Guidance For Collecting 24-Dissolved Oxygen Samples For Routine Aquatic Life Use Monitoring

Proposed Revision for Clarification:

- ***SWQM Procedures Vol. 1, pg. 3-6:***
  - ***24-Hour Dissolved Oxygen Sampling for Compliance with Standards for the Aquatic Life Use*;**
  - ***When to Take Measurements*;**
  - **Handout**

Please review and provide comments to Bill Harrison by November 20, 2014.

Bill.harrison@tceq.texas.gov

Update: Regionalization of the Index of Biotic Integrity for Benthic Macroinvertebrates Collected in Freshwater Streams According to Rapid Bioassessment Protocols in SWQM Procedures Volume 2

Bill Harrison
TCEQ Surface Water Quality Monitoring Team

Major Groups of Freshwater Macroinvertebrates

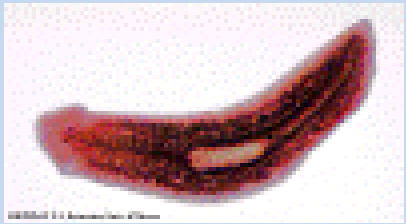
Arthropoda

Hydracarina

Insecta

Crustacea

Platyhelminthes



Turbellaria

Mollusca

Gastropoda

Bivalvia

Annelida

Hirudinea

Oligochaeta

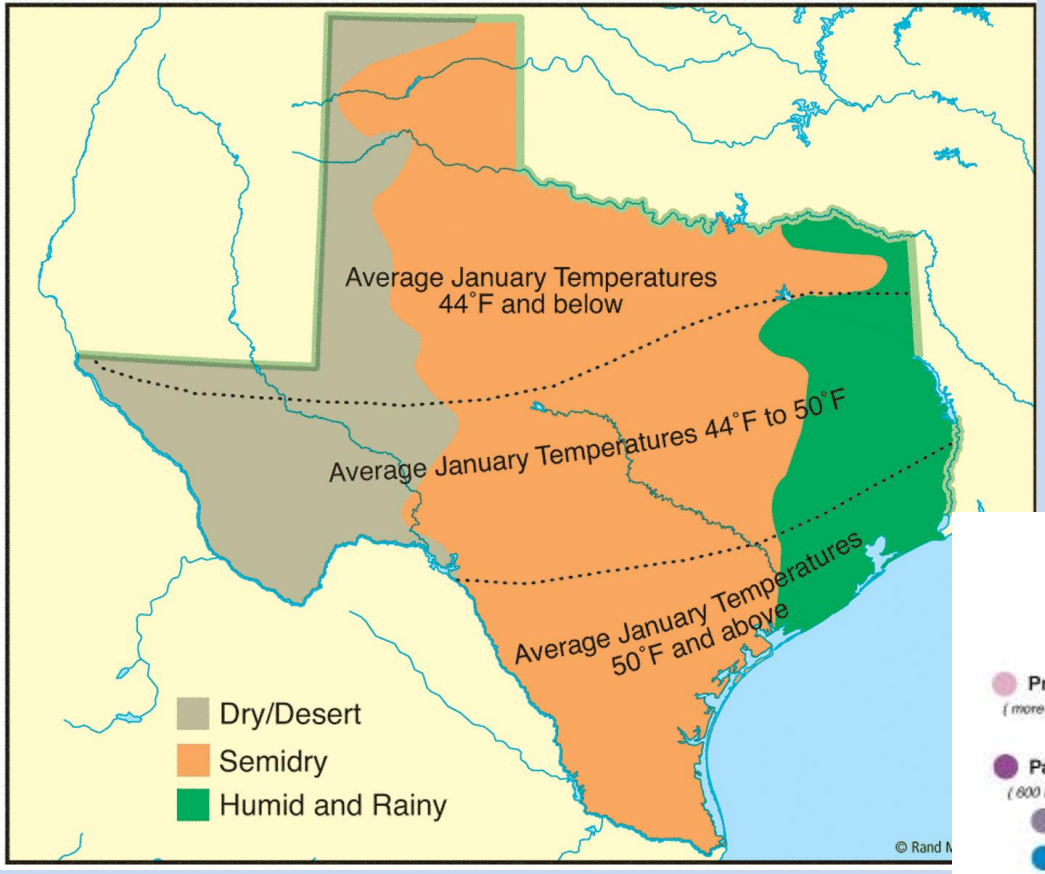
Nematoda

Statewide Metric Set
Richness and Composition Metrics
1. Total Number of Taxa
2. Number of EPT Taxa
3. % Chironomidae
4. % Dominant Taxon
5. % Total Trich. As Hydropsychidae
6. No. Non-Insect Taxa
7. % Elmidae
Trophic Composition Metrics
8. % Dominant Functional Group
9. % Predators
10. % Collector-Gatherers
Tolerance Metrics
11. Hilsenhoff Biotic Index (HBI)
12. Ratio Intolerant to Tolerant Taxa

Statewide Metric Set (1996):

- Derived from samples collected across the state;
- Essentially treats aquatic habitats across the state as relatively homogeneous;
- Less effective than regionalized IBI in reflecting intrinsic differences in biotic assemblages due to ecological variation across Texas;
- As with the fish IBI, statewide benthic IBI developed/used initially since too few samples to allow developing regionalized metrics.

ALU Category	Score Range
Exceptional	>35
High	31 - 35
Intermediate	25 - 30
Limited	<25

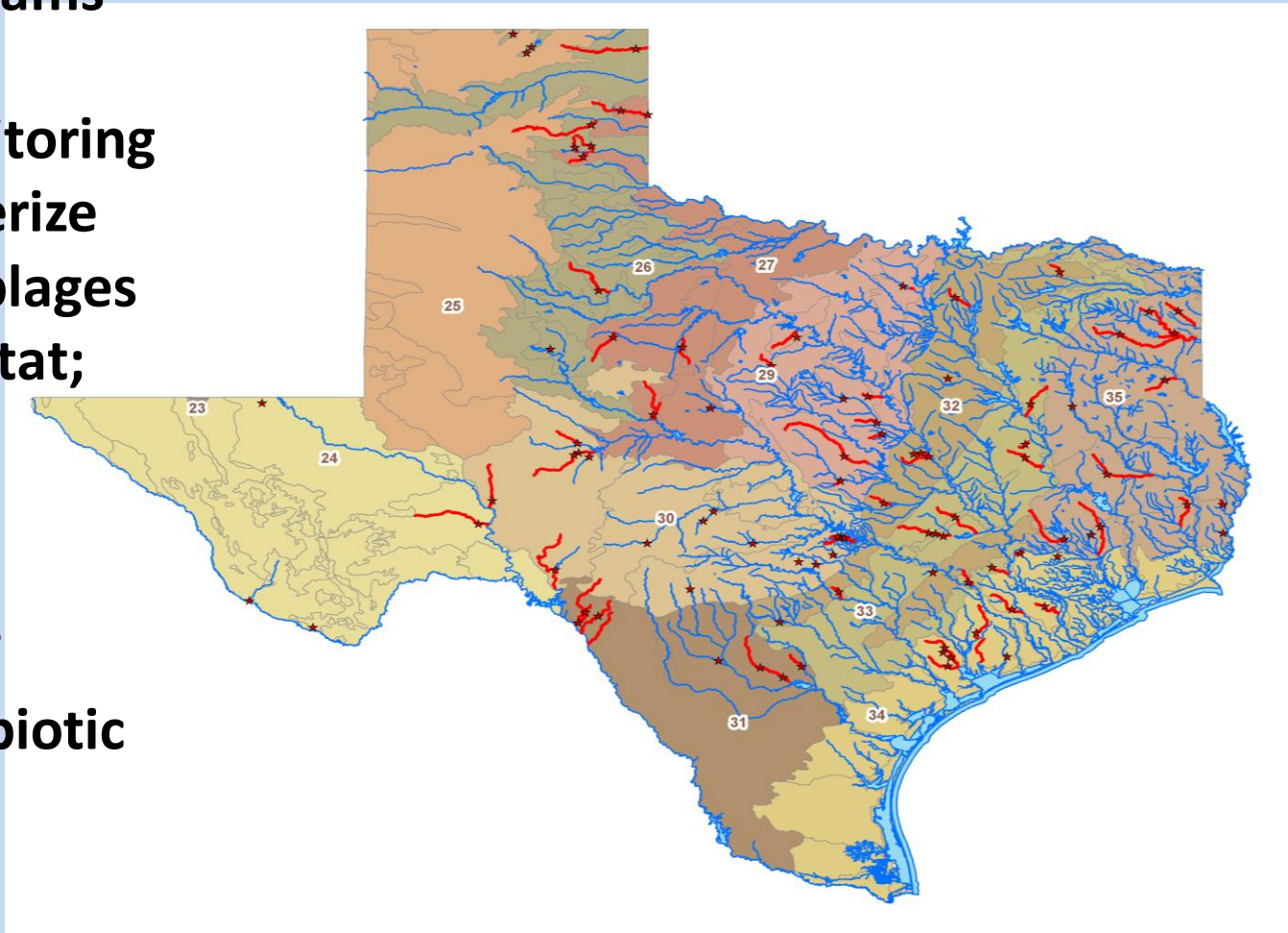


Biological Communities Across Texas Adapted to Different Ecological Settings Related to Changes in Climate and Geology Across Texas

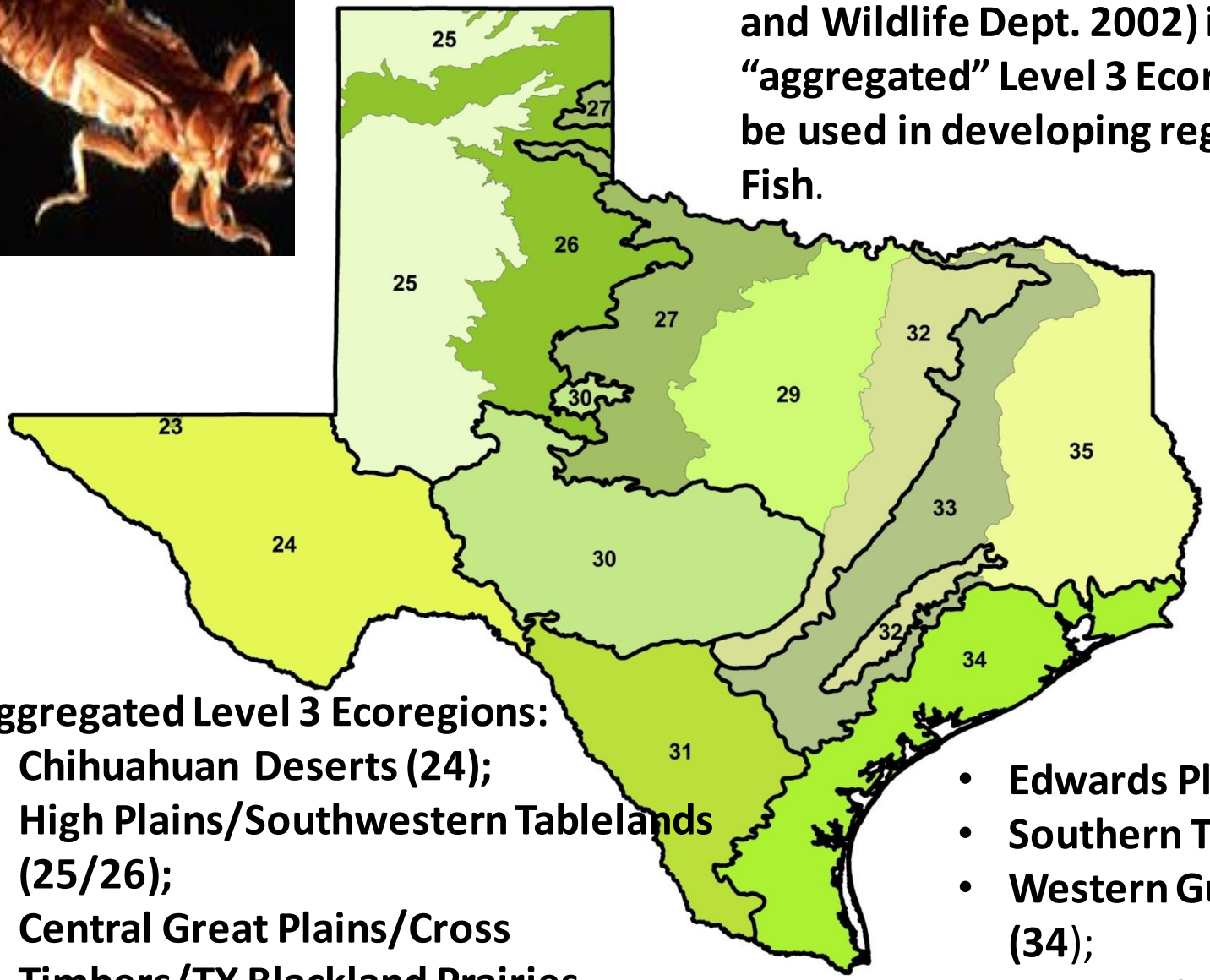
Development of IBI's Based on Biological Sampling Targeting Least Disturbed Ecoregion Reference Streams In Each Ecoregion

Least Disturbed Streams Project:

- **Aquatic Life Monitoring (ALM) to characterize biological assemblages and physical habitat;**
- **Derive metrics;**
- **Describe range of expectations for biotic integrity in each ecoregion.**



The *Regionalization of the Index of Biotic Integrity for Texas Streams*. (Texas Parks and Wildlife Dept. 2002) identifies Seven "aggregated" Level 3 Ecoregions in Texas to be used in developing regionalized IBI's for Fish.



