



Western Washington University
Western CEDAR

Salish Sea Ecosystem Conference

2022 Salish Sea Ecosystem Conference
(Online)

Apr 26th, 4:00 PM - 4:30 PM

Introducing a Different Kind of “Blob” in the PNW – the Snark!

Skip Albertson
Wa Dept Of Ecology

Follow this and additional works at: <https://cedar.wwu.edu/ssec>

Albertson, Skip, "Introducing a Different Kind of “Blob” in the PNW – the Snark!" (2022). *Salish Sea Ecosystem Conference*. 199.

<https://cedar.wwu.edu/ssec/2022ssec/allsessions/199>

This Event is brought to you for free and open access by the Conferences and Events at Western CEDAR. It has been accepted for inclusion in Salish Sea Ecosystem Conference by an authorized administrator of Western CEDAR. For more information, please contact westerncedar@wwu.edu.

Introducing a Different Kind of Blob in the PNW – the Snark!

Skip Albertson, Bos J, Coleman N, Flores, M, Horwith, M, Krembs, C, Pearce M, Rauschi, E, Ruffner, J, and Young H

WA Dept of Ecology

Introduction

Puget Sound experienced progressively saltier conditions from 2017 to 2019 compared to time-averaged seasonal norms from 1999 to 2018. Reduced freshwater inflow from rivers drove much of these salinity increases.

We report on another process raising salinity on the landward end of Case Inlet. Like “Meddies” in the Mediterranean Sea, evaporation leads to the formation of hypersaline blobs of surface water, known as “snarks”.

Materials and methods

- From 1997–2007, we measured salinity, temperature, and density with three different probes (CTDs) aboard two vessels (R/V Barnes and Skookum).
- During the non-winter months, we detected snarks over 70% of the time.
- We also report direct measurements of temperature from the sunlit mudflats, and make an energetic argument to connect the two.
- Data are from different years because we were not planning to look for snarks. We were monitoring for low oxygen levels.

Results

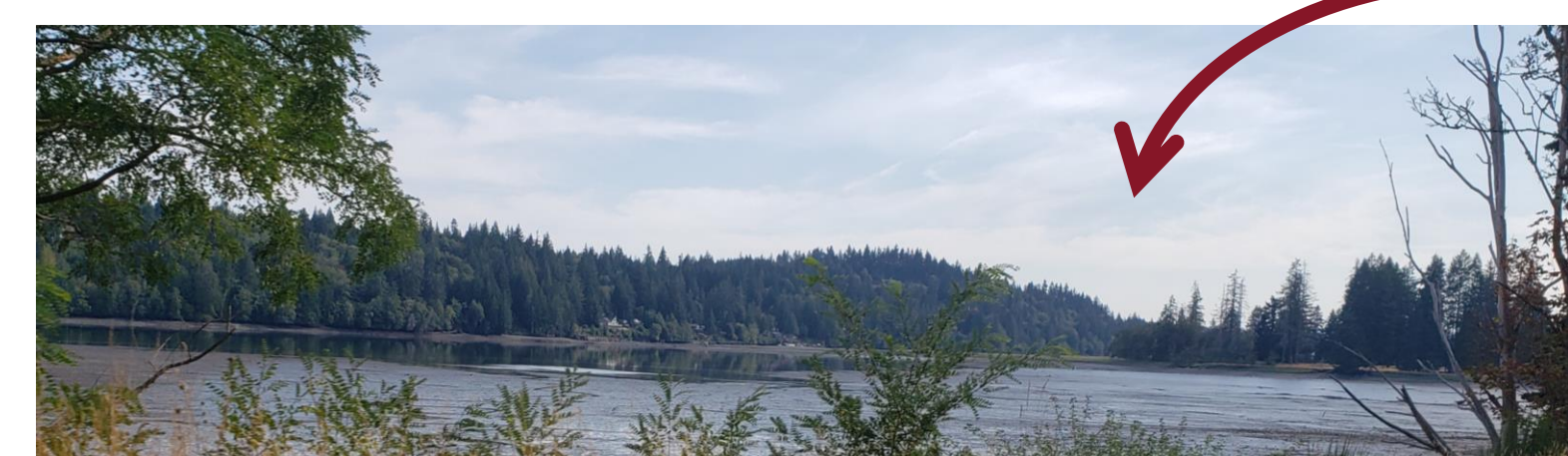


Figure 1. Mud flats at low tide in Oakland Bay.

