Influence of Submerged Aquatic Vegetation on Sediment-Water Nutrient Fluxes

Previous Activities

Examine SAV influence on water quality, especially dissolved oxygen.

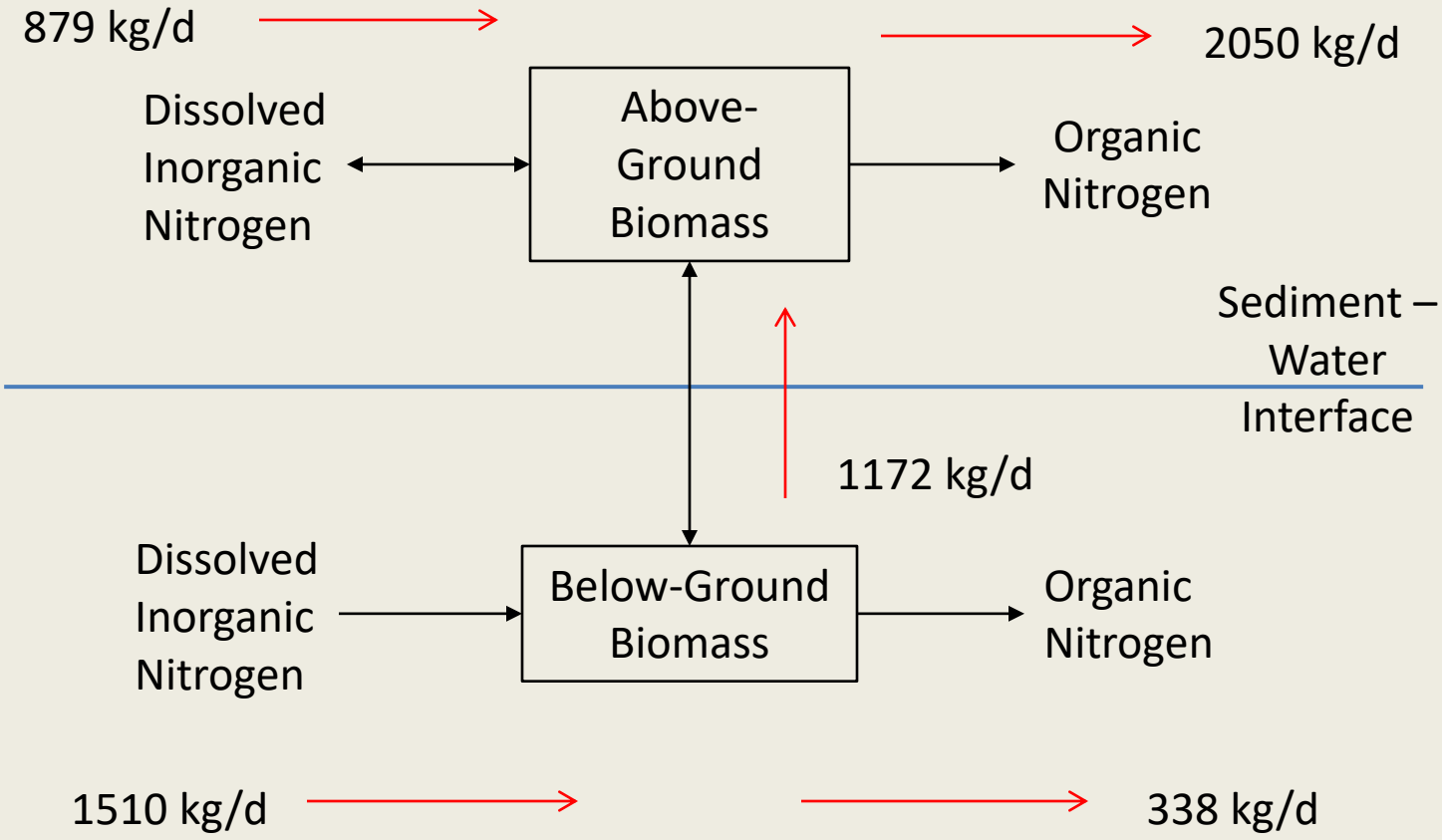
Based on model calibration 1990-2001.

Activity largely completed July 2021.

Next Steps

- Documentation.
- Move analysis to WIP loads and SAV distribution.
- Quantify SAV effect on nutrient fluxes. Compare to other nutrient sources/sinks.

The Nitrogen Cycle



We quantify and can report out the indicated fluxes (CB1TF, vallisneria).

Primary Conclusions

SAV diminishes nutrient retention in sediments.

Diminished nutrient retention is equivalent to an increase in loading.

How to Examine DO?

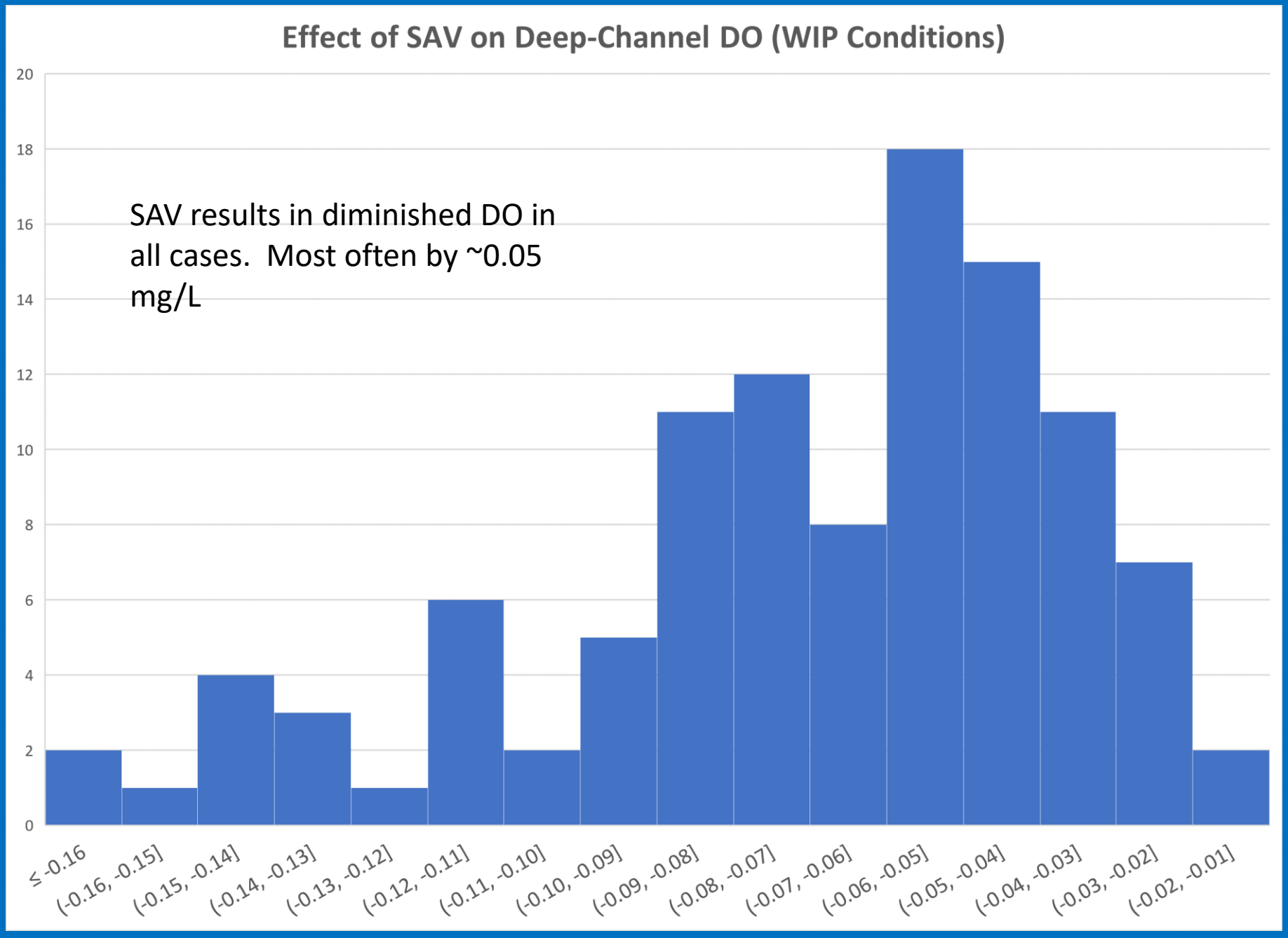
Consider three years, 1993 – 1995.

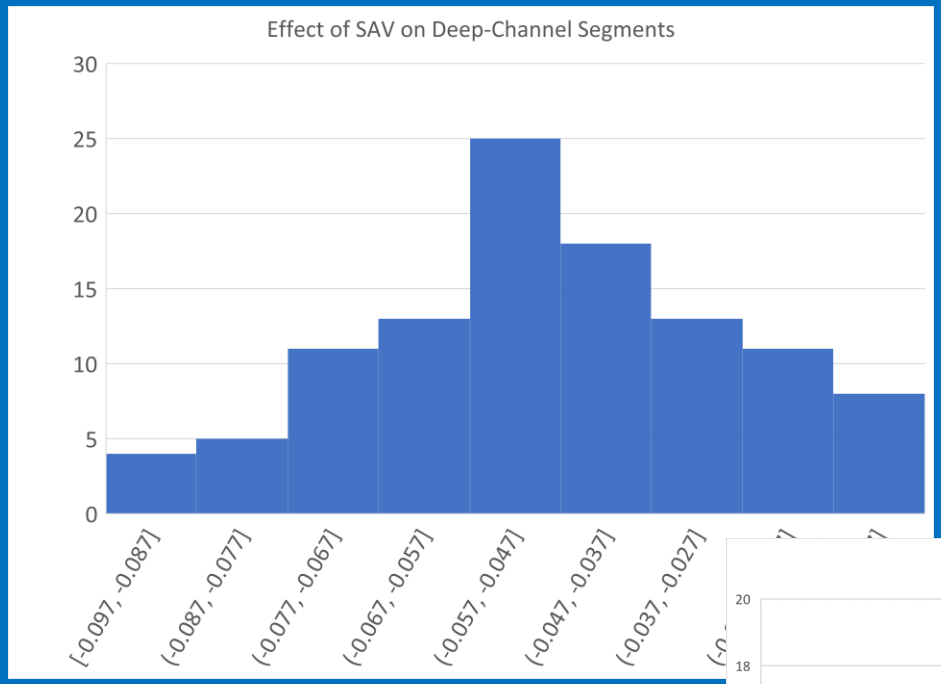
Consider four months, June – September.

Take monthly averages for Deep Channel (DW), Deep Water (DW), and Open Water (OW) segments.

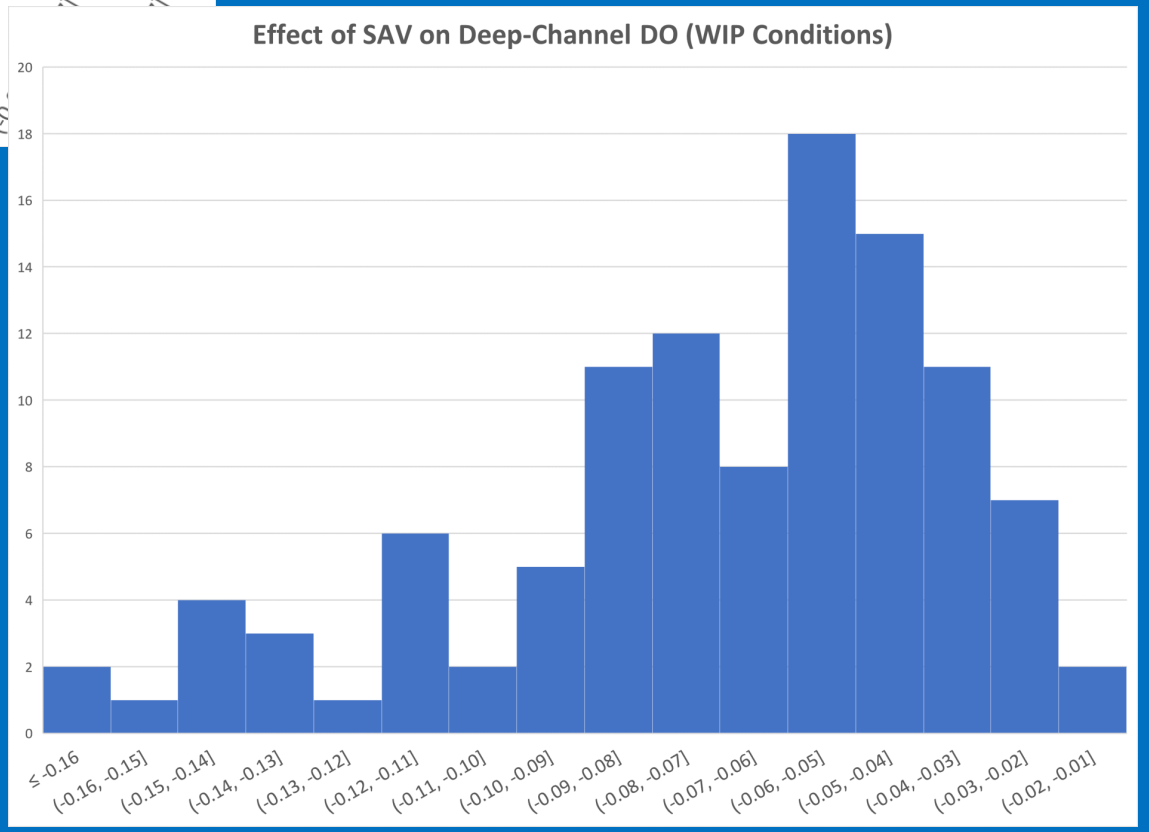
Each Year-Month-Segment average is an “occurrence.”

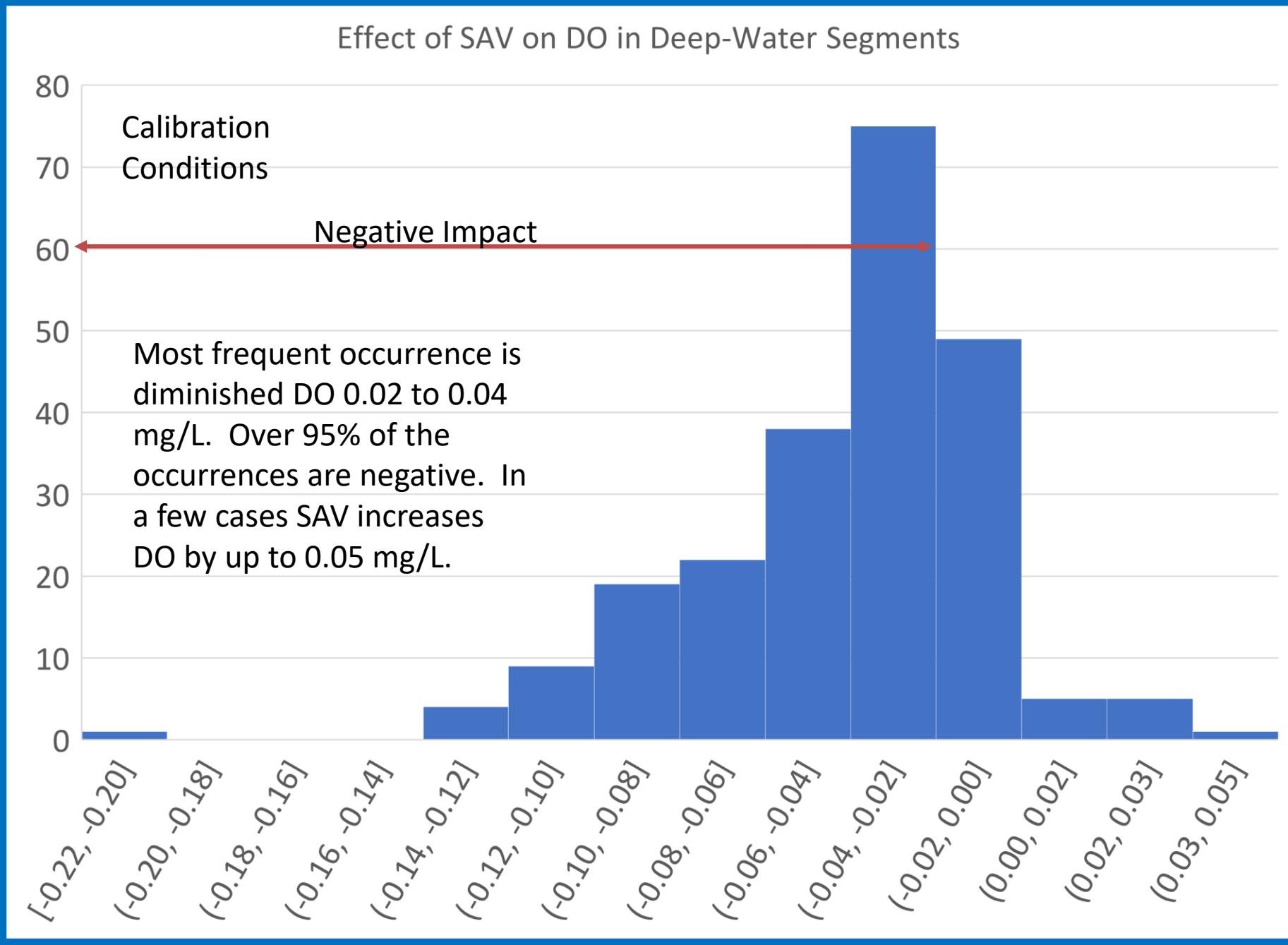
We get from 108 (DC) to 1080 (OW) occurrences.

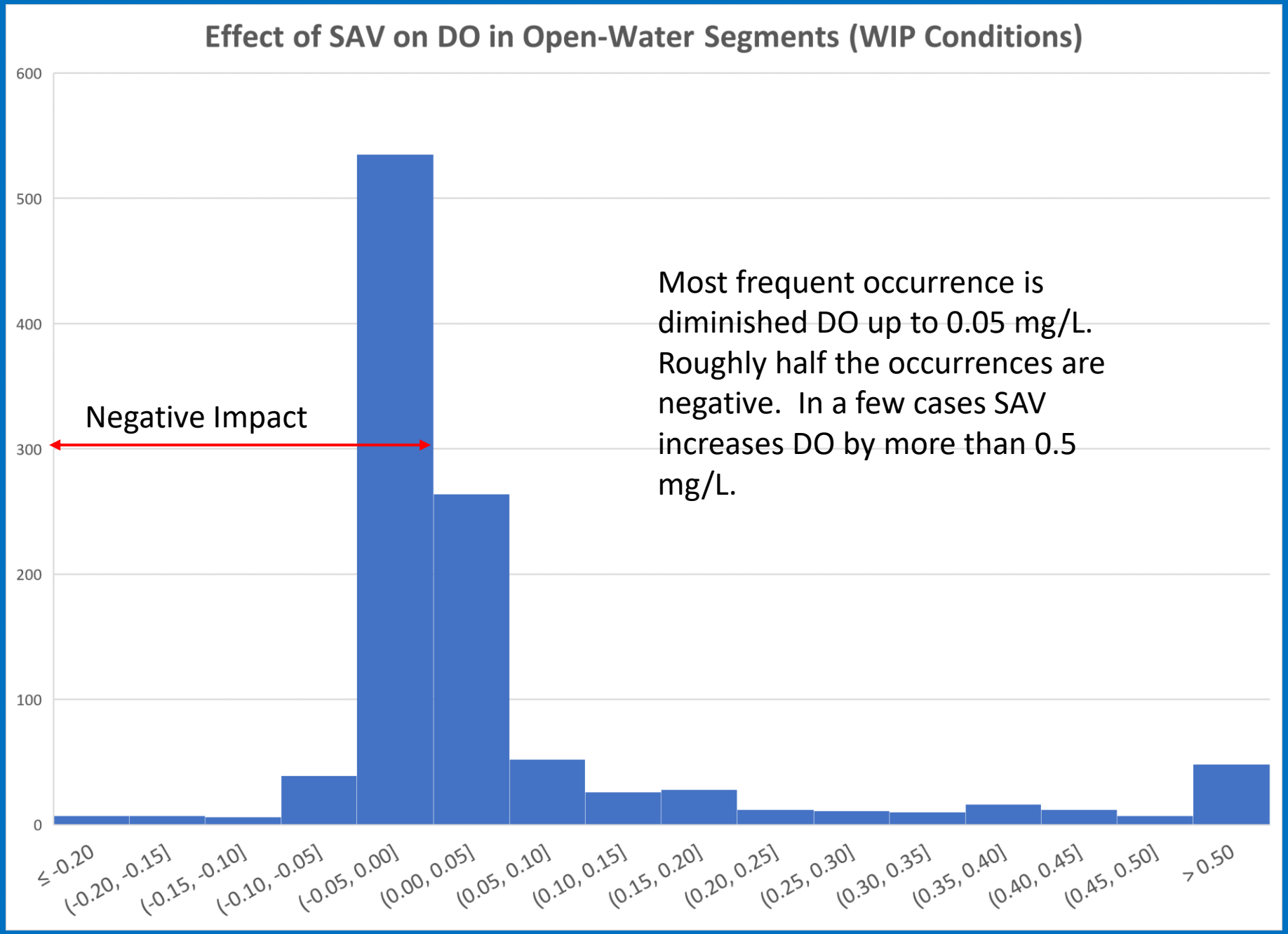

Effect of SAV on Deep-Channel DO (WIP Conditions)
SAV results in diminished DO in all cases. Most often by ~0.05 mg/L
20
18
16
14
12
10
8
6
4
2
0
≤ -0.16
(-0.16, -0.15]
(-0.15, -0.14]
(-0.14, -0.13]
(-0.13, -0.12]
(-0.12, -0.11]
(-0.11, -0.10]
(-0.10, -0.09]
(-0.09, -0.08]
(-0.08, -0.07]
(-0.07, -0.06]
(-0.06, -0.05]
(-0.05, -0.04]
(-0.04, -0.03]
(-0.03, -0.02]
(-0.02, -0.01]

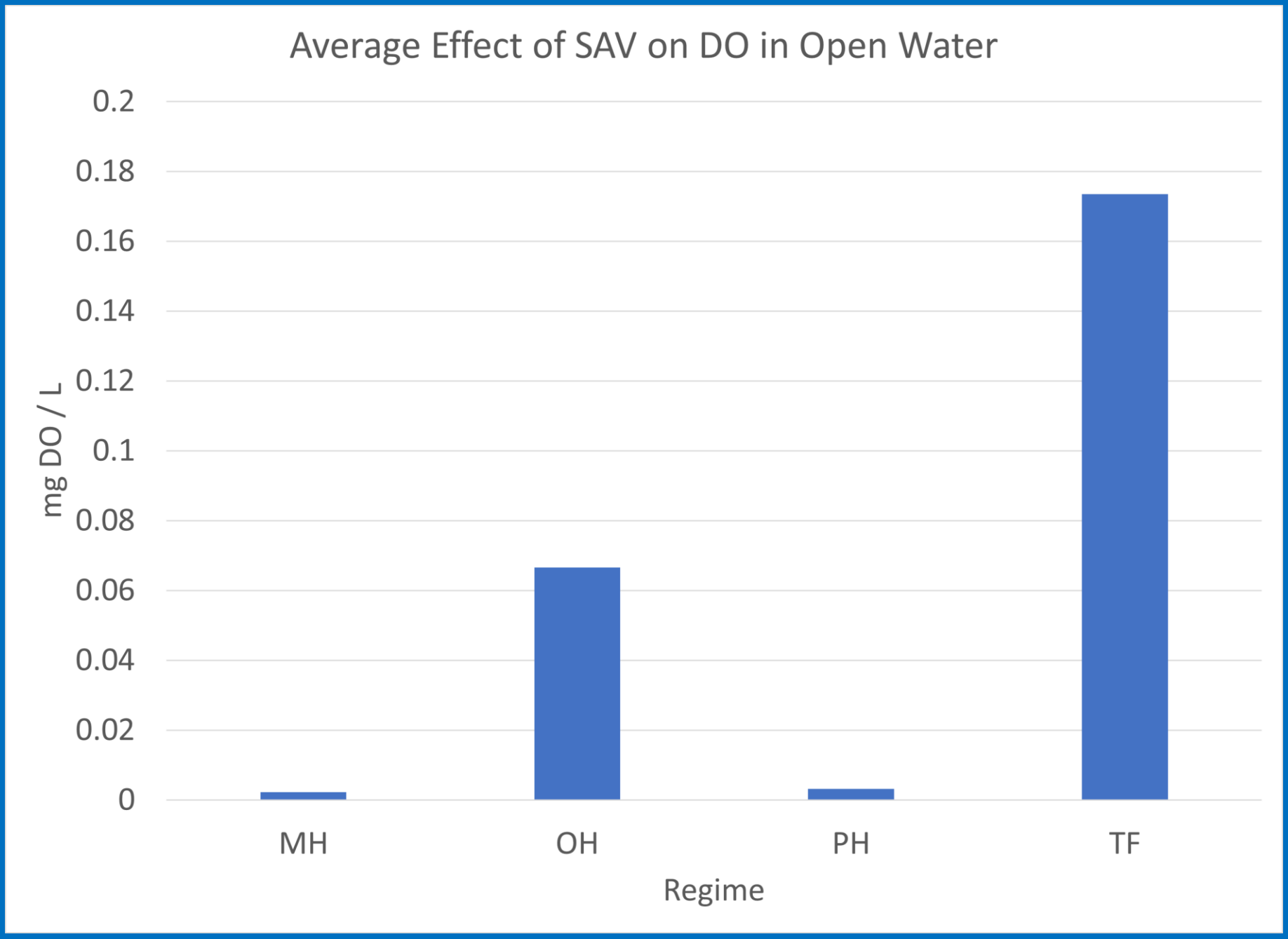


Much longer tail for WIP conditions




Effect of SAV on DO in Deep-Water Segments
80
70
60
50
40
30
20
10
0
Calibration Conditions
Negative Impact
Most frequent occurrence is diminished DO 0.02 to 0.04 mg/L. Over 95% of the occurrences are negative. In a few cases SAV increases DO by up to 0.05 mg/L.
[-0.22, -0.20]
(-0.20, -0.18]
(-0.18, -0.16]
(-0.16, -0.14]
(-0.14, -0.12]
(-0.12, -0.10]
(-0.10, -0.08]
(-0.08, -0.06]
(-0.06, -0.04]
(-0.04, -0.02]
(-0.02, 0.00]
(0.00, 0.02]
(0.02, 0.03]
(0.03, 0.05]

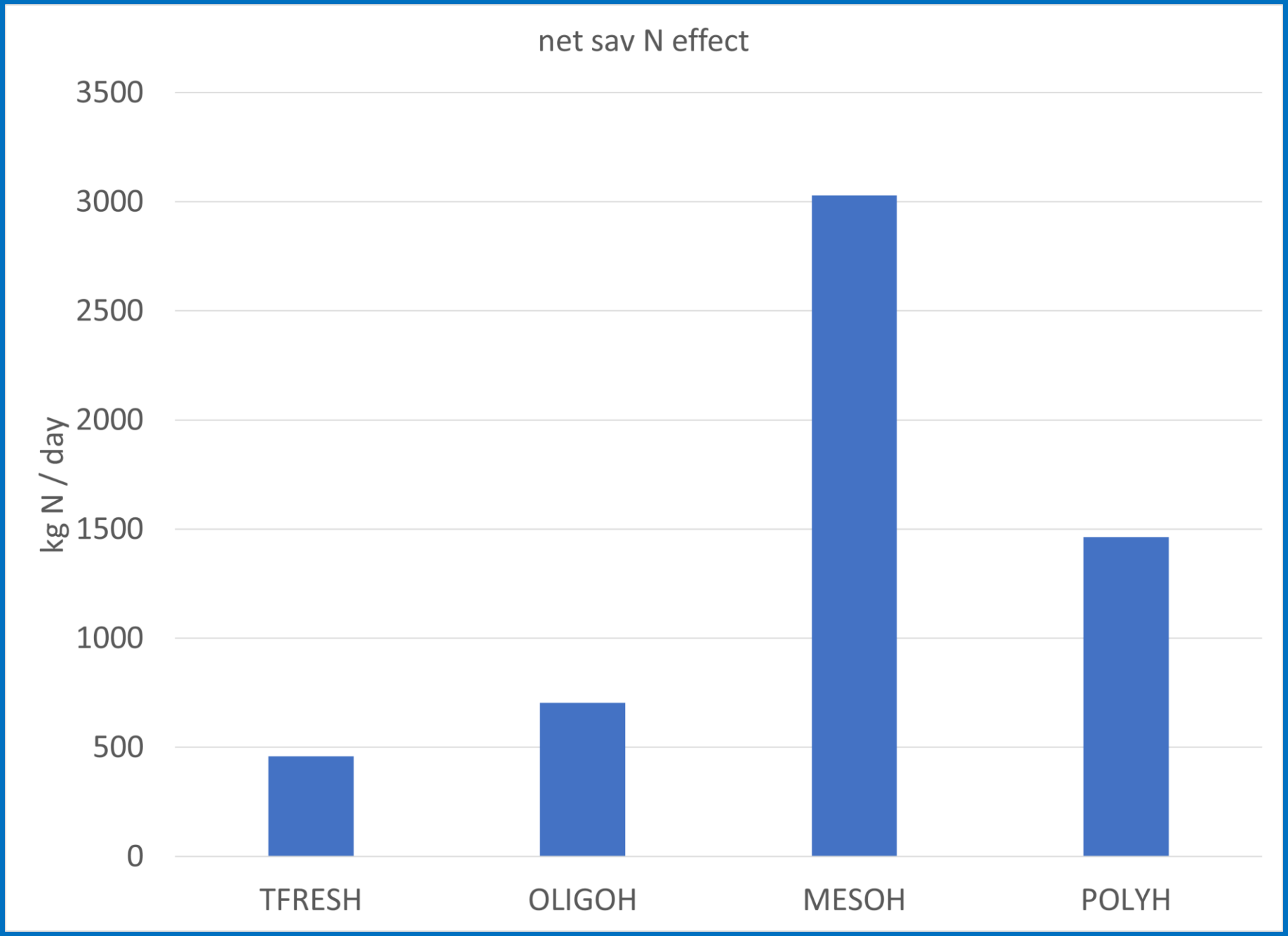

Effect of SAV on DO in Open-Water Segments (WIP Conditions)
600
500
400
300
200
100
0
Negative Impact
Most frequent occurrence is diminished DO up to 0.05 mg/L. Roughly half the occurrences are negative. In a few cases SAV increases DO by more than 0.5 mg/L.
≤ -0.20
(-0.20, -0.15]
(-0.15, -0.10]
(-0.10, -0.05]
(-0.05, 0.00]
(0.00, 0.05]
(0.05, 0.10]
(0.10, 0.15]
(0.15, 0.20]
(0.20, 0.25]
(0.25, 0.30]
(0.30, 0.35]
(0.35, 0.40]
(0.40, 0.45]
(0.45, 0.50]
> 0.50

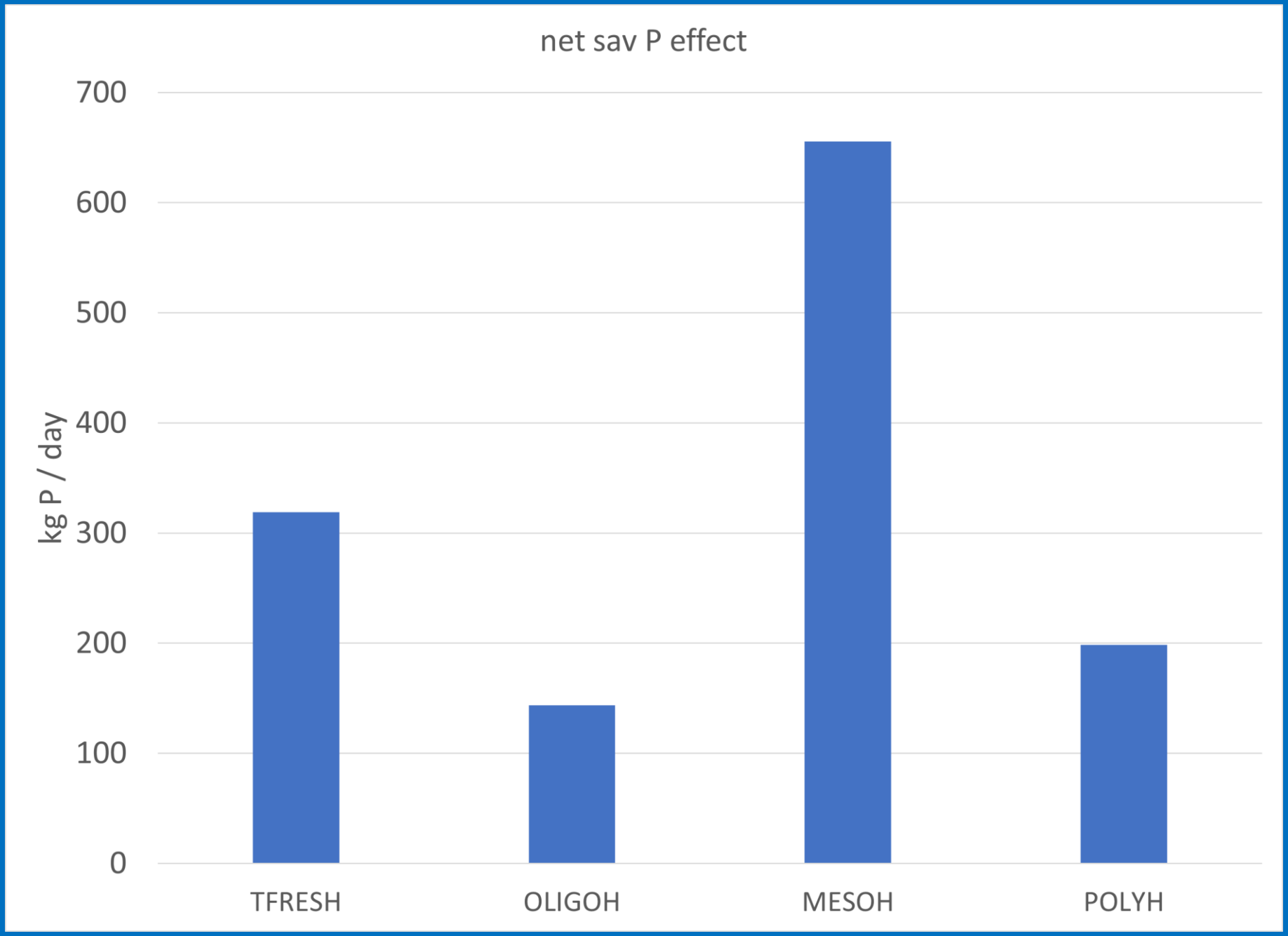

Average Effect of SAV on DO in Open Water
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
mg DO / L
MH
OH
PH
TF
Regime

Primary Conclusions

SAV diminishes nutrient retention in sediments.

Diminished nutrient retention is equivalent to an increase in loading.


net sav N effect
3500
3000
2500
2000
1500
1000
500
0
kg N / day
TFRESH
OLIGOH
MESOH
POLYH


net sav P effect
700
600
500
400
300
200
100
0
kg P / day
TFRESH
OLIGOH
MESOH
POLYH

How Significant Are These Loads?

Distributed N Load from Watershed: 2.09×10^5 kg/d
Net SAV Effect: 5654 kg/d
Percent SAV Effect: 2.7%

Distributed P Load from Watershed: 1.26×10^4 kg/d
Net SAV Effect: 1317 kg/d
Percent SAV Effect: 10.4%

Conclusions

Full build-out of SAV enhances recycling of nutrients from sediments to water column.

The enhanced recycling results in diminished DO in Deep Channel and Deep Water.

The enhanced recycling is equivalent to 2.7% of watershed N load, 10.4% of watershed P load.

These numbers result from comparison of build-out to no SAV conditions. To quantify marginal effect of SAV build-out, we should compare build-out conditions to existing conditions.