



Biological Assessments of Maine's Streams and Rivers

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MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

Protecting Maine's Air, Land and Water

Outline

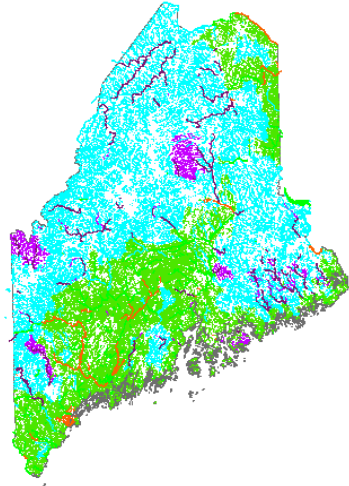
- Overview of biological monitoring of Maine's streams and rivers
- Effects of urban development
- Effects of nutrient enrichment



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Stream Classes



% OF LINEAR MILES OF
STATUTORY
CLASSIFICATIONS

Class AA = 6%

Class A = 47%

Class B = 46%

Class C = 1%



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Narrative Aquatic Life Criteria

Class	Narrative Aquatic Life Criteria
AA	Habitat natural and free flowing. Aquatic life as naturally occurs.
A	Habitat natural. Aquatic life as naturally occurs.
B	Habitat unimpaired. Must support all indigenous aquatic species. No detrimental changes to resident biological community.
C	Must support all indigenous fish species and maintain structure and function of resident biological community.



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Maine DEP's Biological Monitoring Unit

- Determine if streams, rivers, and wetlands are attaining aquatic life criteria
- stream macroinvertebrates since 1983
- wetland macroinvertebrates since 1998
- algae in streams and wetlands since 2000

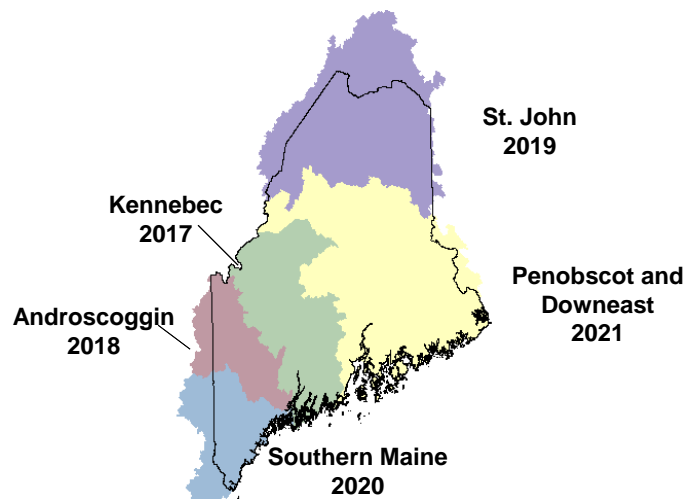
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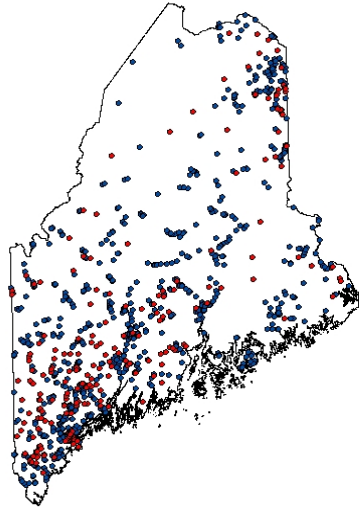
Rotating Basin Approach for Sampling



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Sample Locations



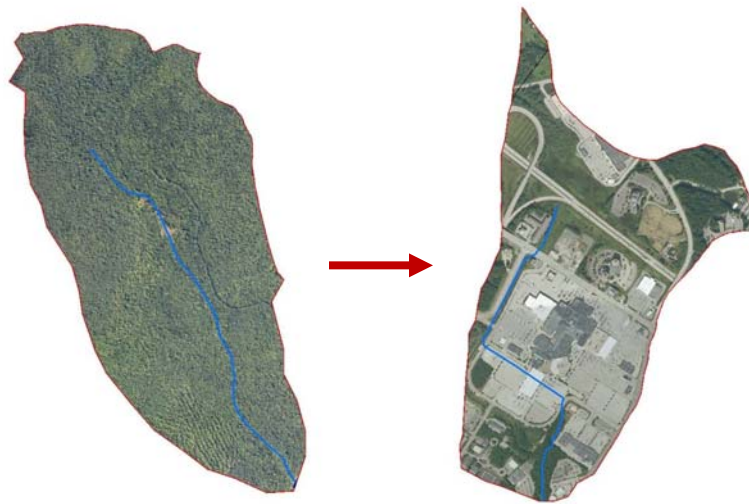
- Wetlands (n=309)
- Streams & Rivers (n=1,140)



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Range of Condition



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Macroinvertebrate Sampling

- Rock baskets or bags
- Standardized size and quantity of rocks
- 3 per site
- Left for 4 weeks



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Macroinvertebrate Sampling

- Retrieve bag with a dip-net downstream
- Transfer bag into a sieve bucket
- Remove macroinvertebrates from bag and rocks
- Preserve sample with alcohol



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Clean Water Macroinvertebrates

Mayflies
(Ephemeroptera)



Stoneflies
(Plecoptera)



Caddisflies
(Trichoptera)



Images by Tom Walker, Tom Murray, TroutNut, and Rick Hafele



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Tolerant Macroinvertebrates

Isopods



nwnature.net

Aquatic Earthworms



ANEBO

Leeches



Aphotofauna

Amphipods



Biodiversity Institute of Ontario

Midges



Tom Murray



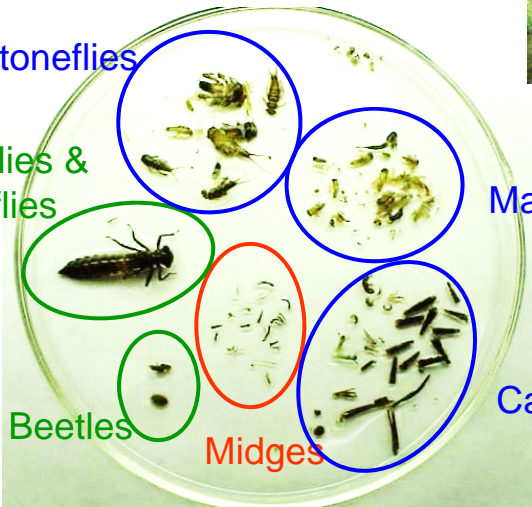
Mardon Erbland



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Class A Stream

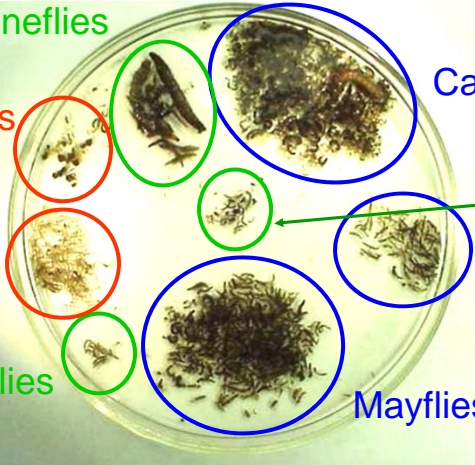


Color Code
Sensitive
Intermediate
Tolerant

Babel Brook, T5 R9 NWP

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Class B Stream



Color Code
Sensitive
Intermediate
Tolerant

Eddy Brook, New Gloucester

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Non-Attainment Stream

Penjawoc Stream,
Bangor

Color Code

- Sensitive
- Intermediate
- Tolerant

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Sampling

Macroinvertebrate Sample

Taxa List

<i>Pteronarcys</i>	2		
<i>Acroneuria</i>	7		
<i>Epeorus</i>	23		
<i>Baetis</i>	14		
<i>Leucrocuta</i>	10	→	
<i>Chimarra</i>	25		
others . . .			

