Ecological Reference Sites in an Assessment Framework: National Water-Quality Assessment (NAWQA) Program

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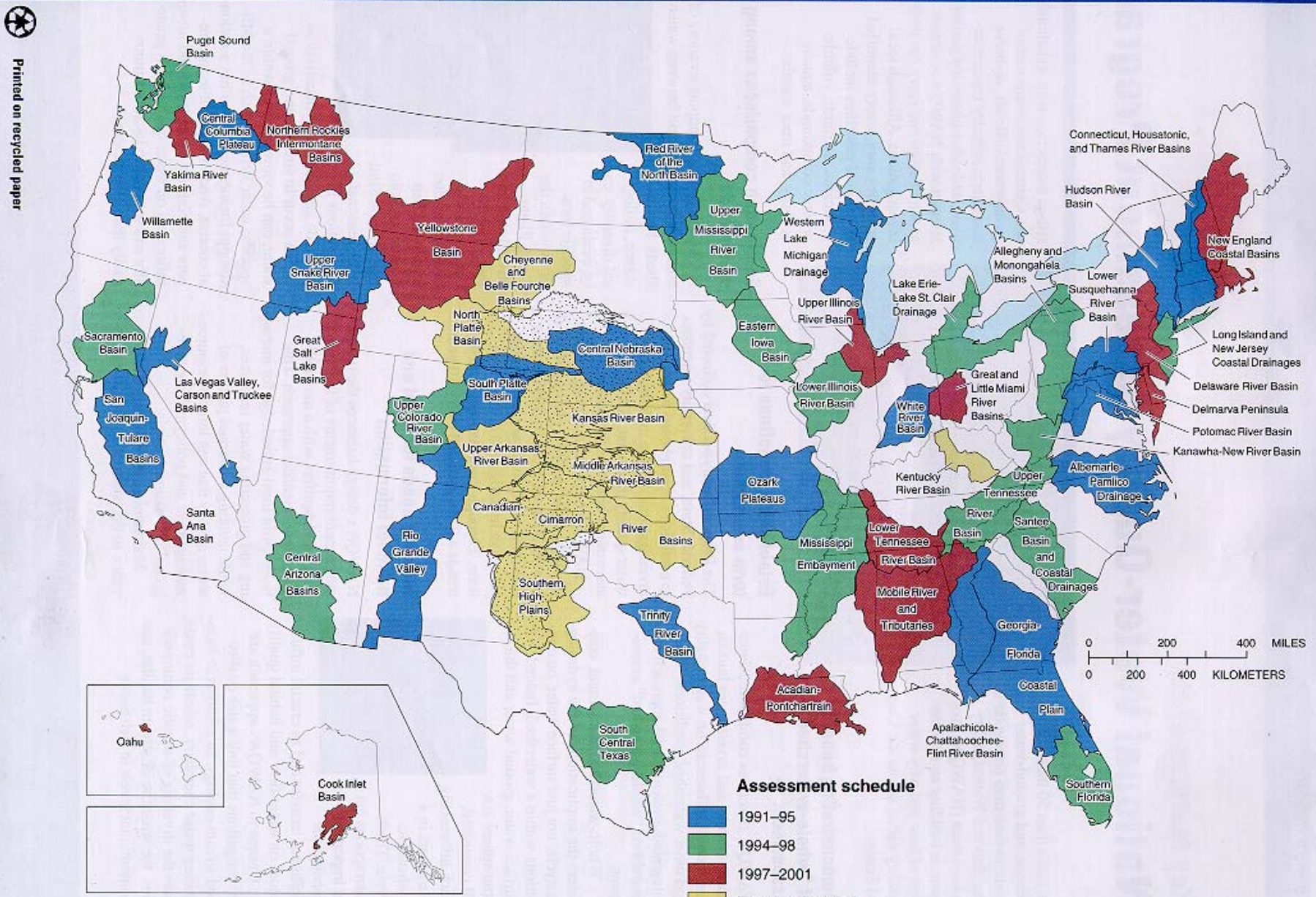
Objectives of NAWQA

- Describe the condition or status of water quality in more than 50 major stream and ground-water systems in the United States.
- Determine water-quality trends.
- Investigate human and natural influences on water-quality and watershed conditions.

U.S. Geological Survey Water-Quality Assessments, 1991–2004

National Water-Quality Assessment (NAWQA) Program



Modified from Gilliom and others, 1995

Printed on recycled paper

Types of NAWQA Surface-Water Sites

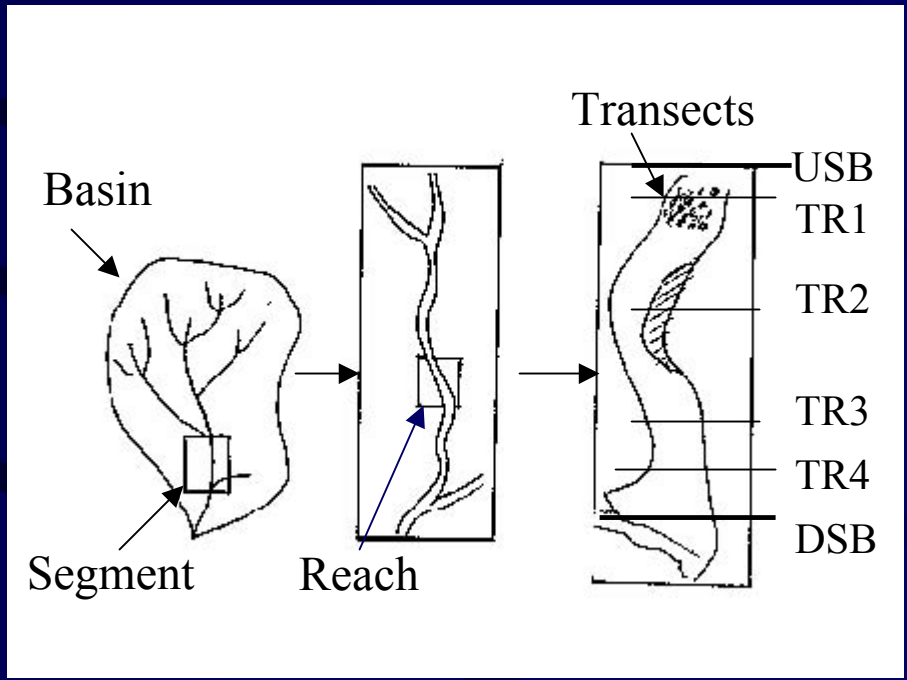
- Fixed stations: Basic fixed and intensive fixed stations
- Synoptic sites
- Special studies sites

