Grant Application

Adrian Tuohy

Email : adrian@wildfishconservancy.org
Application ID : A29TA77
Custom Ref. -

Application Start Date: 2022-04-27 19:16:45
Application Completed Date: 2022-04-28 23:44:06

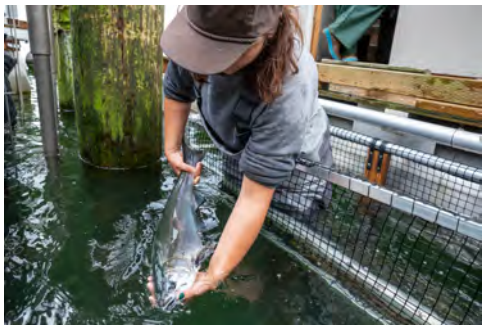
1	Have you ever applied for an OWF grant before?	
	no	
2	Have you ever been denied for an OWF grant before?	
	no	
3	Project Title	
	Study to Support Improved Salmon Management	
4	Name of my Organization	
	Wild Fish Conservancy	
5	If your organization is not a tax-exempt nonprofit, please list the name of your fiscal sponsor - If this does not apply to you, write N/A	
	N/A	
6	Project Manager Full Name	
	Adrian Tuohy	
7	Project Manager Mailing Address - Please enter full address with city, state & zip	
	4202 S Genesee St., Seattle, WA, 98118	

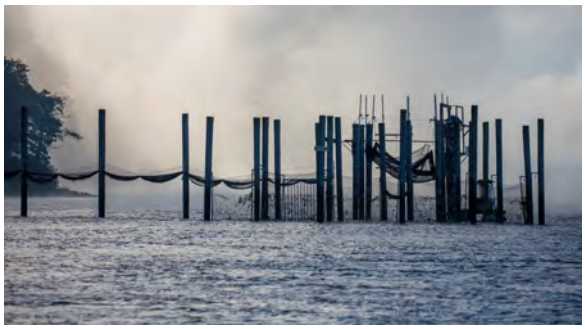
8	Project Manager Phone Number
	(253) 709-9364
9	Project Manager Email Address
	adrian@wildfishconservancy.org
10	Please provide a brief biographical statement about yourself
	Adrian Tuohy (M.S) is a biologist and project manager with the science-based nonprofit conservation organization Wild Fish Conservancy. Adrian has managed Wild Fish Conservancy's six-year evaluation of commercial fish traps for selective harvest and wild salmon bycatch mortality reduction in the lower Columbia River.
11	Provide any social media handles you use - Enter social handles or URLs such as instagram, facebook, twitter, youtube, etc. so that we can use to cross promote on our channels - if you do not have any, please place N/A
	https://www.facebook.com/wildfishconservancy, https://www.instagram.com/wildfishconservancy/?hl=en, https://twitter.com/wildfishnw
12	Please indicate if you are currently following Oregon Wildlife Foundation on our social media channels
	- Instagram - Facebook
13	Total estimated project cost
	267050.00
14	Funding that you are requesting from OWF - If you're request is for more than $5,000, please contact Tim Greseth - tim@myowf.org before submitting your application.
	5000.00
15	What type of project are your proposing?
	Fish
16	Will your project address an Oregon Conservation Strategy habitat or species?
	yes
16.1	What habitat or species is addressed?
	Chinook Salmon, Coho Salmon, Chum Salmon, Steelhead, Estuaries

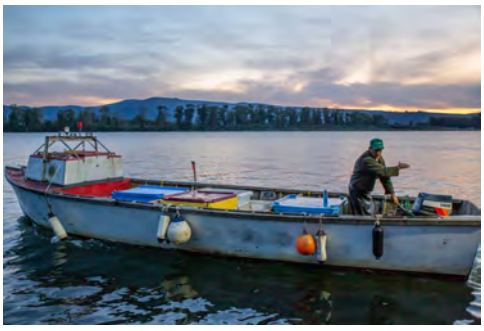
17	Start date of project- Day/Month/Year
	02-07-2022
18	End date of project
	01-07-2023
19	Location of project
	Astoria, OR, USA
20	Has a local, state or federal biologist reviewed this project?
	yes
20.1	What is their name and contact info?
	Thomas Buehrens: tbuehrens@gmail.com, Thomas.Buehrens@dfw.wa.gov
21	Have you already or will you obtain necessary permits from all requisite agencies as applicable to proposed project?
	yes
22	What will the requested funds be used for?
	OWF funds will be used to cover open-access publication of a groundbreaking study on commercial fishery bycatch mortality reduction techniques in a well-respected peer-reviewed scientific journal (cost: ~$4,000) to support improved salmon management in the Columbia River. Funds will also be used to support necessary outreach and dissemination activities associated with publication of the study ($~1,000) for management uptake purposes. All publications and outreach materials will prominently acknowledge OWF support.
23	Provide a brief Project Summary
	Funding from OWF for this project will support scientific peer-review of a groundbreaking fisheries study and open-access publication of the results in the Journal of Experimental Marine Biology and Ecology to support improved salmon fisheries management in the Columbia River and elsewhere across the Pacific Northwest. Commercial fish traps were recently implemented at a limited scale in the lower Columbia River as a sustainable alternative to conventional gill netting to selectively harvest hatchery-origin fishes with significantly reduced mortality of wild-origin salmon and steelhead listed under the U.S. Endangered Species Act (ESA). Building upon the findings of prior studies for a modified passive fish trapping technique demonstrating nearly 100% bycatch survival of released adult salmonids, additional studies evaluating post-release survival of adult Coho Salmon, spring Chinook Salmon, and summer Chinook Salmon were conducted between 2019-2021 at two separate fish trap sites in the lower Columbia River to fill existing data gaps for fisheries managers. Over three years of study, we used unpaired mark-recapture and net pen holding methodologies to estimate post-release survival of Chinook Salmon and Coho Salmon, respectively. Evaluating detections of Passive Integrated Transponder (PIT)-tags at Bonneville Dam over a mean 7 d upriver migration (167 km), total detection of Chinook Salmon passively captured and released from a fish trap in 2019 was 1.000 (95% CI: $S \geq 0.968$). Through two separate net pen holding studies, post-release survival of Coho Salmon was estimated at 1.000 (95% CI: $S \geq 0.975$) over 4 d in 2020 and 0.965 (95% CI: $0.948 \leq S \leq 0.969$) over 6 d in 2021. Findings of these studies support the conclusions of prior research for the fishing practice and provide the most irrefutable evidence to date that passively operated fish traps can allow for selective harvesting of targeted fish stocks with little to no mortality of wild salmonid bycatch. Ultimately, by transitioning commercial salmon fisheries from use of conventional gill nets toward sustainable fishing solutions such as the fish trap, resource managers can nearly eliminate bycatch mortality and allow for the recovery of ESA-listed wild salmonids and coastal fishing economies.

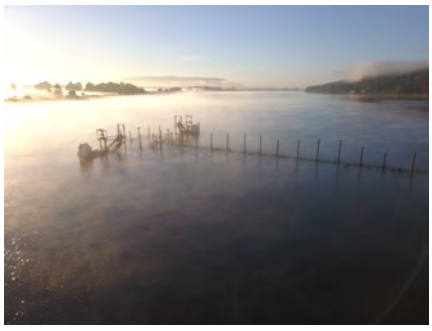
24 Upload pre-project pictures or a video -

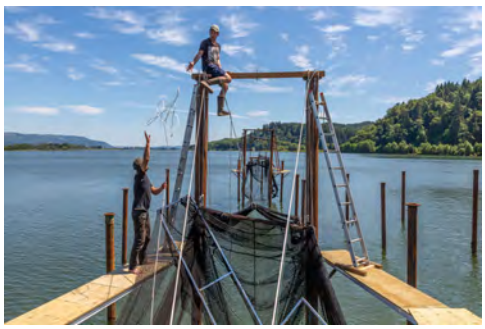
By submitting these photos or video I warrant that I am the legal owner of this media and grant the Foundation permission to reproduce, exhibit, or publish them for all general purposes in relation to Oregon Wildlife Foundation's work. If you have questions about photo or video submissions please refer to myowf.org/grants for guidance.

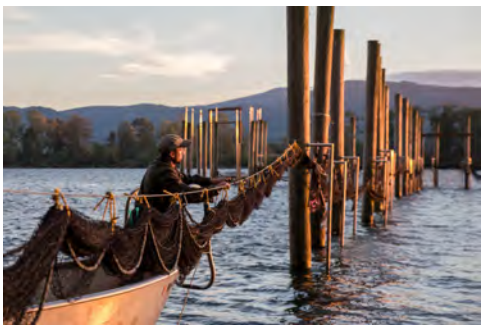


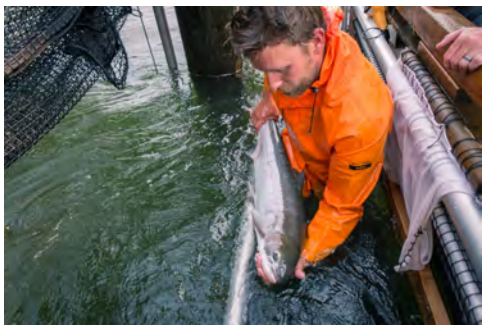


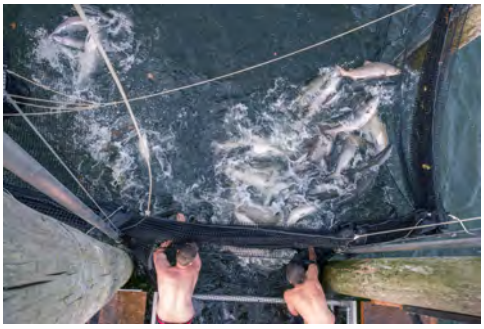


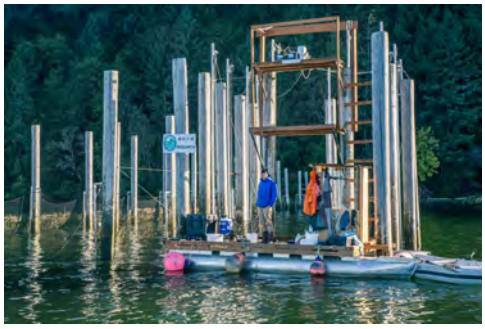












25	Fill out the budget

https://www.youtube.com/watch?v=XKViXpmfmOU

Project Revenue	Cash	In-Kind	Committed / Pending
Oregon Wildlife Foundation Request	5000.00		Pending
NOAA Fisheries Service Bycatch Reduction Engineering Program	171050.00		Committed
Oregon Department of Fish and Wildlife	15000.00		Committed
Washington Department of Fish and Wildlife	25000.00		Committed
Patagonia	46000.00		Committed
Wild Fish Conservancy	5000		Committed
REVENUE	**267050.00**	**0.00**	
		TOTAL PROJECT SUPPORT	**0.00**
Project Expenses	**Cash**	**In-Kind**	**Total**
Fish Trap Development and Implementation (NOAA Fisheries Service Bycatch Reduction Engineering Program)	171050		**171050.00**
Field Research (Oregon Department of Fish and Wildlife)	15000		**15000.00**
Field Research (Washington Department of Fish and Wildlife)	25000		**25000.00**
Field Research (Patagonia)	46000		**46000.00**
Publication, Outreach, and Dissemination (Oregon Wildlife Foundation Request)	5000		**5000.00**
Analysis and Reporting (Wild Fish Conservancy)	5000		**5000.00**
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			0.00
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			0.00
			0.00
		TOTAL PROJECT EXPENSES	**0.00**
Balanced budget? This cell should read "0" ---->		**NET**	**0.00**

26	Upload your Project Narrative - Please make sure your narrative is no more than 7 pages long, single spaced, 12 pt. font (Calibri preferred).	
		1 Document Uploaded
27	Upload letters of support	
		1 Document Uploaded
28	I understand that I am required to submit a Project Completion Report, copies of any publications or social media posts crediting the Foundation's support, and post-project pictures at the completion of my project	
		yes

— Grant Application

Adrian Tuohy

Application ID: A29TA77

Project Narrative – Wild Fish Conservancy – Study to Improve Salmon Management

The Problem: Bycatch mortality from gill nets in Pacific Northwest commercial salmon fisheries impedes the recovery of wild salmon and steelhead and constrains commercial fisheries.

