Dissolved oxygen incubation measurements

- Terms
- Methods
- Newer technologies

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If we are interested in *carbon available for export* or consumption by higher trophic levels, NCP is the key term.

If we want to know how much *total energy was captured by photosynthesis*, we need to know GPP.

If we are interested in the *net total carbon fixed by phytoplankton*, NPP is the key term (GPP- autotrophic R).

The basic concepts of light and dark bottle incubations for productivity measurements

1. Light bottle O_2 minus starting concentration over time is **NCP.** In the absence of a heterotrophic community this would be **NPP**. (Conversion from oxygen to carbon units requires application of the Photosynthetic Quotient (>1.1 O:C)).

2. Dark bottle O_2 minus starting concentration over time is **CR**.

3. The sum of **NCP** and **CR** is GPP

CONSEIL PERMANENT INTERNATIONAL POUR
L'EXPLORATION DE LA MER

RAPPORTS
ET
PROCÈS-VERBAUX DES RÉUNIONS

VOLUME XLII

INVESTIGATIONS
OF THE
PRODUCTION OF PLANKTON IN THE OSLO FJORD
BY
TORBJØRN GAARDER AND H. H. GRAN

EN COMMISSION CHEZ
ANDR. FRED. HØST & FILS
COPENHAGUE

Mars 1927.

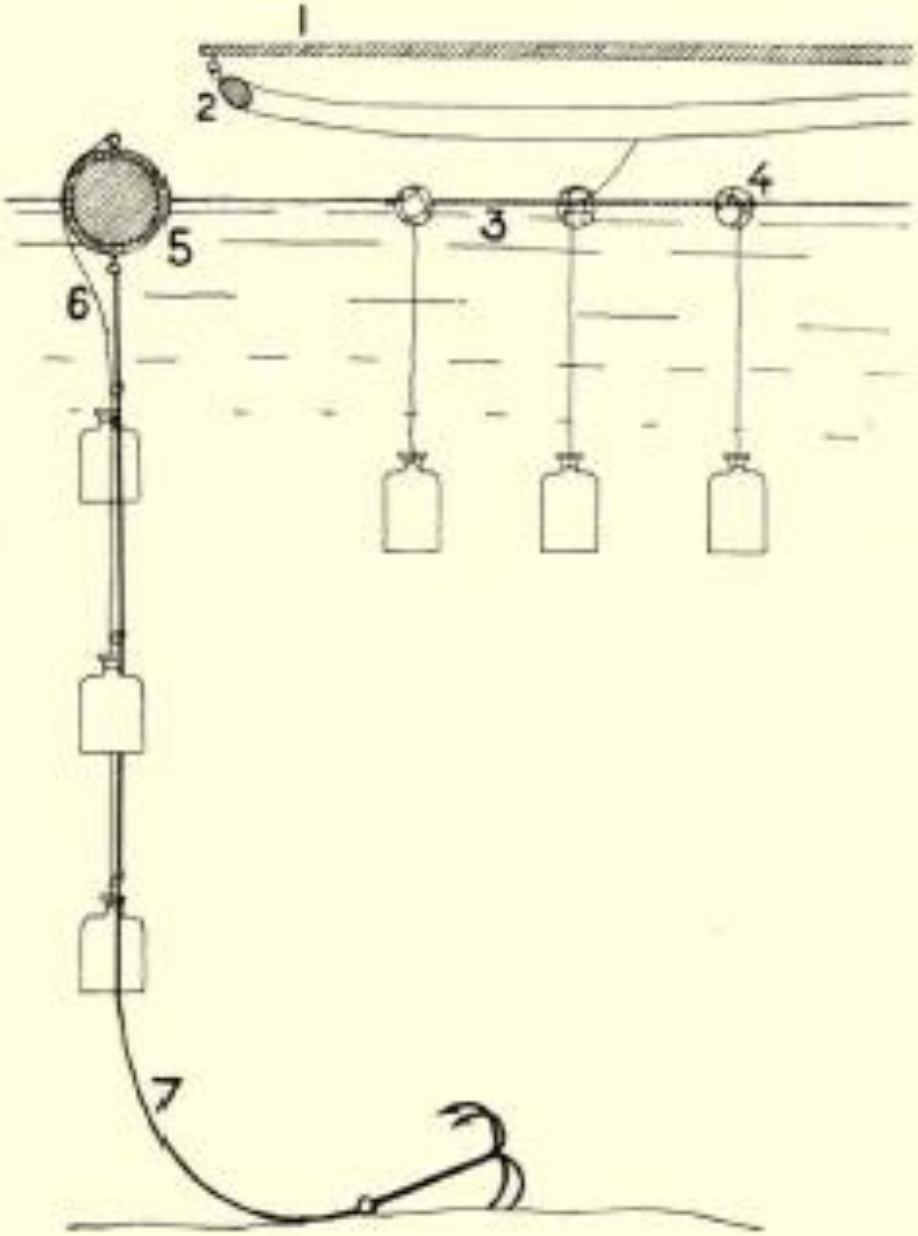

Fig. 1.

