P.M.)	3a. Chinook Landing* (7:00 – 9:00 A.M.)
5. The Fishery*	2a. Rainier Marina (4:00 – 8:00 P.M.)	10a. Ringold Boat Ramp (8:00-10:00 A.M.) (Opened 6/14/00: Wed. – Sun. Only)
8. The Dalles Boat Basin*	2b. Scapoose Bay Marina (11:30 A.M. - 3:30 P.M.)	10b. Umatilla Boat Ramp (5:00 – 8:00 P.M.)
9. Giles French*	6a. Bonneville Trail Head* (11:00 A.M. – 4:30 P.M.)	12a. Lyon’s Ferry (1:00 – 3:00 P.M.)
10. Columbia Point Park	6b. Cascade Locks Boat Ramp (5:00 – 7:00 P.M.)	
11. Vernita Bridge Rest Area*	7a. Maryhill State Park (3:30 – 6:00 P.M.)	
12. Greenbelt*	7b. Bingen Marina* (12:30 – 2:30 P.M.)	
	7c. Hood River Marina* (10:00 A.M. – Noon)	
		4a. Marine Park (PORTCO) (Registration Only)

* Registration Stations open during the season extension.

Registration Stations

Before fishing, anglers participating in the NPSRF were required to complete a registration form at one of 23 registration locations on the Columbia and Snake Rivers (Figure 1). Anglers were registered by station technicians (when present) or self-registered during non-staffed hours using the registration boxes provided.

Eight “main” registration stations were open daily from noon to 8 p.m.. Five “satellite” stations operated for one to three hours per day and were affiliated with a main registration station as a way to increase their efficiency. Nine locations were operated as “hybrid” stations, where a single technician split the eight-hour shift between two or more sites. One location (Marine Park) was a registration only facility. Figure 1 lists locations and hours of operation for the NPSRF registration stations. Hybrid and satellite stations were monitored during the season

and operating schedules were modified or discontinued to increase efficiency and/or reduce operating costs.

Thirteen registration stations continued operating during the season extension (Figure 1). Stations located at the Greenbelt boat ramp and the Vernita rest area kept their normal hours of operation. The 11 other locations were combined into hybrid stations to optimize geographic distribution and maintain convenience for anglers, while reducing program costs (Winther et al. 1996).

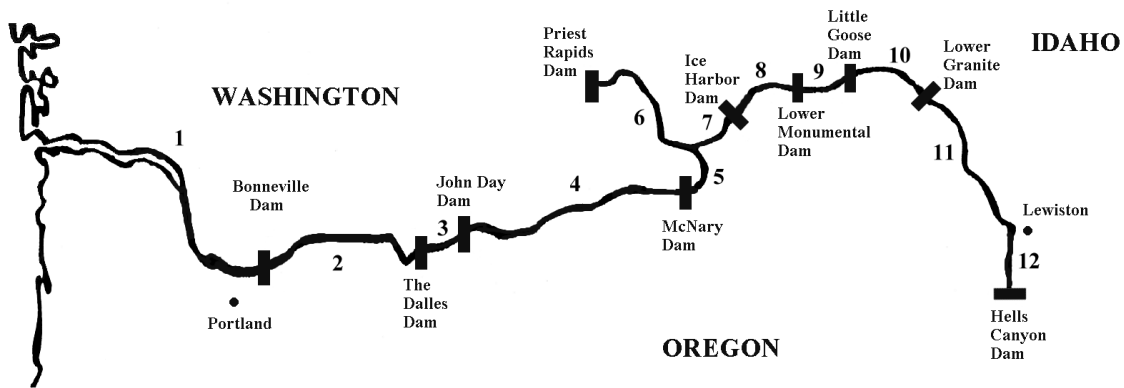
Reward System

The 2000 NPSRF rewarded anglers for northern pikeminnow ≥ 228 mm (9 inches) total length. A tiered reward system [implemented in 1995 (Hisata et al. 1995) and modified in 1999 (Fox et al. 1999)] paid anglers \$4 each for the first 100 northern pikeminnow returned in the season, \$5 each for numbers 101-400 and \$6 each for all fish over 400. As an additional incentive, northern pikeminnow tagged for the NPMP by the Oregon Department of Fish and Wildlife (ODFW) tags were worth \$50 each (Smith et al. 1994). No reward was paid for northern pike minnow , 228 mm total length.

To receive payment, anglers returned their catch (daily) to their initial registration station. Station technicians identified and measured the angler's fish and issued a payment voucher for the total number of eligible northern pikeminnow. Appendix A lists the criteria for determining northern pikeminnow eligibility. Anglers mailed vouchers to the Pacific States Marine Fisheries Commission (PSMFC) for redemption. Anglers returning with ODFW-tagged northern pikeminnow were issued a separate tag payment voucher that was mailed to ODFW for verification before payment by PSMFC.

Returning Angler Sampling

Technicians interviewed all returning anglers at each registration station to determine the location fished (Figure 2), the species of fish caught, and the number of each species caught and harvested by anglers targeting northern pikeminnow. Anglers were asked if they specifically fished for northern pikeminnow at any time during their fishing trip. A "No" response ended the exit interview. With a "Yes" response, anglers were asked how many of each species of fish were caught and released while they targeted northern pikeminnow. A fish was considered "caught" when the angler touched, released or harvested the fish. "Released" was defined as those fish returned to the water alive. "Harvested" was defined as those fish retained by the angler or not returned to the water alive.



Fishing Locations:

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

Figure 2. 2000 Northern Pikeminnow Sport-Reward fishing locations.

NORTHERN PIKEMINNOW HANDLING PROCEDURES

Tag Detection and Biological Sampling

Station technicians examined all northern pikeminnow returned to registration stations for the presence of external tags (spaghetti or dart), fin-clip marks, and signs of tag loss. All tagged northern pikeminnow and fin-clipped northern pikeminnow missing tags were sampled for biological data, which consisted of measuring fork length, determining sex (by evisceration) and collecting a scale sample. Pertinent tag and mark information was recorded. Tags were returned to the angler for submission with their tag payment voucher. Biological data and tag/mark information were forwarded to ODFW for use in their estimation of tag loss (Takata and Ward Draft 2000 Annual Report). Time permitting, technicians sampled other northern pikeminnow for biological data (excluding scale sample collection). Fork lengths were taken for other fish species returned to stations when possible.

PIT Tag Detection

Northern pikeminnow consuming juvenile salmonids may occasionally ingest a fish carry a passive integrated transponder (PIT) tag. The Bonneville Power Administration (BPA) provided the NPSRF with two (PIT) tag “readers” (Destron Fearing portable transceiver system – model # FS2001F) for use in (1) determining if PIT tags could be detected in the gut of

northern pikeminnow, and (2) recording information from PIT tag detections for submission to the Columbia Basin PIT Tag Information System (PTAGIS).

One PIT tag reader was placed at The Fishery registration station, the other was rotated amongst The Dalles Boat Basin, Giles French, and the cold storage facility located in Lyle, Washington. These sites normally receive a high volume of northern pikeminnow, and often collect fish harvested in waters near hydroelectric dams; areas of likely juvenile salmonid predation (Brown et al. 1981). Technicians at these sites individually scanned as many northern pikeminnow as possible during their shift. PIT tag "positive" fish were labeled and frozen for future analysis. Northern pikeminnow not scanned individually were placed into specific collection bins and were "bulk" scanned before delivery to rendering facilities. PIT tag readers were downloaded weekly to a central computer and detection information was forwarded to PTAGIS via electronic mail.

NORTHERN PIKEMINNOW PROCESSING

Northern pikeminnow not eviscerated during biological sampling were caudal-clipped to indicate processing by Washington Department of Fish and Wildlife (WDFW) technicians. Northern Pikeminnow were transported from registration stations in insulated coolers to temporary cold storage facilities and were ultimately delivered to rendering facilities for processing.

NON-RETURNING ANGLER SAMPLING

A goal of surveying 20% of each week's non-returning anglers by telephone was set to obtain non-returning catch data from anglers targeting northern pikeminnow. Non-Returning anglers were defined as those anglers that did not return to a registration station, and thus, did not participate in an exit interview. To attain the 20% goal, 50% of non-returning angler registration forms were randomly selected from all registration stations each week. A technician called anglers from each random sample until they attained the 20% goal (if the 20% goal was not reached during the first pass through the registration forms, technicians continued to re-call anglers that weren't reached during the first attempt until the goal was met). Anglers were asked: "Did you specifically fish for northern pikeminnow at any time during your fishing trip?" With a "Yes" response, anglers were asked to report the number and species of adult and/or juvenile salmonids, and the number of reward size northern pikeminnow that were caught and harvested/released while they specifically fished for northern pikeminnow (angler catch and harvest data were not collected from anglers who did not target northern pikeminnow on their fishing trip). Non-returning angler catch data for non-salmonid species was last obtained in 1996. At that time it was recommended that the procedure be repeated in 2000 to determine if trends in catch had changed (Winther et al 1996). In response, non-returning anglers in 2000 were also asked the above questions as they pertain to non-salmonid species.

DATA ANALYSIS

NON-RETURNING ANGLER CATCH ESTIMATES

Non-Returning anglers were sampled according to the method described above. The samples were found to either have a binomial distribution or to be non-normally distributed. For non-normally distributed samples a mean catch per angler of each occurring species of salmonids and non-salmonids was established ($\bar{x} = \sum x/n$). This mean was then applied to the known population by multiplying it by the population size (N_0). The resulting number is the estimated catch of salmonids and non-salmonids for non-returning anglers. For samples that fit the binomial distribution (0 and 1 catches only in sample) the proportion of occurrences of 1 was estimated using the formula $\hat{p} = X/n$ (where X = the number of occurrences of 1 in the sample) and total catch by the formula $\hat{Y} = \hat{p}N$ (Zar 1999).

In order to set confidence limits around these estimates two methods were used. Using a relationship between the F distribution and the binomial distribution a confidence interval may be computed for the binomial parameter p (Bliss 1967; Zar 1984). The following formulas were used to obtain the upper and lower confidence limits around the estimated proportion:

Lower Confidence Limit

$$L_1 = \frac{X}{X + (n - X + 1)F_{\infty(2)v_1, v_2}}$$

$$v_1 = 2(n - X + 1)$$

$$v_2 = 2X$$

Upper Confidence Limit

$$L_2 = \frac{(X + 1)F_{\infty(2)v'_1, v'_2}}{X + (n - X + 1)F_{\infty(2)v'_1, v'_2}}$$

$$v'_1 = v_2 + 2$$

$$v'_2 = v_1 - 2$$

When n is appreciably large relative to N a finite population correction may be used when estimating confidence limits (Zar 1999). Given the large size of our sample (19.97%) the following correction formulas were used:

Lower Confidence Limit:

$$(L_1)_c = \frac{X - 0.5}{n} - \left(\frac{X - 0.5}{n} - L_1 \right) \sqrt{1 - \frac{n}{N}}$$

Upper Confidence Limit:

$$(L_2)_c = \frac{X'}{n} + \left(L_2 - \frac{X'}{n} \right) \sqrt{1 - \frac{n}{N}}$$

$$X' = X + \frac{X}{n}$$

The corrected L_1 and L_2 were then multiplied by the known population size (N) to transform the proportions into lower and upper confidence limits around the catch estimate. All formulas are from Zar (1999). In order to obtain a lower confidence limit that did not equal 0 and to give comparable points around estimates, the confidence was lowered to the 80% level on all binomial distributed samples.

The bootstrap method was used on samples that did not fit the binomial distribution and were not normally distributed. The bootstrap method may be used to obtain reliable confidence intervals around a point estimate when more traditional methods are found to be inappropriate (Annette Hoffman, biometrician, Wash. Dept. of Fish and Wildlife, personal communication). A random sample was drawn (with replacement) from the original data to create a bootstrap replicate sample. This was repeated 1000 times and the whole procedure repeated for each species of fish in question. The resulting 1000 sample catches were then sorted in ascending order and assigned a number 1 to 1000. The lower and upper confidence limits were then established by 1000(%) and 1000(1-%) respectively (Efron and Tibshirani 1993). For example, to obtain the lower confidence limit at an 80% confidence level: (1000)(.10)= 100. Thus the 100th highest bootstrap replicate sample is the lower confidence limit. Accordingly, the value (1000)(1-.10)= 900 was the upper limit. In order to obtain a lower confidence limit that did not equal 0 and to give comparable points around estimates; the confidence was lowered to the 80% level on all species of fish (75% for bullhead unknown species *Ictaluras spp.*). The lower and upper confidence level figures were then expressed as a mean catch per angler from the sample and multiplied by the known population size (N) to give the final confidence limits around the estimated catch.

LENGTH PROPORTION ESTIMATES

The proportion of northern pikeminnow harvest ranging from 228 – 279 mm (9 to 11 inches) total length was estimated to evaluate the impact of reducing the NPSRF's minimum size requirement. Estimates were developed using fork length data collected at registration stations. According to calculations from Carlander (1969), the fork length of a 228mm (total length) northern pikeminnow is 210mm, while a 279mm northern pikeminnow has a fork length of 256mm. It was assumed that the sampling rate for fork length (57% of all reward size fish) was representative of all fish harvested for reward. The number of fish measuring 210mm to 256mm (fork length) was divided by the number of fish measuring 210mm (fork length) or greater to obtain proportion estimates. Estimates were determined for all registration stations and fishing locations. Confidence intervals were determined using binomial distribution methods. Given our high sample rate, confidence intervals were negligible (none exceeded $\pm 0.4\%$) and are not presented.

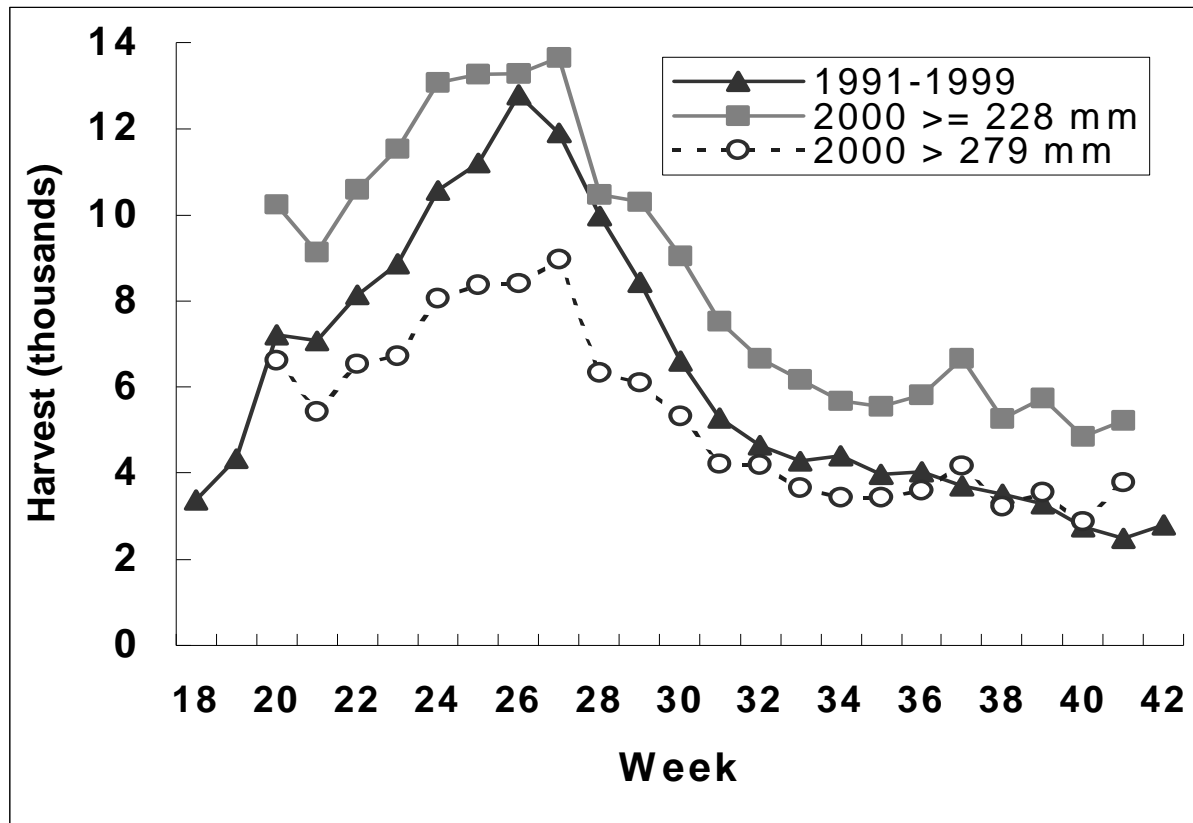


Figure 3. 2000 Sport-Reward Fishery northern pikeminnow total harvest ≥ 228 mm (9 inches), estimated >279 mm (11 inch) component of the 2000 harvest, and the mean 1991 - 1999 harvest by week (≥ 279 mm).

RESULTS

NORTHERN PIKEMINNOW HARVEST

The 2000 NPSRF harvested 189,710 reward-size northern—a 65% increase from 1999’s total of 114,687 (Fox et al. 1999), and a 33% increase from the nine year average (1991-1999) of 142,171. This marked the second highest total in the NPSRF’s history, trailing only the 1995 harvest of 199,600 northern pikeminnow. Returning anglers also harvested 5,051 northern pikeminnow < 228 mm total length.