Compute Metrics

such as
Taxa Richness,
EPT Richness,
and
Hilsenhoff Biotic
Index

Statistical Model

Predicts
probabilities of a
sample attaining
Class AA/A,
Class B, Class C,
or Non-
Attainment (NA)

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Algae Samples

- Establish 6 transects
- Collect 3 rocks per transect
- Total of 18 rocks
- Scrape area of rocks within circle with a brush
- Composite sample

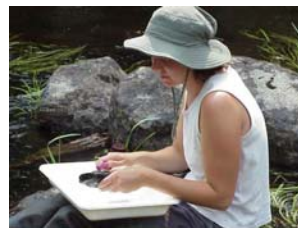


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Natural Substrate Samples

- Establish 6 transects
- Collect 3 rocks per transect
- Total of 18 rocks
- Scrape area of rocks within circle with a brush
- Composite sample

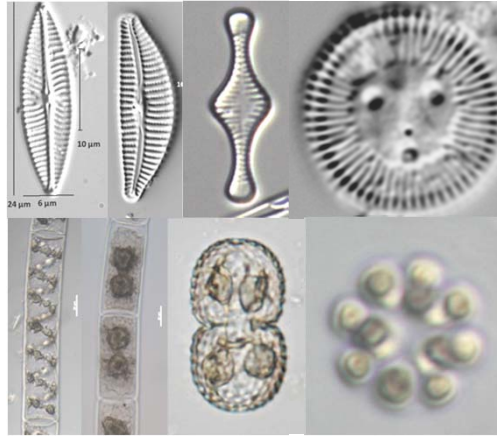


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Types of Algae and Cyanobacteria

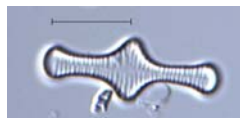
- >1,500 taxa
- Diatoms
- Green
- Cyanobacteria
- Red
- Dinoflagellates
- several other groups



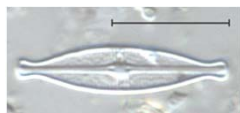
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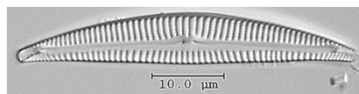
Clean Water Taxa



Tabellaria flocculosa

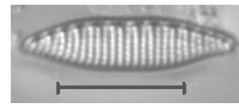


Brachysira microcephala

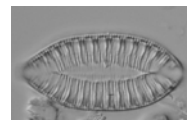


Cymbella gracilis

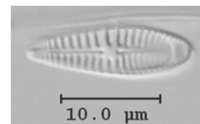
Tolerant Taxa



Nitzschia amphibia



Surirella brebissonii



Rhoicosphena abbreviata



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Stream Algae Model Variables

Metric Description	Environmental Significance
Salt-tolerant diatoms relative richness	Tolerate higher conductivity
Eutrophic diatoms richness	Prefer nutrient rich water
Motile diatoms richness	Ability to move in silt or thick algal mats
Tolerant algae relative richness	Tolerate poor water quality
Sensitive algae richness	Require clean water
Intermediate taxa relative abundance	Unimodal response to disturbance

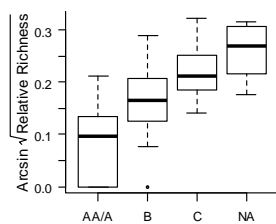
Variable based on **only diatoms** or **all algae**



