Using an underwater glider to detect acoustically-tagged green sturgeon (and Chinook salmon)

John A. Barth[1], Mary Moser[2], Steve Corbett[2], Daniel Erickson[3], Stephen D. Pierce[1], and Anatoli Erofeev[1]

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[3]Ocean Associates Inc., Seattle, WA, U.S.A.

Photo by Ata Suanda

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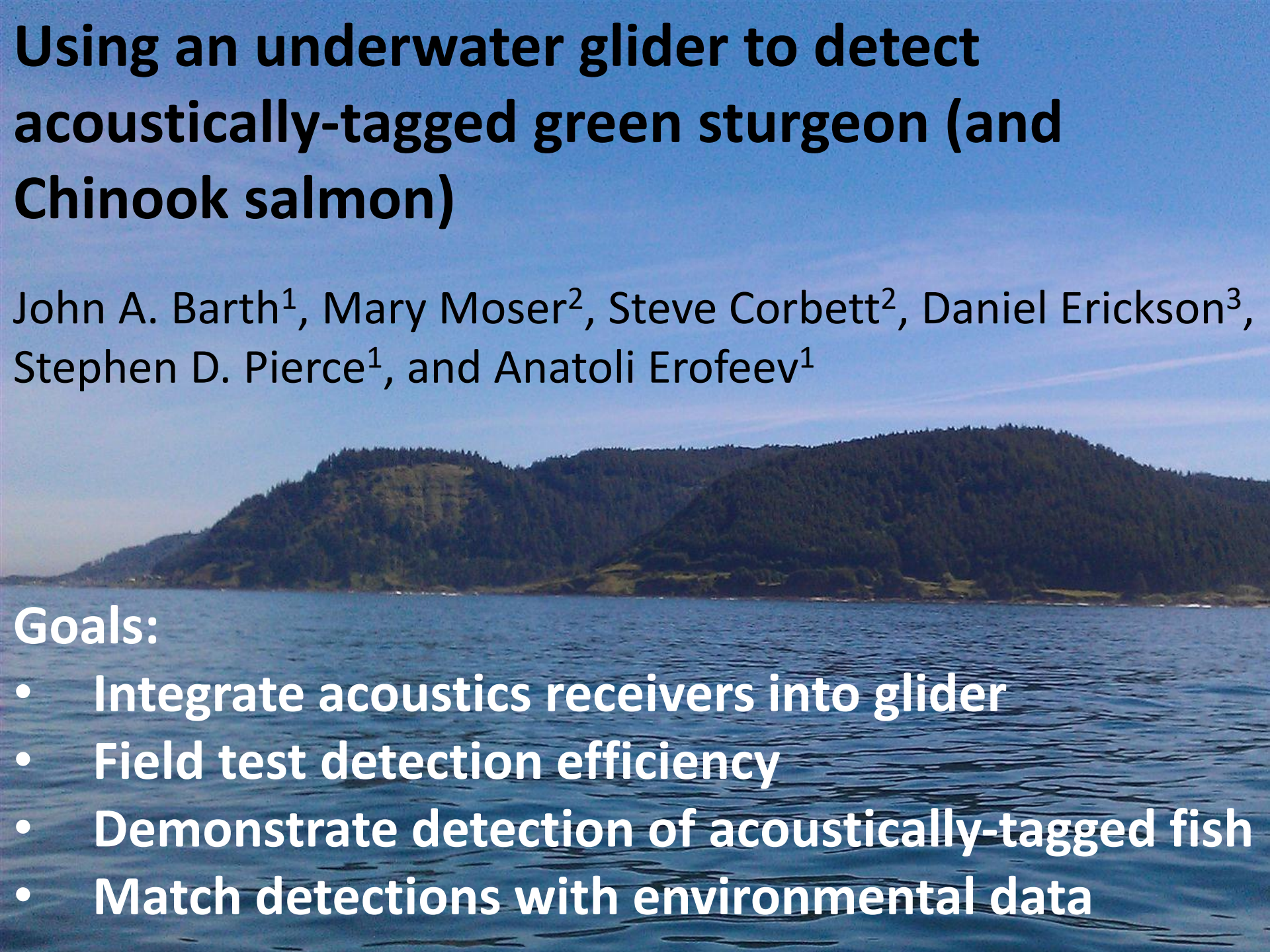


Goals:

- **Integrate acoustics receivers into glider**
- **Field test detection efficiency**
- **Demonstrate detection of acoustically-tagged fish**
- **Match detections with environmental data**

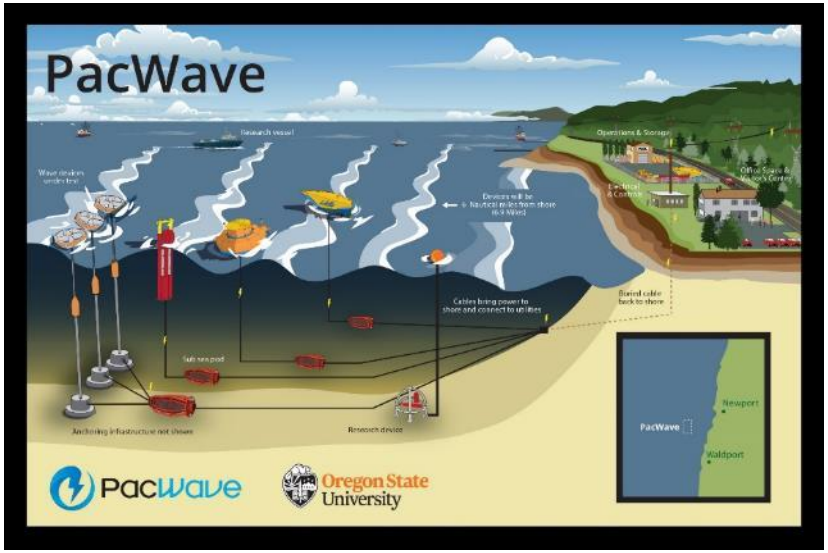
Essential Ocean Variables (EOVs)

