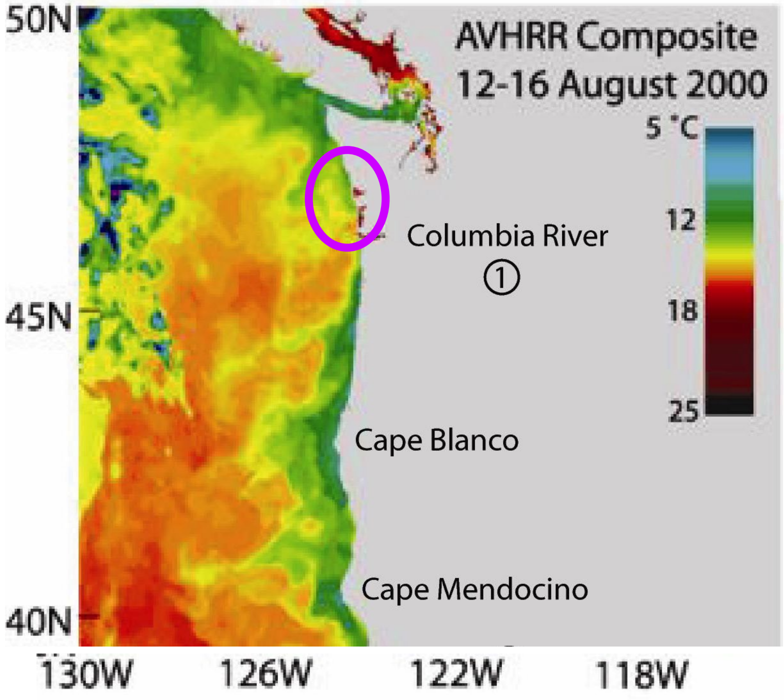
Using (Passive and) Active Acoustics from an Underwater Glider over the Pacific Northwest Continental Shelf



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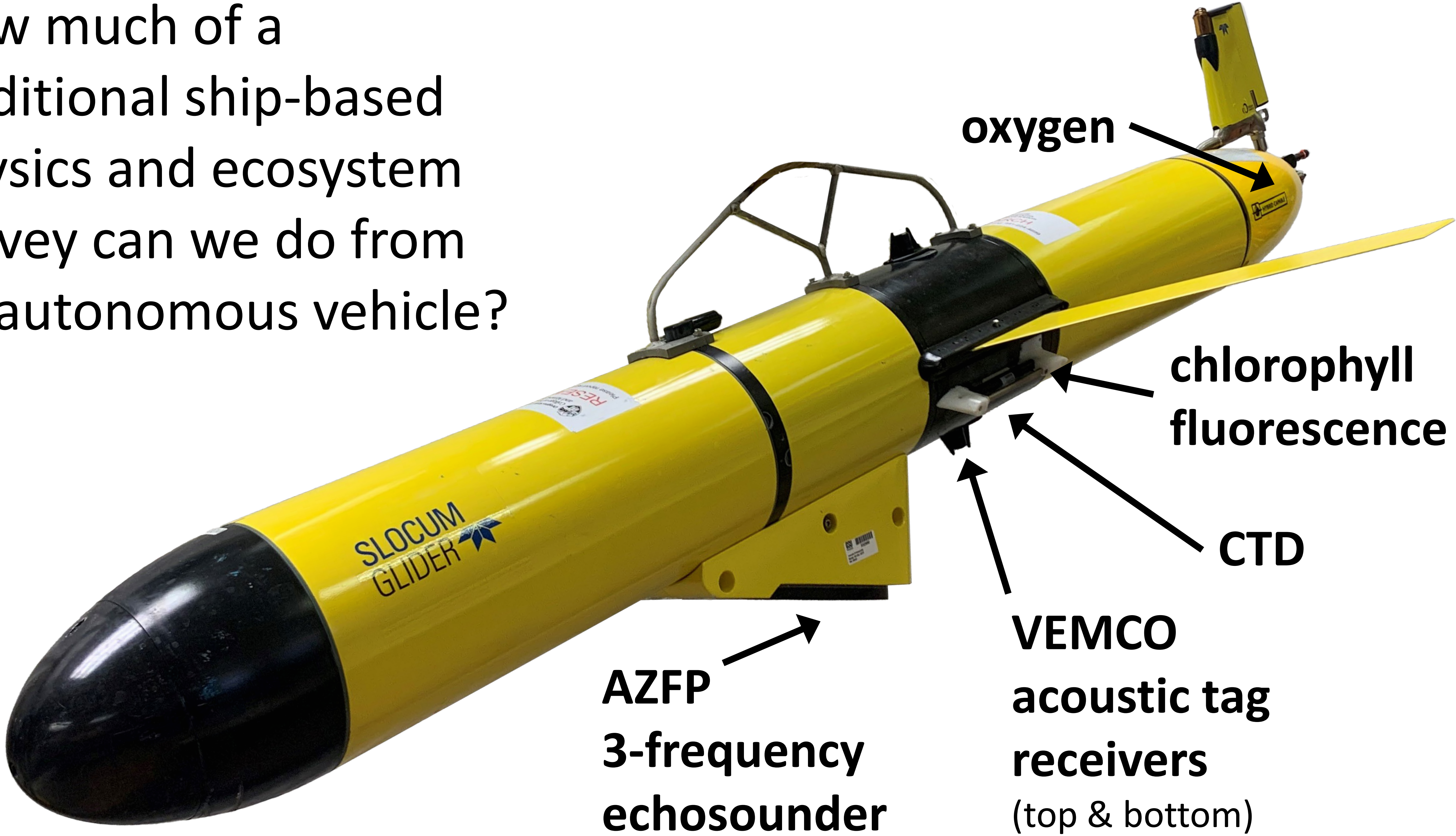
Oregon State University

