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Nutrient Criteria: Protection of Aquatic Life

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Protection of Aquatic Life

- Waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of (warm, cool, cold) water biota.
  [10-CSR 20-7.031 (1)(C)1.]

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Components of Lake Aquatic Life

- Nutrients (TP and TN)
- Phytoplankton (Chlorophyll-a)
- Zooplankton (Daphnia, Protozoa, et al)
- Planktivore fishes
- Piscivore fishes

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Fish Species Commonly Found in Missouri Lakes

Planktivores

- Minnows *(Cyprinidae)*
  - Carp *(Cyprinus Carpio)*
- Herrings *(Clupeidae)*
  - Gizzard Shad *(Dorosoma cepedianum)*
- Catfish *(Ictaluridae)*
  - Channel Catfish *(Ictalurus punctatus)*
  - Flathead Catfish *(Pylodictis olivaris)*

Piscivores

- Sunfishes *(Centrarchidae)*
  - Black Basses *(Micropterus)*
  - Sunfishes *(Lepomus)*
  - Crappies *(Pomoxis)*
- Sea Basses *(Percichthyidae)*
  - Striped Bass *(Morone Chrysops)*
  - White Bass *(Morone saxatilis)*
- Perches *(Percidae)*
  - Walleye *(Stizostedion vitreum)*

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Interaction of Lake Aquatic Life

- Higher trophic levels $\longrightarrow$ higher fish biomass, **however**…
- Primary beneficiaries of higher trophic levels are Planktivores
- Piscivores are visually oriented, do not thrive in turbid water

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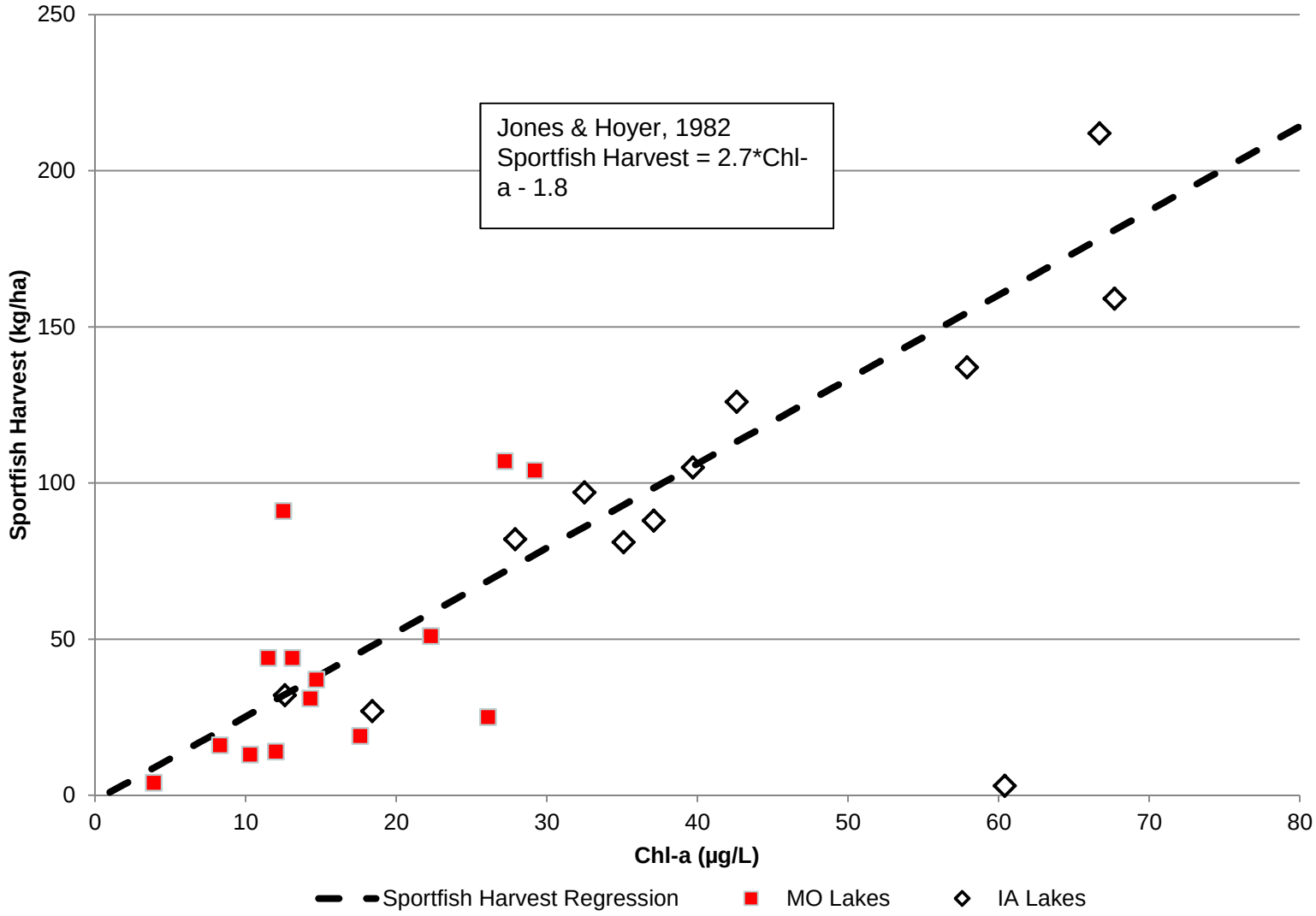