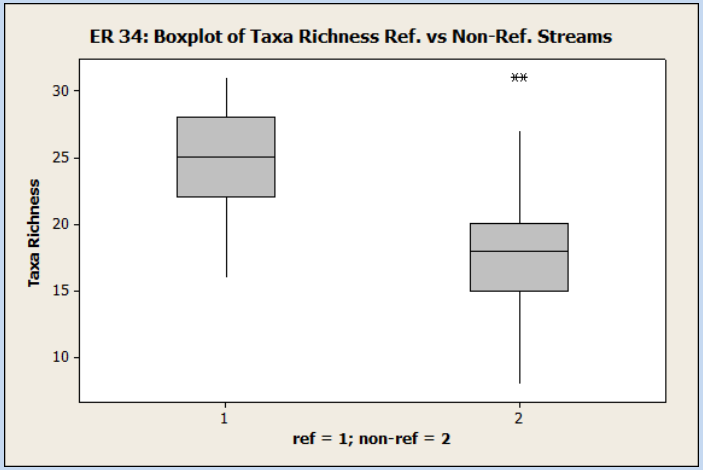
Aggregated Level 3 Ecoregions:

- Chihuahuan Deserts (24);
- High Plains/Southwestern Tablelands (25/26);
- Central Great Plains/Cross Timbers/TX Blackland Prairies (27/29/32);
- Edwards Plateau (30);
- Southern TX Plains (31);
- Western Gulf Coastal Plains (34);
- E. Central TX Plains/S. Central Plains (33/35);

32 Candidate Metrics Evaluated For Each Ecoregion

- Taxa Richness
- % Predator
- % Collector-Gatherers
- % Scraper-Collectors
- % Shredders
- % Filtering Collectors
- Count EPT Taxa
- % EPT
- Count Mayfly Taxa
- Count Caddisfly Taxa
- % Mayflies
- % Caddisflies
- % Chironomidae
- Count CG/FC
- % CG/FC
- Count Predators
- % Elmidae
- % Tanytarsini
- No. Chironomid Taxa
- No. Diptera Taxa
- % Diptera
- % Dominant Taxon
- % Diptera and Non-Insect Taxa
- Count Non-Insect Taxa
- % Corbicula
- % Oligochaeta
- % of Trichoptera as Hydropsychidae
- Ratio IT/T
- Count Intolerant Taxa
- % Tolerant Taxa
- Biotic Index
- Count CG

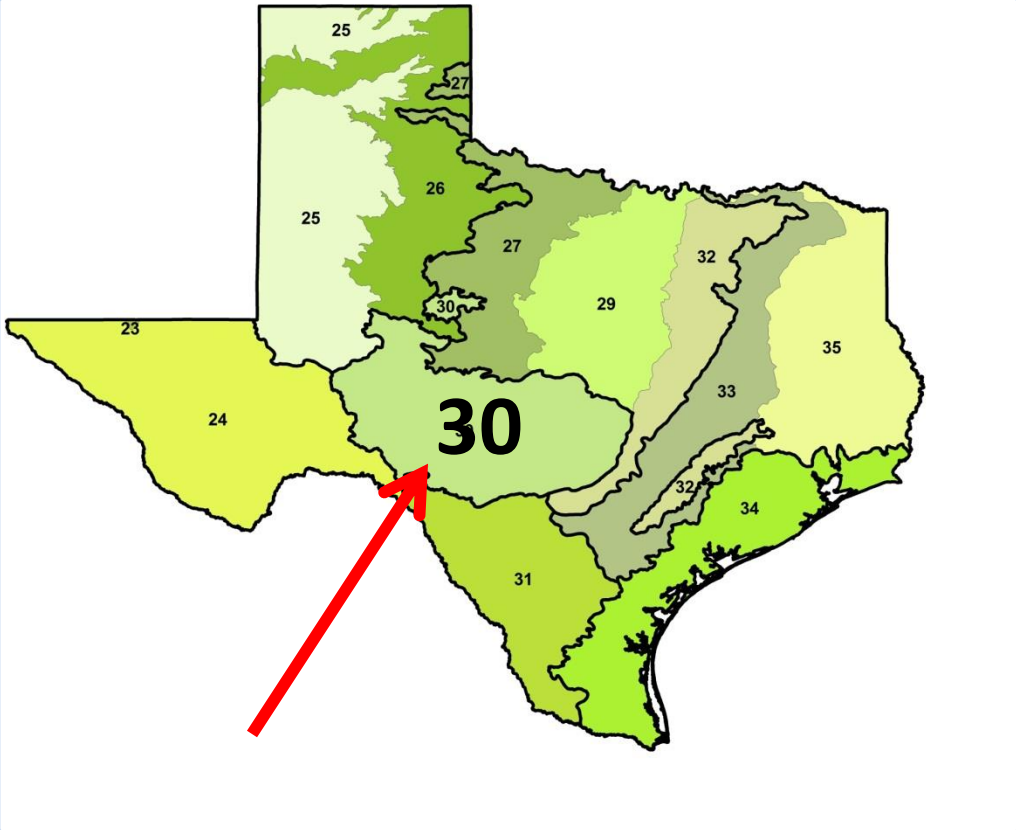
Boxplots of Taxa Richness Values for Samples Collected in Reference vs Non-Reference Streams in Western Gulf Coastal Plain Ecoregion



	Number of Samples		Number of Sample Sites		Number of Individuals Counted/Identified	
Ecoregion	Reference Streams	Non-Reference Streams	Reference Streams	Non-Reference Streams	Reference Streams	Non-Reference Streams
Central Great Plains, Cross Timbers, TX Blackland Prairies (27, 29, 32)	37	154	15	57	6,573	32,811
Edwards Plateau (30)	139	191	39	54	25,359	34,913
E. Central TX Plains (33, 35)	121	251	39	89	22,641	42,201
Western Gulf Coastal Plain (34)	32	75	9	26	6,588	13,995
Chihuahuan Deserts (24)	40	16	9			
Total	369	687	111	226	61,161	123,920
Grand Totals	1,056		337		185,081	

Edwards Plateau (ER 30) Metric Set
Richness and Composition Metrics
1. Total Number of Taxa
2. Number of EPT Taxa
3. % Diptera and Non-Insects
4. % Dominant Taxon
Trophic Composition Metrics
5. % Dominant Functional Group
6. % Predators
7. % Collector-Gatherers
Tolerance Metrics
8. Hilsenhoff Biotic Index (HBI)
9. % Tolerant Organisms
10. Number of Intolerant Taxa

ALU Category	Score Range
Exceptional	>35
High	31 - 35
Intermediate	25 - 30
Limited	<25



Edwards Plateau Ecoregion Draft Metric Set:

- Scoring Criteria derived for each metric;
- Score Ranges Established for Each Aquatic Life Use Category.

Chihuahuan Deserts (ER 24) Metric Set

Richness and Composition Metrics

1. Taxa Richness
2. Number of Mayfly Taxa
3. Percent Caddisflies
4. Percent Chironomidae
5. Percent Diptera
6. Percent of Caddisflies as Hydropsychidae

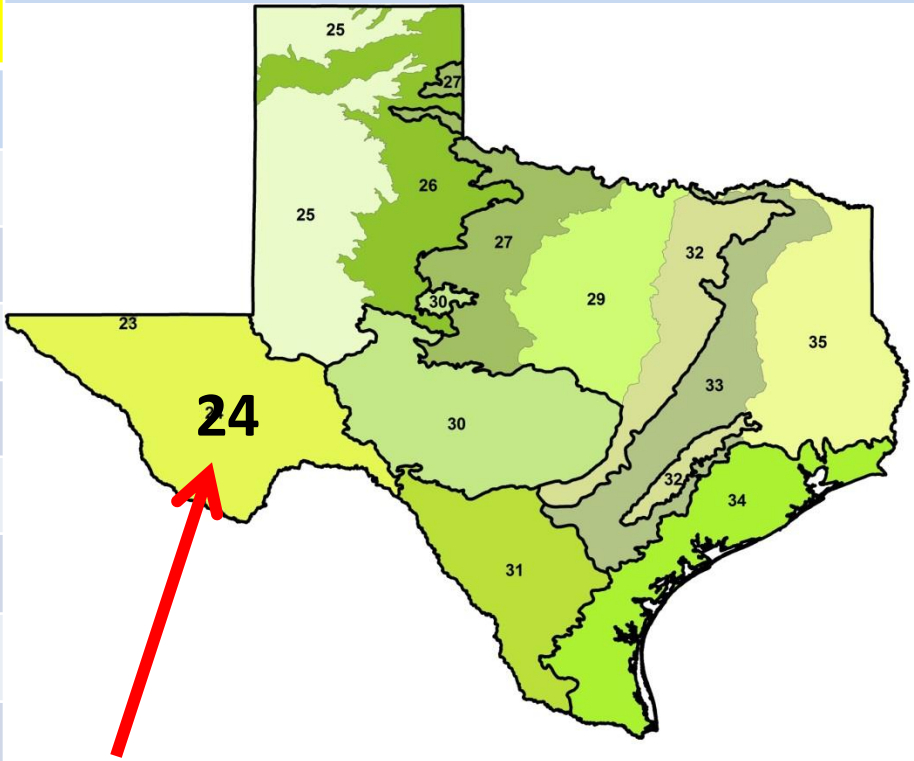
Tolerance Metrics

7. Biotic Index
8. No. of Intolerant Taxa (Tol. <8.5)

Trophic Metrics

9. Percent Collector-Gatherers

ALU Category	Score Range
Exceptional	>35
High	31 - 35
Intermediate	25 - 30
Limited	<25



Chihuahuan Deserts Ecoregion Draft Metric Set:

- Scoring Criteria derived for each metric;
- Score Ranges Established for Each Aquatic Life Use Category

Summary

- Seven aggregated level 3 ecoregions used for TPWD Regionalized Fish IBI's serve as the spatial framework for deriving regionalized benthic macroinvertebrate IBI's;
- Each of the 32 candidate metrics evaluated for discriminatory power (Ref. Vs Non-Ref), correlation/redundancy with other metrics, ease of calculation, minimize 0's for each ecoregion;
- Draft metric sets developed and being tested for the Chihuahuan Deserts (ER 24), and the Edwards Plateau Ecoregions (ER 30);
- Presented the draft metric sets and methodology to the TCEQ/TPWD Interagency Workgroup on Biological Sampling and analysis;
- Developing metric sets for remaining 5 aggregated ecoregions, draft by early spring 2015?;
- Developing schedule for Aquatic Life Monitoring in Least Disturbed Ecoregion Reference Streams in 2015 Index Period.

Contact: bill.harrison@tceq.texas.gov

COASTAL METRIC UPDATE

or WHERE'S THAT COASTAL IBI???

Linda Broach, Ph.D.
TCEQ Houston
Region 12 SWQM

GOALS

- Create index(es) that would allow an evaluation of biological communities in coastal waters*
  - Tidal Stream Nekton
  - Tidal Stream Benthos
  - Open Bay Benthos

*Upper Texas Coast

Tidal Streams

- Brackish water
- Important estuarine habitat
- Nursery area for many estuarine species

- Greater Potential for:
  - More Point Source Discharges
  - Dissolved Oxygen Stress
  - Contaminated Sediments

Steps for Development of a Multimetric Index

- Station and Waterbody Classification
- Metric Testing
- Metric Scoring
- Aggregate Metrics
- Threshold Establishment

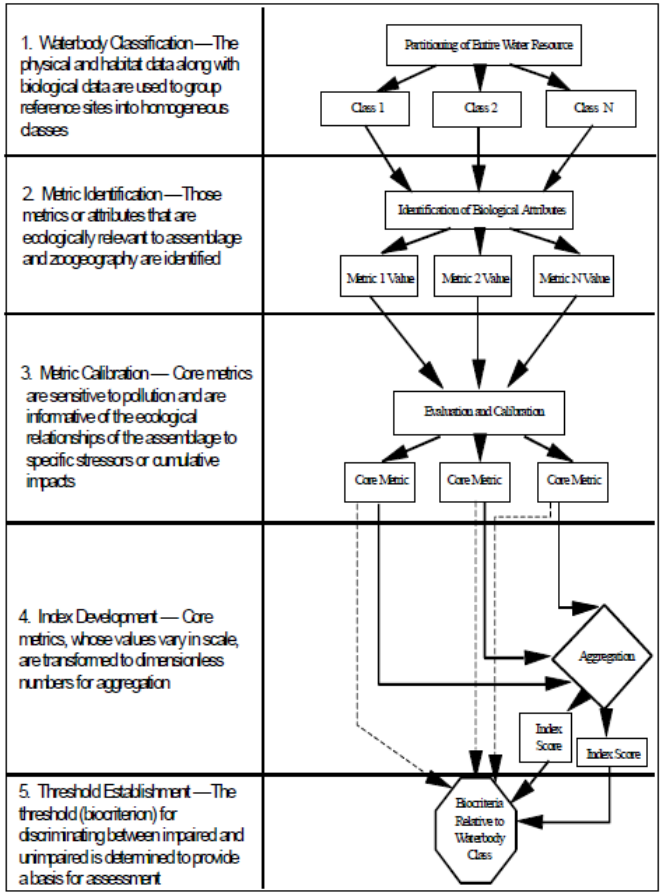


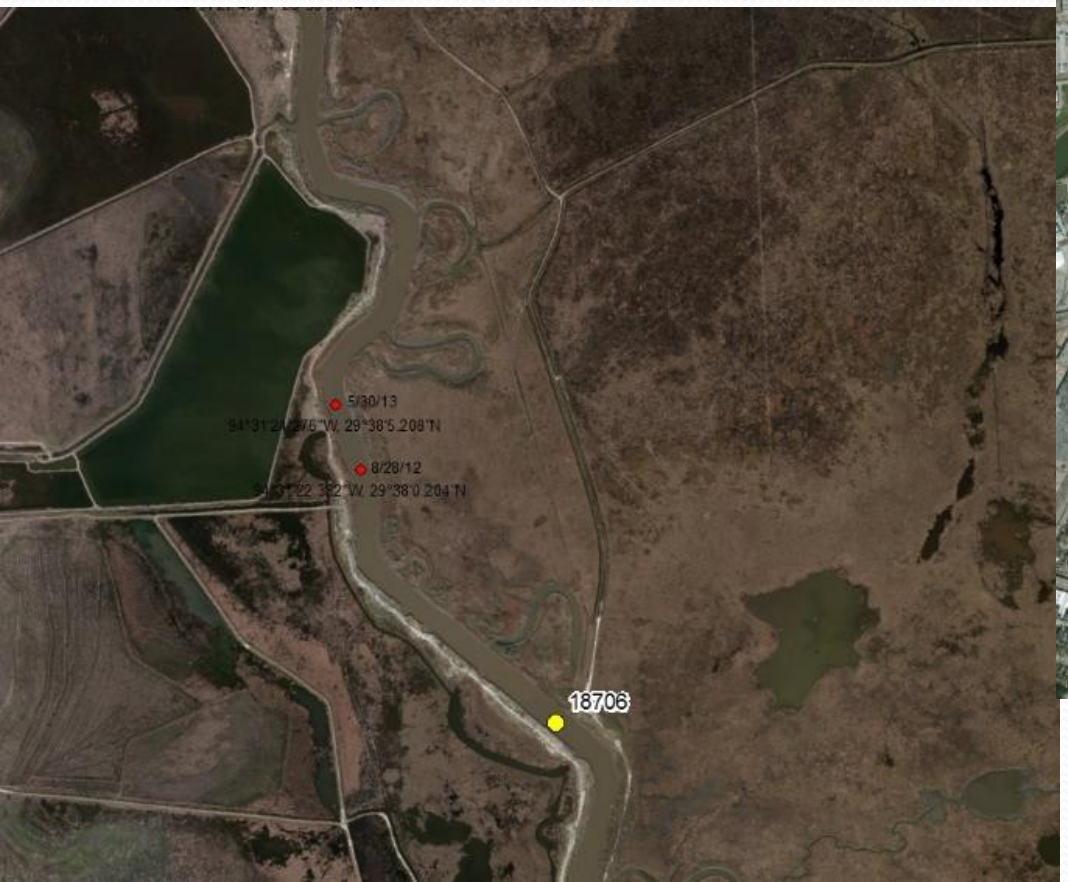
Figure 11-1
The process for progressing from the classification of an estuary to assessing the health of the estuary. Adapted from Paulsen et al. 1991.