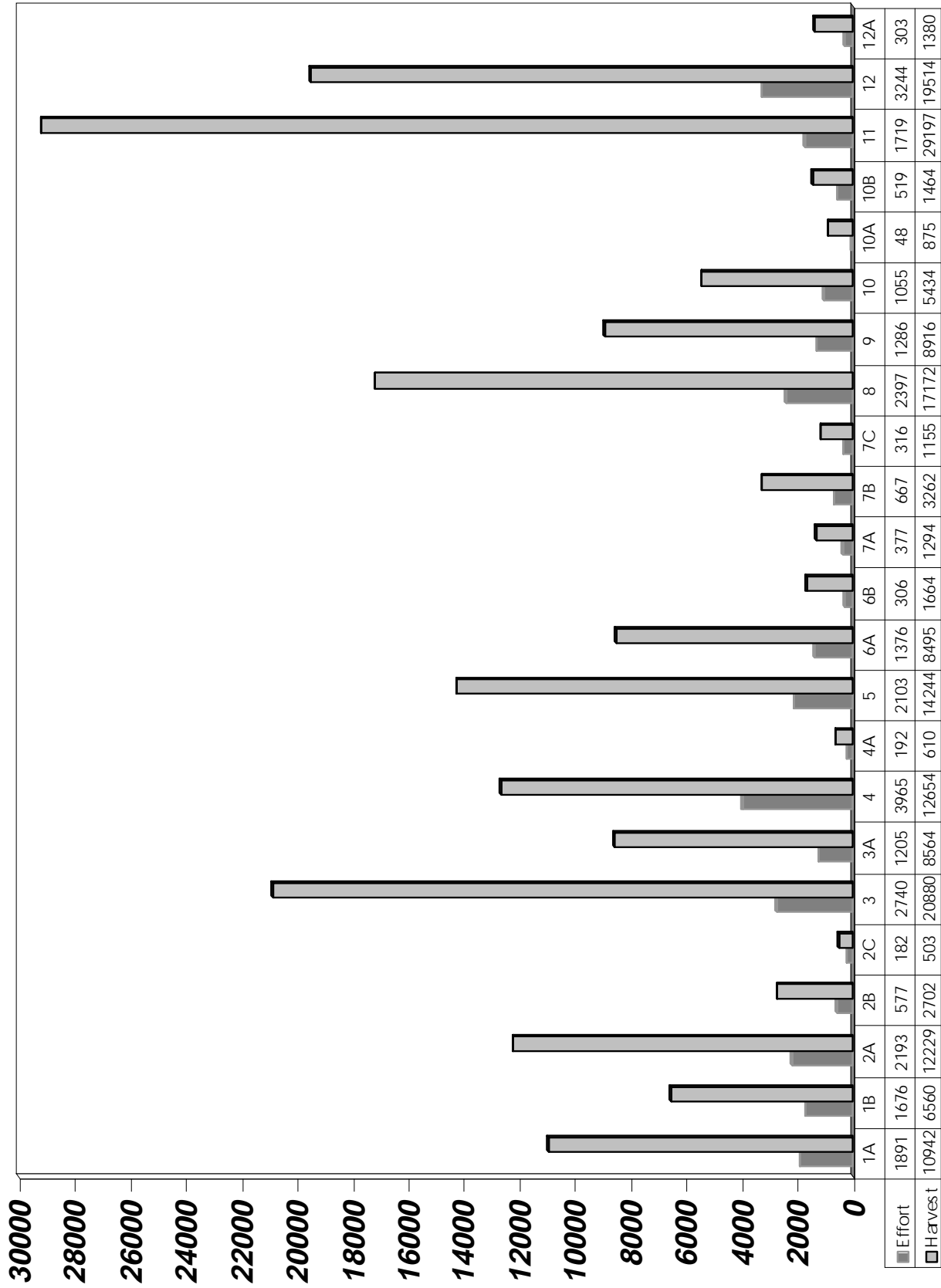
Figure 3 shows the weekly harvest for 2000 compared to the means for each week from the period 1991-99. Peak harvest was 13,648 northern pikeminnow and occurred during the week of July 3rd (week 27)—one week later than the nine year average peak harvest of 12,789 (week 26). The lowest weekly harvest (4,859 northern pikeminnow) occurred during the week

of October 2nd (week 40). This was the second week of the season extension, when only select registration stations were in operation. Mean weekly harvest in 2000 was 8,623 northern pikeminnow.

Harvest by registration station ranged from 29,197 northern pikeminnow at the Vernita Bridge Rest Area (main station) to 503 at the Kalama Marina (satellite station)(Figure 4). Harvest by fishing location ranged from 98,789 northern pikeminnow in fishing location 1 to 347 in fishing location 11 (Figure 5). The harvest in fishing location 1 represents 52% of the total 2000 northern pikeminnow harvest (≥ 228 mm total length).

LENGTH PROPORTION ESTIMATES

An estimated 38.5% (73,075) of the total reward-size northern pikeminnow was attributable to fish 228 – 279mm (9 – 11 inches) total length. The satellite registration station at the Kalama Marina had the highest percentage (65%) of 228 – 279mm northern pikeminnow in its catch, while the hybrid station Maryhill State Park had the lowest (5.2%) (Figure 6). Fishing location 9 yielded the highest percentage of 228 – 279mm northern pikeminnow at 53.3%; fishing location 3 yielded the lowest at 5.8% (Figure 7). Figure 3 presents the 2000 total harvest of reward size northern pikeminnow by week and the estimated portion attributable to fish > 279mm (11 inches), as compared to the 1991 – 1999 mean weekly harvest (≥ 279 mm). The area between the 2000 ≥ 228 mm and >279mm plots represents the estimated portion of total harvest attributable to this size class.



Registration Stations

Figure 4. 2000 Northern Pikeminnow harvest and total effort by registration station.

1A-Cathlamet, 1B-Willow Grove, 2A-Rainier, 2B-Scappoose Bay, 2C-Kalama, 3-M. James Gleason, 3A-Chinook Landing, 4-Washougal, 4A-Marine Park, 5-The Fishery, 6A-Bonneville Trailhead, 6B-Cascade Locks, 7A-Maryhill State Park, 7B-Bingen, 7C-Hood River, 8-The Dalles, 9-Giles French, 10-Columbia Point Park, 10A-Ringold, 10B-Umatilla, 11-Vernita, 12-Greenbelt, 12A-Lyon's Ferry

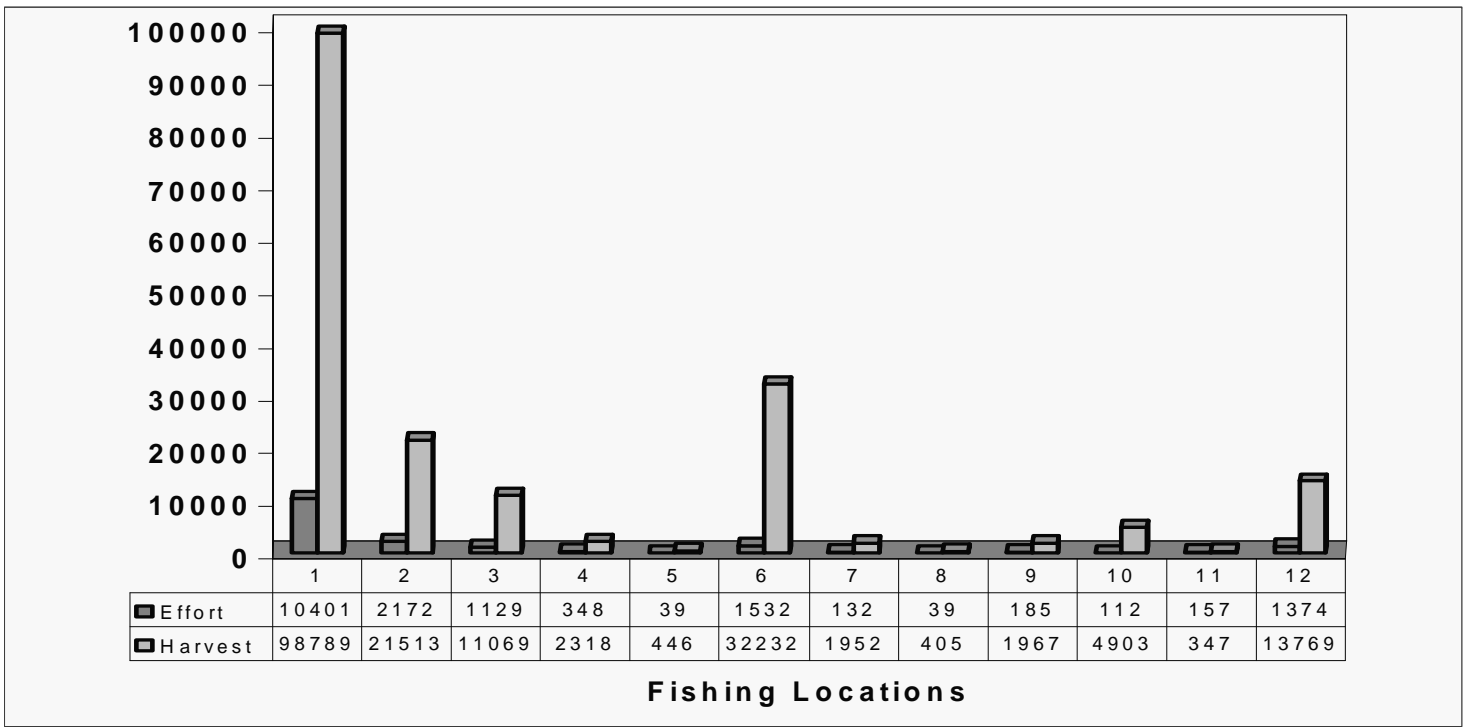


Figure 5. 2000 Sport-Reward Fishery northern pikeminnow harvest and returning angler effort by fishing location.

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

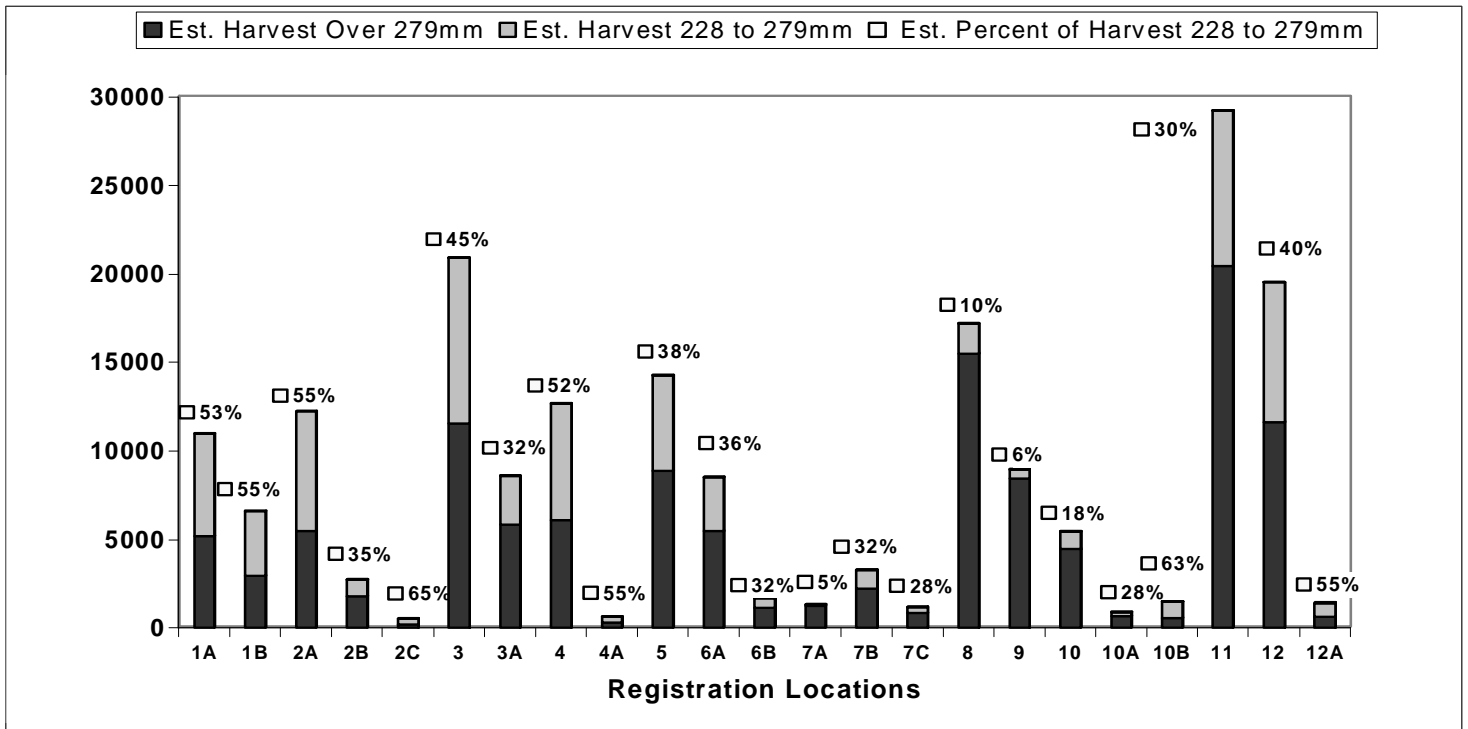


Figure 6. Length proportion estimates by registration station for the 2000 Sport-Reward Fishery northern pikeminnow harvest.

1A-Cathlamet, 1B-Willow Grove, 2A-Rainier, 2B-Scappoose Bay, 2C-Kalama, 3-M. James Gleason, 3A-Chinook Landing, 4-Washougal, 4A-Marine Park, 5-The Fishery, 6A-Bonneville Trailhead, 6B-Cascade Locks, 7A-Maryhill State Park, 7B-Bingen, 7C-Hood River, 8-The Dalles, 9-Giles French, 10-Columbia Point Park, 10A-Ringold, 10B-Umatilla, 11-Vernita, 12-Greenbelt, 12A-Lyon's Ferry

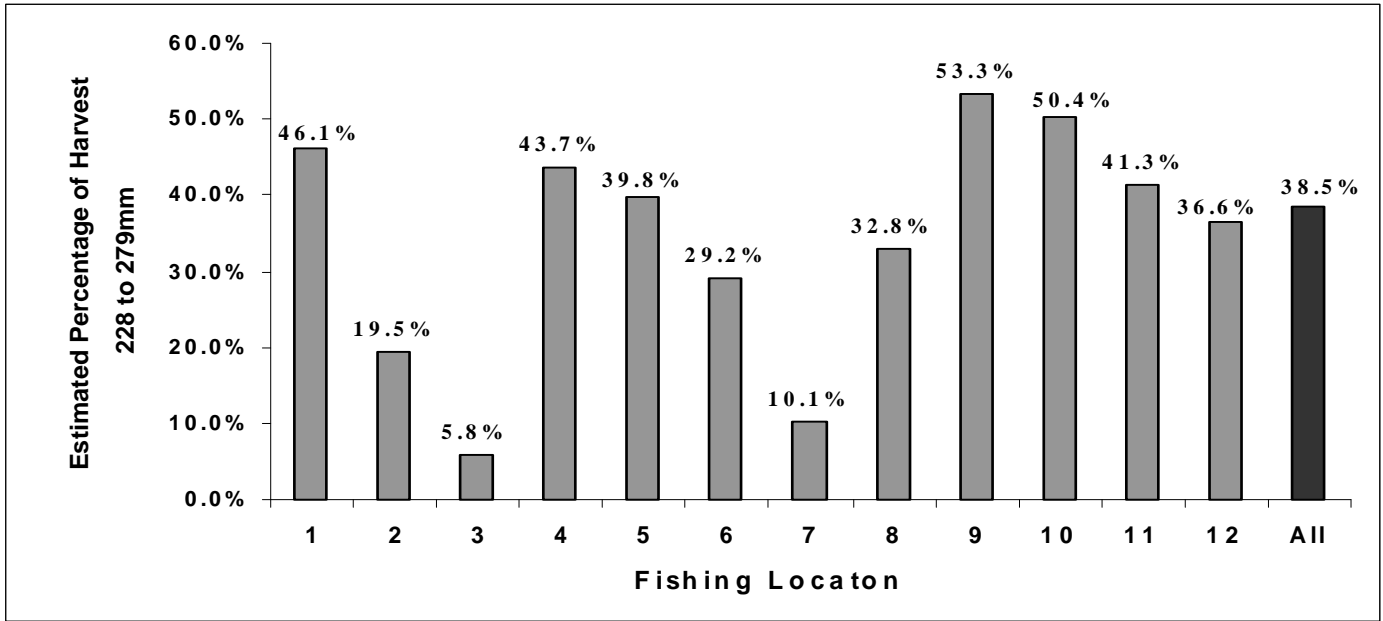


Figure 7. Estimated percentage of the 2000 Sport-Reward Fishery northern pikeminnow harvest attributable to fish 228 – 279mm (9 to 11 inches) total length by fishing location.

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

ANGLER EFFORT

A total of 7,288 anglers participated in the 2000 NPSRF, an increase of 883 from 1999. The unit of effort used to measure angler participation was a “registered angler- day”. Total effort for 2000 was 30,337 registered angler-days. This was a 17% increase (4,431 days) over 1999 (Fox et. al. 1999), but it was 35% lower than the nine-year average of 46,533 days. Peak angler effort occurred during the week of May 29th (week 22) (Figure 8)—five weeks prior to the week of peak harvest (Figure 3).

Returning angler effort (17,620 days) represented 58% of total angler effort, an increase from 52% in 1999 (13,368 days). Effort by fishing location for 2000 (returning anglers only) ranged from 10,401 days in fishing location 1 to 39 days in both fishing

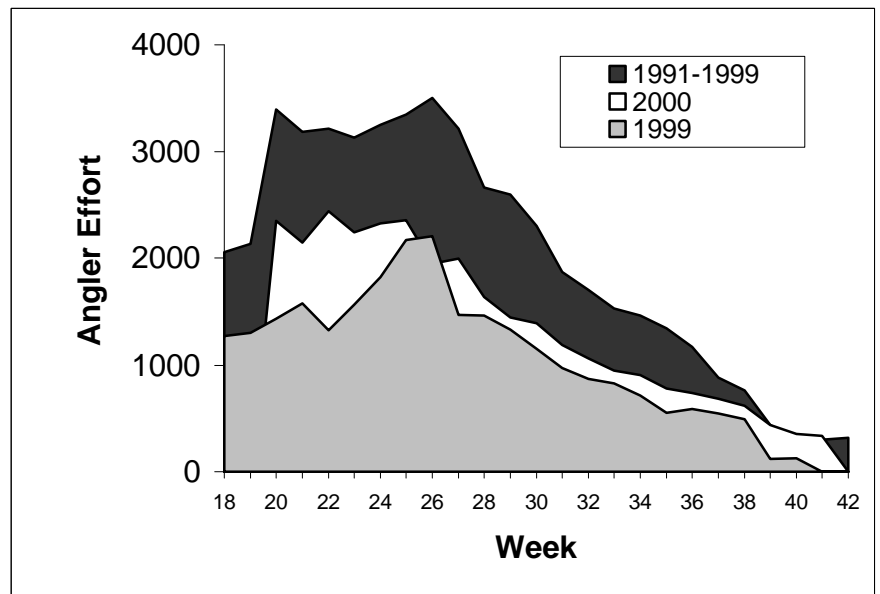


Figure 8. Sport-Reward Fishery total angler effort by week for 1991-1999 (mean), 1999 and 2000.

locations 5 and 8 (Figure 5). The Washougal boat ramp (main station) had the highest total effort, which was 3,244 days, and the Ringold Boat Ramp (satellite station) had the lowest with 48 days (Figure 4).

CATCH PER ANGLER DAY

In 2000, the overall (returning + non-returning anglers) catch per unit of effort (CPUE) for northern pikeminnow ≥ 228 mm was 6.25 fish/angler day, exceeding both the 1999 overall CPUE of 4.43 (Fox et al. 1999) and the 1991-1999 CPUE of 3.06. Overall CPUE in 2000 continued the upward trend in CPUE since 1993 (Fox et al. 1999) and became the highest overall CPUE recorded in the NPSRF's history (Figure 9). Overall CPUE by week remained above the nine-year average throughout the season (Figure 10). Overall CPUE by registration station ranged from 18.23 fish/angler day at the Ringold Boat Ramp (satellite station) to 2.76 at the Kalama Marina (satellite station)(Figure12).

Excluding non-returning anglers, CPUE was 10.77 fish/angler day, and increase from 8.6 in 1999 (Fox et al. 1999). Returning angler CPUE by fishing location ranged from 43.78 fish/angler day in fishing location 10 to 2.21 in fishing location 11 (Figure 11).

The overall northern pikeminnow CPUE was 2.41 fish/angler day for 228 – 279mm (9-11 inch) fish and 3.84 for fish > 279 mm (Figure 9). Excluding non-returning anglers, these values increased to 4.15 and 6.62, respectively. Figure 10 presents the 2000 northern pikeminnow CPUE by week for all reward-size fish and for fish > 279 mm (estimated), as compared to the 1991 –1999 weekly CPUE (≥ 279 mm).

