Impacts of the Hood Canal Bridge on migrating steelhead smolts

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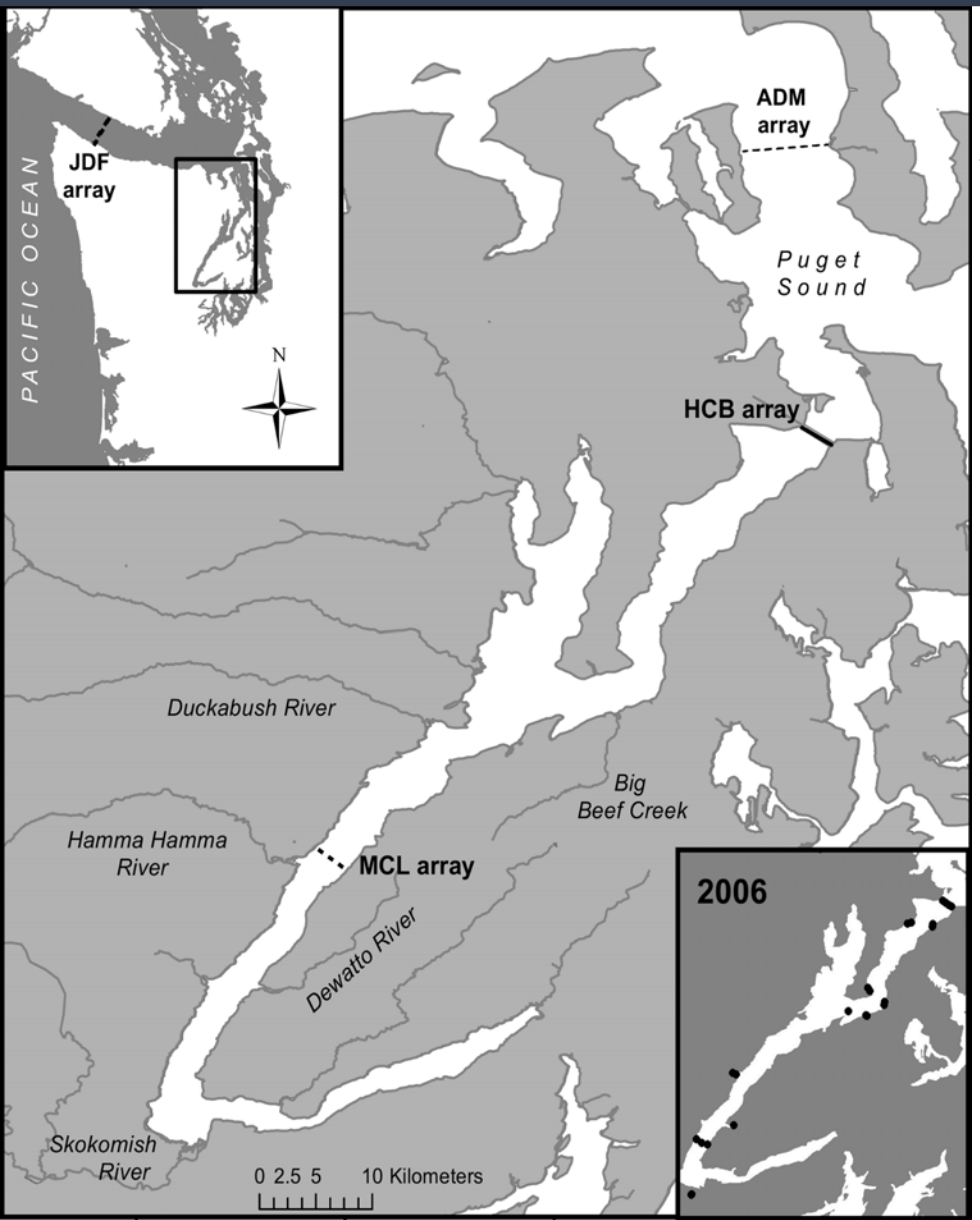
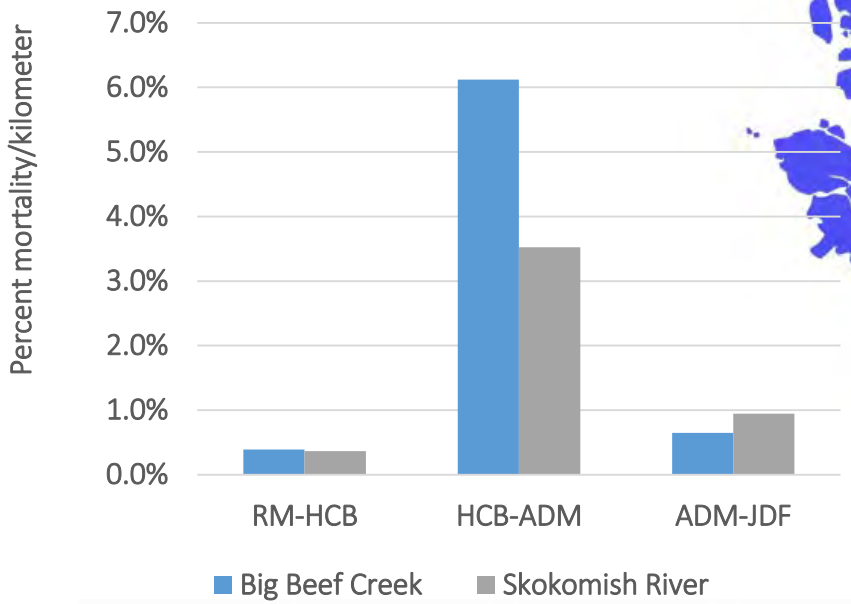
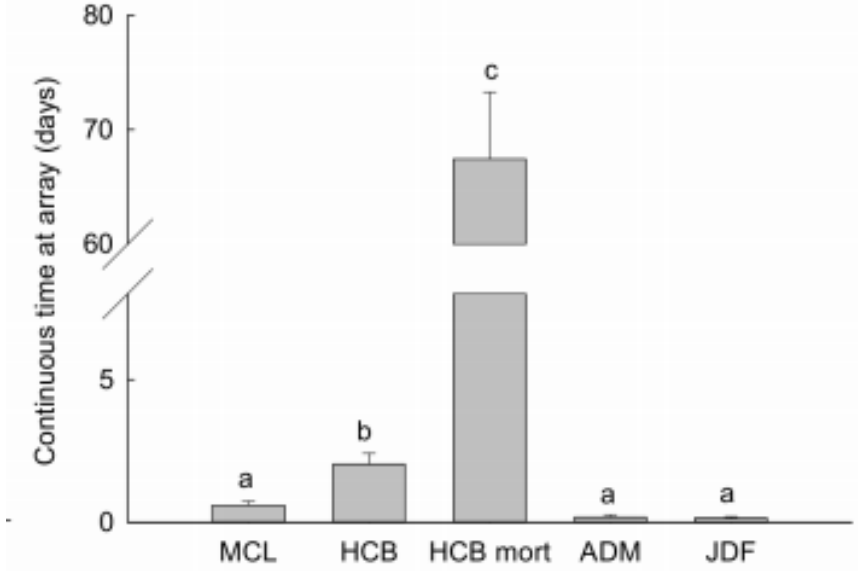
NOAA FISHERIES
Northwest Fisheries Science Center

Abnormal behavior/heightened mortality at Hood Canal Bridge (2006-2010)