Solution/Project Objectives: Wild Fish Conservancy (WFC), Dr. John Skalski (University of WA), and local commercial fishers conducted further testing of fish trapping as a sustainable alternative commercial fishing practice to gill netting between 2019-2021 in the Columbia River salmon fishery. Specifically, objectives were to further evaluate wild Chinook and Coho Salmon bycatch survival from fish traps and the ability of the fishing practice to selectively target hatchery salmon for sustainable harvest. Now that all data are collected, *WFC and partners are seeking OWF support to have the results peer-reviewed and published in a scientific journal for dissemination and management uptake*. Published findings will be used to inform management and implementation of an emerging sustainable commercial fishery in the Columbia River that is currently being developed by agencies of Washington and Oregon.

Benefits: Findings from three years of study support the conclusions of prior research for the fishing practice and provide the most irrefutable evidence to date that passively operated fish traps can allow for selective harvesting of targeted fish stocks with little to no mortality of wild salmonid bycatch. Ultimately, by transitioning commercial salmon fisheries from use of conventional gill nets toward sustainable fishing solutions such as the fish trap, resource managers can nearly eliminate bycatch mortality and allow for the recovery of Endangered Species Act-listed wild salmonids and coastal fishing economies.

Introduction to the Problem: Bycatch and mixed-stock harvesting of Endangered Species Act (ESA)-listed Pacific Salmonids (*Oncorhynchus Spp.)* constrains fishing opportunities for abundant hatchery fishes and impacts wild salmonid populations throughout the Pacific Northwest (NRC 1996). Mostly to the detriment of wild salmonid population genetics (Naish et al. 2008), millions of hatchery fish are produced annually at federal, state, and tribal hatcheries to increase short-term fishing opportunities (Mahnken et al. 1998). However, absent fishing practices that can selectively harvest hatchery fishes while releasing ESA-listed wild salmonids unharmed, neither hatcheries nor salmon fisheries can be managed effectively to achieve conservation and harvest objectives (Gayeski et al. 2018). In the Columbia River, this management paradigm of production hatcheries and mixed-stock harvesting contributed to the decline and extirpation of wild salmonid populations (NRC 1996; Lichatowich 1999). Although efforts have been made to reform both harvest and hatchery management (WFWC 2009, 2013), it is evident that these same management factors continue to limit the recovery of wild salmonids (Lichatowich et al. 2017). For example, the percentage of hatchery-origin spawners consistently exceeds biological targets designed to protect wild salmonid population fitness throughout the basin (HSRG 2009). Furthermore, mixed-stock harvest with gill nets continues to impact ESA-listed fishes and severely constrain fishing opportunities to remove hatchery fish that have been produced for the purpose of increasing harvest opportunities (ODFW & WDFW 2020).

Identifying a Solution: To address the problem, fisheries managers of Washington and Oregon were directed to develop and implement low-impact alternatives to gill netting in the Columbia River to increase harvest of hatchery-origin fishes with minimal mortality to wild salmonids (WFWC 2013; ODFW 2013). In response, the nonprofit Wild Fish Conservancy (WFC) and commercial fishers constructed the first operational fish trap since 1935 in the Cathlamet Channel,

lower Columbia River, WA. The gear was deployed to evaluate the ability of the fishing practice to reduce bycatch impacts and improve selective harvesting of hatchery salmon (Tuohy 2018).

By design, fish traps remain fixed in position by piling and passively funnel returning adult salmonids from the 'lead' (a fine-meshed wall positioned perpendicular to shore) through a maze of compartments in which fish rarely escape (Cobb 1930). Salmonids encountering the lead instinctively move against the current into progressively smaller compartments of the trap ('heart,' 'tunnel,' 'pot,' and 'live well,' respectively). The final compartment has dimensions appropriate for operators to sort the catch for harvest or release with little to no air exposure and handling. Salmonids remain free-swimming within a trap and mesh dimensions prevent entanglement.

The fish trap installed in 2016 functioned to passively corral returning adult fishes from the lead and heart walls to an upstream-positioned pot compartment. When approximately 10-40 fishes could be observed free-swimming in the pot, the catch was quickly brailed to the shallows en masse using line-and-pulley and a solar-powered winch (Tuohy et al. 2019). After the brailing process was completed to transfer the catch to an adjacent submerged live well (depth 1 m), the fishes were hand sorted by species and ad-clip status with all fishes remaining underwater; bycatch were then released by hand over the outer wall of the live well. It must be further noted that free-swimming fishes passively captured in the pot prior to brailing could also be individually dip-netted into a live well for data collection and passive release through a submerged exit. This technique was less efficient for operators, but essentially eliminated mortality effects from air exposure and overcrowding, and reduced capture stress relative to brailing (Cox and Sippel 2020).

To evaluate the effects of the alternative gear to bycatch, post-release survival from brailing operations with the trap was estimated through a paired release-recapture study in 2017 using Passive Integrated Transponder (PIT) tags (Tuohy et al. 2019). Results demonstrated that the trap effectively captured hatchery Chinook Salmon and Coho Salmon (*O. kisutch*) while dramatically improving bycatch survival rates relative to other commercial fishing gear-types. Survival of trapped and brailed fish compared to passively released dip-netted controls over a 400-km migration to McNary Dam was estimated at 0.944 ($\widehat{SE}$ = 0.046) and 0.995 ($\widehat{SE}$ = 0.078) for summer Steelhead (*O. mykiss*) and fall Chinook Salmon, respectively (Tuohy et al. 2019). Yet another critical finding was that fishes unexposed to brailing (e.g., those dip-netted and passively released from fish trap operations) survived at greater rates than those that were brailed. As Cox and Sippel (2020) described in their report to the Department of Fish and Wildlife (TAC 2020), survival of control group fishes that were dip-netted and passively released was estimated at 100%.

Given promising results for dip-netted and passively released fishes in 2017, efforts were made to further improve survival of captured and released fishes from the gear through development of passive capture operations and the phasing-out of brailing techniques. The fish trap design and final capture processes at the Cathlamet, WA site were modified in 2019 in efforts to eliminate fish air exposure and handling associated with the prototype brailing process (Tuohy et al. 2020). In contrast with the prototype design, the upstream-positioned pot was altered to passively funnel fishes one-by-one against the ebb current into an upstream-positioned live well without brailing en masse or necessitating a dip-net. Using underwater cameras, the free-swimming catch could be identified within the live well to species and ad-clip status, allowing for selective removal of hatchery fish and passive release of bycatch through a submerged exit door without brailing, handling, or exposure to air. This method was defined as the 'passive operation'.

Passive operations with the Cathlamet, WA fish trap were evaluated between 2019-2020 when conditions allowed for effective passive capture on the ebb tides (Tuohy et al. 2020). Post-release survival of Sockeye Salmon (*O. nerka*) and Coho Salmon from passive operations was estimated and compared to that of brailing operations in side-by-side studies to assess the effectiveness of gear modifications. Demonstrating significant improvements in bycatch survival and 100% post-release survival for both Sockeye Salmon and Coho Salmon through paired mark-recapture and net pen holding methods, respectively (Tuohy et al. 2020; Fryer et al. 2021), passive operations were expanded to allow for effective capture during all tides with construction of a double-ended fish trap in Clifton Channel, OR in 2021 (Tuohy and Jorgenson 2022).

Objectives: Although data from all relevant studies has indicated that passive operations with fish traps may have little to no effect to released salmonid bycatch (Tuohy et al. 2020; Cox and Sippel 2020; Fryer et al. 2021), bycatch survival rates are known to vary depending on the species encountered, the timing of seasonal gear operation, and water quality conditions (among other factors) (Davis 2002; Raby et al. 2015). For these reasons, stock-specific release survival studies have been required by fisheries management agencies for implementation of most commercial gears within the Columbia River. Therefore, we conducted additional studies of two passively operated fish traps between 2019-2021 to further evaluate bycatch survival rates for Coho Salmon and fill existing data gaps for spring-run and summer-run Chinook Salmon. We hypothesized that survival estimates for passive operations with fish traps would continue to exceed that of brailing operations from the prototype fish trap design, nearing 100%.

Methods and Evaluation:

Study Location

Two fish traps were studied between 2019 and 2021 in the lower Columbia River where fish traps were commonly used in the early 20th Century. In 2019-2020, pilot research of passive capture operations occurred at rkm 67 in Cathlamet Channel (Wahkiakum County, WA). This trap occupied the same location as used in the studies of Tuohy et al. (2020). In 2021, research of passive capture operations occurred near rkm 55 in Clifton Channel (Clatsop County, OR).

Chinook Salmon Survival Study: 2019

Research for spring-run and summer-run Chinook Salmon was conducted between May 5 and July 2, 2019. Similar to concurrent studies of Sockeye Salmon post-release survival (Tuohy et al. 2020), trap operators began a fishing event by deploying the pot compartment from its suspended position above the water column toward the river bottom. Pot tunnels were then opened, enabling the capture of free-swimming fish from the pot compartment for data collection. In capturing the catch for this mark-recapture tagging experiment, fishes were either 1) exposed to brailing en masse, or 2) passively captured and unexposed to brailing.

