Kansas
Department of Health
and Environment

Kansas River Algae
Information Exchange Meeting
May 15, 2012

Our Mission – to Protect and Improve the Health and Environment of all Kansans

Stream & River Trophic State and Phytoplankton in Kansas

(& Blue-Green Algae Risks)

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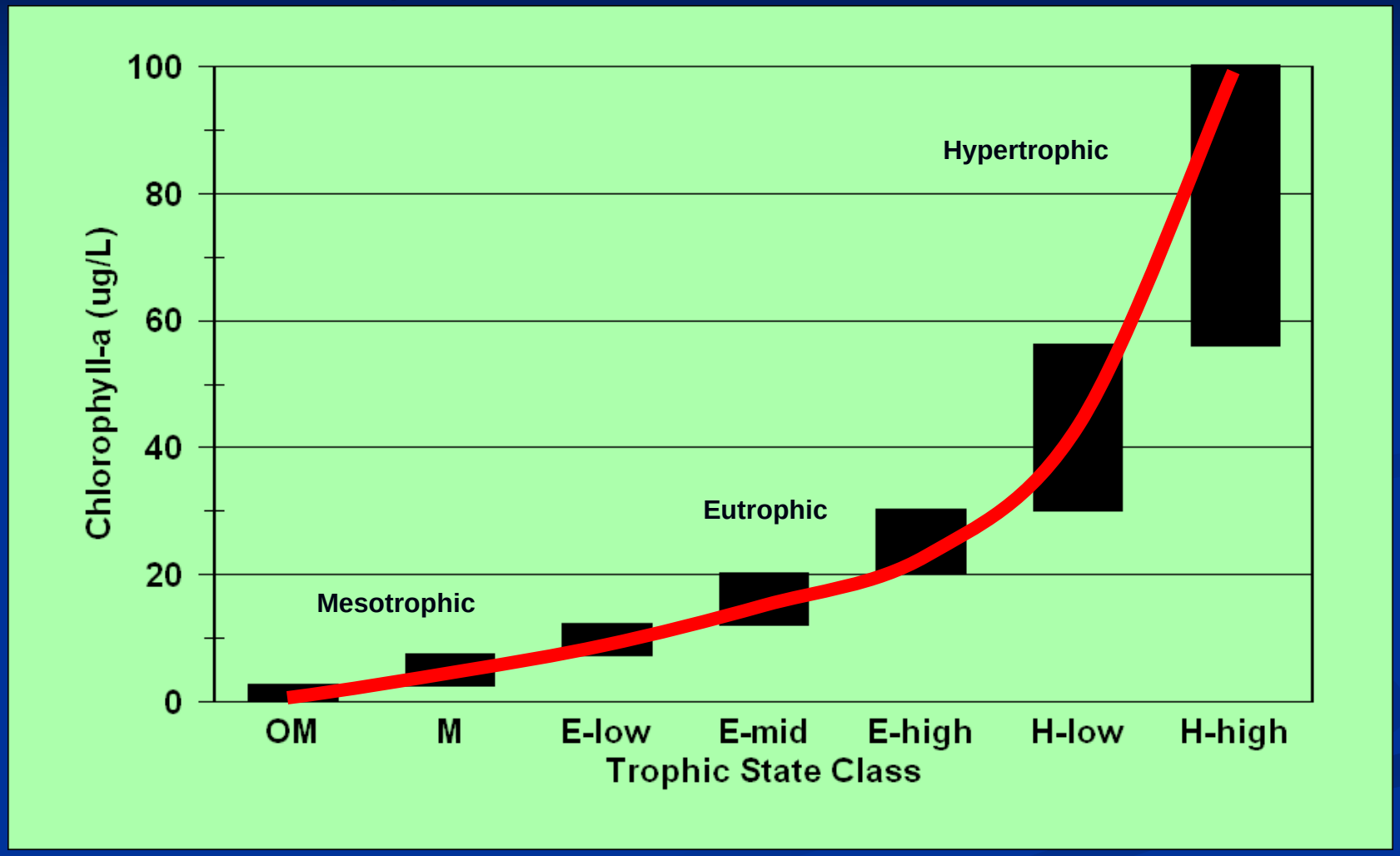
Why Stream Phytoplankton?

- Prior to 2003, stream algae was only examined in regard to fishkills and complaints
- 2003: began to examine planktonic algae in a sub-set of the stream network (57 total stations)
  - For nutrient criteria related purposes
  - Curiosity about an unknown environmental parameter
- Eight years of data presented here
- Comparison to lakes for the same 2003-2010 time frame

Eutrophication and Trophic State

- Eutrophication = nutrient enrichment process
- Trophic State = level of biological production
  - Index period variable
  - Typically assessed by the primary producers
- Lakes (long established trophic class system)
  - Generally trophic state driven by phosphorus in Kansas
    - Nitrogen secondary importance
    - Significant light limitation fairly infrequent
- Streams & Rivers (lack trophic class system)
  - Nitrogen (& silica) seems more important
  - Hydrologic factors far more important

Trophic State Classification System for Lakes



Stream Trophic State
All Stream Sites 2003-2010

Statistic	Chlorophyll-a ug/L	Total Phosphorus ug/L	Total Nitrogen ug/L
Mean	20.9	302	1,850
Median	5.3	101	1,245
Interquartile Range	2.3 to 17.5	36 to 340	495 to 2,394

Eutrophication is for both Lakes and Streams

& the Watershed is the key

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Stream Trophic State
Known Impacted Sites 2003-2010

Statistic	Chlorophyll-a ug/L	Total Phosphorus ug/L	Total Nitrogen ug/L
Mean	47.8	585	3,066
Median	22.3	360	2,281
Interquartile Range	9.7 to 45.6	222 to 661	1,564 to 3,646

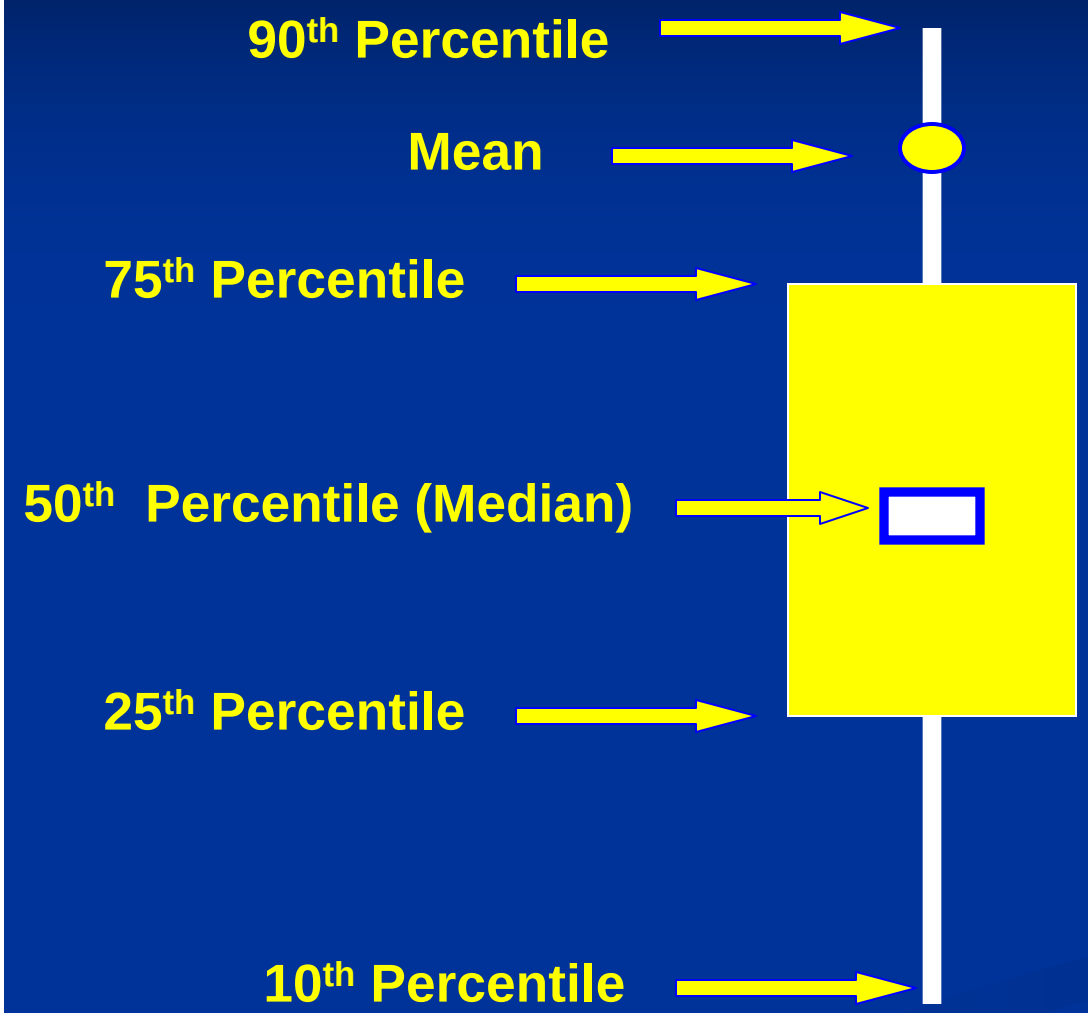
Stream Trophic State
Low-Impact Sites 2003-2010

Statistic	Chlorophyll-a ug/L	Total Phosphorus ug/L	Total Nitrogen ug/L
Mean	5.5	55	793
Median	3.9	38	526
Interquartile Range	1.8 to 6.7	22 to 68	260 to 980

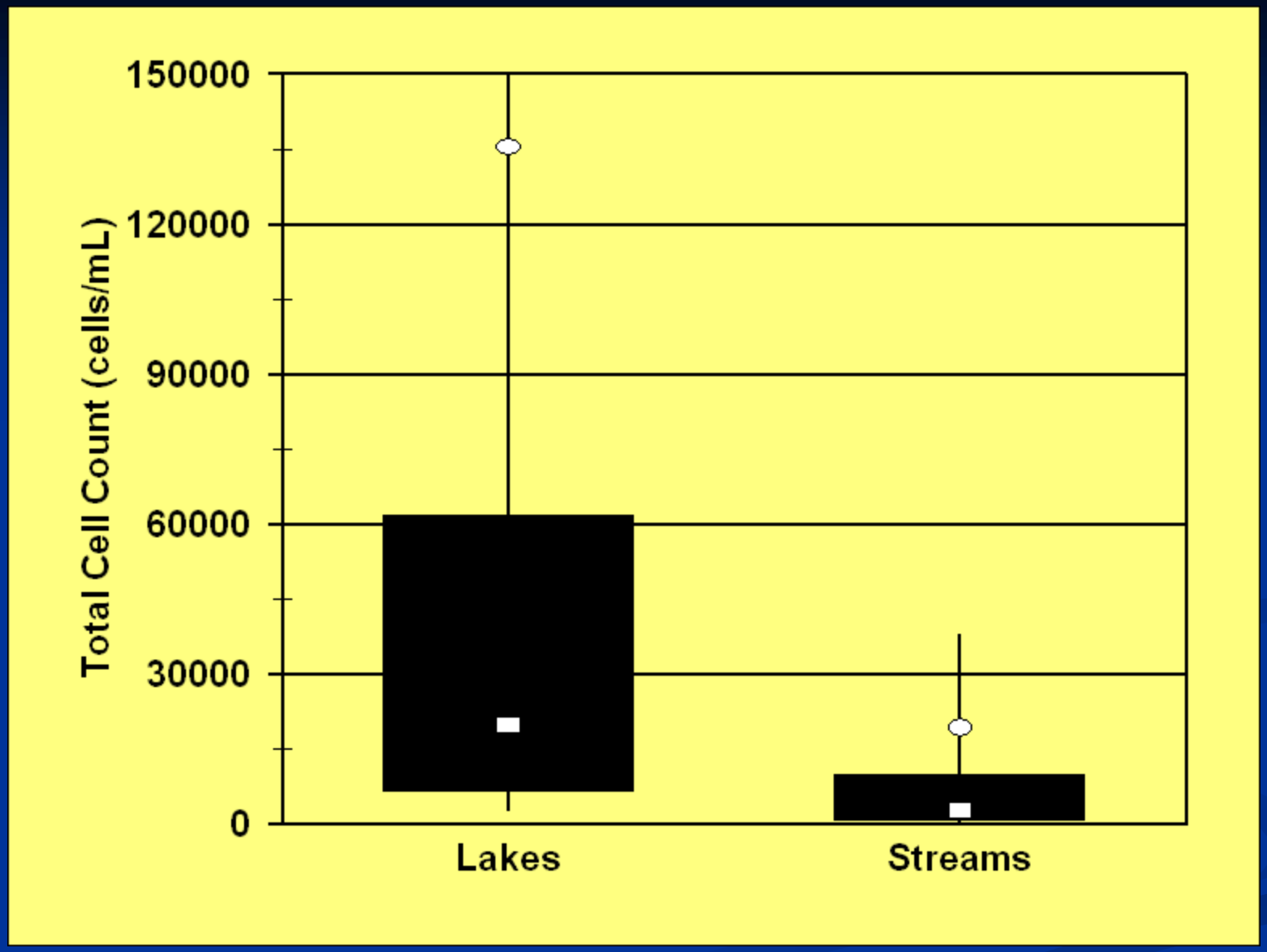
Stream vs. Lakes

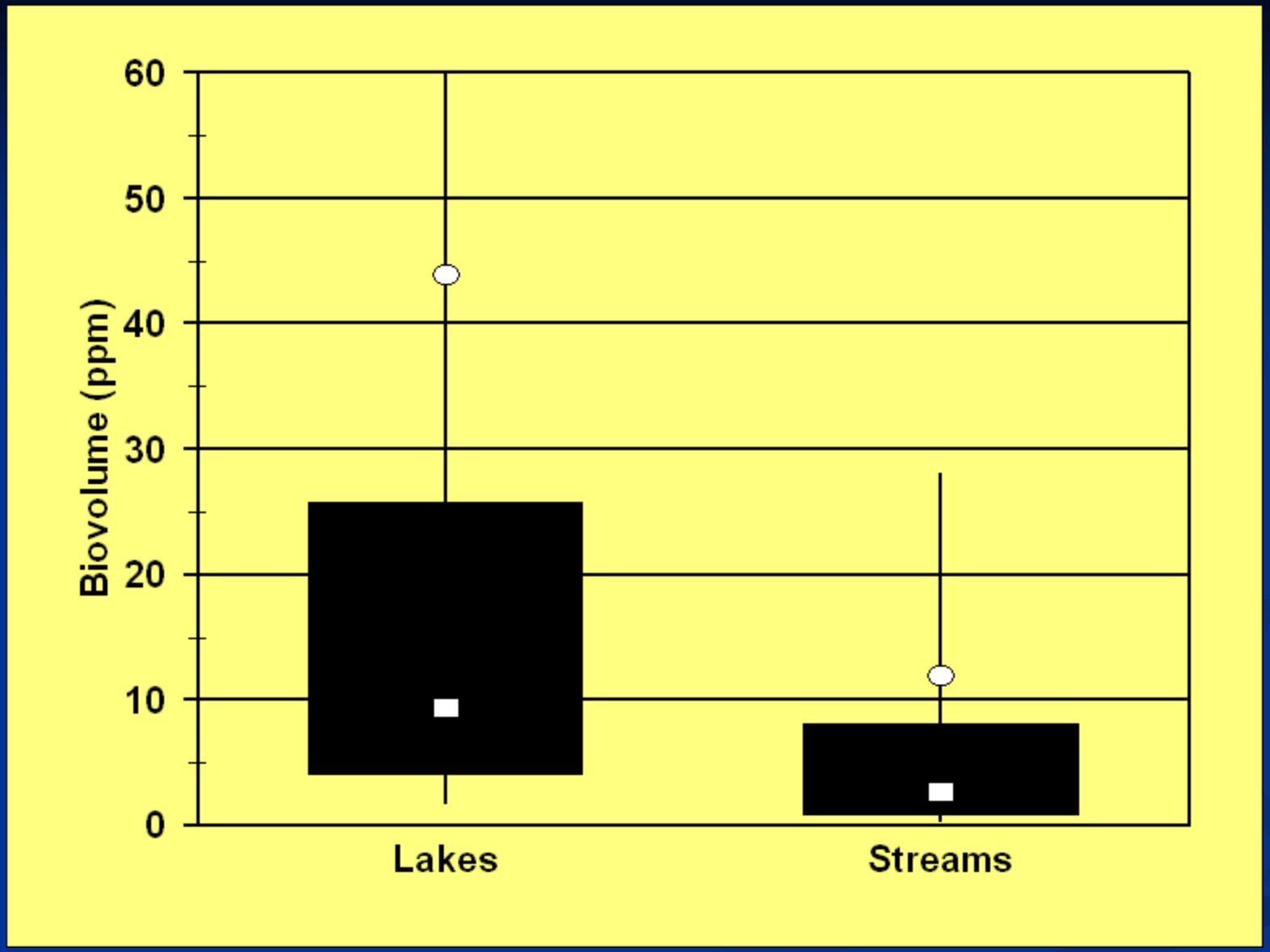
- There are fundamental physical differences between lentic and lotic systems
- The source for phytoplankton differs
  - Lakes: grown on-site
  - Streams: on-site, periphyton entrainment, and upstream lagoon discharges
- So… How different are the planktonic algae between streams and lakes?
- Are there any similarities?