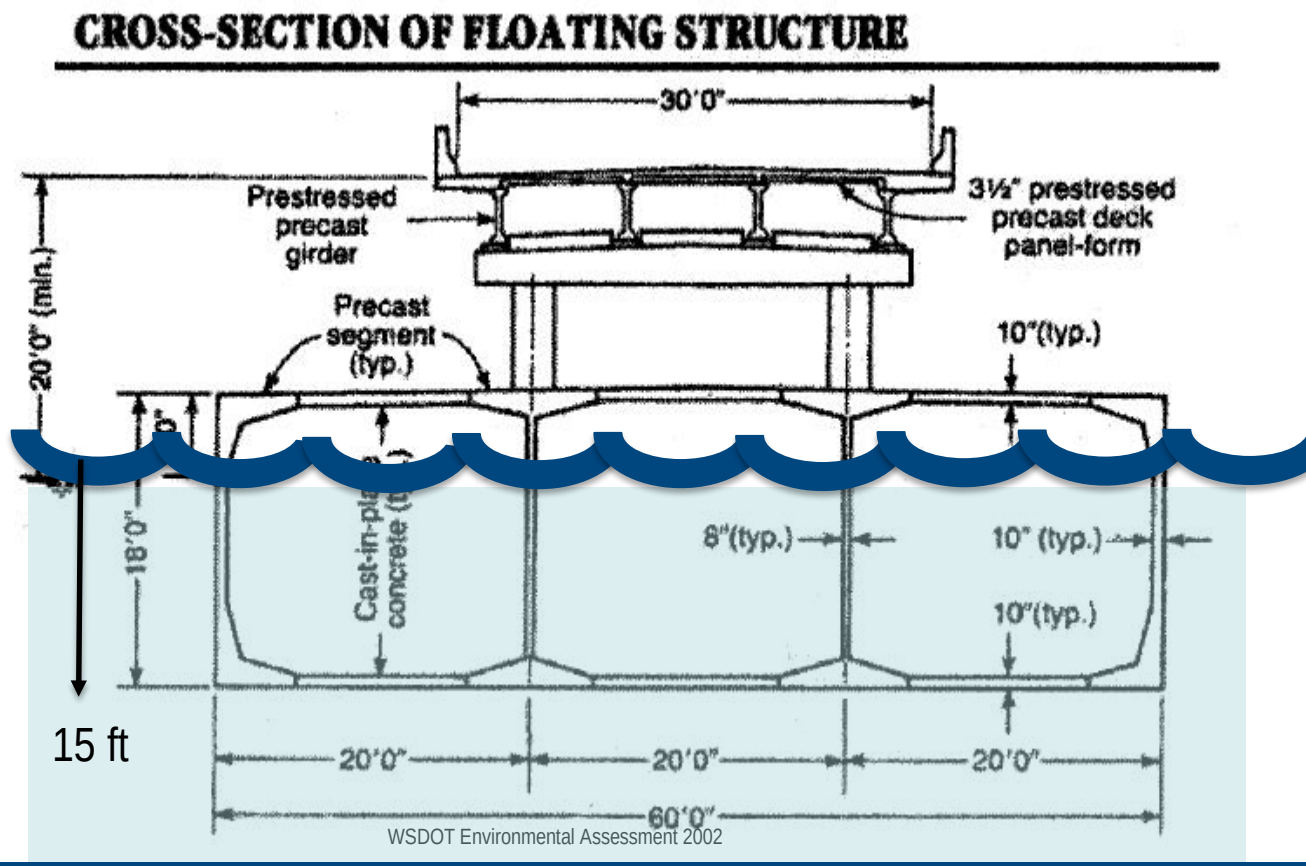






Moore et al. 2013 PLoS ONE

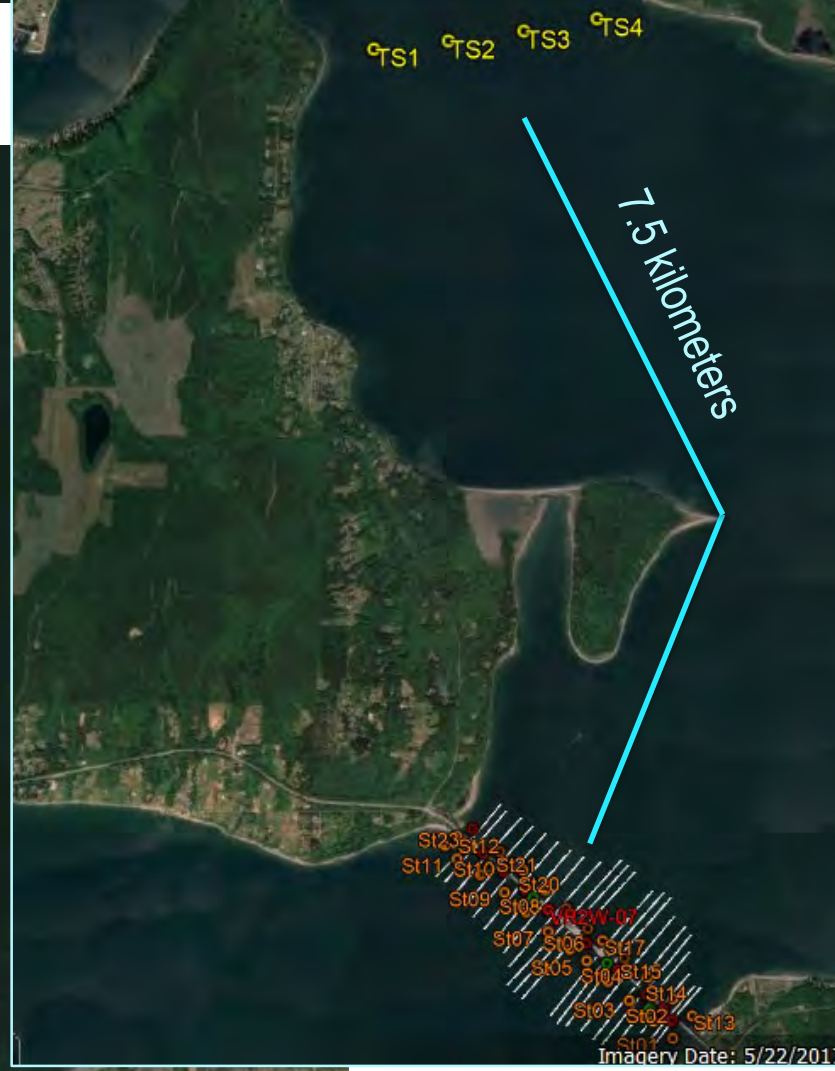
Hood Canal Bridge Anatomy



WSDOT Environmental Assessment 2002

Hood Canal width	1.4 miles
Length of floating portion	1.2 miles
Traffic Lanes	two
Number of pontoons	36
Depth of pontoon	15 feet

Vemco Positioning System (VPS) array

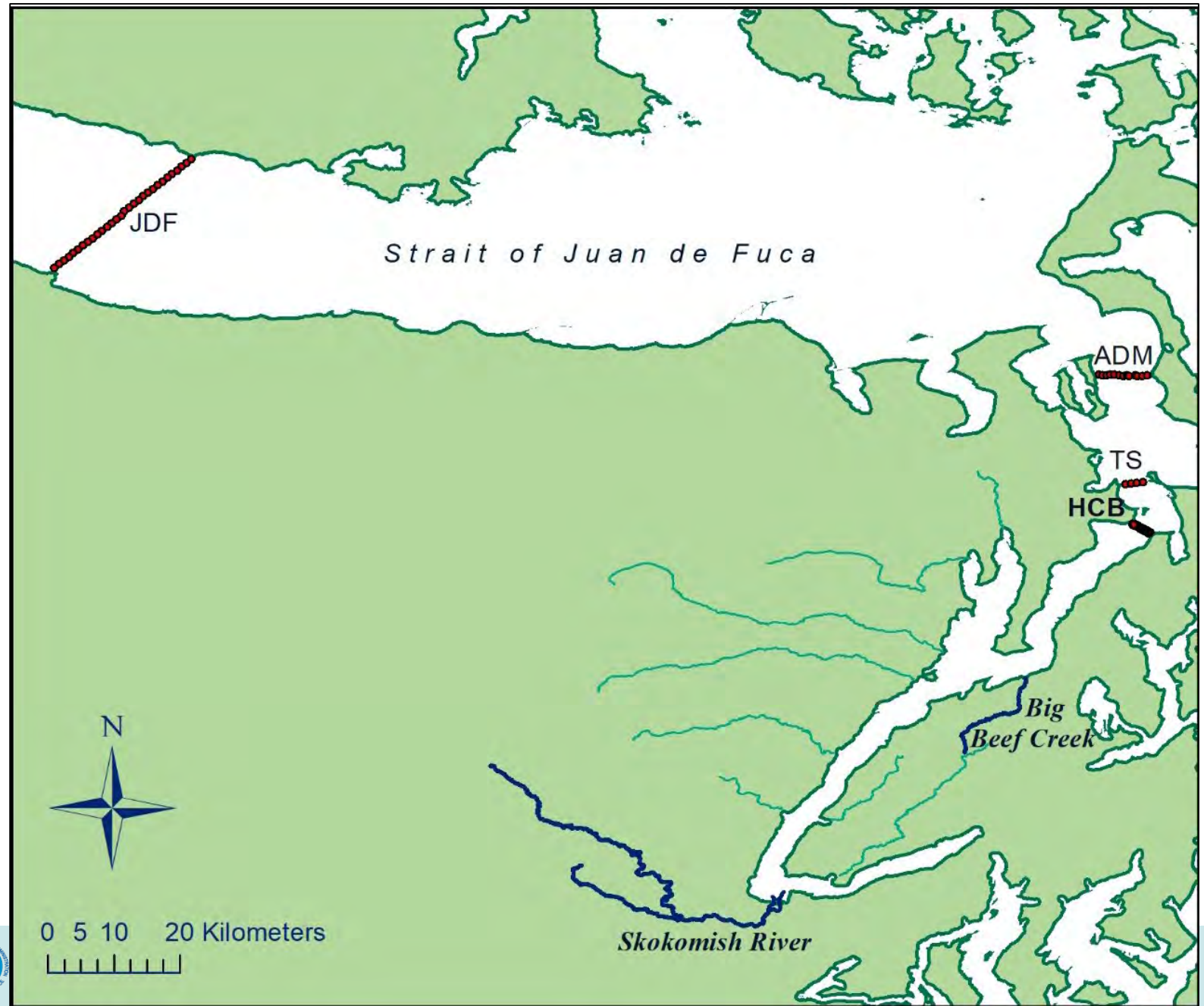


Smolt Tagging (2017 & 2018)

