National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
31 March – 4 April, 2003

LAKES 101

Florida Lake Biocriteria and Bioassessment Development

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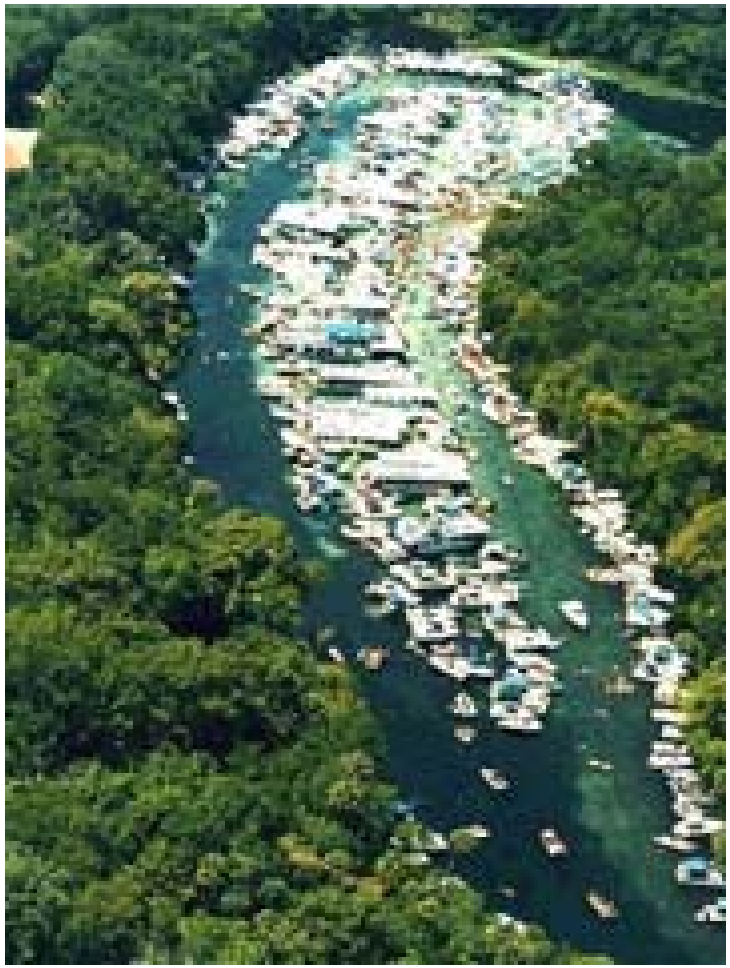
FLORIDA'S BIOCRITERIA/ BIOASSESSMENT HISTORY

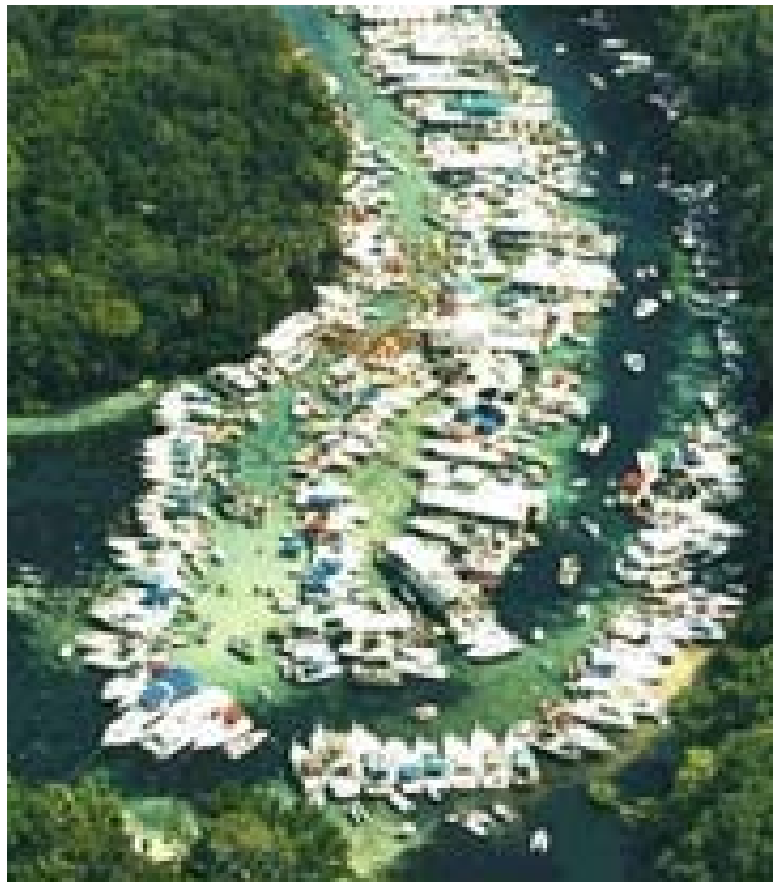
- Macroinvertebrate program started in 1948
- Single metric indices:
  - Beck's Biotic Index in 1950; changed to Florida Index in 1980's
  - Shannon Index into Florida Administrative Code in late 1980's
- Primarily Risk Assessment for organic pollution/DO (wastewater effluents)
- Problems with single metric indices
- Risk Assessment became for NPS (nutrients) in 1990's
- Bioassessment and Biocriteria documents developed, following EPA's recommended procedures:
SCI in 1996; LCI in 2000

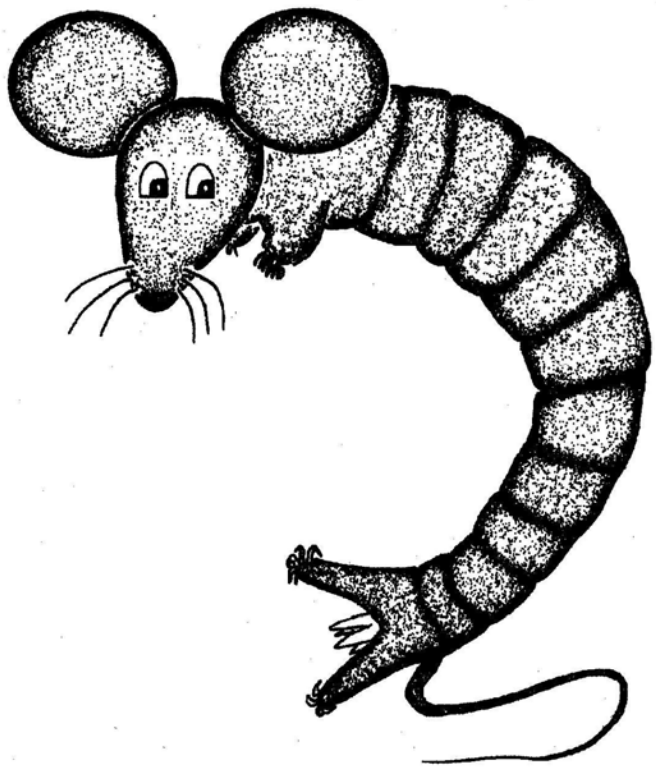
Silver Glen Spring, Ocala National Forest



- >1000 powerboats anchored in spring run at times.

