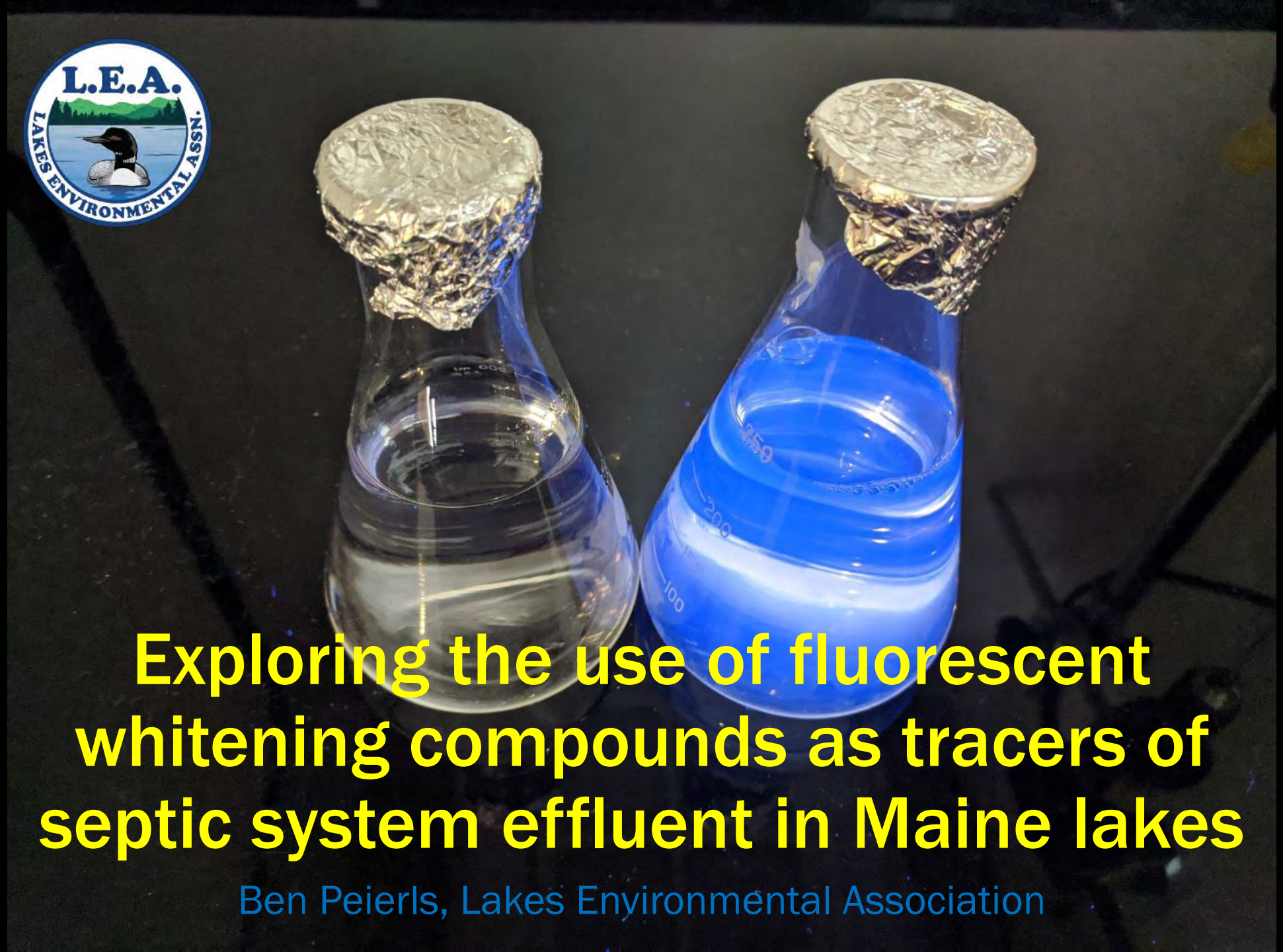
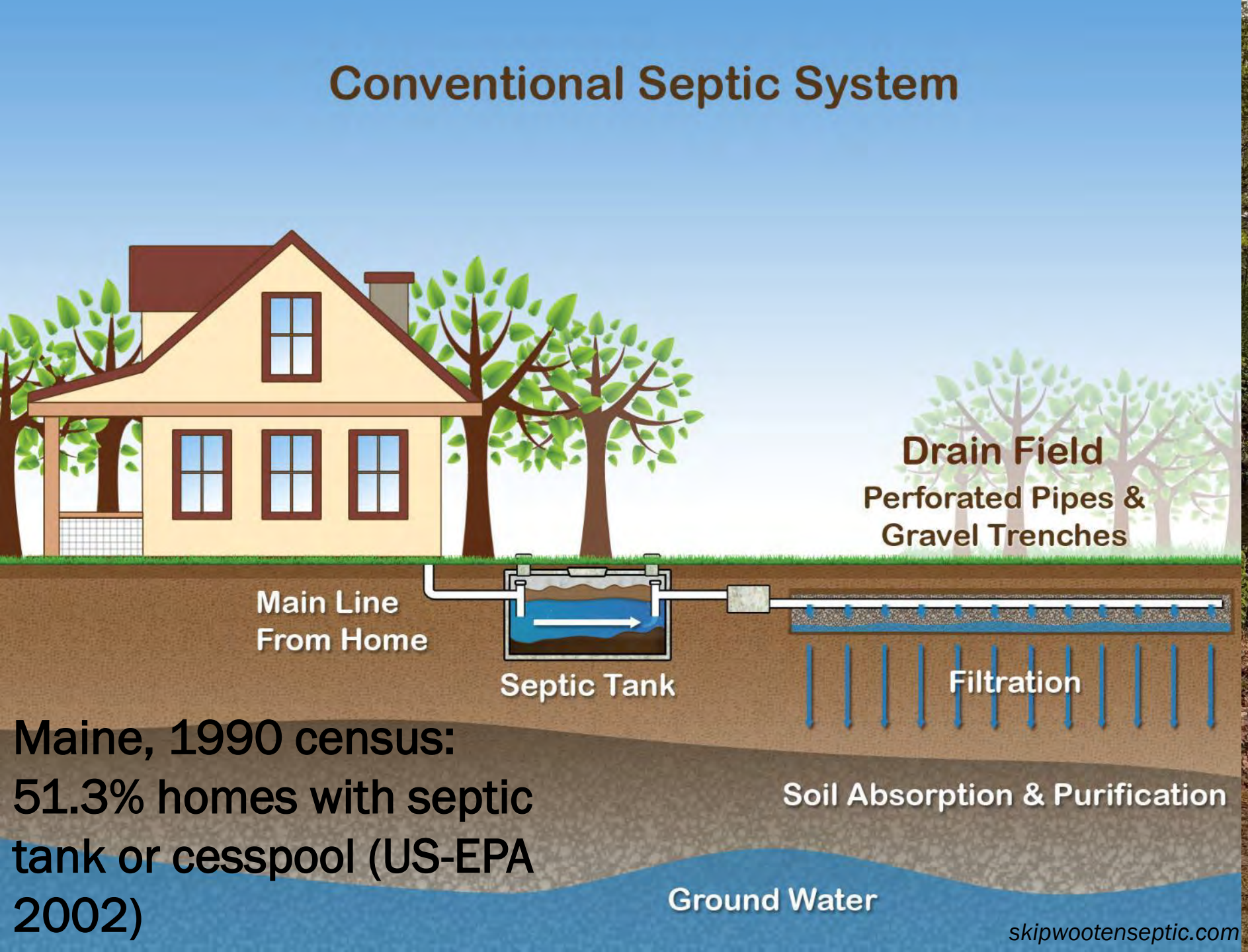