PHYSICS	BIOGEOCHEMISTRY	BIOLOGY AND ECOSYSTEMS
Sea state	Oxygen	Phytoplankton biomass and diversity
Ocean surface stress	Nutrients	Zooplankton biomass and diversity
Sea ice	Inorganic carbon	Fish abundance and distribution
Sea surface height	Transient tracers	Marine turtles, birds, mammals abundance and distribution
Sea surface temperature	Particulate matter	Hard coral cover and composition
Subsurface temperature	Nitrous oxide	Seagrass cover and composition
Surface currents	Stable carbon isotopes	Macroalgal canopy cover and composition
Subsurface currents	Dissolved organic carbon	Mangrove cover and composition
Sea surface salinity		Microbe biomass and diversity (*emerging)
Subsurface salinity		Invertebrate abundance and distribution (*emerging)
Ocean surface heat flux		
CROSS-DISCIPLINARY		
Ocean colour	Ocean Sound	

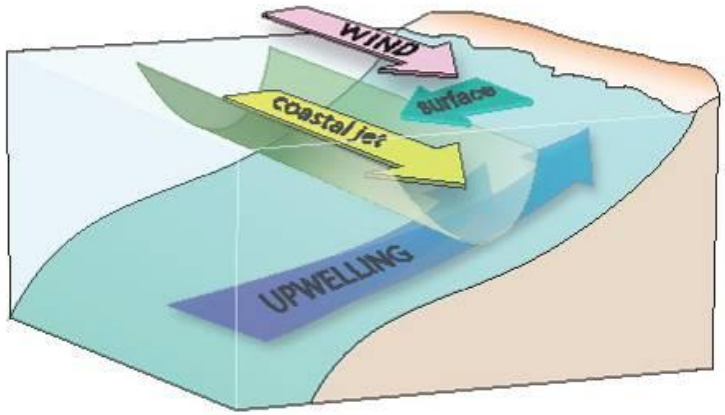
Green sturgeon (*Acipenser medirostris*) are threatened under the U. S. Endangered Species Act

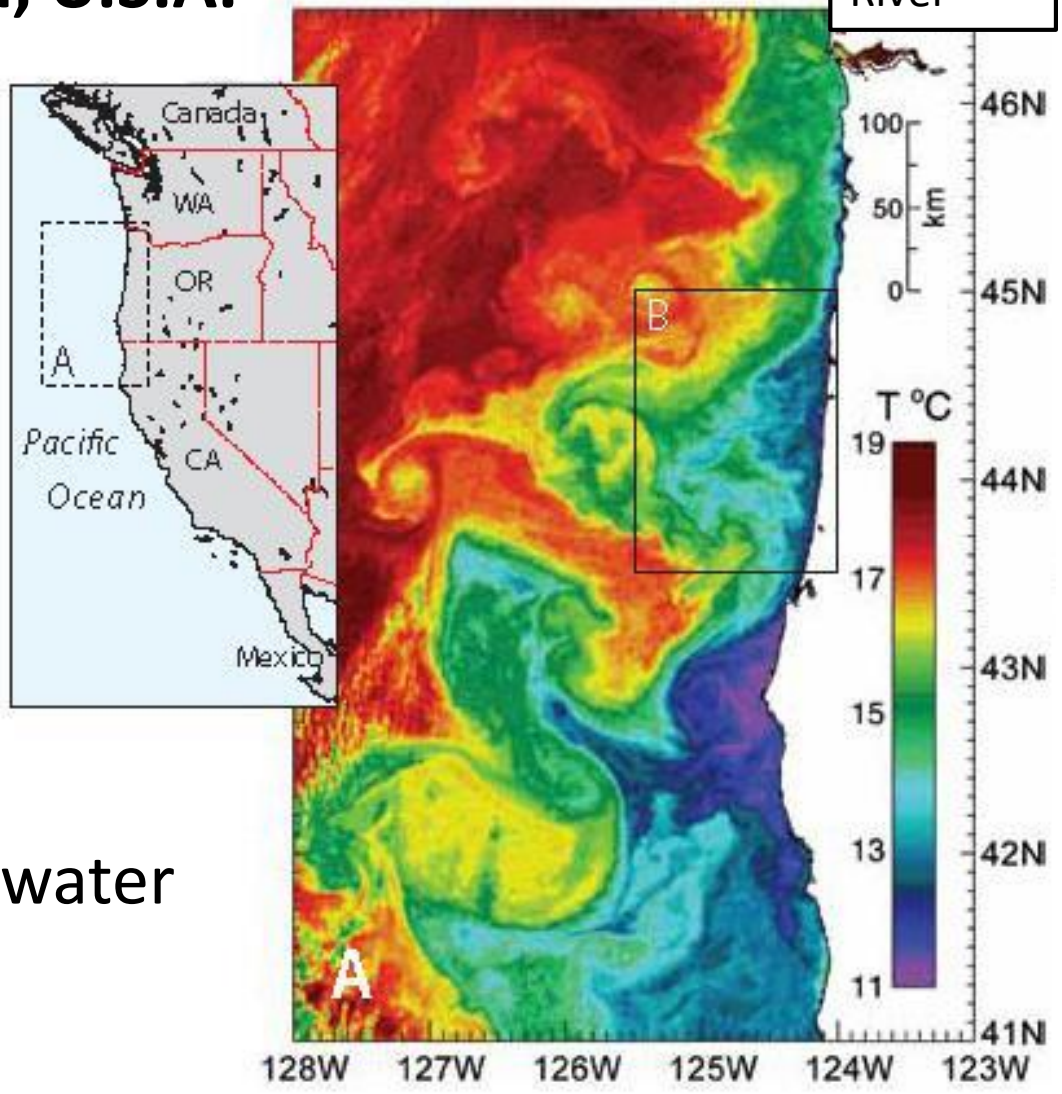
- Olive green to dark green back with yellowish green-white belly
- Green stripe on each side and on belly
- Pointed snout with barbels midway between the tip of the snout and mouth
- Vent is located *between* the pelvic fins
- 8-11 sharp dorsal scutes

Potential conflict with new uses of the coastal ocean like renewable marine energy



Study region is off Oregon, U.S.A.

