Created by: Christy Rains
December 26, 2019

FY19 National Estuary Program Geographic Funds for a Near Term Action (NTA)

Award: $350,000

Completion deadline: December 31, 2021

NTA# 2018-0436: National Hydrography Dataset Update: Correct mapped stream locations as a first step in the development of a shared prioritization tool to better coordinate plans and actions among agencies, across all levels of government, and the private sector.

Phase I – Gathering and digitizing corrected stream locations for the Puget Sound.

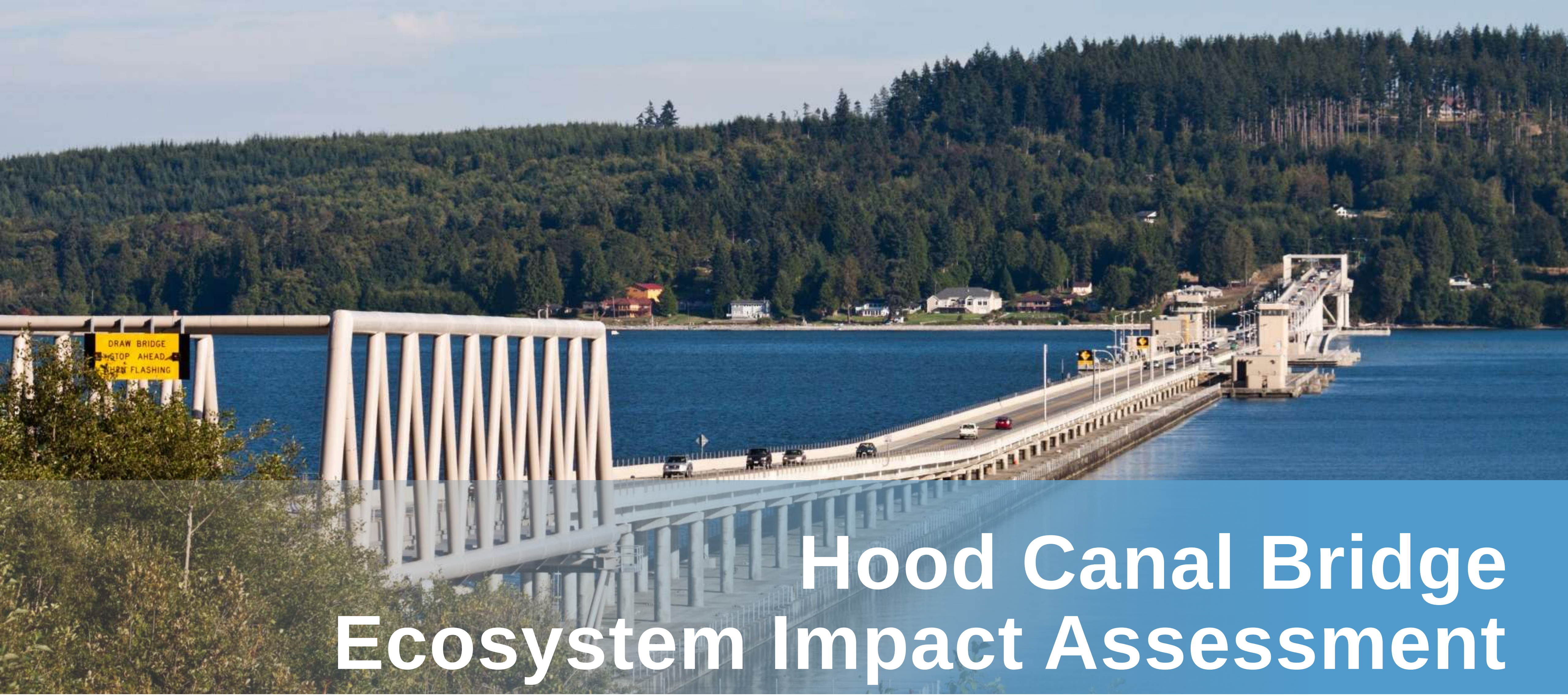
- WDFW has 20+ years of hard copy records from walking streams associated with WSDOT sites.
- ~1500 miles of verified stream locations (a portion of Puget Sound streams).
- Will digitize the rough, hard copy maps of correct stream and tributary locations from surveys.
- Associated habitat survey records will be scanned and more easily available.
- Approximate cost for Phase I is $125,000, estimated 6-months.

Phase II – Dept. of Ecology Updates to National Hydrography Dataset (NHD)

- Dept. of Ecology's Anita Stohr is the data steward for the NHD, which is the USGS stream mapping of WA.
- WDFW will deliver digitized and corrected stream locations and supporting records.
- Ecology will correct stream locations using WDFW digitized maps, habitat survey data, fish barrier database info, Lidar, and other tools.
- Corrections will be published to the NHD to update the Washington State stream map.
- Approximate cost for Phase II is $100,000, estimated 1 year.

Phase III – Create new prioritization tool for Fish Passage web map

- Tool will identify the number of barriers located downstream of Puget Sound sites documented in WDFW's fish barrier database.
- Interest from many partners and stakeholders, including Fish Barrier Removal Board.
- Will provide additional planning support for prioritization and scoping fish passage barriers.
- This tool will be available on our public Fish Passage web map.
- Approximate cost $125,000, estimated 6 months.



Hood Canal Bridge Ecosystem Impact Assessment

Fish Barrier Removal Board

Jan. 21, 2020

Ecosystem Impact Assessment Plan

1969 – Steelhead adopted as WA State Fish

2007 – Puget Sound Steelhead listed under the ESA & Hood Canal Steelhead Project begins

2013 – Moore et al. publishes steelhead tracking results from 2006-2010; Khangaonkar et al. model potential water quality impact

2016 – HCB Assessment begins

Phase 1 fieldwork 2017 & 2018

2020 – Phase 1 report complete

Phase 2 fieldwork 2022 & 2023

Ecosystem Impact Assessment Plan

LONG LIVE THE KINGS
HOOD CANAL COORDINATING COUNCIL HCCC EST. 1985
NOAA
Pacific Northwest NATIONAL LABORATORY
The Port Gamble S'KLALLAM TRIBE
WSDOT
UNITED STATES NAVY

8 partners | 4 years | $2.2 million

Management Committee

Assessment Team

Engineer Team

Ecosystem Impact Assessment Plan

8 partners | 4 years | $2.2 million

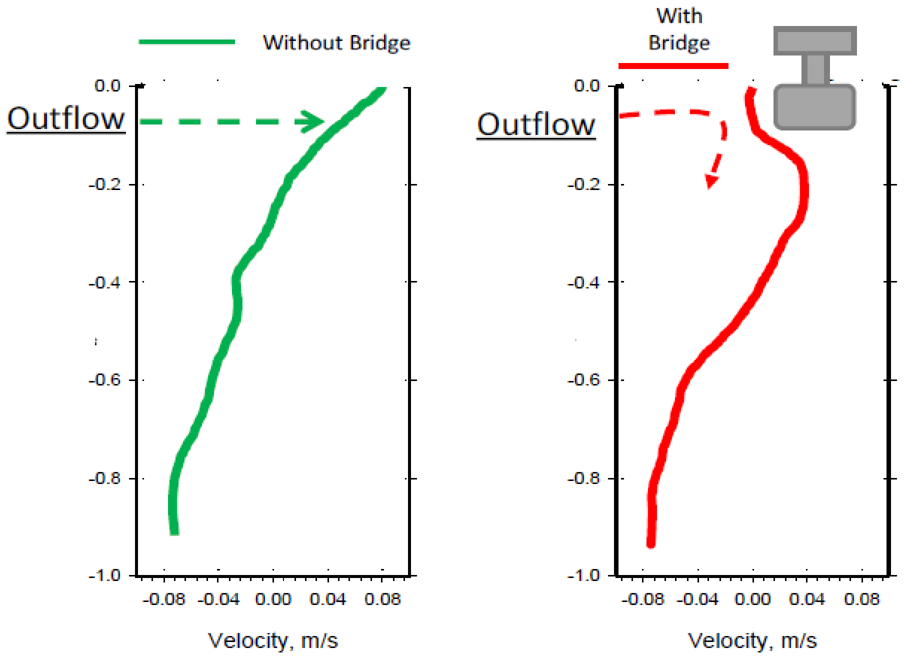
Phase 1 of the plan will:

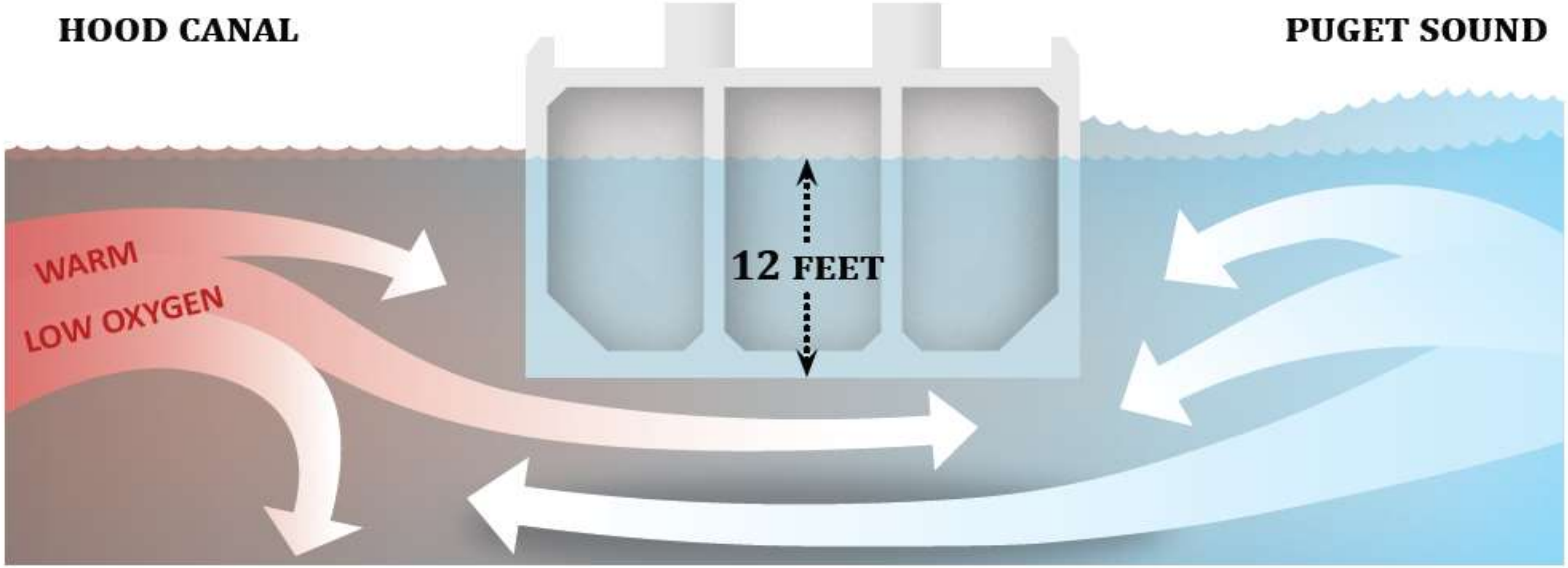
1. Water quality - Confirm the degree of impact to water circulation and water quality, to determine whether further investigation is warranted.
2. Steelhead mortality - Isolate aspects of the bridge that lead to mortality of migrating juvenile steelhead so that solutions can be developed and tested.
3. Other fish - Determine how the bridge influences other fish, including salmon.

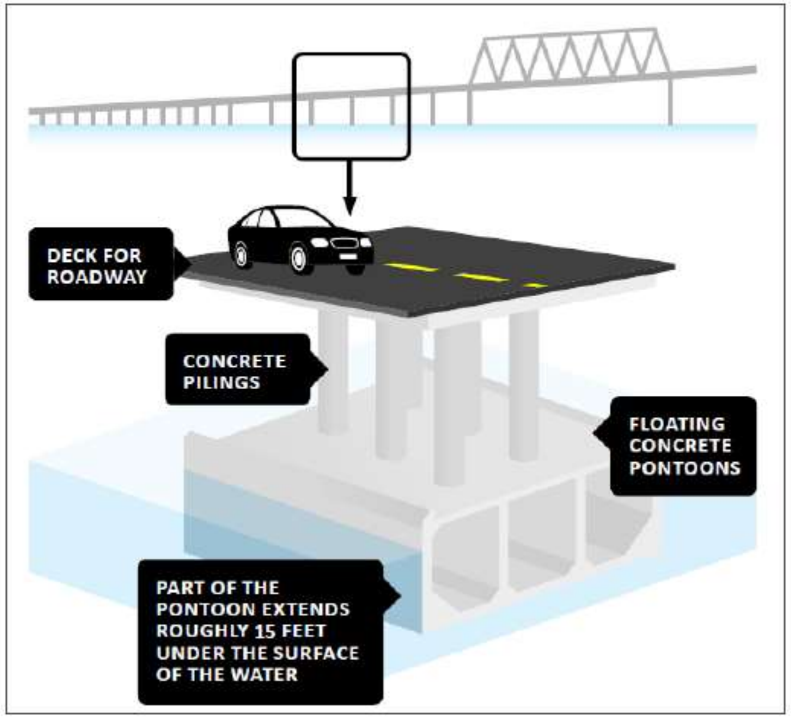
Initial hypothesis:

Hood Canal Bridge alters hydrodynamics near the bridge and could have basin-wide impacts on circulation and water quality