When a fish was captured in a live well through any means, the catch was restrained by hand or rubberized dip-net for data collection. Wading within the live well, biologists enumerated, measured (FL), and identified all specimens by species and ad-clip status. All salmonids were scanned for PIT tags with a Biomark HPR reader (Biomark). If existing PIT tags were detected, codes were recorded; these salmonids were then allowed to passively migrate through the live-well exit door for detection upriver. All Chinook lacking an existing PIT tag were tagged in the peritoneal cavity with a 12.5-mm full-duplex PIT tag. These fish were then scanned to record tag

information and a 1 mm caudal fin clip tissue sample was secured for genetic processing by the Columbia River Inter-Tribal Fish Commission (CRITFC). With all data collected, each fish was passively released through the exit door for detection at Bonneville Dam (rkm 234).

Chinook Salmon Survival Analysis

To determine where each PIT-tagged Chinook Salmon was likely to migrate post-release from the fish trap, genetic samples were processed by CRITFC (Hess et al. 2021). Using a combination of Genetic Stock Identification (GSI) and Parentage Based Tagging (PBT) methods, Hess et al. (2021) assigned each PIT-tagged Chinook Salmon to one of 19 established Columbia River Basin population reporting groups. With genetic assignment results paired with each PIT-tagged Chinook Salmon, the sample was filtered for individuals genetically assigned to upper-basin population reporting groups originating above Bonneville Dam PIT-tag arrays (rkm 234). All PIT-tagged Chinook Salmon genetically assigned to lower-basin reporting groups were removed from the analysis given their genetic affinity to remain below Bonneville Dam.

Given the PIT-tagged Chinook Salmon sample that had genetically assigned to upper-basin reporting groups, we used an unpaired single release–recapture method to estimate the joint probability of survival and detection for Chinook Salmon released from each treatment group between the fish trap site (rkm 67) and Bonneville Dam (rkm 234). Bonneville Dam was selected as the final detection point to mirror prior studies conducted by Vander Haegen et al. (2004).

Upriver detection histories for PIT-tagged Chinook Salmon were downloaded from the Columbia Basin PIT Tag Information System (PTAGIS; www.ptagis.org), which provides public access to all PIT tag detection data throughout the basin. Given interrogations of the tagged sample at Bonneville Dam, the total detection rate was directly estimated by a binomial proportion (p = # detected/# total tagged) with associated binomial variance.

Coho Salmon Survival Studies: 2020-2021

The net pen holding studies conducted in 2020-2021 were similar in design to those conducted by Takata and Johnson (2018) in which Coho Salmon were captured with a commercial gear and released into captivity to directly observe mortalities over a set period of time. Mirroring the timeframe of study in the lower Columbia River for tangle nets when commercial Coho Salmon fisheries commonly occur, holding studies were conducted at the completion of commercial test fishing weeks that occurred from late-September through October 2020. These studies observed Coho Salmon survival from the passive trapping process over 2 d and 4 d post-release periods. At the recommendation of management agency representatives, the study period in 2021 was shifted earlier than any prior Coho Salmon net pen holding study conducted in the Columbia River to evaluate 6 d post-release survival in adverse water quality conditions in early September.

In each year of study, trap operators deployed the pot of the gear to the river bottom and opened the tunnel doors to initiate the soak period. During collection of net pen holding sub-samples, adult Coho (> 47 cm FL) captured with the trap were restrained by hand and transferred individually with a rubberized dip net to a designated temporary holding chamber of the live well until a sample of approximately 29-44 fish was retained. With the desired sample size achieved after a 4-12 h collection period, investigators sealed outlets to all pot tunnels. Coho were once again restrained by hand, enumerated, identified by origin (adipose fin-clipped or unclipped), measured (FL), noted for capture condition, and transferred from the live well by hand or dip-net to the sealed pot

compartment (now functioning as a net pen holding chamber with dimensions similar to Takata and Johnson (2018)). Once the last fish was released into the net pen, investigators initiated holding periods of 0-2 d (S_1), 2-4 d (S_s), and 4-6 d (S_3). With the study underway, a biologist was stationed on-site to note the date, time, water temperature (°C), and fish mortalities.

Coho Salmon Survival Analysis

Post-release survival of Coho was estimated by holding and observing three sub-sample groups (mean = 35, min = 29, max = 38) for a 4 d period in 2020 and five sub-sample groups (mean = 40, min = 38, max = 44) for a 6 d period in 2021. At the end of each holding period, all fish in the pen were enumerated, measured (FL), identified for species type and ad-clip status, and noted for condition ("lively", "lethargic", or "no signs of life"). Survival in each period was directly estimated by a binomial proportion (p = # survived/# total) with associated binomial variance.

Results:

Chinook Salmon

Between May 5 and July 2, 2019 at the Cathlamet, WA fish trap site, a total of 146 spring and summer-run Chinook Salmon were genetic sampled and PIT-tagged for a mark-recapture analysis. In efforts to restrain the catch in the live well for genetic sampling and tagging, 114 were captured through passive operations with the fish trap and 32 fish were captured via brailing with the bunt of the pot net. During all gear operations, tagging, and genetic sampling, zero Chinook Salmon adult or jack immediate mortalities occurred, resulting in an immediate survival estimate of $\hat{S}_0 = 1.000$ (95% CI: $S \geq 0.981$) for returning adults and jacks.

Stock composition of the sampled Chinook Salmon population was estimated by Hess et al. (2021), resulting in genetic stock assignments for 142 PIT-tagged Chinook Salmon. In total, 127 PIT-tagged Chinook Salmon were successfully paired with genetic assignments to defined Columbia River Basin population reporting groups. For the PIT-tagged Chinook Salmon that were captured through passive operations with the fish trap and paired with genetic assignment data ($n = 102$), a total of 83 fish assigned to upper basin reporting groups above Bonneville Dam and 19 fish assigned to lower basin reporting groups below Bonneville Dam. Of the PIT-tagged Chinook Salmon captured via brailing operations and paired with genetic assignment data ($n = 25$), a total of 16 fish assigned to upper basin reporting groups above Bonneville Dam and 9 fish assigned to lower basin reporting groups below Bonneville Dam.

Given the Chinook samples that were tagged and successfully paired with upper-basin genetic assignment data for passive operations ($n_{\text{passive}} = 83$) and brailing operations ($n_{\text{brailing}} = 16$), total detection rates for each group were determined at tag arrays at or above Bonneville Dam. For Chinook exposed to passive operations with the trap, total detection was 1.000 (95% CI: $S \geq 0.968$) based upon 83 unique tag detections from the sample at Bonneville Dam. For Chinook exposed to brailing operations, total detection was 0.938 (95% CI: $0.753 \leq S \leq 0.996$) based upon 15 unique tag detections from the sample. Given these results, detection was significantly different between passive and brailed samples at the $\alpha = 0.05$ level ($|Z| \geq 2.289$, $P < 0.02$).

Coho Salmon

Between 25 September and 15 October 2020, a 4 d net pen holding study was conducted at the Cathlamet, WA trap site for Coho Salmon captured using passive operations. During the research

period, water temperatures ranged from 19.3ºC to 16.7ºC (mean = 18.08ºC). Encountering 2,209 adult Coho Salmon in 2020, there were zero adult immediate mortalities resulting in an immediate survival estimate of $\hat{S}_0 = 1.000$ (95% CI: $S \geq 0.999$). A total of 105 Coho Salmon were held in captivity post-release from the gear in three separate sub-sample groups. No mortalities occurred within 0-2 d, nor did any mortalities occur between 2-4 d for post-release survival estimates of $\hat{S}_1 = 1.000$ (95% CI: $S_1 \geq 0.975$) and $\hat{S}_2 = 1.000$ (95% CI: $S_2 \geq 0.975$), respectively.

In 2021, a 6 d holding study was conducted at the Clifton, OR trap site for Coho Salmon captured using passive operations. This study was conducted earlier in the fishing season than prior years, with fish collection dates occurring between 3 September and 29 September. Throughout the net pen holding experiment, water temperatures ranged from 20.9ºC to 17.4ºC (mean = 19.22ºC). Encountering 1,790 adult Coho Salmon in 2021, there were two adult immediate mortalities, resulting in an immediate survival estimate of $\hat{S}_0 = 0.999$ (95% CI: $0.997 \leq \hat{S}_0 \leq 0.9998$). A total of 200 Coho Salmon were held in captivity post-release from the commercial gear for a 0-2 d duration in five separate sub-sample groups. One mortality occurred during the 0-2 d holding period for a post-release survival estimate of $\hat{S}_1 = 0.995$ (95% CI: $0.978 \leq \hat{S}_1 \leq 0.9997$).

With one mortality occurring between 0-2 d, a total of 199 Coho Salmon were held in captivity for the 2-4 d holding period in five separate sub-sample groups. One mortality occurred between 2-4 d of confinement for a post-release survival estimate of $\hat{S}_2 = 0.995$ (95% CI: $0.978 \leq \hat{S}_2 \leq 0.9997$).

Given the two total mortalities that occurred within the 0-2 d and 2-4 d holding periods and removing two fish from the long-term sample due to pinniped predation within the holding pen, a total of 196 Coho Salmon were held in captivity for the 4-6 d holding period in five separate sub-sample groups. Between 4-6 d of confinement, five mortalities occurred. From these results, 4-6 d post-release survival was estimated at $\hat{S}_3 = 0.974$ (95% CI: $0.946 \leq \hat{S}_3 \leq 0.991$).

Discussion: Using unpaired mark-recapture and net pen holding techniques to estimate post-release survival of Coho Salmon and Chinook Salmon (both spring-run and summer-run stocks) from passive operations with fish traps, results for each species and methodology mostly validate the findings of prior survival studies for Sockeye Salmon, Coho Salmon, fall-run Chinook Salmon, and summer-run Steelhead from passive operations with the gear (Tuohy et al. 2020; Cox and Sippel 2020). Evaluating detections of PIT-tagged spring-run and summer-run Chinook Salmon that were genetically assigned to population reporting groups above Bonneville Dam (Hess et al. 2021), total detection at Bonneville Dam was 1.000 (95% CI: $S \geq 0.968$) over a 6.7 d, 167 km migration. Given that this unpaired analysis lacked a control group to adjust for confounding factors such as tag loss and mortality effects from research handling and tagging, upriver predation, fisheries, and the natural environmental baseline, the survival estimate of 1.000 from this study of spring-run and summer-run Chinook Salmon is remarkable. Although there may seem to be sample size limitations, the fact that 83 of 83 of the PIT-tagged sample that had assigned to upper basin populations were detected at Bonneville Dam in the absence of a control group is highly persuasive and corroborates the findings of prior studies for passively operated fish traps that estimated survival at 1.000 (Tuohy et al. 2020; Cox and Sippel 2020).

