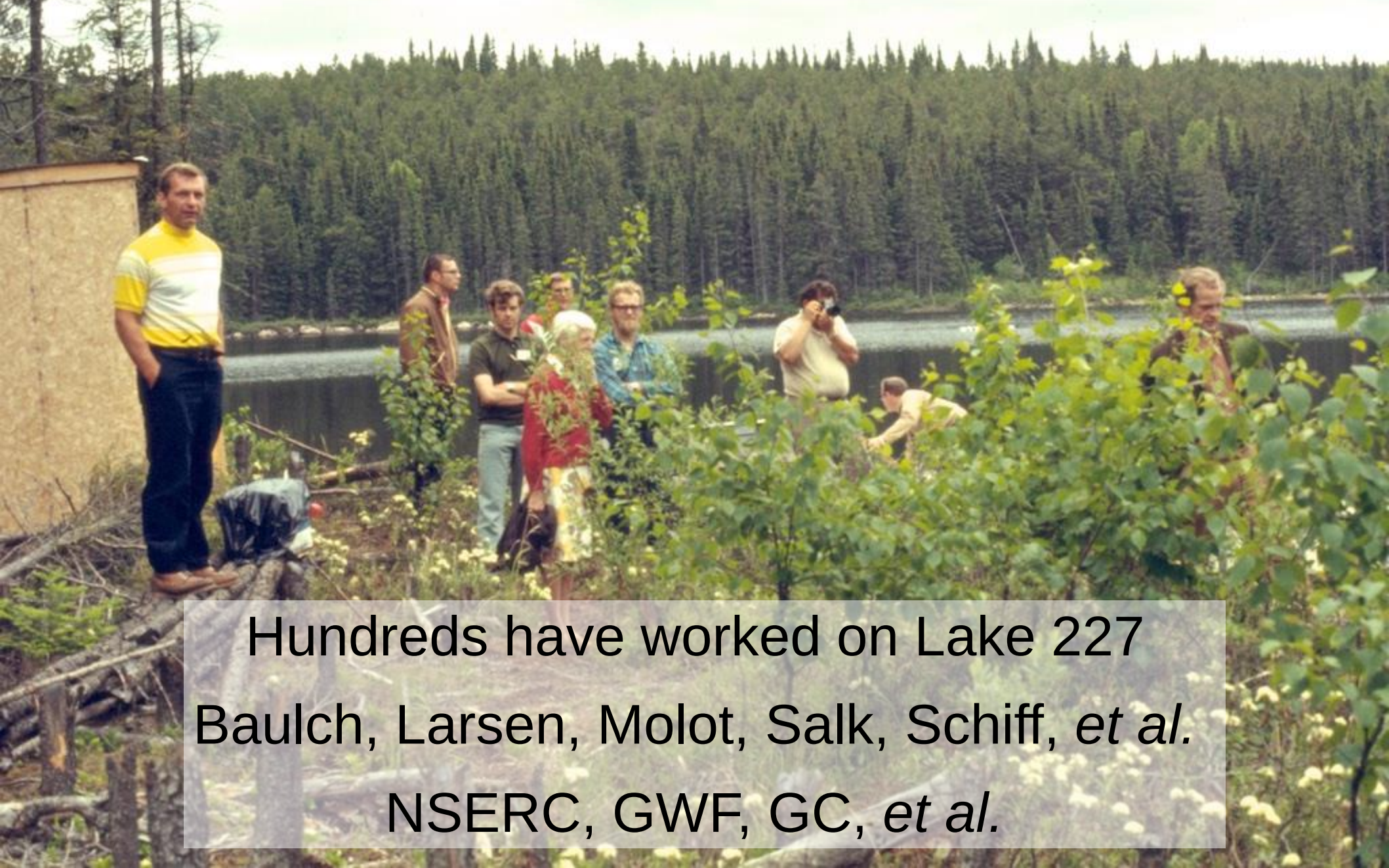
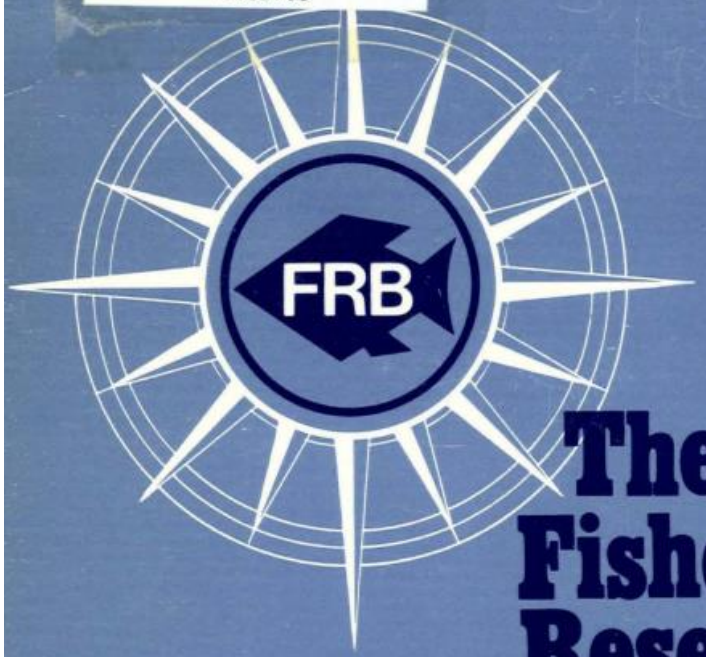

New Discoveries from Old Experiments
FORMBLOOM & REMEdiation
Photo: Bryanna Sherbo



