ZOOPLANKTON METABOLISM, ACTIVE FLUX, AND CONTRIBUTION TO AOU IN THE N.E. PACIFIC OCEAN

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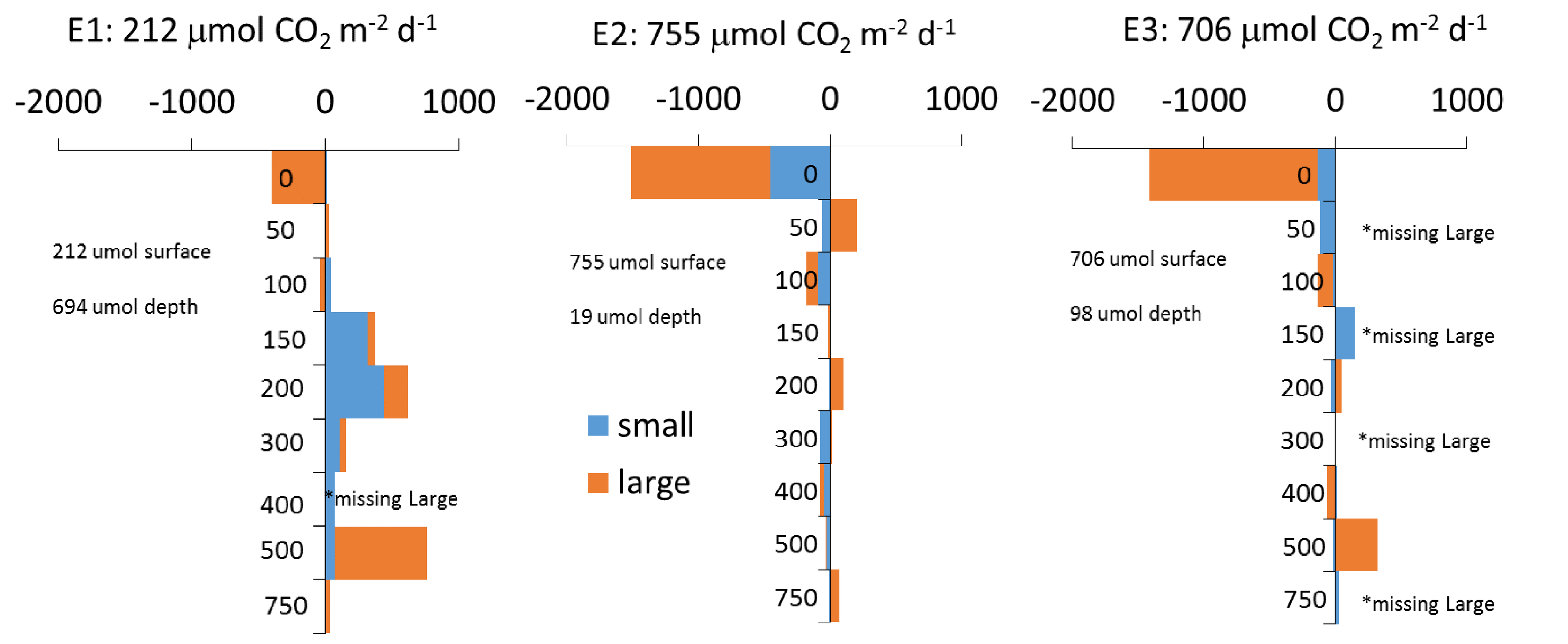
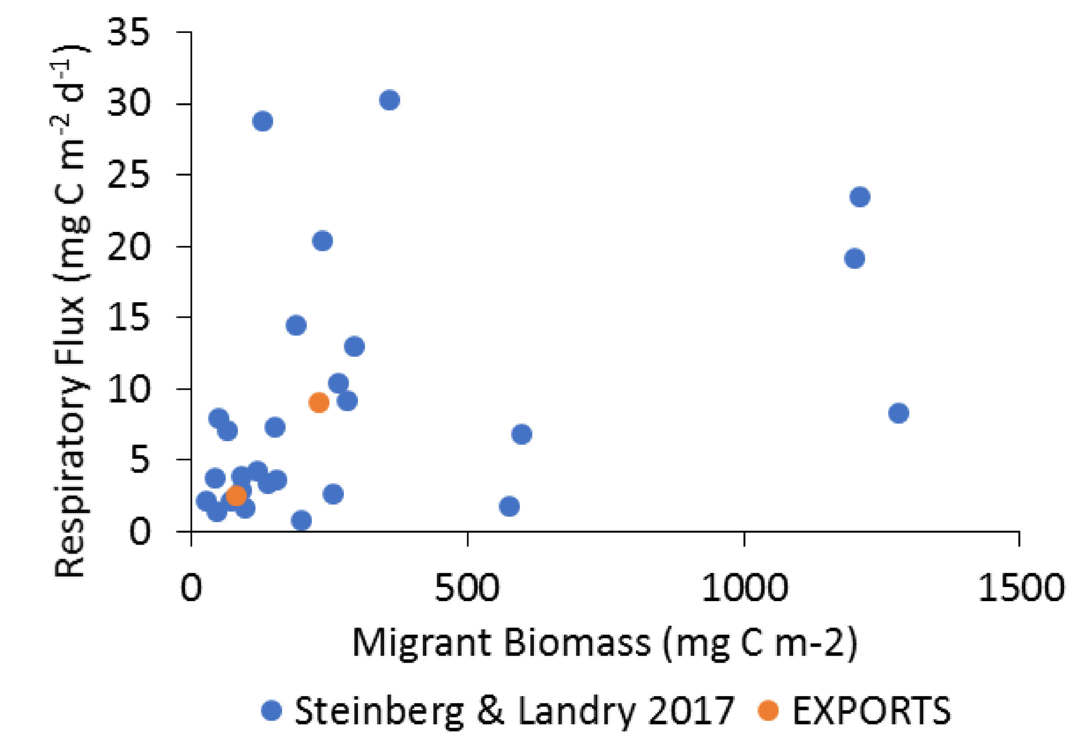
ETS based Respiratory Carbon Contributions (D-N μmol $CO_2 \cdot d^{-1}{}_{m}{}^{-2}$)