Typical Light – Dark (GPP) values per mg chl. (J.D.H. Strickland, 1960)

TABLE VIII. Relation of gross photosynthesis to pigment content.

Approximate mg C/hour synthesised per mg chlorophyll at optimum light	Reference	Remarks
3	Gessner, 1949	Mean value for natural lake populations
1–2	Holmes, 1957	Incubator values for natural marine populations
1–6.5	Clendenning *et al.*, 1956	Cultures of Chlorophyceae and Myxophyceae
ca 4.5	Currie, 1957	Maximum in euphotic zone; all pigments added together
ca. 4.5	Edmondson, 1956	Assuming a tenth of daily value at *ca* 0.13 ly/min
ca. 1	Fleischer, 1935	Light intensity uncertain but probably slightly greater than optimal. *Chlorella* cultures
4–6	Gessner, 1943	Lakes
2	Manning and Juday, 1941	Lakes
3	Riley, 1941b	Coastal water
6	Ryther and Yentsch, 1957	Average for coastal waters
5–10	Ryther and Yentsch, 1957	Various pure cultures
3	Ryther, 1956a	Culture of *Dunaliella euchlora*
4.5	Shimada, 1958	*Net* photosynthesis at a light intensity probably sub-optimal

Some considerations for incubation net-P estimates

- Precision ~±0.5 umol/L for Winkler
- Precision typically > ±1.0 umol/L for optodes
- Error terms
  - Bubble entrainment/ supersaturation
  - Precision of O_2 measurement
  - Temperature effects
  - Presence of heterotrophs
  - Bottle effects
  - Uncertainty in PQ

Brief review of newer automated systems to study dissolved oxygen variability

Langdon Rig
from Langdon et al, 1995

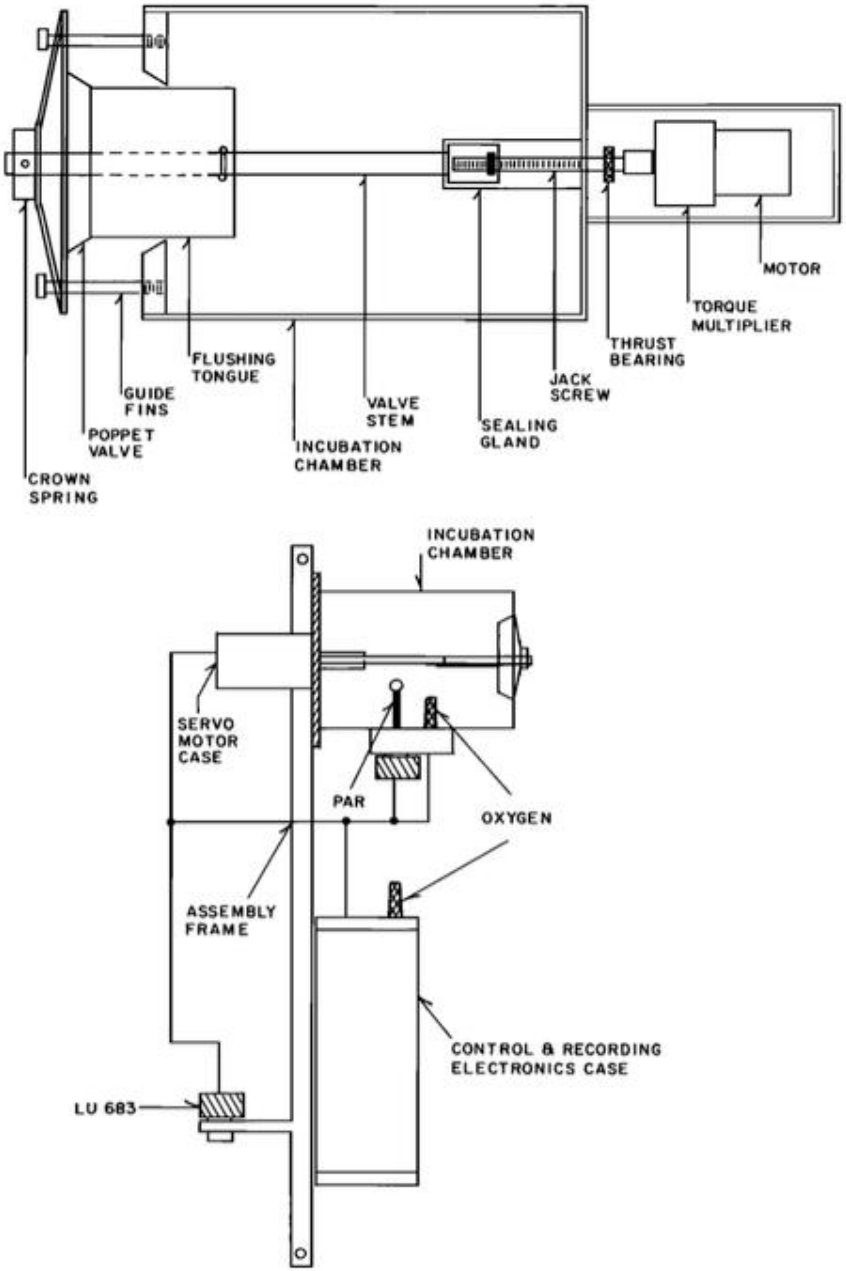

Figure 1. Drawing of a productivity autosampler, showing the layout of the components.

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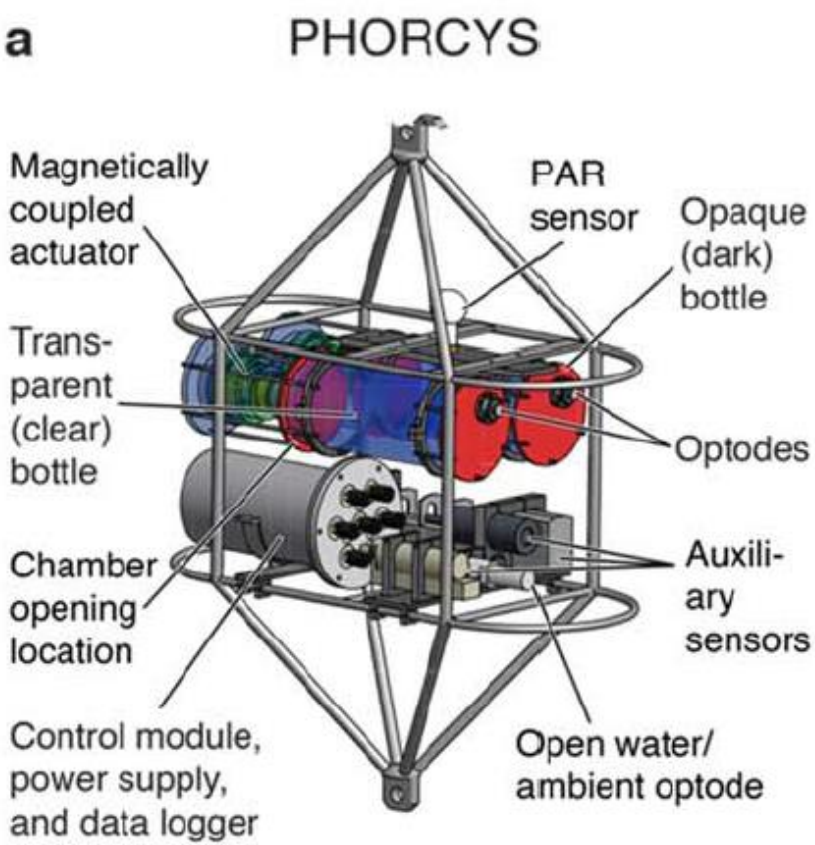
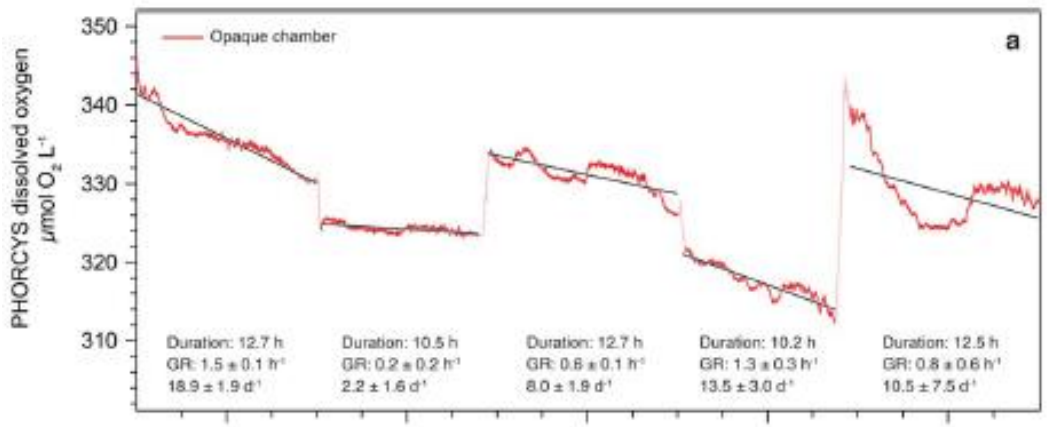
An autonomous, in situ light-dark bottle device for determining community respiration and net community production

James R. Collins,[1,2*†] Paul D. Fucile,[3] Glenn McDonald,[4] Justin E. Ossolinski,[2] Richard G. Keil,[5] James R. Valdes,[3] Scott C. Doney,[2‡] Benjamin A. S. Van Mooy[2*]

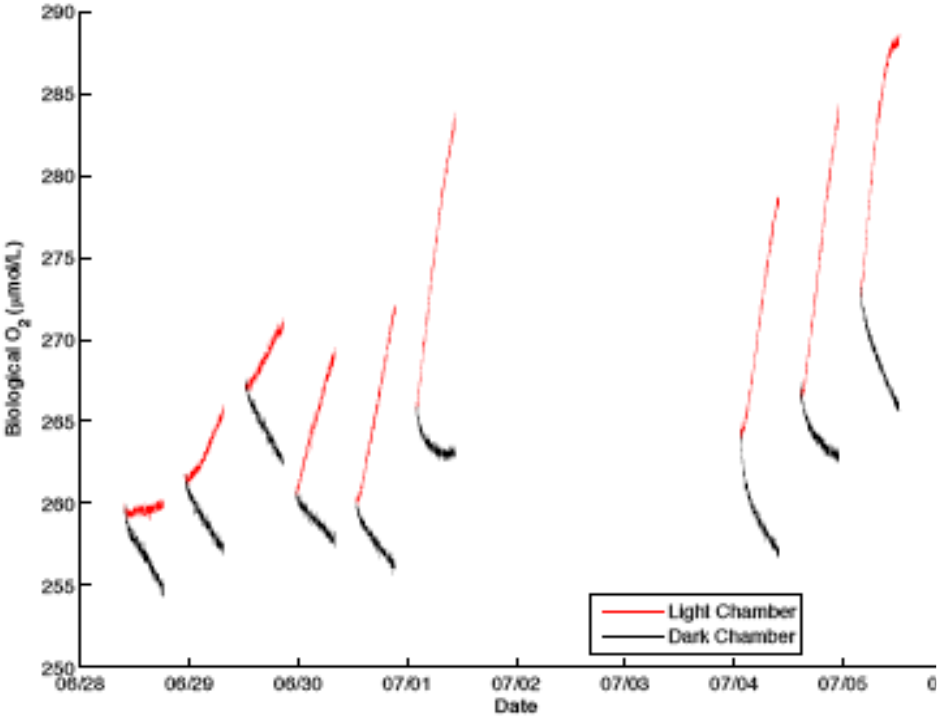


Dark bottle data

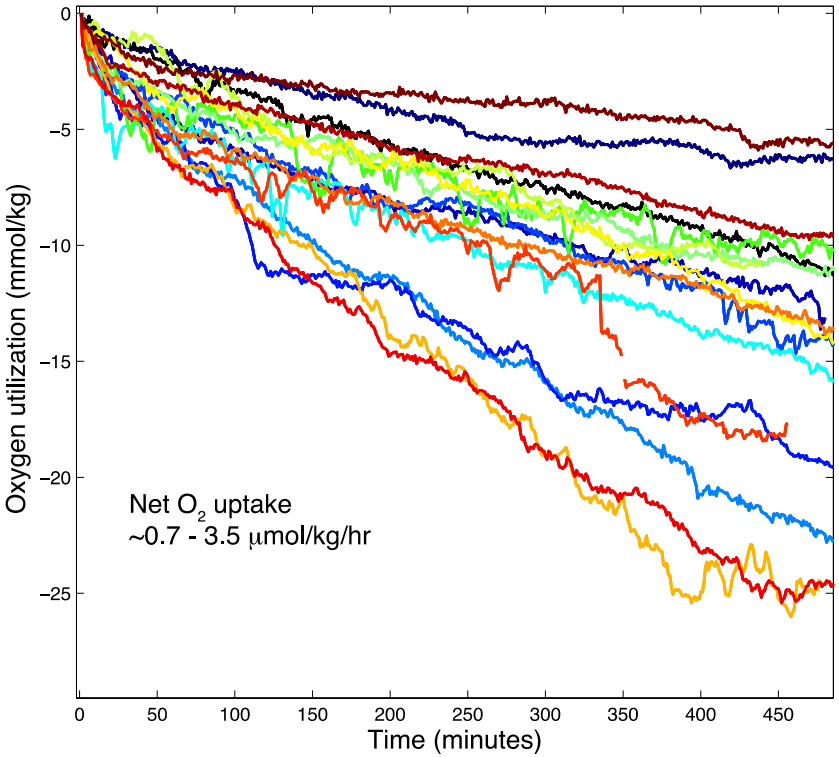


UNH data from automated incubation chambers

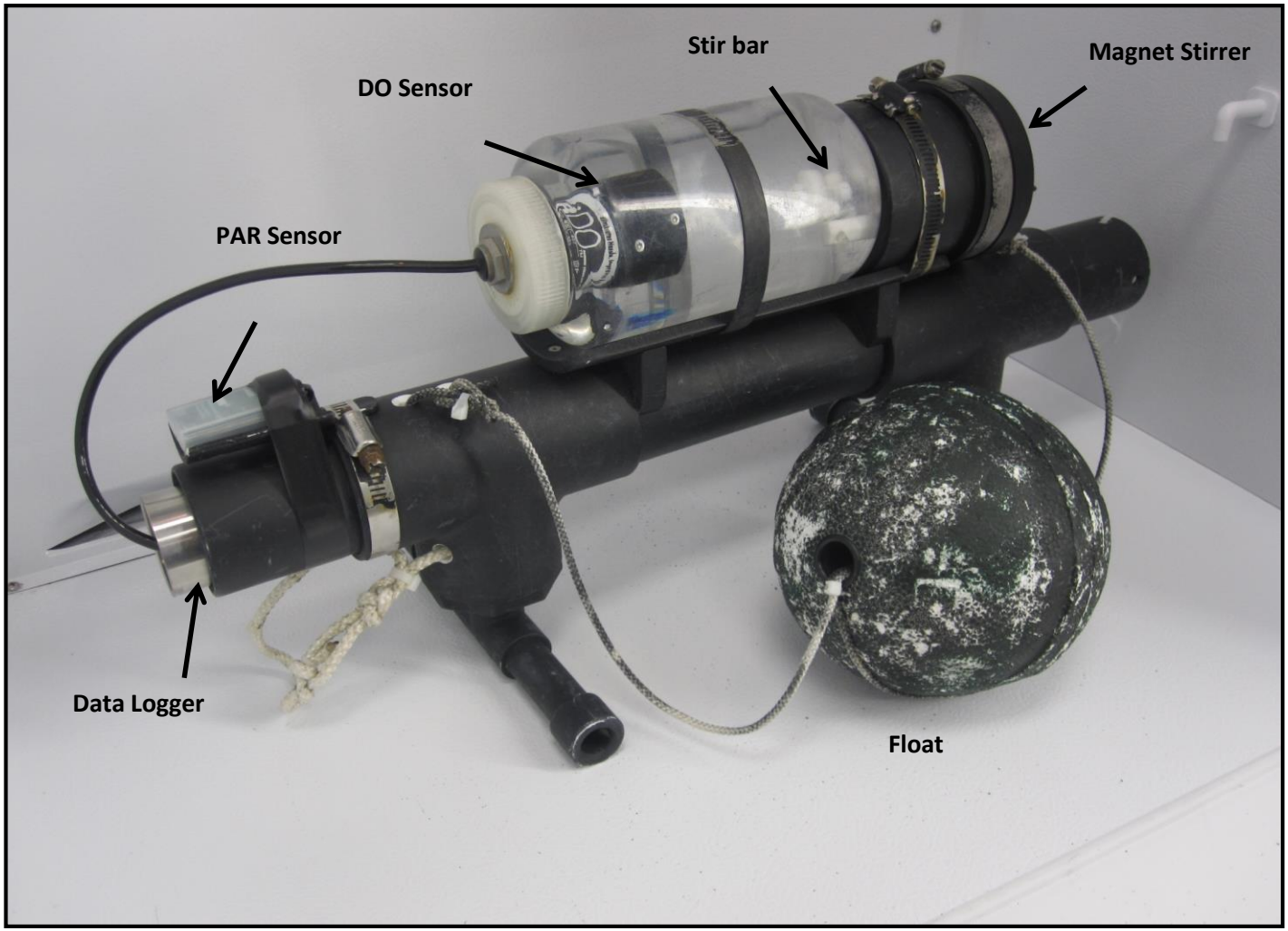
NCP and CR determinations at Fort Point, NH



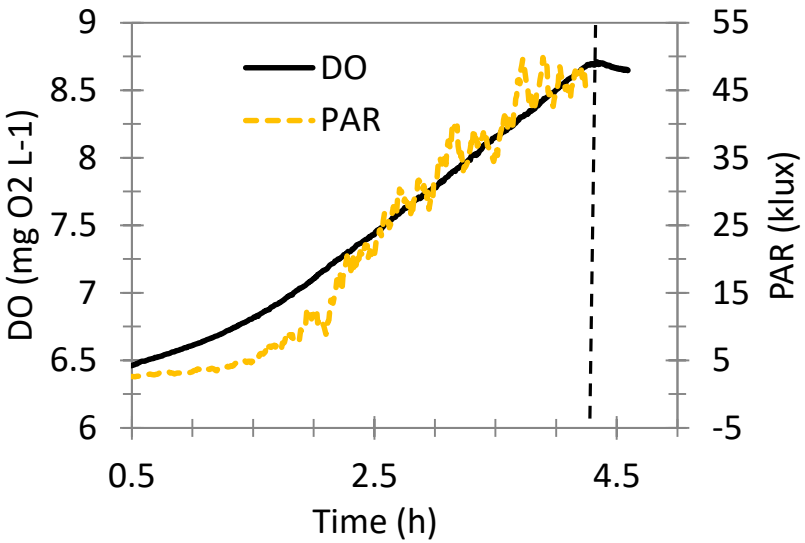
Respiration experiments on the NASA GOMEX campaign

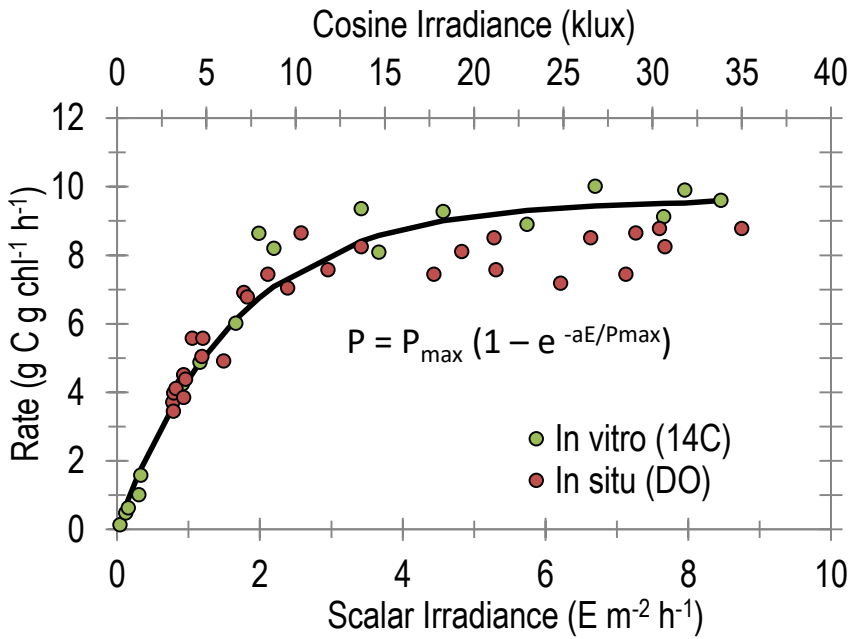


VanDermeulen Rig 1



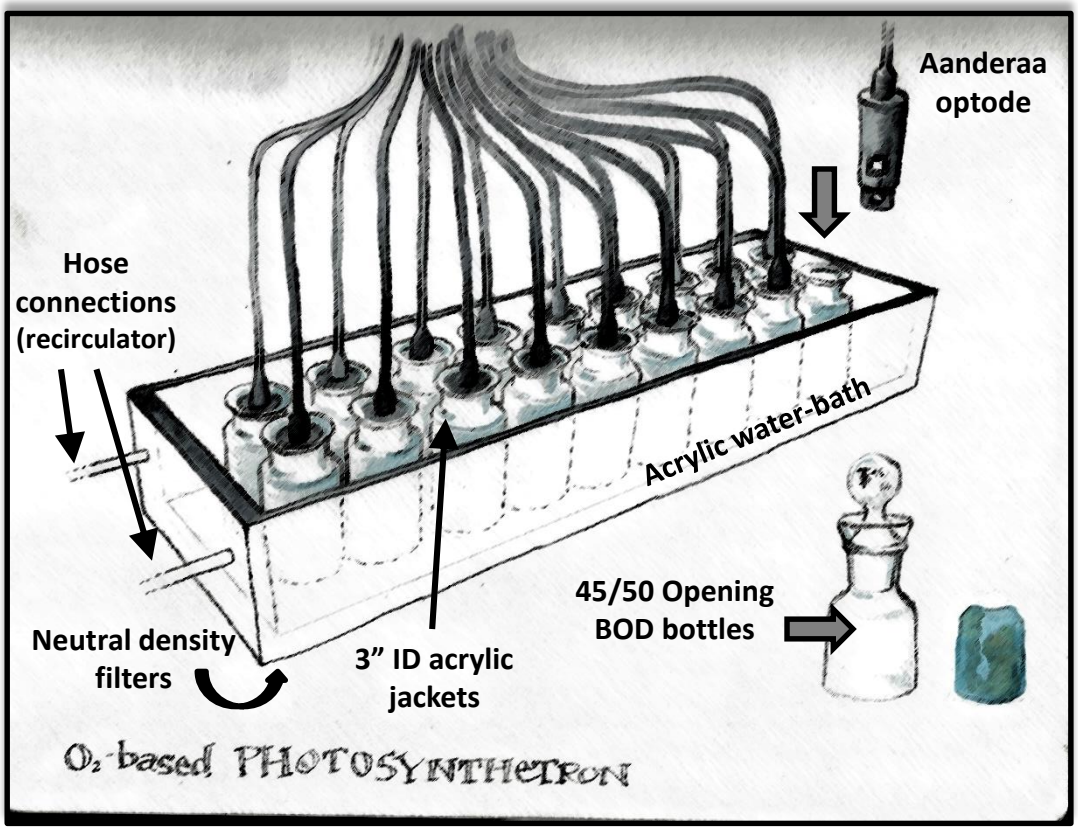
Vandermeulen Data
Oxygen GPP v. ^{14}Carbon





In situ oxygen and light data were used to construct a photosynthesis versus irradiance (P v. E) curve, by averaging the incident light and biological rates in five minute intervals, and plotting them as a function of one another.

Vandermeulen rig 2
Oxygen-based photosynthetron (under development)