Hundreds have worked on Lake 227

Baulch, Larsen, Molot, Salk, Schiff, *et al.*

NSERC, GWF, GC, *et al.*

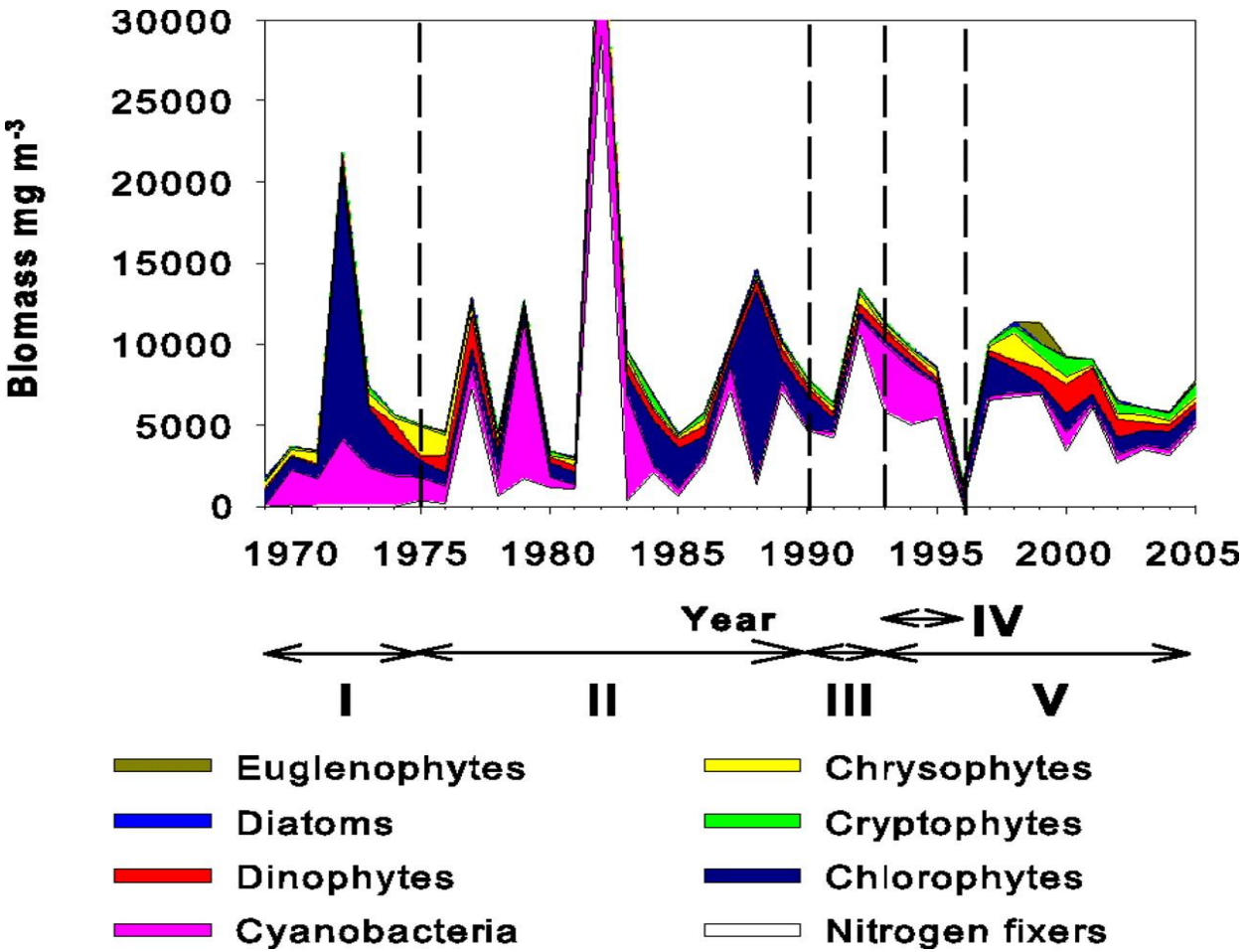


The Fisheries Research Board of Canada

What it is and what it does


227 history in 1 slide

Phytoplankton biomass in the epilimnion by algal group, 1969–2005.



David W. Schindler et al. PNAS 2008;105:32:11254-11258

Continue Lake 227?

- Unique

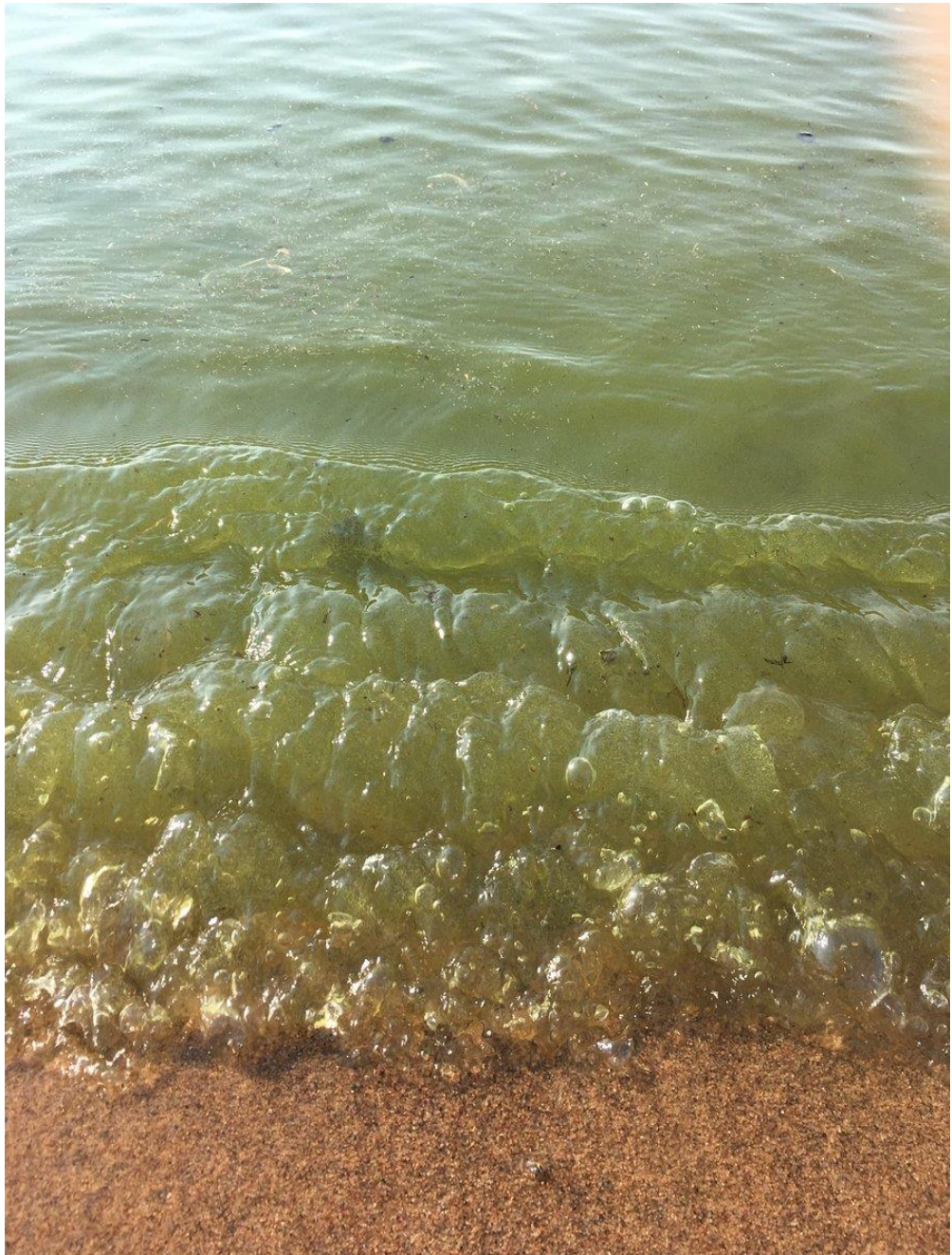


Photo: Brenda Lafrancois via @bobsterner

Continue Lake 227?

