A Brief Meander Through Blue-Green Algae in Kansas

Some Prior Analyses and A Review of Advisory Thresholds Around The World

Interstate Blue-Green Algae Meeting

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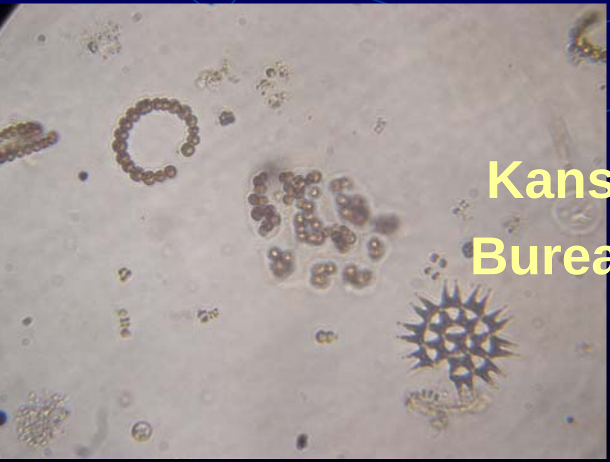
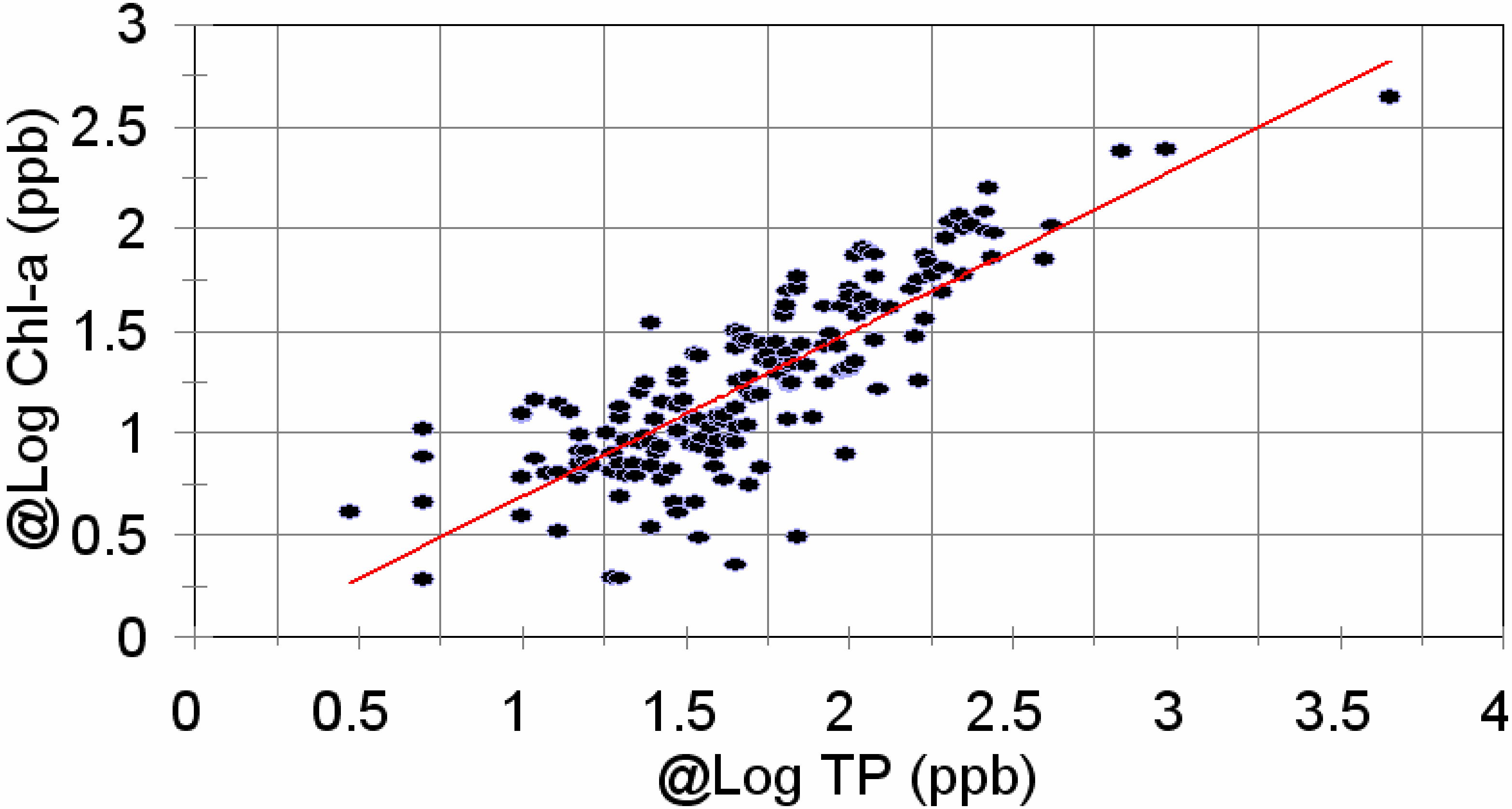


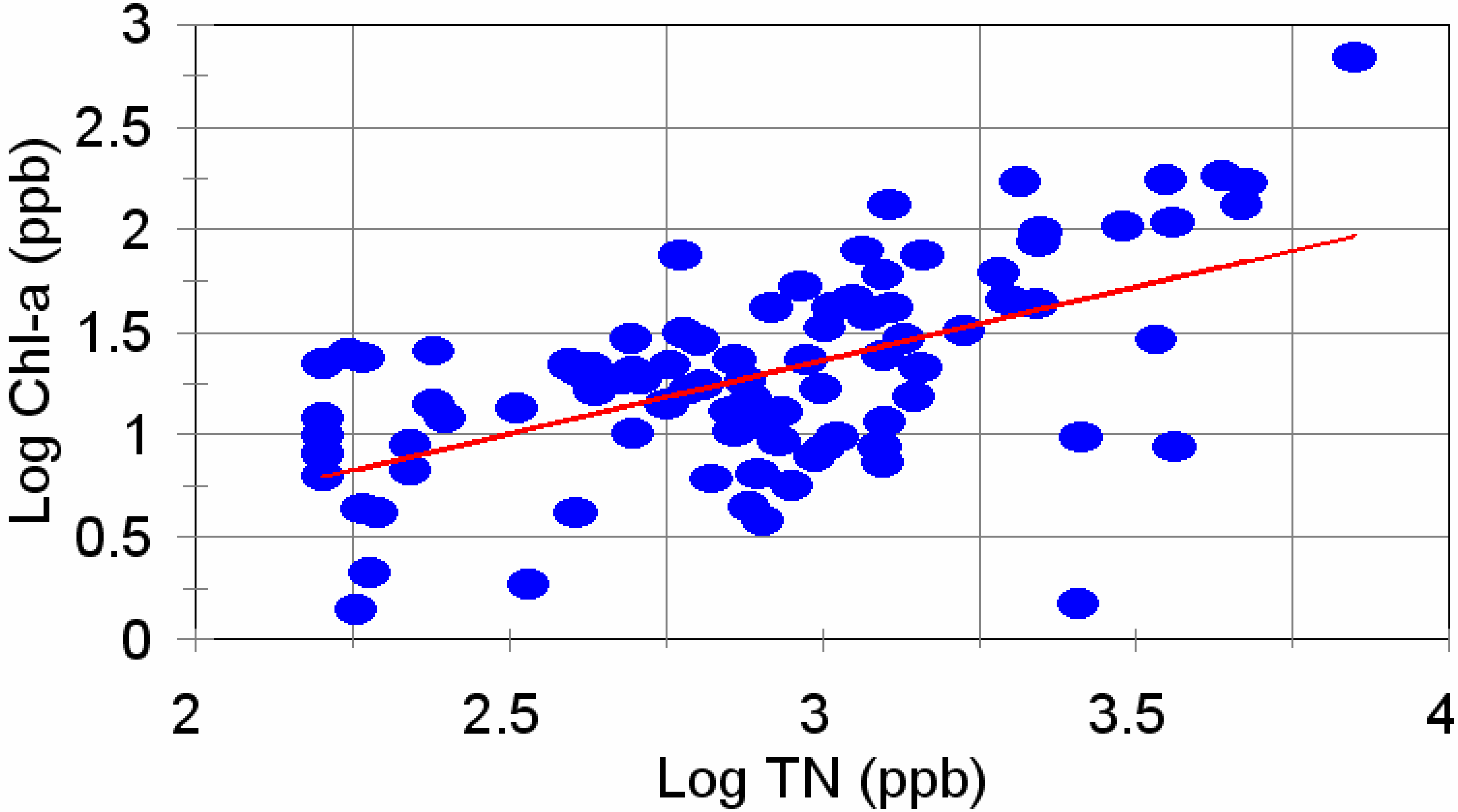
Nutrients versus Algae

Total phosphorus remains the best single explanatory variable. Total nitrogen adds little to predictive models and only a few percent of Kansas lakes are chronically turbid enough to have significant light limitation.