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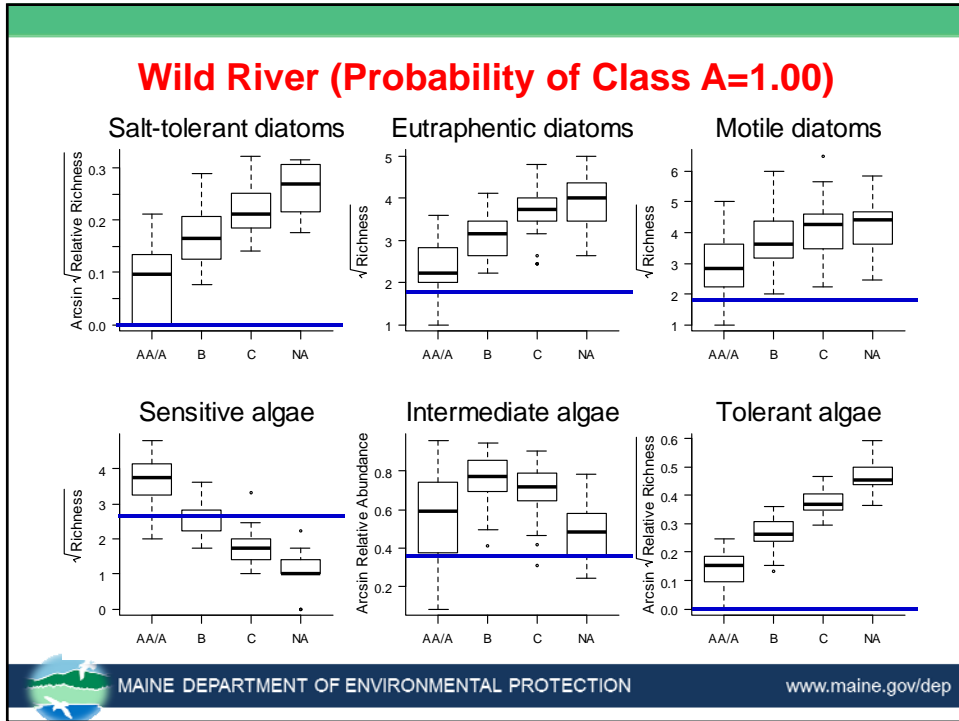
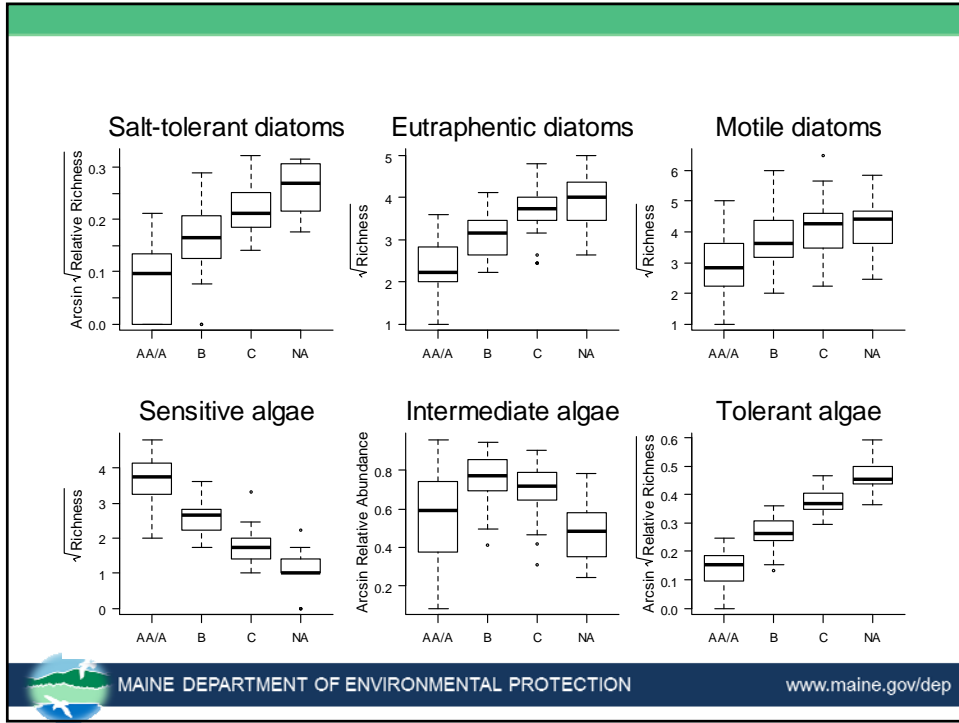
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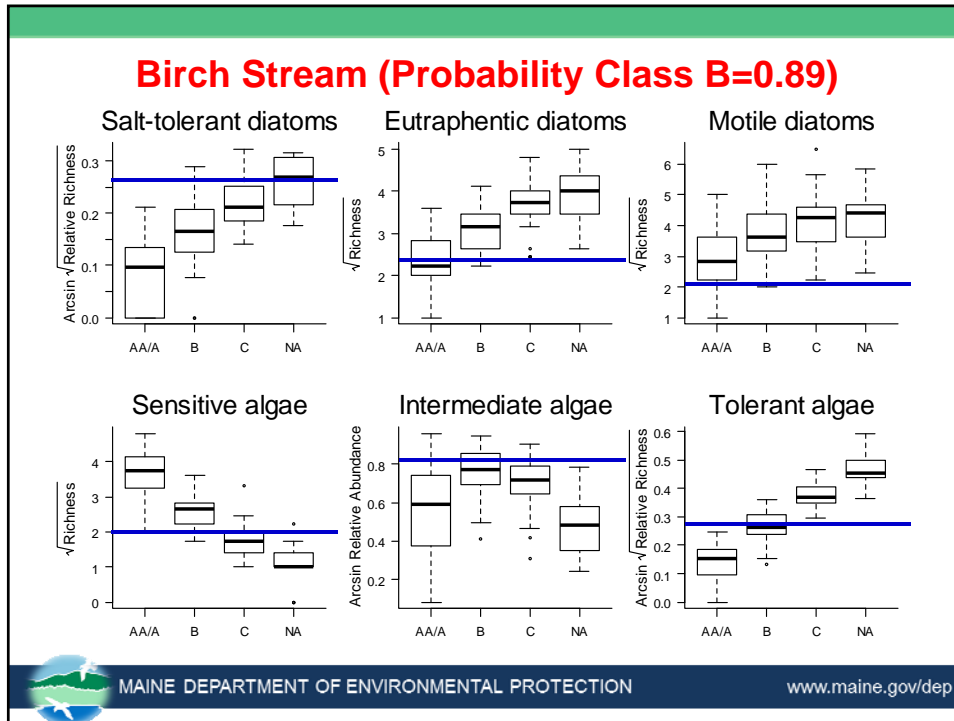
Salt-tolerant diatoms



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Attainment Decisions

Statutory Class	Bioassessment Result	Attains Class?	Next Step
A	A	Yes	--
C	B	Yes	Upgrade class?
A	B	No	Try to fix it
B	NA	No	Try to fix it

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Two Bioassessment Models

Macroinvertebrates	Algae	Possible Stressors
Attains	Attains	--
Does not attain	Does not attain	<ul style="list-style-type: none"> • Look at diagnostic metrics
Attains	Does not attain	<ul style="list-style-type: none"> • Nutrients • Sediment • Specific conductance
Does not attain	Attains	<ul style="list-style-type: none"> • Low dissolved oxygen • Habitat alteration • Particulate organic matter



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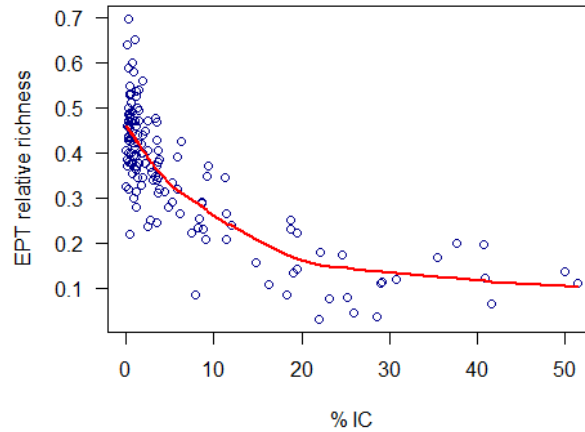
Effects of Urbanization



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Effects of Impervious Cover

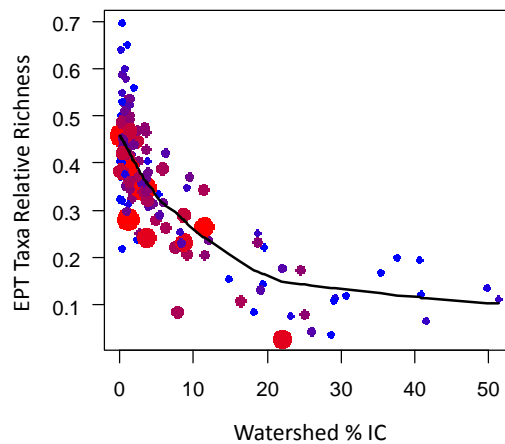


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Wetlands in Watershed

- Larger, redder dots have more wetlands in their watersheds
- Urban sites generally have fewer wetlands remaining in their watersheds

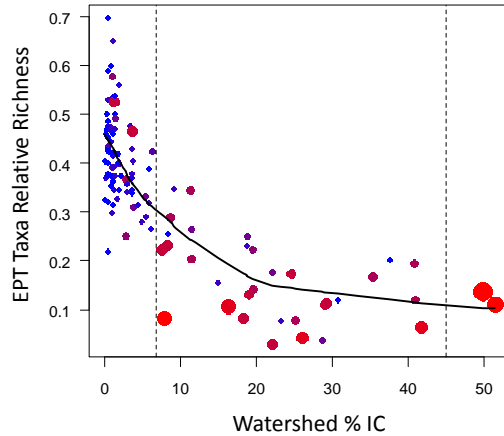


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Location of Development

- Larger, redder points have more IC in the 50m buffer zone
- Sites with more IC in 50 m buffer zone had less Mayflies, Stoneflies, and Caddisflies (EPT)