Findings for spring-run and summer-run Chinook Salmon are further validated through the results of the net pen holding studies for Coho Salmon in 2020-2021. Similar to Tuohy et al. (2020) that estimated Coho Salmon post-release survival from passive operations with fish traps at $\hat{S}_1 = 1.000$ (95% CI: $S_1 \geq 0.978$) over 0-2 d, we estimated 0-2 d post-release survival at $\hat{S}_1 =$

1.000 (95% CI: $S_1 \geq 0.975$) in 2020 and $\hat{S}_1 = 0.995$ (95% CI: $0.978 \leq \hat{S}_1 \leq 0.9997$) in 2021. Similarly, over 4 d of confinement, we estimated post-release survival at $\hat{S}_2 = 1.000$ (95% CI: $S_2 \geq 0.975$) in 2020 and $\hat{S}_2 = 0.995$ (95% CI: $0.978 \leq \hat{S}_2 \leq 0.9997$) in 2021.

Although findings for 4-6 d net pen holding deviate from the conclusions of other studies for passively operated fish traps with post-release survival estimated at $\hat{S}_3 = 0.974$ (95% CI: $0.946 \leq \hat{S}_3 \leq 0.991$), it must be noted that the net pen holding methodology lacked a control group to adjust for confounding mortality factors including confinement in nearly lethal water quality conditions, the natural environmental baseline, and research processes (e.g., dip-netting, fish handling, and other stressors unique to the study). Based upon the environmental conditions experienced during the 2021 holding study, it is likely that the few mortalities that occurred between 4-6 d of captivity were primarily due to the prolonged effects of confinement in lethal water quality conditions and abrasion in the holding pen. In sub-sample period two when the majority of the long-term mortalities occurred, water temperatures consistently neared or exceeded thresholds identified as lethal for fall runs of salmon (20-22°C; Becker 1973; EPA 2021), with the mean temperature during captivity estimated at 20.3°C (95% CI: 20.2°C $\leq \widehat{temp} \leq$ 20.5°C).

While these Chinook and Coho post-release survival studies generally validate the findings of previous studies conducted for passively operated fish traps, Chinook survival results also corroborate the findings of Tuohy et al. (2020) and Cox and Sippel (2020) in supporting the hypothesis that bycatch survival from passively operated fish traps exceeds that of prototype brailing operations for traps in the Columbia River. Although the sample size for the brailed treatment group was limited ($n = 16$), the total detection rate of 0.938 (95% CI: $0.753 \leq S \leq 0.996$) at Bonneville Dam was strikingly similar to Cox and Sippel's (2020) survival estimate of $S = 0.935$ (95% CI: $S \geq 0.648$) for upper-basin fall-run Chinook released from brailing operations. For passive operations with the fish trap, our analysis of PIT-tagged spring-run and summer-run Chinook demonstrated that the joint probability of survival and detection over 167 km to Bonneville Dam was 1.000 (95% CI: $S \geq 0.968$)—a significant difference from that of brailing operations ($|Z| \geq 2.289$, $P < 0.02$). Once again, this conclusion mirrors that of Cox and Sippel (2020) that compared brailing vs. passive operations and similarly estimated survival of upriver-basin fall-run Chinook from passive operations with traps at 1.000 (95% CI: $S \geq 0.752$) = 0.95).

Various studies relevant to passively operated fish traps have now been conducted demonstrating bycatch survival at or near 1.000 (Tuohy et al. 2020; Cox and Sippel 2020); however, there is perhaps no evidence as simple and persuasive as that from these three unpaired mark-recapture and net pen holding studies conducted at two separate fish trap sites across three seasons in the Columbia River. While failing to control for well-established confounding mortality factors, post-release survival was 1.000 for spring-run and summer-run Chinook in 2019; for Coho, post-release survival was estimated at 1.000 and 0.965 in 2020 and 2021, respectively. Given these estimates of survival and the collective evidence from other prior studies of passively operated fish traps, it is evident that the fishing practice can allow for selective harvesting of targeted fish stocks while nearly eliminating bycatch mortality of ESA-listed adult salmonids in Pacific Northwest fisheries. Moving forward with this project, the manuscript summarizing our results must be submitted to a scientific journal (e.g., *Experimental Ecology*) for peer-review and open-access publication (cost: ~$4,000). Outreach / dissemination of the published product (cost: ~$1,000) will inform management and implementation of the emerging commercial trap fishery in the Columbia River and elsewhere in the region to improve the sustainability of commercial salmon fisheries.

Oregon
Kate Brown, Governor

Department of Fish and Wildlife
Fish Division
4034 Fairview Industrial Drive SE
Salem, OR 97302
(503) 947-6201
FAX (503) 947-6202
www.dfw.state.or.us/

26 March 2019

Dr. Wendy Morrison
Office of Sustainable Fisheries
NOAA Fisheries
1315 East West Highway
Silver Spring, MD 20910

RE: Wild Fish Conservancy Proposal for Experimental Commercial Pound Net Evaluation

Dear Dr. Morrison:

The Oregon Department of Fish and Wildlife (ODFW) supports the Wild Fish Conservancy's (WFC) proposal to further develop and assess the efficacy of pound net fish traps as a potential gear to selectively harvest hatchery salmon and as a potential monitoring tool for salmon and steelhead runs in the Columbia River. I believe there are dual primary potential benefits of developing the trap, the first, the selective removal of excess in-river hatchery Chinook and Coho salmon, and the second, the potential of the traps to serve as an early monitoring tool for returning salmon and steelhead.

We believe that identifying and developing commercial fishing gears capable of selectively removing excess in-river hatchery Chinook and Coho salmon in the lower Columbia River is key. Regional scientists have identified increased hatchery production of certain Columbia River salmon stocks as a critical step in halting the decline of the ESA listed Southern Resident Killer Whales (SRKW). Being able to effectively harvest those hatchery fish in-river once they have moved beyond the reach SRKWs will be a necessary component to make sure continued additional production does not adversely affect listed Columbia River salmon and steelhead stocks.

Having an indication of stock strength is at the backbone of Columbia River fisheries management. Current checkpoints include Bonneville Dam and Willamette Falls fish counts. The experimental pound nets have the potential to provide an earlier index as well as providing an index for lower river stocks that do not migrate upstream of the current checkpoints. If release mortality of bycatch is low enough to allow operation through fishing seasons, this monitoring could be an extremely valuable additional piece of information.

However, significant biological and logistical hurdles remain prior to implementing pound nets on a commercial or fisheries monitoring scale. A full assessment of the release mortality rates of non-targeted fish intercepted by pound net traps is amongst the most significant of these hurdles, and is necessary prior to either implementing the gear for commercial fisheries or monitoring applications. Until we have a better understanding of these rates, the pound net's potential for

commercial use in the Columbia River and its potential to aid in wild fish recovery remain uncertain.

To function as a commercial or fisheries monitoring tool the traps also need to be useable at multiple locations. The testing the WFC has completed to date has been focused on a single trap site in Cathlamet Channel. Although initial results from this location have been promising, testing the gear other locations is necessary. However, testing at other locations is potentially problematic given the history of commercial fishing on the river and the presence of commercial fishing drift rights. Drift rights enable their holder to fish a certain stretch of river during commercial fishing seasons and are broadly recognized within the commercial fishing community. The initial pound net trap was tested in conjunction with a commercial fisher on that fisher's existing drift right. The gear's broad adoption by the industry will be fraught if additional testing does not recognize these area constraints, and the ODFW would not be supportive of any effort that impinged upon existing drift rights. The WFC, in working with NOAA researchers and Columbia River commercial fishers, believes they have identified a second testing location that may be effective at catching fish and that is outside existing drift rights.

It is in the spirit of collaborative learning and a hope that several of the hurdles currently limiting this gear's potential might be addressed that ODFW supports this WFC proposal to assess pound net trap release mortality rates and portability to additional sites. Thank you in advance for your full consideration of this important work.

Sincerely,

Tucker A. Jones
Ocean Salmon and Columbia River Program Manager
Oregon Department of Fish and Wildlife
971.673.6067

State of Washington
DEPARTMENT OF FISH AND WILDLIFE
Mailing Address: P.O. Box 43200, Olympia, WA 98504-3200 • (360) 902-2200 • TDD (360) 902-2207
Main Office Location: Natural Resources Building, 1111 Washington Street SE, Olympia, WA

March 29, 2019

Kurt Beardslee
Executive Director
Wild Fish Conservancy
Post Office Box 402
Duvall, WA 98109

Dear Kurt:

The Washington Department of Fish and Wildlife (WDFW) strongly supports the development, testing, and implementation of commercial fishing gear for mark selective harvest of salmon. Successful implementation of gears that are mark selective and can be demonstrated to have low mortality rates for released fish will help maintain the economic viability of commercial fishers in Washington and provide quality, locally-harvested seafood to consumers. Allowing harvest of abundant hatchery-origin salmon with limited impacts on wild stocks of conservation concern is consistent with WDFW policies on hatchery management, fishery reform and with the Columbia Basin salmon management policy.

We support Wild Fish Conservancy's (WFC) proposal for funding to further evaluate pound net traps through locating, constructing, and testing a second pound net in the lower Columbia River in Oregon in 2020. The importance of site selection in regard to encounter with harvestable fish and by-catch and estimation of survival rates of salmonids can be further defined through this evaluation project, and will be instrumental in determining ability to expand use of pound nets as one of a suite of tools to harvest surplus hatchery salmon. Further evaluation of pound net traps will aid agency managers in determining suitability for broader implementation of pound net traps as an alternative gear for harvest of hatchery-origin salmon.

WDFW has initiated a rule-making process to implement pound net trap as a legal gear for commercial harvest of salmon. At present, gillnets and tangle nets are the only commercial gear legal for use in the Columbia and the addition of new alternatives is fundamentally important to advance the conservation and recovery of wild salmon and steelhead and maintain or enhance the economic well-being and stability of the fishing industry. Thank you for developing this proposal; we appreciate your efforts to help achieve these conservation and economic goals.

Sincerely,

Kelly Susewind
Director

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
PT Adams Research Station
PO Box 155 (520 Heceta Place)
Hammond, OR 97121
(503) 861-1818

March, 21, 2019

To Whom It May Concern-

I am writing this letter to express my support and intention to work in close collaboration with the Wild Fish Conservancy on their proposed project to install a pound net within the lower Columbia River (CR) near river mile 28. Since 2010, NOAA Fisheries has been collaborating with CR commercial tangle net fishermen to collect and tag adult spring-run Chinook salmon (*Oncorhynchus tshawytscha*) upon their return as adults to the CR estuary. This study has provided critical information regarding survival and run timing for ESA listed spring run Chinook salmon. Results from our long-term survival study indicate mortality between the estuary and Bonneville Dam is significant and highest for fish arriving early in the spring (e.g., March) compared to those arriving later (e.g., May). Survival modeling indicates this is due to the combined effects of harvest and predation, both of which tend to occur at higher levels in early spring. If estuary entrance timing/order is inherent to a given subpopulation, as our preliminary data suggest, these observations may explain why some CR salmon continue to struggle despite extensive restoration efforts.