Tag Type (2017)	Big Beef Creek	Skokomish	Total
V8 continuous	61	89	150
V8 delay	49	0	49
V9 depth	40	8	48
TOTAL	150	97	249

Tag Type (2018)	Big Beef Creek	Skokomish	Total
V8 continuous	92	58	150
V7 depth	29	21	50
V7 temp	28	22	50
TOTAL	149	101	250

Survival Modeling: mark-recapture models



Survival (Phi)

- Release – RM
- RM – HCB
- HCB – ADM
- ADM-JDF

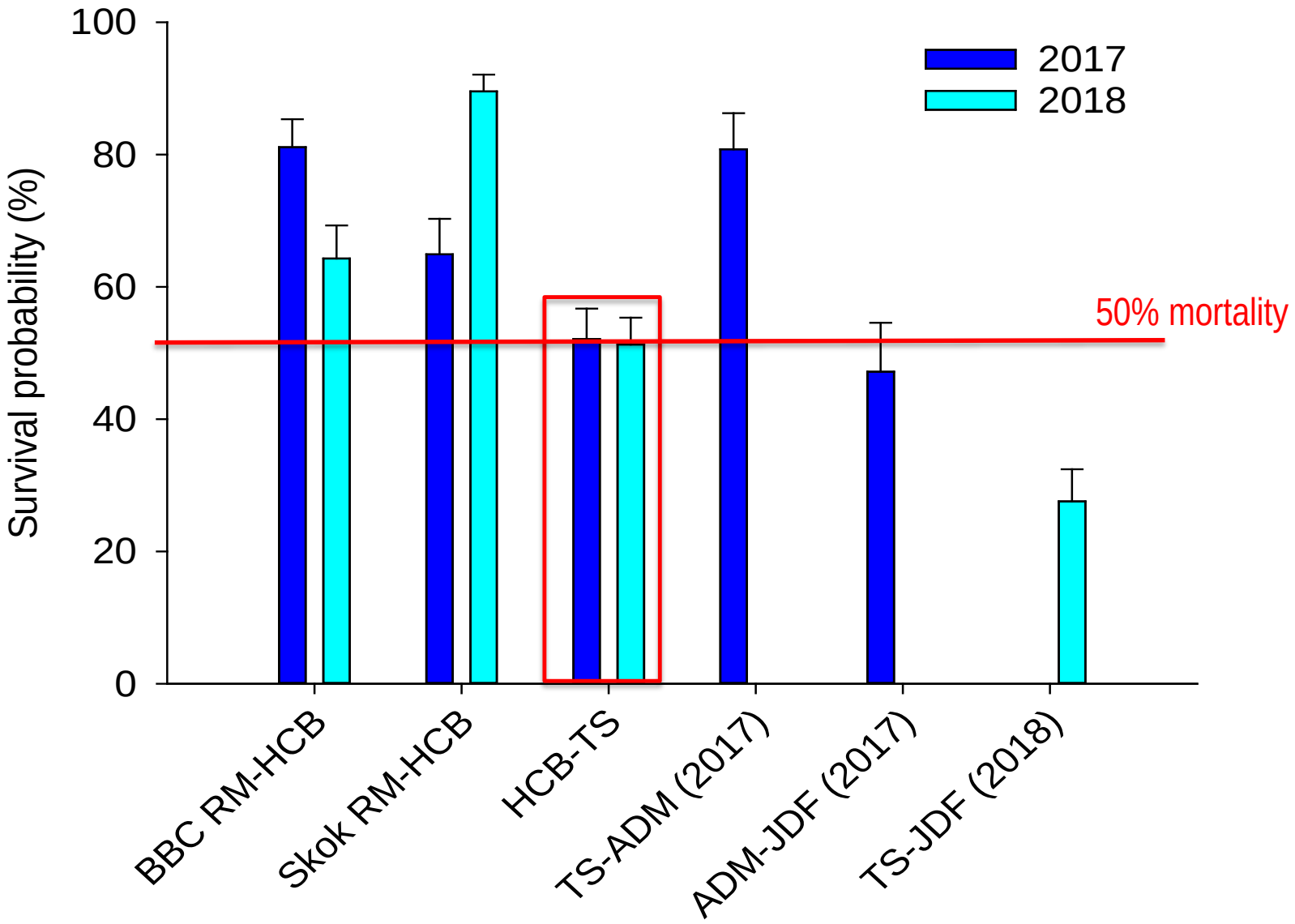
Detection (p)