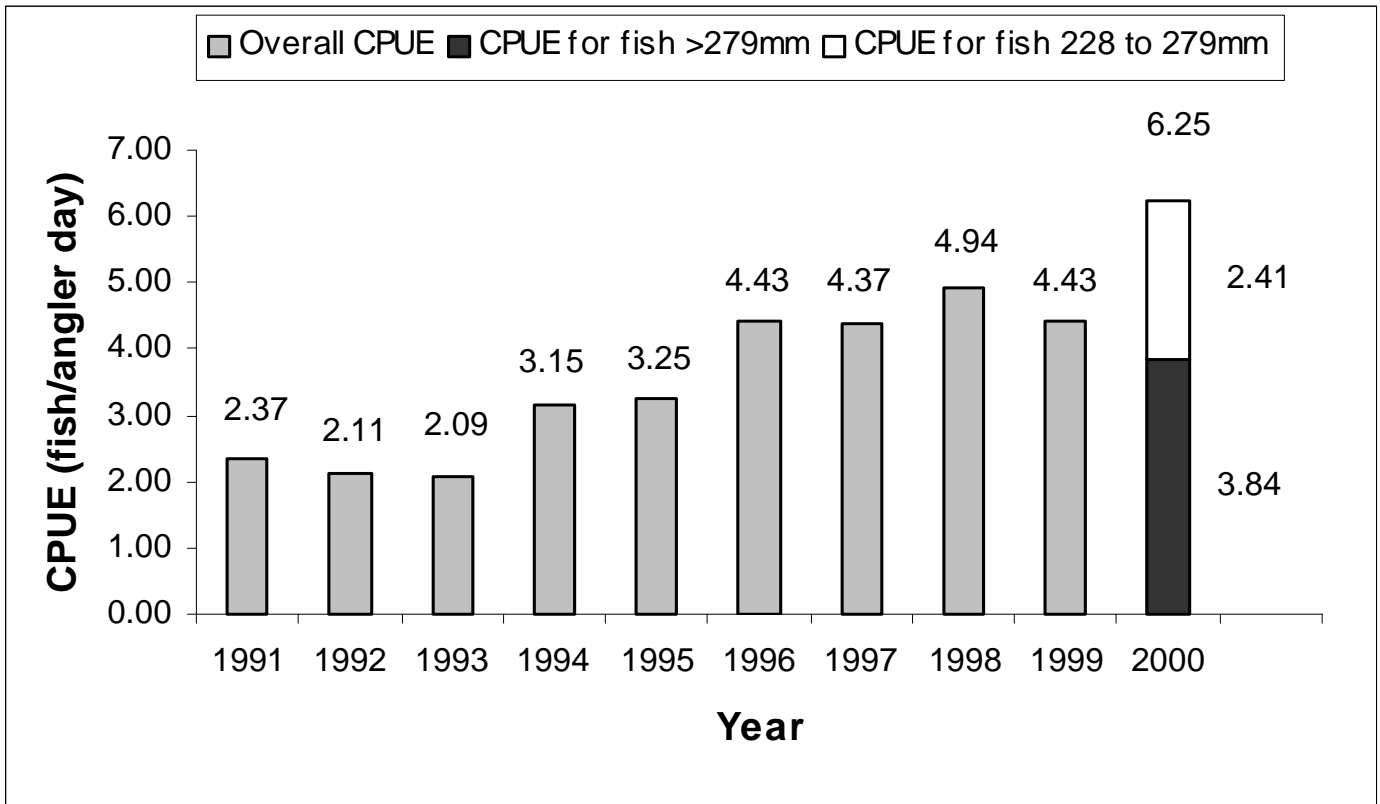


Figure 9. Sport-Reward Fishery catch per unit of effort (CPUE) by year for 1991 – 2000.

(CPUE for northern pikeminnow 228 to 279mm and >279mm are estimated values.)

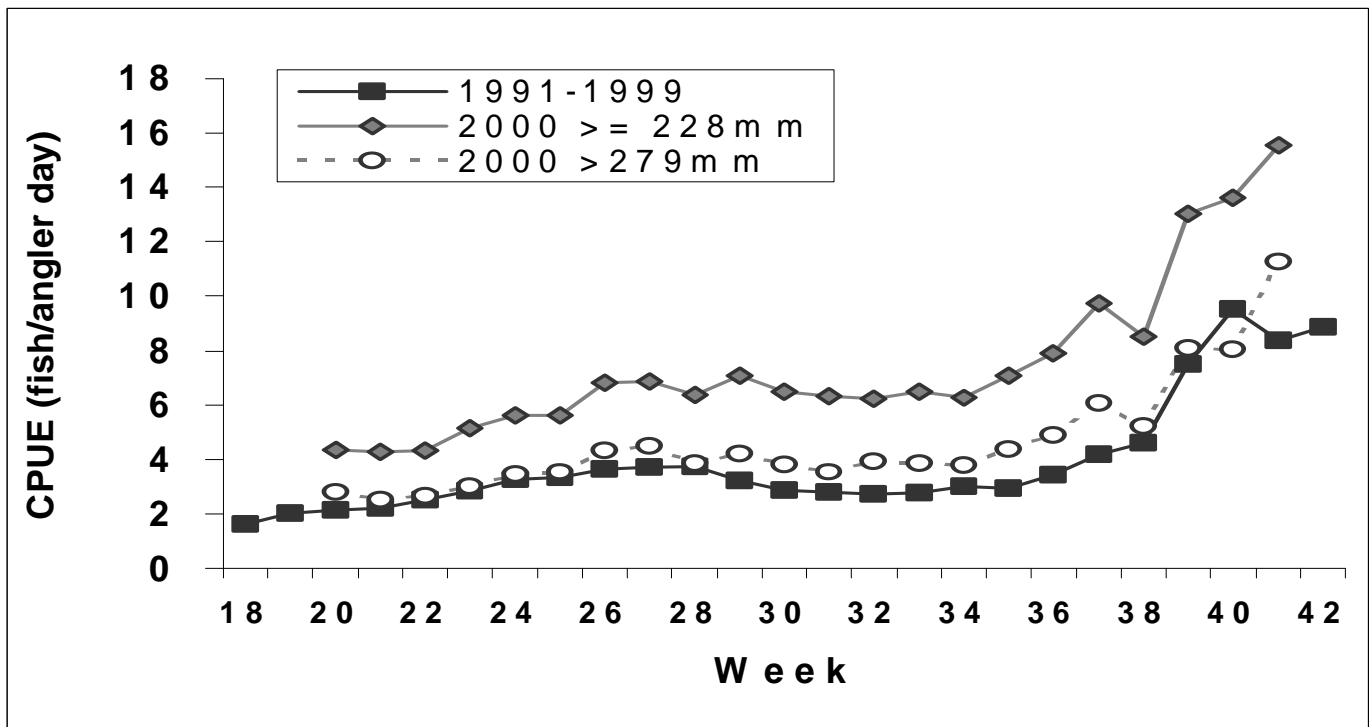


Figure 10. 2000 Sport-Reward Fishery catch per unit of effort (CPUE) by week for northern pikeminnow ≥ 228 mm (9 inches), estimated weekly CPUE for northern pikeminnow >279 mm (11 inches) in 2000, and the weekly 1991 – 1999 CPUE.

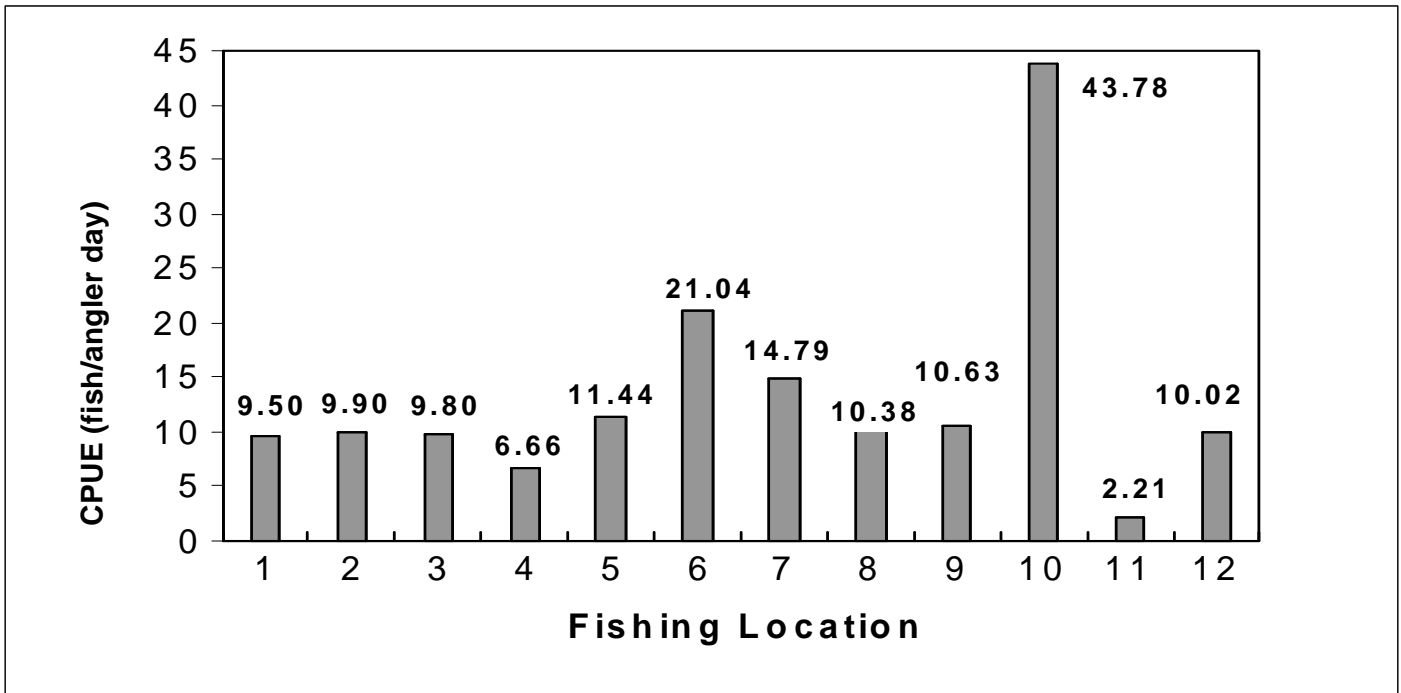


Figure 11. 2000 Sport-Reward Fishery catch per unit of effort (CPUE) by Fishing Location (returning anglers only).
 1-Below Bonneville Dam, 2-Bonneville Reservoir, 3-The Dallas Reservoir, 4-John Day Reservoir, 5-McNary Reservoir to the Mouth of the Snake River, 6-Mouth of the Snake River to Priest Rapids Dam, 7-Mouth of the Snake River to Ice Harbor Dam, 8-Ice Harbor Reservoir, 9-Lower Monumental Reservoir, 10-Little Goose Reservoir, 11-Lower Granite Reservoir to the Mouth of the Clearwater River, 12-Mouth of the Clearwater River to Hell's Canyon Dam

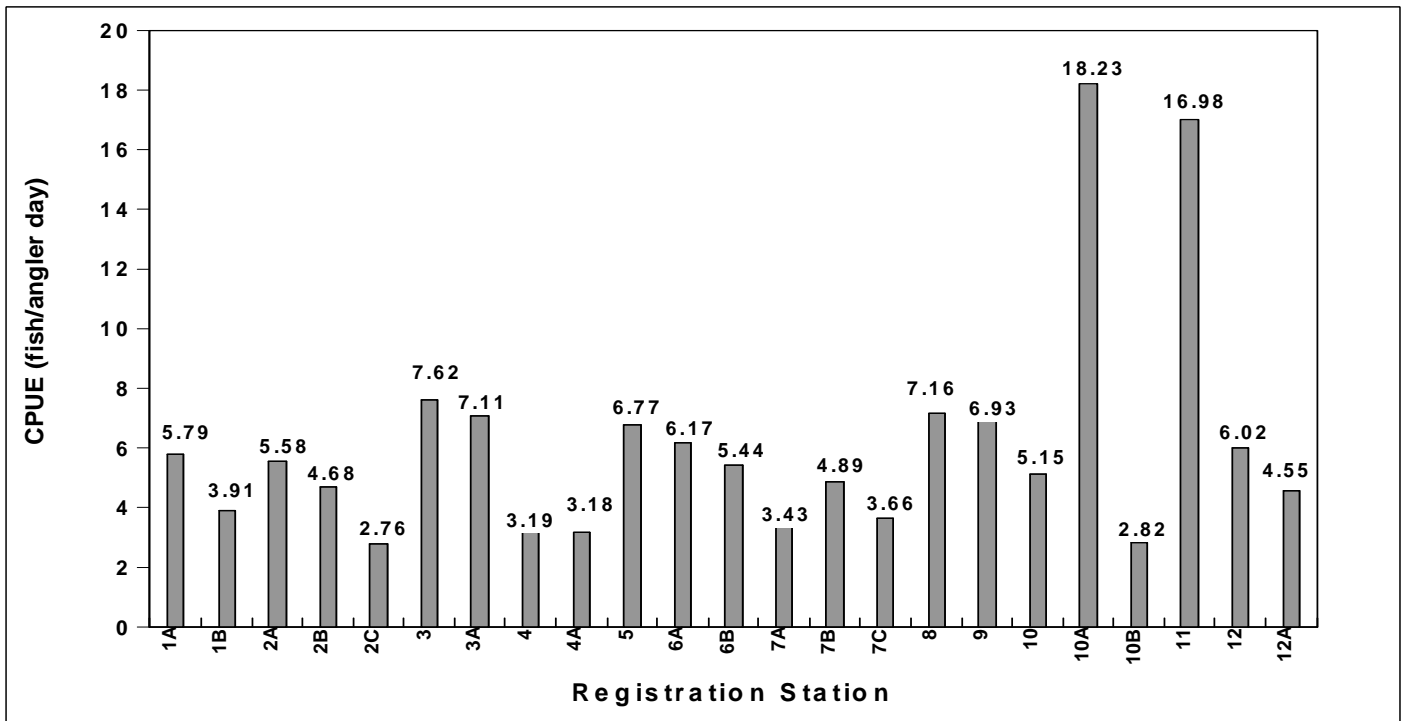


Figure 12. 2000 Sport-Reward Fishery catch per unit of effort (CPUE) by registration station (returning and non-returning anglers).

1A-Cathlamet, 1B-Willow Grove, 2A-Rainier, 2B-Scappoose Bay, 2C-Kalama, 3-M. James Gleason, 3A-Chinook Landing, 4-Washougal, 4A-Marine Park, 5-The Fishery, 6A-Bonneville Trailhead, 6B-Cascade Locks, 7A-Maryhill State Park, 7B-Bingen, 7C- Hood River, 8-The Dalles, 9-Giles French, 10-Columbia Point Park, 10A-Ringold, 10B-Umatilla, 11-Vernita, 12-Greenbelt, 12A- Lyon's Ferry

HARVEST BY REWARD TIER

In 2000, the PSMFC issued payment for 187,596 northern pikeminnow to 2,688 separate anglers (Porter R.G. Draft 2000 Annual Report). Figure 13 shows the percentage of anglers in each tier and their respective contribution to the northern pikeminnow total.

The top angler for the 2000 NPSRF received \$45,534 for harvesting 7,663 northern pikeminnow and surpassed 1995's top angler (\$18,940) as the NPSRF's leading single season money maker (Porter

R.G. Draft 2000 Annual Report).

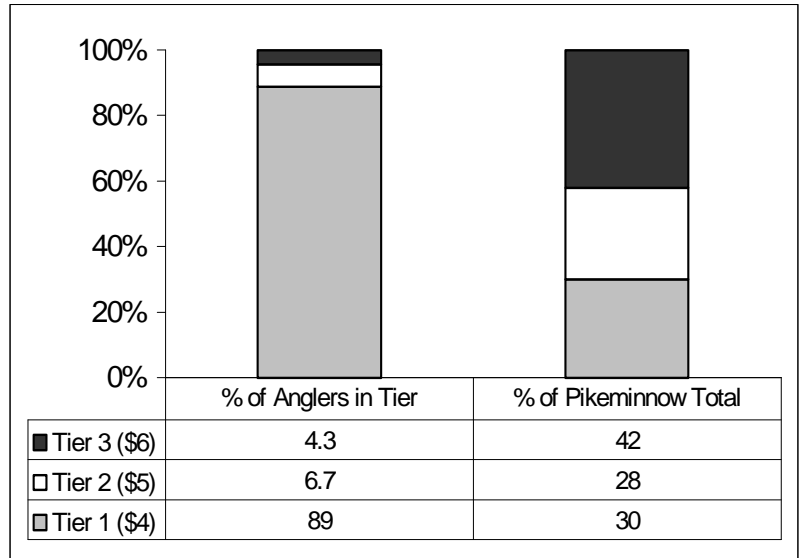


Figure 13. 2000 Reward Tier Summary: percentage of anglers in each tier and the percentage of the northern pikeminnow total attributable to each tier.

RETURNING ANGLER CATCH DATA

Northern pikeminnow targeted and harvested by returning anglers were recorded separately from those harvested by anglers not targeting northern pikeminnow. Of the overall total harvest, 99.7% of northern pikeminnow ≥ 228 mm were targeted. Refer to Appendix B for the list of all species caught and harvested by returning anglers. Incidentally caught fishes composed 29.4% of the overall catch for all species combined. Excluding northern pikeminnow < 228 mm, this rate dropped to 20.6%. Salmonids represented 0.3% of the overall catch. Actual harvest of the incidental catch was 6.6% of the total harvest for all species.

NON-RETURNING ANGLER CATCH DATA

A total of 2,540 non-returning anglers (19.97%) were sampled. Juvenile steelhead (hatchery origin) were the salmonid species most frequently caught by non-returning anglers targeting northern pikeminnow, with an estimated 115 caught (80% confidence interval = 50-190) (Appendix C). This was an increase of 58 over 1999 (Fox et al. 1999). Salmonids represented 2.1% of the total estimated catch of all species by non-returning anglers targeting northern pikeminnow.

Non-returning anglers reported catching 23 incidental non-salmonid species while fishing for northern pikeminnow. Estimates of the total non-returning angler catch for these species were all lower than the actual catch reported by returning anglers, except for bluegill *Lepomis macrochirus*, brown bullhead *Ictalurus nebulosus*, sunfish *Lepomis spp.*, and tench *Tinca tinca*. An estimated 1,282 northern pikeminnow ≥ 228 mm (80% CI = 1,051 – 1,542) were caught by

non-returning anglers, but were not turned in for reward—an increase from 406 (estimated) in 1999 (Fox et al. 1999). Peamouth *Mylocheilus caurinus* was the incidental species most frequently caught by non-returning anglers, with an estimated 2,403 caught (80% CI = 2,008 – 2,784). Refer to Appendix C for a complete list of the species caught by non-returning anglers.