When our study was initiated, we were able to identify study fish as originating from the Snake River, the Upper/Middle CR, the Willamette River or to a combined lower CR stock group. However, beginning in 2014, parental based genetics analysis has allowed us to identify

hatchery origin spring-run Chinook salmon to the subpopulation level. Success of our current sampling method (i.e. tangle net) is dependent on environmental and biological factors such as river height, flow, water clarity, and run size. Subsequently, sample sizes have varied from year to year and the number of fish identified as having originated from populations of special interest such as endangered fish from the Upper CR has not exceeded ten fish annually. Small sample sizes make it challenging to estimate survival and run timing at the subpopulation level with any certainty. Therefore, we seek to explore the use of additional sampling methods such as the pound net.

Additional methods for capturing adult Chinook salmon would serve to both augment the current NOAA tagging effort as well as validate tangle net sampling and handling methodologies used in the past for research and harvest. Furthermore, in addition to providing critical information about what is impacting listed adult salmon at the level of the subpopulation, knowing the timing and order of return for CR spring run fish will allow fisheries managers to make informed, real-time decisions about when to open/close the lower CR to harvest.

Sincerely,

A. Michelle Wargo Rub, D.V.M.
Research Fishery Biologist
NOAA Fisheries, NWFSC, Seattle, WA
(503) 861-1818 ext. 132

SCHOOL OF AQUATIC & FISHERY SCIENCES
COLUMBIA BASIN RESEARCH

UNIVERSITY OF WASHINGTON

29 October 2018

Kurt Beardslee
Executive Director
Wild Fish Conservancy
P.O. box 402
Duvall, WA 98109

Dear Kurt,

I am pleased to write this letter of support for and collaboration with Wild Fish Conservancy's efforts to develop alternative harvest methods for sustainable commercial salmon fisheries of the lower Columbia River sub-basin. In mixed-stock commercial fisheries such as the lower Columbia River salmon fishery, there is an urgent need to study and implement sustainable alternative harvest methods that can maximize the catch of hatchery-origin fish while minimizing bycatch mortality of threatened and endangered native salmon and steelhead. Results of the 2016-2017 Bycatch Reduction Engineering Program research suggest that the modified fish trap may be one of the most sustainable tools developed for the harvest of salmon. As Adrian Tuohy's graduate school advisor, we estimated cumulative survival rates from the trap ranging from 94.4% for steelhead trout to 99.5% for Chinook salmon. These results warrant application of the gear as a stock-selective harvest tool in commercial salmon fisheries.

Wild Fish Conservancy's collaborative evaluation of fish traps in the 2018 test fishery further lend support for larger-scale commercial implementation. During one of the worst salmon returns in history, the trap demonstrated the ability to selectively harvest hatchery-origin fishes and provide profitable jobs to local fishers and processors of the region.

The State of Washington is considering broad-scale commercial implementation of fish traps in the lower Columbia Basin. This is a momentous endeavor and collaboration of bright minds and qualified institutions are needed to ensure social, economic, and ecological objectives are met. To this end, I will continue collaborating with Wild Fish Conservancy and will advise Adrian Tuohy as he pursues his PhD in Aquatic and Fishery Sciences. During his studies, the University of Washington and its faculty will lend support and technical expertise to the proposed S-K project. This collaborative effort will contribute to the development of sustainable fisheries in the Columbia Basin, recovery of ESA-listed wild fish stocks, and revitalization of coastal fishing communities.

Sincerely,

John R. Skalski
Professor of Biological Statistics

1325 Fourth Avenue, Suite 1515, Seattle, Washington 98101-2540
(206) 616-4851 Fax (206) 616-7452 www.cbr.washington.edu

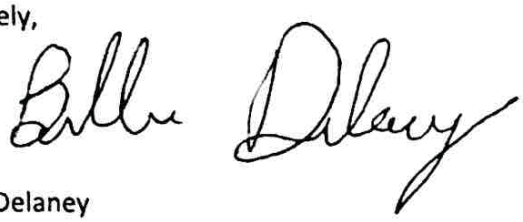
Kurt Beardslee
Executive Director
Wild Fish Conservancy
Post Office Box 402
Duvall, WA 98109

Dear Kurt,

This letter confirms my support for the proposed Wild Fish Conservancy project in the lower Columbia River. Funding of this project will help our collaborative team of fishers and biologists prove the viability of selective gear in the lower Columbia River, OR to increase fishing opportunity and reduce bycatch and hatchery impacts throughout the Columbia Basin.

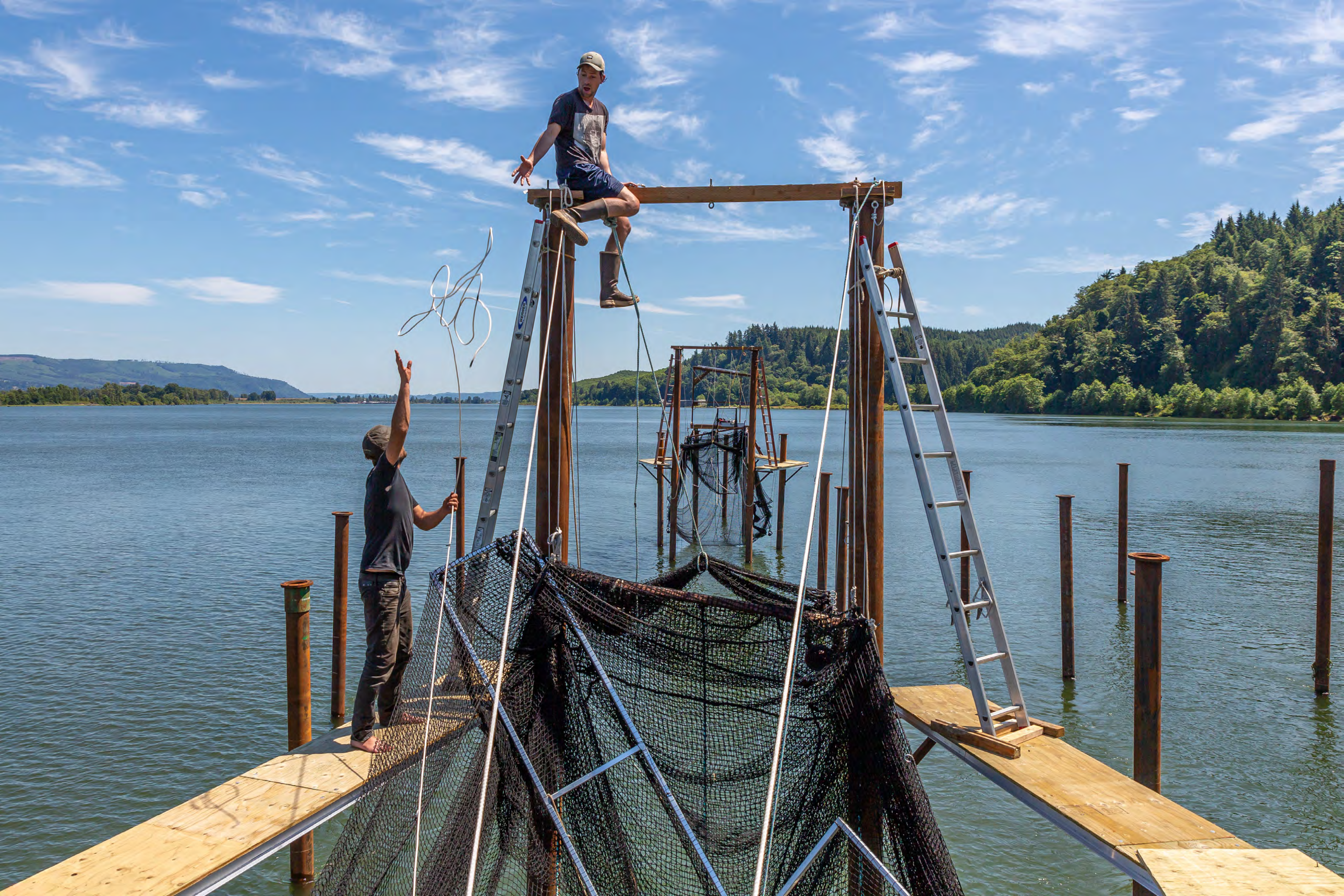
Fishing opportunity has declined dramatically over the last few decades from the loss of the resource and Endangered Species Act management concerns. The State and the Federal government must help transition our fisheries toward use of sustainable gears to provide a future for fishing and industry in our coastal communities. Funding for this project will help us test the viability of alternative gear for use by future generations. Thank you very much for considering this request.