Box-Plot Graphics

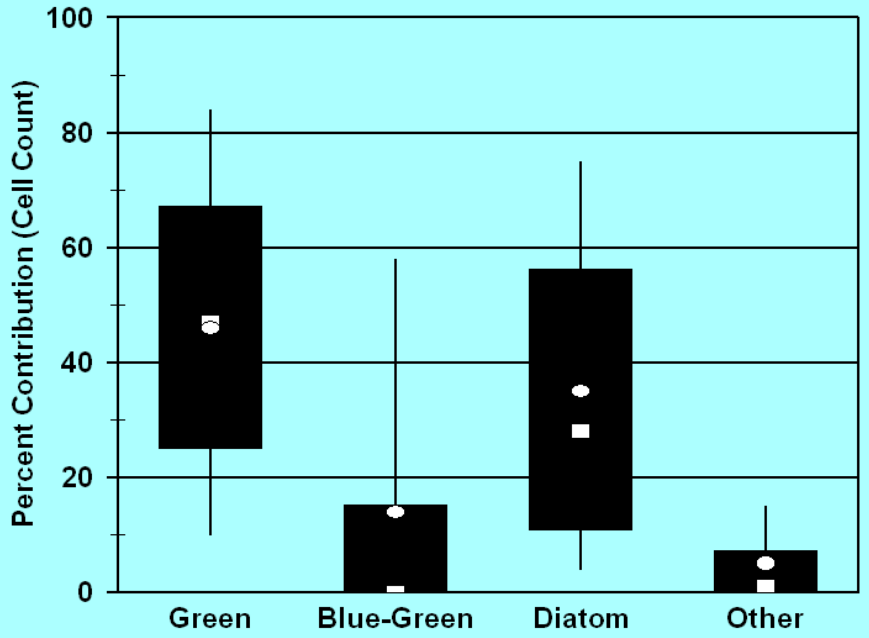


All the graphs in this presentation utilize the same format

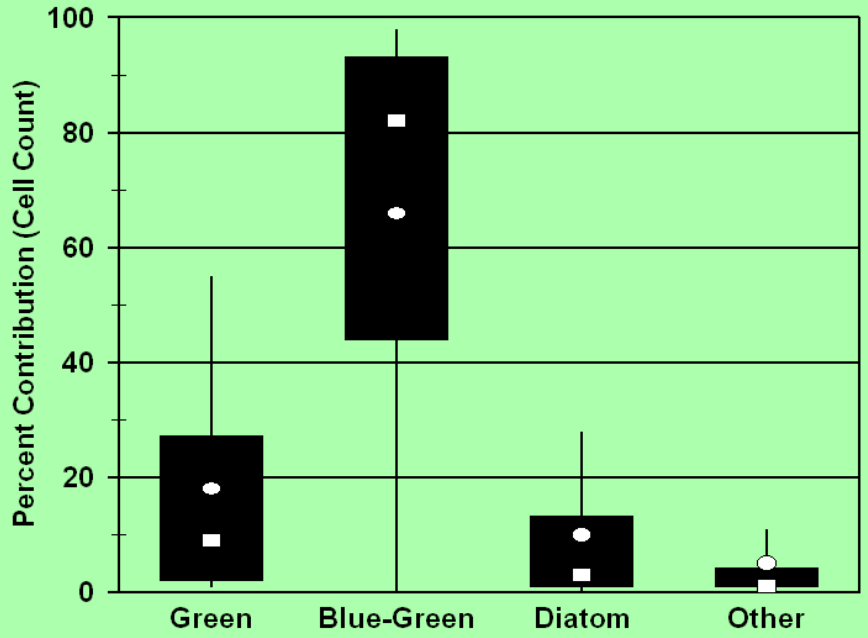

150000
120000
90000
60000
30000
0
Total Cell Count (cells/mL)
Lakes
Streams


60
50
40
30
20
10
0
Biovolume (ppm)
Lakes
Streams

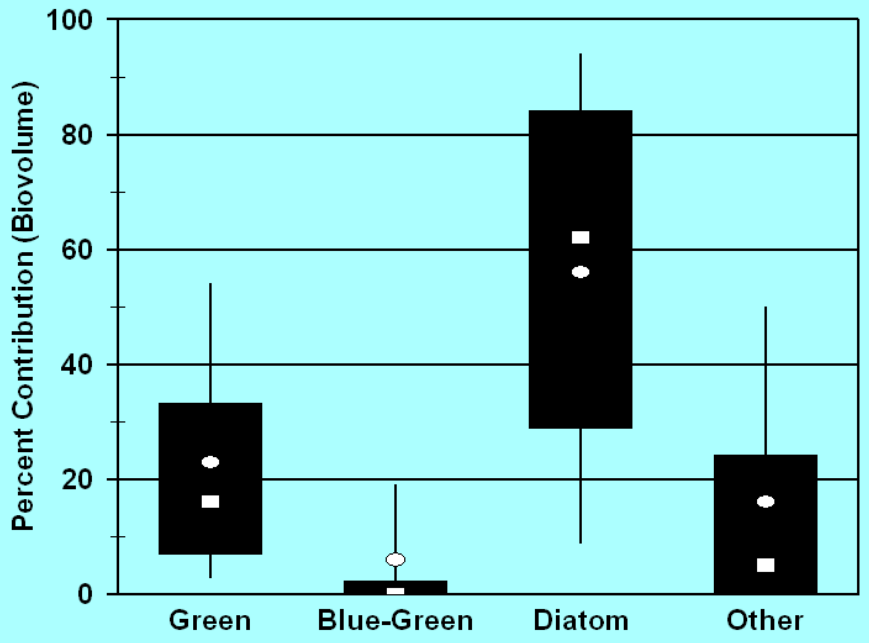
Streams



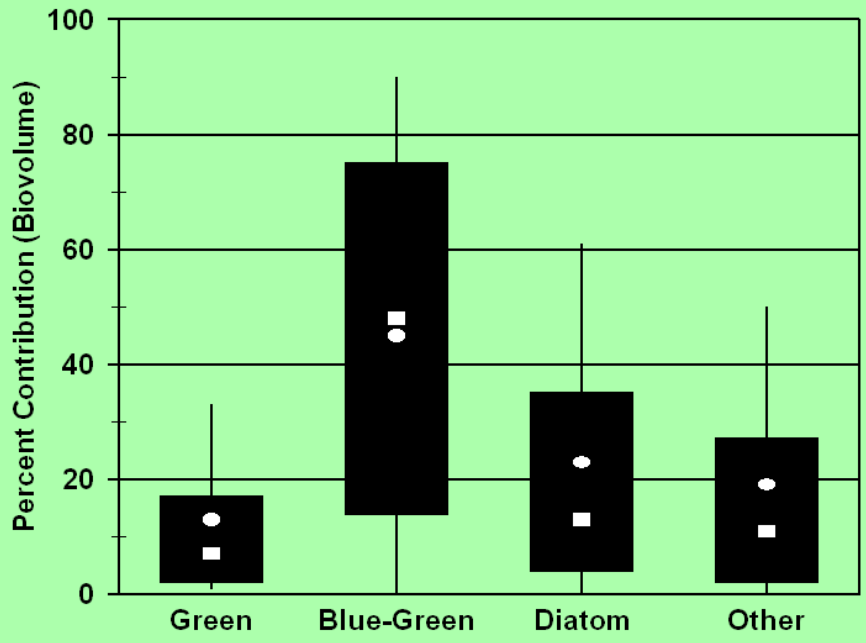
Lakes



Streams

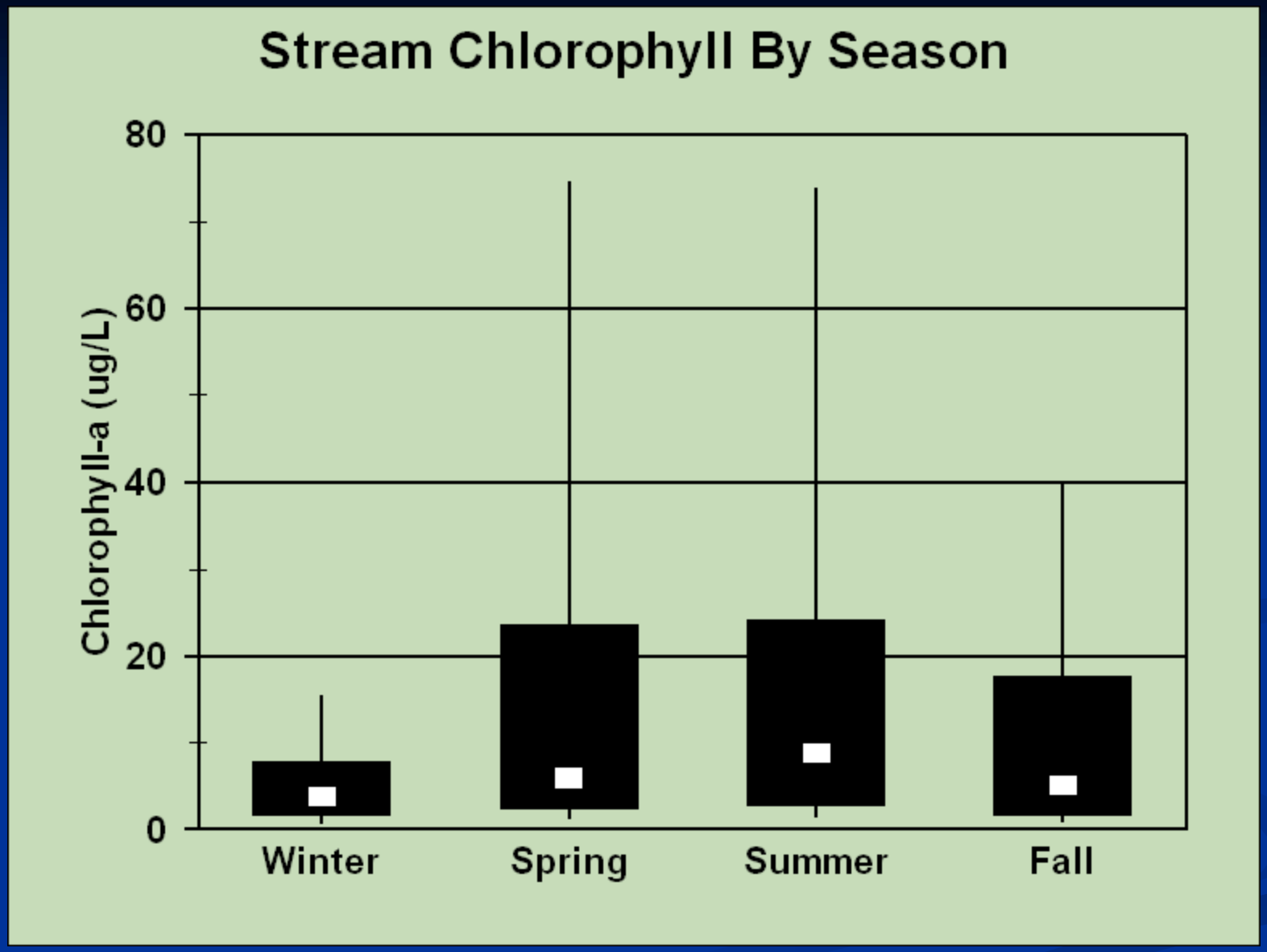


Lakes



Stream Seasonality

- Stream data is collected year-round, while lakes are sampled during the summer “critical period” when recreational and water supply uses are at their peaks
- Do streams show any seasonal trends and differences?



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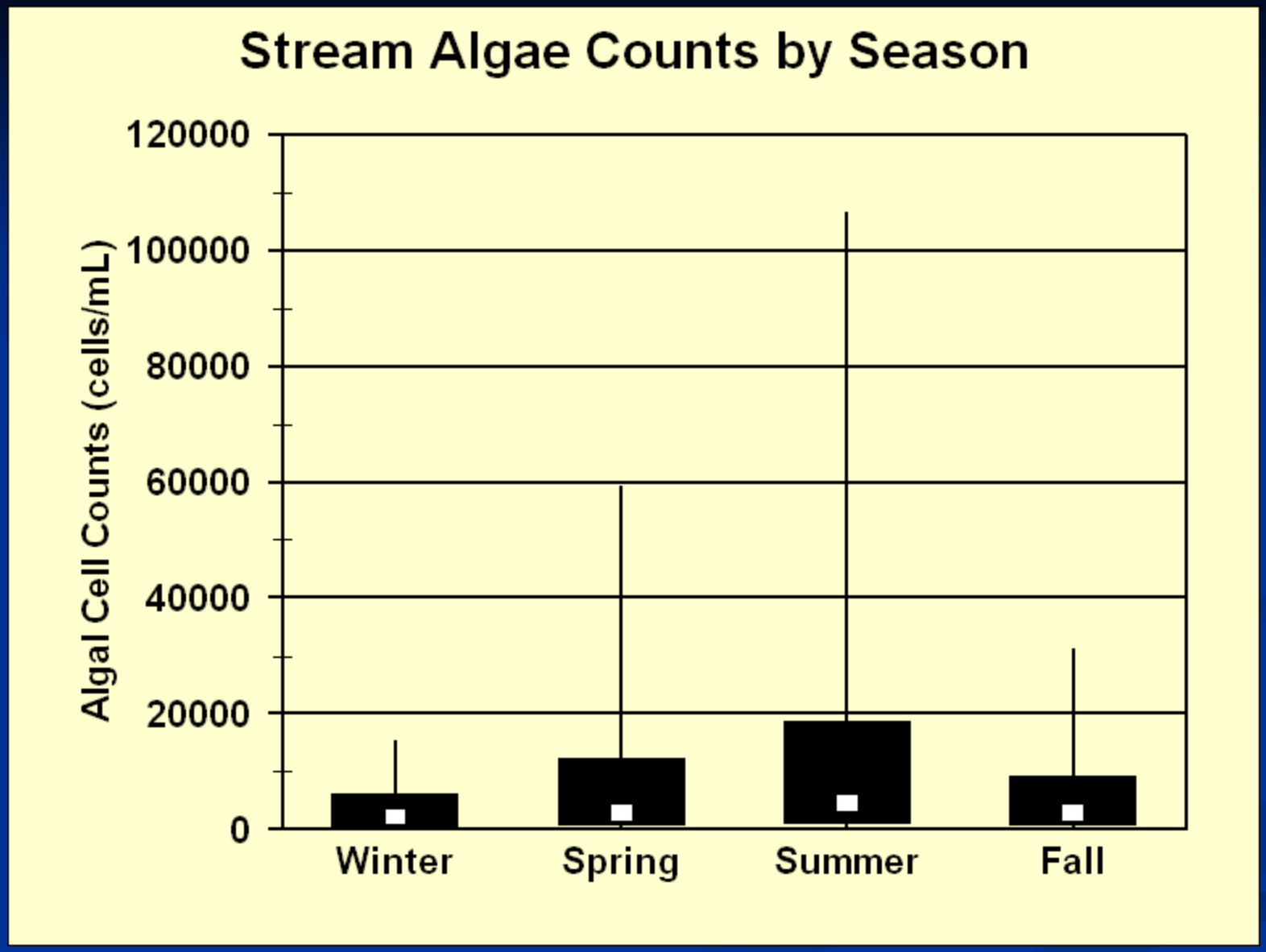
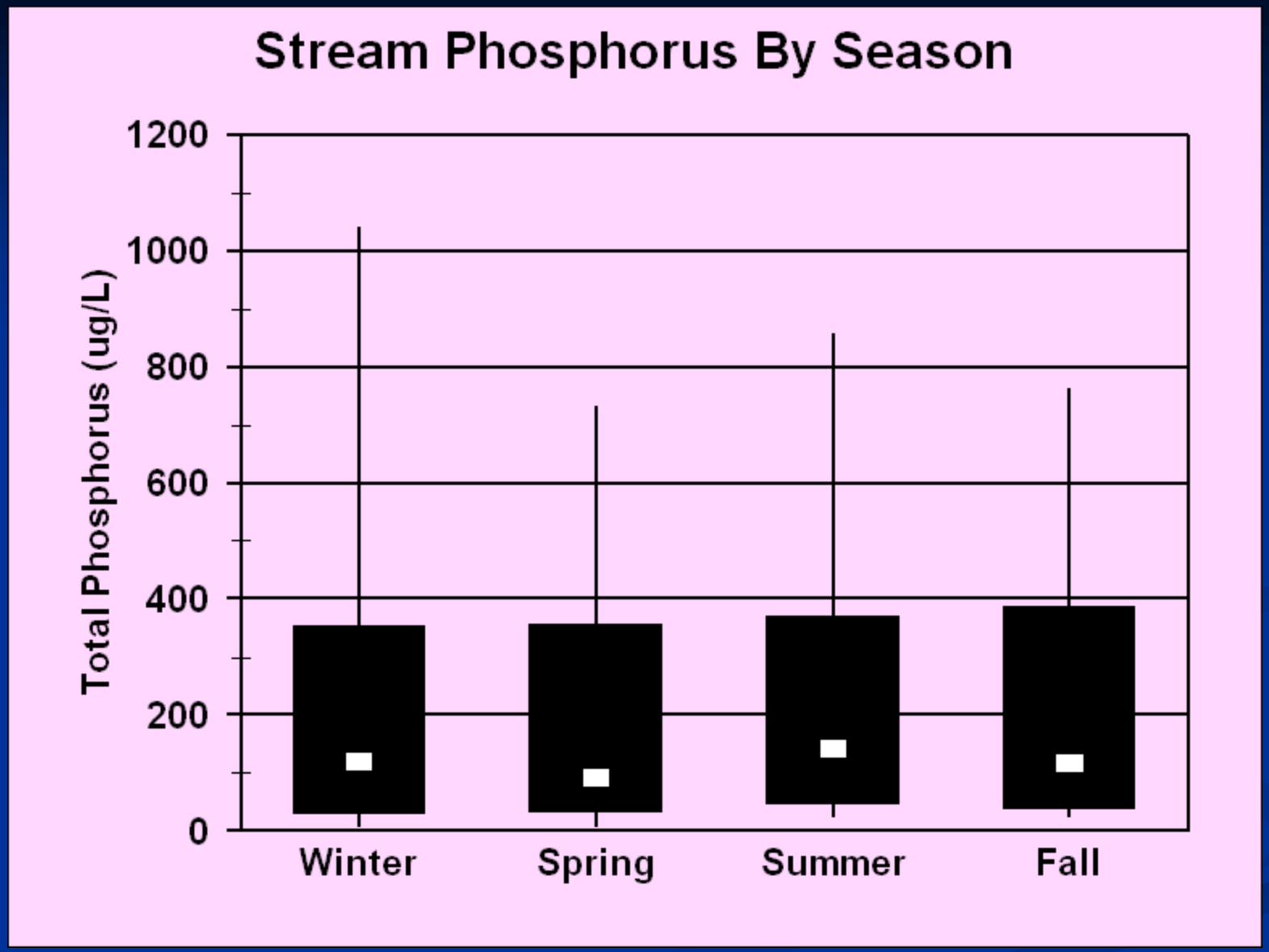

