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

Project Number 1990-077-00

2024 ANNUAL PROGRESS REPORT

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2024 Executive Summary
by

Allan Martin

This report presents results for year thirty-four in the basin-wide Northern Pikeminnow Management Program (NPMP), designed to harvest Northern Pikeminnow[1] (Ptychocheilus oregonensis) and monitor Northern Pikeminnow, Walleye (*Sander vitreus*), Smallmouth Bass (*Micropterus dolomieu*) and Channel Catfish (*Ictalurus punctatus*) for compensatory effects in the Columbia and Snake Rivers. A new online registration application was available for anglers to use at the beginning of the 2023 Sport-Reward Fishery. In 2024, the capabilities of the application were expanded to include an electronic version of the biological exit interview, conducted by a technician, when anglers return their fish to receive a payment voucher. The season started May 1 and ended five days early on September 25. The early closure was due to concerns that the Sport-Reward Fishery fund could be exceeded if the program ran through the planned end date of September 30. During the five-month season, anglers earned tier rewards at the rate of $6 each for the first 25 qualifying Northern Pikeminnow vouchered, $8 each for 26-200 fish and $10 each for 201 fish and greater. In addition to the tier rates, anglers earned incentives for two categories of tagged fish. A Northern Pikeminnow with an external tag was worth $500, while the detection of a program-verified internal tag without the presence of an external tag was worth $200.
Prior to 2022, Oregon Department of Fish and Wildlife's (ODFW) tagging for biological evaluation involved both an external tag and an internal PIT tag. To reduce handling and post-tagging mortality, ODFW began a PIT tag-only protocol for biological assessment of the fishery in 2022. During the season, Program partners decided to continue tagging some of the Northern Pikeminnow population with external tags for promotional purposes. This promotion-only tagging was accomplished by Washington Department of Fish and Wildlife (WDFW) again in 2024 on an opportunistic basis.
The fourth annual Adaptive Management Committee (AMC) meeting was held on July 9. Agenda topics included: funding prioritization, tagging for program evaluation and promotional purposes, results of increased monetary incentives and implementation of an online registration application on angler participation in 2024, and updates on topics covered during the previous AMC.

The committee agreed to allocate any available funds to address ageing infrastructure and safety equipment. Both ODFW and WDFW committed to continue tagging Northern Pikeminnow in 2025. The increased monetary incentives in 2022 and implementation of the online registration application in 2023 continue to have a positive impact regarding overall catch and participation. Total catch increased 56% from the all-time low of 89,542 in 2021 to 140,121 in 2022 and another 12% (156,513) in 2023 from the previous year.

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

The updates from the previous AMC mostly focused on the program's ongoing response to the Northwest Power and Conservation Council's (NPCC) recommendations stemming from the 2019 Independent Scientific Review Panel's (ISRP) program review and the 2020 Columbia River System Biological Opinion direction to evaluate alternative sampling strategies to reduce incidental take. In October of 2023, the NPCC responded with a favorable review from ISRP stating that conditions have been satisfied and that the project meets scientific review criteria. In January 2024 WDFW, ODFW and PSMFC presented a program update to the NPCC that was well received. Representatives from the National Oceanic and Atmospheric Administration have been tracking ODFW's efforts to reduce incidental take and indicated they are encouraged by the implementation of various strategies designed to accomplish these reductions.

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 accounted for a high percentage of mortality that juvenile salmonids experienced from piscivorous fish 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 as much as 40%.

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

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

In 1994, we investigated the use of trapnets and gillnets at specific locations where concentrations of Northern Pikeminnow were known or suspected to occur during the spring season (*i.e.*, March through early June). In addition, we initiated a concerted effort to increase public participation in the sport-reward fishery through a series of promotional and incentive activities. In 1995, 1996, and 1997, promotional activities and incentives were further improved based on the favorable response in 1994. Results of these and other lessons learned over the 32-year period are subjects of this annual report.

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

Program cooperators include the Pacific States Marine Fisheries Commission (PSMFC), Oregon Department of Fish and Wildlife (ODFW), and Washington Department of Fish and Wildlife (WDFW). The PSMFC is responsible for coordination and administration of the program; PSMFC subcontracted various tasks and activities to ODFW and WDFW based on the expertise each brings to the tasks involved in implementing the program. Roles and responsibilities of each cooperator are as follows.

1. **WDFW (Report A)**: Implement a system-wide (*i.e.* Columbia River below Priest Rapids Dam and Snake River below Hells Canyon Dam) sport-reward fishery and operate a system for collecting and disposing of harvested Northern Pikeminnow.

2. **PSMFC (Report B)**: Provide technical, contractual, fiscal and administrative oversight for the program. In addition, PSMFC processes and provides accounting for the reward payments to participants in the sport-reward fishery.

3. **ODFW (Report C)**: Evaluate exploitation rate and size composition of Northern Pikeminnow harvested in the various fisheries conducted. Estimate reductions in predation on juvenile salmonids resulting from Northern Pikeminnow harvest and update information on year-class strength of Northern Pikeminnow.

4. **WDFW (Report D)**: Implement dam angling at The Dalles and John Day dams.

Background and rationale for the Northern Pikeminnow Management Program can be found in Report A of our 1990 annual report (Vigg et al. 1990).

REPORT A

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

2024 Annual Report

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We are thankful to the City of Rainier for the use of the Rainier boat ramp; the City of Richland for the use of Columbia Point Park; the Cowlitz County Parks and Recreation Department for the use of the Willow Grove boat ramp; the Port of Bingen for the use of Bingen Marina; the Port of Camas/Washougal for the use of the Camas/Washougal boat ramp; the Port of Cascade Locks for the use of the Cascade Locks Marine Park; the Port of Cathlamet for the use of the Cathlamet Marina; the Port of Kalama for the use of the Kalama Marina; the Port of Ridgefield for the use of the Ridgefield boat ramp; the Port of The Dalles for the use of The Dalles Boat Basin; the Port of Stevenson for the use of the Stevenson boat ramp; the Port of Umatilla for the use of the Umatilla Marina; the Portland Metro Regional Parks Department for the use of the M. James Gleason and Chinook Landing Boat Ramps ; the U.S. Army Corps of Engineers for the use of the Giles French, Hood Park, Windust Park, Swallows Park, and Greenbelt Boat Ramps; the Washington Department of Transportation for the use of the Vernita Bridge Rest Area; Wally and Joanne Knouf for the use of Lyon's Ferry Marina; and Mike and Monica Omstead for the use of Boyer Park.

We appreciate the efforts of Anna Klundt, Kyle Beckley, Tember Renneau, Betti Gibson, Stuart Kawachi, Lynn Bufka, Eric Meyer, Beck Missildine, Rose Carr, Cooper Sargent, Taylor Ah Mook Sang, Lacey Oltmann, Andrew Vaughn, Ben Veysey, Lauren Ridenour, Gary Griffith, Breanne Rea, Wick Bouton, and James Bruce for operating the 2024 Sport-Reward fishery registration stations.

We also recognize Diana Murillo for her excellent work in computer data entry and document verification, Mike Luepke for his efficient fish rendering activities throughout the program area, Nancy Vert for her many phone survey angler interviews, and Dennis Werlau for compiling and producing our weekly field activity reports throughout the 2024 season.

ABSTRACT

We are reporting on the progress of the Northern Pikeminnow Sport-Reward Fishery (NPSRF) implemented by the Washington Department of Fish and Wildlife (WDFW) on the Columbia and Snake Rivers from May 1 through September 25, 2024. The objectives of this project were to (1) implement a recreational fishery that rewards recreational anglers for harvesting Northern Pikeminnow ≥ 228 mm (9 inches) total length (TL), (2) collect, compile, and report data on angler participation, catch rates, and harvest of Northern Pikeminnow and other fish species during the NPSRF season, (3) examine collected Northern Pikeminnow for the presence of external tags, fin clips, and signs of tag loss, (4) collect biological data on Northern Pikeminnow and other fish species returned to registration stations, (5) scan Northern Pikeminnow for the presence of Passive Integrated Transponder (PIT) tags implanted into Northern Pikeminnow by ODFW, and/or from Northern Pikeminnow containing consumed salmonids with PIT tags, and (6) survey non-returning NPSRF participants targeting Northern Pikeminnow in order to obtain catch and harvest data on Northern Pikeminnow and other specified fish species from this segment of NPSRF participants.

A total of 176,445 Northern Pikeminnow ≥ 228 mm fork length (FL) and 2,541 Northern Pikeminnow < 228 mm TL were harvested during the 2024 NPSRF season. There were a total of 1,628 different individual anglers who spent 12,378 angler days of effort participating in the NPSRF during the 2024 season. Catch per unit effort for combined returning and non-returning anglers was 14.25 fish/angler day. The Oregon Department of Fish and Wildlife (ODFW) estimated that the Northern Pikeminnow harvest activities from the 2024 NPSRF resulted in an overall exploitation rate of 11.6% (Waltz et al. 2025).

Anglers submitted 6 Northern Pikeminnow with external spaghetti or Floy tags, 5 of these also retained an internal ODFW PIT tag. There were also 177 Northern Pikeminnow with ODFW PIT tags, but missing spaghetti or Floy tags (tag-loss). Additionally, 39 PIT tags from ingested juvenile salmonids were recovered from Northern Pikeminnow received during the 2024 NPSRF.

Peamouth *Mylocheilus caurinus*, Smallmouth Bass *Micropteris dolomieui*, and Sculpin *Cottoidea Spp,* were the fish species most frequently caught by NPSRF anglers targeting Northern Pikeminnow during the 2024 NPSRF. The incidental catch of salmonids *Oncorhynchus* spp, by participating anglers targeting Northern Pikeminnow continued to remain below established limits for the Northern Pikeminnow Management Program (NPMP).

INTRODUCTION

Mortality of juvenile salmonids *Oncorhynchus* spp. migrating through the Columbia River system is a major concern of the Columbia Basin Fish and Wildlife Program, and predation is an important component of mortality (Northwest Power Planning Council 1987a). Northern Pikeminnow *Ptychocheilus oregonensis*, formerly known as Northern Squawfish (Nelson et al. 1998), are the primary piscine predator of juvenile salmonids in the Lower Columbia and Snake River Systems (Rieman et al. 1991). Rieman and Beamesderfer (1990) predicted that predation on juvenile salmonids could be reduced by up to 50% with a sustained exploitation rate of 10-20% on Northern Pikeminnow ≥ 275 mm TL (11 inches total length). The Northern Pikeminnow Management Program (NPMP) was created in 1990, with the goal of implementing fisheries to achieve the recommended 10-20% annual exploitation on Northern Pikeminnow ≥ 275 mm TL within the program area (Vigg and Burley 1989). In 2000, NPMP administrators reduced the minimum size for eligible (reward size) Northern Pikeminnow to 228 mm TL (9 inches total length) in response to recommendations contained in a Council review of NPMP justification, performance, and cost-effectiveness (Hankin and Richards 2000). Beginning in 1991, the Washington Department of Fish and Wildlife (WDFW) was contracted to conduct the NPSRF component of the NPMP (Burley et al. 1992). The NPSRF enlists recreational anglers to harvest reward sized (≥9" total length) Northern Pikeminnow from within program boundaries on the Columbia and Snake Rivers using a monetary reward system. Since 1991, NPSRF anglers have harvested over 5.7 million reward sized Northern Pikeminnow and spent over 1 million angler days of effort to become the NPMP's most successful component for achieving the annual 10-20% exploitation rate on Northern Pikeminnow within the program boundaries (Klaybor et al. 1994, Friesen and Ward 1999).

Reward levels included a base reward of $6 per fish for the first 25, $8 per fish for #26-200, and $10 per fish for each fish above 200. Anglers continued to be rewarded an additional amount for returning Northern Pikeminnow with external tags (spaghetti or Floy type) and a lesser amount for fish with only PIT tags installed by the Oregon Department of Fish and Wildlife (ODFW) as part of the NPMP's biological evaluation. Catch and harvest data were collected from both returning anglers and a sub-sample of non-returning anglers in order to continue to monitor the total effects of the NPSRF on other Columbia basin fishes.

The objectives of the 2024 NPSRF were to (1) implement a public fishery that rewards recreational anglers for harvesting Northern Pikeminnow ≥ 228 mm (9 inches) total length, (2) collect, compile, and report data on angler participation, catch rates and harvest of Northern Pikeminnow and other fish species during the season, (3) examine collected Northern Pikeminnow for the presence of external tags, fin-clips, and signs of tag loss, (4) collect biological data on Northern Pikeminnow and other fish species returned to registration stations, (5) scan Northern Pikeminnow for the presence of Passive Integrated Transponder (PIT) tags implanted into Northern Pikeminnow by ODFW as secondary tags, and/or from Northern Pikeminnow containing consumed salmonids with PIT tags, and (6) survey non-returning NPSRF participants targeting Northern Pikeminnow in order to obtain catch and harvest data on Northern Pikeminnow and other salmonid species from this segment of NPSRF participants.

METHODS OF OPERATION

Fishery Operation

Boundaries and Season

The 2024 NPSRF season opened on May 1st and 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 as done since 1991 (Figure 1). In addition, anglers were allowed to harvest (and submit for payment) Northern Pikeminnow caught in backwaters, sloughs, and up to 400 feet from the mouth of tributaries within this area. For the first time ever, the 2024 NPSRF closed earlier than September 30th (9/25/2024) due to the angler reward fund being met.

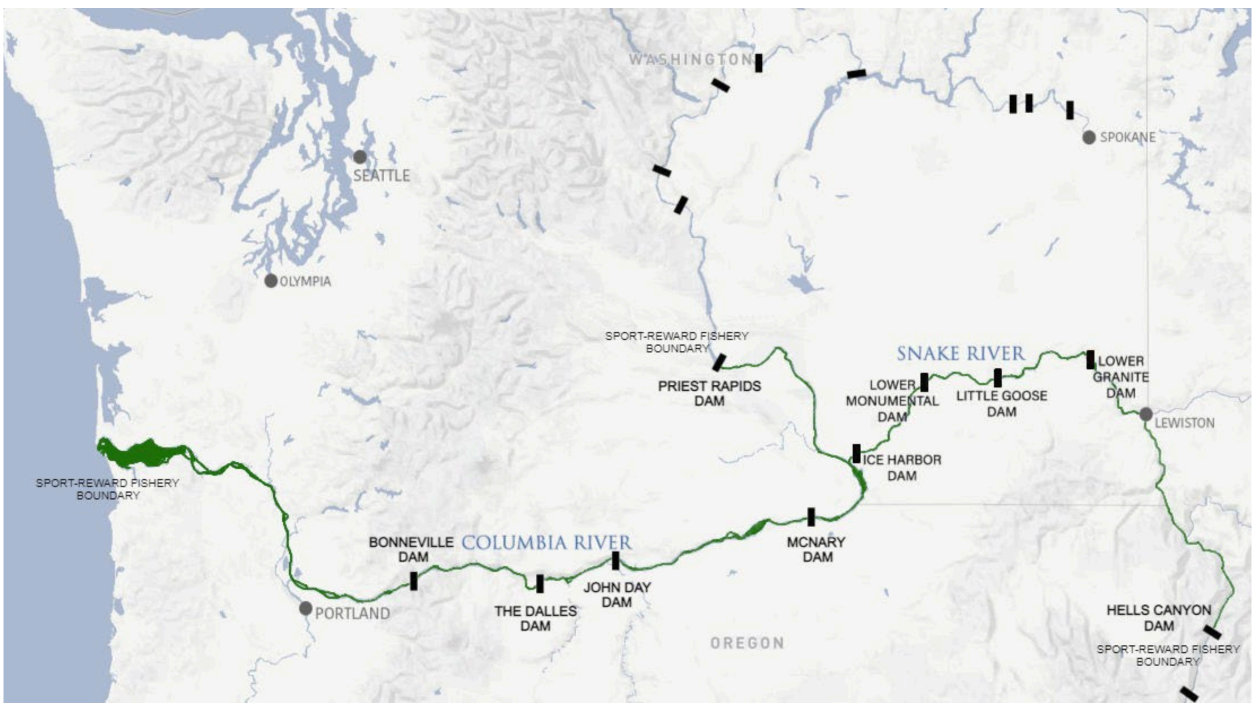

Figure 1. Northern Pikeminnow Sport-Reward Fishery Program Area

Registration Stations

Twenty-two registration stations (Figure 2) were located along the Columbia and Snake Rivers within these boundaries to provide anglers with access to the Sport-Reward Fishery. Registration stations were either "Core stations" (operating the entire 5 month field season), or "Satellite stations" which operated less than the entire 5 month season (Smith et al. 1994). WDFW technicians set up registration stations daily (seven days a week) at designated locations (normally public boat ramps or parks) during their assigned season and were available to anglers at specified times of between 2 and 5 hours per day. Technicians assisted in registering anglers, and compiling data for registered anglers participating in the NPSRF, collected angler creel information, issued pay vouchers to anglers returning with eligible Northern Pikeminnow, recorded biological data, scanned Northern Pikeminnow for the presence of PIT tags, and provided angling advice and Sport-Reward Fishery information to the public. Self-registration boxes were also located at each station so anglers could self-register when WDFW technicians were not present.

Smart phone registration application

Pikeminnow anglers continued to have the phone application (App) option for registering to participate in the 2024 NPSRF. The smart phone app, created and developed by WDFW continued to be available to the public for free download via one of the App Stores (Apple) or Google Play (Android). Phone app registration allowed anglers to register for participation in the 2024 NPSRF without registering at the physical registration station on paper prior to fishing. The intent of the phone App option was to increase angler effort by making the registration process quicker and/or more convenient. Additional functionality was added in 2024 to allow for electronic angler exit interviews (with limited success), as well as planning for tag recovery capture, and biological data collection in future years.

1. Cathlamet Marina 8:30 am -12:30 pm	12. The Dalles 11:30 am – 4:30 pm
2. Willow Grove 1:00 pm - 4:00 pm	13. Giles French 8:00 am – 11:00 am
3. Rainier Marina 8:00 am – 12:00 pm	14. Umatilla 10:00 am – 1:00 pm
4. Kalama Marina 12:30 pm – 4:30 pm	15. Columbia Point 2:00 pm – 6:00 pm
5. Ridgefield Marina 7:30 am – 11:00 am	16. Vernita 10:00 am – 1:30 pm
6. Gleason Boat Ramp 12:30 pm – 4:00 pm	17. Hood Park 3:00 pm – 6:00 pm
7. Chinook Landing 8:00 am – 12:00 pm	18. Windust Park 2:00 pm – 5:30 pm
8. Washougal 12:00 pm – 4:00 pm	19. Lyon's Ferry Marina 10:00 am – 1:00pm
9. Stevenson 11:30 am – 4:00 pm	20. Boyer Park 12:30 pm – 3:30 pm
10. Cascade Locks 8:30 am – 11:00 am	21. Greenbelt 9:30 am – 11:00 am
11. Bingen 8:00 am – 11:00 am	22. Swallow's Park 5:00 pm – 6:30pm

Figure 2. 2024 Northern Pikeminnow Sport-Reward Fishery registration stations and hours of operation

Reward System

The 2024 NPSRF rewarded anglers for harvesting Northern Pikeminnow $\geq$ 228mm TL (9 inches TL) using a tiered reward system first implemented in 1995 (Hisata et al. 1996), which paid anglers a higher reward per fish once they had reached designated harvest levels over the course of the season. To receive payment, anglers returned their catch (daily) to the location where they had registered. WDFW technicians verified fish species (and that anglers had caught their fish in accordance with NPSRF Rules and Regulations) and issued them a payment voucher for the total number of eligible Northern Pikeminnow. Anglers mailed payment vouchers to the Pacific States Marine Fisheries Commission (PSMFC) for redemption. Anglers returning with Northern Pikeminnow that were spaghetti or Floy tagged by ODFW as part of the biological evaluation of the NPSRF (Vigg et al. 1990), or by WDFW as angler incentives, were issued separate tag payment vouchers that were mailed to ODFW for tag verification before payment was made to the angler by PSMFC.

The tiered reward system used during the 2024 season was originally developed and implemented in 1995 (Hisata et al. 1996), and reflects multiple changes to the rewards and/or tier levels in an effort to address periods of declining participation. The tiered reward system paid anglers higher rewards per fish based on achieving designated harvest levels. Tier 1 paid anglers $6 each for their first 25 Northern Pikeminnow, Tier 2 paid anglers $8 each for fish numbers 26-200, and Tier 3 paid anglers $10 each for all fish over 200. The current reward payment tier levels have been in effect since 2022.

Although ODFW discontinued externally tagging Northern Pikeminnow in 2022, anglers continued to be paid $500 for each Northern Pikeminnow retaining a valid external tag (spaghetti or Floy) used by ODFW for the biological evaluation of the NPMP (prior to 2022), or tagged by WDFW as an angler promotional activity in 2022-2024. NPSRF anglers continued to be paid $200 for each Northern Pikeminnow without an external tag but retaining an ODFW PIT tag (formerly referred to as tag-loss) since external tags were not used by ODFW in 2024.

Angler Sampling

Angler data and creel data for the NPSRF were compiled from angler registration forms. One registration form represented one angler day. Angler data consisted of name, date, fishing license number, phone number, and city, state, zip code of participating angler. Creel data recorded by WDFW technicians included fishing location (Figure 3), and primary species targeted. Anglers were asked if they specifically fished for Northern Pikeminnow at any time during their fishing trip. A “No” response ended the exit interview. A “Yes” response prompted technicians to ask the angler (and record data), how many of each species of fish were caught, harvested or released while targeting Northern Pikeminnow. A fish was considered “caught” when the angler touched the fish, whether it was released or harvested. Fish returned to the water alive were defined as “released”. Fish that were retained by the angler or not returned to the water alive were considered “harvested”.

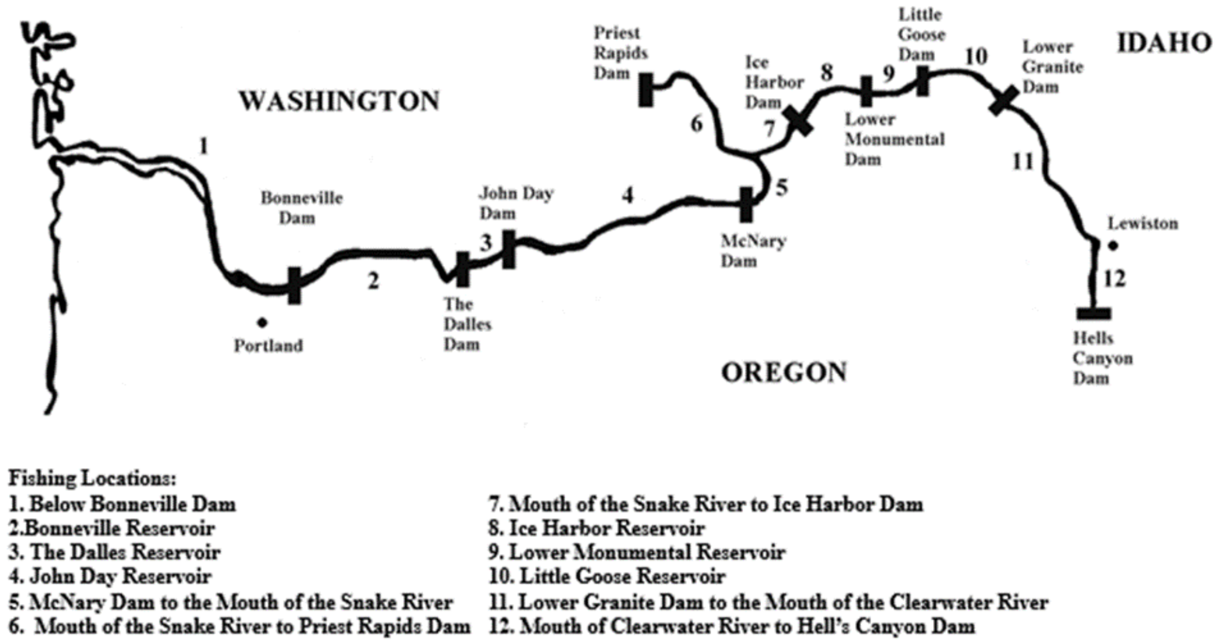

Figure 3. Fishing Location codes used for the 2024 Northern Pikeminnow Sport-Reward Fishery

Returning Anglers

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

Non-Returning Anglers

Non-returning angler data were compiled from the pool of anglers who had registered for the NPSRF and targeted Northern Pikeminnow, but did not return to a registration station to participate in an exit interview. WDFW surveyed a minimum of 20% of the NPSRF's non-returning anglers using a telephone survey in order to obtain creel data from that segment of the NPSRF's participants. To obtain the 20% sample, non-returning anglers were randomly selected from each registration station for each week. A technician called anglers from each random sample until the 20% sample was attained. Non-returning anglers were surveyed with the same exit interview questions used for returning anglers. Anglers were asked: "did you specifically fish for Northern Pikeminnow at any time during your fishing trip?" With a "Yes" response, anglers were asked to report the number and species of adult and/or juvenile salmonids, and the number of reward size Northern Pikeminnow that were caught and harvested/released while they targeted Northern Pikeminnow. Angler catch and harvest data were not collected from non-returning anglers who did not target Northern Pikeminnow on their fishing trip. Non-returning angler catch and harvest data for non-salmonid species were not collected in 2024 per NPSRF protocol (Fox et al. 2000).

Northern Pikeminnow Handling Procedures

Biological Sampling

Technicians examined all fishes returned to registration stations and recorded basic biological data such as species and number of fish per species. Fork lengths and sex of Northern Pikeminnow (as well as for any other harvested fish species) were recorded whenever possible. Technicians also checked all Northern Pikeminnow for the presence of external tags (spaghetti, Floy, dart, etc.), fin-clip marks, and/or signs of tag-loss. All externally tagged Northern Pikeminnow had complete biological data collected whether the fish had a spaghetti tag as used by the NPMP since 1991, or with Floy type anchor tags used by ODFW from 2019-21. Data collected from externally tagged Northern Pikeminnow included Fork Length (FL), tag number, sex (determined by evisceration), and scale samples (if specified). Data from tagged Northern Pikeminnow were recorded both on corresponding tag voucher and on WDFW data form. The external tag was then removed from the Northern Pikeminnow and placed in a tag envelope, stapled to the tag voucher and then given to the angler to submit by mail to ODFW for verification. All tagged Northern Pikeminnow carcasses were then processed or labeled and frozen for data verification and/or PIT tag recovery at a later date.

PIT Tag Detection

All Northern Pikeminnow collected during the 2024 NPSRF were scanned for Passive Integrated Transponder (PIT) tags. PIT tags (prior to 2022) had been used by ODFW as a secondary mark in all Northern Pikeminnow fitted with external, spaghetti or Floy, tags as part of the NPMP's biological evaluation activities (Takata and Koloszar 2004). Beginning in 2022, ODFW discontinued use of external Floy or Spaghetti tags and exclusively used PIT tags for conducting the biological evaluation of the NPMP. Northern Pikeminnow harvested by anglers participating in the NPSRF have also been found to ingest juvenile salmonids that have been PIT tagged by other studies within the basin (Glaser et al. 2001). WDFW technicians were required to scan 100% of all Northern Pikeminnow returned to registration stations for PIT tags using PIT tag "readers". Northern Pikeminnow submitted for payment to the NPSRF were scanned using Biomark portable transceivers (model #HPR.PLUS.04V1) to record information from PIT tag detections for submission to the Columbia Basin PIT tag information System (PTAGIS). Scanning began on the first day of the NPSRF season and continued at all stations throughout the entire season. Technicians individually scanned all reward sized Northern Pikeminnow for PIT tag presence, and complete biological data were recorded from all Northern Pikeminnow with positive readings. All PIT tagged Northern Pikeminnow were processed on site, or labeled and preserved for later dissection and PIT tag recovery. All data were verified by WDFW tag lead biologist after recovery of PIT tags and all PIT tag recovery data were provided to ODFW and the PIT Tag Information System (PSMFC - PTAGIS 2024) on a regular basis. Anglers were eligible for an additional $200 reward from PSMFC for ODFW PIT tagged (formerly "tag-loss") fish which were defined as Northern Pikeminnow with no external tags, but retaining ODFW PIT tags used as part of the NPMP biological evaluation.

Northern Pikeminnow Processing

During biological sampling, all Northern Pikeminnow were either caudal clipped, or dissected to recover PIT tags as an anti-fraud measure to eliminate the possibility of previously processed Northern Pikeminnow being resubmitted for payment. Sampled Northern Pikeminnow were iced and transported to cold storage facilities from which they were ultimately delivered to rendering facilities for final disposal.

RESULTS AND DISCUSSION

Northern Pikeminnow Harvest

During the 2024 NPSRF, anglers harvested a total of 176,445 reward size Northern Pikeminnow (≥ 228 mm TL) over the course of a 22-week field season. Harvest was above mean 1991-2023 harvest of 169,462 fish and was 19,932 fish more than the 2023 harvest (Hone et al. 2024) (Figure 4). The 2024 NPSRF harvest was estimated to equal an exploitation rate of 11.6% (Waltz et al. 2025). In addition to harvesting 176,445 reward size Northern Pikeminnow, anglers participating in the 2024 NPSRF also harvested 2,541 Northern Pikeminnow < 228 mm TL.

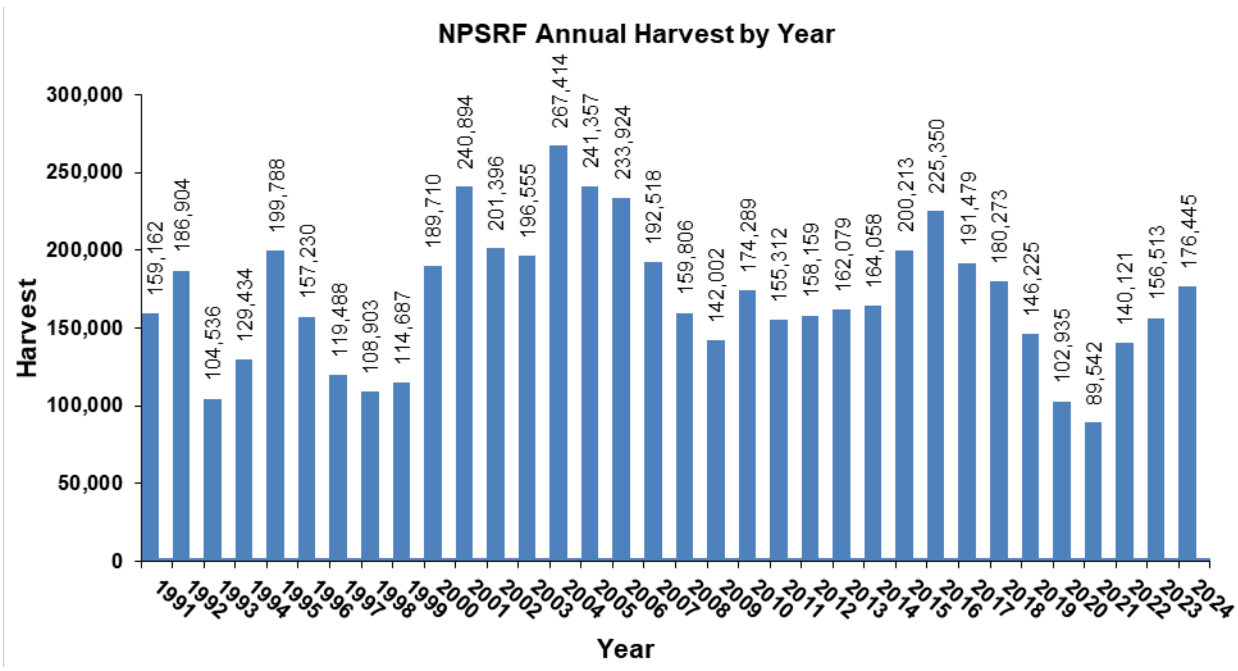

Figure 4. Annual harvest totals for the Northern Pikeminnow Sport-Reward Fishery

Harvest by Week

Peak weekly harvest in 2024 was 11,490 fish in week 34 (Figure 5) and was 1,579 fish higher than the peak harvest week in 2023 (9,911) (Figure 6). Mean weekly harvest was higher in 2024 (8,020) than in 2023 (7,114) and total weekly harvest was above 2023 weekly harvest for 17 of the 22 weeks of the season (Hone et al. 2024). While the 2024 NPSRF once again did not achieve weekly harvest totals of > 10,000 fish per week during the critical first 6 weeks of the season, it was close in weeks 19 and again in weeks 21-22. Weekly harvest also exceeded the 10,000 fish level in weeks 33-34 during the second season peak and was above the historical weekly average harvest for 12 of the 22 weeks of the 2024 season (Figure 7). Generally, weekly NPSRF harvest levels >10,000 fish/week) early in the SRF season, results in overall NPSRF season harvest above the historical season average (169,668).

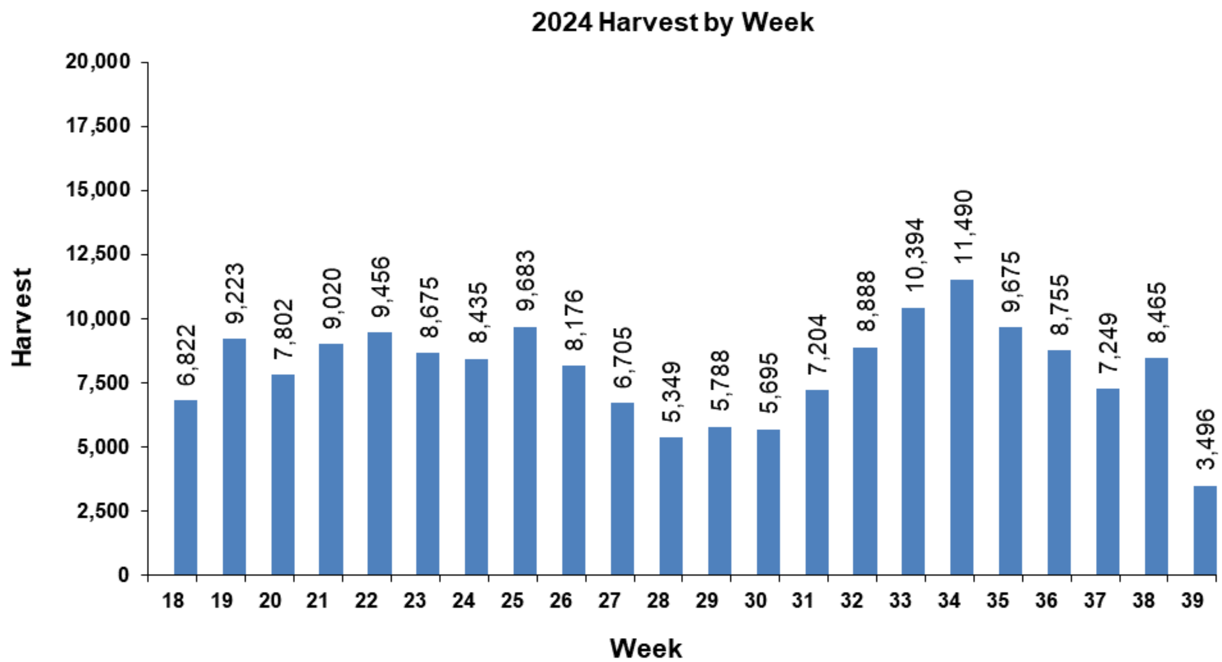

Figure 5. 2024 Weekly Northern Pikeminnow Sport-Reward Fishery harvest

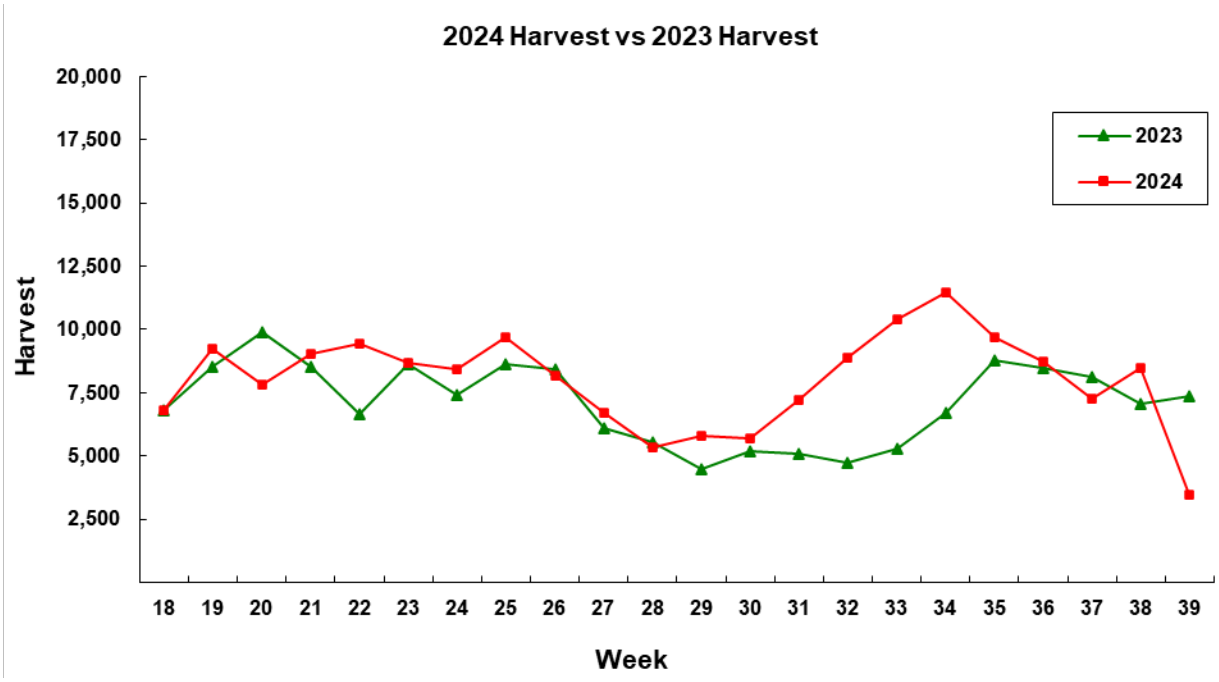

Figure 6. 2024 Weekly NPSRF harvest vs 2023 weekly harvest

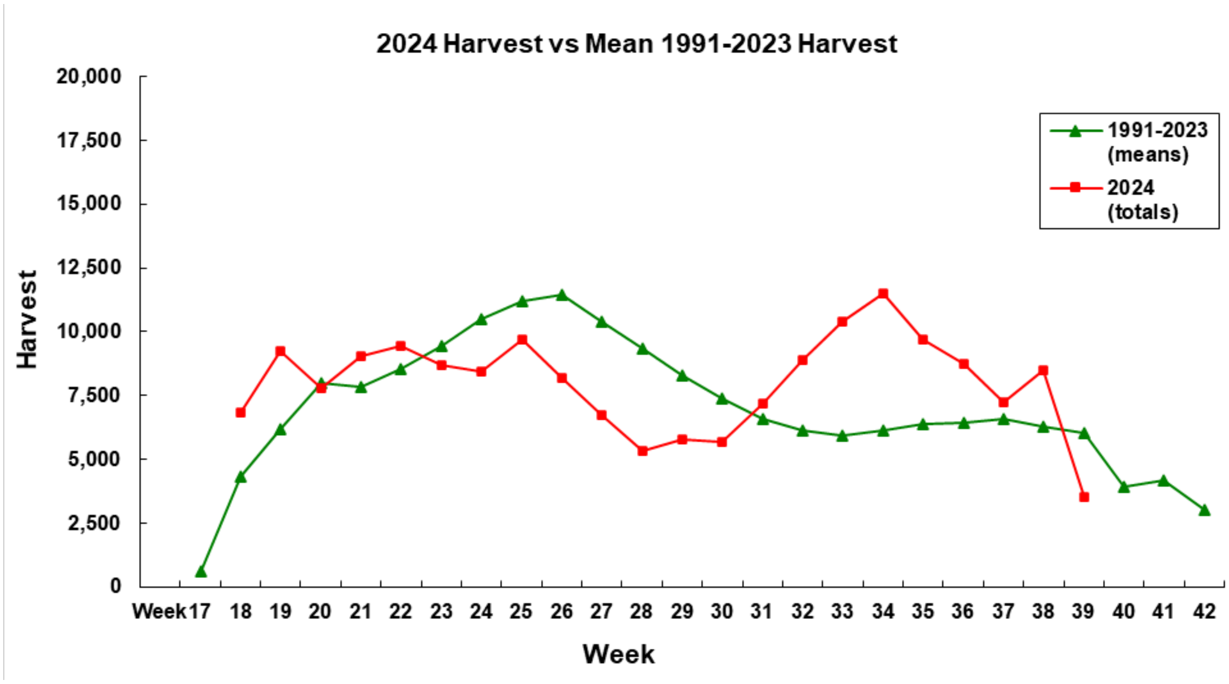

Figure 7. Comparison of 2024 NPSRF weekly harvest to 1991-23 mean weekly harvest

Harvest by Fishing Location

The mean harvest by fishing location for the 2024 NPSRF was 14,704 Northern Pikeminnow (compared to 13,043 in 2023) and ranged from 102,812 reward size Northern Pikeminnow in fishing location 01 (Below Bonneville Dam) to 0 Northern Pikeminnow from fishing location 5 (McNary Dam to the mouth of the Snake River) (Figure 8). Harvest from fishing location 01 (the Columbia River below Bonneville Dam) increased from 40.5% of total NPSRF harvest in 2023 to 58.3% of total NPSRF harvest in 2024. Fishing location 01 remained the highest producing location in 2024, as it has been for all but one of the preceding 33 NPSRF seasons (Hone et al. 2024). Bonneville Reservoir (Fishing Location 02) remained the second highest producing area accounting for 26.5% of total 2024 NPSRF harvest.

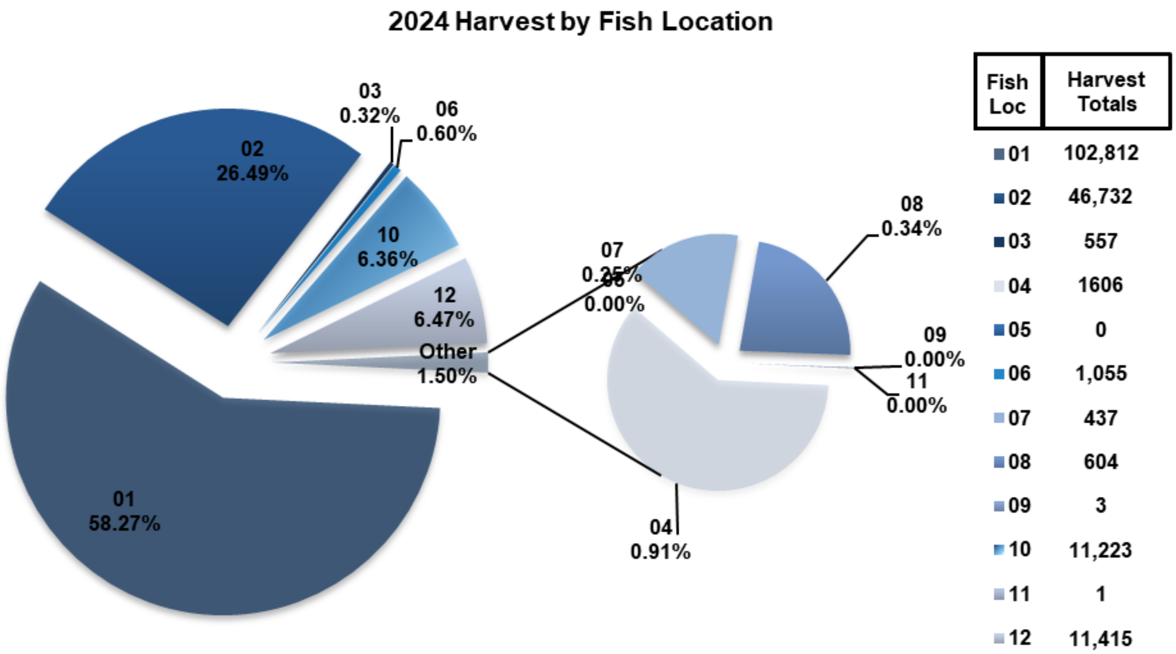

Figure 8. 2024 Northern Pikeminnow Sport-Reward Fishery harvest by fishing location*
*Fishing Location Codes for **Columbia River**; 01 = Below Bonneville Dam, 02 = Bonneville Reservoir, 03 = The Dalles Reservoir, 04 = John Day Reservoir, 05 = McNary Dam to the mouth of the Snake River, 06 = Mouth of the Snake River to Priest Rapids Dam. **Snake River;** 07 = Mouth of the Snake River to Ice Harbor Dam, 08 = Ice Harbor Reservoir, 09 = Lower Monumental Reservoir, 10 = Little Goose Reservoir, 11 = Lower Granite Dam to the mouth of the Clearwater River, 12 = Mouth of the Clearwater River to Hells Canyon Dam.