- Many remain for days; most with no sanitary facilities.





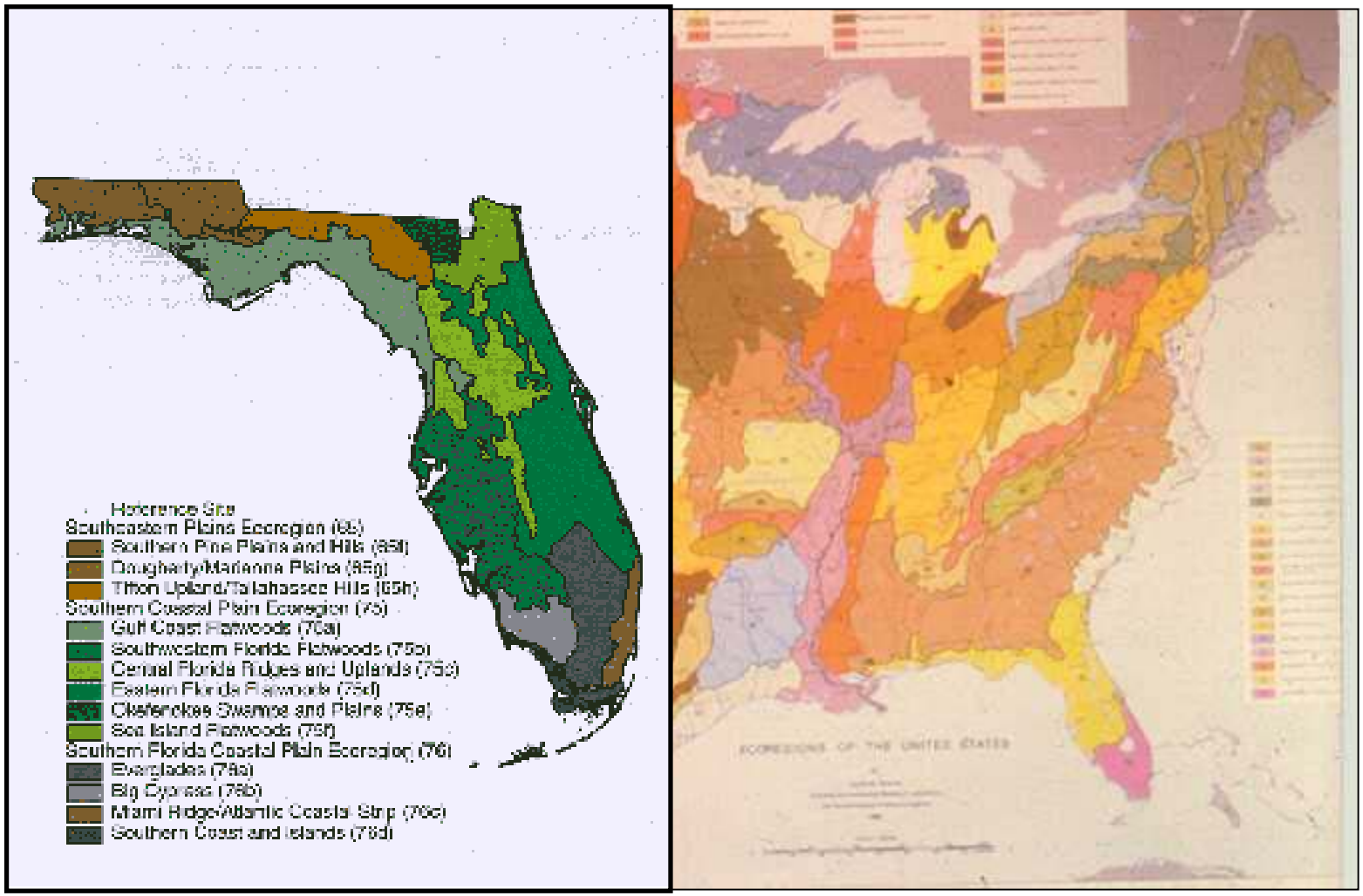
Midgie Mouse

BIOLOGICAL INTEGRITY

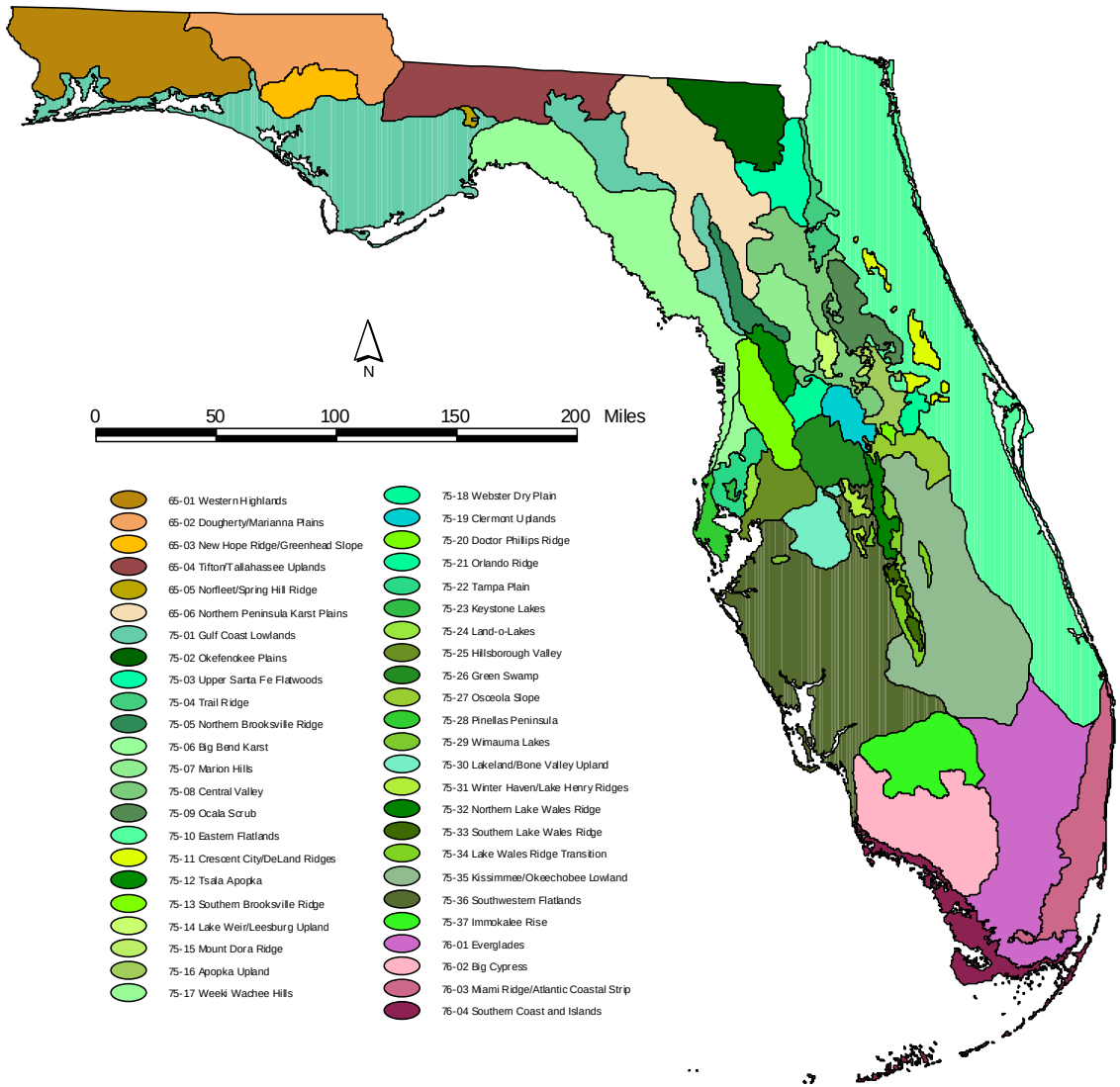
Biological integrity is the ability of an aquatic ecosystem to support and maintain a balanced community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitats within a region.

(Karr and Dudley 1981)

Level IV Sub-ecoregions Level III Ecoregions



Level IV Sub-Ecoregions for Lakes



Establishing Reference Sites and Conditions

Determine sources of effect (NPS, sedimentation, turbidity, human or agricultural activity, proximity of roads)

Evaluate vegetation (shoreline, complexity, age, extent, quality)