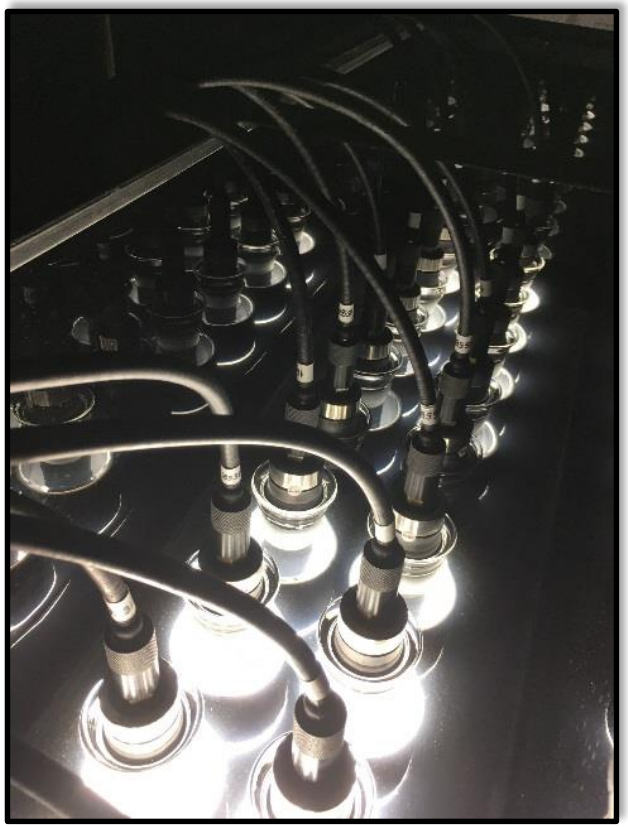
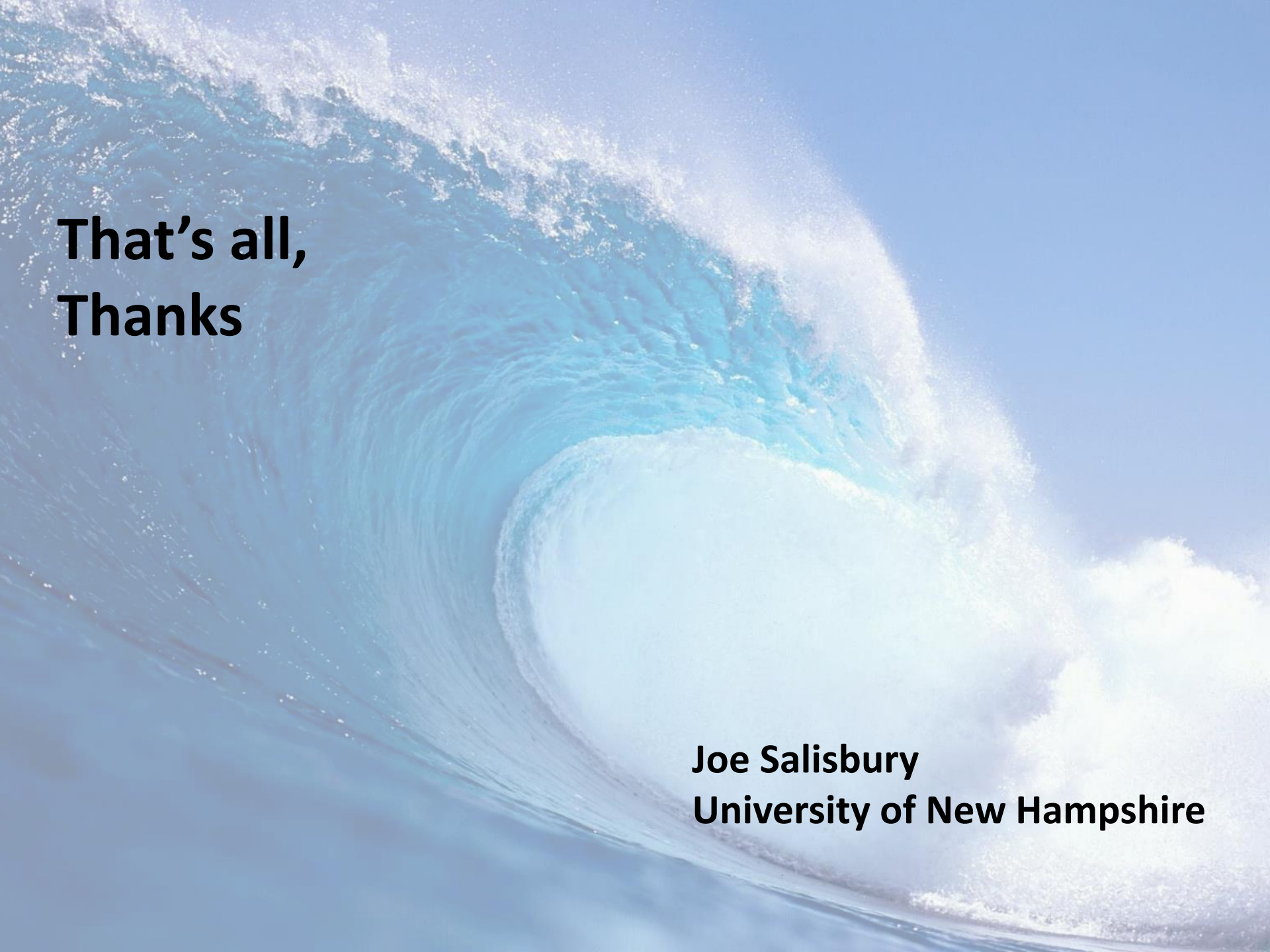


Illustration Credit: Kirsten Carlson



That's all, Thanks

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