Stream Algae Counts by Season
Algal Cell Counts (cells/mL)
120000
100000
80000
60000
40000
20000
0
Winter
Spring
Summer
Fall



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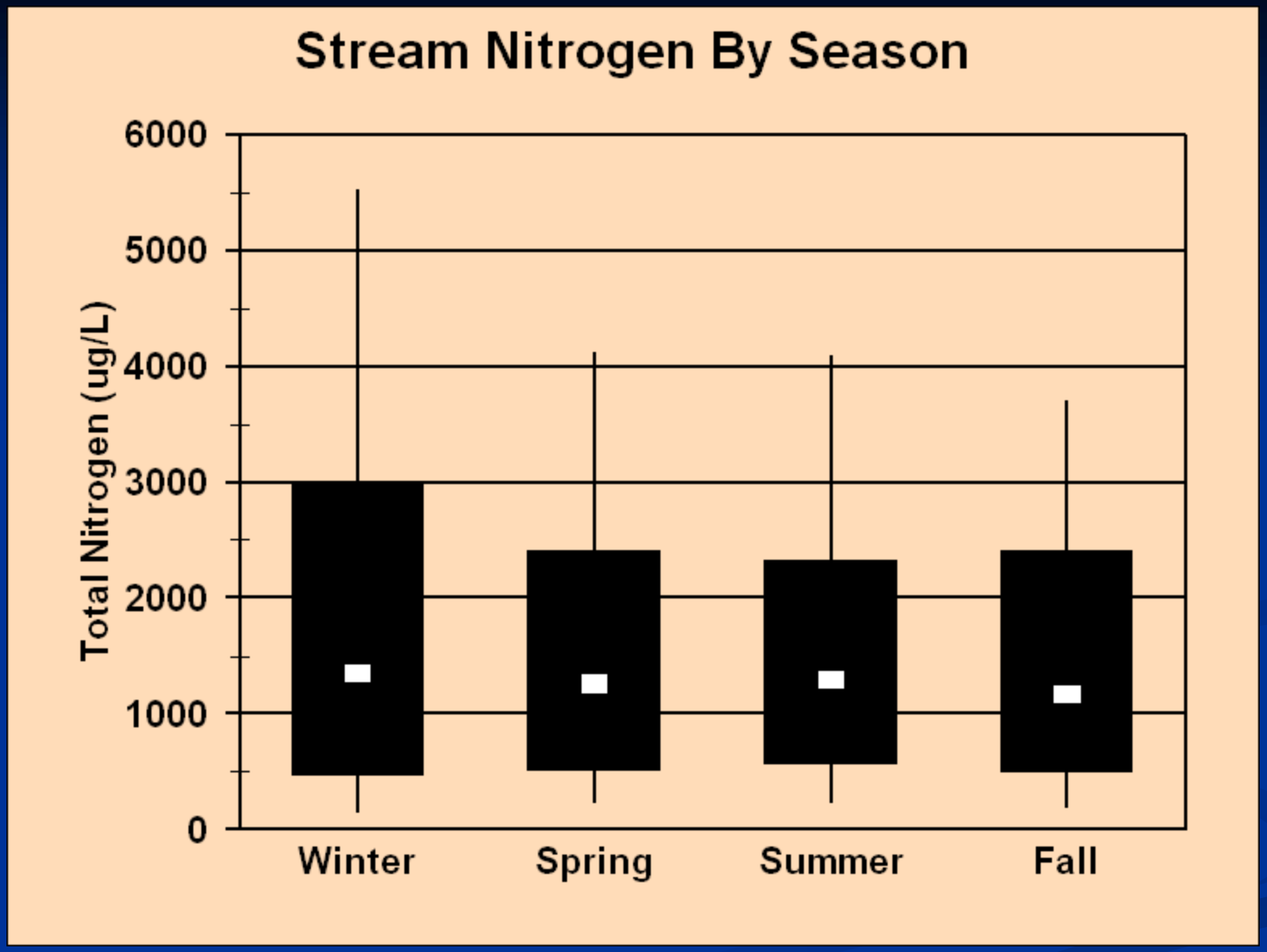

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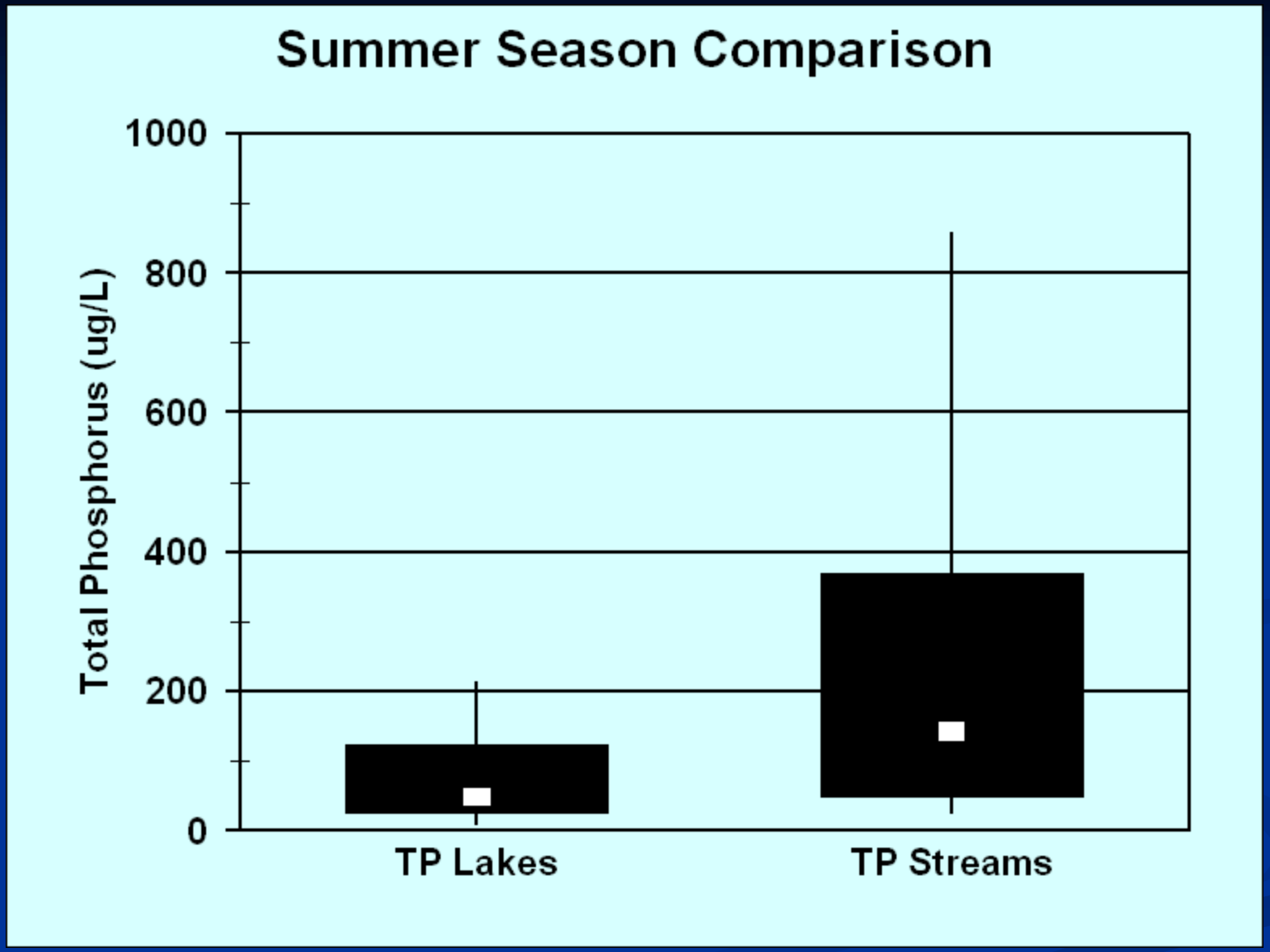
Summer Comparisons

- Since lakes are sampled summer-only, and since streams seem to also have a summer critical period, a summer-only comparison might be useful



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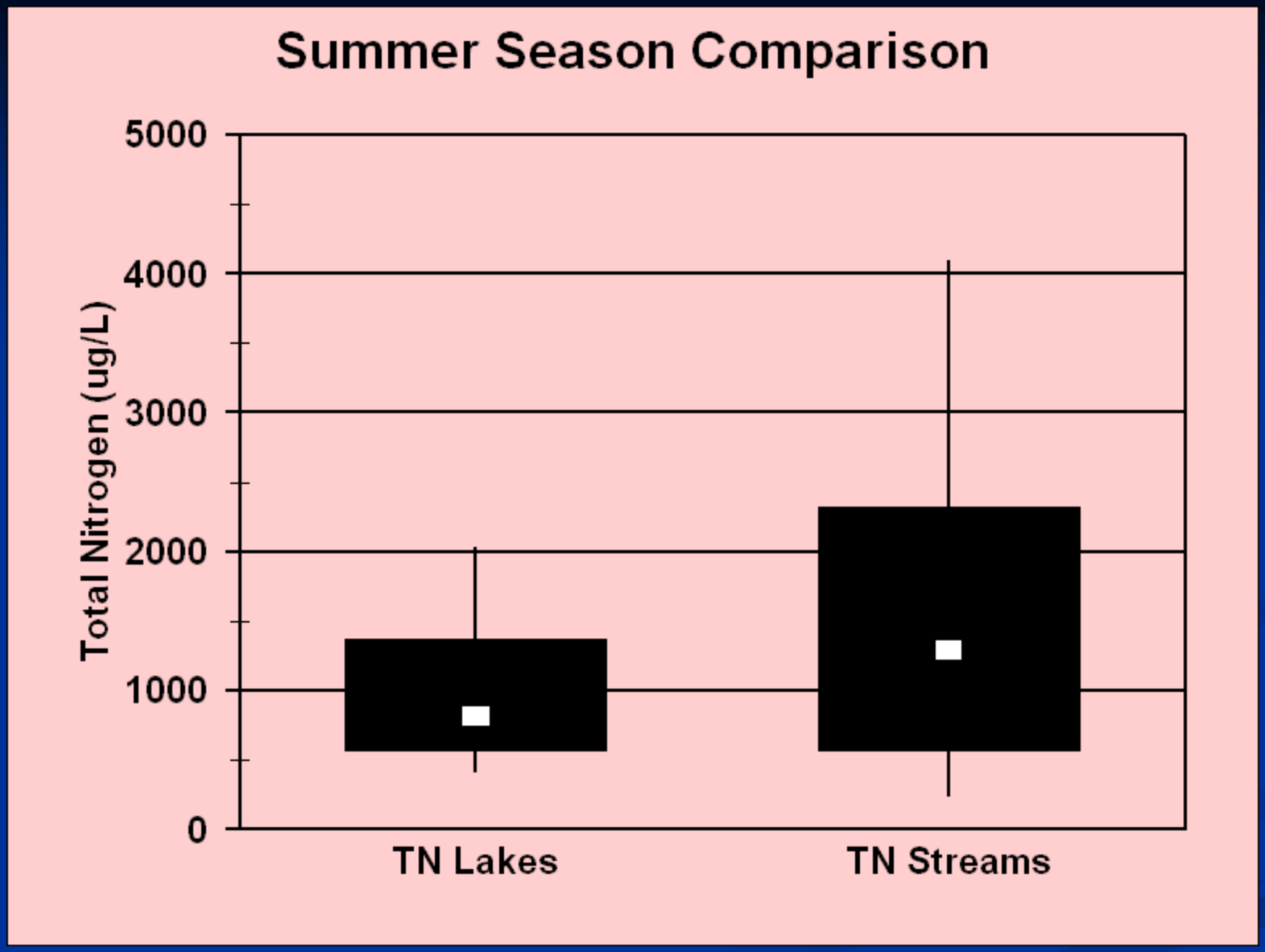
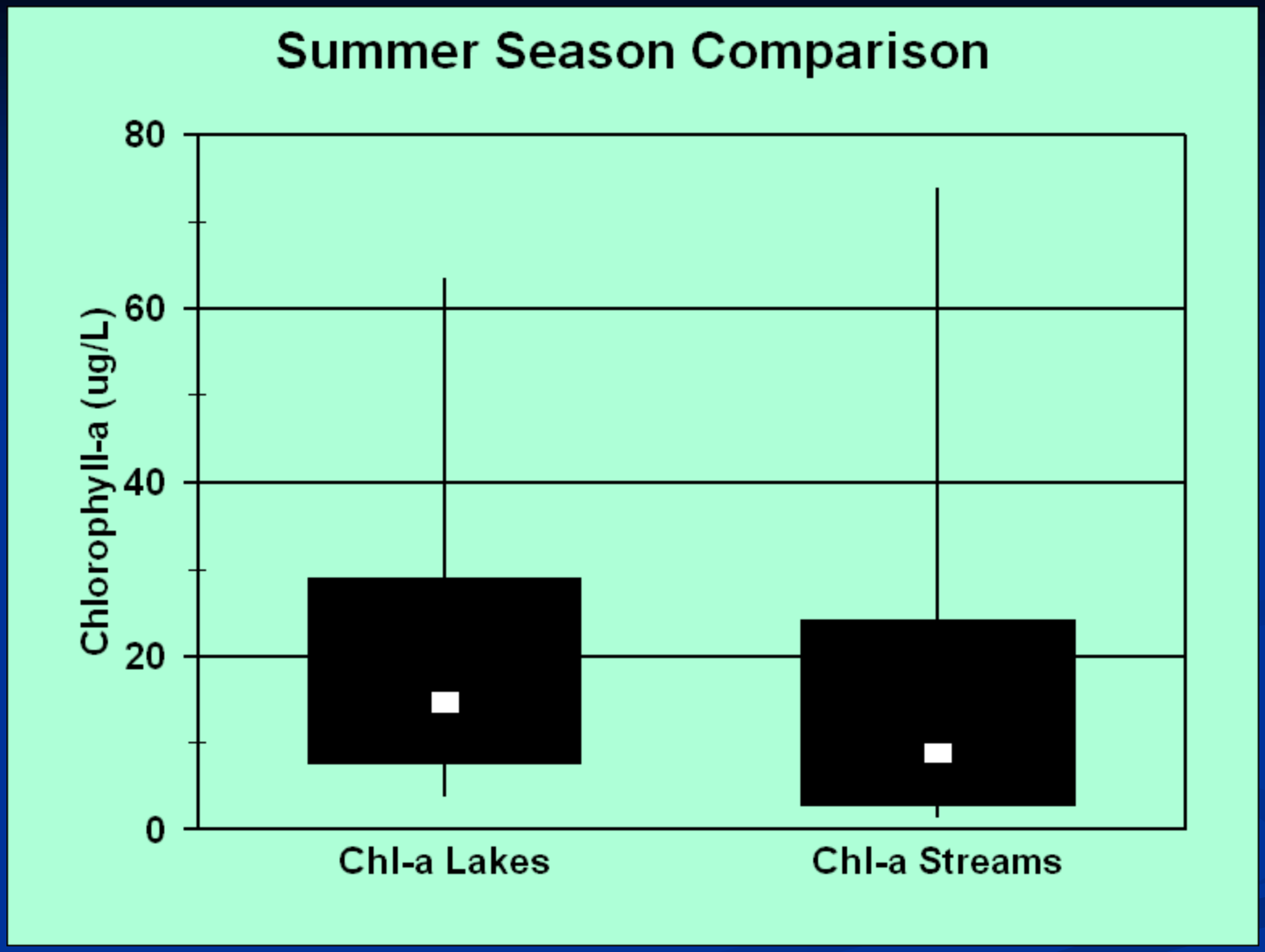

Summer Season Comparison
Total Nitrogen (ug/L)
5000
4000
3000
2000
1000
0
TN Lakes
TN Streams



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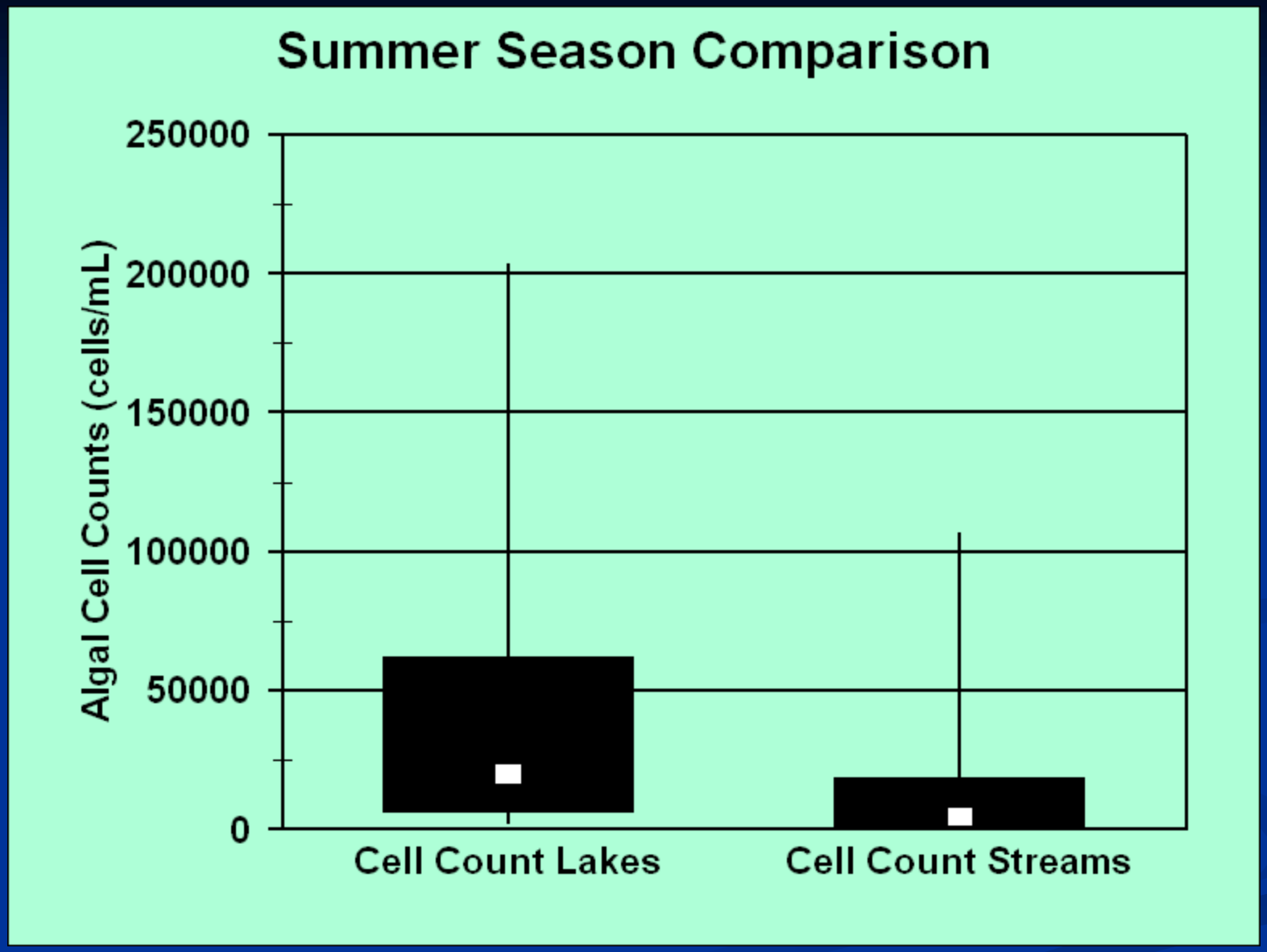
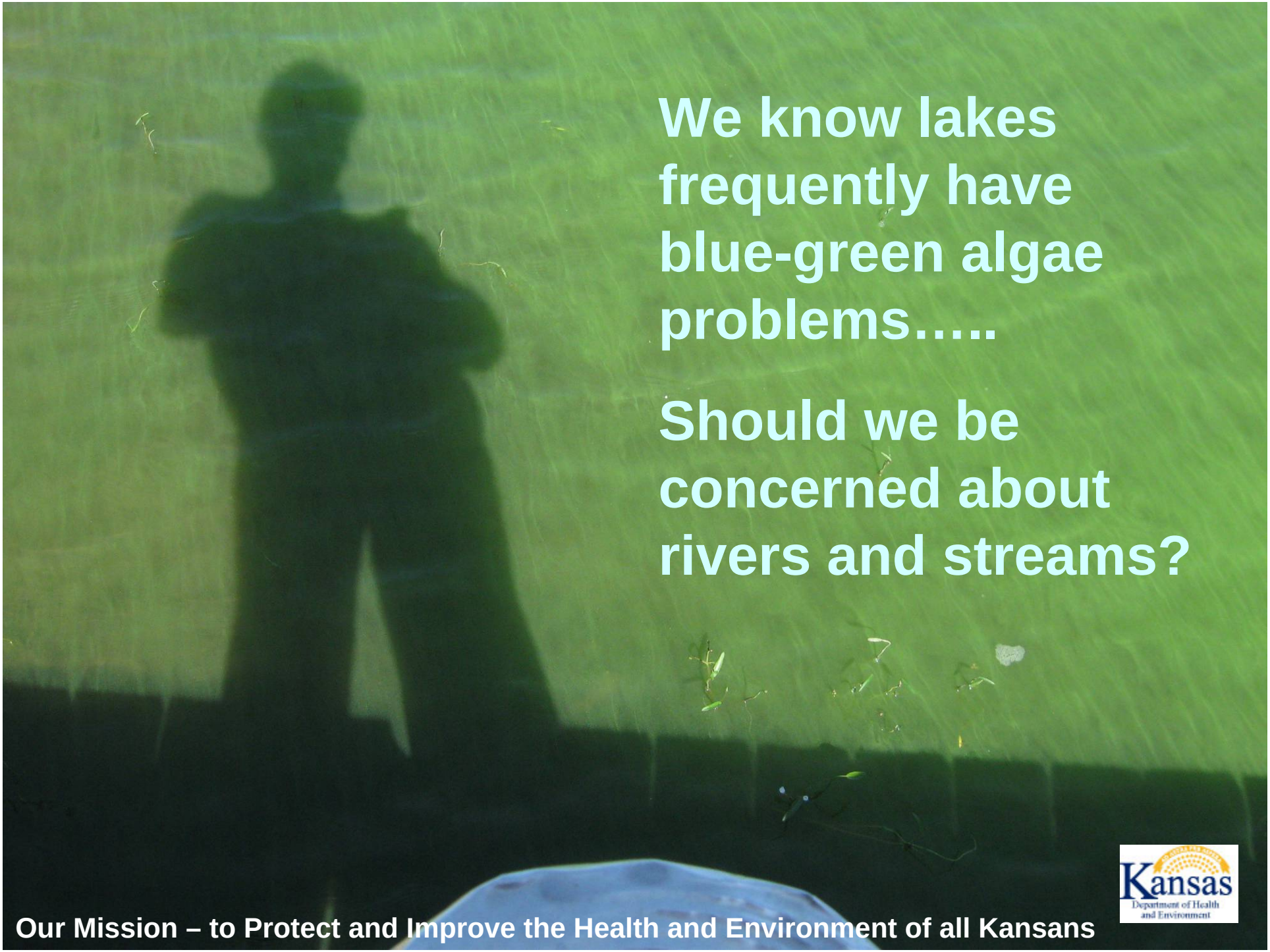
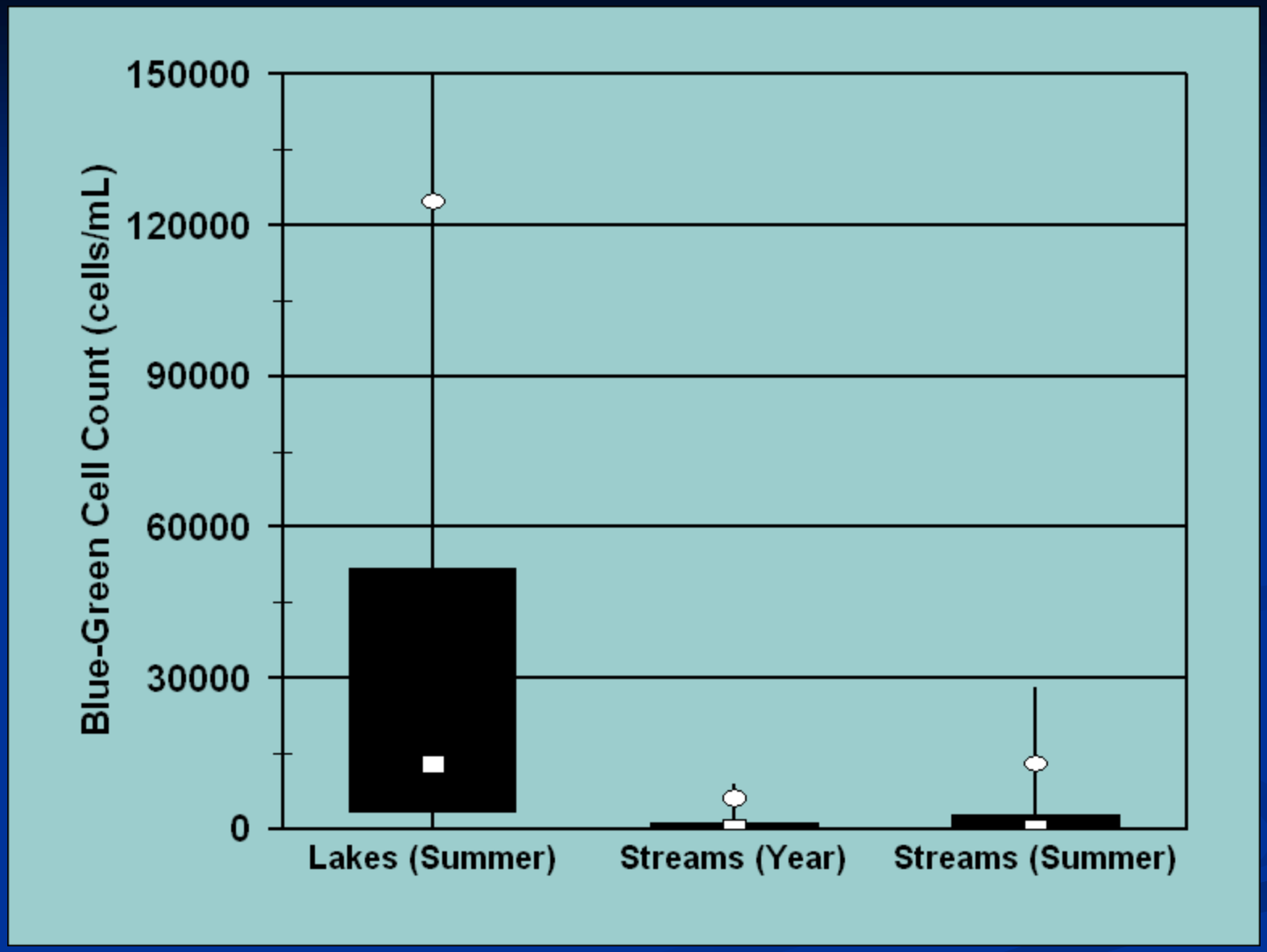

Summer Season Comparison
Algal Cell Counts (cells/mL)
250000
200000
150000
100000
50000
0
Cell Count Lakes
Cell Count Streams



We know lakes frequently have blue-green algae problems…..