- Unique
- Lake Superior has blooms!

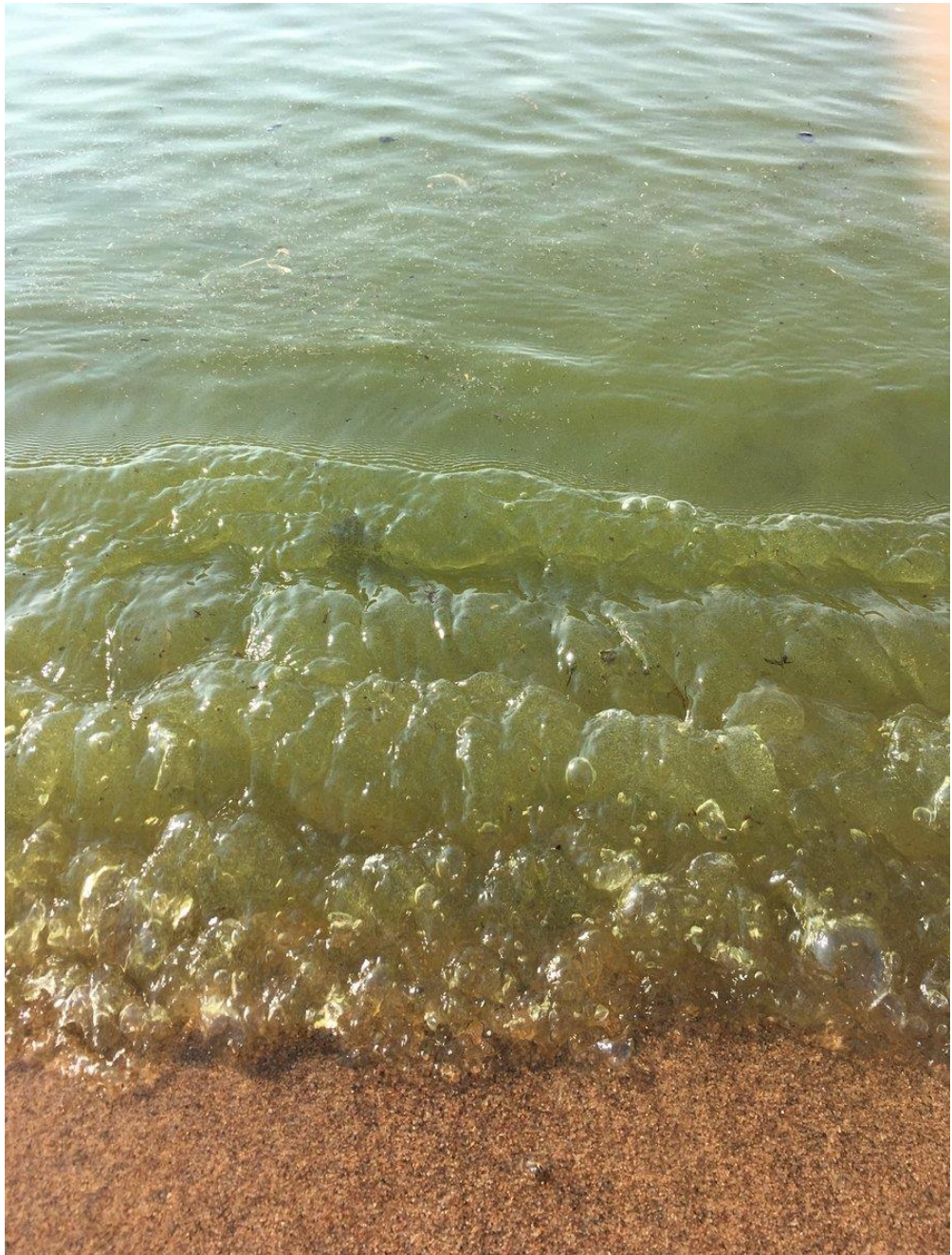
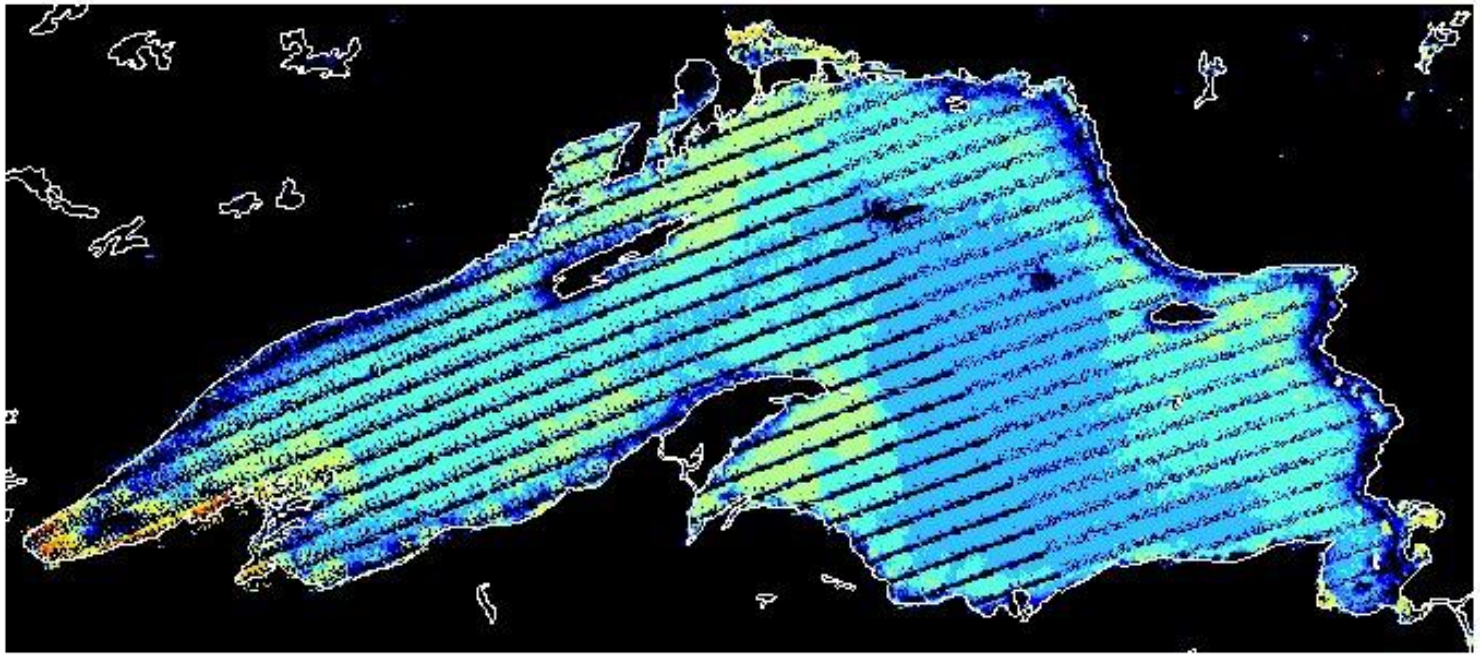