Evaluate biological health of candidate sites

Paleolimnology

Local expert consensus

Review historical data

Conduct aerial and ground reconnaissance

Lake Campbell
clear, acid

Big Blue Lake
clear, acid

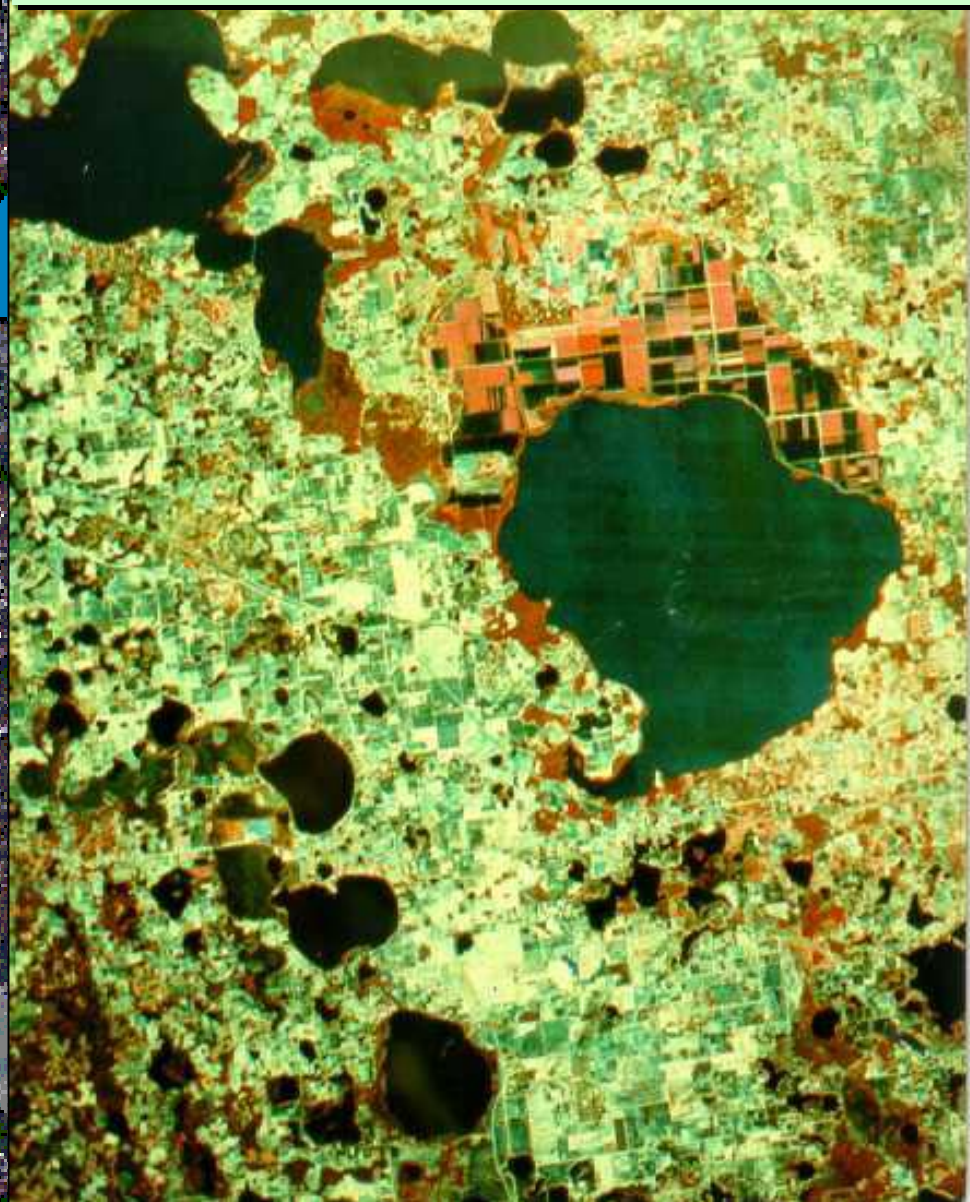
Lake Louisa
colored, acid

Lake Formation

Lake Seminary
(best available)
clear, acid

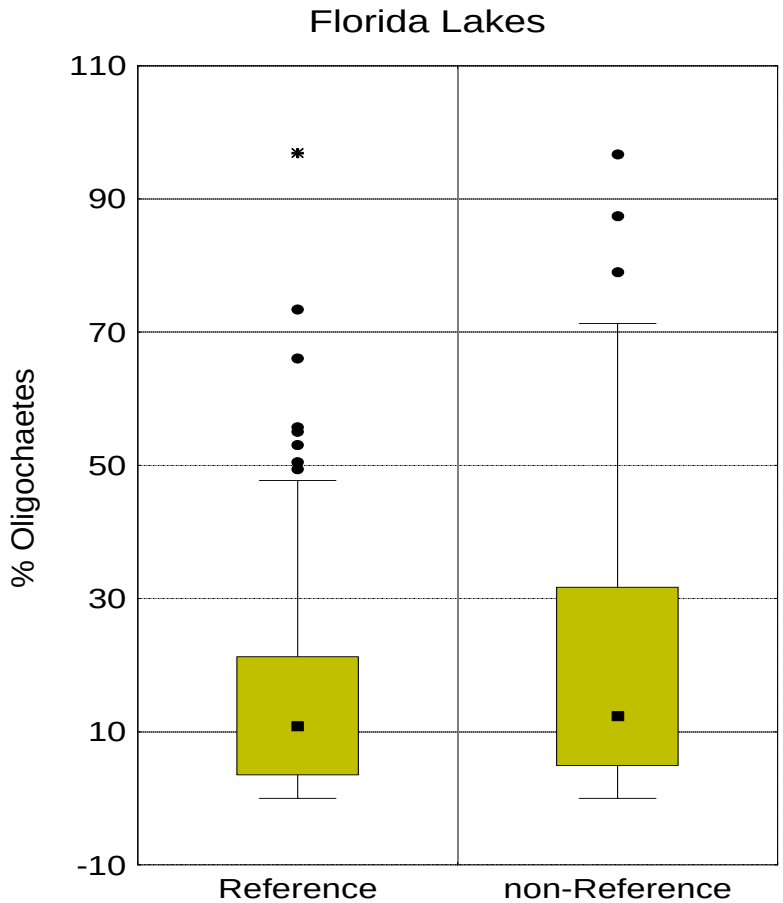
Lake Tsala Apopka
naturally eutrophic

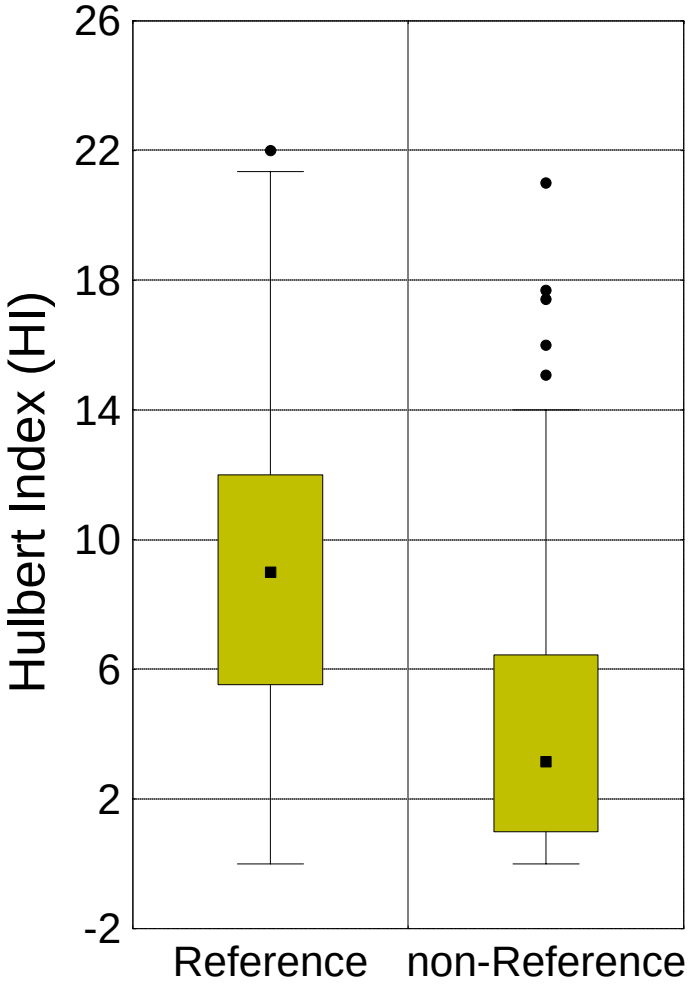