Harvest by Registration Station

Harvest in 2024 was higher than in 2023 at 13 of the 22 registration stations. The Washougal registration station was the NPSRF's top producing station in 2024, where anglers harvested 28,921 Northern Pikeminnow, equaling 16.4% of total NPSRF harvest (Figure 9). The Dalles registration station finished with the second highest total of 23,509 Northern Pikeminnow (13.4% of total) harvested, and the Cathlamet station finished third with 23,464 harvested fish. The average harvest per registration station was 8,020 reward size Northern Pikeminnow, up from 7,114 per station in 2023 (Hone et al. 2024). The registration station with the least harvest was Lyon's Ferry where anglers harvested only 15 Northern Pikeminnow during the 2024 season (although as a satellite station, it was only open for 3 months in 2024).

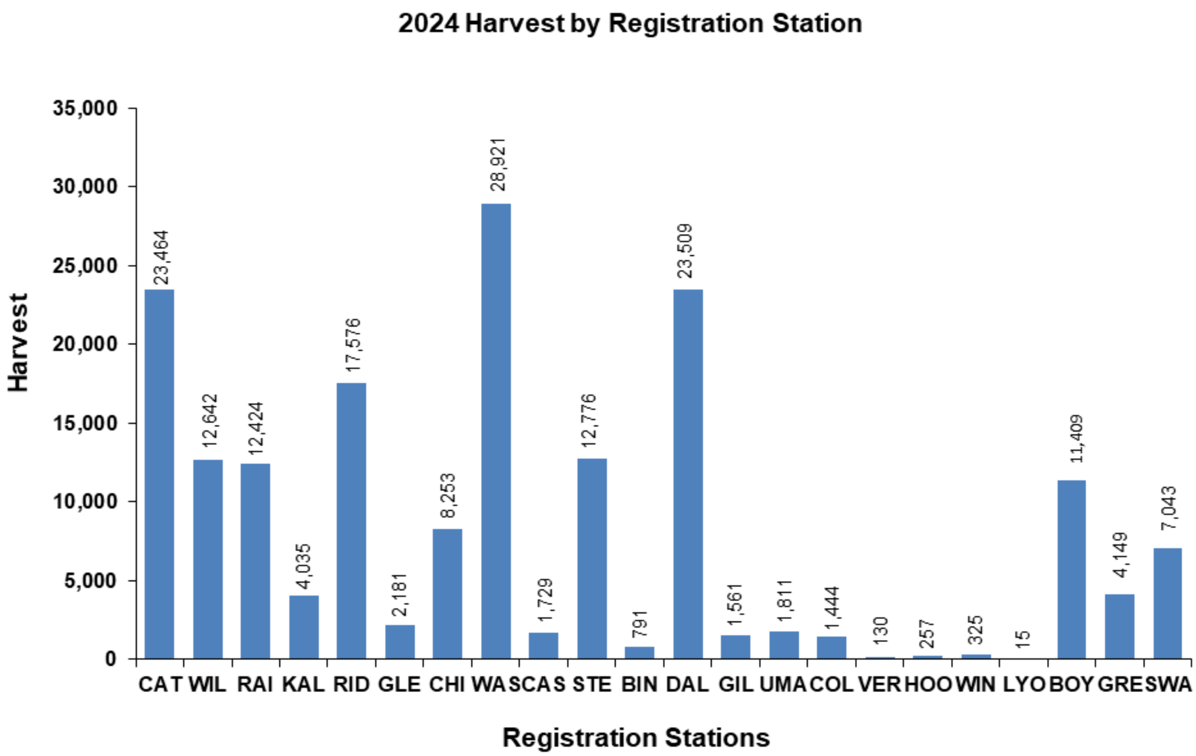

Figure 9. 2024 Northern Pikeminnow Sport-Reward Fishery harvest by registration station
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, GLE-Gleason, CHI-Chinook, WAS-Washougal, CAS-Cascade Locks, STE-Stevenson, BIN-Bingen, DAL- The Dalles, GIL-Giles, UMA-Umatilla, COL-Columbia Point, VER-Vernita, HOO-Hood Park, WIN-Windust, LYO-Lyons Ferry, BOY-Boyer Park, GRE-Greenbelt, SWA-Swallows.

Harvest by Species/ Incidental Catch

Returning anglers

In addition to catching Northern Pikeminnow, returning anglers participating in the 2024 NPSRF also reported that they incidentally caught the salmonid species listed in Table 1. Incidental salmonid catch by returning NPSRF anglers consisted mostly of Cutthroat trout and adult chinook.

Table 1. Catch and harvest of Salmonids by returning anglers targeting Northern Pikeminnow in 2024

Salmon

Species	Caught	Harvest	Harvest Percent
Cutthroat (Unknown)	48	6	12.5%
Chinook (Adult)	33	7	22.21%
Steelhead Juvenile (Hatchery)	23	0	0%
Trout (Unknown)	20	3	15%
Chinook (Juvenile)	12	0	0%
Steelhead Juvenile (Wild)	10	0	0%
Steelhead Adult (Wild)	7	0	0%
Steelhead Adult (Hatchery)	5	2	40%
Chinook (Jack)	2	0	0%
Coho (Adult)	2	0	0%

Anglers reported that all juvenile salmonids caught during the 2024 NPSRF were released. Per NPSRF protocol, technicians recorded all juvenile steelhead caught by NPSRF anglers as "wild", (except those specifically reported as missing an adipose fin). Harvested adult salmonids that were caught incidentally during the 2024 NPSRF were only retained during legal salmonid fisheries. NPSRF protocol is to immediately report anglers illegally harvesting any salmonids (whether juvenile or adult) to the appropriate enforcement entity for action.

Other fish species incidentally caught by returning NPSRF anglers targeting Northern Pikeminnow in 2024 were mostly undersize Northern Pikeminnow, Peamouth, and Smallmouth Bass (Table 2).

Table 2. Catch and harvest of non-Salmonids by returning anglers targeting Northern Pikeminnow in 2024

Non-Salmonid Species	Caught	Harvest	Harvest Percent
Northern Pikeminnow >228mm	176,449	176,445	100%
Northern Pikeminnow <228mm	25,961	2,541	9.79%
Peamouth	19,509	8,657	44.37%
Smallmouth Bass	12,553	1,605	12.79%
Sculpin (unknown)	7,361	4,202	57.08%
Walleye	2,017	725	35.94%
Yellow Perch	1,713	634	37.01%
Catfish (unknown)	1,406	441	31.37%
Sucker (unknown)	1,241	225	18.13%
Channel Catfish	784	115	14.67%
White Sturgeon	782	0	0%
Bullhead (unknown)	467	71	15.20%
Bluegill	272	46	16.91%
Starry Flounder	203	22	10.84%
Chiselmouth	159	18	11.32%
Carp	121	14	11.57%
American Shad	63	27	42.86%
Largemouth Bass	38	3	7.89%
Pumpkinseed	16	1	6.25%
Whitefish	5	0	0%
Crappie (unknown)	5	0	0%

Non-Returning Anglers Catch and Harvest Estimates

As in past years, telephone interviews were conducted to randomly survey non-returning participants at each of the NPSRF's 22 stations in order to determine and record their catch and/or harvest of reward sized Northern Pikeminnow and other incidentally caught salmonid species. In 2024, there were 3,284 non-returning angler days recorded and a total of 692 calls were completed to non-returning anglers (21.1% of all non-returning anglers). Surveyed non-returning anglers targeting Northern Pikeminnow reported that they caught and/or harvested the fish species listed in column 1 of Table 3 during the 2024 NPSRF. A simple estimator was applied to the catch and harvest totals obtained from the surveyed anglers to obtain Total Catch and Total Harvest estimates for non-returning anglers participating in the 2024 NPSRF. Estimated totals are listed in columns 5 and 6 of Table 3.

Table 3. 2024 NPSRF non-returning angler phone survey results with total catch & harvest estimates

Species	Caught	Harvest	%Harvested	Estimated Total Catch	Estimated Total Harvest
Northern Pikeminnow <228 mm	74	8	10.81%	351	38
Northern Pikeminnow ≥ 228 mm	7	7	100%	33	33
Chinook Salmon (Adult)	2	2	100%	9	9

N=3,284 n=692

Fork Length Data

The length frequency distribution for harvested Northern Pikeminnow (≥ 200 mm) from the 2024 NPSRF is presented in Figure 10. Fork length data from 91,077 Northern Pikeminnow ≥ 200 mm FL (51.6% of total harvest) were taken during the 2024 NPSRF. The mean fork length for all measured Northern Pikeminnow (≥ 200 mm) in 2024 was 261 mm (SD= 53.31 mm), which is less than the 263 mm mean in 2023 (Hone et al. 2024). Mean SRF fork length was also less than mean fork length for the Pikeminnow Dam Angler component of 377 mm (Shirley et al. 2025).

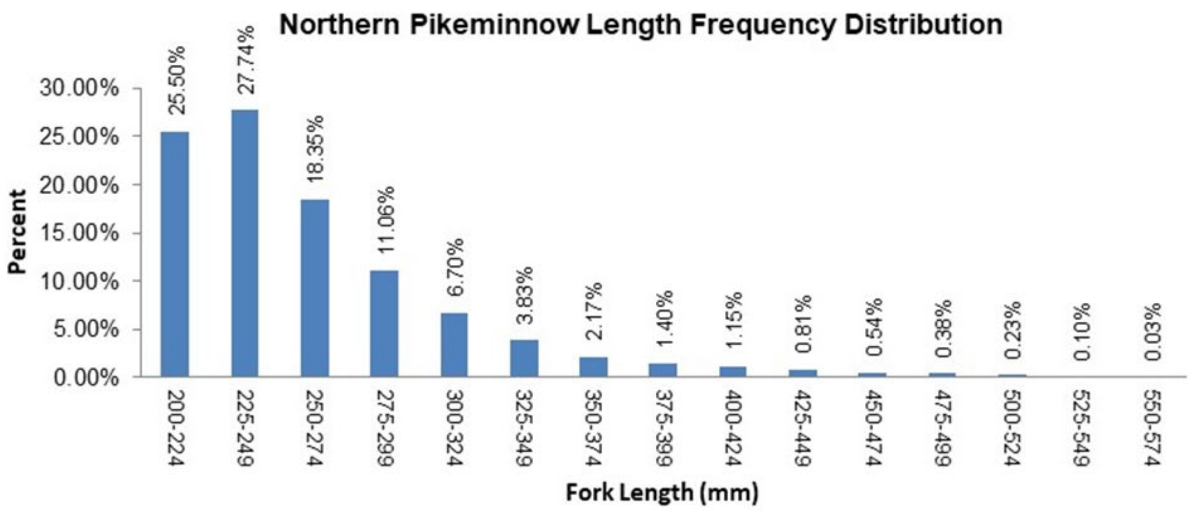

Figure 10. Length frequency distribution of Northern Pikeminnow > 200 mm FL from 2024 NPSRF. n=91,077

Angler Effort

The NPSRF recorded total angler effort of 12,378 angler days spent during the 2024 season, an increase of 338 angler days from 2024 (Hone et al. 2024) (Figure 11). When total effort is divided into returning and non-returning angler days, 9,094 angler days (73.5%) were recorded by returning anglers, and 3,284 angler days (26.5%) were spent by non-return anglers. The percentage of returning anglers in 2024 (73.5%) was lower than the 2023 (75.5%) season (Hone et al. 2024). Sixty-eight-point nine percent (68.9%) of total effort, and 93.8% of returning angler effort (8,527 angler days, 93.8%), was attributed to successful anglers who harvested at least one Northern Pikeminnow in 2024. There were 5,013 angler registrations using the Pikeminnow phone App accounting for 41% of angler registrations in 2024 compared to 27.2% in 2023 (Hone et al, 2024), while 59% of angler registrations continued to use standard paper registrations.

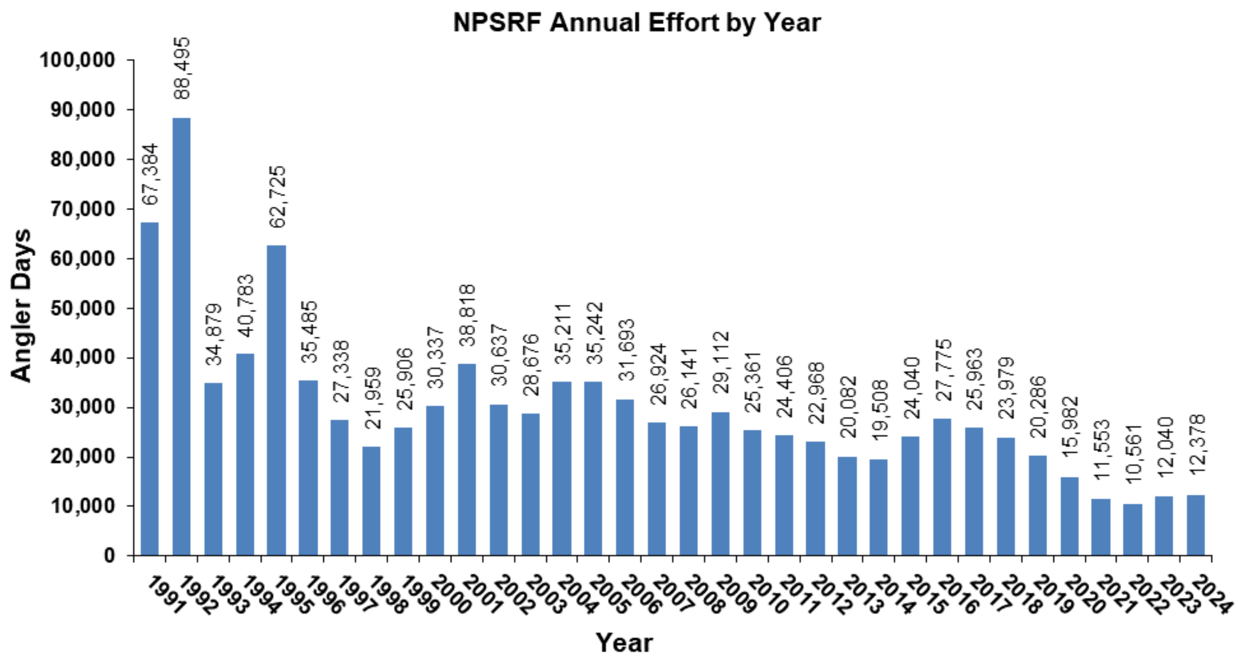

Figure 11. Annual Northern Pikeminnow Sport-Reward Fishery effort

Effort by Week

Peak weekly angler effort occurred in week 19 (Figure 12), which was one week earlier than in 2023 and when we compare weekly effort totals between years, weekly effort totals for 14 of the 22 weeks in 2024 were up from those of 2023 (Hone et al. 2024) (Figure 13). Overall, mean weekly effort for the 2024 NPSRF was 563 angler days per week, an increase from 547 angler days in 2023 (Hone et al. 2024), and continued to follow the effort pattern identified in 2015, where peak effort occurs near the first full week of the season (Figure 14). This pattern is different from the historical 1991-2015 effort pattern (Winther et al. 2016) where the peak typically occurred during the same week as peak harvest. The effort pattern change coincided with lowering NPSRF angler tier levels in 2015, which incentivized anglers to expend more effort earlier in the season as a way to reach higher tier levels sooner which allowed them to maximize their seasonal earnings (Winther et al. 1996).

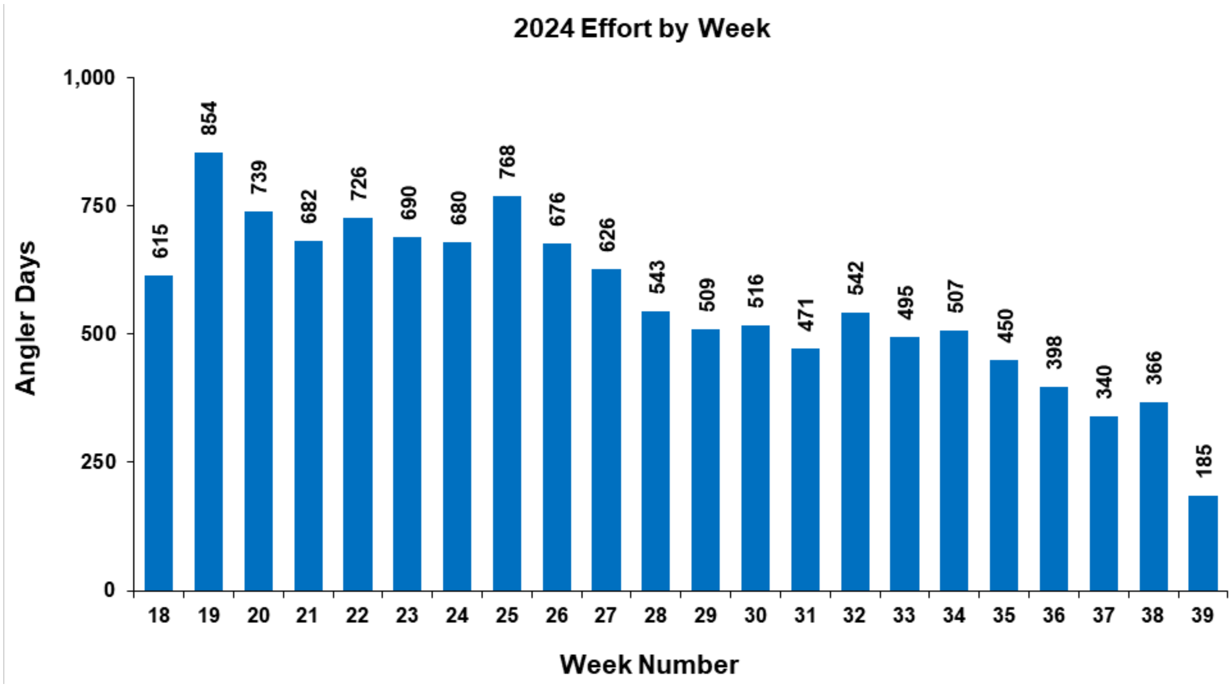

Figure 12. 2024 Weekly Northern Pikeminnow Sport-Reward Fishery angler effort

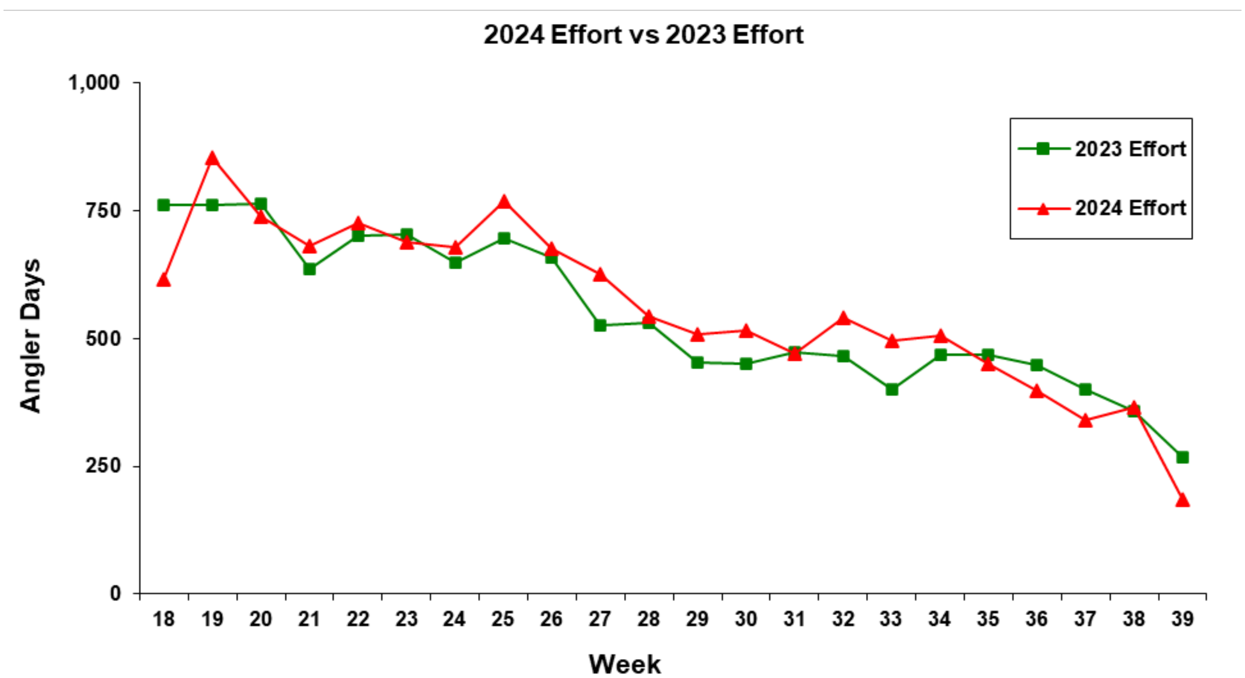

Figure 13. Effort 2024 Northern Pikeminnow Sport-Reward Fishery effort vs 2023 effort

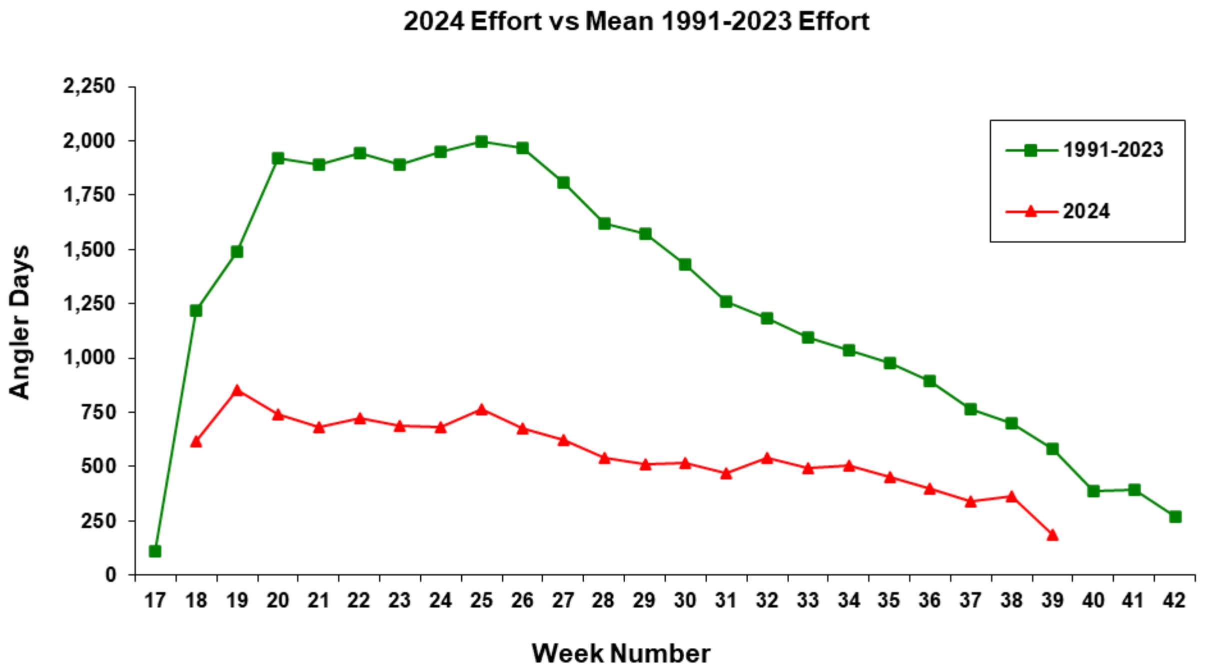

Figure 14. 2024 NPSRF weekly effort vs mean 1991-2023 effort

Effort by Fishing Location

Mean annual effort by fishing location for the 2024 NPSRF increased from 1,003 angler days in 2023 (Hone et al. 2024) to 1,032 angler days in 2024. Effort totals ranged from 4,913 angler days spent in fishing location 01 (below Bonneville Dam) to 1 angler day spent in fishing location 05 on the Columbia River (McNary Dam to the Mouth of the Snake River) (Figure 15). Four of the 12 NPSRF fishing locations recorded an increase in angler effort (from 2023) in 2024.

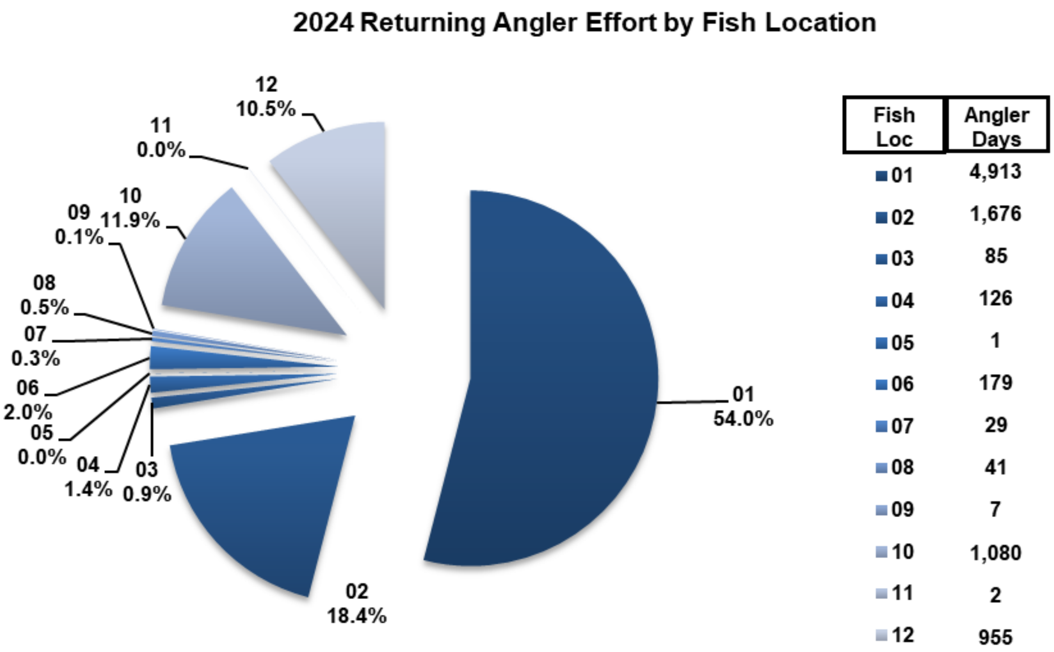

Figure 15. 2024 NPSRF angler effort by fishing location* (returning anglers only)
*Fishing Location Codes for **Columbia River**; 01 = Below Bonneville Dam, 02 = Bonneville Reservoir, 03 = The Dalles Reservoir, 04 = John Day Reservoir, 05 = McNary Dam to the mouth of the Snake River, 06 = Mouth of the Snake River to Priest Rapids Dam. **Snake River;** 07 = Mouth of the Snake River to Ice Harbor Dam, 08 = Ice Harbor Reservoir, 09 = Lower Monumental Reservoir, 10 = Little Goose Reservoir, 11 = Lower Granite Dam to the mouth of the Clearwater River, 12 = Mouth of the Clearwater River to Hells Canyon Dam.

Effort by Registration Station

Effort totals ranged from a high of 1,905 angler days at the Cathlamet station to a low of 23 angler days at the Hood Park station (Figure 16). Mean effort per registration station during the 2024 NPSRF was 563 angler days compared to 547 angler days in 2023 (Hone et al. 2024). Effort increased at 11 of the 22 registration stations with notable increases in angler effort at the Cathlamet, Ridgefield, and Rainier registration stations in 2024.

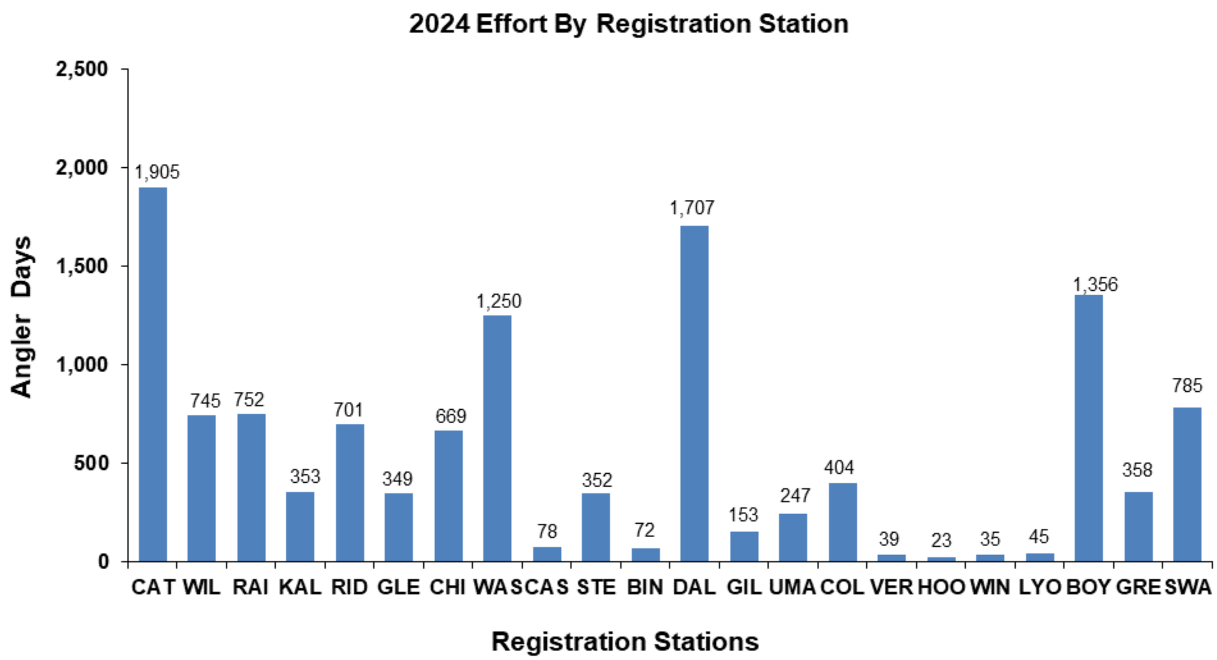

Figure 16. 2024 Northern Pikeminnow Sport-Reward Fishery angler effort by registration station
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, GLE-Gleason, CHI-Chinook, WAS-Washougal, CAS-Cascade Locks, STE-Stevenson, BIN-Bingen, DAL-The Dalles, GIL-Giles, UMA-Umatilla, COL-Columbia Point, VER-Vernita, HOO-Hood Park, WIN-Windust, LYO-Lyon's Ferry, BOY-Boyer Park, GRE-Greenbelt, SWA-Swallows.

Catch Per Angler Day (CPUE)

The 2024 NPSRF recorded an overall (returning + non-returning anglers) catch per unit of effort (CPUE or "catch rate") of 14.25 Northern Pikeminnow harvested per angler day during the season. This catch rate was higher than the 2023 overall CPUE of 13.00 (Figure 17), and in conjunction with increased angler effort, indicates that angling conditions throughout the NPSRF area during the 2024 season were better than the 2023 season. Angler CPUE continued an upward trend seen throughout the NPSRF's 34-year history and was also the highest ever recorded CPUE to date. Returning angler CPUE during the 2024 NPSRF was 19.40 Northern Pikeminnow per angler day, up from the 2023 returning angler CPUE of 17.21 (Hone et al. 2024). The estimated CPUE for non-returning anglers was calculated as 0.11 reward size Northern Pikeminnow per angler day based on 2024 NPSRF phone survey results which is a level has remained constant throughout recent NPSRF history.

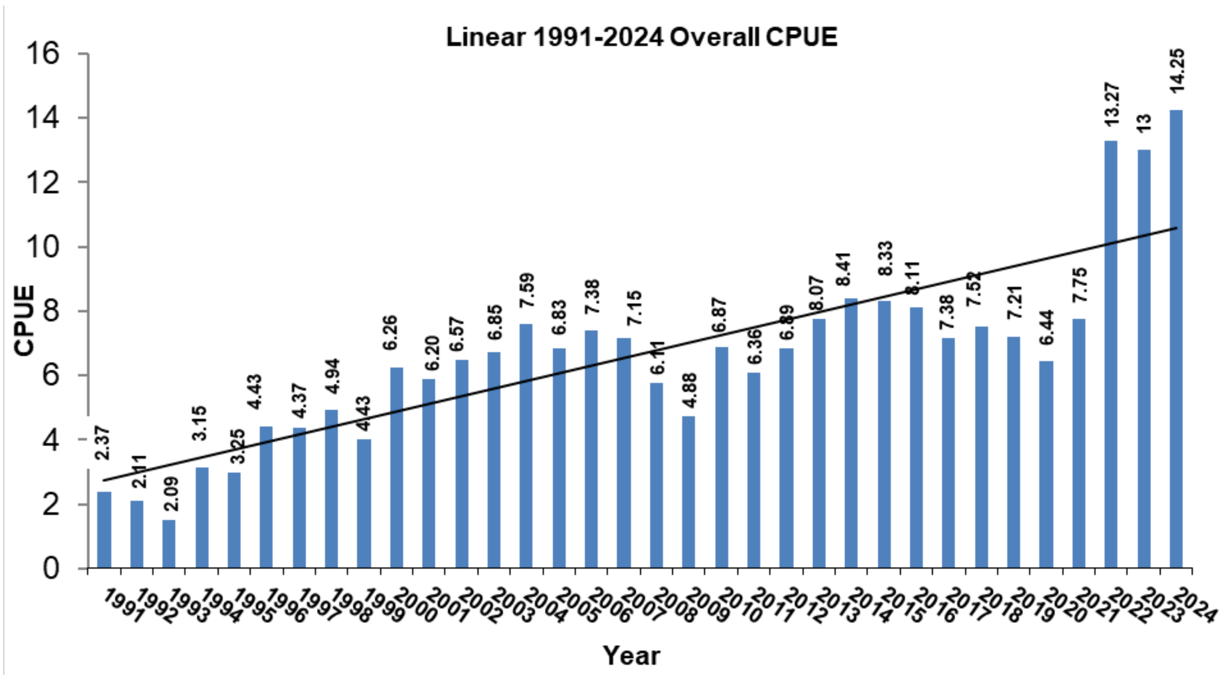

Figure 17. Annual NPSRF CPUE (returning + non-returning anglers) for the years 1991-2024

CPUE by Week

Mean angler CPUE by week for the 2024 NPSRF was 15.16 fish per angler day compared to 13.74 in 2023 (Hone et al. 2024) and ranged from a low of 9.85 in week 28 (July 8-14) to a peak of 23.13 in week 38 (September 16-22) (Figure 18). Weekly CPUE for the 2024 NPSRF followed the typical two-peak pattern with the first peak in week 21 (near the peak of the spawn) and then again late in the season (week 38) when favorable water and angling conditions were present in the lower Columbia and Snake rivers (Winther et al. 2011).

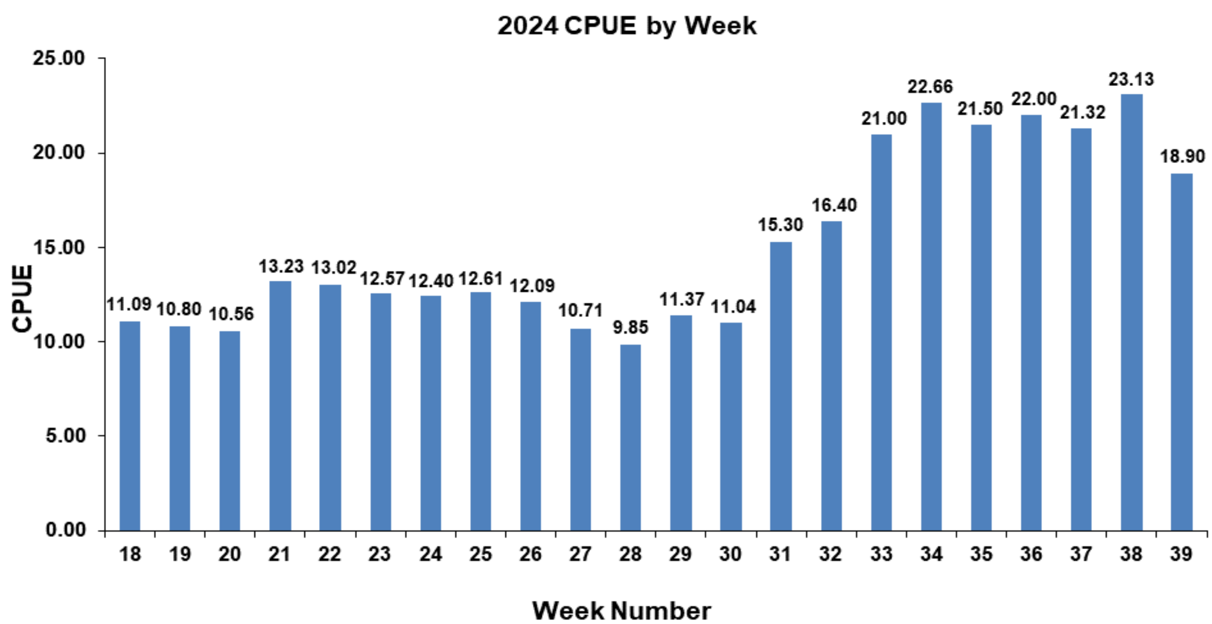

Figure 18. 2024 Northern Pikeminnow Sport-Reward Fishery angler CPUE by week

CPUE by Fishing Location

Angler success rates for the 2024 NPSRF (as indicated by CPUE), represent returning anglers only and varied by fishing location. Success rates ranged from a high of 27.88 Northern Pikeminnow per angler day in fishing location 02 (Bonneville Reservoir) to a low of 0 fish per angler per day in fishing location 05 (McNary Dam to the mouth of the Snake River) (Figure 19). CPUE increased at 7 of the 12 fishing locations and the average CPUE by fishing location was 10.59 Northern Pikeminnow per angler day in 2024 compared to 11.28 in 2023 (Hone et al. 2024).

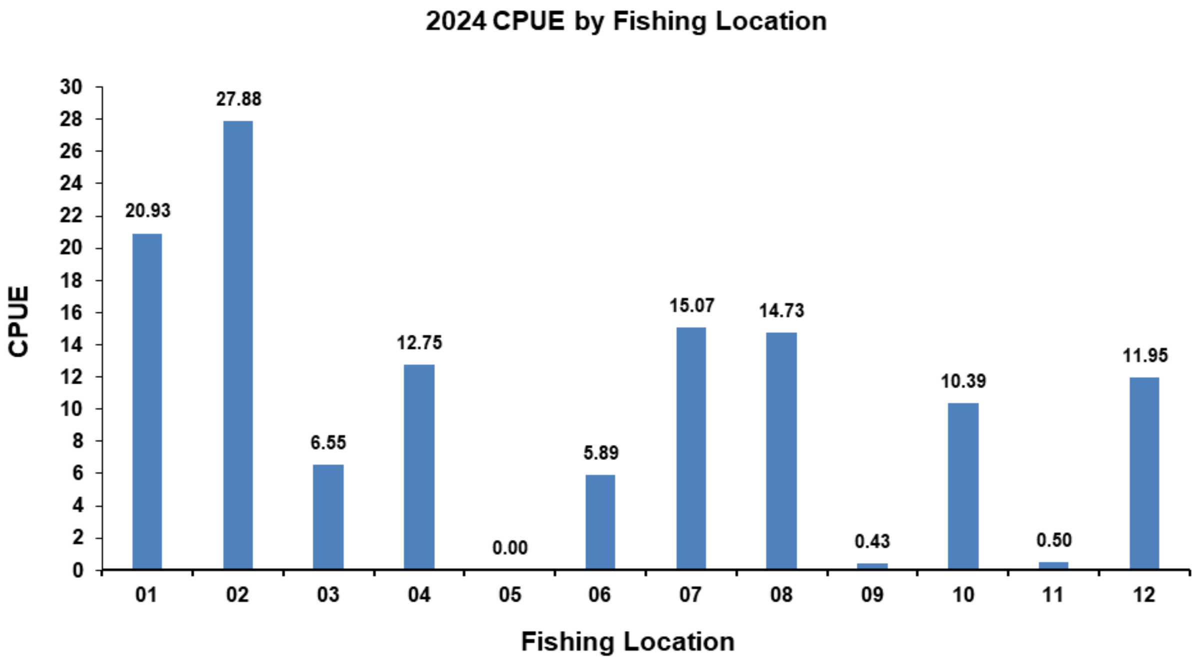

Figure 19. 2024 Northern Pikeminnow Sport-Reward Fishery angler CPUE by fishing location. *
*Fishing Location Codes for **Columbia River**; 01 = Below Bonneville Dam, 02 = Bonneville Reservoir, 03 = The Dalles Reservoir, 04 = John Day Reservoir, 05 = McNary Dam to the mouth of the Snake River, 06 = Mouth of the Snake River to Priest Rapids Dam. **Snake River**; 07 = Mouth of the Snake River to Ice Harbor Dam, 08 = Ice Harbor Reservoir, 09 = Lower Monumental Reservoir, 10 = Little Goose Reservoir, 11 = Lower Granite Dam to the mouth of the Clearwater River, 12 = Mouth of the Clearwater River to Hells Canyon Dam.

CPUE by Registration Station

The registration stations with the highest CPUE during the 2024 NPSRF were the Stevenson and Ridgefield stations where anglers averaged 36.30 and 25.07 Northern Pikeminnow per angler day respectively (Figure 20). The station with the lowest CPUE was the Vernita station with a CPUE of .33 Northern Pikeminnow per angler day. The average angler CPUE by station was 12.79 Northern Pikeminnow per angler day in 2024, up from 12.07 in 2023 (Hone et al. 2024). The largest CPUE increase occurred at the Willow Grove station, where angler CPUE increased from 6.60 in 2023 (Hone et al. 2024) to 16.97 in 2024.

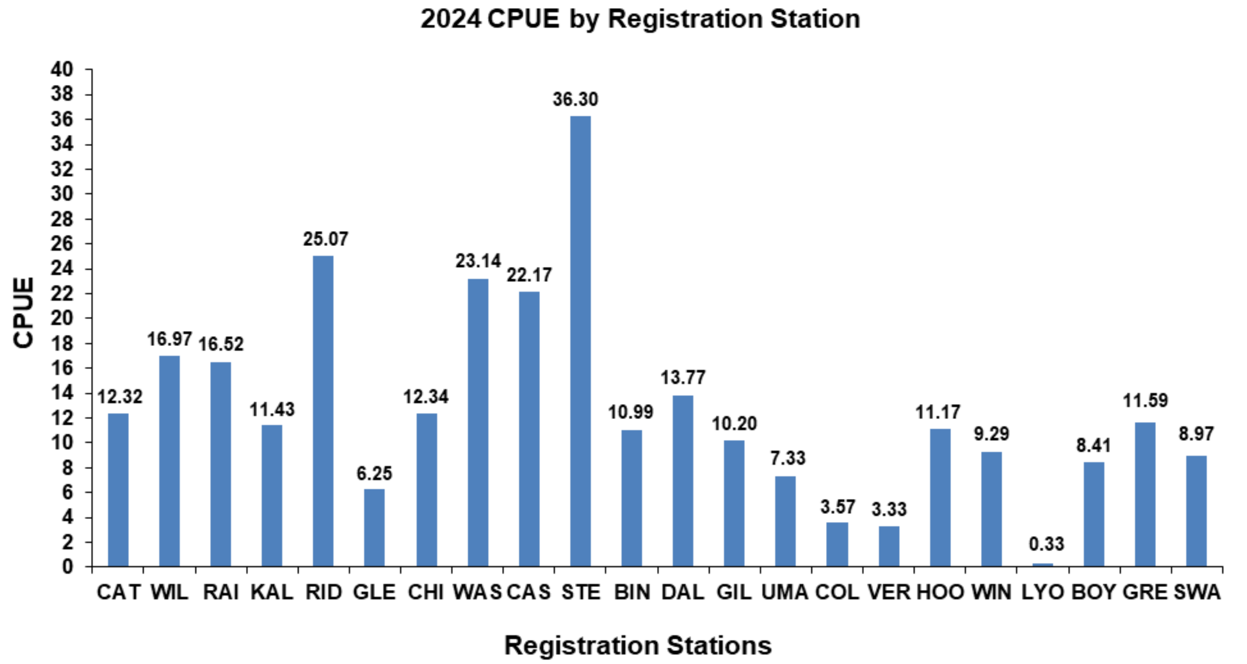

Figure 20. 2024 Northern Pikeminnow Sport-Reward Fishery angler CPUE by registration station
CAT-Cathlamet, WIL-Willow Grove, RAI-Rainier, KAL-Kalama, RID-Ridgefield, GLE-Gleason, CHI-Chinook, WAS-Washougal, CAS-Cascade Locks, BIN-Bingen, DAL-The Dalles, GIL-Giles, UMA-Umatilla, COL-Columbia Point, VER-Vernita, HOO-Hood Park, WIN-Windust, LYO-Lyon's Ferry, BOY-Boyer Park, GRE-Greenbelt, SWA-Swallows.