*From EPA, 2000. Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance

Reference *vs*. Stressed

Buffalo Bayou

Oyster Bayou



TIDAL STREAM NEKTON

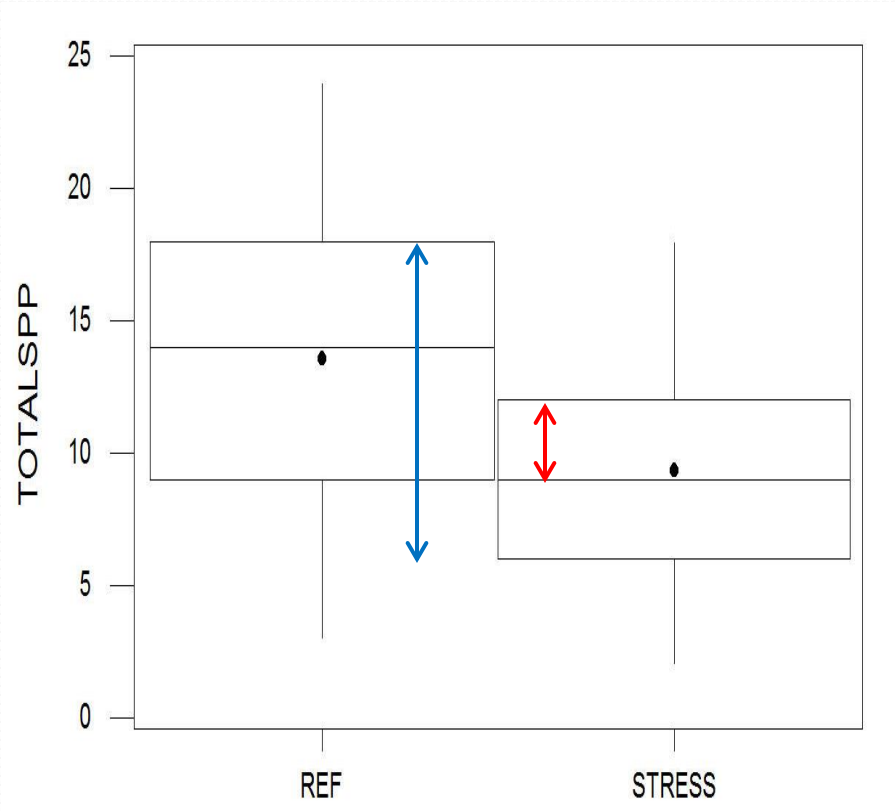
- Collected with a 15' minnow seine with 3/16" delta mesh
- Six* seine hauls
- All nekton counted (i.e. including Inverts)

CATEGORIES FOR THIS ANALYSIS

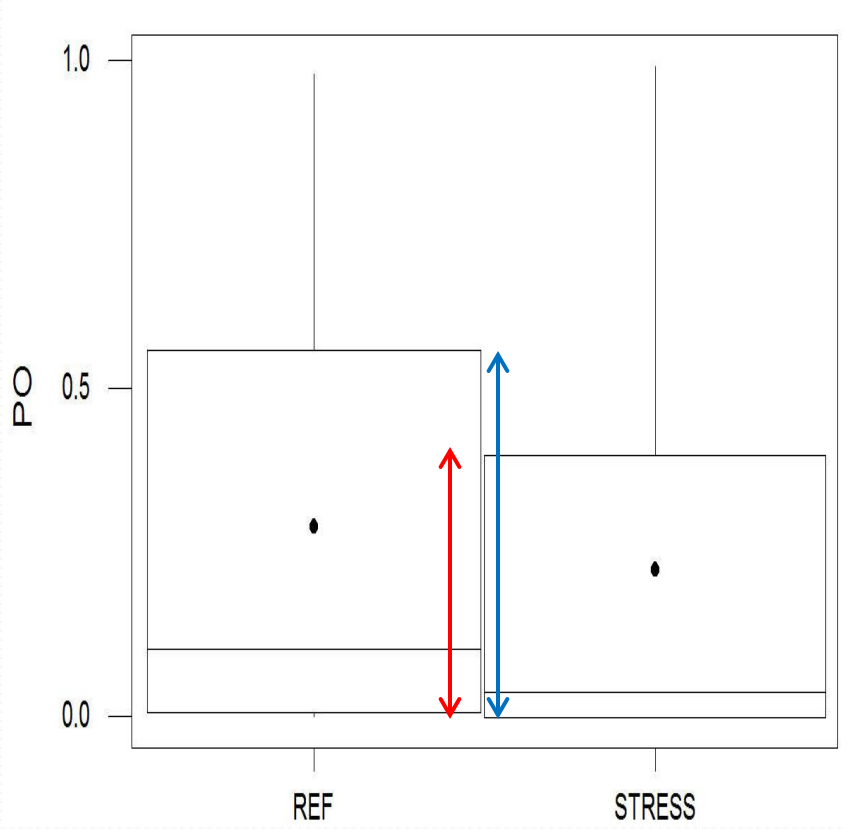
- REF = "REFERENCE" OR "BEST AVAILABLE" STREAMS N=70
  - OYSTER BAYOU 1991-93 AND 2012-13
  - CEDAR LAKES CREEK 1993
  - HALLS BAYOU 2002-03
  - LOST RIVER 2003-04
- STRESS = SOME FORM OF STRESS EXPECTED, USUALLY LOW DO N=73
  - DICKINSON BAYOU 1992-93 AND 2013-13
  - ARMAND BAYOU 2002-03
  - COW BAYOU 2003-04
  - BUFFALO BAYOU 2012-13
  - VINCE BAYOU 2012-13
  - CARPENTER BAYOU 2012-13

SEINING

Metric Evaluations



Total species – 25% overlap

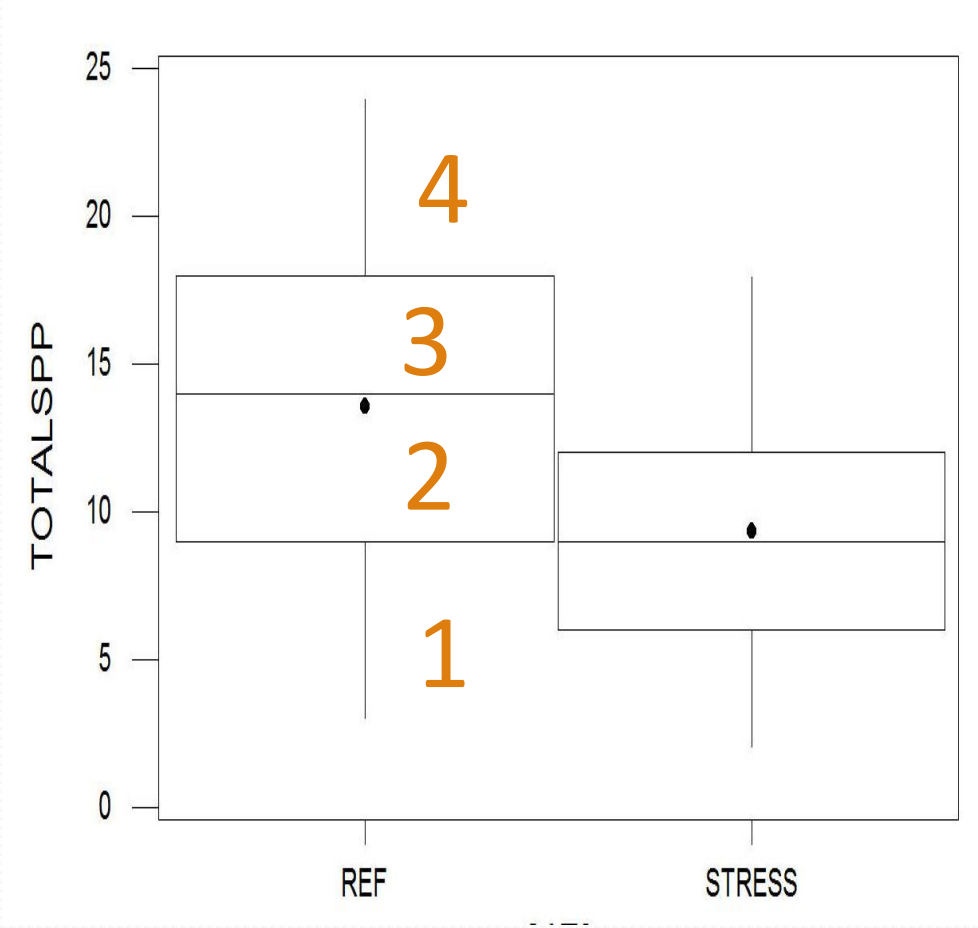


Percent Omnivores – 70% overlap

SEINE METRICS

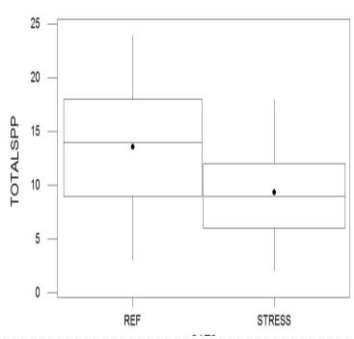
- Total Taxa
- Abundance
- Percent Invertebrates
- Percent Flatfish (flounders)
- Percent Gobies
- Percent Tolerant
- Number of Invertebrate species
- Number of Non-native fish

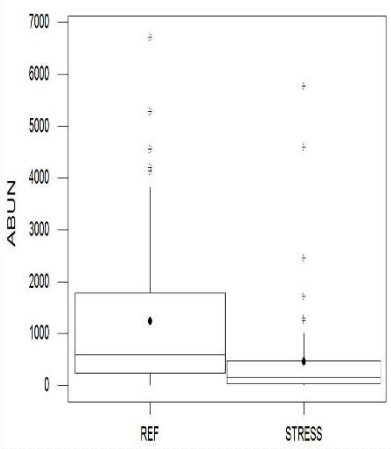
Metric Scores:

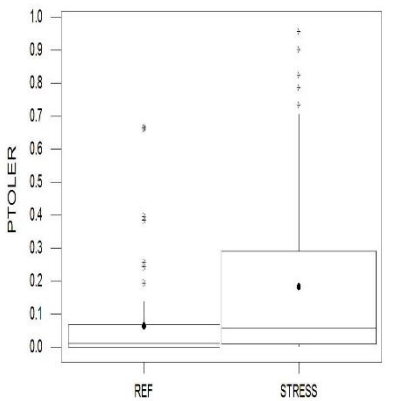


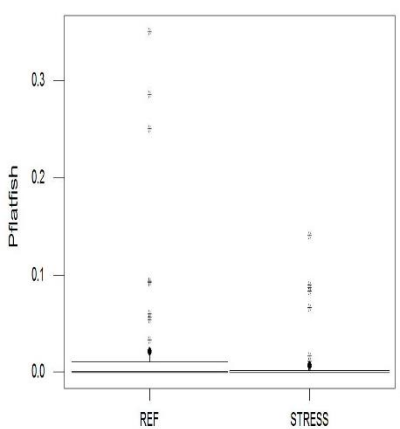
- Assign metric values from 1 to 4
- Based on Quartiles of reference group
- Except NonNative – Assigned 1 if any non-natives, 4 if none