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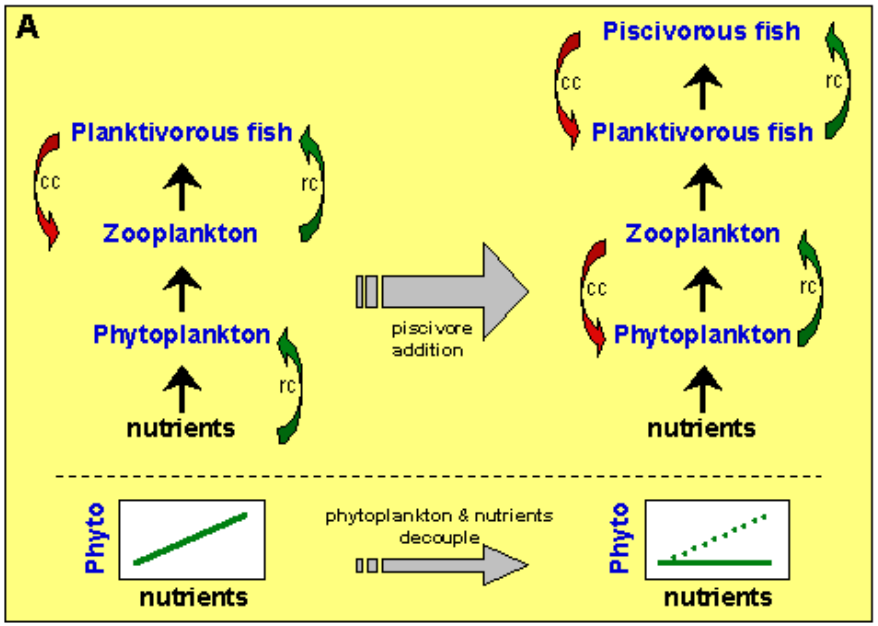
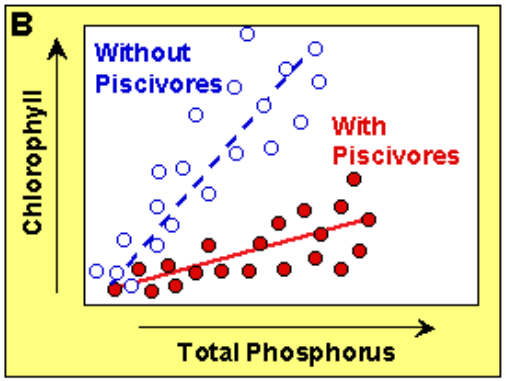
Trophic Cascade Hypothesis