Photo: Brenda Lafrancois via @bobsterner

NOAA CoastWatch
Great Lakes

Lake Superior
7/31/2018 (JD 212)
VIIRS Science Quality

Color Producing Agent (CPA)
Chlorophyll



Chl (ug/L)
- 20+
- 15 - 20
- 8.0 - 15
- 4.0 - 8.0
- 2.0 - 4.0
- 1.5 - 2.0
- 1.0 - 1.5
- 0.5 - 1.0
- < 0.5

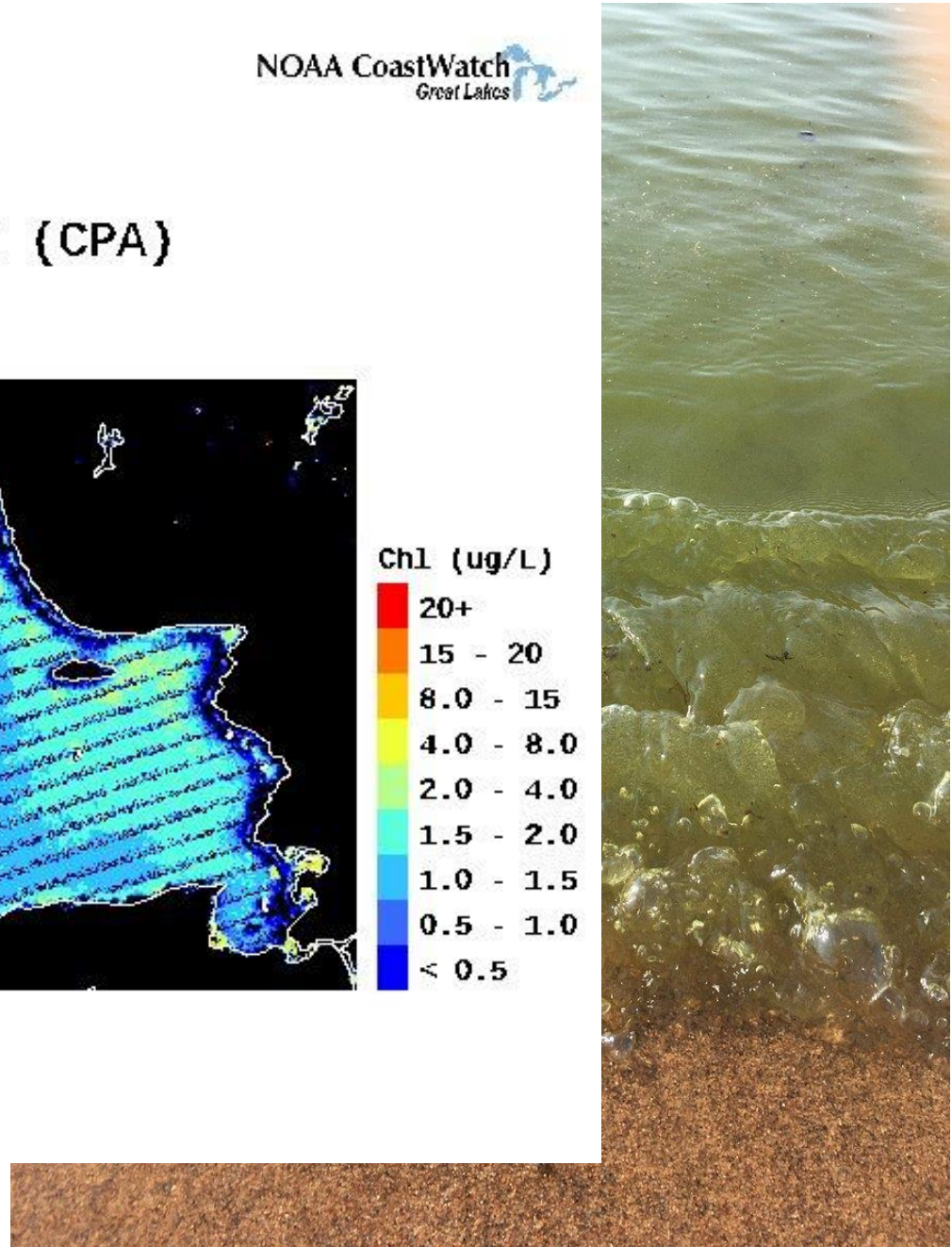
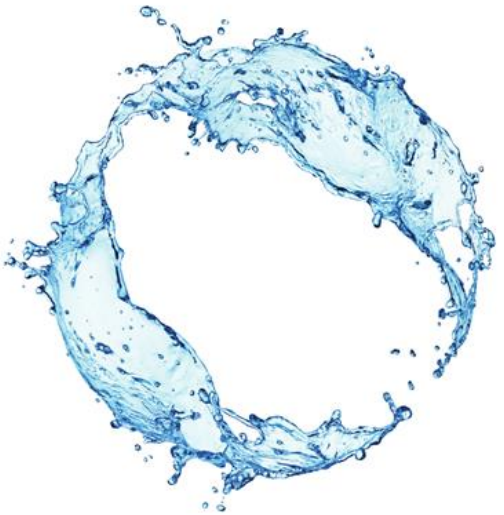


Photo: Brenda Lafrancois via @bobsterner

FORM  BLOOM

Reduce risk

Triggers

New technology

Short-term mitigation options

29 Seasonal Replicate Experiments

- P-only additions to Lake 227 (1990 to 2018)