Khangaonkar & Wang 2013





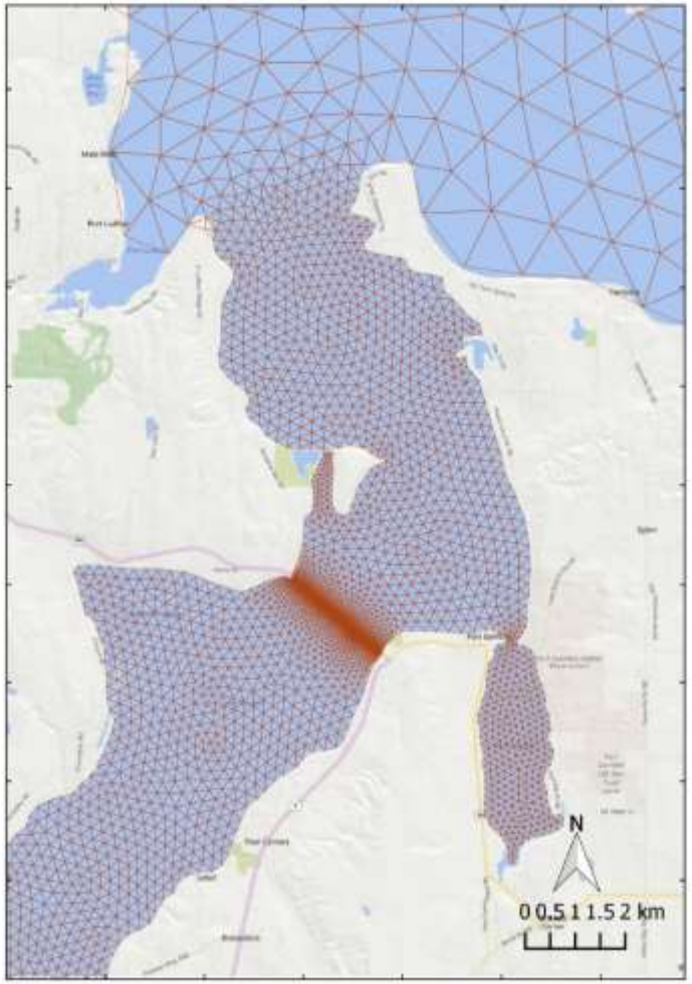


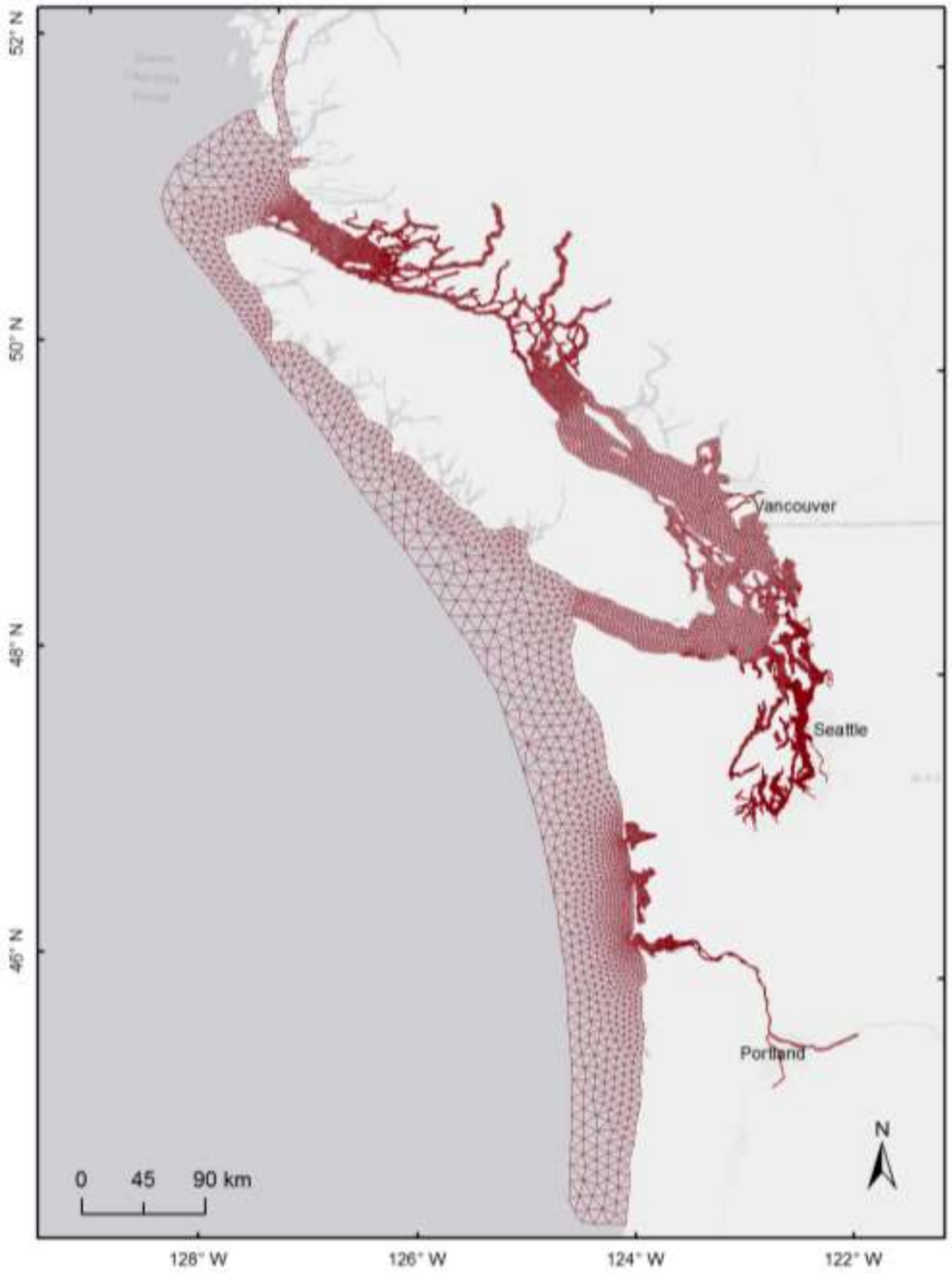
Salish Sea Model Grid Refinement

Hood Canal – Admiralty Inlet Connection

Original

Refined





Bridge pontoon implemented as a velocity block – 4.8 m draft
≈ 85% of the Hood Canal Width

Oceanographic Measurements (2017)

- Validation and calibration of Hood Canal Bridge component of Salish Sea Model

Upward looking ADCP

- ADCPs (Current Profiles)
  - North, Bridge, and South
    - 4/25-6/2 2017
- Point Measurement
  - Nortek Aquadopp
    - 4/27-6/6 2017
- CTD:
  - North: 4 profiles
  - South: 3 profiles

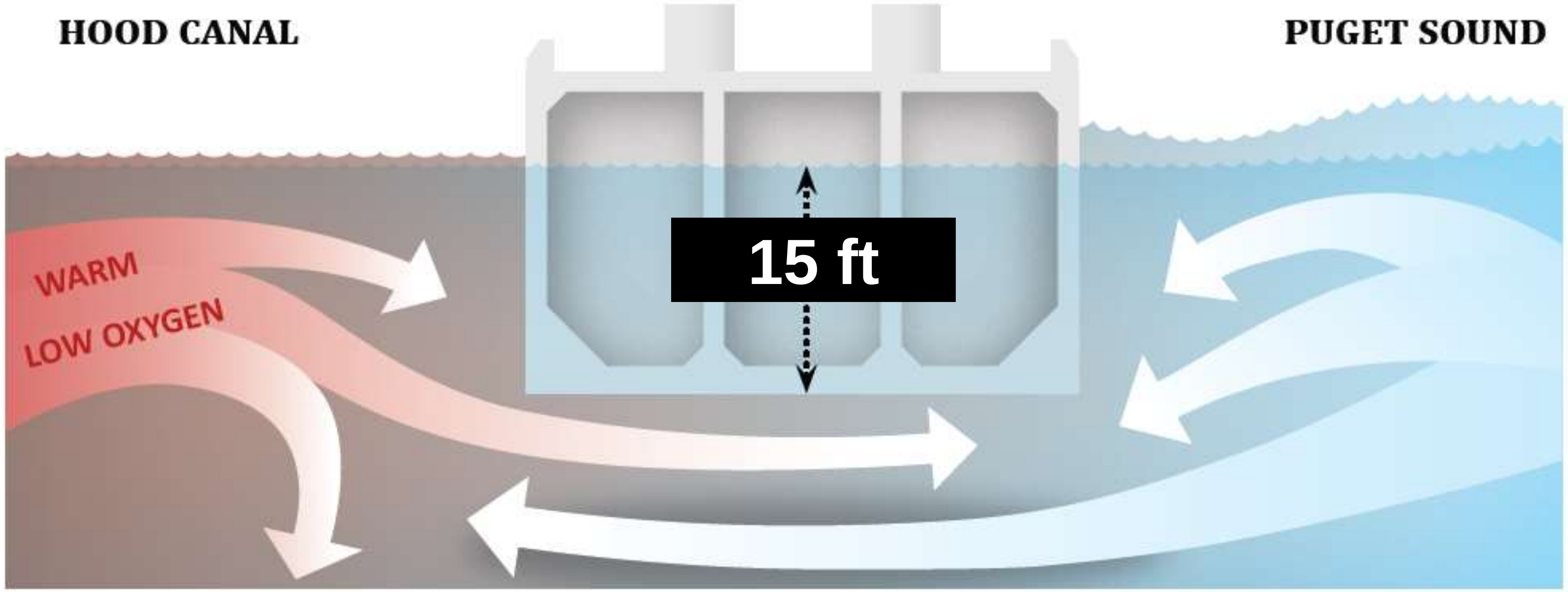
Water Quality

Near the Bridge

- Obstructs the brackish outflow surface layer and induces increased local mixing
- Impacts temperature, salinity, and currents
- Impacts extend 20m below the water’s surface and 2-5km away from either side of the bridge

Hood Canal Wide

- Did not detect a significant canal-wide effect to flushing time or water quality parameters (T, S, dissolved oxygen, nitrate, algal biomass)



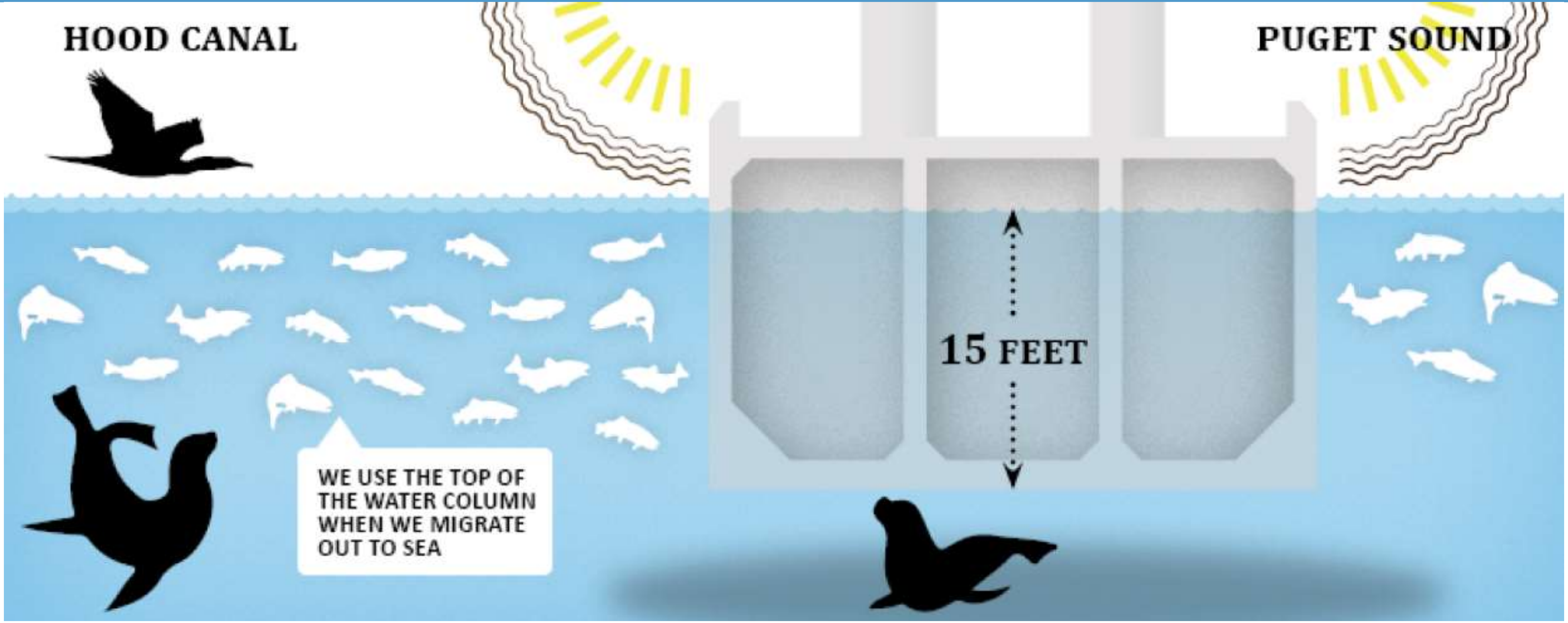
Khangaonkar et al. 2018 JMSE
Khangaonkar & Nugraha 2019 Tech Rept

Water Quality Impacts

Recommendation for Phase 2 Scoping

Additional water quality research completed through the Hood Canal Bridge Assessment should focus on near-field impacts as they relate to fish behavior.