Lake Apopka
culturally eutrophic

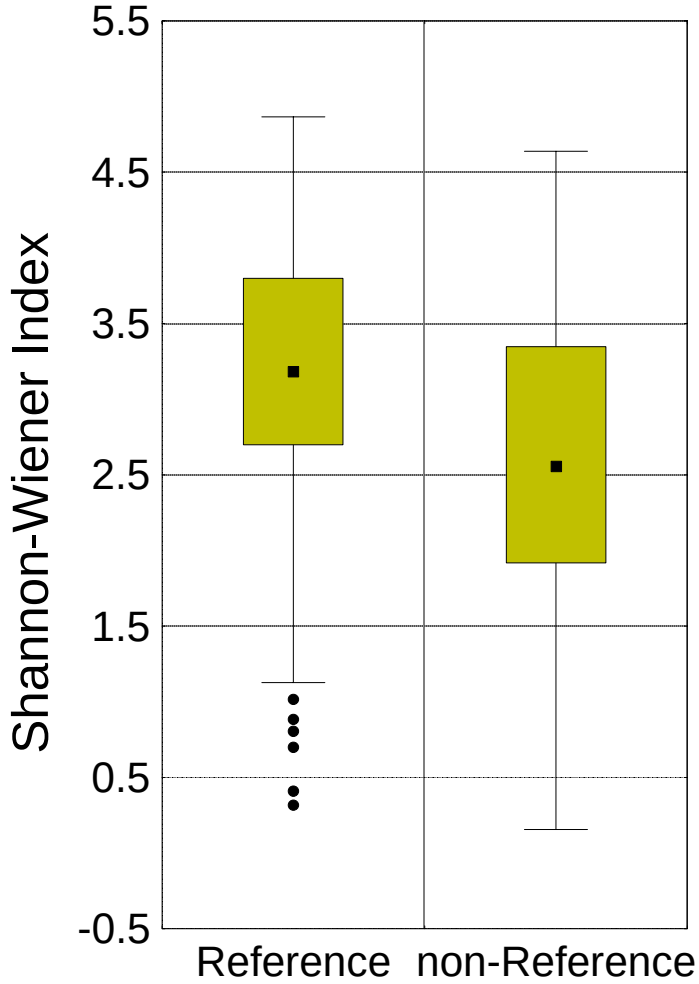


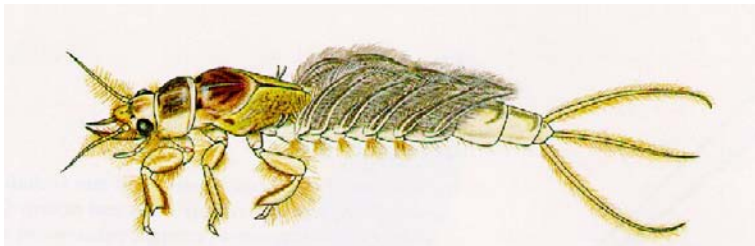
Development of Invertebrate Index

- Examine responsiveness of 33 metrics
  - compare reference and non-reference lakes
  - by lake type
- Select responsive, not overly redundant metrics for multimetric index



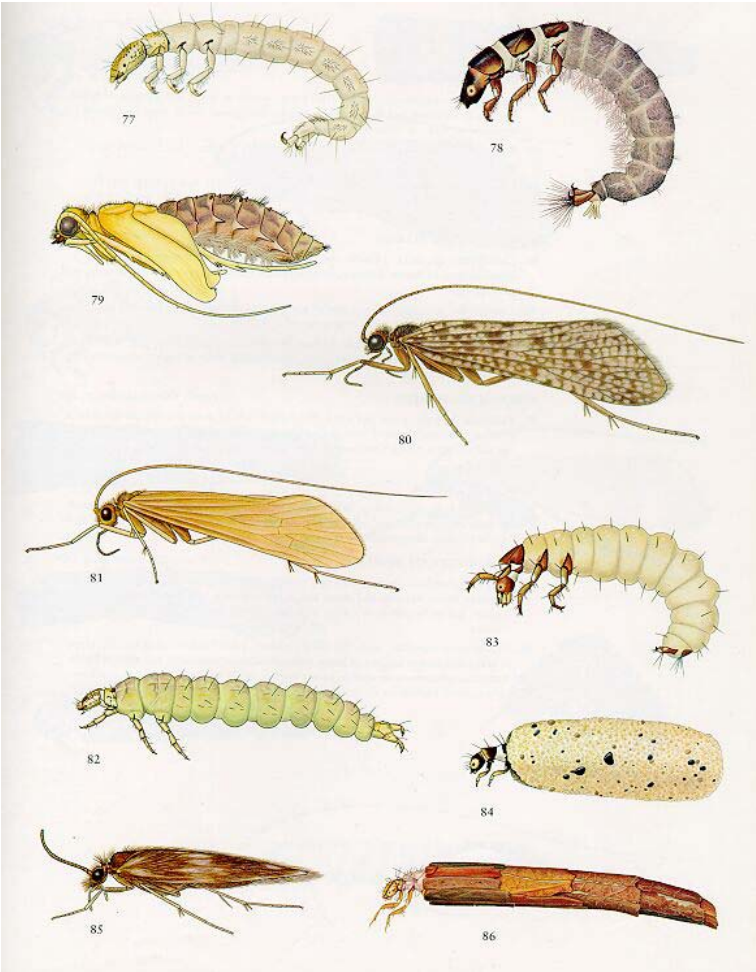

Hulbert Index (HI)
26
22
18
14
10
6
2
-2
Reference
non-Reference