Exploring the use of fluorescent whitening compounds as tracers of septic system effluent in Maine lakes

Ben Peierls, Lakes Environmental Association



Maine, 1990 census:
51.3% homes with septic tank or cesspool (US-EPA 2002)

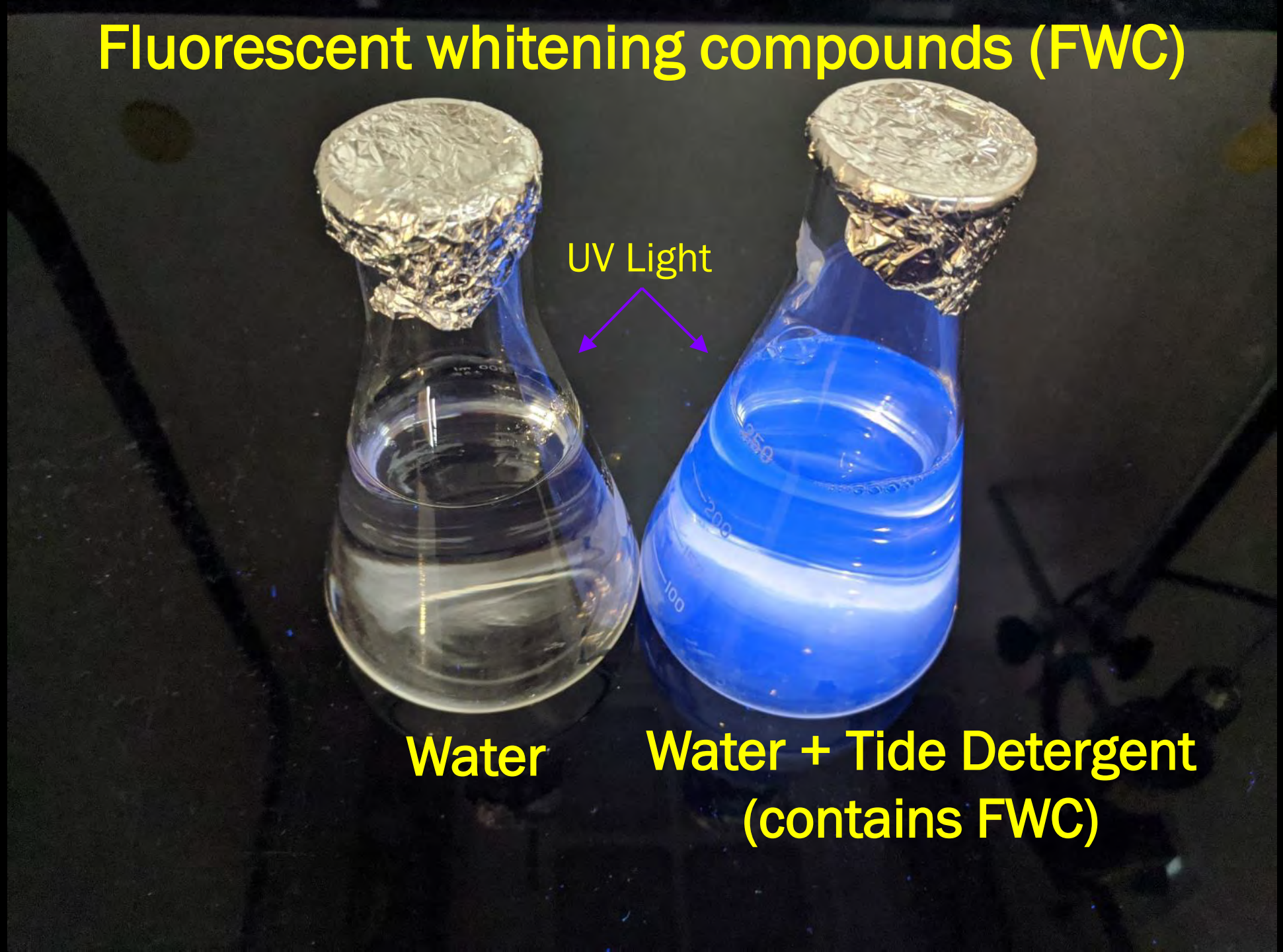
1. Nutrients (P, N)
2. Pathogens (bacteria, viruses)

commons.wikimedia.org/w/index.php?curid=8304442

Fecal Source Tracking:

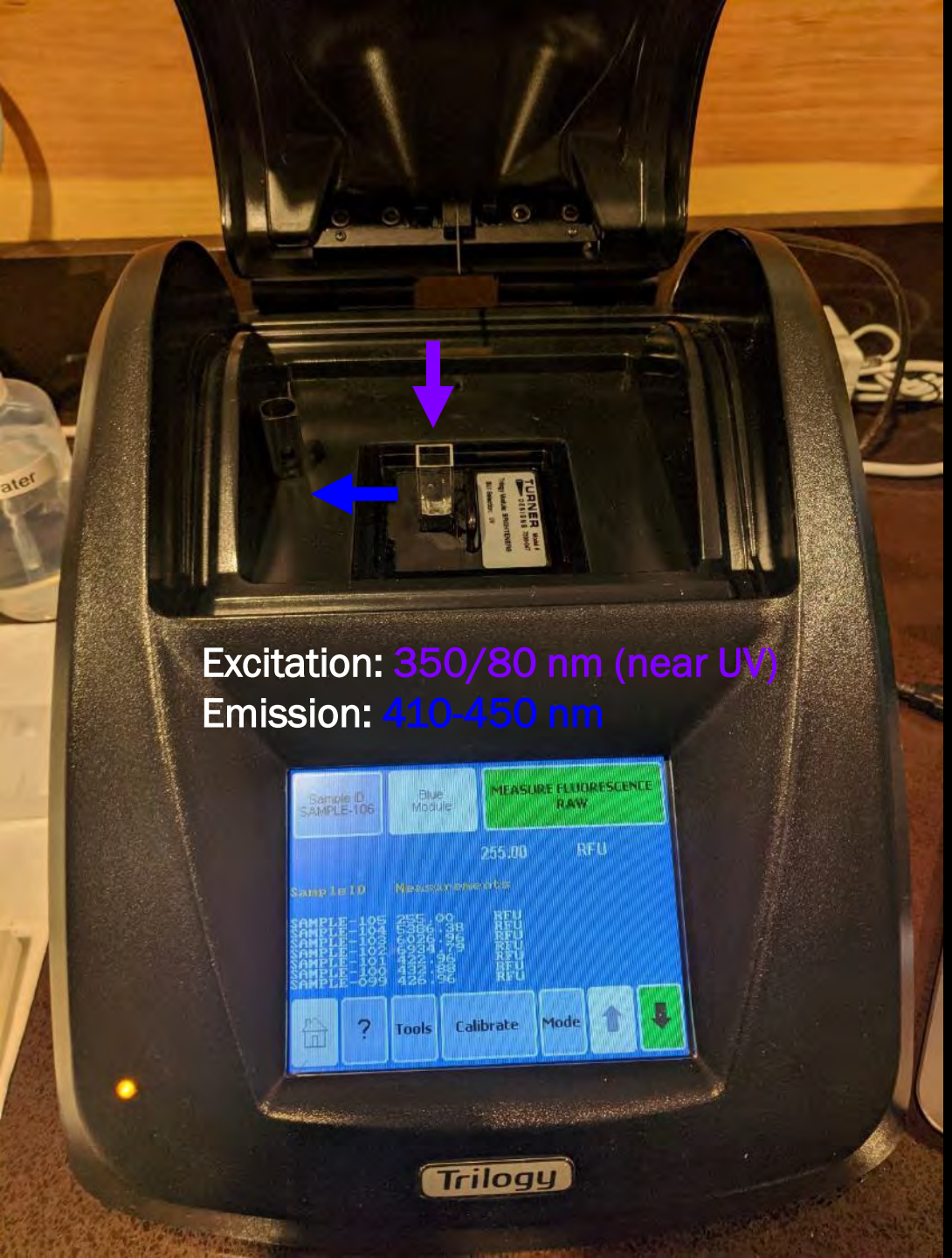
- Molecular methods (e.g., DNA/RNA, cultures)
- Chemical methods
  - Caffeine (see next talk by Brian DiMento)
  - Fluorescent whitening compounds (FWC), also known as optical brighteners

