Lake Washington Basin Predatory Fish Species Suppression

Legislative Proviso Report

Washington Department of FISH & WILDLIFE

December 2024

State of Washington
DEPARTMENT OF FISH AND WILDLIFE
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December 1, 2024

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The Honorable Melanie Morgan
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The Honorable Kristine Reeves
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Dear Chairs,

During the 2023 legislative session—through a proviso contained within the Engrossed Substitute Senate Bill 5187—the Washington State Legislature directed the Washington Department of Fish and Wildlife (Department, WDFW) to initiate a demonstration project to contribute to rebuilding salmon runs in the Lake Washington basin through suppression of predatory fish species.

WDFW contracted with Hickey Brothers Research, LLC (HBR) to determine whether a long-term partnership with this company could be an effective approach to reduce the numbers of predatory fish. The trial contract with HBR was highly successful. HBR's specialized equipment and expertise in capturing fish were exceptional, and a long-term partnership with this organization will significantly advance any predator suppression effort in Lake Washington. The five-week trial project conducted in 2024 suggests that a larger effort using similar gear types could be an effective way to manage the abundance of non-native predator fish and the northern pike minnow in Lake Washington.

An important component of the project is to assess the benefits of removing predatory fish on the survival rates of juvenile salmon in the Lake Washington basin. Technological advances in hydroacoustic monitoring suggested that these improved tools might now be used to monitor the number of the juvenile salmon migrating to Puget Sound. The juvenile salmonid hydroacoustic monitoring program was effective in detecting and enumerating smolt schools through the Lake Washington Ship Canal. Detections of smolt schools matched passive integrated transponder (PIT) tag detections at the Ballard Locks, indicating the expanded PIT tagging effort proved one effective method to ground truth hydroacoustic data, provide species composition, and quantify outmigration timing through the system. Together, these results suggest that hydroacoustic monitoring will provide an effective tool to monitor the trends in the freshwater survival of juvenile salmon and evaluate the success of the effectiveness of the predator removal.

In 2019, the Legislature directed the Washington Fish and Wildlife Commission to adopt rules to liberalize bag limits for bass, walleye, and channel catfish in all anadromous waters in the state to reduce the predation risk to salmon smolts. WDFW assessed the fishing rules that were adopted because of this direction and concluded the recreational fishing rules implemented in 2020 did not appear to have affected the abundance of largemouth or smallmouth bass in Lake Washington. Other non-native fish species that prey on juvenile salmon including yellow perch, rock bass, and black crappie, did not appear to have been affected by the 2020 recreational fishing rules. Environmental factors such as climate change likely have a stronger influence non-native predator fish species abundance in Lake Washington than fishing regulations. Illegal introductions of new non-native predator fish species such as rock bass, northern pike, and walleye are a recurring threat to salmon species rearing in Lake Washington. A program involving direct removal of non-native predator fish species may be a more effective tool for decreasing abundances than changes to recreational fishing regulations.

The initial year of the project demonstrated that a larger effort using similar gear types could be an effective way to suppress the abundance of nonnative predator fish and the northern pikeminnow in Lake Washington that are impeding the rebuilding of ESA-listed Chinook salmon and contributing to a high risk of extirpation of sockeye salmon. The following interim report provides project updates and data collected so far in the implementation of this demonstration project.

If you have any questions about this report, please reach out to our new Legislative Director, Melena Thompson, at (564) 791-2755.

Sincerely,

Kelly Susewind
Director

Lake Washington Basin Predatory Fish Species Suppression

Legislative Proviso Report

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Report acknowledgements

We would like to acknowledge and thank our Lake Washington Basin fisheries co-managers the Muckleshoot Indian Tribe and Suquamish Tribe for their support and collaboration on this project, and the conservation and recovery of salmon and steelhead in the Lake Washington watershed.

Cover photo by Jim Souders: an invasive northern pike caught and removed from Lake Washington.

Acknowledging the Indigenous People of the Pacific Northwest

Since time immemorial, Indigenous People have lived in the Pacific Northwest and hunted, fished, and gathered natural resources, traditional foods, and medicinal plants to support their diverse cultures. They were the original occupants and stewards of this land that all Washingtonians enjoy today.

The very survival of the Pacific Northwest Tribes is a testament of resiliency of what they have endured and continue to endure throughout generations on this landscape. Through many historical encounters of massacre, renunciation of religious freedom, systemic racism, cultural assimilation of native children through institutional residential schools, and the fight for their inherent rights and liberties, they have prevailed. Throughout this painful history brought by colonization, abrogated treaties, infringement of civil rights, and the salmon protests of the 1960s, the Northwest Tribes and the Washington Department of Fish and Wildlife (WDFW) have founded a commitment of respect, unity, and alliance informed by the realities of the past.

Today, tribal governments and WDFW work collaboratively to conserve and manage aquatic and terrestrial resources statewide and practice sound science to guide management decisions. The Tribes and WDFW work together to ensure the sustainability of fish, wildlife, ecosystems, and culture for the next seven generations and beyond.

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Background

Proviso Language

The 2023 operating budget (SB 5147, Sec. 308(35), pg. 432) stated: (35)(a) $400,000 of the general fund—state appropriation for fiscal year 2024 and $300,000 of the general fund—state appropriation for fiscal year 2025 are provided solely to initiate a demonstration project to contribute to rebuilding of salmon runs in the Lake Washington basin through suppression of predatory fish species. The project shall include: (i) Removal of nonnative species and northern pike minnow using trap, nets, or other means; (ii) Assessment of the benefits of reduced predator abundance on juvenile salmon survival; and (iii) Assessment of the recreational fishing rules that were implemented in 2020 in the Lake Washington basin. (b) An interim report on the demonstration project must be provided to the appropriate committees of the legislature by December 1, 2024.

This document serves as the interim report for the first year of project work associated with the Lake Washington Predatory Fish Species Suppression proviso (Lake Washington Proviso) conducted in the 2023-24 fiscal year. All planning and spending during the first year of the Lake Washington Proviso project was done with the idea that $400k was available for use in the 2023-24 fiscal year.

Following an initial year of funding at the $700K/biennium level the Lake Washington Proviso funding was increased in the second year to $1.4M/biennium in the 2024 operating budget, with the revised language reading as follows: (35)(a) $700,000 of the general fund—state appropriation for fiscal year 2024 and $700,000 of the general fund—state appropriation for fiscal year 2025 are provided solely to initiate a demonstration project to contribute to rebuilding of salmon runs in the Lake Washington basin through suppression of predatory fish species. The project shall include: (i) Removal of nonnative species and northern pike minnow using trap, nets, or other means; (ii) Assessment of the benefits of reduced predator abundance on juvenile salmon survival; and (iii) Assessment of the recreational fishing rules that were implemented in 2020 in the Lake Washington basin. (b) An interim report on the demonstration project must be provided to the appropriate committees of the legislature by December 1, 2024.

History

Lake Washington is in the heart of an urban area of King County and Chinook, coho, and sockeye are well known, highly visible salmon species inhabiting the watershed. Chinook and particularly sockeye salmon returns to the Lake Washington watershed and the Cedar River have experienced precipitous declines in recent years and the Cedar River sockeye population is currently in a state of crisis. Research and monitoring conducted over the past decade in Lake Washington indicates that predation by non-native fish species and northern pike minnow is limiting survival for juvenile salmon. Climate change and continued illegal introductions of predator fish such as walleye and northern pike exacerbate the predation problem. Poor salmon returns in this highly populated watershed disproportionately affects under-served communities and Native American tribes. One management action that has been

proposed to help recover sockeye and Chinook in Lake Washington is a program to reduce the abundance of piscivorous fish species, including all nonnative predator fish species and northern pike minnow, that prey on juvenile salmon rearing in the Lake. Hydroacoustic monitoring of juvenile Chinook and sockeye outmigration via sonar deployment provides a critical validation tool for determining success of predator removal.

First-year implementation of the demonstration project involved deployment of nets in Lake Washington to locate and remove predator fish species during the time that juvenile Chinook and sockeye salmon are rearing and migrating in the watershed. The project approach was informed by previous monitoring and research efforts that have identified areas of the Lake Washington watershed where non-native piscivorous fish species such as northern pike, walleye, yellow perch, bass, black crappie, and northern pike minnow consume juvenile Chinook and sockeye during the Lake-rearing and out-migration periods. Suppression of predatory fish species is intended to increase survival for Chinook and sockeye salmon, leading to increased adult returns and fishing opportunities for these species in Lake Washington. To assess the success of efforts to suppress predatory fish species, a juvenile salmonid hydroacoustic monitoring effort is underway to assess the abundance of outmigrating smolts. Using this technology in conjunction with supplemental juvenile PIT tagging efforts, this project aims to quantify survival trends of juvenile salmonids through the Lake Washington Ship Canal.

Nearly 2.5 million people live in King County where the Lake Washington watershed is located and more than 1 million of those people reside in cities directly adjoining Lake Washington itself (Seattle, Bellevue, Renton, Rainier City, Kirkland, etc.). The Lake Washington demonstration project, if successful, would benefit millions of people. Increased returns of adult salmon would result in direct and indirect benefits to all local residents and the many diverse communities located in the Seattle area.