Angler Totals

There were 1,628 separate anglers who participated in the 2024 NPSRF, representing an increase of 4.8% from 2023 (75 participants) (Hone et al. 2024). Six hundred sixty-four of these anglers (40.8% of total compared to 41.8% in 2023 were classified as successful, harvesting at least one reward size Northern Pikeminnow (for which a voucher was issued) during the 2024 season. Of the successful anglers, 71.7% (476 anglers) sent in their vouchers to PSMFC for payment (PSMFC 12/09/24 Sport-Reward Payment Summary) while 188 anglers (28.3%) did not. The average successful angler harvested 266 Northern Pikeminnow during the 2024 NPSRF compared to 241 in 2022.

When we break down the 664 successful anglers by tier, 409 of these anglers (61.60%) harvested fewer than 25 Northern Pikeminnow and were classified as Tier 1 anglers (Figure 21). This is up from the 394 individual Tier 1 anglers in 2023 (Hone et al. 2024). The number of Tier 2 anglers decreased slightly to 137 (20.63%) in 2024, compared to 138 in 2023, while the number of Tier 3 anglers (known as "highliners") increased slightly from 117 anglers to 118 (17.77%) in 2024.

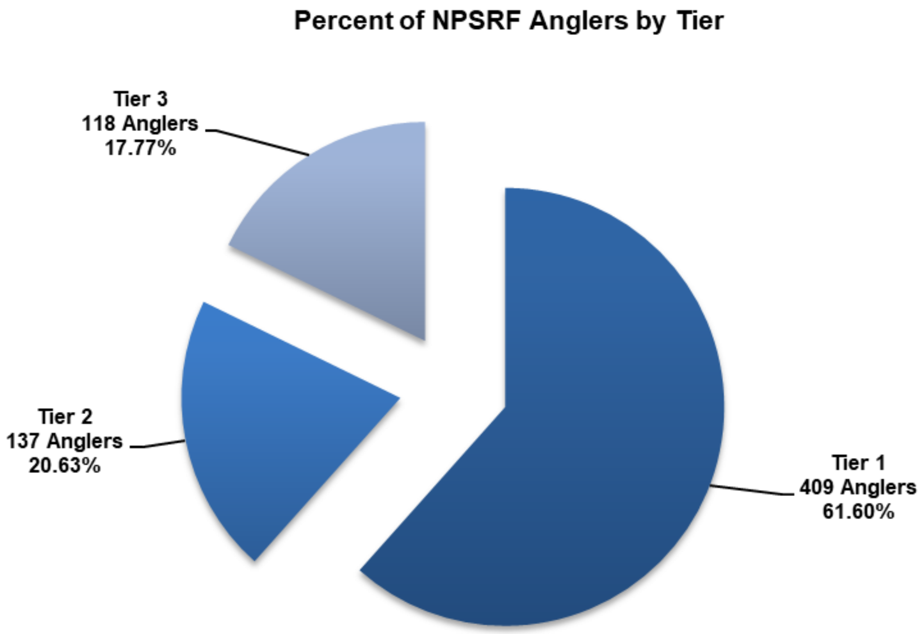

Figure 21. 2024 Percentage of NPSRF anglers by tier (returning anglers) based on total harvest

The continued high percentage of overall harvest achieved by Tier 3 anglers in 2024 remained especially important for successfully reaching 2024 NPSRF harvest and exploitation objectives since historically, Tier 3 anglers have much higher harvest and CPUE levels than Tier 1 or 2 anglers (Hisata et al. 1996).

While Tier 1 anglers made up 61.60% of all successful NPSRF participants in 2024, they only accounted for 1.3% of total NPSRF harvest (2,280 Northern Pikeminnow) (Figure 22). Tier 2 anglers made up 20.63% of all successful anglers and harvested 5.96% of total NPSRF harvest (10,520 fish). Tier 3 anglers made up 17.77% of all successful anglers and accounted for 92.75% of total 2024 NPSRF harvest (163,645 fish), but represented only 7.25% of all NPSRF participants (both returning and non-returning anglers).

The average annual harvest per angler in 2024 remained the same as 2023 for Tier 1 and Tier 2 anglers while increasing for Tier 3 anglers (Hone et al. 2024). Tier 1 angler annual average harvest was 6 fish per year while Tier 2 anglers harvested an annual average of 77 fish per year in 2024. Average annual harvest for Tier 3 anglers increased to 1,387 fish per year in 2024 compared to 1,228 fish per year in 2023.

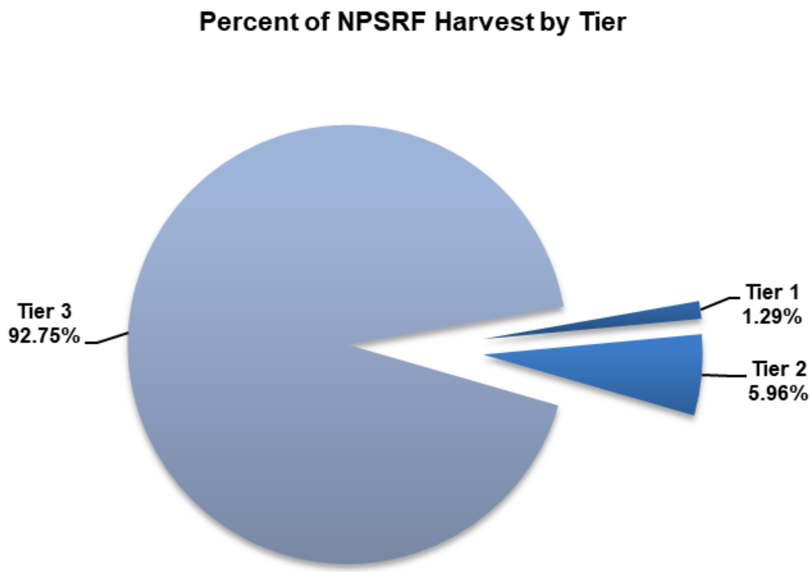

Figure 22. 2024 NPSRF harvest by angler tier (Tier 1 = <25, Tier 2 =26-200, Tier 3 = > 200)

The overall average NPSRF participant (returning anglers + non-returning anglers) expended less effort pursuing Northern Pikeminnow during the 2024 season (7.6 angler days) than in 2023 (7.75 angler days) (Hone et al.2024). When we look at successful anglers only, the average successful angler spent slightly less annual effort during the 2024 NPSRF (12.84 angler days) than spent in 2023 (13.00 angler days). When we break down successful angler effort by tier, all three tier levels expended the same amount of annual effort in 2024 as they did in 2023. Tier 1 anglers spent an average of 4 days fishing, Tier 2 anglers spent an average of 17 days fishing, and Tier 3 anglers averaged 58 days fishing in 2024 (Figure 23).

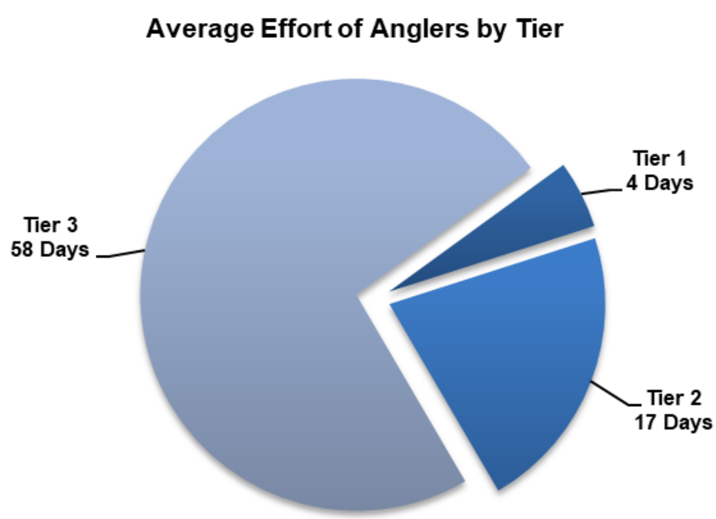

Figure 23. Average effort (angler days) of 2024 NPSRF anglers by tier (Tier 1 = < 25, Tier 2 = 26-200, Tier 3 = > 200)

When 2024 angler CPUE by tier is compared to 2023, CPUE for anglers at Tier 1 remained at 1.36, the same as in 2024 (Figure 24). Angler CPUE for Tier 2 anglers decreased slightly from 4.65 fish per angler day in 2023 to 4.59 in 2024 (Hone et al. 2024), while CPUE for Tier 3 anglers increased from 21.36 fish per angler day in 2023 to 23.88 in 2024.

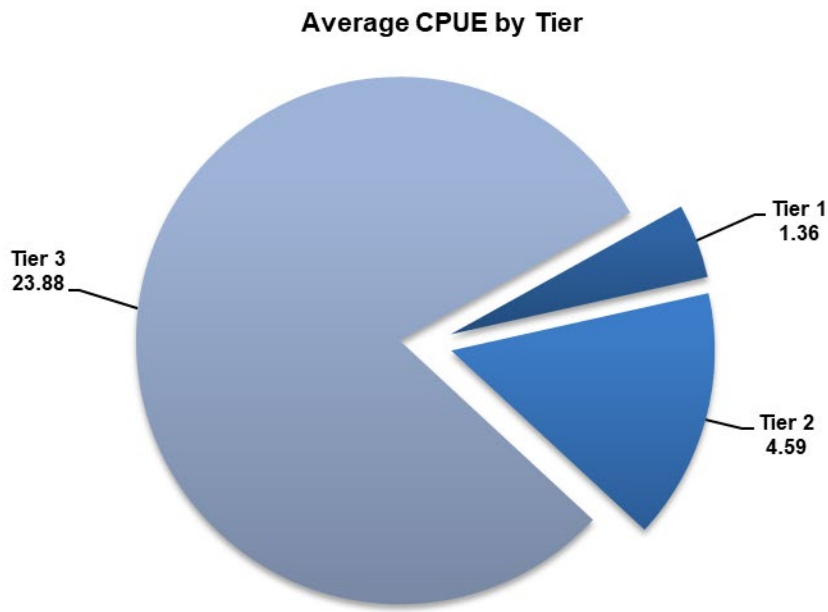

Figure 24. Average CPUE of 2024 NPSRF anglers by tier (Tier 1 = <25, Tier 2 =26-200, Tier 3 = > 200)

The top individual angler for the 2024 NPSRF harvested a NPSRF record number of fish caught with 16,150 Northern Pikeminnow harvested (including 16 PIT tagged Northern Pikeminnow) worth total earnings of $164,260 (PSMFC 12/09/2024 Sport-Reward Payment Summary). The 2024 top angler caught 5,395 more reward sized Northern Pikeminnow than the top angler did in 2023 (Hone et al. 2024). The CPUE for this year's top angler (144 fish per angler day) was up from the top angler in 2023 (76.81 fish per angler day) reflecting more productive fishing/river conditions seen for all Tier 3 anglers in 2024. The top angler in 2024 also spent 28 fewer days of effort (112 days total) than the top angler did in 2023. By comparison, the top angler in terms of participation (rather than harvest) for the 2024 NPSRF fished 147 days of the 148 available days (99.3% of available days) and harvested 2,680 Northern Pikeminnow.

Tag Recovery

Northern Pikeminnow Tags

WDFW deployed 16 external spaghetti or Floy tags during 2024 as an angler incentive intended to supplement ODFW's PIT tagging activities. Returning anglers harvested 6 Northern Pikeminnow tagged with external spaghetti or Floy tags during the 2024 NPSRF compared to 14 external spaghetti/Floy tags harvested in 2023 (Hone et al. 2024). There were also 177 Northern Pikeminnow recovered with ODFW PIT tags in 2024 (ODFW discontinued using external tags in 2021 and now uses only PIT tags). Tag recoveries (both external and PIT) peaked during weeks 19 and 23 (Figure 25), which partially matched week 23 peak tag recoveries in 2023. Of the 6 externally tagged Northern Pikeminnow recovered in the 2024 NPSRF, 5 retained PIT tags added by ODFW. The WDFW tag recovery data from the 2024 NPSRF (Spaghetti/Floy and/or PIT) was used by ODFW to estimate a 11.6% exploitation rate for the NPMP in 2024 (Waltz et al. 2025).

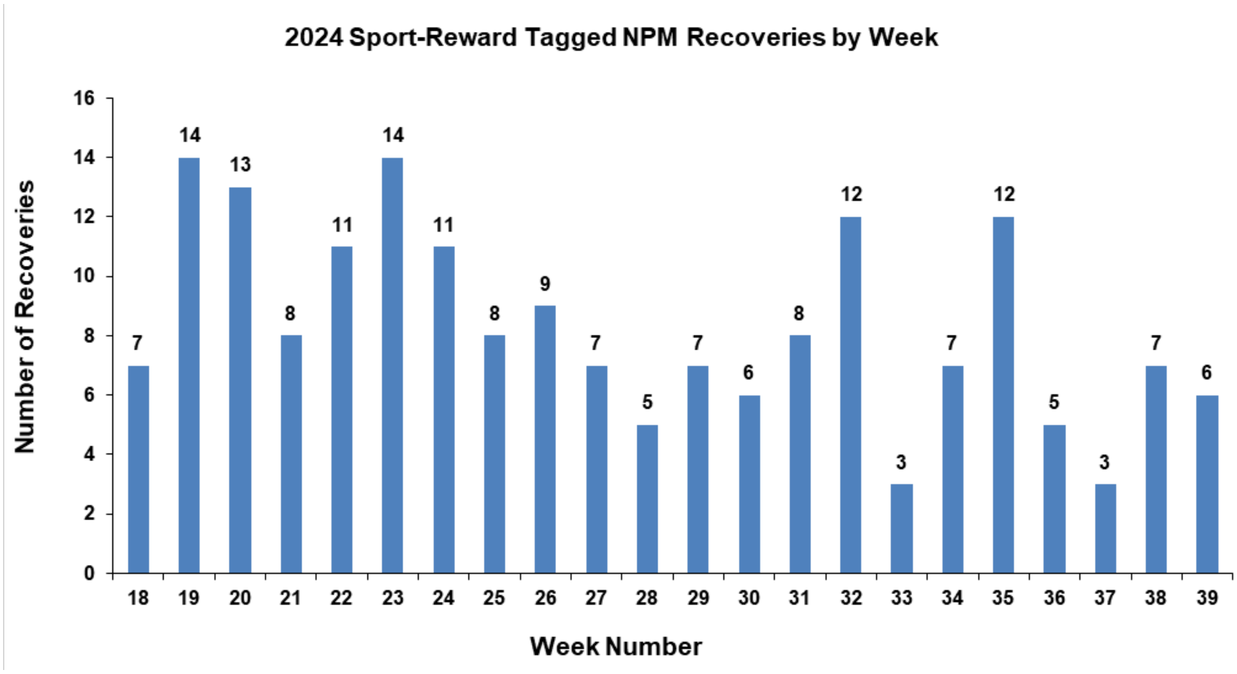

Figure 25. 2024 NPSRF tagged NPM recoveries by week

Ingested PIT Tags

A total of 176,445 Northern Pikeminnow were individually scanned for the presence of PIT tags in 2024. This represents 100% of the total harvest of qualifying reward-size fish for the 2024 NPSRF (Northern Pikeminnow not qualifying for rewards were also scanned whenever possible). Technicians recovered a total of 39 PIT tags from consumed smolts that had been ingested by Northern Pikeminnow harvested during the 2024 NPSRF, an overall occurrence rate of 1:4,524 compared to 1:6,261 in 2023 (Hone et al. 2024). Total ingested PIT tag recoveries of salmonid smolts ingested by Northern Pikeminnow in 2024 were 14 more than the previous year and peaked during week 22 of the 2024 NPSRF. The final ingested PIT tag recovery for the 2024 NPSRF occurred during week 29 (July 15th – July 21st) (Figure 26), two weeks later than in 2023.

Ingested PIT tag recoveries by fishing location during the 2024 NPSRF showed that Northern Pikeminnow harvested from fishing location 02 (Bonneville Reservoir) consumed the largest number of PIT tagged juvenile salmonids totaling 13 (Figure 27).

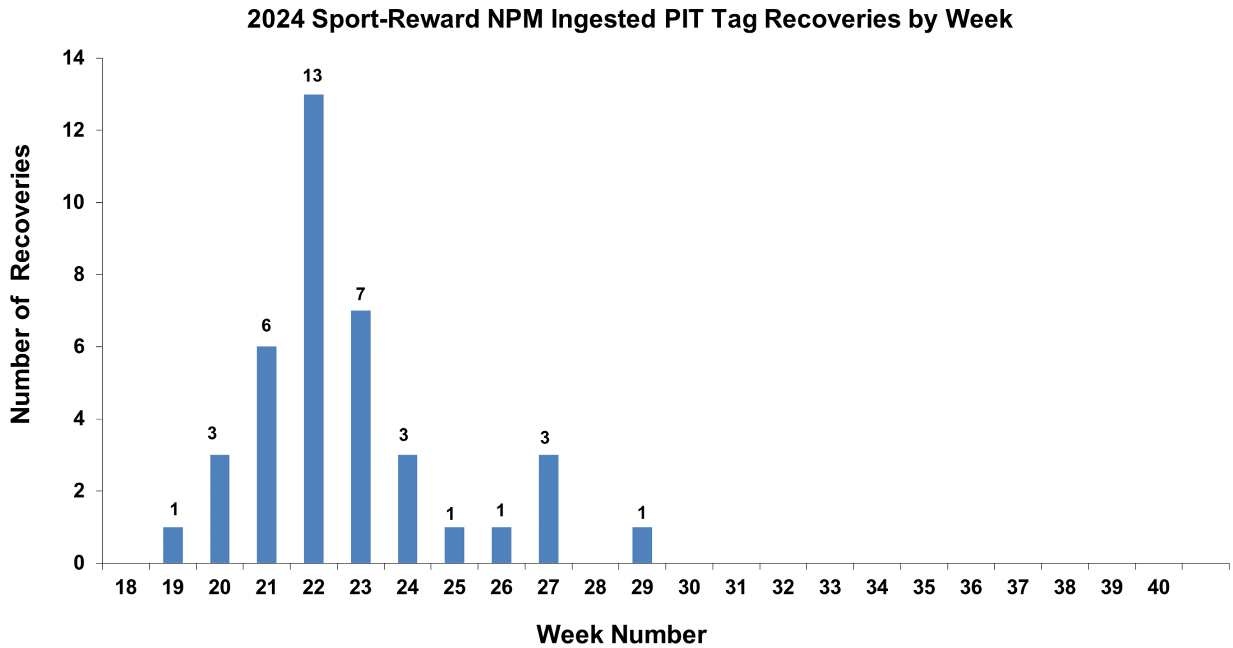

Figure 26. 2024 NPSRF ingested PIT Tag recoveries by week

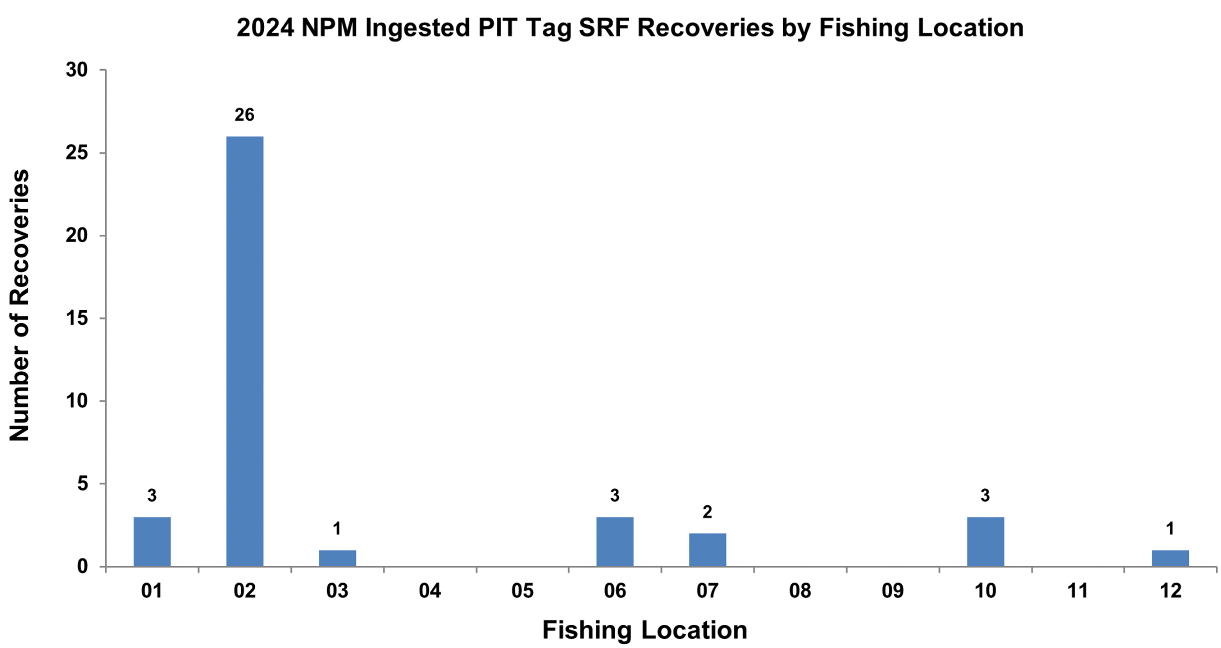

Figure 27. 2024 NPSRF ingested PIT Tag recoveries by fishing location*

*Fishing Location Codes – **Columbia River**; 01 = Below Bonneville Dam, 02 = Bonneville Reservoir, 03 = The Dalles Reservoir, 04 = John Day Reservoir, 05 = McNary Dam to the mouth of the Snake River, 06 = Mouth of the Snake River to Priest Rapids Dam. **Snake River**; 07 = Mouth of the Snake River to Ice Harbor Dam, 08 = Ice Harbor Reservoir, 09 = Lower Monumental Reservoir, 10 = Little Goose Reservoir, 11 = Lower Granite Dam to the mouth of the Clearwater River, 12 = Mouth of the Clearwater River to Hells Canyon Dam.

Species composition of PIT tagged smolts ingested by Northern Pikeminnow harvested in the 2024 NPSRF was obtained from PTAGIS and showed that 26 of the 39 ingested PIT tag recoveries (66.7%) were from Chinook smolts (Figure 28). 24 of the 26 Chinook smolts PTAGIS indicated that the smolts were of hatchery origin and 2 were of wild origin. PTAGIS queries further revealed that the hatchery Chinook PIT tag recoveries consisted of 9 Fall Chinook, 10 Spring Chinook, 7 Summer Chinook. Finally, PTAGIS queries revealed that the other 13 ingested PIT tag recoveries consisted of 4 hatchery summer Sockeye, 1 unknown origin unknown run sockeye, 3 Coho, 4 hatchery summer Steelhead, and 1 unknown run Steelhead PIT tag recovery.

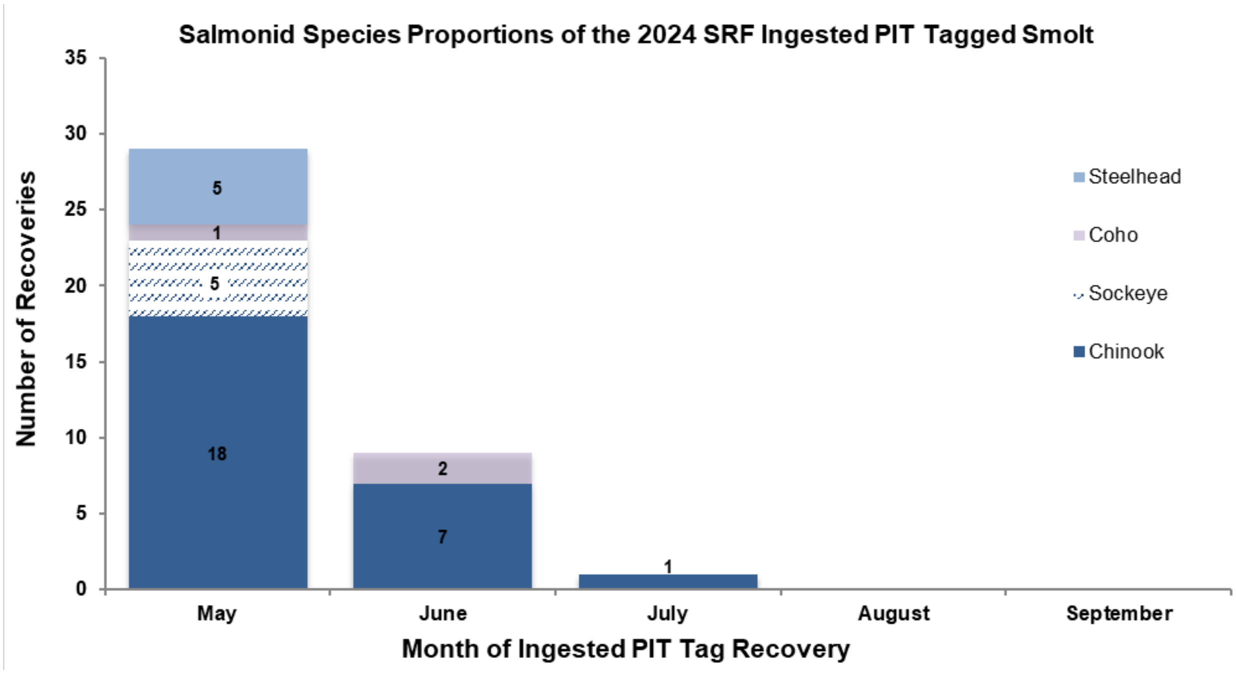

Figure 28. Recoveries of ingested Salmonid PIT Tags from the 2024 NPSRF

Analysis of PIT tag recovery data from the 2024 NPSRF continues to document actual Northern Pikeminnow predation on downstream migrating juvenile salmonids (and occasional lamprey) and may help to identify possible predation "hotspots". Further data collection and analysis of PIT tag recoveries from juvenile salmonids consumed by Northern Pikeminnow harvested in the NPSRF may lead to a better understanding of Northern Pikeminnow predation on salmonid smolts and the factors affecting the vulnerability of smolts and juvenile lamprey to predation while migrating through the Columbia River System.

SUMMARY

- The 2024 NPSRF season resulted in a significant improvement in harvest from the previous season and was the third consecutive season of increasing harvest, most likely due to more favorable river conditions. The 2024 NPSRF also saw an increase in angler effort for the second consecutive year, which was directly related to improved fishing success and to the additional awareness of, and improved availability of the electronic angler registration phone App. Another indication of improved fishing conditions during the 2024 NPSRF was that the top angler's harvest was the highest in NPSRF history, as was overall angler CPUE.

- Total 2024 NPSRF harvest of 176,445 was above 1991-2023 average annual harvest (169,462), and was the third consecutive year of increased harvest equaling an estimated 11.6% exploitation rate. Washougal was the top producing station with 28,921 Northern Pikeminnow harvested and Fishing location 01 continued to be the most productive harvest area.

- With the 12,378 angler days recorded by Pikeminnow anglers during the 2024 SRF season, the NPSRF continued to add to the more than **1 million angler days** of effort (1,014,627) recorded by anglers since the NPSRF's inception in 1991. Annual angler effort in 2024 increased by 338 angler days from 2023 while the number of individual anglers also increased by 75 anglers.

- CPUE increased from 13.00 fish per angler day in 2023 to 14.25 in 2024. The upward trend in angler CPUE seen since the NPSRF's inception continued in 2024 along with the best catch rates again occurring in the last month of the season rather than during the spawn period of late June.

- We recovered 6 Northern Pikeminnow with external spaghetti or Floy tags in 2024 and an additional 177 Northern Pikeminnow which had no external tags but retained ODFW PIT tags (formerly "tag-loss"). Mean fork length for Northern Pikeminnow harvested in the 2024 NPSRF was 261 mm, down from 263 mm in 2023. Incidental catch consisted primarily of Peamouth, Smallmouth Bass, and Sculpin, reflecting a similar pattern seen in past NPSRF seasons, and only 2 adult salmonids were caught by surveyed non-returning anglers.

- Detection of PIT tags from juvenile salmonids ingested and retained in the gut of Northern Pikeminnow continues to yield valuable data about Northern Pikeminnow predation on juvenile salmonids. The occurrence rate of ingested salmonids decreased to 1:4,524 from 1:6,261 in 2023, and species composition of the 39 ingested PIT tags recovered from harvested Northern Pikeminnow continued to indicate that most (26) were from Chinook smolts, and 24 of those were of hatchery origin. There were also 4 hatchery and (1 unknown) Sockeye, 4 hatchery summer steelhead (and 1 unknown steelhead), and 3 hatchery coho recorded according to PTAGIS.

RECOMMENDATIONS

1.) Continue to evaluate the use of adjusting season dates (typically May 1st-Sept 30th) for select stations during implementation of the 2025 NPSRF in order to maximize opportunities for angler effort and harvest during known productive angling times/dates. This would be similar to the "satellite" station concept first used in the 1994 SRF for non-core stations during limited times and durations as a means to increase SRF efficiency and angler outreach.

a) Resume the use of early openings at select stations (as the NPSRF did in the 1990's) to enhance Northern Pikeminnow harvest opportunities in areas where angler success is historically highest at the start of the season. Early starts may also generate additional angler effort and harvest later in the season by providing more opportunity for anglers to reach higher tier levels when large numbers of Northern Pikeminnow are more readily available early in the season.
b) Consider opening stations for shorter durations than the usual 5 month season (one month minimum) to take advantage of fish availability and good angling conditions.
c) Consider shortening station hours or closing stations when local "harvest windows" have closed or if low harvest or participation warrants.

2.) Continue to use, develop, and expand the use of the Pikeminnow smart phone App and related electronic data collection options. Development of the ability to electronically collect angler exit interviews, catch data and biological data should be tied to existing electronic angler registrations from the phone App, along with ability to electronically capture PIT tag data.

3.) Continue to implement and evaluate angler incentives such as the $6 base reward level used in 2024 as an incentive designed to recruit new anglers to the 2025 NPSRF. Continue to utilize the standard Tier levels used in 2024 which were designed to incentivize current, proficient, knowledgeable anglers to expend additional effort participating in the 2025 NPSRF.

4.) Continue use of angler clinics, coupons, and sport shows as tools to recruit new anglers and promote NPSRF awareness. Develop additional ways to attract and engage anglers to participate in the NPSRF.

5.) Continue to develop video content for use in improving angler education, NPMP awareness using Facebook, Instagram and other online/ social media as a means to maintain or increase NPM harvest.

6.) Continue to scan all Northern Pikeminnow for PIT tags from ingested juvenile salmonids, from Northern Pikeminnow tagged by ODFW as part of the biological evaluation of the NPMP, and as a way to deter fraud by identifying PIT tagged Northern Pikeminnow coming from outside NPSRF boundaries. Investigate the feasibility of using PIT tag scanners to communicate with Ipad type devices (used for phone App) for data collection.

7.) Continue to evaluate and expand the use Floy or Spaghetti type tags as external promotional tags deployed by WDFW on Northern Pikeminnow as an angler incentive.

8.) Survey a minimum of 20% of non-returning NPSRF anglers to record non-returning angler catch of Northern Pikeminnow and all salmonids and estimate total catch and harvest of Northern Pikeminnow, all salmonids and all other fish species in 2025 per NPMP protocol. Analyze and monitor this data to identify any changes in non-returning angler catch trends.

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REPORT B

Northern Pikeminnow Sport-Reward Payments

2024 Annual Report

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March 2025

ABSTRACT

Northern Pikeminnow Sport-Reward Program Payments: *PSMFC to provide technical, contractual, fiscal and administrative oversight for the program. In addition, PSMFC processes and provides accounting for the reward payments to participants in the sport-reward fishery.*

In 2024, there was no early startup, but there was a five-day early closure on September 25. There were no late season increases to the dollar amount paid for eligible Northern Pikeminnow or verified tagged fish. All vouchers issued from May 1 through September 25, 2024 were paid at $6, $8 and $10 per fish for the three payment tiers (1-25 fish, 26-200 fish and 201-up). The rewards for tagged fish were $200 per fish with a PIT tag only and $500 per fish with an external tag.

A total of 175,084 fish were paid at the standard payment tiers (excluding coupon amounts, tagged fish and tag-loss bonus payments). The season total reward paid for these fish was $1,665,192.

A combined total of 6 tagged fish (having an external spaghetti or floy tag) were paid in 2024. The season total paid for tag rewards was $3,000.

A total of 176 tag loss fish (external tag missing but still possessing a verifiable PIT tag or PIT tag only as of 2022) were paid a *bonus* reward of $200. The season total paid for tag loss *bonus* was $35,200.

A total of 406 anglers attached a one-time *$10 bonus coupon* to their reward voucher before submission for payment. The season total paid for *$10 bonus coupons* was $4,060.

A total of 1,628 separate anglers registered to fish, of which 476 (29%) caught one or more fish and received payments during the season. The total value for all 175,090 Northern Pikeminnow submitted for payment in 2024 (including all coupons, tagged fish and tag loss *bonus* payments) was $1,707,452.

INTRODUCTION

The **Northern Pikeminnow Sport Reward Program** was again administered by PSMFC in 2024. The program is a joint effort between the fishery agencies of the states of Washington (WDFW) and Oregon (ODFW), and the Pacific States Marine Fisheries Commission (PSMFC) and is funded by the Bonneville Power Administration (BPA). WDFW was responsible for the sport-reward registration/creel check stations throughout the river, handled all fish checked in to the program, externally tagged fish for promotional purposes and conducted dam angling at John Day Dam and The Dalles Dam. ODFW provided fish tagging services, population studies, and food habit studies, as well as exploitation rate estimates. PSMFC provided technical, contractual, fiscal and administrative oversight for all segments of the Program and processed all reward vouchers for the sport-reward anglers.

THE 2024 SEASON

The 2024 Northern Pikeminnow Sport-Reward Fishery started May 1 and ran through September 25. The season was characterized by above average catch, below average effort and above average catch per unit effort. Of the 176,445 pikeminnow vouchered, 175,090 (99.2%) were successfully submitted for payment (Table 1). There were 7,666 (4.4%) vouchered fish paid at the Tier 1 level, 27,492 (15.7%) vouchered fish were paid at the Tier 2 level, and 139,926 (79.9%) vouchered fish were paid at Tier 3. Anglers that obtained Tier 1 status by the end of the season harvested 1,542 (0.9%) of the total paid. Anglers that obtained Tier 2 status by the end of the season harvested 10,417 (5.9%) of the total paid. Anglers that obtained Tier 3 status by the end of the season harvested 163,131 (93.2%) of the total paid.

PSMFC distributed $1,707,452 (99.6%) of the $1,714,661 Sport-Reward fund to anglers participating in the program. Of the funds distributed, $45,996 (2.7%) were paid at the Tier 1 rate ($6/fish), $219,936 (12.9%) at Tier 2 ($8/fish) and $1,399,260 (81.9%) at Tier 3 ($10/fish) for successful submission of a standard voucher. Another $42,260 (2.5%) in Sport-Reward funds were paid out for tag vouchers, tag loss fish and one-time bonus coupons.

Table 1. Total number of Northern Pikeminnow vouchered and rewarded by tier group in 2024.

	Angler Catch					
	Tier 1 ($6)	Tier 2 ($8)	Tier 3 ($10)	Incentives	Payout (% of Total)	Total
Northern Pikeminnow	7,666	27,492	139,926	6	175,090 (99.2%)	176,445
Rewards	$45,996	$219,936	$1,399,260	$42,260	$1,707,452 (99.6%)	$1,714,661

Four hundred seventy-six anglers successfully submitted vouchers for payment by the November 15 deadline. Out of the 231 (49%) Tier 1 anglers paid, 177 caught ten or less pikeminnow (Figure 1). One hundred twenty-nine (27%) anglers paid achieved Tier 2 status by the end of the season and 116 (24%) achieved Tier 3 status by the end of the season. The top 20 anglers caught 93,548 (53%) of all pikeminnow paid and earned $945,720 (55%) of the total funds disbursed.

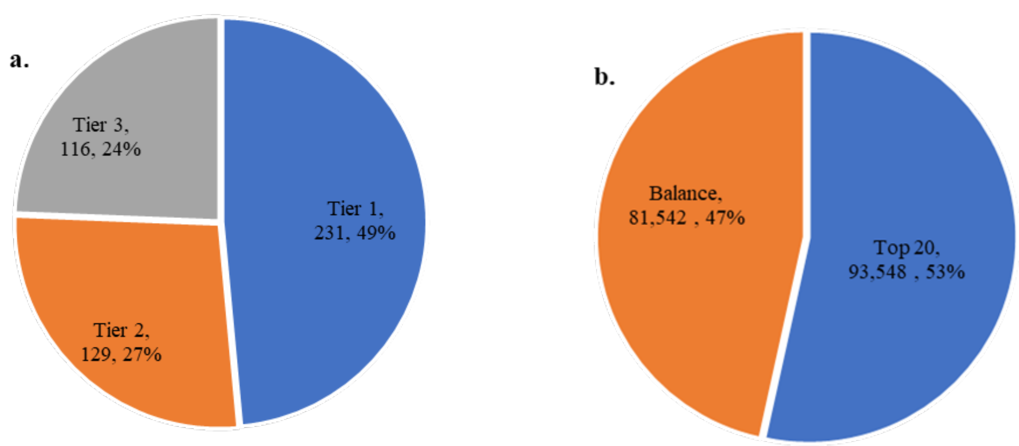

Figure 1. Number and percent of anglers with successful voucher submissions by tier level (a) and number and percent of vouchered fish successfully submitted by the Top 20 anglers versus the balance (b).

PARTICIPATION AND PAYMENT

A total of 664 anglers who registered were successful in catching one or more fish in 2024. Of those anglers; 476 caught one or more fish, submitted their voucher before the payment deadline (with no unresolved issues preventing payment) and received payment during the season.

In 2024 a total of 176,445 fish were harvested in the sport-reward fishery. Of this total, 175,090 (99.2%) fish were submitted for payment and paid preceding the 2024 payment deadline. To obtain payment, vouchers must have been received no later than November 15, 2024. In addition, any *received* vouchers with issues preventing payment (missing information, voiding of voucher for program violations, etc.) that had not been resolved by November 15, 2024, became null and void.

TAGGED FISH AND PAYMENTS

Registered anglers caught and submitted a total of 6 tagged fish (showing an external spaghetti or floy tag) to station technicians. For each tagged fish, the angler was issued a special tag voucher. The tag was placed in a special tag envelope which was stapled to the tag voucher. It was then the angler's responsibility to mail both the tag and voucher to ODFW for verification. Once the tag was verified, the information was forwarded to PSMFC for payment of the special $500 tagged fish reward. The season total paid for tag rewards was $3,000.

TAG LOSS BONUS PAYMENT

Prior to 2022, all tagged Northern Pikeminnow initially had both a spaghetti/floy tag and a PIT (Passive Integrated Transponder) tag. However, the special $500 tagged fish reward was valid only for fish that still retained the original spaghetti/floy tag. All qualifying Northern Pikeminnow submitted by registered anglers were scanned to check for the presence of a PIT tag. When a PIT tag was detected on a fish with no spaghetti/floy tag, the fish was considered a *standard* fish (and paid at the standard tier rate of $6, $8, and $10 per fish) but was also flagged for verification (by ODFW) of a valid program PIT tag. Upon positive confirmation by ODFW; the angler was then sent an additional $200 *bonus* check and congratulatory letter which included the tagging date and approximate area of release. As of 2022, ODFW began a PIT tag only protocol. These PIT tag only fish were paid at the same bonus rate as tag-loss fish. In 2024, a total of 176 tag loss fish qualified for and were paid the *bonus* reward of $200. The season total paid for tag loss *bonus* was $35,200.

ONE-TIME $10 BONUS COUPON

Leading up to the start of the season, brochures containing "coupons" were mailed to anglers in the pikeminnow database who participated in the program within the past 5 years (2019 – 2023) and to those who signed up for our mailing list at the various sportsmen's shows. The 2024 Coupon was worth a *one-time $10 bonus* when attached to a voucher for qualifying pikeminnow caught and turned in for the reward payment. A total of 406 anglers attached the *one-time $10 bonus coupon* to their reward voucher before submission for payment. The season total paid for *$10 bonus coupons* was $4,060.

Table 2. Incentives received and processed by category in 2024.

	External Tags	PIT Tags	Coupons	Total
Value	$500	$200	$10	
Submitted Incentives	6	176	406	588
Total	$3,000	$35,200	$4,060	$42,260

TOTAL ACCOUNTING

Total payments for the season of regular vouchers, *$10 bonus coupons*, tag vouchers and *tag loss bonus* payments were $1,707,452.

All IRS Form 1099-NEC Statements were sent to the qualifying anglers for tax purposes on January 21, 2025. Appropriate reports and copies were provided to the IRS on January 21, 2025.

A summary of the catch and rewards paid, including information on the "top 20" anglers, is provided in Table 1.

Table 3. 2024 Sport-Reward Payment Summary.

2024 SPORT REWARD PAYMENTS SUMMARY

The following is a summary of all vouchers received and paid as of 2024

	Fish	Incentives	Reward
Fish paid @ tier 1 ($6 each):	7,666	0	$45,996
Fish paid @ tier 2 ($8 each):	27,492	0	$219,936
Fish paid @ tier 3 ($10 each):	139,926	0	$1,399,260
Tags paid (@ $500 each):	6	0	$3,000
Coupons issued (@ $10 each):	0	406	$4,060
Tag-loss issued (@ $200 each):	0	176	$35,200
Total:	175,090		$1,707,452

Anglers @ tier 1	*231*
Anglers @ tier 2	*129*
Anglers @ tier 3	*116*
Number of separate anglers	*476*
Anglers with 10 fish or less:	*177*
Anglers with 2 fish or less:	*88*

	Total Fish	$500 Tags	Tag Loss	Coup.	Total Reward
1.	16,150	0	$ 3,200	$ 10	$ 164,260
2.	9,034	0	$ 1,400	$ 10	$ 91,300
3.	7,363	0	$ 1,000	$ 10	$ 74,190
4.	5,076	0	$ 600	$ 10	$ 50,920
5.	4,968	0	$ 400	$ 10	$ 49,640
6.	4,555	0	$ 1,200	$ 10	$ 46,310
7.	4,620	0	$ 400	$ 10	$ 46,160
8.	4,336	0	$ 1,200	$ 10	$ 44,120
9.	4,125	1	$ 1,200	$ 10	$ 42,500
10.	3,808	0	$ 1,000	$ -	$ 38,630
11.	3,766	0	$ 200	$ 10	$ 37,420
12.	3,455	0	$ 600	$ 10	$ 34,710
13.	3,347	0	$ 200	$ 10	$ 33,230
14.	3,199	0	$ 200	$ -	$ 31,740
15.	2,956	0	$ 800	$ 10	$ 29,920
16.	2,861	0	$ 1,200	$ 10	$ 29,370
17.	2,680	0	$ 600	$ 10	$ 26,960
18.	2,551	1	$ 200	$ 10	$ 25,760
19.	2,291	1	$ 1,400	$ -	$ 24,350
20.	2,407	0	$ 600	$ 10	$ 24,230
	93,548	3	$ 17,600	$ 170	$ 945,720

NORTHERN PIKEMINNOW
SPORT-REWARD FISHERY VOUCHER

2024 STANDARD

TO ENSURE PROMPT PAYMENT:
1) Verify voucher is complete.
2) Fill out, detach and keep receipt.

