DISSOLVED OXYGEN VULNERABILITY & CLIMATE CHANGE INTERN

Isabella Showman

Major: Atmospheric Sciences: Climate

Minor: Oceanography

Why EarthLab

- Great opportunity for first internship
- Cohort experience

Why my internship

- Figure out what I like
- Experience something different

SCHOOL OF AQUATIC & FISHERY SCIENCES

About the Internship

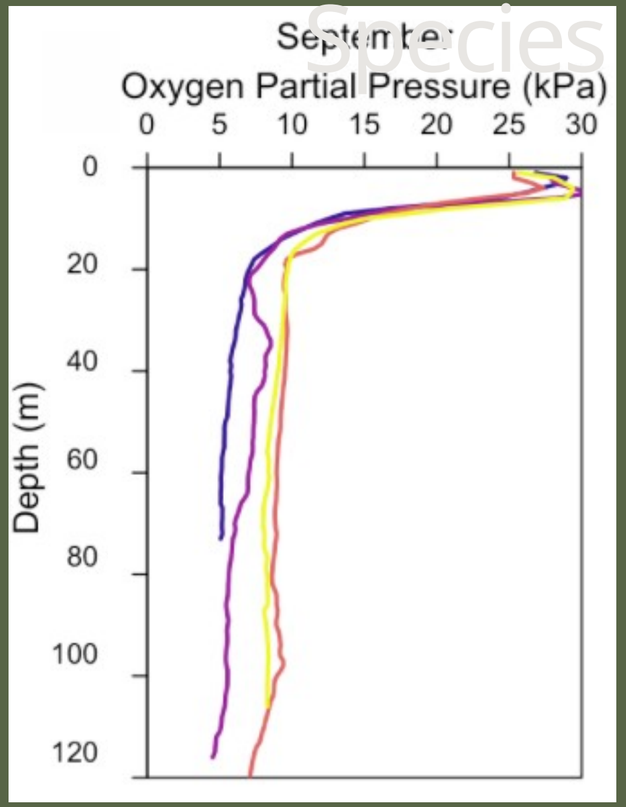
- Structured literature review
- Spreadsheets
- RStudio

Goal

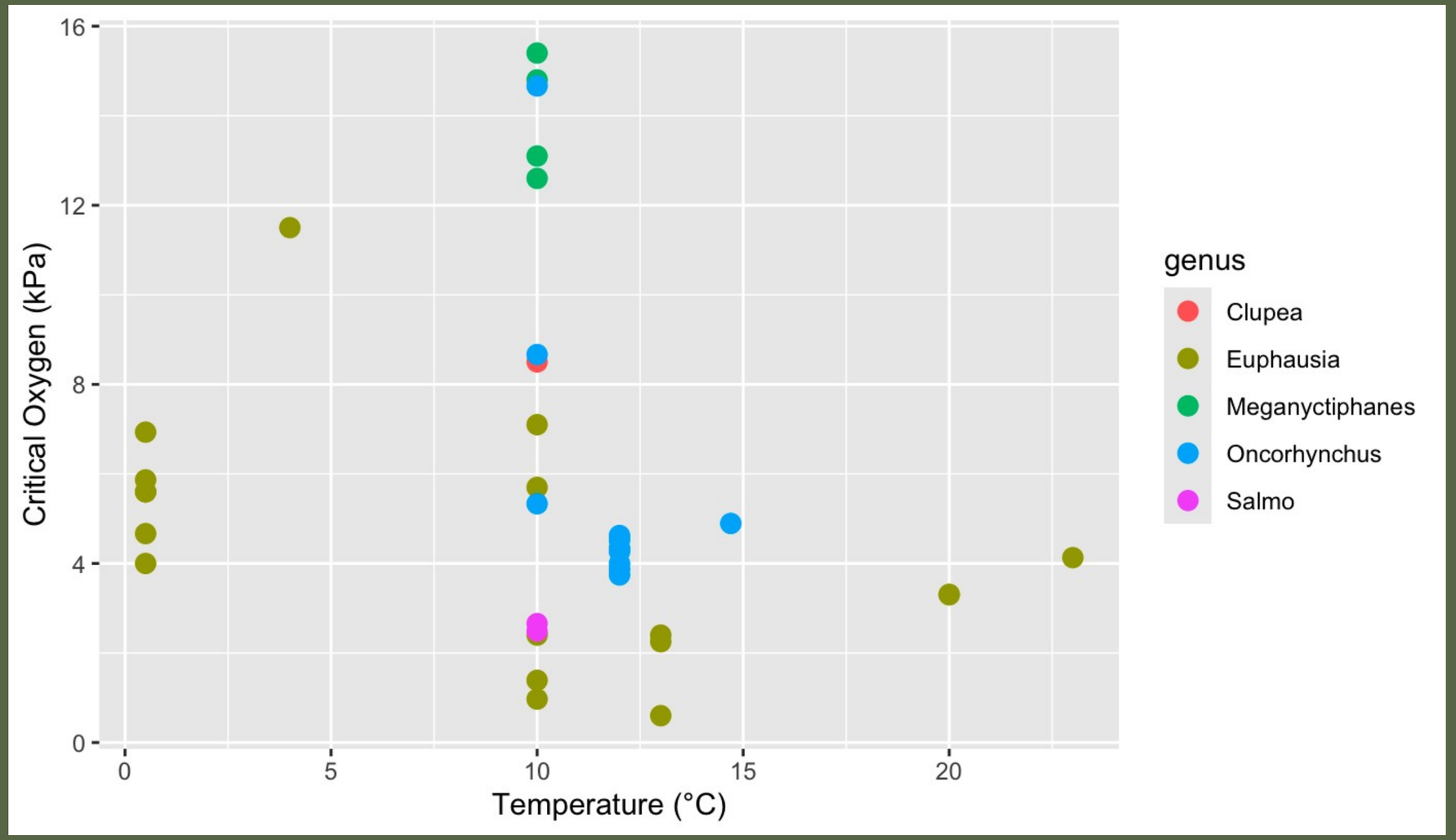
Develop a database of oxygen thresholds for three marine taxa that are important for Puget Sound