Drenner and Hambright, 2002





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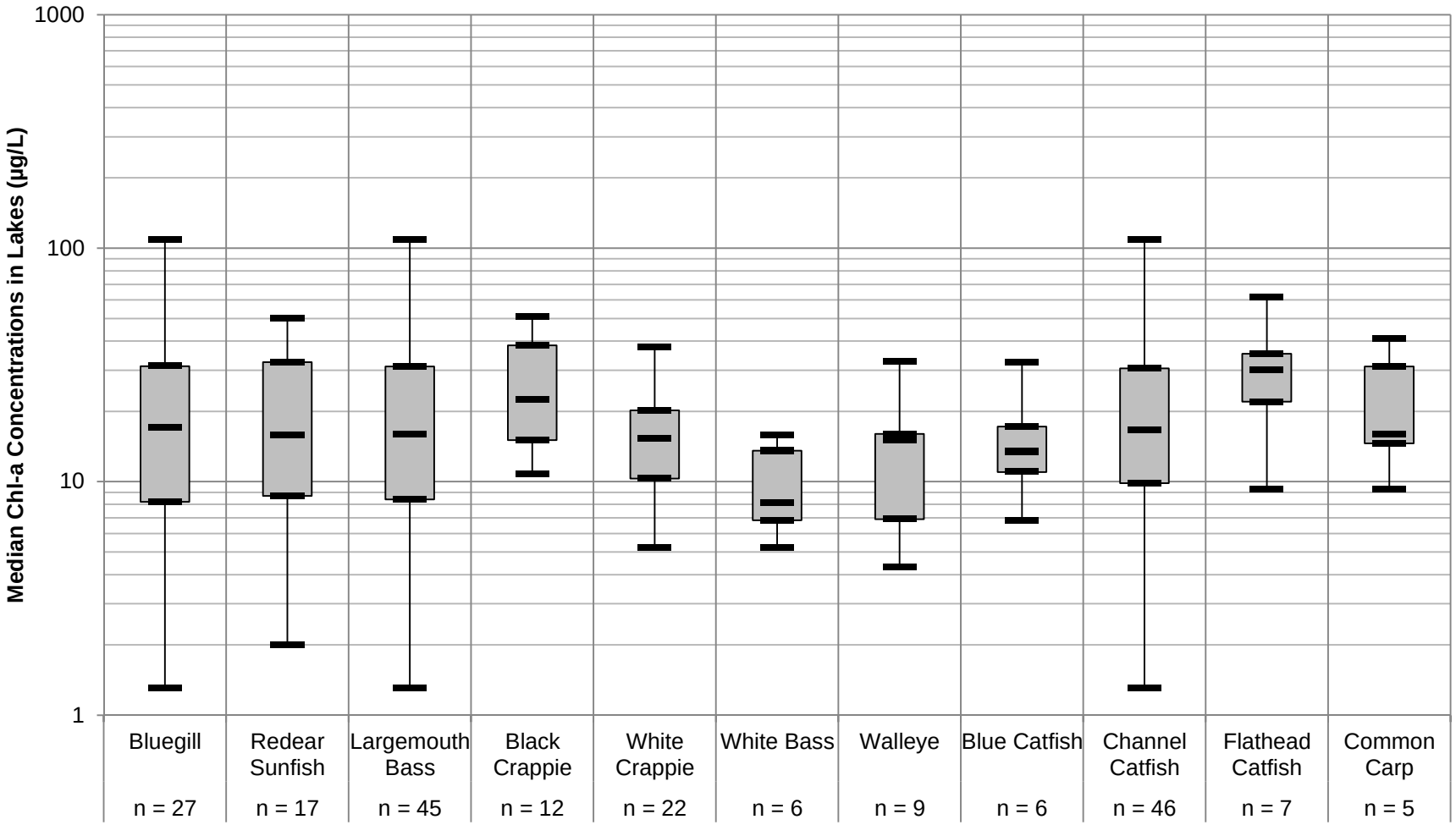