- RM
- HCB
- TS
- ADM
- JDF

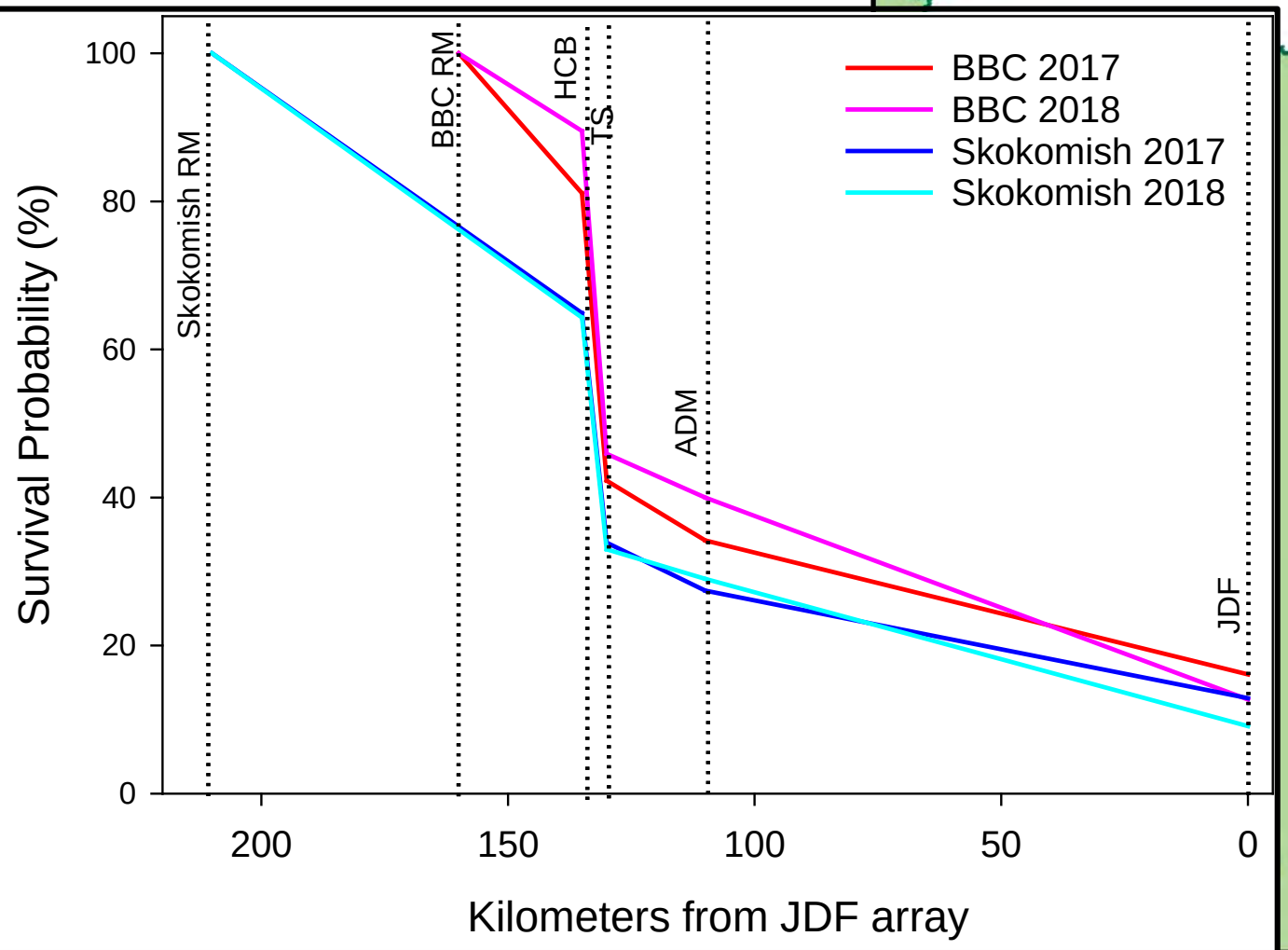
Factors

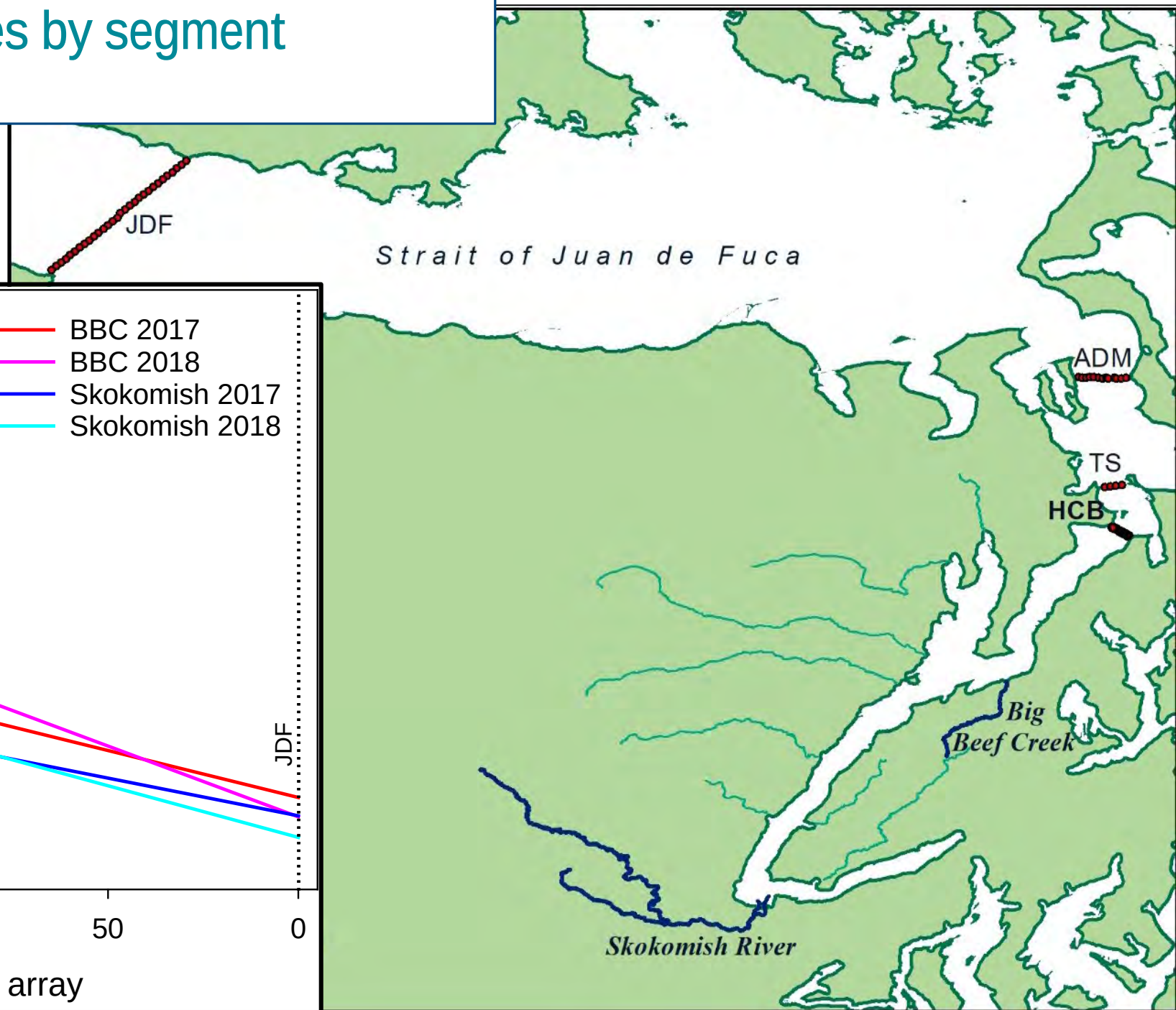
- Segment
- Population
- Tag type
- Release date