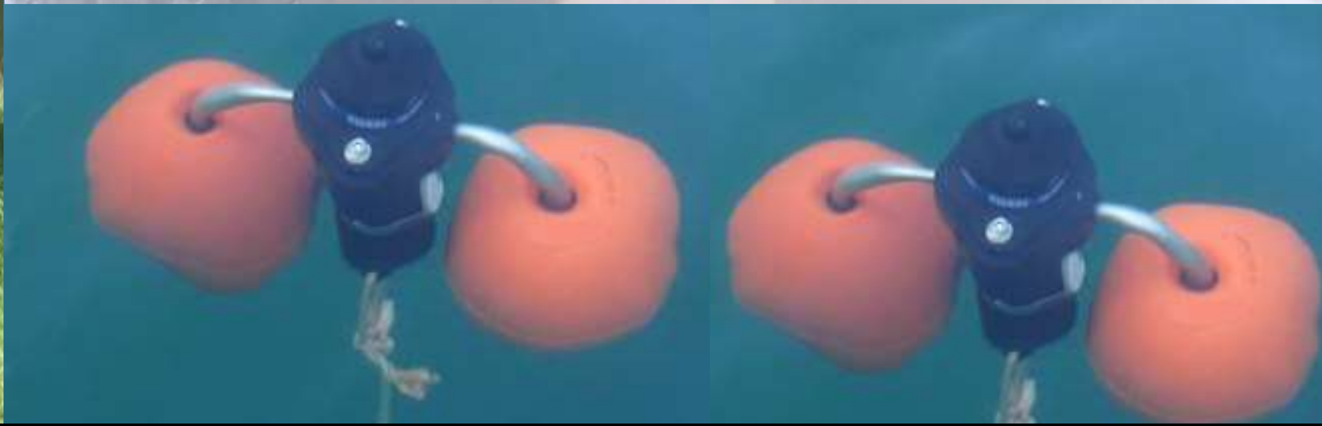
Barrier to Salmon and Steelhead Migration



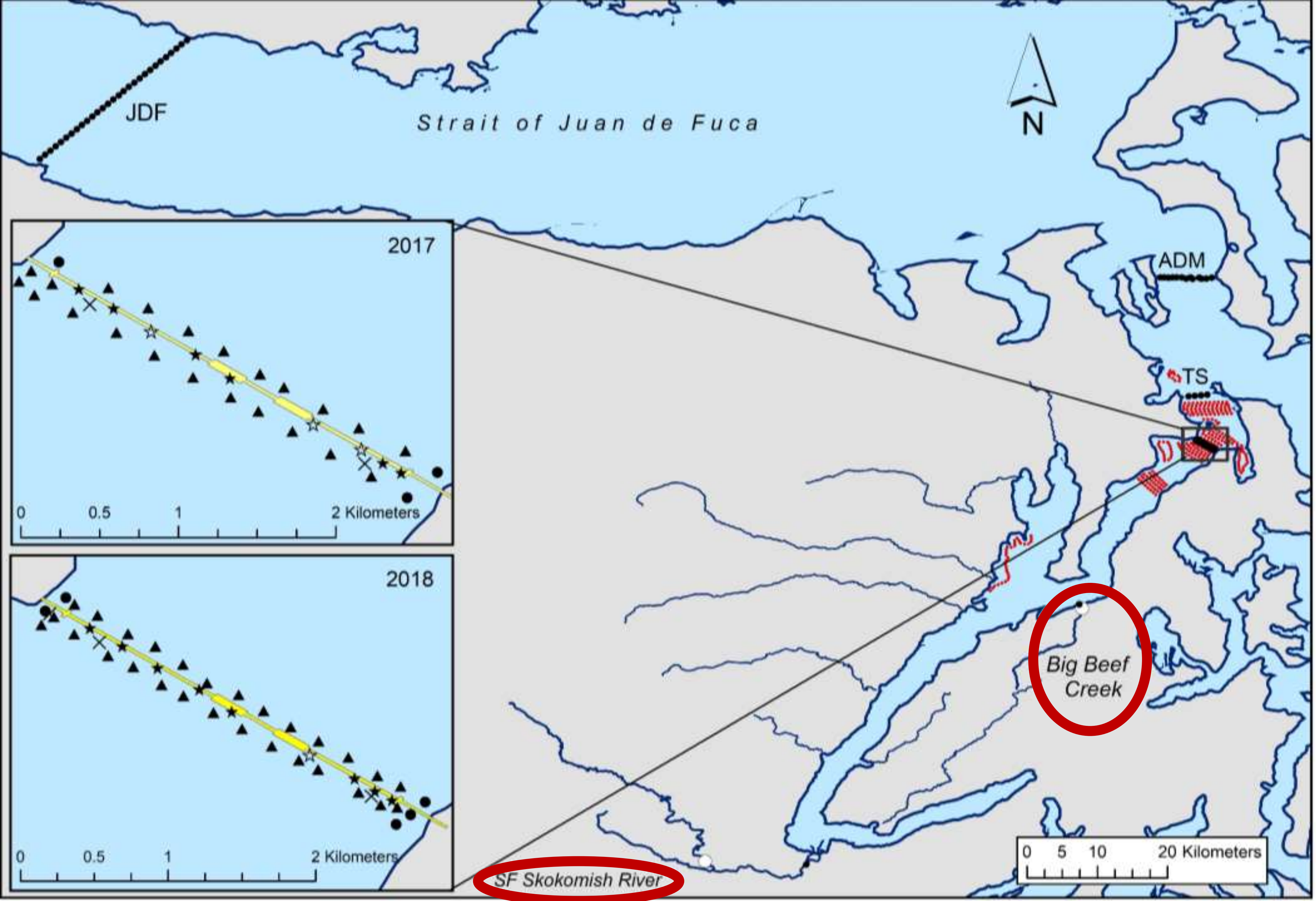
- Obstructed migration | pontoons, circulation changes, noise, light
- Attractive nuisance | artificial reef effect
- Predator haven | increased fish densities, confused fish, shade, light


DRAW BRIDGE
STOP AHEAD
FLASHING

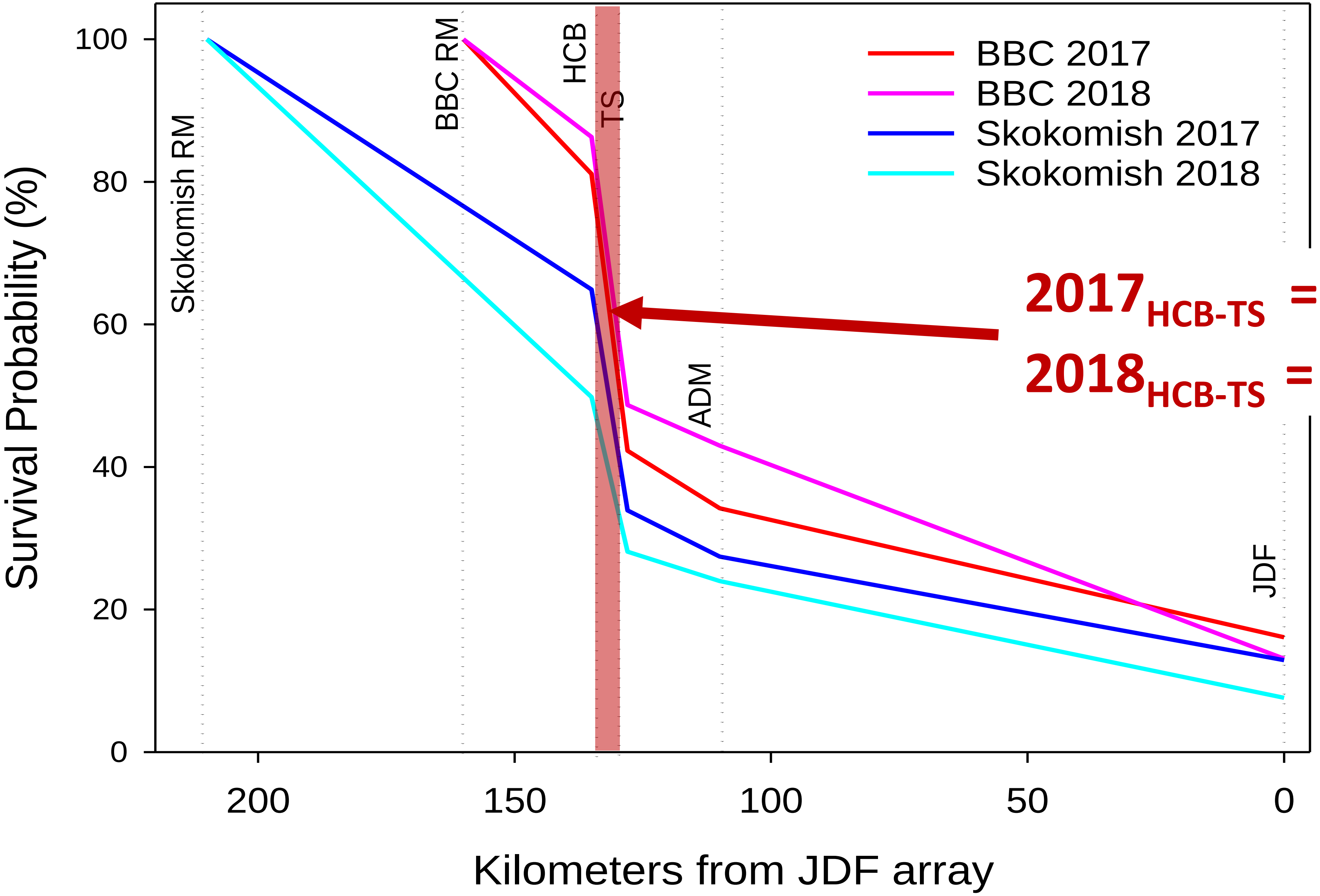




How do we see through a fish's eyes?


JDF
Strait of Juan de Fuca
N
ADM
TS
2017
0 0.5 1 2 Kilometers
2018
0 0.5 1 2 Kilometers
Big Beef Creek
SF Skokomish River
0 5 10 20 Kilometers

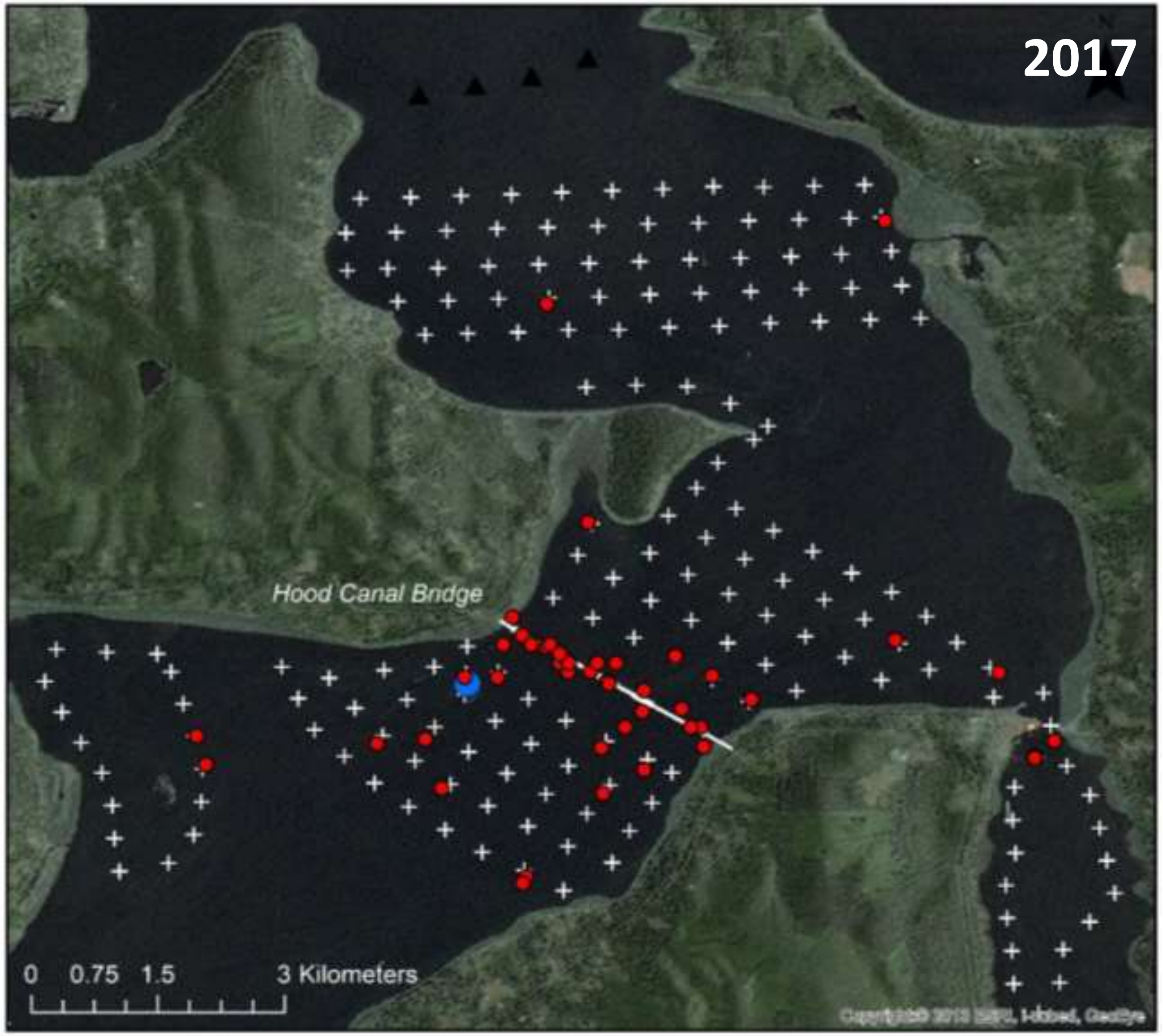
About half of our steelhead die near the bridge