MAIL TO: NORTHERN PIKEMINNOW SPORT-REWARD FISHERY
PO Box 82128
Portland, OR 97282-0128

LAST NAME | FIRST NAME | MI

ADDRESS

CITY | STATE | ZIP CODE

ANGLER TELEPHONE NUMBER ___ – ___ – ____

VOUCHER #

EMAIL (OPTIONAL - By providing your email, you are agreeing to receive email communications from the Sport-Reward Program) @

MONTH | DAY | 2 0 2 4

DOCUMENT #

STATION

TOTAL # OF QUALIFYING NORTHERN PIKEMINNOW CLAIMED (EXCLUDING TAGGED FISH)

(NUMBER) X (WRITTEN TOTAL)

LAST 4 DIGITS SS#: –

I hereby swear under the penalty of perjury that the above information is true and correct and that I caught all fish claimed on this voucher in accordance with all Sport-Reward Fishery Rules and Regulations printed on the back of this voucher.

X **TECHNICIAN SIGNATURE**

X **SIGN HERE**

ANGLER SIGNATURE (Must be signed in the presence of Technician)

DATE

STATION

Fishing Date: ______

Station: ______

Voucher #: ______

Document Number: ______

Number of fish: ______

*** * * DETACH & KEEP THIS STUB FOR YOUR RECORDS * * ***

REWARD VOUCHER INFORMATION

1-800-769-9362 (Toll Free)

E-MAIL: vouchers@pikeminnow.org

*****TO OBTAIN PAYMENT, THIS VOUCHER MUST BE RECEIVED BY PSMFC NO LATER THAN 11/15/24.*****

[ANY ISSUES PREVENTING PAYMENT (missing information, voiding of vouchers for sport-reward fishery rule violations ect.) MUST BE RESOLVED PRIOR TO THIS DATE OR THE VOUCHER BECOMES NULL AND VOID]

Figure 2. 2024 Northern Pikeminnow Sport-Reward Fishery Standard Voucher.

NORTHERN PIKEMINNOW
SPORT-REWARD FISHERY VOUCHER

2024 TAG

LAST NAME | FIRST NAME | MI

ADDRESS

CITY | STATE | ZIP CODE

ANGLER TELEPHONE NUMBER

TAG VOUCHER #

MONTH | DAY | 2 0 2 4

DOCUMENT #

STATION | FISH LOC | EXTERNAL TAG # | TAG TYPE (S/F) | FORK LENGTH

PIT TAG #

LAST 4 DIGITS SS# -

X
TECHNICIAN SIGNATURE

I hereby swear under the penalty of perjury that the above information is true and correct and that I caught all fish claimed on this voucher in accordance with all Sport-Reward Fishery Rules and Regulations printed on the back of this voucher.

X
SIGN HERE

ANGLER SIGNATURE (Must be signed in the presence of Technician) | DATE | STATION

STAPLE TAG ENVELOPE HERE

X
ODFW TAG VERIFICATION SIGNATURE

TO ENSURE PROMPT PAYMENT:
1) Verify voucher is complete.
2) Fill out, detach and keep receipt.

MAIL TO:
ODFW
NORTHERN PIKEMINNOW PROGRAM
PO Box 2290
Clackamas, OR 97015

Fishing Date: ______
Station: ______
Voucher #: ______
Document Number: ______
Tag Number: ______

* * * DETACH & KEEP THIS STUB FOR YOUR RECORDS * * *
REWARD VOUCHER INFORMATION
1-800-769-9362 (Toll Free)
E-MAIL: vouchers@pikeminnow.org

*****TO OBTAIN PAYMENT, THIS VOUCHER MUST BE RECEIVED BY PSMFC NO LATER THAN 11/15/24.*****
[ANY ISSUES PREVENTING PAYMENT (missing information, voiding of vouchers for sport-reward fishery rule violations ect.) MUST BE RESOLVED PRIOR TO THIS DATE OR THE VOUCHER BECOMES NULL AND VOID]

Figure 3. 2024 Northern Pikeminnow Sport-Reward Fishery Tag Voucher.

NORTHERN PIKEMINNOW SPORT-REWARD FISHERY RULES AND REGULATIONS

Anglers participating in the Northern Pikeminnow Sport-Reward Fishery must adhere to each of the following rules:

1) Present a valid fishing license and picture identification upon request by any authorized program representative.

2) Adhere to all applicable state fishing regulations for the area in which you fish. Contact your local state fishery agency for license requirements and current fishing regulations.

3) Register in person at one of the designated registration stations each day prior to fishing. Anglers may register during times when stations are unstaffed by using the station's self-registration box. Anglers may not register at multiple stations simultaneously.

4) Provide true and accurate information to authorized program representatives regarding the taking, possession, delivery, transportation, sale, transfer or any other use of fish caught while participating in the Northern Pikeminnow Sport-Reward Fishery.

5) Comply with the directions of authorized program personnel related to the collection of sampling data and angler participation in the Northern Pikeminnow Sport-Reward Fishery.

6) Mail in all reward vouchers within 30 days of the end of each year's fishery. To obtain payment, vouchers must be received no later than Nov. 15, 2024. Any issues preventing payment (missing information, voiding of voucher for program violations, etc.) must be resolved by Nov. 15, 2024 or the voucher becomes null and void.

7) Fish must have been caught in the mainstem Columbia River from the mouth up to the restricted zone below Priest Rapids Dam, or in the Snake River from the mouth up to the restricted zone below Hells Canyon Dam. The "mainstem" includes backwaters, sloughs, and up tributaries 400 feet from the tributary mouths. "Tributary mouth" is as defined by state fishing regulations.

8) Fish must be returned to the same registration station where the angler registered. They must be returned on the same calendar day stamped on the angler's registration form before that station closes for that day, and they must have been caught subsequent to that day's registration time.

9) Fish must have a total length greater than or equal to 9 inches. Fish less than 9 inches total length are not eligible for reward payment.

10) All fish to be redeemed for reward payment must have been personally caught solely by the angler submitting them for reward payment.

11) Fish must be alive or in fresh condition. Fish that are or were frozen, or that are in otherwise poor condition, will not be accepted for payment. Technicians have the authority to determine whether Northern Pikeminnow submitted for payment meet these standards.

12) Violation of any of the above rules may result in disqualification from the Northern Pikeminnow Sport-Reward Fishery.

Figure 4. Northern Pikeminnow Sport-Reward Fisher Rules and Regulations.

Report C

System-wide Predator Control Program: Fisheries and Biological Evaluation

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ABSTRACT

Since 1990, the Northern Pikeminnow Management Program (NPMP) has applied targeted fisheries in the Columbia and Snake rivers to restructure populations of Northern Pikeminnow (*Ptychocheilus oregonensis*) in an effort to suppress predation on out-migrating juvenile Pacific salmon and steelhead (*Oncorhynchus* spp.). During 2024, the Oregon Department of Fish and Wildlife (ODFW) evaluated the continued efficacy of the Northern Pikeminnow removal program and assessed potential outcomes of the fisheries through a combination of field activities, laboratory work, and data analyses. This report augments historical information with current data and seeks to: 1) estimate rates of targeted fisheries exploitation of Northern Pikeminnow and the concomitant reduction in juvenile salmonid predation by Northern Pikeminnow; 2) characterize population parameters of Northern Pikeminnow, Smallmouth Bass *(Micropterus dolomieu*), and Walleye (*Sander vitreus*) in the area below Bonneville Dam and the Bonneville Reservoir and 3) assess evidence of possible intra- and inter-specific compensatory responses by Northern Pikeminnow, Smallmouth Bass, and Walleye related to the sustained removal of Northern Pikeminnow from the lower Columbia and Snake rivers. To quantify exploitation during 2024, a Brownie bird band mark/recovery model was used in tandem with ODFW marking and Washington Department of Fish and Wildlife (WDFW) Sport Reward Fishery (SRF) recovery data, to calculate exploitation rates for Northern Pikeminnow in the area covered by program implementation. Analyses of recaptures indicated that system-wide exploitation of Northern Pikeminnow greater than or equal to 250 mm FL during 2024 was 11.6% (lower - upper confidence limit, 9.0 – 14.7%). Based on this level of exploitation, modeled results predict that predation by Northern Pikeminnow in 2025 will be reduced by 28% (range: 10–42%), relative to pre-program levels. These metrics suggest that NPMP continues to be successful to reduce predation on juvenile salmonids by Northern Pikeminnow. Fisheries independent biological evaluation was conducted during spring in the area below Bonneville Dam and Bonneville Reservoir to generate additional information about trends in the indices of abundance, consumption, and predation for Northern Pikeminnow and Smallmouth Bass. An index of abundance was also estimated for Walleye. These indices showed variable patterns during the 34-year time series of the data with some decreasing trends for Northern Pikeminnow and increasing trends for Smallmouth Bass and Walleye in several areas. NPMP continued to effectively restructure the Northern Pikeminnow population to reduce predation on out-migrating salmonids by more than 25%. Fisheries independent data provided a means to assess long-term trends in population structure and potential compensatory responses among Northern Pikeminnow, Smallmouth Bass, and Walleye. This information provides the region with an important piscine predation reduction tool as well as fisheries management relevant information about three piscine predators to out-migrating juvenile salmonids.

INTRODUCTION

The Columbia and Snake rivers historically supported large numbers of naturally produced anadromous Pacific salmon (*Oncorhynchus* spp.). Declines in adult returns have been attributed to multiple factors, including habitat degradation and overexploitation (Nehlsen et al. 1991; Wismar et al. 1994), and hydroelectric and flood control activities (Raymond 1988). Predation on out-migrating juveniles was also identified as a significant factor in adult salmon returns (Rieman et al. 1991; Collis et al. 2002). Escalating concern in the 1980s surrounding the impacts of predation on juvenile salmon and steelhead (salmonids) prompted researchers to further examine the degree to which predation, especially by resident fishes, may constrain juvenile salmonid survival in the Columbia River Basin. The John Day Reservoir in the Columbia River was selected as a "model" system to investigate predator impacts on juvenile salmonids given that: (1) the upper reaches of the reservoir were known to be an important area for rearing of subyearling Chinook Salmon (*Oncorhynchus tshawytscha*); (2) passage and residualism of juvenile salmonids was considered an issue in the reservoir; and (3) the John Day Reservoir supported substantial populations of resident predatory fishes (Poe and Rieman 1988). Based on existing information (e.g., Hjort et al. 1981), four species; Smallmouth Bass (*Micropterus dolomieu*), Walleye (*Sander vitreus*), Channel Catfish (*Ictalurus punctatus*), and Northern Pikeminnow *(Ptychocheilus oregonensis*) were identified as potentially important sources of juvenile salmonid mortality. Ultimately, research in the John Day Reservoir provided evidence that the native Northern Pikeminnow was the most abundant and dominant predator on juvenile salmonids, accounting for the majority of predation-related mortality observed during the study period (Beamesderfer and Rieman 1991; Poe et al. 1991; Rieman et al. 1991; Vigg et al. 1991). While data indicated predation by Northern Pikeminnow contributed appreciably to juvenile salmonid mortality in the John Day Reservoir, questions remained surrounding impacts of Northern Pikeminnow predation in other areas of the lower Columbia and Snake rivers. To answer these questions, indices were developed to allow rapid assessment of predation by Northern Pikeminnow throughout the system. From 1991 through 1993, researchers applied these indices to data collected in the lower Columbia River reservoirs (1990 and 1993), the Columbia River downstream of Bonneville Dam (1991), and lower Snake River reservoirs (1992) to characterize abundance, consumption, and predation (Ward et al. 1995). Results from these evaluations showed temporally variable predation by Northern Pikeminnow on juvenile salmonids was problematic in areas throughout the lower Columbia and Snake River reservoirs. Management strategies aimed at decreasing predation on juvenile salmonids were examined, according to the premise that persistent exploitation of Northern Pikeminnow (i.e., 10–20% per year) could lead to a disproportionate reduction in predation (i.e., up to 50%; Rieman and Beamesderfer 1990). Ultimately, assessments of various management strategies identified targeted removal fisheries as a favorable option to address the issue of predation on juvenile salmonids and provided the foundation for the contemporary NPMP.

From its inception, NPMP has operated based on two underlying objectives: (1) implementation of the predator control program (see reports A, B, and D) and (2) evaluation of the predator control strategy. The Oregon Department of Fish and Wildlife (ODFW) is responsible for

Objective 2 through standardized monitoring techniques in the Columbia and Snake rivers. This sampling has been ongoing at monitoring locations since the early 1990s. The data collected through these monitoring efforts have been used to evaluate the efficacy of targeted removals to reduce predation and assess possible compensatory consequences (e.g., intra- and inter-specific responses to management actions) that may be related to sustained removals of Northern Pikeminnow. Additionally, ODFW in collaboration with WDFW and the Pacific States Marine Fisheries Commission (PSMFC) has monitored the population of the native predator, Northern Pikeminnow, for signs of significant population declines related to the predation control program. There are two current Northern Pikeminnow predator removal strategies being incorporated by NPMP, both managed by WDFW. The first involves a reward based recreational angler fishery, known as the Sport Reward Fishery (SRF). The second involves WDFW staff directly removing Northern Pikeminnow from areas with high concentrations of these predators below the powerhouse turbine outflows in the tailrace of The Dalles Dam and the John Day Dam, known as the Dam Angling Fishery (DAF). More details on SRF and DAF removal fisheries can be found in reports A and D, respectively.

ODFW evaluates the efficacy of the predator removal efforts and fish population parameters through a combination of field and laboratory studies incorporating data obtained throughout the Columbia and Snake rivers in the states of Oregon, Washington, and Idaho (Fig. 1). Broadly, ODFW estimates Northern Pikeminnow exploitation from SRF and DAF, salmonid predation reduction, and curation of long-term data to assess piscine predator population trends. ODFW relies on data collected through independent activities within the agency as well as biological samples acquired through SRF and DAF. ODFW field activities span two field studies. The first field study was designed to mark Northern Pikeminnow to incentivize the SRF and inform a mark/recovery-based estimate of exploitation from SRF and DAF (fisheries evaluation). The second field study was designed to obtain fisheries independent assessments of abundance and provide predator digestive material used to estimate prey consumption for Northern Pikeminnow, Smallmouth Bass, and Walleye (biological monitoring). Laboratory techniques were applied to quantify gut contents used to inform indices of consumption and predation as well as to address the question of predator compensation due to continued exploitation of Northern Pikeminnow. ODFW biological monitoring efforts deviated from the historical pattern during the 2024 season. Historically, the monitoring area has been divided into sub-units (below Bonneville Dam/Bonneville Reservoir, The Dalles Reservoir/John Day Reservoir, and the Snake River reservoirs from Ice Harbor to above Lower Granite Dam). Since 2005, ODFW has collected biological monitoring data from one river sub-unit on a three-year rotating cycle. In 2024 we implemented biological monitoring in one sub-unit; the area below Bonneville Dam/Bonneville Reservoir sub-unit. This was done to opportunistically expand the sampling frequency in the area below Bonneville Dam and Bonneville Reservoir allowing for further assessment of Northwest Power and Conservation Council Independent Scientific Review Panel (ISRP) recommendation regarding the metrics used to monitor Northern Pikeminnow, Smallmouth Bass, and Walleye. This report augments historical information with data collected in 2024 from areas of the Columbia and Snake rivers and evaluates spatiotemporal changes of fish population parameters and their relation to reductions in juvenile salmonid predation from SRF and DAF activities where possible. Specific goals for this reporting period were to:

(1) Estimate rates of exploitation of Northern Pikeminnow and quantify potential predation reduction resulting from the targeted removal fisheries.

(2) Characterize population parameters of Northern Pikeminnow, Smallmouth Bass, and Walleye in the area below Bonneville Dam and Bonneville Reservoir.
(3) Assess evidence of possible intra- and inter-specific compensatory responses by Northern Pikeminnow, Smallmouth Bass, and Walleye related to the sustained removal of Northern Pikeminnow from the Columbia and lower Snake rivers.
(4) Assess ISRP recommendations to improve biological monitoring and evaluation related to NPMP.

METHODS

Sport Reward Fishery Evaluation and Predation Reduction Estimates

Field Procedures

Boat electrofishing was historically used to annually tag (mark) Northern Pikeminnow in the Columbia River from river kilometer (rkm) 76 (near Clatskanie, Oregon) upstream to rkm 637 (Priest Rapids Dam), and in the Snake River from Little Goose Dam to rkm 251 (near Asotin, WA) upstream of Lower Granite Dam (Fig. 1). Due to changes in resource availability and requests to reduce electrofishing effort, marking efforts were restricted to the area below Bonneville Dam and the Bonneville Reservoir during the 2024 field season. Additionally, a strategic marking approach was implemented in 2024 which represents a change from the historic approach to electrofish every river mile in our marking areas. The strategic effort was implemented to utilize locational data and previous years' mark totals to target specific areas where there has been greater catch of Northern Pikeminnow to balance maximum deployment of marks with a focused electrofishing effort.

ODFW researchers conducted marking efforts using Smith-Root™ 18-EH model electrofishing boats equipped with a 5.0 or 7.5 generator powered pulsator electrofisher powered by a Kohler Power Systems™ gas generator or Smith-Root electrofishing boat equipped with an Apex™ electrofisher powered by an air-cooled Honda generator. When engaged, the electrofishing unit applies pulsed direct current at a rate of 60 pulses/s to maximize capture efficiency with minimal injury to fishes. Two boom arms extend forward from the bow of each boat, each supporting an array of six electrodes that functions as an anode. Electrodes hanging from the boat and the hull itself, function as the cathodes. Electrofishing controls were set according to federal guidelines for waters containing ESA listed salmonids where peak output does not exceed 800 V at water conductivity 100 to 300 µS/cm (NMFS 2000). The targeted average electrical current during all electrofishing events was 3–4 A. All controls were standardized across boats with minor adjustments to the duty cycle and/or voltage to achieve the targeted output. Electrofishing protocols were followed to minimize fish exposure to electric current yet induce uncontrolled swimming toward the anode (electrotaxis) and avoid intense muscle contraction to the point of becoming stiff (tetany). Additionally, protocols were developed and implemented to reduce interactions with species listed under the U.S. Endangered Species Act to guide sampling efforts. These protocols included, but were not limited to, discontinuing electric current when encountering listed species, or terminating sampling transects when encountering 500 or more out-migrating juvenile salmonids or 50 adult salmonids. Sampling occurred along shallow shoreline areas as the effective range of boat electrofishing was limited to an approximate maximum depth of 3 m. The timing of sampling generally ranged from early April to mid-June between 1800 and 0500 hours. When weather or other reasons required, sampling was strategically adjusted to eliminate sampling areas with historically low rates of mark deployment. Ideally, all tagging activities would have concluded before SRF and DAF began. However, that was unachievable due to time constraints and the extent of the sampling area below Bonneville Dam. All fish marked in the Bonneville Reservoir were tagged prior to the start of the fisheries (1 May 2024). Northern Pikeminnow ≥ 200 mm fork length (FL) were marked with an internal 134.2 MHz passive integrated transponder (PIT) tag injected into the dorsal sinus cavity (Fig. 2). In 2022, ODFW initiated a PIT tag only marking strategy in which Northern Pikeminnow were not marked externally. This strategy was deployed in an effort to increase survival of marked fish and increase our recapture rate through increased tag retention and fish survival. During Northern Pikeminnow marking operations, Walleye were also captured, measured, and weighed. Working with WDFW, mark recovery information was obtained from the SRF and DAF (Report D). SRF occurred daily from 1 May to 25 September 2024 (Report A). Participating anglers received payment for all harvested Northern Pikeminnow ≥230 mm (9 in) total length (TL). This size criterion for TL corresponds to the minimum FL (200 mm) of Northern Pikeminnow marked during tagging operations. The 2024 reward payment schedule consisted of three tiers (see Report B for details). Further, anglers were eligible for a $500 reward for each externally tagged fish returned to a check station and a $200 reward for each "tag-loss" fish (i.e., 2024 PIT tag only fish or fish tagged prior to 2024 for which an external tag had been lost in the environment but retained a functioning PIT tag). It was assumed 100% of the Northern Pikeminnow marked with an external and/or an internal PIT tag harvested by participating anglers were submitted to a check station for reward payment during the season.

DAF operated from 30 April to 26 September 2024 (Report D) in the powerhouse tailraces of The Dalles and John Day dams and used a team of anglers with hook-and-line fishing gear to remove Northern Pikeminnow. WDFW personnel examined all fish for the presence of external tags (loop and T-bar) and PIT tags. Tagged Northern Pikeminnow removed in the DAF were accounted for when estimating exploitation rates for the SRF.

Data Analysis

Sport Reward Fishery Exploitation

A multi-year mark-recovery model was assessed that incorporated a Brownie bird band framework (Brownie, 1978). This allowed exploitation to be estimated for 2024 using tags deployed in previous years. This mark-recovery model was new to the program starting in 2023. Recovery data were reported through fish returned by anglers to NPMP creel stations operated by WDFW. Marking efforts were changed to a strategic sampling plan in 2024 due to limited resources. Exploitation was estimated using a Brownie bird band model structure in the program Mark (White and Burnham, 1999) within the package RMark (Laake, 2013) via the R statistical analysis framework (R Core Team, 2021). The Brownie bird band model produces the probability of survival between marking periods (years) and the probability of recovery (exploitation) using mark-recovery data where marks were deployed through electrofishing activities (ODFW) and recoveries were obtained through creel stations with SRF (WDFW).

Because NPMP had numerous years of mark-recovery data, a model was fit using variable survival and recovery, year to year. The proportion of the Northern Pikeminnow population removed during program fisheries was quantified using mark-recovery data for the entire area covered by SRF (system-wide). To account for a reduction in the minimum length of Northern Pikeminnow eligible for sport-reward payment from 11 inches TL (≥ 278 mm TL; ≥ 250 mm FL) to 9 inches TL (≥ 230 mm TL; ≥ 200 mm FL) beginning in the year 2000, rates of exploitation were calculated for two size-classes: 1) ≥□200 mm FL (all marked fish); and 2) ≥ 250 mm FL. The subset of fish ≥ 250 mm FL was used for long-term temporal comparisons.

Predation Reduction

Indirect measures of predation reduction were used to evaluate the efficacy of Northern Pikeminnow removals (Beamesderfer et al. 1996), due to numerous confounding factors that limit the ability to measure success in terms of increased number of juvenile salmonids reaching the estuary or returning as adults. A model based on Friesen and Ward (1999) was implemented to estimate changes in predation on juvenile salmon that have occurred since before the onset of the program. The model was designed to estimate the effects of the NPMP on predation of juvenile salmonids if all other factors were held constant (e.g., river and ocean conditions, number of migrating juvenile salmonids, passage conditions/mortality at dams). The model also assumed no compensation by non-native predators and remaining Northern Pikeminnow. That assumption was assessed through the biological evaluation. The model estimated potential predation reduction from pre-program levels by incorporating: (1) Northern Pikeminnow population size structure before removals by fisheries, (2) area- and size-specific annual exploitation rates, (3) an estimate of natural mortality and recruitment, (4) area- and size-specific abundance estimates, and (5) area- and size-specific estimates of seasonal consumption of juvenile salmon by Northern Pikeminnow (Friesen and Ward 1999). The details for these components were:

1. Northern Pikeminnow population size (length) structure before SRF and DAF removals were simulated using length-frequency distributions in each reservoir (Parker et al. 1995; Knutsen and Ward 1999).

2. Historically, area specific exploitation rates were calculated using within year estimates based on Lincoln-Peterson derived mark/recovery models for the area below Bonneville Reservoir, the pooled Columbia River reservoirs and the pooled Snake River reservoirs. In 2024, as previously mentioned, one system-wide exploitation rate was calculated using a Brownie bird band model structure. The 2024 Predation Reduction model assumes this system-wide exploitation rate is representative of these three individual areas. Relationships between exploitation and length of Northern Pikeminnow were used to estimate age-specific exploitation rates (Friesen and Ward 1999). Age increments were changed to 15 mm FL increments based on measured annual growth from mark recapture information (Weaver et. al 2008).

3. A linear regression on a growth curve, constructed from adjusted age frequencies (Ricker 1975), was used to estimate natural mortality (0.611 for area below Bonneville Reservoir, 0.62 for impounded Columbia and Snake River reservoirs) and mean index of recruitment to age five or 240 mm FL (Friesen and Ward 1999).

4. Area specific size structure was adjusted over time for exploitation and natural mortality using equation 1:

$$A_{h+j} = A_{h-1,j-1}\left(1 - E_{(h-1,j-1)}(1-M)\right), \quad (1)$$

where

A_{h+j} = abundance index for size-h fish in year j,

$A_{h-1,j-1}$ = abundance index of fish size h -1 in year j –1,

$E_{h-1,j-1}$ = exploitation rate of fish size h –1 in year j –1, and

M = annual natural mortality rate.

5. Consumption information from 1990 to 1996 was collected and the consumption index as calculated below in equation (2) was converted to consumption rates:

$$C = -0.077 + 0.618(CI) \quad (2)$$

where

C = number of juvenile salmonids per Northern Pikeminnow per day

CI = consumption index

Separate size and area specific consumption rates were calculated for the area below Bonneville Dam and Bonneville reservoir.

Using these five model components, consumption rates for each size class were multiplied by the abundance index and the number of days in each season (Spring 91, Summer 62) to get a loss index by season and area. Summing loss by season and area estimated the total loss for the year for all areas contained within the NPMP. Relative predation was calculated by subtracting the overall loss index in the current year and divide it by the 1990 overall loss index and multiply by 100.

PSD, DAF

Rates of exploitation of Northern Pikeminnow increase with increasing fish size (Zimmerman et al. 1995). A model describing proportional size distribution (PSD; Anderson 1980; Guy et al. 2007) was fit to characterize variation in size structure for Northern Pikeminnow to three groups; those sampled during fishery evaluation (not calculated for 2024), biological evaluation, and from DAF. Models describing PSD for Walleye and Smallmouth Bass populations sampled during biological evaluation; were applied using the equation 3:

$$PSD_i = 100 \times \frac{FQ_i}{FS_i}, \qquad (3)$$

where

FQ_i = number of fish ≥ quality-length for species *i*, and

FS_i = number of fish ≥ stock-length for species *i*.

Proportional Size Distribution, preferred length (PSD-P), Fishery Evaluation and DAF

Proportional size distribution of preferred-length fish (PSD-P) was calculated for Smallmouth Bass and Walleye (Gabelhouse 1984; Guy et al. 2007) sampled during DAF and biological evaluation using equation 4:

$$PSD - P_i = 100 \times \frac{FP_i}{FS_i}, \qquad (4)$$

where

FP_i = number of fish ≥ preferred-length for species *I*, and

FS_i = number of fish ≥ stock-length for species *i*.

Stock and quality minimum length categories used for Northern Pikeminnow were 250 and 380 mm FL, respectively (Beamesderfer and Rieman 1988; Parker et al. 1995). Stock, quality, and preferred minimum length categories were collected from the literature (Anderson 1980; Gabelhouse 1984) and converted them to FL measurements using a species-specific model for Smallmouth Bass ($FL_{SMB} = TL_{SMB} /1.040$). The published stock-length measurement is smaller than our target size (200 mm FL) for Smallmouth Bass. To remove any bias in our data from variation in sampling procedures among years, our target size was used as the minimum stock-length for PSD and PSD – P analyses. Thus, stock, quality, and preferred minimum FL categories for Smallmouth Bass were 200, 269, and 337 mm, respectively. Similarly, using published categories (Anderson 1980; Gabelhouse 1984) and the species-specific model for Walleye ($FL_{WAL}= TL_{WAL}/1.060$), these categories were calculated as 236, 358, 481 mm FL, respectively. Annual PSD and PSD – P values were calculated only when sample sizes exceeded 19 stock-length fish in an area. To characterize uncertainty surrounding PSD and PSD – P values, a non-parametric bootstrap approach using the 'boot' package (Fox and Weisberg 2011) in the R programming environment (R Core Team 2021) was used to calculate 95% confidence intervals. Temporal monotonic trends were calculated for PSD of Northern Pikeminnow and PSD and PSD-P of Walleye by applying a non-parametric Mann-Kendall test (Mann 1945). All analyses were conducted in the R programming environment using the 'Kendall' (McLeod 2011) and, where necessary, the 'boot' or 'tsboot' (Fox and Weisberg 2011) packages. Significant differences were assessed at $\alpha \leq 0.05$.

Relative Weight (W_r), DAF

Relative weight (W_r) (Wege and Anderson 1978) was calculated to compare the condition of Northern Pikeminnow over time. Length-specific standard weights predicted by a length-mass regression model ($\log_{10}[W_s]=a'+b\cdot\log_{10}[L]$) were used for Northern Pikeminnow (Parker et al. 1995) to calculate W_r according to equation 5:

$$W_r = 100 \times \frac{W}{W_s}, \quad (5)$$

where

W = the mass of an individual fish, and
W_s = predicted standard weight.

To account for sexual dimorphism, male and female W_r values were calculated separately for Northern Pikeminnow. Additionally, these analyses only included fish that met minimum target sizes, 250 mm FL for Northern Pikeminnow. Annual median W_r values were calculated only when sample sizes exceeded four target sized fish in a given reservoir and by sex for Northern Pikeminnow. 95% confidence intervals were estimated for median W_r values using a non-parametric bootstrap approach (Fox and Weisberg 2011; R Core Team 2021).

Temporal monotonic trends in median W_r were assessed for Northern Pikeminnow by applying a non-parametric Mann-Kendall test (Mann 1945). Spline interpolation was used to account for data gaps, when present. Last, to help visualize trends, locally weighted scatterplot smoothing

(LOWESS) curves were fit to the data. All analyses were conducted in the R programming environment using the 'Kendall' (McLeod 2011) and, where necessary, the 'boot' or 'tsboot' (Fox and Weisberg 2011) packages. Significant differences were assessed at $\alpha \leq 0.05$.

DAF Consumption Index (DAF-CI)

Consumption indices provide a proxy of the number of juvenile salmon eaten per day by an average predator. Previous work has demonstrated that the output values are correlated with consumption rates for Northern Pikeminnow (Ward et al. 1995). An index of consumption for DAF fish (DAF-CI) was calculated for each week using the model of Ward et al. (1995) for Northern Pikeminnow (CI_{NPM}) using the equation 6:

$$\boldsymbol{CI_{\mathrm{NPM}} = 0.0209 \times T^{1.60} \times W^{0.27} \times (S \times GW^{-0.61})}, \qquad \mathbf{(6)}$$

where

T = mean water temperature per week stratum (°C),

W = mean predator mass (g),

S = mean number of juvenile salmon per predator, and

GW = mean diet mass (g) per predator.

Water temperature data were downloaded from the Columbia River Operational Hydrometeorological Management System. CI-DAF was calculated when sample sizes exceeded five fish, per week, per dam.

Biological Monitoring

Field Procedures

Standardized boat electrofishing techniques were used to evaluate Northern Pikeminnow, Smallmouth Bass, and Walleye population parameters in the area below Bonneville Dam and Bonneville Reservoir during 2024 (Ward et al. 1995; Zimmerman and Ward 1999). Sampling was conducted in the early morning (0200–1000 hours) during Spring (May 6th-May 24th, 2024) in the forebay, mid-reservoir, and tailrace of the area below Bonneville Dam and Bonneville Reservoir. Sampling areas in Bonneville Reservoir included the shoreline areas around Cascade Locks, Oregon (rkm 146-150), Hood River, Oregon (rkm 174-177) and The Dalles, Oregon (rkm 188-191) and the adjacent side on the Washington shoreline. Sampling areas below Bonneville Dam included the tailrace area below the dam, and three separate areas near Troutdale, OR (rkm 188–194), Portland, OR (rkm 173–181) and Kalama, WA (rkm 116–121). The objective was to analyze predatory fish diets, focusing on salmonid consumption. The timing of this work was selected to correspond with peak smolt outmigration. Sampling locations were randomly selected fixed-site transects, approximately 500-m long, in each area along all shorelines of the river. Effort at each transect consisted of a 900-second boat electrofishing period with continuous output of approximately 3-4 A. Temperature (nearest 0.1°C) and minimum/maximum observed depth were recorded for each transect (nearest 0.1').

Species, FL (nearest mm), and mass (nearest 10 g) were recorded for all Northern Pikeminnow, Smallmouth Bass, and Walleye ≥200 mm. Target-sized Northern Pikeminnow that were not previously marked were euthanized and the digestive tract was extracted for digestive tract content analysis in the laboratory. To remove NPM digestive tracts, an incision was made along the ventral midline from the pectoral fins to the vent. The digestive tract was removed by securing both ends with hemostats, removing extra tissue, and placing the complete digestive tract into individual Whirl-Pak bags. Digestive tracts were squeezed with forceps from one end to the other to extract the contents and water was added to reduce post-collection digestion. Sex and stage of maturity were assessed by examining the gonads and scoring maturity from 0-4 with '0' representing a juvenile fish and '4' representing a mature fish that had recently spawned (spawned-out). Diet samples were collected from target-sized Smallmouth Bass and Walleye by a non-lethal gastric lavage method using a modified Seaburg sampler (Seaburg 1957). Gut contents were flushed from the foregut of each fish into a 425 μm sieve and then transferred into individual sample bags. For all species, diet samples were stored on ice while in the field and transferred to a freezer until processing.

Using the protocol described above, diet samples were also collected from Northern Pikeminnow, Smallmouth Bass, and Walleye captured during the 2024 DAF in Bonneville and The Dalles reservoirs. Smallmouth Bass and Walleye were sampled to assess the feasibility of obtaining digestive content samples for these species through DAF in order to compare the temporal variability from diets among all three species during the DAF season. Diets were collected from a representative subsample of catches at each dam weekly from 30 April – 26 September, 2024, generally two days per week, with a target of 20 fish per day at each dam. In addition, FL, mass, sex, and stage of maturity were recorded for each fish sampled, where possible.

Laboratory Procedures

Contents of diets from Northern Pikeminnow, Smallmouth Bass, and Walleye collected during biological evaluation field activities, and Northern Pikeminnow collected from the DAF were examined to quantify relative consumption of juvenile salmonids. All diet samples in 2024 were scanned for the presence of Coded Wire Tags (CWT). Positive CWT detections were analyzed as per methodology described in Appendix C of this report and excluded from consumption calculations. When Smallmouth Bass subsampling occurred with samples collected during the biological evaluation process, CWT positive diet samples were replaced with diets from a Smallmouth Bass from the same area and size class. All Northern Pikeminnow and Walleye digestive contents collected in the field, excluding positive CWT detections, during 2024 were processed in the laboratory as described below.

Frozen field samples were thawed in the laboratory and the diet contents were sorted into general prey categories (i.e., fish, crayfish, other crustaceans, insects, other invertebrates, vegetation, miscellaneous). Parasitic invertebrates (e.g., tapeworms, nematodes, parasitic copepods) found in the diet samples were noted in our dataset comments, but they were not weighed, categorized as prey items, or included in the prey consumption calculations. Diet items were blotted with a paper towel to remove excess moisture and weighed to the nearest 0.01 g according to prey category. For Smallmouth Bass and Walleye, portions of diet samples containing fish were returned to the original sample bags for chemical digestion. To ensure complete recovery of diagnostic structures from Northern Pikeminnow diet samples, the entire digestive tract was chemically digested along with possible fish tissue. To chemically digest soft tissues, a 20 ml of solution of pancreatin (20 g/L) and sodium sulfide nonahydrate (Na_2O_9S; 10 g/L) in tap water was added to each sample. Next, sample bags were placed in a desiccating oven at approximately 48°C for 24 h. After removal from the oven, a 20 ml solution of sodium hydroxide (lye, NaOH) mixed at 30g/L with tap water was added to dissolve remaining fatty materials and the sample was agitated. Contents of each sample bag were then poured into a 425 µm sieve and rinsed with tap water. In rare cases, the presence of fish was recorded during the initial sorting and weighing but no bones were found after chemical digestion. When this occurred, those bones were assumed lost, and therefore one unidentified fish was counted present in the sample (unless the taxon was identified during the preprocessing stage). Diet samples of fishes that did not contain any diet items (empty) were included in all statistical analyses.

Bones from prey items, post chemical digestion, were identified to the lowest possible taxon (typically family) using stereoscopic dissecting microscopes at 6.1x-55x magnification with 10x eyepieces and standard keys (Hansel et al. 1988, Frost 2000, and Parrish et al. 2006). Paired structures were enumerated to arrive at minimum counts of a given prey taxon in a diet sample, but only presence/absence could be determined for certain prey items. For example, if ventral scutes of American Shad (*Alosa sapidissima*) were the only diet item present in a sample, it was assumed that one American Shad had been consumed because the total number of scutes associated with an individual fish is ambiguous. A similar assumption was made for instances where lamina of lampreys (family Petromyzontidae) were present in diet samples. Diet samples containing large numbers of juvenile shad bones were sampled to estimate the total number of shad using a subset of the diagnostic bones. The dentaries and parasphenoid bones were used as rapid identification diagnostic bones, allowing staff to process these samples in a fraction of the time needed for full diagnostic bone enumeration. Shad quantified in this way were identified in our database and the complete sample of bones was stored for future enumeration, should the need arise.

For samples where fish vertebrae were observed, it was possible to distinguish between salmonid and other fish prey; however, it was impossible to determine the exact number of juvenile salmon consumed. In these cases, it was assumed that one juvenile salmon was consumed to avoid artificially inflating the count. Given these constraints, diet data represent a conservative enumeration of prey fish within diet samples. Lastly, to calibrate identification accuracy among analysts, 10% of all samples were re-analyzed at random by a second reviewer.

Data Analysis

Biological Monitoring Abundance Index (AI)

Catch per unit effort (CPUE) was found to be the strongest index of abundance to correlate with mark recapture population estimates (Ward et al, 1995). Following the methods of Ward et al. (1995), seasonal abundance index values were calculated for each predator species using the mean CPUE of boat electrofishing by season and area, the surface area (ha) of the specific sampling locations in each river area, divided by 1,000 for scale using the equation 7:

$$AI_i = \frac{(D_i \times S_i)}{1{,}000}, \qquad (7)$$

where:

AI_i = abundance index for area *i*

D_i = density in area *i* as determined by mean CPUE and

S_i = surface size (hectares of area *i*)

Biological Monitoring Consumption Index (CI)

Consumption indices provide a proxy of the number of juvenile salmon eaten per day by an average predator and previous work has demonstrated that the output values are correlated with consumption rates for Northern Pikeminnow (Ward et al. 1995) and Smallmouth Bass (Ward and Zimmerman 1999). An index of consumption (CI) was calculated using the models of Ward et al. (1995) and Ward and Zimmerman (1999) for Northern Pikeminnow (CI_{NPM}) and Smallmouth Bass (CI_{SMB}) using the equations 6 and 8:

$$CI_{\mathrm{SMB}} = 0.0407 \times e^{(0.15)(T)} \times W^{0.23} \times (S \times GW^{-0.29}), \qquad (8)$$

where

T = mean water temperature per season-area stratum (ºC),
W = mean predator mass (g),
S = mean number of juvenile salmon per predator, and
GW = mean diet mass (g) per predator.

Water temperature data were either collected in the field (boat electrofishing) or downloaded from the Columbia River Operational Hydrometeorological Management System (DAF collected fish). CI was calculated when sample sizes exceeded five fish for a given species, season, and sampling area.

Biological Monitoring Predation Index (PI)

To quantify compensatory responses to removals, a predation index (PI) was developed to describe changes in the relative magnitude of predation on juvenile salmonids by Northern Pikeminnow (Ward et al, 1995) and Smallmouth Bass (Ward and Zimmerman, 1999). Currently, no comparable model exists to evaluate Walleye consumption and predation. Seasonal-and location-specific PI estimates were generated for Northern Pikeminnow and Smallmouth Bass using the product of seasonal AI and CI values (Ward et al. 1995) using equation 9:

$$PI_i = AI_i \times CI_i, \tag{9}$$

where

PI_i = predation index for area *i*.

AI_i= abundance index in area *i,*

CI_i= consumption index in area *i.*

Proportional Size Distribution (PSD)

PSD was calculated for Northern Pikeminnow, Smallmouth Bass, and Walleye caught during biological evaluation using equation 3.

Proportional Size Distribution, preferred length (PSD-P)

PSD-P was calculated for Smallmouth Bass and Walleye (Gabelhouse 1984; Guy et al. 2007) sampled during biological evaluation using equation 4.

Stock and quality minimum length categories used for Northern Pikeminnow were 250- and 380-mm FL, respectively (Beamesderfer and Rieman 1988; Parker et al. 1995). Stock, quality, and preferred minimum length categories were collected from the literature (Anderson 1980; Gabelhouse 1984) and converted them to FL measurements using a species-specific model for Smallmouth Bass ($FL_{SMB} = TL_{SMB} /1.040$). The published stock-length measurement was smaller than the target size (200 mm FL) for Smallmouth Bass from this study and to remove any bias in these data from variation in sampling procedures among years, the target size was used as the minimum stock-length for PSD and PSD – P analyses. Thus, stock, quality, and preferred minimum FL categories for Smallmouth Bass were 200, 269, and 337 mm, respectively. Similarly, using published categories (Anderson 1980; Gabelhouse 1984) and the species-specific model for Walleye ($FL_{WAL}= TL_{WAL}/1.060$), these categories were calculated as 236, 358, 481 mm FL, respectively. Annual PSD and PSD – P values were calculated only when sample sizes exceeded 19 stock-length fish in an area. To characterize uncertainty surrounding PSD and PSD – P values, a non-parametric bootstrap approach using the ‘boot’ package (Fox and

Weisberg 2011) in the R programming environment (R Core Team 2021, Canty et al. 2021) was used to calculate 95% confidence intervals.

Relative Weight (W_r)

Relative weight (W_r; Wege and Anderson 1978) was calculated to compare the condition (within species) of Northern Pikeminnow, Smallmouth Bass, and Walleye over time. Length-specific standard weights predicted by a length-mass regression model ($\log_{10}[W_s]=a'+b\cdot\log_{10}[L]$) were used for Northern Pikeminnow (Parker et al. 1995), Smallmouth Bass (Kolander et al. 1993), and Walleye (Murphy et al. 1990) to calculate W_r according to equation (5).

To account for sexual dimorphism, male and female W_r values were calculated separately for Northern Pikeminnow. However, field sampling methodologies precluded diagnosis of sex for Smallmouth Bass and Walleye as they were not sacrificed. Therefore, calculations of W_r for Smallmouth Bass and Walleye were, for both sexes, combined. Additionally, these analyses only included fishes that met minimum target sizes (250 mm FL for Northern Pikeminnow and 200 mm FL for Smallmouth Bass and Walleye). Annual median W_r values were calculated only when sample sizes exceeded four target sized fish in a given reservoir and by sex for Northern Pikeminnow. 95% confidence intervals were estimated for median W_r values using a non-parametric bootstrap approach (Fox and Weisberg 2011; R Core Team 2021).