	family	genus	taxon	collection_location	data_type	methodology	methods_summary	temperature_c	p_crit	units
2	Euphausiidae	Euphausia	E. eximia	Costa Rica Dome Region (9	Experimental	Oxygen consumption regulation	Oxygen consumption regulation and lactate accumulation use	10	2.1	kPa (PO2)
3	Euphausiidae	Nematoscelis	Nematoscelis gracilis	Eastern Tropical Pacific	Experimental	Flow-through respirometry	animals could be maintained at a constant oxygen concentrati	10		kPa (PO2)
4	Euphausiidae	Nematoscelis	Nematoscelis difficilis	California Current	Experimental	Flow-through respirometry		10		kPa (PO2)
5	Euphausiidae	Euphausia	E. diomedeae	Red Sea (22°29′ N 30°2′ E)	Experimental	Oxygen consumption regulation	Oxygen consumption regulation and lactate accumulation use	22		kPa (PO2)
6	Euphausiidae	Euphausia	E. pacifica	South California	Experimental	Closed-respirometry	Rate of change in partial pressure of dissolved oxygen in the c	10	18	mm Hg
7	Euphausiidae	Euphausia	E. superba	Antarctica Coast	Experimental	Closed-respirometry	Critical oxygen partial pressure (pc) where respiration chang	4	11.5	kPa (PO2)
8	Euphausiidae	Euphausia	E. pacifica	Northern California Current	Experimental	Closed-respirometry	Cold season (April). For both seasons, pc that was measurec	10	7.1	kPa (PO2)
9	Euphausiidae	Euphausia	E. pacifica	Northern California Current	Experimental	Closed-respirometry	Warm season (September)	10	5.7	kPa (PO2)
10	Euphausiidae	Euphausia	E. superba	Scotia Sea (60° S 40° W)	Experimental	Closed-respirometry	Winter. Specimens taken in upper 1000 m of water column in	0.5	52	mm Hg
11	Euphausiidae	Euphausia	E. superba	Antaractica Coast (65° S 46	Experimental	Closed-respirometry	Fall. Time required for consumption of oxygen to low levels v	0.5	42	mm Hg
12	Euphausiidae	Euphausia	E. superba	Scotia Sea (60° S 40° W)	Experimental	Closed-respirometry	Spring	0.5	42	mm Hg
13	Euphausiidae	Euphausia	E. superba	Scotia Sea (60° S 40° W)	Experimental	Closed-respirometry	Winter	0.5	30	mm Hg
14	Euphausiidae	Euphausia	E. superba	Scotia Sea (60° S 40° W)	Experimental	Closed-respirometry	Spring	0.5	44	mm Hg
15	Euphausiidae	Euphausia	E. superba	Antaractica Coast (65° S 46	Experimental	Closed-respirometry	Fall	0.5	35	mm Hg
16	Euphausiidae	Euphausia	E. mucronata	Southern California and Me	Experimental	Closed-respirometry	Shipboard respiration measurements determined euphausiid	10	1.39	kPa (PO2)
17	Euphausiidae	Euphausia	E. mucronata	Southern California and Me	Experimental	Closed-respirometry		20	3.3	kPa (PO2)
18	Euphausiidae	Euphausia	E. gibboides	Southern California and Me	Experimental	Closed-respirometry		13	2.25	kPa (PO2)
19	Euphausiidae	Euphausia	E. gibboides	Southern California and Me	Experimental	Closed-respirometry		23	4.13	kPa (PO2)
20	Euphausiidae	Euphausia	E. hanseni	Southern California and Me	Experimental	Closed-respirometry		10	0.97	kPa (PO2)
21	Euphausiidae	Euphausia	E. hanseni	Southern California and Me	Experimental	Closed-respirometry		20	3.31	kPa (PO2)
22	Euphausiidae	Euphausia	E. gibboides	Eastern Tropical North Atlar	Experimental	Closed-respirometry	Only adult euphausiids used. Goal was to include pCO2, but E	13	2.4	kPa (PO2)
23	Euphausiidae	Euphausia	E. mucronata	Eastern Tropical South Paci	Experimental	Closed-respirometry		13	0.6	kPa (PO2)
24	Euphausiidae	Euphausia	E. mucronata		Experimental	Closed-respirometry	Data from Teal and Carey (1967) supplement the observation	20		kPa (PO2)