- Slightly different climate forcings

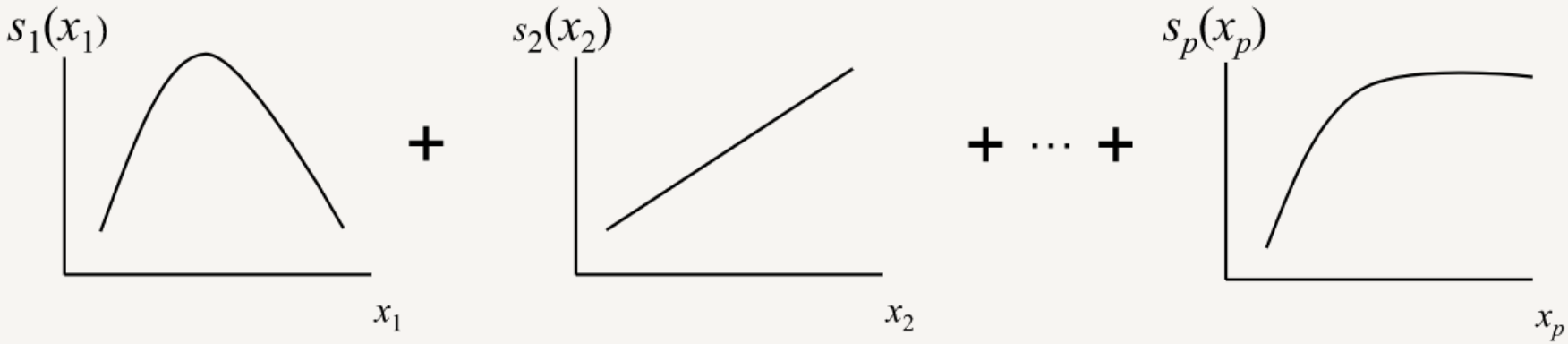
29 Seasonal Replicates

- A lot of data – *onset & collapse*

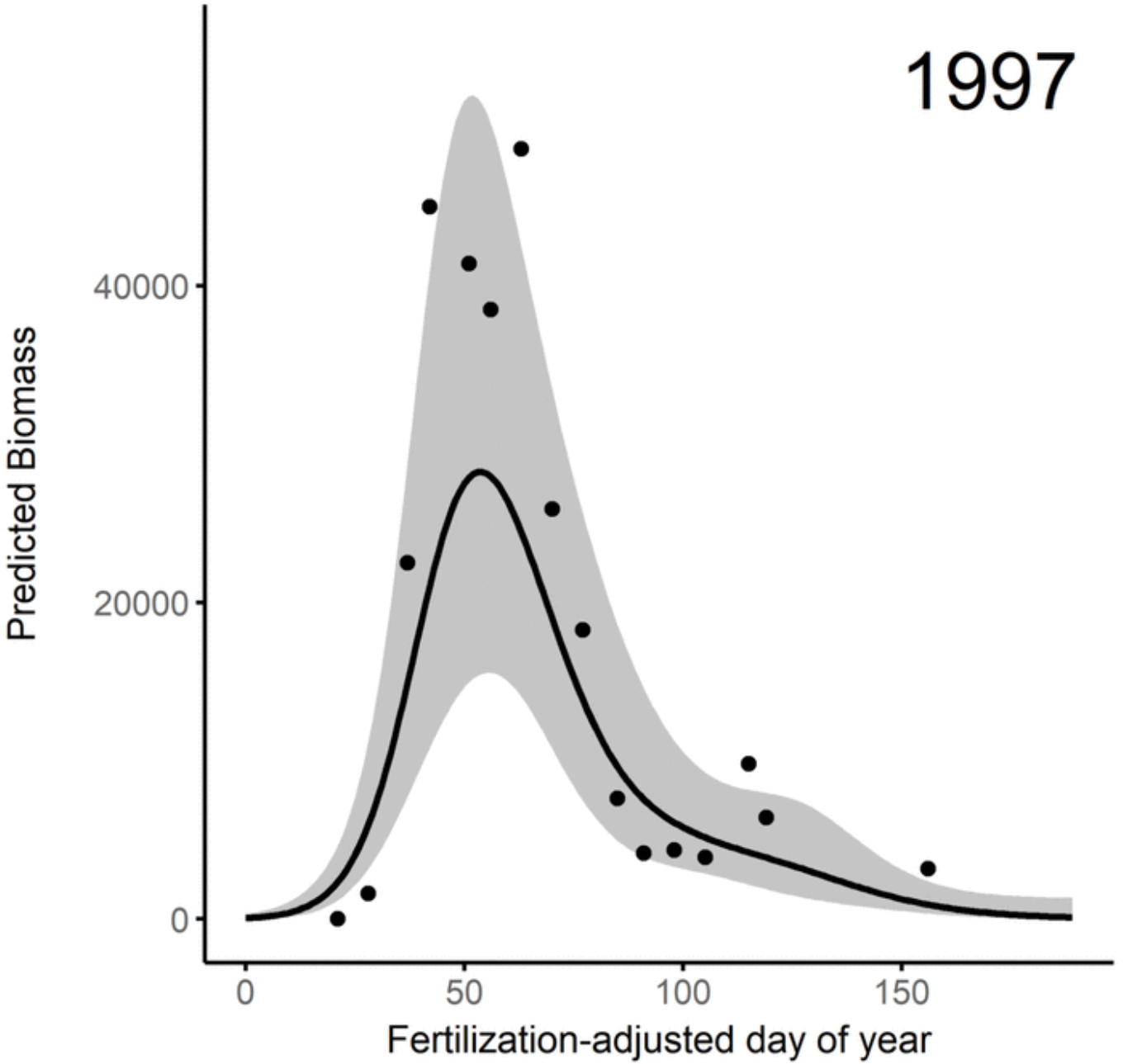
29 Seasonal Replicates

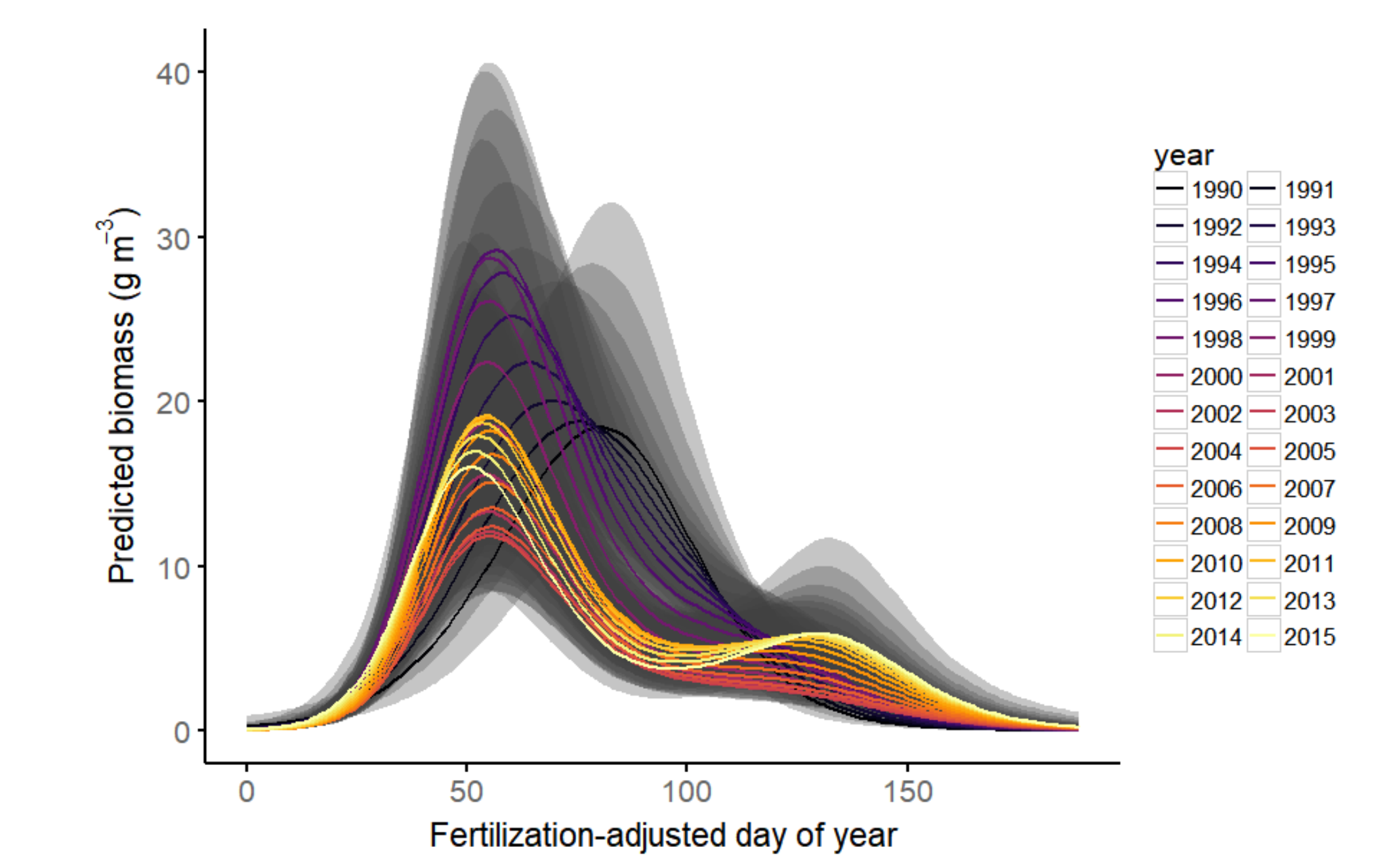
- A lot of data – *onset & collapse*

$$g(E(Y)) = s_1(x_1) + s_2(x_2) + \cdots + s_p(x_p)$$