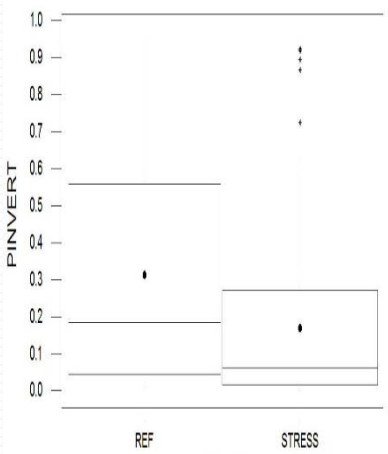
Combine Metrics for Index

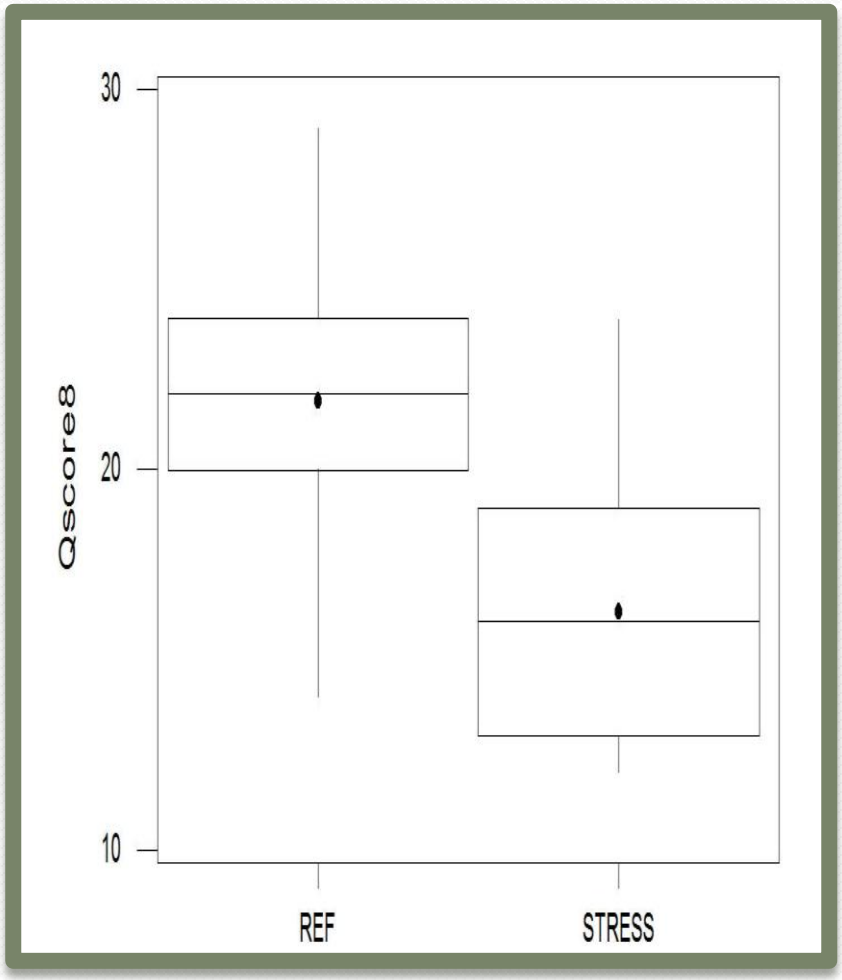




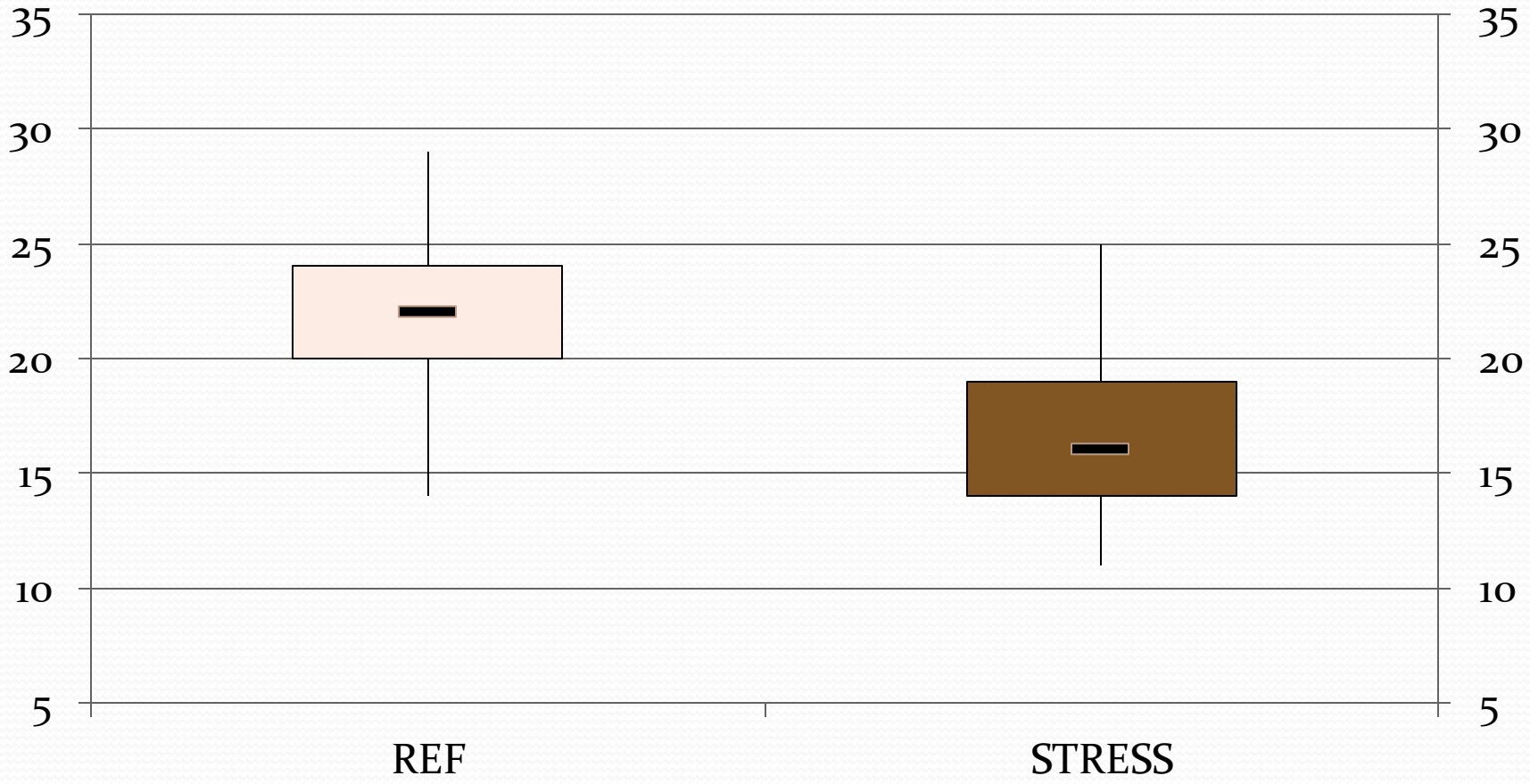




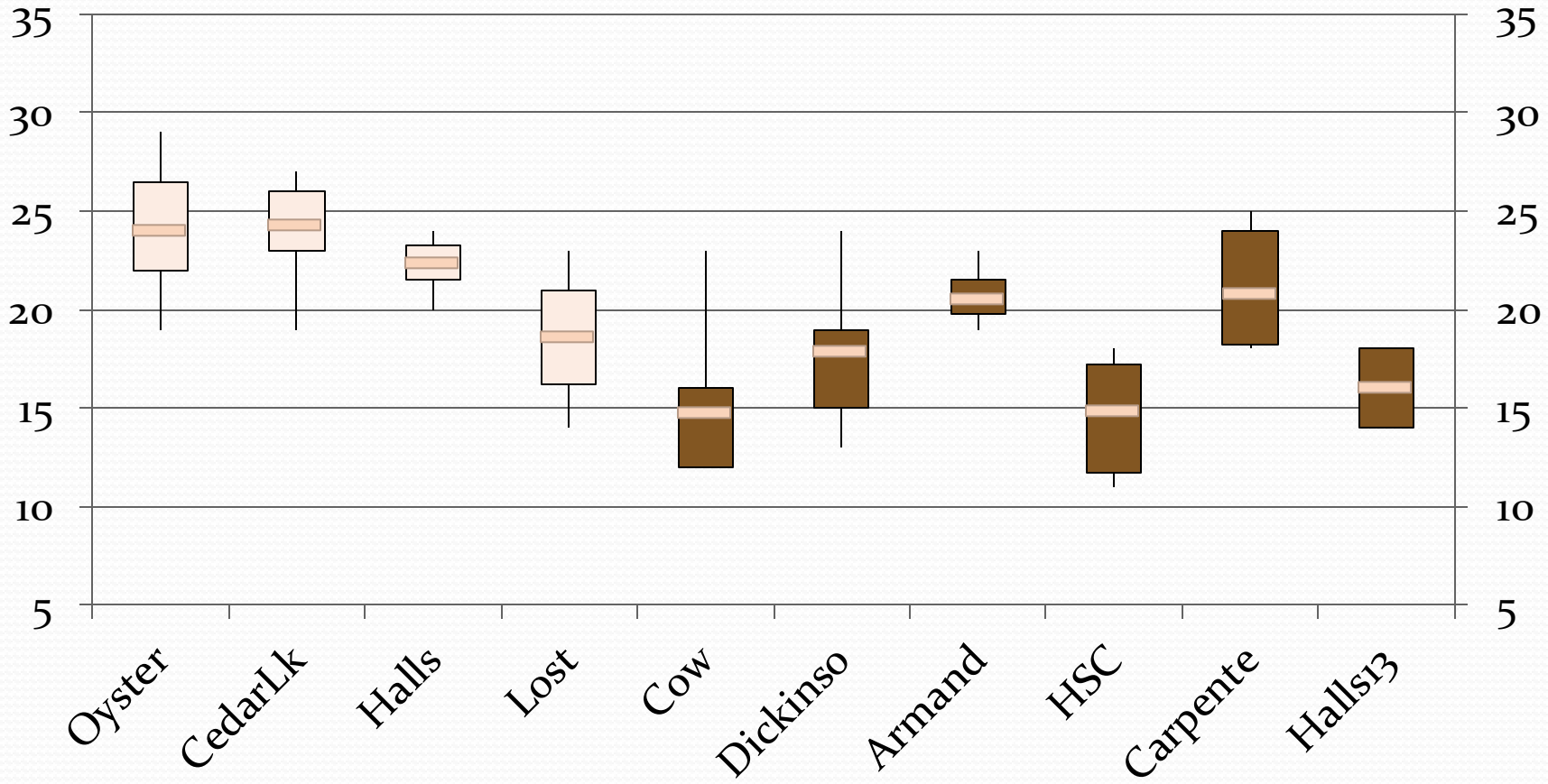




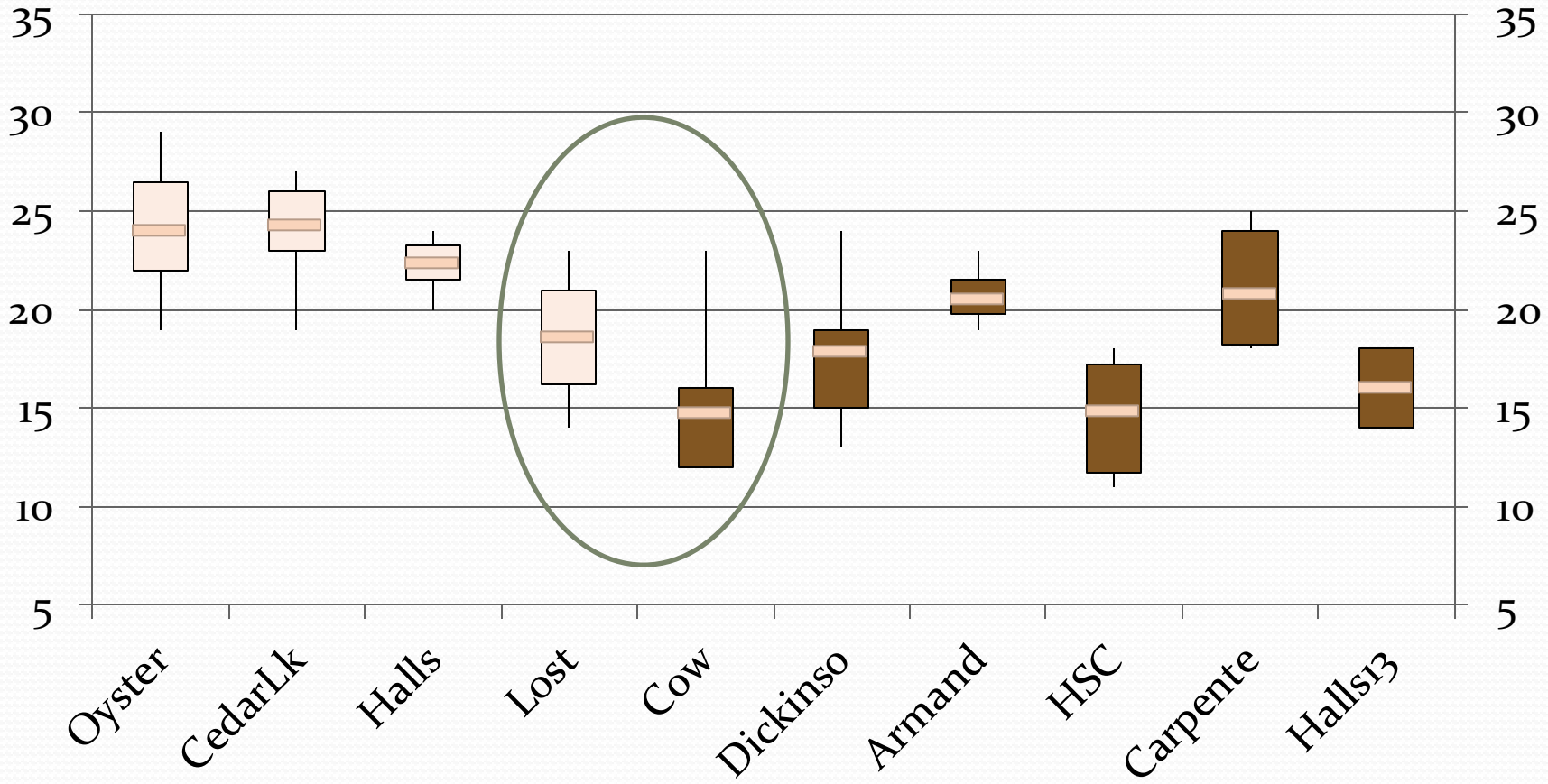
Q score – Reference vs. Stressed



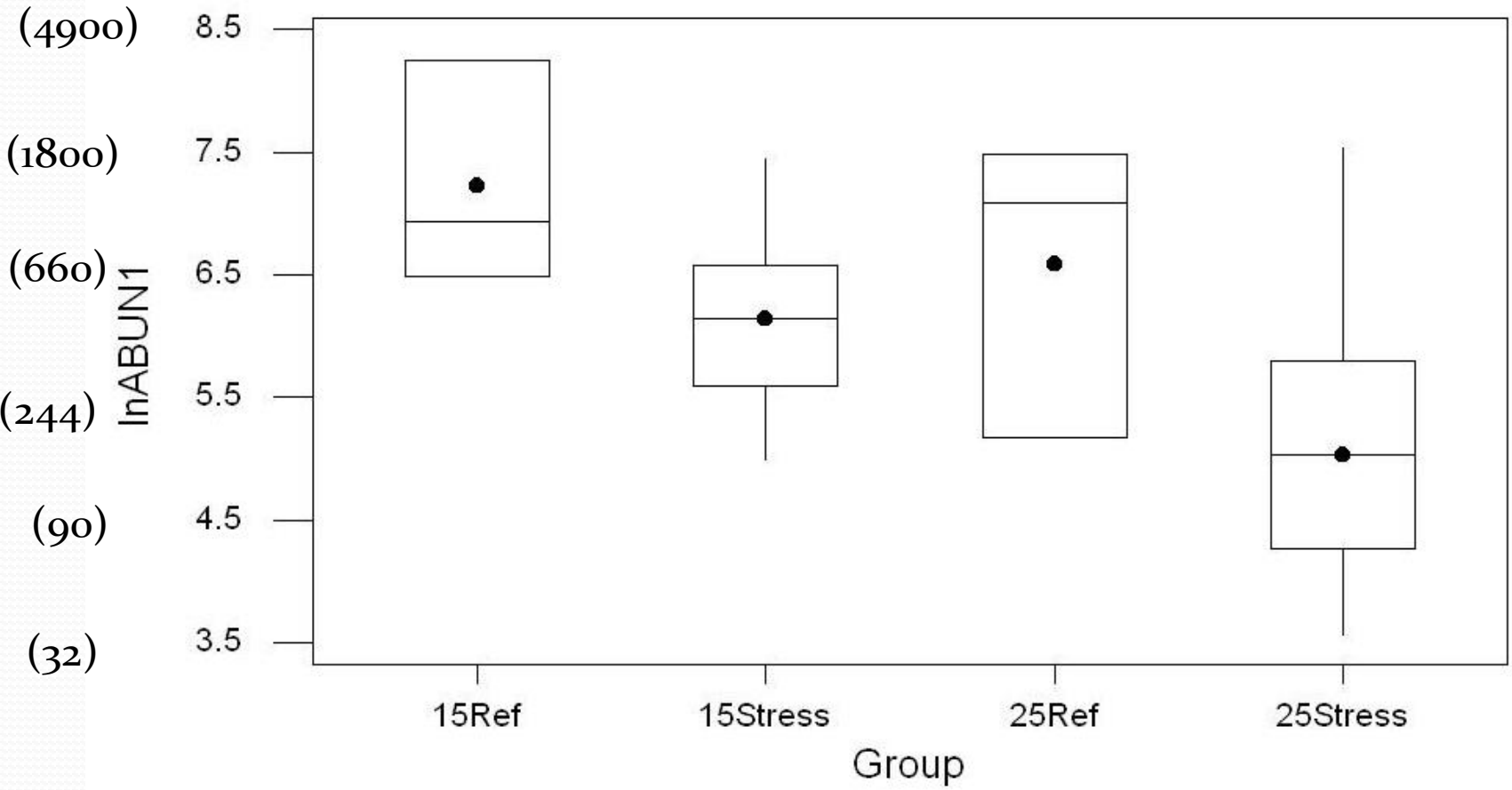
Nekton Qscore for each Bayou



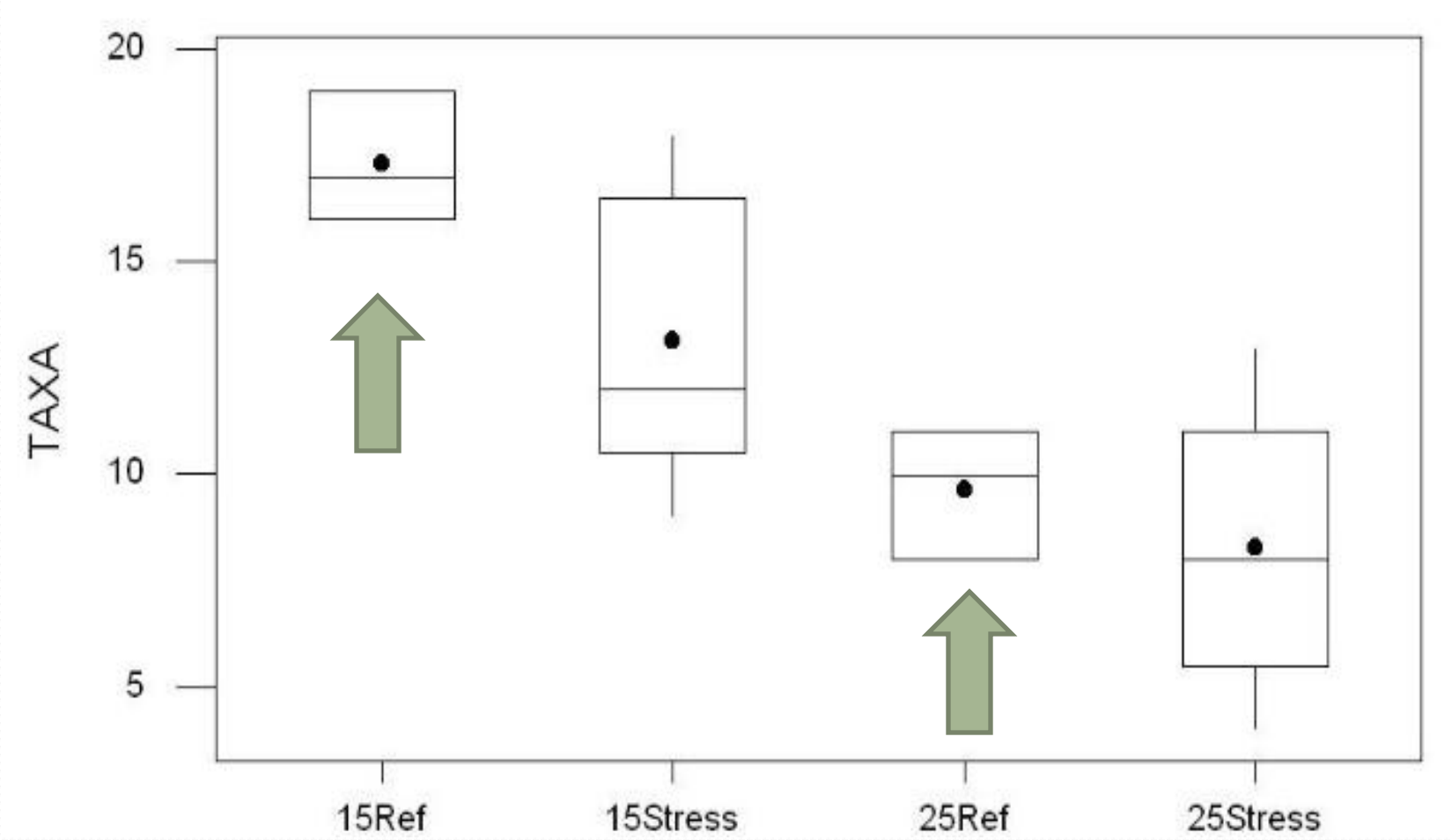
Nekton Qscore for each Bayou



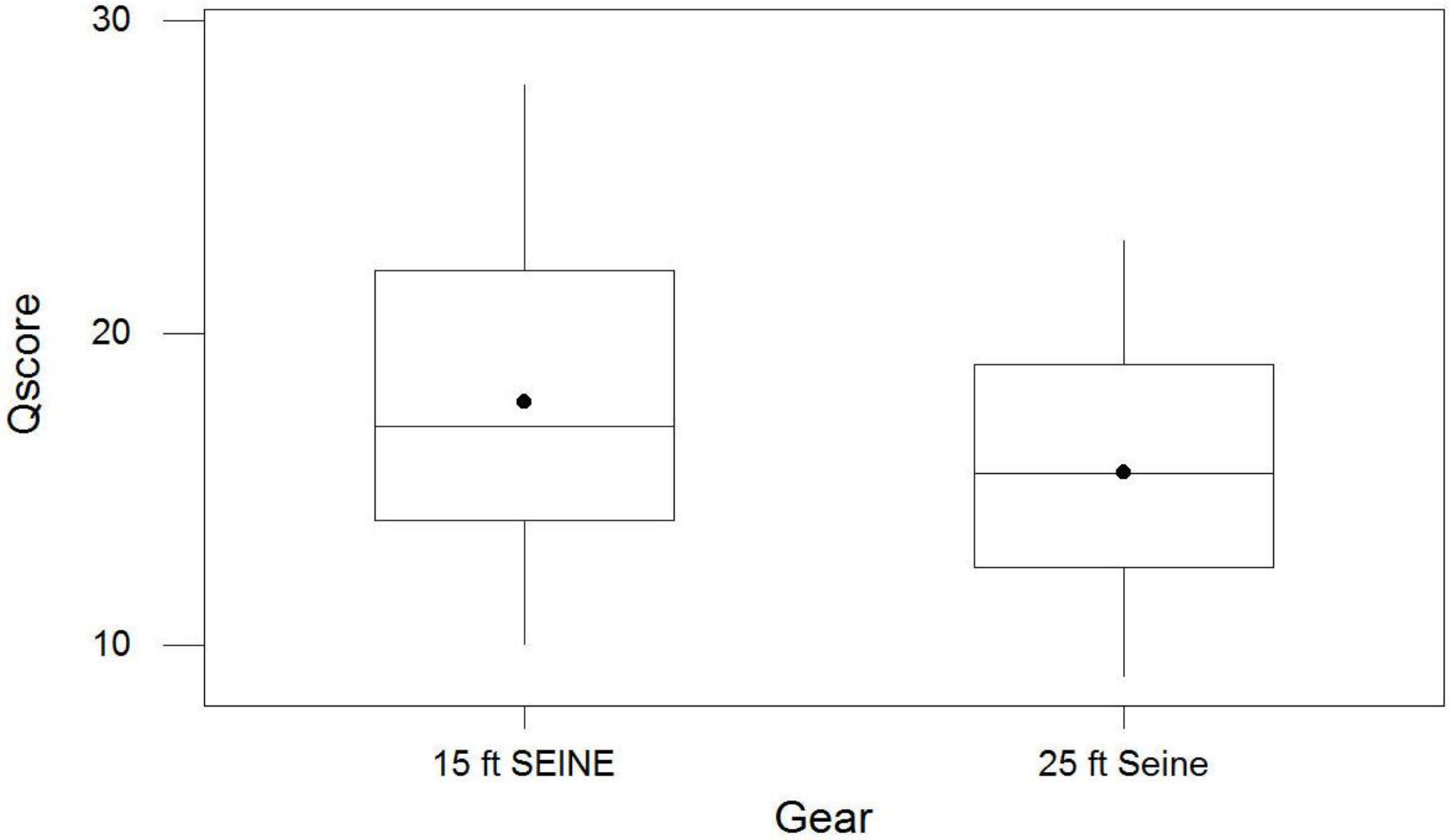
Abundance in 2 different Seine Sizes



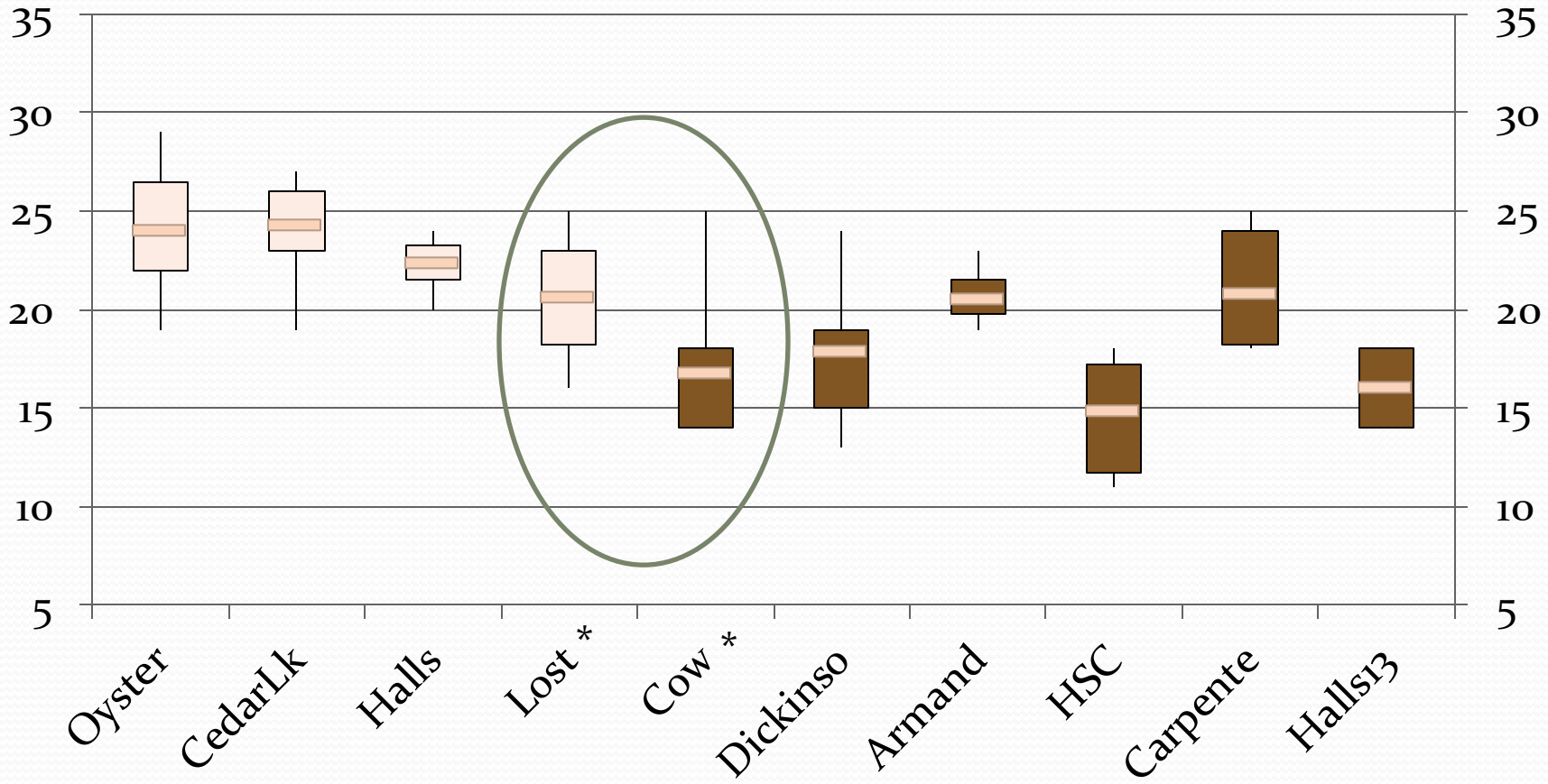
Taxa in 2 different Seine Sizes



Overall Score



Nekton Qscore for each Bayou