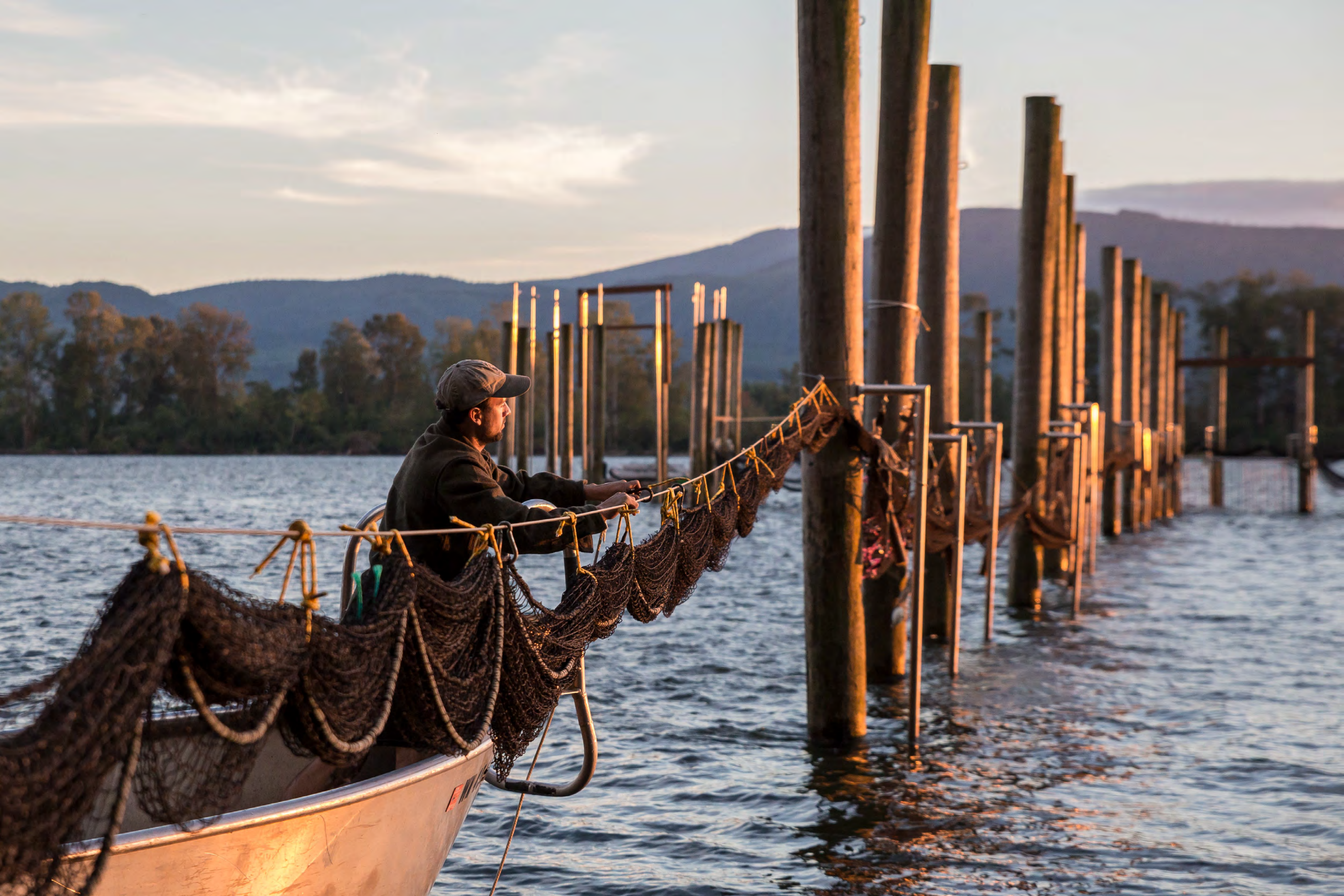
Sincerely,

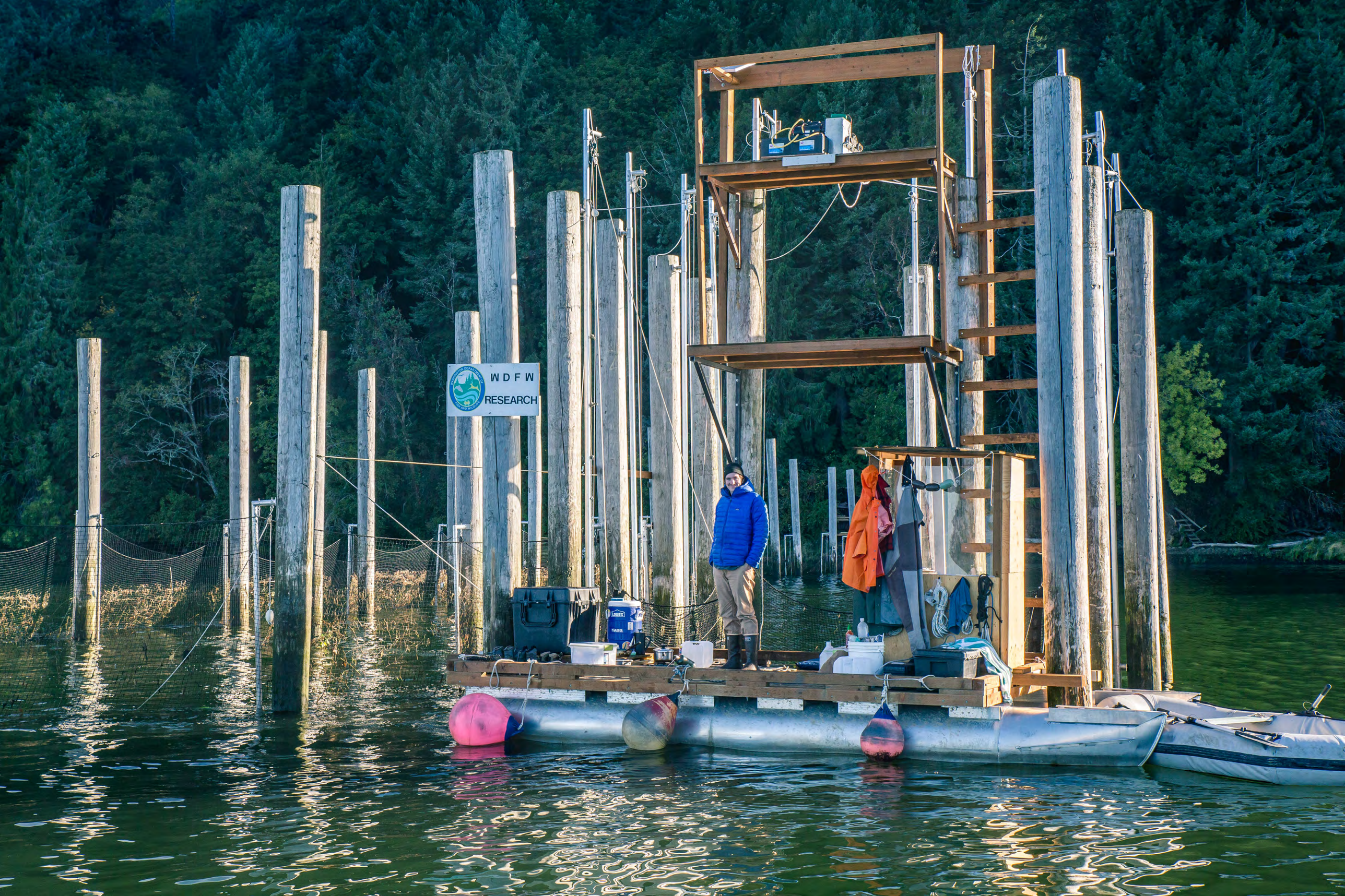


Billie Delaney

Commercial Fisher



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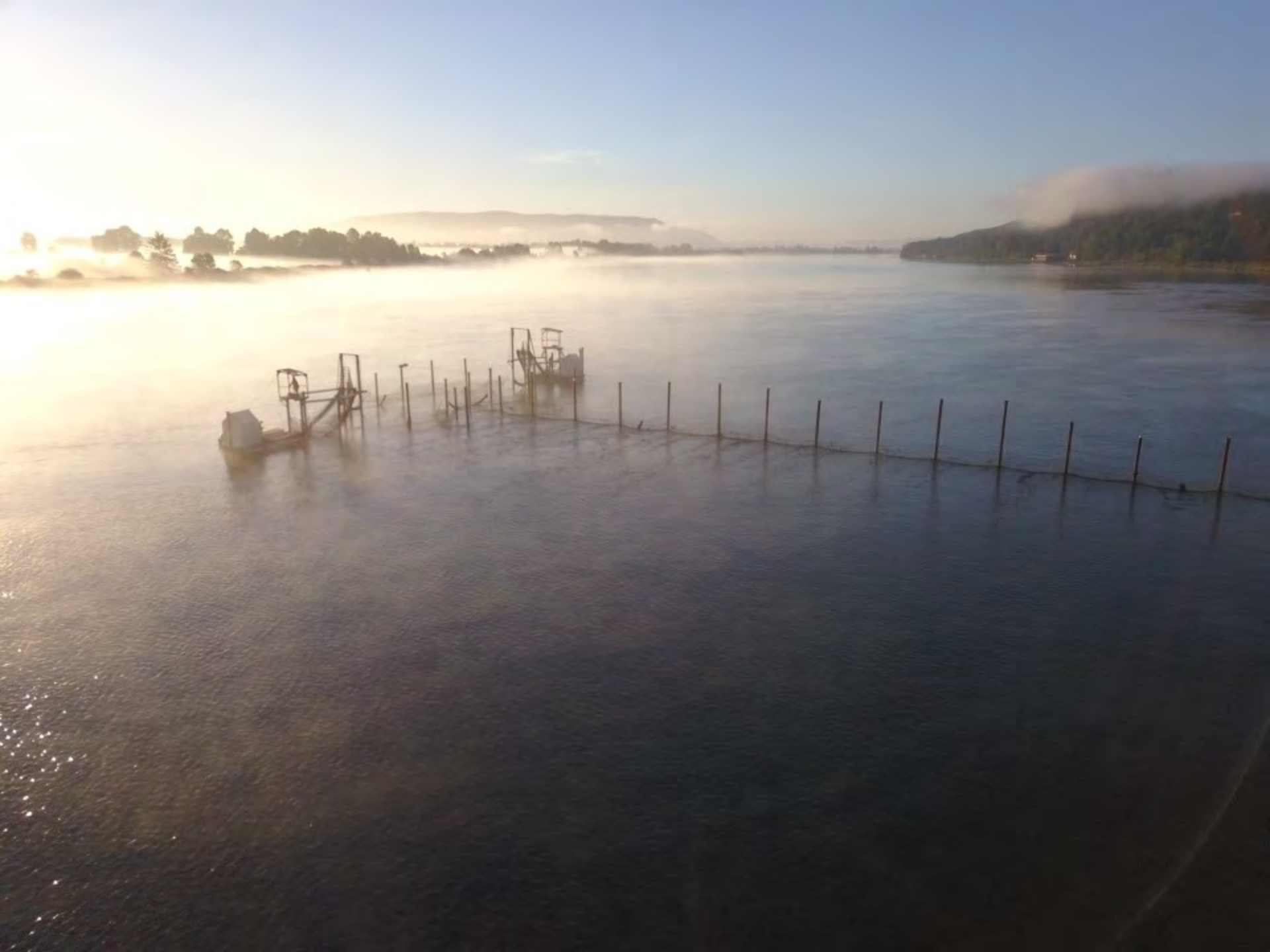

