



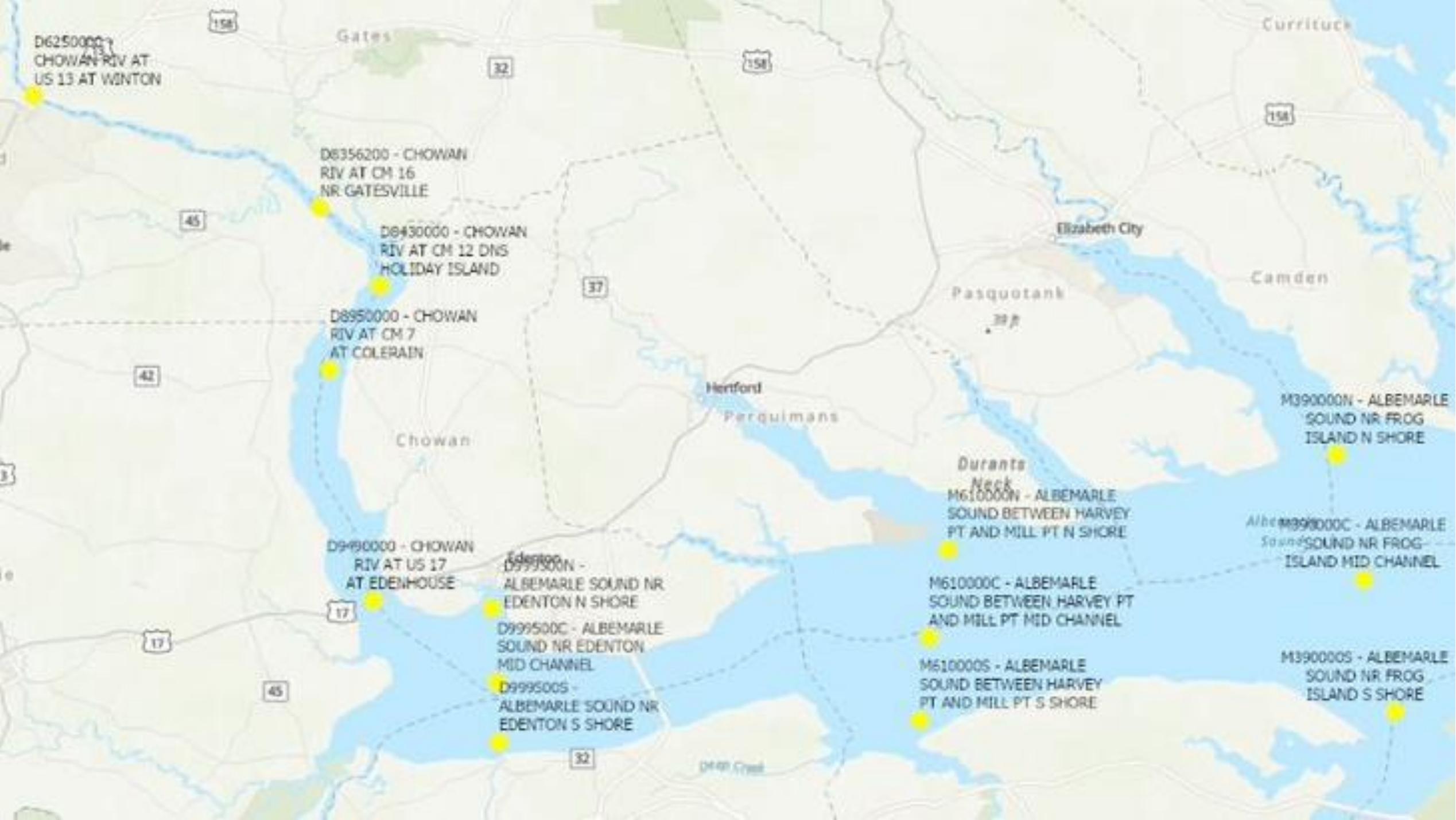
*DO Data Analysis
Chowan/Albemarle*

*NCDP SAC
June 17, 2020*



DWR MAB Analysis





of Sampling Events per Year by Station

Year	D6250000	D8356200	D8950000	D9490000	D999500C	M610000C	M390000C
2009	12	12	12	12	12	12	12
2010	12	11	11	11	11	10	11
2011	12	11	11	11	10	10	10
2012	9	8	8	8	9	9	7
2013	11	10	10	11	11	12	9
2014	11	10	10	10	10	10	10
2015	10	8	8	8	9	6	6
2016	11	9	9	9	9	8	9
2017	8	12	12	12	11	8	9
2018	7	6	6	7	6	5	6

Questions

Is the current assessment methodology (surface) for dissolved oxygen representative for Chowan and Albemarle?

Approach: data evaluation

If YES, we move on to other parameters

If NO, moves over to assessment to address recommendations



NC DO Standard - Saltwater

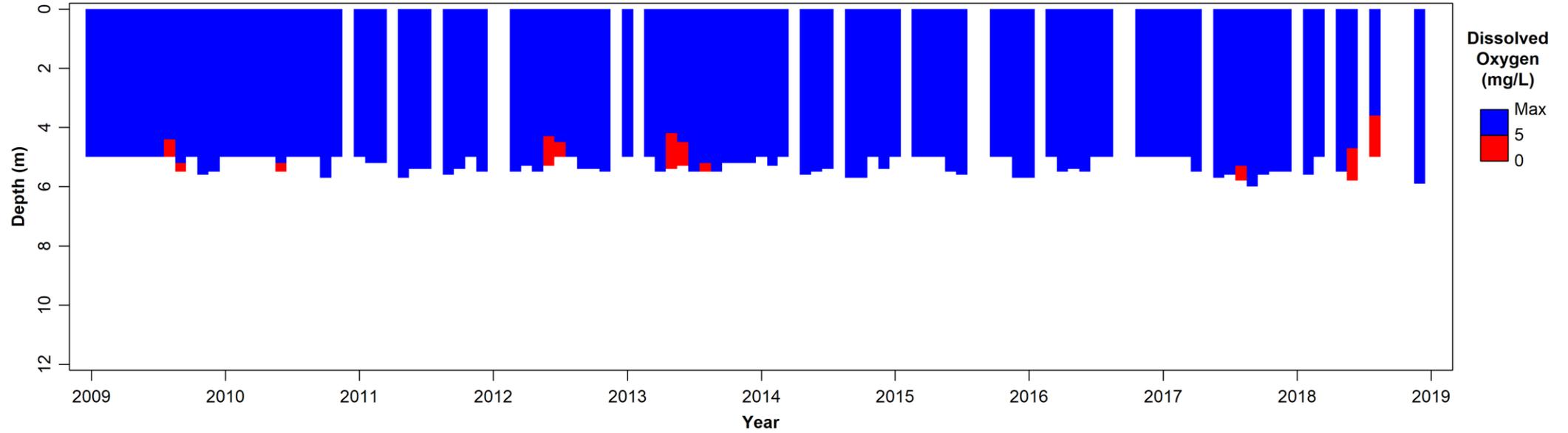
Dissolved oxygen: not less than 5.0 mg/l, except that swamp waters, poorly flushed tidally influenced streams or embayments, or estuarine bottom waters may have lower values if caused by natural conditions;



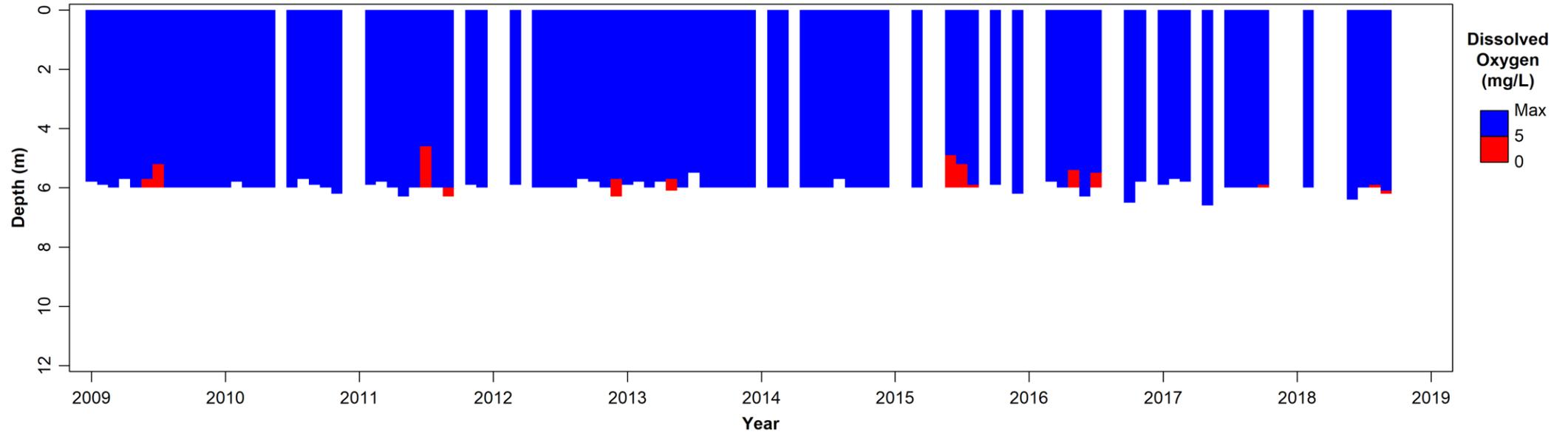
Albemarle Sound Stations



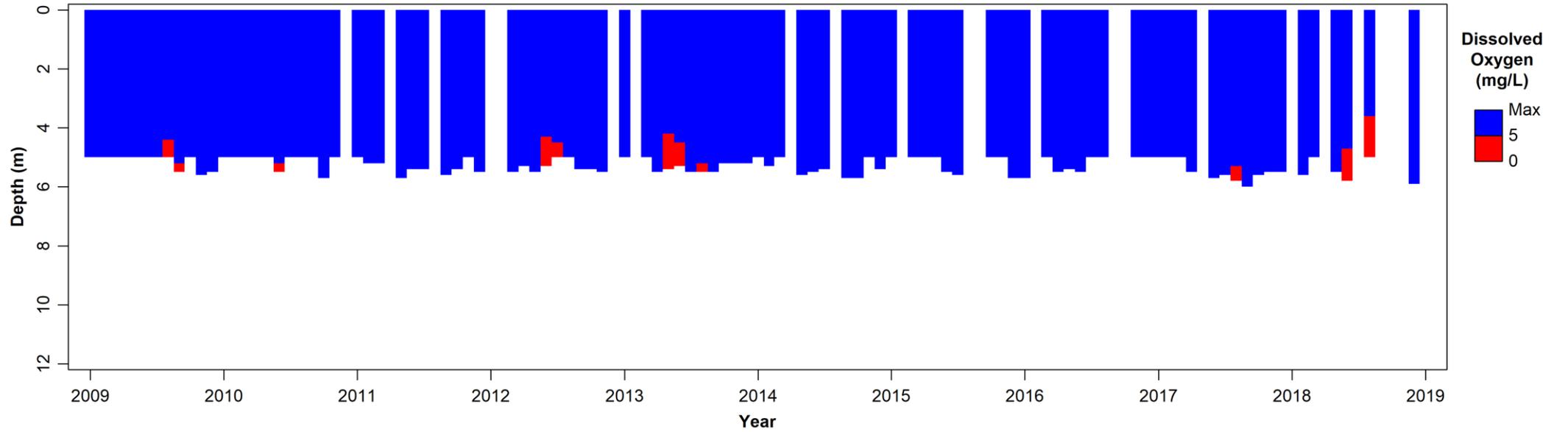
D999500C
ALBEMARLE SOUND NR EDENTON MID CHANNEL