Should we be concerned about rivers and streams?



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Blue-Green Relative Risks

- The KDHE HAB protocol uses a two tier threshold for advisories and warnings
  - 20,000 BG cells/mL
  - 100,000 BG cells/mL
- What are the relative risks for triggering a response?

Sample Contents	Lakes (% samples)		Streams (% samples) 2003-2010
	1991-2011	2003-2010	
Blue-Greens Present (>0%)	74.8	87.9	28.3
Blue-Greens Dominant (>50%)	56.8	73.6	12.8
Blue-Greens >20,000 cells/mL	32.5	42.1	6.2
Blue-Greens >100,000 cells/mL	12.9	15.7	1.8

General Conclusions

- There <u>are</u> differences in phytoplankton between lakes and streams
  - Both community size and structure
- There are <u>also</u> similarities
  - Summer critical period for water quality
  - Trophic state related to watershed condition
- Stream nutrient/algae models are statistically significant (like lakes) but less "powerful" as predictive tools (unlike lakes)
  - Stream models: R^2 = 0.35 to 0.55
  - Lake Models: R^2 = 0.65 to 0.85
- Stream phytoplankton has proven to be a useful parameter, just as is true for lakes

Conclusions: Blue-Greens in Streams and Rivers

- In general, streams and rivers should not be a concern regarding blue-green algae
  - Note: upstream lagoon discharges
- High blue-green counts in lakes
  - Strongly related to development in the watershed
  - Many lakes have large blue-green communities
- Most higher counts in streams and rivers were from a small number of sites and times (maximums)
  - Buffalo Creek (404,000 BG cells/mL)
  - Kansas River (181,000 BG cells/mL)
  - Arkansas River (141,000 BG cells/mL)
  - Big Blue River (236,000 BG cells/mL)
  - Wolf River (148,000 BG cells/mL)

The Kansas River

- The risks of microcystins for water supplies along the Kaw has been made an issue…. Is the risk real? Is it significant?

The Kansas River

- Data from streams across the state
  - Show little risk from blue-green algae
  - Show that even these low risks are from
    - Periods of extreme low flow
    - Upstream lagoon discharges (primarily on small streams)

KDHE Kansas River Data

2003-2010 SC 254,260 2008-2010 SC 257	SC 260 KS River at Wamego	SC 257 KS River at Lecompton	SC 254 KS River at DeSoto
Percent Samples with Blue-Greens Present	62%	71%	85%
Mean Blue-Green Contribution to Cell Count (%)	22%	29%	37%
Mean Blue-Green Cell Count (cells/mL)	12,800	2,000	19,500
Mean Chlorophyll-a (ug/L)	23.9	34.6	47.7

Milford Lake Releases to the Kansas River

Sept. 8, 2011 Survey	KS River Wamego	KS River Belvue	KS River Topeka	KS River Lecompton
Microcystis sp. Cells/mL	0	1,900	5,000	17,000
Microcystins By ELISA ug/L	~0.5	~0.5	~0.5	1.0

USGS data 9-2-11 to 9-8-11, upstream of Wamego, average 5.3 ug/L microcystins and values decline from there in both space and time, averaging <1 ug/L downstream of Manhattan

The Kansas River

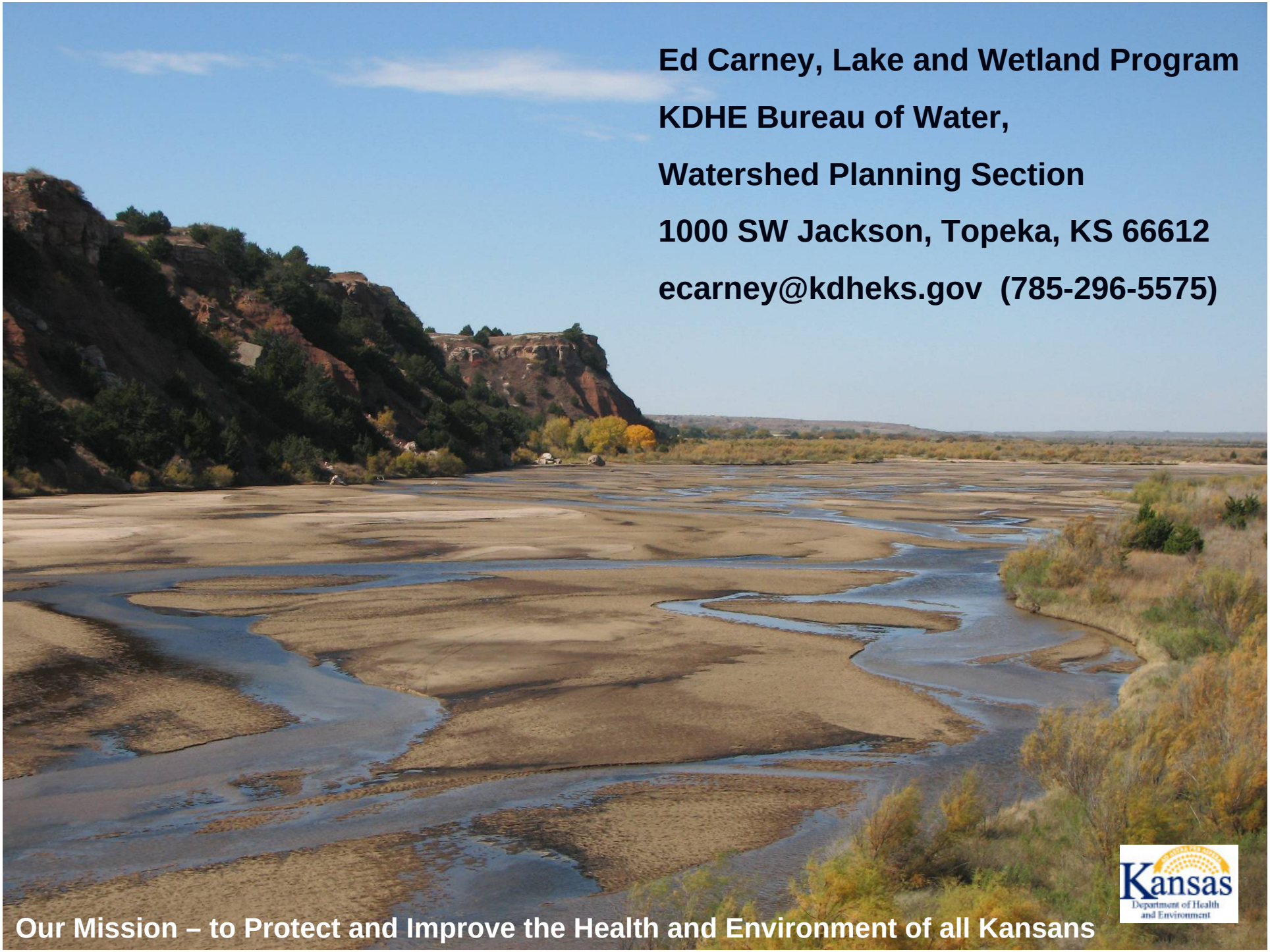
- There have been only 8 samples, over 8 years, along the Kansas River with <u>total</u> cell counts >100,000/mL
- Most are from 2004 or 2006, when the river was at extreme low flow condition

The Kansas River

Date	% Blue-Greens Cells	Biomass	Blue-Green Cell Count (#/mL)	Dominant Genera	Chlorophyll-a ug/L
Wamego					
May 5, 2004	41	16	58,000	Oscillatoria	80.1
Nov. 3, 2004	25	14	25,000	Microcystis, Planktothrix	45.6
July 5, 2006	77	6	181,000	Merismopedia	33.8
DeSoto					
May 6, 2004	10	3	13,000	Oscillatoria	194.3
May 4, 2006	18	8	32,000	Microcystis	49.8
July 6, 2006	67	16	165,000	Merismopedia	45.3
Sept. 7, 2006	50	33	76,000	Microcystis	102.2
June 3, 2009	31	11	40,000	Phormidium	163.3

Conclusions: The Kansas River

- Microcystin risk, and risk from algal toxins in general, along the Kansas River are very minimal
  - i.e., low flow times or unusual release events
- Algal taste & odor problems may also be expected to coincide with those conditions
  - So… If you are successfully doing preventative treatment of taste & odor problems, odds are potential toxins are also being impacted
  - But bear in mind that not all T&O events are algal in origin



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