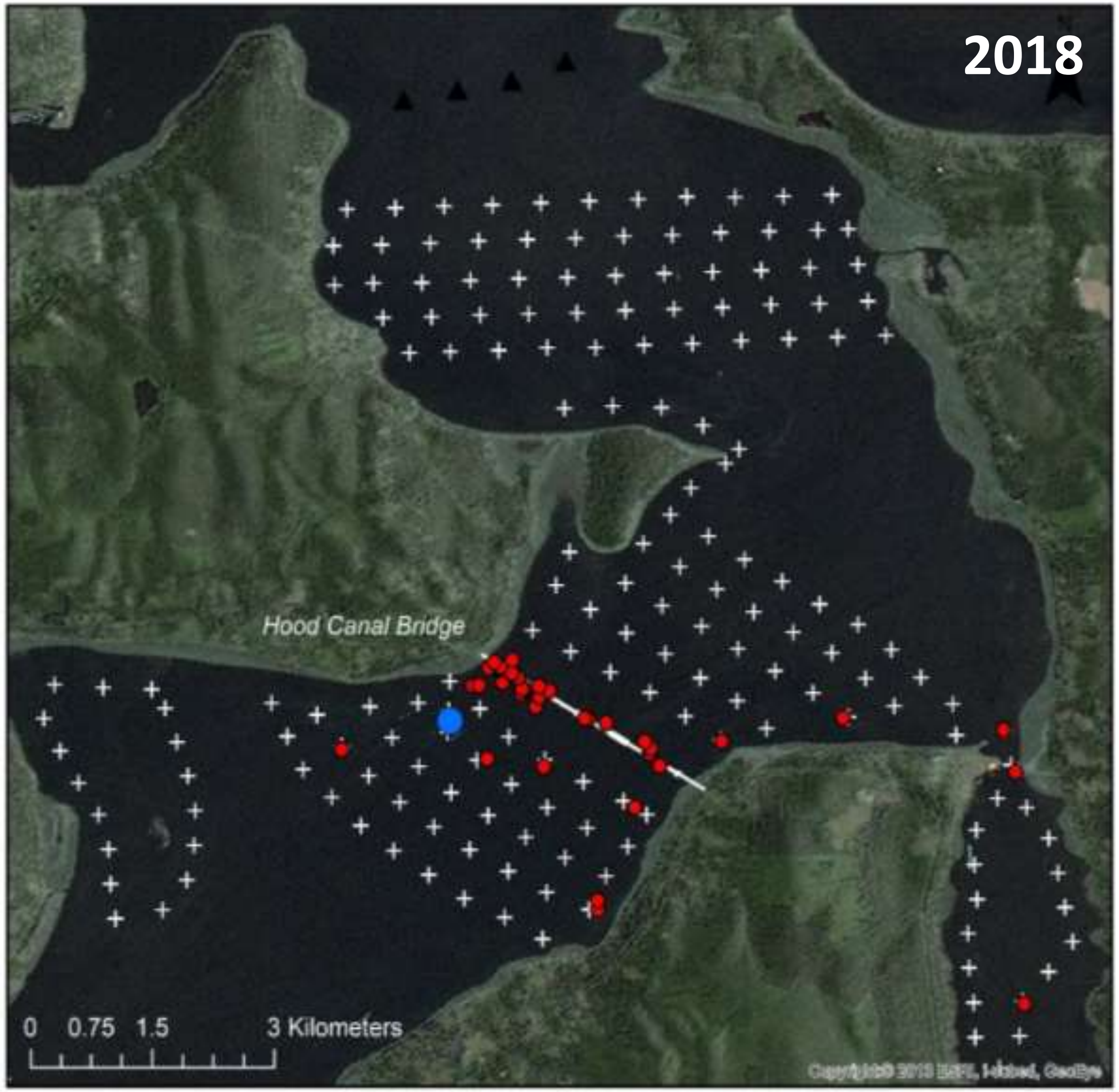


$2017_{HCB\text{-}TS}$ = 51% mortality

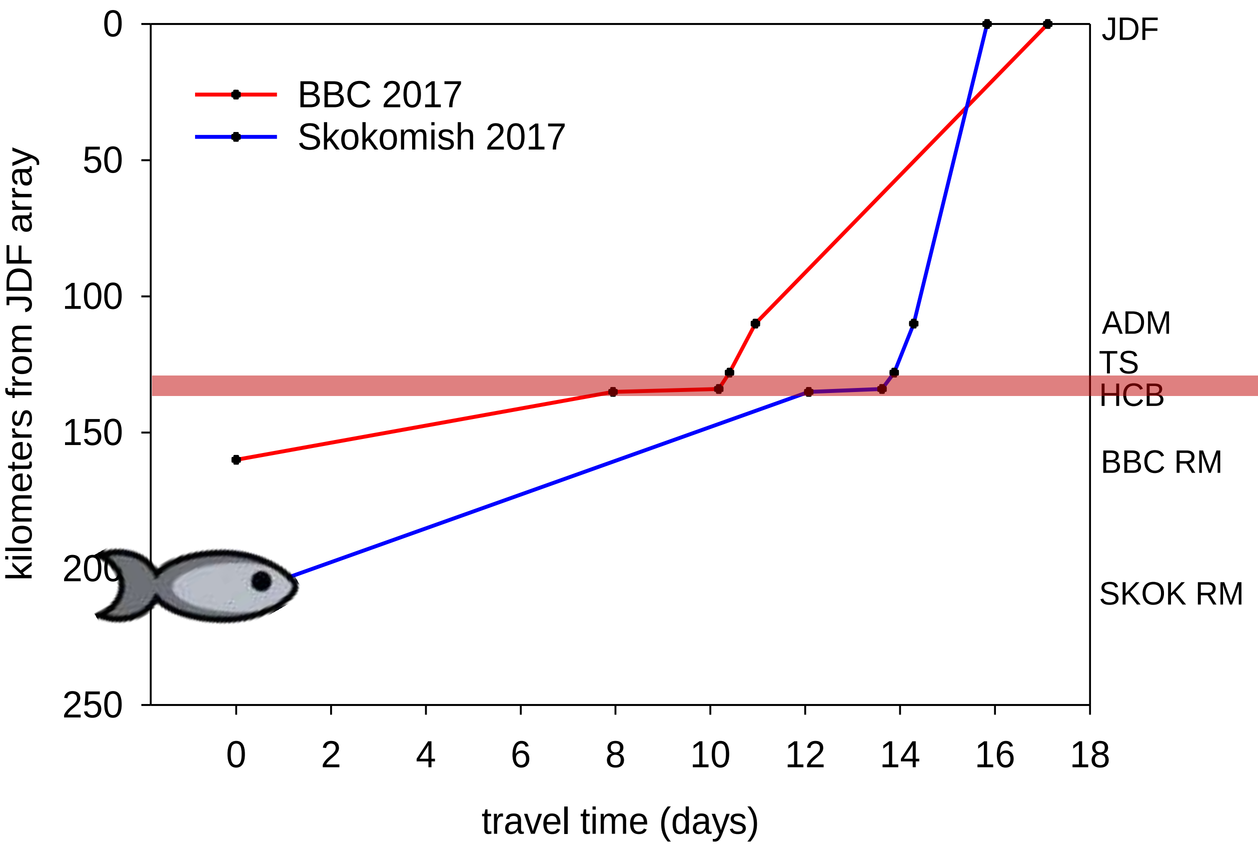
$2018_{HCB\text{-}TS}$ = 44% mortality

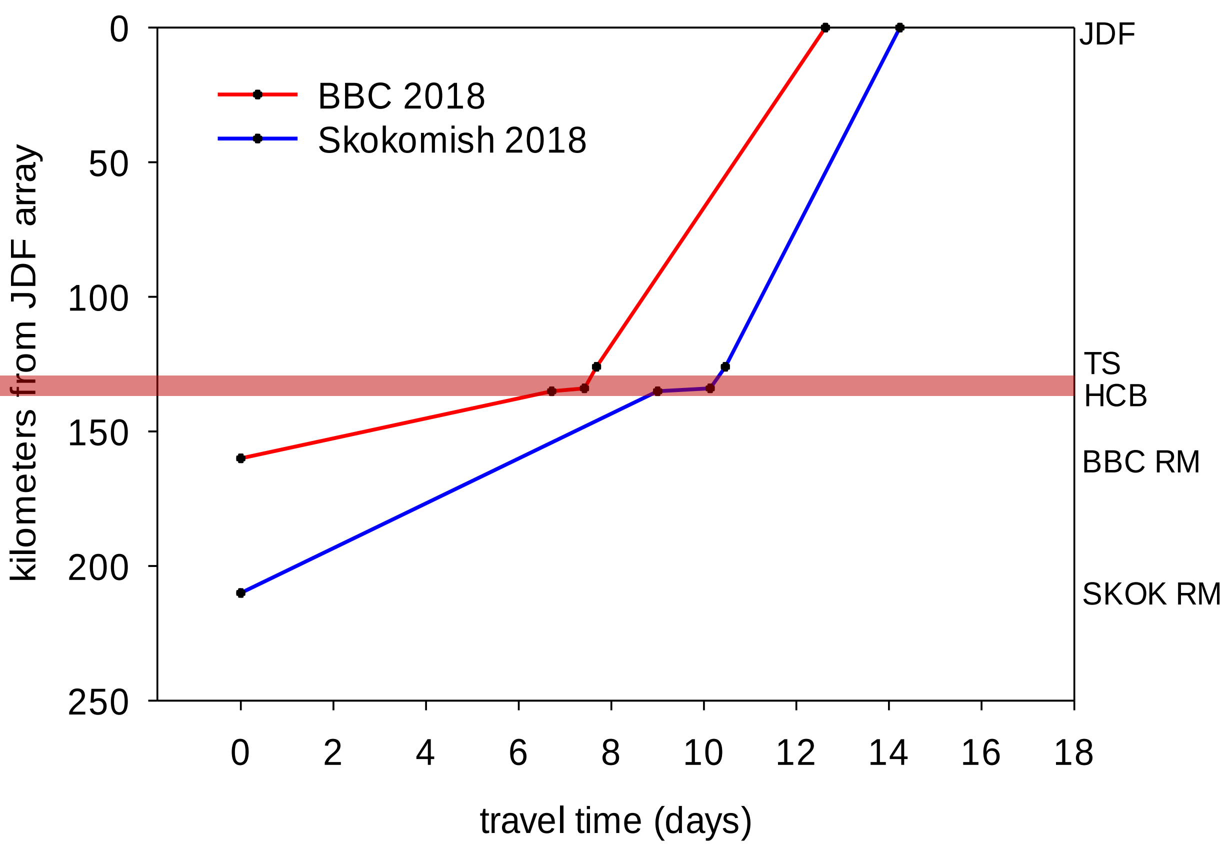
And most of those fish die AT the bridge