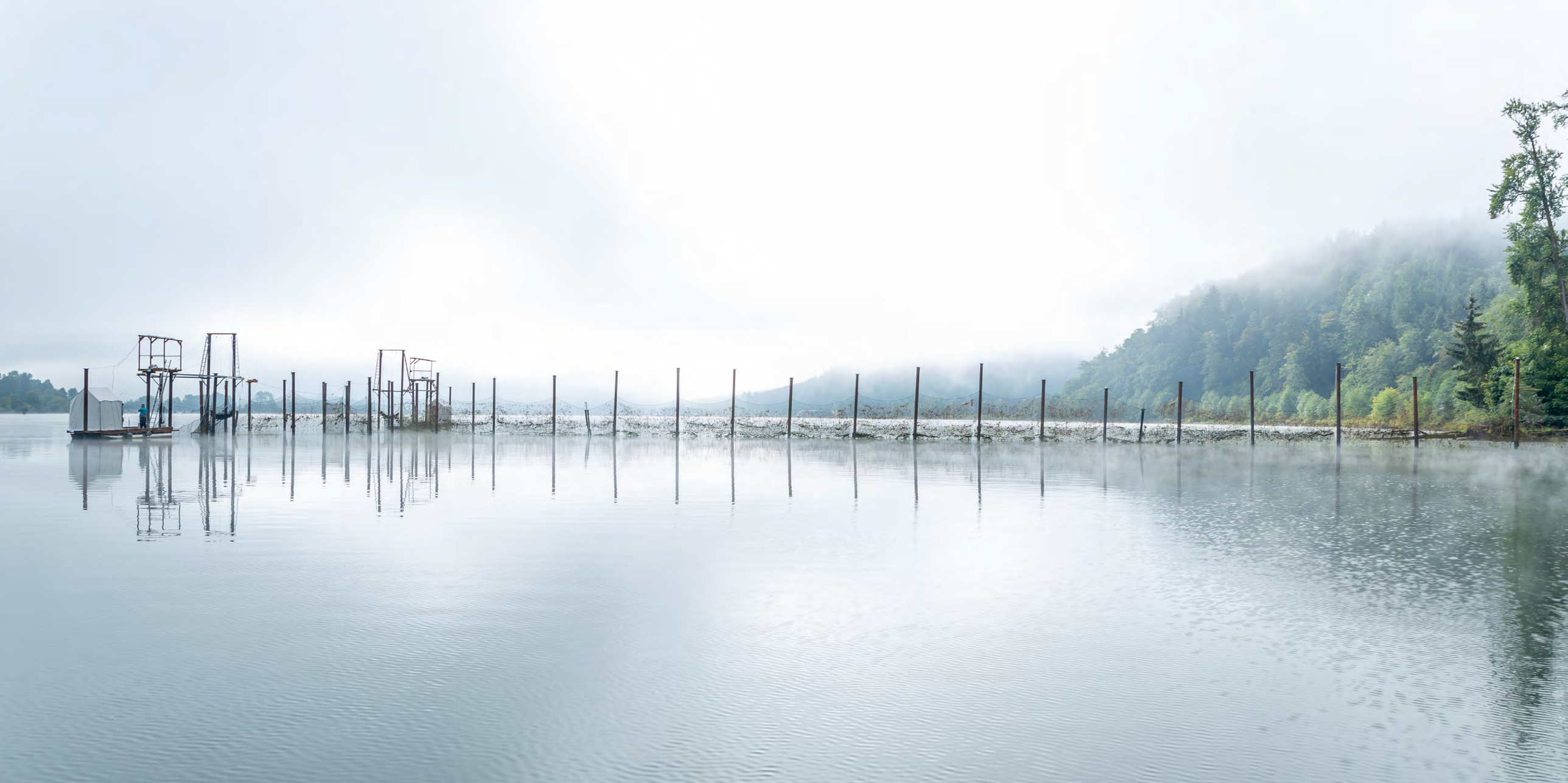

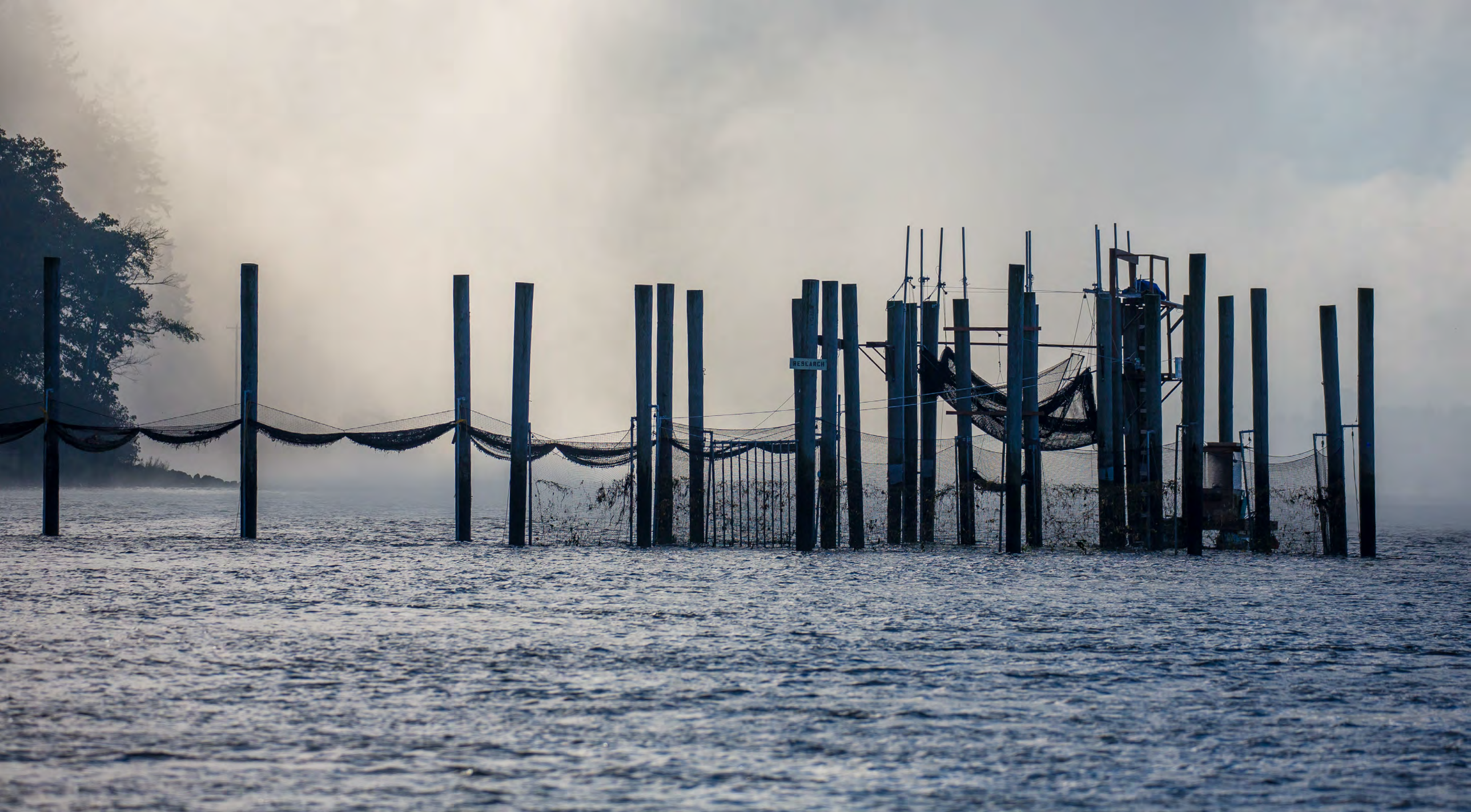
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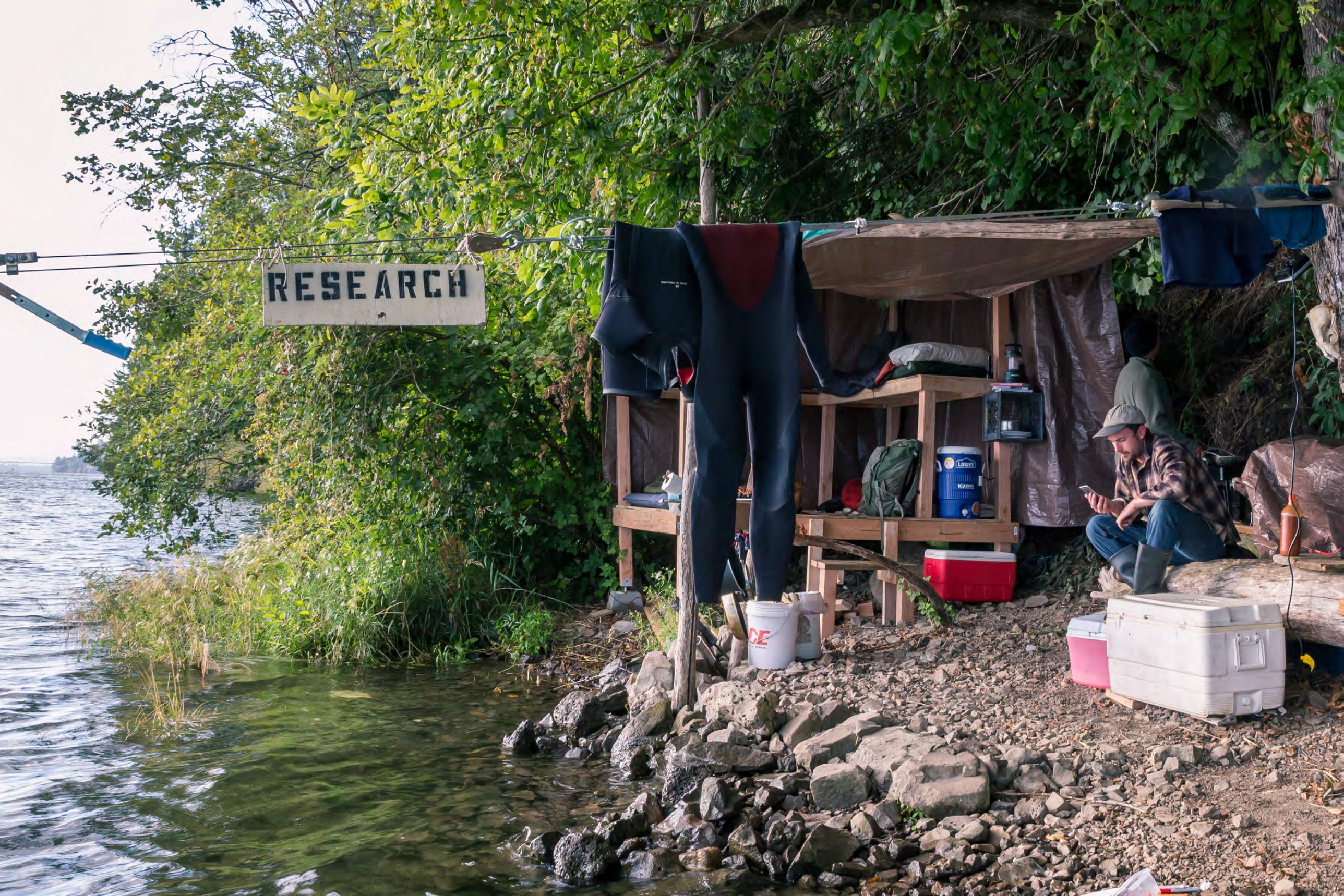
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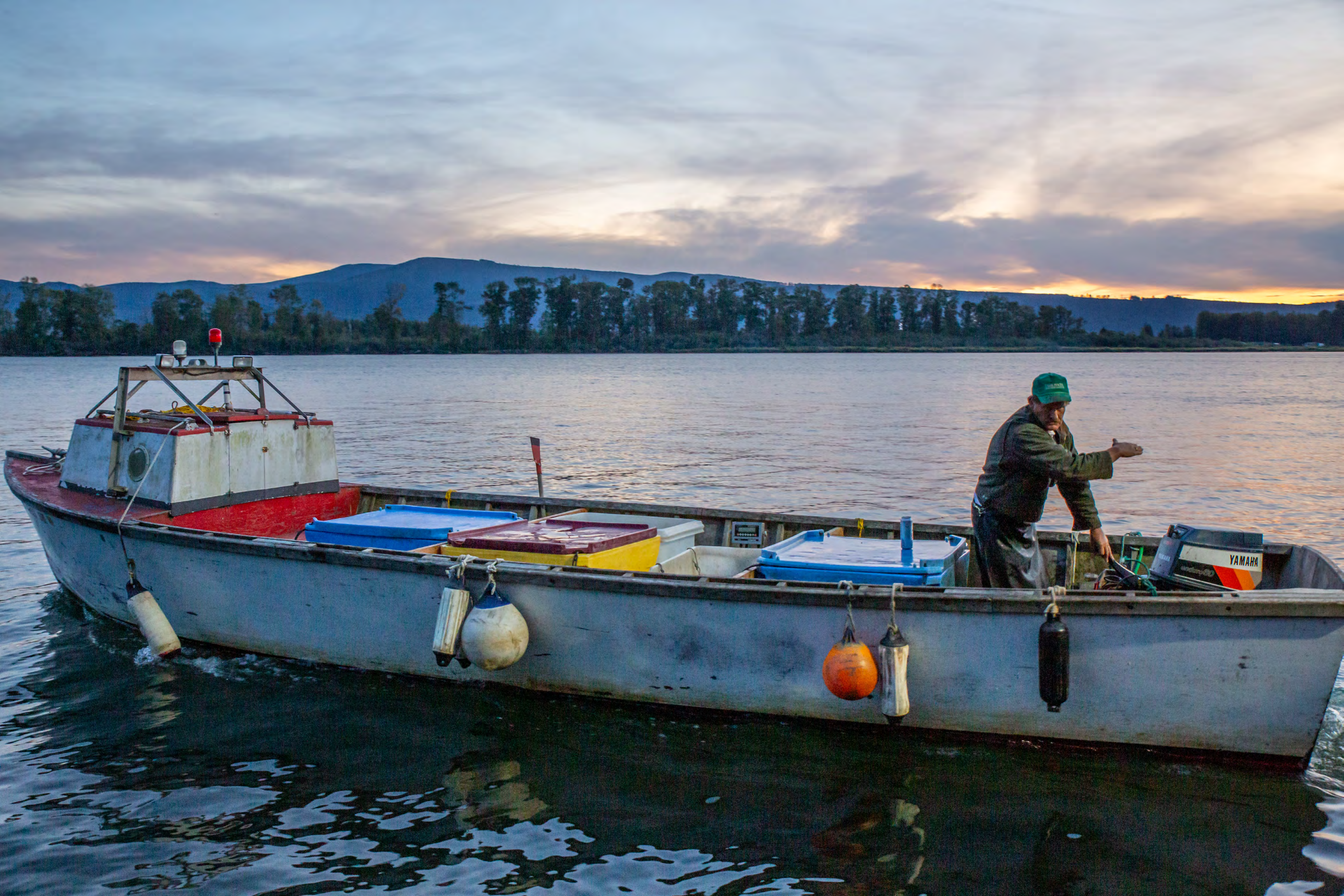
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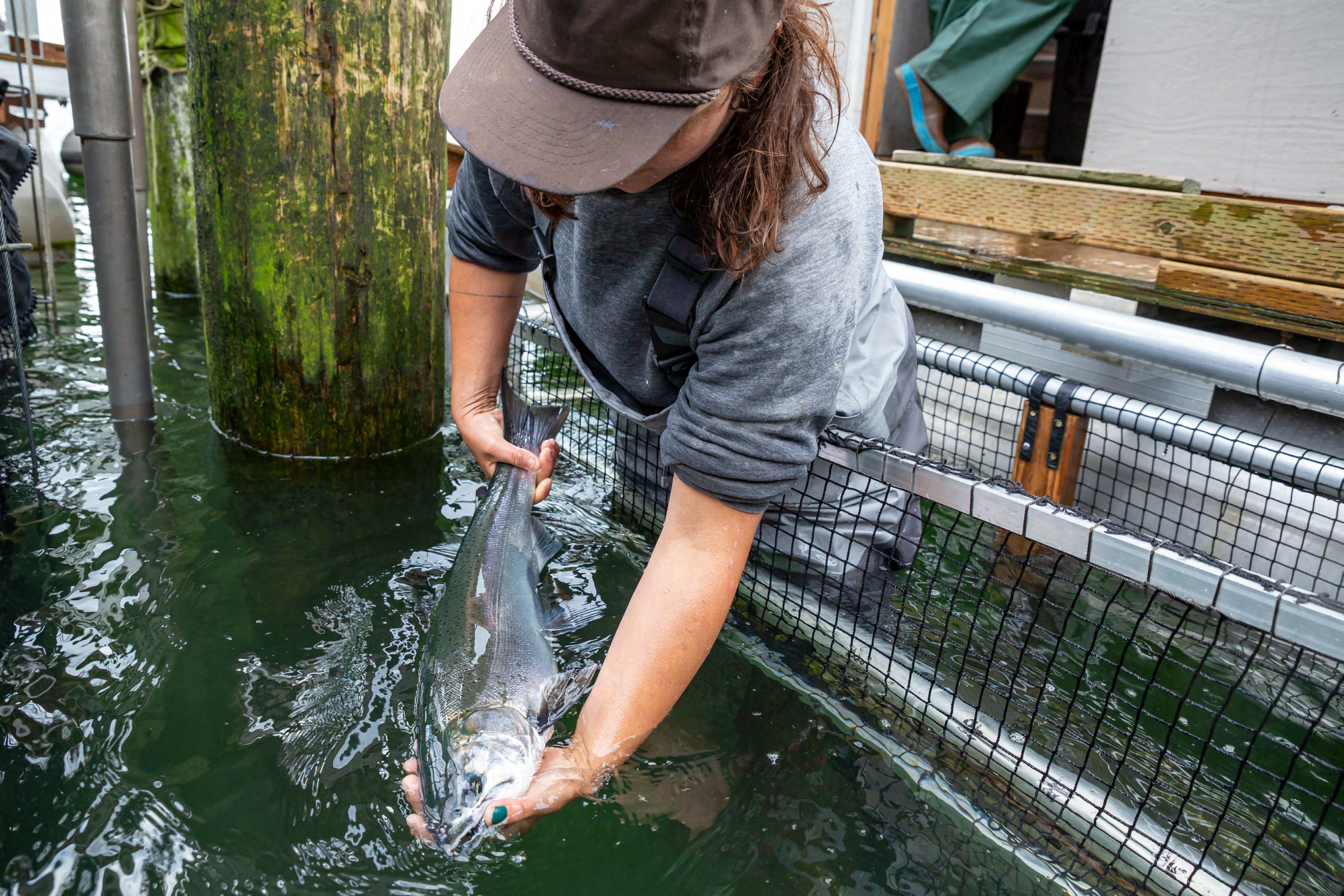