Segment-specific survival

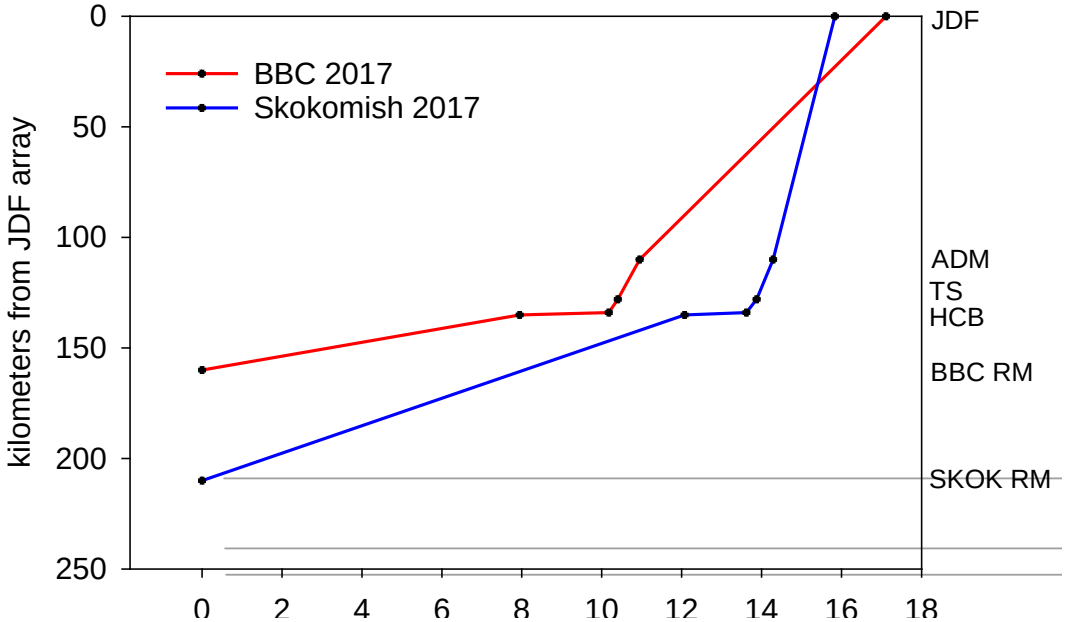


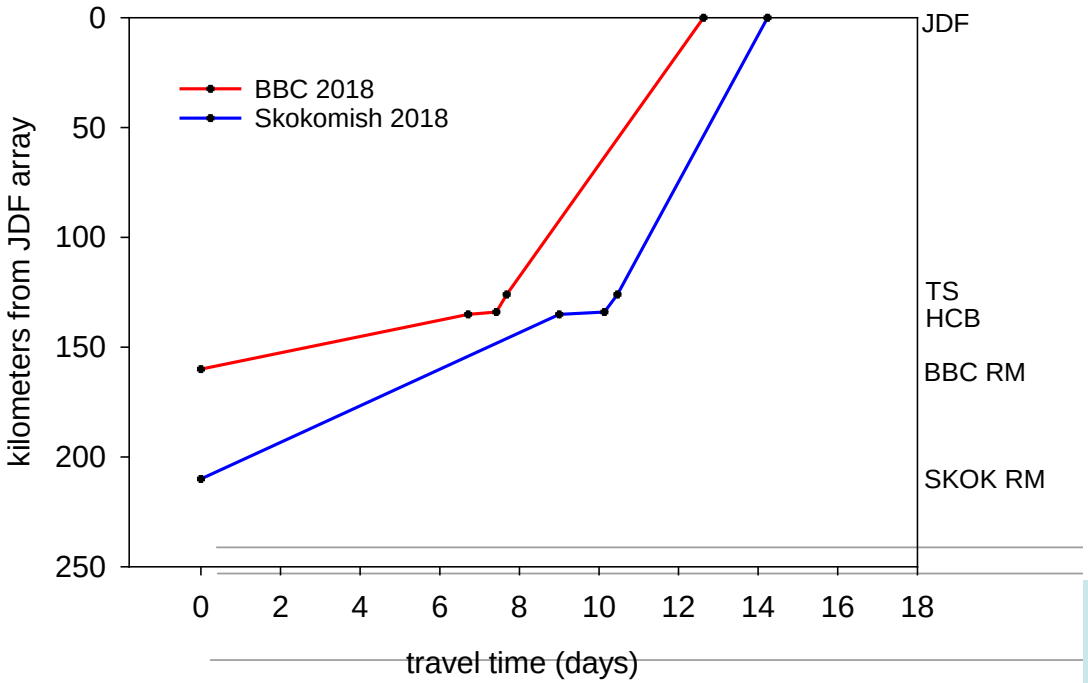
2017 and 2018 survival rates by segment

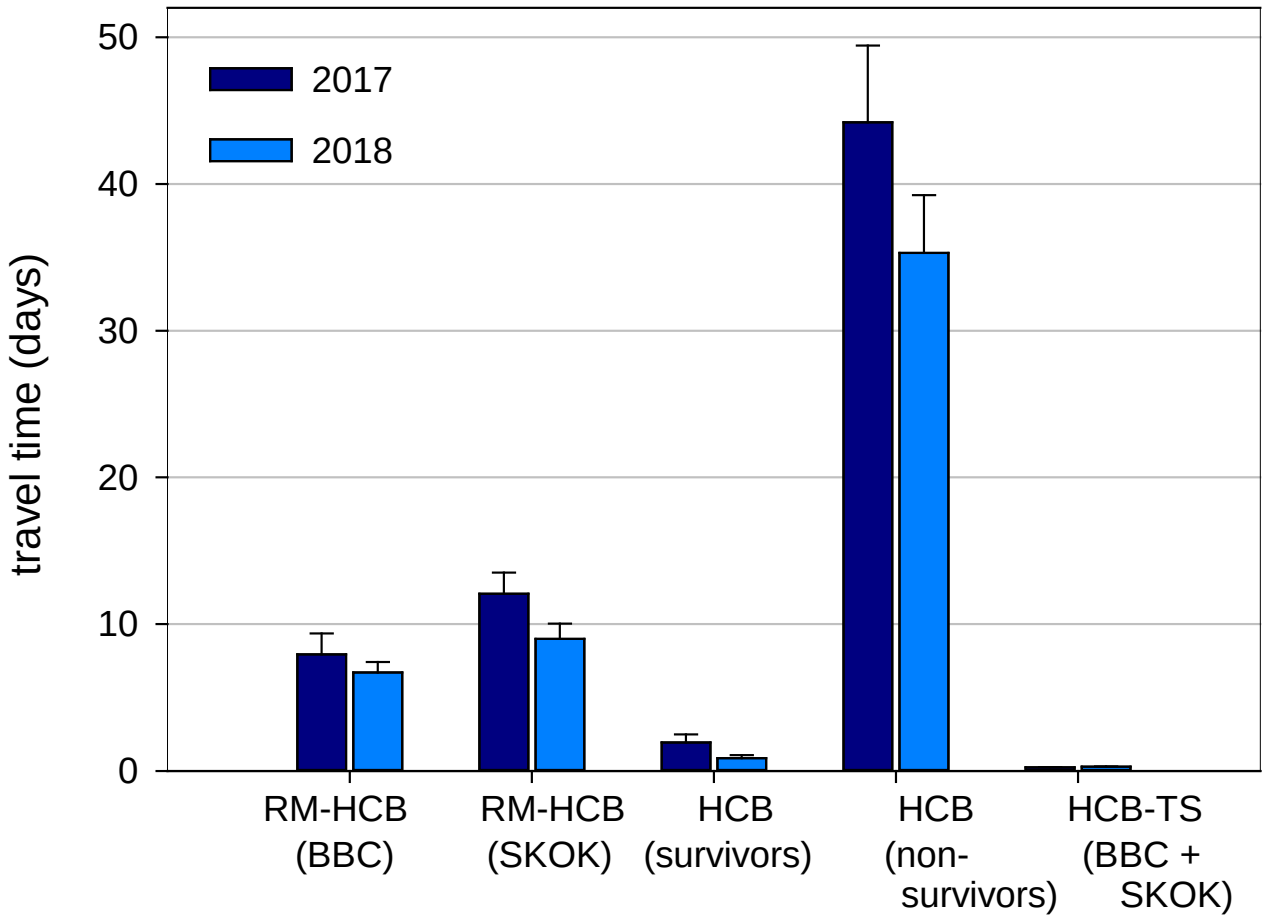




Travel time by segment, 2017 and 2018



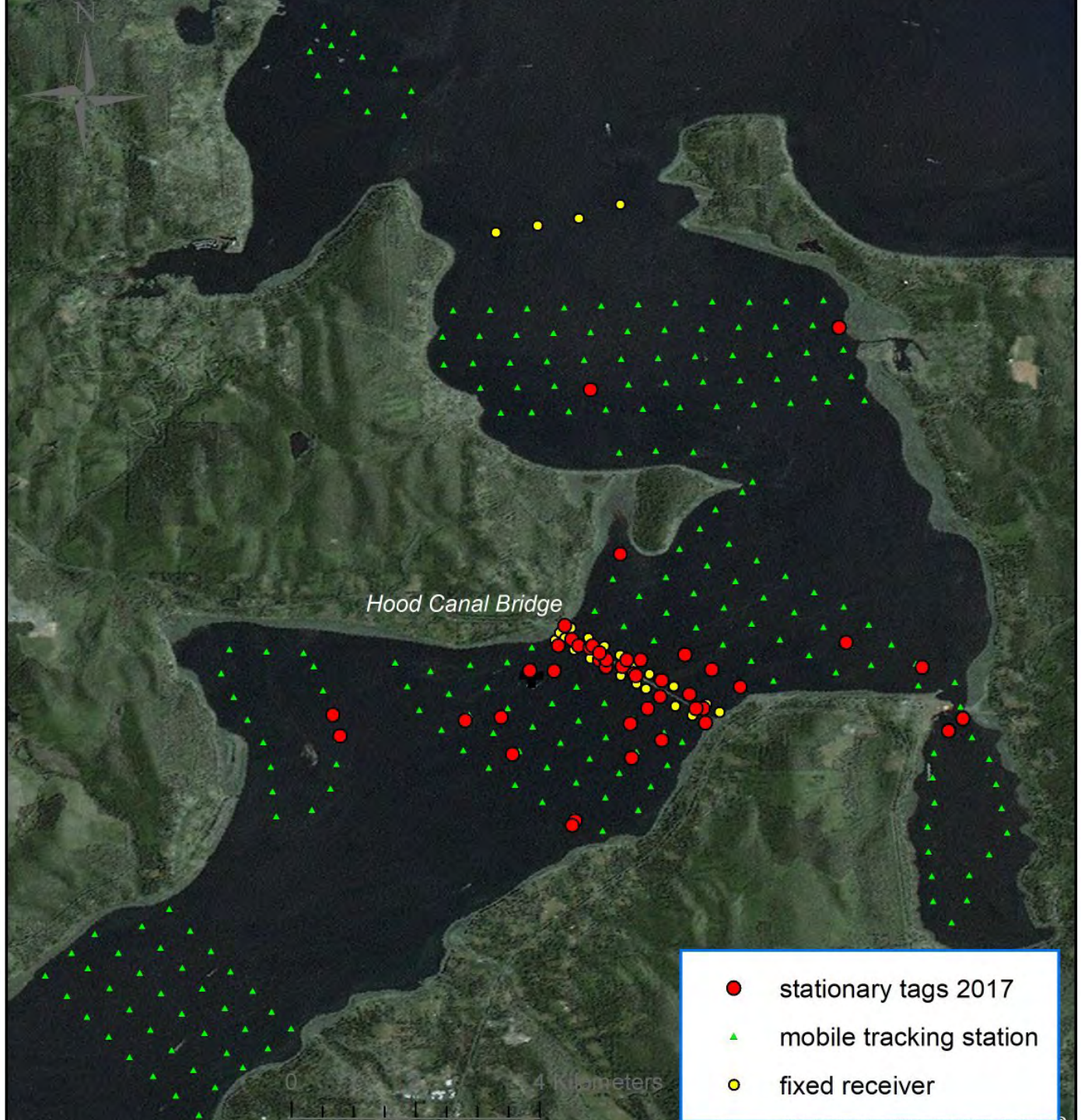




Stationary Tags = mortality

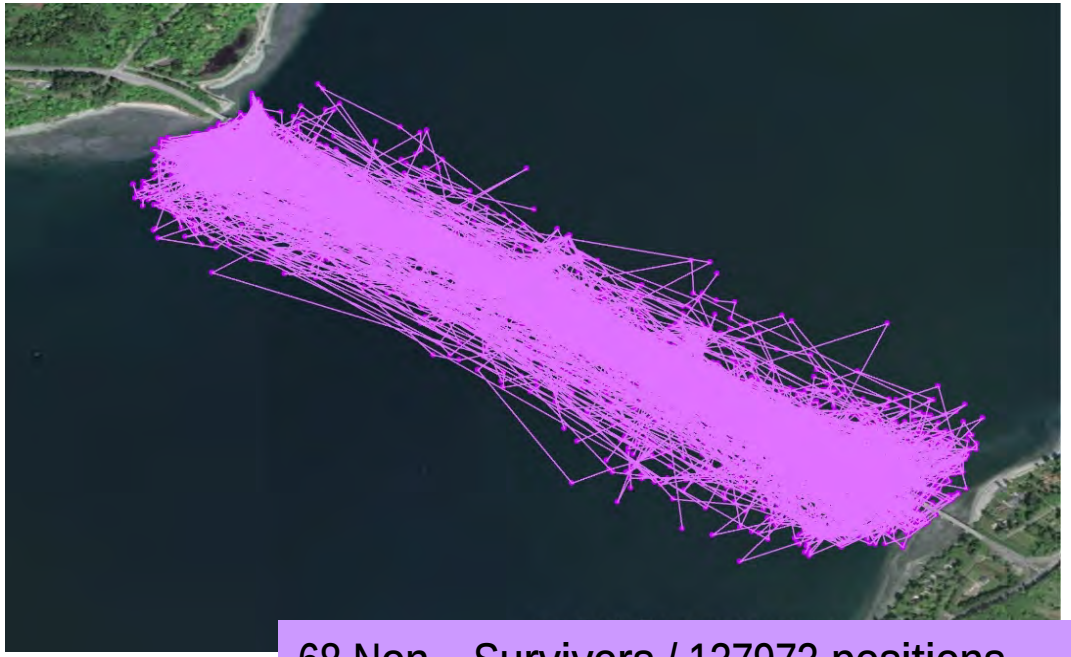
Mobile tracking in 2017 and 2018

- Listen for tags after migration window
- 400+ stations in HCB vicinity and harbor seal haulouts
- Far greater number of stationary tags found near the bridge than at stations farther away



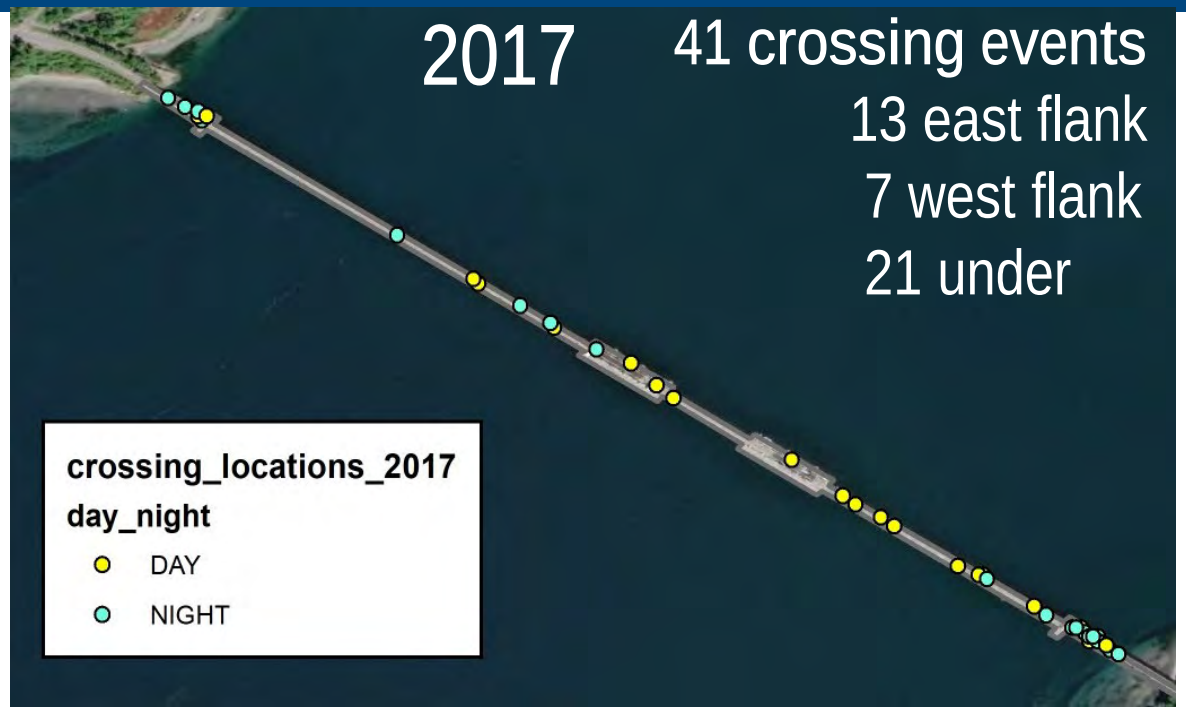
VPS Position Data 2017

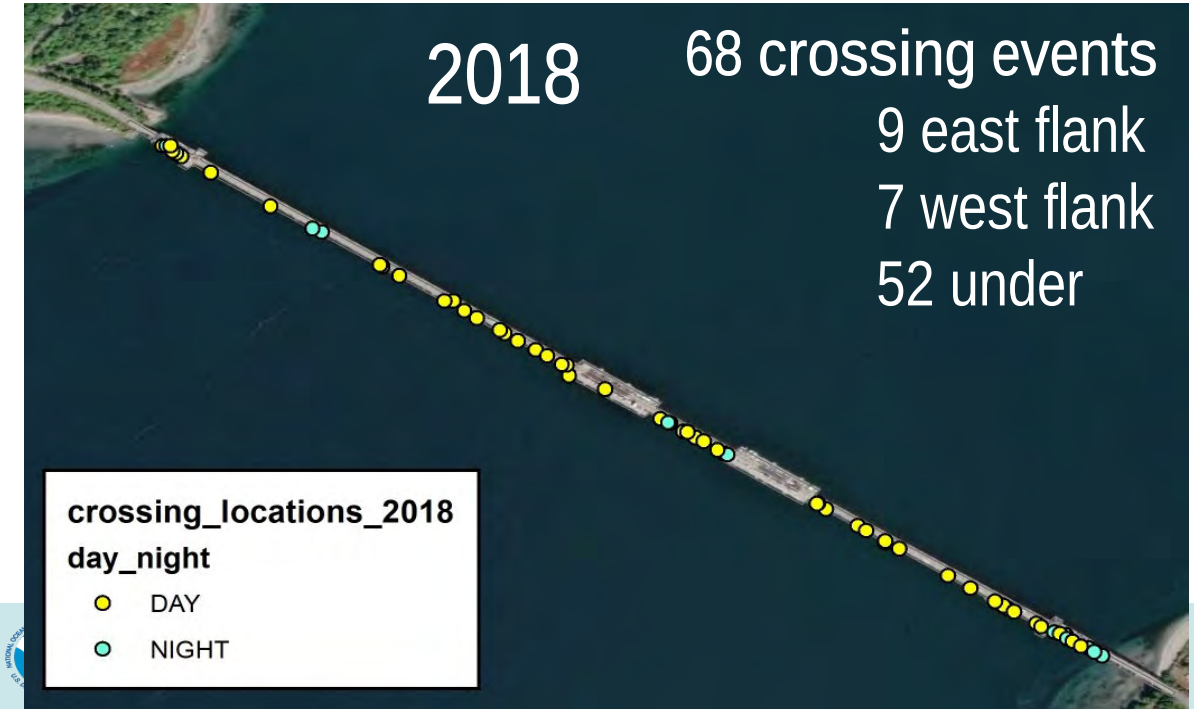
63 Survivors / 3272 positions

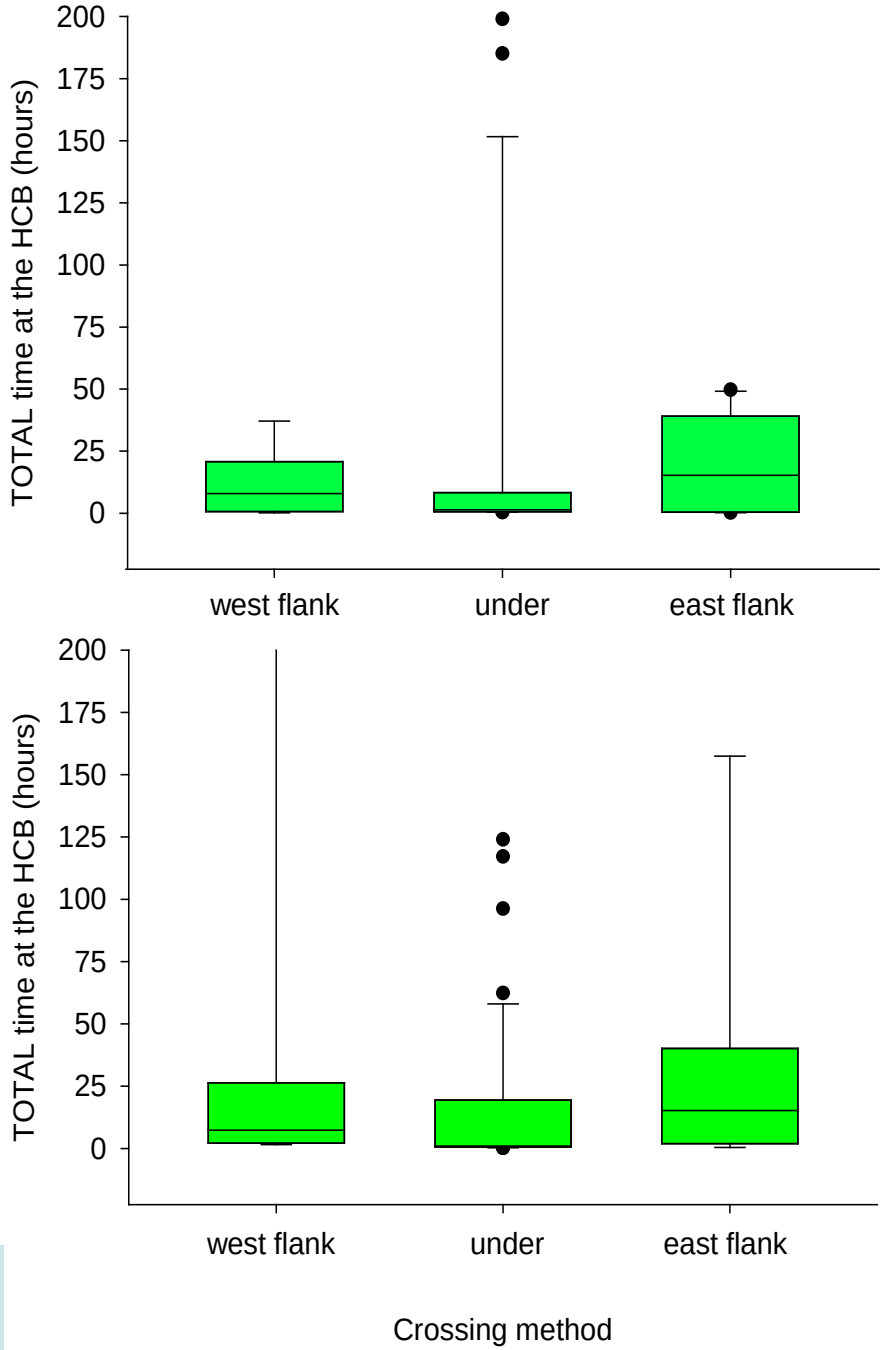


68 Non – Survivors / 137973 positions

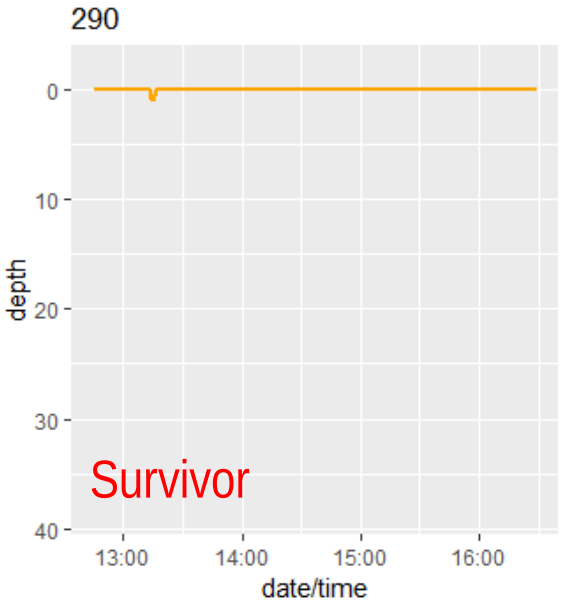
2017 data: Inverse-weighted density maps (number of detections^{-1})

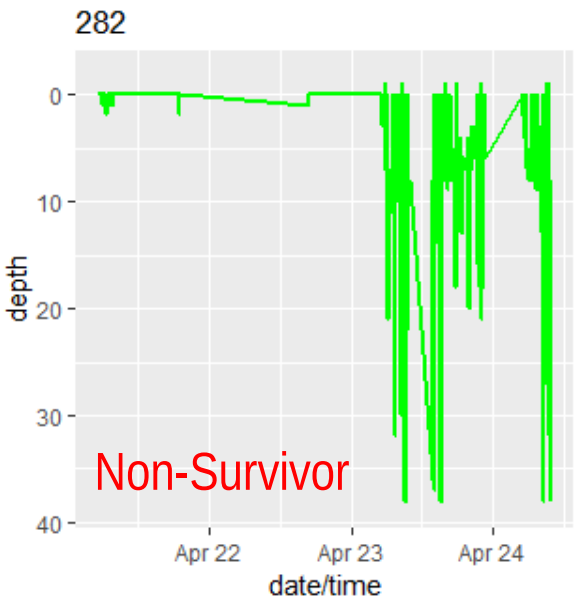

2017
41 crossing events
13 east flank