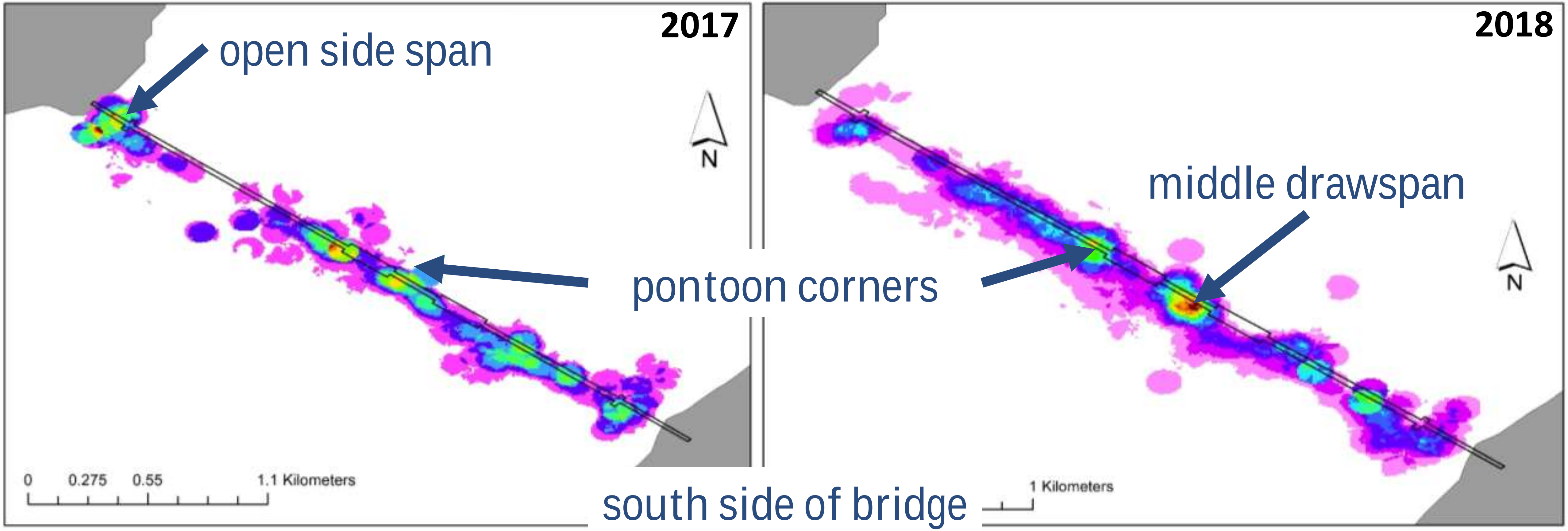


Travel rate is rapid – except at the bridge

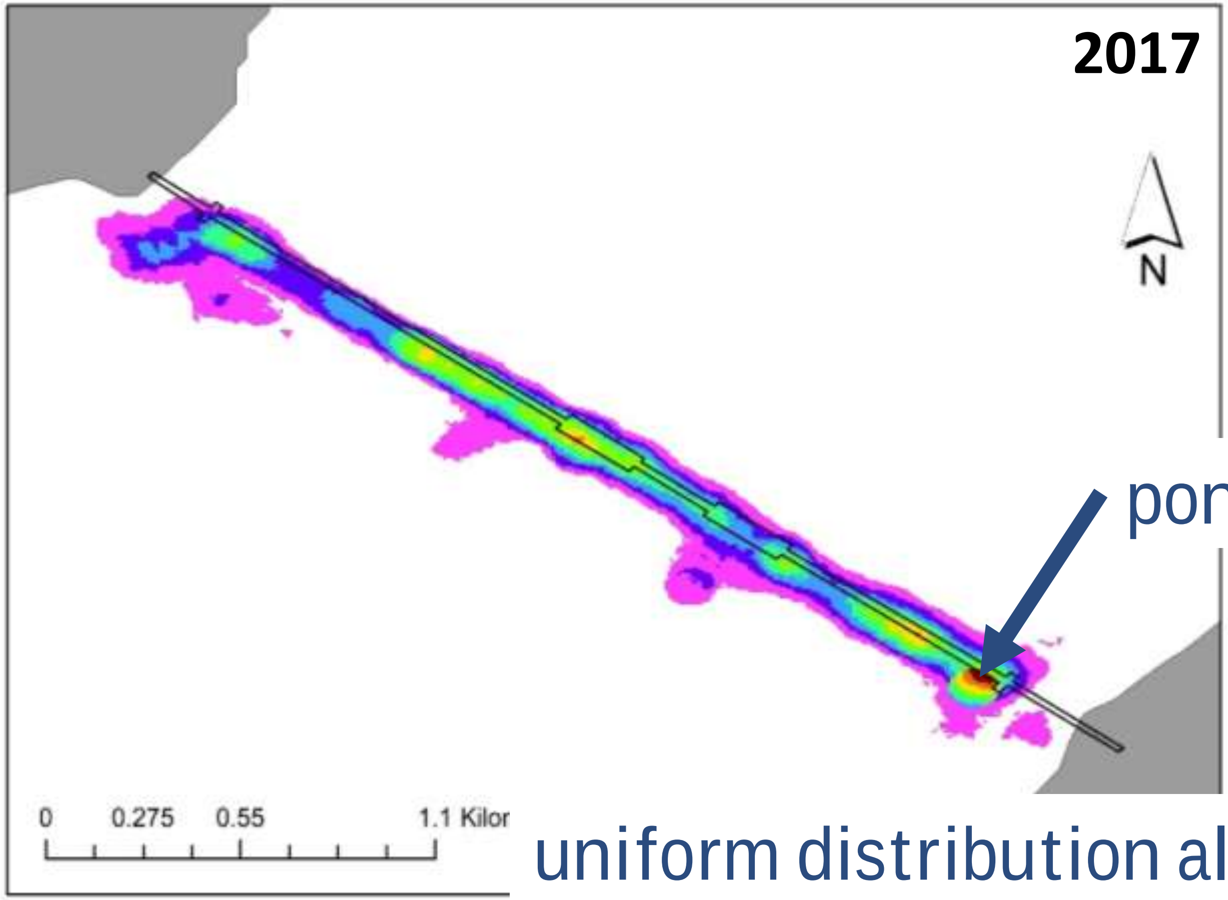


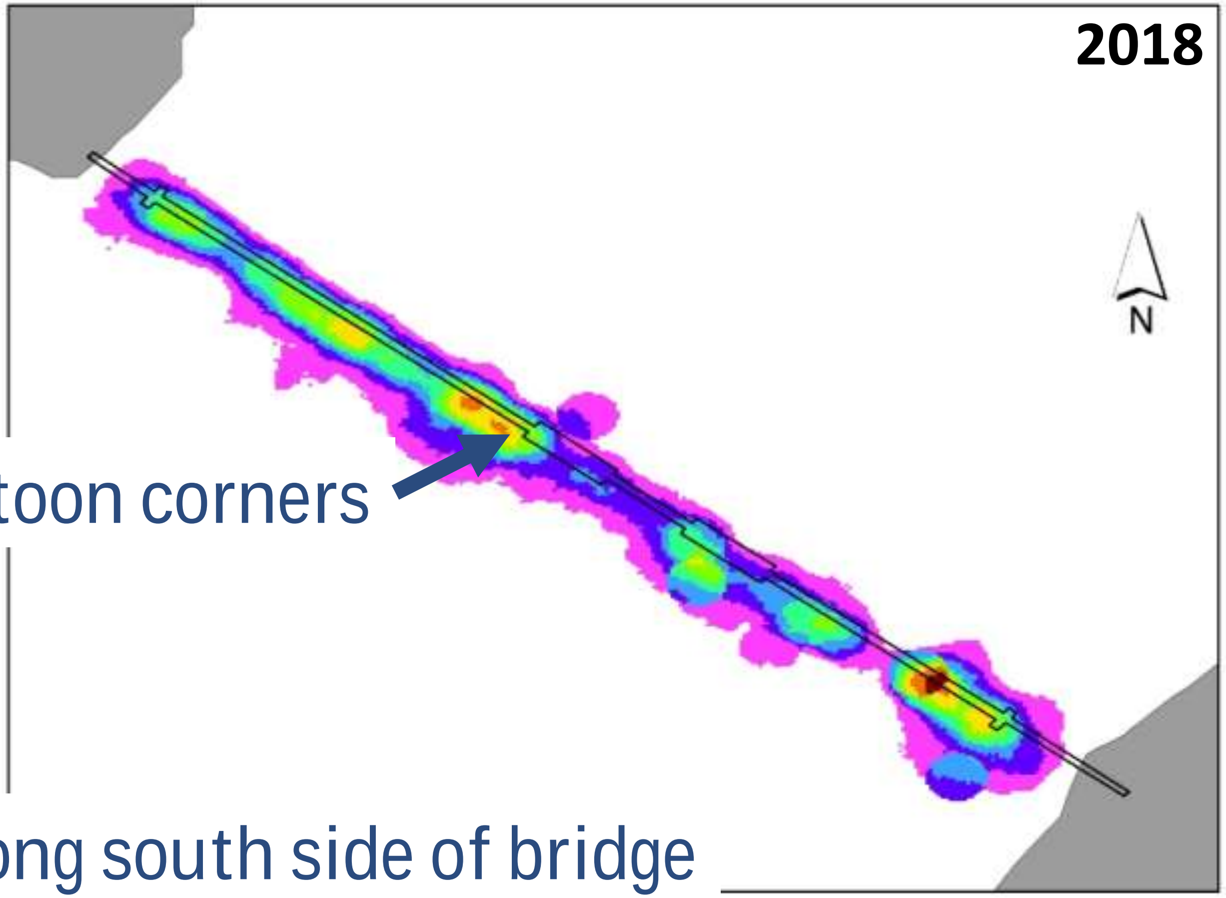


High densities (“hotspots”) of survivors



High densities ("hotspots") of non-survivors

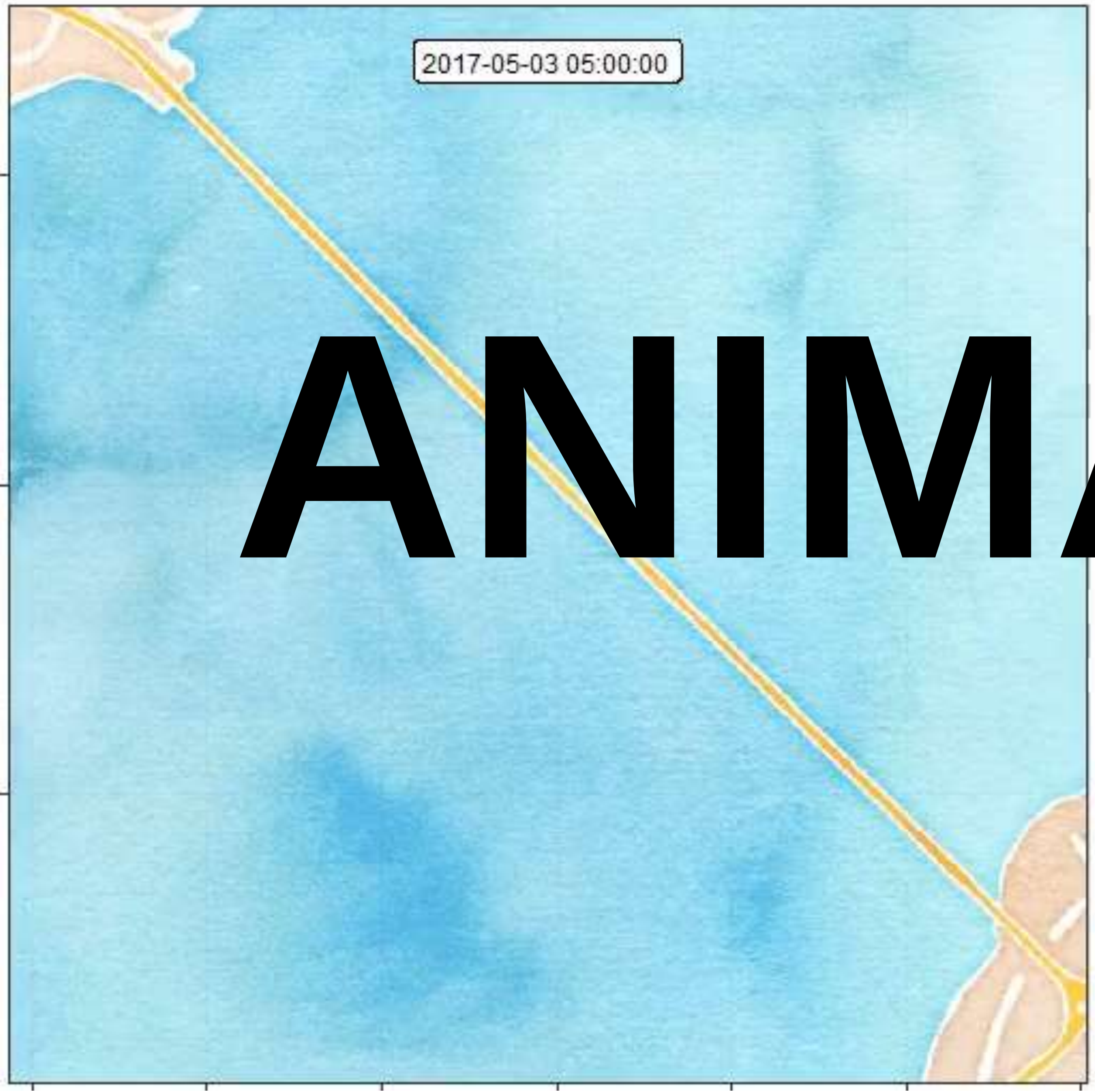




pontoon corners

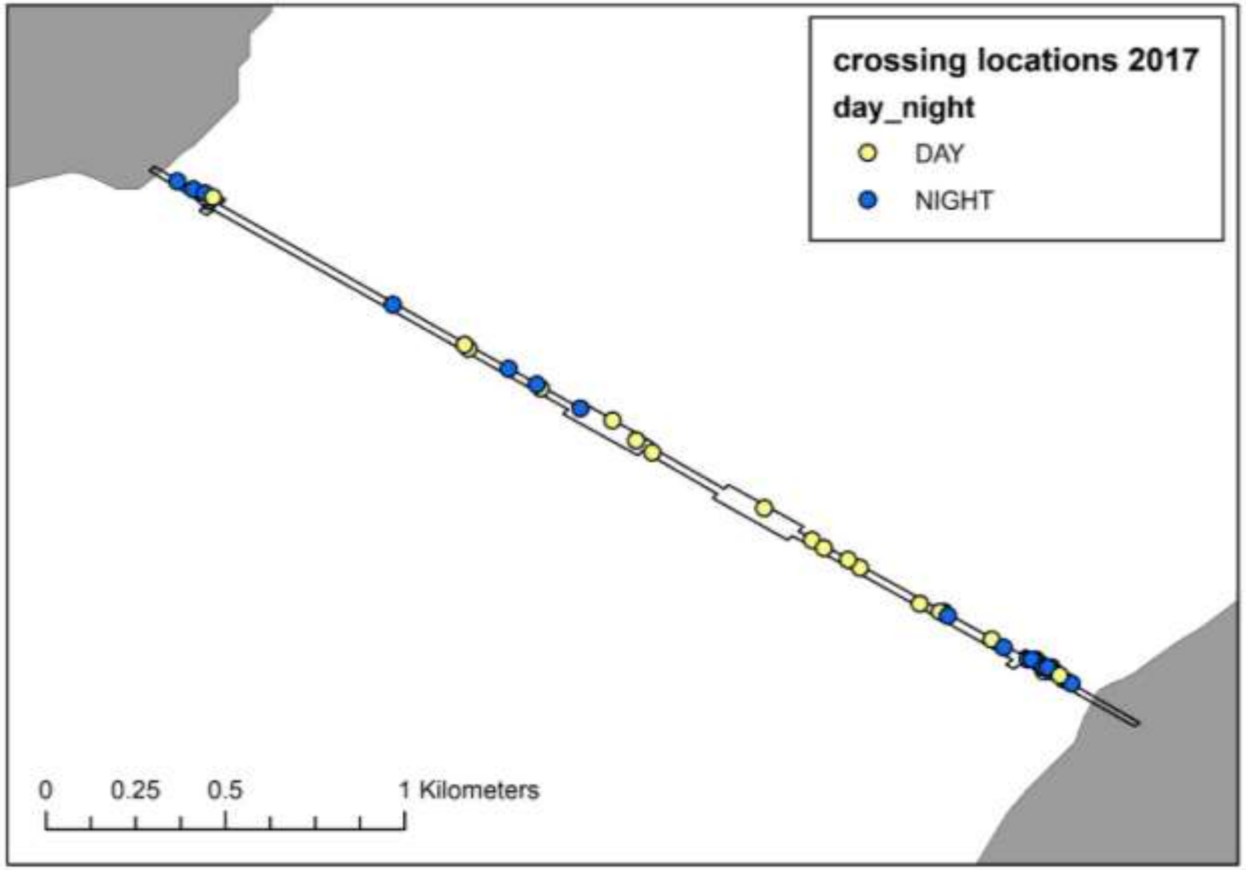
uniform distribution along south side of bridge