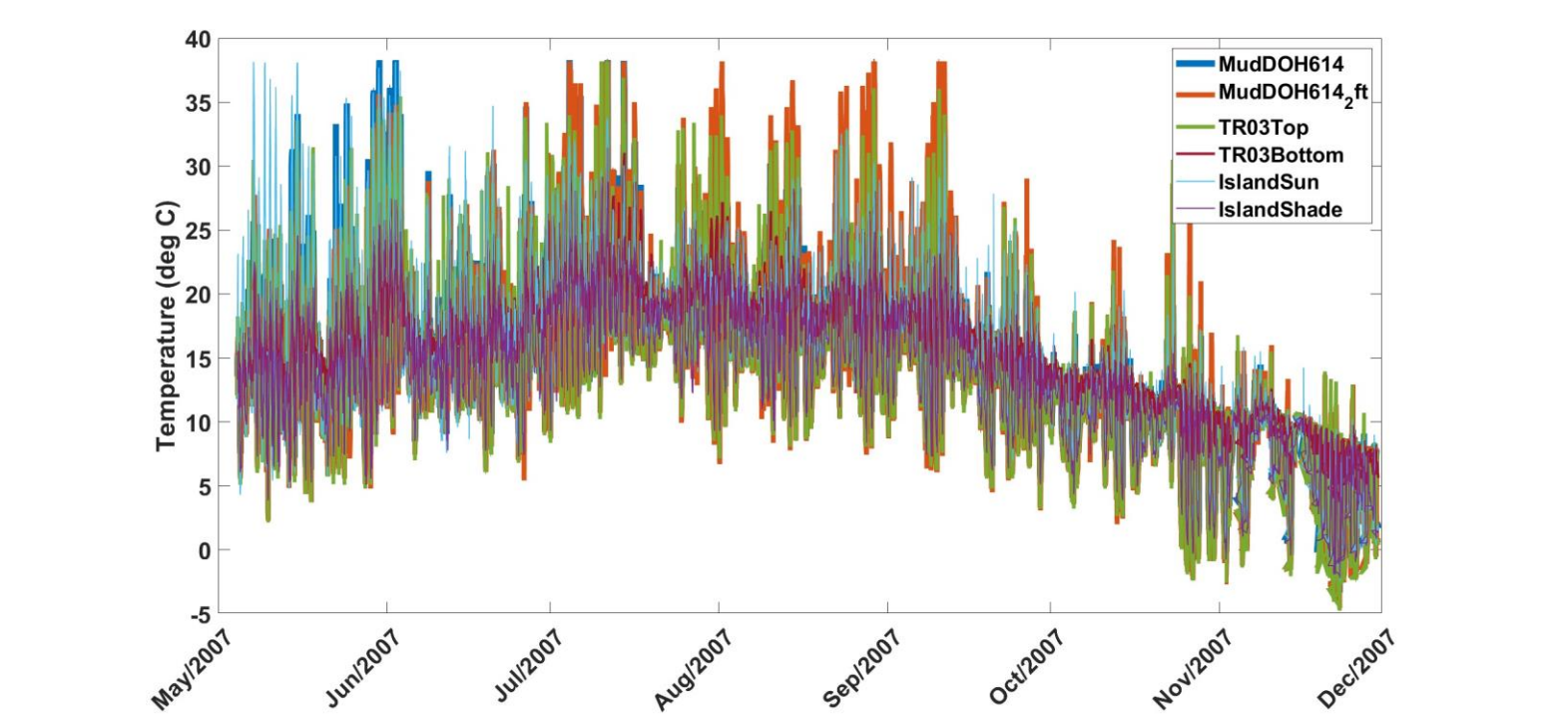


Figure 2. Time series of mud temperatures in Oakland Bay.