7 west flank
21 under
crossing_locations_2017
day_night
DAY
NIGHT

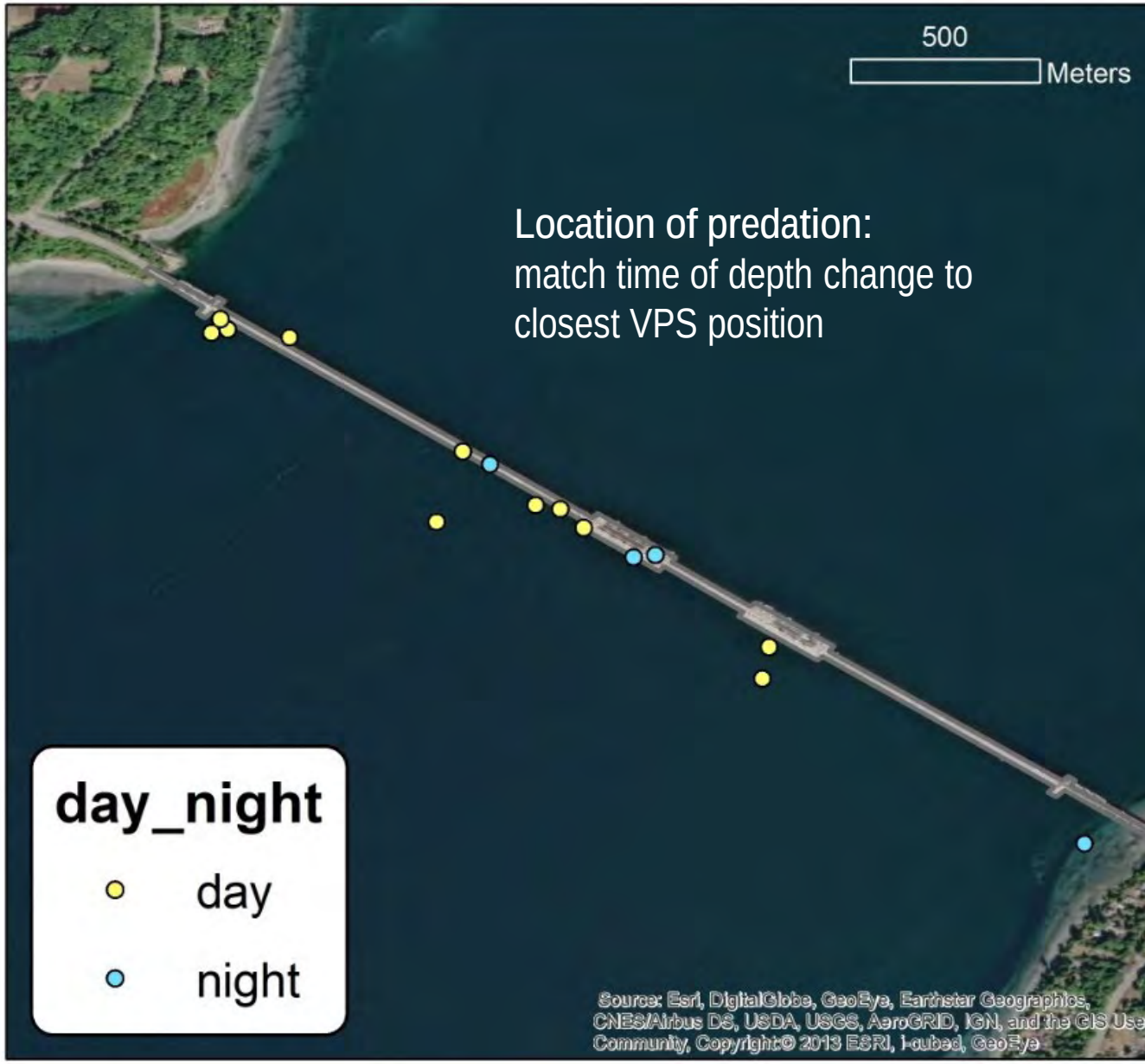

2018
68 crossing events
9 east flank
7 west flank
52 under
crossing_locations_2018
day_night
DAY
NIGHT


TOTAL time at the HCB (hours)
200
175
150
125
100
75
50
25
0
west flank
under
east flank
TOTAL time at the HCB (hours)
200
175
150
125
100
75
50
25
0
west flank
under
east flank
Crossing method