Average Active Flux (D-N 12:12)

Interval	μmol CO_2 $d^{-1} \cdot m^{-2}$	mg C $d^{-1} \cdot m^{-2}$	mmol CO_2 $d^{-1} \cdot m^{-3}$	mg C $d^{-1} \cdot m^{-3}$
0-50	-618.86	-7.43	-30.94	-371.32
50-100	19.40	0.23	1.94	23.29
100-150	-74.60	-0.90	-7.46	-89.52
150-200	101.69	1.22	10.17	122.03
200-300	81.80	0.98	8.18	98.16
300-400	44.32	0.53	11.08	132.97
400-500	-59.53	-0.71	-14.88	-178.60
500-750	119.72	1.44	29.93	359.16
750-1000	23.09	0.28	5.77	69.27

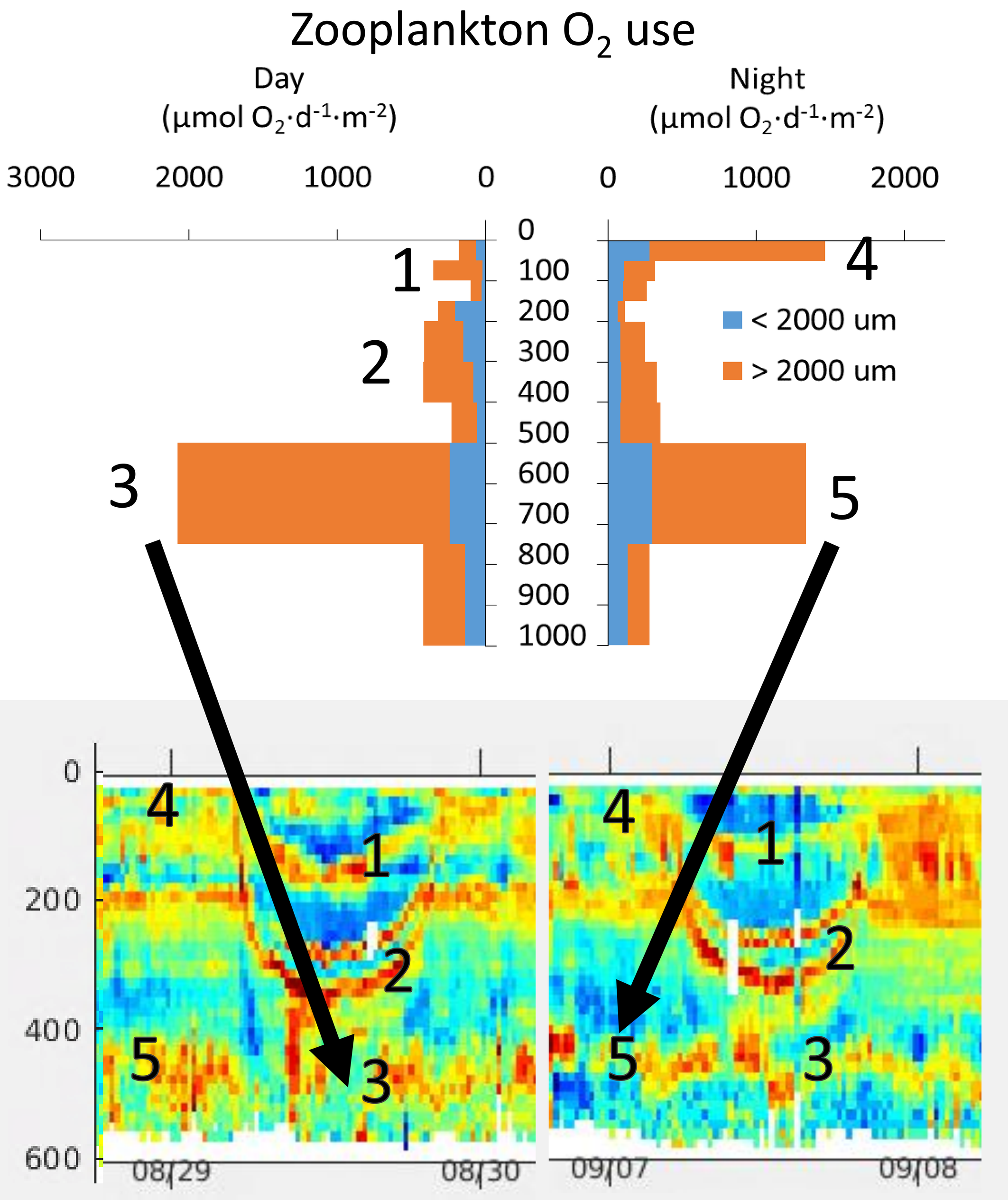


Average Zooplankton AOU

Interval	mmol O_2 $d^{-1} \cdot m^{-2}$	μmol O_2 $d^{-1} \cdot m^{-3}$
0-50	0.82	16.48
50-100	0.33	6.69
100-150	0.18	3.67
150-200	0.22	4.36
200-300	0.33	3.32
300-400	0.38	3.77
400-500	0.29	2.92
500-750	0.57	2.27
750-1000	0.12	0.47