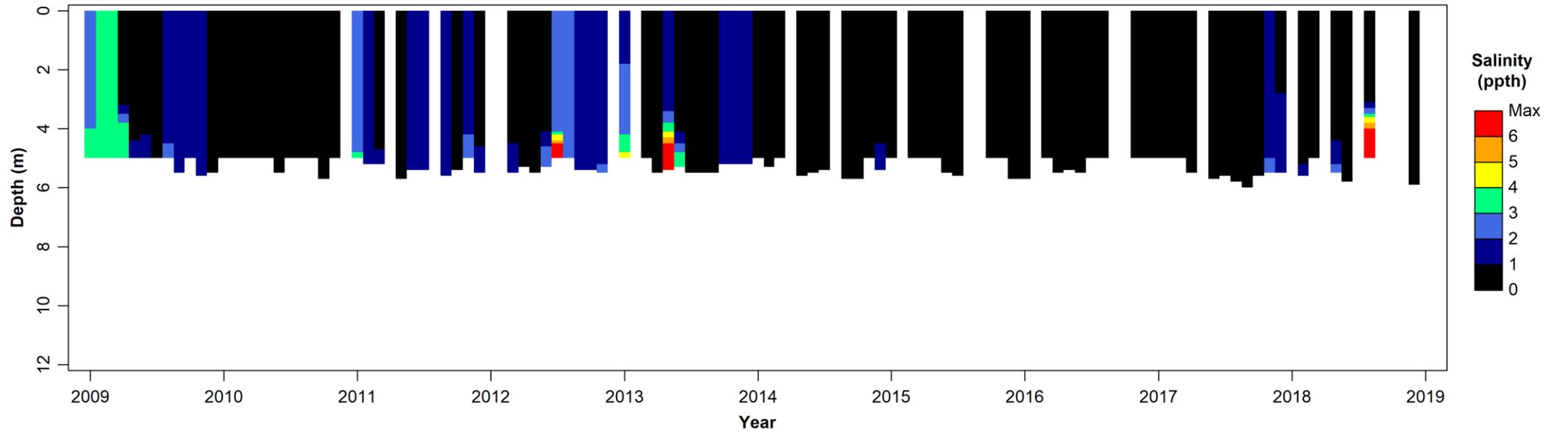
M610000C
ALBEMARLE SOUND BETWEEN HARVEY PT AND MILL PT MID CHANNEL



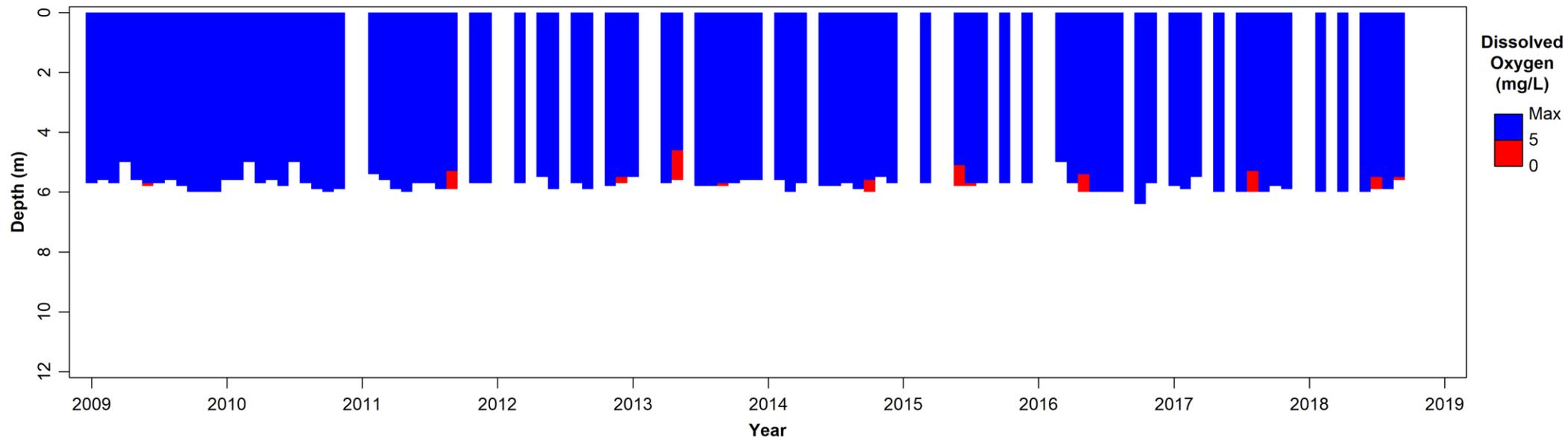
D999500C
ALBEMARLE SOUND NR EDENTON MID CHANNEL

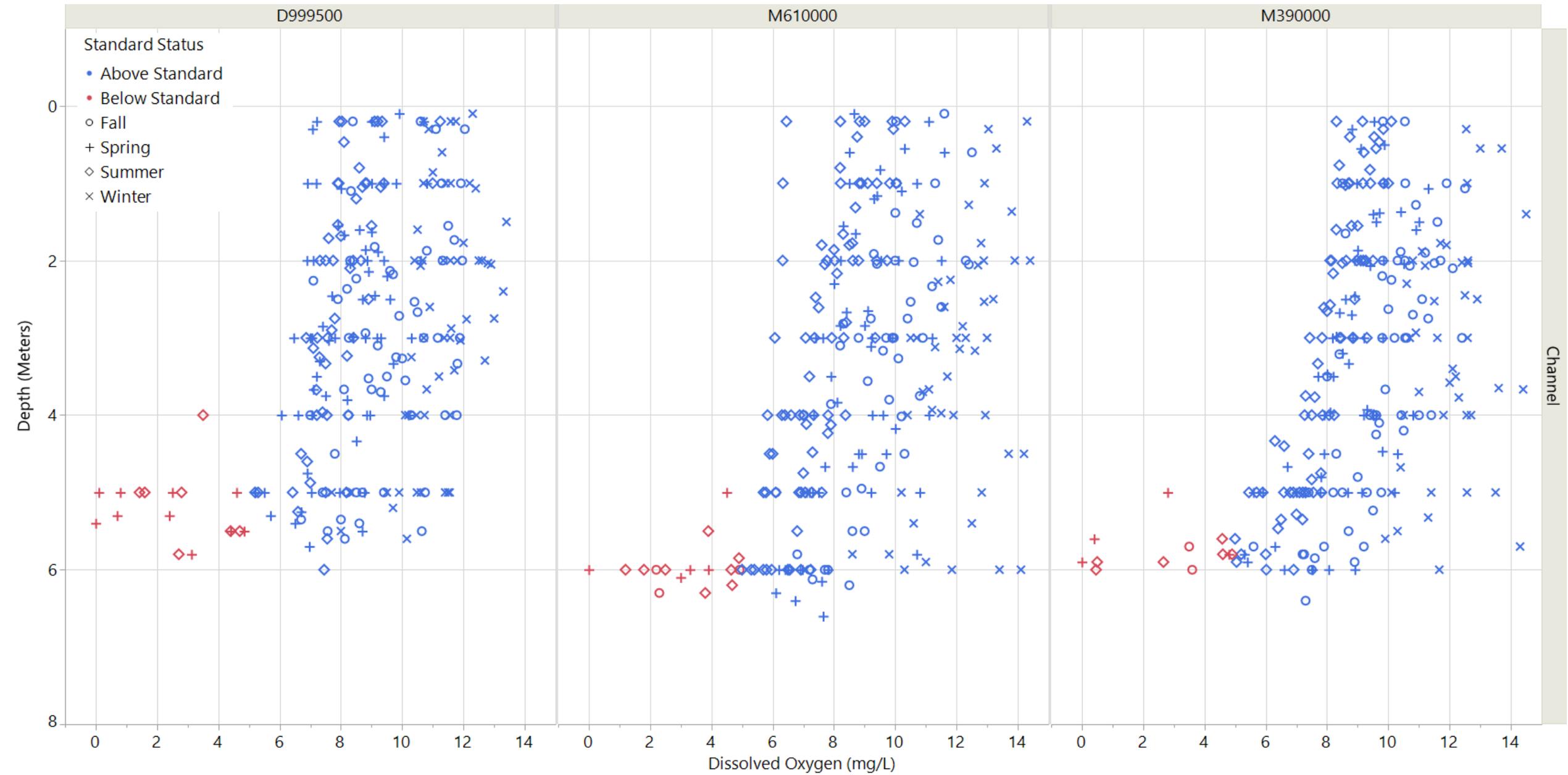


D999500C
ALBEMARLE SOUND NR EDENTON MID CHANNEL



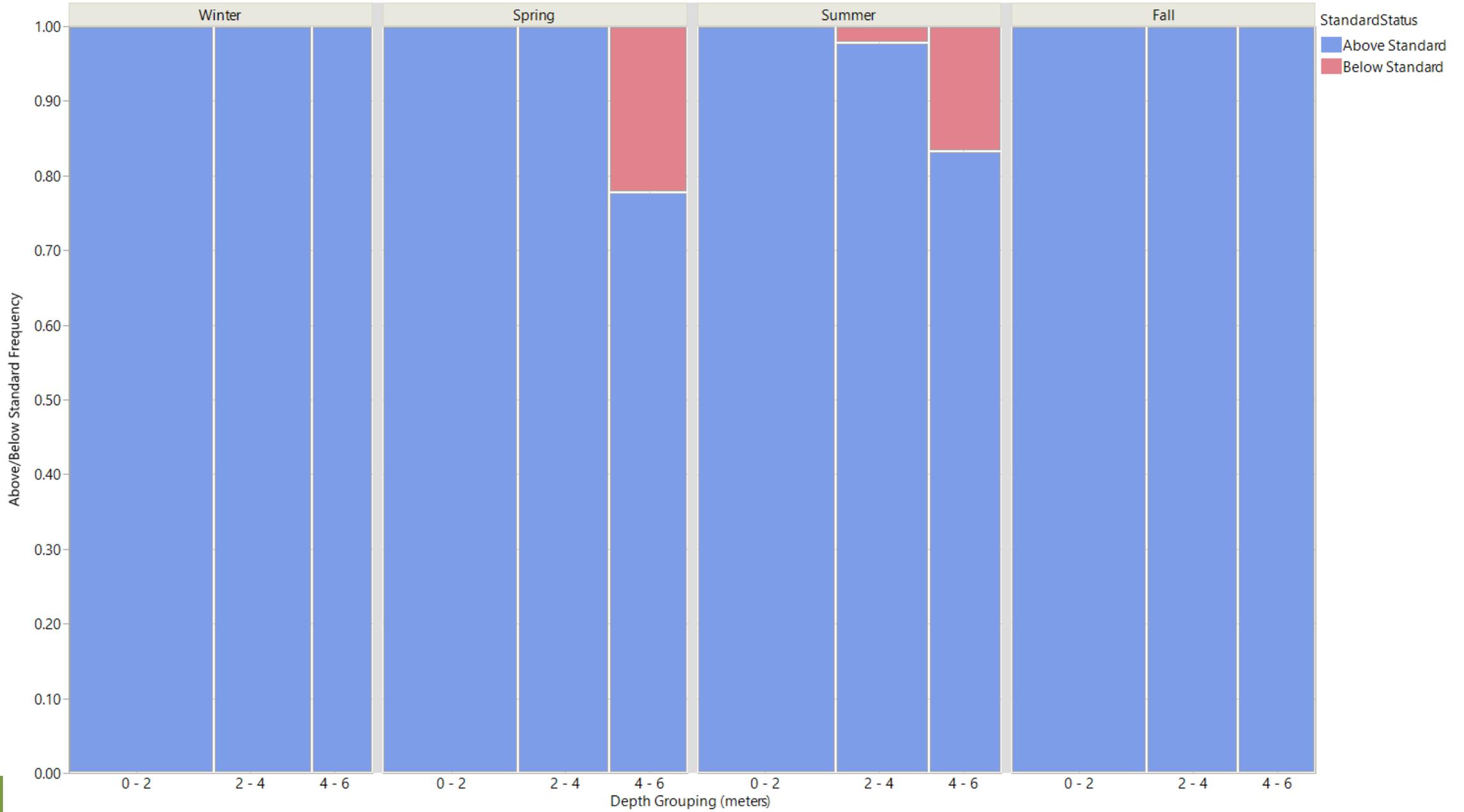
M390000C
ALBEMARLE SOUND NR FROG ISLAND MID CHANNEL





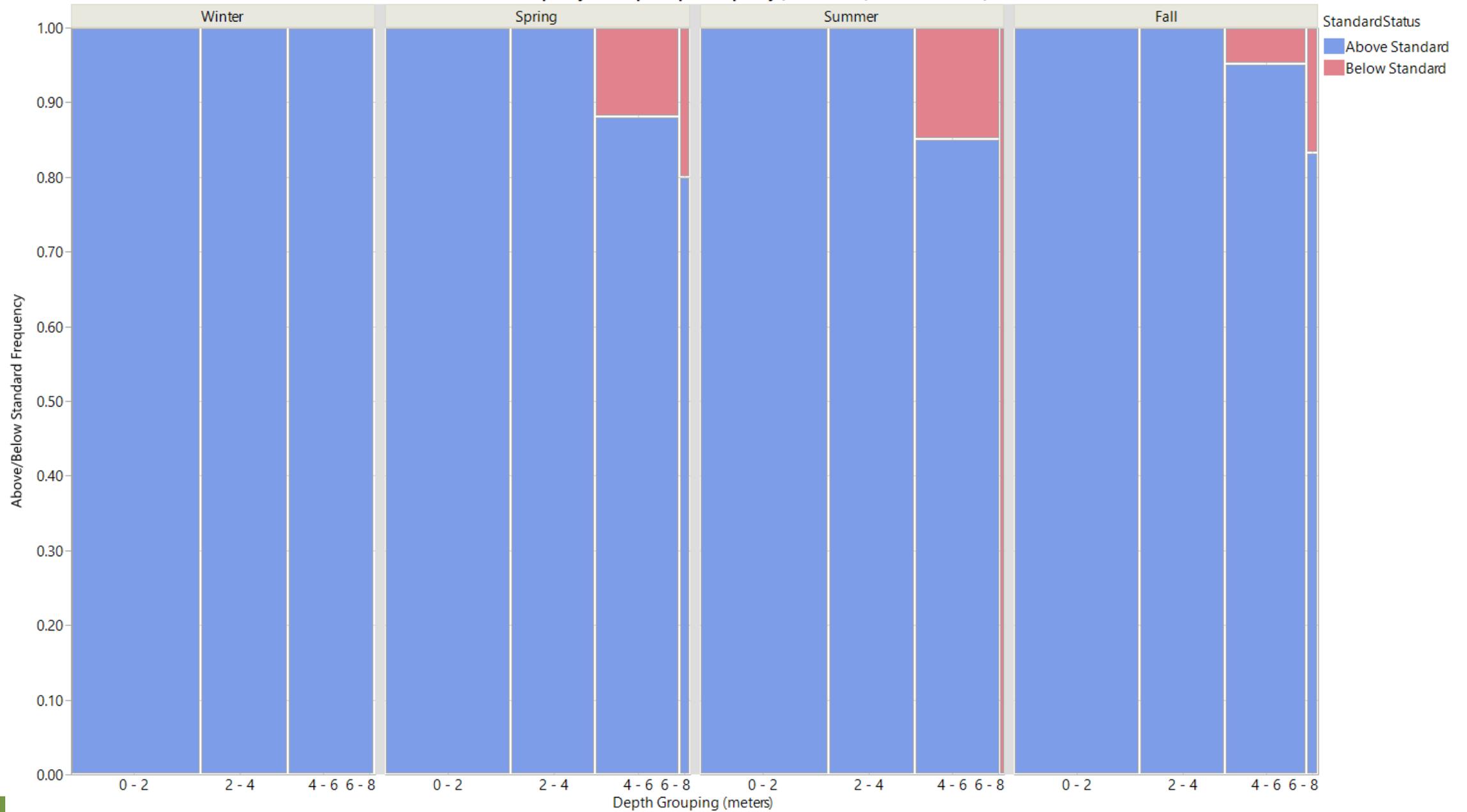
D999500 – Salt Water

D999500C - N Exceedance Frequency vs Sample Depth Frequency (2009 - 2018, DO Standard = 5)



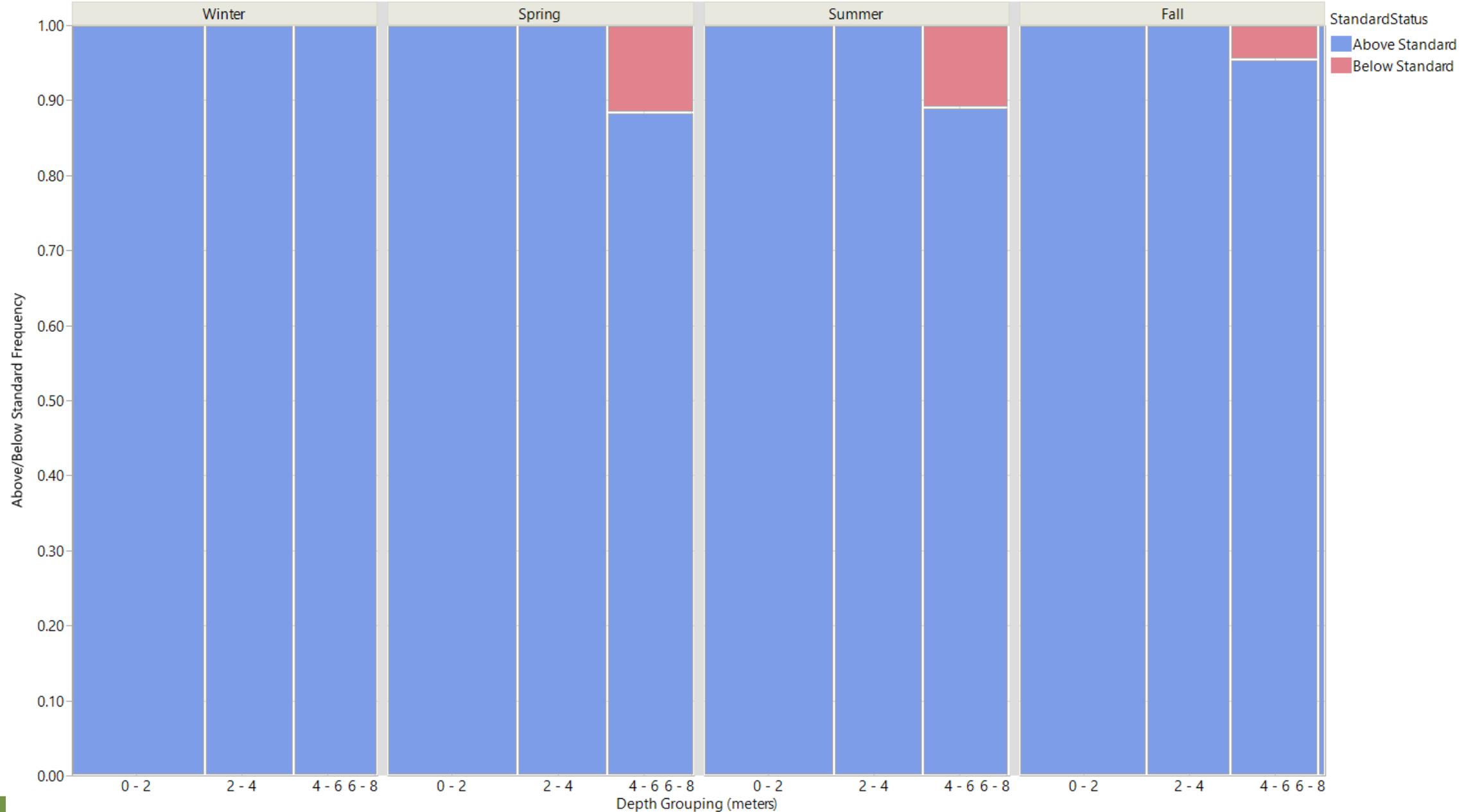
M610 – Salt Water

M610000C - N Exceedance Frequency vs Sample Depth Frequency (2009- 2018, DO Standard = 5)



M390 – Salt Water

M390000C - N Exceedance Frequency vs Sample Depth Frequency (2009- 2018, DO Standard = 5)

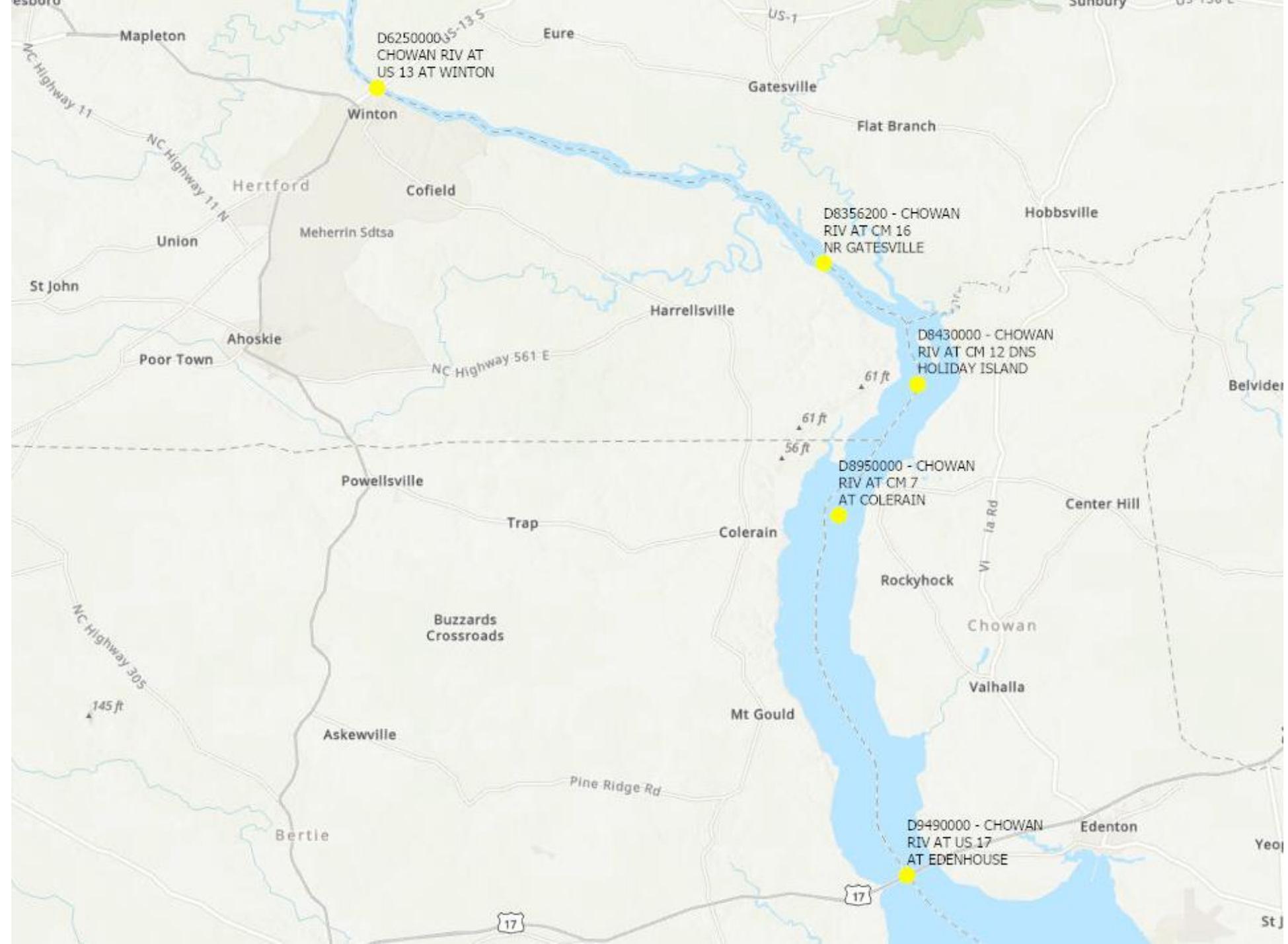


NC DO Standard - Freshwater

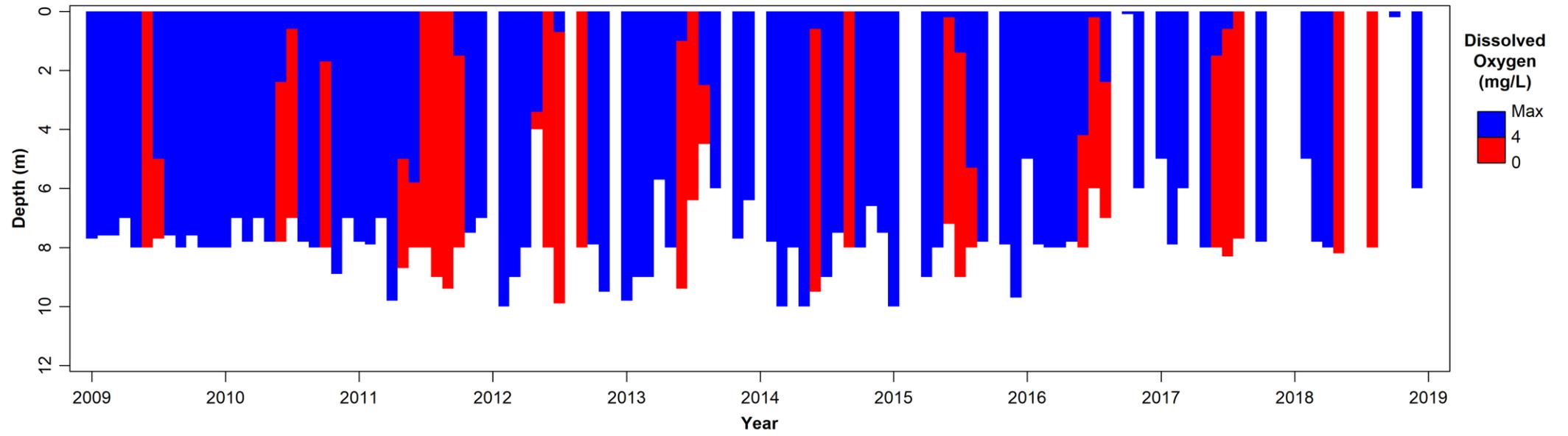
For non-trout waters, not less than a daily average of 5.0 mg/l with an instantaneous value of not less than 4.0 mg/l; swamp waters, lake coves, or backwaters, and lake bottom waters may have lower values if caused by natural conditions



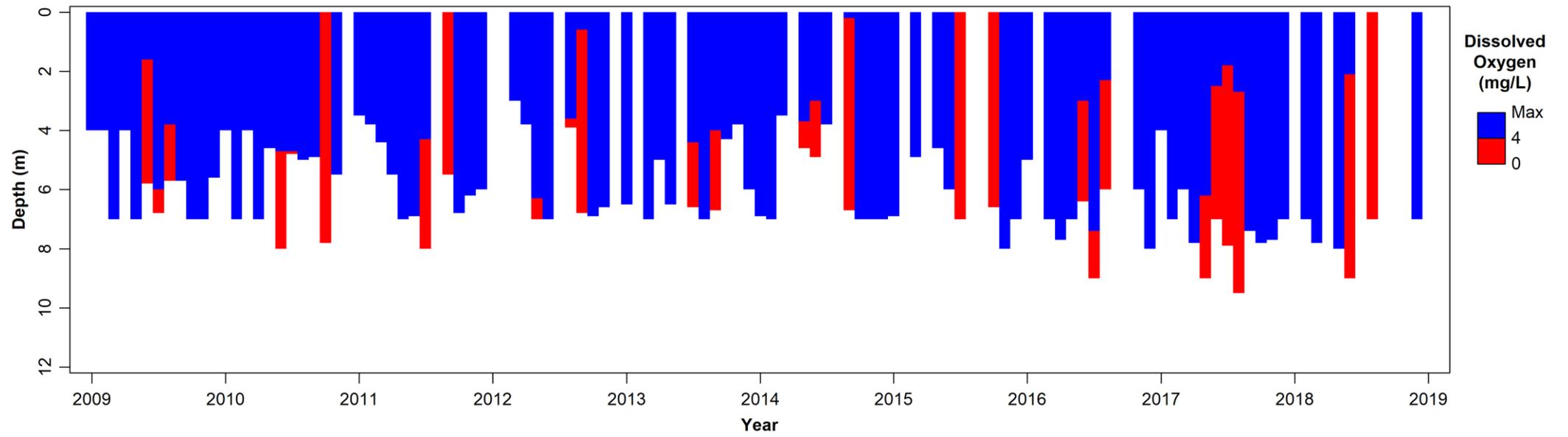
Chowan River Stations



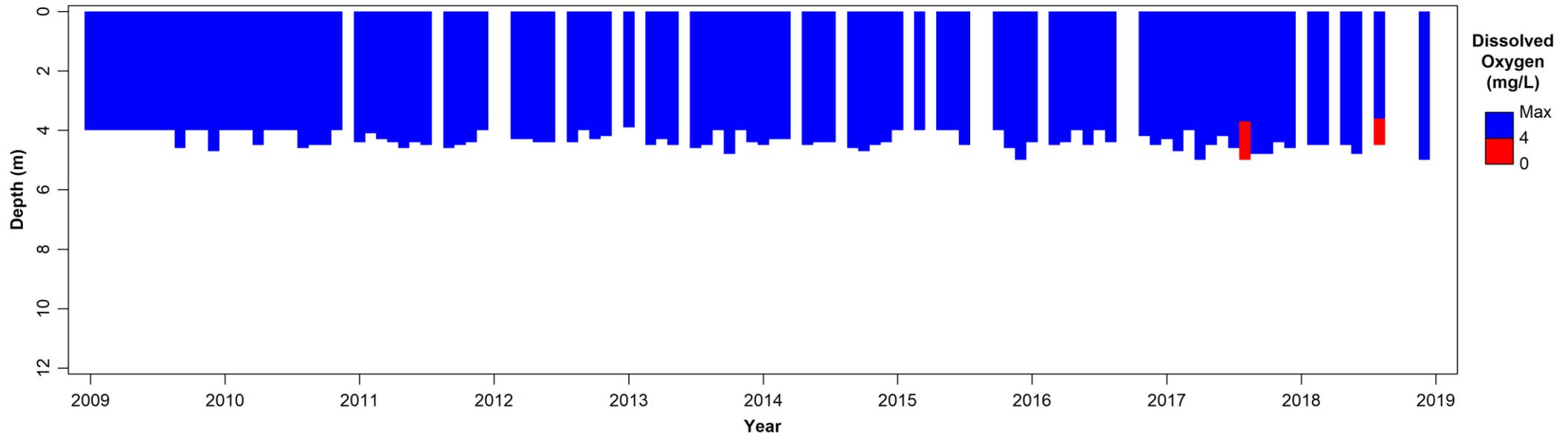
D625000
CHOWAN RIV AT US 13 AT WINTON



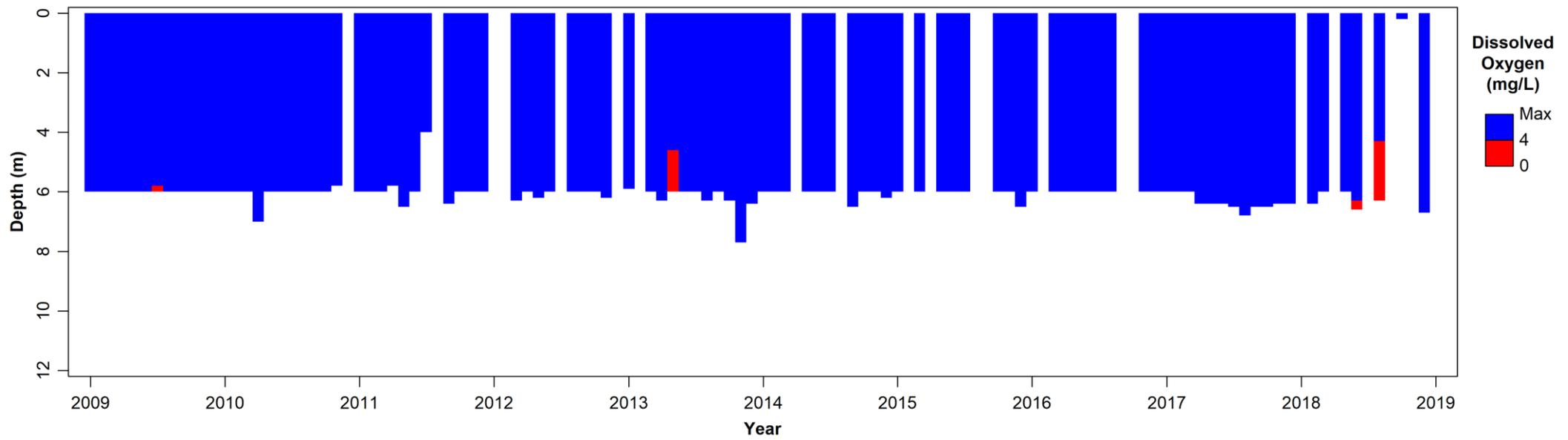
D8356200
CHOWAN RIV AT CM 16 NR GATESVILLE



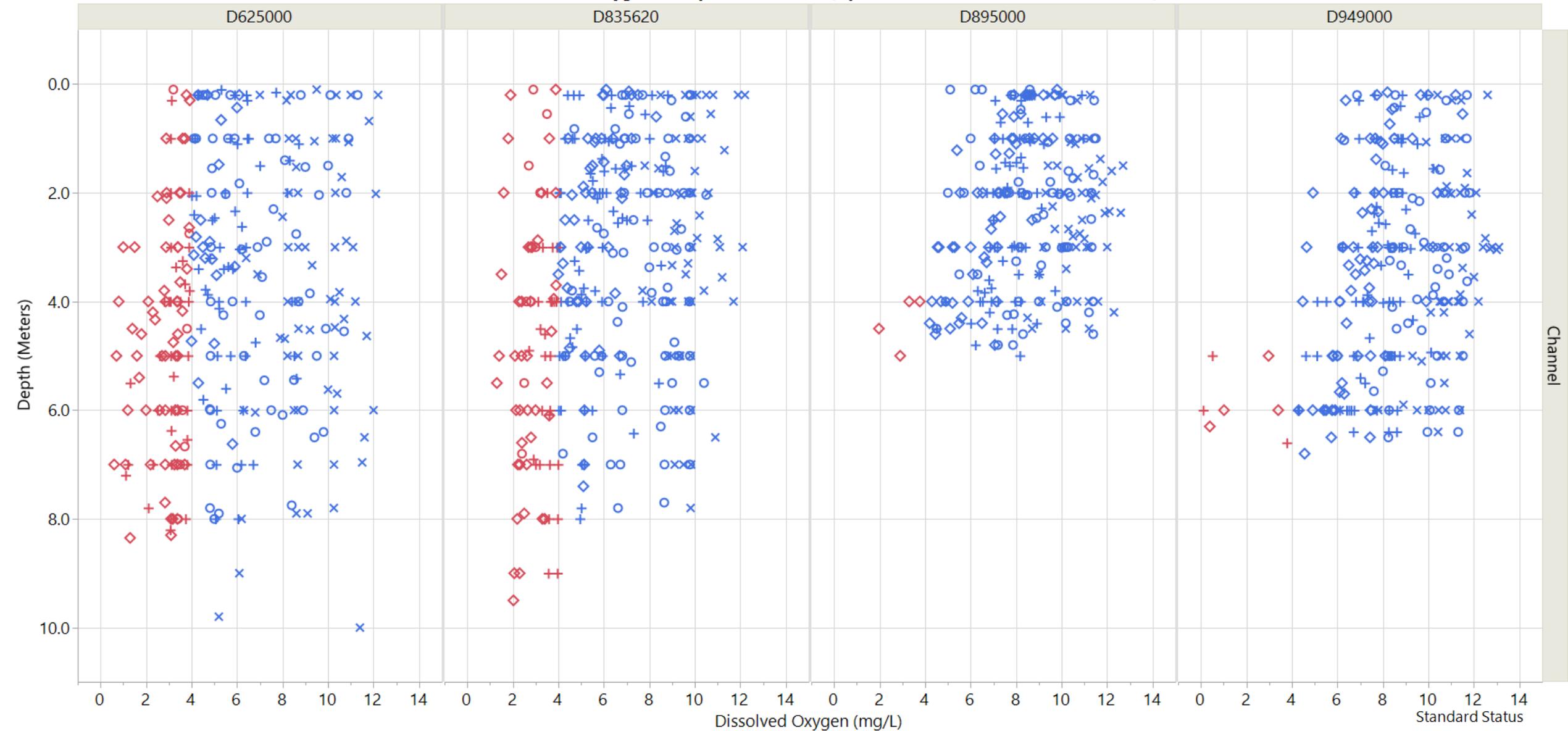
D8950000
CHOWAN RIV AT CM 7 AT COLERAIN



D9490000
CHOWAN RIV AT US 17 AT EDENHOUSE



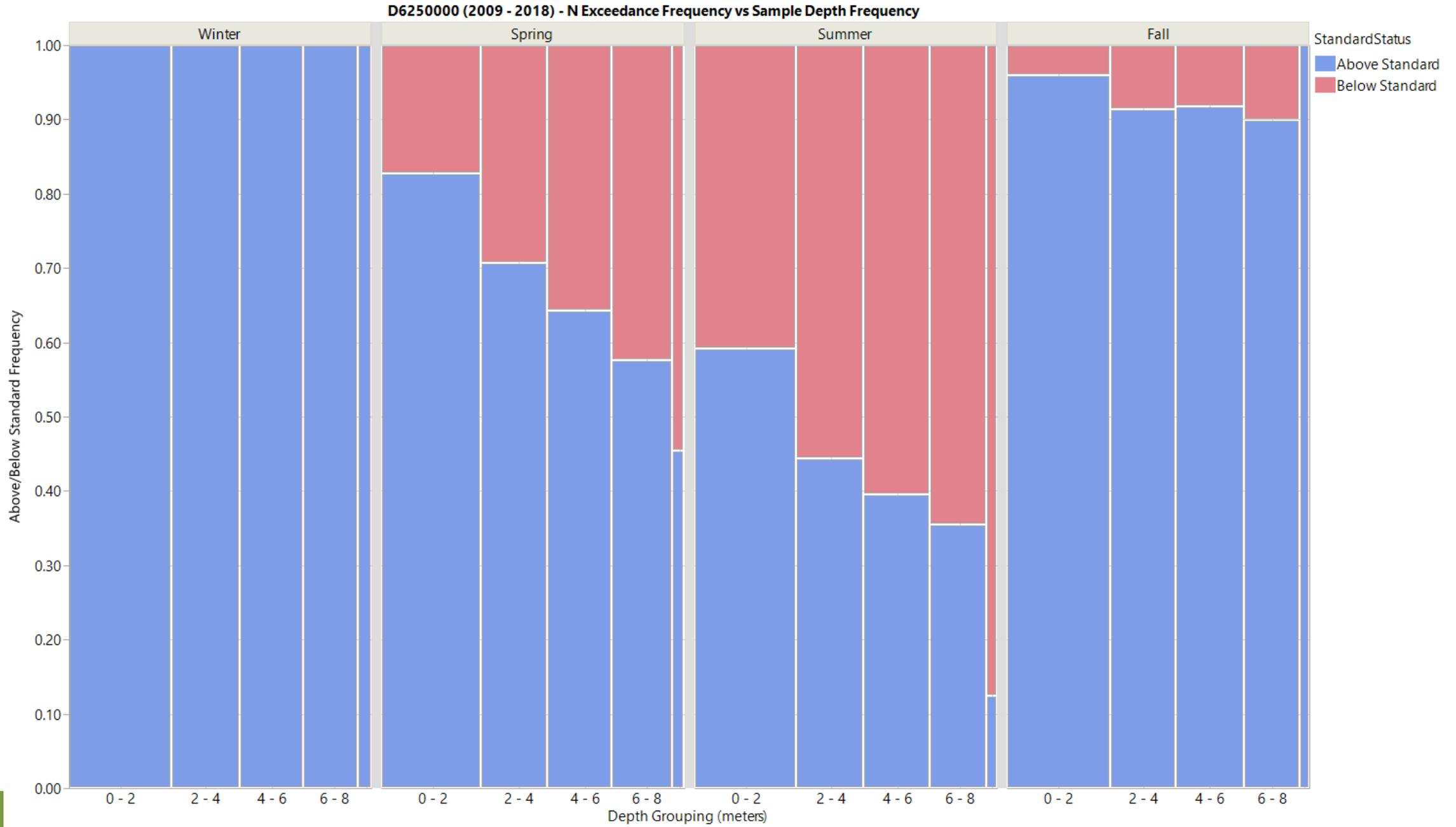
2009-2018 Dissolved Oxygen vs Depth with Season (Upstream to Downstream Station Order)



Where (Station = D625000, D835620, D843000, D895000, D949000
and Year = 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018)

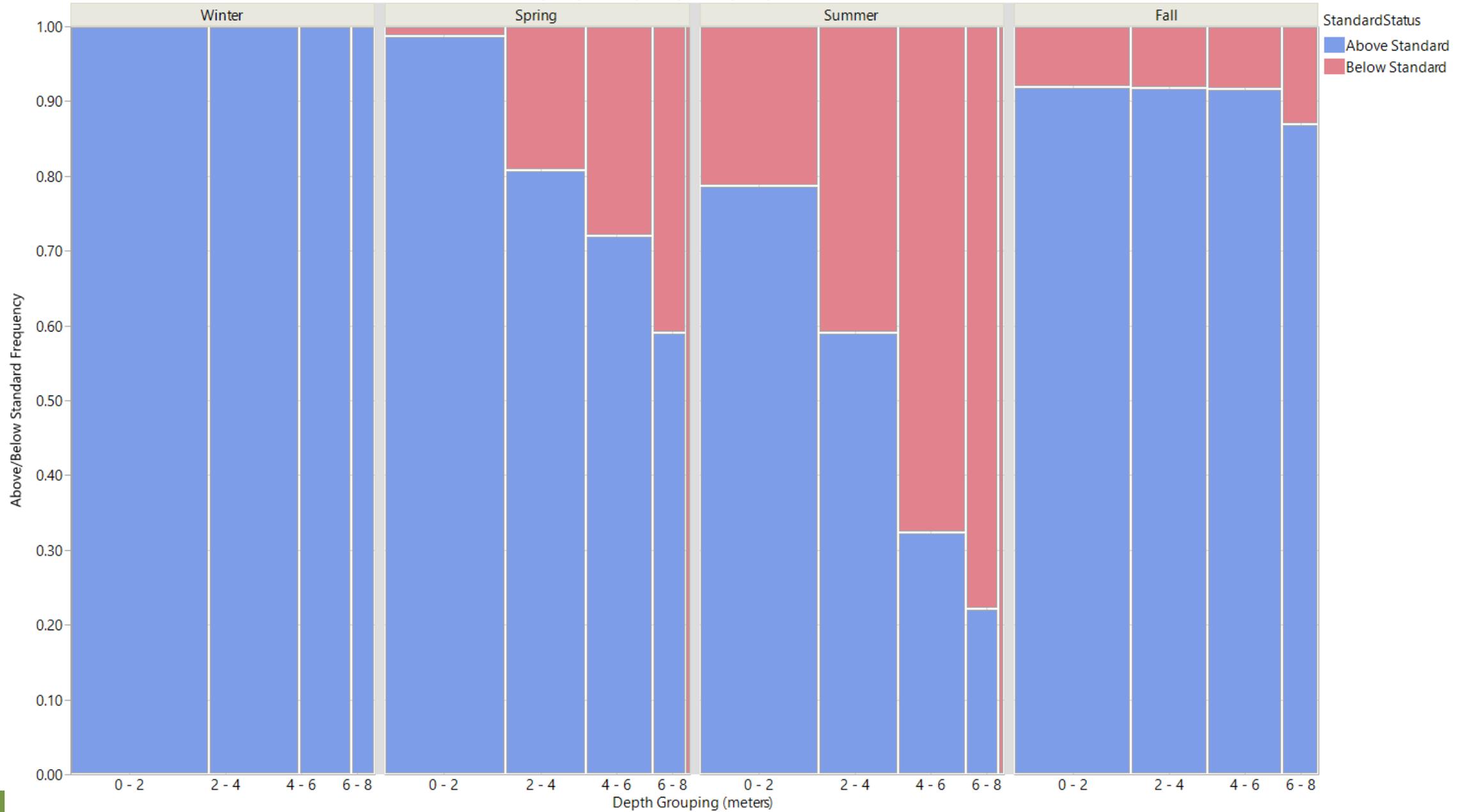
- Above Standard
- Below Standard
- Fall
- + Spring
- ◇ Summer
- × Winter

Chowan R – D625



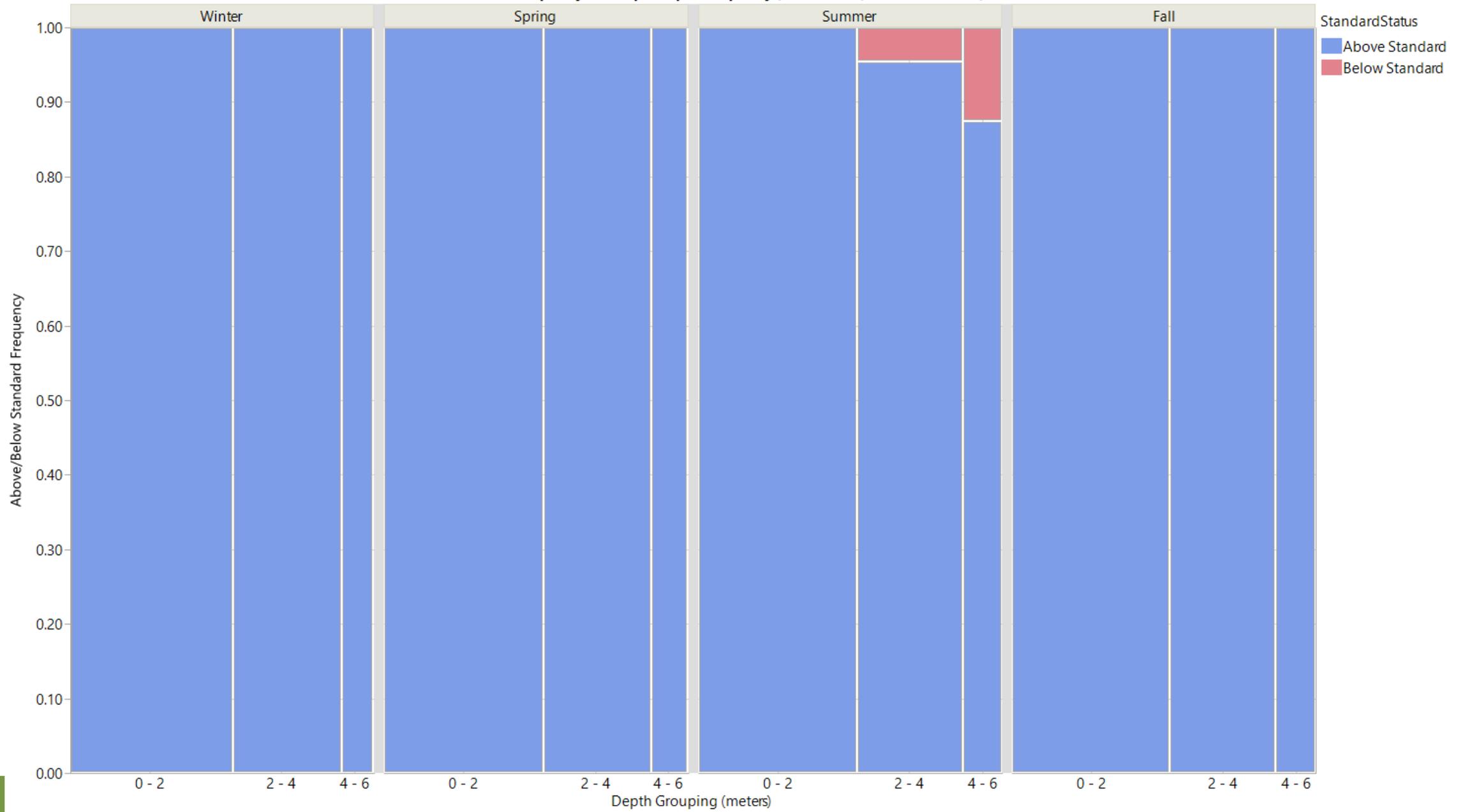
Chowan R – D8356200

D8356200 - N Exceedance Frequency vs Sample Depth Frequency (2009- 2018, DO Standard = 4)



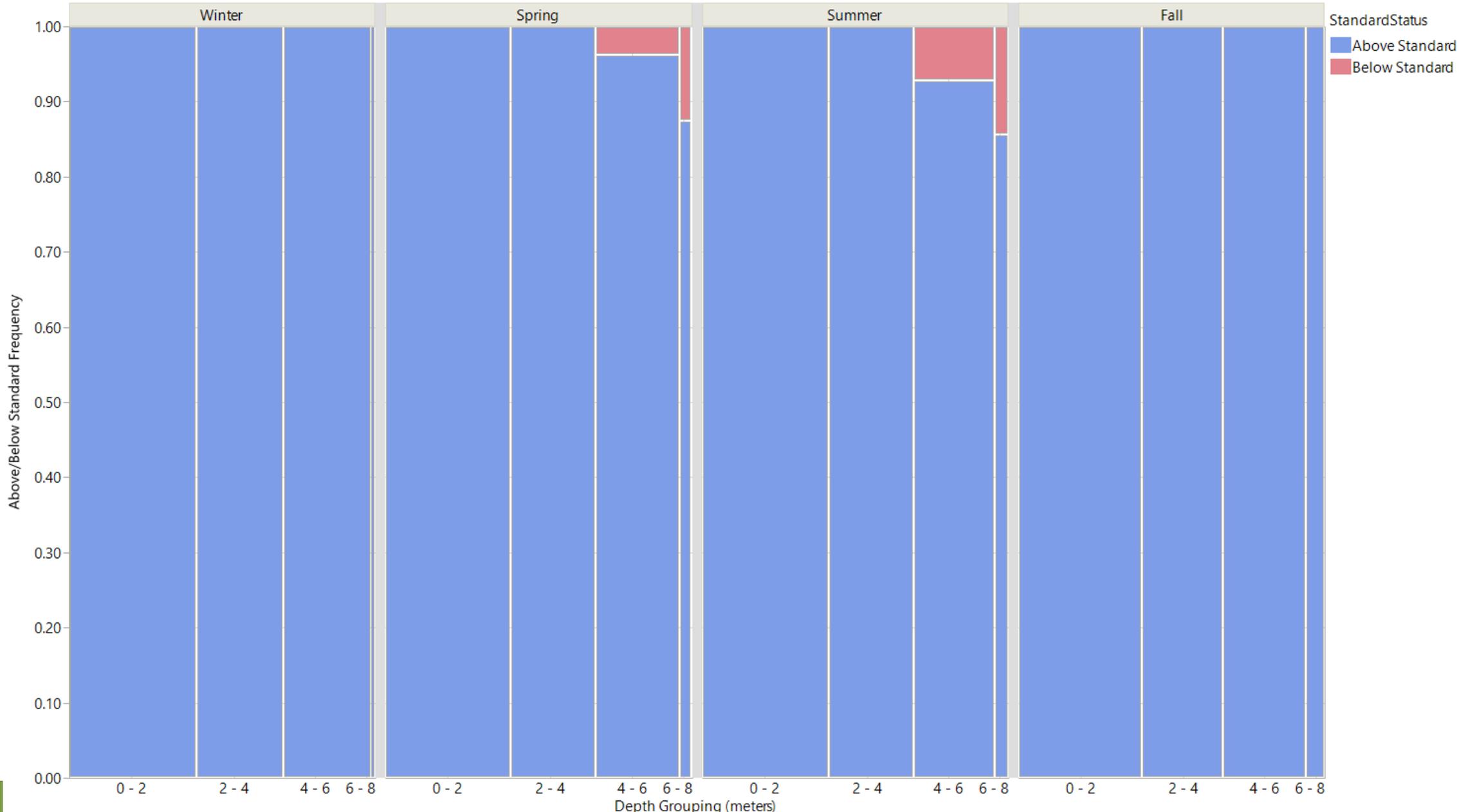
Chowan R – D895

D8950000 - N Exceedance Frequency vs Sample Depth Frequency (2009 - 2018, DO Standard = 4)

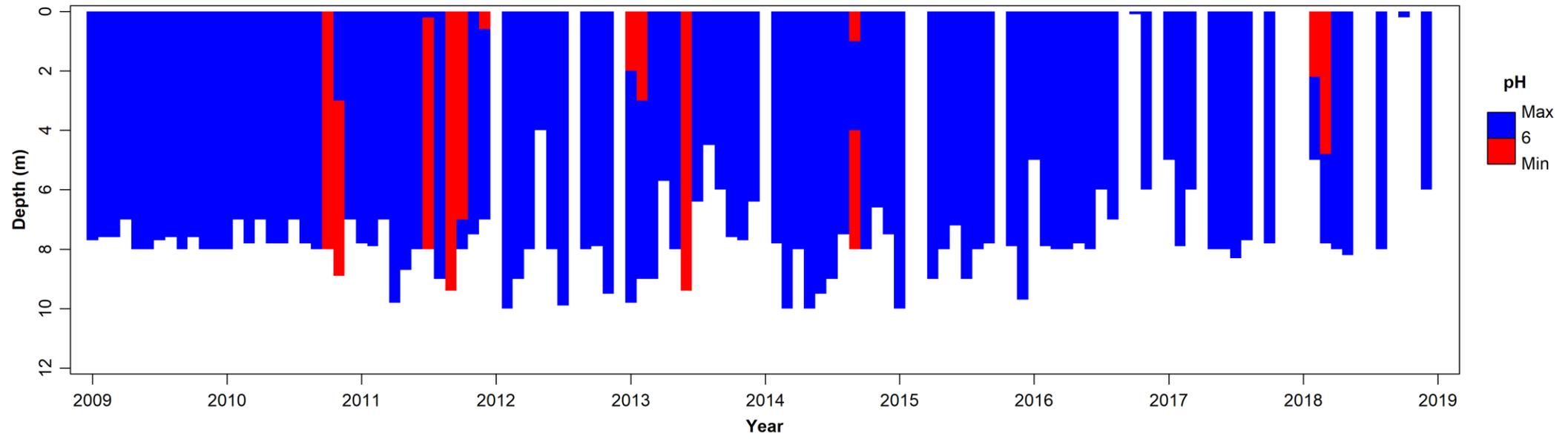


Chowan R – D949

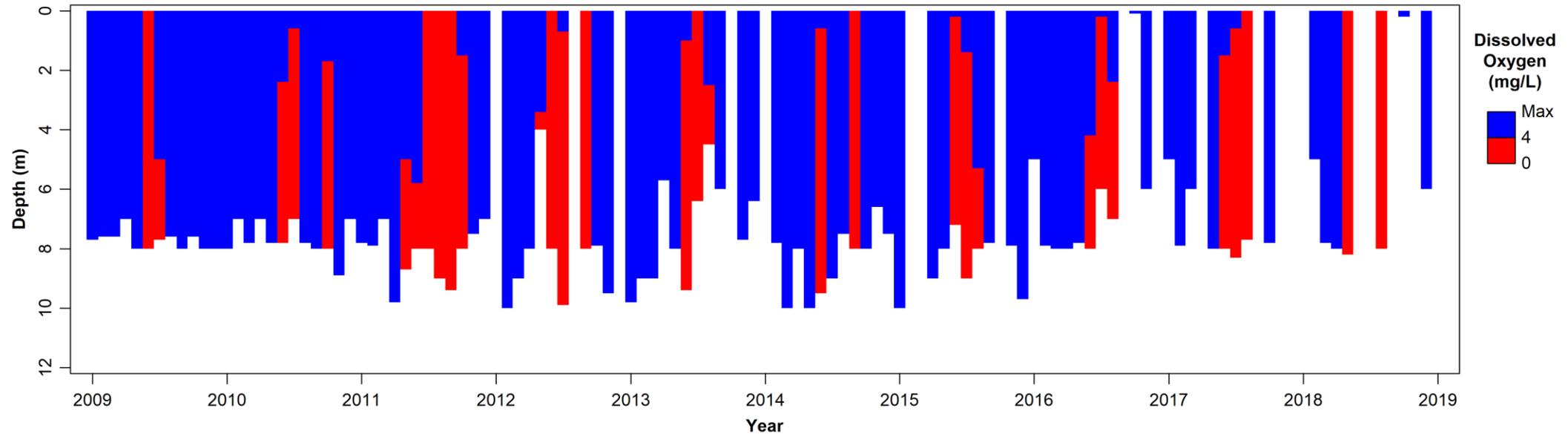
D9490000 - N Exceedance Frequency vs Sample Depth Frequency (2009- 2018, DO Standard = 4)



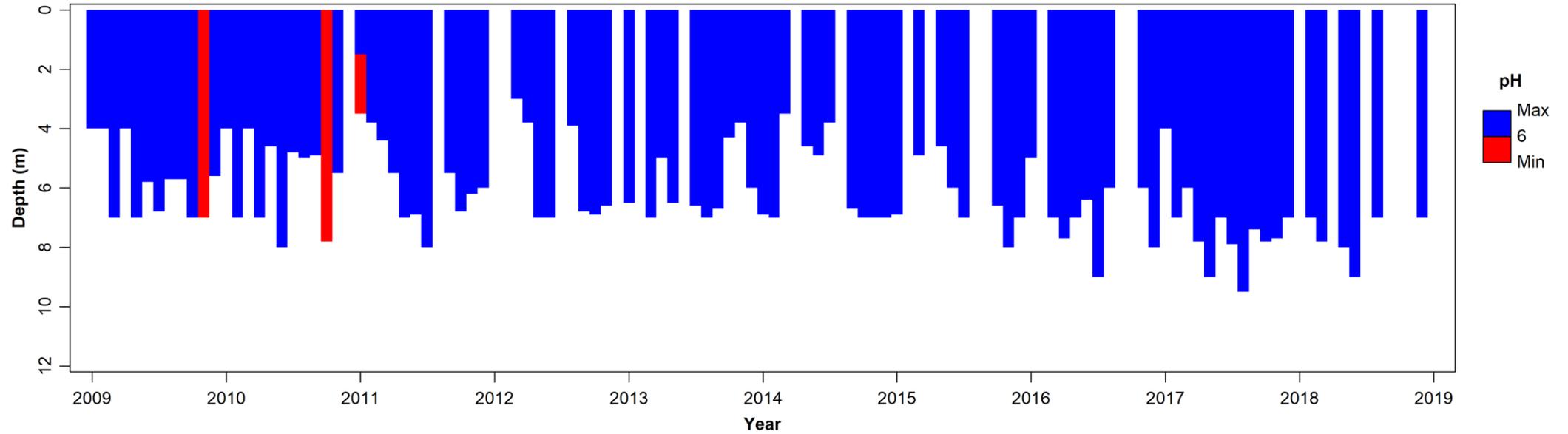
D625000
CHOWAN RIV AT US 13 AT WINTON



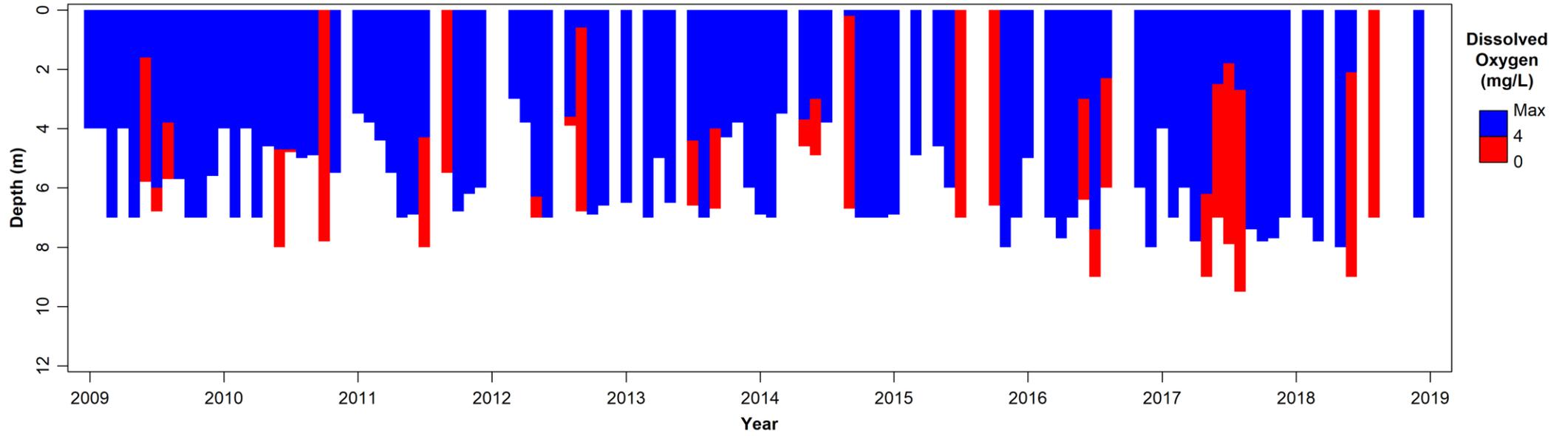
D625000
CHOWAN RIV AT US 13 AT WINTON



D8356200
CHOWAN RIV AT CM 16 NR GATESVILLE



D8356200
CHOWAN RIV AT CM 16 NR GATESVILLE



Summary Results

Albemarle - assessment methodology appears adequate, meets standards in top 4 meters, low DO in bottom waters periodically in summer months.

Chowan - assessment methodology appears representative, low DO in headwaters throughout water column.

Cause of Low DO in headwaters? Swamp inputs, other organic sources, nutrients? Will be evaluated for 2020 303(d) impairment decision.





June 17, 2020

*A (Very) Brief Overview of EPA's Draft Numeric Nutrient
Criteria for Lakes & Reservoirs*



General Information

Draft document published on 05/22/2020

- Public comment period ends: 07/21/2020

Statistical stressor-response models to determine criteria for:

- Chlorophyll-a
- TP & TN-DIN (*minus* dissolved inorganic N)

Models based on EPA National Lakes Assessment data

- Samples collected in 2007 & 2012

Online model tools provided (see slide #9)

Chlorophyll-a Criteria

Address multiple risk metrics for aquatic life & human health uses *(see next slide)*

Duration recommended as a growing season geometric mean

Frequency is recommended as not-to-exceed



Designated Use	Assessment Endpoint	Risk Metric	Model Output (criterion)	Applicability
Aquatic life	Zooplankton biovolume	Rate of change of zooplankton biomass relative to phytoplankton biomass	Chlorophyll-a	All lakes
Aquatic life	Cool- & cold-water fish	Daily depth-averaged DO below the thermocline (deep water hypoxia)	Chlorophyll-a	Dimictic lakes with cool- or cold-water fish
Recreation	Human health	Microcystin concentration to prevent liver toxicity in children	Chlorophyll-a	All lakes
Drinking water	Human health	Microcystin concentration to prevent liver toxicity in children	Chlorophyll-a	All lakes

Zooplankton Biomass Model Relationships

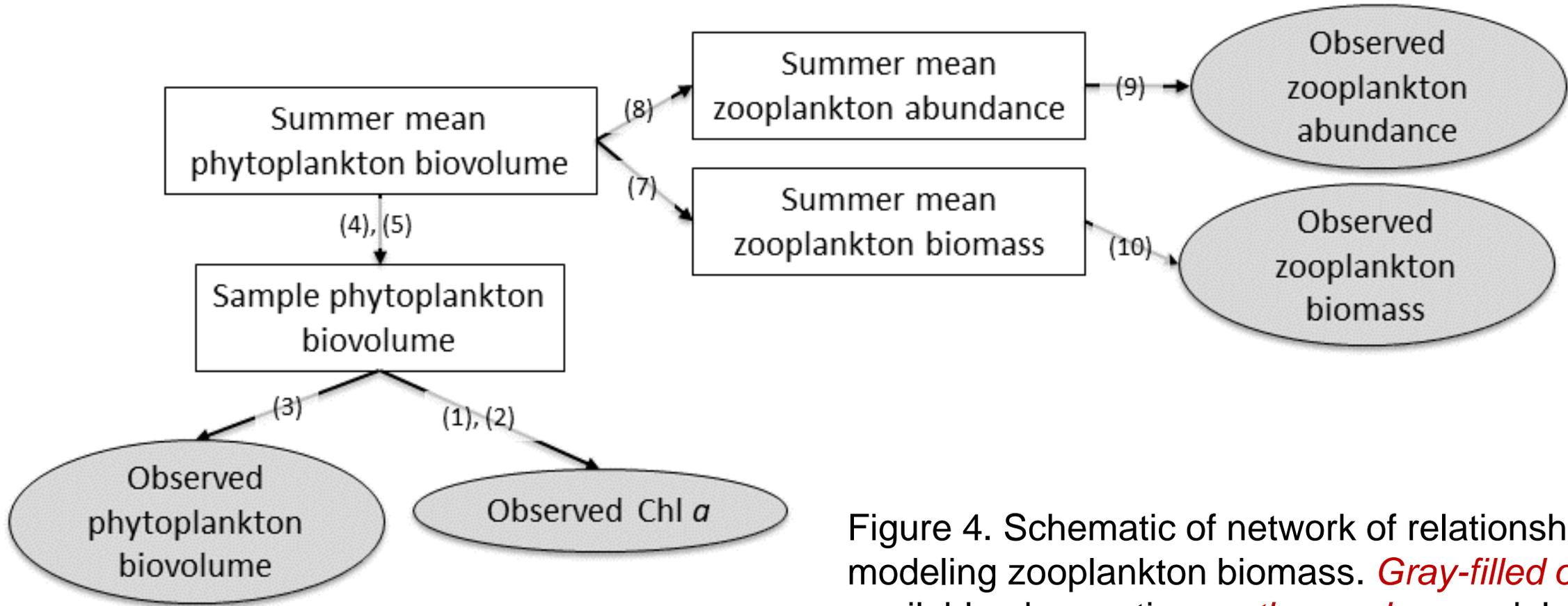


Figure 4. Schematic of network of relationships for modeling zooplankton biomass. *Gray-filled ovals*: available observations; *other nodes*: modeled parameters; *numbers in parentheses* refer to equation numbers in the text.

Microcystin Model Relationships

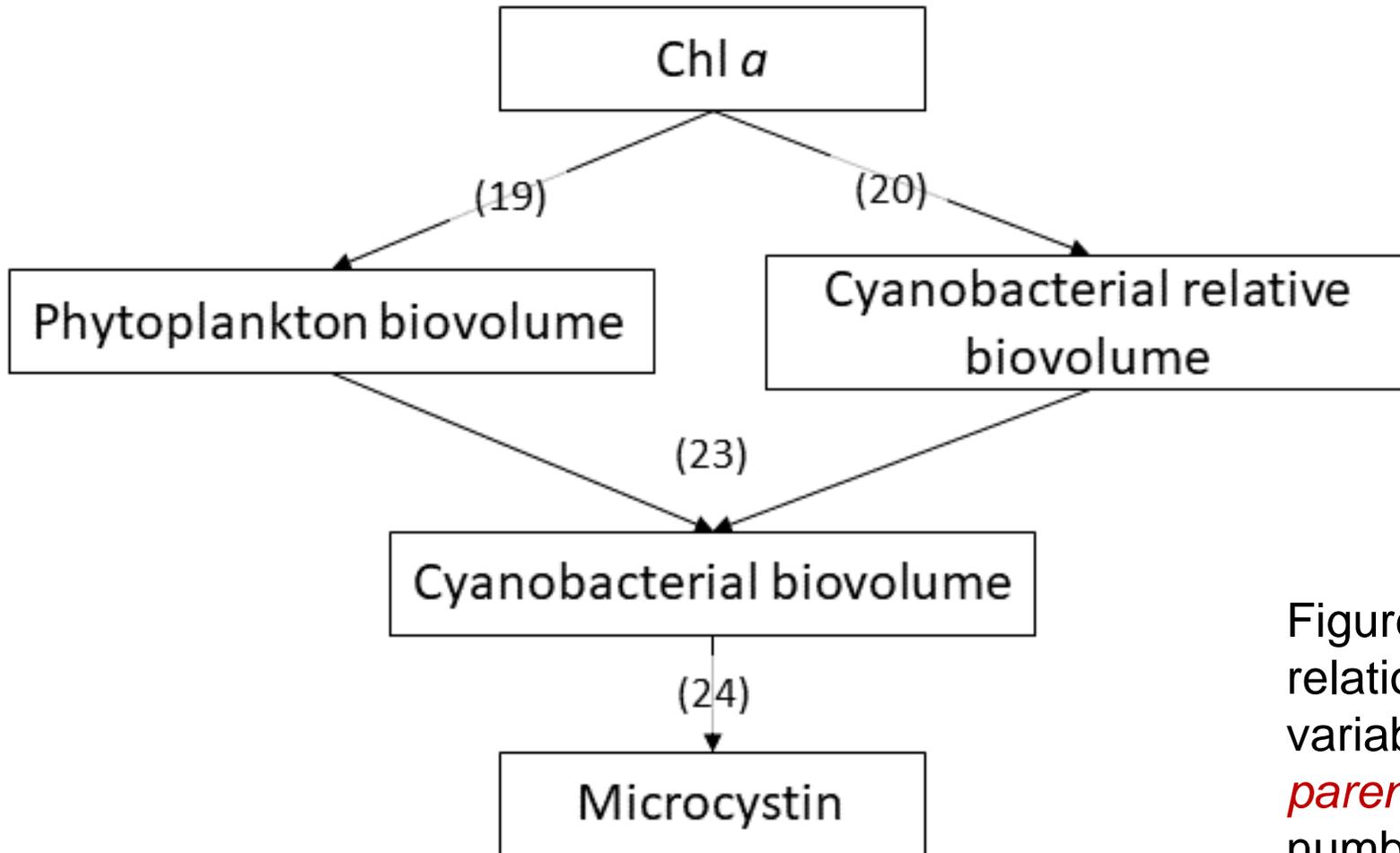


Figure 20. Schematic showing relationship between different variables predicting MC. *Numbers in parentheses:* refer to equation numbers in the text.

TN & TP Criteria

Lakes data used to establish relationships between:

- TP (various compartments), Chlorophyll-a, lake depth, ecoregion geography and turbidity
- TN (various compartments), Chlorophyll-a, and ecoregion geography

TN & TP models similar except impact of N content of inorganic suspended sediment on Chlorophyll-a was negligible

TN & TP Criteria

TN & TP models provide two criteria for each

One based on the *Ambient* concentration

- Associated with a targeted Chl a concentration that then provides a candidate criterion for TN-DIN or TP

One based on the *Limiting relationship*

- Can potentially be used to estimate the change in Chl a that would result from a change in the amount of biologically available N or P in the water column (estimate effects of load reductions)

Duration recommended as a growing season geometric mean

Frequency is recommended as not-to-exceed

Summary

Draft criteria models that provide....

Chlorophyll-a criteria for:

1. Two different aquatic life risk metrics (zooplankton/hypoxia)
2. Two different human health risk uses (recreation/drinking)

&

TN & TP criteria based on:

1. Ambient concentrations
2. Limiting relationships

Interactive Model Tools

Tools allow user to manipulate model inputs to derive criteria for the various uses

Phytoplankton/zooplankton: <https://chl-zooplankton-prod.app.cloud.gov/>

Deep water hypoxia: <https://chl-hypoxia-prod.app.cloud.gov/>

Chlorophyll-microcystin model: <https://chl-microcystin-prod.app.cloud.gov/>

TN/TP: <https://tp-tn-chl-prod.app.cloud.gov>



June 17, 2020

*Candidate Algal Criteria for the Chowan River and
Albemarle Sound*



Candidate Algal Criteria

- Chlorophyll *a*
- Phycocyanin
- Exposure or Recreational Contact Advisory Days
- Cyanotoxins
- Algal Density
- Algal Biovolume

Other ideas?

Questions for Each Candidate Criterion

- Background
- Pros
- Cons
- Ambient or episodic application?
- Preliminary recommendation: continue or drop?