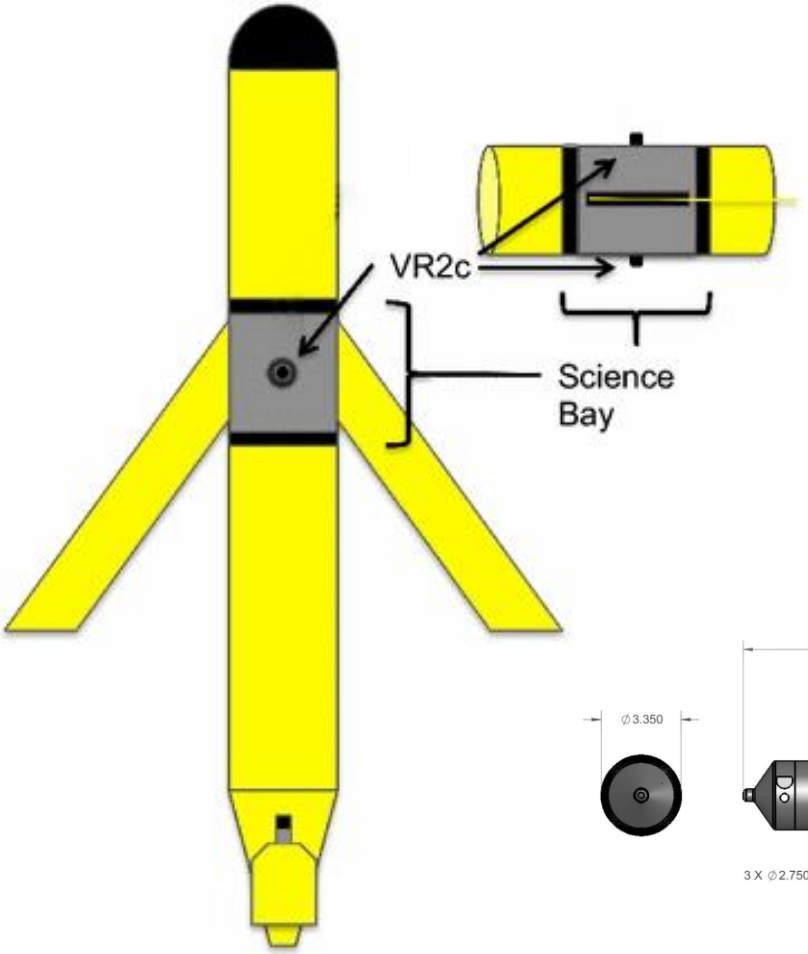


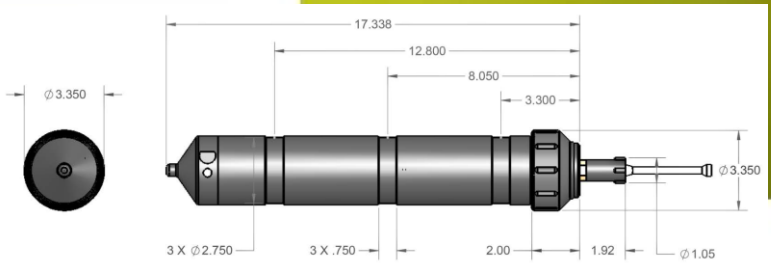


- coastal upwelling zone during summer
- cold, salty, low-oxygen water upwelled onto shelf

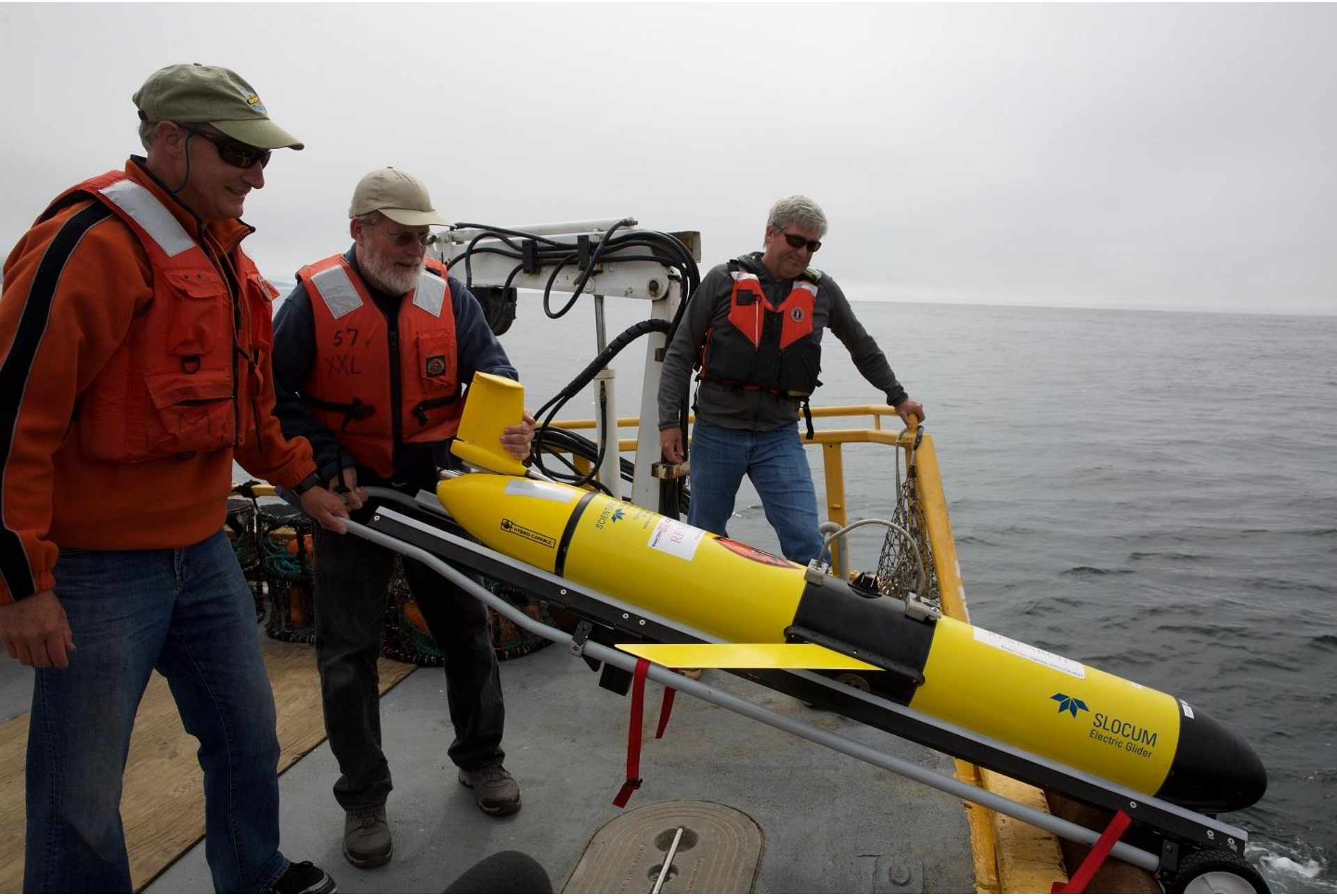
- Columbia River water flows south in summer at surface; north in winter