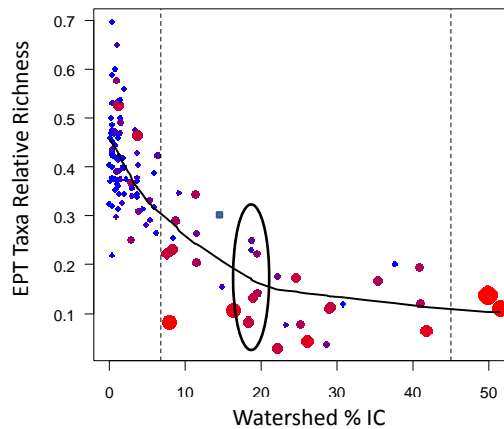


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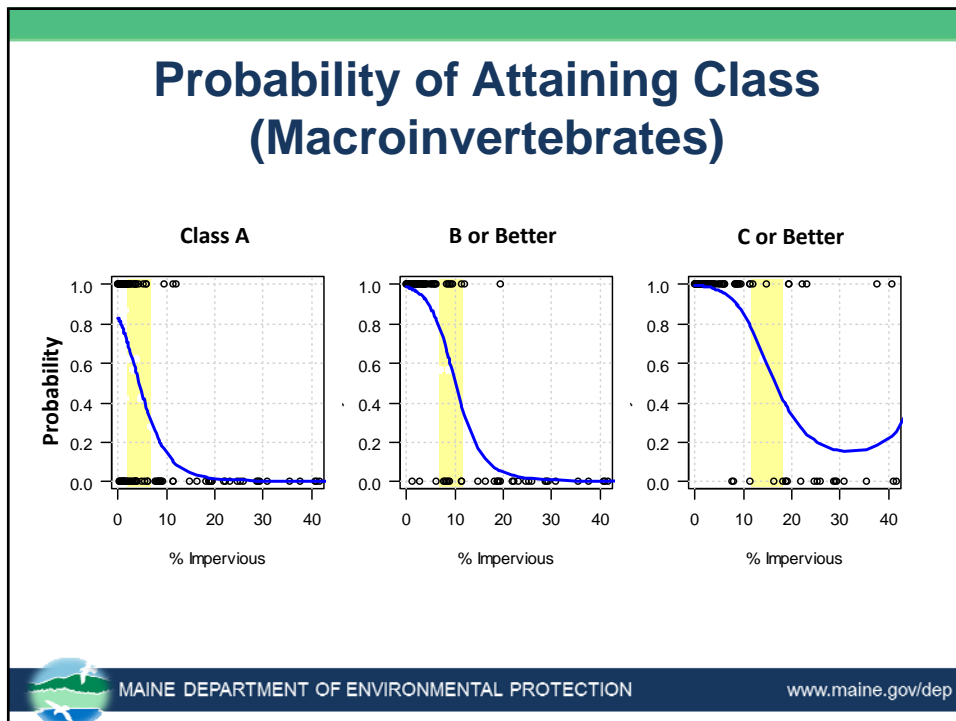
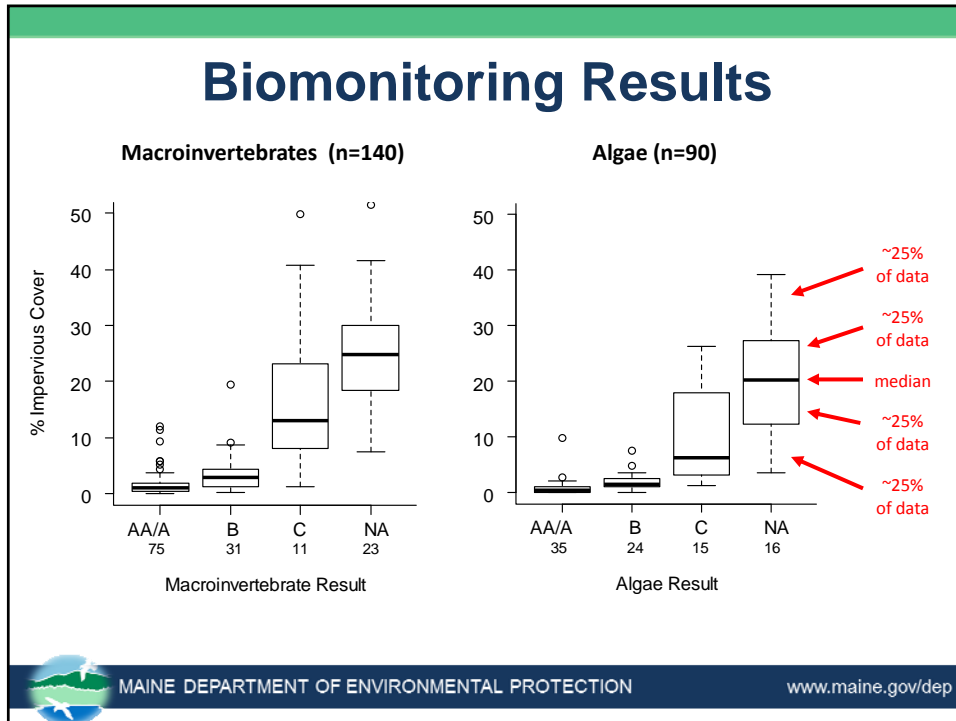
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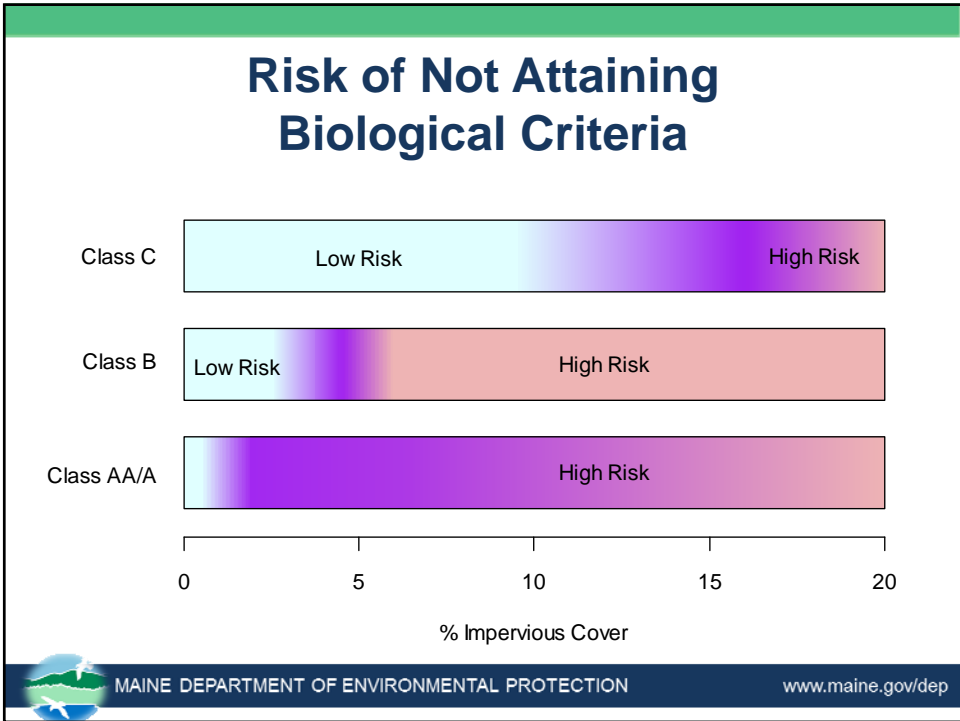
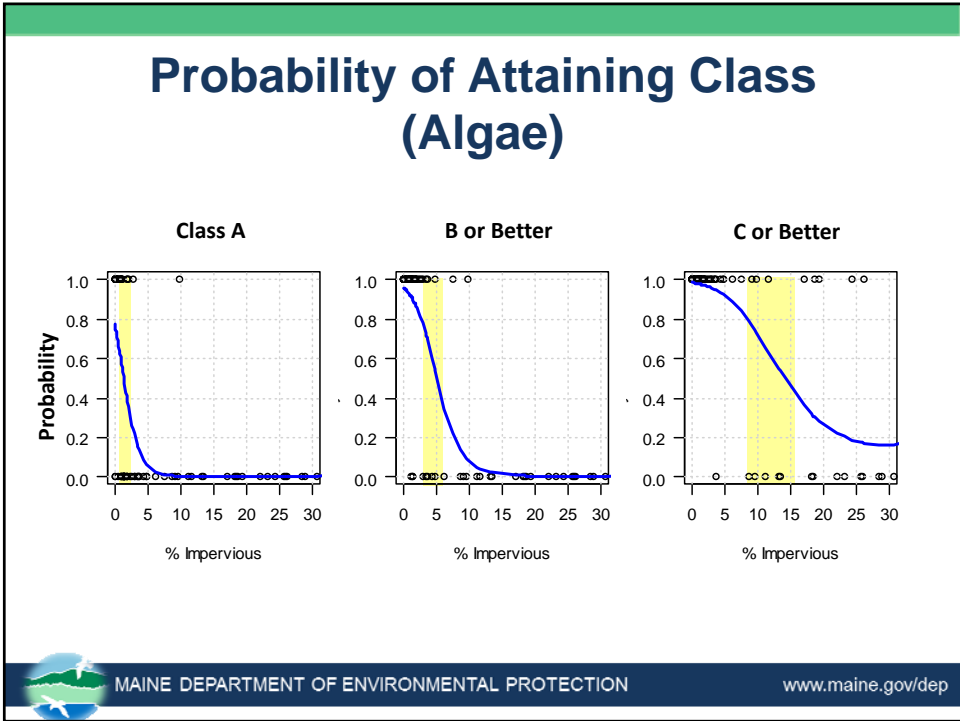
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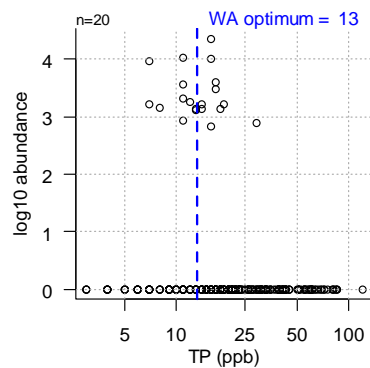
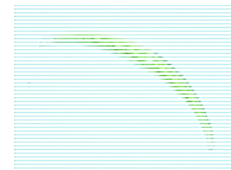
Effects of Nutrient Enrichment