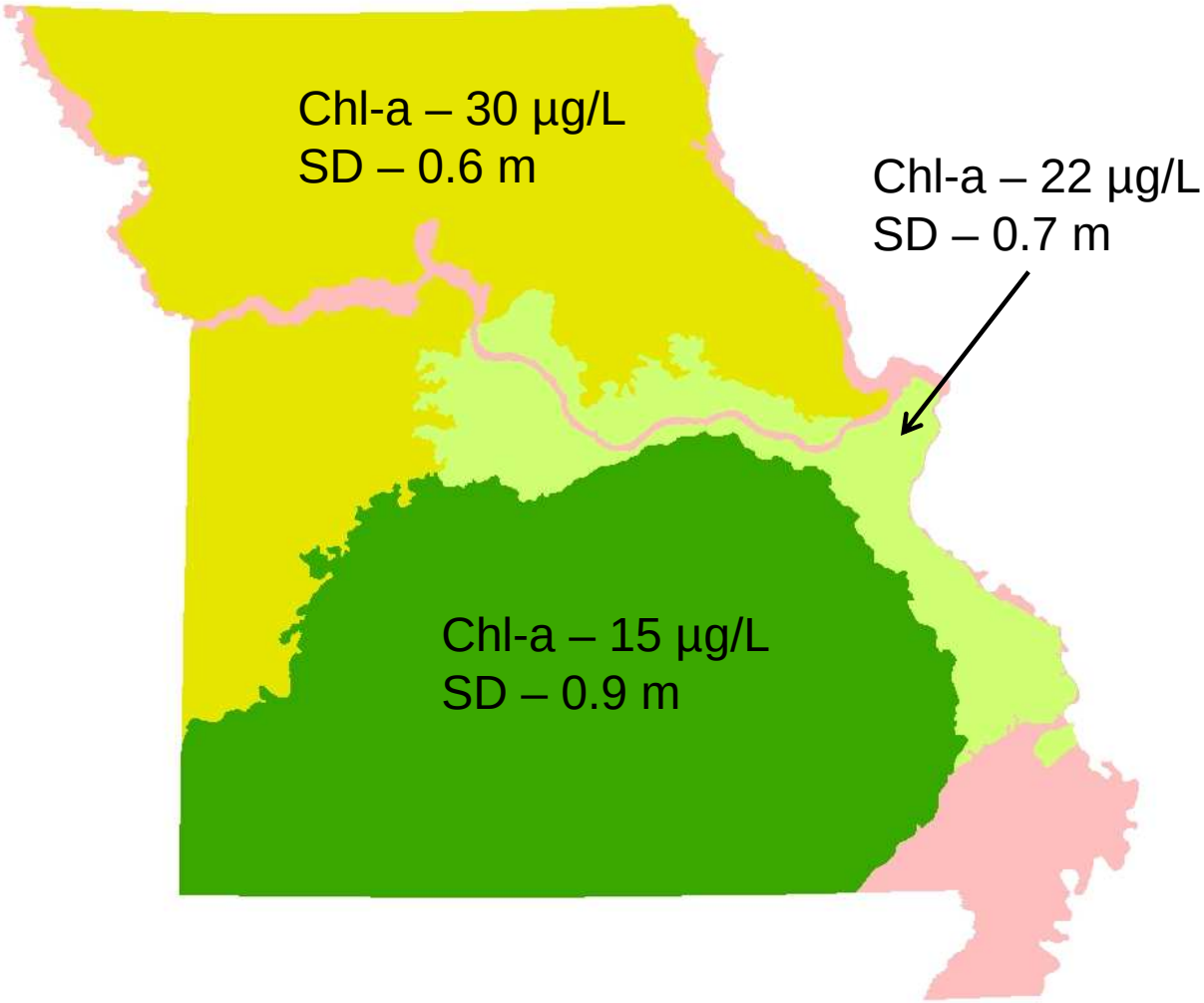
Presence of various fish species and Median Chlorophyll-a