Zooplankton respiratory flux ranged between 2.5 – 9.06 mg C m^{-2} d^{-1}

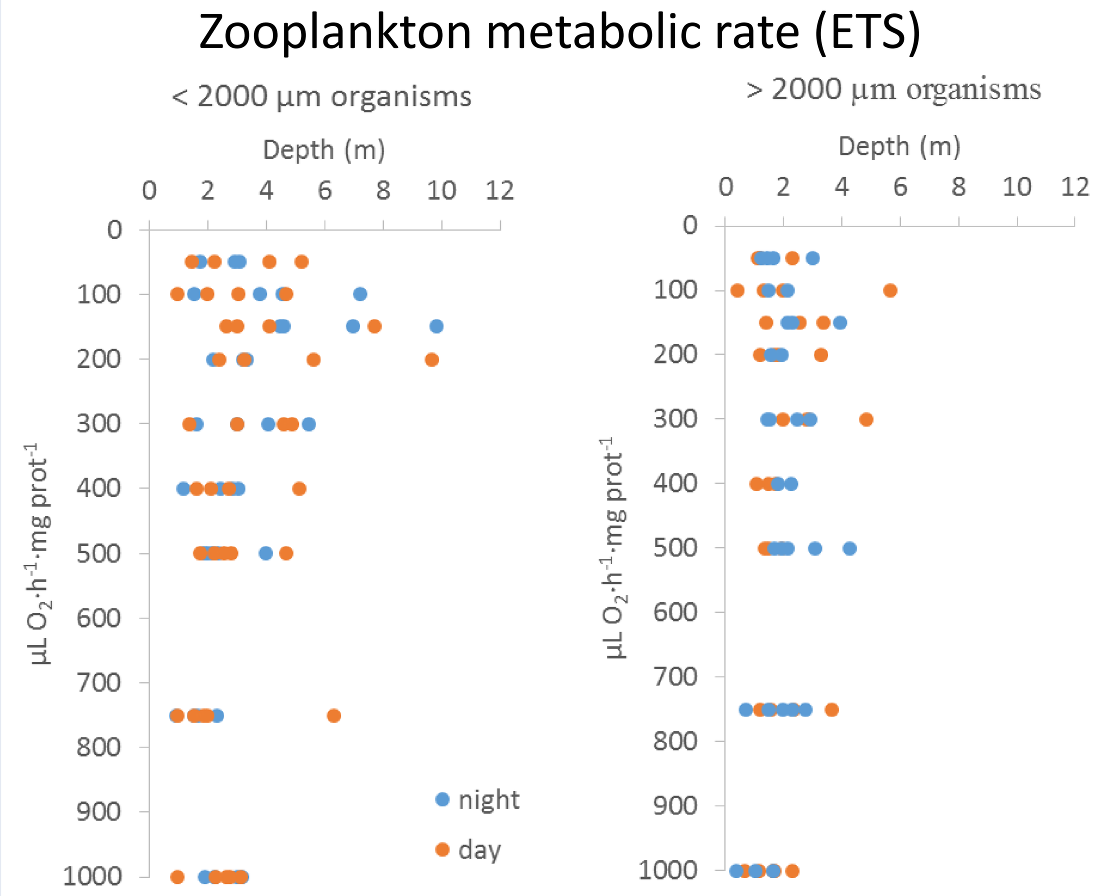
Zooplankton O_2 use