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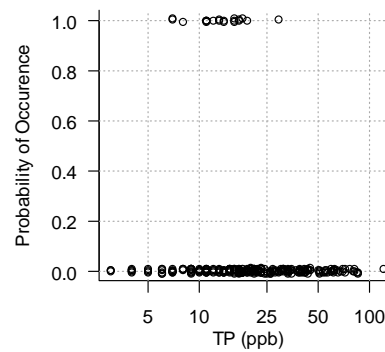
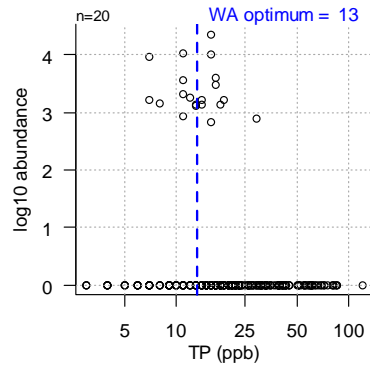
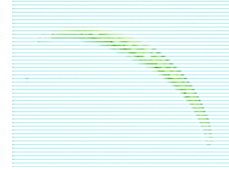
Oligotrophic Species (*Closterium parvulum*)



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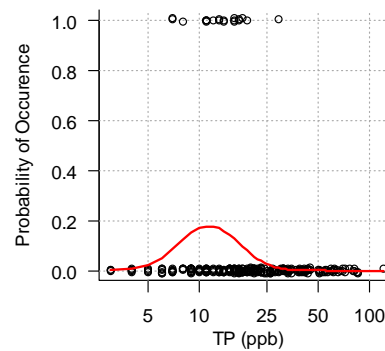
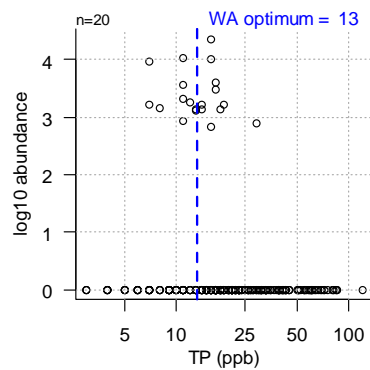
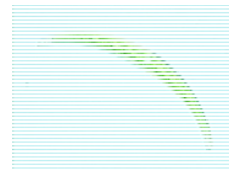
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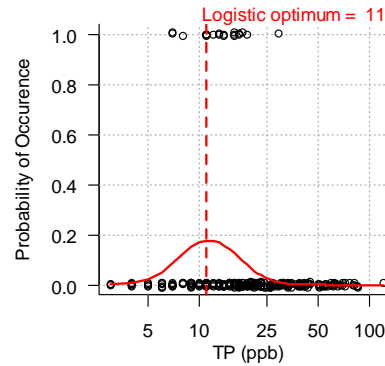
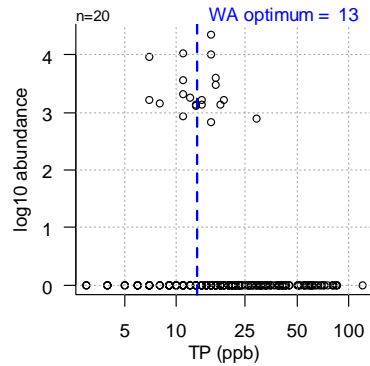
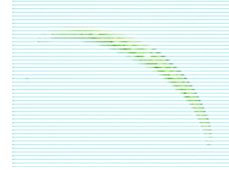
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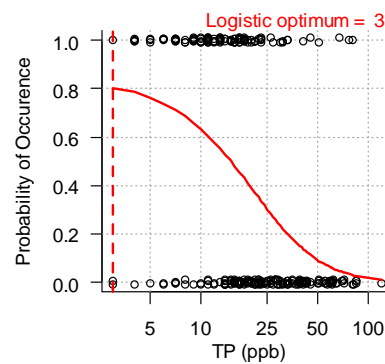
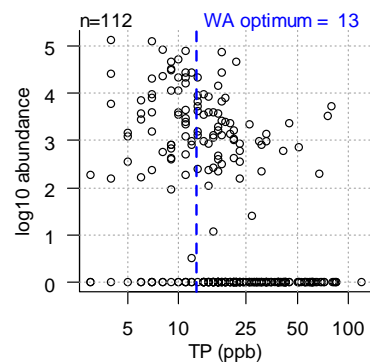
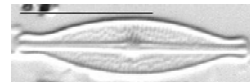
Oligotrophic Species (*Closterium parvulum*)