Removal of nonnative and invasive species

Introduction

Project work described in this section of the report was conducted in support of section (i) of the Legislative Proviso; “Removal of nonnative species and northern pike minnow using trap, nets, or other means”. During the 2023-24 fiscal period approximately $130K was available for use in support of removal of nonnative species and northern pike minnow.

Predation on juvenile salmon by predatory fish species during rearing and migration limits salmon survival/recovery in the Lake Washington basin. A reduction in the abundance of predatory fish from areas used by juvenile salmon for rearing and migration is anticipated to increase survival rates for juvenile salmon in the Lake Washington basin. The idea of increasing survival rates for juvenile salmon through the suppression of predatory fish species in Lake Washington is strongly supported by the local Salmon Recovery Council for WRIA 8 and the tribal co-managers (Muckleshoot and Suquamish Indian Tribes).

Netting work associated with the 2024 proviso project was contracted (WDFW Contract #24-23597) to Hickey Brothers Research, LLC (HBR), a company highly experienced and uniquely qualified in the fabrication and use of multiple gear types to efficiently capture large numbers of freshwater fish. HBR is used by other state and federal natural resource management agencies to help with similar projects that involve the capture of large numbers of fish from freshwater lakes. For example the National Park Service has an annual contract worth ~$2M with HBR to conduct fish capture/removal in Yellowstone Lake, Montana. The Yellowstone Lake project involves the capture of non-native lake trout to recover native cutthroat trout inhabiting the lake. The project on Yellowstone Lake is considered highly successful and has been ongoing for over 20 years. The $130K available for fish removal work in Lake Washington during the 2023-24 fiscal period was invested in a trial contract with HBR to assess their performance and determine whether a long-term partnership with this company could be an effective approach in addressing the predation problem.

Project work in 2024 was guided by previous predation studies in the Lake Washington basin, and netting effort focused on sectors of the basin where non-native predators and northern pike minnow overlap with rearing and migration areas used by juvenile salmon. Mesh sizes of nets were optimized for capturing non-native predator fish species (walleye, northern pike, American shad, smallmouth bass, and largemouth bass) and northern pike minnow that have larger bodies and inhabit deep-water habitats during winter. Effort and catch data were recorded by WDFW staff working aboard the private research vessel (Figure 1a).

Figure 1a. Hickey Bros Research vessel contracted to conduct fish capture in Lake Washington.

Methods

Project work in 2024 involved wintertime gillnetting during the months of March and April. Adult salmon (Chinook, sockeye, and coho) begin migrating into the Lake Washington basin during June each year and are present in the system until the end of the spawning period which generally extends through December. Therefore, gillnetting work in Lake Washington is best timed during the winter months (Jan-May) to avoid incidental catches of adult salmon. Previous monitoring work indicated that catch rates

for northern pike minnow, American shad, and other non-native predator fish were highest in the south half of Lake Washington during winter, and all netting work in 2024 was therefore concentrated in the portion of the Lake south of the I-90 bridges (Figure 1b). All netting was conducted by Hickey Bros. Research LLC under contract number 24-23597. Effort and catch data were recorded by WDFW staff working aboard the private research vessel.

Gillnets were deployed throughout the portion of Lake Washington located south of Interstate 90 (Figure 1b) over a five-week period starting on March 4, 2024, and extending through April 5, 2024 with nets being deployed four days per week (20 net-nights in all). Multiple gillnet panels measuring 300-feet long and 10-feet high were strung end-to-end to create a total net length averaging approximately 13,300 feet that was deployed nightly (approximately 57,000 feet (~11 miles) deployed each week). Each 300-foot panel consisted of a single mesh size ranging from 3.5-inch stretch mesh to 5-inch stretch and soak times for each nightly set averaged approximately 23 hours. Mesh sizes ranging from 3.5-inch stretch to 5-inch stretch are known to be most effective for capturing adult northern pikeminnow and these mesh sizes were used most frequently during the survey. Nets were set in a serpentine pattern (Figure 1b) that generally paralleled shoreline areas and sets encompassed water depths ranging from approximately 15-feet to 200-feet. Gillnet configurations and depths were designed to maximize coverage and optimize catch rates for northern pikeminnow and other non-native species.

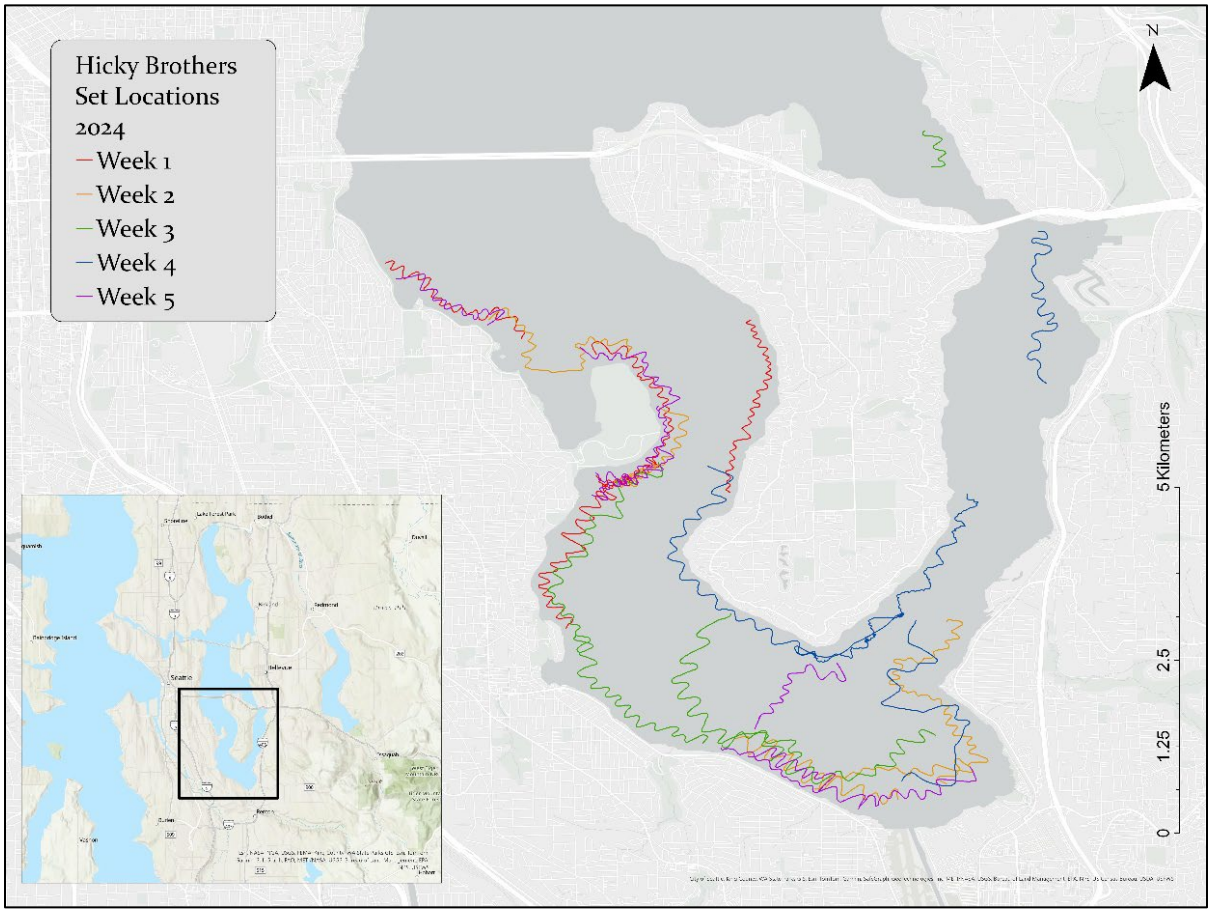

Figure 1b. Gillnet set locations in March and April of 2024.

Results/Discussion

Gillnetting was conducted by HBR in the southern portion (Figure 1b) of Lake Washington for five consecutive weeks in March-April of 2024. Approximately 57,000 feet (~11 miles) of gillnet was set and deployed each week. Mesh sizes and set locations were selected to optimize catch of the northern pike minnow and non-native fish species known to prey on juvenile salmon. HBR's specialized equipment and expertise in capturing fish were exceptional, and a long-term partnership with this organization will significantly advance any predator suppression effort in Lake Washington.

A total of 941 northern pike minnow were captured during the five-week netting period. Non-native fish species that were captured include northern pike (1), American shad (1,412), brown bullhead (329), smallmouth bass (710), rock bass (197), yellow perch (245), black crappie (65), common carp (8), and tench (2). Native fish species captured include cutthroat trout (567), largescale sucker (1,995), and peamouth chub (462). Native fish species encountered in the netting effort were released immediately after being removed from the net.