NAWQA "Reference" Site

- Homogenous land use in the watershed, and expected to remain so.
- Screening of historical water-quality and stream-flow data and information.
- High degree of channel integrity.
- Representative of natural setting.

NAWQA Reach-Based Assessment

- Basin-level assessment includes slope, drainage density, drainage texture, stream order, soils, runoff, surficial geology, land use, etc. …
- Segment-level assessment includes segment length (linear and curvilinear), slope, channel sinuosity, water management features, etc. ...
- Reach-level assessment includes frequency and types of geomorphic channel units, instantaneous discharge, bank and in-channel substrate, riparian vegetation, reach map, etc. …



NAWQA Bioassessment Components

- Fish community assessment involves reach-based species composition and relative abundance information. Methods include two electrofishing passes, seining and other netting techniques.
- Benthic macroinvertebrates and periphytic algae assessment includes collecting reach-based composited semiquantitative Richest Targeted Habitat (RTH) and Qualitative Multihabitat (QMH) samples.
- Surficial bed sediment and tissue of targeted taxa are analyzed for selected organics and trace metals.

Case Study

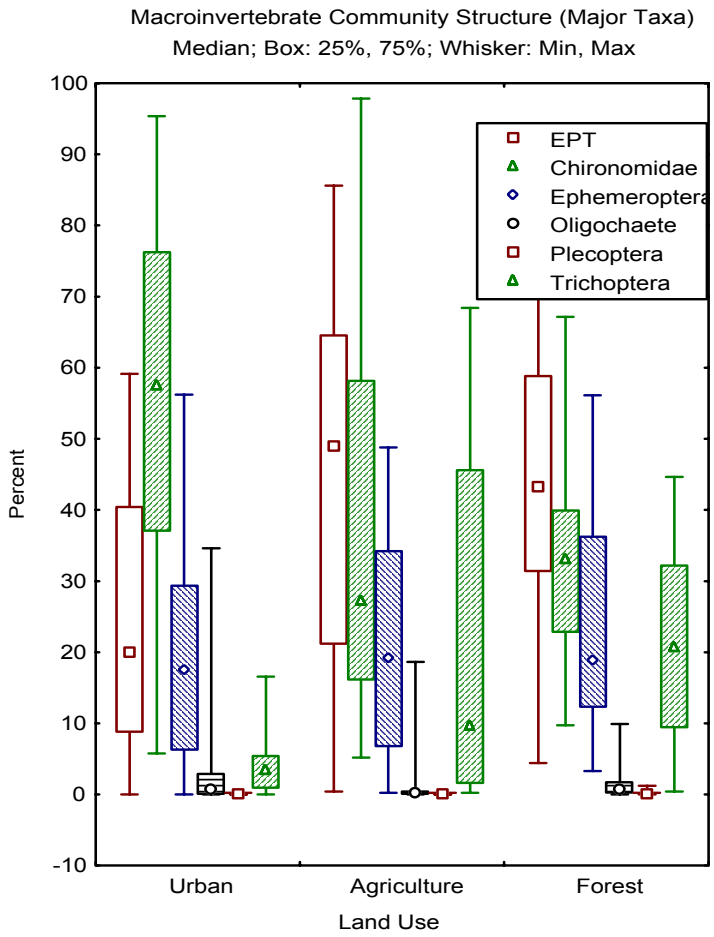
Status of In-Stream Biological Resources in Selected Watersheds of Southeastern Texas, 1997-98