Fluorescent whitening compounds (FWC)



1. Nutrients (P, N)
2. Pathogens (bacteria, viruses)
3. Fluorescent whitening compounds

commons.wikimedia.org/w/index.php?curid=8304442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Emission: 410-450 nm
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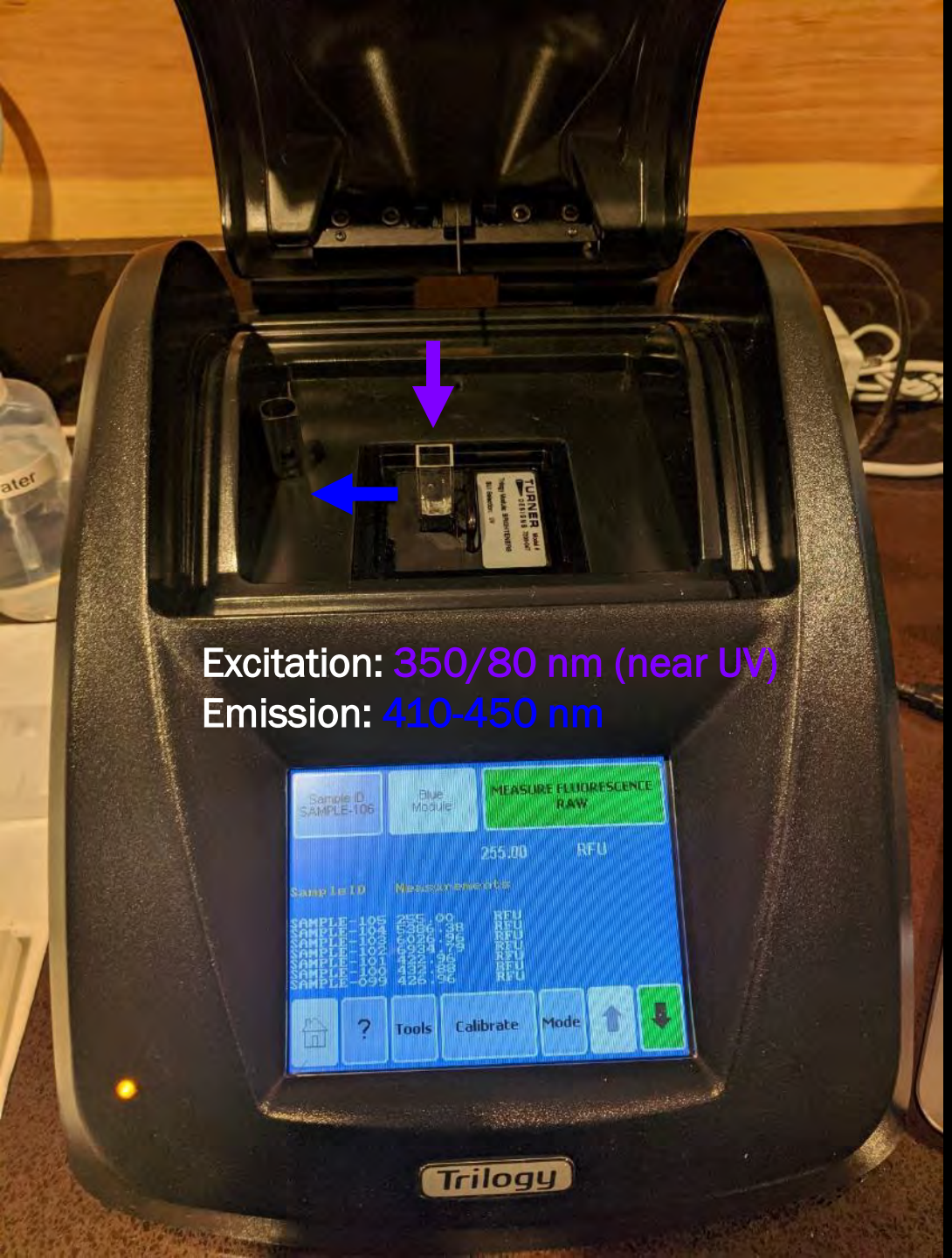
SAMPLE-106
Blue
Module
MEASURE FLUORESCENCE
RAW
255.00
RFU
Sample ID
SAMPLE-105
SAMPLE-104
SAMPLE-103
SAMPLE-102
SAMPLE-101
SAMPLE-100
SAMPLE-099
RFU
?
Tools
Calibrate
Mode
Trilogy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SAMPLE-102 5934.79 RFU
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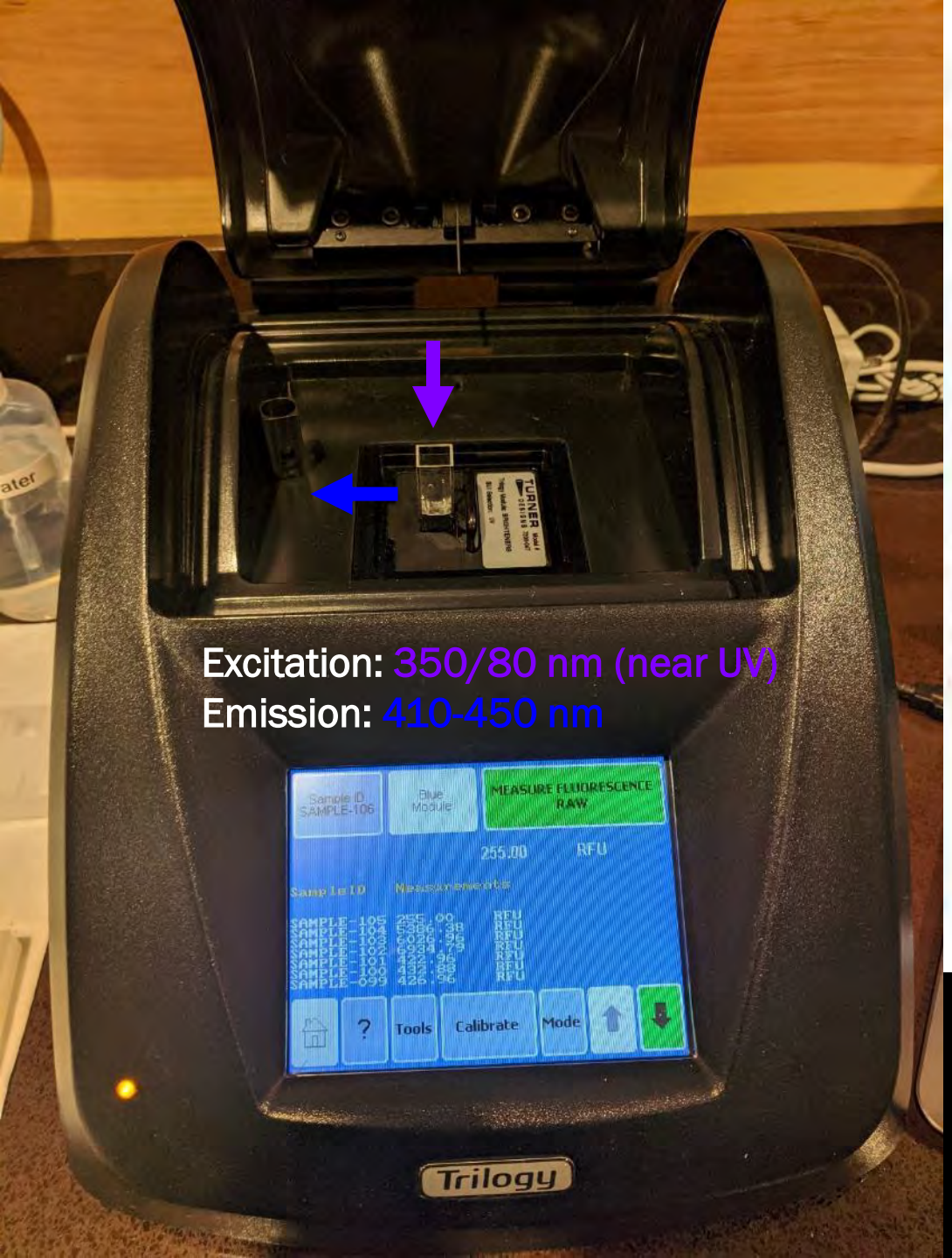
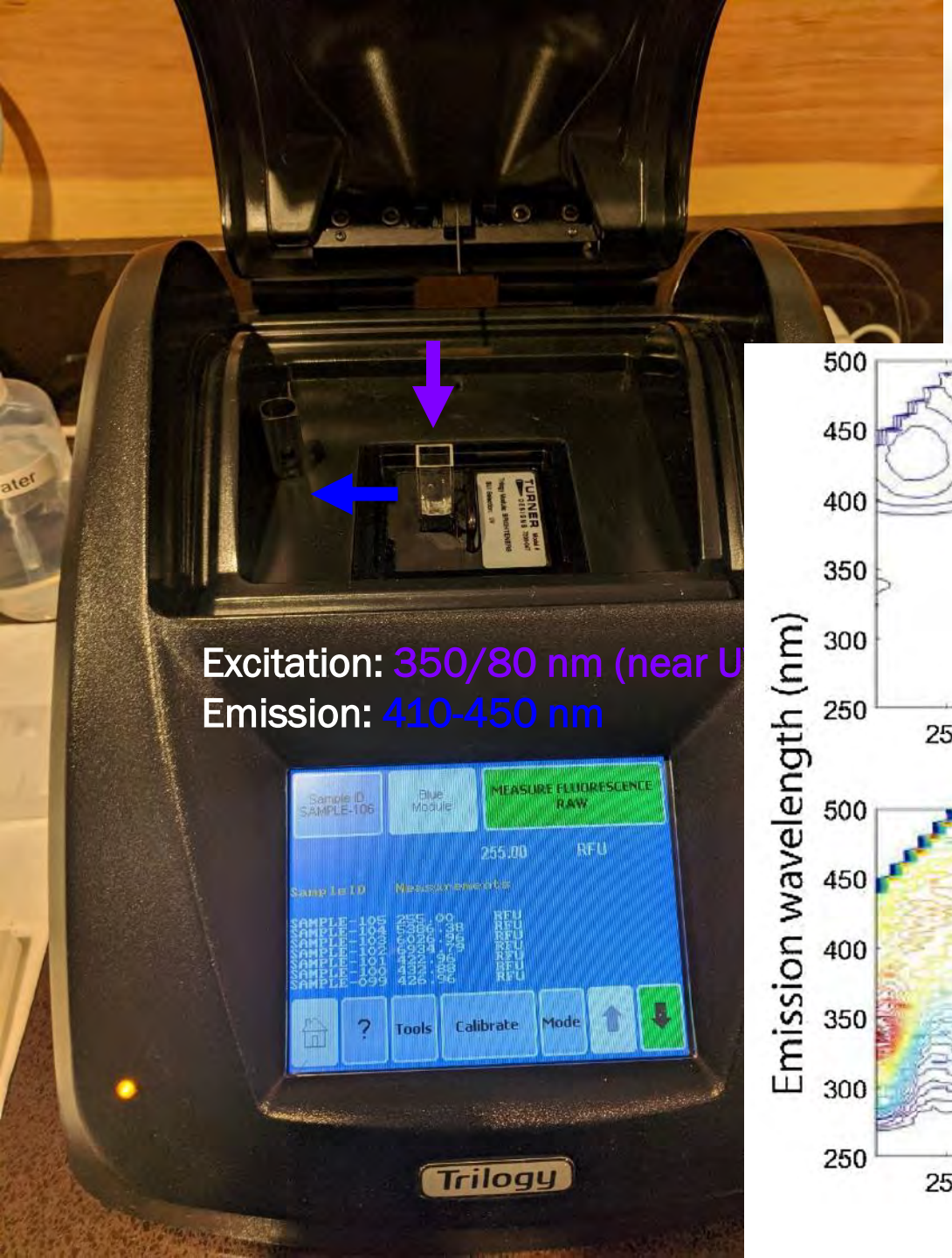
?
Tools
Calibrate
Mode
Trilogy