Shannon-Wiener Index
5.5
4.5
3.5
2.5
1.5
0.5
-0.5
Reference
non-Reference



FW macroinvertebrate indicators

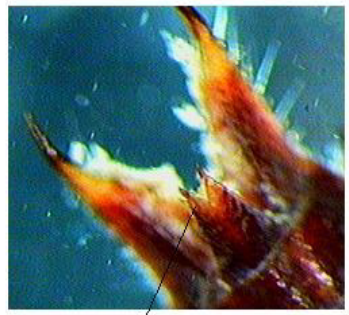
- "EPT" - larval mayflies, stoneflies, and caddisflies
  - occur mainly in clean and flowing streams
  - adult stages very short-lived
  - stoneflies chiefly in Panhandle area
  - well known to fly fishermen

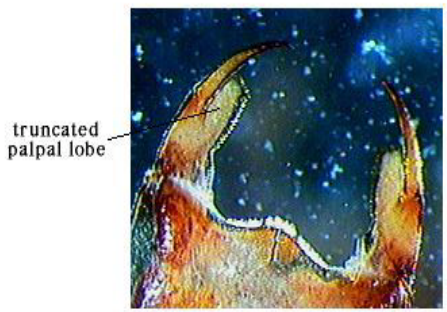


Dragonflies and Damselflies (Odonata)