25	Euphausiidae	Meganyctiphanes	M. norvegica	Gullmarsfjord (58° 19.9′ N,	Experimental		Field and Labratory studies conducted. Each tank was covere	8		kPa (PO2)
26	Euphausiidae	Meganyctiphanes	M. norvegica	Gullmaarsfjord, SW Swede	Experimental	Closed-respirometry	Both individual MO2s (expressed as µl O2 mg wet mass−1 h	10	13.1	kPa (PO2)
27	Euphausiidae	Meganyctiphanes	M. norvegica	Gullmaarsfjord, SW Swede	Experimental	Closed-respirometry	Both individual MO2s (expressed as µl O2 mg wet mass−1 h	10	14.8	kPa (PO2)
28	Euphausiidae	Meganyctiphanes	M. norvegica	Gullmaarsfjord, SW Swede	Experimental	Closed-respirometry	Both individual MO2s (expressed as µl O2 mg wet mass−1 h	10	15.4	kPa (PO2)
29	Euphausiidae	Meganyctiphanes	M. norvegica	Gullmaarsfjord, SW Swede	Experimental	Closed-respirometry	Both individual MO2s (expressed as µl O2 mg wet mass−1 h	10	12.6	kPa (PO2)
30	Clupeidae	Clupea	Clupea pallasii	Hood Canal	Field Observation	Cross site comparison and time seri	Performed 1-4 CTD casts per site at different times. Echosou	10	3.6	mg/L
31	Clupeidae	Clupea	Clupea pallasii	Hood Canal	Field Observation	Temporal analysis	At each site, 2–4 profiles were collected each month	8		mg/L
32	Clupeidae	Clupea	Clupea pallasii	Cherry Point, WA	Experimental	Threshold experiment	Pacific herring were exposed to hypoxia for several hours and	12.8		mg/L
33	Clupeidae	Clupea	Clupea harengus	Bornholm basin	Field Observation	Cross-site analysis	Oxygen saturation thresholds used to conduct a time series of	6.8		
34	Clupeidae	Clupea	Clupea harengus	Lake Rossfjord	Field Observation	Temporal Analysis	Measured depth profiles of oxygen, temp, and salinity	10		ml/L
35	Clupeidae	Clupea	Clupea harengus	North Sea Center, Denmark	Experimental	Closed-respirometry	Recirculatory flow technique, tank in open circulation except f	10	8.5	kPa (PO2)
36	Clupeidae	Clupea	Clupea harengus	Dunstaffnage Bay, Scotland	Experimental	Breakpoint analysis	10 replicate experiements, held in local conditions of temp and	15		
37	Clupeidae	Clupea	Clupea harengus	Bornholm basin	Field Observation	Cross-site analysis	Determined vertical thresholds of salinity and oxygen saturation by which the species occured.			
38	Clupeidae	Sprattus	Sprattus sprattus	Norwegian fjord	Field Observation	Cross-site analysis	The large trawl aperture and lack of a closing device prevente	7		ml/L
39	Clupeidae	Sardinops	Sardinops sagax	Northern Benguela Current	Field Observation	Cross-site analysis	CTD deployed to collect data on temperature, salinity and oxygen every metre between the surface ar			ml/L
40	Clupeidae	Sardinops	Sardinops sagax	Benguela and Angola-Bengu	Field Observation	Cross-site analysis		16	2.5	ml/L
41	Salmonidae	Oncorhynchus	O. mykiss	Miracle Springs	Experimental	Intermittent-flow respirometry	Strain A batch spawned on 25 October 2015 and 8 November	7.4	14.4	% saturation
42	Salmonidae	Oncorhynchus	O. mykiss	Miracle Springs	Experimental	Intermittent-flow respirometry	Strain B was batch spawned on 17 November 2015 in six gro	7.4	11.9	% saturation
43	Salmonidae	Oncorhynchus	O. mykiss	Rochester, WA	Experimental	Intermittent-flow respirometry	Strain C was spawned 31 December 2015 as single-pair cros	7.4	9.7	% saturation
44	Salmonidae	Oncorhynchus	O. mykiss	Plouigneau, France	Experimental	Controlled titration	The gradual decline of oxygen concentration was conducted b	16.3	2.3	mg/L
45	Salmonidae	Oncorhynchus	O. mykiss	Apeldoorn, The Netherlands	Experimental		The experiments were carried out in a recirculation system w	15	8	kPa (PO2)