But...



Color caused by dissolved matter: tannins

www.usgs.gov



Color caused by dissolved matter: tannins

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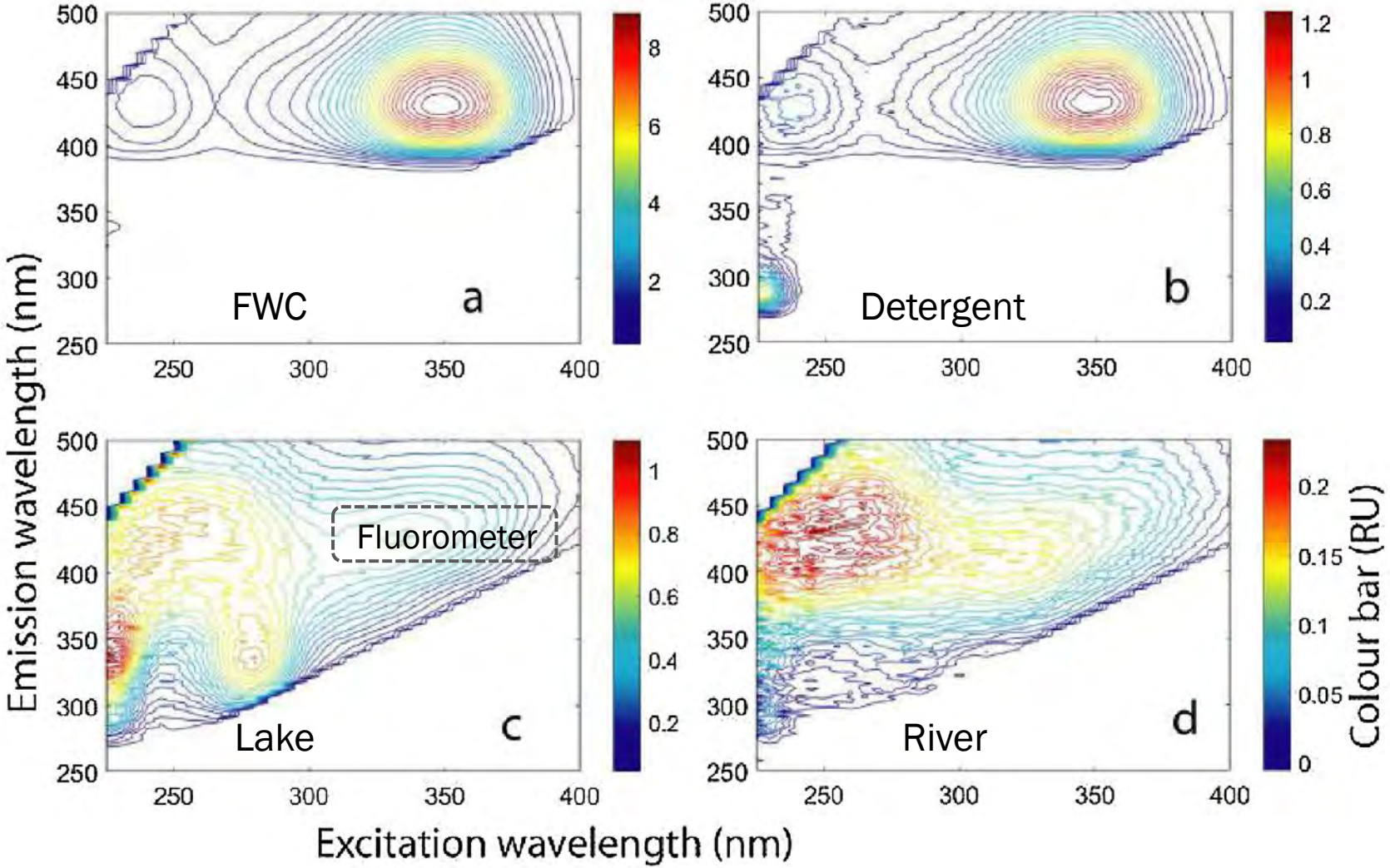
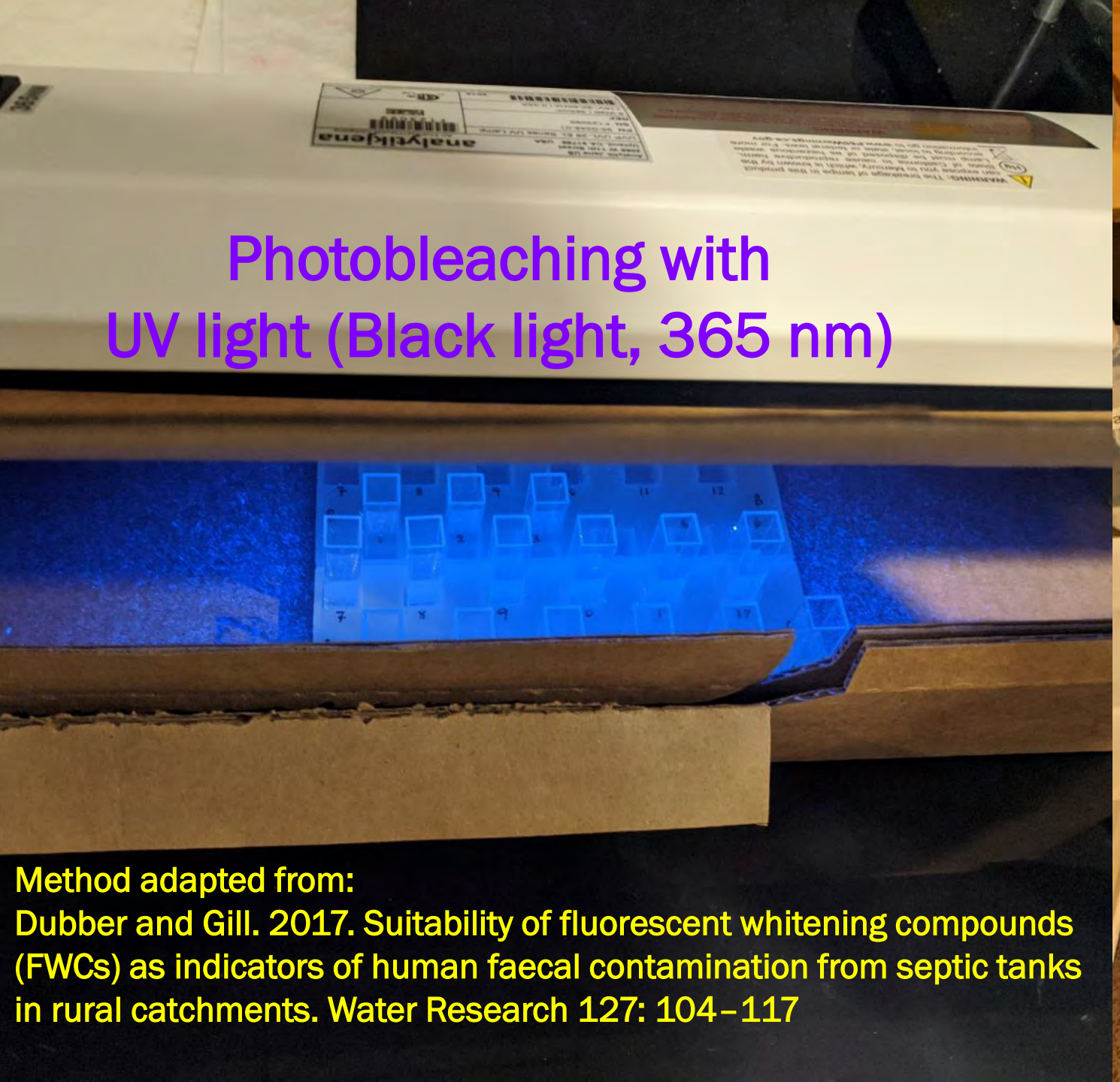
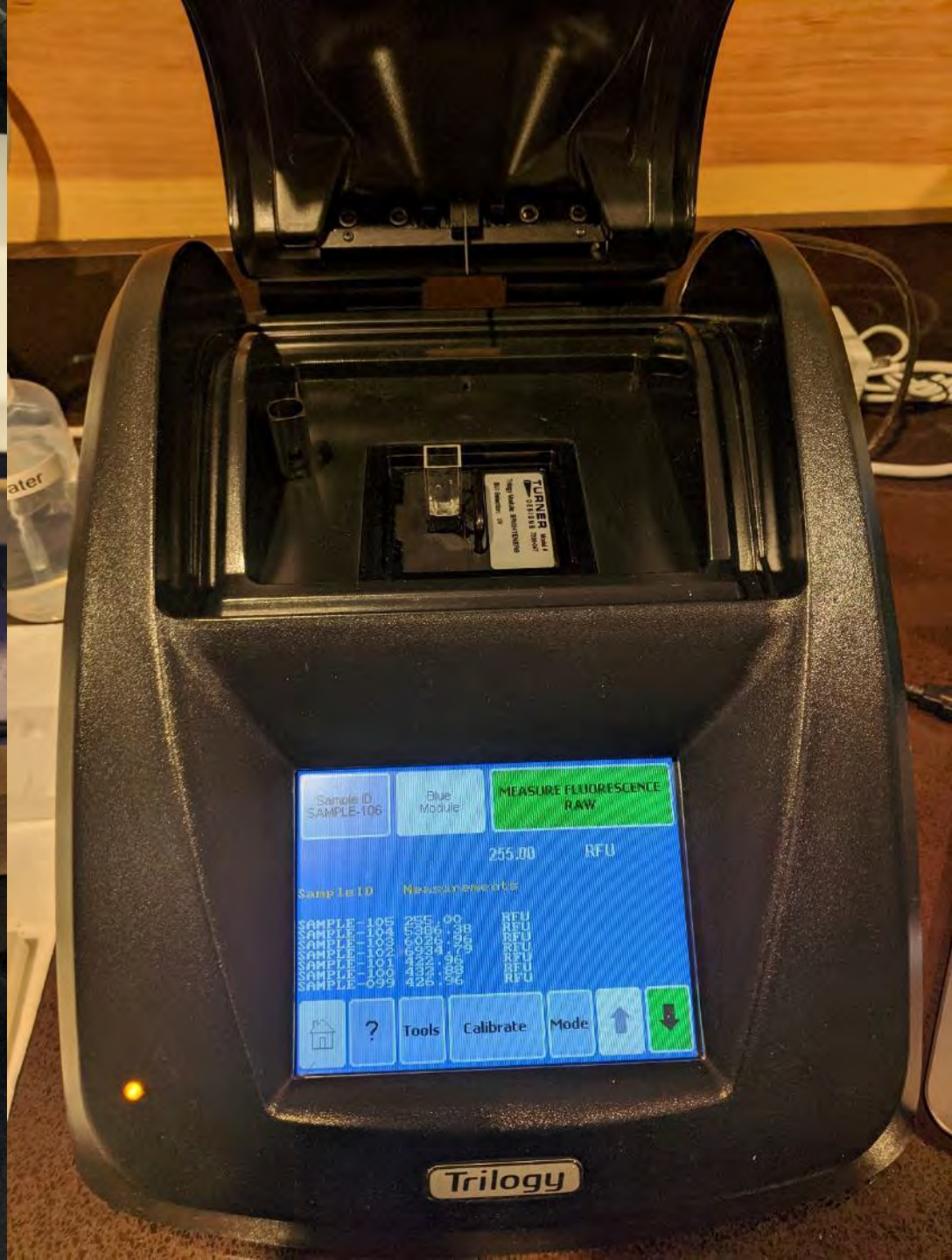