Kim Larsen, formerly of Stitch Fix now of Uber

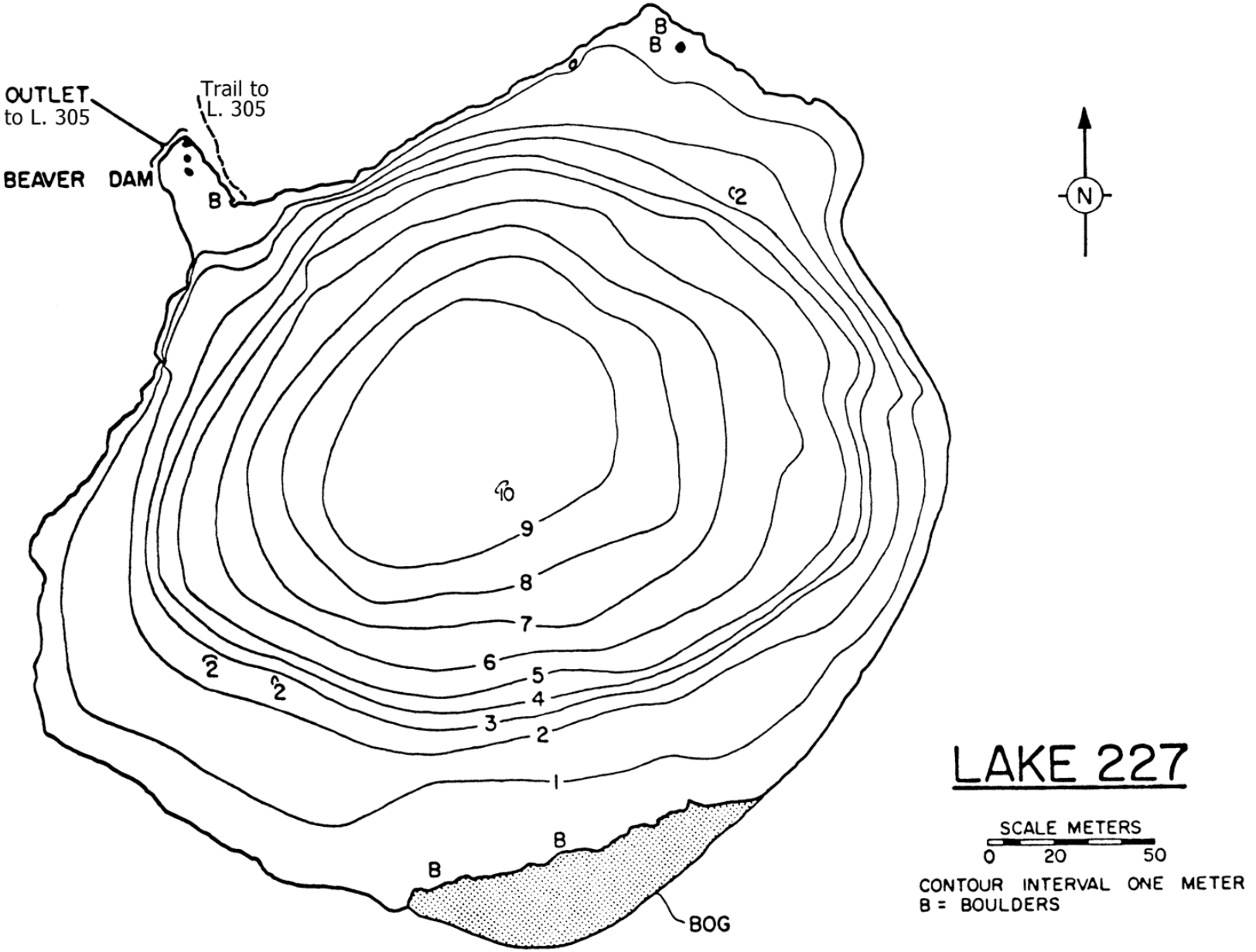

1997
Predicted Biomass
40000
20000
0
0
50
100
150
Fertilization-adjusted day of year


Predicted biomass (g m^{-3})
40
30
20
10
0
0
50
100
150
Fertilization-adjusted day of year
year
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015