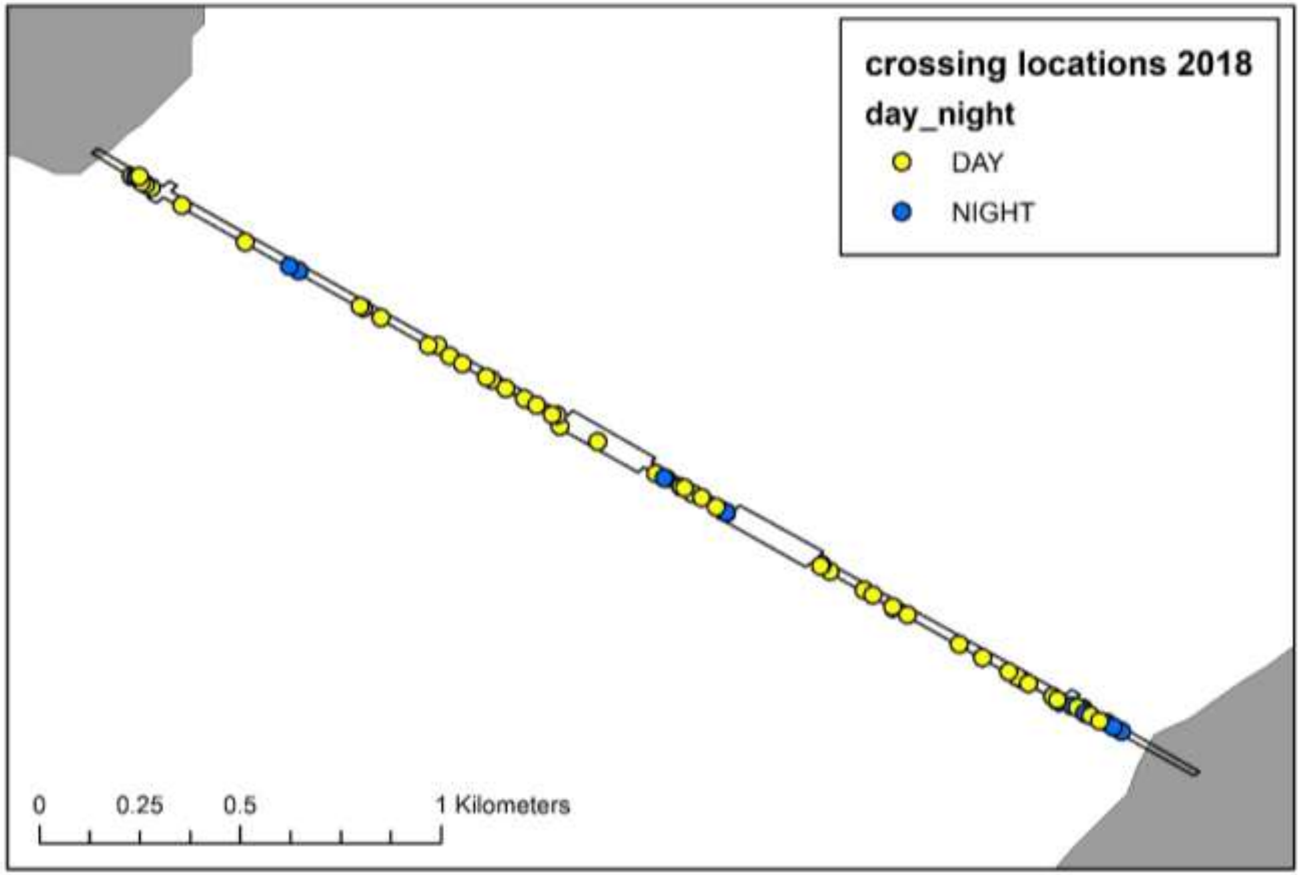
Survivors vs. Non-survivors



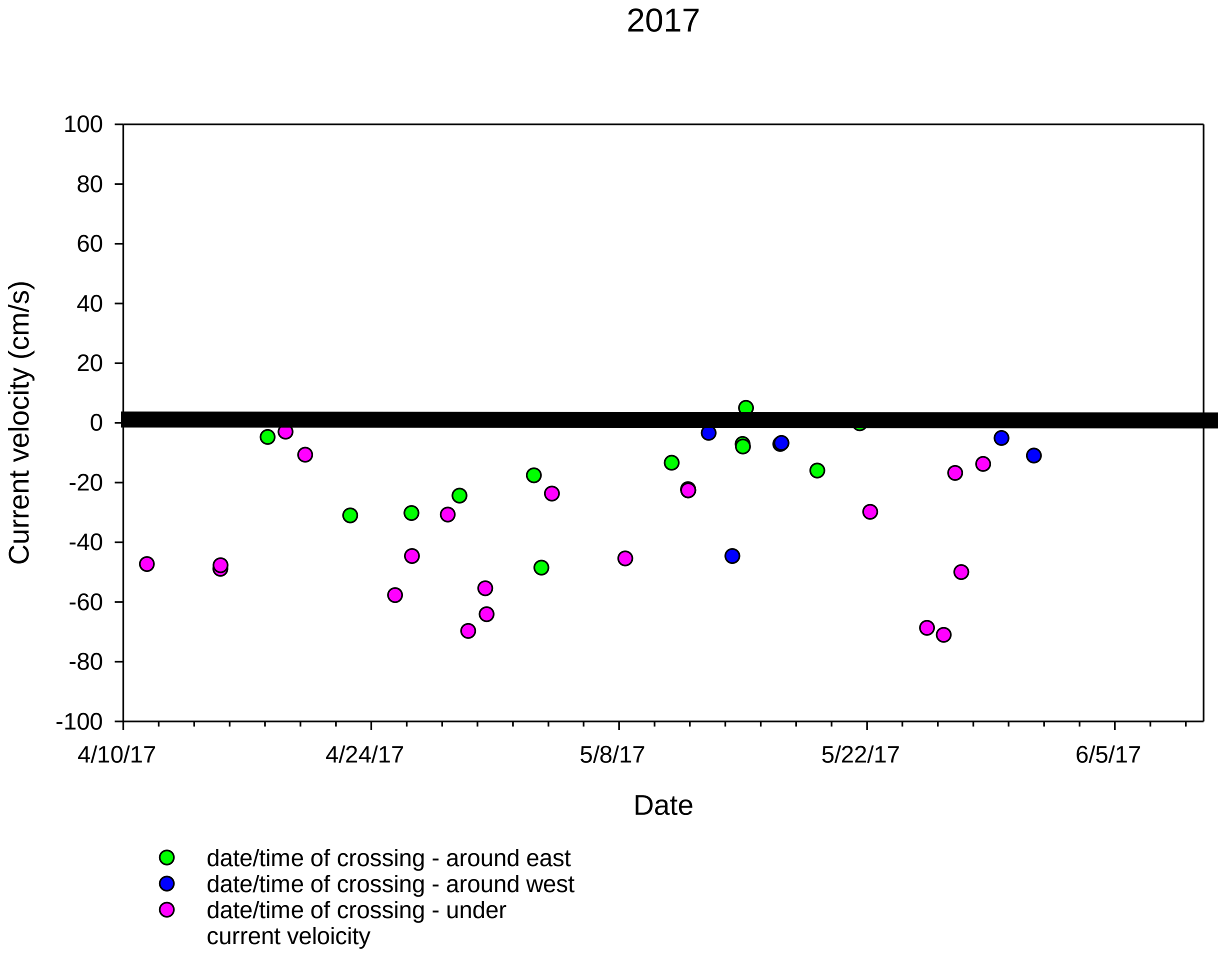
ANIMATION

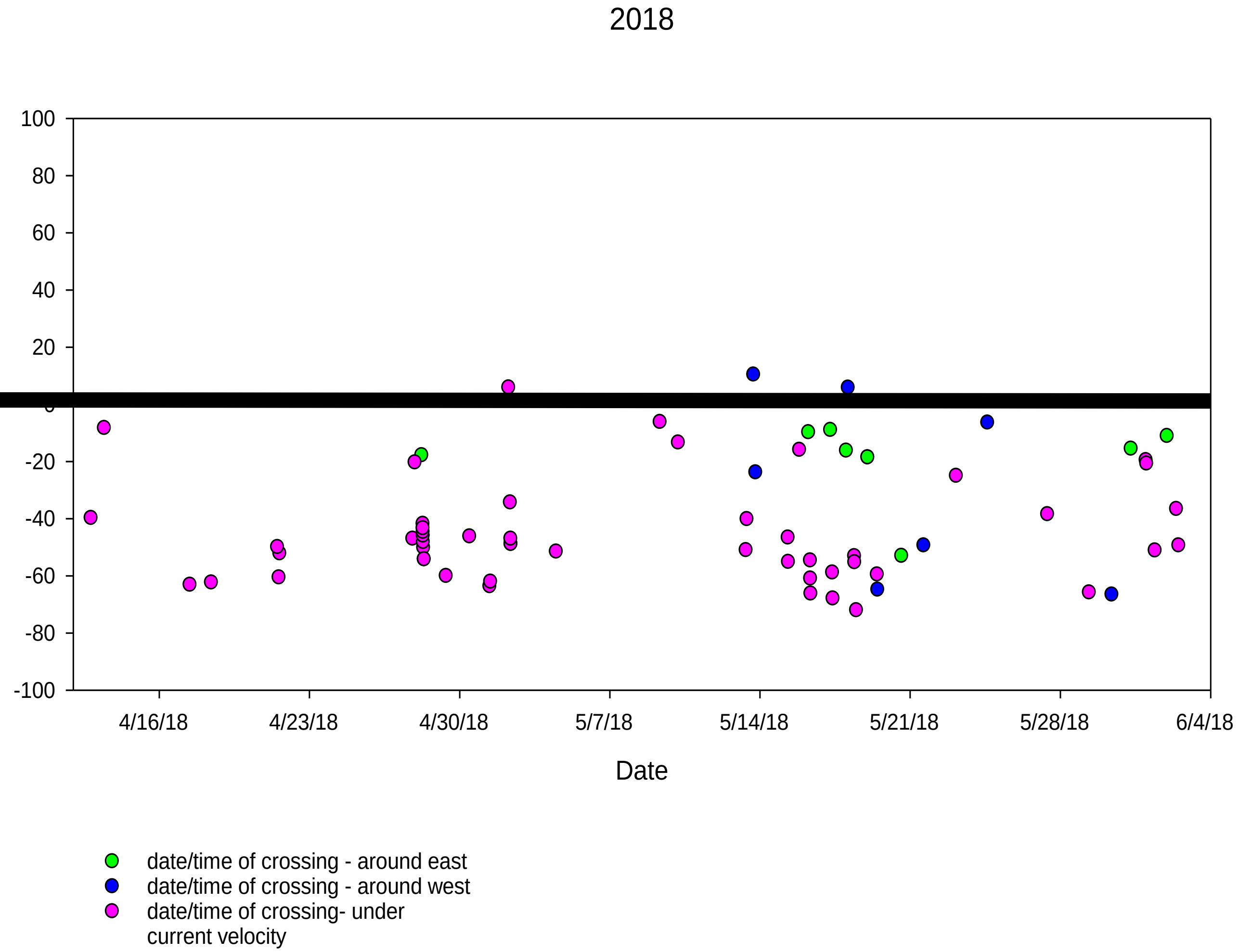
Fish go around and under, during day and night





Steelhead only cross on ebbing currents

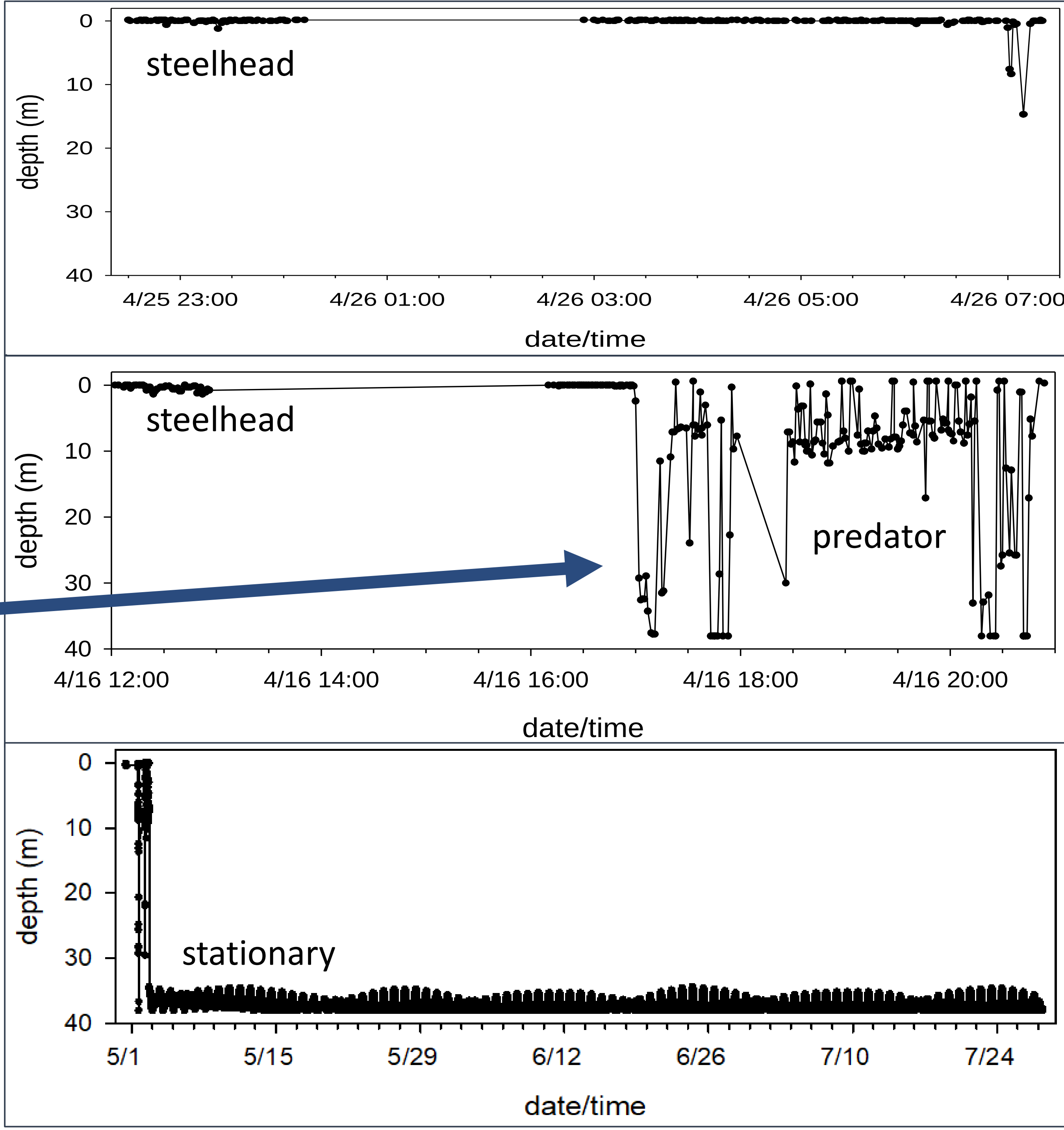




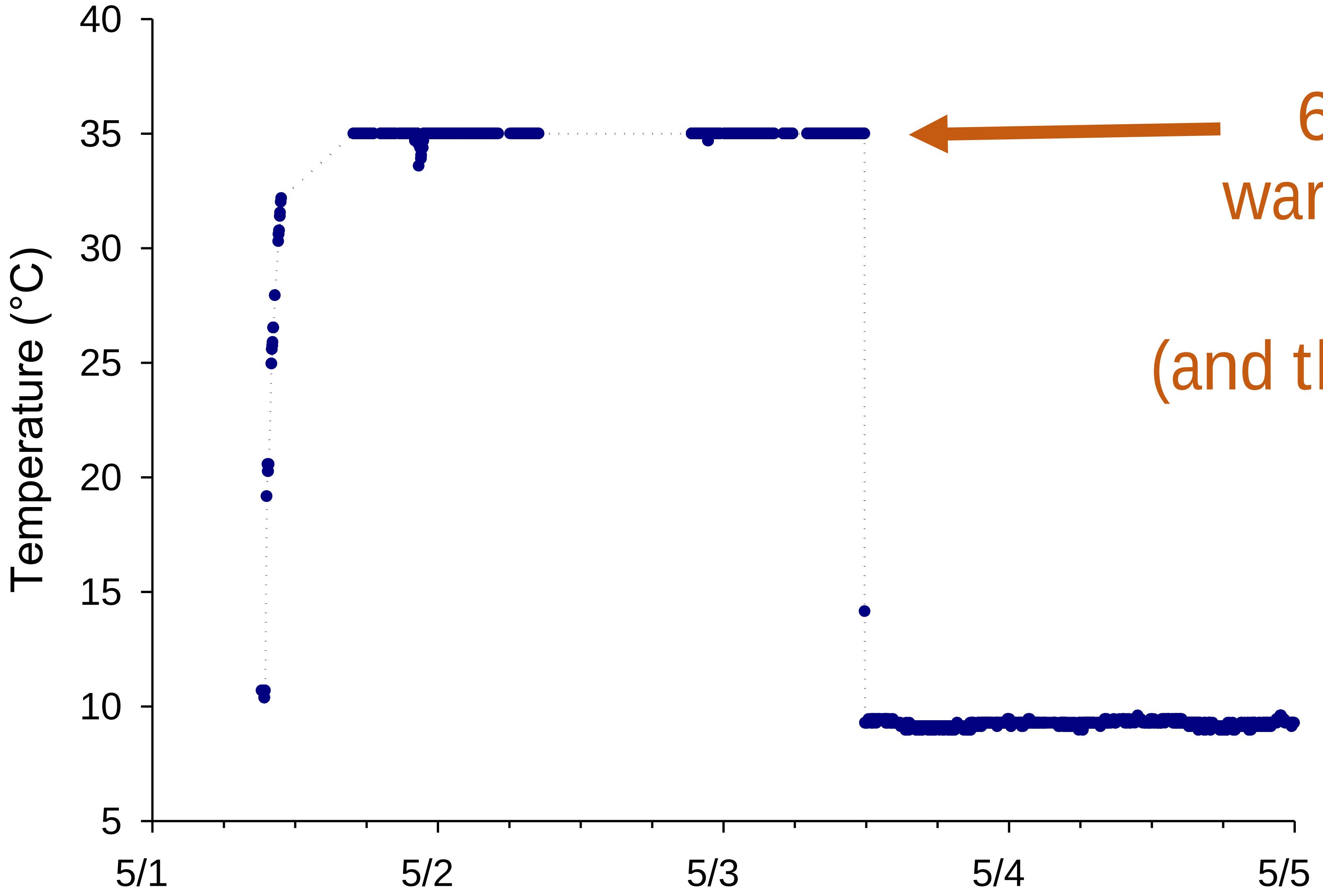
Steelhead don't dive
...but predators do.

83% to 85% of mortalities showed frequent deep dive behavior

(and then became stationary)



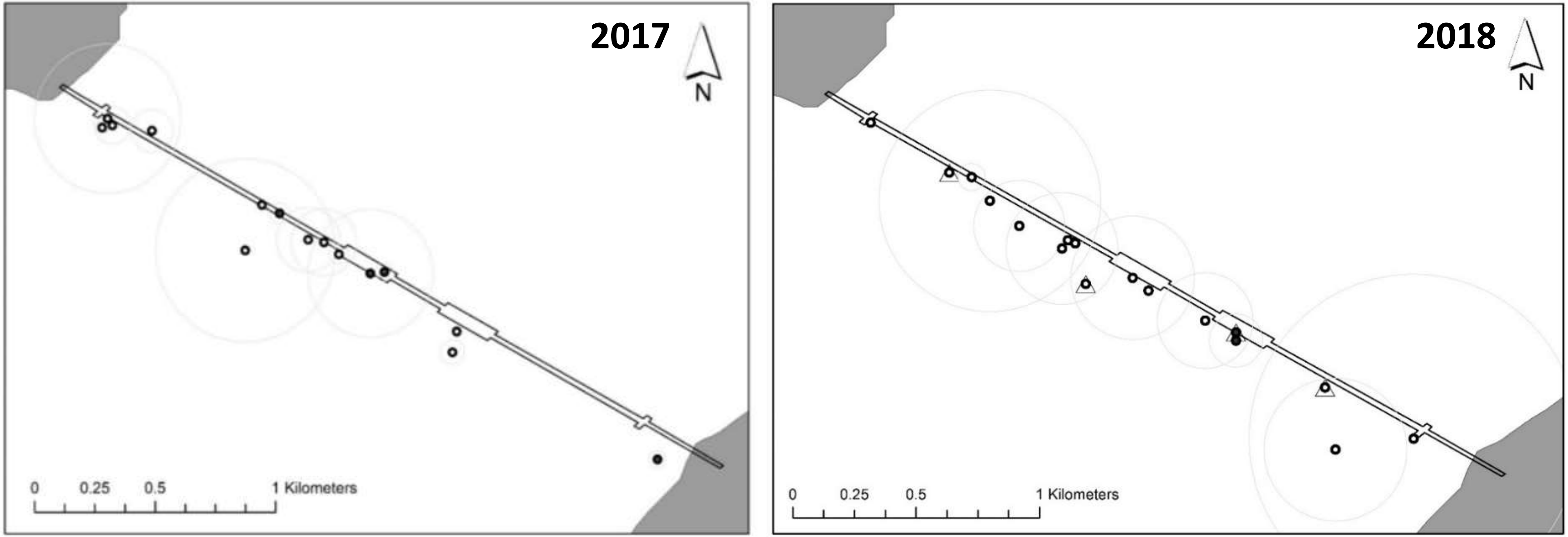
Steelhead got eaten by warm-blooded predators



69% of mortalities
warmed up to 35˚C/95˚F

(and then became stationary)

Predators ate fish along the length of the bridge, mostly during daylight hours




CAUTION
DRIVING OVER HATCHES
MAY CAUSE DAMAGE




VIDEO


VIDEO

Potential Impacts to Other Salmonids

Recommendations for Phase 2 Scoping

The team should assess the bridge's relative impact to Chinook and chum.

Solutions to Juvenile Steelhead Mortality

Seeking to test solutions that will either:

Increase Fish Passage

- Signal fish via velocity changes
- Guide fish to east and west side of the bridge.

- and/or -

Decrease Predator Effectiveness

- Restrict access to habitat (haul-outs)
- Use harassment techniques

Solutions can be tested and refined by:

- Fish tracking methods
- Fine-scale current modeling
- Visual predator surveys
- Predator tracking
- Scat sampling

Solutions to Juvenile Steelhead Mortality

Recommendations for Phase 2 Scoping

Prioritize resources to implement near-term solutions to reduce steelhead mortality based on the Phase 1 findings.

The Assessment Team and Management Committee should consider long term solutions that replace or significantly alter the bridge to facilitate fish passage.

Solutions to Juvenile Steelhead Mortality

Potential solutions that are/were considered:

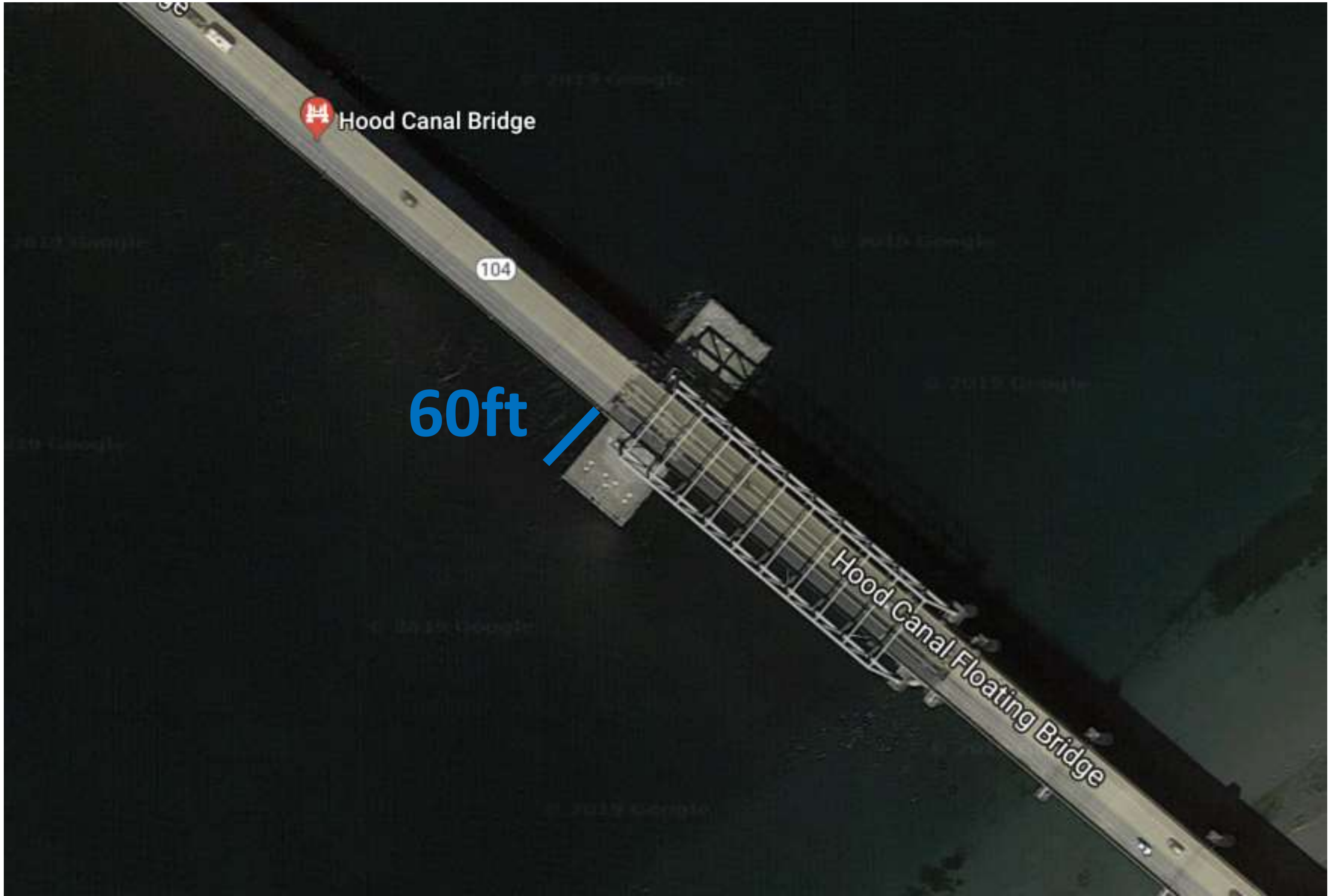
- Restricting access to pontoons corners
- Open bridge draw span
- Disrupt water velocities at ends of the bridge
- Using pumps to signal passage
- Guide approach trajectory
- Manipulating currents to signal passage
- Bubble curtains
- Trap and haul

- Replace bridge with "fish-friendly" design

- Encourage buffer prey
- Reduce light
- Reducing noise
- Remove marine growth, apply anti-fouling coating
- Increasing turbidity
- Lethal removal of nuisance predators
- Non-lethal removal of nuisance predators
- Predator exclusion netting
- Acoustic deterrent devices
- Reduce predator habitat

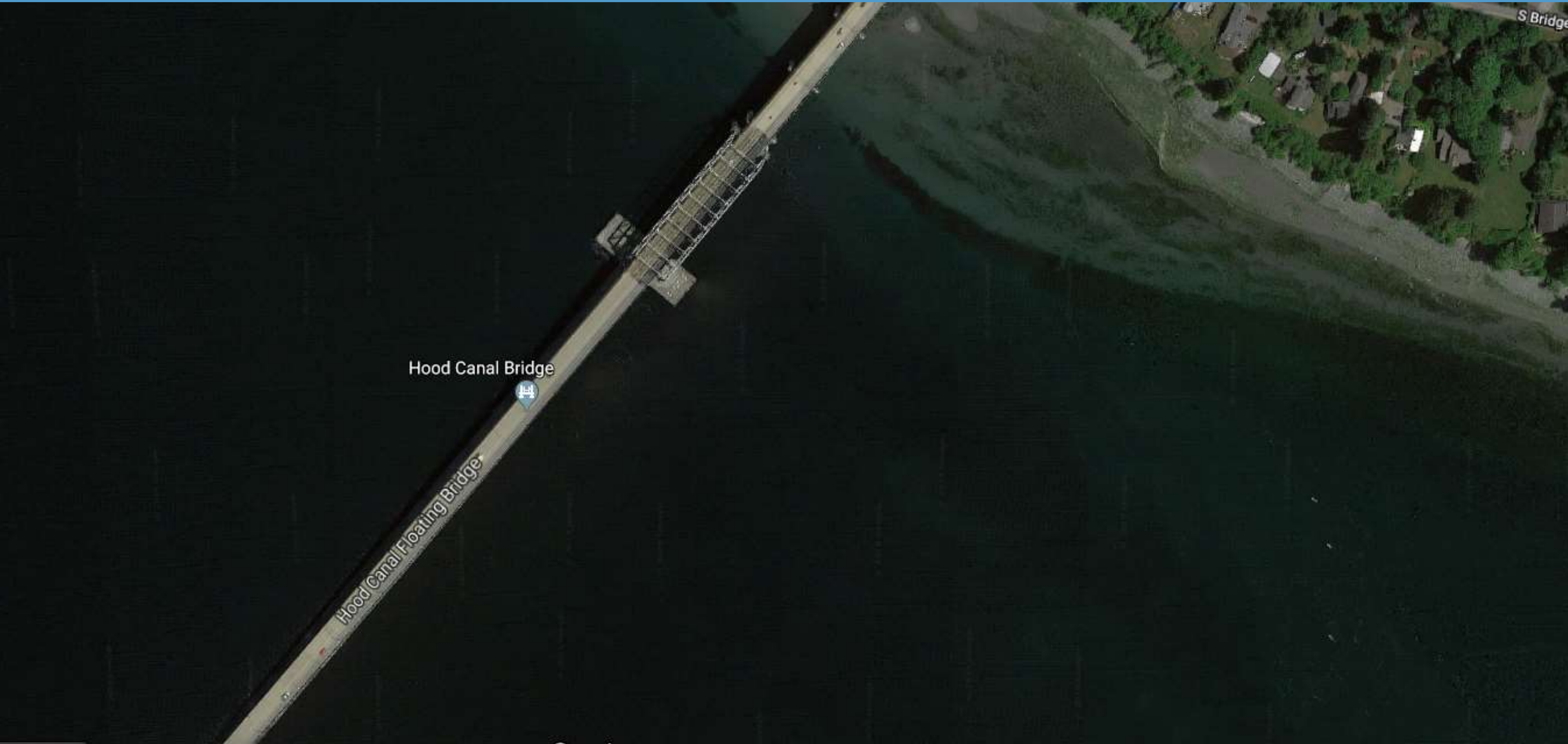
Solutions to Juvenile Steelhead Mortality

Solutions to Juvenile Steelhead Mortality



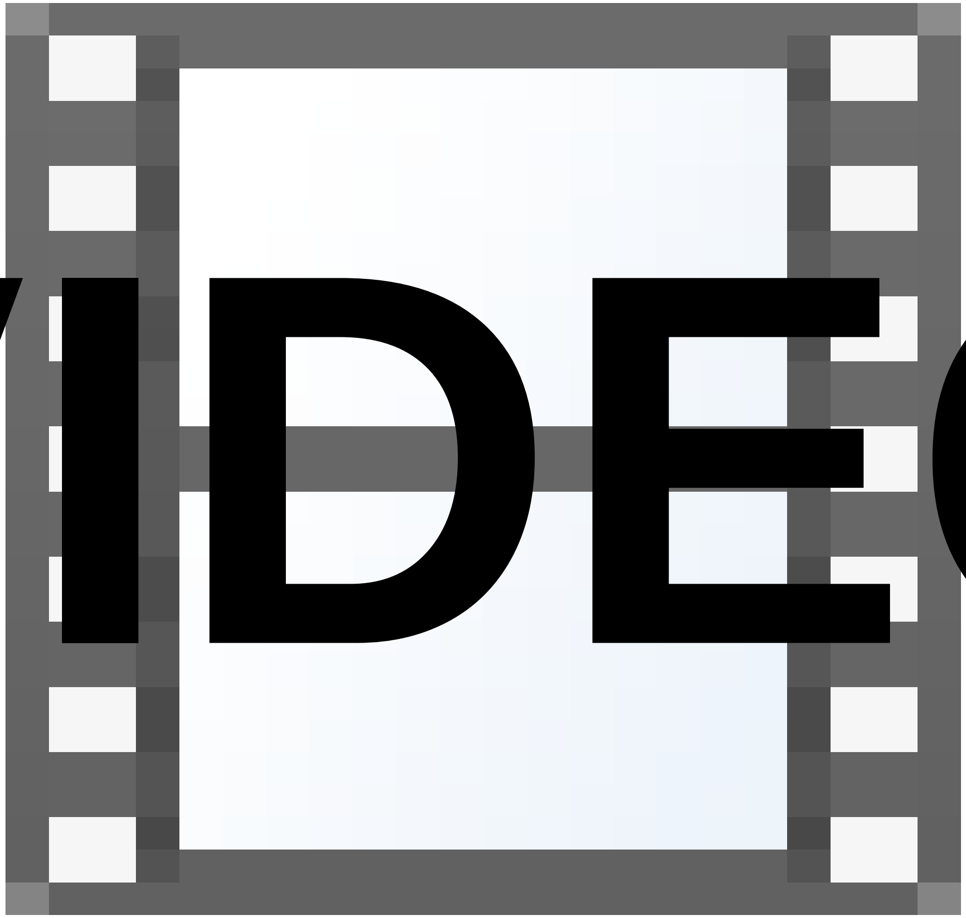
Solutions to Juvenile Steelhead Mortality

Solutions to Juvenile Steelhead Mortality



Solutions to Juvenile Steelhead Mortality

Solutions to Juvenile Steelhead Mortality



VIDEO

What are we working on right now?