ADCP: 75kH (E2, E3)

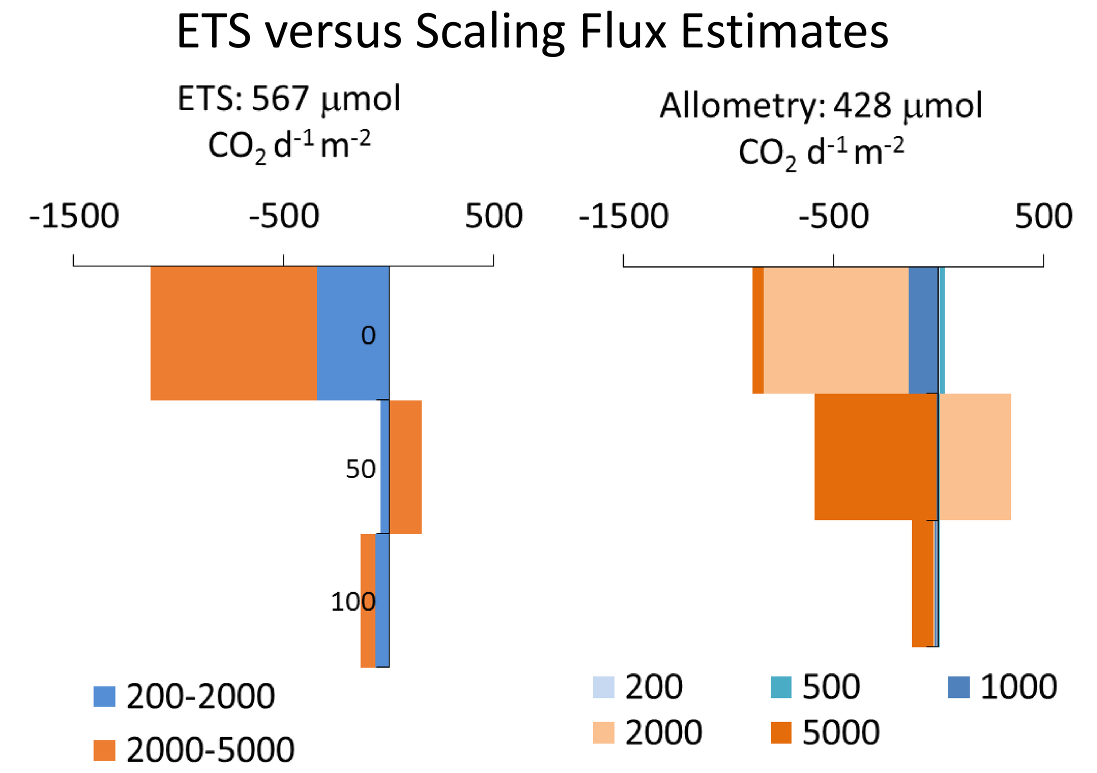
High zooplankton AOU in 3 day time bands and 2 or 3 night time bands (see ADCP!)