TAG RECOVERY

Anglers returned 172 northern pikeminnow tagged with external spaghetti or dart tags, of which 170 were eligible for a \$50 reward. Station technicians identified an additional 15 northern pikeminnow with a fin-clip mark and/or wounds consistent with having lost a tag.

A total of 53,385 northern pikeminnow were individually scanned for the presence of PIT Tags. In addition, an estimated 26,100 northern pikeminnow ($95\% \pm 4200$) from 79 fish collection bins were “bulk” scanned before rendering. A total of 59 PIT tags were located and interrogated from these fish. The overall tag occurrence rate was 0.07%. Figure 14 presents occurrence rates by week for the 2000 NPSRF. After the week of July 31st, no PIT tags were found.

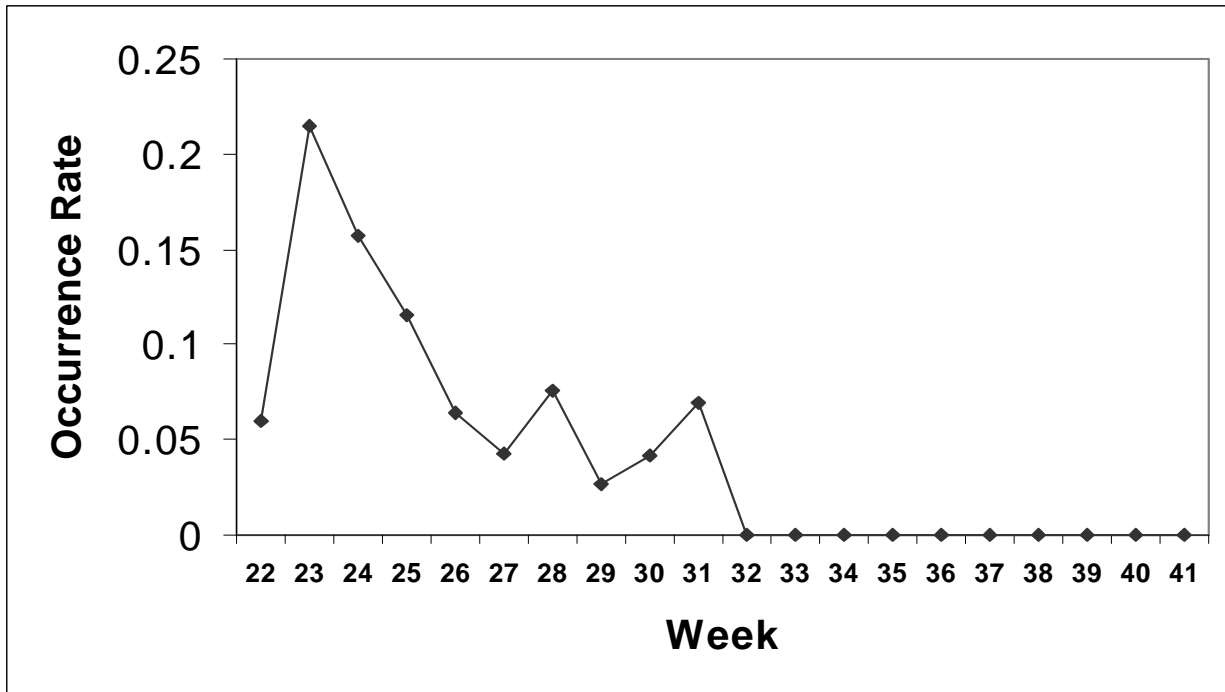


Figure 14. Occurrence Rates by week for PIT tags recovered in the 2000 Sport-Reward Fishery.

EXPLOITATION RATE

The ODFW has estimated the 2000 exploitation rate for the NPSRF to be 10.9% for northern pikeminnow ≥ 228 mm total length (Takata and Ward Draft 2000 Annual Report), down from 12.5% in 1999 (Zimmerman and Friesen 1999). Exploitation rates for the 228 to 279mm and >279 mm size classes were 6.6% and 11.9%, respectively (Takata and Ward Draft 2000 Annual Report).

FORK LENGTH DATA

A total of 112, 392 northern pikeminnow were sampled for fork length in 2000. Of these, 108, 432 fish (96%) had a fork length ≥ 228 mm. The mean fork length for northern pikeminnow ≥ 228 mm was 290 mm (S.D.=64)

DISCUSSION

Reduction of the northern pikeminnow target size by the NPMP heavily influenced angler participation, success rates, and behavior in the 2000 NPSRF. In effect, a relatively unexploited size-class of northern pikeminnow (228 – 279mm total length) was made available to program anglers. This prompted an increase in angler participation, both in the number of individual anglers and in total angler effort, similar to that seen when increasing monetary rewards (Vigg et al. 1990, Hisata et al. 1995, and Fox et al. 1999). Due to the contribution of the 228 to 279mm size-class, angler CPUE was the highest in program history (Figure 9). Increases in angler effort and CPUE led to an increase in northern pikeminnow harvest over 1999 as well as the nine-year average (1991-1999). The 228 to 279mm size-class contributed an estimated 38.5% (73,075 fish) of the 2000 harvest, which accounts for the majority of the increase from 1999 (75,023 fish). The harvest of fish in this size-class was bolstered by changes in angler behavior. Communication with anglers in the field revealed that many were fishing new areas and changing their techniques to target smaller northern pikeminnow.

Despite increases in harvest, angler effort and success rates, the overall exploitation rate for the NPSRF decreased from 1999. Estimates by size-class indicate that 228-279mm northern pikeminnow were exploited at a lower rate than fish over 279mm, accounting for the decrease in overall exploitation (Takata and Ward 2000 Draft Annual Report). While increased harvest and angler participation are beneficial to the NPSRF, the true measure of the program's success lies in the exploitation rate of northern pikeminnow it is able to achieve. Continued monitoring of the 228-279 mm size-class and its contribution to the overall exploitation rate should remain a priority.

Weekly trends in harvest, effort, and CPUE remained similar to the respective nine-year averages. Weekly harvest increased quickly early in the season, peaked in early July (week 27) and began declining thereafter with a small spike just prior to the season extension (week 38, Figure 3). Angler effort began high, peaked during the week of May 29 (week 22), and steadily declined throughout the remainder of the season (Figure 8). The CPUE gradually increased

throughout the season with a sharp increase and peak during the season extension, when less productive sites were closed (Figure 10).

The majority of the 2000 northern pikeminnow harvest (52%) and angler effort (59%) occurred in fishing location 1 (below Bonneville Dam, Figure 5). This is most likely due to a large population of northern pikeminnow in this area (Zimmerman and Ward 1999) and its proximity to major population centers (Fox et al. 1999). An estimated 46.1% of the northern pikeminnow harvest in fishing location 1 was composed of 228 to 279mm fish (Figure 7), suggesting that this size-class comprises a large percentage of the northern pikeminnow population below Bonneville Dam and/or this size-class is more easily exploited in this area.

Angler success increased in 2000 and is reflected in high CPUE values and increased returning angler effort; however, reward tier composition data (Figure 13) indicates that a small percentage of individual anglers produced the majority of the northern pikeminnow harvest. Anglers in tier 2 (\$5/fish) and tier 3 (\$6/fish) represented 11% of the NPSRF's anglers and received payment for 70% (131,219) of the northern pikeminnow total (Porter R.G. Draft 2000 Annual Report). This emphasizes the importance of maintaining and attempting to expand the Sport-Reward Fishery's core angler base through incentives, recruitment, and training of new anglers (Hisata et al. 1995).

Catch and harvest data collected from returning anglers (Appendix B) and estimates of catch by non-returning anglers (Appendix C) were used to evaluate the impact of the NPSRF on species other than northern pikeminnow. The incidental catch of all species was within acceptable limits established by the National Marine Fisheries Service (F. Young, CBFWA, personal communication; NMFS 1995). In general, estimates indicated non-returning anglers caught fewer of each species than returning anglers, supporting trends found in 1996 and, again, suggesting that non-returning angler surveys to collect complete catch data may not be necessary each year (Winther et al. 1996). In response, a return to the 1999 non-returning angler sampling procedures (Fox et al. 1999) is recommended.

Detection and subsequent interrogation of PIT tags retained in the gut of northern pikeminnow proved to be possible using the Destron Fearing "readers" provided by the BPA. The low overall PIT tag occurrence rate (0.07%) may have been partially attributable to the timing of scanning operations. "Readers" were not fully implemented until the week of June 4th (week 23), which was the week of peak PIT tag occurrence (0.21%). The plot of weekly occurrence rates (Figure 14) suggests scanning operations were begun when PIT tag occurrence was already declining. An earlier start may have provided a substantially larger number of tag detections. In addition, "reader" use was limited to sites near Bonneville and The Dalles dams. It may be possible to increase the number of PIT tag detections in future seasons by scanning a larger number of northern pikeminnow from a broader area.

RECOMMENDATIONS FOR THE 2001 SEASON

1. Continue monitoring the effects of the 228-279mm (total length) size-class on the NPSRF and the northern pikeminnow exploitation rate.
2. Begin the 2001 NPSRF in early May and continue through late September 2001.
3. Retain the option to extend the NPSRF season on a site-specific basis if harvest, angler effort and CPUE levels warrant.
4. Continue incentives designed to maintain the NPSRF's core angler group and continue efforts to recruit/train new anglers.
5. Modify the non-returning angler survey to exclude species other than salmonids. Resample for all species in 2005 to verify that trends have not changed.
6. Begin PIT tag scanning operations earlier in the season and investigate ways to efficiently scan a larger number of northern pikeminnow from a broader area.

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APPENDICES

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

Catch, harvest and percent harvested of salmonids and non-salmonids by returning anglers targeting northern pikeminnow.

Salmonids

Species	Caught	Harvest	Harvest Percent
Chinook (Adult) <i>Oncorhynchus tshawytscha</i>	15	8	53.33%
Chinook (Jack)	58	14	24.14%
Chinook (Juvenile)	77	1	1.30%
Coho (Adult) <i>Oncorhynchus kisutch</i>	4	3	75.00%
Coho (Juvenile)	8	1	12.50%
Dolly Varden/Bull Trout <i>Salvelinus malma/confluentus</i>	7	0	0.00%
Kokanee <i>Oncorhynchus nerka</i>	2	0	0.00%
Sockeye (Adult) <i>Oncorhynchus nerka</i>	3	2	66.67%
Steelhead Adult (Hatchery) <i>Oncorhynchus mykiss</i>	49	20	40.82%
Steelhead Adult (Wild)	16	2	12.50%
Steelhead Juvenile (Hatchery)	86	3	3.49%
Steelhead Juvenile (Wild)	35	3	8.57%
Trout (Unknown) <i>Oncorhynchus spp.</i>	253	44	17.39%
Rainbow Trout <i>Oncorhynchus mykiss</i>	42	7	16.67%
Searun Cutthroat Trout <i>Oncorhynchus clarki</i>	12	4	33.33%
Cutthroat Trout <i>Oncorhynchus clarki</i>	22	4	18.18%

Non-Salmonid

Species	Caught	Harvest	Harvest Percent
Northern Pikeminnow >228mm*	189054	188988	99.97%
Northern Pikeminnow <228mm	29578	5051	17.08%
American Shad <i>Alosa sapidissima</i>	559	242	43.29%
Black Bullhead <i>Ictalurus melas</i>	1	0	0.00%
Black Crappie <i>Pomoxis nigromaculatus</i>	15	13	86.67%
Blue Catfish <i>Ictalurus punctatus</i>	10	2	20.00%
Bluegill <i>Lepomis macrochirus</i>	42	23	54.76%
Bridgellip Sucker <i>Catostomus columbianus</i>	194	10	5.15%
Brown Bullhead <i>Ictalurus nebulosus</i>	36	2	5.56%
Bullhead (unknown) <i>Ictalurus spp.</i>	2354	85	3.61%
Carp <i>Cyprinus carpio</i>	556	79	14.21%
Channell Catfish <i>Ictalurus punctatus</i>	1110	382	34.41%
Chiselmouth <i>Acrochilus alutaceus</i>	818	234	28.61%
Crappie (unknown) <i>Pomoxis spp.</i>	156	30	19.23%
Green Sturgeon <i>Acipenser medirostris</i>	1	0	0.00%
Largemouth Bass <i>Micropterus salmonids</i>	34	4	11.76%
Largescale Sucker <i>Catostomus macrocheilus</i>	19	2	10.53%
Longnose Sucker <i>Catostomus catostomus</i>	4	1	25.00%
Peamouth <i>Mylocheilus caurinus</i>	24728	4996	20.20%
Pumpkinseed <i>Lepomis gibbosus</i>	5	0	0.00%
Redside Shiner <i>Richardsonius balteatus</i>	19	7	36.84%
Sculpin (unknown) <i>Cottus spp.</i>	2562	459	17.92%
Smallmouth Bass <i>Micropterus dolomieu</i>	6020	760	12.62%
Starry Flounder <i>Platichthys stellatus</i>	953	36	3.78%
Sucker (unknown) <i>Catostomus spp.</i>	2072	329	15.88%
Sunfish (Unknown) <i>Lepomis cyanellus</i>	5	0	0.00%
Tench <i>Tinca tinca</i>	0	0	0.00%
Walleye <i>Stizostedion vitreum</i>	325	237	72.92%
White Crappie <i>Pomoxis annularis</i>	12	0	0.00%
White Sturgeon <i>Acipenser transmontanus</i>	4572	62	1.36%
Whitefish (unknown) <i>Prosopium spp.</i>	23	10	43.48%
Yellow Bullhead <i>Ictalurus natalis</i>	52	11	21.15%
Yellow Perch <i>Pevca flaescen</i>	1205	210	17.43%

*Reflects reward size northern pikeminnow caught by anglers while targeting northern pikeminnow; does not represent total program harvest.

APPENDIX C

Estimated catch of salmonids by non-returning anglers targeting northern pikeminnow in 2000.

Species*	Method	Confidence Level	Estimated Catch	Range
Chinook (Adult)	Binomial	80%	5	(1 to 18)
Chinook (Jack)	Binomial	80%	10	(3 to 27)
Chinook (Juv.)	Bootstrap	80%	65	(25 to 105)
Steelhead (Hatchery)	Binomial	80%	5	(1 to 18)
Steelhead (Wild)	Bootstrap	80%	25	(10 to 40)
Steelhead Juv. (Hatchery)	Bootstrap	80%	115	(50 to 190)
Cutthroat	Binomial	80%	5	(1 to 18)
Rainbow Trout	Bootstrap	80%	40	(20 to 60)
Coho (Adult)	Binomial	80%	5	(1 to 18)

N=12717 n=2540

*Refer to Appendix B for species scientific names.

Estimated catch of non-salmonids by non-returning anglers targeting northern pikeminnow in 2000.

Species*	Method	Confidence Level	Estimated Catch	Range
Northern Pikeminnow > 228mm	Bootstrap	80%	1282	(1051 to 1542)
American Shad	Bootstrap	80%	386	(140 to 676)
Bluegill	Bootstrap	80%	70	(35 to 105)
Bridgelip Sucker	Binomial	80%	5	(1 to 18)
Brown Bullhead	Bootstrap	80%	926	(716 to 1116)
Bullhead (unknown)	Bootstrap	75%	25	(10 to 45)
Carp	Bootstrap	80%	471	(360 to 581)
Channell Catfish	Bootstrap	80%	431	(325 to 531)
Chiselmouth	Bootstrap	80%	421	(260 to 606)
Crappie	Bootstrap	80%	115	(10 to 225)
Largemouth Bass	Bootstrap	80%	30	(15 to 50)
Longnose Sucker	Binomial	80%	5	(1 to 18)
Peamouth	Bootstrap	80%	2403	(2008 to 2784)
Pumpkinseed	Binomial	80%	5	(1 to 18)
Sculpin (unknown)	Bootstrap	80%	1357	(1096 to 1627)
Smallmouth Bass	Bootstrap	80%	1121	(941 to 1317)
Starry Flounder	Bootstrap	80%	696	(491 to 916)
Sucker (unknown)	Bootstrap	80%	1147	(946 to 1337)
Sunfish	Bootstrap	80%	50	(15 to 85)
Tench	Bootstrap	80%	60	(30 to 90)
Walleye	Bootstrap	80%	75	(40 to 115)
White Sturgeon	Bootstrap	80%	1302	(1076 to 1532)
Yellow Perch	Bootstrap	80%	416	(305 to 526)

N=12717 n=2540

*Refer to Appendix B for species scientific names.

REPORT B

NORTHERN PIKEMINNOW SPORT REWARD PAYMENTS – 2000

Prepared by
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February, 2001

INTRODUCTION

The **Northern Pikeminnow Predator Control Program** was administered by PSMFC in 2000. The program is a joint effort between the fishery agencies of the states of Washington and Oregon, the Columbia River treaty tribes, the Columbia River Intertribal Fish Commission (CRITFC), the Columbia Basin Fish and Wildlife Authority (CBFWA) 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 contracted with the CBFWA for technical administration of the program. PSMFC provided fiscal and contractual oversight for all segments of the Program and processed all reward vouchers for the sport-reward anglers. CRITFC and the treaty tribes 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 2000 a total of 189,462 fish were harvested in the sport-reward fishery. Vouchers for 187,768 fish were submitted for payment totaling rewards of \$978,938. Rewards were paid at \$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. 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 2000 as an incentive to stimulate angler participation. A total of 2,322 coupons were returned for payments of \$9,288. Anglers were able to use a coupon on a voucher when they caught one or more pikeminnows for the extra \$4 reward. A total of 2,688 anglers who registered were successful in catching one or more fish in 2000. The 2000 season ran from May 15, 2000 through October 8, 2000.

TAGGED FISH PAYMENTS

A total of 172 tagged fish were caught. Anglers were issued a special tagged fish voucher for all tagged fish brought to the registration station. The tag voucher was then sent in with the tag for verification and payment of the special \$50 tagged fish reward. This resulted in tag reward payments of \$8,600.

TOURNAMENTS

There were no tournaments during 2000 for the first time in a number of years. The 2000 season saw a change in the size eligible for rewards lowered to 9 inches from 11 as this years incentive for anglers.

ACCOUNTING

Total payments for the season of regular vouchers, tagged fish, coupons and tournaments totaled \$978,938. All IRS Form 1099 Mis. Statements were sent to the qualifying anglers for tax purposes in the third week of January, 2001. Appropriate reports and copies were provided to the IRS by the end of February, 2001.

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.

REPORT C

**CONTROLLED ANGLING FOR NORTHERN PIKEMINNOW AT LOWER
COLUMBIA RIVER DAMS IN 2000**

Prepared by

Roy E. Beaty

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2000 Annual Report

ACKNOWLEDGMENTS

Thanks to Yakama Nation (YN) Biologist, George Lee, and fishery technicians Glen Pinkham, Priscilla Cloud, Clifford Alexander, Maynard Olney, and Daniel Craig for implementing the fishery and providing the data reported here. Jonas Greene, CRITFC Fishery Technician, entered and summarized data and submitted weekly reports during my absence. Mary Marvin at the Columbia Basin Fish and Wildlife Authority was patient and helpful in accepting our weekly data reports and revisions. Randy Henry of the Columbia River Inter-Tribal Fish Commission kindly provided the GIS map of fishing sites for this report and Dale McCullough provided assistance in final stages of report assembly.