MDC Recommendations



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MDC Rationale

- Fish biomass and production increase with higher TP and Chl-a. (Jones & Hoyer, 1982; Downing & Plante, 1993)
- Reductions in nutrient inputs have led to declines in sport fisheries (Ney, 1996)
- Regional variability based on EPA nutrient guidance documents.

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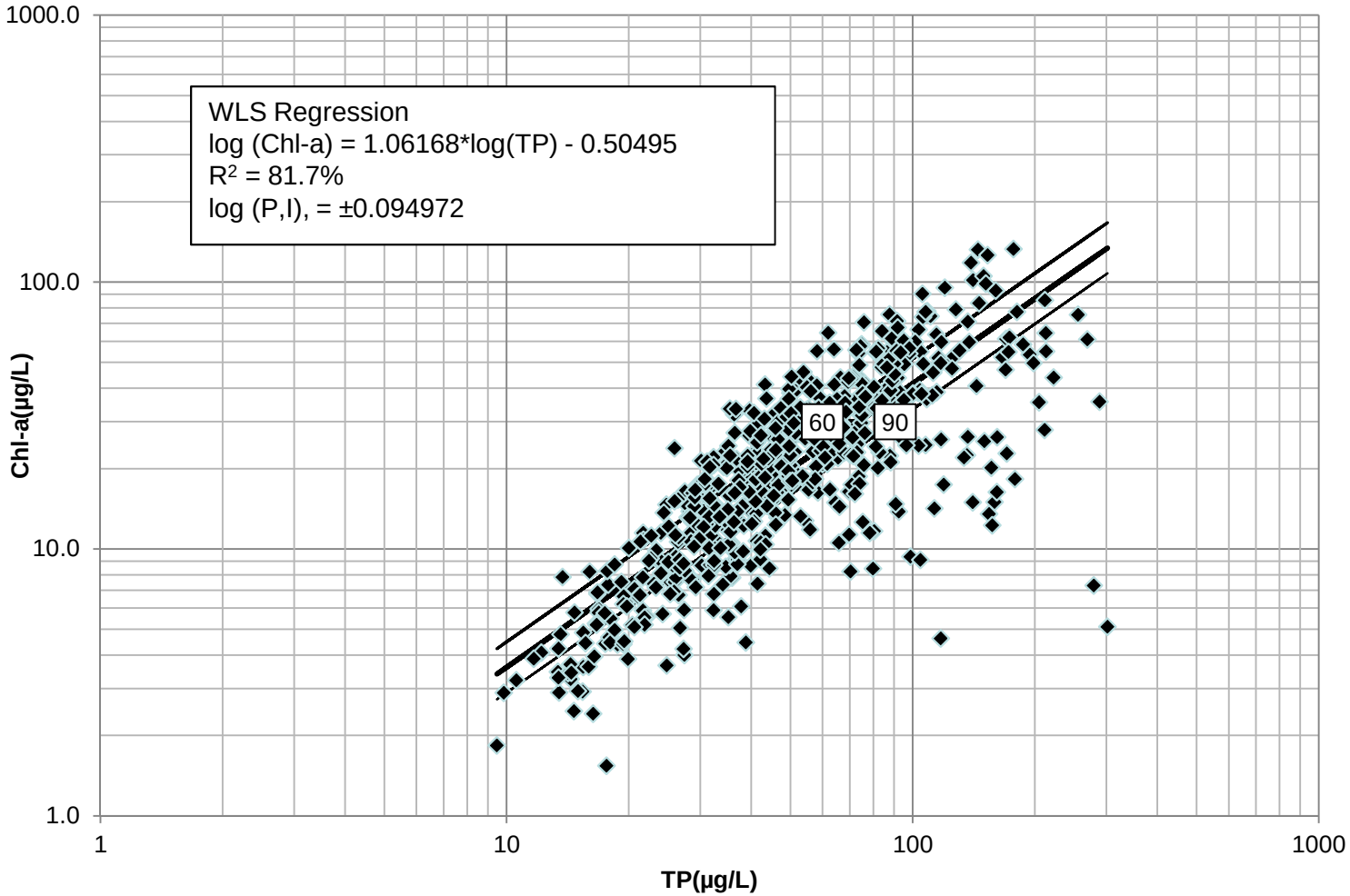
MDC Rationale (cont'd)