Zooplankton metabolic rate (ETS)



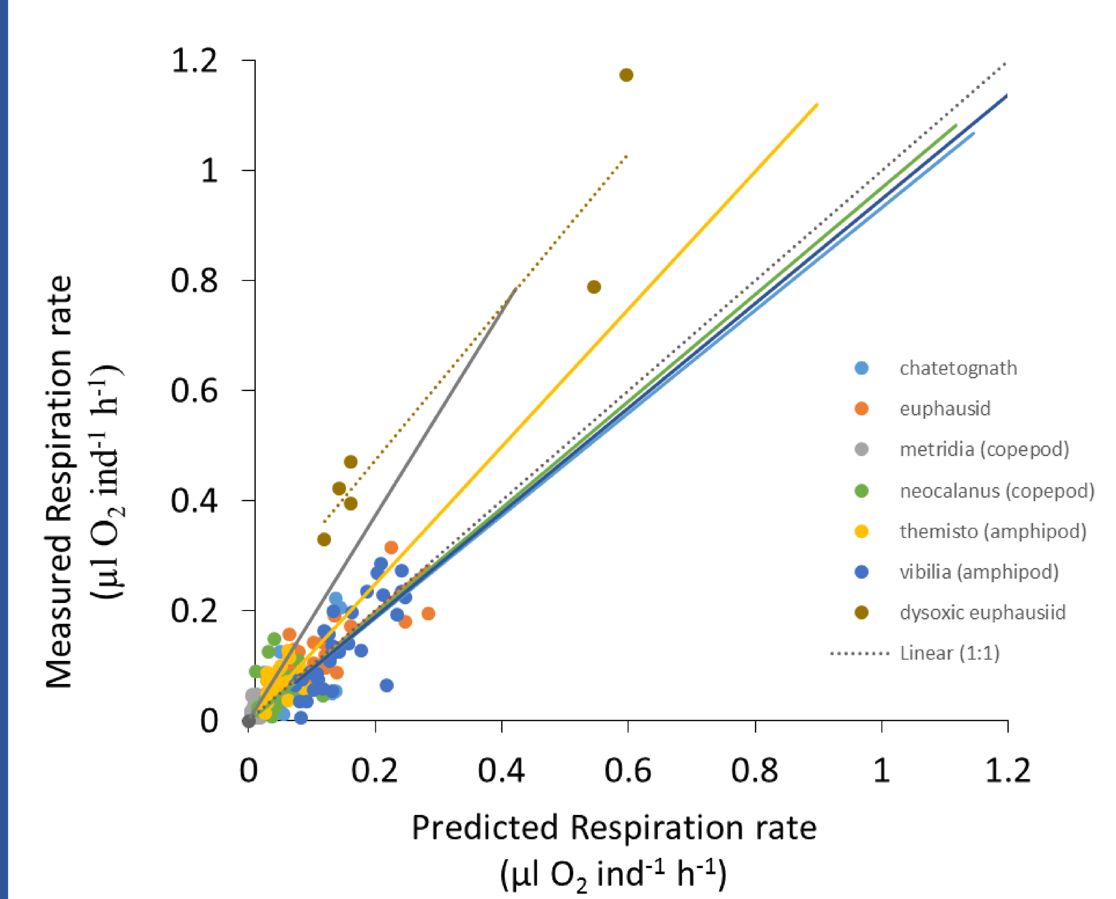
ETS based metabolic rate peaked between 50-150 m for the small size, no pattern in large size