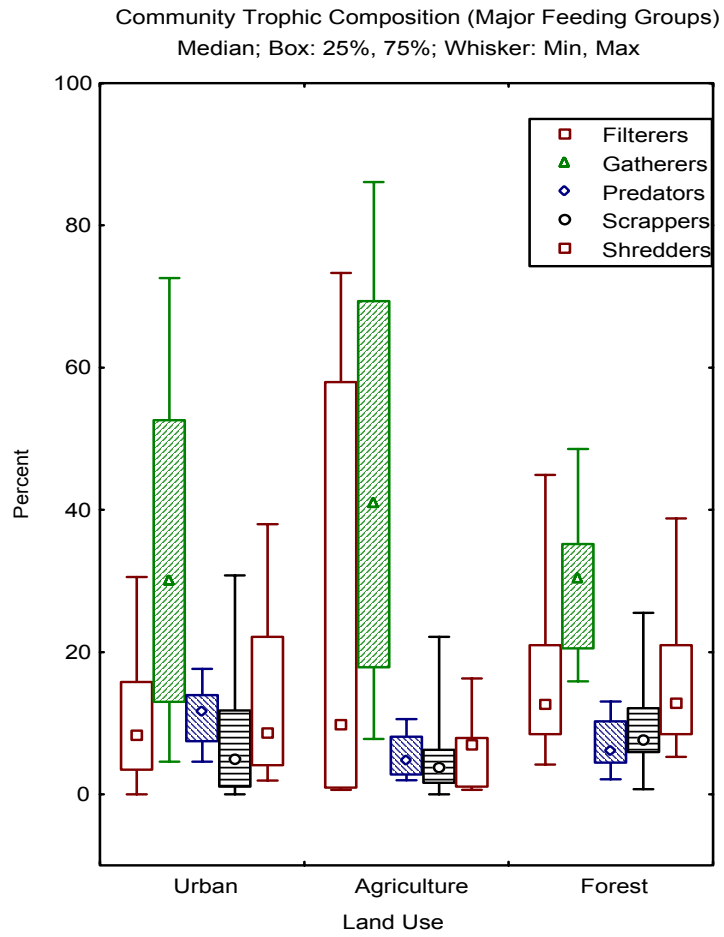
Bioassessment Sites in the Houston-Galveston Council's (HGAC) Service Area

Objectives

- Baseline assessment and the status of fish, benthic macroinvertebrates and stream habitat at 56 sites.
- Determine the relation of land use to biota and stream habitat.
- Select reference condition sites for long term monitoring efforts.

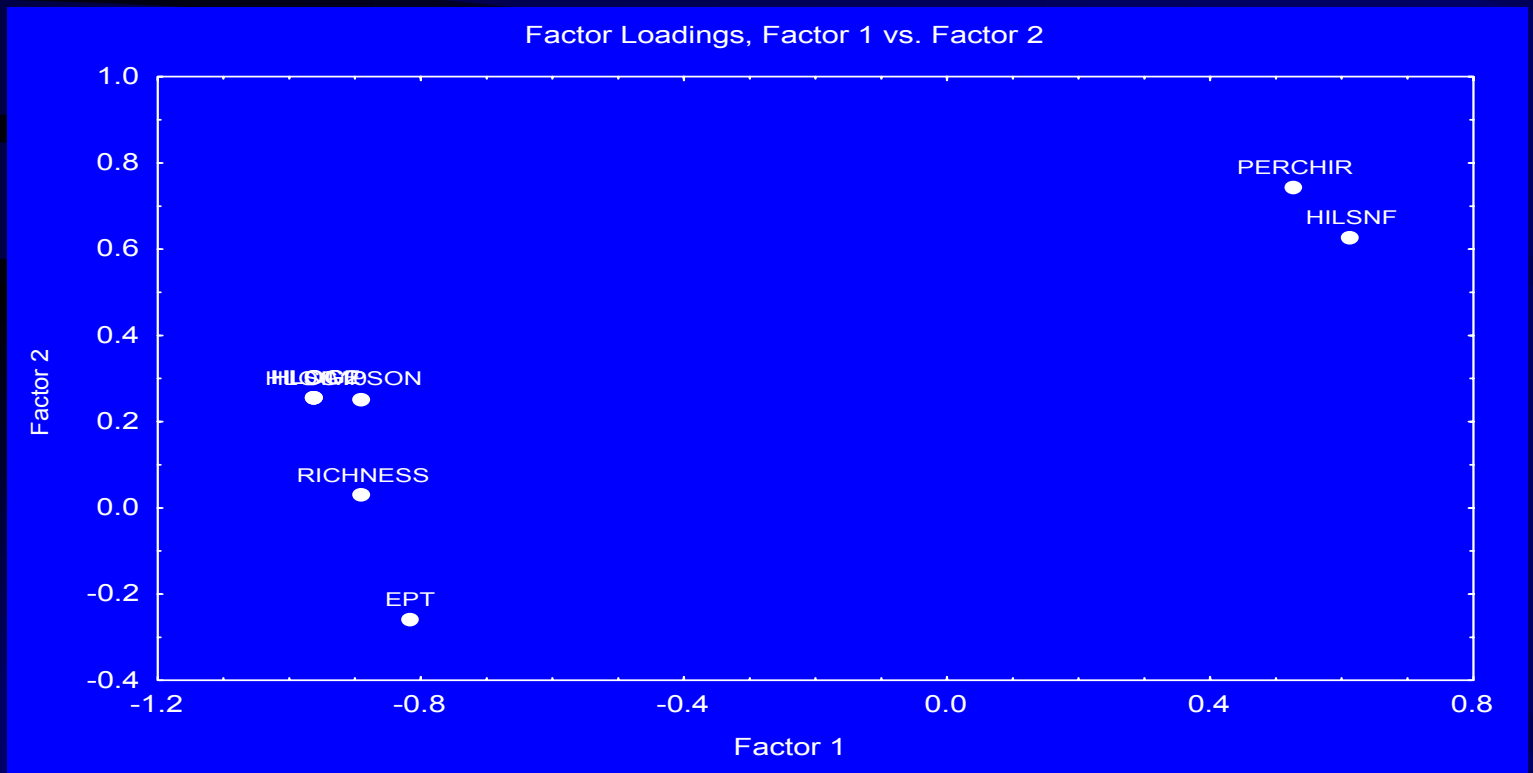
Benthic Macroinvertebrates by General Land Use