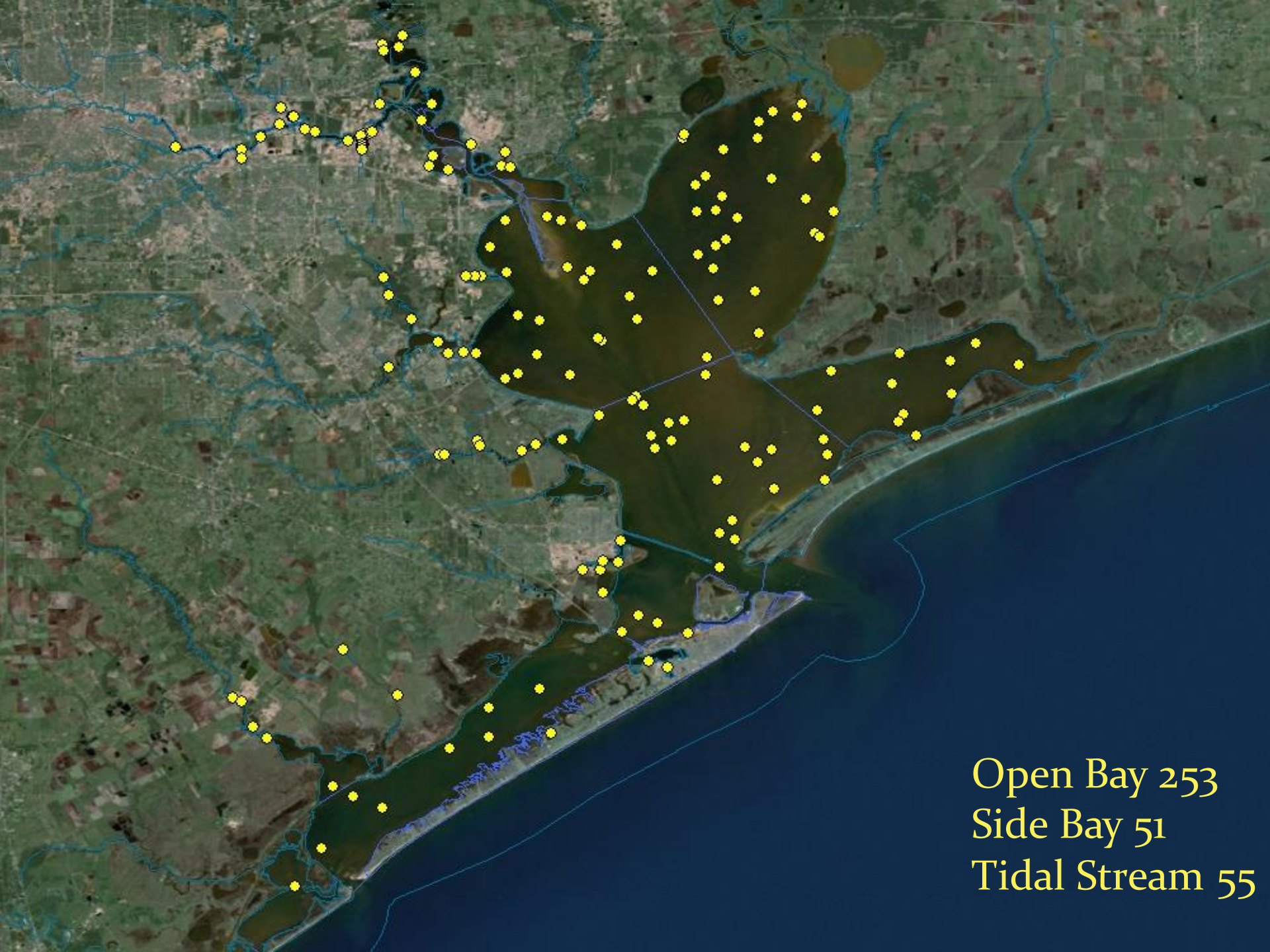


*moved the boxes up 2 points

BENTHIC MACROINVERTEBRATES

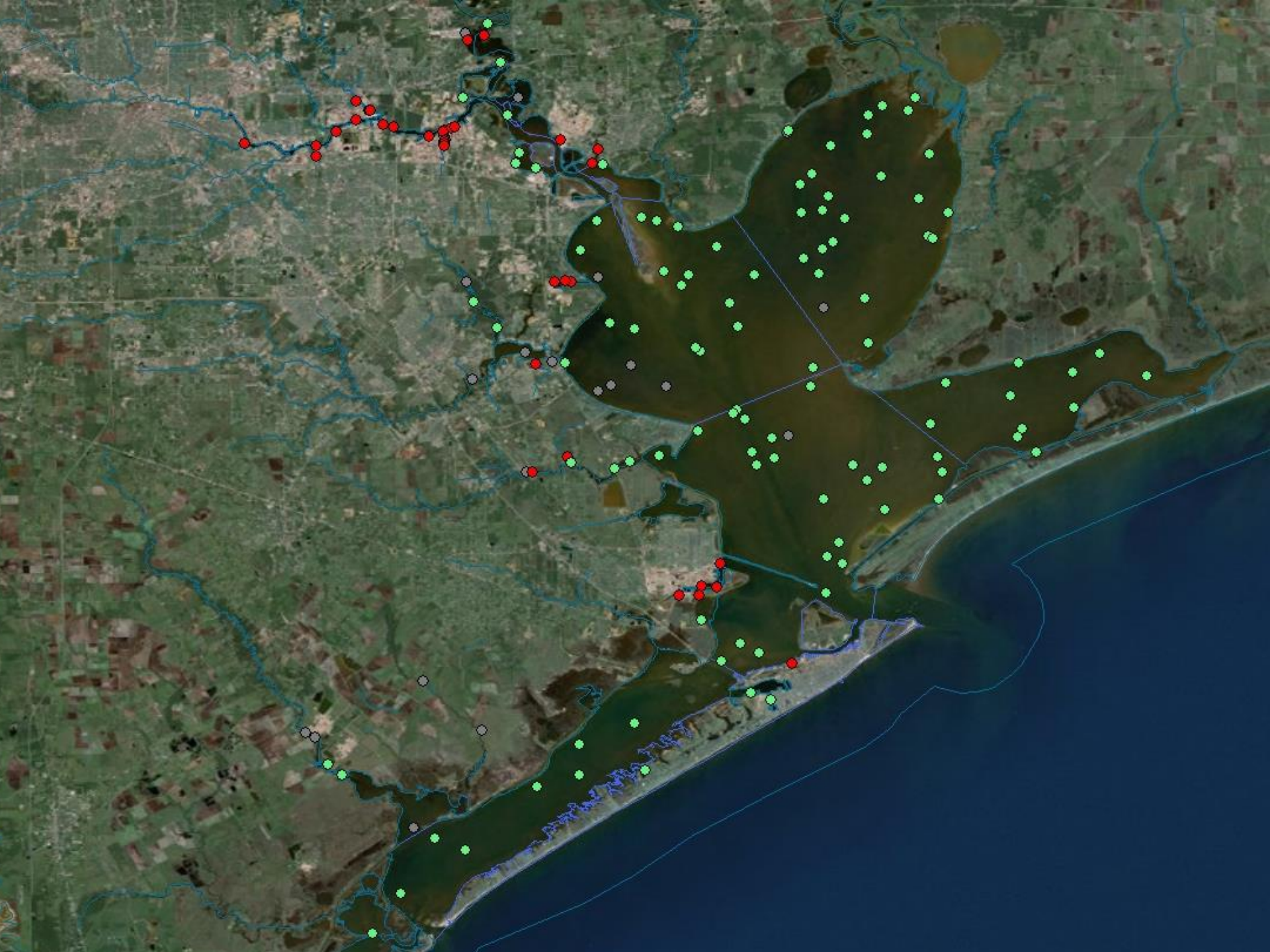
Benthics

- Not very mobile
- In direct contact with sediment and associated contaminants
- Oxygen levels lowest near bottom


Open Bay 253
Side Bay 51
Tidal Stream 55

REFERENCE vs. STRESSED

- REFERENCE (all must be true)
  - Dissolved Oxygen > 4 mg/L
  - NO Sediment Contaminants > ERM
  - NO more than 3 Sediment Contaminants > ERL
  - NO Significant Toxicity
- STRESSED (any true)
  - Dissolved Oxygen < 2.5 mg/L
  - One or more Sediment Contaminants > ERM