- Michaletz, Obrecht, and Jones (2012) studied interactions of several fish species, lake morphometry, and watershed characteristics in smaller lakes.
  - Benefits from higher fertility, up to point of hyper-eutrophy.
  - Management of fisheries requires decisions between which species to favor.

Extrapolation of Base and Alternate Nutrient Criteria



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Other Findings

- Egertson & Downing (2004) found that carp and other benthivores benefitted from increased Chl-a at expense of piscivore species.
- Maceina et al (1996), found that reductions in Chl-a to 10 – 15 µg/L would not hurt production of black bass and crappie fisheries in Alabama.

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Lines of Evidence – Chlorophyll-a (µg/L)

Lake Eco-Region	RTAG Benchmark	RTAG MO Reference	EPA Regional	Eastern Nebraska	MDC
Plains	8.0	9.2	5.6 – 18.8	10	30
Ozark Border		5.0	6.1 – 9.1	*	22
Ozark Highlands			6.1	*	15

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Lines of Evidence – Total Phosphorus (µg/L)

Lake Eco-Region	RTAG Benchmark	RTAG MO Reference	EPA Regional	Eastern Nebraska & Illinois	MDC, Extrapolated (Base & Alternate)
Plains	35	47	30 – 55	50	60, 90
Ozark Border		27	24 – 30	*	46, 94
Ozark Highlands			24	*	26, 42

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Lines of Evidence – Total Nitrogen (µg/L)

Lake Eco-Region	RTAG Benchmark	RTAG MO Reference	EPA Regional	Eastern Nebraska	MDC, Extrapolated (Base & Alternate)
Plains	700	477	614 – 964	1000	952, 1241
Ozark Border		465	499 – 614	*	786, 1187
Ozark Highlands			499	*	550, 856

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EPA View

- Recommends lower limits based on reference lake values, RTAG benchmarks, et al.
- May be able to justify MDC figures for specific lakes if:
  - Assigned a “sportfish use” designation, and
  - No higher attainment in water quality (WBC, DWS, etc.) is expected for those lakes, and
  - Fish species for which lake is managed are shown to need higher trophic conditions to thrive.

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Truman Lake
Photo: 7/19/2014
Sample 7/16/2014
TP – 630 µg/L
TN – 1520 µg/L