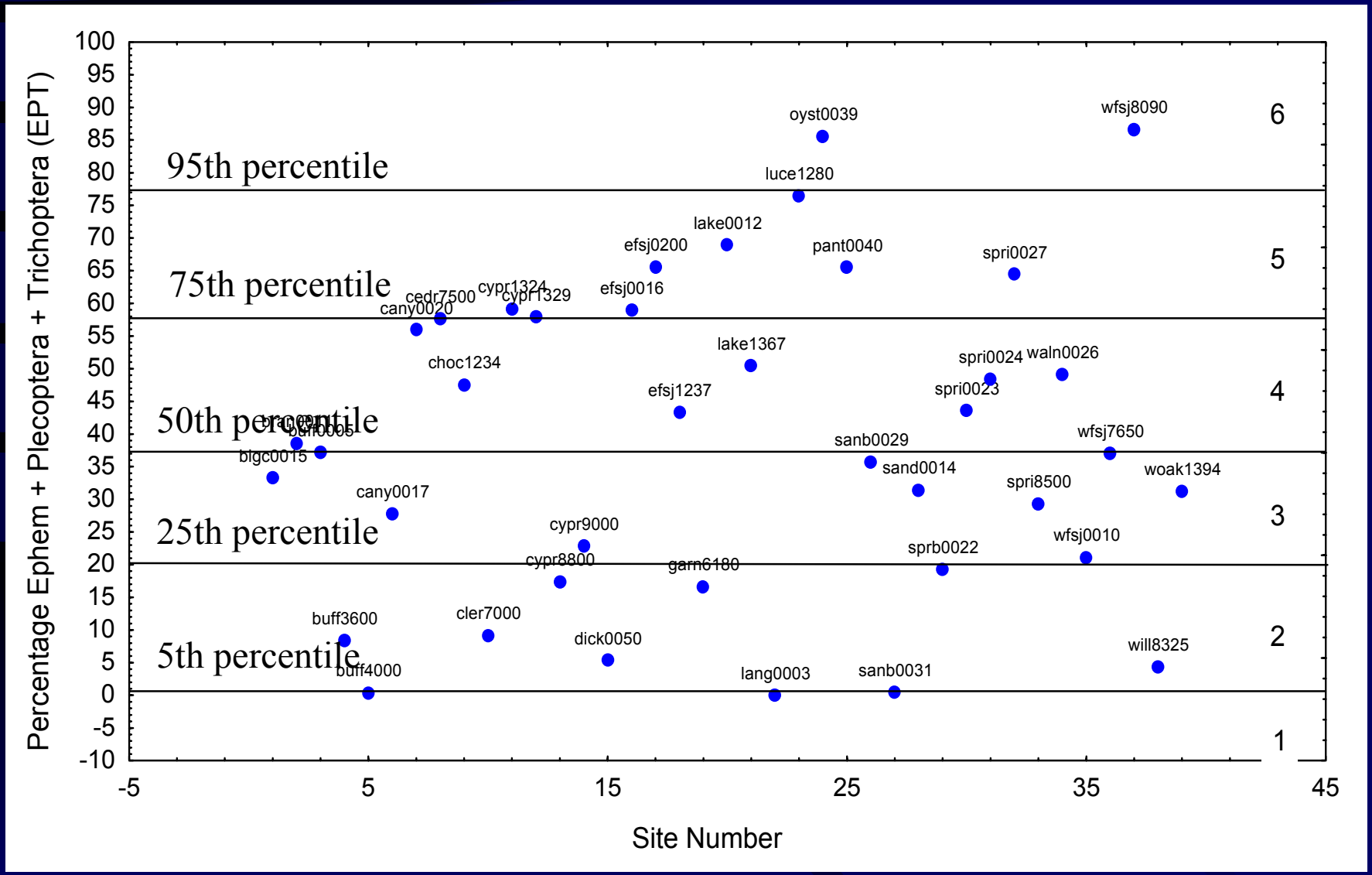


Selection of Benthic Invert. Variables

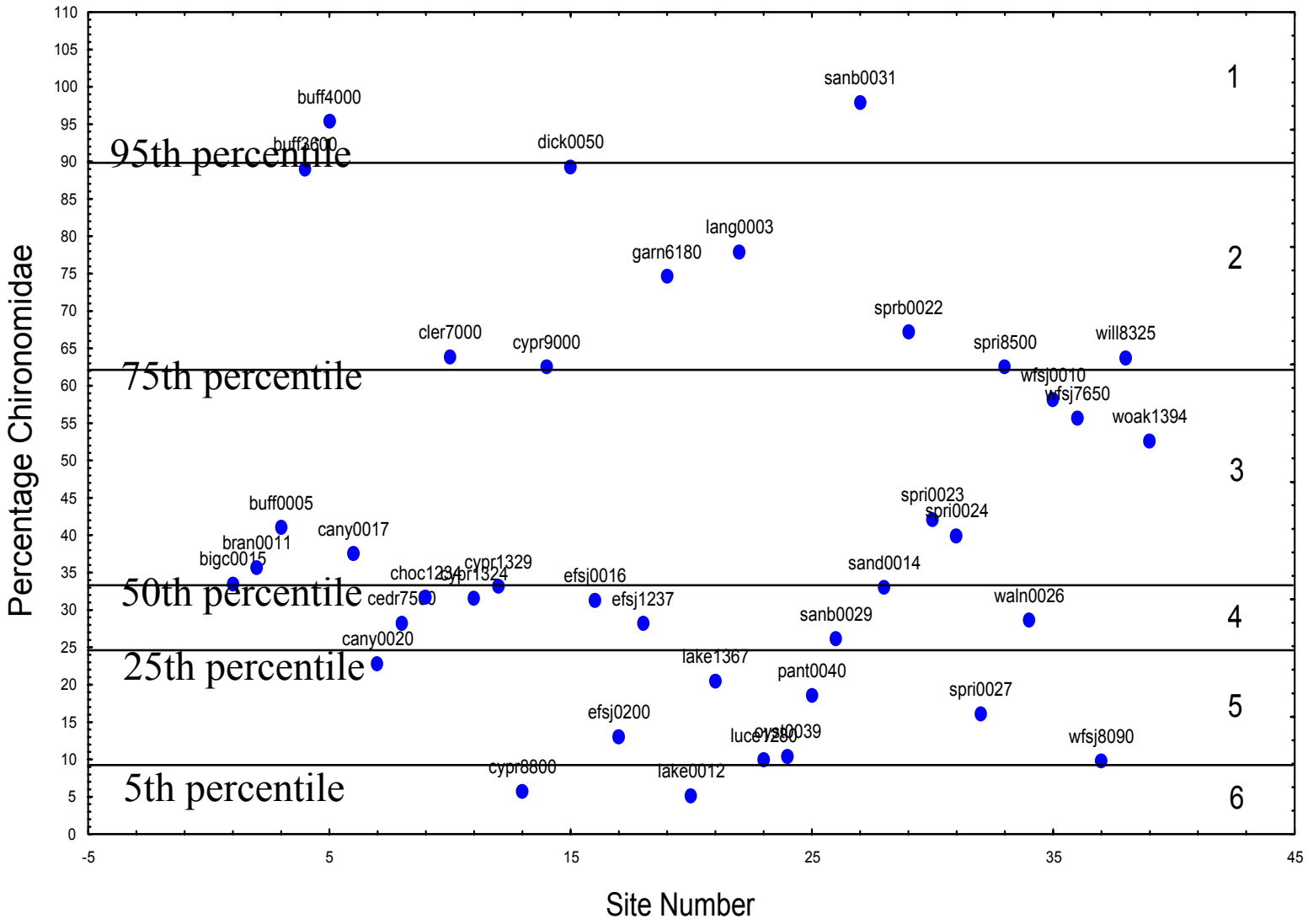
Variable	Factor 1	Factor 2
Richness	-.889796 *	.029107
EPT	-.816575 *	-.259319
Proportion Chironomidae	.526962	.743354
Hilsenhoff	.612488	.626835
Explained Variance	.710355	.159080



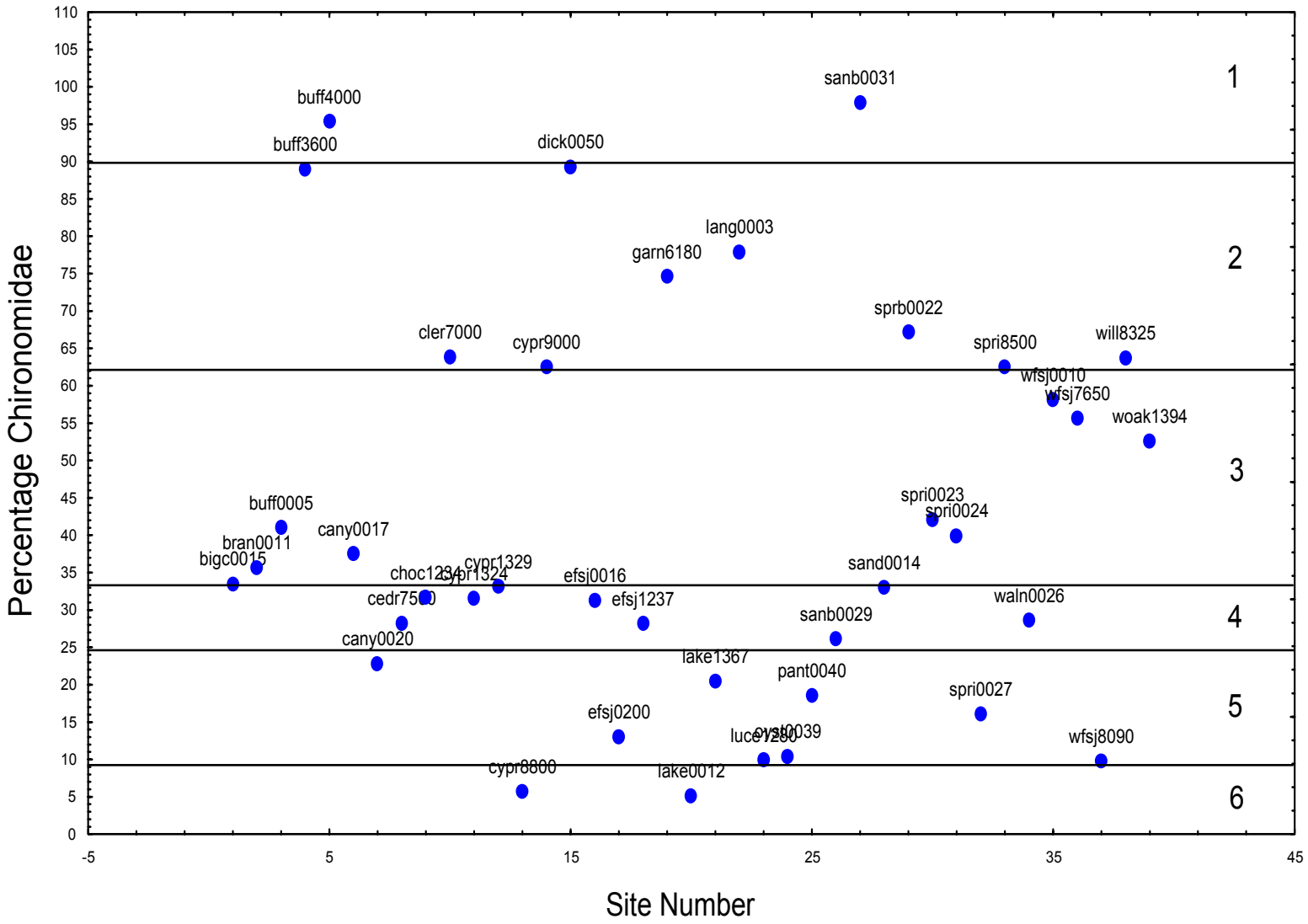
Integrity Score for Percent EPT



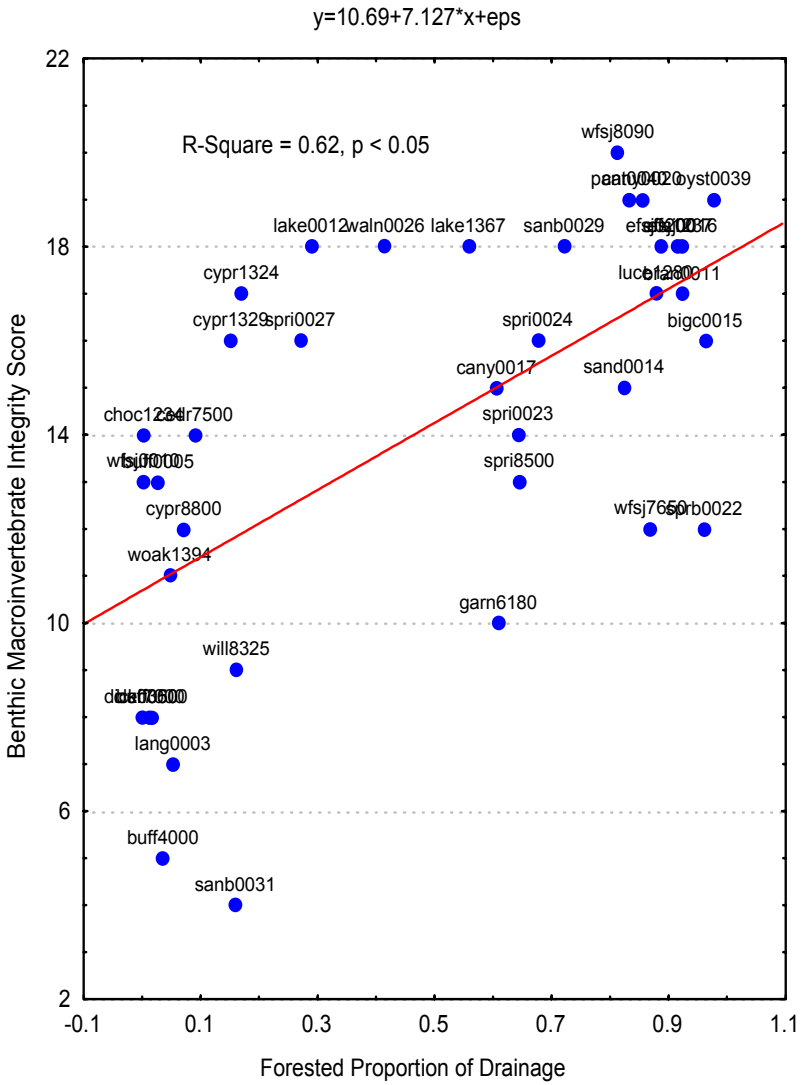
Integrity Score for Percent Chironomidae