  - 4 or more Sediment Contaminants > ERL
  - Whole Sediment Toxicity Test Significantly Toxic
- MIDDLE group: DO between 2.5 and 4 mg/L, but meets other requirements for Reference group



Galveston Bay Summer Samples 1988-2008

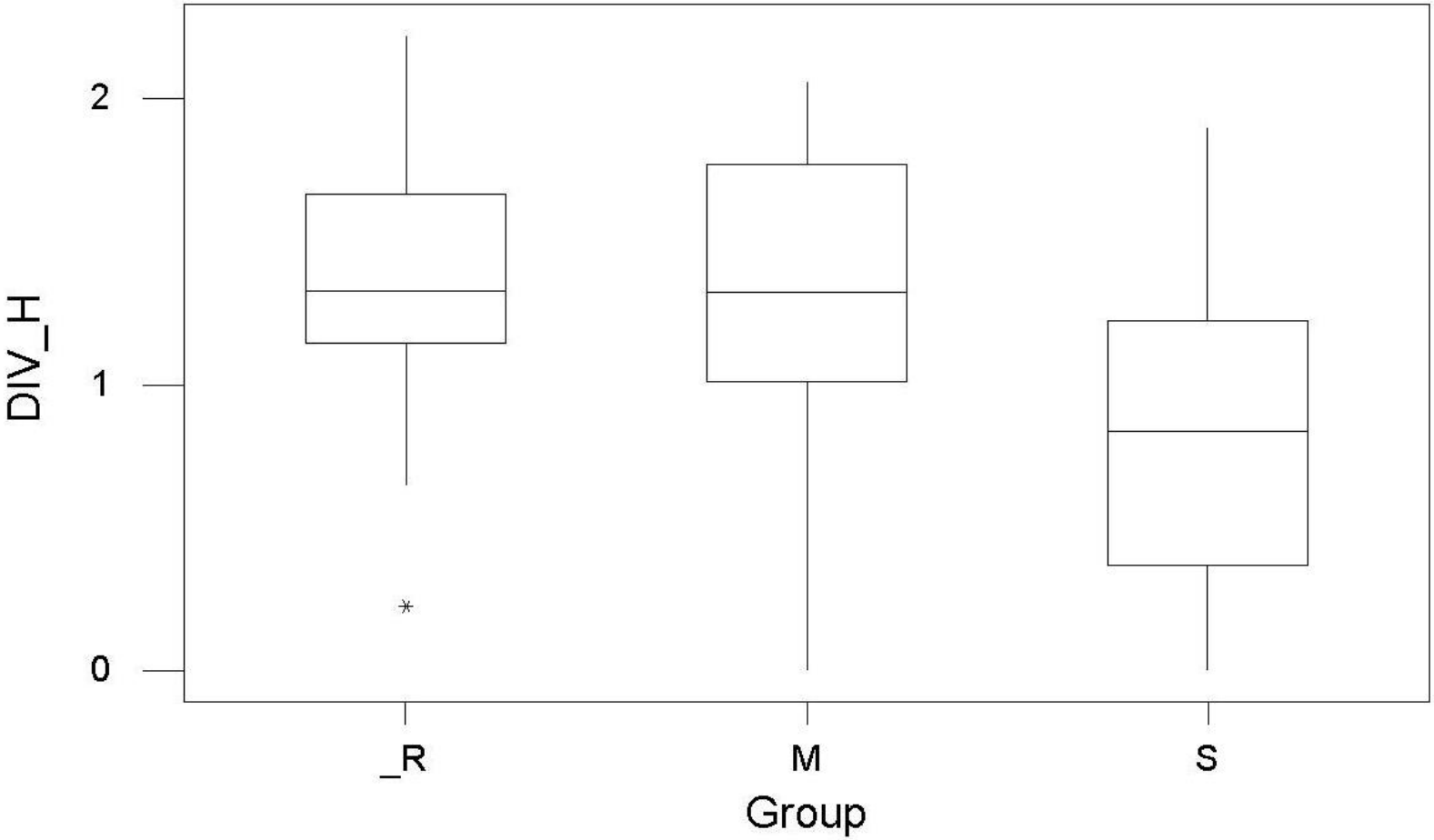
STRATA	STRESSED	MIDDLE	REFERENCE	TOTAL
OPEN BAY	5	12	240	257
TIDAL STREAM/ SIDE BAY	52	15	35	102
TOTAL	**57**	**27**	**275**	**359**

- In the Tidal Stream/Side Bay strata, used only summer samples with salinity < 20 ppt (n=94)
- Stressed (n=48), Middle (n=14), Reference (n=32),

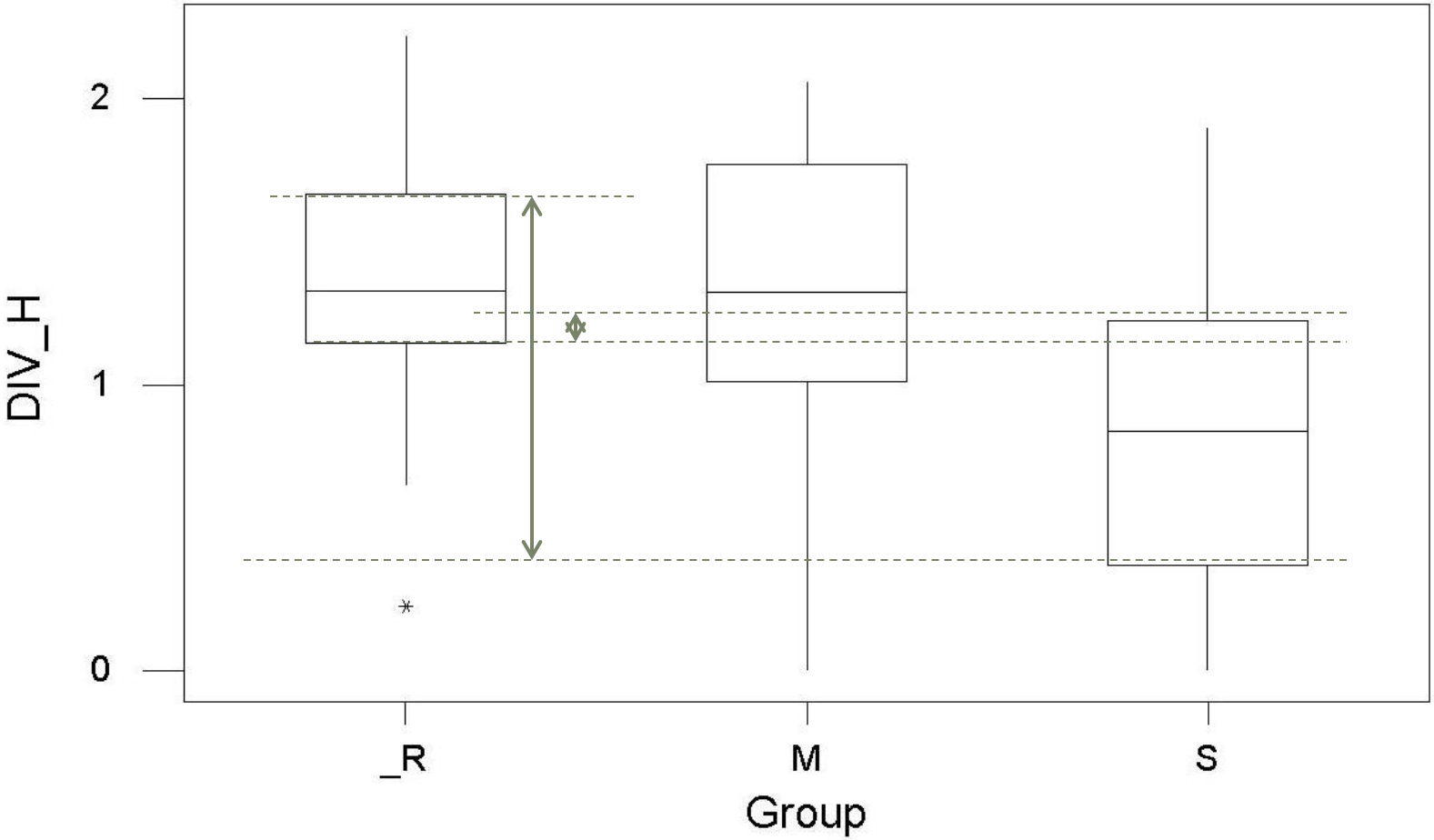
METRICS CONSIDERED . . .