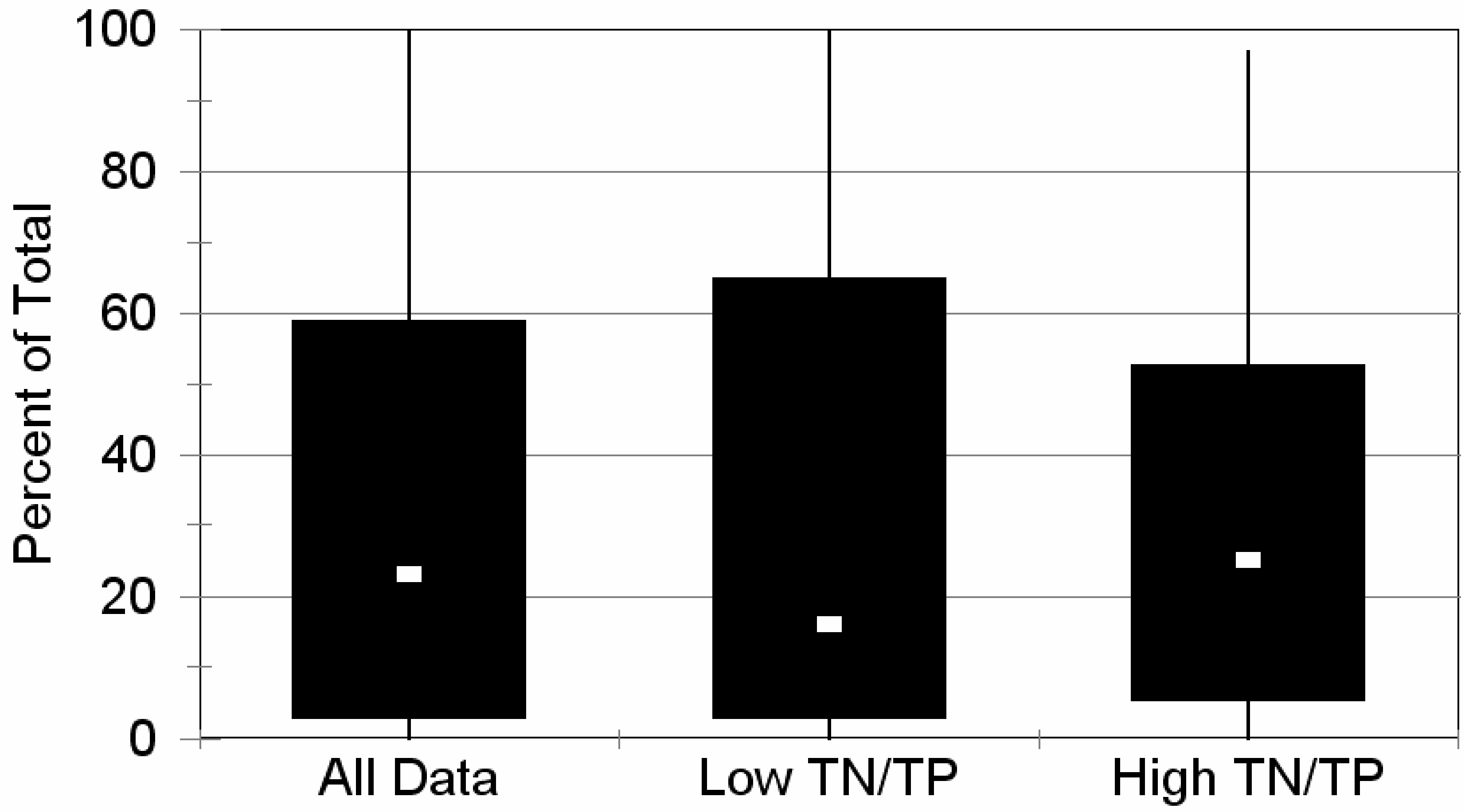
Chlorophyll-a Vs. TP

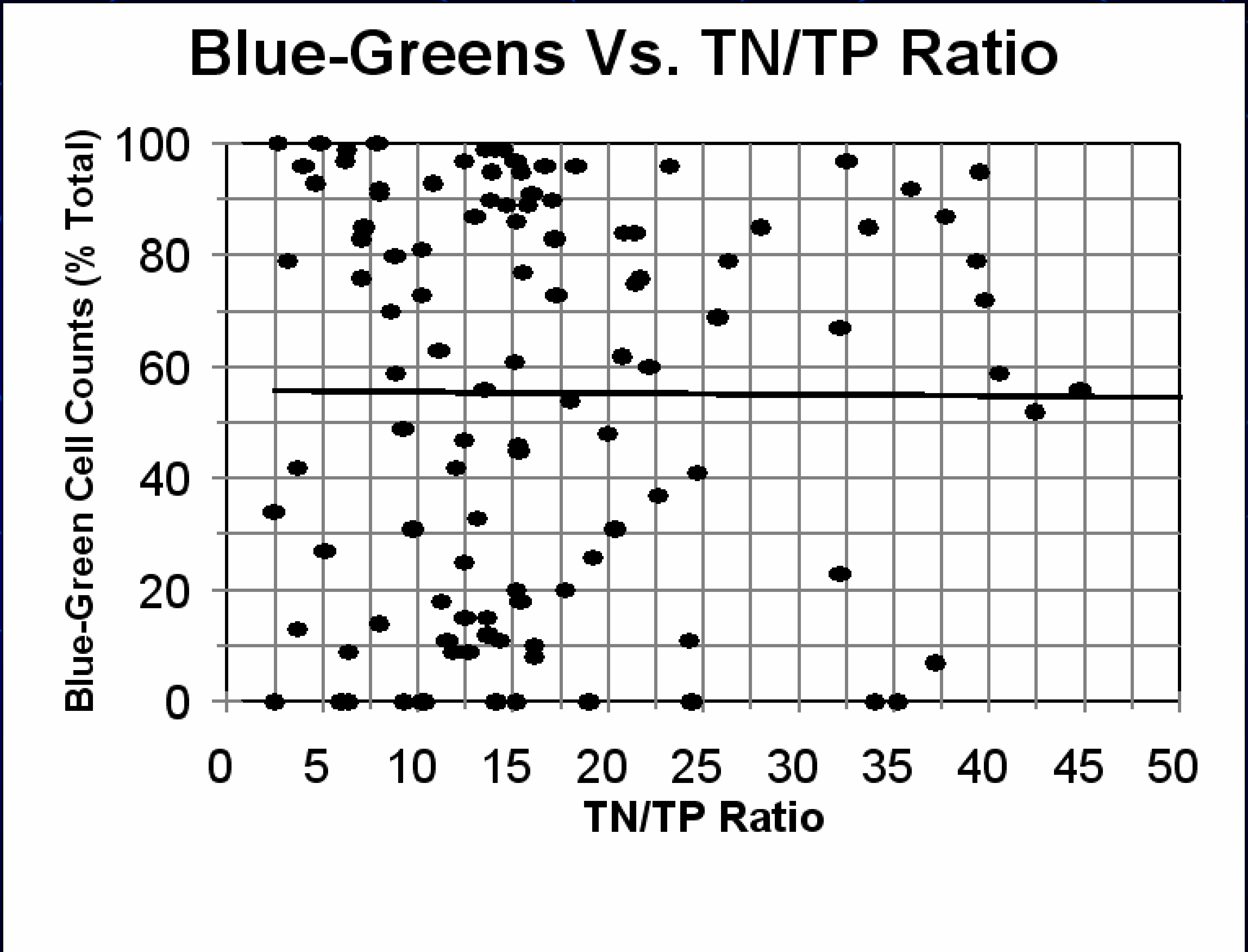


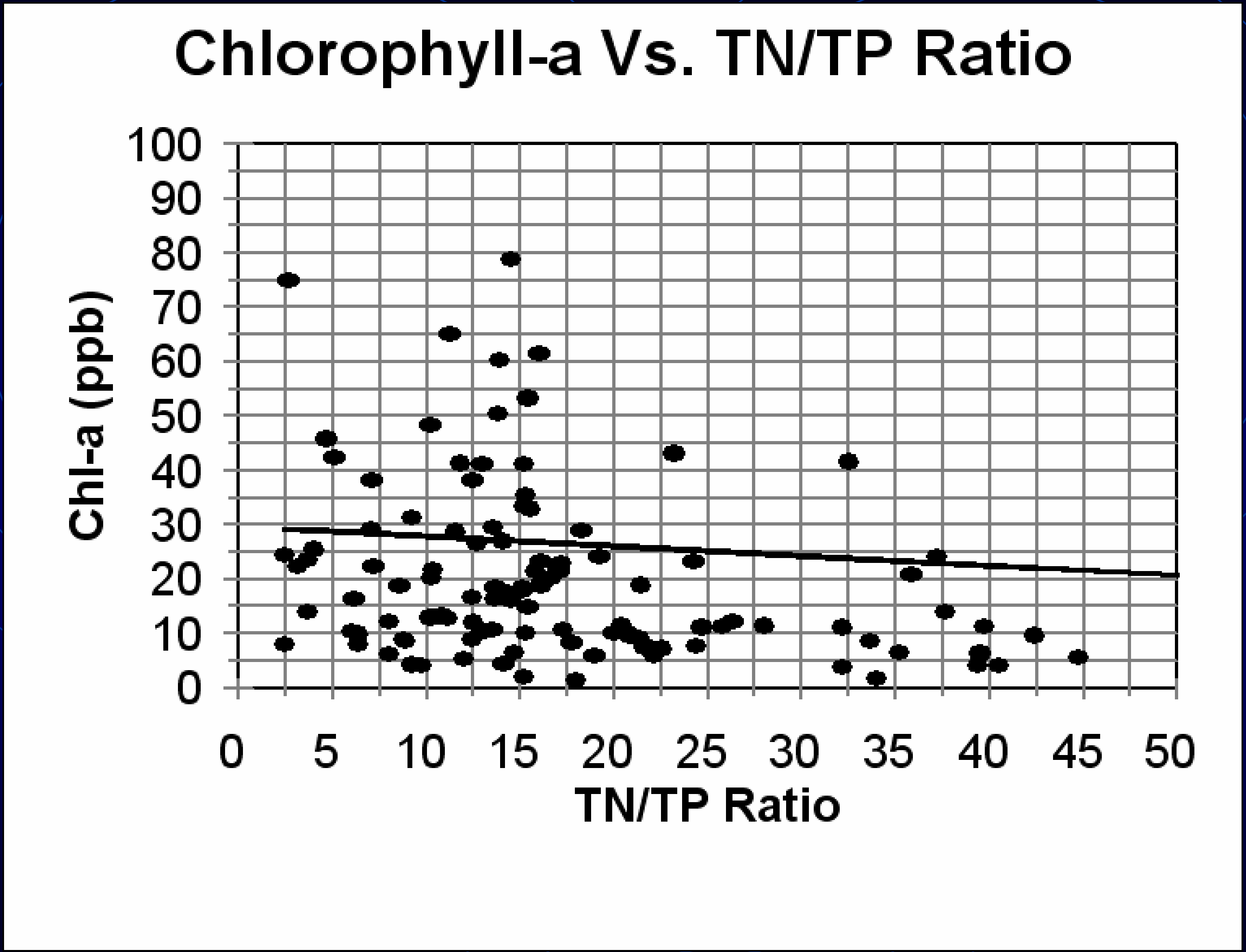
Chlorophyll-a vs. TN



Blue-Green Biovolume

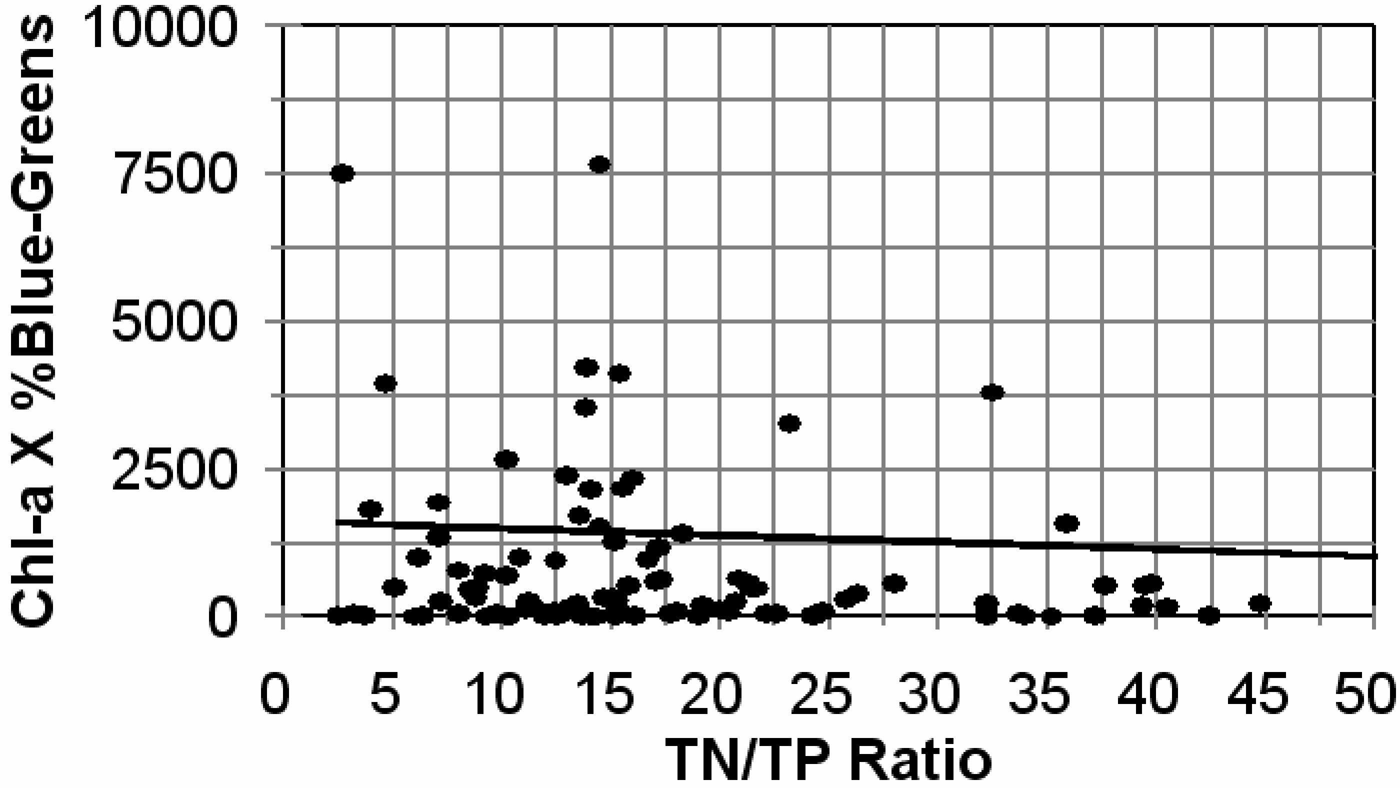



Blue-Greens Vs. TN/TP Ratio
Blue-Green Cell Counts (% Total)
100
80
60
40
20
0
0
5
10
15
20
25
30
35
40
45
50
TN/TP Ratio



Chlorophyll-a Vs. TN/TP Ratio
100
90
80
70
60
50
40
30
20
10
0
Chl-a (ppb)
0
5
10
15
20
25
30
35
40
45
50
TN/TP Ratio

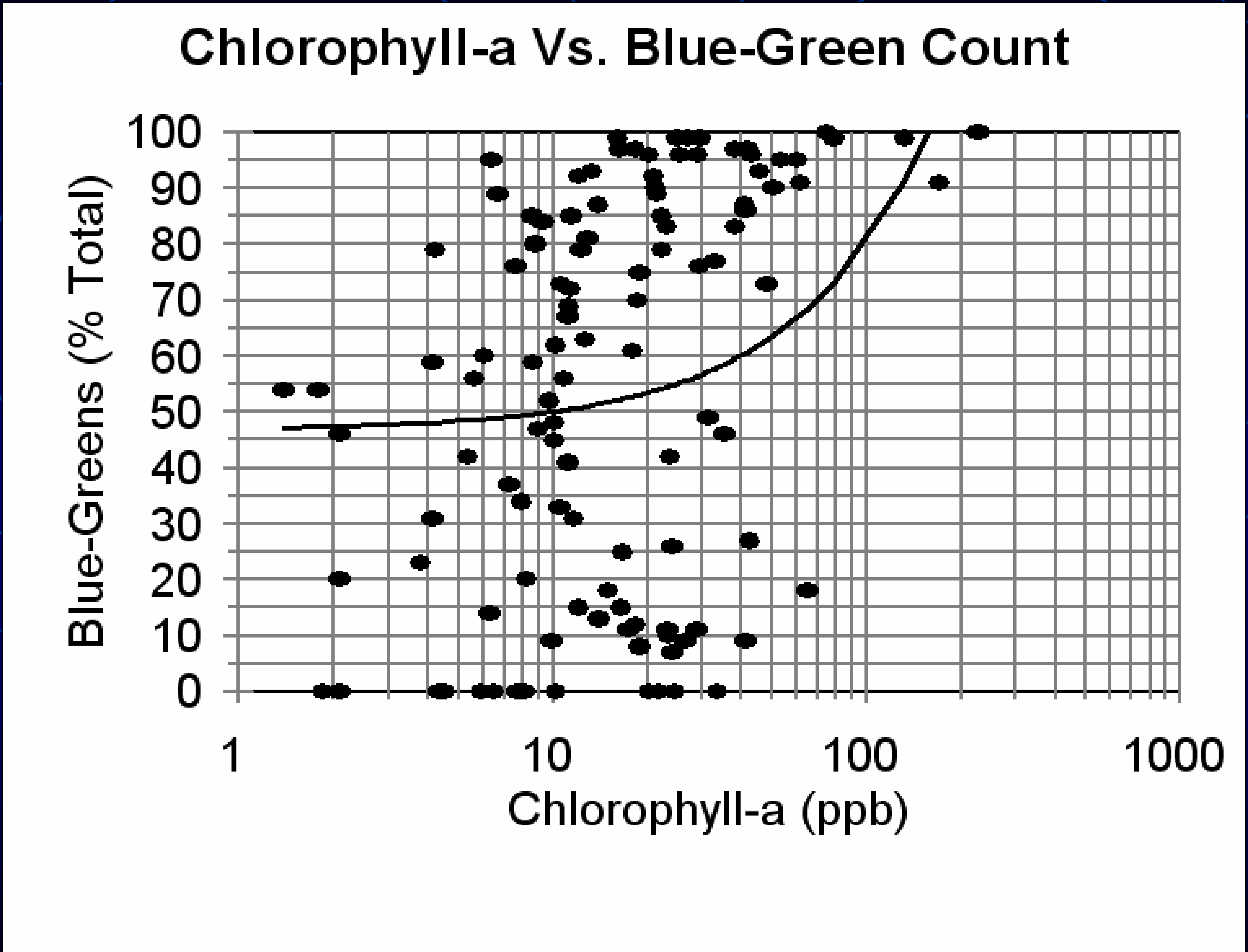
Blue-Green Abundance Vs. TN/TP Ratio



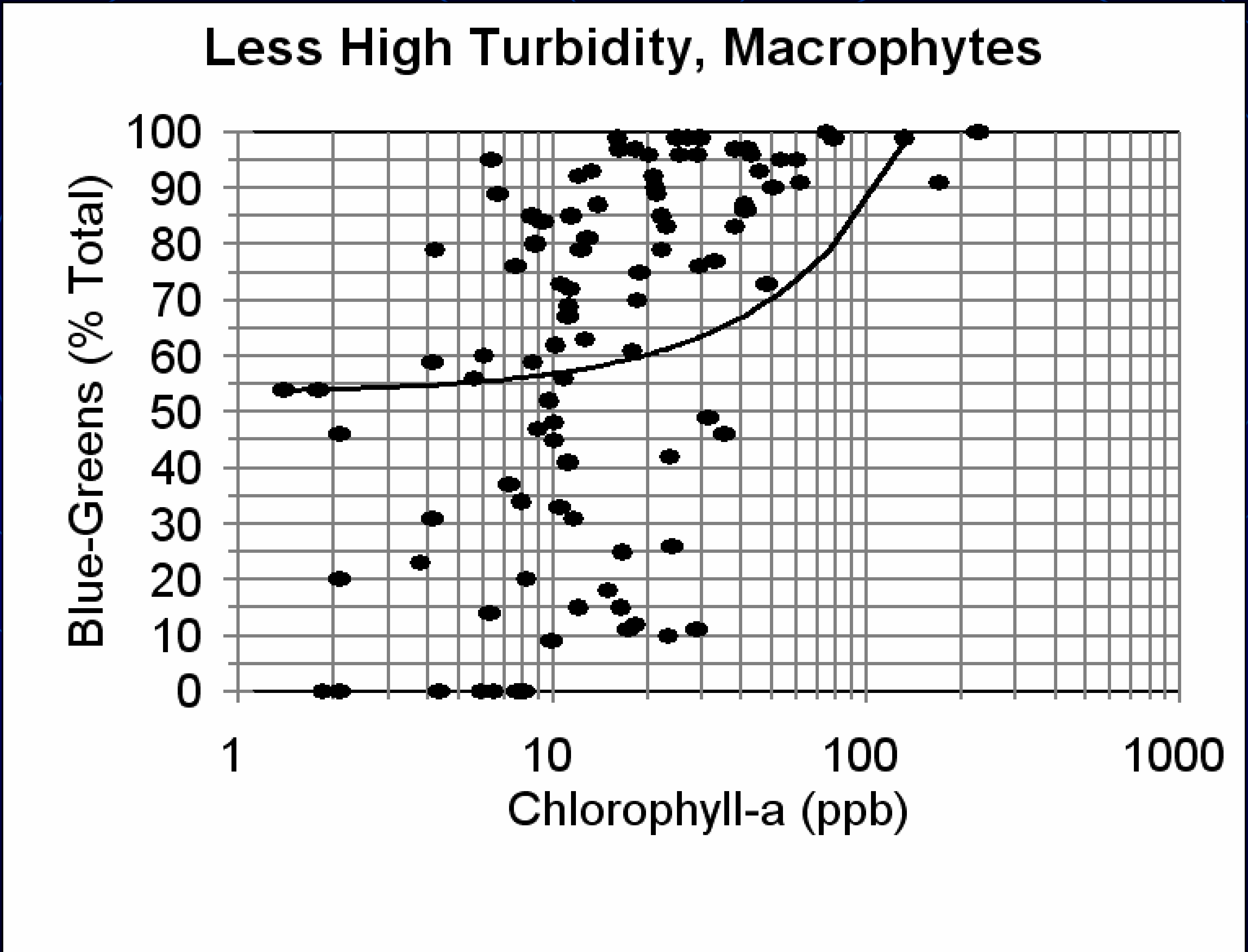
Nutrients to Algae to Blue-Greens

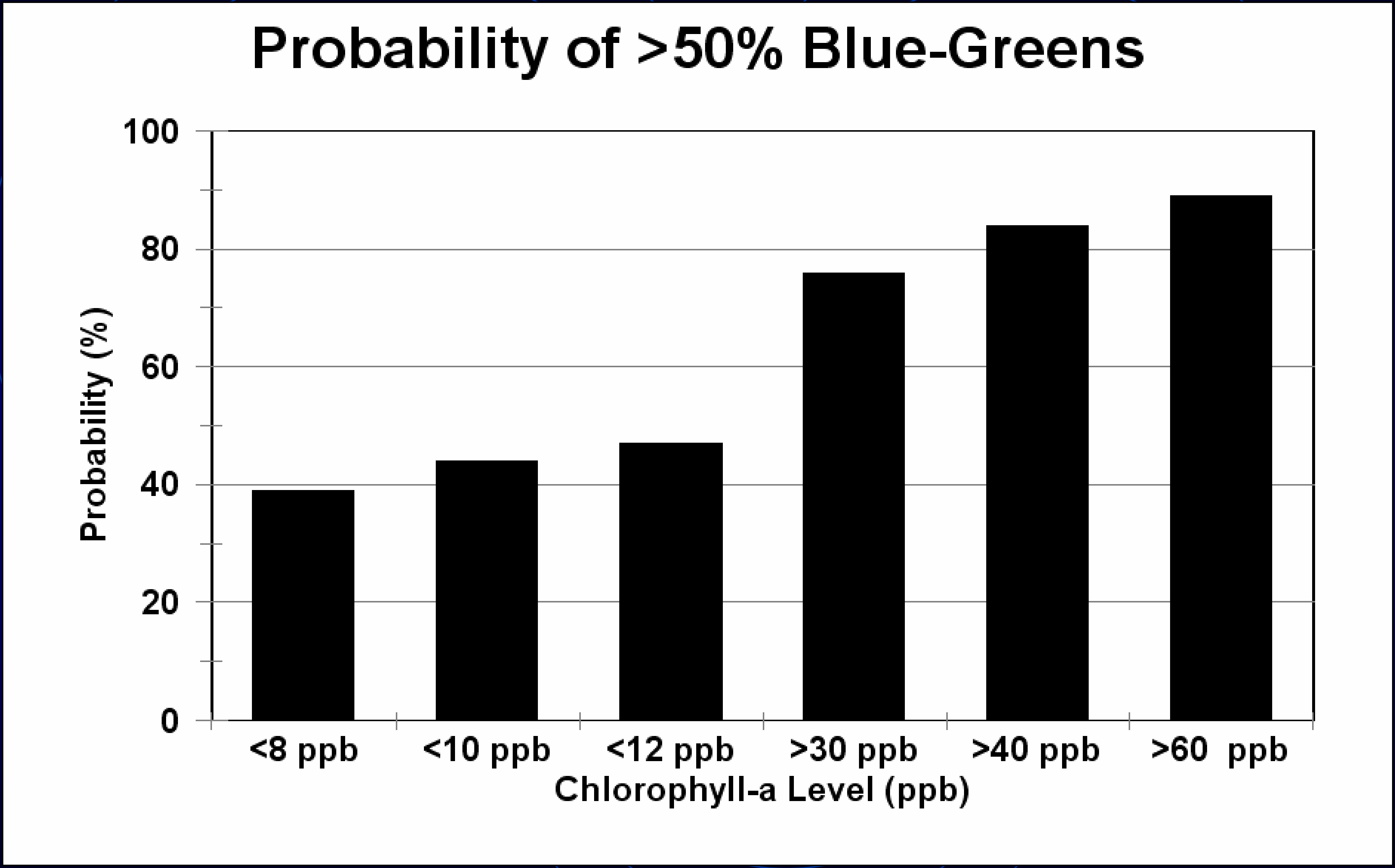
Total phosphorus turns out to be a very good predictor of algal chlorophyll.

Also, algal chlorophyll turns out to be a very good predictor for blue-green dominance.



Chlorophyll-a Vs. Blue-Green Count
Blue-Greens (% Total)
100
90
80
70
60
50
40
30
20
10
0
1
10
100
1000
Chlorophyll-a (ppb)


Less High Turbidity, Macrophytes
Blue-Greens (% Total)
100
90
80
70
60
50
40
30
20
10
0
1
10
100
1000
Chlorophyll-a (ppb)


Probability of >50% Blue-Greens
Probability (%)
0
20
40
60
80
100
<8 ppb
<10 ppb
<12 ppb
>30 ppb
>40 ppb
>60 ppb
Chlorophyll-a Level (ppb)

Giani et al., 2005
Canadian Journal of Fisheries and Aquatic Science

Showed that TP best explained Chl-a and cyanophyte biomass, but TN better predicted toxin production. Concluded that environmental factors control the occurrence of potentially toxic species but then exert only limited effect on the toxins produced.