Temporal monotonic trends in PSD were assessed for Northern Pikeminnow and Walleye and median W_r for Northern Pikeminnow, Smallmouth Bass, and Walleye by applying a non-parametric Mann-Kendall test (Mann 1945). Similarly, PSD – P was also analyzed with this method for Walleye. Spline interpolation was used to account for data gaps, when present. Due to a large gap in length data for Northern Pikeminnow in the DAF (1997–2005 in Bonneville Reservoir and 1996–2006 in The Dalles Reservoir), data for this large data gap were not interpolated. Instead, the two periods were treated as separate time series; data collected before 1997 as "early" and data collected after 2005 as "late". Data that were normally distributed were tested for differences in mean PSD between early and late periods for each DAF location using ANOVA. A non-parametric Mann-Whitney U test was used to compare PSD values between early and late years for each reservoir when PSD data were not normally distributed. Last, to help visualize trends, locally weighted scatterplot smoothing (LOWESS) curves were fit to the data. All analyses were conducted in the R programming environment using the 'Kendall' (McLeod 2011) and, where necessary, the 'boot' or 'tsboot' (Fox and Weisberg 2011) packages. Significant differences were assessed at $\alpha \leq 0.05$.

RESULTS

Sport Reward Fishery Evaluation and Predation Reduction Estimates

A total of 829 Northern Pikeminnow ≥ 200 mm FL were marked below Bonneville Dam or in Bonneville Reservoir during 2024, of which 496 were ≥ 250 mm FL (Table 1). Overall, 116 of the fish marked in 2024 were recovered from SRF and none from DAF. One fish tagged in Bonneville Reservoir was recaptured below Bonneville Dam. All fish recaptured in 2024 in the SRF were at large from 6 to 2604 days. The oldest recapture was a Northern Pikeminnow that was initially tagged in April of 2017. Three Northern Pikeminnow were tagged below Bonneville Dam without a recorded FL and were only counted as a mark for ≥200 mm FL size class. Sport Reward Fishery recaptures greater than or equal to 250 mm FL accounted for 75.1% of all 2024 tag recoveries (Table 1).

Sport Reward Fishery Exploitation

The system-wide exploitation rate using the Brownie bird band model and mark/recovery data from 2012 - 2024 for Northern Pikeminnow ≥ 250 mm FL during SRF was estimated at 11.6% (9 – 14.7%; 95% confidence interval; Figure 3). This estimate was within the targeted exploitation range of 10-20% (Fig. 3). The system-wide exploitation rate using the Brownie bird band model and recovery data from 2012 - 2024 for Northern Pikeminnow ≥ 200 mm FL during SRF was estimated to be 14% (11.8-16.5%; 95% confidence interval). The system-wide exploitation rate using the Lincon Peterson model and mark/recovery data exclusively from 2024 for Northern Pikeminnow ≥ 250 mm FL during SRF was estimated at 11.2% (7.7 – 14.7%; 95% confidence interval). The system-wide exploitation rate using the Lincon-Peterson model and mark/recovery data exclusively from 2024 for Northern Pikeminnow ≥ 200 mm FL during SRF was estimated to be 14.2% (11.1-17.3%; 95% confidence interval).

Sport Reward Fishery Predation Reduction

Using the systemwide Brownie bird band mark/recovery derived estimate of exploitation, the model-estimated median reduction of predation on juvenile salmonids by Northern Pikeminnow relative to pre-program levels for 2025 was 28% (range: 10-42%) and predictions for 2026 was 30% (range: 13–43%; Fig. 4). Model projections based on continuation of the current fishery, population structure, and mean rates of exploitation suggest predation on juvenile salmon by Northern Pikeminnow will remain at suppressed levels through 2028 with an estimated median reduction near 30% (Fig. 4).

Dam Angling Fishery

During the 2024 DAF season, 708 diet samples were processed from fish harvested at the angler accessible areas in the powerhouse turbine outflow areas (powerhouse tailraces) of Bonneville reservoir (fishing from the Dalles Dam) and The Dalles reservoir (fishing from the John Day Dam). Of those, 510 were Northern Pikeminnow diet samples, 139 were Smallmouth Bass diet samples, and 59 were Walleye. There was a variation in fish size, Northern Pikeminnow ranged in size from 221-588 mm FL, Smallmouth Bass ranged in size from 206-520 mm FL, and

Walleye ranged in size from 230-531 mm FL. In Bonneville Reservoir, the most prevalent diet item was fish, while in The Dalles it was non-crayfish invertebrates, followed by fish. The proportion of salmonids in the diets of Northern Pikeminnow caught in the powerhouse tailrace areas of Bonneville Dam and The Dalles Dam in 2024 was 8-18% while the proportion of American Shad was higher at 9 – 22% (Table 2).
There were consistent weekly trends in diet prey item composition for Northern Pikeminnow caught during DAF in Bonneville Reservoir and The Dalles Reservoir with lamprey, salmonids, and other fish being present in the first few weeks of DAF which transitioned to a diet composed primarily of American Shad around statistical week 31 (Fig. 5). This pattern was more distinct in Bonneville Reservoir during 2024 as there were samples obtained every week through week 36, whereas The Dalles Reservoir had a number of weeks with insufficient sample size or gaps in fishing effort throughout the season. Smallmouth Bass and Walleye had inconsistent weekly trends due to insufficient sample size, but did show consumption of Salmonids, Lamprey and non-salmonid fishes earlier in the season with a shift to American Shad later in the season (Fig. 6 and 7), parallel to the pattern observed for Northern Pikeminnow.

The 2024 weekly juvenile salmonid consumption index for Northern Pikeminnow removed during DAF in Bonneville and The Dalles reservoirs was the greatest during week 27. This time period corresponded with pulses of outmigration of sub-yearling Chinook salmon (Fig. 8).
PSD of Northern Pikeminnow in Bonneville Reservoir during DAF was significantly greater during the early years (1990-1996) of sampling than during the later years (2006-2024) ($F=42.76$, $P < 0.01$, Fig. 9). There was no significant difference in PSD at The Dalles Reservoir during the early years (1990-1996), relative to the later years (2007-2024) ($W = 78$, $P = 0.12$) (Fig. 9). PSD for DAF caught fish in both reservoirs has followed a decreasing trend since 2023.
W_r of female Northern Pikeminnow from DAF in Bonneville Reservoir in 2024 was 105.7%, and there was not a significant monotonic trend (Mann-Kendall $\tau = -0.24$, $P = 0.21$) (Fig. 10). W_r of male Northern Pikeminnow from DAF in Bonneville Reservoir in 2024 was 96.3%, and there was not a significant monotonic trend (Mann-Kendall $\tau = -0.23$, $P = 0.25$) (Fig. 10). W_r of female Northern Pikeminnow from DAF in The Dalles Reservoir in 2024 was 112.6%, and there was not a significant monotonic trend (Mann-Kendall $\tau = 0.06$, $P = 0.74$) (Fig. 11). W_r of male Northern Pikeminnow from DAF in The Dalles Reservoir in 2024 was 103.3%, and there was not a significant monotonic trend (Mann-Kendall $\tau = -0.03$, $P = 0.88$) (Fig. 11).

Biological Monitoring

Field staff conducted a total of 146 electrofishing runs during spring 2024 to collect fishes for biological monitoring in the area below Bonneville Dam and Bonneville Reservoir. Due to time, budget, and ESA-listed species constraints, total effort was reduced to only include a spring biological monitoring season. In 2024, ODFW sampled 691 piscine predators; 432 Smallmouth Bass (62.5% of the total catch), 206 Northern Pikeminnow (29.8% of the total catch), and 53 Walleye (7.7% of the total catch). The timing of our annual biological evaluation fieldwork was planned to coincide with predicted peak juvenile salmon outmigrations. Sampling in Bonneville Reservoir and below Bonneville Dam was slightly later than peak yearling salmonid outmigration but still fell during a period of high outmigration (Fig. 12).

Diet Composition

Detailed results of the diet assessments are found in Table 3A and 3B but relevant trends are listed here. Diets were examined from 68 Northern Pikeminnow, 98 Smallmouth Bass, and 17 Walleye below Bonneville Dam, and from 133 Northern Pikeminnow, 329 Smallmouth Bass, and 36 Walleye in Bonneville Reservoir. Food items were present in the majority of digestive tracts assessed during biological monitoring (71% - 100%, Table 2A). Fish were found in digestive tracts of all predator species (8% - 82%). Salmonids were detected in the digestive tracts of all predator species (2% - 76%). Walleye below Bonneville Dam had the highest proportion (76%) of diets containing salmonids. Proportions of diets containing lampreys were low (0% - 13%) across all predator species below Bonneville Dam and in Bonneville Reservoir.

<u>AI, Northern Pikeminnow</u>

Northern Pikeminnow AI showed a declining trend over the course of the 34-year timeseries in biological monitoring sites rkm 116 – 121, rkm 173 – 181, and rkm 188 - 194, although there was an increase from 2023 between rkm 188 – 194. The tailrace showed a stable trend and generally low AI (Fig. 13). Northern Pikeminnow AI in Bonneville Reservoir showed a declining trend in the forebay and mid-reservoir sites while the tailrace had a stable trend over the 34-year timeseries. AI in the mid reservoir increased in 2023 and 2024, with both values being above the trendline (Fig. 14).

<u>AI, Smallmouth Bass</u>

Smallmouth Bass AI showed a low but increasing trend over the course of the 34-year timeseries in biological monitoring sites below Bonneville Dam in rkm 116 – 121 and the tailrace. AI between rkm 188 – 194 was generally increasing, with high variability throughout the time series, but the 2024 value was elevated above the trendline. There was no consistent trend in Smallmouth Bass AI between rkm 173 – 181 but the AI for 2024 was elevated above the trendline. (Fig. 13). Smallmouth Bass AI in Bonneville Reservoir had an increasing trend over the 34-year time series in the forebay and mid-reservoir sites and a stable trend in the tailrace (Fig. 14).

<u>AI, Walleye</u>

Walleye AI showed a stable low trend in all biological monitoring sites below Bonneville Dam over the course of the 34-year timeseries , with an AI of 0 for rkm 116 – 121and rkm 173 – 181. However, AI in rkm 188 – 194 was the highest recorded value in the timeseries (Fig. 13). Walleye AI showed a stable low trend in all biological monitoring sites in Bonneville Reservoir over the course of the 34-year timeseries with an AI of 0 for the forebay (Fig.14).

<u>CI, Northern Pikeminnow</u>

Northern Pikeminnow CI in biological monitoring sites below Bonneville Dam showed an increasing trend over the course of the 34-year time series in rkm 116 – 121 and the tailrace, but no consistent trend in rkm 188 – 194. There was a slightly decreasing trend in rkm 173 – 181, but CI could not be calculated for 2024 due to insufficient sample size (n < 6). There was variability in CI in all sites throughout the time series (Fig. 15). Northern Pikeminnow CI showed a generally increasing trend in biological monitoring sites in Bonneville Reservoir in the tailrace over the 34-year time series, though there was variability throughout the time series. The mid reservoir showed a generally stable, low trend but had the highest recorded value in 2023 and then a CI of 0 in 2024. The forebay showed a stable trend, though CI was unable to be calculated in 2024 due to insufficient sample size (n < 6) (Fig. 16).

<u>CI, Smallmouth Bass</u>

Smallmouth Bass CI in biological monitoring sites below Bonneville Dam over the 34-year time series showed low but increasing trends in rkm 173 – 181, and stable to slightly increasing trends in rkm 188 – 194 and the tailrace. There was a stable low trend in rkm 116 – 121, though CI was unable to be calculated in 2024 due to insufficient sample size (n < 6) (Fig. 15). Smallmouth Bass CI in Bonneville Reservoir showed an increasing trend in all three biological evaluation sites over the 34-year time series (Fig. 16).

<u>PI, Northern Pikeminnow</u>

Northern Pikeminnow PI in biological monitoring sites below Bonneville Dam over the 34-year time series showed an increasing trend in rkm 116 – 121, declining trend in rkm 188 – 194, and a stable trend in the tailrace. PI in rkm 173 – 181 showed a declining trend, though it was unable to be calculated for 2024 due to insufficient sample size (n < 6) (Fig. 17). Northern Pikeminnow PI in Bonneville Reservoir showed an increasing trend in the mid-reservoir and tailrace over the 34-year time series, though PI in the mid-reservoir was 0 in 2024. PI in the forebay showed a slight decline but was unable to be calculated in 2024 due to insufficient sample size (n < 6) (Fig. 18).

<u>PI, Smallmouth Bass</u>

Smallmouth Bass PI was low in all biological monitoring sites below Bonneville Dam during the 34-year time series, with a stable trend the tailrace, and increasing trends in rkm 173 – 181 and rkm 188 - 194. However, PI was greater in 2024 than any previous year in rkm 173 – 181and rkm 188 – 194. PI was stable in rkm 116 – 121, though values were unable to be calculated in 2024 due to insufficient sample size (n < 6) (Fig. 17). Smallmouth Bass PI showed an increasing trend in Bonneville Reservoir in all three biological monitoring sites, but PI in the mid reservoir for 2024 was below the trendline (Fig. 18).

<u>PSD, Northern Pikeminnow (see Fig, 19)</u>

Northern Pikeminnow PSD below Bonneville Dam in 2024 was 40.1%, and there was not a significant monotonic trend (Mann-Kendall $\tau = 0.23$, $P = 0.14$). Northern Pikeminnow PSD in Bonneville Reservoir was 9.5% and there was a significant decreasing monotonic trend (Mann-Kendall $\tau = -0.36$, $P = 0.02$).

<u>PSD, Smallmouth Bass (see Fig. 20)</u>

Smallmouth Bass PSD below Bonneville Dam in 2024 was 28.7%, and there was a decreasing monotonic trend (Mann-Kendall $\tau = -0.32$, $P = 0.03$). Smallmouth Bass in Bonneville Reservoir in 2024 was 55.1%, and there was significant increasing monotonic trend (Mann-Kendall $\tau = 0.28$, $P = 0.048$).

PSD-P, Smallmouth Bass (see Fig. 21)

Smallmouth Bass PSD-P Below Bonneville Dam in 2024 was 9.1%, and there was not a significant monotonic trend (Mann-Kendall $\tau = -0.25$, $P = 0.08$). Smallmouth Bass PSD-P in Bonneville Reservoir in 2024 was 22.8%, and there was a significant increasing monotonic trend (Mann-Kendall $\tau = 0.40$, $P = 0.0092$).

PSD/PSD-P, Walleye

Walleye PSD and PSD-P could not be calculated Below Bonneville Dam in 2024, due to insufficient sample size (n = 8, minimum for PSD n = 20). Walleye PSD and PSD-P could not be calculated in Bonneville Reservoir in 2024, due to insufficient sample size (n = 11, minimum for PSD n = 20).

W_r, Northern Pikeminnow (see Fig. 22)

Female Northern Pikeminnow W_r Below Bonneville Dam in 2024 was 106.8%, and there was not a significant monotonic trend (Mann-Kendall $\tau = 0.24$, $P = 0.1$). Male Northern Pikeminnow W_r Below Bonneville Dam in 2024 was 102.3%, and there was a significant increasing monotonic trend (Mann-Kendall $\tau = 0.53$, $P = 0.0001$).

W_r, Northern Pikeminnow (see Fig. 23)

Female Northern Pikeminnow W_r in Bonneville Reservoir in 2024 was 100.9%, and there was not a significant monotonic trend (Mann-Kendall $\tau = -0.07$, $P = 0.68$). Male Northern Pikeminnow W_r Bonneville Reservoir in 2024 was 97.4%, and there was not a significant monotonic trend (Mann-Kendall $\tau = 0.20$, $P = 0.18$).

W_r, Smallmouth Bass (see Fig.24)

Smallmouth Bass W_r below Bonneville Dam in 2024 was 101.4%, and there was not a significant monotonic trend (Mann-Kendall $\tau = -0.18$, $P = 0.23$). Smallmouth Bass W_r in Bonneville Reservoir in 2024 was 94.6%, and there was not a significant monotonic trend (Mann-Kendall $\tau = -0.11$, $P = 0.49$).

W_r, Walleye (see Fig. 25)

Walleye W_r below Bonneville Dam in 2024 was 95.1%, and there was not a significant monotonic trend (Mann-Kendall $\tau = 0.22$, $P = 0.15$). Walleye W_r in Bonneville Reservoir 2024 was 90.6%, and there was a significant decreasing monotonic trend (Mann-Kendall $\tau = -0.42$, $P = 0.005$).

DISCUSSION

Overview

NPMP was tasked with reducing the predation on juvenile salmonids, by Northern Pikeminnow, as they migrate through the hydropower systems of the Columbia and Snake rivers. NPMP was a multi-agency collaboration incorporating sport reward and dam fisheries managed by WDFW which promoted focused removals of Northern Pikeminnow. These removal efforts were paired with requisite biological monitoring of the Northern Pikeminnow targeted by these removal activities as well as evaluation into the efficacy of the Northern Pikeminnow removal efforts on the reduction in predation to juvenile salmonids conducted by ODFW. NPMP program administration and contract management was led by PSMFC.

Sport Reward Fishery Exploitation

The 2024 Sport Reward Fishery system wide exploitation rate of Northern Pikeminnow ≥ 250 mm FL was 11.6% (9%-14.7%; 95% C.I.). The point estimate was within the range of the exploitation management goal, though the lower confidence limit was just outside the range of the exploitation target. 2023 was the first year that NPMP incorporated a new mark/recovery analytical framework, a Brownie bird band model, which utilizes tag recoveries from multiple years of marking. NPMP is still in the process of assessing how an exploitation estimate based on a Brownie bird band model and multiple years of recovery data compares to the historically used Lincoln-Peterson model, which incorporates only within-year recoveries. The 2024 exploitation estimates between the Brownie bird band model and Lincoln-Peterson based model provided similar point estimates of exploitation, though the confidence interval was smaller for the Brownie bird band model than the Lincoln-Peterson model. This result is positive and NPMP will continue to implement and evaluate the replacement of the Lincoln-Peterson model with the Brownie bird band model. Going forward, NPMP will continue to adapt and make project management decisions to optimize resources to meet project objectives within a constrained budget.

Predation Reduction

The target predation reduction will be met in 2025 at a median, system wide reduction of 28%. The variability associated with this predation reduction estimate was indicative of uncertainty associated with the numerous indices that were integrated into the predation reduction model. Despite this uncertainty, the predation reduction estimates were comparable to previous years and as expected with the measured level of exploitation. The exploitation estimate coupled with the estimated predation reduction value suggest that the removal program continued to be successful. These findings were designed to be presented in conjunction with biological evaluation of additional fisheries metrics, allowing NPMP to further assess whether long-term exploitation of Northern Pikeminnow contributed to predatory compensation with non-native piscivores and native Northern Pikeminnow. The biological evaluation metrics also provide a means to monitor for a chronic decline in the Northern Pikeminnow population.

Fishery Evaluation Trends

During the 2024 field season, ODFW utilized a strategic sampling plan to mark fish, which differed from historical methods, in the area below Bonneville Dam and Bonneville Reservoir. This new method allowed for focused efforts in locations that historically have a higher density of Northern Pikeminnow and resulted in relatively large numbers of marked Northern Pikeminnow in 2024, with respect to electrofishing effort. This approach also allowed the crews to opportunistically explore other areas if the chosen sites were not productive. The marking results from 2024 suggests the strategic marking approach may represent a balance between electrofishing effort and marks deployed. NPMP will continue to explore this approach in the other areas and assess it as a means to mark suitable numbers of Northern Pikeminnow while efficiently distributing our electrofishing effort in areas open to SRF. Length and weight measurements from fish captured during fishery evaluation have been used to assess systemwide trends in proportional size distribution and W_r. However, because 2023 and 2024 did not include systemwide marking efforts for the fishery evaluation and incorporated a change in approach in 2024, it is unknown whether these metrics will be comparable in space and time with historic fishery metrics. Part of the ongoing assessment of the strategic approach will be to further analyze the relationship between previous methods and the trends in fisheries metrics to future fishery evaluation efforts.

DAF

Northern Pikeminnow removed in DAF appeared to be feeding regularly in the powerhouse tailrace areas of Bonneville and The Dalles reservoirs. Additionally, 8 - 18% of the diet composition of DAF caught Northern Pikeminnow was salmonids. These proportions were calculated from Northern Pikeminnow collected from 30 April - 25 September 2024. During this time, there were documented pulses of out-migrating juvenile salmonids associated with increases in the proportions of juvenile salmonids in the diet of Northern Pikeminnow. There was intra-annual variation in the diet composition. Salmonids and lamprey were primarily predated during the early weeks of DAF (weeks 20-29), with diet composition largely consisting of American Shad in later weeks (weeks 30-39). These data suggest that Northern Pikeminnow feeding in the powerhouse tailrace areas may be influenced by prey availability. Though previous years of data indicate Northern Pikeminnow feeding on pulses of out-migrating salmonids (Carpenter et al. 2019), diet data from DAF 2024 showed salmon and lamprey consumption early in the season followed by diets consisting largely of American Shad. One possible explanation is a particularly large outmigration of shad beginning week 31, concurrent with a reduction in the number of outmigrating salmonids. Because of this, salmonids and other prey items became a much smaller proportion of the diet of Northern Pikeminnow in the powerhouse tailrace areas. 2024 was the first year Smallmouth and Walleye diet samples were taken during DAF. These samples were taken to test the viability of collection and analysis of diet samples and to ultimately compare diet composition from native Northern Pikeminnow to non-native Smallmouth Bass and Walleye. Due to limited sample size at various times during the 2024 DAF season, there were weeks of data missing for both Smallmouth Bass and Walleye. Despite the gaps in digestive content data for Smallmouth Bass and Walleye during some of the DAF season, the broad trends appear to parallel those of Northern Pikeminnow. These results are encouraging and provide the project a framework to continue to collect and compare digestive contents from these native and non-native predators. Digestive content data from all three species will allow the program to assess the importance of powerhouse tailrace areas, which were previously identified key feeding areas for Northern Pikeminnow, to Smallmouth Bass and Walleye diets from these same areas.

Due to sampling location, and timing differences, a comparison between the diets of DAF caught Northern Pikeminnow and diets sampled during biological evaluation was not possible. The continuation of diet composition analyses from DAF caught Northern Pikeminnow, Smallmouth Bass, and Walleye may be valuable to track trends in the predation of numerous taxa traveling through the powerhouse tailraces, several of which may be threatened or endangered. The significance of this work is elevated in the context of high proportions of salmonids in digestive tracts of Northern Pikeminnow caught in the boat restricted zones in previous years. Unfortunately, due to budget cuts, safety and logistical concerns, and access restrictions, sampling in these areas has been eliminated from the study design. Therefore, DAF diet composition data provide one mechanism to fill data gaps surrounding potentially important native and non-native piscine predator feeding areas adjacent to the powerhouse tailrace areas. These data were useful in augmenting the understanding of the predator/prey dynamics between Northern Pikeminnow, juvenile salmonids, lampreys, American Shad, and numerous other prey taxa. In addition, the removal of Northern Pikeminnow from the powerhouse tailrace areas via DAF mitigates for the direct impact of the Federal Columbia River Power System (FCRPS) through a means that is inaccessible to anglers participating in the SRF.

PSD for Northern Pikeminnow in Bonneville Reservoir powerhouse tailrace (The Dalles Dam), caught through DAF, was significantly lower during the more recent sampling time period (2006 – 2024) relative to the older time period (1990 – 1995). This may indicate a fishing signal from DAF, which began actively removing Northern Pikeminnow in 1990. The Dalles Reservoir powerhouse tailrace (John Day Dam) did not have a significant difference in PSD for late relative to early time periods. DAF may have initially depressed PSD in the powerhouse tailrace area in Bonneville Reservoir but these data don't suggest this happened in The Dalles reservoir powerhouse tailrace. The mechanism for this difference remains unknown. Potential explanations include a shift in SRF effort and/or catch between the two reservoirs (Winther et al. 2021), or differential population responses to abiotic and/or biotic factors (e.g., Jackson 2001). There appear to be cyclical patterns in both PSD and W_r from tailrace areas fished by DAF, possibly indicating broad population level changes from recruitment or other biotic or abiotic factors. Future biological evaluation of Bonneville and The Dalles Reservoirs will be conducted through 2025 and may help to further elucidate trends in PSD across the sub-areas of each reservoir.

Northern Pikeminnow W_r was not significantly different in either powerhouse tailrace for males or females. This result may not be surprising, given that several hundred to thousands of Northern Pikeminnow were removed from the powerhouse tailrace areas each year through DAF, thereby possibly reducing the intraspecific competition from presumably food rich areas of these hydropower reservoirs. However, if these powerhouse tailrace areas were prime feeding areas, increasing competition from other predators may change the present predator/prey dynamics, potentially impacting when or how much food Northern Pikeminnow were able to access from the powerhouse tailrace areas. Ongoing biological monitoring of these areas, as well as the inclusion of two additional piscine predator species (i.e., Smallmouth Bass and Walleye) should continue as they provide important insight into shifts in predator dynamics that other sampling within NPMP cannot address.

Biological Monitoring

In addition to modeling the predation reduction due to the NPMP SRF and DAF, fishery metrics were measured for three predatory species: Northern Pikeminnow, Smallmouth Bass, and Walleye. These data were collected independently of the SRF and DAF and were designed to test for indications of a compensatory predatory response among these three species due to focused Northern Pikeminnow removals and monitor for signs of Northern Pikeminnow population declines. The primary indicator of a compensatory response was whether the level of predation changed within Northern Pikeminnow populations and how it compared with other piscine predators of salmon and steelhead, particularly non-native Smallmouth Bass and Walleye. Changes in the abundance of these predators or trends in the consumption of juvenile salmonids among these predators can provide additional evidence of a compensatory response to Northern Pikeminnow removals.

Broad patterns in piscine predator indices suggest variable patterns in abundance, consumption, and predation in the sub-unit below Bonneville Dam and Bonneville Reservoir. Long-term trends in Bonneville Reservoir suggest stable to declining abundance, consumption, and predation by Northern Pikeminnow, and stable to increasing trends of those indices for Smallmouth Bass. The Bonneville mid-reservoir site shows distinct inverse trends in AI, PI, and CI between Northern Pikeminnow and Smallmouth Bass where the index values are declining for Northern Pikeminnow over time. This trend could indicate a compensatory response from SRF or a signal from other factors affecting these fish populations that are not measured as part of this program. Walleye were detected in low abundance in Bonneville Reservoir. NPMP does not currently include an index of consumption or predation for this species.

In contrast, long-term trends in indices of abundance, consumption, and predation below Bonneville Dam show different patterns than Bonneville Reservoir. The abundance index of Northern Pikeminnow shows declining trends over time, but this appears to be driven by an initial decline in the years following the initiation of SRF and a leveling of that pattern for the next couple of decades. Smallmouth Bass show relatively small changes in the index of abundance during the same time. The trends in consumption and predation indices for Northern Pikeminnow suggest variable but stable consumption with declining trends in predation, likely related to the declining trend in AI. Smallmouth Bass had lower index values for consumption and predation, though the long-term trend in predation suggests an increase over time. Walleye were infrequently encountered in the area below Bonneville Dam. The muted and variable patterns in trends of AI, CI, and PI of Northern Pikeminnow and Smallmouth Bass below Bonneville Dam may indicate differing ecological dynamics in this area relative to Bonneville Reservoir. Bonneville Reservoir is situated between two large hydropower facilities: The Dalles Dam upstream and Bonneville Dam downstream. In contrast, the area below Bonneville Dam encompasses more than 100 river kilometers downstream of Bonneville Dam without any hydropower facilities or other anthropogenic infrastructure to control water flow. These and other physical characteristics could contribute to some of the trends in indices among Northern

Pikeminnow, Smallmouth Bass, and Walleye that were observed here. Studies have demonstrated that preferences in physical conditions can structure riverine and reservoir biological communities in different ways (e.g., Scarnecchia et al. 2014). Thermal preferences are different for all three piscine predator species and elevated water temperatures associated with slower moving water in the reservoir habitat could contribute to some of the inverse trends we observed in Northern Pikeminnow AI relative to Smallmouth Bass AI, as Smallmouth Bass generally have higher preferred water temperatures (e.g., Van Zuiden et al. 2016). Additionally, there may be net movement of Northern Pikeminnow from Bonneville Reservoir into the area below Bonneville Dam, offsetting some of the losses occurring due to the consistent exploitation from the NPMP SRF in the area below Bonneville Dam (Diallo et al. in prep.).

A comparable consumption or predation index is not currently available for Walleye in this program, with respect to Smallmouth Bass and Northern Pikeminnow. However, there were notable patterns in diet proportion among the three species in Bonneville Reservoir and the area below Bonneville Dam (Table 3). Walleye had the highest proportion of salmonids in their digestive tracts in both areas. Walleye are specialized visual predators that become piscivorous as they increase in size, starting around 30mm (e.g., Hartman 2009) so this result is not surprising and compliments the general pattern of diet composition observed among these three species over time through NPMP (Waltz et al. 2033). However, the scale of the difference in the diet proportion is notable as Walleye had 3 to approximately 10 times proportionally more salmonids in their digestive tracts than Smallmouth Bass and Northern Pikeminnow. One Walleye sampled during biological monitoring from the Bonneville Reservoir in 2024 had at least 10 juvenile salmonids in its digestive tract. These results were noteworthy, as they suggest a potential differential impact to juvenile salmonid predation should Walleye continue to expand in abundance or distribution as indicated in other areas sampled by NPMP (Waltz et al. 2023). Walleye were encountered in lower numbers in Bonneville Reservoir and the area below Bonneville Dam relative to Smallmouth Bass and Northern Pikeminnow. This difference was reflected in the sample size of digestive contents sampled during 2024. NPMP will continue to assess patterns in catch and diet composition that indicate strong compensatory responses. In addition, the results presented here suggest that ongoing monitoring of interspecies predator dynamics are needed to provide actionable management information for the highly modified Columbia River Basin.

The interpretations from biological monitoring efforts were complicated by the fact that the Columbia and Snake River reservoirs were assessed on a multi-year rotating schedule that has varied spatially and temporally throughout the history of the project. This schedule rotation left gaps in the data leading to a coarser temporal scale used to assess trends in AI, CI, and PI. The coarser temporal scale of data could miss important high or low index years leading to misinterpretations of the long-term trends present in the data. The rotating biological monitoring schedule was driven by the incorporation of rapid assessment methods necessary to generate management actionable data through chronic flat funding for this program. The results presented here demonstrate the difficulty in assessing fish predator populations with limited data and means for assessment.

Two additional fisheries metrics were calculated for these three species, independent of SRF and DAF, for the biological monitoring areas assessed in 2024. These metrics were PSD and W_r, which provided additional information about the size frequency distribution and body condition of these species. These metrics can be used to assess for further signs of compensation among predator species, potentially related to Northern Pikeminnow removal, as well as to monitor for signs of overfishing of Northern Pikeminnow. Northern Pikeminnow PSD showed a significant decline in Bonneville Reservoir while there was a significant increase in Smallmouth Bass PSD-P in the same reservoir. At the same time, there was no significant change in W_r for either species. These results could suggest processes related to compensatory responses that only led to changes in abundance but didn't affect the ability of the remaining Northern Pikeminnow to obtain similar levels of nutrients that would lead to a decline in W_r. It's also possible these patterns were unrelated to Northern Pikeminnow removals from SRF and may instead signal changes in piscine predator dynamics from other processes (e.g., recruitment of Northern Pikeminnow). Male Northern Pikeminnow W_r significantly increased below Bonneville Dam, with no significant changes in PSD. This could represent a sex specific or density-dependent effect and compensatory response by remaining Northern Pikeminnow as AI decreased across the time series in the area but the remaining fish had less competition for food leading to increasing weight. Additionally, there were no changes in PSD or W_r for Smallmouth Bass or Walleye in this same area.

Taken in aggregate, the fisheries independent indices of abundance, consumption, and predation suggest spatiotemporally variable patterns in Northern Pikeminnow populations. Below Bonneville Dam, Northern Pikeminnow populations appear stable while in some areas of Bonneville Reservoir, their populations and subsequent predation on juvenile salmonids may be reduced relative to Smallmouth Bass and Walleye. Walleye recently showed substantial increases in AI and expansion into areas they were not previously encountered during NPMP biological monitoring in the Snake River sub-unit (Waltz et al. 2023). This trend should be tracked as Walleye are known contributors to significant predation on juvenile salmonids. A similar pattern emerged in the NPMP data from biological monitoring in the John Day Reservoir in 2022 (Waltz et al. 2022), where Northern Pikeminnow were detected in relatively low numbers and Walleye and Smallmouth Bass had shown substantial increasing trends over the 32-year timeseries. While it was not possible to say for certain that the patterns between declining metrics for Northern Pikeminnow and some increasing metrics for Smallmouth Bass and Walleye were indicative of a compensatory response, there was evidence that both species were considerably more prevalent than Northern Pikeminnow in John Day Reservoir in 2022 than at the start of NPMP in 1990. This also suggests that predation of juvenile out-migrating salmonids by Northern Pikeminnow has been reduced while it has increased by Smallmouth Bass and Walleye. John Day Reservoir may function as a model reservoir for what the Region could expect if Smallmouth Bass and Walleye continue to expand in abundance and distribution in other areas of the Columbia River Basin, like Bonneville Reservoir and the areas below Bonneville Dam. Smallmouth Bass were well documented in other areas in the Columbia River Basin (Tiffan et al. 2020) while Walleye appear to have lower abundance in NPMP sample areas though there is evidence they have expanded into new areas recently (Waltz et al. 2023; Idaho Department of Fish and Game, 2023). While NPMP doesn't have consumption or predation index values for Walleye, the proportion of salmonids in their diets would suggest that the increase in the index of abundance would lead to an increase in predation of out-migrating juvenile salmonids by Walleye (Table 3).

Continued evidence of compensatory responses to Northern Pikeminnow removals across multiple reservoirs could justify a need to augment the current study design to expand investigations into the predator/prey dynamics occurring in areas where compensation is suspected. In the absence of long-term, scientifically rigorous data, state and federal resource managers will not be able to accurately assess the effects of long-term fishing pressure, subsequent reduction in predation on juvenile salmonids, and changes to the multi-species predator/prey dynamics in this highly modified river system. It is important that NPMP adapts and continues to monitor these areas through biological evaluation and monitoring to assure a viable population of the native predator.

The rapid assessment methods incorporated into this report provided cost effective methods to biologically monitor and evaluate the effect of recreational sport reward fishery for Northern Pikeminnow. While these methods were not spatially or temporally exhaustive, they did provide an additional year of scientifically robust data that was used to augment the existing 34years of historical data. In doing so, NPMP was able to address the efficacy of the sport reward fishery to exploit 10 – 20% of the Northern Pikeminnow population, estimate the concomitant juvenile salmonid predation reduction, monitor for predator compensation, and provide a safeguard against overexploiting a native fish. These methods provided evidence that there may be a compensatory response in Smallmouth Bass and Walleye, potentially due to the removal of Northern Pikeminnow in some areas of Bonneville Reservoir. Of particular interest is the distinct, inverse trend in Northern Pikeminnow to Smallmouth Bass AI, CI, and PI in Bonneville mid-reservoir areas and the high proportion of salmonids in the digestive tract of Walleye in the Bonneville Reservoir and areas below Bonneville Dam. These results suggest the dynamics among piscine predators may be shifting which have important implications for juvenile salmonid predation. These potential compensatory responses need to be monitored carefully, as continuing to remove one predator, only to have the reductions to juvenile salmonid predation negated by predation from another predator, counteracts the essence of the efforts of NPMP. There were many factors that influenced the predatory impact of piscivorous fishes on ESA listed salmonids. In the effort to elucidate the relationships among these factors, NPMP will continue adapting the research methods to provide management with actionable information about the predation of juvenile salmonids in the Columbia and Snake rivers.

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TABLES

Table 1. Number of Northern Pikeminnow marked and recaptured[a] in the Sport Reward and Dam Angling Fisheries during 2024 by location and size class. Represented marks are from 2024 Tagging season while recaptures are from all previous years (1990-2024).

	200-249 mm FL		≥ 250 mm FL		≥ 200 mm FL		
Reach/Reservoir	Marked	Recaptured	Marked	Recaptured	Marked	Recaptured	Recaptures of 2024 Marks
Below Bonneville	235	29	366	67	604	96	73
Bonneville	99	15	130	48	229	63	43
The Dalles	___	___	___	3	___	3	___
McNary	___	___	___	1	___	1	___
Ice Harbor	___	___	___	2	___	2	___
Little Goose	___	___	___	9	___	9	___
Lower Granite	___	___	___	3	___	3	___
All areas	334	44	496	133	833	177	116

[a] Fish that were recaptured the same week in which they were tagged are not included in this table or in calculations of exploitation to avoid violating mark-recapture assumptions (i.e., incomplete mixing). '≥ 200 mm' includes fish that don't fit within either the '200 – 249 mm' category or the '≥ 250 mm' category. Summing across '200 – 249 mm' and '≥ 250 mm' does not sum to the value used in the '≥ 200 mm' fields.

Table 2. Number (n) of Northern Pikeminnow diets examined from Dam Angling Fishery catch from Bonneville (tailrace of The Dalles Dam) and The Dalles (tailrace of John Day Dam) reservoirs and proportions containing specific prey items (cray =crayfish, other invert = all invertebrates not identified as crayfish, sal = salmon or steelhead, lam = lamprey, ash = American Shad). Note: Start and end dates for the Dam Angling Fishery and the affiliated fishery monitoring have varied year to year.

Reservoir, Year	n	$\hat{p}_{\text{food}}$	$\hat{p}_{\text{fish}}$	$\hat{p}_{\text{cray}}$	$\hat{p}_{\text{other invert}}$	$\hat{p}_{\text{sal}}$	$\hat{p}_{\text{lam}}$	$\hat{p}_{\text{ash}}$	$\hat{p}_{\text{other fishes}}$
Bonneville,									
2006	129	0.36	0.21	0.08	0.04	0.04	0.17	0.00	0.05
2007	340	0.61	0.40	0.04	0.22	0.13	0.31	0.00	0.06
2008	209	0.63	0.44	0.04	0.33	0.11	0.31	0.00	0.12
2009	223	0.70	0.64	0.06	0.19	0.09	0.50	0.01	0.14
2010	395	0.62	0.49	0.06	0.14	0.16	0.18	0.15	0.18
2011	329	0.66	0.44	0.07	0.19	0.36	0.09	0.00	0.08
2012	275	0.77	0.57	0.09	0.19	0.15	0.18	0.00	0.00
2013	216	0.77	0.43	0.12	0.34	0.17	0.22	0.04	0.06
2014	489	0.58	0.46	0.07	0.13	0.19	0.47	0.19	0.42
2015	474	0.75	0.53	0.13	0.29	0.07	0.53	0.21	0.15
2016	463	0.73	0.37	0.03	0.44	0.07	0.14	0.13	0.08
2017	415	0.76	0.53	0.03	0.35	0.14	0.18	0.17	0.14
2018	346	0.72	0.46	0.04	0.36	0.06	0.05	0.29	0.15
2019	383	0.82	0.49	0.03	0.50	0.07	0.24	0.13	0.12
2020	336	0.69	0.49	0.03	0.26	0.16	0.26	0.07	0.13
2021	327	0.78	0.55	0.04	0.34	0.18	0.23	0.03	0.19
2022	221	0.71	0.54	0.04	0.20	0.09	0.14	0.31	0.11
2023	506	0.73	0.57	0.02	0.24	0.05	0.20	0.30	0.10
2024	318	0.86	0.56	0.05	0.47	0.08	0.21	0.22	0.14
The Dalles,									
2007	453	0.58	0.37	0.02	0.27	0.13	0.08	0.11	0.21
2008	64	0.81	0.36	0.03	0.69	0.09	0.23	0.00	0.08
2009	224	0.61	0.56	0.08	0.31	0.11	0.40	0.00	0.14
2010	382	0.55	0.29	0.07	0.34	0.16	0.10	0.02	0.07
2011	283	0.70	0.22	0.06	0.56	0.15	0.07	0.00	0.02
2012	479	0.77	0.39	0.13	0.48	0.15	0.12	0.04	0.00
2013	447	0.78	0.47	0.22	0.34	0.23	0.16	0.09	0.05
2014	363	0.72	0.44	0.31	0.27	0.18	0.46	0.14	0.36
2015	337	0.79	0.45	0.24	0.37	0.14	0.45	0.12	0.16
2016	426	0.73	0.31	0.04	0.57	0.14	0.04	0.06	0.07
2017	329	0.61	0.30	0.05	0.48	0.11	0.07	0.09	0.08
2018	473	0.75	0.30	0.04	0.57	0.13	0.09	0.06	0.04
2019	410	0.77	0.38	0.06	0.54	0.14	0.16	0.06	0.06
2020	549	0.70	0.48	0.04	0.39	0.13	0.19	0.19	0.03
2021	317	0.67	0.45	0.06	0.40	0.20	0.20	0.08	0.07
2022	161	0.70	0.48	0.06	0.37	0.27	0.21	0.06	0.06
2023	173	0.65	0.39	0.02	0.43	0.06	0.08	0.19	0.08
2024	386	0.90	0.55	0.10	0.67	0.18	0.18	0.09	0.17

Table 3A and 3B. Number (n) of Northern Pikeminnow, Smallmouth Bass, and Walleye (≥ 200 mm FL) diets examined during biological evaluation in Bonneville Reservoir and below Bonneville Reservoir during spring 2024 and proportion of samples containing specific prey ite items (cray = crayfish, crust = all crustacea not identified as crayfish, sal = salmon or steelhead, lam = lamprey).

3A

Spring 2024	Below Bonneville							
Species	*n*	$\hat{p}_{food}$	$\hat{p}_{fish}$	$\hat{p}_{cray}$	$\hat{p}_{crust}$	$\hat{p}_{insect}$	$\hat{p}_{sal}$	$\hat{p}_{lam}$
Northern Pikeminnow	68	0.71	0.44	0.25	0.01	0.1	0.24	0.13
Smallmouth Bass	98	0.99	0.74	0.15	0.28	0.24	0.27	0.01
Walleye	17	1	0.82	0	0.06	0.18	0.76	0

3B

Spring 2024	Bonneville Reservoir							
Species	*n*	$\hat{p}_{food}$	$\hat{p}_{fish}$	$\hat{p}_{cray}$	$\hat{p}_{crust}$	$\hat{p}_{insect}$	$\hat{p}_{sal}$	$\hat{p}_{lam}$
Northern Pikeminnow	133	0.84	0.08	0.09	0.16	0.12	0.02	0.02
Smallmouth Bass	329	0.98	0.31	0.45	0.34	0.22	0.08	0.01
Walleye	36	0.97	0.61	0.11	0.36	0.17	0.31	0

FIGURES

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

Figure 2. Tag placement areas for 134.2 MHz passive integrated transponder (PIT) tags for marked Northern Pikeminnow.