Oxygen Threshold vs. Temperature by Species

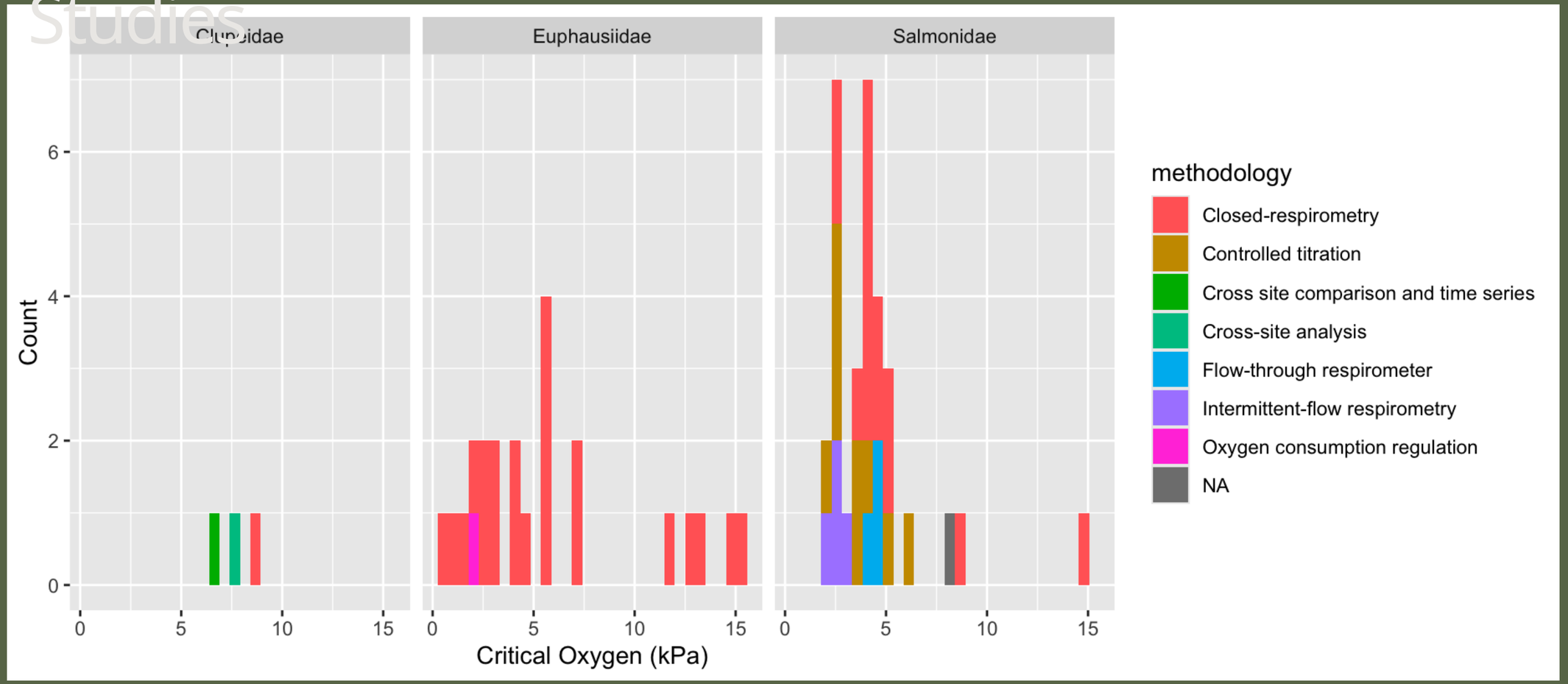


- Dissolved oxygen in a changing climate
- Why does it matter?



Critical oxygen threshold in relation to temperature for controlled titration experiments, and the colors represent genus.

High Variability of Oxygen Threshold Across Studies



Critical oxygen threshold frequency by family, and the colors represent what methodology researchers used.

Reflection

- Self-motivation is important for creating good work, but can be hard to maintain
- Became comfortable asking peers and my supervisor when I felt unsure of my pace/work
- Learned to be okay with imperfections
- Education and career paths do not have to perfectly line up

Acknowledgements

Thank you to...

The EarthLab team

My supervisor, Tim

The PSI team

and my cohort