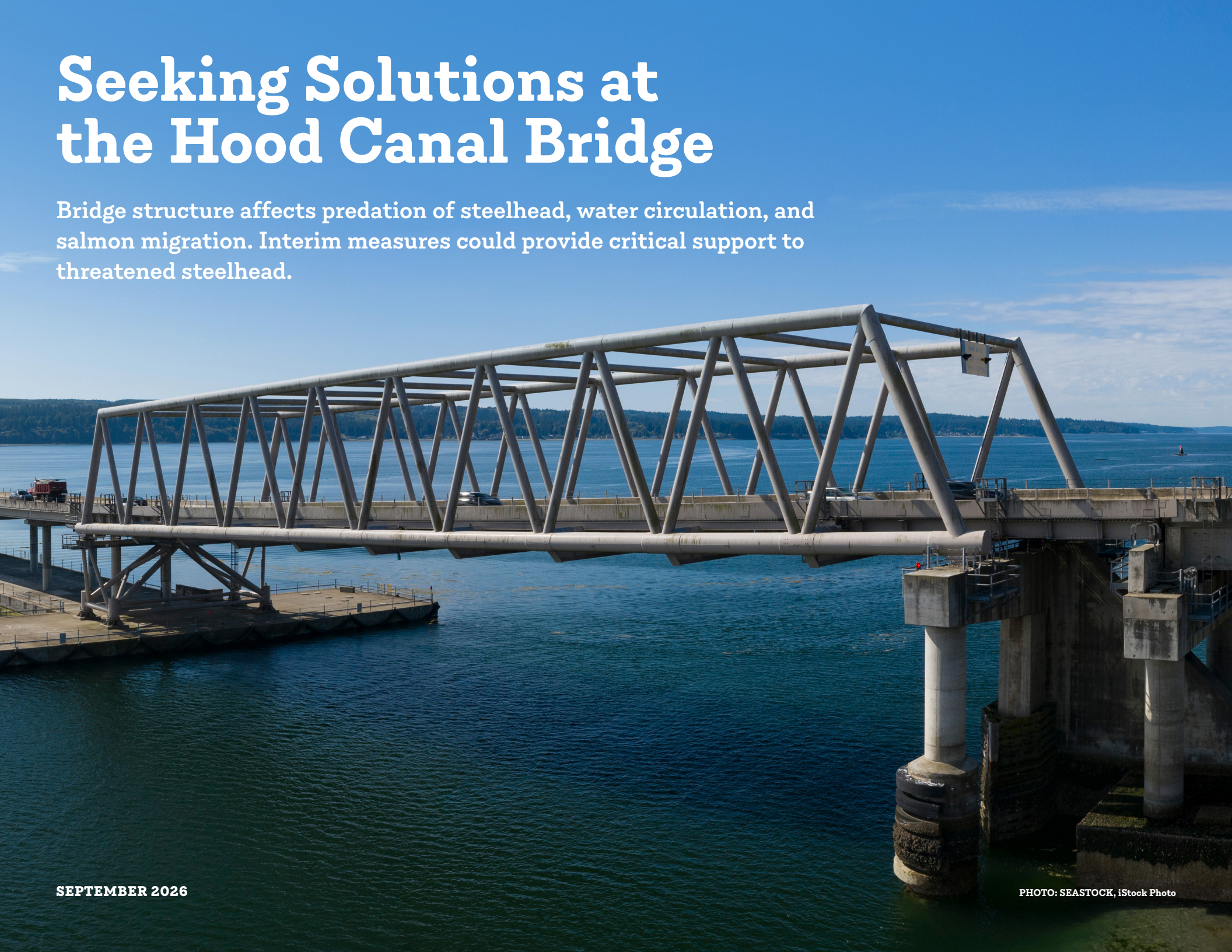
Seeking Solutions at the Hood Canal Bridge

Bridge structure affects predation of steelhead, water circulation, and salmon migration. Interim measures could provide critical support to threatened steelhead.



SEPTEMBER 2026

PHOTO: SEASTOCK, iStock Photo

Connecting Communities at a Cost

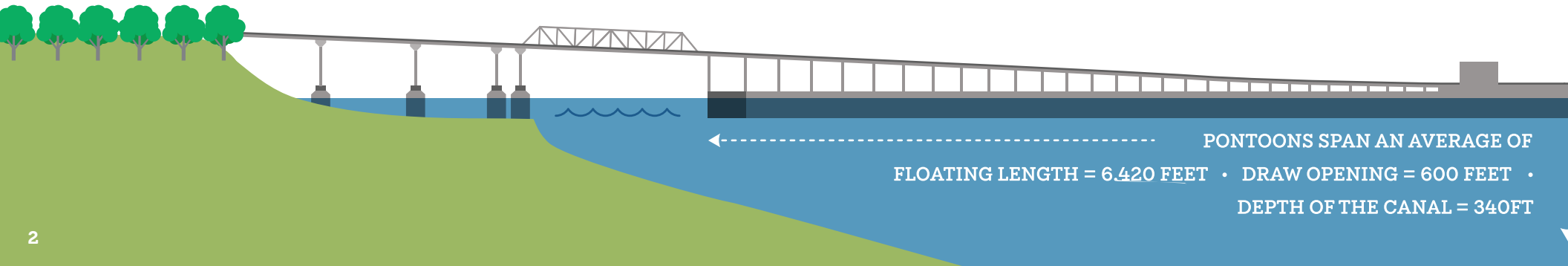
The Hood Canal Bridge has served as an essential link between communities on the Olympic and Kitsap Peninsulas since it opened in 1961. The longest saltwater floating bridge in the world, this important shortcut to the Olympic Peninsula stretches 1.5 miles in waters that are more than 300 feet deep. Unfortunately, the bridge's design has some big downsides for both humans and nature.

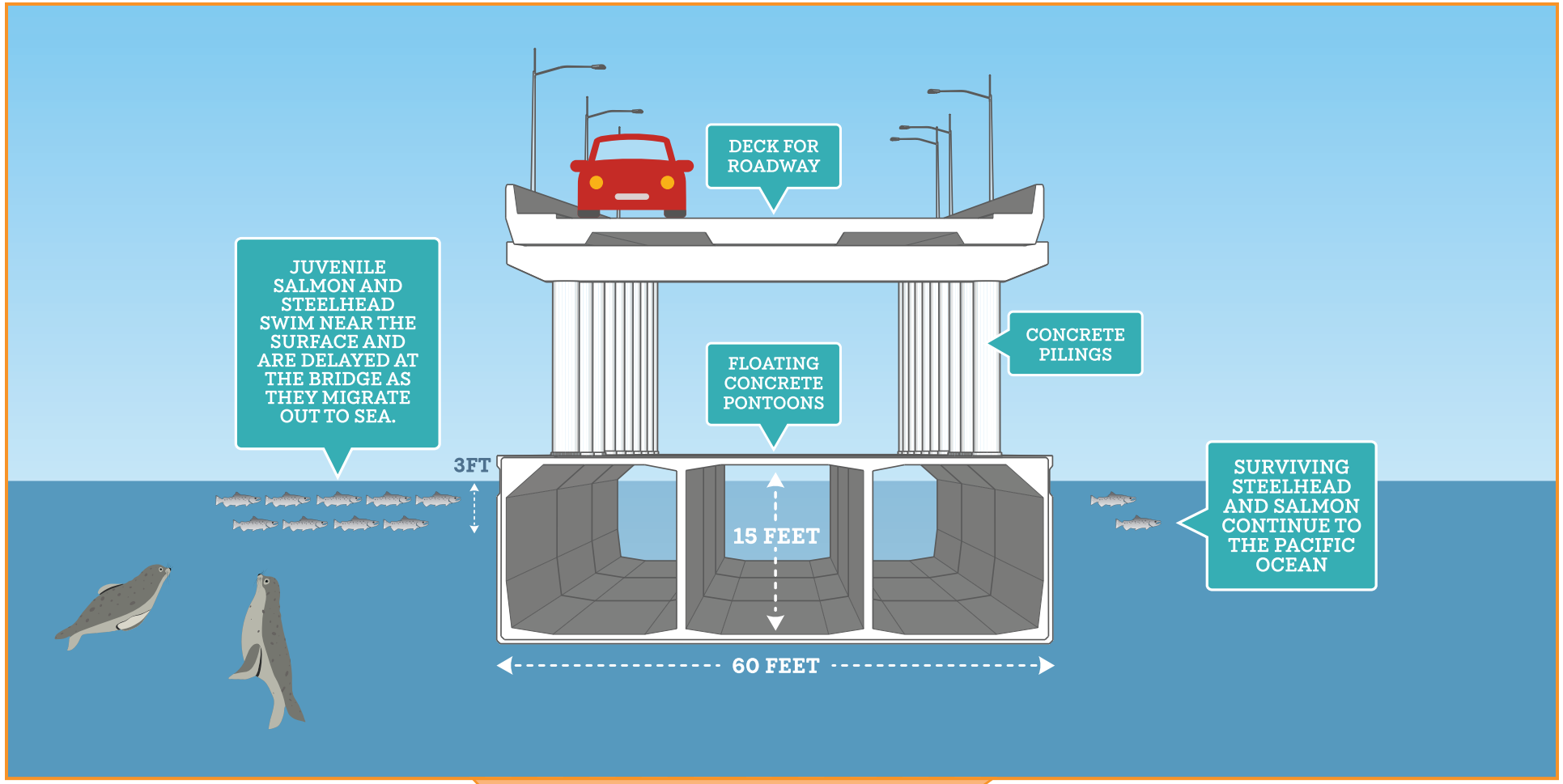
The 68-mile-long fjord that is Hood Canal is a vital habitat for many species and acts as a gateway for salmon and steelhead on their journeys out to the ocean and returning to spawn. Within the Pacific Northwest, these fish are anchors of the ecosystem, serving as a food source for orcas, eagles, and other wildlife, and carrying marine-derived nutrients into forests and streams. Puget Sound steelhead are listed as Threatened under the Endangered Species Act and roughly 10% of their habitat is upstream of the bridge. While more than $100 million has been invested in salmon and steelhead recovery actions in recent years, the Hood Canal Bridge's impact on the entire fjord means we may not be realizing the full value of this habitat restoration.

From Tribal communities to recreational and commercial fishing, these waters are vital to this part of Puget Sound, which is why the Hood Canal Bridge poses such a serious problem. Up to half of all young steelhead don't survive their encounter with the bridge. It's a loss felt by everyone with a stake in Hood Canal's health.

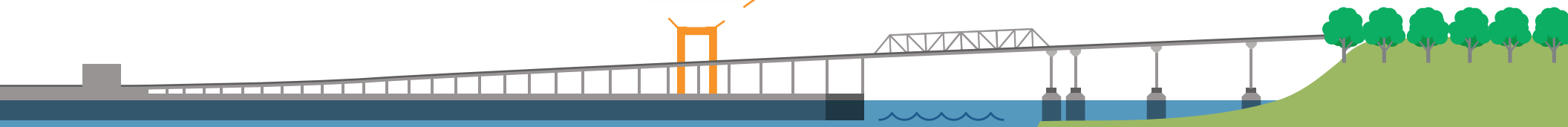


The Hood Canal Bridge provides a vital transportation link across the 68-mile-long fjord, but the bridge also impedes the migration of salmon and steelhead from many high-quality streams on the Olympic and Kitsap Peninsulas.



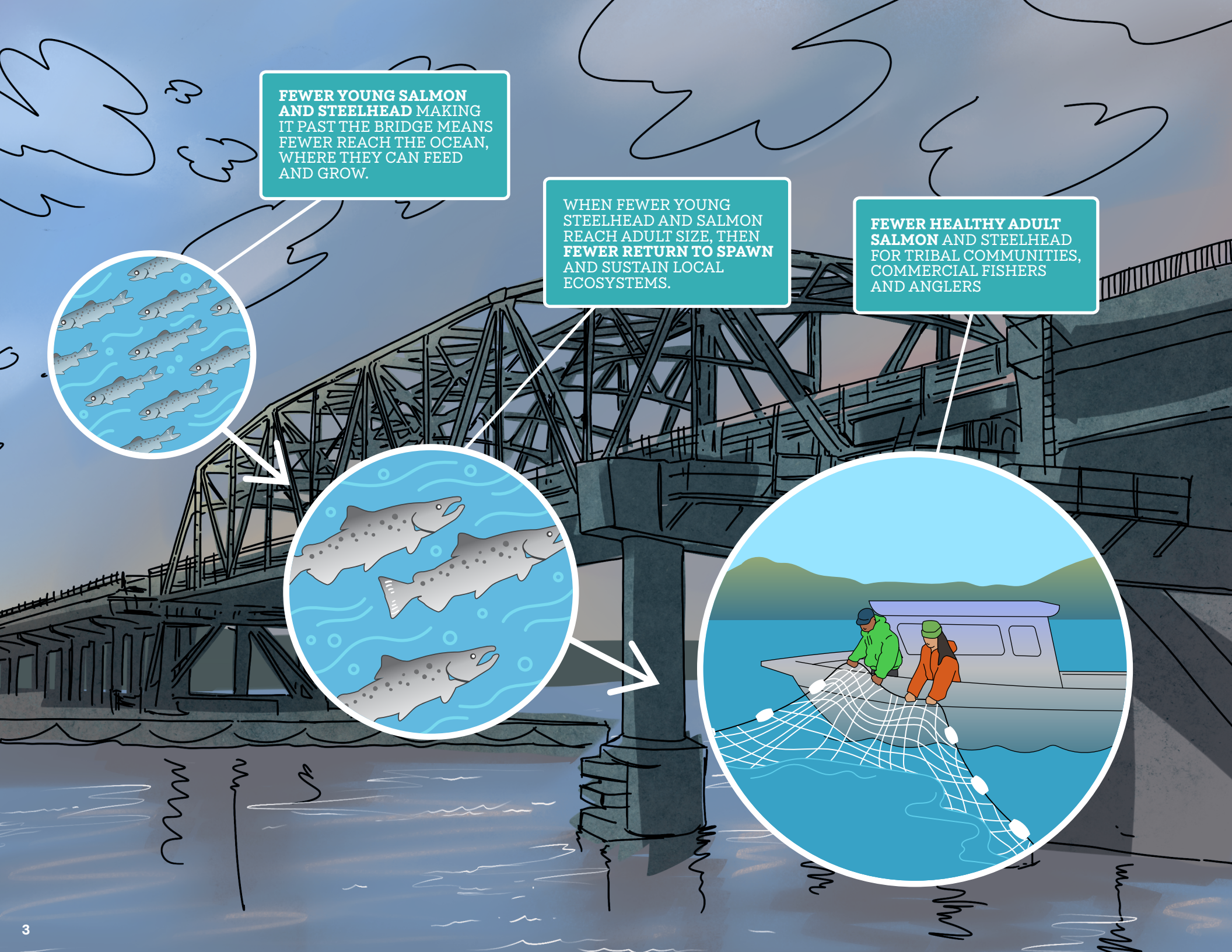


The Hood Canal Bridge's large concrete pontoons pose a challenge for fish and an opportunity for predators.



80% OF THE WIDTH OF THE CANAL

NAVIGATION CHANNEL WIDTH = 230 FEET • AVERAGE DAILY TRAFFIC = 18K VEHICLES


FEWER YOUNG SALMON AND STEELHEAD MAKING IT PAST THE BRIDGE MEANS FEWER REACH THE OCEAN, WHERE THEY CAN FEED AND GROW.
WHEN FEWER YOUNG STEELHEAD AND SALMON REACH ADULT SIZE, THEN **FEWER RETURN TO SPAWN** AND SUSTAIN LOCAL ECOSYSTEMS.
FEWER HEALTHY ADULT SALMON AND STEELHEAD FOR TRIBAL COMMUNITIES, COMMERCIAL FISHERS AND ANGLERS

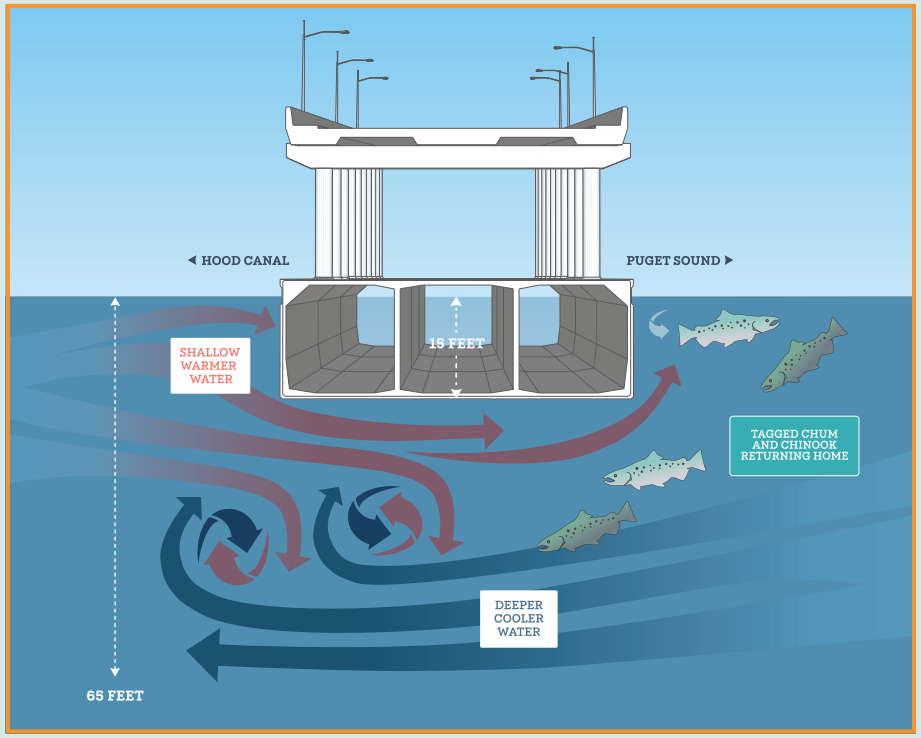
Project History

The first phase of the Hood Canal Bridge Assessment found that the bridge significantly delays migrating salmon and steelhead. Young steelhead are hit hard because they swim near the surface, leading them straight into the bridge's submerged pontoons. They are delayed in this area with no natural cover from predators, giving seals, who've learned to hunt there, a chance to take advantage of the situation. The result is a survival rate of steelhead reduced down to as little as 50 percent. Young salmon are also likely affected by the bridge, though tagging data doesn't yet exist to confirm the extent of the impact. Adult salmon and steelhead returning to spawn also face delays. The toll isn't only ecological. Anglers have fewer fish to catch, and Tribes have fewer fish returning, reducing their ability to target fish for sustenance, ceremony, and commercial purposes. After a multi-million-dollar effort to rebuild Hood Canal steelhead populations, their numbers are declining again, even with 388 miles of relatively pristine streams and rivers available to them. Proactively and consistently addressing fish passage barriers is a more cost-effective path forward and could help avoid expensive litigation or regulation down the line.

Returning Adult Salmon

Understanding how the bridge affects adult salmon returning to spawn is key to gaining a full picture of the bridge's effect on the ecosystem. To do that, researchers from the National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries and the Port Gamble S'Klallam Tribe) captured 19 adult hatchery-origin Chinook salmon and 112 adult fall-run chum salmon as they approached the Hood Canal Bridge on their return migration. Acoustic transmitters used to track the fish were attached before they were released back into their migratory path.

Results indicate that all of the tagged adult Chinook and more than 85 percent of the tagged adult chum ultimately made it past the bridge indicating that there is unlikely to be substantial mortality associated with adults passing the bridge. The presence of the bridge influenced nearly two thirds of the tagged fish, causing them to slow down or change direction as they approached the structure, rather than swimming in a direct path. This suggests that there is a short delay associated with the bridge, which may be in part because of the mixing zone created under the bridge. These results indicate that interim measures can focus on young salmon and steelhead.



A mixing zone of water occurs under the bridge where warmer surface water from Hood Canal is pushed down into the colder water from Puget Sound, which may confuse returning fish and delay their migration.

Finding a Fix

EXPEDITING FISH PASSAGE: In the initial study, corners created by bridge cross-pontoons were found to delay young steelhead migration. These areas create back-eddies, where water flow swirls like a bathtub drain, leading fish to congregate and linger there. This confuses fish and makes them more prone to predation. In fact, seals were observed corralling fish in the corners as a foraging strategy.

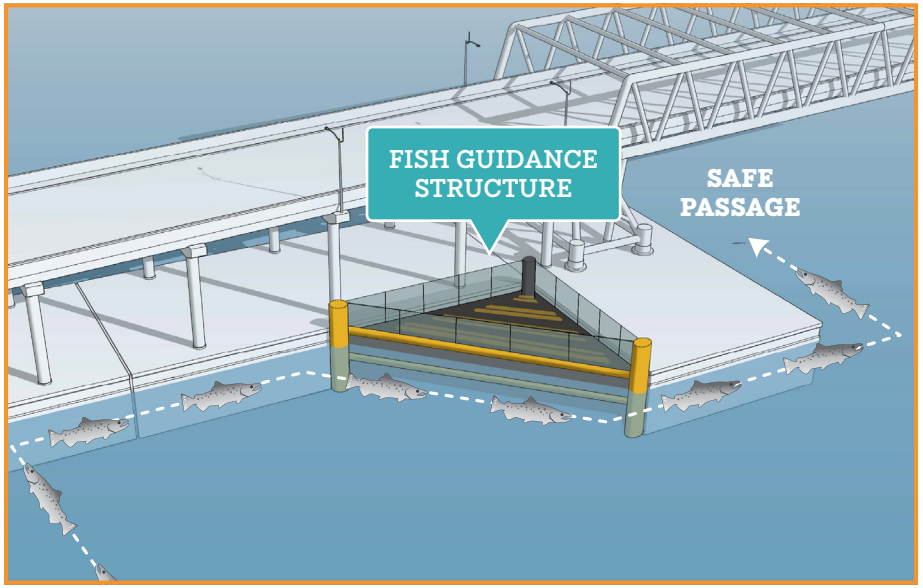
To move fish away from those vulnerable areas and eliminate the large eddies, fish guidance structures were installed in two corners by the Assessment Team researchers. These floating guides were built from high-density polyethylene piping with sheeting, standing nearly 22 feet high. These designs were consistent with approaches used to guide young fish around structures at dams and other human infrastructure.

One fish guidance structure was placed at the bridge in 2023, and two structures were placed in 2024. Each year, the structures were deployed and then removed to create clear time periods when researchers from NOAA Fisheries and the Port Gamble S'Klallam Tribe could evaluate the structures' effectiveness. Young steelhead were tagged with acoustic tags, released, and then tracked to determine the survival rate of those that encountered the pontoon corner with and without the structures.

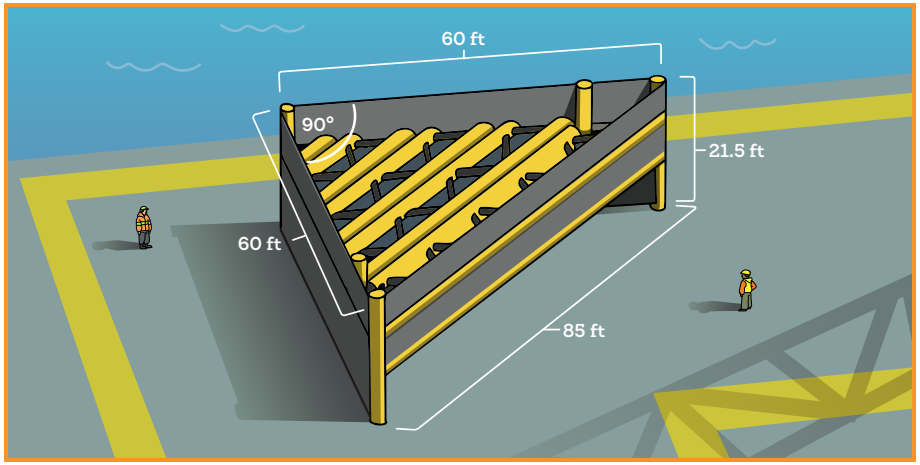
The results of the study found that the fish guidance structures reduced the formation of eddies in the corners. The percentage of steelhead surviving past the bridge, however, only slightly increased with the structures in place, and the statistical analysis found the difference to be insignificant. It also took longer for steelhead to pass the bridge when the guidance structures were in place.

Without more detailed tracking data, the reason for the lack of steelhead response is unclear. Although they were large, each device only addressed a small portion of the bridge surface, and the effect may not have been sufficient. There may be adjustments to the design, placement, or scale of the structures that could improve their effectiveness, but given the high cost of operating the structures, it is not a responsible path forward at this time without a regulatory mandate.

The tracking data showed that between 11 and 26 percent of young steelhead did not make it past the bridge. The percentage of fish dying was less than previously shown in 2017 and 2018, where up to 51 percent of fish were found not to make it past the bridge. There is, however, nothing to indicate that this has been a permanent shift to better survival, and so there could be years of worse survival again in the future. The loss of steelhead in this short reach at the bridge in 2017 and 2018 is comparable to the cumulative loss of young steelhead as they pass through all eight of the Snake River and lower Columbia River dams and reservoirs.



The fish guidance structure placed inside the corners of the bridge was designed to prevent back-eddies, providing steelhead with a calmer route around the bridge.



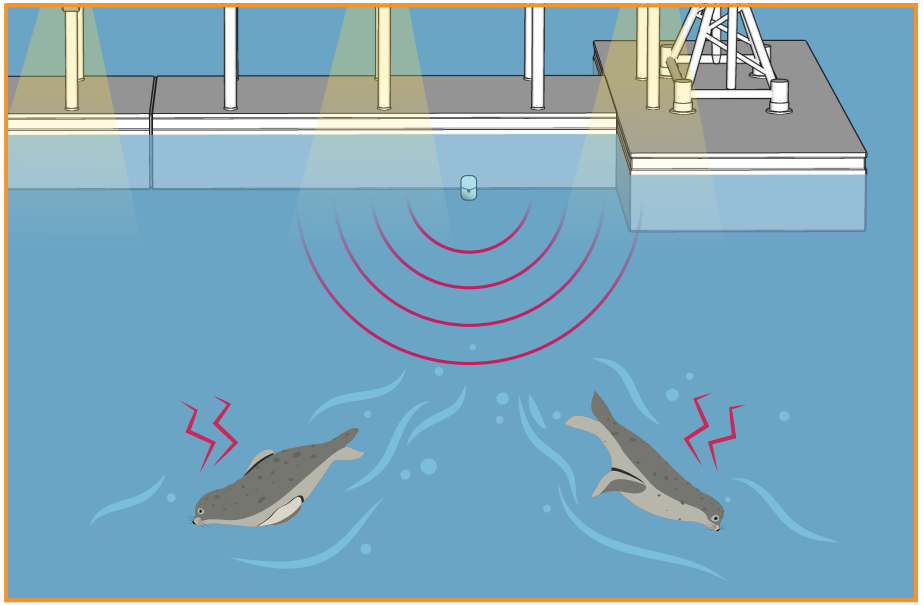
Between 2023 and 2024, fish guidance structures were installed and then removed to gather data about steelhead populations both with and without the structure. Unfortunately, the study indicates that the presence of the structure did not significantly improve fish survival.

DETERRING PREDATORS: Predation is a key problem for migrating steelhead and salmon at the bridge. Harbor seals have learned that young steelhead and salmon often concentrate in higher numbers at the bridge as they seek a way around. These skilled predators take advantage of this and use the bridge's structure to corral these fish, making them easier to catch.

To reduce the presence of seals at the bridge, the Port Gamble S'Klallam Tribe, Washington Department of Fish and Wildlife, and Oceans Initiative tested an acoustic startle device. These devices make a brief, steady sound designed to disrupt an animal's behavior and trigger a flight response, which causes the animal to leave the area. Unlike other deterrent devices, they are designed to avoid harming seals while also reducing the likelihood that seals become accustomed to the device.

To test the effectiveness of the device, an acoustic startle device was installed next to the bridge's southeast cross-pontoon, an area where predation rates are suspected to be high. It was deployed during peak migration of young steelhead and salmon heading to the ocean, first in late Spring 2023 and again in late Spring 2025. Researchers from the Port Gamble S'Klallam Tribe used an imaging sonar unit to produce an underwater image to track harbor seal presence and the amount of time spent in the area. This was combined with Oceans Initiative's visual observations of seals at the surface to determine if the device, while active, reduced the number of seal sightings in the area, increased the seal distance from the device, or caused any other changes in seal behavior.

Fewer seals were sighted at the surface near the bridge when the device was on. The imaging sonar data showed a reduction of underwater seal detection rates by as much as 80 percent. Seal behavior also changed, with a reduction in corralling fish and increased directional movement compared to when the devices were turned off. What is most promising is that the results were consistent between years, suggesting that the findings of the study are repeatable. These results show promise that these devices can scale up to reduce seal presence along the bridge, but additional research is needed to confirm this possibility.

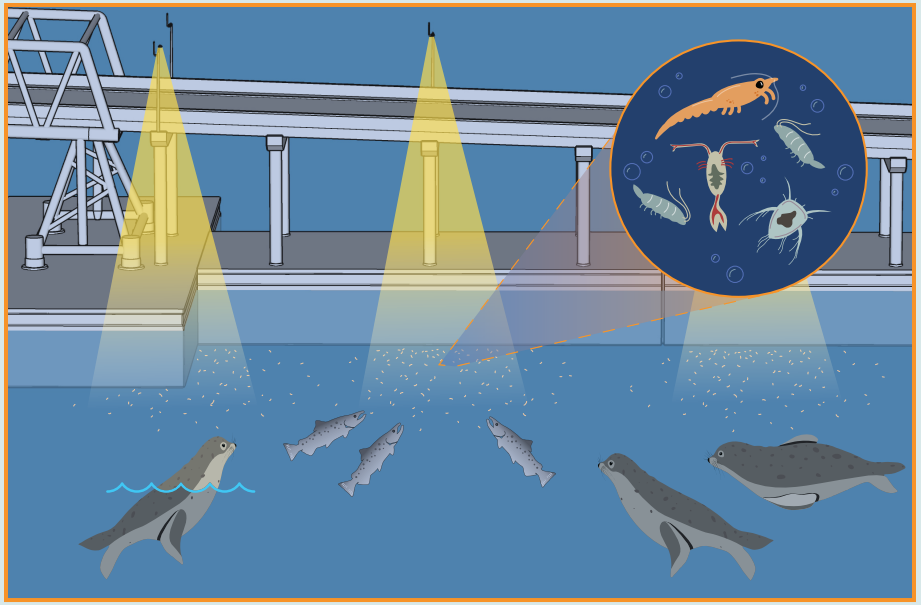


Seals were successfully deterred from hanging out near the bridge when the acoustic startle devices were turned on, reducing their fish corralling behavior.

Looking Forward

ARTIFICIAL LIGHTING AT NIGHT: One area for further study is to understand how artificial lighting at the bridge affects young steelhead and salmon. In 2023, the Washington State Department of Transportation removed numerous sources of light, and the remaining lighting was changed to LED. While this was done to be more energy efficient, an overall reduction in artificial lighting is likely to be better for migrating salmon and steelhead. However, LED lights are brighter and emit a different light spectrum that may help predators have a higher degree of success while feeding.

It is likely that the remaining lights continue to attract zooplankton and other prey for these young fish, causing the fish to congregate, and creating a funnel for predators to target them. Additional research is needed to determine if that is the case and if additional changes to the lighting could improve conditions for salmon.

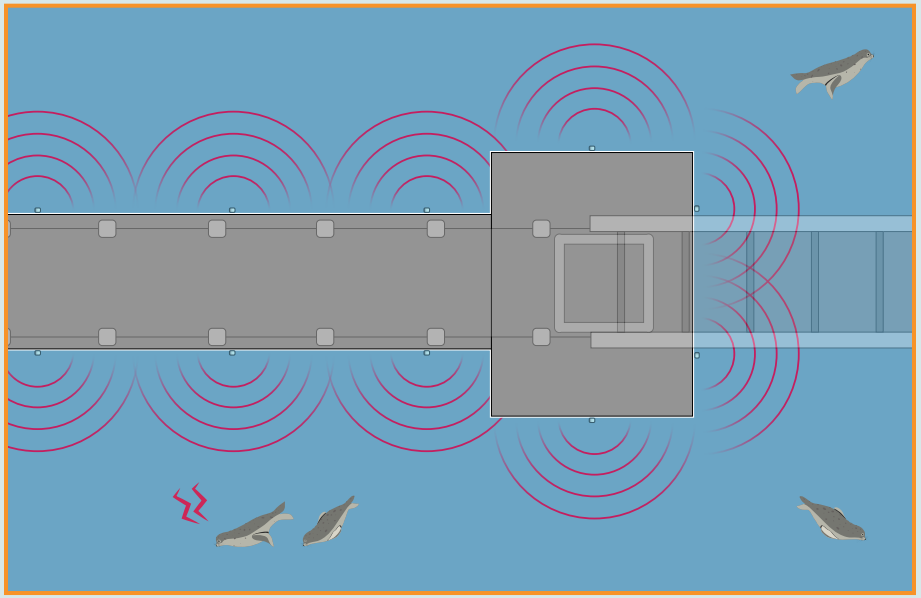


At night, a series of events might occur: artificial light draws in small prey like zooplankton, which then attracts fish and large predators. To improve this, adjustments could be made to remove this unnatural situation and encourage fish to continue migrating.

FURTHER RESEARCH INTO ACOUSTIC STARTLE DEVICES: The initial acoustic startle device testing showed that it is effective at deterring seals from the bridge, but more research is needed to understand the long-term effectiveness and scalability of the devices.

Since each device has a limited effective range, researchers need to understand how to scale up the effect of the devices and operate a series of devices to create an area of deterrence along the bridge. Another key component is learning if seals grow accustomed to the devices over time, which would reduce their effectiveness.

While the results were promising with the initial studies of acoustic startle devices, more work is needed to confirm that they increase survival of steelhead and salmon, and to develop a dependable strategy for yearly deployment.



While acoustic startle devices were initially successful at deterring seals, continued research into how to scale up the effect across the bridge is needed.

Urgent Solutions Needed

DECLINING STEELHEAD NUMBERS: Since Phase One of this project, wild young steelhead have continued to decline despite decades of investment in time and resources toward steelhead conservation. While wild steelhead in Hood Canal tributaries were sufficient in numbers to tag as they migrated out during Phase One, that was not the case in Phase Two.

To compensate for the decreased numbers, hatchery steelhead were used to supplement the study. Only 12 to 16 percent of hatchery-born steelhead survived their release and made it to the bridge compared to more than 60 percent of wild steelhead.

Puget Sound steelhead, Washington's state fish, are already listed under the Endangered Species Act. If losses at the bridge continue, these fish could be pushed toward an even higher risk status, which would mean tighter fishing regulations and added costs. Proactively reducing steelhead deaths would be the most effective and affordable path forward.

Linking Communities and Habitats

Many questions have been answered about the problems facing salmon and steelhead as they encounter the Hood Canal Bridge. The bridge influences these species as they head out to the ocean and as they return to spawn as adults.

Reducing seal predation is key to helping more young steelhead reach the ocean. Even in the years when survival was relatively high, the loss of 11 to 26 percent of young steelhead encountering the bridge remains high compared to other fish passage barriers, such as many hydropower dams in Pacific Northwest rivers that are investing millions in fish passage improvements. Some measures show promise but need more research, such as acoustic startle devices. These measures, while important, only treat the symptoms. The underlying cause is the bridge itself, and that will only be resolved by a redesign that addresses the barrier.

The bridge also links communities and supports the regional economy, but the current design comes with some challenges: traffic delays when the draw span opens and closures when repairs are needed. A redesigned bridge that offers more consistent travel would help everyone who depends on this corridor, including the salmon and steelhead. If bridge replacement is initiated, the process could take 10 to 20 years, including planning, environmental review, funding, and construction. Until then, continued testing of interim measures offers the best chance to reduce harm.

Ultimately, finding a path forward that works for communities, travelers, and fish who all rely on the Hood Canal is worth the effort it will take.



BRIDGE ASSESSMENT TEAM

Barry Berejikian, NOAA Northwest Fisheries Science Center
Casey Clark, WA Department of Fish and Wildlife
Hans Daubenberger, Port Gamble S'Klallam Tribe*
Khadijah Homolka, Port Gamble S'Klallam Tribe*
Tom Mohagen, WA Department of Transportation
Dean Moon, WA Department of Transportation
Megan Moore, NOAA Northwest Fisheries Science Center*
Alicia Olivas, Hood Canal Coordinating Council
Joseph Pavel, Skokomish Indian Tribe
Jennifer Stern, NOAA Northwest Fisheries Science Center*
Julia Stockton, U.S. Navy (military liaison)
Julliana Sullivan, Port Gamble S'Klallam Tribe
Chris Waldbillig, WA Department of Fish and Wildlife
Lindsay Wourms, WA Department of Fish and Wildlife

CONTRIBUTORS

Erin Ashe, Oceans Initiative
Steve Ashe, Oceans Initiative
Matthew Hays, Northwest Biota
Chris Hunt, U.S. Navy (former)
Brad Johnson, Kleinschmidt Associates
Nick Rodda, WA Department of Transportation (former)
Rob Williams, Oceans Initiative*
Katie Wold, Oceans Initiative

COORDINATORS

Shaara Ainsley, Long Live the Kings
Lucas Hall, Long Live the Kings
Kaelie Spencer, Long Live the Kings

REPORT WRITING, ILLUSTRATION, AND DESIGN

Kevin Cody
Jay Marsh
Lisa Terry

**Principal Investigator*

All names above are listed alphabetically.

PREPARED BY

LONG LIVE THE KINGS

IN PARTNERSHIP WITH

HOOD CANAL COORDINATING COUNCIL HCCC EST. 1985

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

nəxʷqíyt nəxʷsƛ̓áy̓əm PORT GAMBLE S'KLALLAM TRIBE

SKOKOMISH INDIAN TRIBE
Sqʷuqʷu ʔəʃɬ "People of the River"

Washington Department of FISH and WILDLIFE

WSDOT

THIS WORK WAS MADE POSSIBLE BY

Washington State Recreation and Conservation Office, National Ocean and Atmospheric Administration's Restoration Center, U.S. Navy, Bureau of Indian Affairs, U.S. Environmental Protection Agency, Pacific Coastal Salmon Recovery Fund, Port Gamble S'Klallam Tribe, Washington Department of Fish and Wildlife, and National Fish and Wildlife Foundation.

ADDITIONAL THANKS TO

The remaining Hood Canal Bridge Assessment Management Committee members, including Jefferson County, Kitsap County, Mason County, Clallam County, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, Suquamish Tribe, Point No Point Treaty Council, Washington Department of Ecology, Puget Sound Partnership, Washington Department of Natural Resources, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency and U.S. Coast Guard.

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BRIDGING THE GAP: WORKING TOGETHER TO SAVE SALMON AND STEELHEAD AT THE HOOD CANAL BRIDGE