Depth tag data: depth change indicates predation event







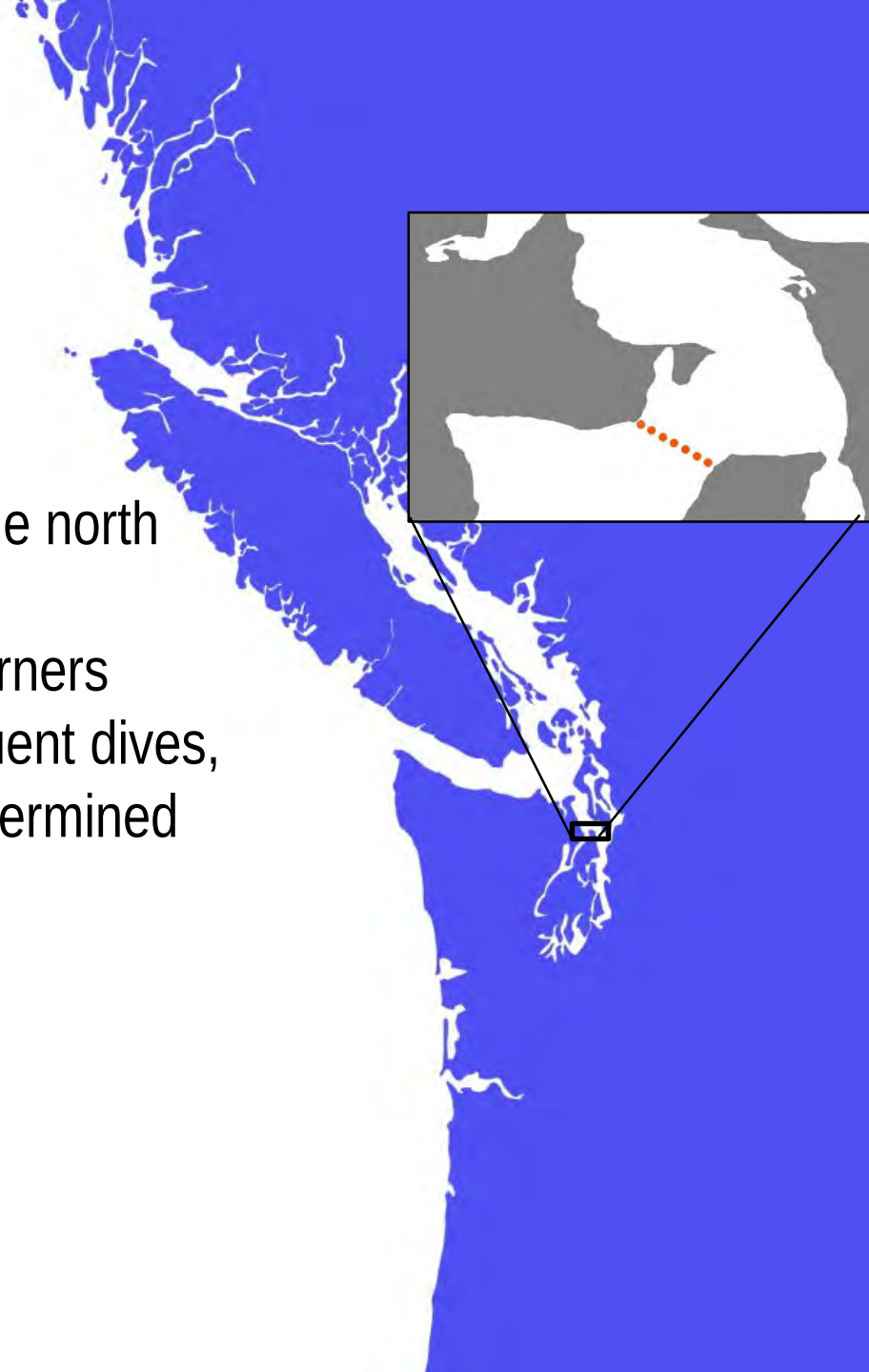
	Non-survivor	Survivor
Depth tags detected at HCB	16	11
Max depth range	25-38 (tag max)	16
Number with max depth =/> 37 m	15	0

Preliminary conclusions:

- Survival between HCB and TS estimated at 50%
- Travel time is delayed by 1-2 days on average
- Mortality locations are more concentrated on the south side than the north side, and distributed along entire length
- Surviving fish density and predators concentrated near pontoon corners
- Steelhead migrate at the surface, predators display deep and frequent dives, which allow predation location and possibly predator type to be determined

Future plan:

- More data analysis, especially 2018 data
- Propose phase II: test solutions



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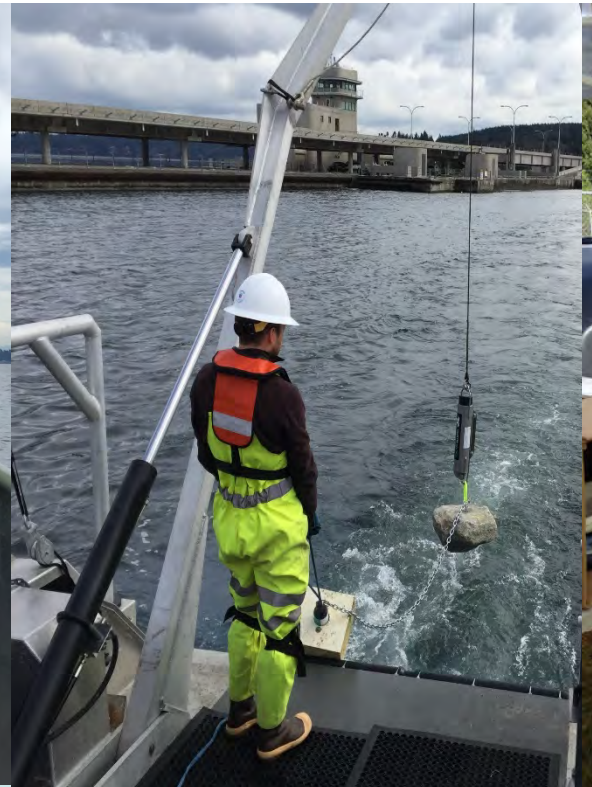
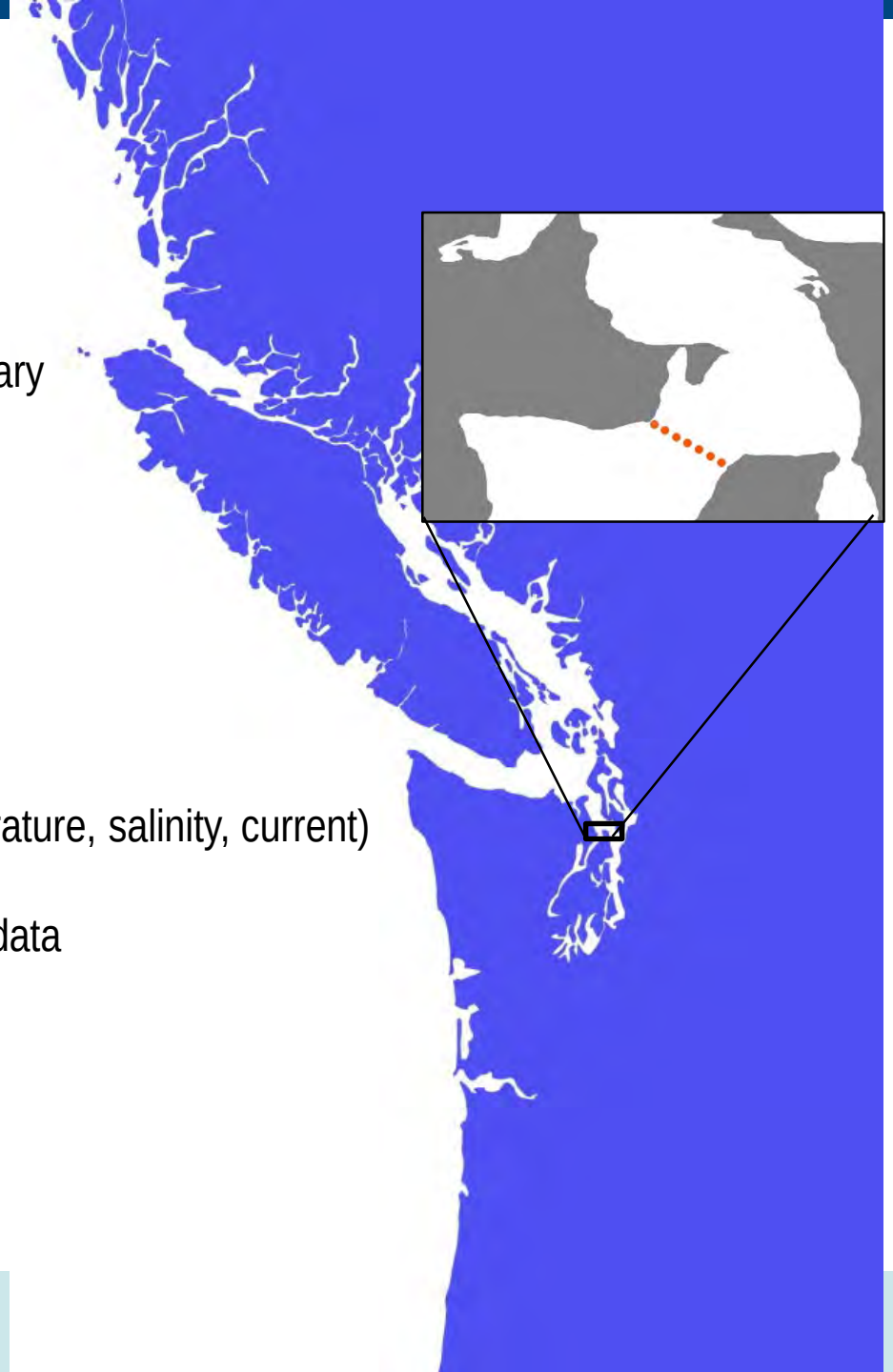


Still need to finish….

- Logistic regression for 2018
- ID and map stationary tags using VPS data
- Density maps of non-survivor tags without stationary detections
- Predation locations
- Animations

Then Synthesis:

- Model of fish habitat variable preferences (temperature, salinity, current)
- Overlap analysis with predator survey data
- NetCDF file raster images – overlay fish location data
- Sync fish location data with hydro-acoustic data