- Temperatures of nearly 40°C were recorded on the mud flat surfaces of Oakland Bay (Figs 1 and 2) (Squaxin acknowledgment) in 2007, which was not as warm a year as 2003-2006, or 2015-2016 (PSEMP references).
- A 2-km x 1-km snark, about 5 m thick, was observed sinking in Case Inlet south of Pickering Passage during September, 1997 (Fig 3a & b), which is a volume of about 10,000,000 m³. The salinity within the snark was 29.7 psu, and 28.9 psu in the surrounding water (Fig. 4 shows the relationship to density). A volume of about 270,000 cubic meter would have to be evaporated on the mud flats if they were a suitable explanation.

The surface area of the mudflats and the water for Oakland Bay and Totten Inlet are about 2,500,000 m² and 917,000,000 m², respectively. Assuming an average wind speed of 5 m/s, an average air temperature of 25°C with a relative humidity of 50 (using a Mollier diagram), and a 24-hour average solar input of 240 W/m² during the longer days of summer, it would take about 2.7 day to evaporate enough water to achieve this. This seems feasible, especially during sunnier and warmer years. We know from a dye release study at the WWTP in Shelton that Oakland Bay is a very retentive system – 92% of the water removed by estuarine circulation is refluxed back into the bay (Albertson, 2004). We might look for sporadic salinity jumps in the summer within the long-term record at Ecology station OAK004 (Fig 5).