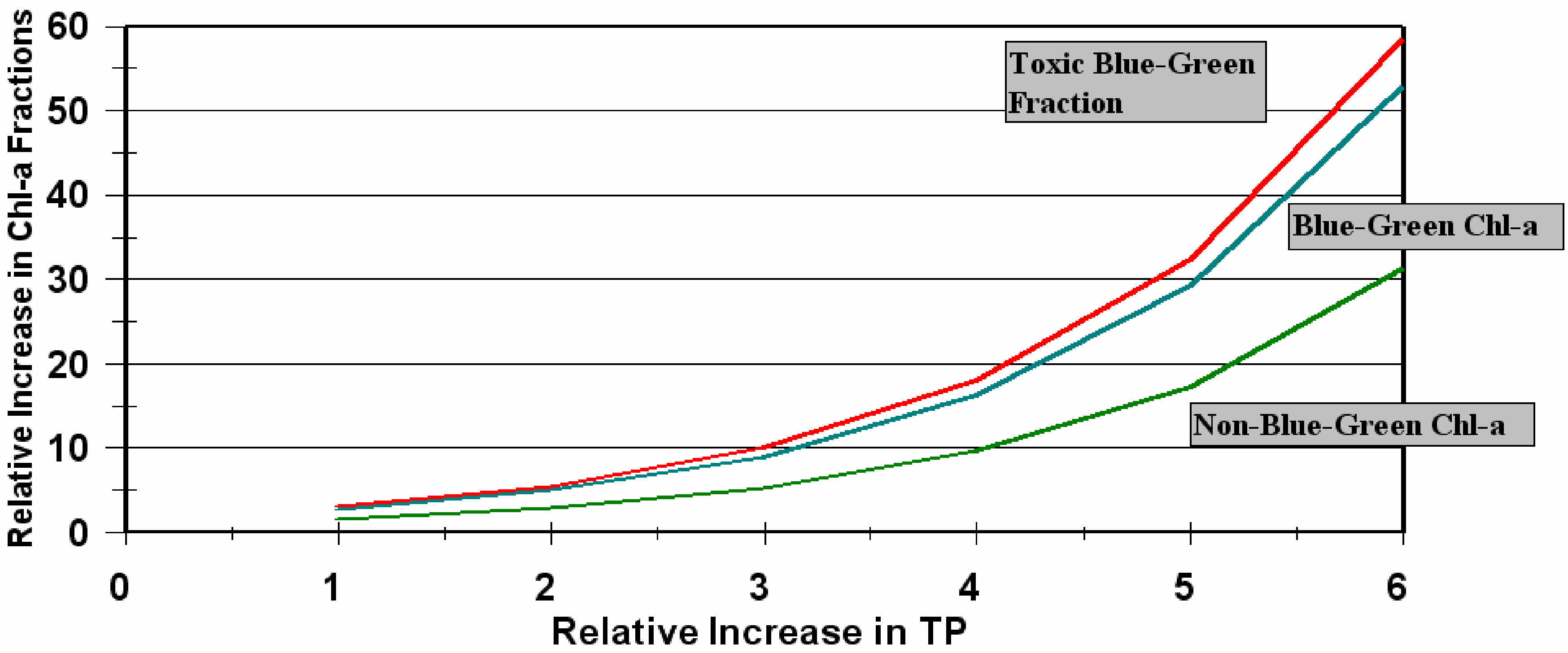
In addition, they found no relationships regarding blue-greens and pH, free carbon dioxide, dissolved nutrients, retention time, or TN/TP ratio.

Concluded that, with increasing TP, changes are much faster for blue-green biomass than for non-blue-green biomass, and fastest for the microcystin producing portion of blue-green biomass.

So…relatively small changes in TP may produce fairly sudden changes in the toxicity of resulting algal communities.

Relative Impacts

Based on Giani et al., 2005



Advisory Guidelines and Thresholds Around The World

There have been many attempts around the world to establish regulatory and health advisory thresholds for blue-green algae and their toxins.

Water Supply (Adult)

Carmichael & Falconer 1993, United States: 5,000 cells/mL Microcystis

(5.0 ppb Chl-a)

NHMRC/ARMCANZ 1996, Australia/New Zealand: 2,000 cells/mL Microcystis

(2.7 ppb Chl-a)

Duy et al. 2000, Australia/New Zealand: 4,400/1,600 cells/mL microcystins/microcystin-LR

(4.55/2.3 ppb Chl-a)

Livestock Water (Cattle)

Duy et al. 2000: 18,400/6,650 cells/mL

microcystins/microcystin-LR

(12.0/6.0 ppb Chl-a)

Recreation

Johnstone 1995, Australia: 20,000 cells/mL Microcystis (12.65 ppb Chl-a)

Fitzgerald et al. 1999, Australia: 50,000/20,000 cells/mL Microcystis/Anabaena (23.5/12.65 ppb Chl-a)

Chorus & Cavalieri 2000, Europe: 100,000/20,000 cells/mL Total BGs Acute/Chronic (37.5/12.65 Chl-a)

WHO 2000, Proposed Worldwide: 100,000 cells/mL Total BGs moderate-high toxicity risk (37.5 Chl-a)

Recreation Thresholds

From 1998-2002, KDHE staff duplicated the risk based threshold approach used in Minnesota (Heiskary & Walker 1988) and developed primary and secondary recreation thresholds for total chlorophyll-a as a potential alternative to current assessment protocols.

Recreation versus Algae

Primary Contact Recreation

Impacts began at 10 ppb Chl-a with non-support threshold at 23 ppb Chl-a

Secondary Contact Recreation

Impacts began at 21 ppb Chl-a with non-support threshold at 38 ppb Chl-a

Translated to Blue-Green Algae Cell Counts

Primary Contact Recreation

Impacts began at 14,000 cells/mL with non-support threshold at 48,500 cells/mL

Secondary Contact Recreation

Impacts began at 42,500 cells/mL with non-support threshold at 102,000 cells/mL