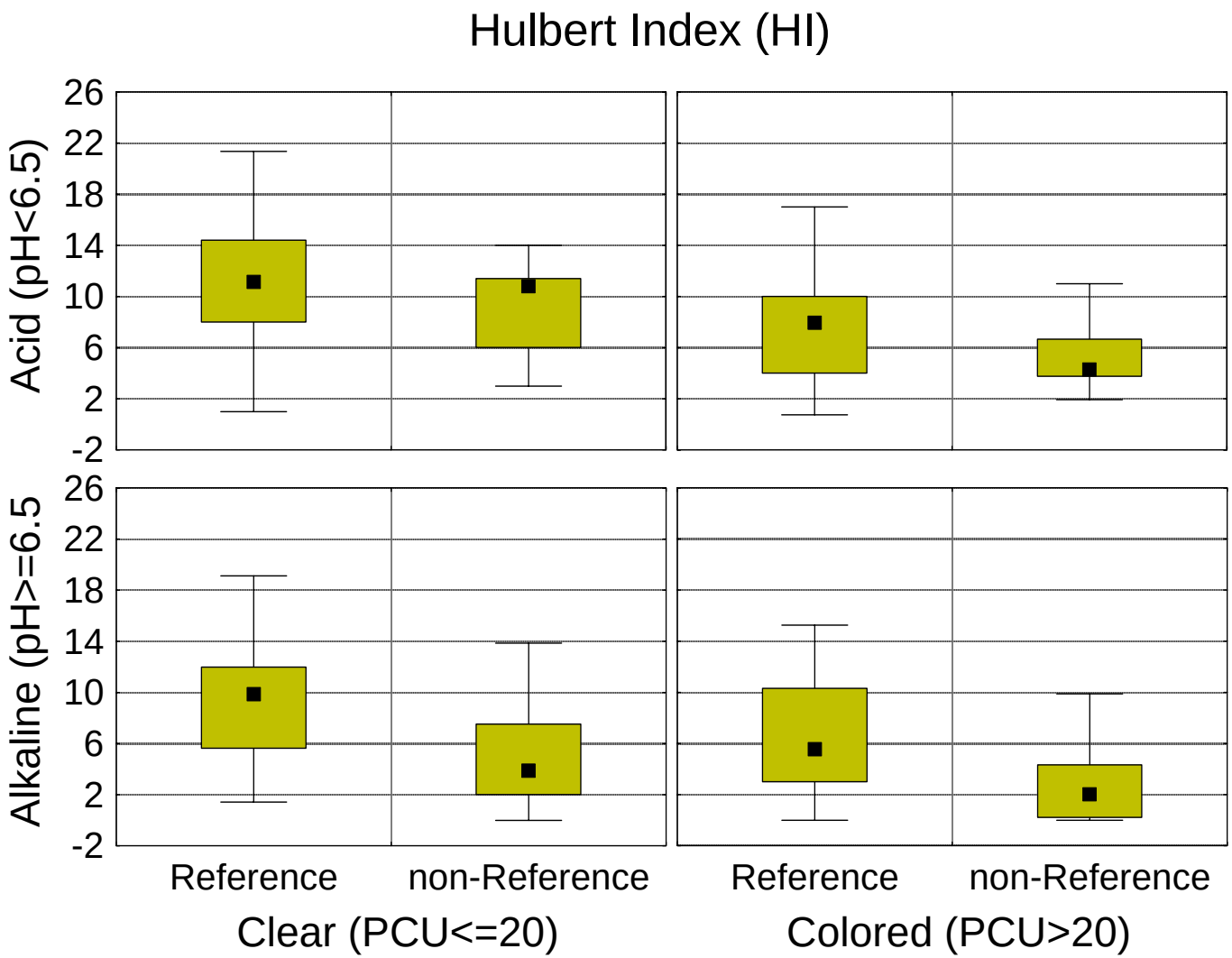
various species of *Argia*

Boyeria vinosa



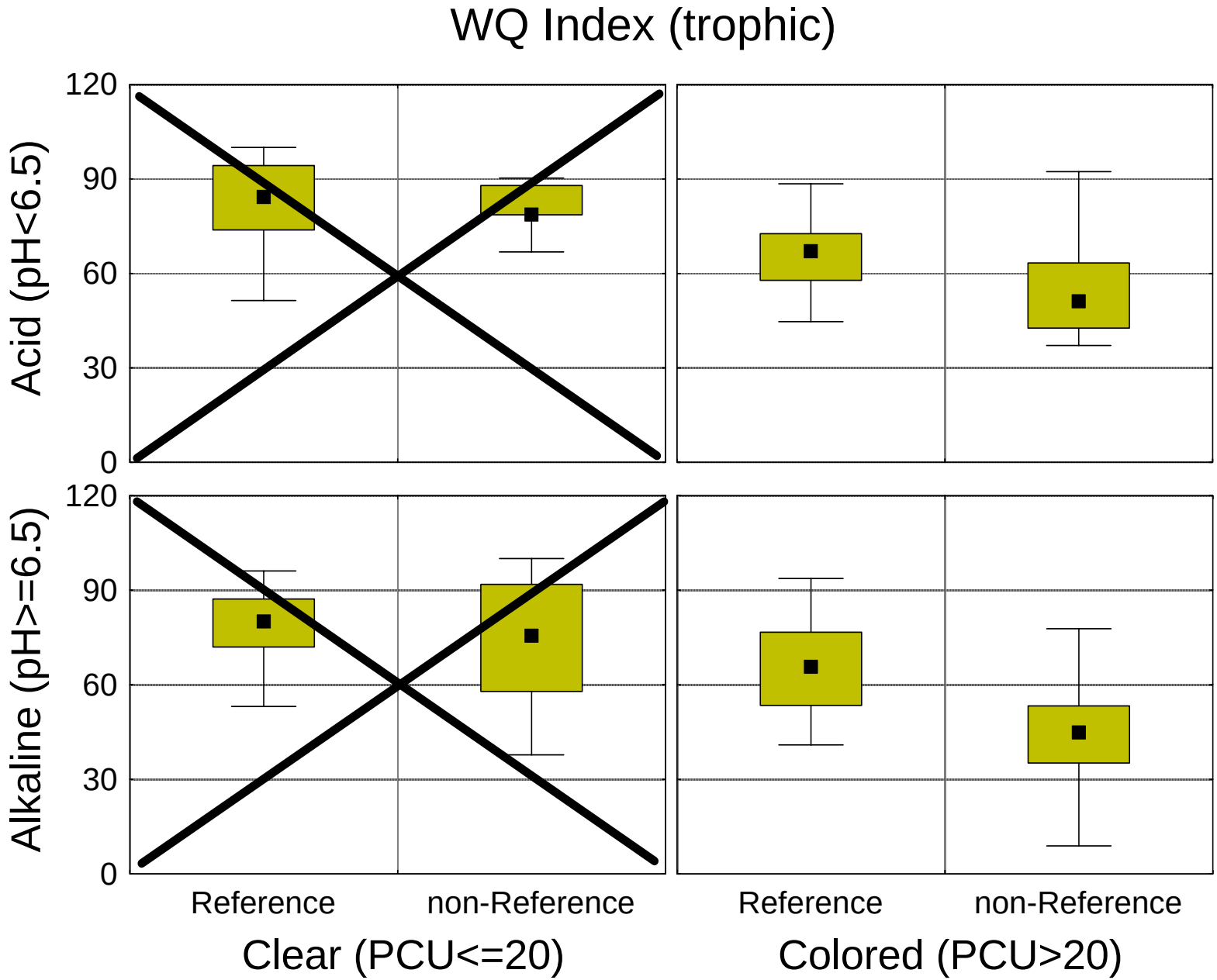


Response varies among lake types



5 practical lake classes

- Acid clear
  - Southeastern Plains (65)
  - Southern Coastal Plain (75)
- Acid colored
- Alkaline clear
- Alkaline colored