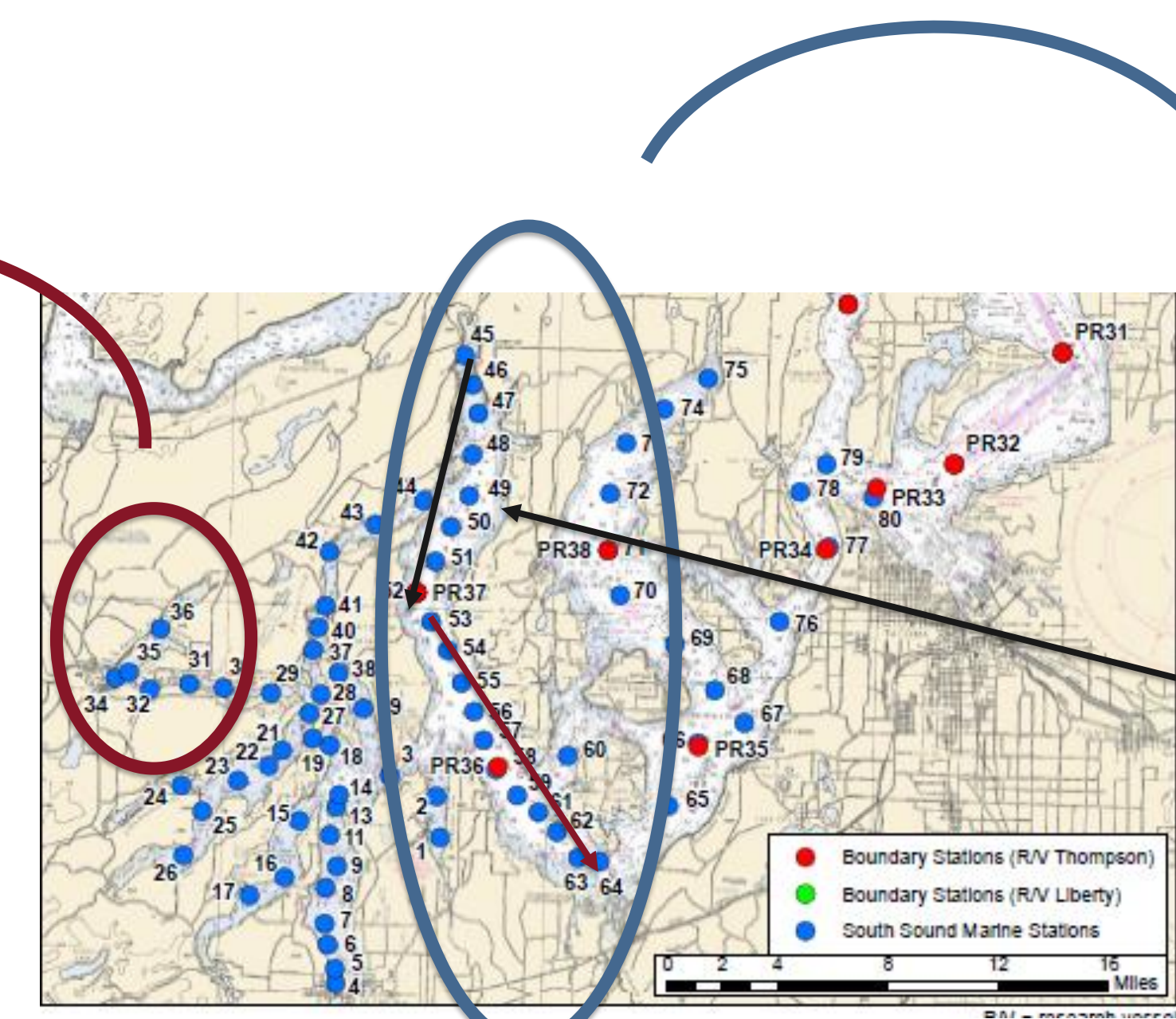


Figure 3a. Stations 46 (northern) to 64 (southern) in Case Inlet used in vertical contour plot.