ETS versus Scaling Flux Estimates

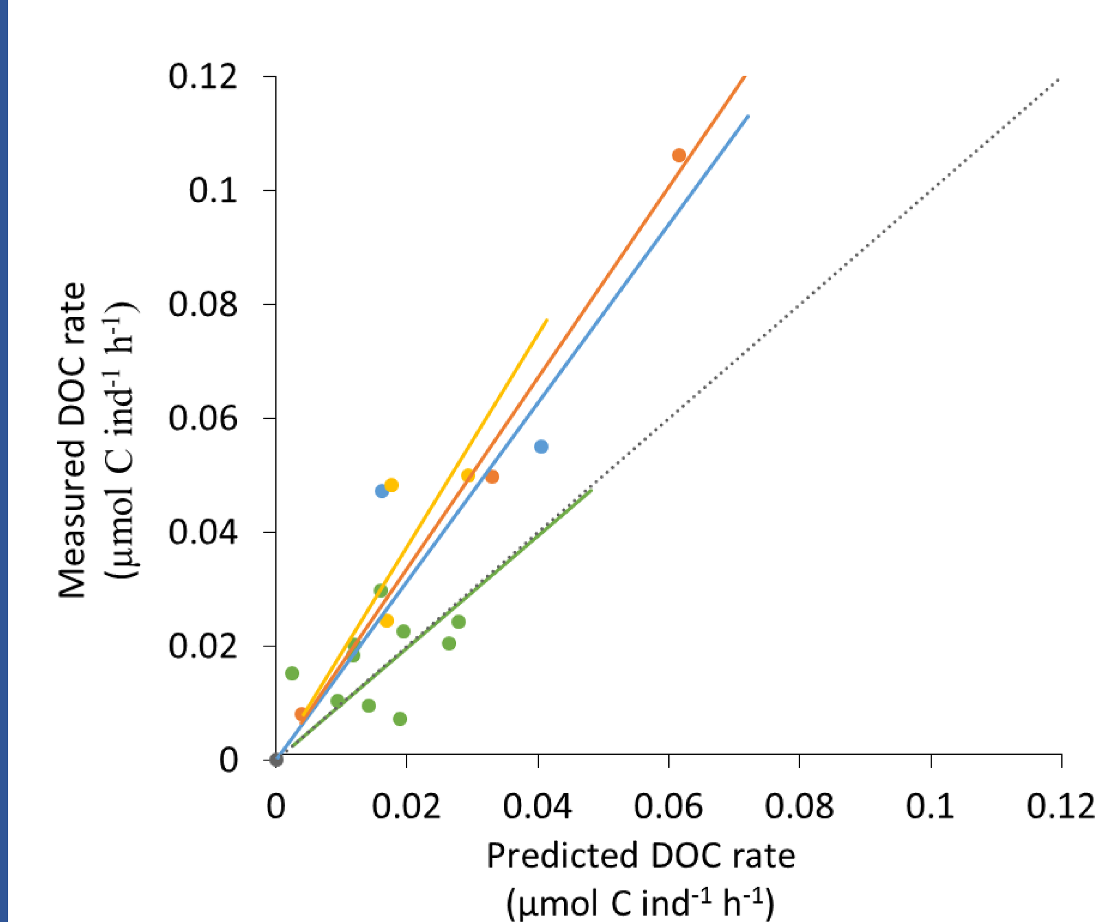


SO many ways to calculate…but all getting a similar measurement

Predicted rate based on organism size compared to measured individual rate



Species specific allometric equations for estimating respired CO_2 and DOC are decent (unless hypoxia)



INTRO:

Zooplankton drive two pathways of flux:

1) The creation of fecal pellets (particulate organic carbon; POC) that sink from surface waters
2) The transport of carbon to depth via diel vertical migrations (DVM) called "active transport". This includes respiratory CO_2 as well as excreted dissolved (DOC) and particulate (POC) matter.

Active transport is one of the least sampled export pathways, in part due to the difficulties of determining community respiration rate.

The objective of this work was to measure vertically stratified contributions of the zooplankton to respiratory CO_2 in the N.E. Pacific and to compare various methodologies of estimating zooplankton active flux as part of the NASA EXPORTS project. This can also give us apparent oxygen utilization (AOU) by this size fraction.

METHODS

1. Zooplankton were sampled in vertically stratified net tows using a Multiple Open and Closing Net Environmental Sensing System (MOCNESS). Samples were size fractionated and frozen (ETS), dried (biomass), or preserved in formalin
2. Enzymatic analyses of the electron transport system (ETS) were made of ¼ fraction of each net (whole community samples).
3. Migratory species were collected from night 1 m^2 net tows. Individual species respiration experiments were run using a Firesting optical spot sensing system. Experiments were conducted in an incubator at 4-8 °C and using water collected from 200 m, replicating midwater conditions.
4. Community respiration was calculated by applying measured temperature corrected respiration rates to biomass data.

CONVERSION FACTORS:

- Calculated μL $O_2 \cdot d^{-1} \cdot m^{-3}$ = ETS * 24 h * biomass (with Arrhenius correction) assuming ETS/O_2 = 0.5 (low food, Hernandez-Leon & Gomez, 1996)
- μmol $O_2 \cdot d^{-1} \cdot m^{-3}$ = μL $O_2 \cdot d^{-1} \cdot m^{-3}$ * 1 mol/22.4 L
- μmol $CO_2 \cdot d^{-1} \cdot m^{-3}$ = μmol $O_2 \cdot d^{-1} \cdot m^{-3}$ * 0.97 (RQ from Omori and Ikeda 1984).
- Convert mg DW to mg C with 40% estimate (Dam and Peterson, 1993).
- μmol CO_2 = mg C * 12 g mol^{-1}/1000
- Zooplankton DW = protein*5.3198 (small) DW = protein*2.8393 (large)