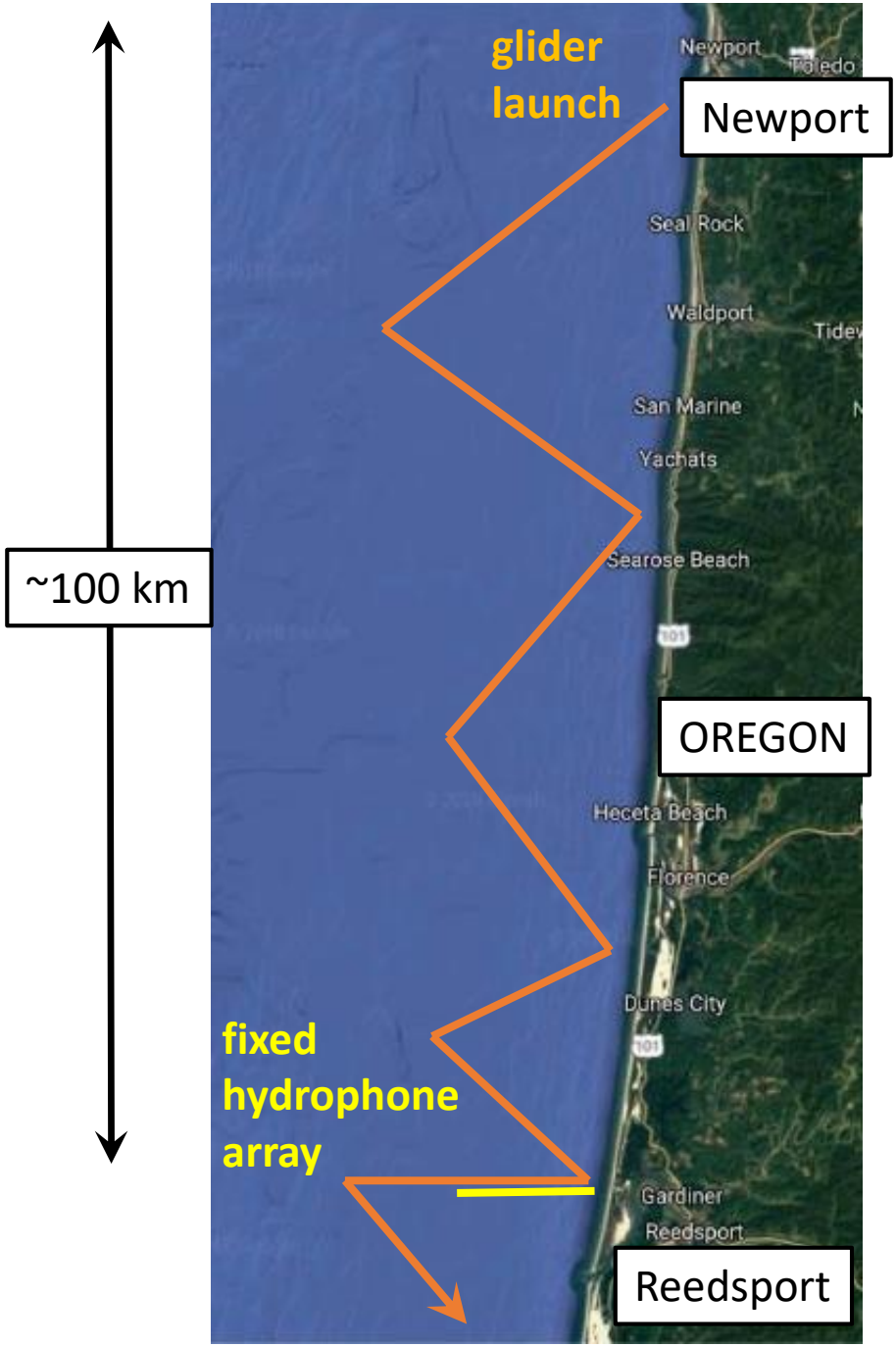
VEMCO hydrophones (69 kHz) on TWR 200-m underwater glider



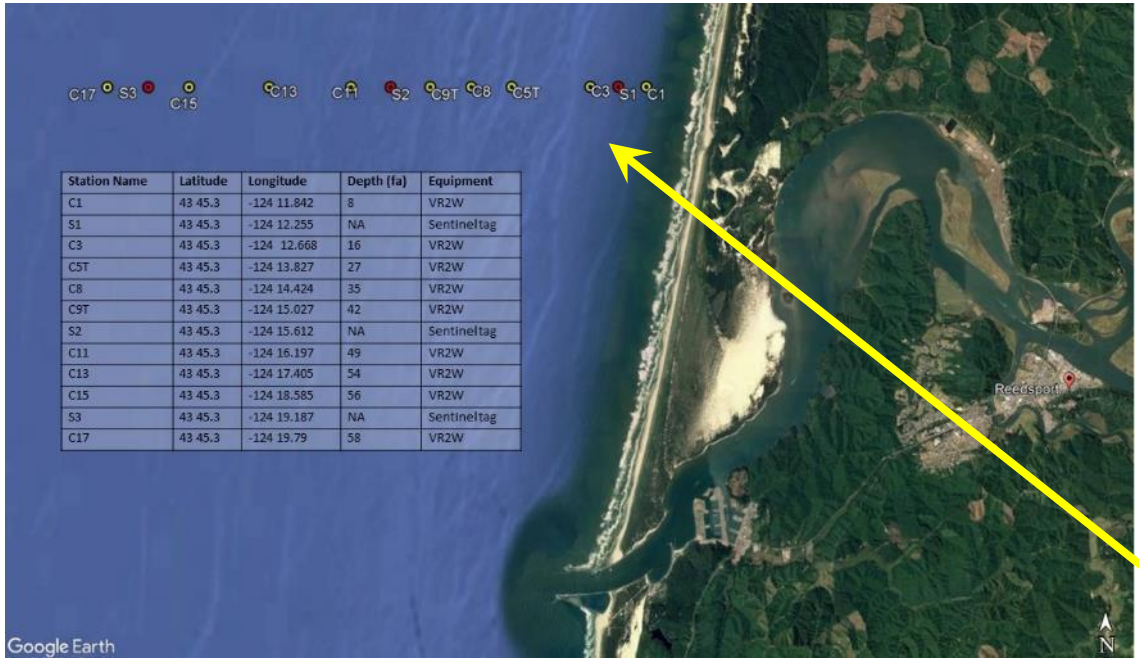


From Oliver et al. (2017)


SLOCUM
Electric Glider


glider launch
Newport
Toledo
Newport
Seal Rock
Waldport
San Marine
Yachats
Searose Beach
101
OREGON
Heceta Beach
Florence
Dunes City
101
fixed hydrophone array
Gardiner
Reedsport
Reedsport
~100 km

Cross-shore fixed array of hydrophones



Station Name	Latitude	Longitude	Depth (fa)	Equipment
C1	43 45.3	-124 11.842	8	VR2W
S1	43 45.3	-124 12.255	NA	Sentineltag
C3	43 45.3	-124 12.668	16	VR2W
C5T	43 45.3	-124 13.827	27	VR2W
C8	43 45.3	-124 14.424	35	VR2W
C9T	43 45.3	-124 15.027	42	VR2W
S2	43 45.3	-124 15.612	NA	Sentineltag
C11	43 45.3	-124 16.197	49	VR2W
C13	43 45.3	-124 17.405	54	VR2W
C15	43 45.3	-124 18.585	56	VR2W
S3	43 45.3	-124 19.187	NA	Sentineltag
C17	43 45.3	-124 19.79	58	VR2W

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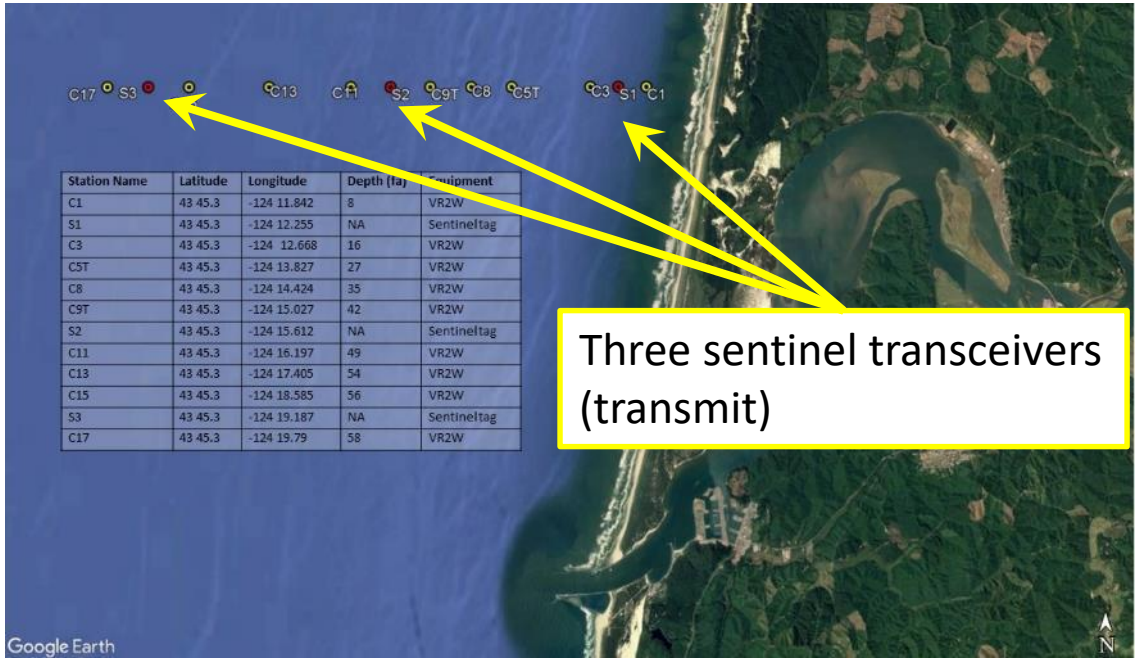
Cross-shore fixed array of hydrophones



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Three sentinel transceivers (transmit)

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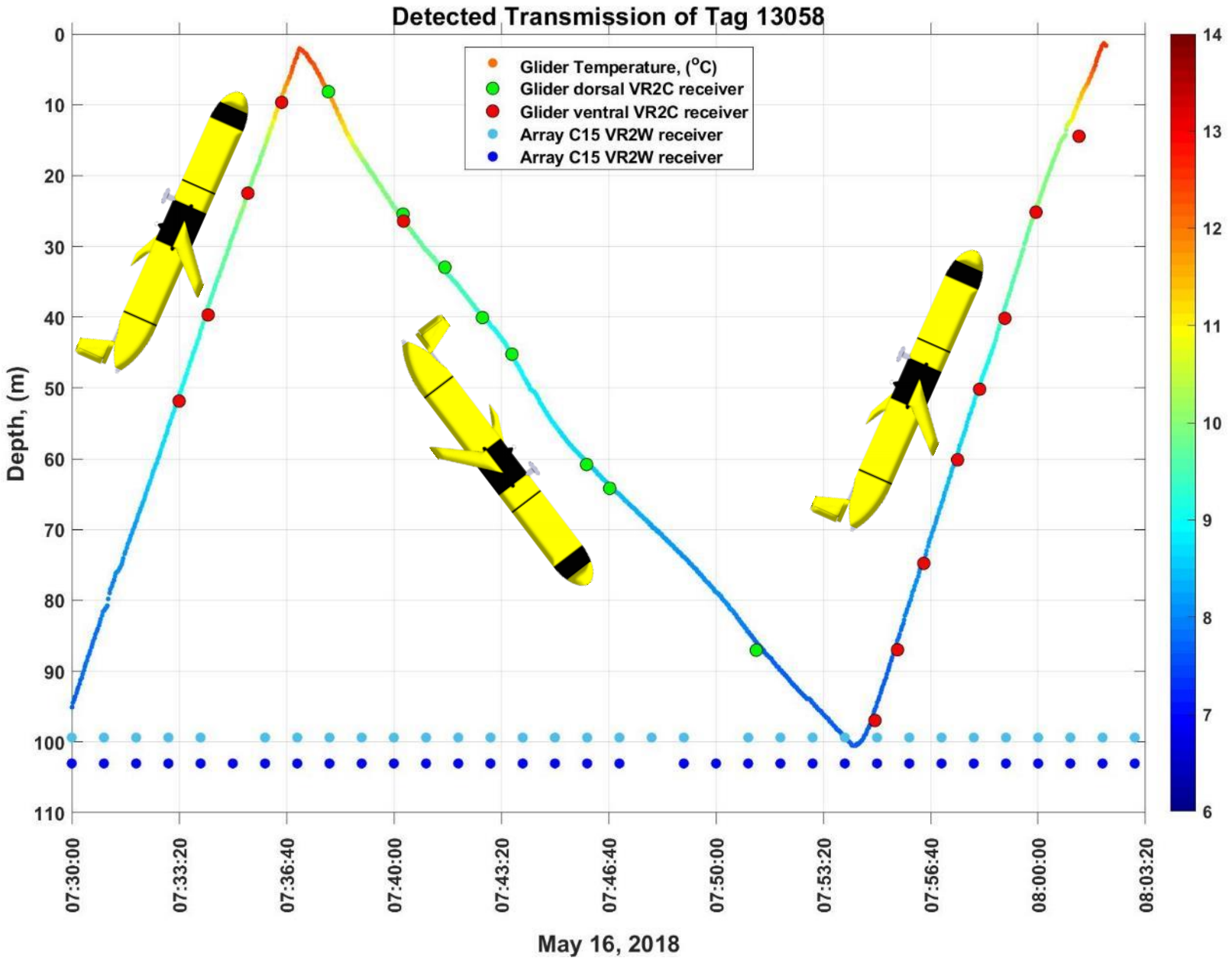
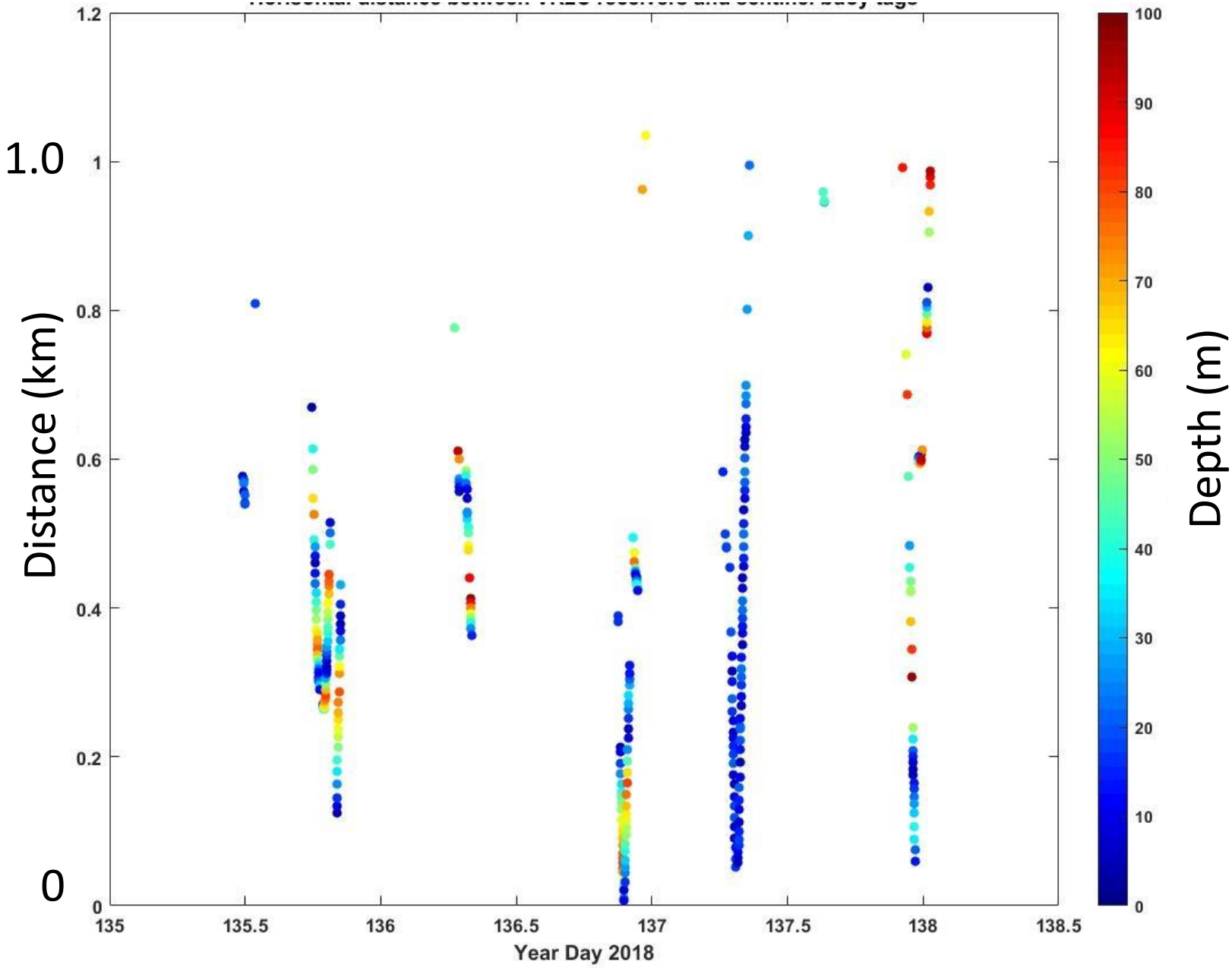
dorsal receiver

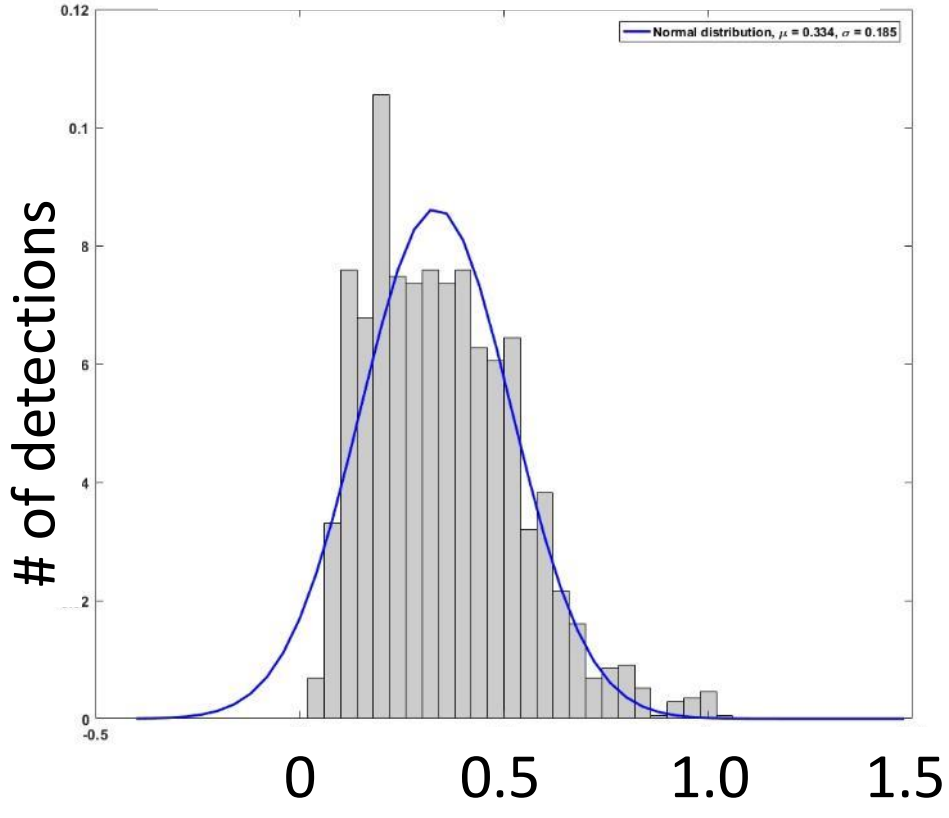
ventral receiver



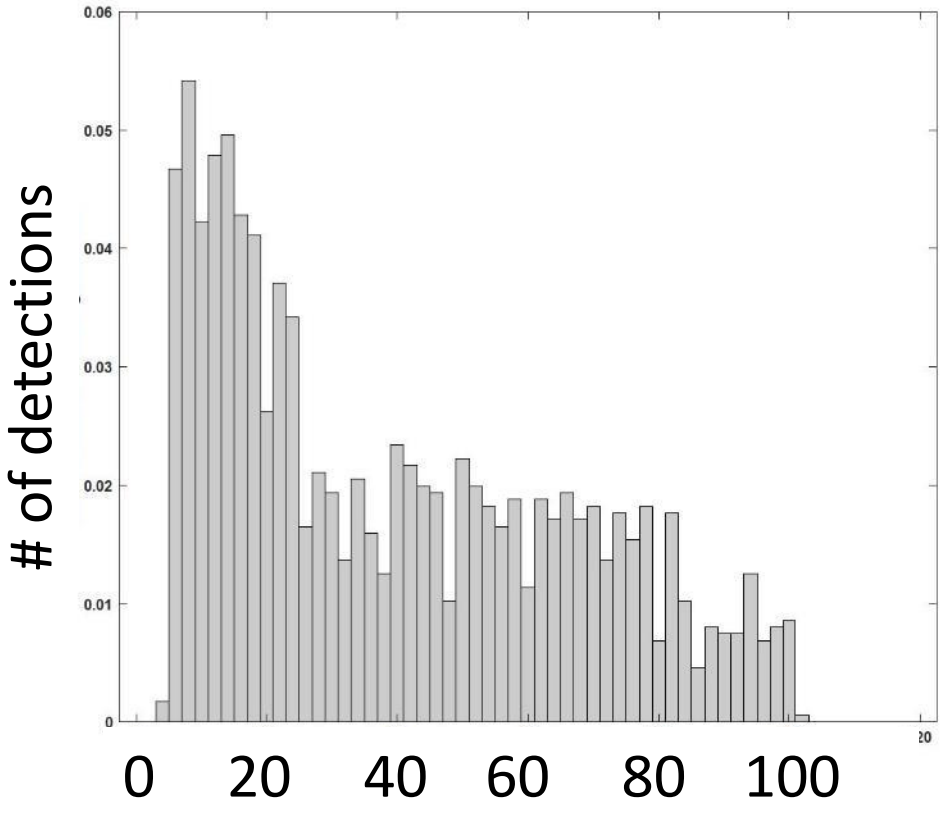
Horizontal distance between glider VR2C receiver and sentinel tags

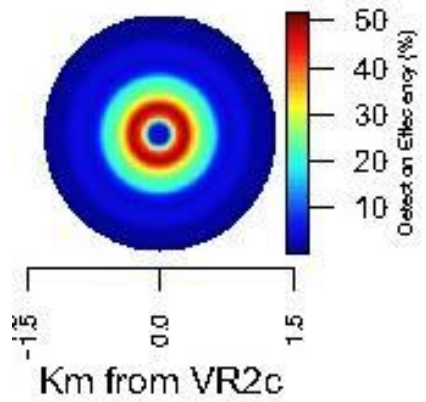


Distance (km) from glider VR2C to sentinel tags



Glider depth (m) at detection

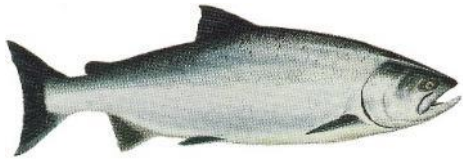




"Doughnut effect"
From Oliver et al. (2017)

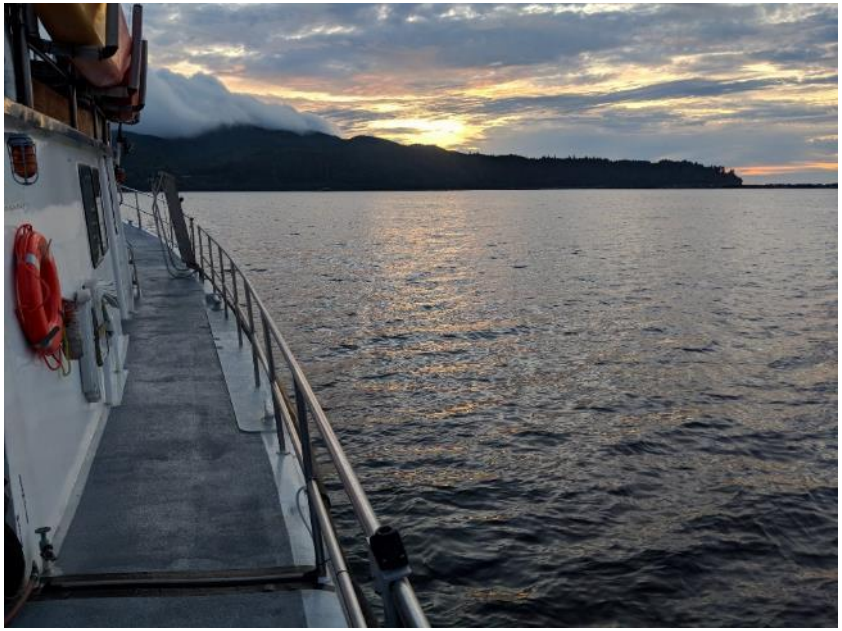
Tracking Chinook & coho salmon and bull trout off Washington

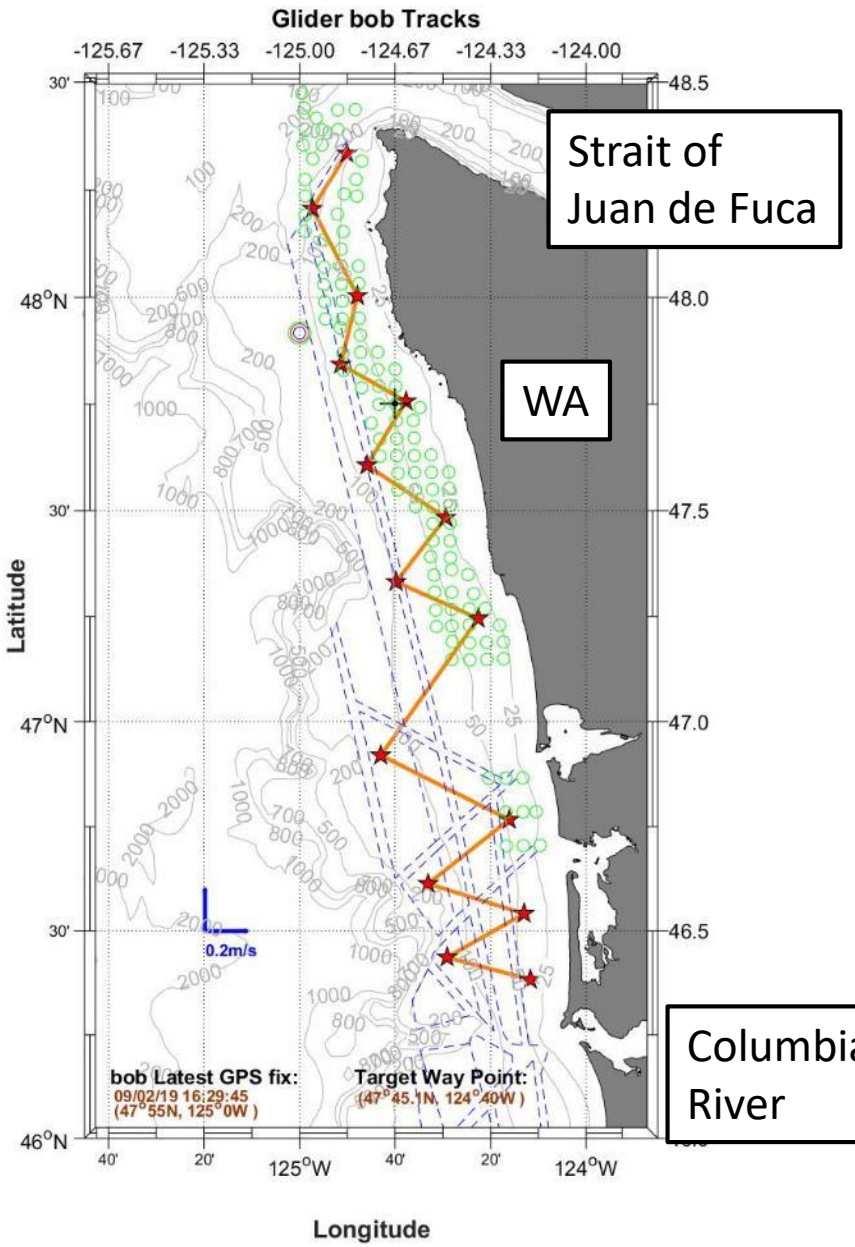
September 2019



With David Huff and Joe Smith (NOAA, NWFSC)

107 fixed receivers (in green)





Summary

- Acoustic tag detection from gliders works
  - 0.2-1 km detection range
  - Near-bottom dwelling (green sturgeon) and upper-water column dwelling (Chinook salmon)
- Glider data on water column habitat can aid interpretation of fish locations
  - Dissolved oxygen
  - Fresh, swift Columbia River plume
- Next steps: run more missions

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Oregon State University

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