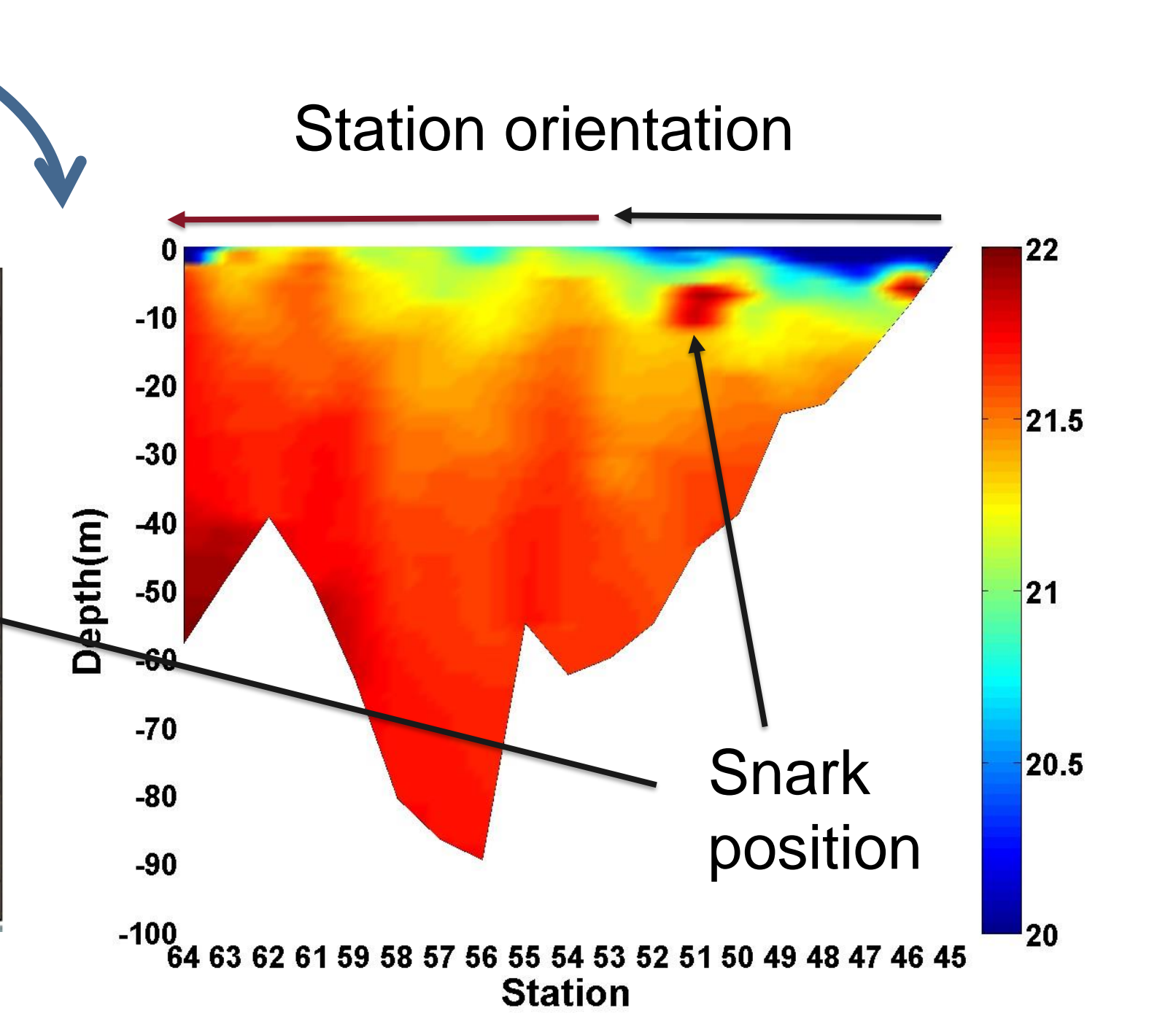


Figure 3b. Vertical contour of density in Case Inlet showing two snarks.

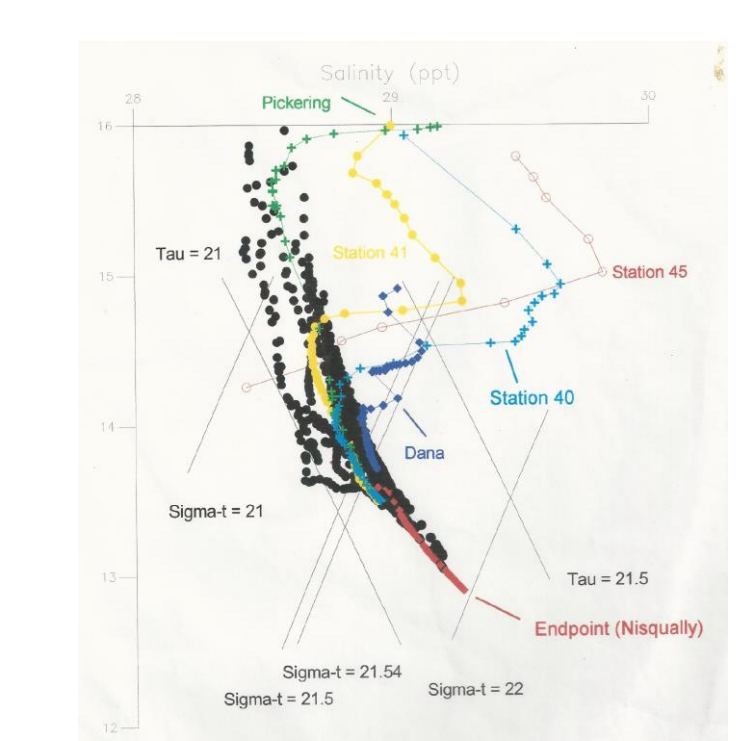


Figure 4. A T-S diagram showing the relationship of temperature, salinity, and density for the observed snark.