The single northern pike (photo on cover) that was captured as part of the project was an important observation as it indicates that illegal introductions of this species are on-going, and that a robust monitoring program in Lake Washington is needed for early detection and removal of non-native predatory fishes that are planted illegally. Highly invasive and aggressive predators, in Washington state northern pike (Esox Lucius) are a harmful non-native fish classified as a prohibited aquatic invasive species. More information is available in WDFW's April 2024 news release.

Winter-time concentrations of northern pike minnow (Figure 1e) in south Lake Washington were located and targeted during the 5-week netting effort. Northern pike minnow were most frequently encountered in water depths ranging from 10-40 feet and also in deeper areas of the Lake ranging from 80-110 feet (Figure 1d). Catch rates for northern pike minnow were initially high, but generally declined over the course of the project (Figure 1c) suggesting that the netting approach may be highly effective for reducing abundances of this species. American shad (Figure 1f) are a non-native species that have recently become highly abundant in Lake Washington. Although American shad are not considered a predator species, they likely compete with juvenile salmon for limited food resources in Lake Washington and are considered a species of concern. Catch rates for shad declined significantly during the project period (Figure 1c) suggesting that the approach may be effective for reducing shad abundances. Another non-native species of interest is the smallmouth bass (Figure 1e) which, similar to the northern pike minnow, is known to prey on juvenile salmon and is highly abundant in Lake Washington. Similar to the northern pike minnow and American shad, catch rates for smallmouth also declined over the project period (Figure 1c) indicating that the approach is effective at reducing abundances of this species as well.

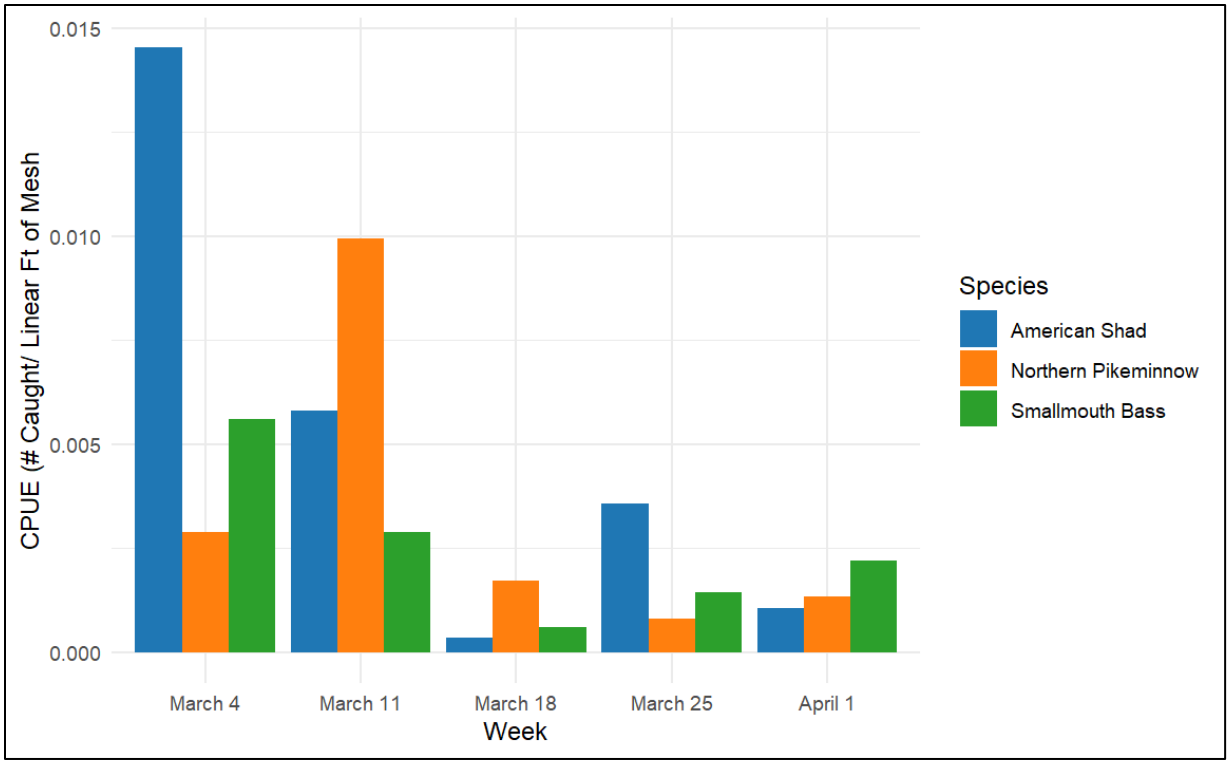

Figure 1c. Catch rates for selected fish species during the 5-week netting period in 2024.

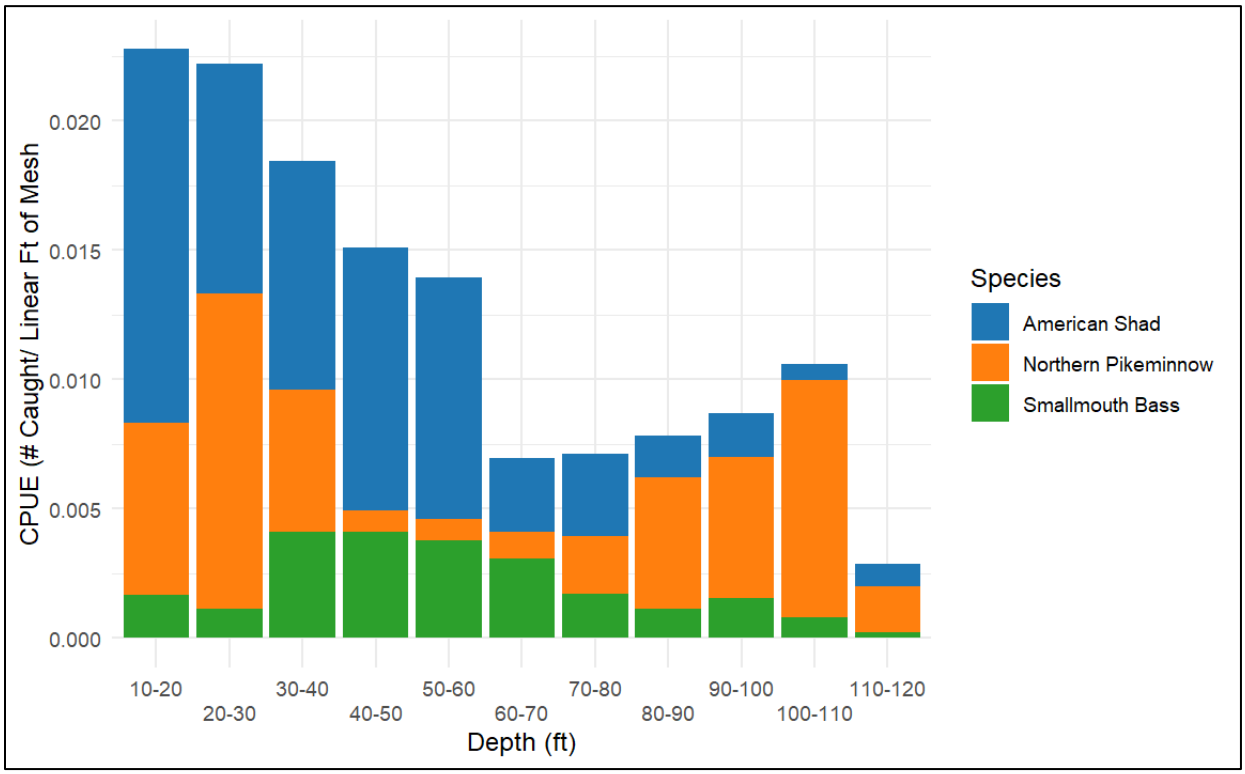

Figure 1d. Catch rates for selected fish species across depth ranges netted in 2024.

Figure 1e. Northern pike minnow (left photo) and smallmouth bass (right photo) captured in Lake Washington.

Figure 1f. Non-native American shad captured in Lake Washington.

Key Points

1. The trial contract with HBR was highly successful. HBR's specialized equipment and expertise in capturing fish were exceptional, and a long-term partnership with this organization will significantly advance any predator suppression effort in Lake Washington.

2. The five-week trial project conducted in 2024 suggests that a larger effort using similar gear types could be an effective way to manage the abundance of non-native predator fish and the northern pike minnow in Lake Washington.

Assessment of reduced predator abundance

Hydroacoustic Smolt Outmigration Monitoring

Introduction

WDFW in partnership with Tribal comanagers, began efforts to enumerate outmigrating juvenile salmonids from the Lake Washington basin to Puget Sound via Lake Washington Ship Canal (LWSC) using a hydroacoustic array in early 2024. The goal of the initial pilot year was to determine whether juvenile salmonids could be detected using two different hydroacoustic technologies, and to investigate methodologies to groundtruth acoustic data. The second year and long-term goals for this effort are to enumerate outmigrating salmonids to species, to determine species-specific counts of outmigrants, and evaluate species-specific temporal trends.

Methods

The hydroacoustic array used for this effort included both an ARIS 1200 multibeam imaging SONAR (Soundmetrics, Inc., Bellevue, WA) and a 200 kHz split-beam echosounder (Biosonics, Inc., Seattle, WA) (Figure 2a,b). Both these systems have proven effective at detecting juvenile salmonids in systems throughout the Pacific northwest, however due to inherent limitation in each, they operate more effectively when combined. With the ARIS 1200, individual juvenile salmon-sized targets can be effectively detected within 35 m of transducer face, and both directionality of movement and behaviors can be observed. The split-beam systems can detect targets at much greater range, out to 200m or more from the transducer face, but lacks the high-resolution data provided by the ARIS 1200. Split beam acoustics can provide a total biomass estimation (index) for the system, with the ARIS confirming schooling behavior and direction of movement.

Two technicians (WDFW Scientific Technician-2) were employed from March through September to assist with deployment, daily operation of acoustic array, gear maintenance, and to review data, identify, and enumerate salmonid schools throughout the peak of the outmigration window. Technicians also assisted with increased PIT tagging efforts from March through April, and in reviewing PIT tag detections recorded at the Ballard Locks.

For both the hydroacoustic systems, groundtruthing targets is essential to confirm species presence in the system. To accomplish this in year 1, we explored amplifying the number of PIT tagged juvenile salmonids to track presence/absence of the different species, as well as an Aqua-Vu underwater camera deployed at the study site to visually observe juvenile salmonids and potentially identify schools to species (Figure 2c). During spring 2024, we deployed over 4000 additional PIT tags, which included 2000

tags in extended reared juvenile Sockeye, 1000 in yearling juvenile Coho, and 1000 in sub-yearling Chinook salmon to observe presence and absence of species throughout the course of the study season. This brought the total number of PIT tagged juvenile salmonids in the Lake Washington basin to over 8000, including 2000 Sockeye, 2000 Coho, and over 4000 Chinook. PIT tag detections recorded at the Ballard locks indicate peak outmigration occurred in late May and into early June, with the number of detections decreasing throughout June into July (Figure 2d). Timing of PIT tag detections changed throughout the season, with early season detections recorded throughout the day, shifting to more nighttime detections moving into June (Figure 2e). Further analysis of PIT tag data in the fall of 2024 will determine species specific timing of PIT detections and outmigration.

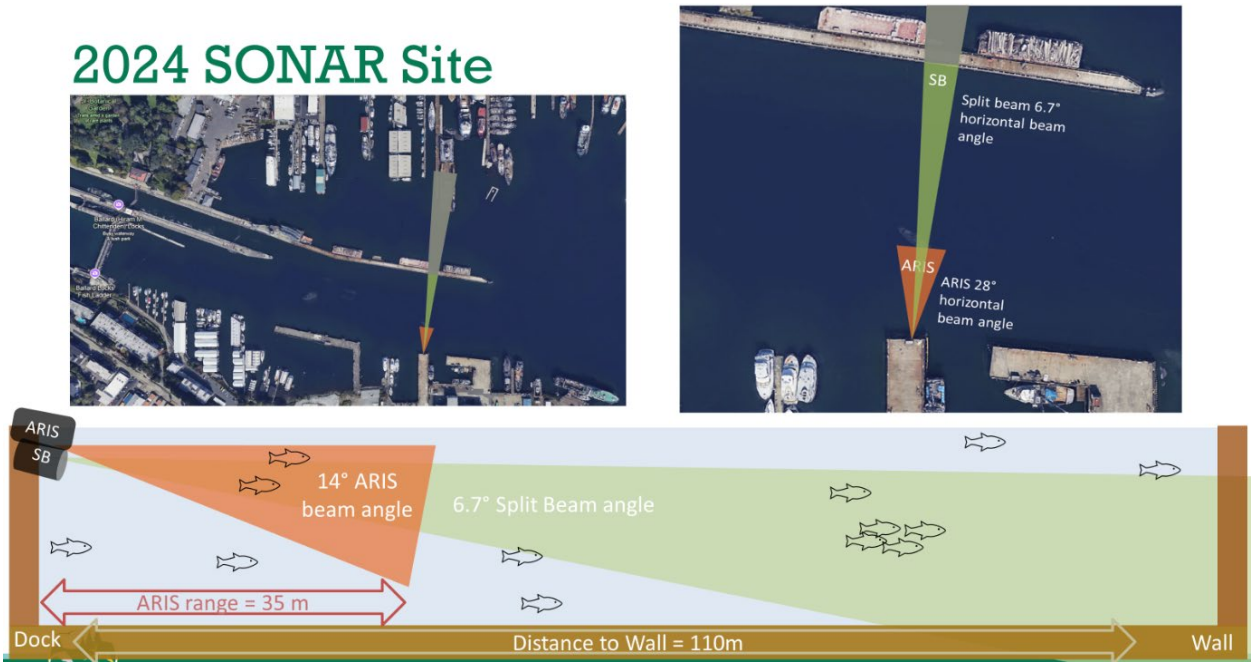

Figure 2a: Images of the juveninile salmonid hydroacoustic monitoring project set-up along the Lake Washington Ship Canal, including location of both the ARIS 1200 multibeam imaging SONAR and the Biosonics 200kHz split-beam transducer.

Figure 2b: Images of the juveninile salmonid hydroacoustic monitoring project set-up along the Lake Washington Ship Canal, including location of both the ARIS 1200 multibeam imaging SONAR and the Biosonics 200kHz split-beam transducer.

Results/Discussion

Based on data collected beginning in early April and technician review of ARIS files, juvenile salmonid schools begin appearing in the LWSC near the Ballard Locks in mid-April (Figure 2f). From early to mid-May, there was an increase in school activity, school size, and an increase in movement observed overnight. By June, nighttime activity decreased, and large schools were observed mid-day. During the second half of June, fewer schools were observed during the day, likely due to warmer water temperatures. Juvenile salmonid school observations dropped in July, with more adults being observed, and larger, diffuse schools that were determined to be stickleback, based on size, behavior, and timing (WDFW Regional Staff, personal communication).

The number of schools detected increased from deployment in mid-April through June (Figure 2e), and net downstream movement (defined as number of downstream moving schools minus number of upstream moving schools) also increased during this time, indicating an increase in salmon outmigration from May through June, peaking in late June. The pattern of schools observed in ARIS data lines up well with PIT tag detections observed at the Ballard Locks (Figure 2g), with both total observed schools and

net downstream moving schools increasing in May and June at a similar rate to observed PIT tag detections.

Preliminary analysis of the LWSC acoustic monitoring effort indicate that both ARIS and split-beam systems are effective for detecting and enumerating smolt schools in Lake Washington Ship Canal when used in conjunction to provide both high resolution data in the near-field (out to 35m) and a snapshot of the entire width of the LWSC. Initial review of data indicates increasing activity from mid-May through June, with a peak in total school counts, net downstream movement, and PIT tag detections in June. The observed increase in school detections from mid-May through late June lines up well with PIT tag detections, and further analysis of PIT tag data will help determine species specific temporal patterns in the data. Initial data review from the pilot season is ongoing and will continue until all data files are visually processed for juvenile salmonid schools and counts. Additional observations of smolts in Aqua-Vu and at Locks can be used to help further ground truth acoustic data and will be explored more in future years of this study. In additional to visual observation of acoustic data, future years of this project will include semi-automated data processing capacity.

Figure 2c: Static images of a juvenile salmonid school (left) and predation of juvenile salmondis by adult salmon (right) observed with the Aqua-Vu underwater camera at the Lake Washington Ship Canal juvenile salmonid hydroacoustic monitoring site.

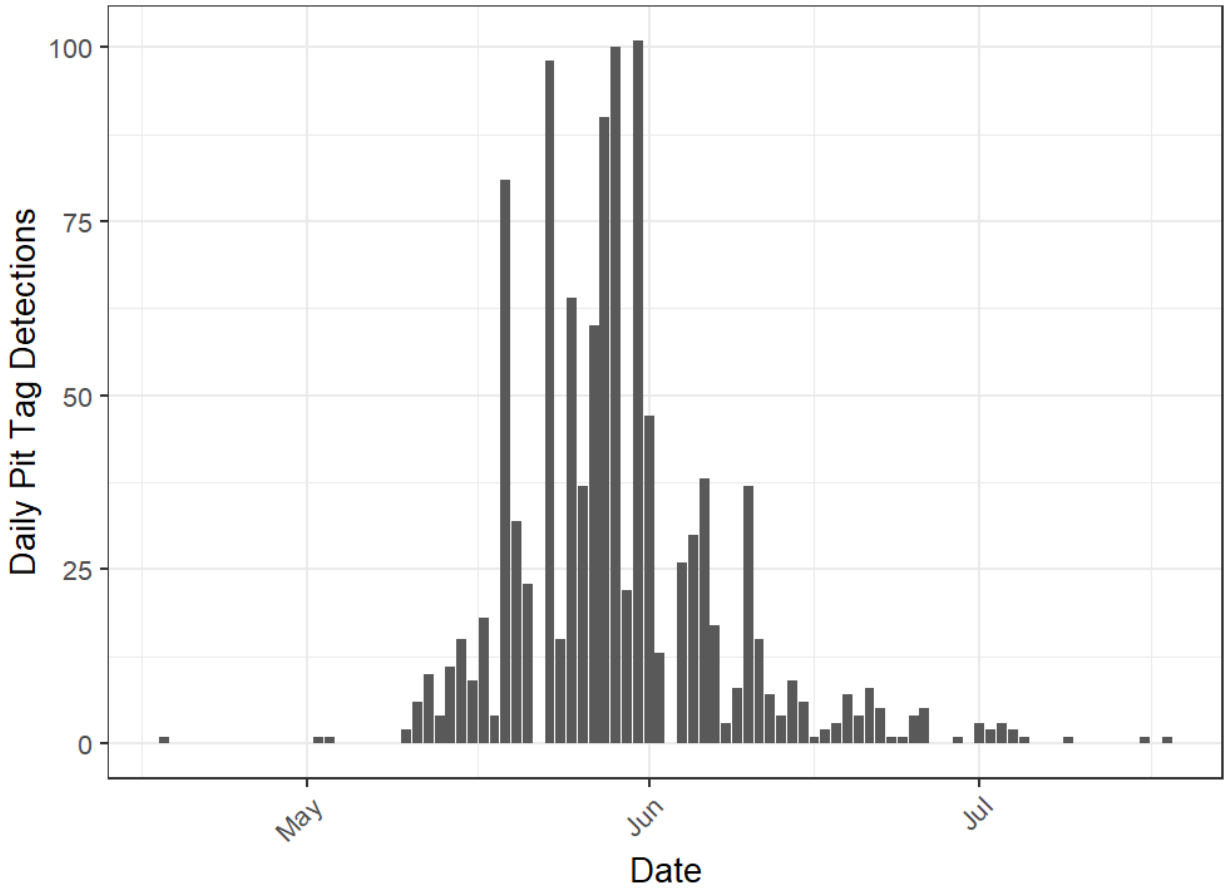

Figure 2d: Daily PIT tag detections recorded at the Ballard Locks on the Lake Washington Ship Canal during the 2024 pilot season.

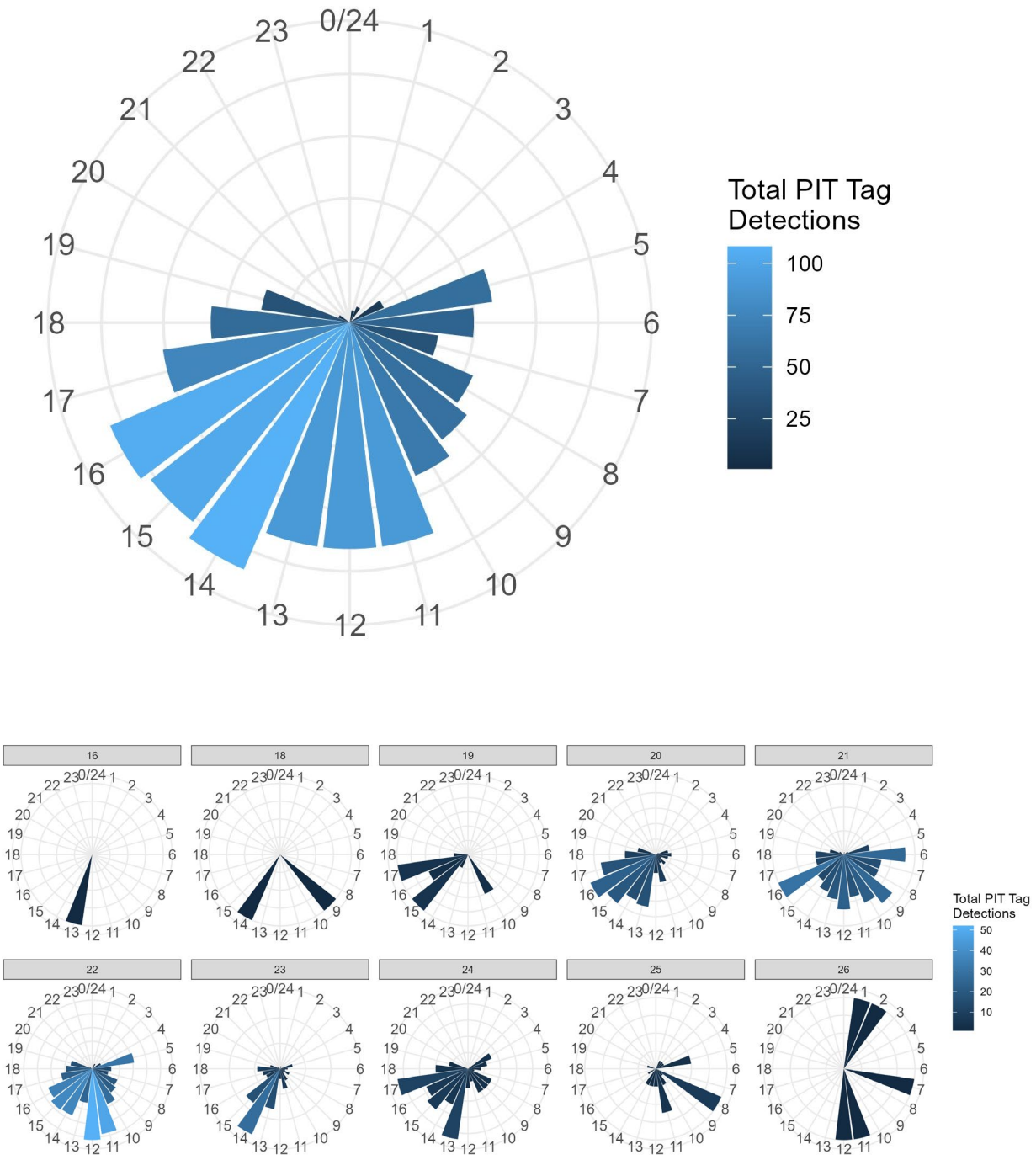

Figure 2e: PIT tag detections by hour recorded at the Ballard Locks on the Lake Washington Ship Canal during the 2024 pilot season. Top figure shows cumulative detections by hour for the study season. Bottom figure shows a weekly breakdown of PIT tag detections from Week 16 (mid-April) to Week 26 (late June).

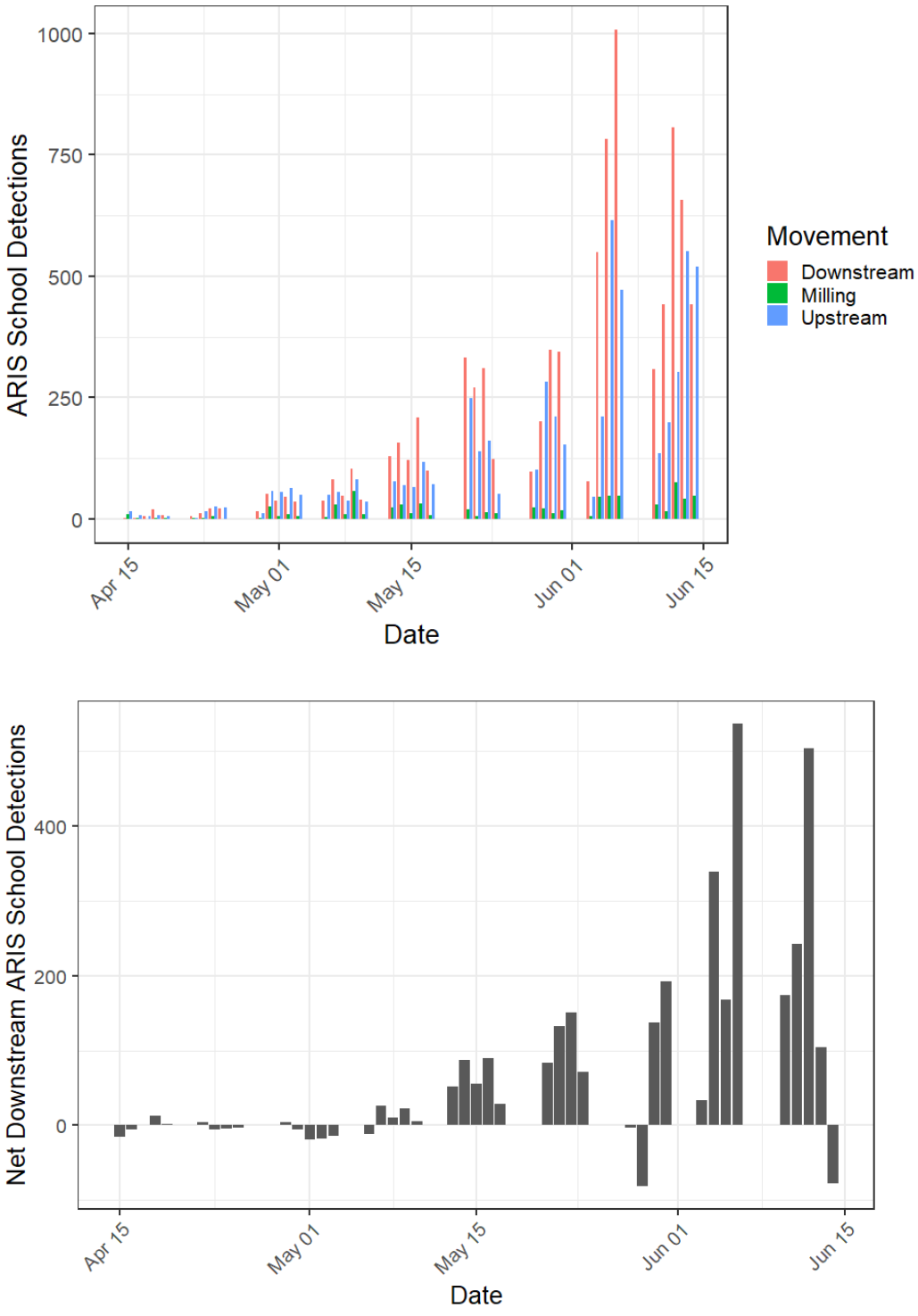

Figure 2f: The number of salmonid schools observed daily by technician review of ARIS 1200 footage from mid-April through mid-June. Top figure shows movement of downstream moving, milling, and upstream moving schools are shown. Bottom figure shows the number of net downstream (downstream – upstream) moving salmonid schools observed daily by technician review of ARIS 1200 footage from mid-April through mid-June.