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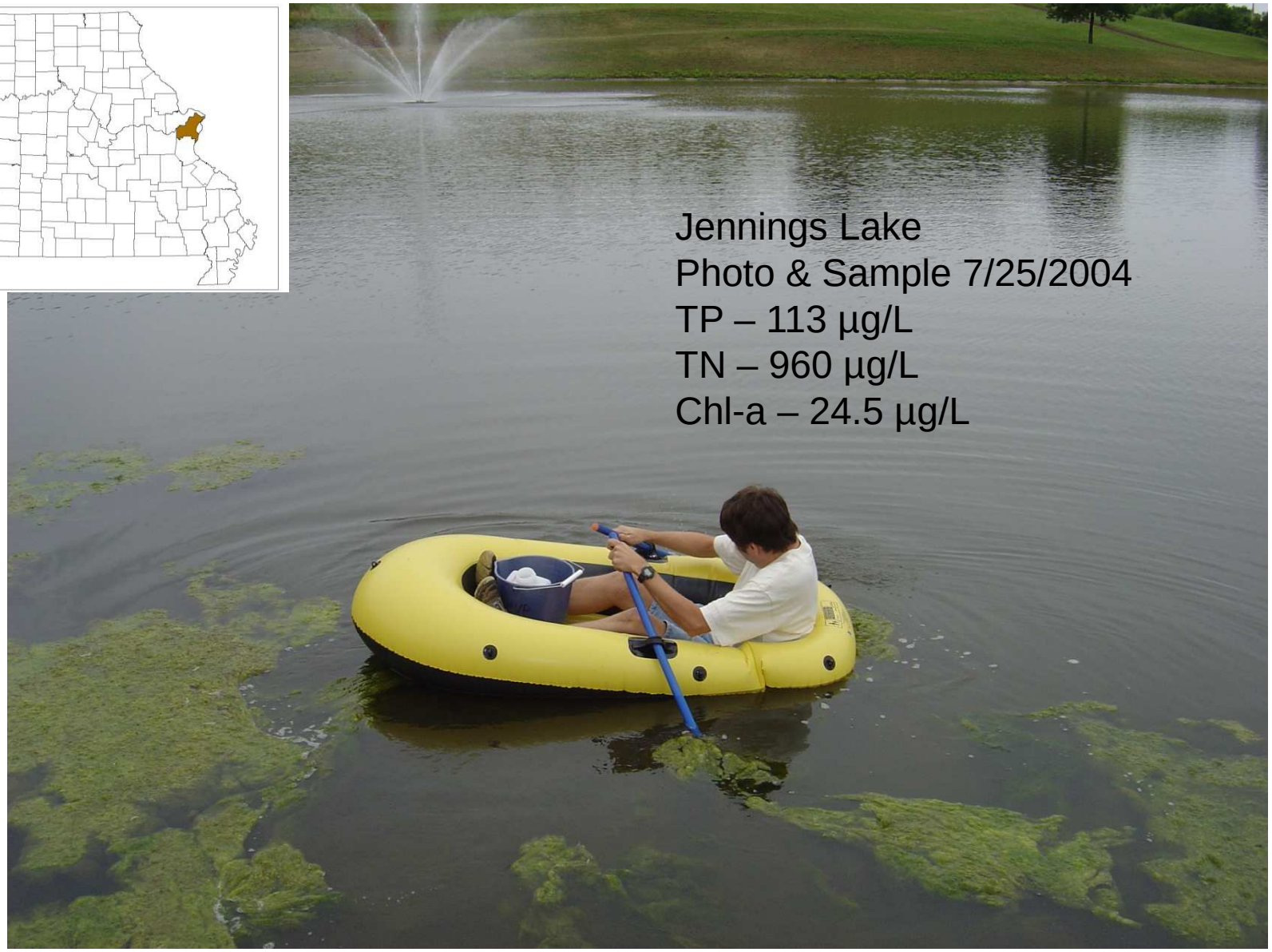