what's going on
MARVIN GAYE
TAMLA
ORCHESTRA CONDUCTED
AND ARRANGED BY:
DAVID VAN DePITTE

New Discoveries from Old Experiments

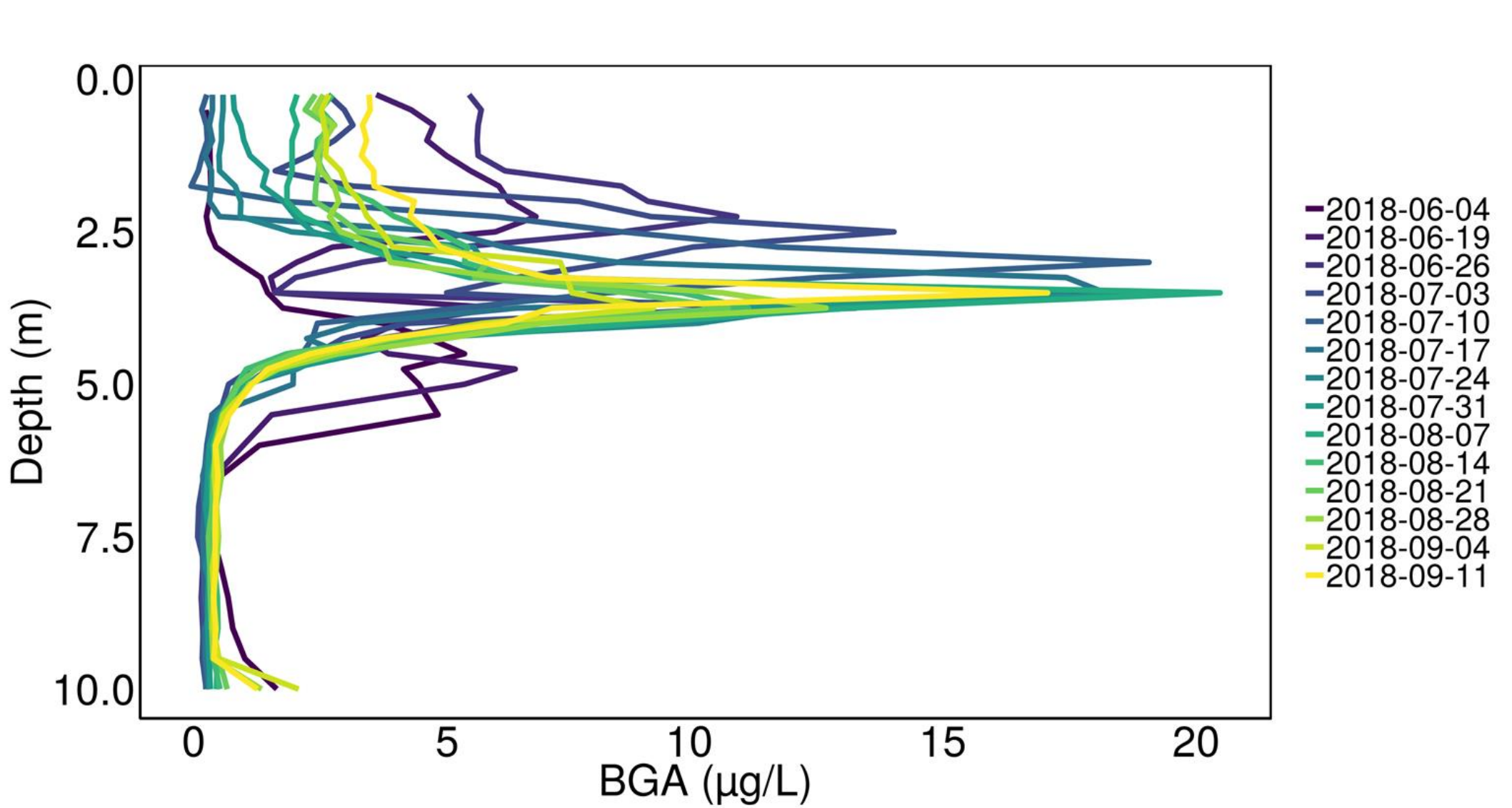
Time and *Space*

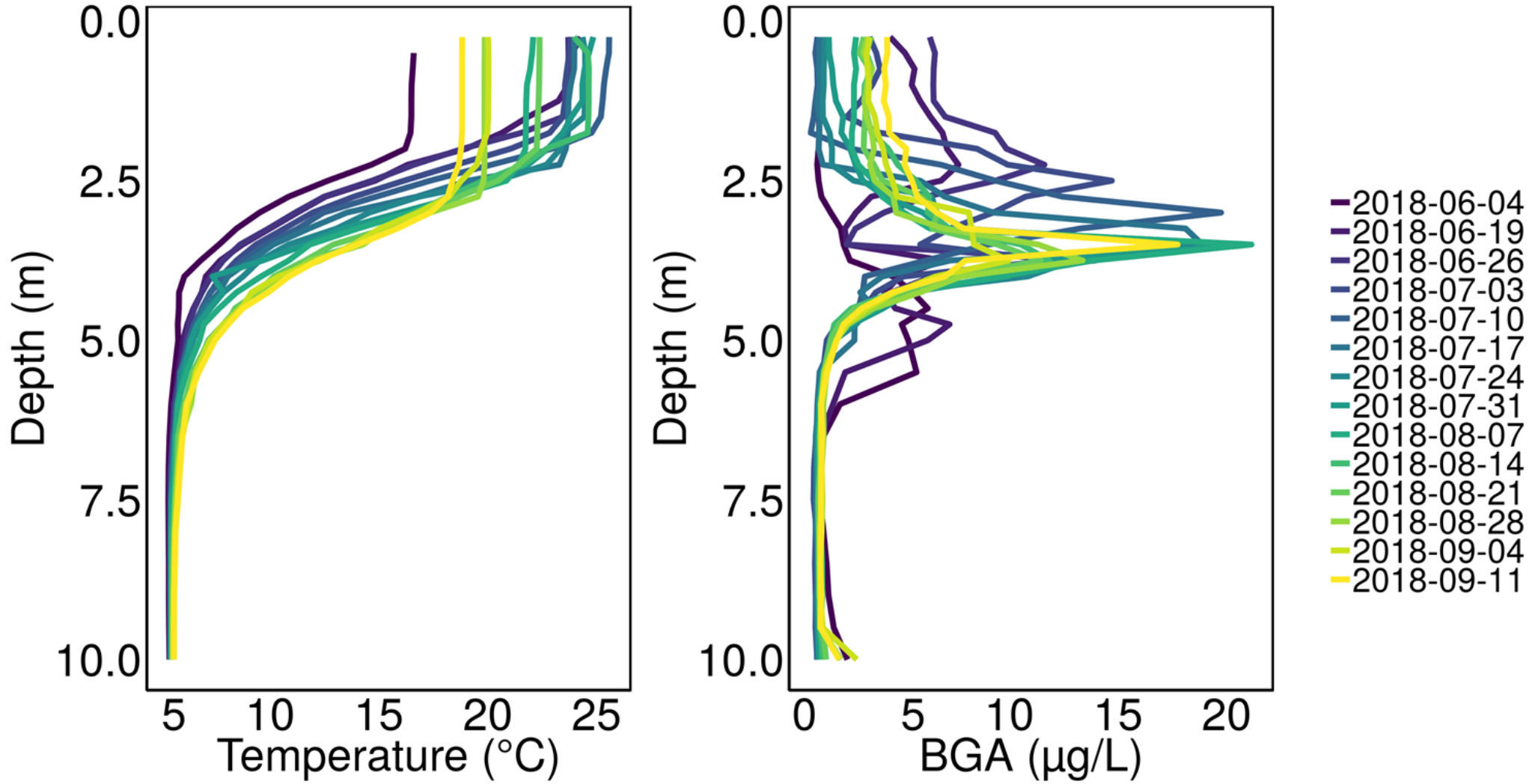


LAKE 227

SCALE METERS
0 20 50

CONTOUR INTERVAL ONE METER
B = BOULDERS


0.0
2.5
5.0
7.5
10.0
Depth (m)
0
5
10
15
20
BGA (µg/L)
2018-06-04
2018-06-19
2018-06-26
2018-07-03
2018-07-10
2018-07-17
2018-07-24
2018-07-31
2018-08-07
2018-08-14
2018-08-21
2018-08-28
2018-09-04
2018-09-11


0.0
2.5
5.0
7.5
10.0
Depth (m)
5
10
15
20
25
Temperature (°C)
0
5
10
15
20
BGA (µg/L)
2018-06-04
2018-06-19
2018-06-26
2018-07-03
2018-07-10
2018-07-17
2018-07-24
2018-07-31
2018-08-07
2018-08-14
2018-08-21
2018-08-28
2018-09-04
2018-09-11


Where to next?

Role of Fe in cyanos – beyond P&N

- *Phospho-ferrous hypothesis*
  - P controls amount
  - Fe controls species

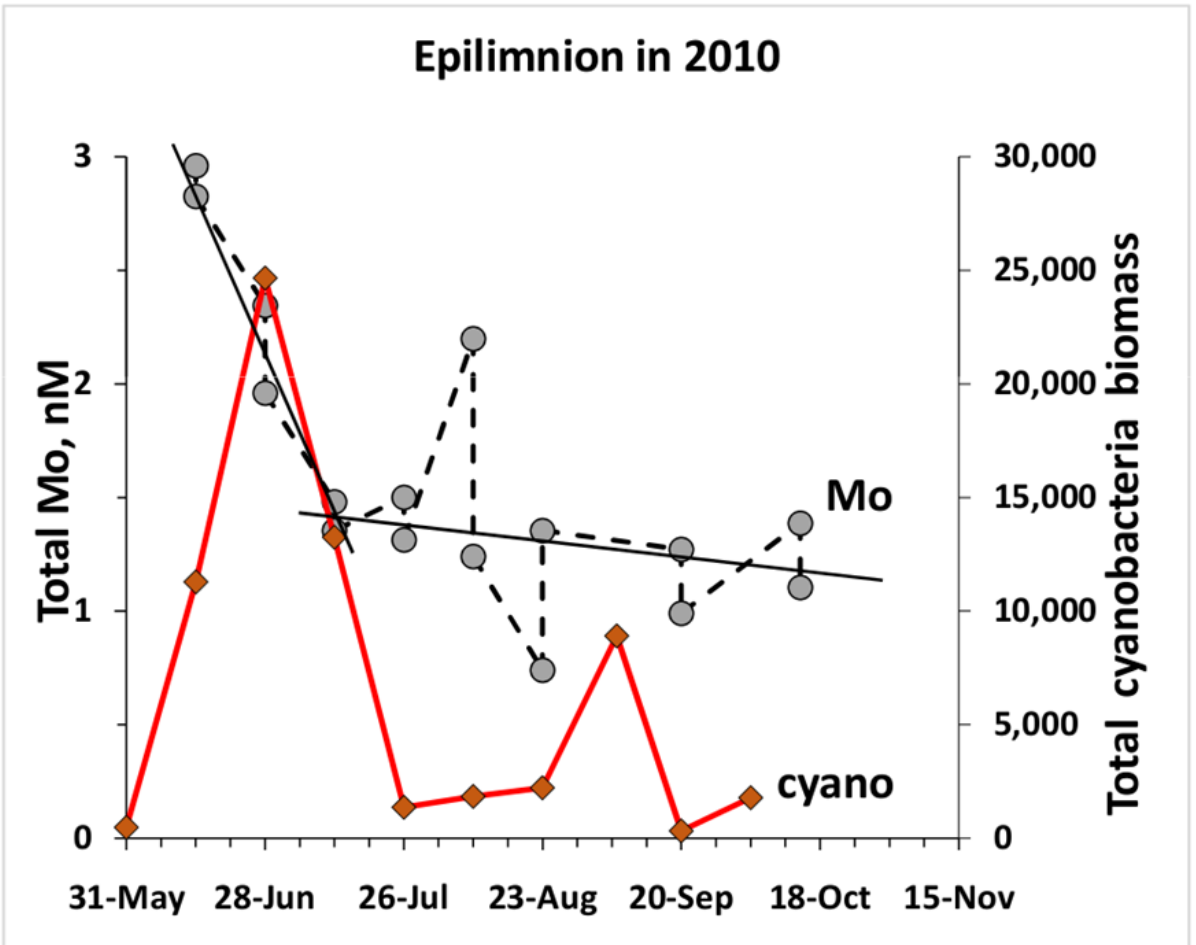
Molot et al. 2014 Freshwater Biology; Verschoor et al. 2017 CJFAS

Role of Fe in cyanos – beyond P&N

- *Phospho-ferrous hypothesis*
  - P controls amount
  - Fe controls species
- Where is the iron?
- Ferrous switch between cyanos and eukaryotes?

Molot et al. 2014 Freshwater Biology; Verschoor et al. 2017 CJFAS

Aphanizomenon bloom in Lake 227 shut off in early summer. Was this because of low Mo?



Total Mo declined 50% to 1.5 nM during 28 day bloom period.

Would bloom have lasted longer if Mo was higher?

Lewis Molot, York University

Trace Metals & Broad Applicability

- Can phytoplankton run out of metals for enzymes?

- Nitrogenase (Fe and FeMo)
- Nitrate reductase (Mo)
- Urease (Ni, Mn and Co in lab studies)

REMEdiation: Lakes 303 & 304

- *REdox and trace MEtal mitigation options for harmful algal blooms*

- Polymictic, P-loading patterns, metals
- Mechanistic tests


Where to now?