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE NOAA

NANOOS | Northwest Association of Networked Ocean Observing Systems

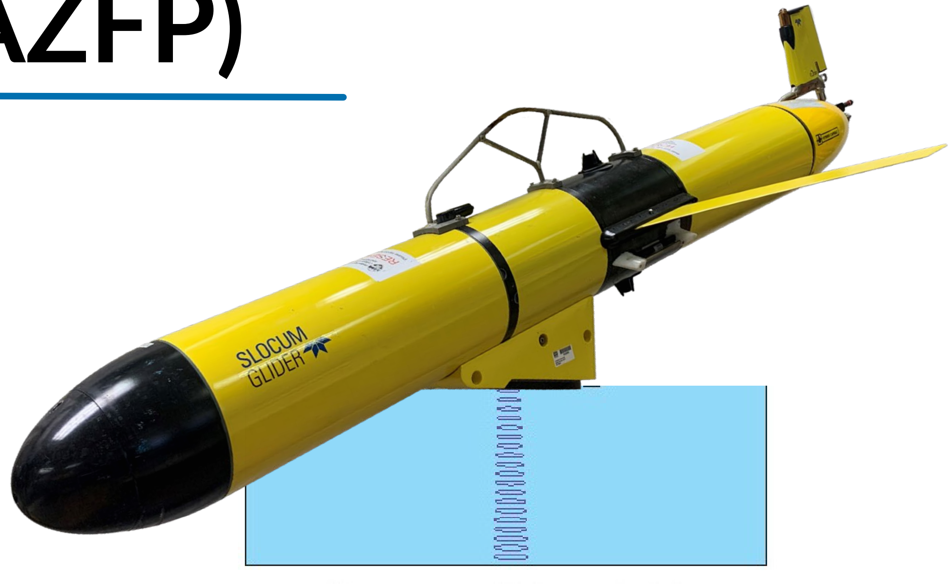
How much of a traditional ship-based physics and ecosystem survey can we do from an autonomous vehicle?



Active acoustics using ASL Acoustic Zooplankton and Fish Profiler (AZFP)

ASL Environmental Sciences

- 67-, 120- and 200-kHz
- Sample on dive only
- 5 second ping Interval
- 330-350 µs pulse length
- 67.5 kHz: 17° beam width
  125 & 200 kHz: 7° beam width



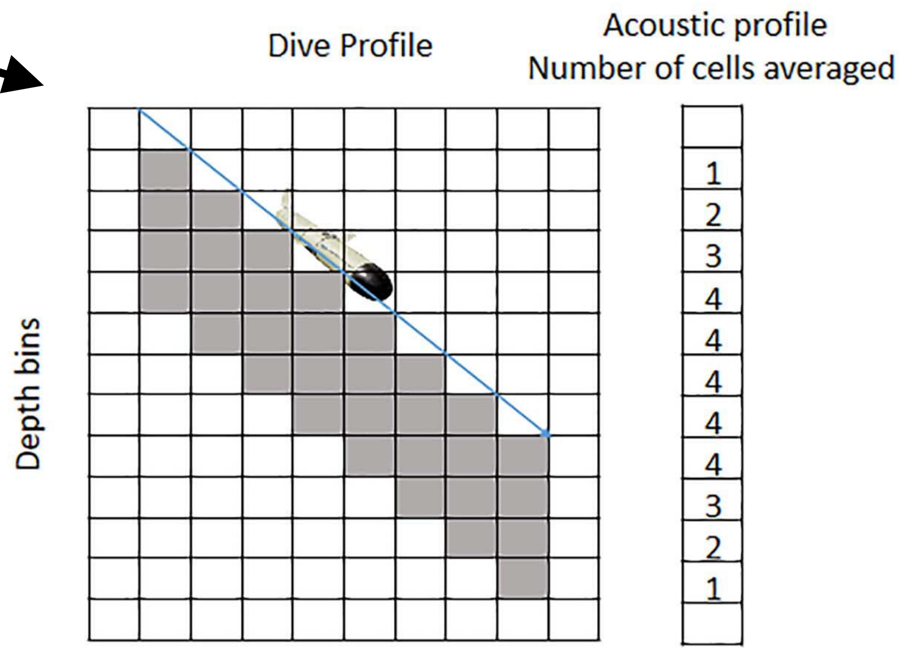
OSU Glider Team:
Anatoli Erofeev
Steve Pierce
Undergrad and grad student volunteers

Angelina Lopez

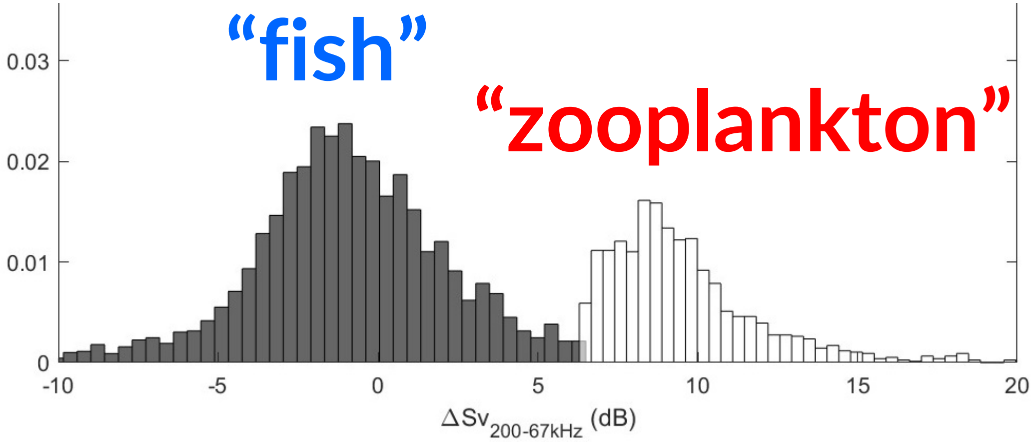
Data processing

https://echopype.readthedocs.io/en/stable/

- *echopype* for converting raw ASL data using python (Lee, Wu-Jung et al., 2021)
- 1-m bin-averaging (Reiss et al., 2021)



- Frequency difference (200-67 kHz) (e.g., Sato et al., 2018)

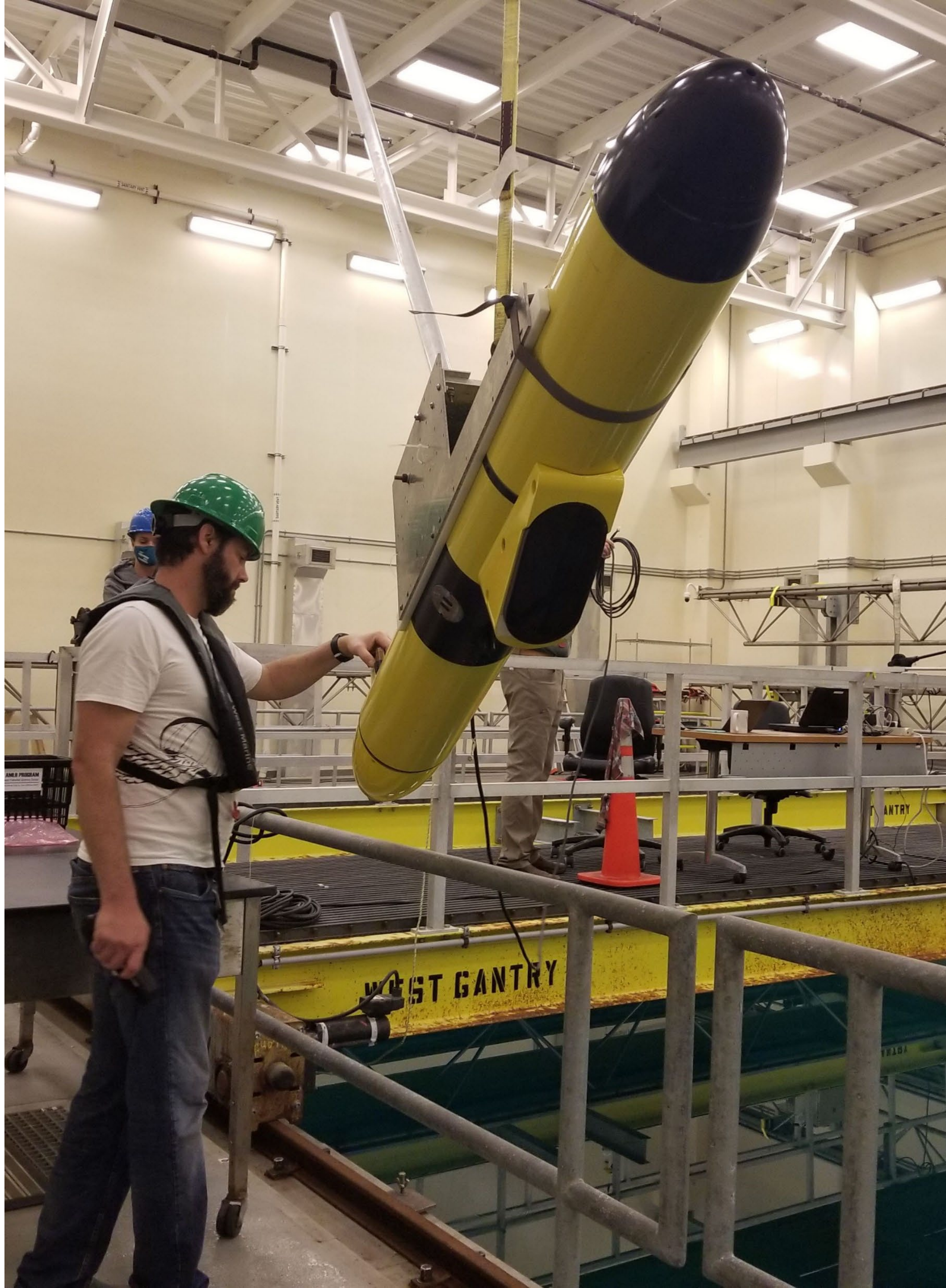


Calibration

- in the lab at NOAA’s Southwest Fisheries Science Center

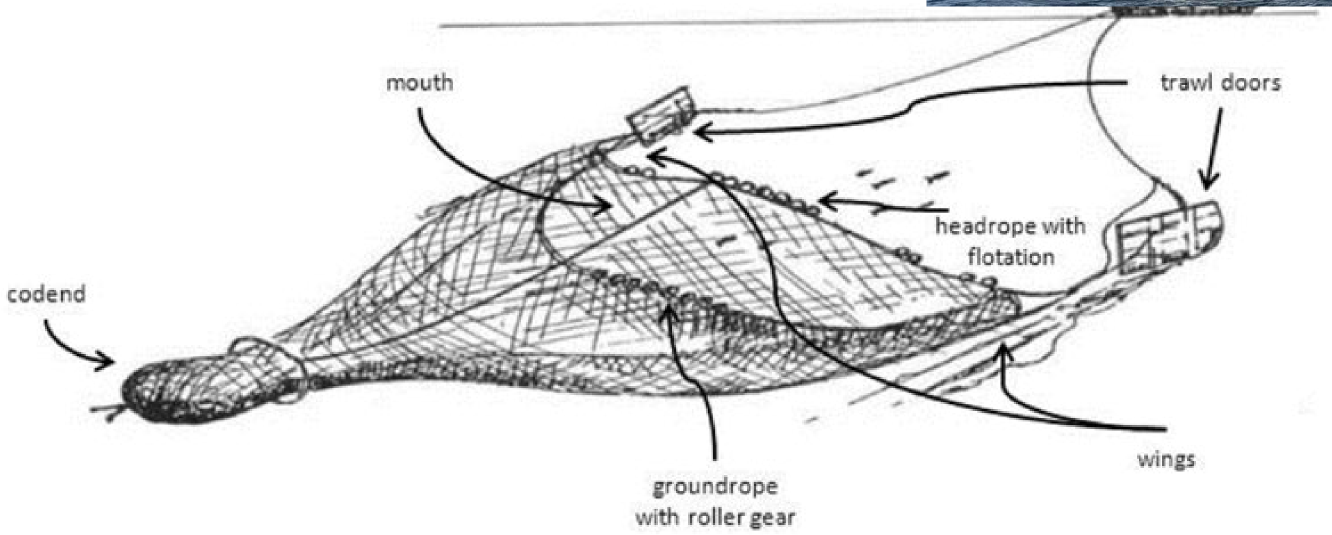
  (thanks Christian Reiss and Tony Cossio)

- In the field alongside NOAA’s *FSV Bell M. Shimada*



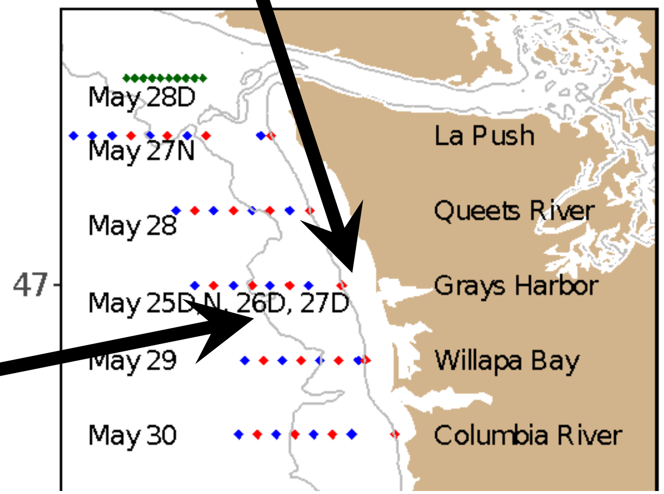
Trawling: *FSV Bell M. Shimada*

Brian Wells and
David Huff, NOAA



15-minute midwater trawl
Headrope at 30-m

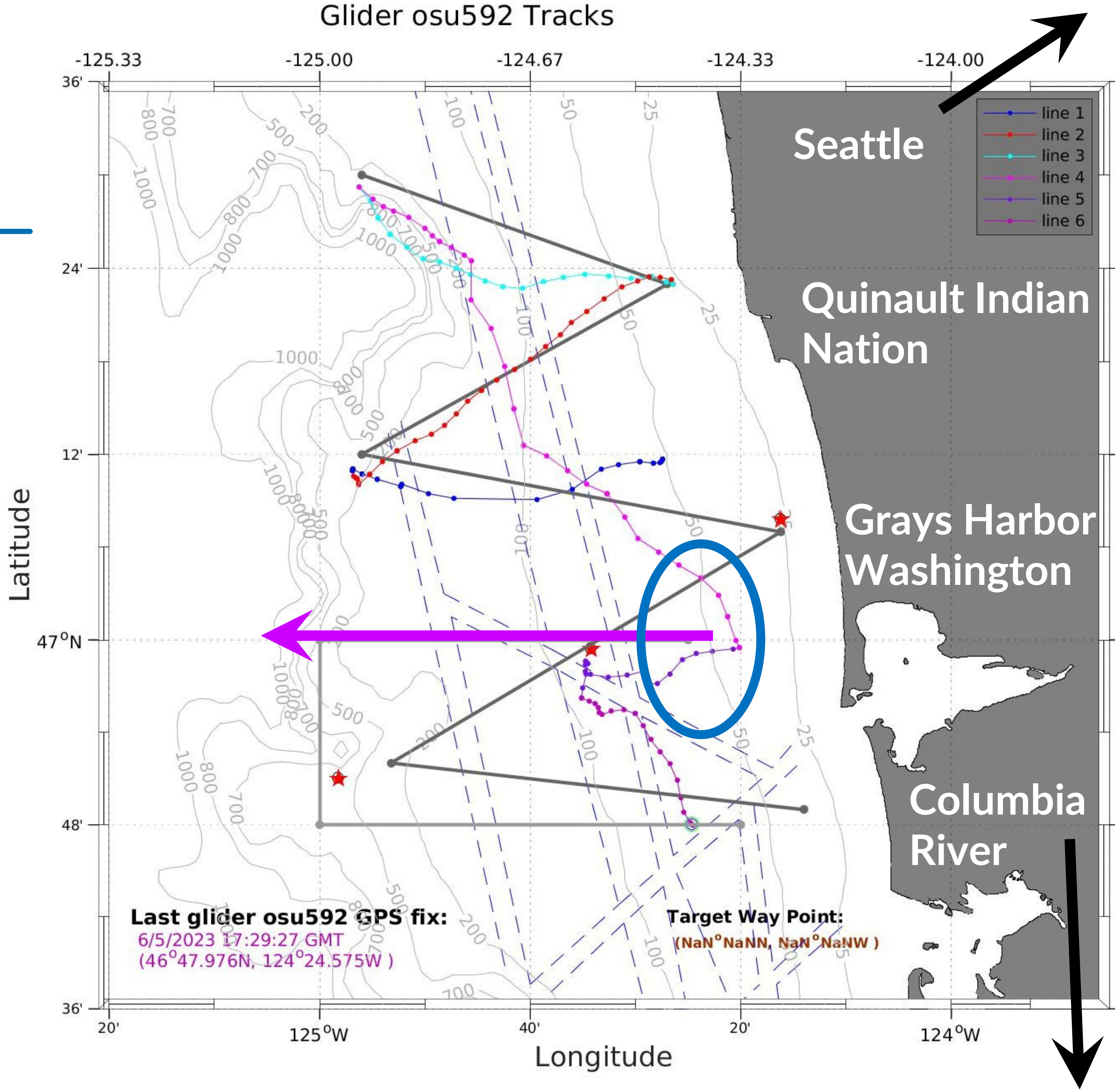
Allosmerus elongatus
whitebait smelt, 18-23 cm
Inshore of front (@50-m isobath)



Euphausiids
krill 1-2.5 cm
offshore of front
(@150-m isobath)

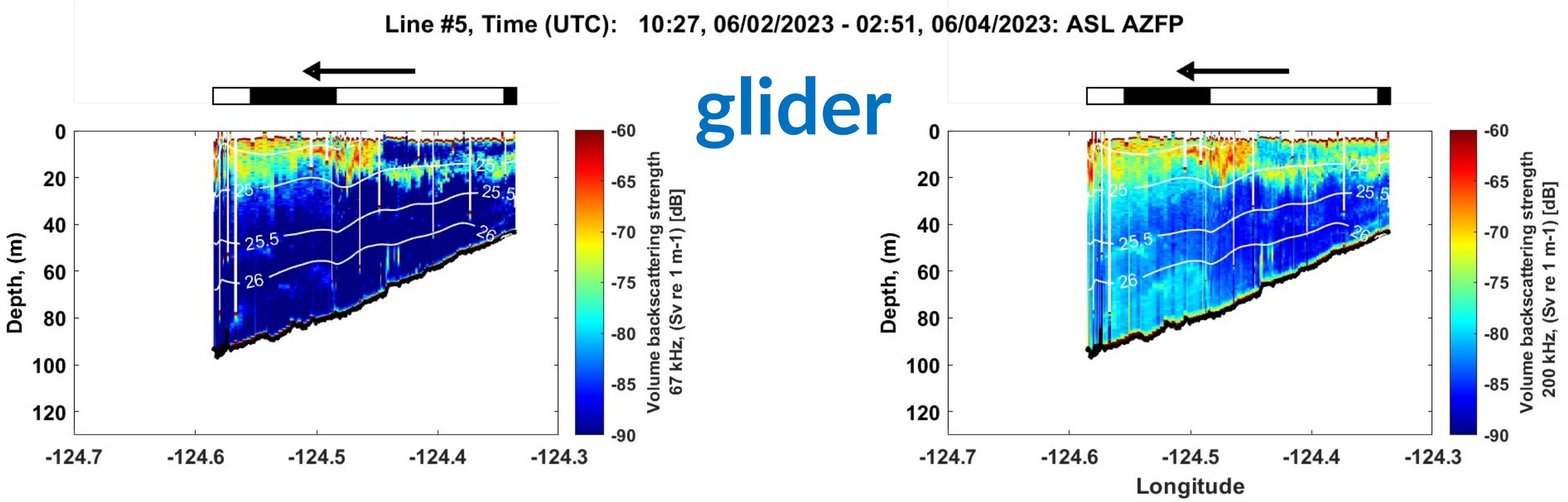
Mapping off the Washington coast

- *May 24 to June 5, 2023*
- *R/V Bell Shimada track*
- Area of glider-ship comparison

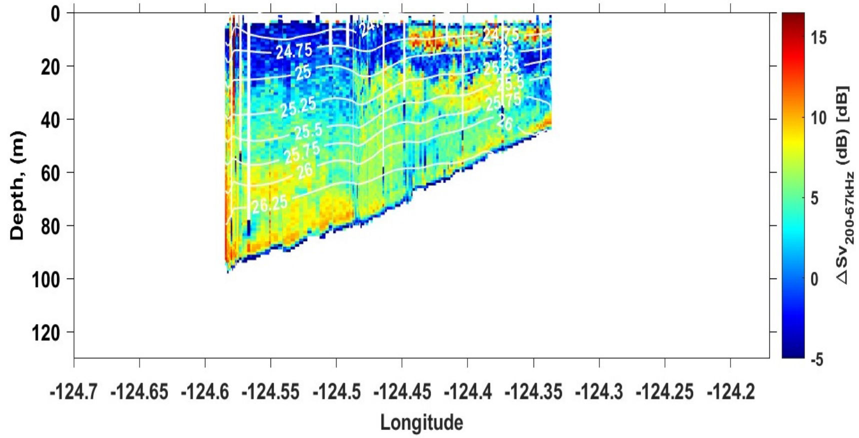


Frequency differencing using glider acoustics

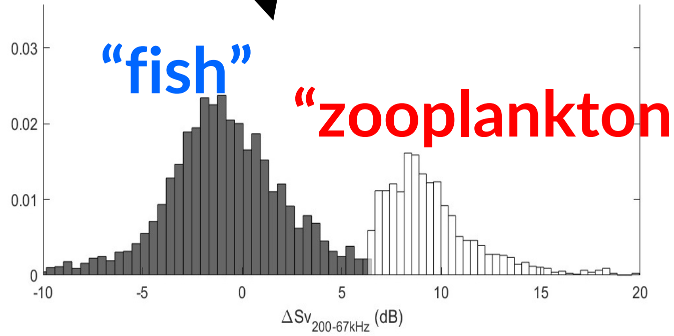
67-kHz **200-kHz**



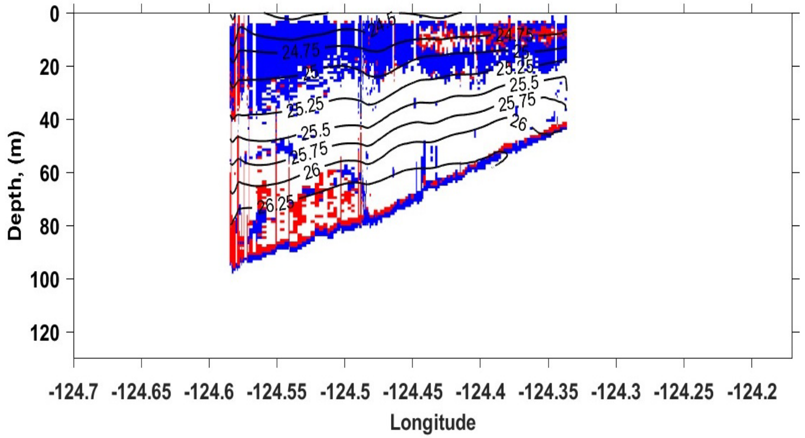
ΔSv (200-67 kHz)



use histogram to create mask

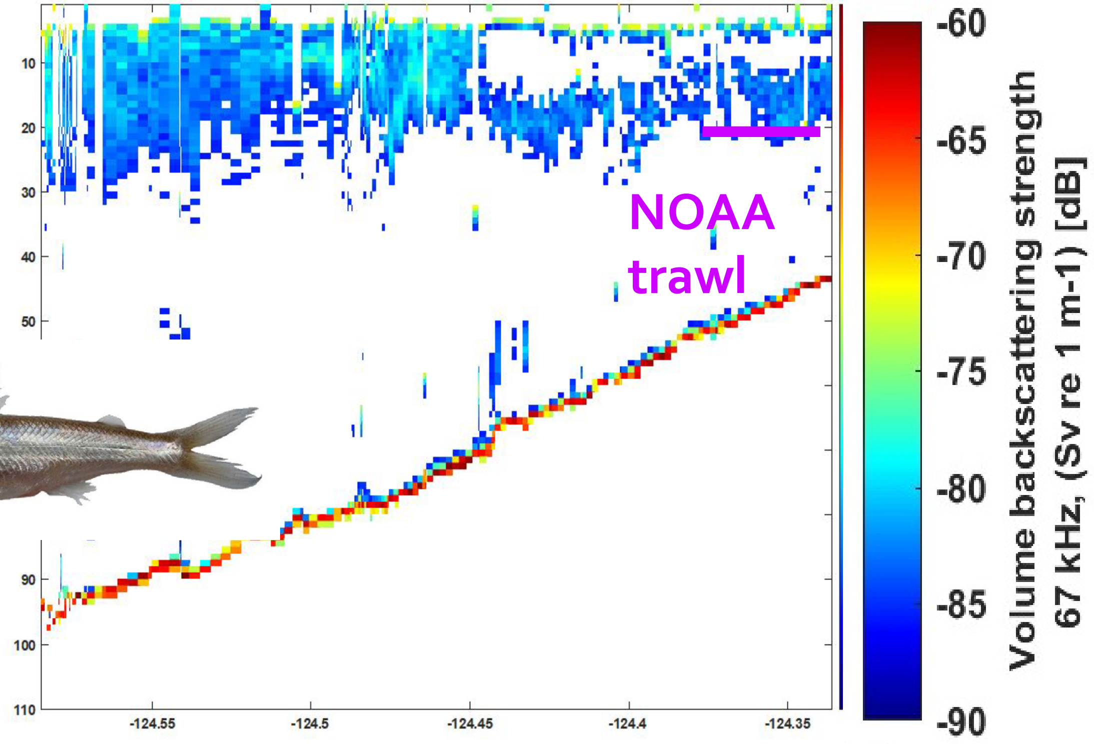


mask



Glider-based “fish” distributions

Sv 67-kHz with “fish” mask



whitebait
smelt

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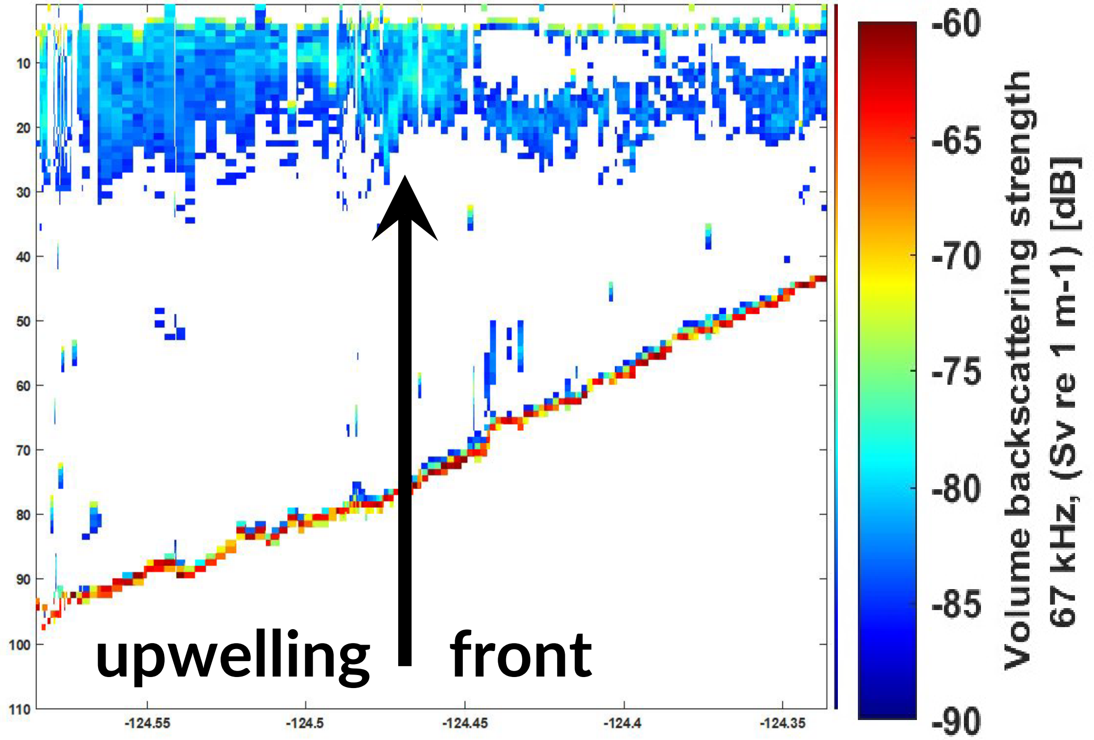
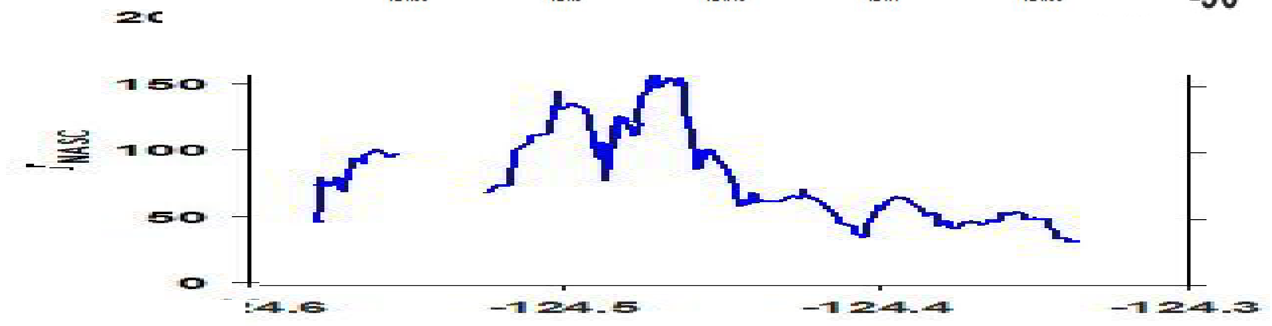
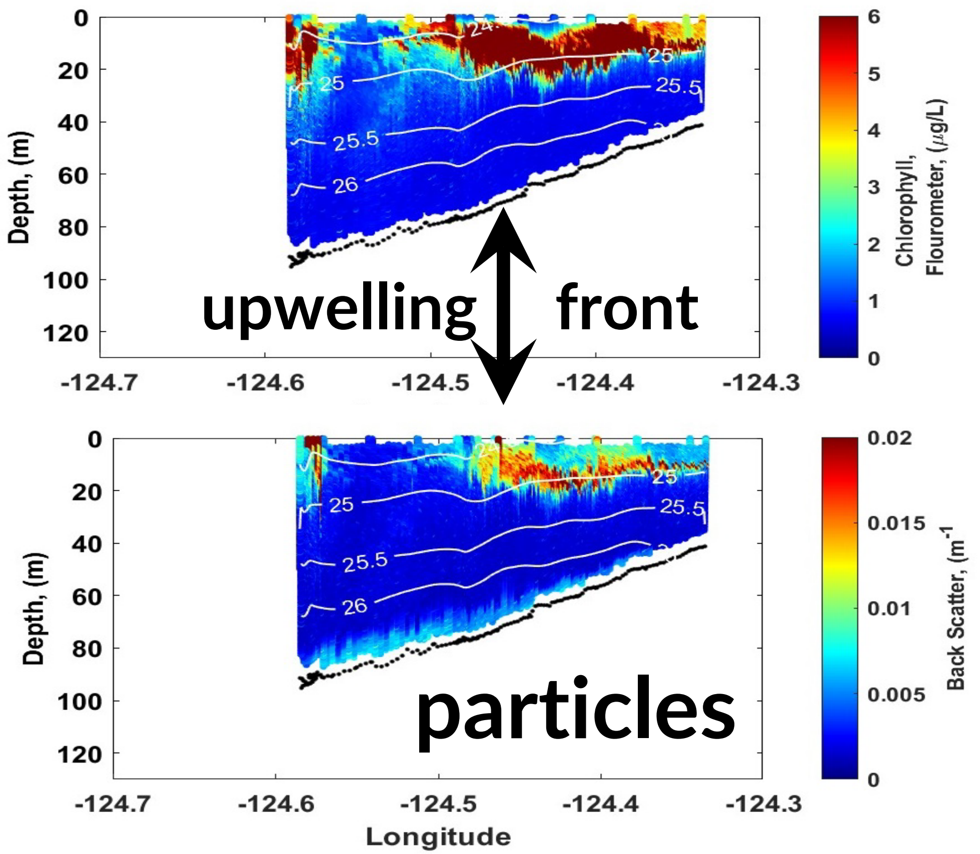


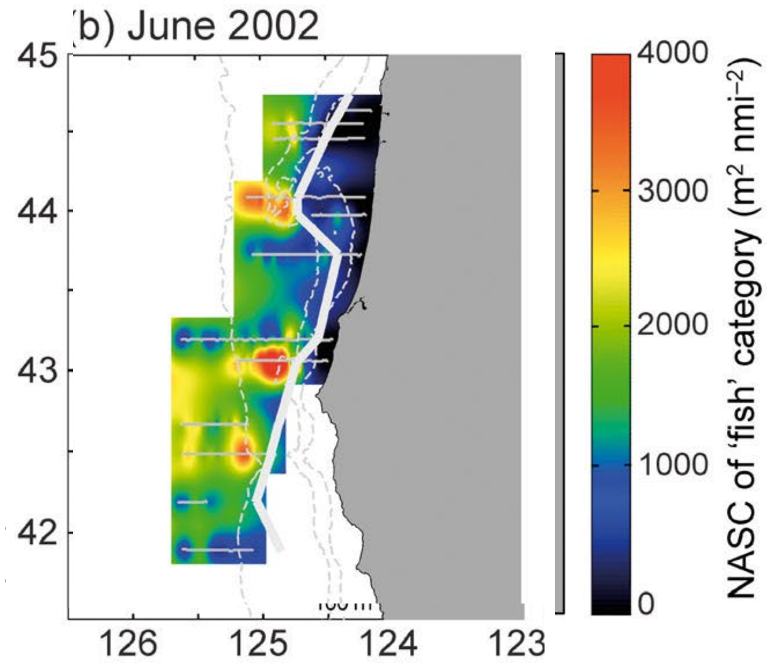


Chlorophyll fluorescence

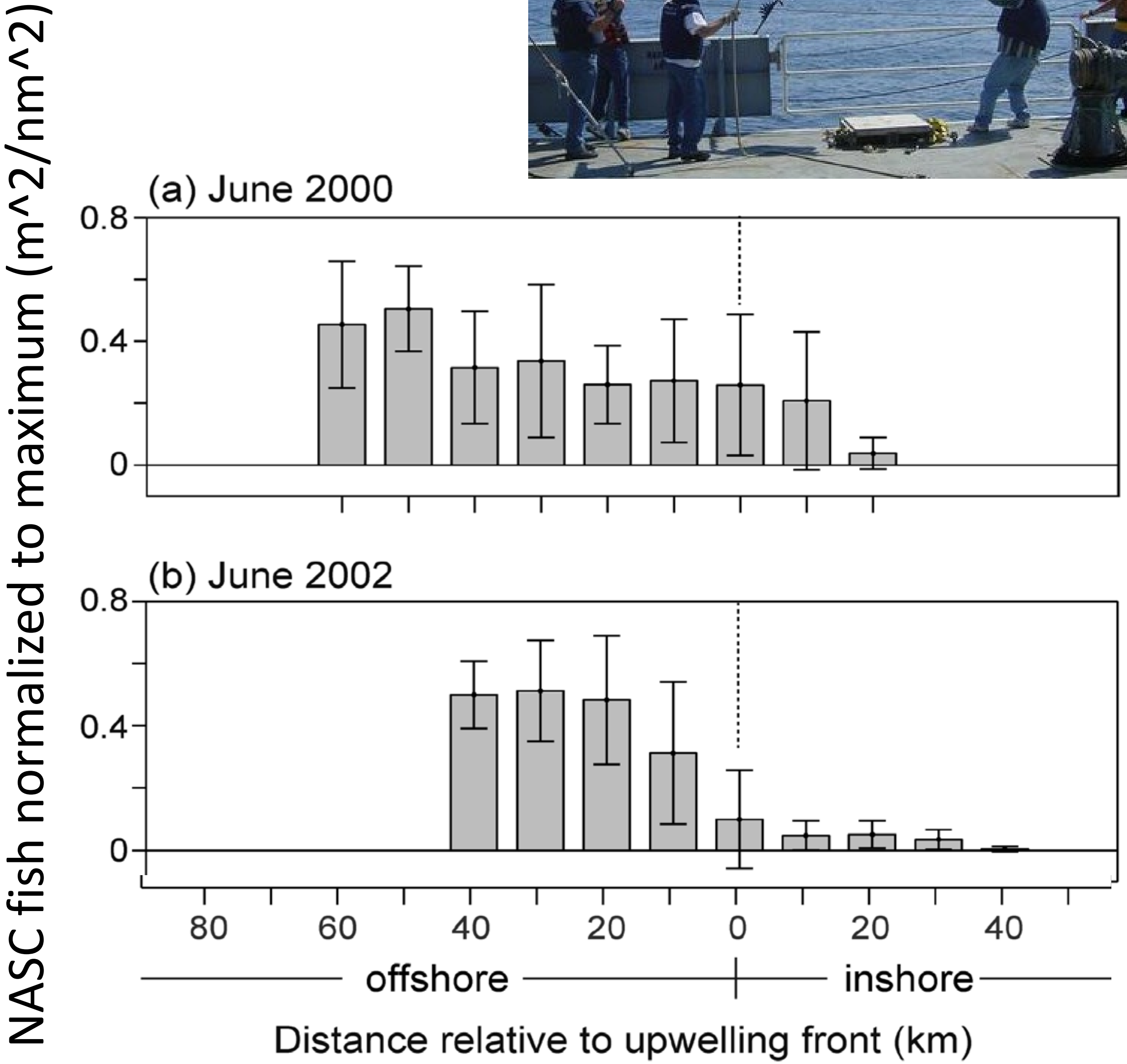


Maximum vertically integrated “fish” (NASC)

Compare with ship-based GLOBEC survey of northern California Current



Sato , Barth et al. (MEPS, 2018)



Summary and Next Steps

- 3-frequency active acoustics from autonomous underwater glider to map "fish" and "zooplankton"
- Comparison with ship-based acoustics helps verify glider-based results
- Nice to have trawl samples to identify targets!
- Day-night signals? (work underway by Otavio Mendes)
- Mapped "fish" and "zooplankton" hotspots in space
- Relate hotspots to oceanographic features

→ "Yes, we can use autonomous vehicles to map physics and ecosystem components simultaneously"