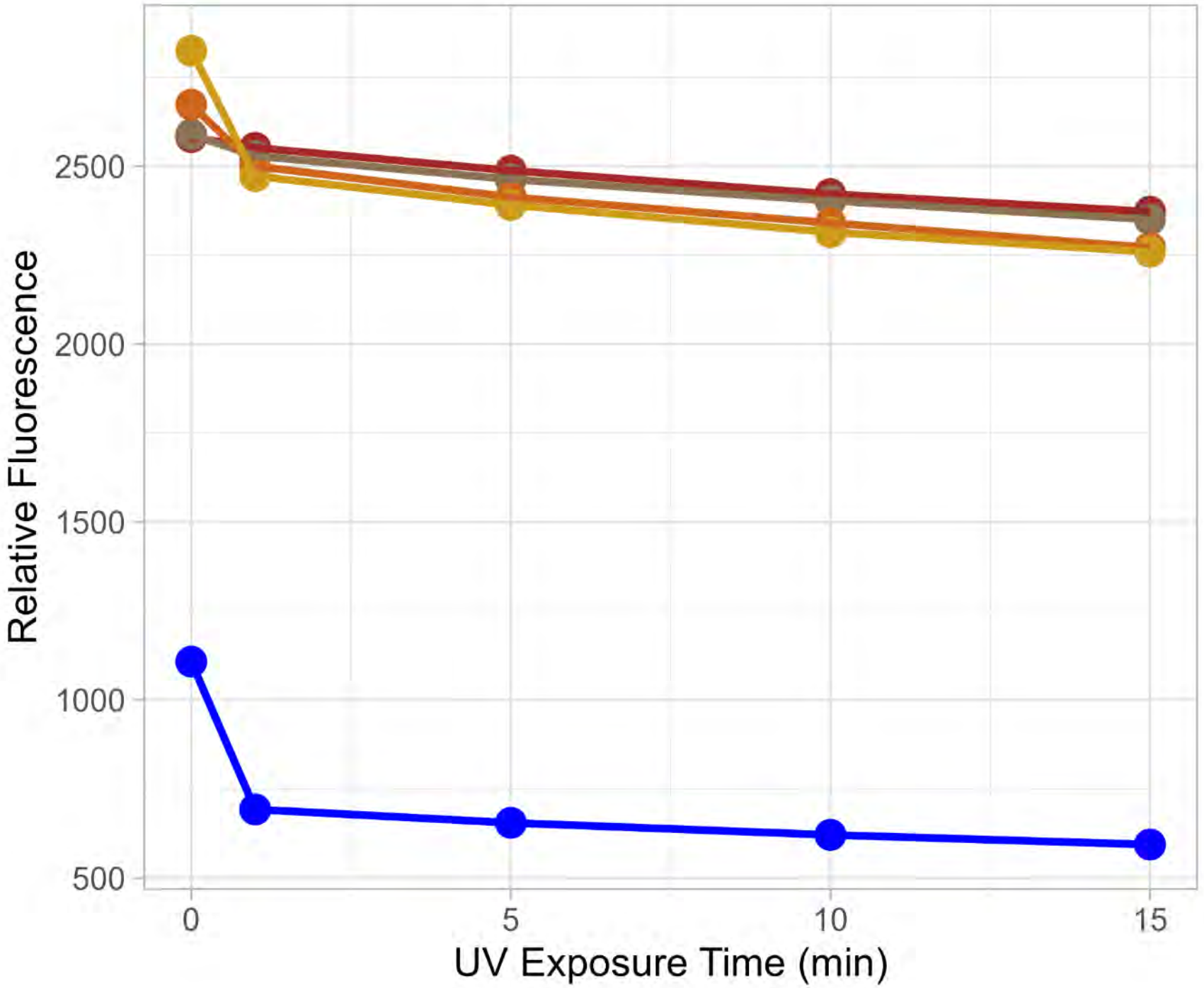


Photobleaching with UV light (Black light, 365 nm)