Personnel from the U.S. Army Corps of Engineers (Corps) assisted in providing access for the crew to work at Corps dams: Jennifer Sturgill, Tom Savidge, Bob Cordie, and Miroslaw Zyndol. We appreciate their support.

Funding for this work was provided by the Bonneville Power Administration (John Skidmore, Contracting Officer's Technical Representative) through the Pacific States Marine Fisheries Commission (Russell Porter, Program Manager) with coordination from the Columbia Basin Fish and Wildlife Authority (Frank Young, Program Manager).

ABSTRACT

In 2000 a single YN crew angled for northern pikeminnow (NPm) at Bonneville, The Dalles, and John Day dams during the four months between June 6 and October 5. Angling and data collection methods were the same as in 1999, except that the crew measured its effort generally as the time spent on the dam rather than as the time spent actively angling, as in previous years.

The crew caught 423 NPm > 200mm FL in 1,356 hr of angling, for a seasonal catch per angler hour (CPAH) of 0.3. Relative to 1999, catch declined 89%, effort (as reported) declined 58%, and CPAH declined 75%. If effort had been recorded as in other years, then angler hours in 2000 would have been about 30% lower than reported here. CPAH was uniformly low at all dams, and the overall CPAH is approximately half the previous minimum of 0.7 in 1995. Incidental species, primarily centrarchids caught at The Dalles Dam, composed 6.6% of the total catch. No salmonids were caught.

INTRODUCTION

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

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

METHODS

In 2000, dam angling was conducted only at Bonneville, The Dalles, and John Day dams on the lower Columbia River (Fig. C-2). Our angling was confined to the boat-restricted zones (BRZ) at these dams, with most effort focused in the tailraces

The angling season extended four months from June 6 through October 5, with differences among dams in dates fished (Table C-1). The fishery in 2000 comprised just one crew, employed by the Yakama Nation (YN), which fished at all three dams. The season began when contracts and hiring were complete, and ended in October when catches dropped to zero. Angling did not begin at Bonneville Dam until August 14, because of delays in completing administrative arrangements between the YN and the Corps.

Field procedures were essentially the same as in years past: anglers fished the most favorable daytime and/or nighttime hours, explored and exploited fishing sites as conditions (e.g., spill) changed and success varied, and used their choice of baits/lures and angling techniques. Anglers were encouraged to experiment and to innovate.

Data were recorded on paper forms and transmitted to the Columbia River Inter-Tribal Fish Commission (CRITFC) via fax. We then entered the data into a computer database (Microsoft Excel) and summarized them for weekly reports.



Figure C-1. Location of the three dams at which fish was conducted in 2000.

Table C-1. Northern pikeminnow (NPM) catch, effort (angler hours), and catch per angler hour (CPAH) for dam-based and boat angling (combined), by statistical week at Columbia River dams in 2000. First and last fishing days are shown in parentheses beside dam names. Rounding may cause some apparent discrepancies.

Statistical Week		Bonneville (8/14-10/5)			The Dalles (6/6-10/3)			John Day (6/12-10/5)		
No.	Dates	NPM	Effort	CPAH	NPM	Effort	CPAH	NPM	Effort	CPAH
23	6/5/00 – 6/11/00	–	0	–	14	40.7	.3	–	0	–
24	6/12/00 – 6/18/00	–	0	–	1	29.1	<.1	11	75.2	.1
25	6/19/00 – 6/25/00	–	0	–	79	105.9	.7	3	11.5	.3
26	6/26/00 – 7/2/00	–	0	–	58	36.9	1.6	–	0	–
27	7/3/00 – 7/9/00	–	0	–	70	64.9	1.1	–	0	–
28	7/10/00 – 7/16/00	–	0	–	23	112.3	.2	1	5.8	.2
29	7/17/00 – 7/23/00	–	0	–	24	87.1	.3	9	39.9	.2
30	7/24/00 – 7/30/00	–	0	–	11	124.3	.1	3	16.1	.2
31	7/31/00 – 8/6/00	–	0	–	4	58.4	.1	–	0	–
32	8/7/00 – 8/13/00	–	0	–	3	64.4	<.1	–	0	–
33	8/14/00 – 8/20/00	18	42.0	.4	–	0	–	–	0	–
34	8/21/00 – 8/27/00	61	85.8	.7	–	0	–	–	0	–
35	8/28/00 – 9/3/00	19	47.9	.4	–	0	–	–	0	–
36	9/4/00 – 9/10/00	2	21.0	.1	–	0	–	–	0	–
37	9/11/00 – 9/17/00	4	62.8	.1	–	0	–	–	0	–
38	9/18/00 – 9/24/00	2	21.0	.1	2	32.9	.1	0	9.0	.0
39	9/25/00 – 10/1/00	2	16.0	.1	0	53.9	.0	0	9.0	.0
40	10/2/00 – 10/8/00	0	29.8	.0	0	20.9	.0	0	30.2	.0
Totals:		107	326.2	.3	289	831.5	.3	27	196.6	.1

Effort was measured differently this year. Instead of monitoring and recording just the time spent angling, the crew recorded essentially all of the time they spent on the dam, including breaks, moving from site to site, recording data, changing gear, etc. The effect, relative to methods in previous years, is to increase the apparent (i.e., not real) amount of angler hours and to decrease the catch per angler hour (CPAH). I estimated the magnitude of this effect by comparing, between 1999 and 2000, the proportions of time on the dam (measured from time of first data record to last data record for a shift) recorded as angling minutes. However, I report the data here as they were submitted; no adjustments were made for this difference in methods.

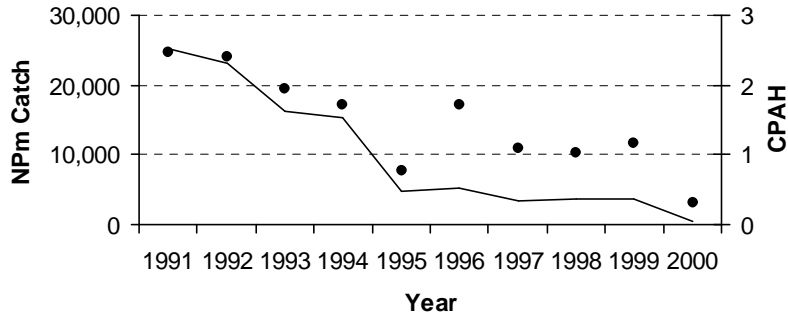
RESULTS AND DISCUSSION

In 2000 the angling crew caught 423 Npm (>200 mm fork length) in 1,356 hours of fishing, for a seasonal CPAH of 0.3 (Table C-2). Total catch decreased 89% relative to 1999, and effort (as reported) was 58% less than in 1999. Had angling time been measured the same as in 1999, angler hours in 2000 would have been about 30% less than reported and about 70% less than in 1999. Likewise, CPAH in 2000 would have been about 40% higher (0.45 instead of 0.32). Although the large decline in catch in 2000 may be attributed partially to the significant reduction in effort, the large decline in CPAH cannot (Fig. C-2). Overall CPAH in 2000 was approximately half of the previous lowest value (0.7 in 1995), and results were uniformly low at all three dams (Table C-2). Starting at Bonneville before August 14 may have improved results there, because in 1999 over half of the Bonneville catch and some of the best weekly CPAH values were obtained in July (Beaty 2000).

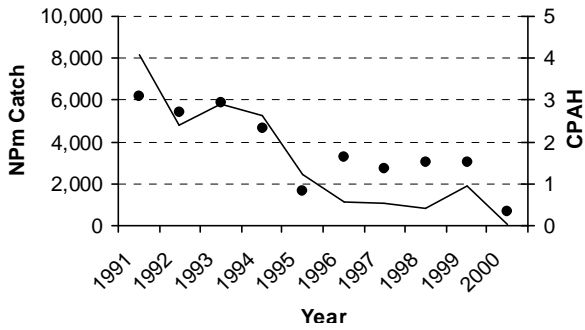
All of the catch was taken in the tailraces of the dams. Some angling occurred in the forebays of Bonneville and The Dalles dams, but no Npm were caught there.

Total incidental catch in 2000 was 6.6% (Table C-3), composed almost entirely of bass and other centrarchids caught at The Dalles Dam. Two sturgeon were caught at The Dalles Dam; no salmonids were caught at any dam.

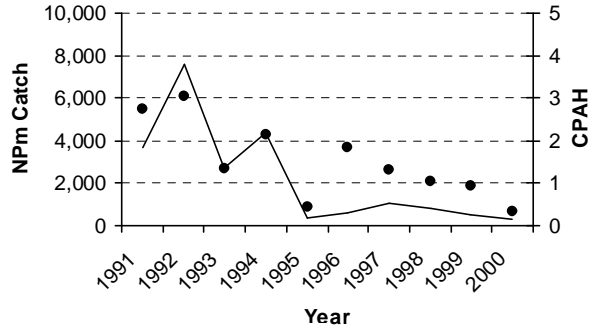
All Columbia R. Dams



Bonneville



The Dalles



John Day

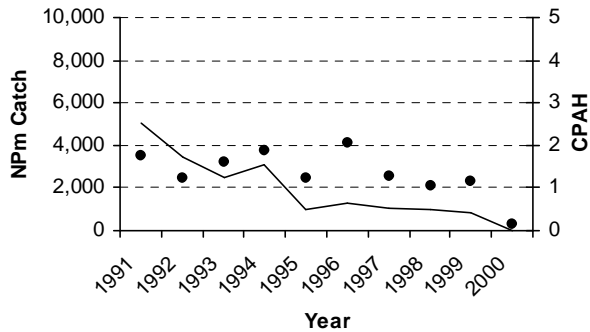


Figure C-2. Trends in annual NPM catch (lines) and CPAH (●), 1991-2000, for Columbia R. dams where angling was conducted in 2000.

Table C-2. Northern pikeminnow (NPm) catch, effort (angler hr), and catch per angler hour (CPAH) for hook-and-line angling at Columbia and Snake river dams, 1991-2000.

	COLUMBIA RIVER DAMS										SNAKE RIVER DAMS						GRAND TOTALS								
	Bonneville					The Dalles					Ice Harbor			Lower Granite				Season							
	NPm	Effort	CPAH	NPm	Effort	CPAH	NPm	Effort	CPAH	NPm	Effort	CPAH	NPm	Effort	CPAH	NPm		Effort	CPAH	NPm	Effort	CPAH	NPm	Effort	CPAH
1991	8,131	3,674	3.1	5,004	8,348	2.8	2,816	3.1	3,313	1,486	2,052	.7	4,915	4,480	14,194	39,351									
	2,621	1,333	3.1	2,816	3,416	2.5	10,186	2.5	2,471	2,052	.7	2,140	2,448	9,112	19,298										
	3.1	2.8	3.1	1.8	2.4	2.5	2.5	1.3	1.3	1.8	.7	2.3	1.8	1.6	2.0										
1992	4,814	7,561	3.1	3,427	7,297	2.4	23,099	2.4	475	278	.9	1,664	2,352	4,769	27,868										
	1,781	2,496	2.7	2,775	2,523	2.4	9,575	2.4	943	298	.9	3,062	2,880	7,183	16,758										
	2.7	3.0	2.7	1.2	2.9	2.4	2.4	.5	.5	.9	.9	.5	.8	.7	1.7										
1993	5,836	2,712	2.9	2,509	5,148	1.9	16,205	1.9	105	122	.3	100	678	1,005	17,210										
	1,991	1,992	1.4	1,561	2,780	1.6	8,324	1.6	396	404	.3	378	734	1,911	10,235										
	2.9	1.4	1.4	1.6	1.9	1.6	1.9	.3	.3	.3	.3	.3	.9	.5	1.7										
1994	5,238	4,393	2.3	3,083	2,556	1.7	15,270	1.7	27	23	.2	92	685	827	16,097										
	2,232	2,064	2.3	1,649	2,966	1.9	8,910	1.9	55	141	.2	203	692	1,092	10,002										
	2.3	2.1	2.3	1.9	.9	1.7	1.7	.5	.5	.5	.5	.5	1.0	.8	1.6										
1995	2,422	409	.9	950	1,002	.8	4,783	.8	1	9	.1	186	320	516	5,299										
	2,823	920	.9	777	1,670	1.2	6,190	1.2	38	80	.1	183	798	1,099	7,289										
	.9	.4	.9	1.2	.6	.8	.8	.4	.4	.1	.1	1.0	.4	.5	.7										
1996	1,135	623	1.6	1,278	2,184	1.0	5,220	1.0	27	0	0	96	112	235	5,455										
	693	338	1.6	618	1,372	1.8	3,022	1.8	75	56	0	206	307	645	3,666										
	1.6	1.8	1.6	2.1	1.6	1.7	1.7	.4	.4	0	0	.5	.4	.4	1.5										
1997	1,086	1,084	1.4	1,086	263	1.3	3,519	1.3	-	-	-	-	-	-	3,519										
	784	826	1.4	857	746	1.3	3,214	1.3	0	0	0	0	0	0	3,214										
	1.4	1.3	1.4	1.3	.4	1.1	1.1	.4	.4	.4	.4	.4	.4	.4	1.1										
1998	829	800	1.5	945	1,106	1.0	3,680	1.0	-	-	-	-	-	-	3,680										
	538	758	1.5	902	1,356	1.1	3,554	1.1	0	0	0	0	0	0	3,554										
	1.5	1.1	1.5	1.0	.8	1.0	1.0	.8	-	-	-	-	-	-	1.0										
1999	1,926	506	1.5	853	452	1.2	3,737	1.2	-	-	-	-	-	-	3,737										
	1,249	540	1.5	726	691	1.2	3,206	1.2	0	0	0	0	0	0	3,206										
	1.5	.9	1.5	1.2	.7	1.2	1.2	.7	-	-	-	-	-	-	1.2										

2000	NPm	107	289	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	423	423
	Effort	327	832	197	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,356	1,356
	CPAH	.3	.3	.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.3	.3
	TOTA NPm	31,524	22,051	19,162	28,356	101,093	1,918	3,948	7,053	8,627	21,546	122,639								
	L																			
	Effort	15,039	12,099	12,878	17,520	57,537	3,031	3,979	6,172	7,859	21,041	78,579								
	CPAH	2.1	1.8	1.5	1.6	1.8	.6	1.0	1.1	1.1	1.0	1.6								

Table C-3. Npm catch and incidental catch for the dam angling fishery in 2000, by dam.

Dam	Npm Catch		Incidental Catch							% of Total
	≥ 200mm FL	Salmonids		Sturgeon	Bass	Catfish	Walleye	Shad	Other	
		Juv.	Ad.							
Bonneville	107	0	0	0	0	0	0	0	0	.0
The Dalles	289	0	0	2	26 ^a	0	0	0	0	9.7
John Day	27	0	0	0	0	0	0	0	0	.0
Total	423	0	0	2	26^a	0	0	0	0	6.6

^a Includes an unknown number of centrarchids other than bass.

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REPORT D

**SITE-SPECIFIC GILLNETTING FOR NORTHERN PIKEMINNOW IN
THE LOWER COLUMBIA AND SNAKE RIVERS IN 2000**

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2000 Annual Report

ACKNOWLEDGEMENTS

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ABSTRACT

Two crews fished small-meshed gillnets at six locations in Bonneville Reservoir and other areas of the lower Columbia and Snake rivers in 2000. This site-specific gillnet fishery is part of the on-going program to control the abundance of northern pikeminnow (NPM) and their predation on juvenile salmonids *Oncorhynchus* spp.

In the May 17 to July 8 season, 557 NPM were caught in a total of 258 net-hr of effort, for a catch-per-net-hour (CPNH) of 2.2. Compared to 1999, effort decreased 77% and catch decreased 71%, which combined for a 29% increase in CPNH. Drano Lake and the mouth of the Klickitat River again produced most (89.8%; 500 NPM) of the catch.

Incidental species composed 51.6% of the total catch; suckers *Catostomus* spp. accounted for almost half (44.7%) of the incidentals. The one juvenile and 23 adult salmon and steelhead composed 2.1% of the total catch, which is slightly higher than the 1.8% in 1999.

INTRODUCTION

Implemented in 1990, the Northern Pikeminnow Management Program seeks to increase survival of juvenile salmonids by controlling the abundance of northern pikeminnow *Ptychocheilus oregonensis* (NPM) of predaceous or nearly predaceous size ($\geq 200\text{mm FL}$) in the lower Columbia and Snake rivers. One component of this program, the site-specific gillnet fishery, was first tested in 1993 and since then has been employed to target predators where they are known to concentrate, such as near hatchery-release points in Bonneville Reservoir (Collis et al. 1995). The objective of the fishery again in 2000 was to catch NPM as efficiently as possible while keeping incidental impacts to salmonids to a minimum. The Nez Perce Tribe (NPT) and Yakama Nation (YN) were contracted to conduct the fishing; the Columbia River Inter-Tribal Fish Commission supported their work through procurement, coordination, data management, and reporting.

METHODS

Two boats and crews fished small-meshed gillnets² at six locations in the lower Columbia and Snake rivers: four in Bonneville Reservoir; one in the Columbia River at Pasco, WA; and one in the Snake River just upstream of Lower Granite Dam (Figure D-1). Effort was initially focused in the most productive locations in Bonneville Reservoir, but was dispersed upstream after a sockeye salmon *Oncorhynchus nerka* was caught incidentally at the Klickitat River on June 5. The fishery commenced May 17 and ended July 8.

Operational criteria to reduce impacts to salmonids were essentially the same as in previous years (Collis et al. 1995; Hatch et al. 1998). For example, fishing was conducted only at night, and nets were fished only about 45 minutes so that incidentally caught salmonids could be quickly found and released. Each crew fished three or four nets simultaneously, pulling, checking, and resetting the nets in a regular rotation.

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

Data were recorded on paper forms that were faxed to the CRITFC office in Portland. CRITFC then entered the data into computer database (Microsoft Access) files and summarized them for weekly reports that were submitted to the Program Coordinator.

² Gillnets were 2.4 m deep by 45.6 m long with mesh of 4.4 cm and/or 5.1 cm bar measures.

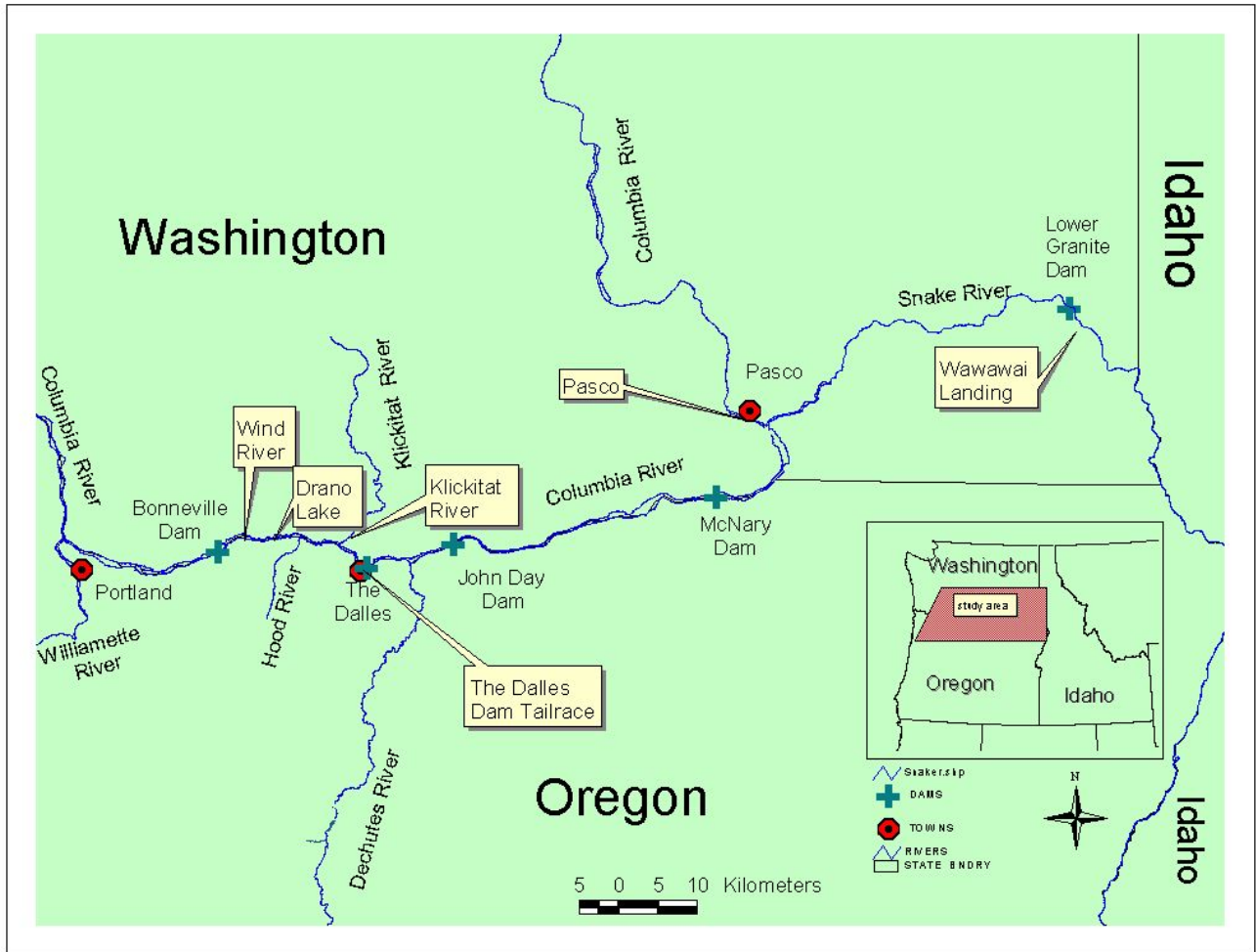


Figure D-1. Locations of site-specific gillnetting in 2000.

RESULTS & DISCUSSION

In 2000, 557 NPM ≥ 200 mm fork length (fl) were caught in 258 net hours of fishing, for a catch-per-net-hour (CPNH) of 2.2 (Table D-1). Relative to 1999, effort decreased 77%, catch decreased 71%, and CPNH increased by 29%. Mean FL of the NPM caught in 2000 was 363 mm ($n=360$, $s.d.=45.3$ mm), 7% lower than the mean in 1999 (390mm, $n=1,405$, $s.d.=51.6$ mm).

Bonneville Reservoir again dominated the results, accounting for 70% of the effort and the vast majority (94.4%) of the NPM caught. Drano Lake and the Klickitat River remained the most fruitful locations (Table D-2), together producing 89.8% of the NPM catch. Since its inception in 1993, this fishery has removed 32,735 predators from Bonneville Reservoir (Table D-1).

I speculate that the increase in catch rate over that in 1999 may be partially attributable to the substantial reduction in effort in Bonneville Reservoir. I question whether CPNH would have

increased relative to 1999 if the same effort had been applied to Drano Lake and the Klickitat River (i.e., 5.3 times more net hours than in 2000).

Incidental species composed 51.6% (595/1,152) of the total catch in 2000 (Table D-3), a reduction from the 61.6% in 1999 (Beaty 2000). Salmonids were 2.1% of the total catch in 2000, compared to 1.8% in 1999 (from data in Beaty 2000). One adult sockeye was caught at the mouth of the Klickitat River on June 5 and released in good condition. As in the previous two years, suckers *Catostomus* spp. were the most commonly caught incidental species in 2000, accounting for nearly half (44.7%) of all incidentals (Table D-3).

Table D-1. Northern pike-minnow catch, effort (net hr), and catch per net hour (CPNH) for the site-specific gillnet fishery, 1993-2000. Rounding may cause some apparent discrepancies.

	Columbia River										Snake River					GRAND TOTAL (mean)
	Below Bonneville	Reservoirs					McNary	Season	Ice Harbor	Lwr Monumental	Reservoirs		Lower Granite	Season		
		Bonneville	The Dalles	John Day	McNary	Season					Little Goose					
1993	Catch	-	1,772	-	-	-	-	-	-	-	-	-	-	-	1,772	
	Effort	0	394	0	0	0	394	0	0	0	0	0	0	0	394	
	CPNH	-	4.5	-	-	-	4.5	-	-	-	-	-	-	-	4.5	
1994	Catch	-	8,890	5	42	10	8,947	-	5	72	77	9,024				
	Effort	0	1,195	18	43	67	1,323	0	17	102	120	1,442				
	CPNH	-	7.4	.3	1.0	.2	6.8	-	.3	.7	.6	6.3				
1995	Catch	263	8,668	25	136	57	9,149	231	22	60	335	9,484				
	Effort	166	1,844	19	139	45	2,213	112	26	66	217	2,430				
	CPNH	1.6	4.7	1.3	1.0	1.3	4.1	2.1	.8	.9	1.5	3.9				
1996	Catch	38	5,822	232	63	11	6,166	-	-	-	-	6,166				
	Effort	35	2,584	121	91	47	2,878	0	0	0	0	2,878				
	CPNH	1.1	2.3	1.9	.7	.2	2.1	-	-	-	-	2.1				
1997	Catch	1	2,538	226	35	23	2,823	-	8	-	8	2,831				
	Effort	4	1,296	172	84	28	1,584	0	25	0	25	1,609				
	CPNH	.2	2.0	1.3	.4	.8	1.8	-	.3	-	.3	1.8				
1998	Catch	76	2,847	111	1	-	3,035	-	-	-	-	3,035				
	Effort	28	1,119	108	15	0	1,270	0	0	0	0	1,270				
	CPNH	2.7	2.5	1.0	.1	-	2.4	-	-	-	-	2.4				
1999	Catch	186	1,672	33	-	-	1,891	-	-	-	-	1,891				
	Effort	94	970	46	0	0	1,110	0	0	0	0	1,110				
	CPNH	2.0	1.7	.7	-	-	1.7	-	-	-	-	1.7				
2000	Catch	-	526	-	-	7	467	-	-	-	24	491				
	Effort	0	181	0	0	49	207	0	0	0	28	235				
	CPNH	-	2.9	-	-	.1	2.3	-	-	-	.9	2.1				
Total	Catch	564	32,735	632	277	108	34,316	231	35	22	444	34,760				
	Effort	327	9,583	484	372	236	11,002	112	68	13	196	11,391				
	CPNH	1.7	3.4	1.3	.7	.5	3.1	2.1	.5	1.7	.8	3.1				

Table D-2. Npm (>200mm FL) catch, effort, and catch per net hour (CPNH) by location, 2000.

Area/Location	Npm Catch	Effort (net hr)	CPNH
<i>Bonneville Reservoir</i>			
Wind R.	25	16.2	1.5
Drano Lake	212	77.4	2.7
Klickitat R.	288	77.4	3.7
The Dalles Dam tailrace	1	9.6	.1
<i>McNary Reservoir</i>			
Pasco	7	48.9	.1
<i>Lower Granite Reservoir</i>			
Wawawai Landing	24	28.4	.8
<i>TOTAL</i>	557	257.8	2.2

Table D-3. Species composition of the site-specific gillnet fishery catch in 2000. Condition codes for salmonids: 1 = minimal injury, certain to survive; 2 = moderate injury, may or may not survive; 3 = dead, nearly dead, or certain to die.

Species	No.	Species	No.
Northern Pikeminnow (<i>Ptychocheilus oregonensis</i>)			
	≥ 200mm FL	557	
	< 200mm FL	0	
		557	
Total Northern Pikeminnow			
Salmon & Steelhead (<i>Oncorhynchus</i> spp.)			
	<i>Condition</i>		
Juveniles (undetermined spp.)	1	1	
	2	0	
	3	0	
Adults			
<i>O. tshawytscha</i> (chinook)	1	4	
	2	0	
	3	0	
		12	
<i>O. mykiss</i> (steelhead)	2	3	
	3	0	
		1	
<i>O. nerka</i> (sockeye)	1	1	
	2	0	
	3	0	
		3	
unspecified			
		24	
Total Salmon and Steelhead			
Game Fishes			
<i>Ictalurus</i> spp. (catfish/bullhead)			87
<i>Acipenser transmontanus</i> (white sturgeon)			57
<i>Micropterus</i> spp. (bass)			22
<i>Alosa sapidissima</i> (American shad)			10
<i>Stizostedion vitreum</i> (walleye)			2
<i>Salvelinus</i> spp. (char)			1
<i>O. mykiss</i> (rainbow trout)			1
unspecified			16
			196
Total Game Fishes			
Non-game Fishes			
<i>Catostomus</i> spp. (suckers)			266
Cyprinids (carp, peamouth, chiselmouth)			98
unspecified			11
			375
Total Non-game Fishes			
			1,152
Total Catch			

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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 tenth 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 2000, (2) estimated reductions in predation on juvenile salmonids since implementation of the fisheries, (3) estimated tag loss rates for two types of tags and their relative effectiveness, and (4) validation of aging methodology for northern pikeminnow based on scale readings.

System-wide exploitation of northern pikeminnow ≥ 250 mm fork length (FL) was 11.9% for sport-reward, 0.0% for dam angling, and 0.0% for site-specific gillnet fisheries. For northern pikeminnow 200-249 mm FL, system-wide exploitation was 6.6% in the sport-reward fishery, 0.4% in the dam angling fishery, and 0.0% in the site-specific fishery. System-wide exploitation of all northern pikeminnow ≥ 200 mm was 10.9% for sport-reward, 0.1% for dam angling, and 0.0% for the site-specific fishery. Among reservoirs/river areas, exploitation of northern pikeminnow ≥ 200 mm by the sport-reward fishery was highest in Bonneville, McNary (including the Hanford Reach), Little Goose, and Lower Granite reservoirs, as well as the area downstream of Bonneville Dam. Mean length of northern pikeminnow harvested in the site-specific gillnet and dam angling fisheries exceeded that of fish in the sport-reward fishery.

Incidental fish composed 29.4% of the catch by sport-reward anglers targeting northern pikeminnow, 6.2% of the dam angling catch, and 51.6% of the site-specific gillnet catch. The proportion of the northern pikeminnow catch consisting of predator-sized (≥ 200 mm FL) fish was highest in the dam angling (100%) and gillnet (100%) fisheries, and lowest in the sport-reward fishery (86.5%). The incidental catch of salmonids by all fisheries combined comprised 0.3% of the total catch.

Assuming system-wide exploitation of northern pikeminnow remains constant through 2006, we estimate that juvenile salmonid predation will be held to 77% of levels estimated prior to implementation of predator control fisheries. If exploitation decreases to below mean 1994-2000 levels, potential predation may increase in the future.

Within-season tag loss was estimated to be 2.6% for spaghetti tags and 33.3% for dart tags. We concluded that spaghetti tags were a more effective means of tagging northern pikeminnow.

The rate of agreement between two readings for independent age assignments of northern pikeminnow scales was 39%, but increased to 84% with a margin of error of \pm one year. This level of precision is probably adequate for assessing changes in relative age structure in the northern pikeminnow population.

INTRODUCTION

The goal of the Northern Pikeminnow Management Program (NPMP) is to reduce mainstem mortality of juvenile salmonids attributed to predation by northern pikeminnow *Ptychocheilus oregonensis* in the lower Columbia River Basin. We established baseline levels of predation and described northern pikeminnow population characteristics prior to the implementation of sustained predator control fisheries by estimating abundance, consumption, and predation in Columbia River reservoirs in 1990 and 1993, Snake River reservoirs in 1991, and the unimpounded lower Columbia River downstream from Bonneville Dam in 1992 (Ward et al. 1995). From 1994 to 1996, we sampled in areas where sufficient numbers of northern pikeminnow could be collected to compare changes in predation among years (Zimmerman and Ward 1999). Ward (1998) provided a comprehensive summary of NPMP evaluation from 1990 to 1996. In this report, we describe our activities and findings for 2000, and wherever possible, evaluate changes from previous years.

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

METHODS

FISHERY EVALUATION, PREDATION ESTIMATES, AND TAG LOSS

Field Procedures

Three northern pikeminnow fisheries were conducted in 2000. The sport-reward fishery was implemented by the Washington Department of Fish and Wildlife (WDFW) from May 15 to October 15 throughout the lower Columbia and Snake rivers. This year, for the first time, northern pikeminnow as small as 9 inches (228 mm) total length (TL) (approximately equivalent to 200 mm FL) were eligible for a reward. The dam angling fishery was implemented by the Yakama Nation from June 12 to October 5 at Bonneville, The Dalles, and John Day dams. A site-specific gillnet fishery was implemented by the Yakama Nation and Nez Perce Tribe from May 15 to June 11 in Bonneville, McNary, and Lower Granite reservoirs. Both the dam angling and site-specific gillnet fisheries also targeted northern pikeminnow ≥ 228 mm TL.

We tagged and released northern pikeminnow ≥ 200 mm FL to estimate exploitation rates for each fishery. We used electrofishing boats and bottom gillnets to collect northern pikeminnow from April 6 to June 22. A detailed description of sampling gears and methods is given in Parker et al. (1995). We allocated equal sampling effort in all river kilometers (Rkm), with few exceptions, from Rkm 78 through Rkm 634 (Priest Rapids Dam tailrace) on the Columbia River, and on the Snake River from Rkm 72 to Rkm 171 and Rkm 190 to Rkm 246 (downstream of the Grande Ronde River mouth). In the Columbia River, and Snake River downstream of Lower Granite Dam, northern pikeminnow ≥ 200 mm FL were tagged with a serially-numbered spaghetti tag. Above Lower Granite Dam, northern pikeminnow ≥ 200 mm FL were tagged with a serially-numbered dart tag. To evaluate tag loss rates, we clipped the left ventral fins on all tagged fish.

DATA ANALYSIS

We used mark-and-recapture data to compare exploitation rates of northern pikeminnow ≥ 200 mm FL among fisheries and reservoirs in 2000. Weekly estimates of exploitation for each fishery were calculated by dividing the number of tagged northern pikeminnow recovered (including fish tagged in 2000 that had lost their tags) by the number of tagged fish at large and summed to yield total exploitation rates (Beamesderfer et al. 1987).

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

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

where

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

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

We compared incidental catch among fisheries by calculating the percent of the total catch composed 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, and the catch rate of salmonids in each fishery.

We used the model of Friesen and Ward (1999) to estimate predation on juvenile salmonids relative to predation prior to implementation of the NPMP. The model incorporates age-specific exploitation rates on northern pikeminnow and resulting changes in age structure to estimate changes in predation. We used a 10-year “average”

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

We estimated the potential relative predation in 2000 based on observed exploitation rates, and the eventual minimum potential predation assuming continuing exploitation at mean 1994-2000 levels. Because inputs to the model included three potential relationships between age of northern pikeminnow and consumption, and three estimates of exploitation (point estimate plus confidence limits), we computed nine estimates of relative predation for each year (Friesen and Ward 1999). We report the maximum, median, and minimum estimates.

To estimate tag loss, we used the formula

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

where

L = percent tag loss,

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

r = number of northern pikeminnow recaptured with year 2000 tags intact.

We estimated tag loss separately for the spaghetti and dart tags; therefore, the dataset for each tag type only included the areas where each tag type was applied. Because approximately 24 river kilometers and a dam (Lower Granite) separated the areas where different tags were used, we believe it unlikely that any mixing of tag groups occurred.

AGE VALIDATION

FIELD AND LABORATORY PROCEDURES

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

DATA ANALYSIS

We compared assigned ages of scales collected at the time of tagging and recapture to identify discrepancies in age identification. For example, northern pikeminnow tagged in 2000 and recaptured in the same year should theoretically be assigned the same age at recapture and tagging because less than a full year had elapsed. Different ages assigned to the same fish at tagging and recapture in 2000 were considered an aging discrepancy. When discrepancies occurred, we noted the number of years that the ages differed and whether ages were overestimated or underestimated.

RESULTS

FISHERY EVALUATION, PREDATION ESTIMATES, AND TAG LOSS

We tagged and released 1,218 northern pikeminnow throughout the lower Columbia and Snake rivers in 2000. Two hundred and forty-two of these fish were 200 to 249 mm FL and 976 were ≥ 250 mm FL. A total of 123 northern pikeminnow tagged in 2000 were recaptured in the three fisheries: 122 in the sport-reward fishery, 1 in the dam-angling fishery, and 0 in the site-specific gillnet fishery. Of these 123 recaptures, 16 were 200-249 mm and 107 were ≥ 250 mm.

System-wide exploitation of northern pikeminnow ≥ 200 mm by all fisheries combined in 2000 was 11.0% (95% confidence interval of 6.8% to 16.8%), and reservoir/area-specific exploitation ranged from 12.7% in Bonneville Reservoir to 0.0% in John Day Reservoir. The system-wide exploitation rate on northern pikeminnow 200-249 mm by all fisheries was 7.1% (confidence interval not available due to $mn < 30$), and ranged from a high of 33.3% in McNary Reservoir to a low of 0.0% in The Dalles, John Day, Lower Monumental, and Little Goose reservoirs. For northern pikeminnow ≥ 250 mm, all fisheries combined had a system-wide exploitation rate of 11.9% (95% confidence interval of 7.3% to 19.1%), ranging from 16.7% in Lower Monumental and Little Goose reservoirs to 0.0% in John Day Reservoir (Figure 1; Appendix A).

System-wide exploitation of northern pikeminnow ≥ 200 mm FL by the sport-reward fishery was 10.9% in 2000. Exploitation on these fish ranged from a high of 12.4% in Bonneville Reservoir to a low of 0.0% in John Day Reservoir. Sport-reward exploitation of northern pikeminnow 200-249 mm was 6.6% system-wide. The range in reservoir/area-specific exploitation rates for these fish by the sport-reward fishery was similar to that for all fisheries combined because the vast majority of tagged northern pikeminnow were recaptured in the sport-reward fishery. For northern pikeminnow ≥ 250 mm, sport-reward exploitation was the same as that stated for all fisheries combined (11.9%) and had the same range of reservoir/area exploitation rates (Figure 1; Appendix A). John Day Reservoir was the only reservoir/area in which no year 2000-tagged northern pikeminnow were recaptured by the sport-reward fishery. Mean length of

northern pikeminnow harvested in the sport-reward fishery (including only those eligible for reward payment) was 290 mm FL (M. Wachtel, WDFW, personal communication).

Only one tagged northern pikeminnow was recaptured in the dam angling fishery in 2000. This fish was caught in Bonneville Reservoir and was in the 200-249 mm size class. The system-wide exploitation rate on these fish by the dam angling fishery was estimated to be 0.4%. Because no tagged northern pikeminnow ≥ 250 mm were recaptured in this fishery,

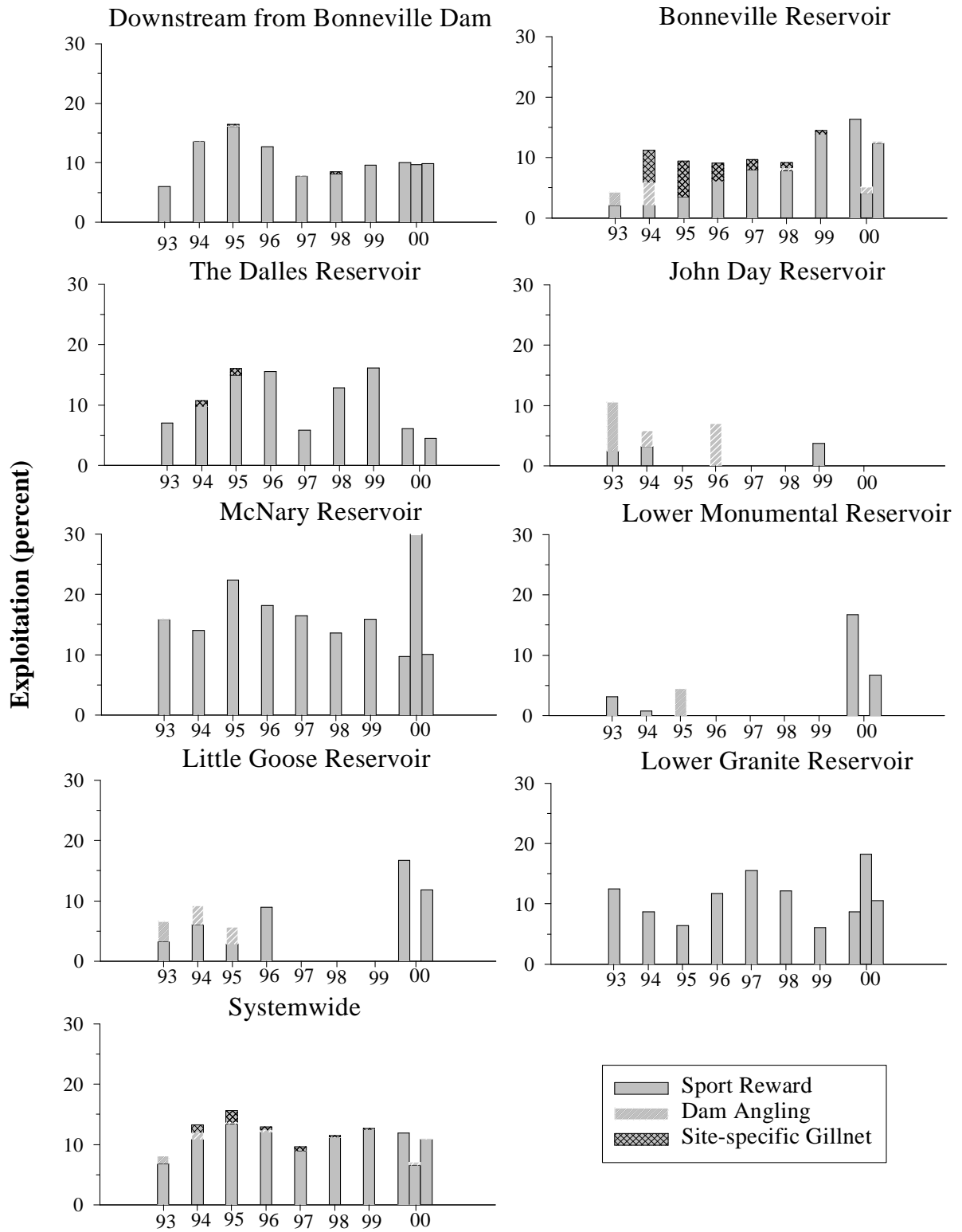


Figure 1. Exploitation of northern pikeminnow ≥ 250 mm fork length (FL) by reservoir/area and fishery, 1993-2000. For 2000, vertical bars, from left to right, show exploitation for northern pikeminnow ≥ 250 mm FL, 200-249 mm FL, and ≥ 200 mm FL.

overall exploitation of northern pikeminnow ≥ 200 mm was slightly lower at 0.1% (Figure 1; Appendix A). Northern pikeminnow were not measured in the dam angling fishery in 2000; therefore, mean size of harvested fish was unknown.

No tagged northern pikeminnow were recaptured by the site-specific gillnet fishery in 2000 (Figure 1; Appendix A). For the site-specific fishery, mean length of harvested northern pikeminnow was 363 mm FL (R. Beaty, CRITFC, personal communication).

Appendix Tables A-5 through A-7 show weekly system-wide exploitation rates for the various fisheries. Weekly exploitation rates are also presented in Appendix Tables A-8 through A-11 for John Day and McNary reservoirs (including Hanford Reach), where tagging and fishing occurred simultaneously.

In 2000, the three management fisheries reported a total incidental catch of 79,352 fish, including northern pikeminnow < 200 mm FL (Table 1). The most common incidental fishes were northern pikeminnow < 200 mm, other cyprinids, centrarchids, ictalurids, catostomids, and white sturgeon *Acipenser transmontanus*. The incidental catch rate was 29.4% for anglers who targeted northern pikeminnow in the sport-reward fishery, 6.2% in the dam angling fishery, and 51.6% in the site-specific gillnet fishery. The proportion of the northern pikeminnow catch consisting of predator-sized (≥ 200 mm) fish was highest in the site-specific gillnet and dam angling fisheries (100%), and lowest in the sport-reward fishery (86.5%). In the sport-reward fishery, 0.3% of the total catch consisted of salmonids. Salmonids made up 2.3% of the total catch in the site-specific gillnet fishery. No salmonids were caught in the dam angling fishery. For all fisheries combined, salmonids made up 0.3% of the total catch.

Modeling results indicate that potential predation by northern pikeminnow on juvenile salmonids in 2000 ranged from 64% to 89% of pre-program levels, with a median estimate of 77% (Figure 2). Continued harvest at mean 1994-2000 exploitation levels will result in minimal additional reductions in predation.

The within-year loss rate of spaghetti tags was 2.6% (97.4% retention). We tagged 1,161 northern pikeminnow with spaghetti tags and recaptured 117 (after 3-185 days at large), of which 3 had lost tags. For dart tags, the within-year loss rate was 33.3% (66.7% retention). We tagged 57 northern pikeminnow with dart tags and recaptured 6 (after 6-60 days at large), of which 2 had lost tags. Therefore, we found the spaghetti tags to be more effective for tagging northern pikeminnow.

AGE VALIDATION

Agreement on initial ages assigned to tagged and recaptured northern pikeminnow averaged 60% between the two scale readers. Most disagreements consisted of a one-year difference. When final ages assigned to scales collected at tagging were compared

to final ages assigned to scales collected at recapture for the same fish, the two ages matched exactly

Table 1. Number of northern pikeminnow and incidental fishes in each fishery in 2000. 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	189,054	423	557
< 200 mm FL	29,578	0 ^a	0
Salmonidae			
Chinook (adult/jack)	73	0	4
Coho (adult/jack)	4	0	0
Sockeye (adult)	3	0	1
Steelhead (adult)	65	0	15
Cutthroat trout	34	0	0
Juvenile salmon/steelhead	206	0	1
All other salmonids ^b	327	0	5
White sturgeon	4,572	2	57
Walleye	325	0	2
Smallmouth bass	6,020	-- ^c	-- ^c
Yellow perch	1,205	0	0
American shad	559	0	10
Cyprinidae ^d	26,121	0	98
Catostomidae	2,289	0	266
Ictaluridae	3,563	0	87
Centrarchidae	269 ^e	26	22
Other/unidentified	3,516	0	27
Total (all species)	267,783	451	1,152
Percent incidental catch	29.4	6.2	51.6

^a Estimate based on 1999 catch proportion. Northern pikeminnow were not measured in 2000.

^b Includes juveniles and adults of *Oncorhynchus* spp., *Salvelinus* spp., and mountain whitefish *Prosopium williamsoni*.

^c Included in centrarchidae catch.

^d Excluding northern pikeminnow.

^e Excluding smallmouth bass.

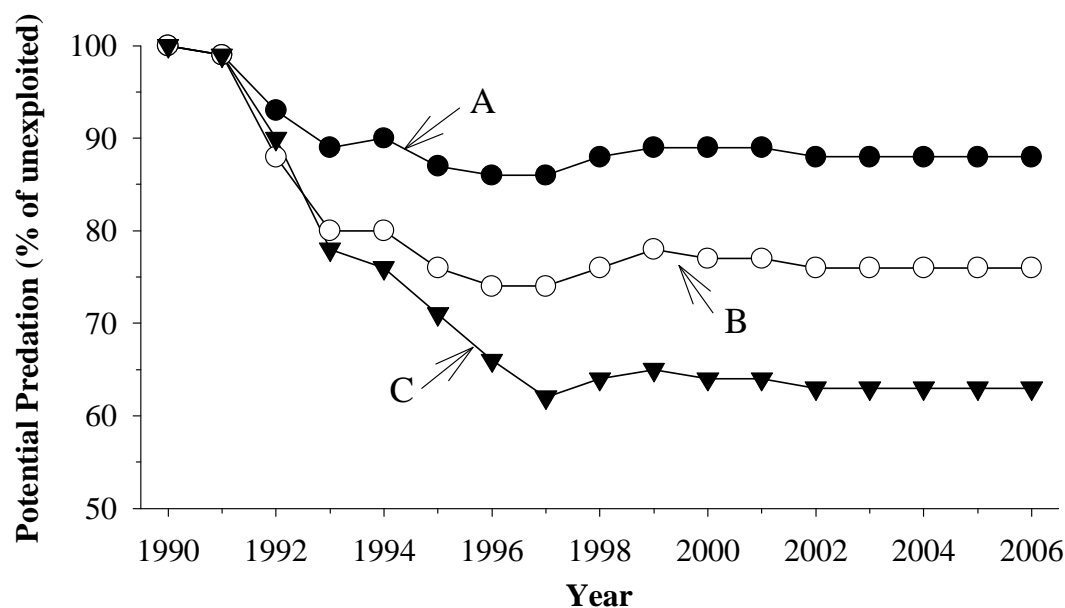


Figure 2. Maximum (A), median (B), and minimum (C) estimates of potential predation on juvenile salmonids by northern pikeminnow relative to predation prior to implementation of the northern pikeminnow management program. Trends after 2000 indicate predicted predation in future years if exploitation is maintained at mean 1994-2000 levels.

(ie. zero discrepancy) 39% of the time (Figure 3). However, agreement within \pm one year occurred 84% of the time. The most common discrepancy was to overestimate by one year the "target" age of the fish on the scales collected at tagging relative to those collected at recapture.

DISCUSSION

System-wide exploitation of northern pikeminnow \geq 250 mm by the three management fisheries in 2000 matched the 11.9% mean exploitation rate for the period 1993-1999. The 2000 exploitation rate was slightly lower than the 12.7% exploitation rate in 1999, reversing a modest increasing trend since 1997 (Figure 1). Exploitation of northern pikeminnow \geq 250 mm by all fisheries combined increased from 1999 levels in the area below Bonneville Dam and in Bonneville, Lower Monumental, Little Goose, and

Lower Granite reservoirs. In particular, exploitation in Lower Monumental and Little Goose reservoirs had been 0% for the

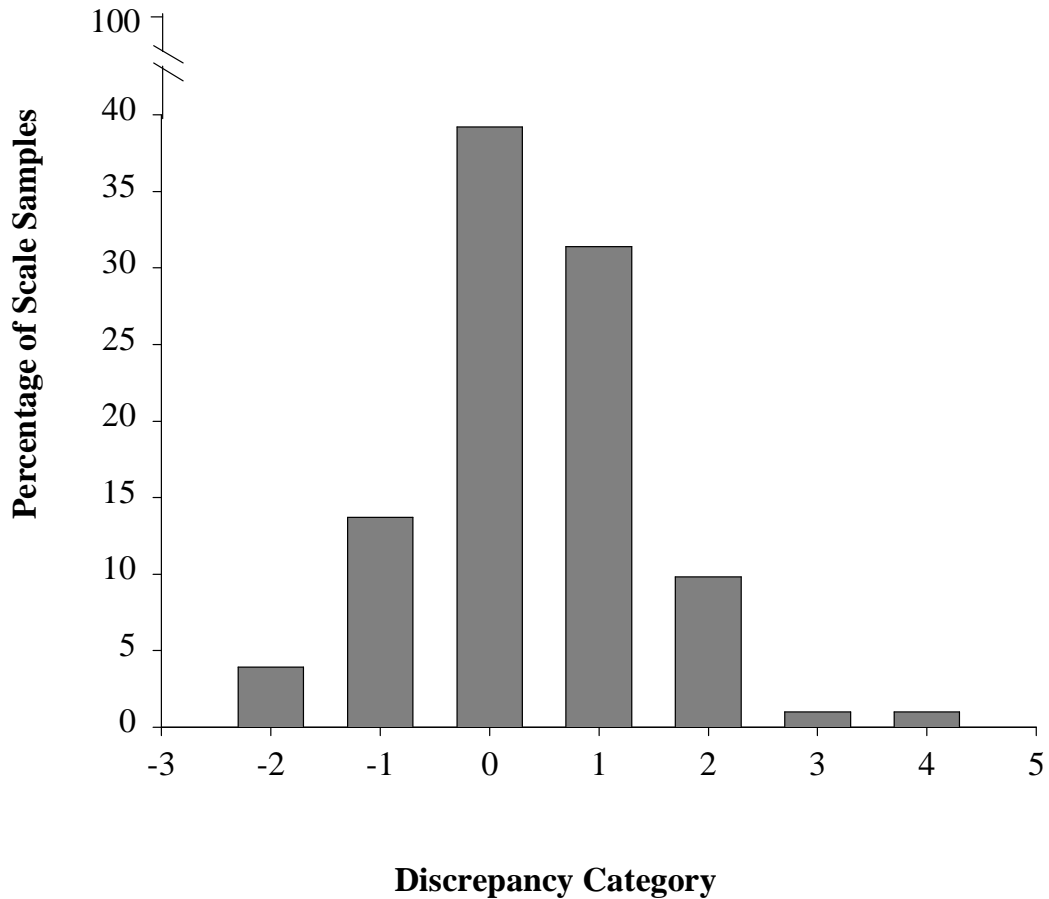


Figure 3. Distribution of discrepancies (in years) for northern pikeminnow aged at tagging and then recapture in 2000. A discrepancy of zero would indicated a fish was assigned the same age at tagging and recapture.

past 3 to 4 years and increased sharply to 16.7% in both reservoirs in 2000. However, these unusually high exploitation rates were probably due to the small sample sizes in those reservoirs. One of only six tagged northern pikeminnow ≥ 250 mm and 2 of 12 tagged northern pikeminnow ≥ 250 mm were recaptured in Lower Monumental and Little Goose reservoirs, respectively. In John Day Reservoir in 2000, 29 northern pikeminnow ≥ 200 mm were tagged, and 2,318 were harvested by the sport-reward fishery; however, no tagged northern pikeminnow were recaptured. Exploitation in that reservoir has been 0% in four of the last eight years.

Because 2000 was the first year that rewards were paid for northern pikeminnow 200-249 mm, exploitation on these fish cannot be compared to other years. As expected, exploitation on these smaller fish was lower than exploitation of fish ≥ 250 mm. Although this reduced the overall exploitation rate on northern pikeminnow ≥ 200 mm, exploitation of fish ≥ 250 mm was near the mean exploitation rate for previous years. Exploitation rate of the smaller fish will probably always be relatively low; however, harvest will these fish from reaching the size of maximum predation on juvenile salmonids.

As in previous years, sport-reward exploitation greatly exceeded exploitation by other fisheries. The dam angling and site-specific gillnet fisheries, while contributing less to exploitation, harvested localized concentrations of northern pikeminnow that may have aggregated to feed on juvenile salmonids (Beamesderfer and Rieman 1991; Poe et al. 1991; Collis et al. 1995). In addition, the dam angling fishery was able to harvest northern pikeminnow in boat restricted zones below dams that are inaccessible to sport-reward anglers. Compared to the sport-reward fishery, mean size of harvested northern pikeminnow was greater in the site-specific gillnet fishery, and probably also the dam angling fishery, based on mean length data for that fishery in previous years.

The incidental catch rate of salmonids for all three fisheries combined has averaged only 0.3% for the past six years. The dam angling fishery, in particular, encounters few salmonids. With the increasing number of salmonid stocks becoming listed under the Endangered Species Act in recent years, the relatively low impact on salmonids of the NPMP may become an important consideration in making management decisions on the Columbia and Snake rivers.

If exploitation rates remain similar to mean 1994-2000 levels, it is unlikely that further reductions in potential predation will be realized. Predation will likely remain at approximately 77% of pre-program levels. Exploitation rates lower than mean 1994-2000 levels may result in increases in potential predation. In accordance with recommendations made in the audit of the NPMP (Hankin and Richards 2000), preliminary estimates of potential predation using sex-specific growth and natural mortality rates were calculated and did not result in appreciable differences in potential predation compared to the model currently used. The model will continue to be refined and may include changes in length-at-age data based upon ongoing evaluation of aging accuracy and precision. We plan to use this new model in subsequent years to estimate potential predation.

The tag loss rate for dart tags far exceeded that for spaghetti tags. Although the sample size was small for the dart tags (2 tag loss fish out of 6 recaptures), intuitively, dart tags would be expected to have a higher tag loss rate compared to spaghetti tags because they do not penetrate through the body as the spaghetti tags do. Although the larger wound created by spaghetti tags may increase the likelihood of infection, the relatively high recapture rate for these tags suggests that this probably is not a significant problem. These findings, coupled with the fact that spaghetti tags are 25% less expensive

than dart tags, lead us to conclude that spaghetti tags are more appropriate for use on this project.

Empirically-based within-year loss for the spaghetti tags was estimated to be 2.6%, lower than the 4.2% estimate used to adjust recapture rates in previous years. However, some fish were recaptured in 2000 with missing tags and fin clips reported to be different from the left ventral clip used this year. Because no other fin clips have been used for several years, some or all of these fish could have been additional year-2000 tag loss fish, with either the wrong fin clipped at tagging or wrong fin reported clipped at recapture. In addition, severely eroded fins could have been mistaken for clipped fins. Due to this uncertainty, these fish were not included in calculating tag loss rates. However, if they were all actually tag-loss fish from this year, this would have increased tag loss rates to 6.6% for the spaghetti tags and 55.6% for the dart tags.

We found that absolute agreement of ages assigned by two readers to scales taken from northern pikeminnow at tagging and recapture in 2000 was relatively low. However, agreement within a margin of \pm one year was relatively high. Although this creates some uncertainty regarding the ages assigned to sampled northern pikeminnow, a margin of error of \pm one year is probably sufficient for estimating relative differences in age class strength. Alternative structures, as well as the use of oxytetracycline as a temporal marker, are being evaluated as a means of improving aging accuracy and precision.