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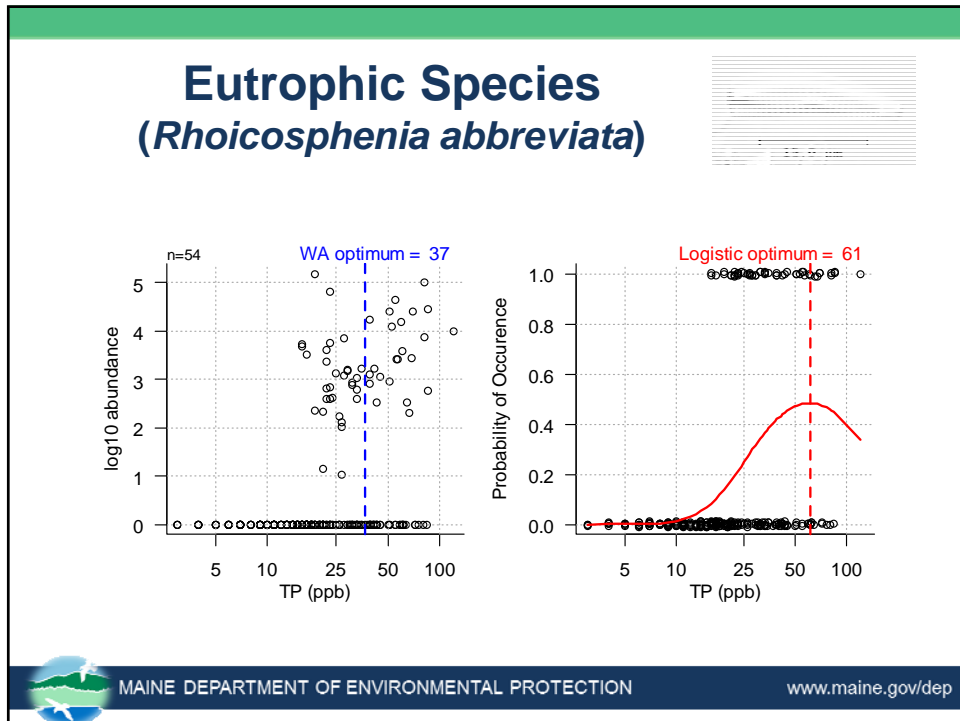
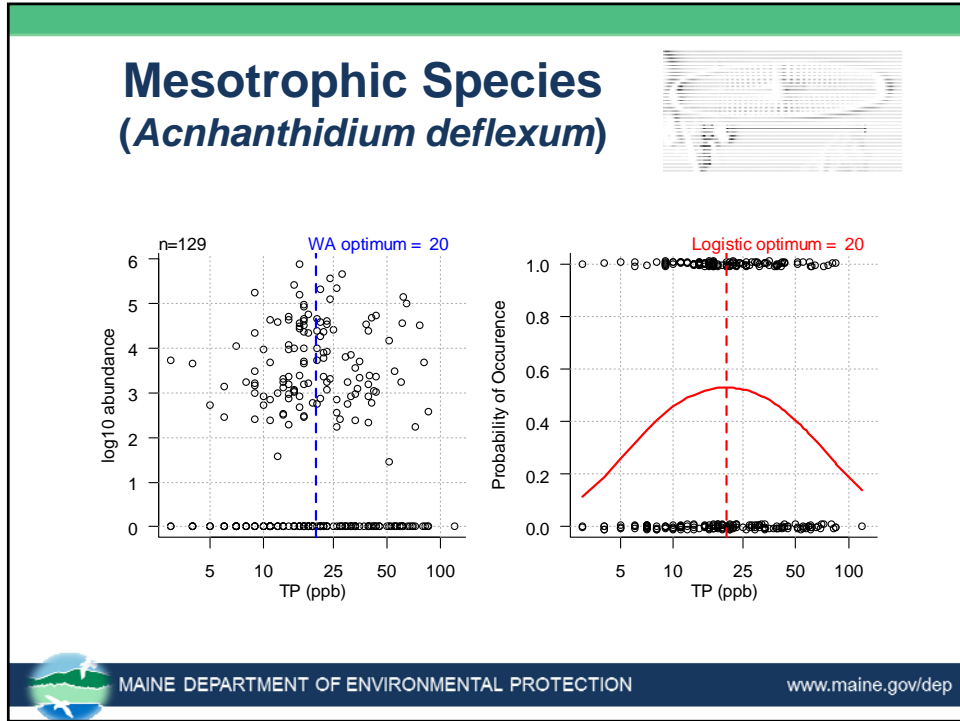
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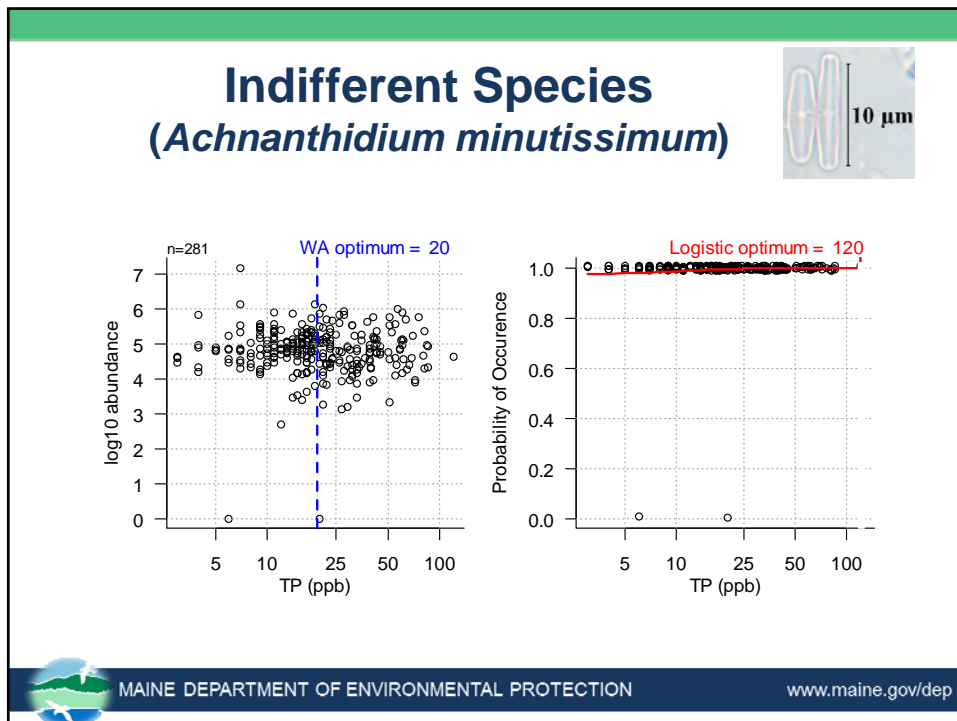
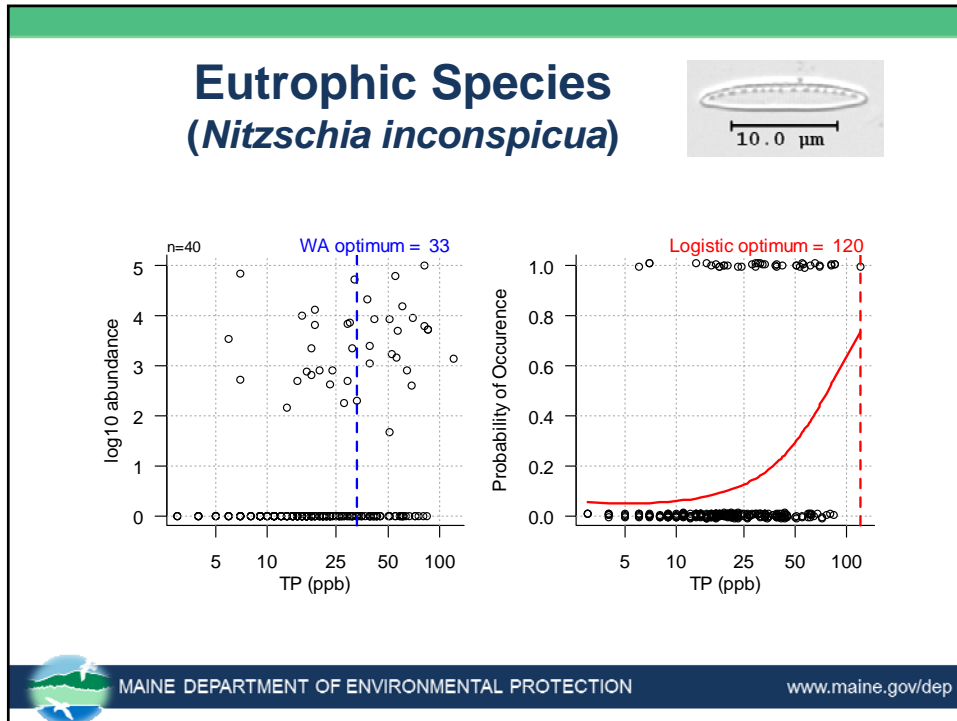
Oligotrophic Species (*Brachysira microcephala*)