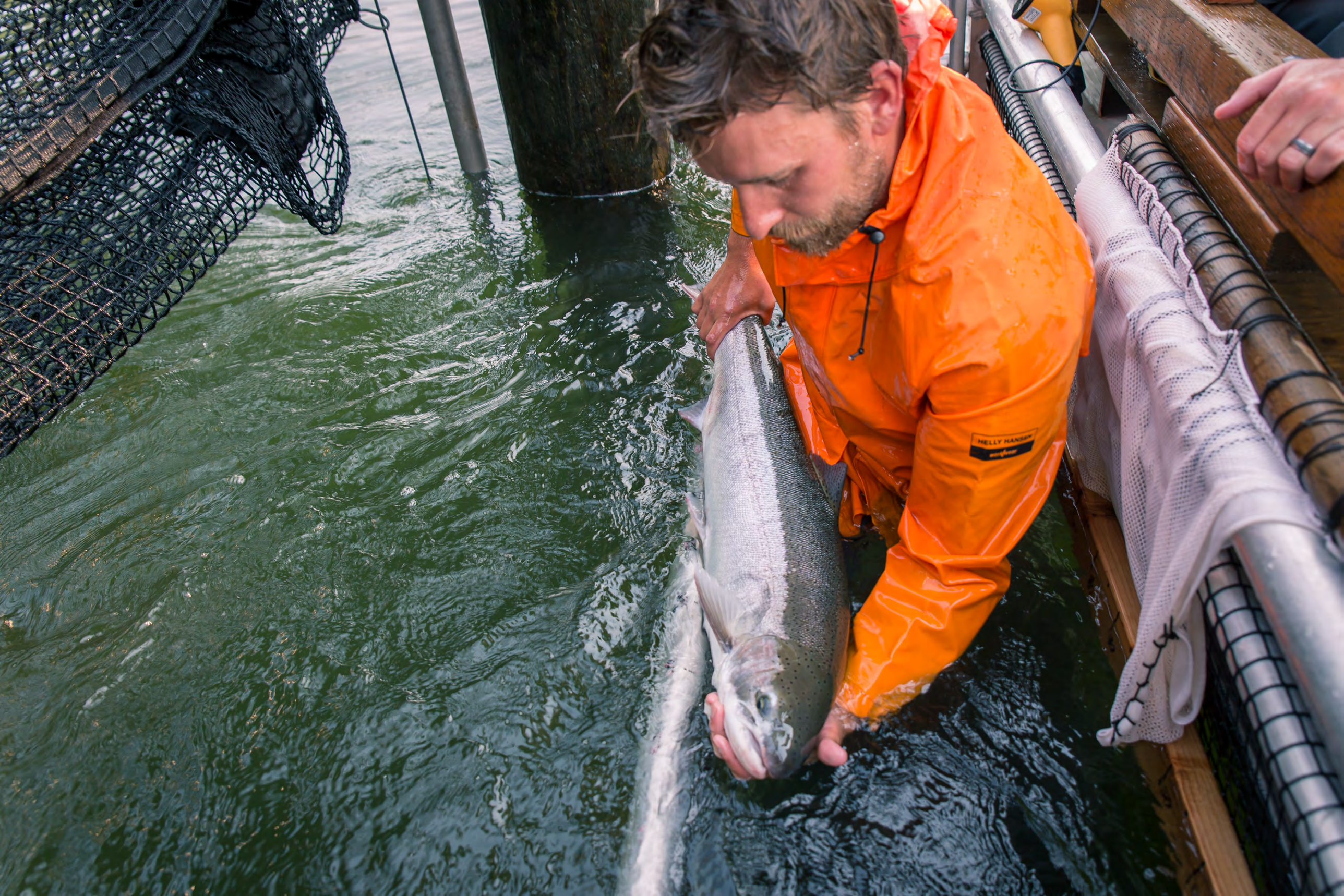
HELLY HANSEN