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APPENDIX A

EXPLOITATION OF NORTHERN PIKEMINNOW, 1993-2000

Appendix Table A-1. Exploitation rates (%) of northern pikeminnow ≥ 250 mm fork length (FL) for all fisheries combined, 1993-2000.

Area or Reservoir	1993	1994	1995	1996	1997	1998	1999	2000 ^a
Downstream from								
Bonneville Dam	6.0	13.8	16.5	12.7	8.0	8.4	9.6	10.0 (9.7) ^{a1} (9.9) ^{a2}
Bonneville	4.3	11.2	9.4	9.1	9.7	9.2	14.5	16.3 (5.2) ^{a1} (12.7) ^{a2}
The Dalles	7.0	10.7	16.0	15.5	5.8	12.8	16.1	6.1 (0.0) ^c ^{a1} (4.5) ^{a2}
John Day	10.5	5.8	0.0 ^c	7.0	0.0 ^c	0.0 ^c	3.7	0.0 ^c (0.0 ^c) ^{a1} (0.0 ^c) ^{a2}
McNary	16.0	14.0	22.4	18.2	16.5	13.6	15.9	9.7 (33.3) ^{a1} (10.2) ^{a2}
Ice Harbor	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b
Lower Monumental	3.1	0.8	4.5	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	16.7 (0.0) ^c ^{a1} (6.7) ^{a2}
Little Goose	6.6	9.2	5.7	8.9	0.0 ^c	0.0 ^c	0.0 ^c	16.7 (0.0) ^c ^{a1} (11.8) ^{a2}
Lower Granite	12.5	8.7	6.4	11.7	15.5	12.1	6.1	8.7 (18.2) ^{a1} (10.5) ^{a2}
System-wide	8.1	13.2	15.5	12.9	9.6	11.5	12.7	11.9 (7.1) ^{a1} (11.0) ^{a2}

^a In 2000, 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, 1993-2000.

Area or Reservoir	1993	1994	1995	1996	1997	1998	1999	2000 ^a
Downstream from								
Bonneville Dam	6.0	13.6	16.1	12.7	7.8	8.2	9.6	10.0 (9.7) ^{a1} (9.9) ^{a2}
Bonneville	2.1	2.2	3.5	6.1	8.0	7.8	13.9	16.3 (4.1) ^{a1} (12.4) ^{a2}
The Dalles	7.0	9.8	14.9	15.5	5.8	12.8	16.1	6.1 (0.0) ^c ^{a1} (4.5) ^{a2}
John Day	2.4	3.2	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	3.7	0.0 ^c (0.0 ^c) ^{a1} (0.0 ^c) ^{a2}
McNary	15.9	14.0	22.4	18.2	16.5	13.6	15.9	9.7 (33.3) ^{a1} (10.2) ^{a2}
Ice Harbor	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b
Lower Monumental	3.1	0.8	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	16.7 (0.0) ^c ^{a1} (6.7) ^{a2}
Little Goose	3.3	6.1	2.9	8.9	0.0 ^c	0.0 ^c	0.0 ^c	16.7 (0.0) ^c ^{a1} (11.8) ^{a2}
Lower Granite	12.5	8.7	6.4	11.7	15.5	12.1	6.1	8.7 (18.2) ^{a1} (10.5) ^{a2}
System-wide	6.8	10.9	13.4	12.1	8.9	11.1	12.5	11.9 (6.6) ^{a1} (10.9) ^{a2}

^a In 2000, 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, 1993-2000.

Area or Reservoir	1993	1994	1995	1996	1997	1998	1999	2000 ^a
Downstream from Bonneville Dam	0.0 ^c	0.1	0.2	0.0 ^c	0.2	0.0 ^c	0.0 ^c	0.0 ^c (0.0 ^c) ^{a1} (0.0 ^c) ^{a2}
Bonneville	2.2	3.7	0.0 ^c	0.0 ^c	0.0 ^c	0.5	0.0 ^c	0.0 ^c (1.0) ^{a1} (0.3) ^{a2}
The Dalles	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c (0.0 ^c) ^{a1} (0.0 ^c) ^{a2}
John Day	8.1	2.6	0.0 ^c	7.0	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c (0.0 ^c) ^{a1} (0.0 ^c) ^{a2}
McNary	0.1	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	-- ^d	-- ^d
Ice Harbor	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b
Lower Monumental	0.0 ^c	0.0 ^c	4.5	0.0 ^c	-- ^d	-- ^d	-- ^d	-- ^d
Little Goose	3.3	3.1	2.8	0.0 ^c	-- ^d	-- ^d	-- ^d	-- ^d
Lower Granite	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	-- ^d	-- ^d	-- ^d	-- ^d
System-wide	1.3	1.1	0.3	0.3	0.1	0.1	0.0 ^c	0.0 ^c (0.4) ^{a1} (0.1) ^{a2}

^a In 2000, 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, 1994-2000.

Area or Reservoir	1994	1995	1996	1997	1998	1999	2000 ^a
Downstream							
Bonneville Dam	-- ^d	0.2	0.0 ^c	0.0 ^c	0.3	0.0 ^c	-- ^d
Bonneville (0.0 ^c) ^{a1} (0.0 ^c) ^{a2}	5.3	5.9	3.0	1.7	0.9	0.6	0.0 ^c
The Dalles	0.9	1.1	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	-- ^d
John Day	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	0.0 ^c	-- ^d	-- ^d
McNary (0.0 ^c) ^{a1} (0.0 ^c) ^{a2}	0.0 ^c	0.0 ^c	0.0 ^c	-- ^d	-- ^d	-- ^d	0.0 ^c
Ice Harbor	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b	-- ^b
Lower Monumental	0.0 ^c	0.0 ^c	-- ^d	0.0 ^c	-- ^d	-- ^d	-- ^d
Little Goose	-- ^d	0.0 ^c	-- ^d	-- ^d	-- ^d	-- ^d	-- ^d
Lower Granite (0.0 ^c) ^{a1} (0.0 ^c) ^{a2}	0.0 ^c	0.0 ^c	-- ^d	-- ^d	-- ^d	-- ^d	0.0 ^c
System-wide (0.0 ^c) ^{a1} (0.0 ^c) ^{a2}	1.2	1.9	0.5	0.6	0.3	0.2	0.0 ^c

^a In 2000, 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 2000.

Sampling Week Net	Tagged	Recaptures				Exploitation (%)	
		Sport	Dam	Net	At Large	Sport	Dam
14	6	--	--	--	--	--	--
--							
15	221	--	--	--	6	--	--
--							
16	329	--	--	--	227	--	--
--							
17	303	--	--	--	556	--	--
--							
18	54	--	--	--	859	--	--
--							
19	57	--	--	--	913	--	--
--							
20	126	8	--	--	970	0.8	--
--							
21	69	8	--	--	1088	0.7	--
--							
22	12	9	--	--	1149	0.8	--
--							
23	8	12	--	--	1152	1.0	--
--							
24	15	11	--	--	1147 ^a	1.0	--
--							
25	18	8	--	--	1151	0.7	--
--							
26	--	14	--	--	1161	1.2	--
--							
27	--	15	--	--	1147	1.3	--
--							
28	--	7	--	--	1132	0.6	--
--							
29	--	7	--	--	1125	0.6	--
--							
30	--	8	--	--	1118	0.7	--
--							
31	--	--	1	--	1110	--	0.1
--							
32	--	--	--	--	1109	--	--
--							
33	--	3	--	--	1109	0.3	--
--							
34	--	3	--	--	1105 ^b	0.3	--
--							
35	--	--	--	--	1102	--	--
--							
36	--	1	--	--	1102	0.1	--
--							

37	--	2	--	--	1101	0.2	--	
--								
38	--	1	--	--	1099	0.1	--	
--								
39	--	2	--	--	1098	0.2	--	
--								
40	--	1	--	--	1095 ^c	0.1	--	
--								
41	--	2	--	--	1094	0.2	--	
--								
Total	1218	122	1	0	--	10.9	0.1	0.0

^a A tagged northern pikeminnow was caught by a commercial fisher in the Columbia River.

^b A tagged northern pikeminnow was caught by a Washington Department of Fish and Wildlife sampling crew in the Toutle River.

^c A tagged northern pikeminnow was caught by an angler in the North Fork Lewis River.

Appendix Table A-6. Weekly exploitation of northern pikeminnow 200-249 mm fork length system-wide in 2000.

Sampling Week Net	Tagged	Recaptures				Exploitation (%)	
		Sport	Dam	Net	At Large	Sport	Dam
14	--	--	--	--	--	--	--
--							
15	24	--	--	--	--	--	--
--							
16	68	--	--	--	24	--	--
--							
17	97	--	--	--	92	--	--
--							
18	11	--	--	--	189	--	--
--							
19	11	--	--	--	200	--	--
--							
20	3	1	--	--	211	0.5	--
--							
21	5	--	--	--	213	--	--
--							
22	5	3	--	--	218	1.4	--
--							
23	4	--	--	--	220	--	--
--							
24	9	1	--	--	223	0.4	--
--							
25	5	--	--	--	231	--	--
--							
26	--	1	--	--	236	0.4	--
--							
27	--	2	--	--	235	0.9	--
--							
28	--	1	--	--	233	0.4	--
--							
29	--	2	--	--	232	0.9	--
--							
30	--	2	--	--	230	0.9	--
--							
31	--	--	1	--	228	--	0.4
--							
32	--	--	--	--	227	--	--
--							
33	--	1	--	--	227	0.4	--
--							
34	--	--	--	--	225	--	--
--							
35	--	--	--	--	225	--	--
--							
36	--	--	--	--	225	--	--
--							

37	--	--	--	--	225	--	--	
--								
38	--	--	--	--	225	--	--	
--								
39	--	--	--	--	225	--	--	
--								
40	--	1	--	--	224	0.4	--	
--								
41	--	--	--	--	223	--	--	
--								
Total	242	15	1	0	--	6.6	0.4	0.0

Appendix Table A-7. Weekly exploitation of northern pikeminnow ≥ 250 mm fork length system-wide in 2000.

Sampling Week Net	Tagged	Recaptures				Exploitation (%)	
		Sport	Dam	Net	At Large	Sport	Dam
14	6	--	--	--	--	--	--
--							
15	197	--	--	--	6	--	--
--							
16	261	--	--	--	203	--	--
--							
17	206	--	--	--	464	--	--
--							
18	43	--	--	--	670	--	--
--							
19	46	--	--	--	713	--	--
--							
20	123	7	--	--	759	0.9	--
--							
21	64	8	--	--	875	0.9	--
--							
22	7	6	--	--	931	0.6	--
--							
23	4	12	--	--	932	1.3	--
--							
24	6	10	--	--	923	1.1	--
--							
25	13	8	--	--	919	0.9	--
--							
26	--	13	--	--	924	1.4	--
--							
27	--	13	--	--	911	1.4	--
--							
28	--	6	--	--	898	0.7	--
--							
29	--	5	--	--	892	0.6	--
--							
30	--	6	--	--	887	0.7	--
--							
31	--	--	--	--	881	--	--
--							
32	--	--	--	--	881	--	--
--							
33	--	2	--	--	881	0.2	--
--							
34	--	3	--	--	878	0.3	--
--							
35	--	--	--	--	875	--	--
--							
36	--	1	--	--	875	0.1	--
--							

37	--	2	--	--	874	0.2	--	
--								
38	--	1	--	--	872	0.1	--	
--								
39	--	2	--	--	871	0.2	--	
--								
40	--	--	--	--	868	--	--	
--								
41	--	2	--	--	868	0.2	--	
--								
<hr/>								
Total	976	107	0	0	--	11.9	0.0	0.0
<hr/>								

Appendix Table A-8. Weekly exploitation of northern pikeminnow $\geq 200^a$ mm fork length in John Day Reservoir in 2000.

Sampling Week	Recaptures				Exploitation (%)			
	Tagged	Sport	Dam	Net	At Large	Sport	Dam	Net
14	--	--	--	--	--	--	--	--
--								
15	--	--	--	--	--	--	--	--
--								
16	--	--	--	--	--	--	--	--
--								
17	--	--	--	--	--	--	--	--
--								
18	9	--	--	--	--	--	--	--
--								
19	--	--	--	--	9	--	--	--
--								
20	--	--	--	--	9	--	--	--
--								
21	--	--	--	--	9	--	--	--
--								
22	12	--	--	--	9	--	--	--
--								
23	8	--	--	--	21	--	--	--
--								
24	--	--	--	--	29	--	--	--
--								
25	--	--	--	--	29	--	--	--
--								
26	--	--	--	--	29	--	--	--
--								
27	--	--	--	--	29	--	--	--
--								
28	--	--	--	--	29	--	--	--
--								
29	--	--	--	--	29	--	--	--
--								
30	--	--	--	--	29	--	--	--
--								
31	--	--	--	--	29	--	--	--
--								
32	--	--	--	--	29	--	--	--
--								
33	--	--	--	--	29	--	--	--
--								
34	--	--	--	--	29	--	--	--
--								
35	--	--	--	--	29	--	--	--
--								
36	--	--	--	--	29	--	--	--
--								

37	--	--	--	--	29	--	--	
--								
38	--	--	--	--	29	--	--	
--								
39	--	--	--	--	29	--	--	
--								
40	--	--	--	--	29	--	--	
--								
41	--	--	--	--	29	--	--	
--								
Total	29	0	0	-- ^b	--	0.0	0.0	-- ^b

^a Exploitation rates for northern pikeminnow 200-249 mm FL and ≥ 250 mm FL were the same as that for northern pikeminnow ≥ 200 mm FL.

^b No fishing effort.

Appendix Table A-9. Weekly exploitation of northern pikeminnow ≥ 200 mm fork length in McNary Reservoir (including Hanford Reach) in 2000.

Sampling Week Net ^a	Tagged	Recaptures				Exploitation (%)	
		Sport	Dam	Net	At Large	Sport	Dam
14	--	--	--	--	--	--	--
--							
15	--	--	--	--	--	--	--
--							
16	--	--	--	--	--	--	--
--							
17	--	--	--	--	--	--	--
--							
18	--	--	--	--	--	--	--
--							
19	--	--	--	--	--	--	--
--							
20	125	--	--	--	--	--	--
--							
21	70	2	--	--	125	1.6	--
--							
22	--	--	--	--	193	--	--
--							
23	--	3	--	--	193	1.6	--
--							
24	--	3	--	--	190	1.6	--
--							
25	--	--	--	--	187	--	--
--							
26	--	4	--	--	187	2.1	--
--							
27	--	3	--	--	183	1.6	--
--							
28	--	1	--	--	180	0.6	--
--							
29	--	--	--	--	179	--	--
--							
30	--	1	--	--	179	0.6	--
--							
31	--	--	--	--	178	--	--
--							
32	--	--	--	--	178	--	--
--							
33	--	--	--	--	178	--	--
--							
34	--	--	--	--	178	--	--
--							
35	--	--	--	--	178	--	--
--							
36	--	--	--	--	178	--	--
--							

37	--	--	--	--	178	--	--	
--								
38	--	--	--	--	178	--	--	
--								
39	--	1	--	--	178	0.6	--	
--								
40	--	--	--	--	177	--	--	
--								
41	--	--	--	--	177	--	--	
--								
Total	195	18	-- ^a	0	--	10.2	-- ^a	0.0

^a No fishing effort.

Appendix Table A-10. Weekly exploitation of northern pikeminnow 200-249 mm fork length in McNary Reservoir (including Hanford Reach) in 2000.

Sampling Week	Tagged	Recaptures				Exploitation (%)		
		Sport	Dam	Net	At Large	Sport	Dam	Net ^a
14	--	--	--	--	--	--	--	--
--								
15	--	--	--	--	--	--	--	--
--								
16	--	--	--	--	--	--	--	--
--								
17	--	--	--	--	--	--	--	--
--								
18	--	--	--	--	--	--	--	--
--								
19	--	--	--	--	--	--	--	--
--								
20	3	--	--	--	--	--	--	--
--								
21	5	1	--	--	3	33.3	--	--
--								
22	--	--	--	--	7	--	--	--
--								
23	--	--	--	--	7	--	--	--
--								
24	--	--	--	--	7	--	--	--
--								
25	--	--	--	--	7	--	--	--
--								
26	--	--	--	--	7	--	--	--
--								
27	--	--	--	--	7	--	--	--
--								
28	--	--	--	--	7	--	--	--
--								
29	--	--	--	--	7	--	--	--
--								
30	--	--	--	--	7	--	--	--
--								
31	--	--	--	--	7	--	--	--
--								
32	--	--	--	--	7	--	--	--
--								
33	--	--	--	--	7	--	--	--
--								
34	--	--	--	--	7	--	--	--
--								
35	--	--	--	--	7	--	--	--
--								
36	--	--	--	--	7	--	--	--
--								

37	--	--	--	--	7	--	--	
--								
38	--	--	--	--	7	--	--	
--								
39	--	--	--	--	7	--	--	
--								
40	--	--	--	--	7	--	--	
--								
41	--	--	--	--	7	--	--	
--								
Total	8	1	-- ^a	0	--	33.3	-- ^a	0.0

^a No fishing effort.

Appendix Table A-11. Weekly exploitation of northern pikeminnow ≥ 250 mm fork length in McNary Reservoir (including Hanford Reach) in 2000.

Sampling Week Net ^a	Tagged	Recaptures				Exploitation (%)	
		Sport	Dam	Net	At Large	Sport	Dam
14	--	--	--	--	--	--	--
--							
15	--	--	--	--	--	--	--
--							
16	--	--	--	--	--	--	--
--							
17	--	--	--	--	--	--	--
--							
18	--	--	--	--	--	--	--
--							
19	--	--	--	--	--	--	--
--							
20	122	--	--	--	--	--	--
--							
21	65	1	--	--	122	0.8	--
--							
22	--	--	--	--	186	--	--
--							
23	--	3	--	--	186	1.6	--
--							
24	--	3	--	--	183	1.6	--
--							
25	--	--	--	--	180	--	--
--							
26	--	4	--	--	180	2.2	--
--							
27	--	3	--	--	176	1.7	--
--							
28	--	1	--	--	173	0.6	--
--							
29	--	--	--	--	172	--	--
--							
30	--	1	--	--	172	0.6	--
--							
31	--	--	--	--	171	--	--
--							
32	--	--	--	--	171	--	--
--							
33	--	--	--	--	171	--	--
--							
34	--	--	--	--	171	--	--
--							
35	--	--	--	--	171	--	--
--							
36	--	--	--	--	171	--	--
--							

37	--	--	--	--	171	--	--	
--								
38	--	--	--	--	171	--	--	
--								
39	--	1	--	--	171	0.6	--	
--								
40	--	--	--	--	170	--	--	
--								
41	--	--	--	--	170	--	--	
--								
Total	187	17	-- ^a	0	--	9.7	-- ^a	0.0

^a No fishing effort.

APPENDIX B

DATES OF SAMPLING IN 2000

Appendix Table B-1. Dates of each sampling week in 2000.

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