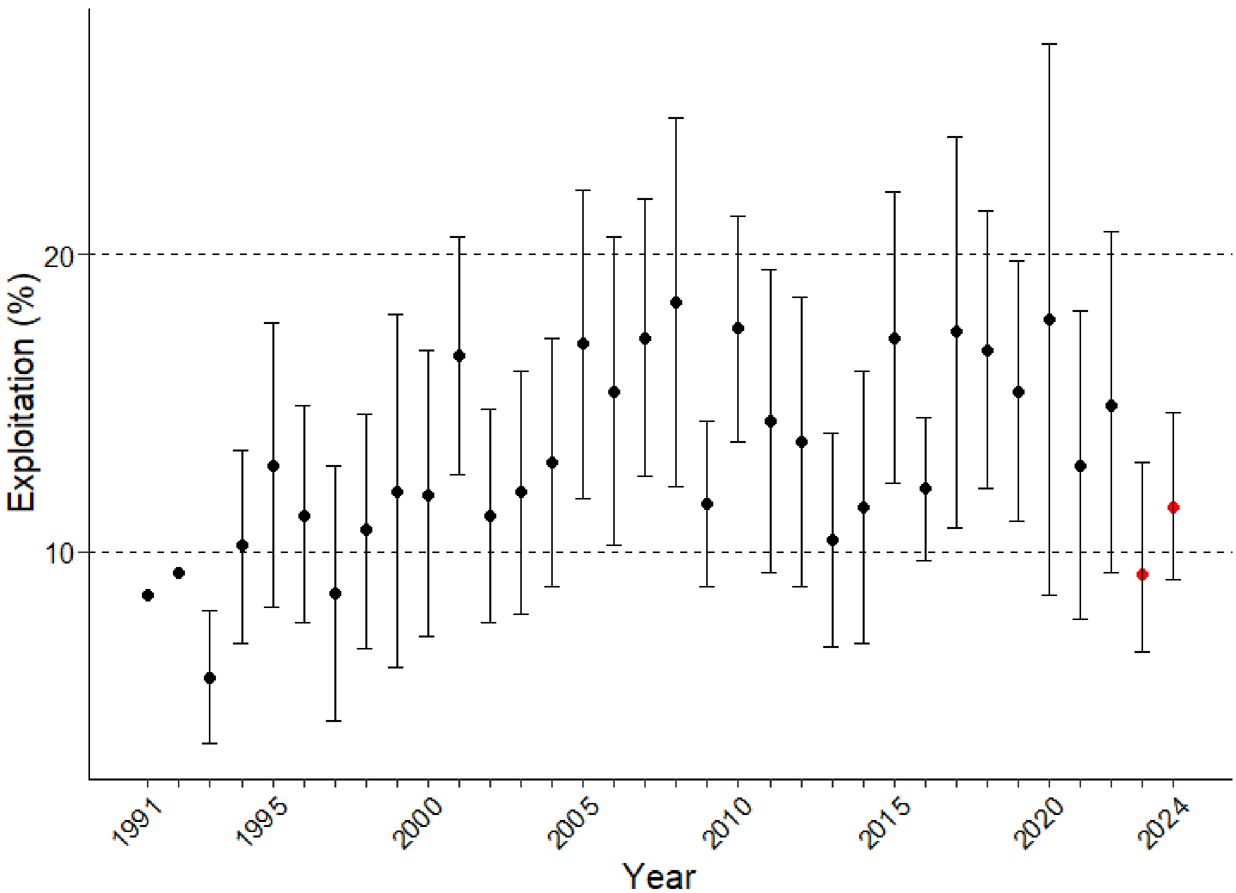

Figure 3. System-wide exploitation rates of Northern Pikeminnow (≥ 250 mm FL) in the Sport Reward Fishery, 1991–2024. Error bars represent 95% confidence intervals, though variation was not estimated for the years 1991–1992. Target exploitation is 10–20% (dashed lines).

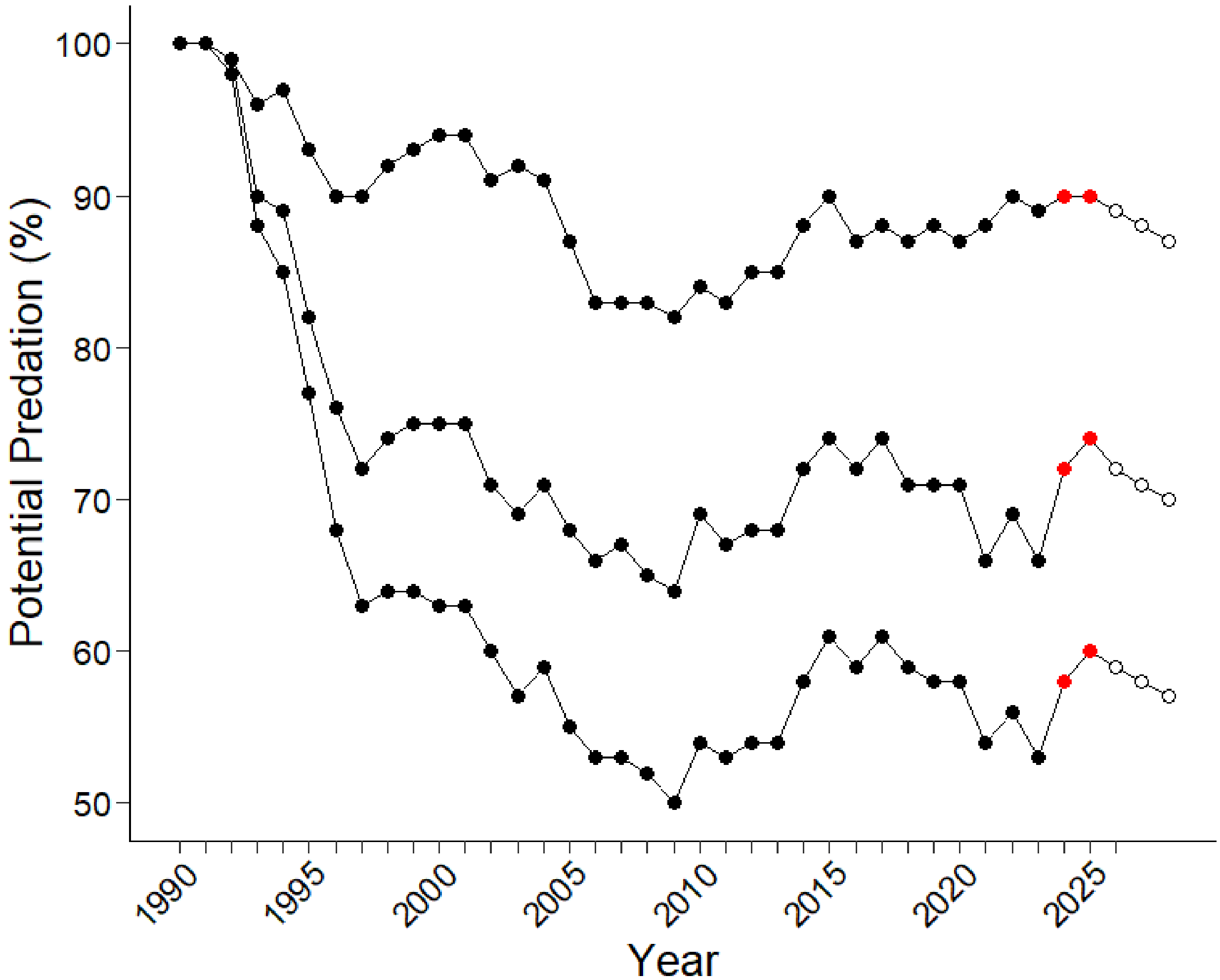

Figure 4. Estimates of maximum, median, and minimum annual levels of potential predation by Northern Pikeminnow on juvenile salmon relative to predation levels before implementation of the Northern Pikeminnow Management Program. For the years 1991–2024, model estimates (filled circles) are based on exploitation rates from the previous year. Model forecast predictions after 2025 (open circles) are based on average exploitation estimates from years with similar fishery structure (2001, 2004–2025). Change in analysis methods (filled red circles) in 2024-2025.

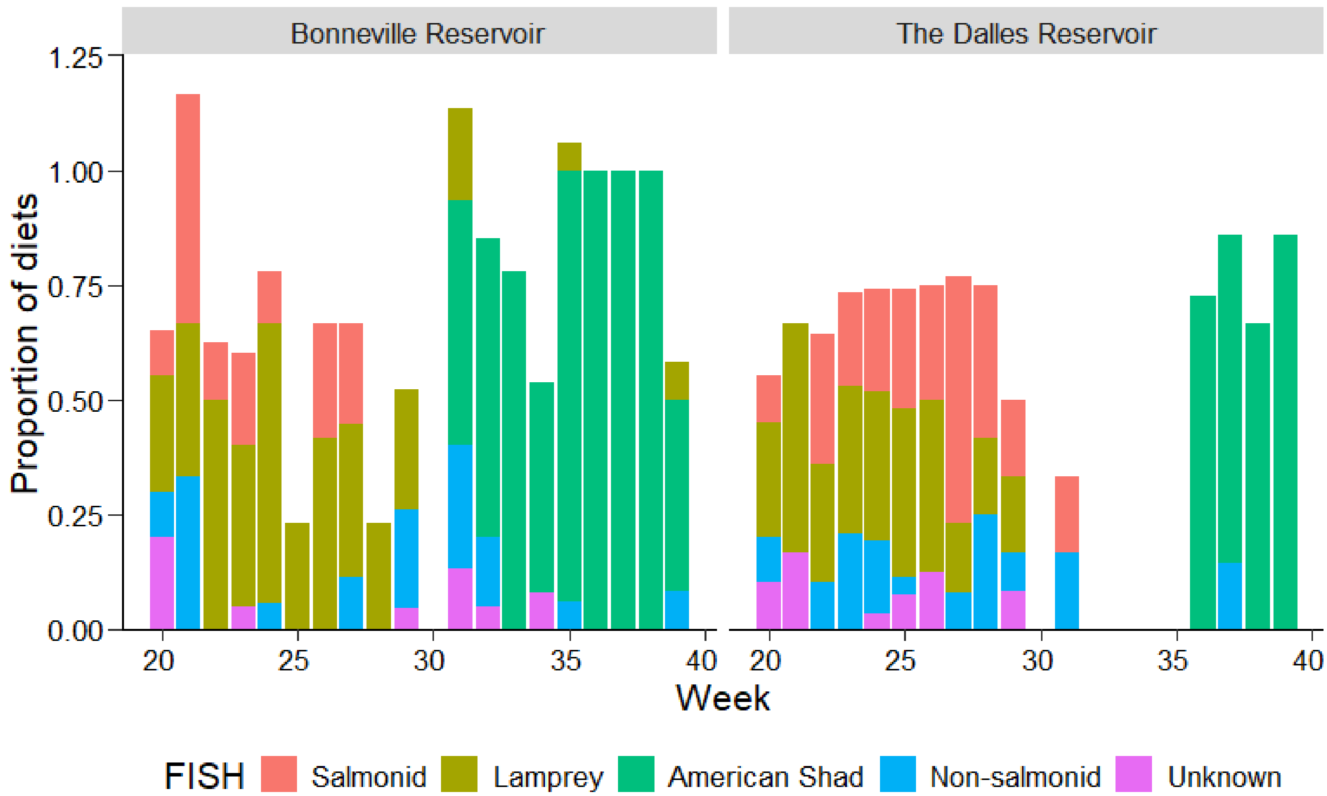

Figure 5. Proportion of all Northern Pikeminnow diet samples containing prey fish collected during the Dam Angling Fishery from the powerhouse tailraces of Bonneville (fishing from The Dalles Dam) and The Dalles (fishing from John Day Dam) reservoirs, April – September 2024. All Northern Pikeminnow diet samples collected were included in this analysis, including samples that were empty or fishless. Multiple fish groups may be represented in individual Northern Pikeminnow diets. Note: weeks without data indicate that sampling was not conducted, or sample sizes were insufficient for analyses (n < 6).

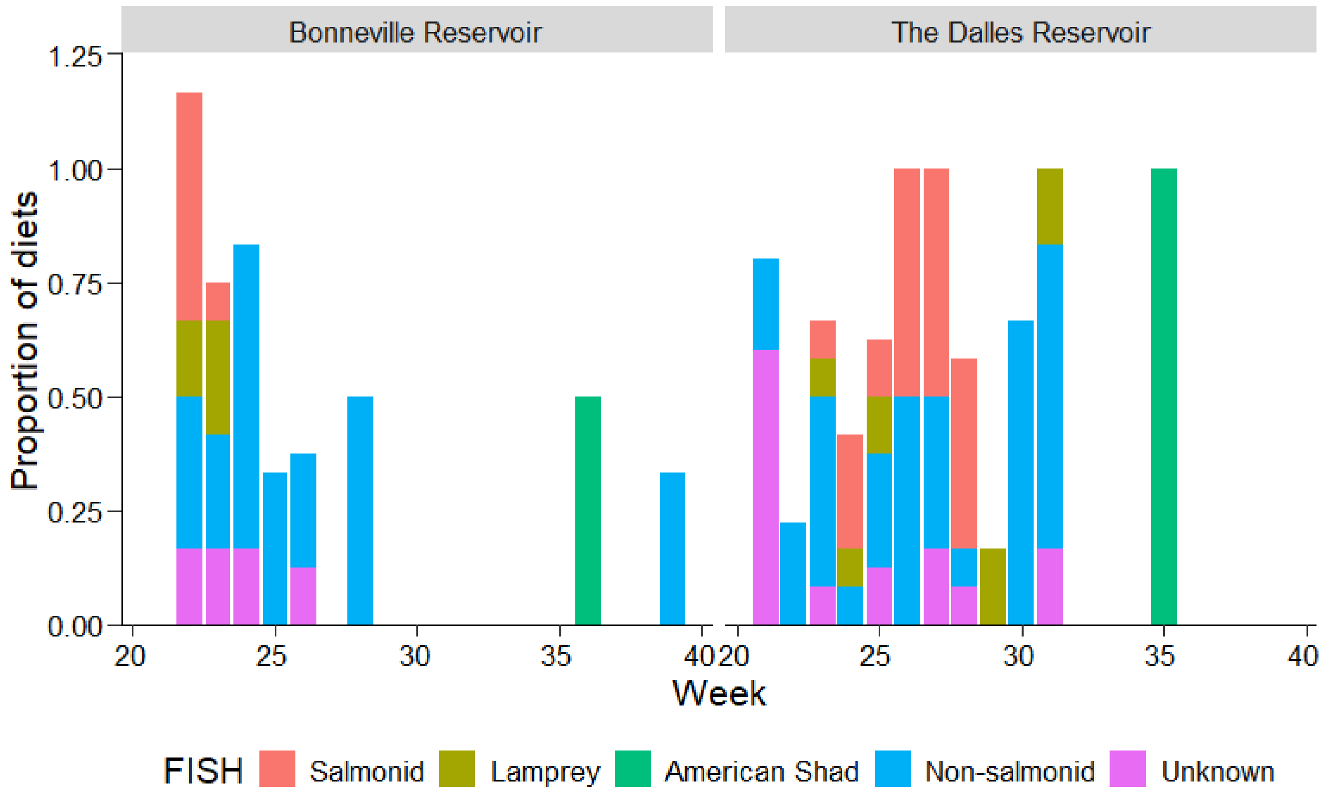

Figure 6. Proportion of all Smallmouth Bass diet samples containing prey fish collected during the Dam Angling Fishery from the powerhouse tailraces of Bonneville (fishing from The Dalles Dam) and The Dalles (fishing from John Day Dam) reservoirs, April – September 2024. All Northern Pikeminnow diet samples collected were included in this analysis, including samples that were empty or fishless. Multiple fish groups may be represented in individual Northern Pikeminnow diets. Note: weeks without data indicate that sampling was not conducted, or sample sizes were insufficient for analyses (n < 6).

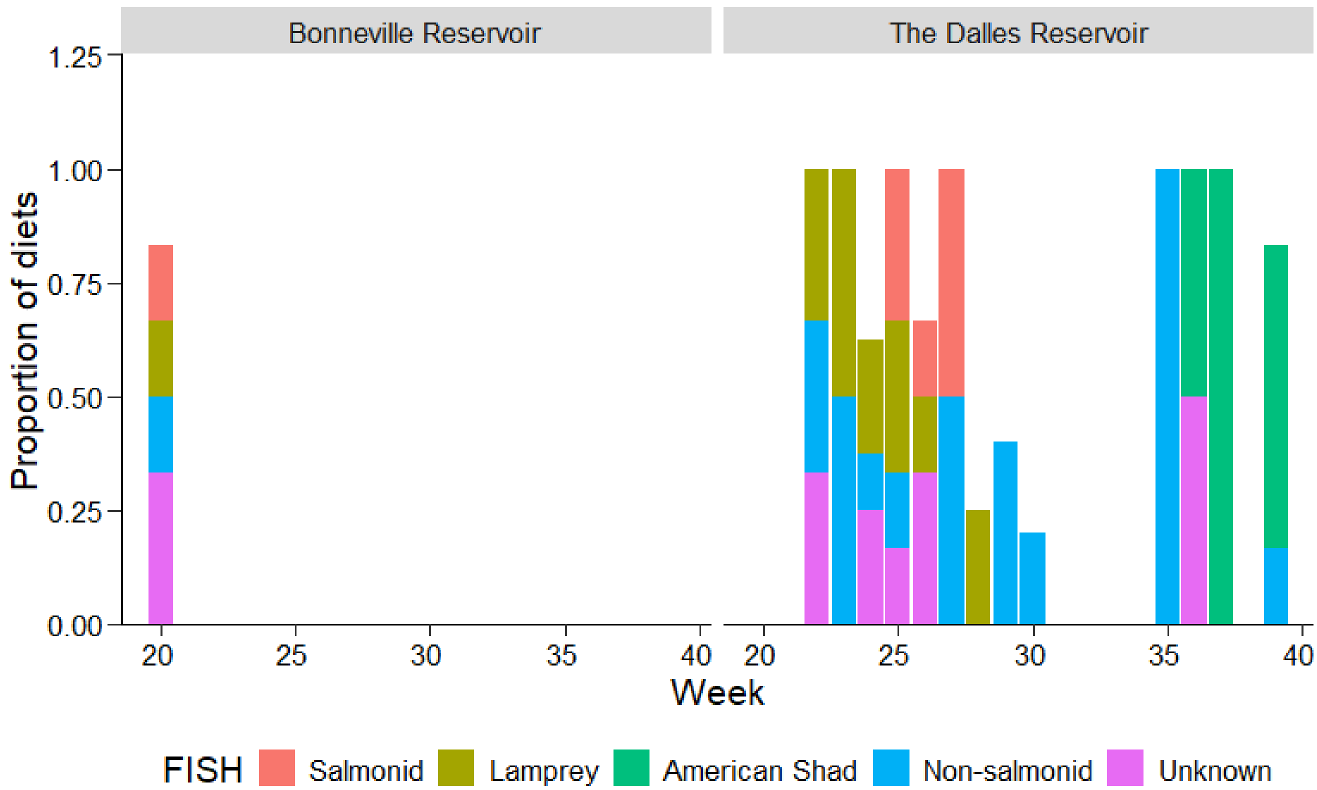

Figure 7. Proportion of all Walleye diet samples containing prey fish collected during the Dam Angling Fishery from the powerhouse tailraces of Bonneville (fishing from The Dalles Dam) and The Dalles (fishing from John Day Dam) reservoirs, April – September 2024. All Northern Pikeminnow diet samples collected were included in this analysis, including samples that were empty or fishless. Multiple fish groups may be represented in individual Northern Pikeminnow diets. Note: weeks without data indicate that sampling was not conducted, or sample sizes were insufficient for analyses (n < 6).

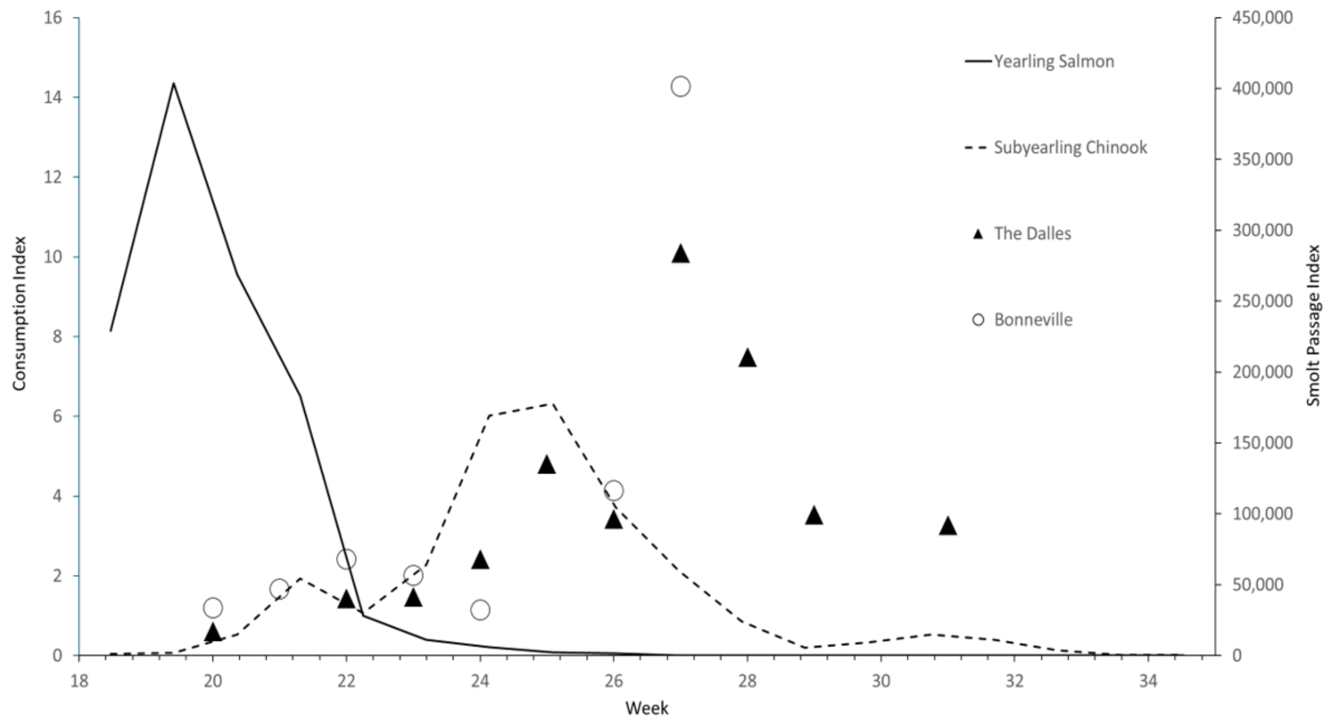

Figure 8. Mean weekly juvenile salmon consumption index for Northern Pikeminnow captured from the Dam Angling Fishery (DAF) in Bonneville (open circles) and The Dalles (filled triangles) reservoirs compared to the weekly smolt passage index at McNary Dam, 2024. Smolt passage data are summarized from Fish Passage Center (unpublished data). DAF sampling was conducted from Weeks 20-31. Weeks without data indicate that sampling was not conducted, or sample sizes were insufficient for analyses (n < 6).

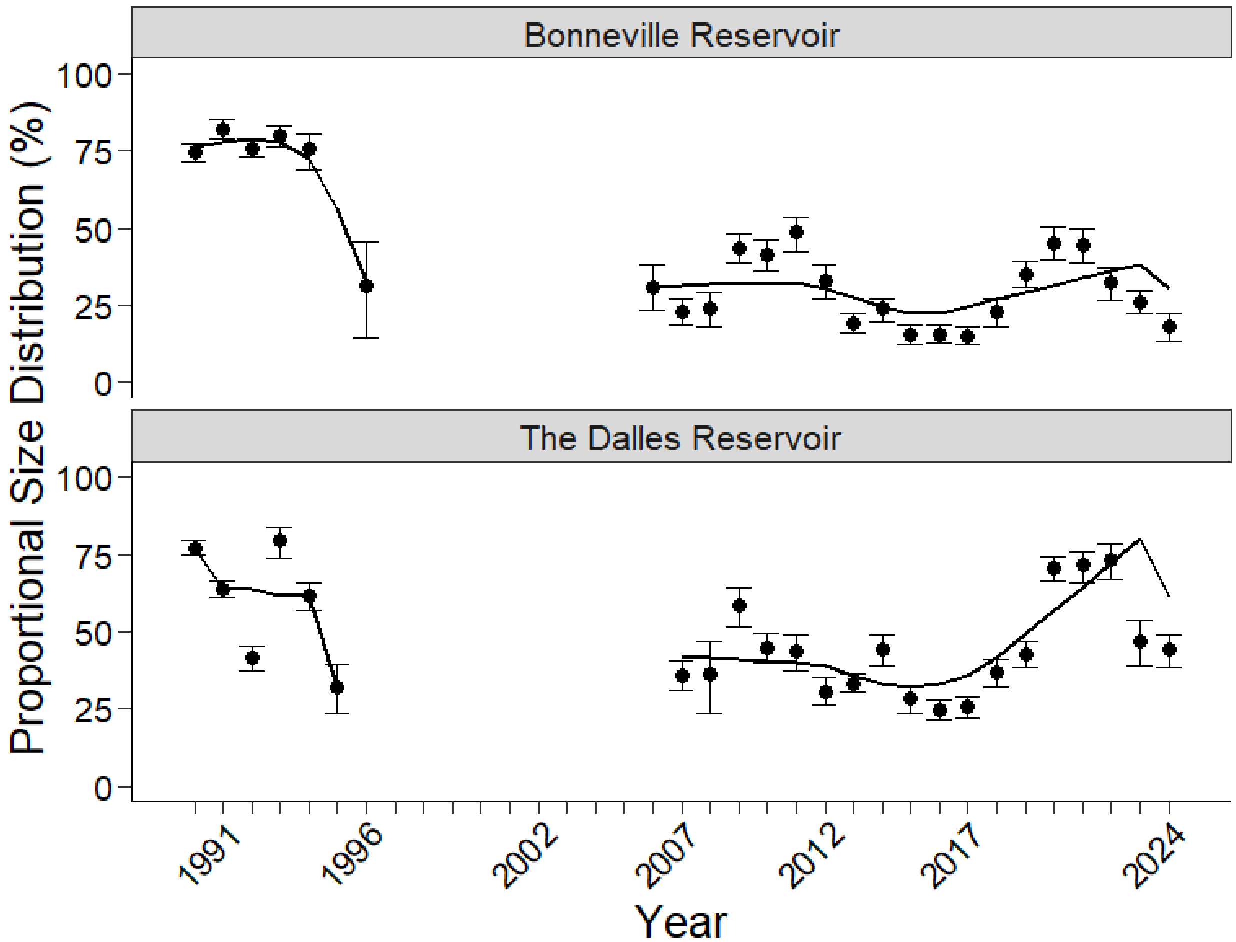

Figure 9. Estimates of proportional size distribution (PSD, %) of Northern Pikeminnow sampled in Bonneville and The Dalles reservoirs during the Dam Angling Fishery, 1990–2024. Error bars represent 95% bootstrap confidence intervals. Data are fit with LOWESS curves for two different time series: early (1990–1996) and late (2006–2024), due to the large data gap between them. Years without data indicate sampling was not conducted or sample sizes were insufficient for analyses (n_s < 20).

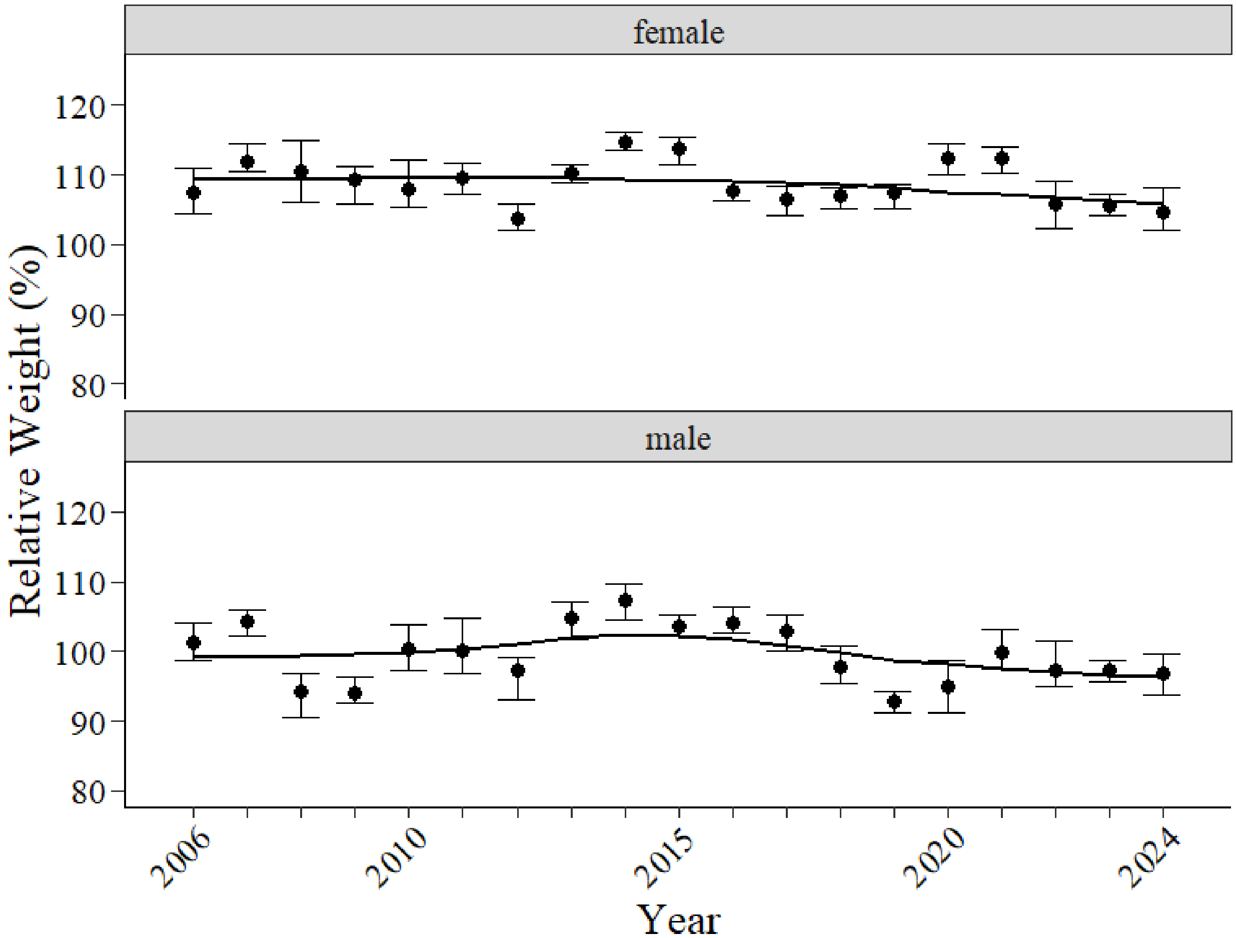

Figure 10. Median relative weight (*Wr*, %) for female and male Northern Pikeminnow collected in Bonneville Reservoir during the Dam Angling Fishery, 2006–2024. Error bars represent 95% bootstrap (percentile) confidence intervals. Data are fit with LOWESS curves. Results from a Mann-Kendall test of monotonic trend are presented for each sex.

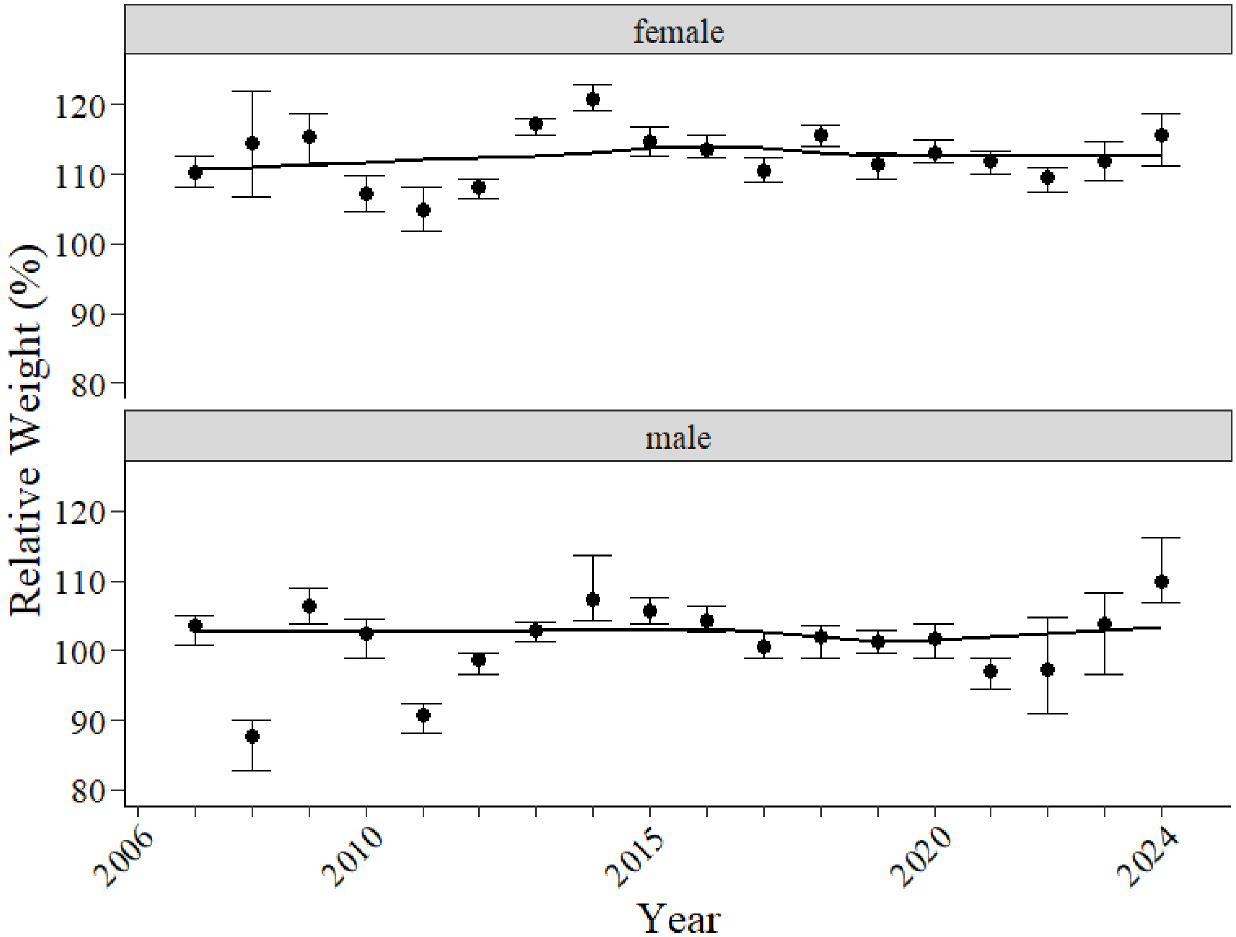

Figure 11. Median relative weight (*Wr*, %) for female and male Northern Pikeminnow collected in The Dalles Reservoir during the Dam Angling Fishery, 2007–2024. Error bars represent 95% bootstrap (percentile) confidence intervals. Data are fit with LOWESS curves. Results from a Mann-Kendall test of monotonic trend are presented for each sex.

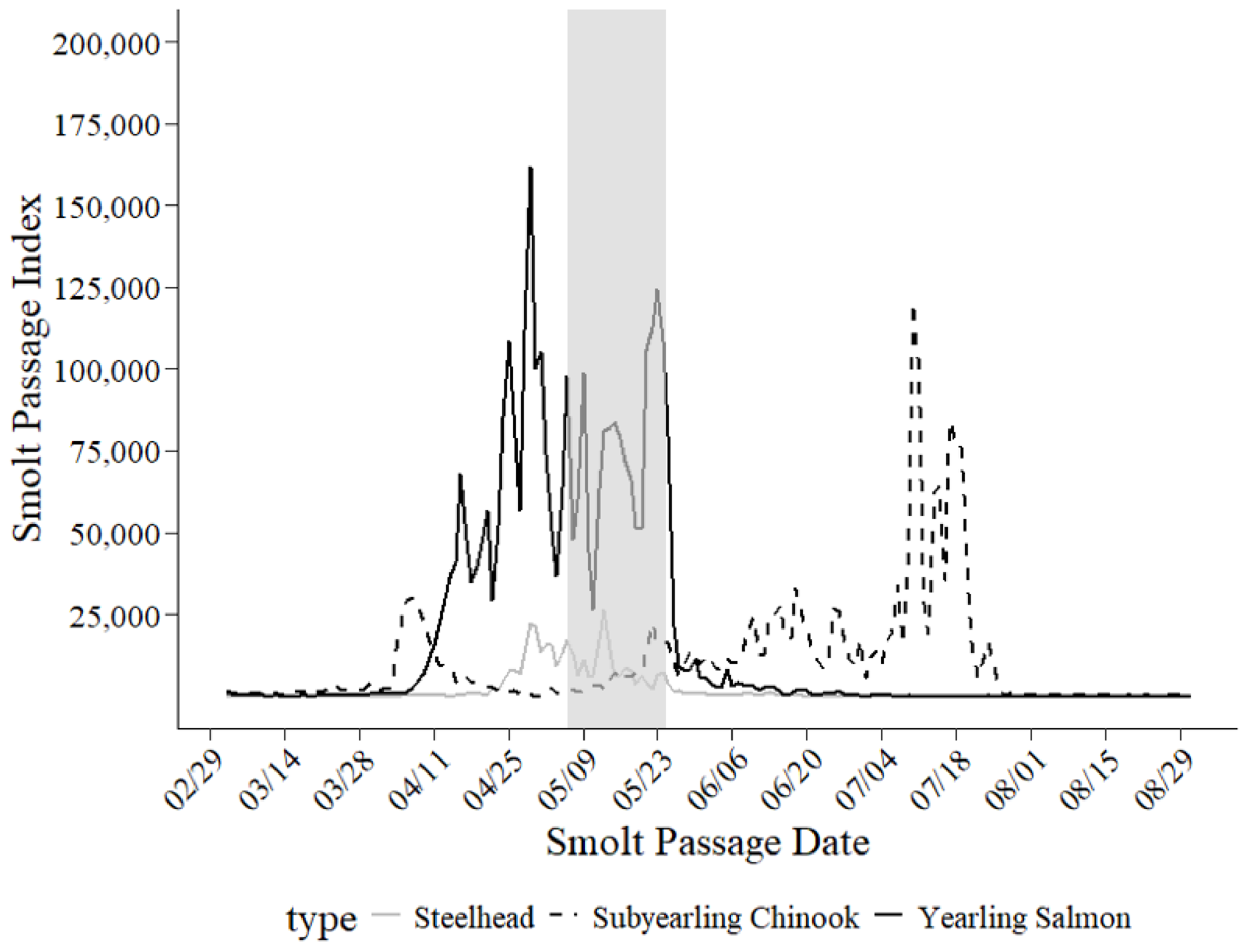

Figure 12. Period of biological evaluation (vertical bar) in the area below Bonneville Dam and Bonneville Reservoir and juvenile salmon and steelhead daily passage index through Bonneville Dam, February–August 2024 (Source: Fish Passage Center, unpublished data).

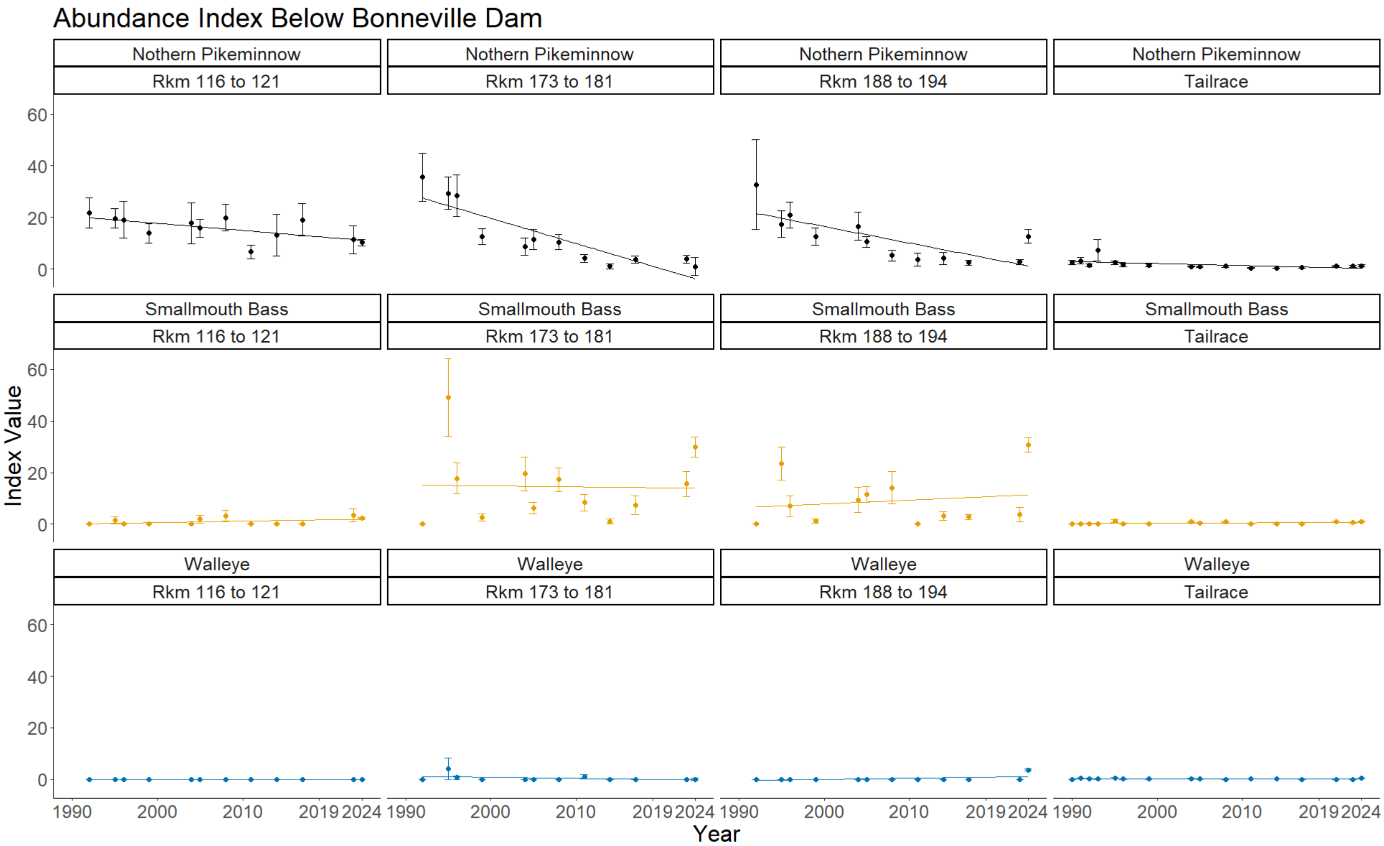

Figure 13. Spring abundance index values (mean catch per 900-s boat electrofishing scaled to surface area [ha] divided by 1,000; and SE) for Northern Pikeminnow (≥ 250 mm FL), Smallmouth Bass (≥ 200 mm FL), and Walleye (≥ 200 mm FL) Below Bonneville Dam, 1990–2024. Years without data indicate sampling was not conducted or sample sizes were insufficient for analysis.

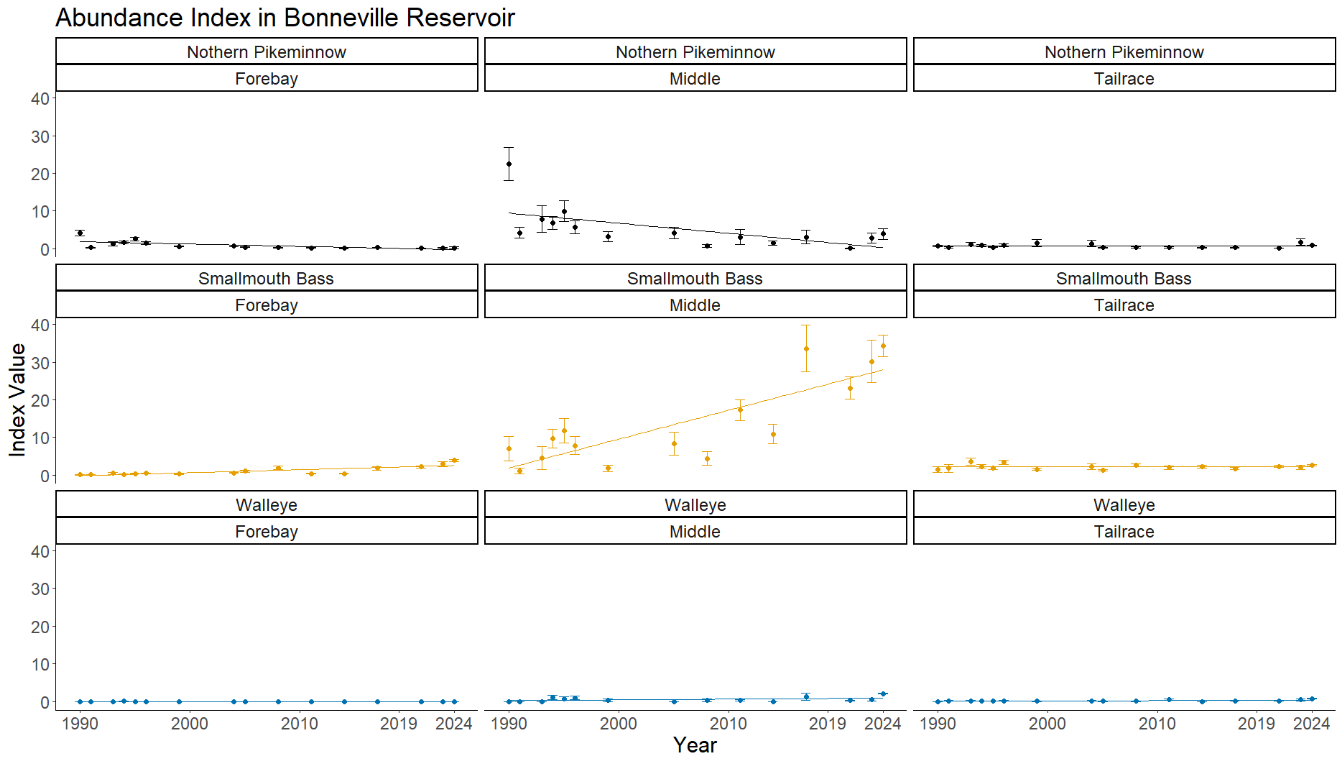

Figure 14. Spring abundance index values (mean catch per 900-s boat electrofishing scaled to surface area [ha] divided by 1,000; and SE) for Northern Pikeminnow (≥ 250 mm FL), Smallmouth Bass (≥ 200 mm FL), and Walleye (≥ 200 mm FL) in Bonneville Reservoir, 1990–2024. Years without data indicate sampling was not conducted or sample sizes were insufficient for analysis.

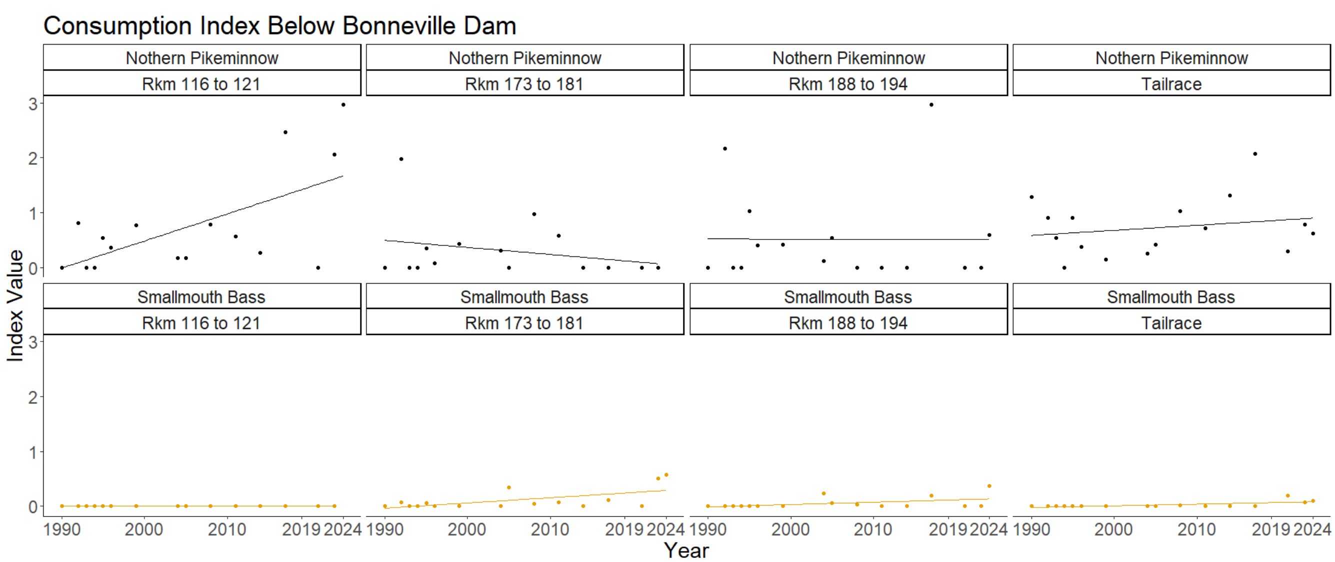

Figure 15. Annual spring consumption index values for Northern Pikeminnow (≥ 250 mm FL), and Smallmouth Bass (≥ 200 mm FL) captured during biological evaluation Below Bonneville Dam, 1990–2024. We were unable to calculate values for Walleye, due to a lack of existing predation index model for this species. Mean and SE were calculated for each location across the time series. Years without data indicate sampling was not conducted or sample sizes were insufficient for analysis.

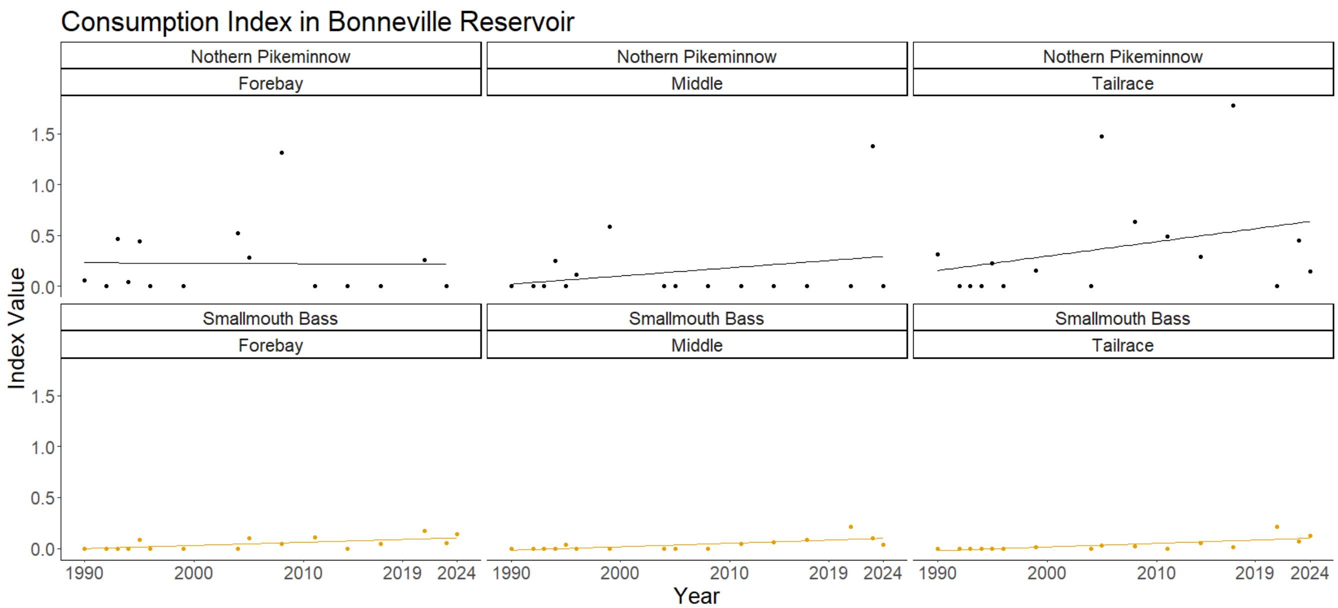

Figure 16. Annual spring consumption index values for Northern Pikeminnow (≥ 250 mm FL), and Smallmouth Bass (≥ 200 mm FL) captured during biological evaluation in Bonneville Reservoir, 1990–2024. We were unable to calculate values for Walleye, due to a lack of existing predation index model for this species. Mean and SE were calculated for each location across the time series. Years without data indicate sampling was not conducted or sample sizes were insufficient for analyses.

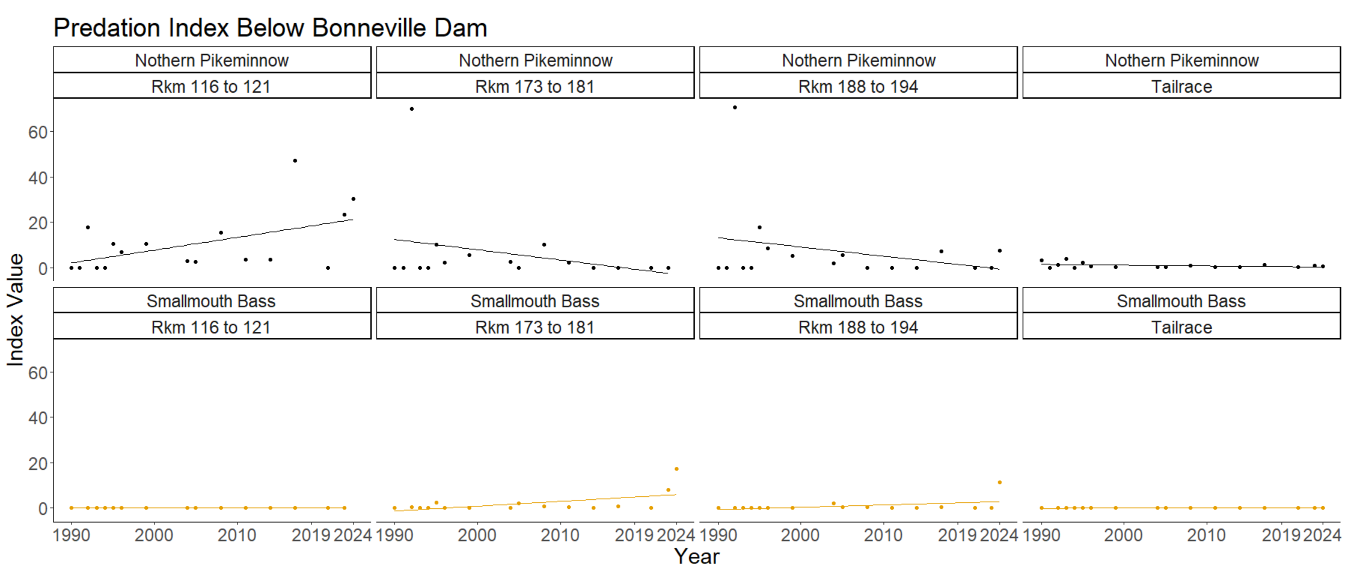

Figure 17. Annual spring predation index values for Northern Pikeminnow (≥ 250 mm FL) and Smallmouth Bass (≥ 200 mm FL) captured during biological evaluation Below Bonneville Dam, 1990–2024. We were unable to calculate values for Walleye, due to a lack of existing predation index model for this species. Mean and SE were calculated for each location across the time series. Years without data indicate sampling was not conducted or sample sizes were insufficient for analyses.

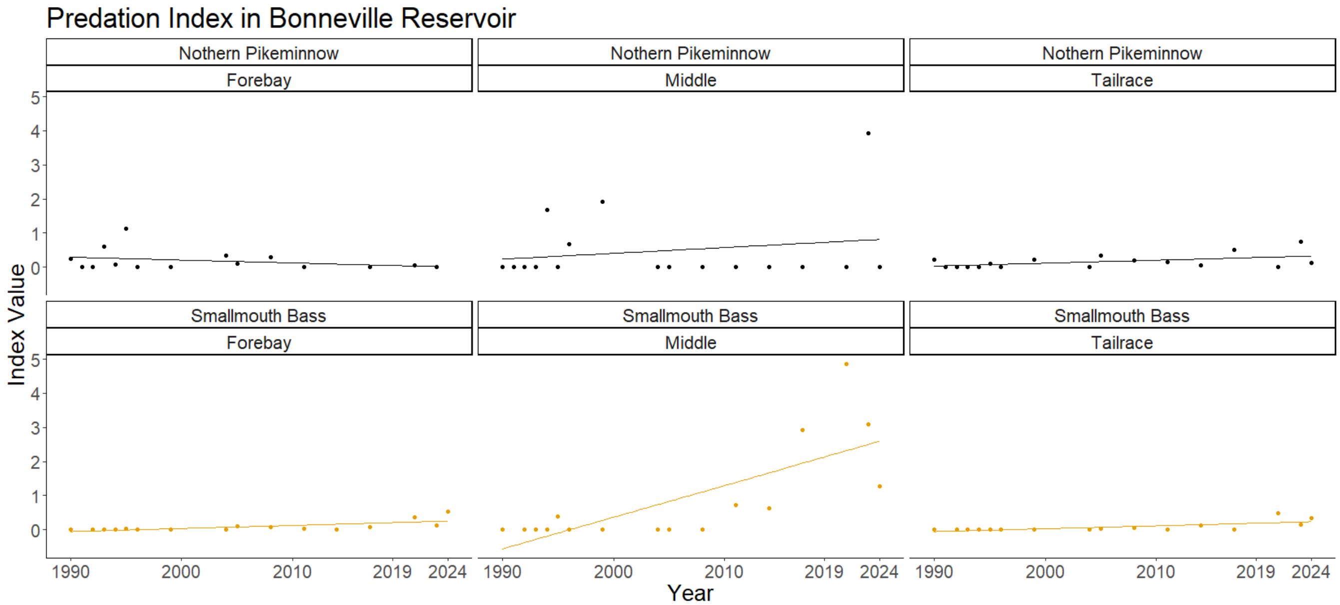

Figure 18. Annual spring predation index values for Northern Pikeminnow (≥ 250 mm FL) and Smallmouth Bass (≥ 200 mm FL) captured during biological evaluation in Bonneville Reservoir, 1990–2024. We were unable to calculate values for Walleye, due to a lack of existing predation index model for this species. Mean and SE were calculated for each location across the time series. Years without data indicate sampling was not conducted or sample sizes were insufficient for analyses.

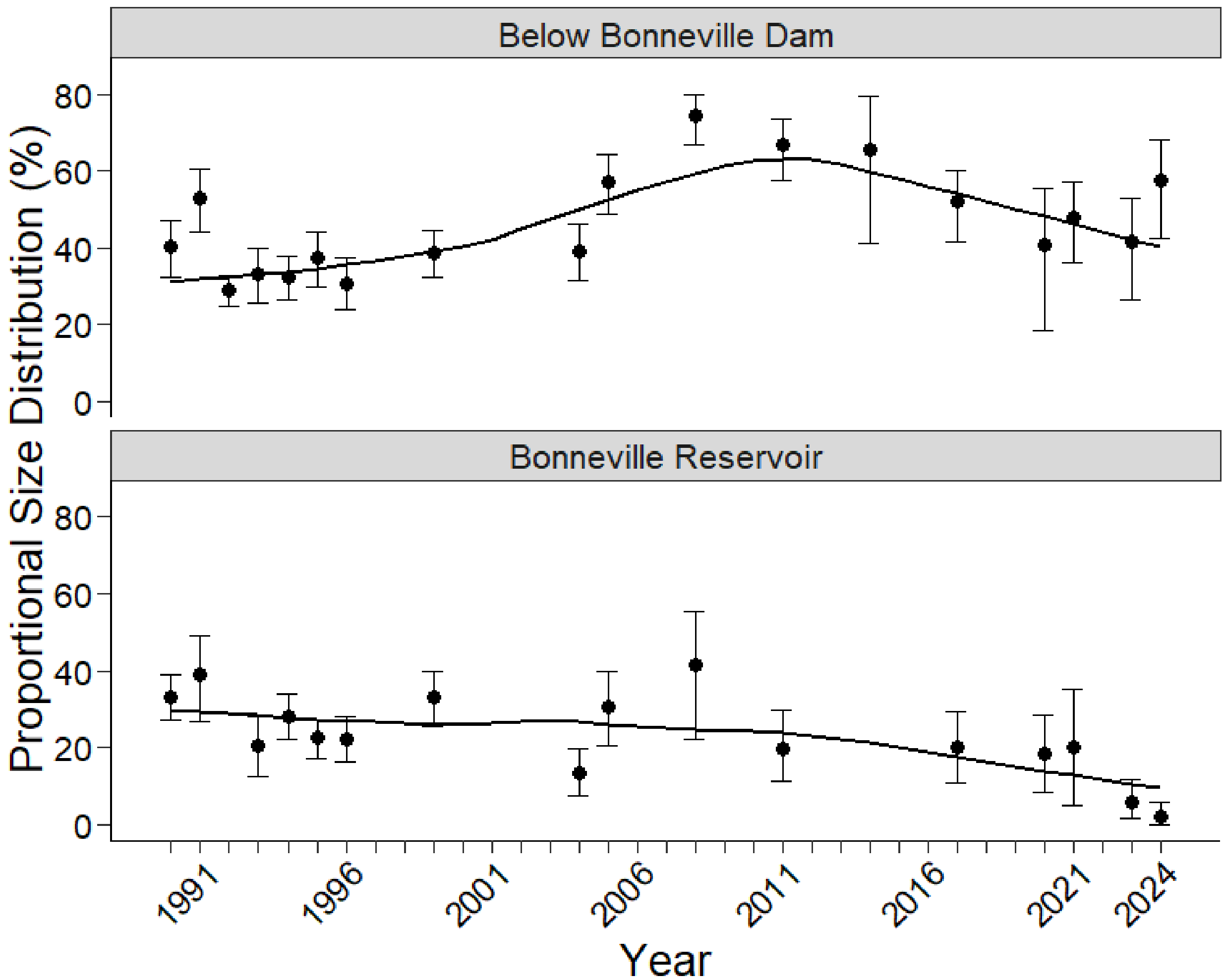

Figure 19. Estimates of proportional size distribution (PSD, %) of Northern Pikeminnow collected during biological evaluation Below Bonneville Dam and in Bonneville Reservoir, 1990–2024. Error bars represent 95% bootstrap confidence intervals. Data are fit with LOWESS curves. Years without data indicate sampling was not conducted or sample sizes were insufficient for analysis (n_s < 20).

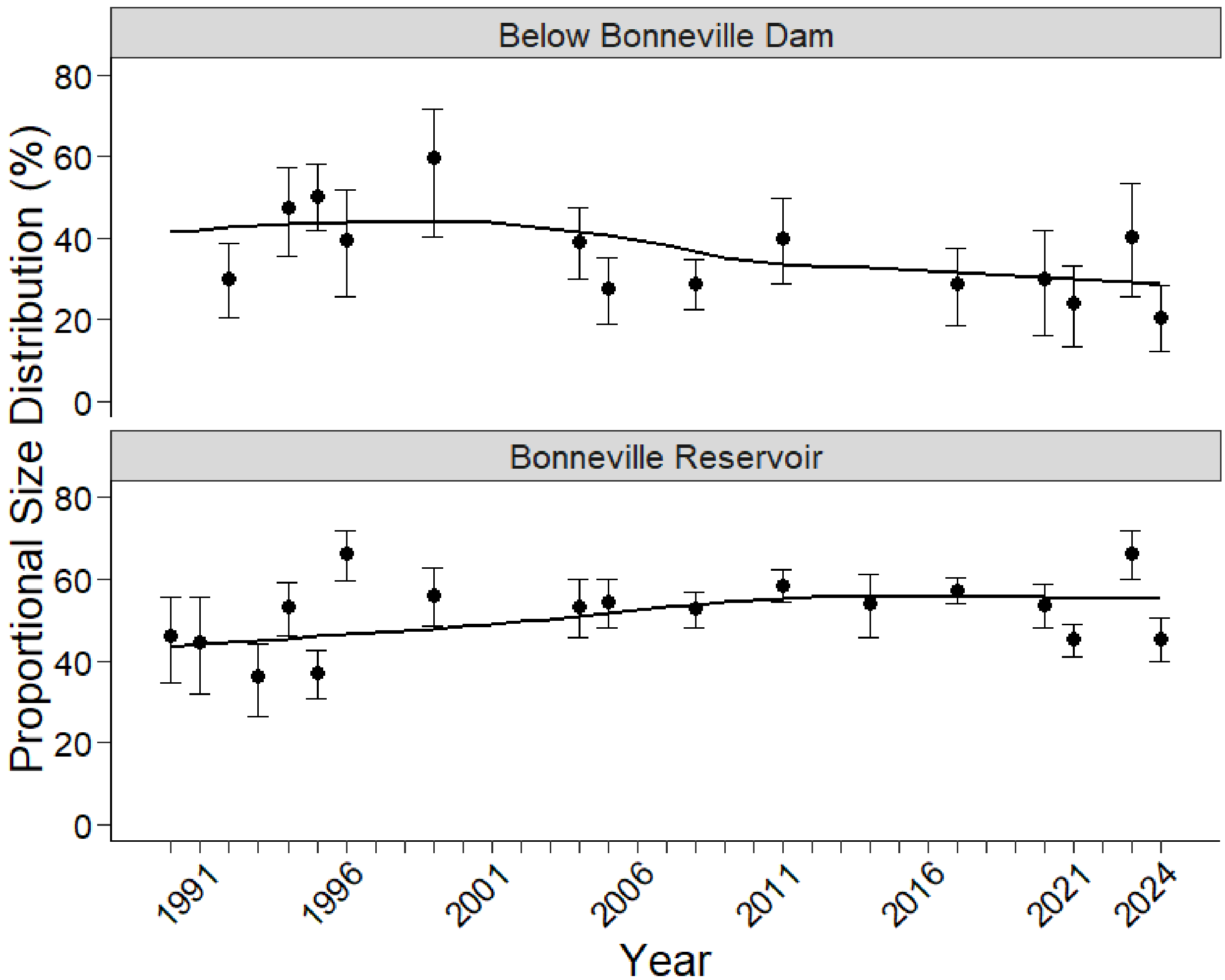

Figure 20. Estimates of proportional size distribution (PSD, %) of Smallmouth Bass collected during biological evaluation Below Bonneville Dam and in Bonneville Reservoir, 1990–2024. Error bars represent 95% bootstrap confidence intervals. Data are fit with LOWESS curves. Years without data indicate sampling was not conducted or sample sizes were insufficient for analysis (n_s < 20).

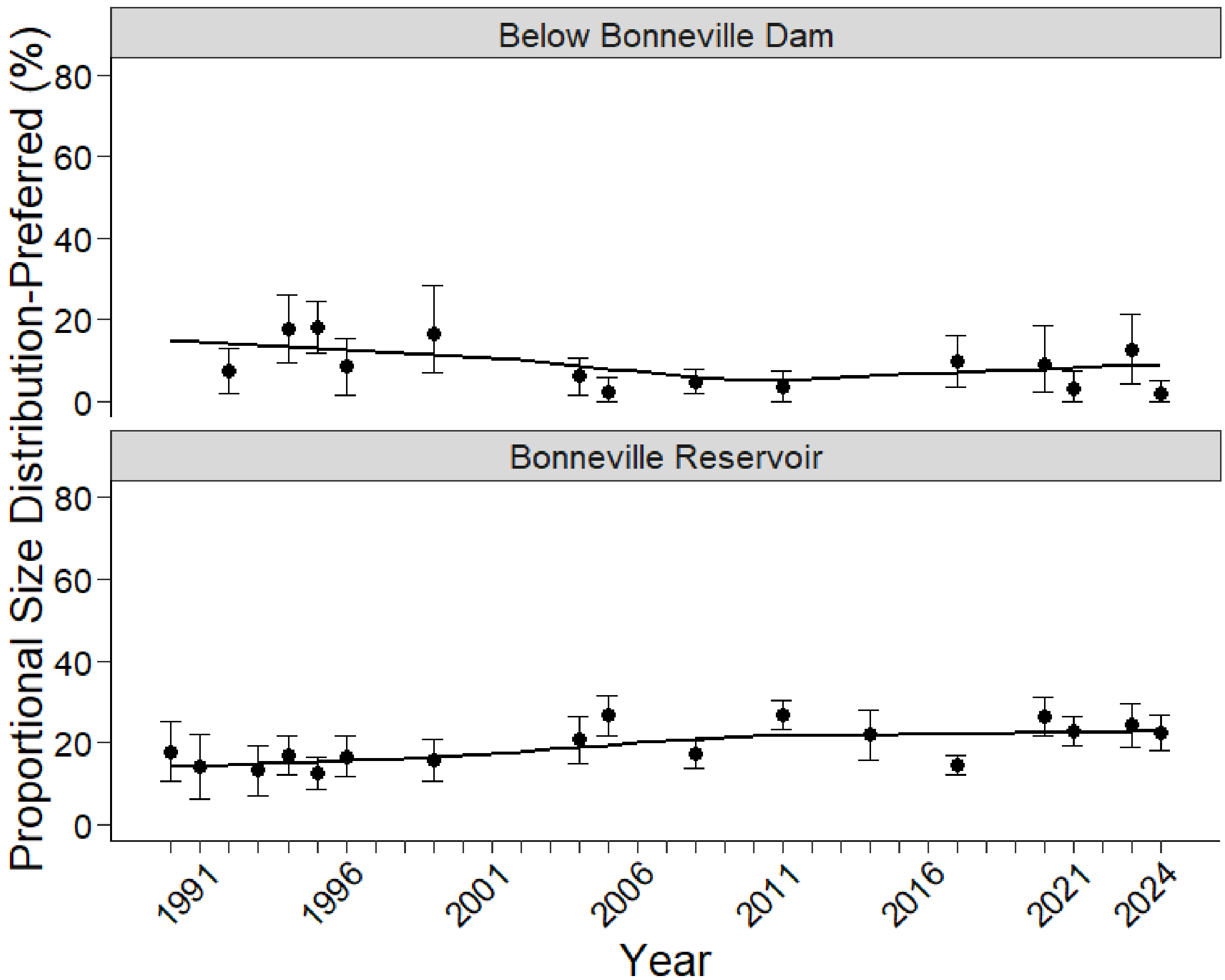

Figure 21. Estimates of proportional size distribution of preferred-length (PSD – P, %) Smallmouth Bass collected during biological evaluation Below Bonneville Dam and in Bonneville Reservoir, 1990–2024. Error bars represent 95% bootstrap confidence intervals. Data are fit with LOWESS curves. Years without data indicate sampling was not conducted or sample sizes were insufficient for analysis (n_s < 20).

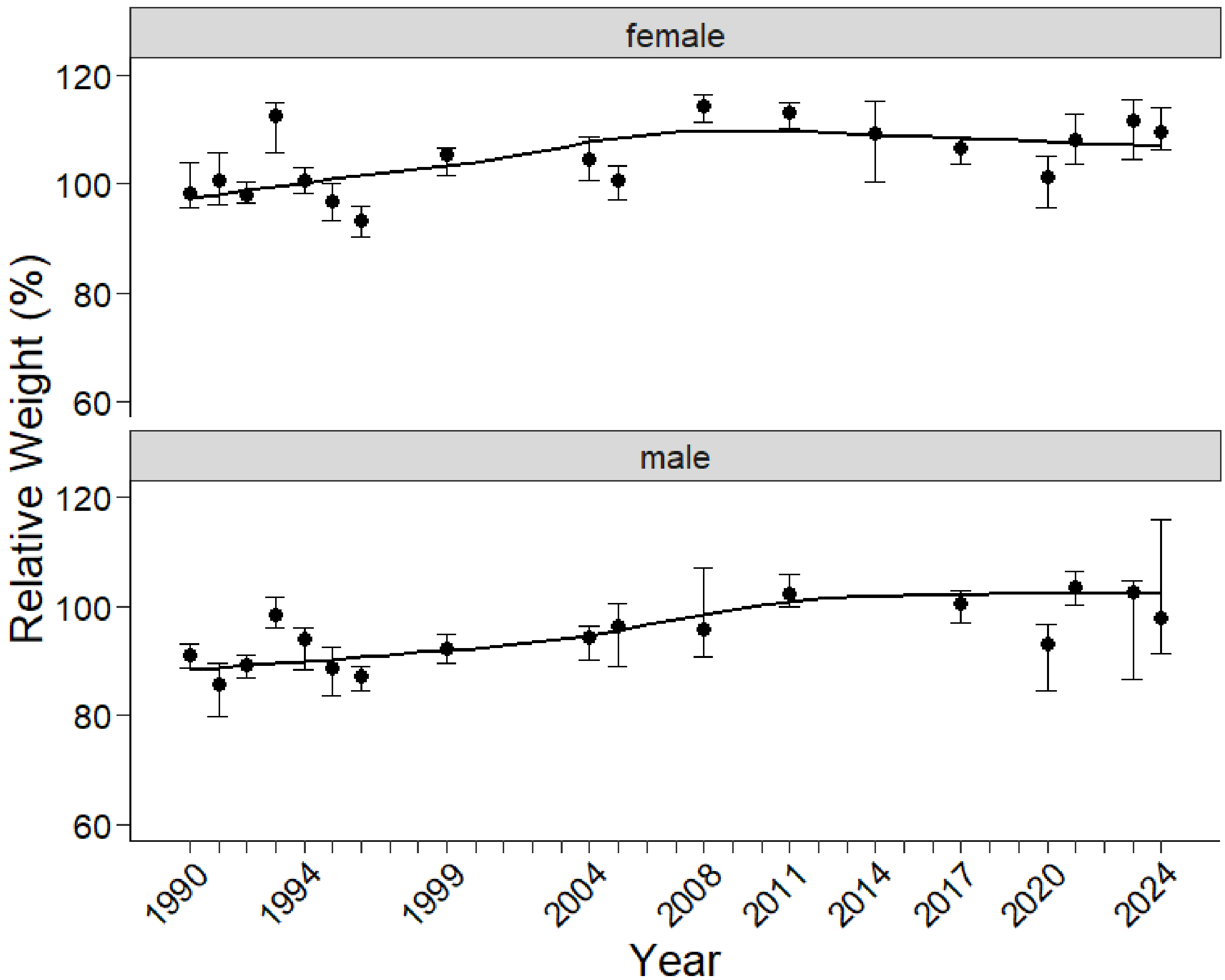

Figure 22. Median relative weight (W_r, %) of Northern Pikeminnow collected during biological evaluation Below Bonneville Dam, 1990–2024. Error bars represent 95% bootstrap (percentile) confidence intervals. Data are fit with LOWESS curves. Results from a Mann-Kendall test of monotonic trend are presented for each time-series. Years without data indicate that sampling was not conducted, or sample sizes were insufficient for analyses (n < 5).

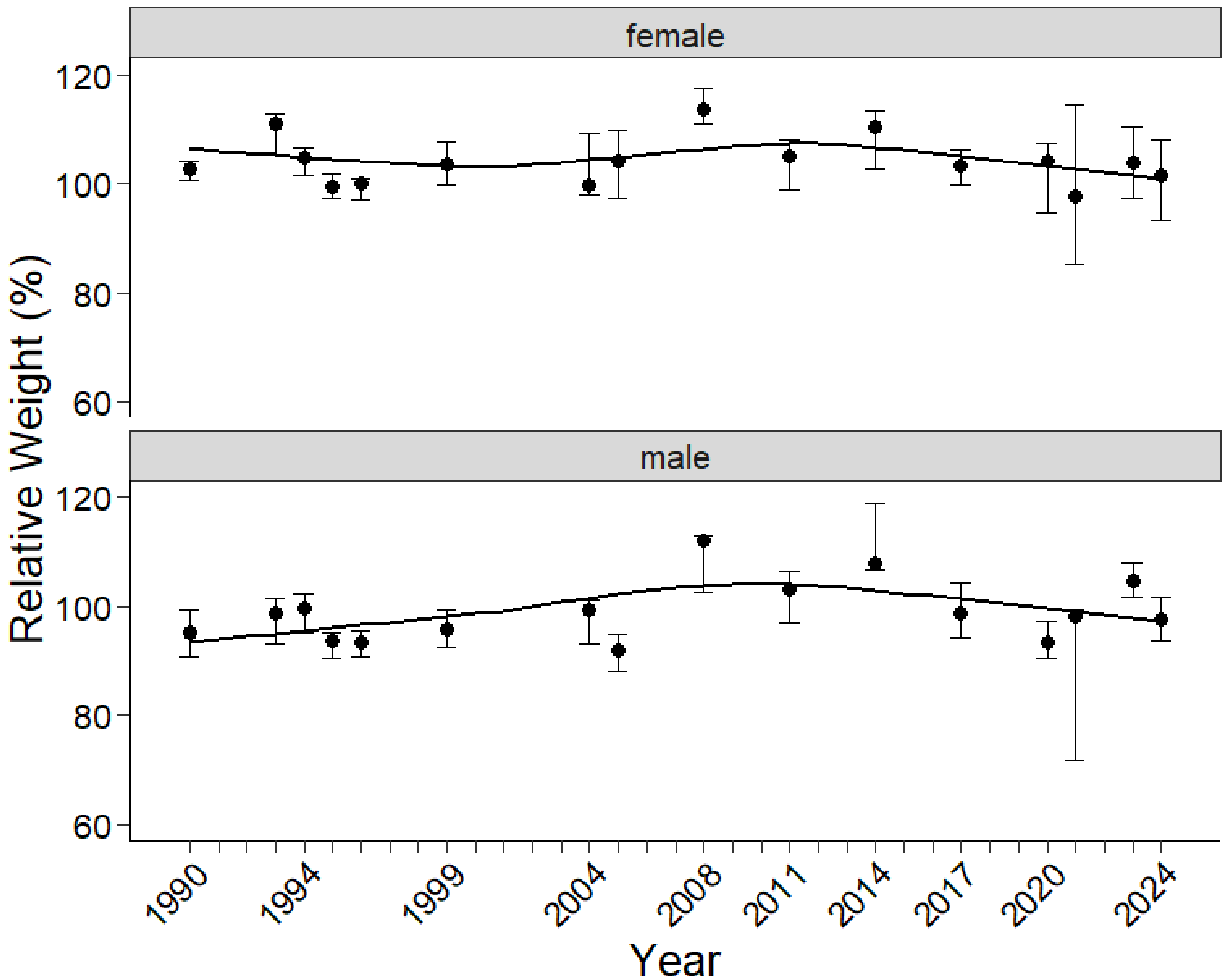

Figure 23. Median relative weight (W_r, %) of Northern Pikeminnow collected during biological evaluation in Bonneville Reservoir, 1990–2024. Error bars represent 95% bootstrap (percentile) confidence intervals. Data are fit with LOWESS curves. Results from a Mann-Kendall test of monotonic trend are presented for each time-series. Years without data indicate that sampling was not conducted, or sample sizes were insufficient for analyses (n < 5).

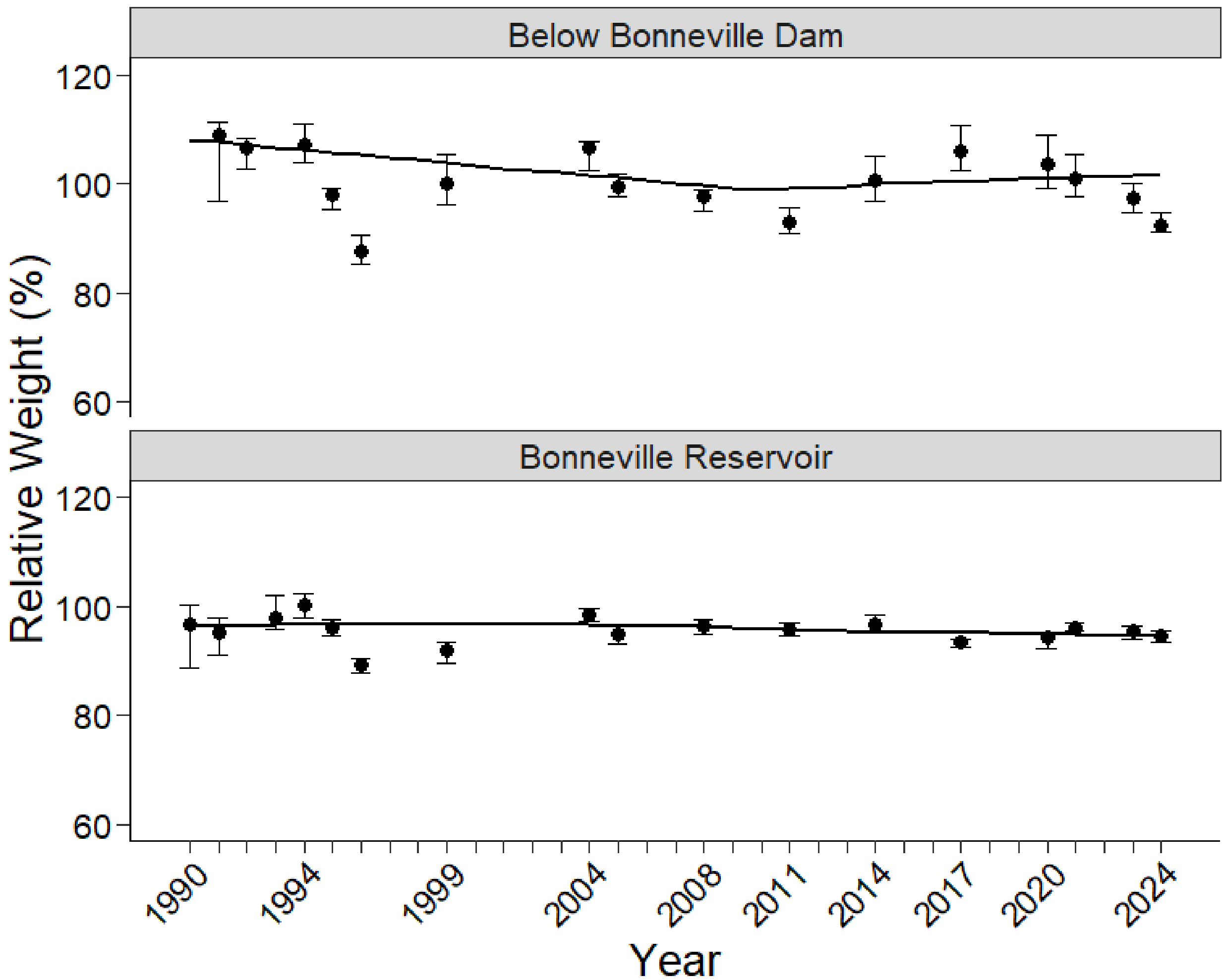

Figure 24. Median relative weight (W_r, %) of Smallmouth Bass collected during biological evaluation Below Bonneville Dam and in Bonneville Reservoir, 1990–2024. Error bars represent 95% bootstrap (percentile) confidence intervals. Data are fit with LOWESS curves. Results from a Mann-Kendall test of monotonic trend are presented for each time-series. Years without data indicate that sampling was not conducted, or sample sizes were insufficient for analyses (n < 5).

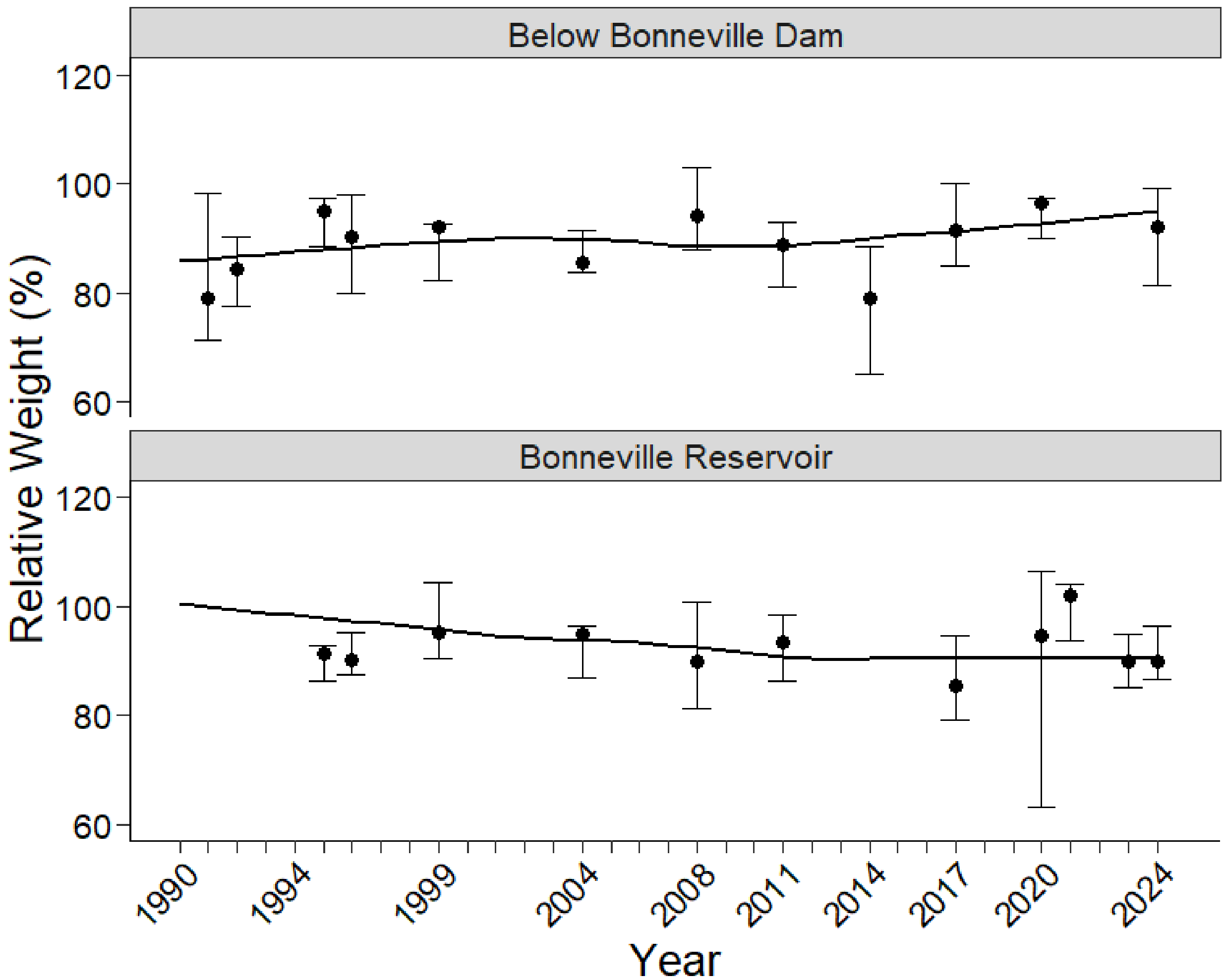

Figure 25. Median relative weight (W_r, %) of Walleye collected during biological evaluation Below Bonneville Dam and in Bonneville Reservoir, 1990–2024. Error bars represent 95% bootstrap (percentile) confidence intervals. Data are fit with LOWESS curves. Results from a Mann-Kendall test of monotonic trend are presented for each time series. Years without data indicate that sampling was not conducted, or sample sizes were insufficient for analyses (n < 5).

REPORT D

Northern Pikeminnow Dam Angling on the Columbia River

2024 Annual Report

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We appreciate the efforts of Kyle Beckley as the Pikeminnow Dam Angling crew leader, along with Steve Lines, Benjamin Veysey and Cooper Sargent who served as our 2024 dam angler crew.

We also recognize Diana Murillo and Dennis Werlau for their work on Dam Angler data entry and document verification, and Dennis Werlau for producing the Dam Angling Weekly Field Activity Reports throughout the 2024 season.

ABSTRACT

We are reporting on the 2024 Northern Pikeminnow Dam Angling component of the Northern Pikeminnow Management Program (NPMP) as implemented by the Washington Department of Fish and Wildlife (WDFW). Angling took place within the boat restricted tailrace areas of The Dalles and John Day dams during 22 weeks from April 30th through September 26th 2024. The objectives of this project were to (1) implement a recreational-type hook and line fishery harvesting Northern Pikeminnow from within the boat restricted zones (BRZs), where angling is unavailable to the public at The Dalles and John Day dams, (2) allocate Dam Angler effort between The Dalles and John Day dams based on Dam Angler CPUE in order to maximize harvest of Northern Pikeminnow, (3) collect, compile and report data on Dam Angler harvest, CPUE, gear/techniques and incidental catch for each project, (4) scan, record and report Passive Integrated Transponder (PIT) tag data from all Northern Pikeminnow, Smallmouth Bass, Walleye, and Channel Catfish caught by the Dam Angling crew and record with the presence of any external spaghetti tags, fin-clips, or signs of tag-loss from these fishes for use in coordination with other predation studies, (5) collect relevant biological data on all Northern Pikeminnow and other fishes caught by the 2024 Dam Angling crew.

A Dam Angling crew of four anglers harvested a total of 3,413 Northern Pikeminnow during the 2024 season. Of those, 1,829 Northern Pikeminnow were harvested at The Dalles Dam and 1,584 were harvested at the John Day Dam. The crew fished a total of 1,186.5 hours during the 22 week fishery, averaging 155 fish per week and for a combined overall average catch per angler hour (CPUE) of 2.9 Northern Pikeminnow. At The Dalles Dam, the crew averaged 3.1 fish per angler hour, and cumulatively 30 Northern Pikeminnow per day. At the John Day Dam, the crew averaged 2.7 fish per angler hour with a cumulative crew total of 30 fish per day.

Based on the previous success of the WDFW Dam Angling Crew in implementing the Dam Angling component of the NPMP from 2010-2023, the 2024 crew continued to use back bouncing soft plastic lures with rod and reel as the primary angling method for harvesting Northern Pikeminnow from the turbine decks of The Dalles and John Day dams. Incidental species most frequently caught by the Dam Angling crew in 2024 were Smallmouth Bass *Micropterus dolomieue* and Walleye *Sander vitreus.*

INTRODUCTION

Mortality of juvenile salmonids *Oncorhynchus spp.* migrating through the Columbia River system is a major concern of the Columbia Basin Fish and Wildlife Program, and predation is an important component of mortality (Northwest Power Planning Council 1987a). Northern Pikeminnow *Ptychocheilus oregonensis*, formerly known as northern squawfish (Nelson et al. 1998), are the primary piscine predator of juvenile salmonids in the Lower Columbia and Snake River Systems (Rieman et al. 1991). Rieman and Beamesderfer (1990) predicted that predation on juvenile salmonids could be reduced by up to 50% with a sustained exploitation rate of 10-20% on Northern Pikeminnow ≥ 275 mm FL (11 inches total length). The Northern Pikeminnow Management Program (NPMP) was created in 1990, with the goal of implementing fisheries to achieve the recommended 10-20% annual exploitation on Northern Pikeminnow ≥275 mm FL within the program area (Vigg and Burley 1989). The primary component of the NPMP is the Northern Pikeminnow Sport-Reward Fishery (NPSRF) implemented by the Washington Department of Fish and Wildlife (WDFW) (Burley et al. 1992). Beginning in 2010, WDFW was also contracted to conduct the Dam Angling component of the NPMP (Hone et al. 2011) and 2024 marked the 15th consecutive year WDFW has implemented this component. The Dam Angling component of the NPMP utilized a 3-4 person crew of experienced anglers using recreational-type hook and line angling techniques to harvest Northern Pikeminnow from within the boat-restricted zones (BRZ's) below The Dalles and John Day dams on the Columbia River in 2024.

The objectives of the 2024 Dam Angling component of the NPMP were to (1) implement a recreational-type hook and line fishery targeting Northern Pikeminnow (and harvesting incidentally caught non-native predator fishes) from within the boat restricted zones (BRZs), where angling is unavailable to the public at The Dalles and John Day dams, (2) allocate Dam Angler effort between The Dalles and John Day dams based on Dam Angler CPUE in order to maximize harvest of predatory Northern Pikeminnow, (3) collect, compile and report data on angler harvest, CPUE, gear/techniques and incidental catch for each project, (4) scan, record and report Passive Integrated Transponder (PIT) tag data from all Northern Pikeminnow, Smallmouth Bass, Walleye and Channel Catfish caught by the Dam Angling crew and record the presence of any external spaghetti or Floy tags, fin-clips or signs of tag-loss from these fishes for use in coordination with other predation studies, and (5) collect relevant biological data on all Northern Pikeminnow and other fishes caught by the 2024 Dam Angling crew.

METHODS

Project Area

In 2024, as a continuing supplemental component to the NPMP, Northern Pikeminnow hook-and-line removal activities were conducted at The Dalles and John Day Dams on the Columbia River utilizing a Dam Angling crew (Figure 1). Dam Angling activities in 2024 were planned to occur during an approximately five-month season scheduled to run from May through September. All angling activities at both The Dalles, and John Day Dams were conducted within the tailrace BRZs where no public angling is permitted. For The Dalles Dam, the Dam Angling crew fished primarily along the turbine deck (Figure 2), and at the John Day Dam, the crew fished exclusively along the turbine deck (Figure 3).

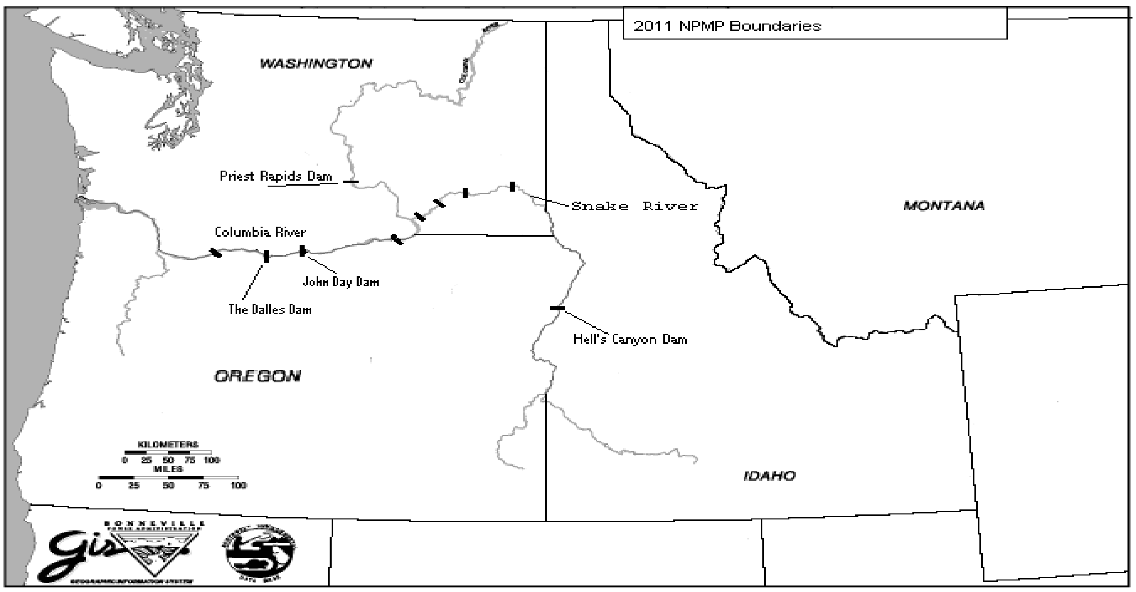

Figure 1. Northern Pikeminnow Management Program boundaries, including 2024 Dam Angling sites.


Figure 2. Angling locations for 2024 Dam Angling at The Dalles Dam

Figure 3. Angling locations for 2024 Dam Angling at the John Day Dam

The Dam Angling Season

In order to achieve the primary project objective of maximizing harvest of predatory Northern Pikeminnow in 2024, the WDFW Dam Angling crew continued to use WDFW's Dam Angling Strategy (DAS) established in 2011 (Dunlap et al. 2012), which implemented and maintained full scale angling activities when CPUE was $\geq$ 2.0 fish/angler hour, and reduced scale angling activities when CPUE fell below 2.0 fish/angler hour.

The Dam Angling Crew

The 3-4 member Dam Angling crew generally worked four ten hour days a week, (usually Tuesday - Friday) during the 2024 season (Figure 4). Angling start times in the morning varied from approximately 4:30 am to 6:00 am at The Dalles Dam and from 5:00 am to 6:00 am at the John Day Dam. Evening start times ranged from 6:00 pm to 1:00 am. A crew leader was present each day to oversee angler safety and crew supervision, to collect, record and compile data on Northern Pikeminnow harvest, other fish species caught, and ensure that all NPMP project protocols and Corps of Engineers (USACE) rules were adhered to.

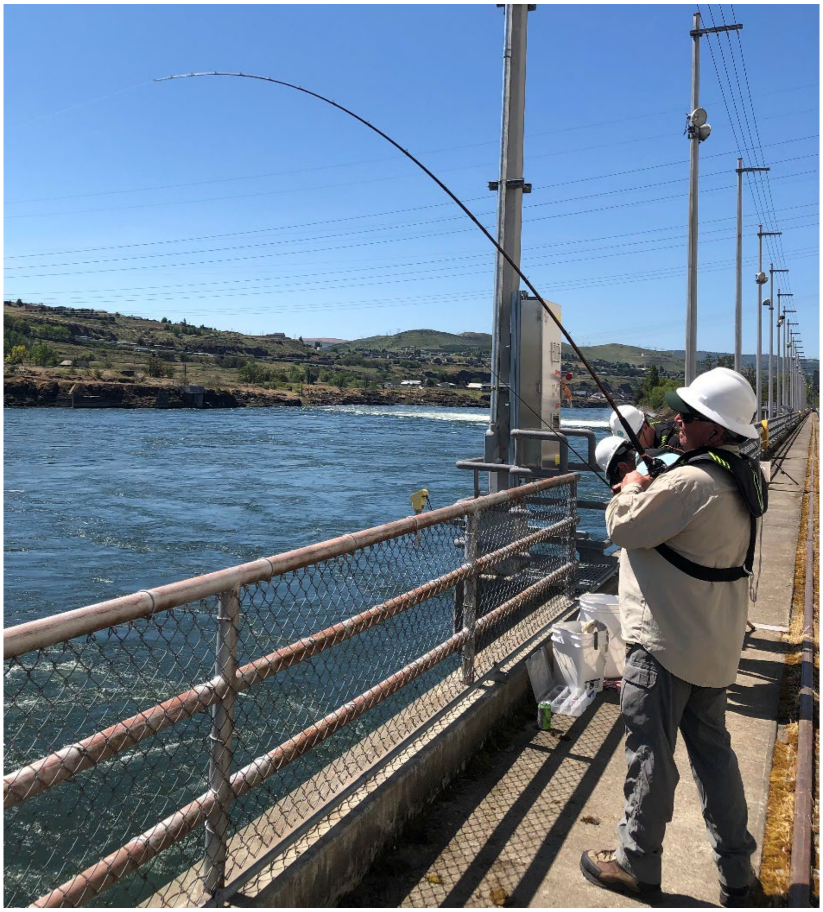

Figure 4. The Dam Angling Crew at John Day Dam

Angling Gear

Dam Anglers used Berkley Air IM8 Graphite 10'6" (2-8 oz. extra heavy casting) rods equipped with either Daiwa Lexa_HD 300 or Shimano TranX 300 series reels. Each reel was spooled with either 15# or 20# test braided main line (Power Pro), tied to a size 7 barrel swivel and a 24"-30" monofilament leader of 15-20# Maxima (Figure 5). Cannonball sinkers were attached to the swivel using a 4-6" dropper line of 12# monofilament leader. Cannonball weights varied from 2-6 ounces depending on river flow. Terminal gear consisted primarily of assorted soft plastic lures rigged with two octopus style hooks (size 1 to 1/0 Gamakatsu hooks) spaced at 1 1/8" apart (Figure 6). Hook size varied in order to match the size of the soft plastic lure. Soft plastic lures used were in the 2-5" size range and included tubes, flukes, grubs and sassy shad.

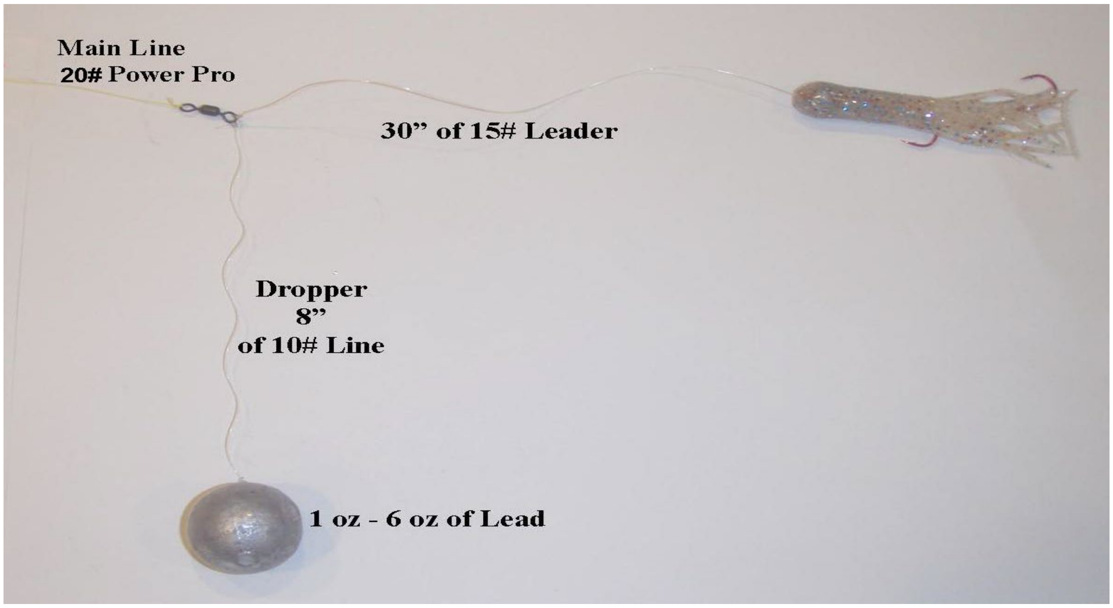

Figure 5. Example of typical rigging used by 2024 NPMP Dam Anglers

Figure 6. Examples of soft plastic tube lures used by 2024 NPMP Dam Angling Crew.

Data Collection

Creel data were recorded onto data sheets for each individual angler and for each angling day. Angler data sheets were then combined and summarized into daily crew totals, which were then combined into weekly crew totals submitted for each of the two projects (The Dalles and John Day dams). Collected data included total angling hours of effort per angler, Northern Pikeminnow harvest per angler, incidental catch per angler, location and hour of all caught fishes by angler, as well as specific lures used (and number of fish caught with each color/type lure by angler. Weekly catch and harvest totals (by project) for Dam Anglers were submitted to PSMFC using a Weekly Field Activity Report (WFAR) as is done for the NPSRF.

Biological Sampling

Fork lengths (FL) of all Northern Pikeminnow harvested by the Dam Angling crew were recorded on biological data sheets provided by the NPSRF. Technicians also examined all Northern Pikeminnow for the presence of external tags (spaghetti, Floy, etc.), fin-clip marks, and signs of tag-loss. Complete biological data were collected from all externally tagged Northern Pikeminnow including FL, tag number, sex (determined by evisceration), and scale samples if specified. Spaghetti or Floy tagged Northern Pikeminnow carcasses were then labeled and preserved for later data verification and/or tag recovery. External tags from harvested Northern Pikeminnow along with biological data were recorded on NPSRF tag envelopes and all tag data were submitted to WDFW Tag Lead Biologist for processing. Processed tag recovery data were then provided to ODFW for utilization in NPMP exploitation estimates.

PIT Tag Detection

All Northern Pikeminnow collected by Dam Anglers during 2024 were also scanned for Passive Integrated Transponder (PIT) tags. PIT tags have been used by ODFW as a secondary mark in all Northern Pikeminnow fitted with external spaghetti or Floy type tags (beginning in 2003) as part of the NPMP's biological evaluation activities (Takata and Koloszar 2004), and as a primary mark beginning in 2022. Northern Pikeminnow harvested by anglers participating in the NPSRF have also been found to ingest juvenile salmonids which have been PIT tagged by other studies within the basin (Glaser et al. 2001). Dam Angling technicians were required to scan 100% of all harvested Northern Pikeminnow for PIT tags using Biomark portable transceivers (model #HPR.PLUS.04V1). Technicians also scanned all incidental catches of Walleye, Smallmouth Bass and Channel Catfish for PIT tags from ingested juvenile salmonids. Scanning began on the first day of dam angling and continued throughout the duration of dam angling activities. Technicians individually scanned all Northern Pikeminnow for PIT tag presence, and complete biological data were recorded from all Northern Pikeminnow with positive readings. All Northern Pikeminnow with PIT tags were labeled and preserved for later dissection and tag recovery. All PIT tag data were verified after recovery of PIT tags by WDFW Tag Lead Biologist, entered into the PIT Tag Information System (PTAGIS) and provided to ODFW as required.

Northern Pikeminnow Processing

During biological sampling, all Northern Pikeminnow were caudal clipped as an anti-fraud measure to reduce the possibility of previously processed Northern Pikeminnow being submitted to the Sport-Reward Fishery for payment. Sampled Northern Pikeminnow were iced and transported to cold storage facilities from which they were ultimately delivered to rendering facilities for final disposal.

RESULTS AND DISCUSSION

Combined The Dalles / John Day Dam Findings

2024 Dam Angling Season

The 2024 Dam Angling Season took place from April 30th through September 26th. Total harvest for The Dalles and John Day dams combined was 3,413 Northern Pikeminnow in 2024 compared to 2,946 in 2023 (Shirley et al. 2024). There were 1,186.5 angling hours spent conducting Dam angling in 2024 with a combined angler CPUE of 2.9 fish per angler hour. Peak weekly harvest occurred in week 26 (Figure 7). The Dam Angling crew first achieved the 2.0 CPUE goal per DAS protocol (Dunlap et al. 2012) in week 19 during the 2024 season (2nd week) and maintained that CPUE level through week 32 (Figure 8). Weeks when CPUE was below the 2.0 fish/angler hour goal were typically due to deployment of limited crews (< 50% effort) for "prospecting" purposes to locate and/or determine if catchable numbers of fish were present and/or available in order to schedule additional angling effort.

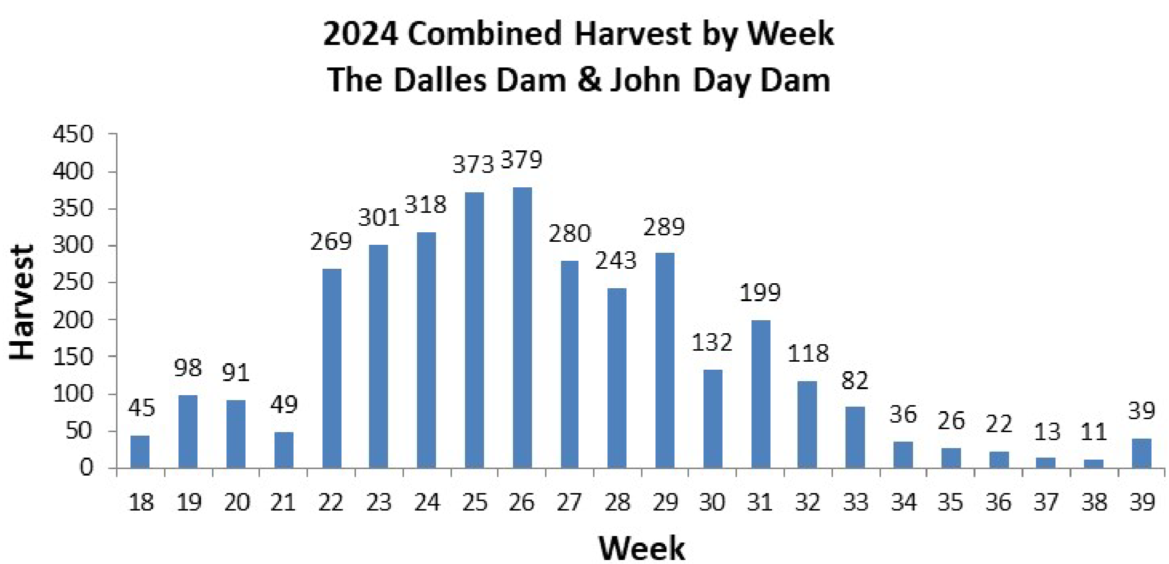

Figure 7. 2024 Weekly harvest of The Dalles (TD) and John Day (JD) Dams combined

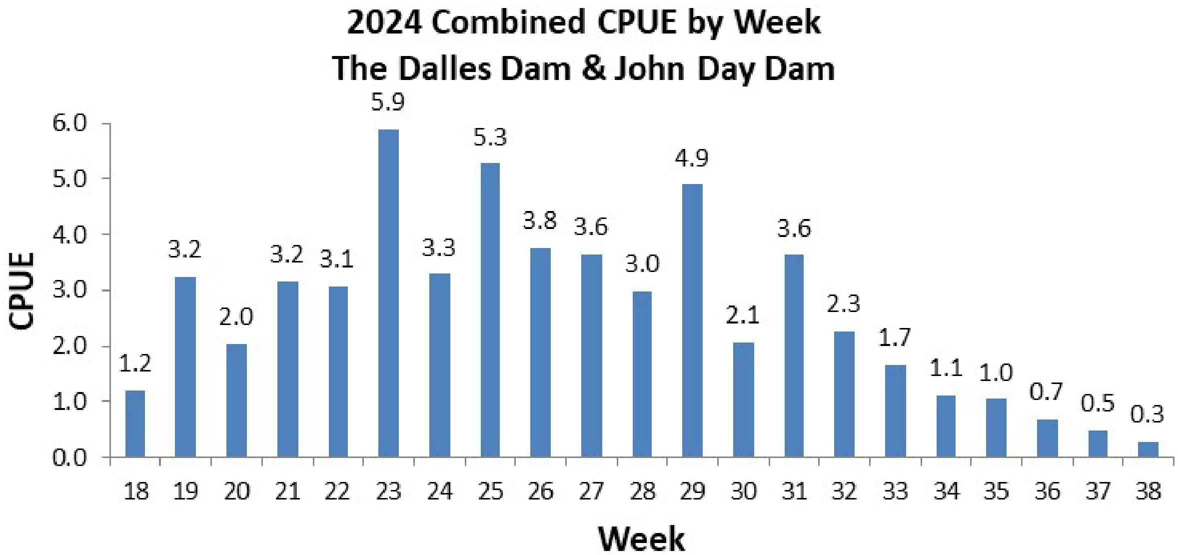

Figure 8. 2024 Combined Weekly CPUE (fish/angler hour) for The Dalles (TD) and John Day (JD) Dams.

Angling Gear and Technique

The 2024 Dam Angling crew primarily targeted fishing areas and fishing times at each dam that had been productive in past years. This consisted primarily of fishing from the turbine deck during early morning and evening hours. Our top producing lure in 2024 was the 3.75” Gitzit tube (a soft plastic lure) in Smoke/Black Copper Glitter color.

Incidental Catch

The Dam Angling crew incidentally caught the fish species listed in Table 1 while targeting Northern Pikeminnow at The Dalles and John Day dams in 2024. Data from all incidentally caught fish were recorded and all incidentally caught fish other than Smallmouth Bass, Walleye, and Channel Catfish were released in 2024. All Smallmouth Bass, Walleye and Channel Catfish were harvested and removed according to the WDFW Non-native Predator Policy approved by the Washington Fish and Wildlife Commission (wdfw.wa.gov). Incidental species most often caught in 2024 were Walleye *Sander vitreus and* Smallmouth Bass *Micropterus dolomieue*. The Dam Angling crew also continued to observe numbers of juvenile lamprey *Entosphenus* spp. and/or *Lampetra* spp. regurgitated by Northern Pikeminnow, Smallmouth Bass and Walleye caught at The Dalles Dam and John Day Dam during May and June 2024 (figure 9).

Figure 9. Juvenile lamprey regurgitated by Northern Pikeminnow

Table 1. 2024 WDFW Dam Angler incidental catch by project

Incidental Catch

Species	The Dalles Dam	John Day Dam
Smallmouth Bass	288	953
Walleye	21	147
Sculpin	8	1
American Shad	4	15
Channel Catfish	0	4

The Dalles Dam

Harvest

The Dam Angling crew harvested 1,829 Northern Pikeminnow in 22 weeks of Dam Angling at The Dalles Dam in 2024. Weekly harvest for the Dam Angling crew averaged 83 fish per week during the 2024 season (Figure 10).

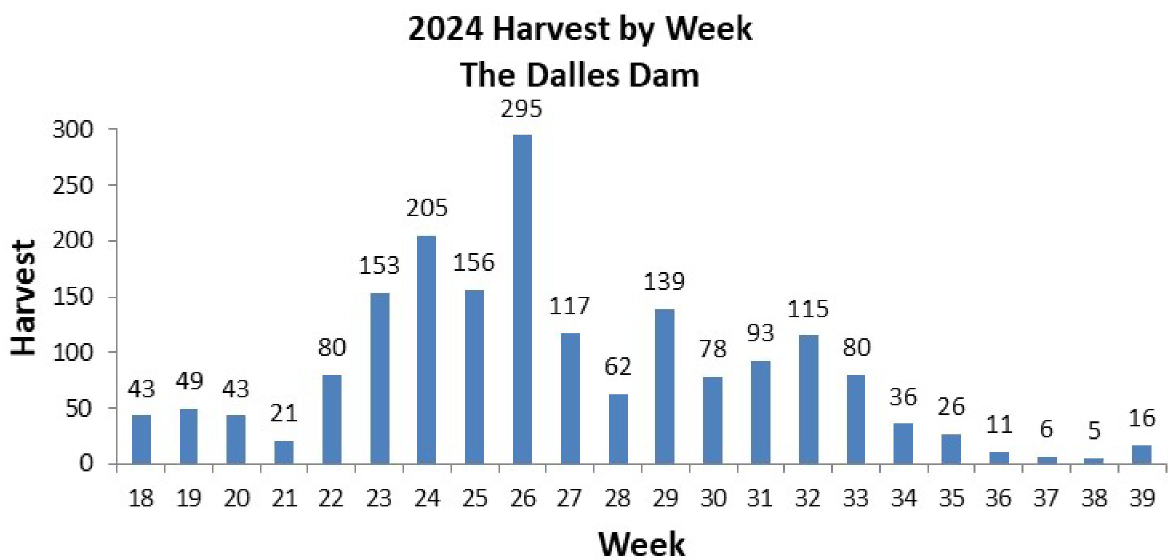

Figure 10. 2024 Weekly Dam Angler harvest of Northern Pikeminnow at The Dalles Dam

Effort

The Dam Angling crew fished 62 days at The Dalles Dam over 22 weeks at The Dalles Dam in 2024, expending 594.3 angler hours of effort in 2024. This equaled 50% of the combined effort total for Dam Angling at both projects in 2024.

CPUE

The Dam Angling crew harvested 1,829 Northern Pikeminnow in 594.3 angler hours at The Dalles Dam in 2024 for an overall average CPUE of 3.1 fish/angler hour (Figure 11). Peak weekly CPUE at The Dalles Dam occurred during week 29.

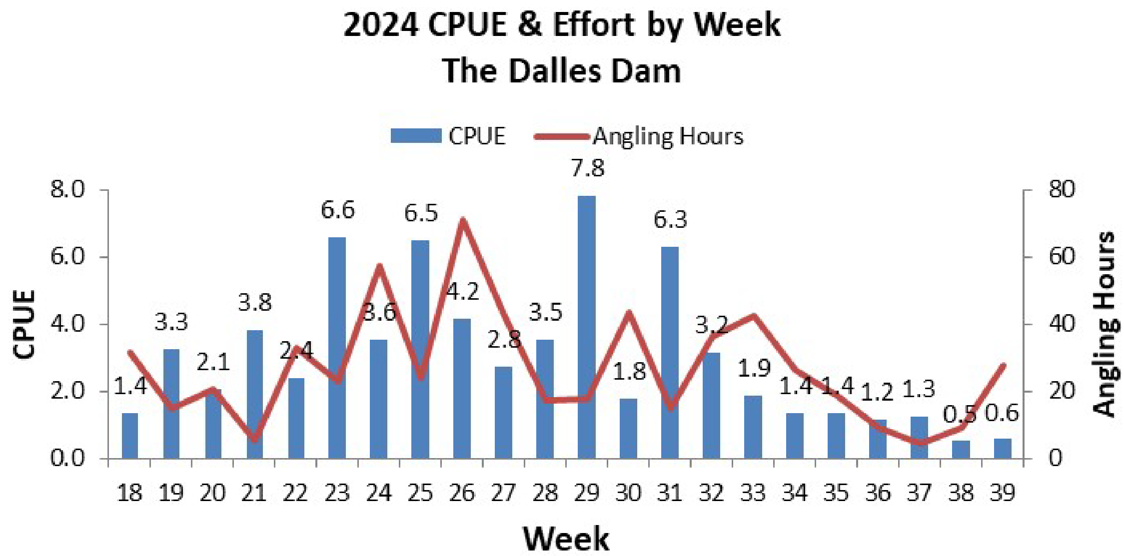

Figure 11. 2024 Weekly Dam Angler CPUE and Effort at The Dalles Dam

Fork Length Data

Fork lengths were recorded from 1,829 (100%) Northern Pikeminnow harvested by the Dam Angling crew at The Dalles Dam during the 2024 Season. The length frequency distribution of Northern Pikeminnow harvested at The Dalles Dam in 2024 is presented in Figure 12. Mean fork length for Northern Pikeminnow caught at The Dalles Dam in 2024 was 339 mm. By comparison, mean fork length for Northern Pikeminnow from the John Day Dam was 377 mm and mean fork length for the 2024 NPSRF was 261 mm (Shirley et al. 2025).

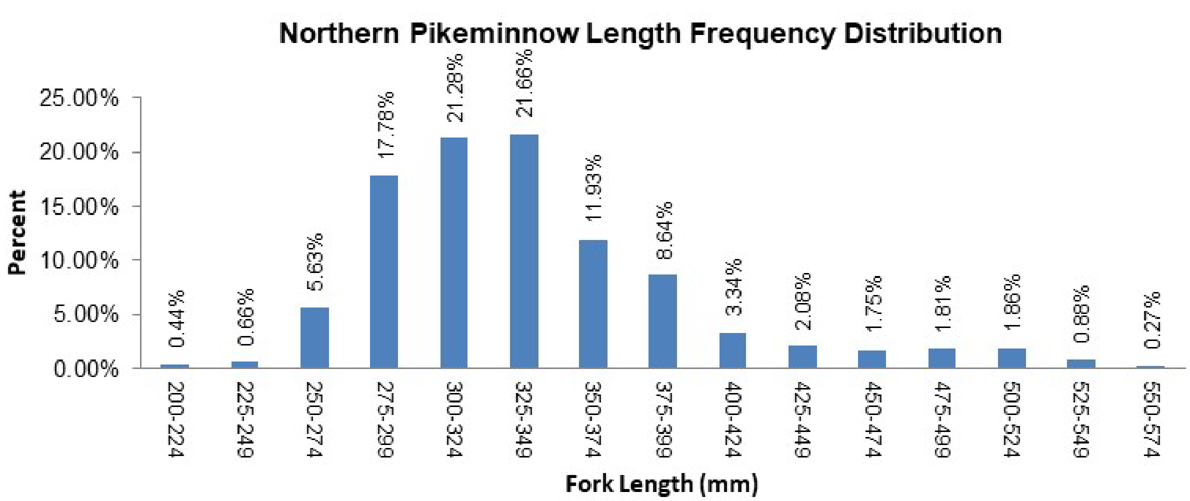

Figure 12. Northern Pikeminnow length frequency distribution at The Dalles Dam in 2024

John Day Dam

Harvest

The Dam Angling crew harvested 1,584 Northern Pikeminnow over 22 weeks at the John Day Dam in 2024, with peak weekly harvest occurring in week 25 (Figure 13).

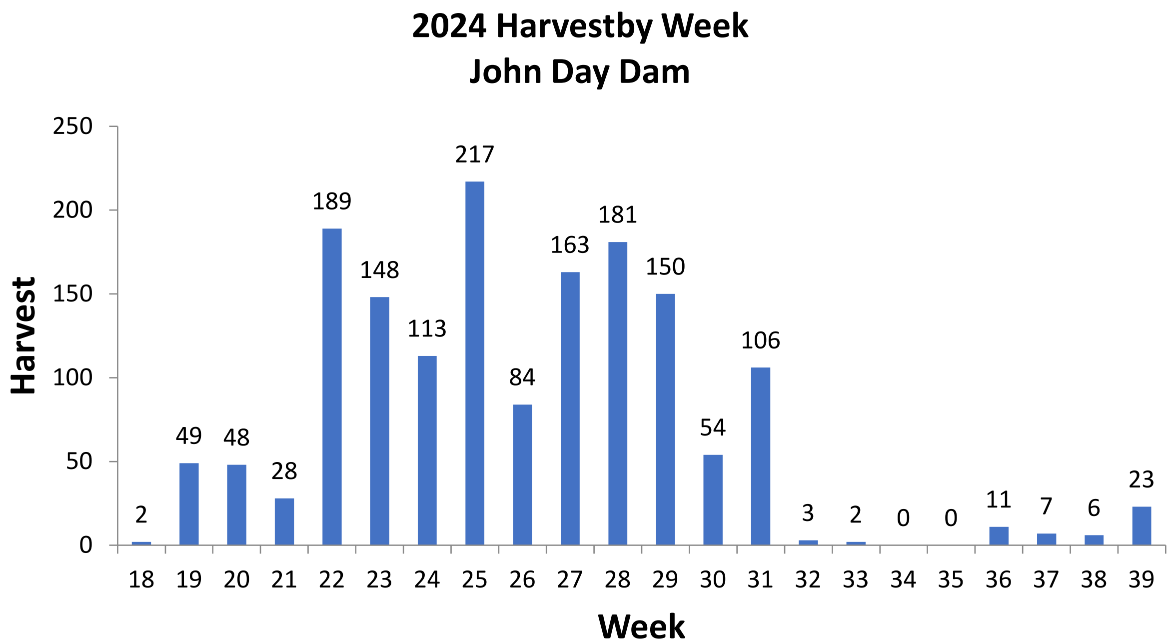

Figure 13. 2024 Weekly Dam Angler harvest of Northern Pikeminnow at the John Day Dam

Effort

The Dam Angling crew fished 52 days at John Day Dam over 22 weeks in 2024, expending 592.3 angler hours of effort. This equaled 50% of total combined Dam Angling effort for both projects in 2024.

CPUE

The Dam Angling crew harvested 1,584 Northern Pikeminnow in 592.3 angler hours at the John Day Dam in 2024 for an overall average CPUE of 2.7 fish/angler hour (compared to 3.1 at The Dalles Dam). Peak weekly CPUE at the John Day Dam occurred during week 23 (Figure 14).

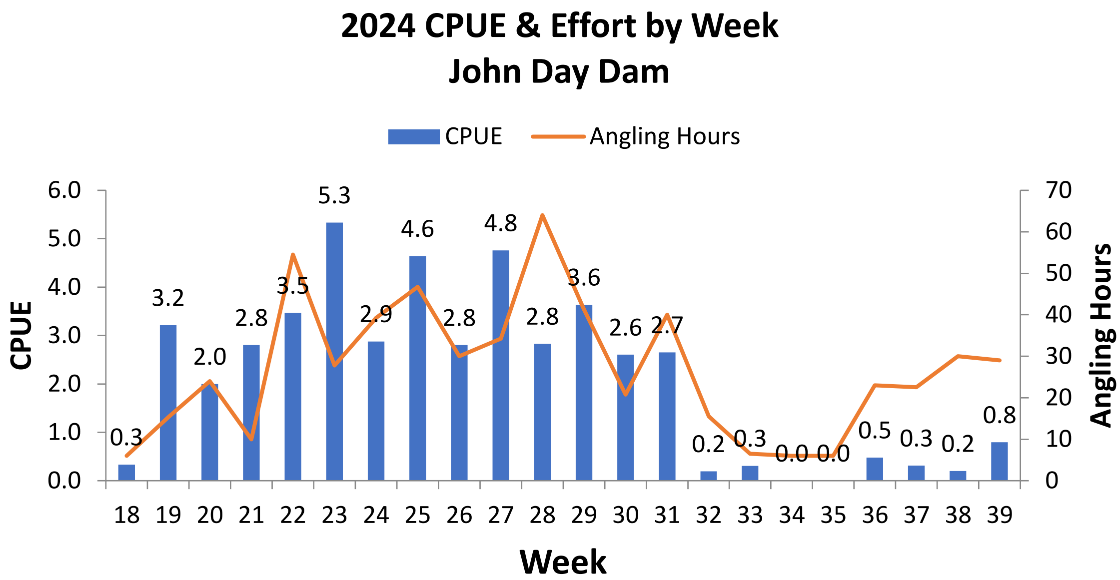

Figure 14. 2024 Weekly Dam Angling CPUE at John Day Dam

Fork Length Data

Fork lengths were recorded from 1,536 (97%) Northern Pikeminnow harvested by the Dam Angling crew at the John Day Dam during the 2024 Season. The length frequency distribution of harvested Northern Pikeminnow from the John Day Dam in 2024 is presented in (Figure 15). Mean fork length for Northern Pikeminnow from the John Day Dam in 2024 was 377 mm compared to 339 mm at The Dalles Dam, and 261 mm for the 2024 NPSRF (Shirley et al. 2025).

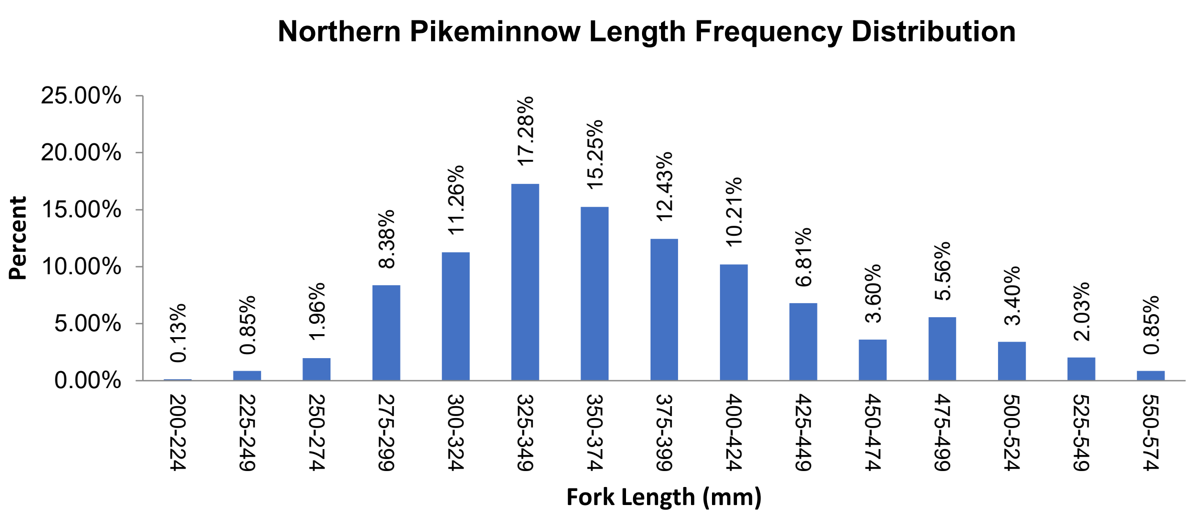

Figure 15. Northern Pikeminnow length frequency distribution at the John Day Dam in 2024

SUMMARY

Combined harvest was 3,413 compared to 2,946 in 2023. During the core harvest period of May-July 2024(weeks 19-31), Dam Angling harvest remained above the 2.0 CPUE goal at both The Dalles and John Day dams (except for the 1.8 CPUE during week 30 at The Dalles Dam).

Mean Fork lengths for Northern Pikeminnow harvested by the 2024 Dam Angling Crew at The Dalles and John Day dams were considerably larger than the mean fork length for the NPSRF with the mean of 339 mm at The Dalles Dam, and 377 mm at the John Day Dam, versus 261 mm from the 2024 NPSRF.

While targeting Northern Pikeminnow, the 2024 Dam Angling crew incidentally harvested and removed a combined total of 1,241 Smallmouth Bass, 168 Walleye, and 4 Channel Catfish. The Dam Angling crew also caught and released 19 American Shad and 9 Sculpin between the two projects.

RECOMMENDATIONS FOR 2025

1.) Maintain the Dam Angling component of the NPMP to remove predatory Northern Pikeminnow from the Boat Restricted Zones in the tailrace areas of The Dalles and John Day dams where Northern Pikeminnow Sport-Reward Fishery participants are not allowed.

2.) Continue to investigate and further develop Northern Pikeminnow angling techniques in 2025 such as finding additional exploitation opportunities of Northern Pikeminnow in areas not previously fished or currently fishable.

3.) Continue retaining and removing incidentally caught Smallmouth Bass, Walleye, and Channel Catfish according to WDFW's Non-Native Predator Policy.

4.) Plan for 2025 Dam Angling activities to occur during the standard May-September Dam Angling season with a focus on maximizing Dam Angler effort during peak CPUE weeks.

5.) Continue to utilize the 2.0 CPUE goal (DAS) to allocate Dam Angler effort between projects in order to maximize angler harvest of Northern Pikeminnow.

6.) Continue to use HPR PIT tag scanners for scanning other incidentally caught predator fishes for PIT tags and improve data collection in the areas of enumerating juvenile lamprey encountered in fish caught by Dam Anglers in 2025.

7.) Continue to investigate conducting Pikeminnow Dam Angling at other Columbia and Snake River dams as funding and resources allow, or during non-peak times at TD and JD dams. Offer Dam Angler assistance to other research projects wishing to obtain Northern Pikeminnow and other fishes from BRZ areas to determine project feasibility and/or as a possible step to adding additional dams to the DA project.

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Appendix A

<u>eDNA work with Yakama Nation Fisheries and Cramer Fish Sciences</u>

ODFW collaborated with Yakama Nation and Cramer Fish Sciences to conduct a side-by-side comparison between eDNA and visual/chemical digestion techniques implemented to assess diet composition of piscine predators. Conducting this comparison would provide NPMP information about the utility of eDNA techniques to augment our current visual/chemical digestion process used to identify and quantify digestive contents. The Independent Scientific Review Panel (ISRP) identified eDNA techniques as a priority for NPMP to explore with utility to augment our current methods (ISRP 2019). Diets were taken from three different predator species which were Northern Pikeminnow, Smallmouth Bass, and Walleye. Full digestive tracts from all predator species were dissected and processed in a manner that allowed for sampling using both eDNA and visual/chemical techniques, The efforts to conduct this work led to 20 samples being collected and processed using both techniques. The work is in progress and additional information will be provided in future NPMP annual reports as we complete this pilot study.

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Appendix B

Coded Wire Tag Detections

INTRODUCTION

Juvenile salmonids have been coded wire tagged (CWT) for decades by numerous agencies (Nandor et al. 2010). The recovery of these CWTs in piscine predator digestive tracts may provide an additional source of stock information from predated juvenile salmonids in the Columbia River Basin and may provide a mechanism to enhance estimates of predation to juvenile salmonids. During the 2024 field season we tested the ability to retrieve ingested CWTs from diet samples of known piscine predators and investigated the potential insight on predation of juvenile salmonids. If we were able to retrieve CWTs from our collected samples, we may then be able to obtain additional information about the impacts of piscine predation on juvenile salmonids.

METHODS

Contents of diets from Northern Pikeminnow (*Ptychocheilus oregonensis*), Smallmouth Bass (*Micropterus dolomieu*), and Walleye (*Sander vitreu*s) collected during biological evaluation field activities and the Dam Angling Fishery were examined to quantify relative consumption of juvenile salmonids. All samples were scanned with Northwestern Marine Technologies CWT T-wand and V-board to detect metallic materials. Frozen field samples that contained metal were thawed in the laboratory then a pencil magnet was used to retrieve CWT(s) in the sample. If no CWT was found, the contents of each sample bag were then poured into a 3-tier sieve stack consisting of a 425 µm, 230 µm, and a final solid catch pan and rinsed through with water. The pencil magnet was again used on each sieve to collect any CWTs that may have been missed initially. CWT codes were then recorded in a database and the Regional Mark Information System (RMIS) was queried to acquire stock information (e.g., species, rearing location, and location and date of release).

RESULTS

In the spring of 2024, ODFW collected 726 stomach contents from Smallmouth Bass (n=443), Walleye (n=54) and Northern Pikeminnow (n=207) during our biological evaluation in Bonneville Reservoir and Below Bonneville Dam. During the Dam Angling Fishery, we collected 708 stomach contents from Smallmouth Bass (n=139), Walleye (n=59) and Northern Pikeminnow (n=510). Using our updated methods, we were able to successfully detect and obtain 16 CWTs from Northern Pikeminnow (n=13, 11 from DAF and 2 from Biological Monitoring) and Smallmouth Bass (n=3 all from DAF) through our laboratory process (Table 1). No CWTs were recovered from Walleye.

DISCUSSION

In 2023, we were able to develop field and lab protocols to capture CWTs in piscine predator digestive tracts. Those data were summarized and presented at a scientific conference (Chambliss et al. 2024). In 2024, we once again successfully utilized these methods to collect

CWTs. As each year and each area is different, there are plans to continue testing methods for collecting CWTs to evaluate the utility of these data to better understand predator-prey dynamics. CWTs contain stock information, including species, run type, evolutionarily significant units, release location and date, and hatchery of origin. This information paired with catch data of the predator, including species, size, and catch date could help resource managers better understand the dynamics of piscine predation and inform resource management decisions.

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