- Phase 1 reporting and Phase 2 planning
  + engineering consultation

- $275,000 Supplemental Budget Request
  - Feasibility assessment and preliminary designs

- Preliminary discussions re: long-term solutions


HCCC
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Pacific Northwest
NATIONAL LABORATORY
WSDOT
NOAA
The Port Gamble
S'KLALLAM TRIBE
LONG LIVE
THE KINGS

LONG LIVE THE KINGS

Hood Canal Bridge Assessment

How can we reduce the environmental impacts of a floating bridge?

Project Duration

2016 – 2019

Phase 1

Estimated Total Project Cost

$2.2 Million

Funds Raised To Date

$2.2 Million

Project Status

Phase 1 synthesis and reporting

Project Partners

- Hood Canal Coordinating Council
- Port Gamble S'Klallam Tribe
- Washington Department of Fish and Wildlife
- National Oceanic and Atmospheric Administration
- Pacific Northwest National Laboratory
- Washington State Dept of Transportation
- U.S. Navy
- U.S. Fish and Wildlife Service

Species Impacted

- Salmon and steelhead
- Forage fish
- Groundfish (rockfish)
- Shellfish, crab, and shrimp
- Harbor seals and killer whales

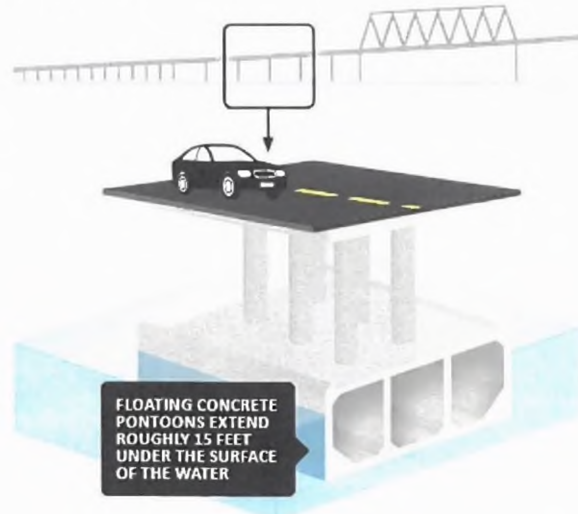
Purpose:

The Hood Canal Bridge Ecosystem Impact Assessment is investigating the causes of high fish mortality at the bridge and whether the bridge impacts water quality in a priority water body of Washington State. Solutions that improve fish passage and survival without compromising bridge functionality will then be identified and tested.

Context:

Vital elements of Hood Canal's natural ecosystem are at risk. Wild salmon — including Chinook, chum, and steelhead — are listed as threatened under the Endangered Species Act.

The Hood Canal Bridge spans the northern outlet of Hood Canal, connecting the Olympic and Kitsap peninsulas. As a floating bridge, its pontoons span 83% of the width of Hood Canal and extend 15 feet into the upper water layer.

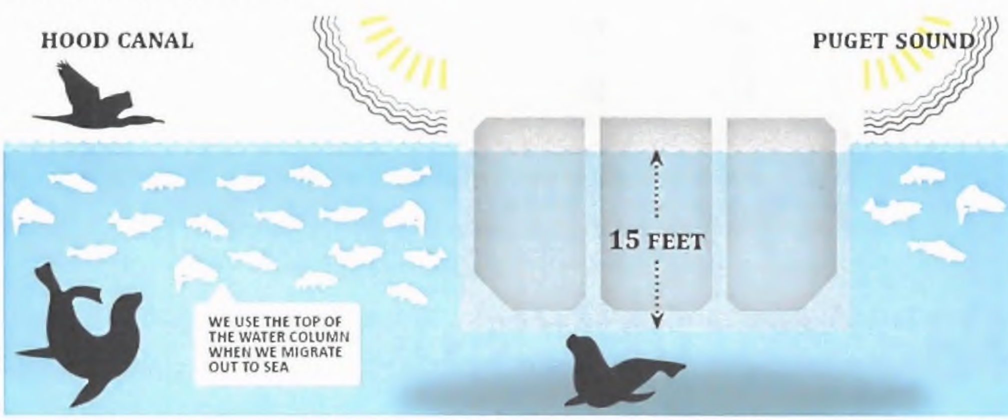


Preliminary Phase 1 Results:

Tracking data indicates that up to 50% of juvenile steelhead that make it to the bridge do not survive past it. Furthermore, water quality modeling shows that the bridge impacts temperature, salinity, and currents down to ~20 m below the water surface and up to 2-5 km away from the bridge. This dual threat to fish and their ecosystem may be limiting the effectiveness of millions of dollars already spent recovering steelhead, salmon, and their habitat in Hood Canal.

How does the bridge increase juvenile fish mortality?

Bridge pontoons create an obstruction, increasing fish densities and making juvenile steelhead more vulnerable to predators near the bridge. Light, shade, and noise from the bridge may lend an advantage to predators but do not appear to directly contribute to fish mortality. Furthermore, certain portions of the bridge appear to aggregate plankton, incentivizing Chinook, chum and forage fish to linger at the bridge, which could increase their susceptibility to predation.

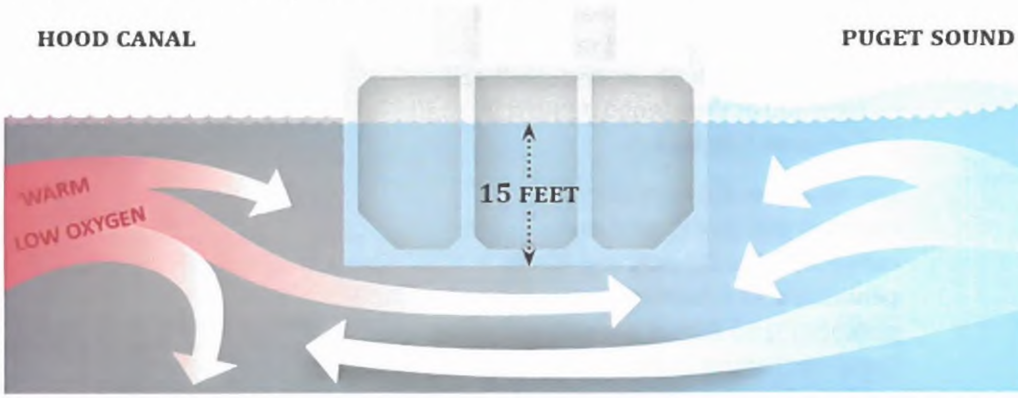


Updated August, 2019

Hood Canal Bridge Assessment

Is a Floating Bridge Impacting the Hood Canal Ecosystem?

How does the bridge impact water quality and circulation?
Previous research suggested that the bridge may be affecting water quality throughout Hood Canal by limiting the exchange of water critical to the fjord's health. Phase 1 of the assessment collected water quality data near the bridge to refine existing models in order quantify the bridge's impact to temperature, salinity, dissolved oxygen, nitrate, and algal biomass. Modeling efforts indicate water quality impacts near the bridge, but the assessment did not show significant canal-wide impacts. Additional research is needed to fully understand impacts to marine life near the bridge and understand bridge effects under changing climate scenarios.



Approach:

The Hood Canal Bridge Assessment Team – a collaboration of federal, state, tribal, and non-profit partners coordinated by Long Live the Kings – is working to pinpoint the causes of increased fish mortality at the bridge and determine the impacts to water quality. During phase 2 of the assessment, the Team will work cooperatively with the Management Committee to develop, test, refine, and ultimately implement a suite of potential management actions to address adverse impacts of the bridge without affecting the function of the bridge as a major transportation corridor.

Measures of Success:

- Identifies impacts of the bridge on steelhead survival, salmon, and forage fish distribution, and impacts to water quality in the Hood Canal ecosystem (phase 1).
- Develops, simulates, and field-tests potential management actions based on assessment results (phase 2).
- Implements data-driven solutions that minimize or mitigate impacts to salmonids and the ecosystem (phase 2)

Phase 1 Cost: $2.2 million (2016-2019)

The project received $2,210,000 from the Salmon Recovery Funding Board, Port Gamble S'Klallam Tribe, NOAA, Hood Canal Coordinating Council, Laird Norton Family Foundation, Washington State Appropriation, and other federal sources. In 2020, we will shift to testing management solutions (Phase 2).

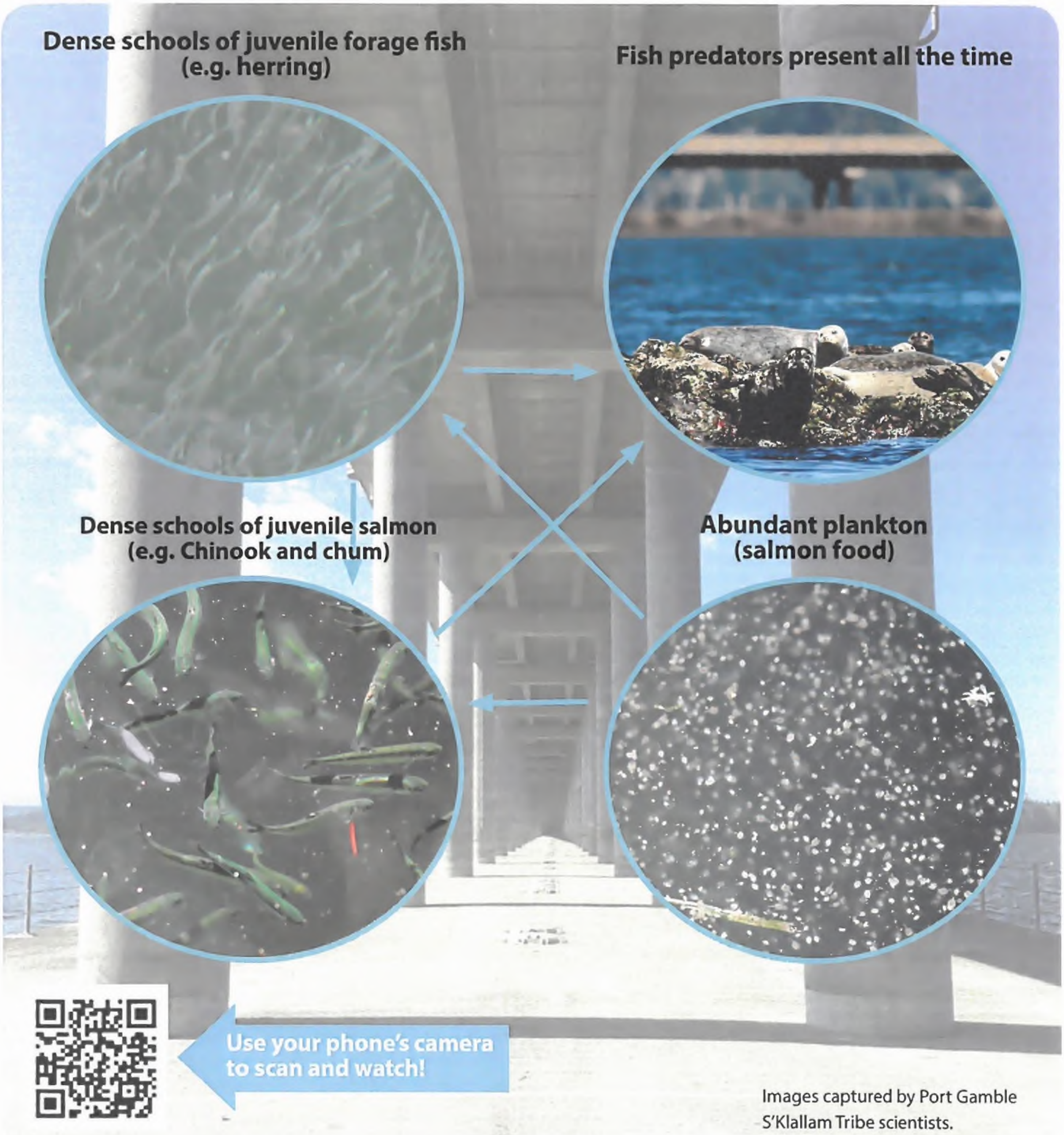
For more information, please contact Lucas Hall at (206) 382-9555 x30 or lhall@lltk.org.

1326 5th Ave Suite 450, Seattle, WA 98101 | www.lltk.org | lhall@lltk.org | (206) 382-9555

Hood Canal Bridge Assessment

Is a Floating Bridge Impacting the Hood Canal Ecosystem?

At the Hood Canal Bridge we see...



Images captured by Port Gamble S'Klallam Tribe scientists.

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