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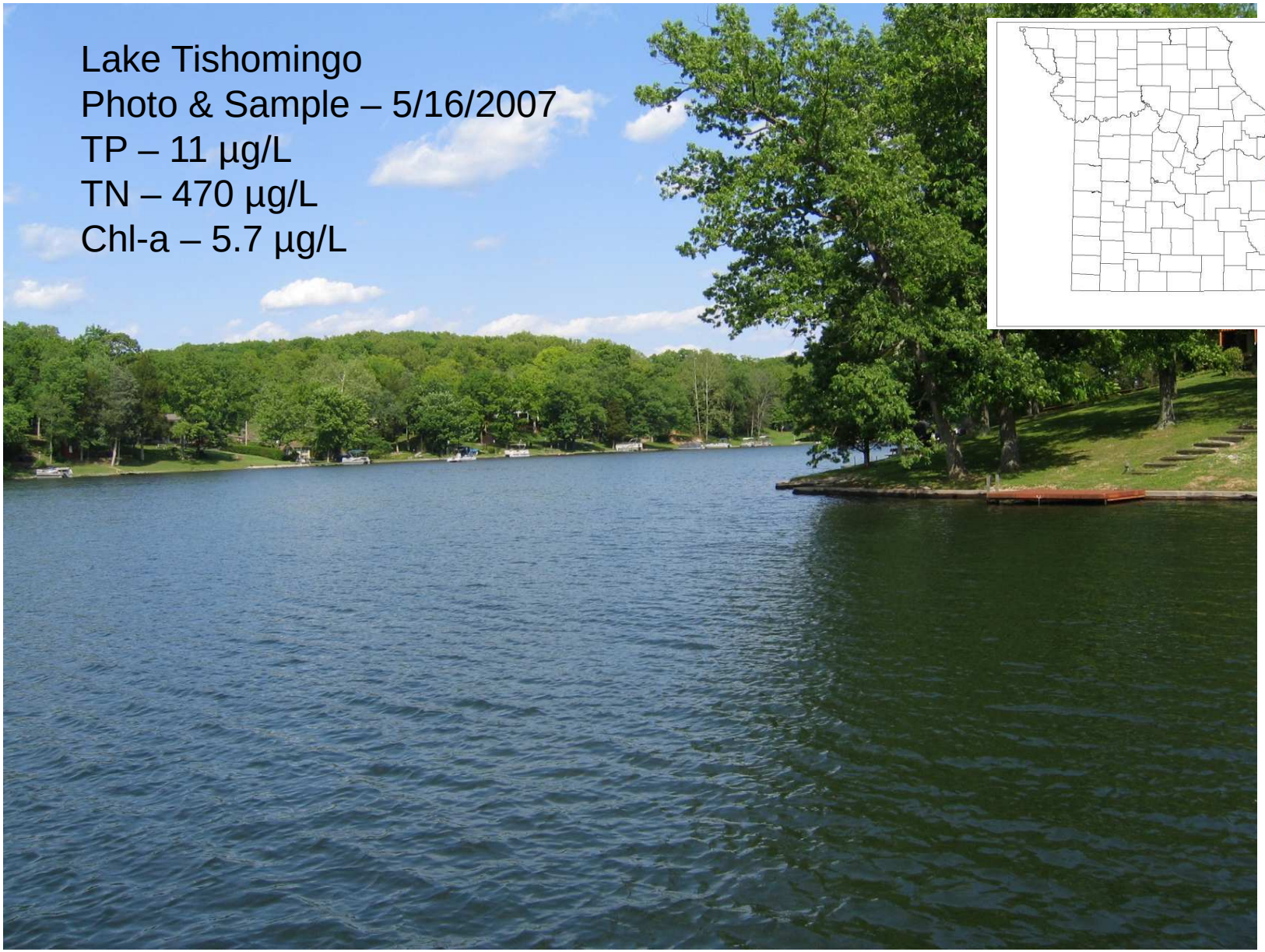

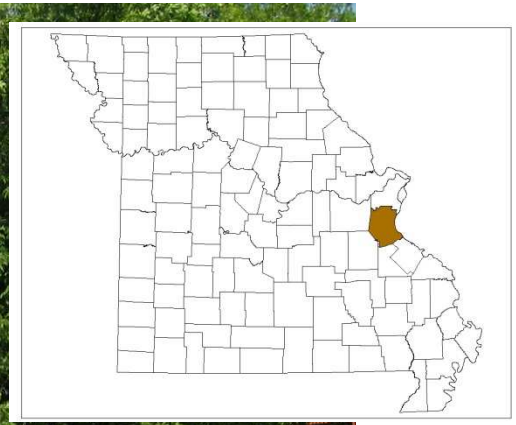

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