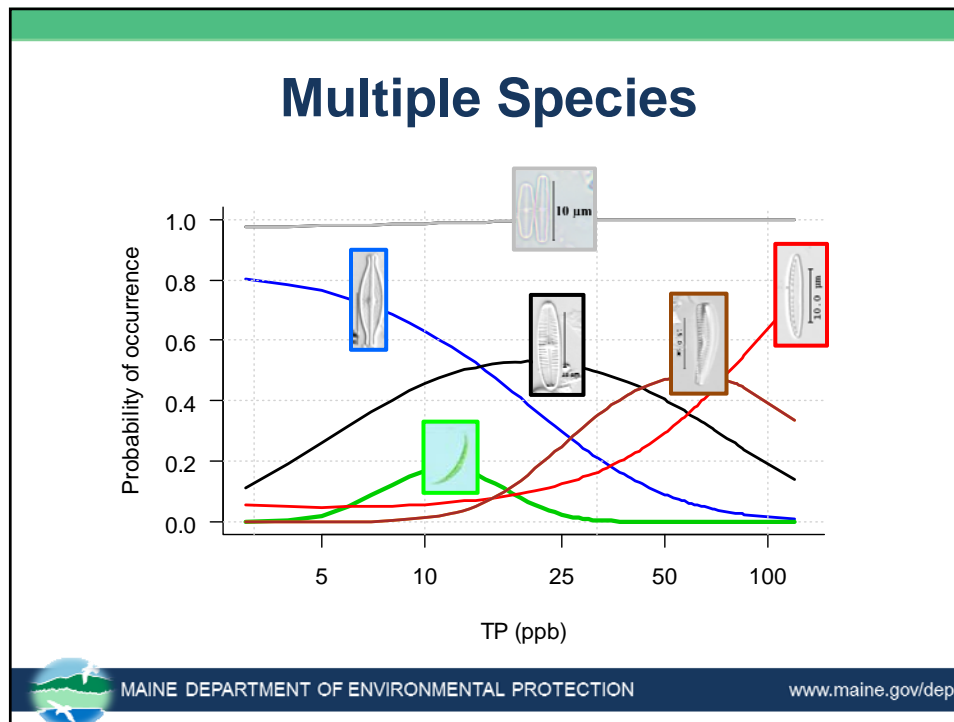


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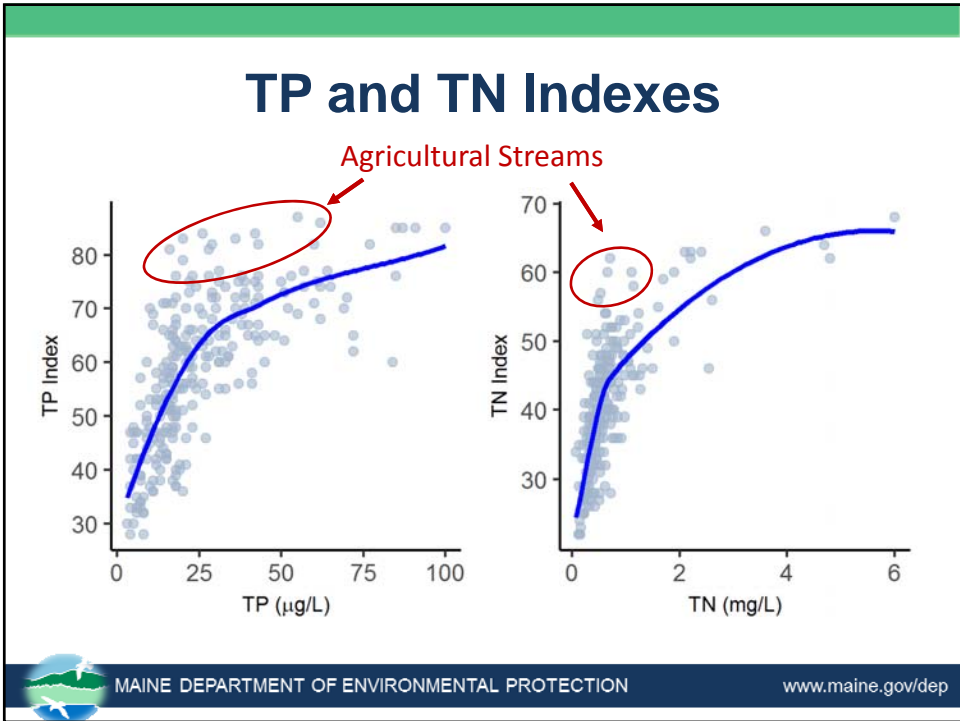
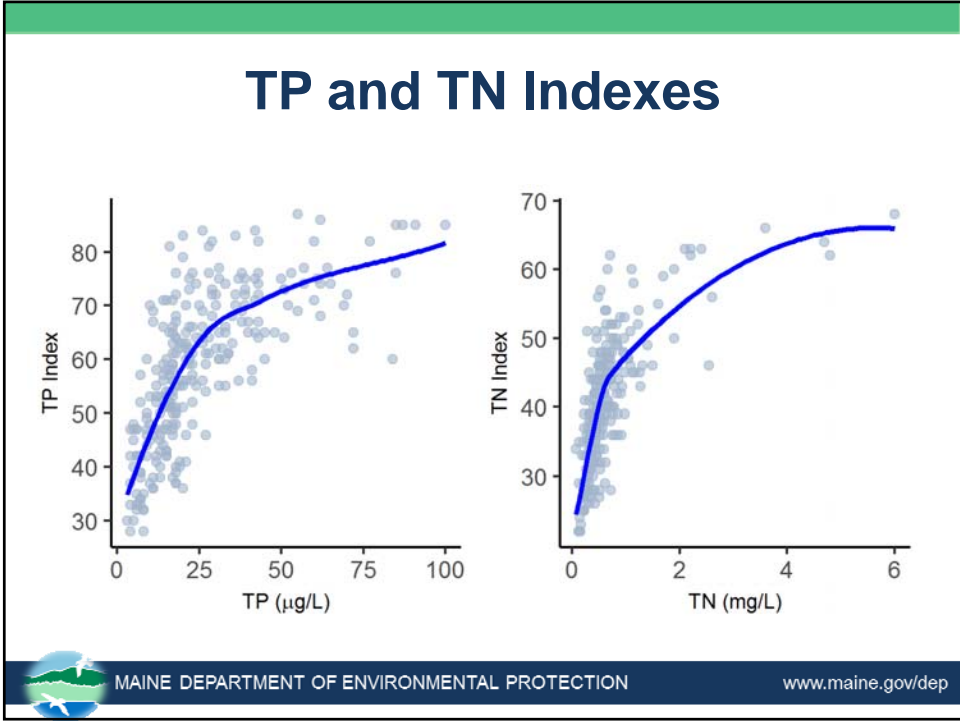






Tolerance Values and Indexes

- Based on combination of weighted average optima and logistic regression optima
- Rescaled to 0-100
- Excluded indifferent taxa
- Indexes are simple weighted average indexes



Nutrient Thresholds

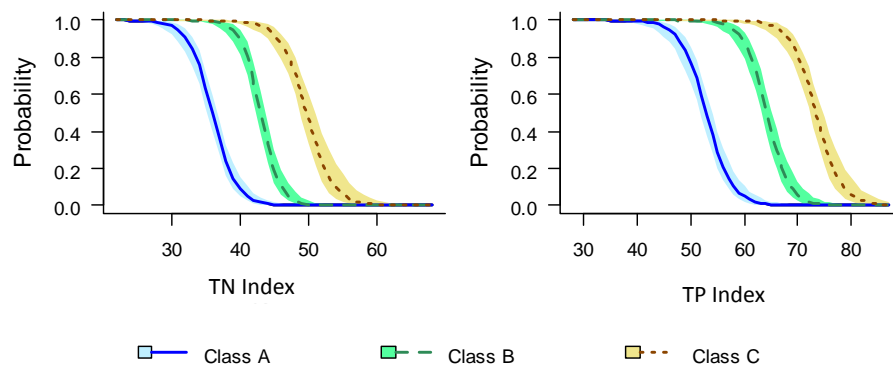
- Logistic regression
- Probability of attaining biological criteria
 - TN
 - TP
 - TN Index
 - TP Index