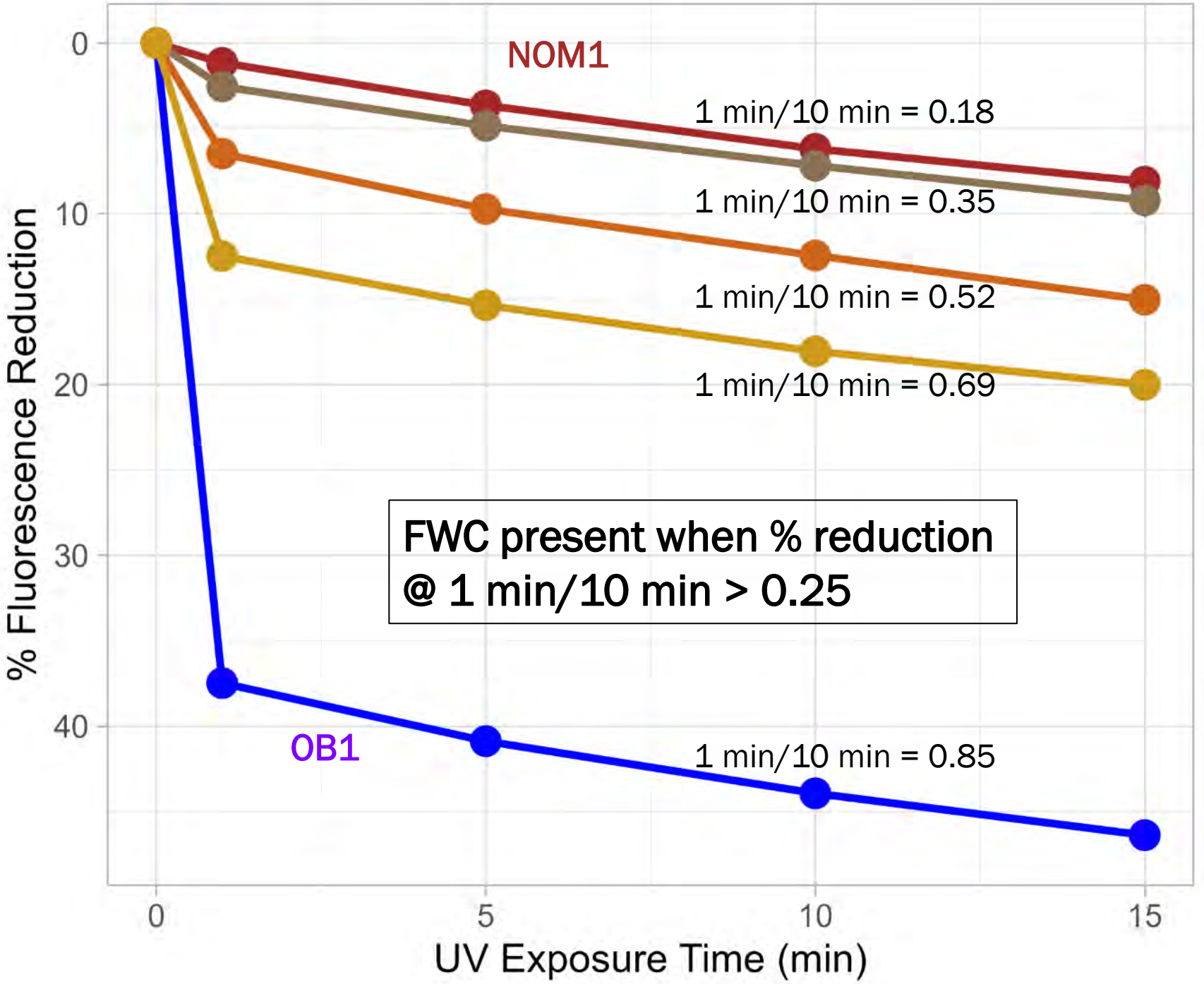


Method adapted from:
Dubber and Gill. 2017. Suitability of fluorescent whitening compounds (FWCs) as indicators of human faecal contamination from septic tanks in rural catchments. Water Research 127: 104–117

Photobleaching of FWC and Natural Organic Matter (NOM)



Photobleaching of FWC and Natural Organic Matter (NOM)

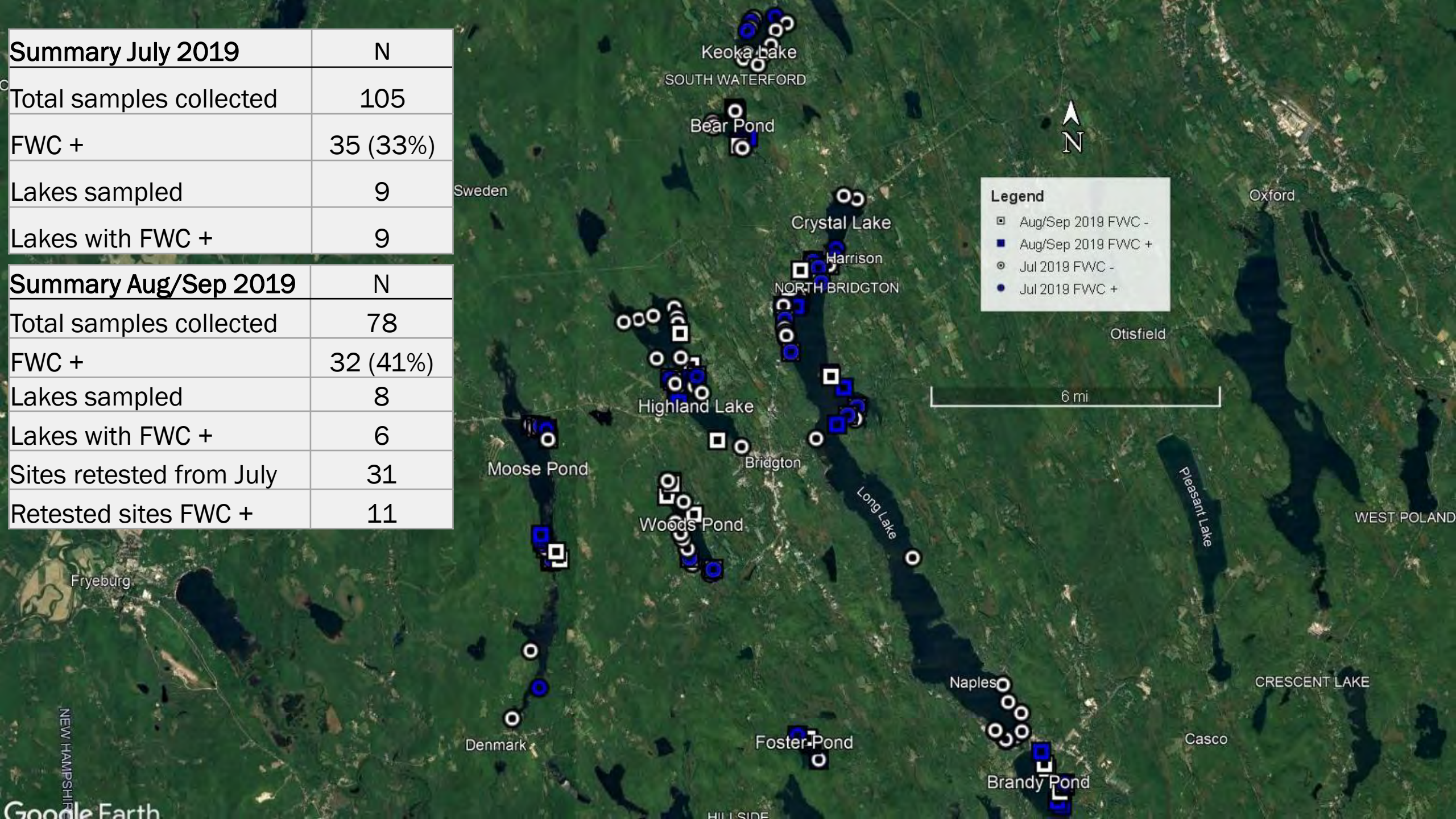


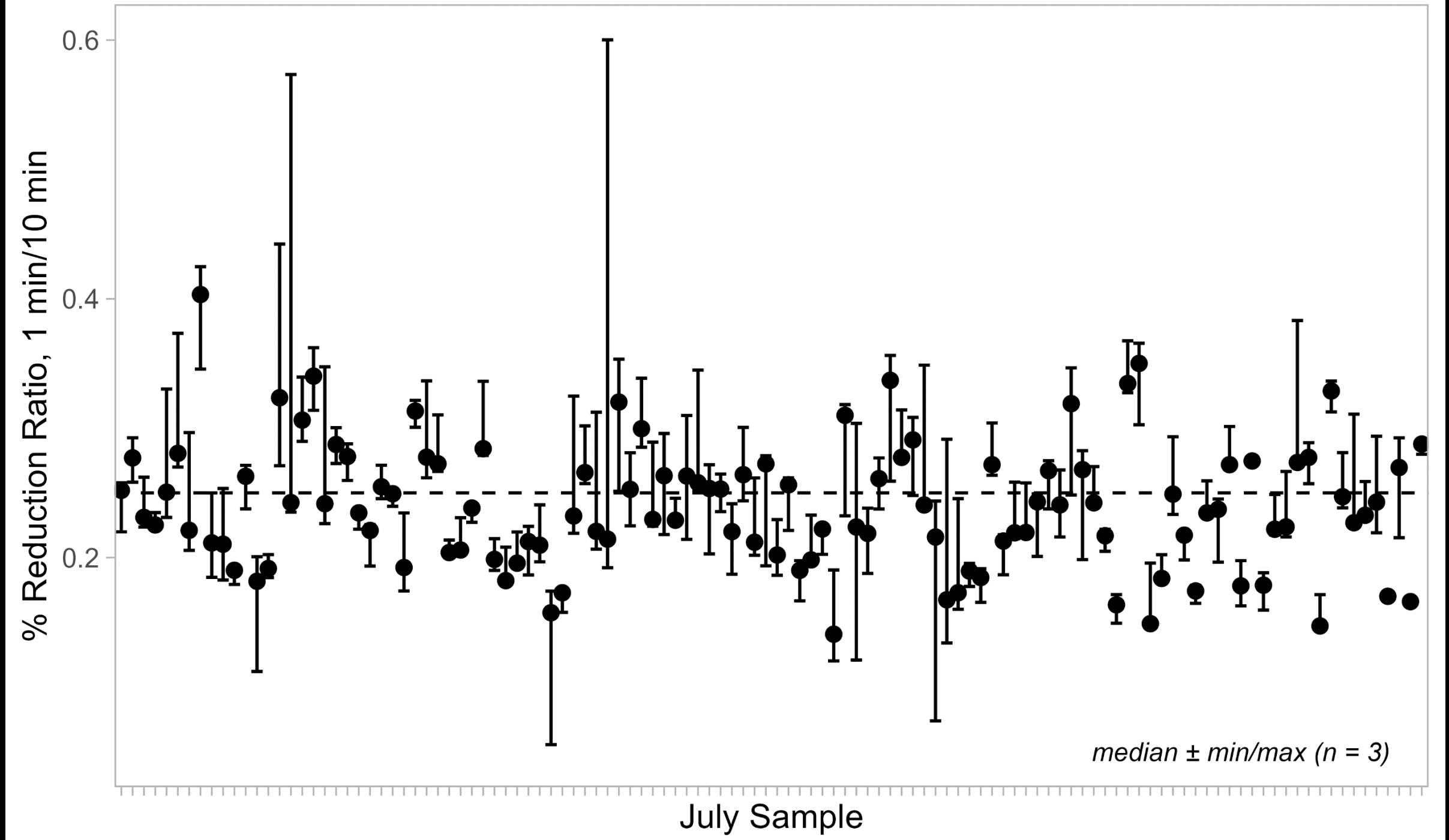
Sample + Tide
(NOM = Moose Pond)

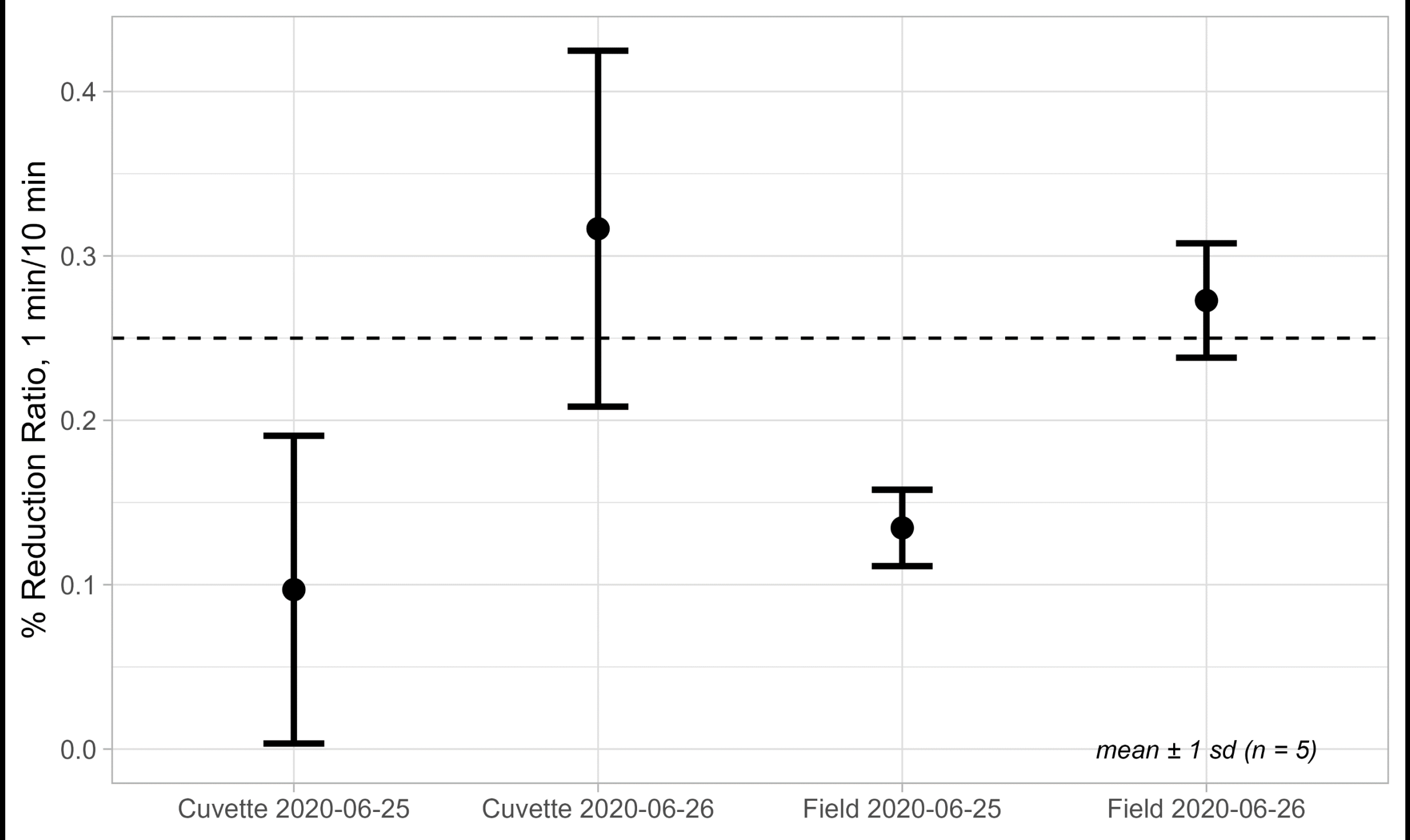
- DI+5ppm
- NOM
- NOM+0.5ppm
- NOM+2.5ppm
- NOM+5ppm

Summary July 2019	N
Total samples collected	105
FWC +	35 (33%)
Lakes sampled	9
Lakes with FWC +	9

Summary Aug/Sep 2019	N
Total samples collected	78
FWC +	32 (41%)
Lakes sampled	8
Lakes with FWC +	6
Sites retested from July	31
Retested sites FWC +	11




0.6
0.4
0.2
% Reduction Ratio, 1 min/10 min
median ± min/max (n = 3)
July Sample


% Reduction Ratio, 1 min/10 min
0.4
0.3
0.2
0.1
0.0
mean ± 1 sd (n = 5)
Cuvette 2020-06-25
Cuvette 2020-06-26
Field 2020-06-25
Field 2020-06-26

Summary:

- FWC detected in 37% of all samples
- Method relatively inexpensive and easy
- Caveat: analytical variability and colored organic matter can limit detection

Acknowledgements:

Maine Community Foundation, Garrett Higgins, and many volunteer sample collectors