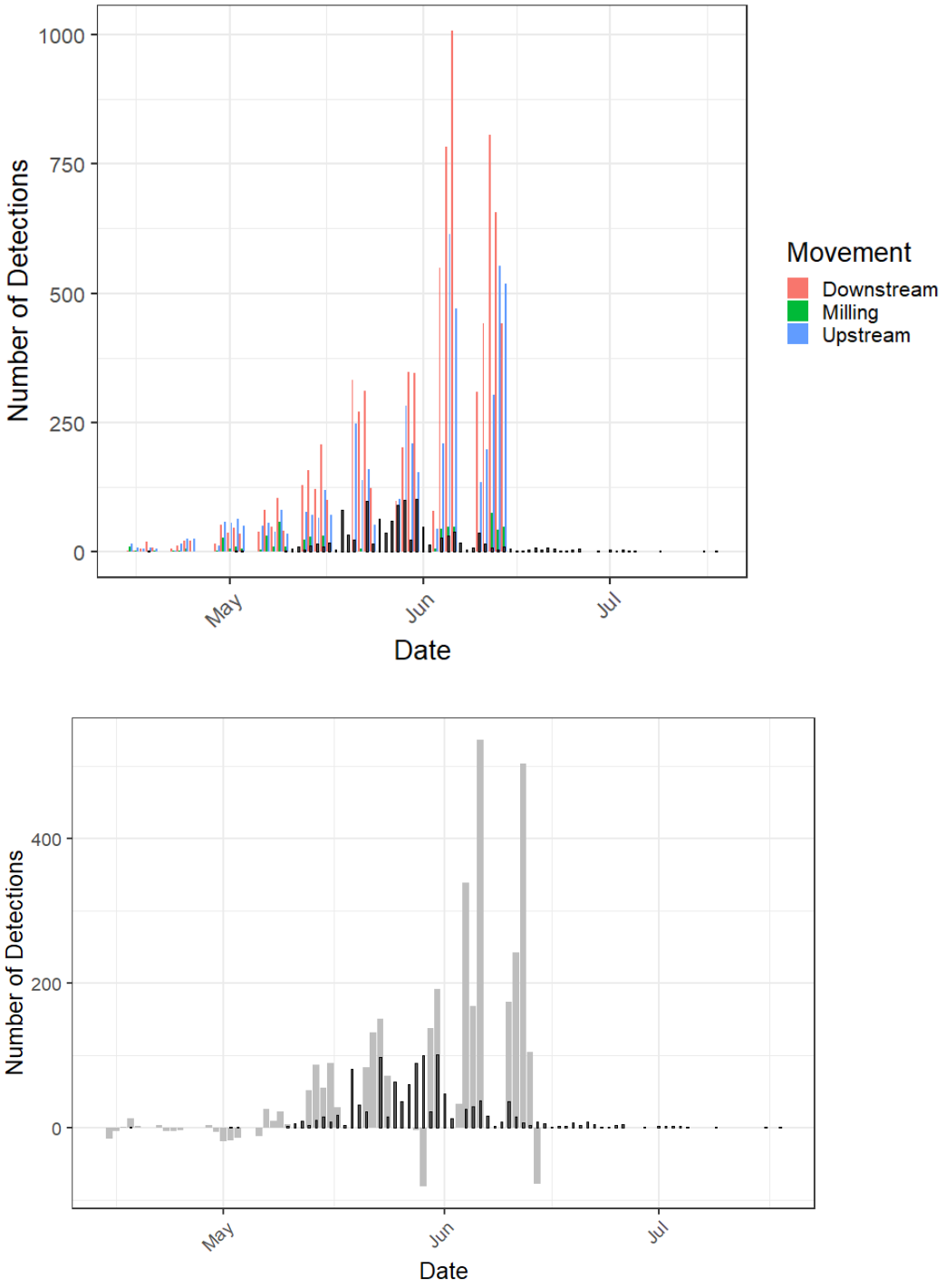

Figure 2g: The number of salmonid schools observed daily by technician review of ARIS 1200 footage from mid-April through mid-June and PIT tag detections during the same time. Top figure shows movement of downstream moving, milling, and upstream moving schools are shown, with PIT tag detections in black. Bottom figure shows the number of net downstream (downstream – upstream) moving salmonid schools observed daily by technician review of ARIS 1200 footage from mid-April through mid-June in gray, with concurrent PIT tag detections in black.

Key Points

1. The juvenile salmonid hydroacoustic monitoring program was effective in detecting and enumerating smolt schools through the Lake Washington Ship Canal.
2. Detections of smolt schools matched PIT tag detections at the Ballard Locks, indicating the expanded PIT tagging effort proved one effective method to groundtruth hydroacoustic data, provide species composition, and quantify outmigration timing through the system.

Assessment of recreational fishing rules

Introduction

The third element of the proviso included an assessment of the recreational fishing rules that were implemented in 2020 in the Lake Washington basin. The assessment involved an evaluation of the warmwater fish species community in Lake Washington in 2024 (four years after implementation of the new fishing regulations) compared to a previous warmwater assessment that was conducted in 2005 (fifteen years prior to the new regulations). Fish densities (measured by catch rates or CPUEs) for selected non-native warmwater fish species observed in gillnet surveys conducted in Lake Washington in 2005 were compared to catch rates in 2024 gillnet surveys to look for shifts in abundance that could be explained by changes to the regulations implemented in 2020. The 2024 gillnet surveys replicated the previous work, and 22 of the 2005 sites were surveyed again in 2024 at the same time of year using the same gillnet gear. Additionally, angler catch data from bass fishing tournaments was compared from the years prior-to and after implementation of the 2020 regulation changes to see if the new rules had any effect on catch rates for bass species in Lake Washington. None of the funding from the proviso project was available for the assessment of recreational fishing rules and this work was supported by a combination of local grant funding and WDFW regional funds.

The 2020 fishing rules, approved by the Fish and Wildlife Commission, were the result of legislation passed in 2019 by the Washington State Legislature (HB 1579, 2019), and intended to help aid the endangered Southern Resident Killer Whale population by reducing the risk of predation on salmon smolts by non-native warmwater fish species. The following changes to size and daily limits of warmwater fish species went into effect on January 17, 2020, in 77 lakes around the state, including Lake Washington:

- Largemouth bass: Change from 5 to a 10-fish daily limit; only one fish may be over 17 inches.
- Smallmouth bass: Change from 10 to a 15-fish daily limit; only one fish may be over 14 inches.
- Channel catfish: Change from 5 to a 10-fish daily limit. No minimum size.
- Walleye: Change from 8 to a 16-fish daily limit; only one fish may be over 22 inches.

Small numbers of channel catfish and walleye may be present in Lake Washington as a result of illegal introductions however, self-sustaining populations of these two species do not inhabit the Lake and the

2020 regulation changes will not affect these species. In contrast, largemouth and smallmouth bass populations are present in Lake Washington, and are known to prey on juvenile salmon rearing in the lake or migrating through it en route to marine waters. The intent of the recreational fishing rules implemented in 2020 was to reduce the abundance of largemouth and smallmouth bass in waters where these species overlap with juvenile salmon.

Beyond the fishing rules governing largemouth and smallmouth bass, recreational fishing rule changes implemented in 2020 did not affect other non-native warmwater fish species inhabiting Lake Washington. Other non-native warmwater fish species known to prey on juvenile salmonids in Lake Washington include yellow perch, rock bass, black crappie, brown bullhead. However, fishing rules for these species in Lake Washington are already quite liberal and allow fishing year-round with no minimum size or daily limit.