- # TAXA
- ABUNDANCE
- DIVERSITY (H')
- TOLERANT (%)
- INTOLERANT (%)
- PERCENT DOMINANT
- # POLYCHAETE TAXA
- CRUSTACEA
  - AMPHIPODA
  - DECAPODA
- OLIGOCHAETA
- POLYCHAETA
  - SPIONIDA
  - CAPITELLIDAE
- MOLLUSCA
  - BIVALVIA
  - GASTROPODA
- INSECTA
  - DIPTERA
  - CHIRONOMIDAE
  - EPT
- NEMERTEA
- ECHINODERMATA

DIVERSITY

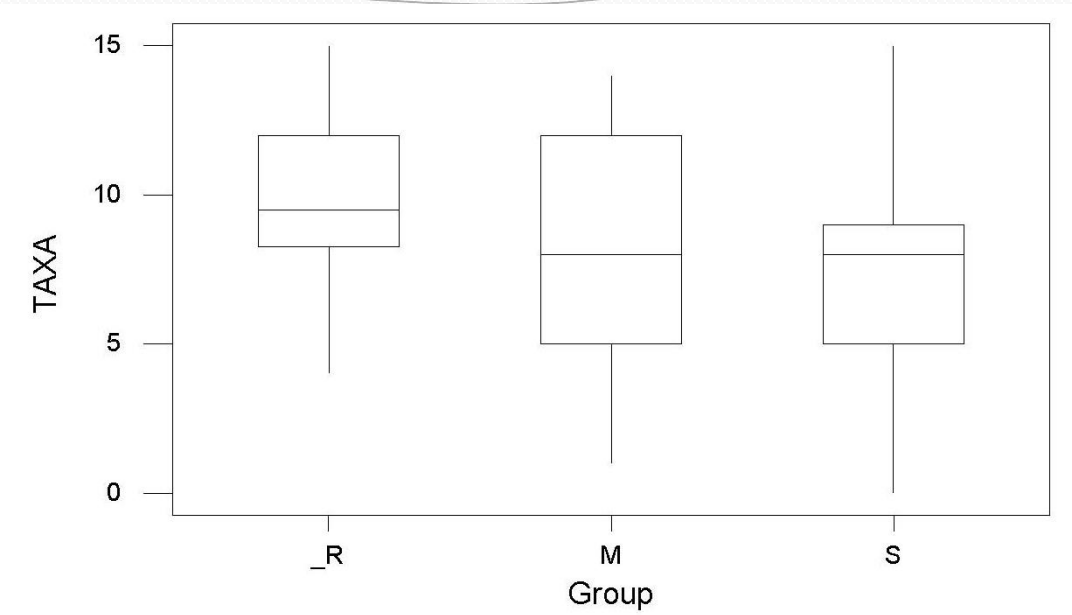


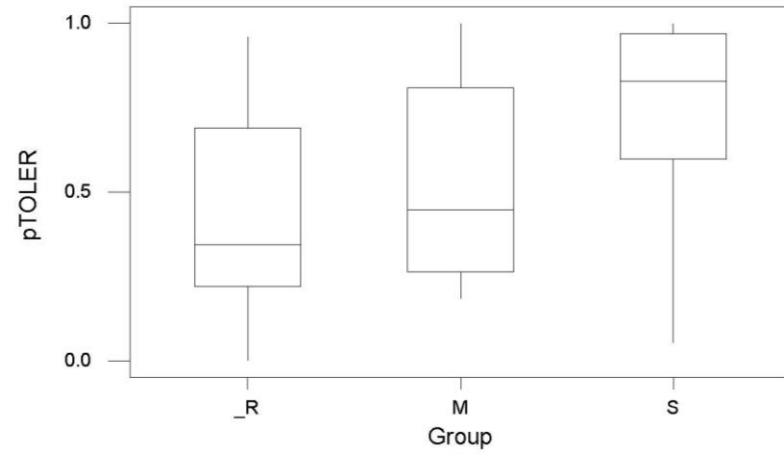
DIVERSITY

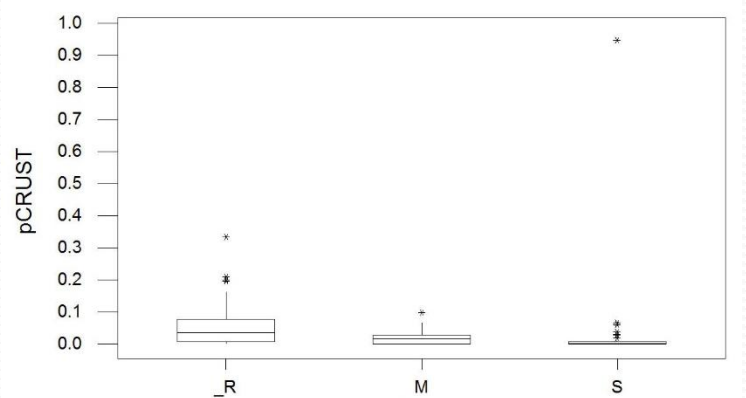


METRICS

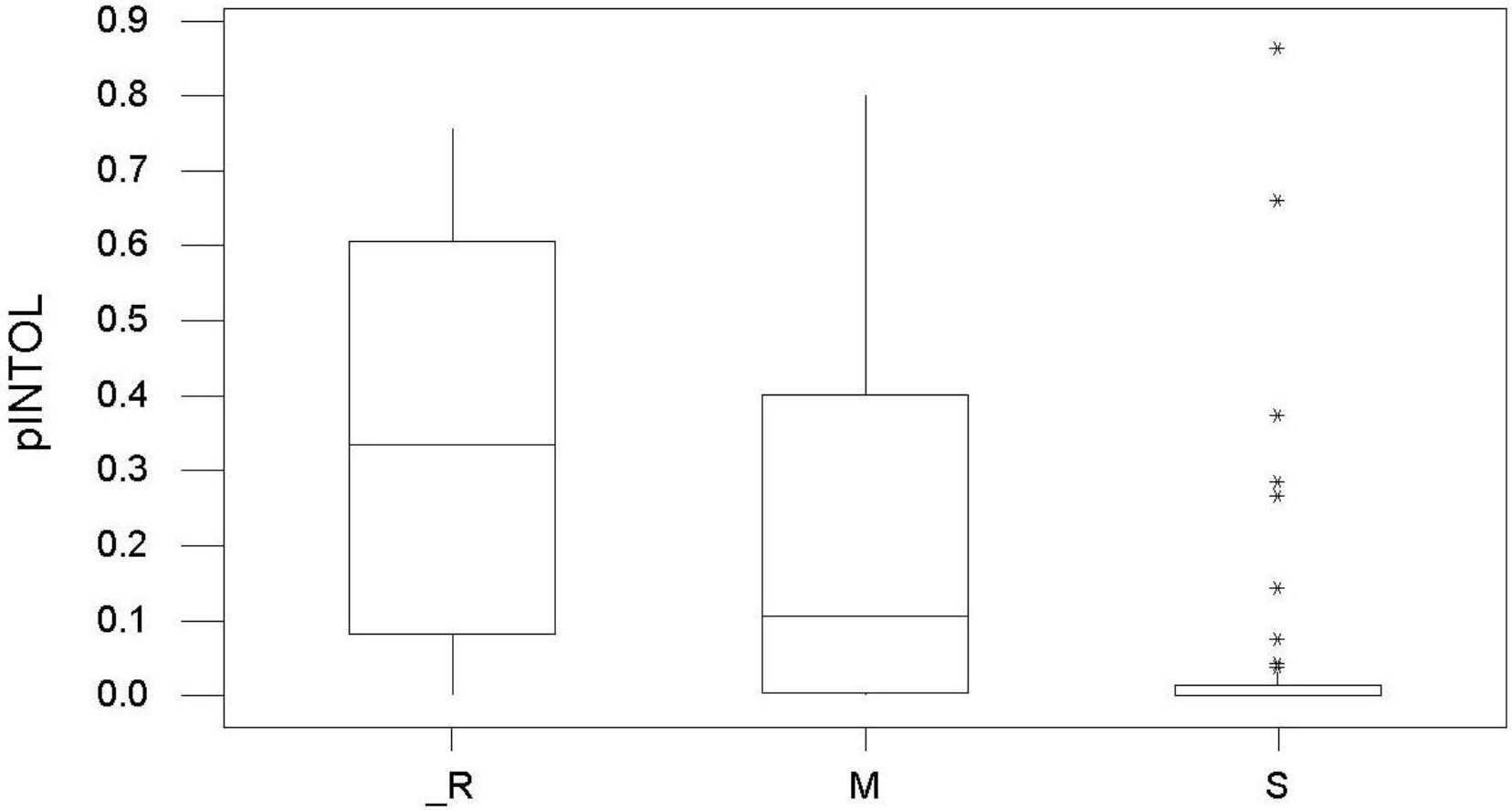
- # TAXA
- DIVERSITY (H')
- TOLERANT (%)
- INTOLERANT (%)
- PERCENT DOMINANT
- CRUSTACEA (%)
- MOLLUSCA (%)