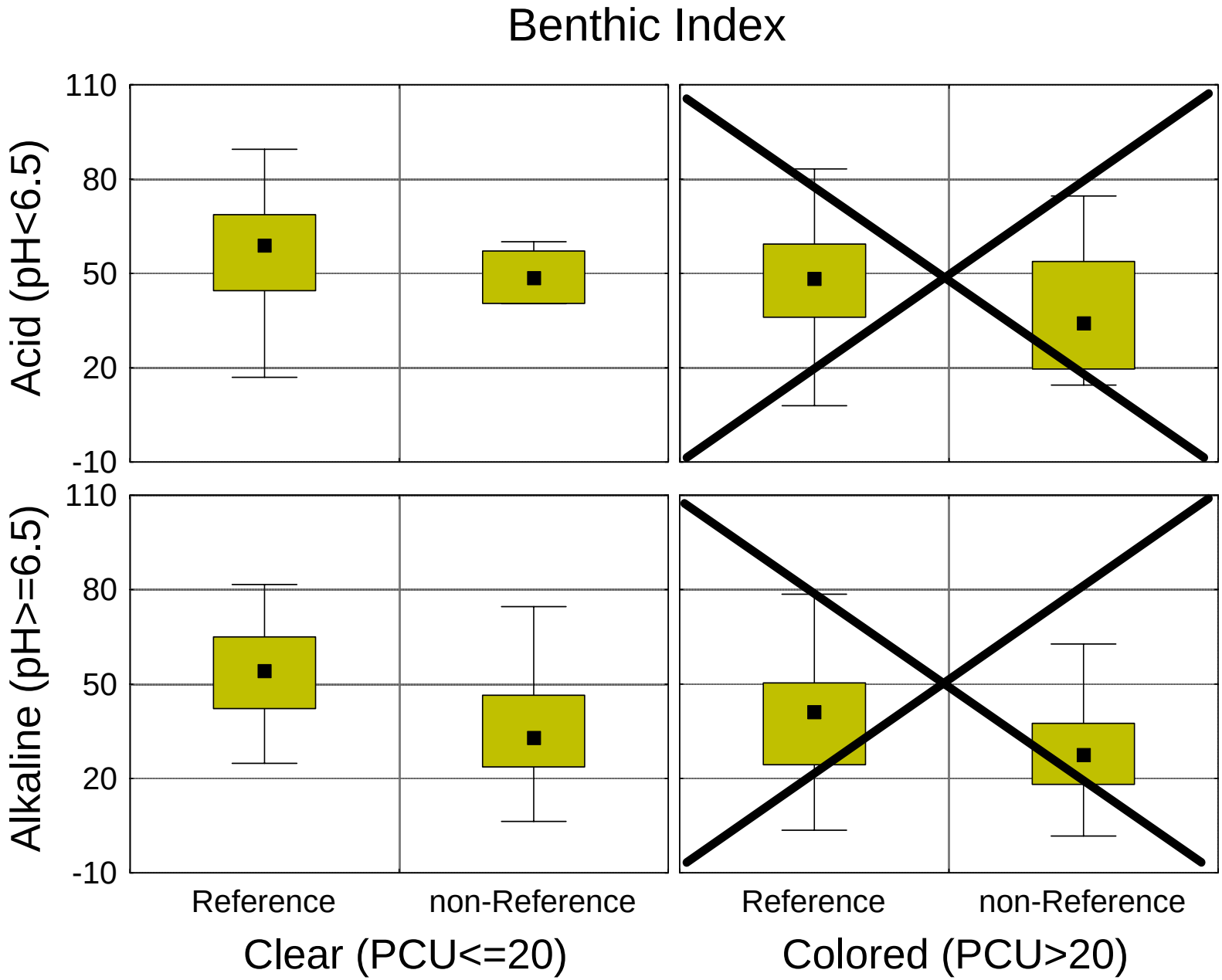

WQ Index (trophic)
Acid (pH<6.5)
Alkaline (pH>=6.5)
120
90
60
30
0
Reference
non-Reference
Reference
non-Reference
Clear (PCU<=20)
Colored (PCU>20)

Benthic Lake Index

Invertebrate index of 6 metrics:

- **Total taxa**
- **EOT taxa (mayflies, dragonflies, caddisflies)**
- **Hulbert tolerance index (HI; macroinvertebrate part)**
- **Shannon-Wiener diversity**
- **% EOT**
- **% Diptera**

Works best in clear lakes (<60 PCU)


Benthic Index
Acid (pH<6.5)
Alkaline (pH>=6.5)
110
80
50
20
-10
Reference
non-Reference
Clear (PCU<=20)
Colored (PCU>20)

Conclusions

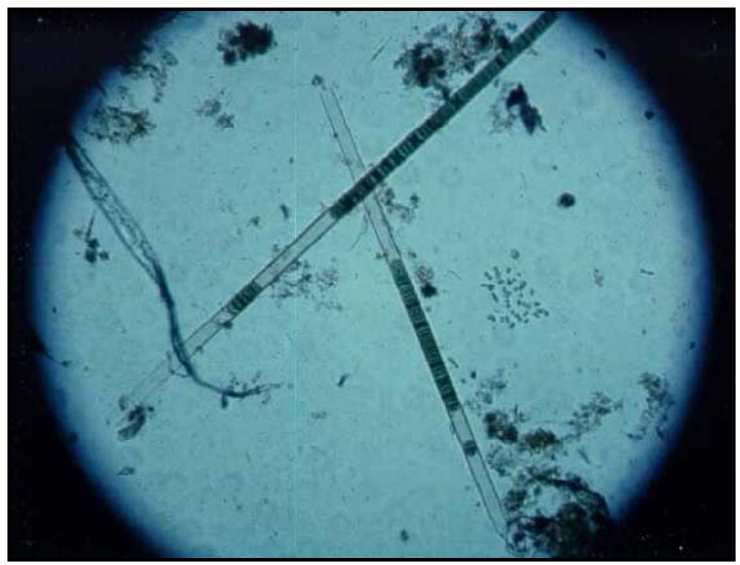
- No single index (among 5) was able to consistently discriminate reference from stressed lakes. Use of two indexes will allow assessment throughout Florida