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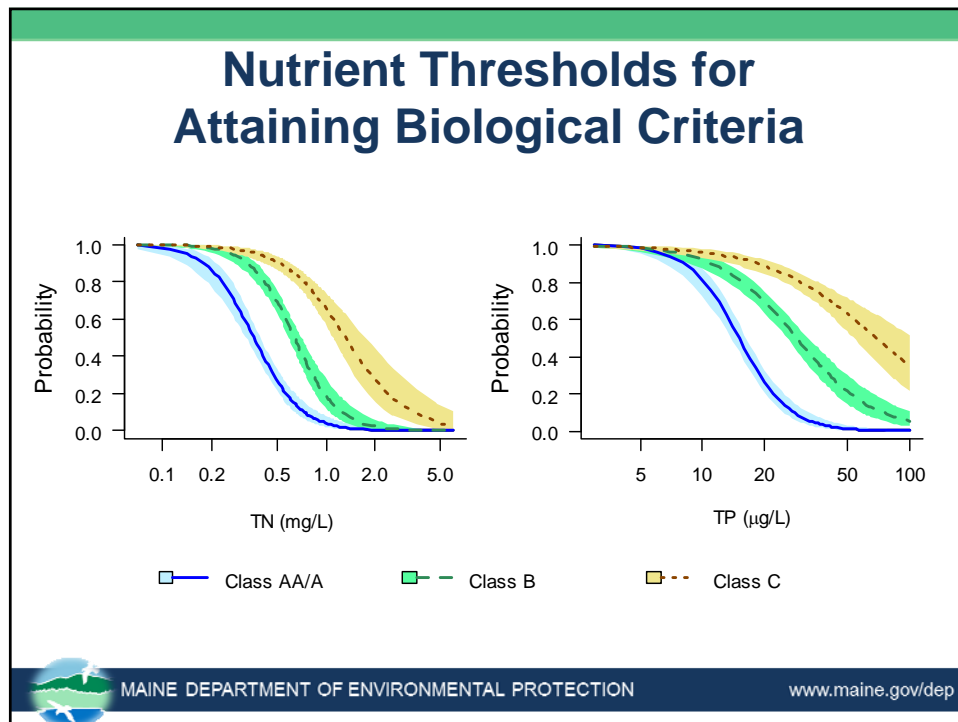
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Index Thresholds for Attaining Biological Criteria



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Summary

- Bioassessment models determine overall health and attainment of water quality standards
- Diagnostic metrics and indexes help identify cause of impairment
- Threshold analysis can help setting goals for protection and restoration



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