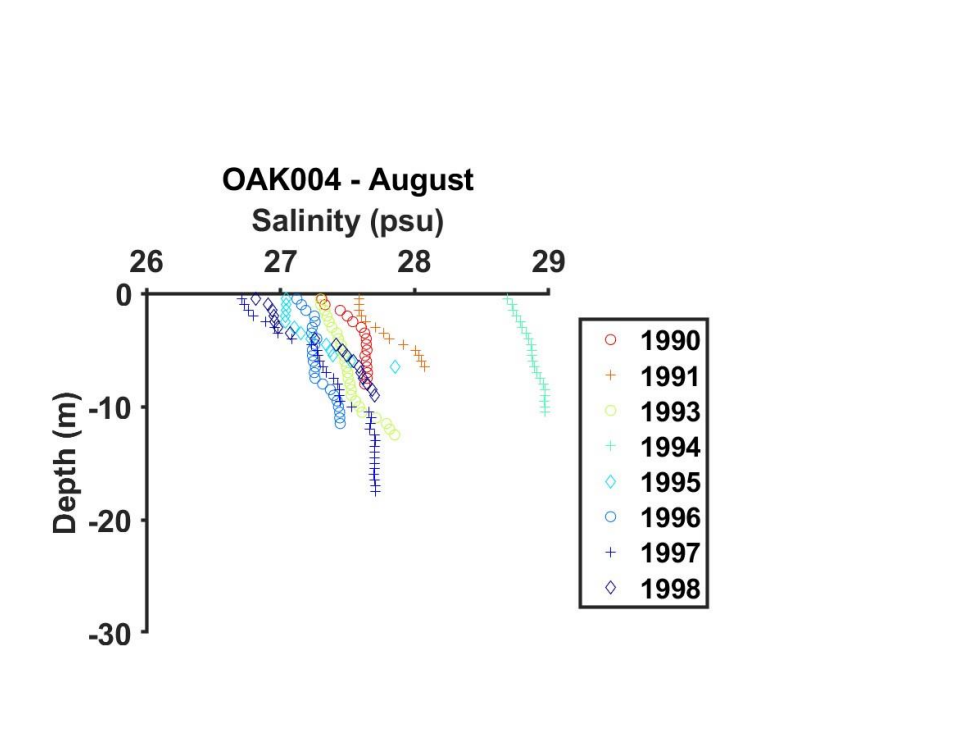


Figure 5. Spaghetti plots of salinity profiles in Oakland Bay showing a sporadic salinity jump in 1994.

Conclusions

- When denser, hypersaline water sinks on the landward side of an estuary, it can cause inverse-estuarine conditions and increase the residence time of the embayment.
- Snarks may amplify documented stressors to key estuarine species in the shallow waters of South Puget Sound, such as Olympia oysters and salmon (Lawlor and Arellano, 2020).
- Climate change will extend periods of warm, dry weather in the summer which can lead to more widespread instances of snarks in Case Inlet and potentially elsewhere.
- We present repeated observations of this phenomenon, which show that some of these snarks can extend for 10 km and be vertically 10m thick.
- Better understanding of snark formation and persistence is important for managing shellfish and other fisheries.

Literature cited

Albertson, S.L., 2004. Oakland Bay Study: A dye and modeling study in an enclosed estuary with a high degree of refluxing. Washington State Department of Ecology. Environmental Assessment Program, Olympia, WA. Publication # 04-03-020.

Guarini et al.: Modelling mud surface temperature and on intertidal flats to investigate the spatio-temporal dynamics of the benthic microalgal photosynthetic capacity. *Marine Ecology Progress*, Vol 153, 25-36, 1997

Lawlor JA, Arellano SM. Temperature and salinity, not acidification, predict near-future larval growth and larval habitat suitability of Olympia oysters in the Salish Sea. *Scientific Reports*. 2020 Aug; 10(1):13787. DOI: 10.1038/s41598-020-69568-w. PMID: 32796854; PMCID: PMC7429507.

PSEMP Marine Waters Workgroup. 2011-9. Puget Sound marine waters: overview. URL: www.psp.wa.gov/PSEMP/PSmarinewatersoverview.php. Contact: marinewaters@psemp.org.

Acknowledgments

John Konovsky, and the Squaxin Tribe for collecting and sharing mudflat temperature data gathered in Oakland Bay (near Shelton, WA).



Further information

Please see <https://ecology.wa.gov/Research-Data/Monitoring-assessment/Puget-Sound-and-marine-monitoring>.