Methods

Gillnet surveys were conducted in June of 2024 at 22 sites (Figure 3a) that had also been sampled using gillnets in the 2005 survey. Gillnets used in 2024 were identical in size to those used in 2005 with nets measuring 45.7m in length and 2.4m in depth, consisting of four sinking panels (two each at 7.6m and 15.2m in length) of variable-size monofilament mesh (13, 19, 25, and 51mm stretched mesh). Gillnets were set in the afternoon and retrieved the following morning, resulting in net nights of approximately 20-hour duration. During both the 2005 survey and the 2024 survey each of the 22 sites was fished for a single night. Catch Per Unit Effort (CPUE) for the 2005 work and again in 2024 was calculated by dividing species-specific catch totals by net nights (1) and total sites assessed (22). Catch rate (CPUE) comparisons were made between the surveys conducted in 2005 and in 2024 for indications of changes in fish density for largemouth and smallmouth bass as well as other species of interest. In addition to the gillnet surveys, Lake Washington bass derby data from the years prior-to and after implementation of the 2020 regulation changes were assessed for changes in catch rates or fish size for smallmouth bass.

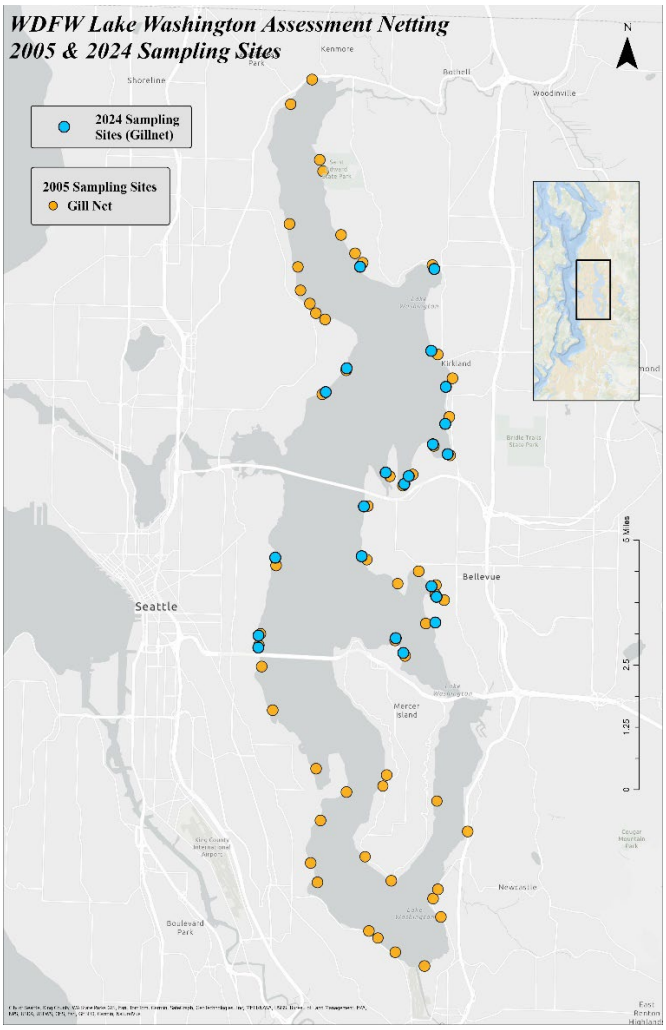

Figure 3a. Map of locations fished during the 2005 gillnet surveys and the replicate sites assessed again using gillnets in 2024.

Results/Discussion

Catch rates for largemouth bass have more than doubled since 2005 with CPUEs increasing from ~1 fish/net in 2005 to ~2.3 fish/net in 2024 (Figure 3.b). In contrast, smallmouth bass catch rates decreased slightly from a CPUE of ~2.6 fish/net in 2005 to ~2.1 fish/net in 20204 (Figure 3b). Catch rates for largemouth and smallmouth bass are now similar (~2.3 fish/net in 2024 for largemouth versus ~2.1 fish/net for smallmouth) to one another. Results indicate that there has been an increase in largemouth bass abundance since the 2005 while smallmouth bass abundance appears to have decreased since 2005 (Figure 3b) such that the abundance of these two bass species in the Lake is now similar whereas in 2005 there were far more smallmouth bass than largemouth.

Yellow perch (Figure 3f) abundances appear to have increased in Lake Washington since 2005, and catch rates increased from ~32 fish/net in 2005 to ~54 fish/net in 2024 (Figure 3c). Black crappie (Figure 3h) catch rates remain low in general but increased from ~1 fish/net in 2005 to ~2 fish/net in 2024 (Figure

3d). Rock bass (Figure 3g) were not observed in the 2005 surveys anywhere in Lake Washington but are now abundant (rock bass catch rates in 2024 were ~6.5 fish/net) and widely distributed throughout the Lake (Figure 3d).

One northern pike (Figure 3h) was also encountered during the assessment surveys. The northern pike was an important observation and indicates that illegal stocking of this species continues to occur. Robust monitoring surveys such as this are an important tool in the Lake Washington system for the early detection and removal of illegally planted non-native predators such as the northern pike. Highly invasive and aggressive predators, in Washington state northern pike (Esox Lucius) are a harmful non-native fish classified as a prohibited aquatic invasive species.

It is not clear if the apparent decline in smallmouth bass abundance was caused by the 2020 fish rule change or if there were other contributing factors. It is possible that rock bass, which were not present in 2005 but are abundant now, compete with smallmouth bass for food and habitat and have contributed to the decline in smallmouth. Yellow perch, which also seem to have increased in abundance since 2005, may also be displacing smallmouth bass and contributing to the apparent decline in their numbers. The 2020 fishing rule changes did not appear to reduce populations of yellow perch, black crappie, or rock bass, each of which is known to feed on juvenile salmon in Lake Washington. However, the fishing regulations for these species did not change in 2020; fishing for these species is open year-round and there is no size limitations or bag limits, allowing anglers to keep as many as they are able to catch.

Bass fishing tournament data suggests that there was very little change in the number of tournaments per year, angler catch rates, or average fish size in the three-year period immediately prior to the regulation change compared to the three year period immediately after (Figure 3e). The average number of tournaments (3-year avg., 2017-19) held prior to 2020 was 14 while the average number after 2020 was 15 (3-year avg., 2020-22). Average total number of fish caught, catch rates, and fish weights all increased after the 2020 regulation changes were implemented. Three-year (2017-19) average total fish caught was 1,388, catch/hour was 0.27, and fish weight was 2.19 prior to the regulation change while the 3-year (2020-22) average total fish caught was 1431, catch/hour was 0.32, and fish weight was 2.34 after the regulation change. Since tournament fishing is highly selective however, it is possible that more time will be needed to detect any changes or reductions in average catch rates or fish sizes.

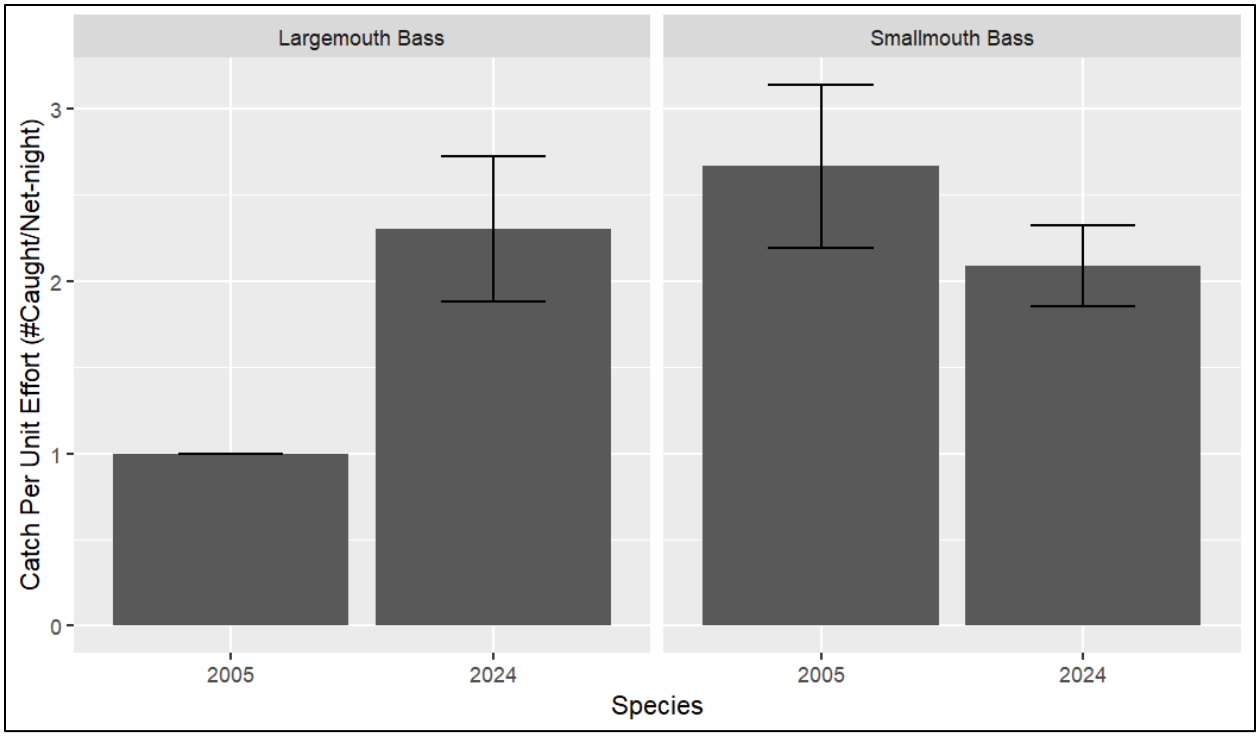

Figure 3b. CPUE for largemouth bass and smallmouth bass in 2005 and again in 2024.