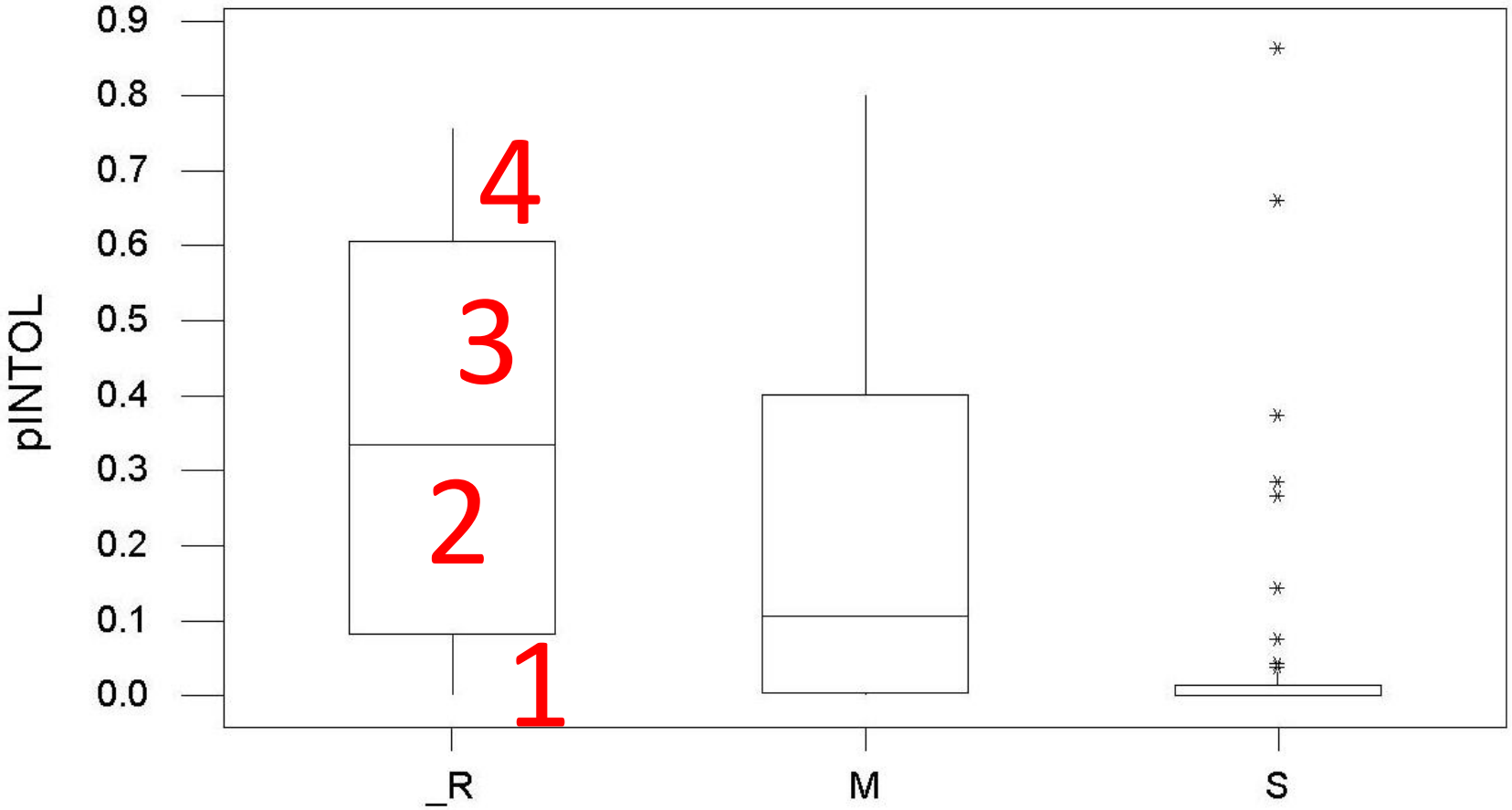




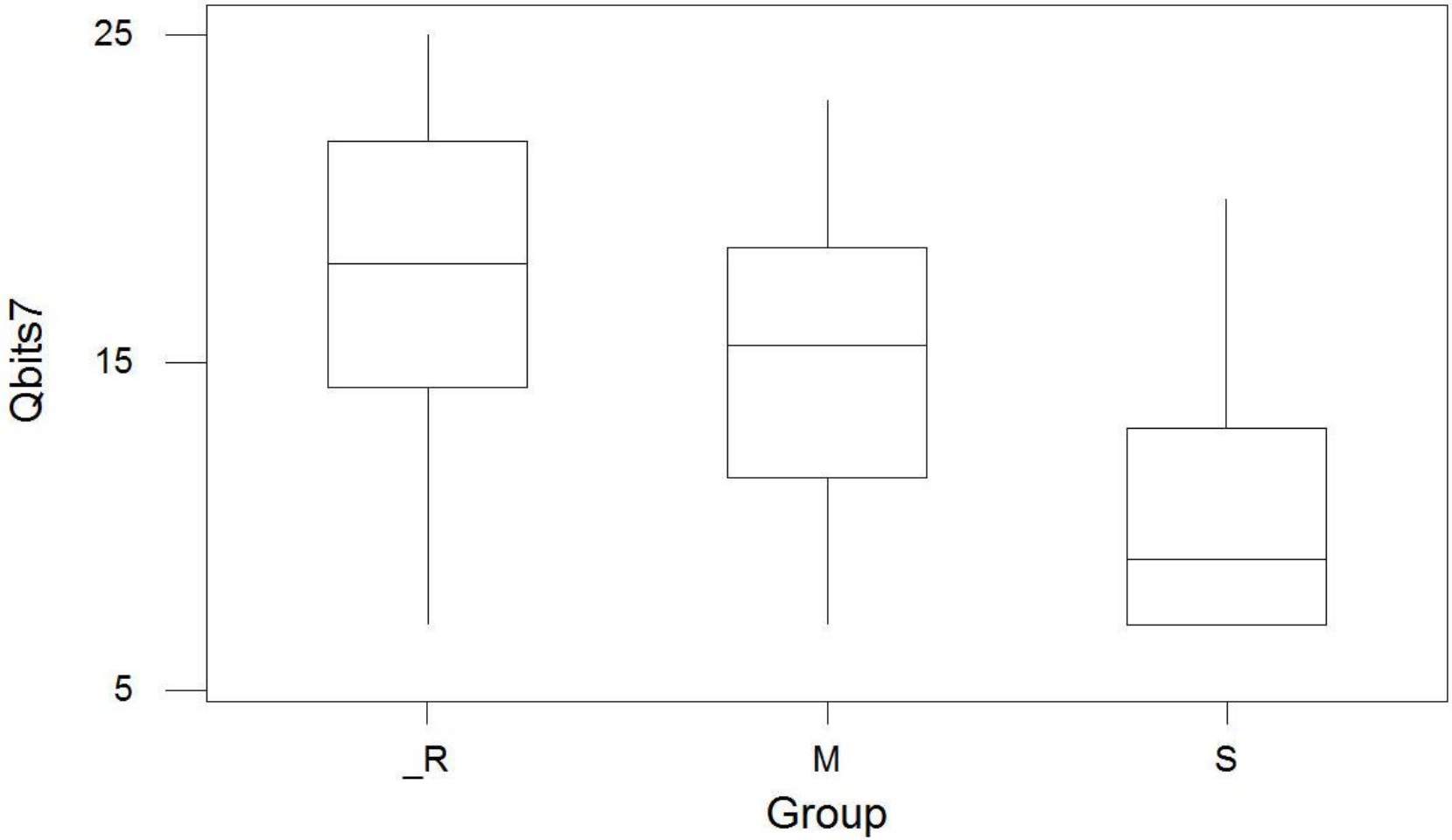
% INTOLERANT



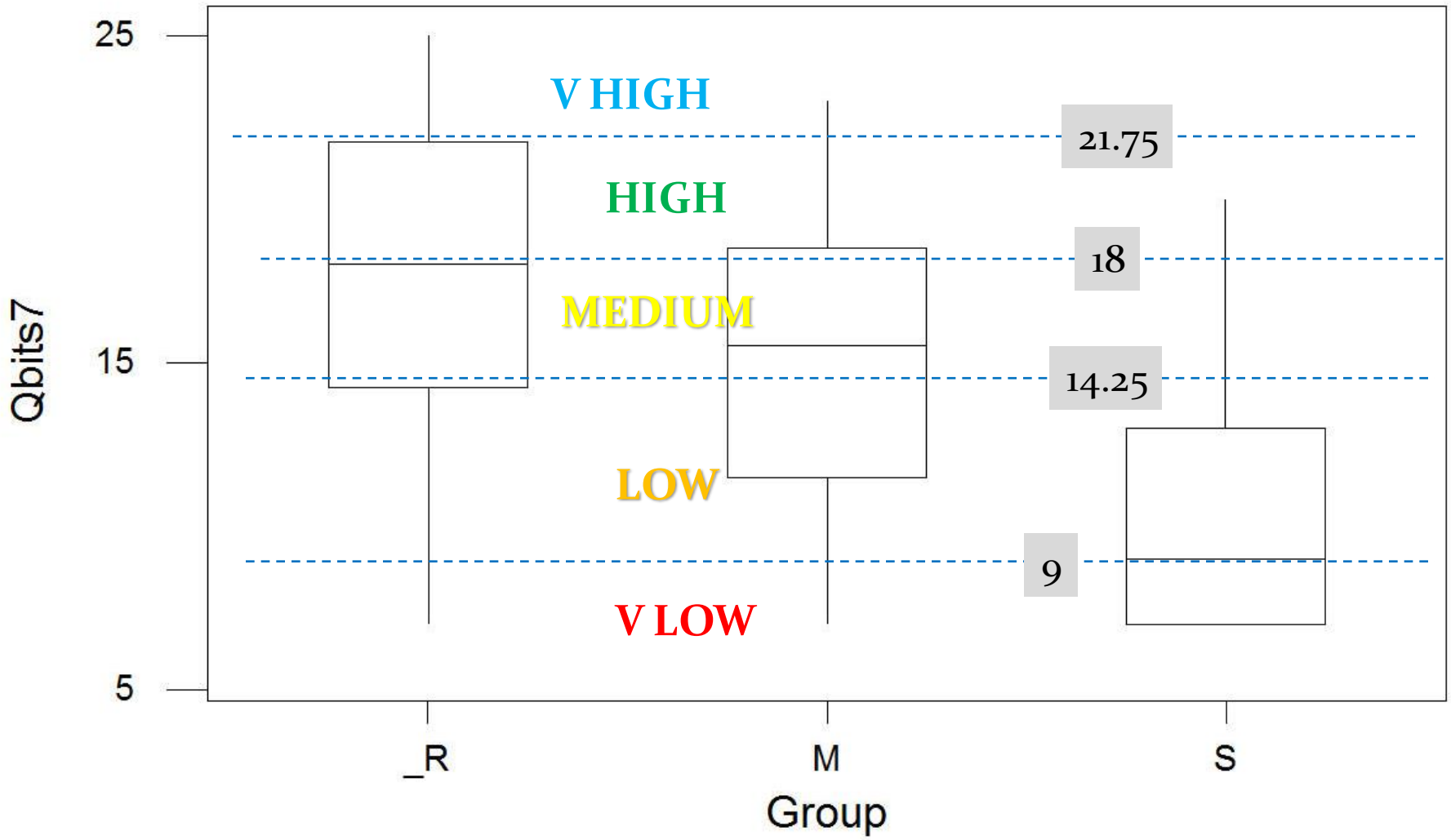
% INTOLERANT



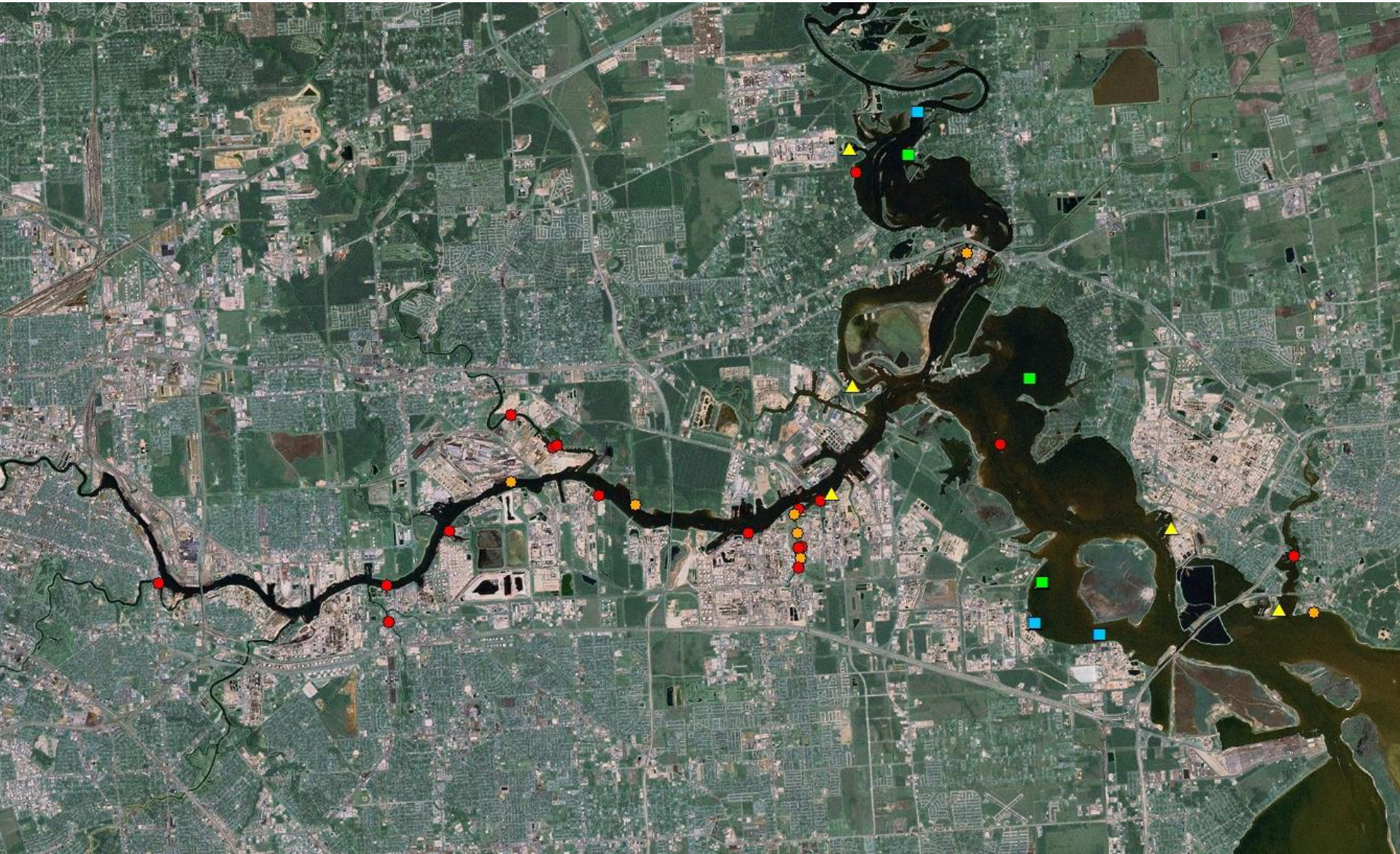
Total Score



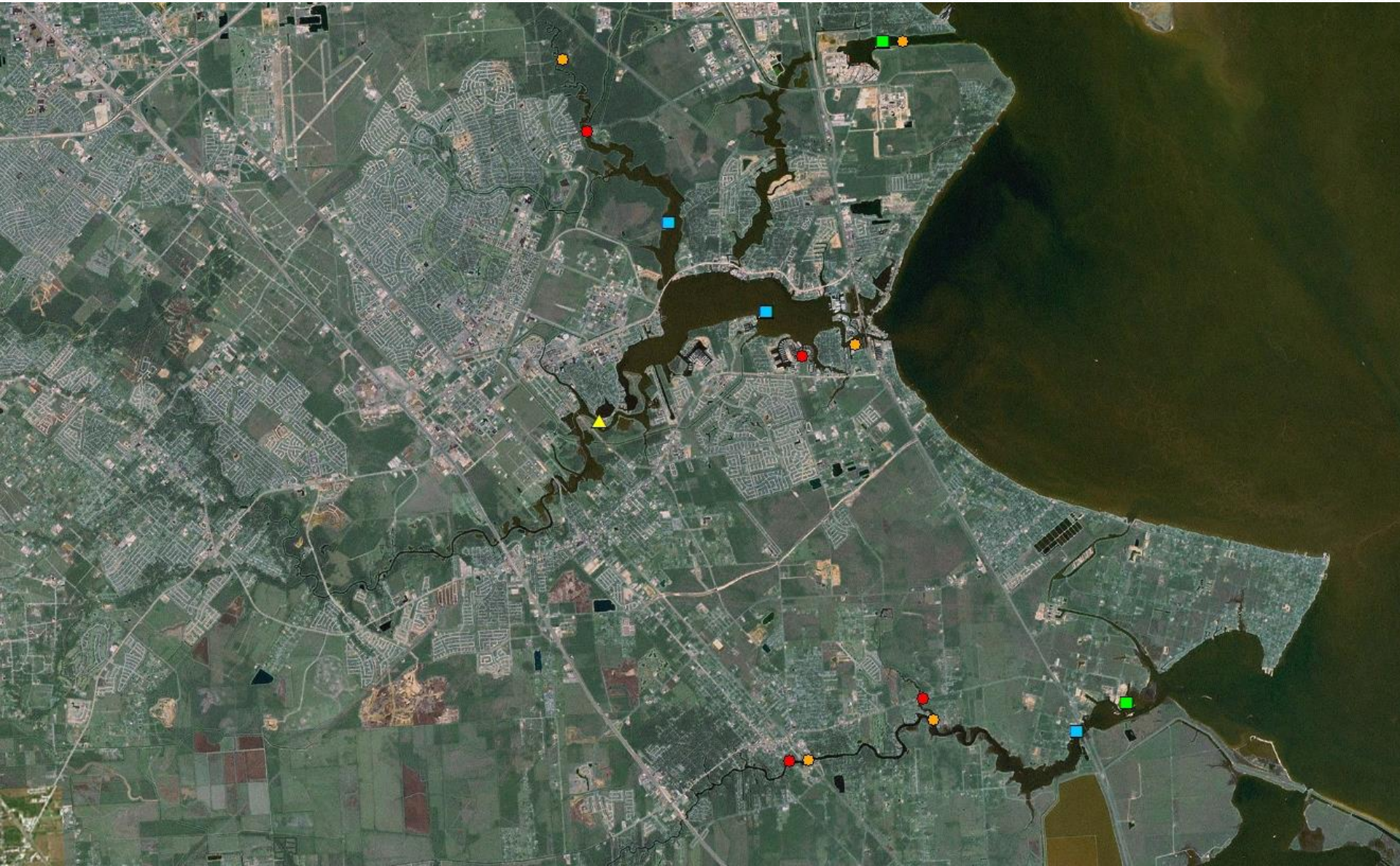
CATEGORIES


25
15
5
Qbits7
V HIGH
HIGH
MEDIUM
LOW
V LOW
21.75
18
14.25
9
_R
M
S
Group

HSC area



Clear Lake area



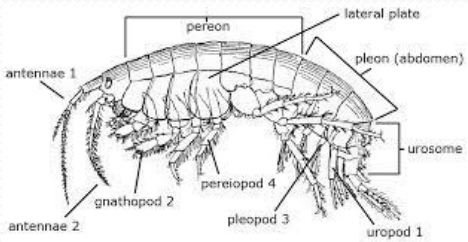
West Bay area

SUMMARY

- Tidal Stream Nekton Index discriminated between samples from stressed and impaired watersheds
  - 8 metrics (70 Ref + 73 Stress)

- Benthic Index for Tidal Streams also worked well to rank those benthic samples
  - 7 metrics (32R + 48 Stress)

- Still working on Open Bay Benthic Index



QUESTIONS?