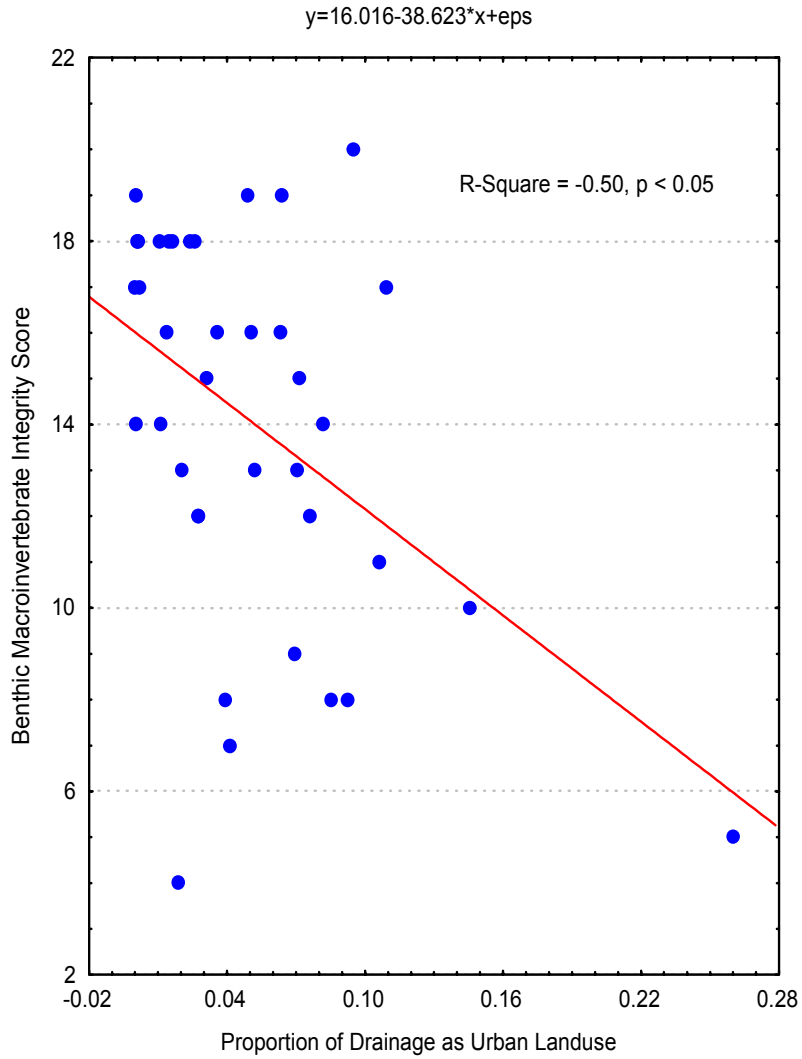


Integrity Score for Percent Chironomidae

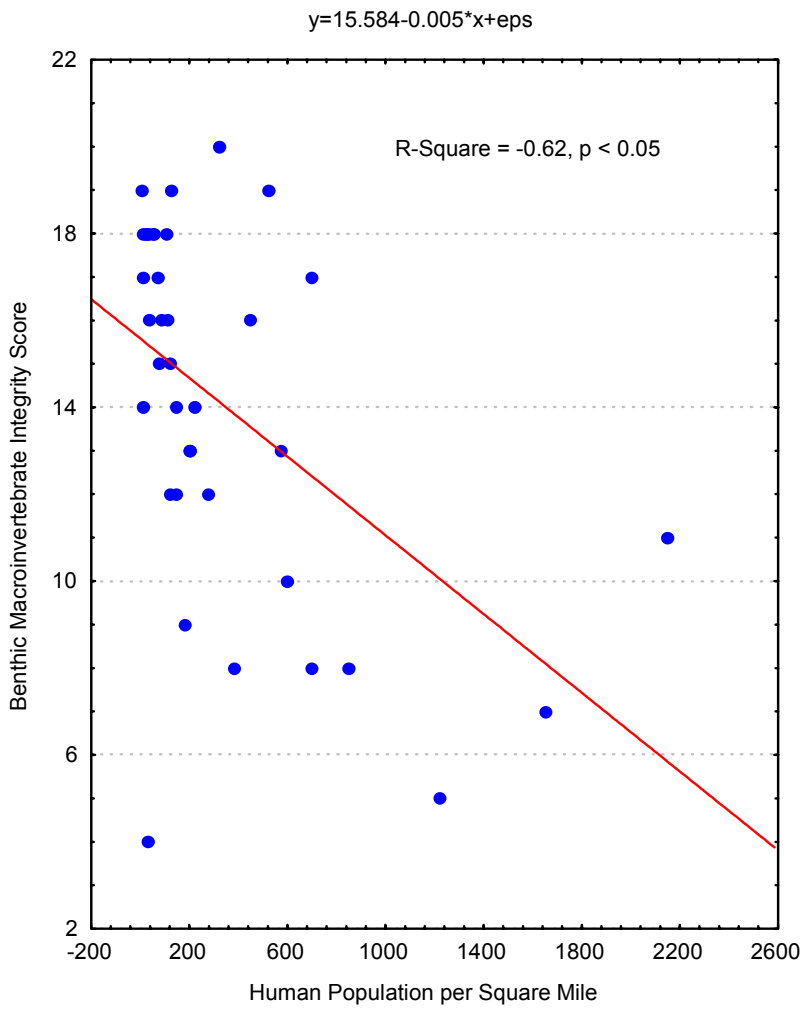


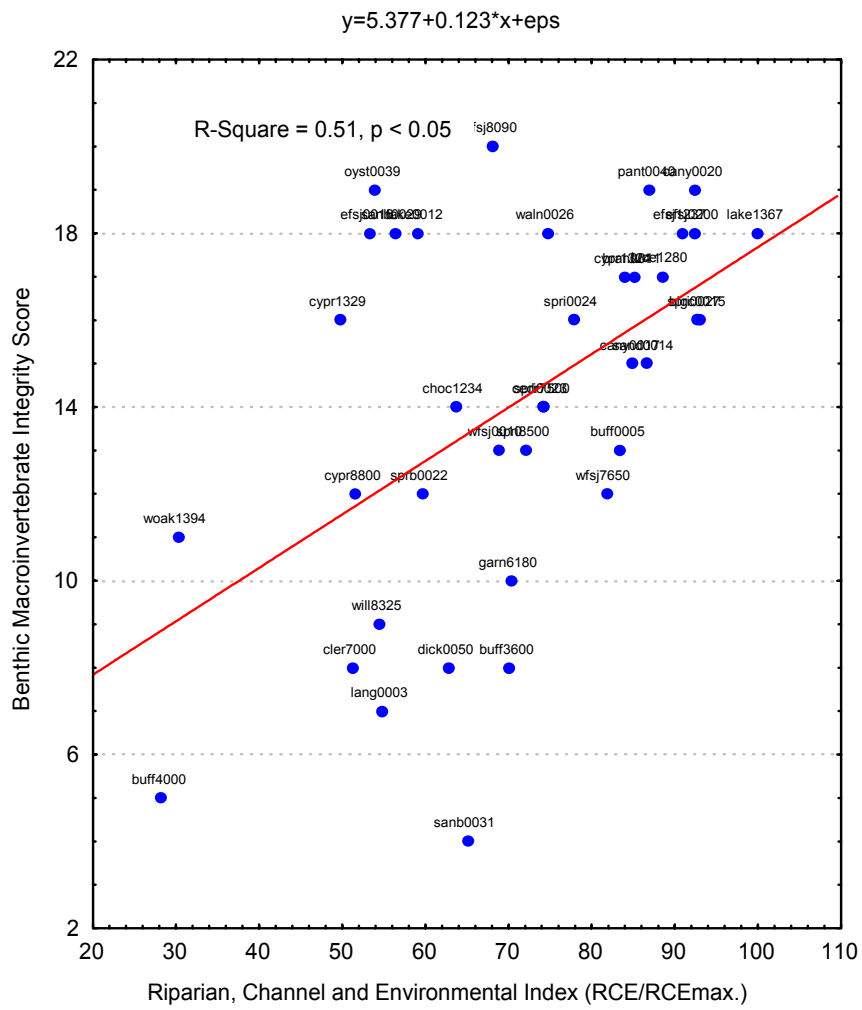
Land Use in Relation to Benthic Invert. Integrity Score





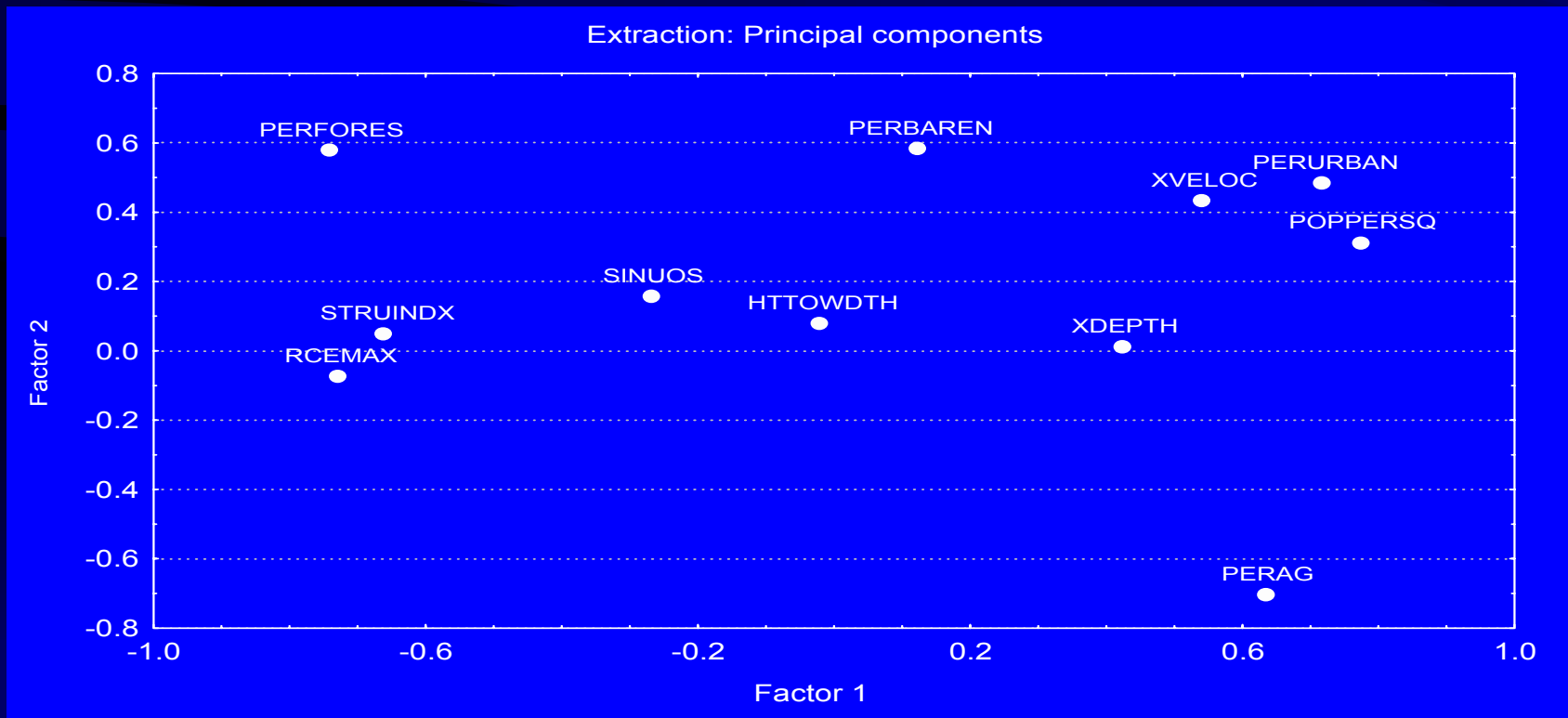
Human Population and RCEmax in Relation to Benthic Invert. Integrity Score





Selection of Land-Use and Stream Habitat Variables

Variable	Factor 1	Factor 2
RCE Maximum (RCE/RCEmax.)	-.730573 *	-.073528
Percent Urban	.716319 *	.484761
Percent Forested	-.742175*	.579658
Humans per sq. mile	.773099	.311757
Explained Variance	.326773	.157310



Predictive Tool: Stepwise Multiple Regression

$$Y = (-.67\ (\%\ \text{urban})\ x + -3.0\ (\%\ \text{Ag}) + -2.6\ (\%\ \text{Forest}) + -.09\ (\text{Population}) + 1.31\ (\text{RCEmax.})) + 45.27$$

Summary

- EPT, species richness and percent Chironomidae explained biological variability.
- Sinuosity and Riparian, Channel and Environmental (RCE) Index explained variability in stream habitat.
- Percent urban, forest and ag land use, in this order, explained site differences and are highly correlated to EPT and RCEmax and the biological (benthic invert.-based) integrity scores.
- Is it more important to have discrete reference sites or to address site/environmental gradients to get away from a priori assignment of a reference site.