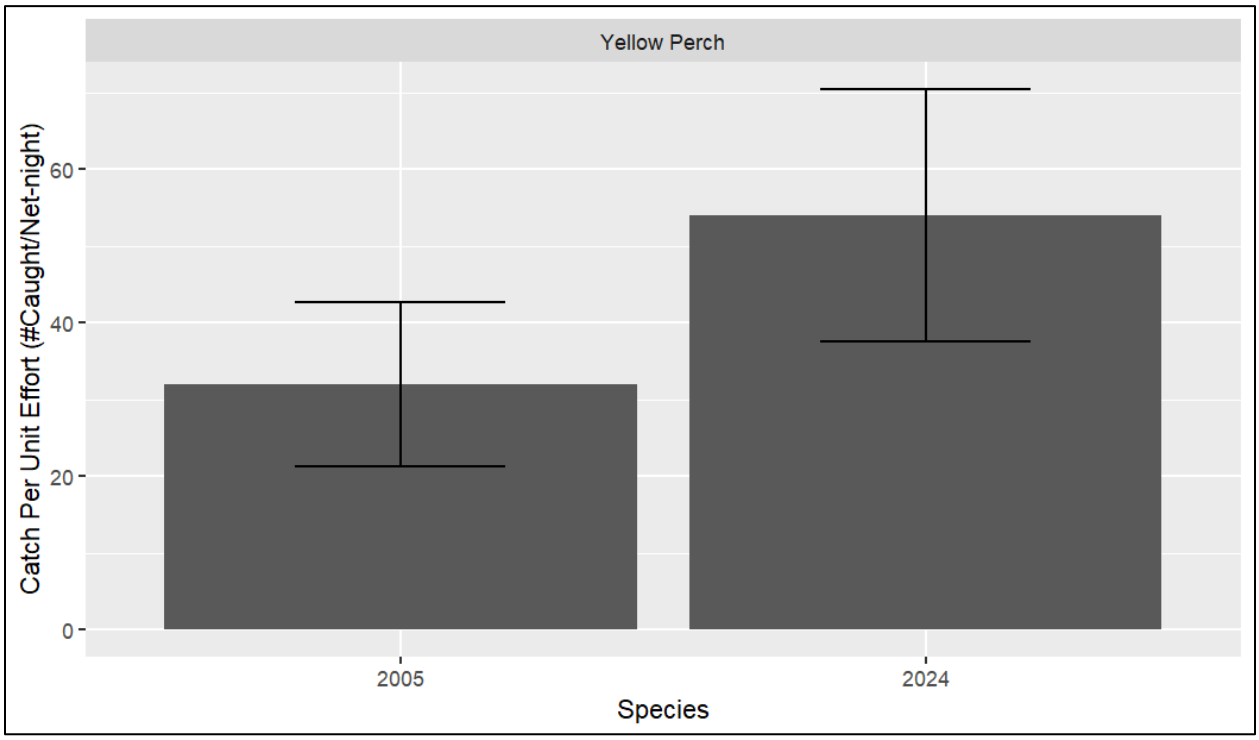

Figure 3c. Catch rates for yellow perch in the 2005 and 2024 surveys.

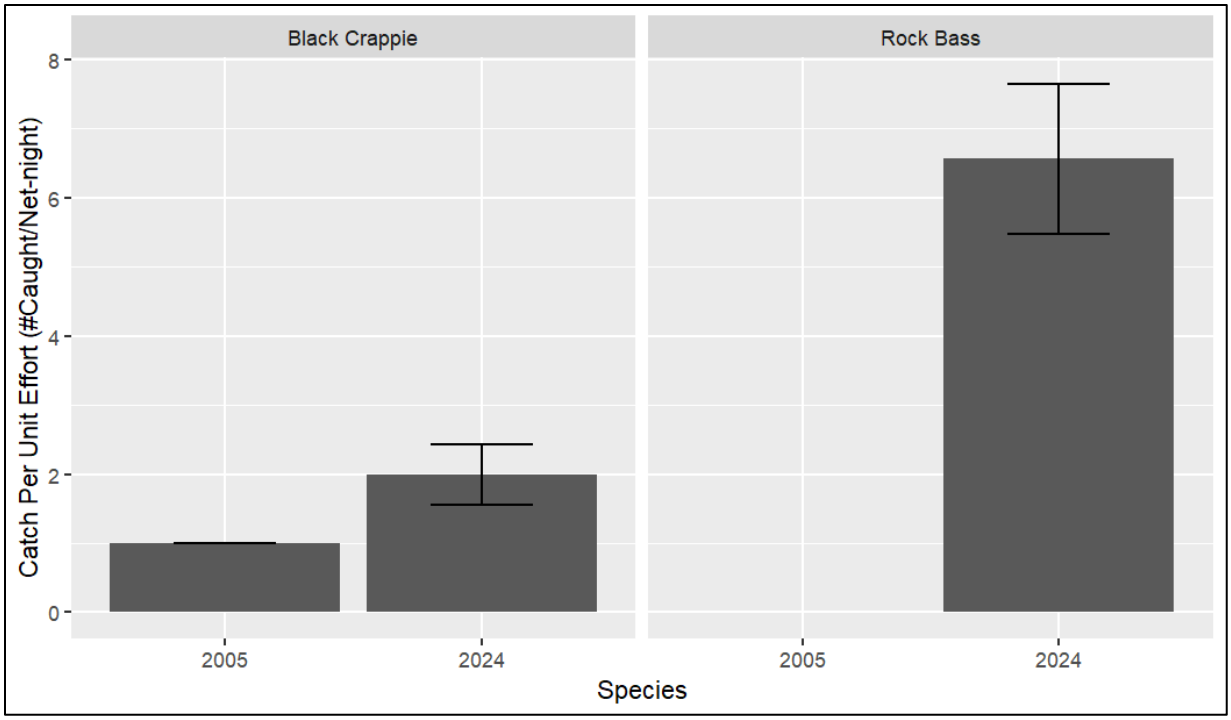

Figure 3d. Catch rates for black crappie and rock bass in the 2005 and 2024 surveys.

Year	Number of Tournaments	Total Angler Hours	Total Catch	Catch/Angler Hour (fish)	Avg Fish Weight
2008	11	**6266**	**795**	0.13	2.32
2009	13	**6414**	**1128**	0.18	2.31
2010	13	**5147**	**1050**	0.20	2.34
2011	11	**4594**	**1076**	0.23	2.11
2012	16	**7223**	**1396**	0.19	2.30
2013	17	**4509**	**986**	0.22	2.12
2014	15	**5012**	**1372**	0.27	2.07
2015	18	**6350**	**1596**	0.25	2.34
2016	12	**3847**	**1035**	0.27	2.27
2017	15	**7286**	**1783**	0.25	2.29
2018	13	**4922**	**1193**	0.24	1.74
2019	13	**3871**	**1189**	0.31	2.54
		Regulation Change			
2020	13	**4032**	**1223**	0.30	2.13
2021	17	**5543**	**1772**	0.32	2.32
2022	14	**3702**	**1297**	0.35	2.58

Figure 3e. Bass derby data from tournaments held on Lake Washington prior-to and after the recreational fishing rules implemented in 2020.

Figure 3f. Yellow perch in Lake Washington caught feeding on sockeye and Chinook fry near the mouth of the Cedar River (left photo) and feeding on Chinook smolts near the entance to the Lake Washington Ship Canal (right photo).

Figure 3g. Rock bass in Lake Washington caught feeding on sockeye fry near the mouth of the Cedar River in winter.

Figure 3h. Black crappie (left two photos) caught in Lake Washington feeding on sockeye and Chinook fry near the mouth of the Cedar River. Northern pike (right photo) caught in Lake Washington near the mouth of the Cedar River.

Key Points

1. The recreational fishing rules implemented in 2020 do not appear to have affected the abundance of largemouth or smallmouth bass in Lake Washington.
2. Other non-native fish species that prey on juvenile salmon, including yellow perch, rock bass, and black crappie, do not appear to have been affected by the 2020 recreational fish rules.
3. Environmental factors such as climate change likely have a stronger influence non-native predator fish species abundance in Lake Washington than recreational fishing regulations.
4. Illegal introductions of new non-native predator fish species such as rock bass, northern pike, and walleye are a recurring threat to salmon species rearing in Lake Washington.
5. A program involving direct removal of non-native predator fish species may be a more effective tool for decreasing abundances than changes to recreational fishing regulations.