  - benthic macroinvertebrate index for uncolored lakes (color ≤ 20 PCU)

  - Trophic index for colored lakes (color > 20 PCU)

- Benthic macroinvertebrate assemblage associated with color and transparency

  - highly colored lakes have depauperate benthic fauna tolerant to low DO, organic muck



Conclusions

- Throughout Florida, the lake index is associated with trophic state.
- Lake index and trophic state are associated with urban or agricultural land use in 2 types:

  - Acid, clear lakes of region 65 (Panhandle uplands)

  - Alkaline, colored lakes throughout

Recommendations

- Adoption of 2 LCIs
  - macroinvertebrate LCI for clear lakes (< 80 PCU?)
  - trophic LCI for colored lakes (> 20 PCU)
- Further calibration and testing of benthic LCI in acid-clear lakes, especially stressed or altered lakes
- Examination of 20-80 PCU “intermediate” color range
- Use LCIs as primary response variable for nutrient criteria development

Floristic Quality Index Development

- Compile list of all taxa sampled
- Floristic quality response form
    - Species list
    - Coefficient of Conservation scoring criteria
- Compile and calculate “Coefficient of Conservation” (C of C)
- Calculate the “Floristic Quality Index”

Floristic Quality Index

"Simple Mean" Coefficient of Conservation

Avg C of C = ($\sum$ C of C_{ijk})

where *j* is the sampling unit, *i* is each species at unit *j* and *k* is the weighting factor

Coefficient of Conservatism Scoring Criteria

(modified from Fennessy et al. 1996)

0	Alien and invasive native taxa
1.0 - 3	Tolerant taxa
3.1 - 6	Ubiquitous taxa
6.1 - 9	Intolerant (sensitive) taxa
9.1 - 10	Taxa that exhibit high degrees of fidelity to a narrow set of ecological conditions.

Habitat Assessment

Field observations by trained biologist.

Accompanies biological sampling.

If habitat is impaired, biota will be adversely affected, despite presence of good water quality.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
LAKE HABITAT ASSESSMENT FIELD DATA SHEET (2-22-00)

STORET STATION NUMBER:	DATE (M/D/Y):	LAKE NAME:	FIELD ID/NAME:

ECO-REGION:	COUNTY:	SAMPLING LOCATION/DESCRIPTION:	LAKE SIZE:

Parameter	Optimal	Suboptimal	Marginal	Poor
Hydrology ☐	No surface inflow or outflow present, very long water residence time, groundwater seepage dominates	Surface water inflow present, but flow is rare, moderate to long water residence time	Surface water inflow and outflow present (or outflow only), sometimes with visible flow, short water residence time	Impounded, hydrology of system artificially controlled
Color ☐	Very clear, uncolored water (benthic sampling appropriate) ☐	Water somewhat tannin stained (benthic sampling appropriate) ☐	Dark, discolored water (water color 40 PCU or higher) ☐	Visibility extremely reduced due to high color ☐
Secchi ☐	Secchi >3 m or VOB (Secchi (m)) 20 19 18 17 16	3 m 2.6 2.2 1.8 1.4 (Secchi (m)) 15 14 13 12 11	1.0 0.8 0.6 0.7 0.6 (Secchi (m)) 10 9 8 7 6	0.5 0.4 0.3 0.2 0.1 (Secchi (m)) 5 4 3 2 1
Vegetation Quality ☐	Diverse, expected native vegetation (emergent or submersed), less than 5% nuisance taxa 20 19 18 17 16	Mostly expected native plants, but moderate growths (6%-20% of lake) of nuisance macrophytes, or more than 50% of lake covered with plants 15 14 13 12 11	Large masses (21%- 40%) of nuisance macrophytes (e.g., Hydrilla, hyacinth, cattail, etc.) or algal mats 10 9 8 7 6	Lake choked (>40%) with nuisance macrophytes (duckweed, hyacinth, etc.) or algal mats, or few plants present at all (e.g., plants removed) 5 4 3 2 1
Stormwater Inputs ☐	Stormwater enters system via sheet flow over non-cultivated and/or natural vegetation 20 19 18 17 16	Some direct stormwater inputs (ditches, pipes, cultivated vegetation < 10%) but good BMPs in place 15 14 13 12 11	Moderate direct inputs of stormwater (ditches, pipes, cultivated vegetation 11%-50%) but few BMPs in place 10 9 8 7 6	Much direct input of stormwater (ditches, pipes, cultivated vegetation > 51%) and no or ineffective BMPs in place 5 4 3 2 1
Bottom Substrate Quality ☐	Diverse mixture of sand, detritus, with small amounts of CPOM/mud/muck. SAV may be present 20 19 18 17 16	Mixture of sand or clay and detritus with higher % CPOM/mud/muck content. SAV may be present 15 14 13 12 11	Moderate layer of CPOM/ mud/muck, or hardpacked sand only, or moderate algal growth (mats or Chara) on bottom 10 9 8 7 6	Thick deposits of CPOM, or fine detritus and anaerobic muck/mud/silt, or algal growth or nuisance plants (Hydrilla) cover bottom 5 4 3 2 1
Lakeside Adverse Human Alterations ☐	Very few man-made structures, roads, or other disturbance adjacent to lake (<10%) 20 19 18 17 16	Moderate disturbance visible (structures, roads or other), 10%-49% lakeside affected 15 14 13 12 11	Many structures, roads or other human disturbance visible (50%-70%) lakeside affected) 10 9 8 7 6	Highly developed or disturbed (>70% of lakeside affected) 5 4 3 2 1
Upland Buffer Zone ☐	Expected native vegetation between uplands and littoral zone, greater than 90% of shore with >18 m buffer 20 19 18 17 16	89%-51% of shoreline with >18m buffer or >75% with 10m to 18m buffer 15 14 13 12 11	50%-30% of shoreline with >18m buffer or 50%-74% with 10m to 18m buffer 10 9 8 7 6	< 29% of shoreline with >18m buffer 5 4 3 2 1
Adverse Watershed Land Use ☐	Score the potential effects from adverse human land uses, based on a continuum of amount and type, with least to most adverse as follows: Native vegetation, Silviculture, Pasture or Citrus, Low Density Residential, Row Crops, Commercial, High Density Residential, Urban, Industrial 20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

Total Score ☐	COMMENTS: