South Carolina's Approach to Probability-Based Monitoring: Trends and Uses

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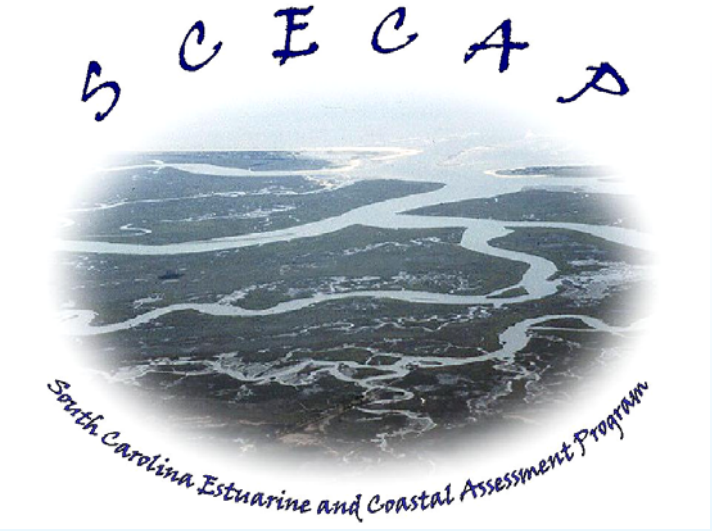
The South Carolina Estuarine and Coastal Assessment Program



Objectives:

- ***Monitor the overall quality of all South Carolina estuaries***
  - **Water Quality**
  - **Sediment Quality**
  - **Biological Condition**
- ***Report findings to the public in understandable formats***
- ***Use the data for management / regulatory decisions***

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

DHEC
PROMOTE PROTECT PROSPER
South Carolina Department of Health and Environmental Control

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

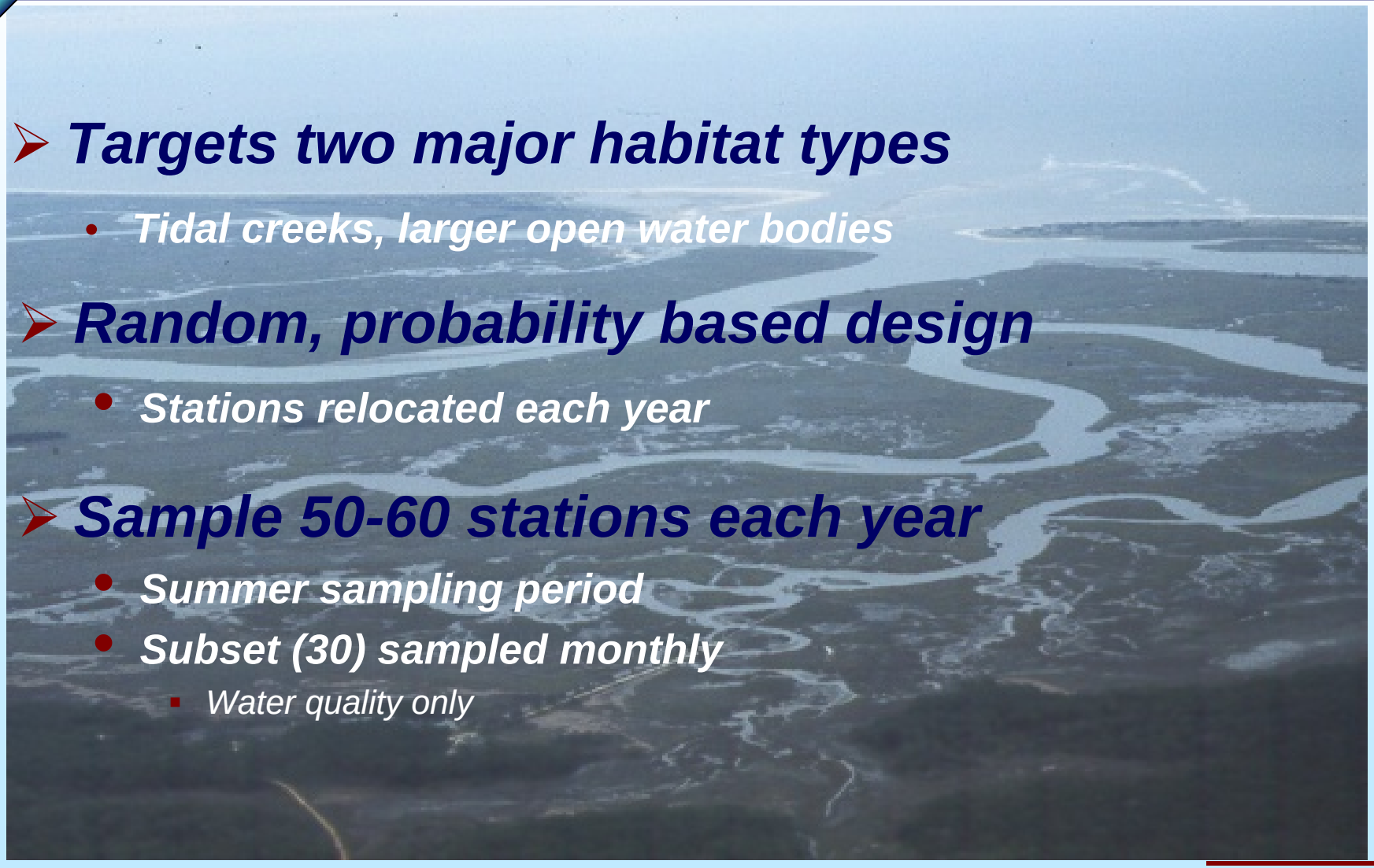
Program Approach / Advantages

- ***Uses integrated measures of condition*** ***(water, sediment, biota)***
- ***Unbiased sampling design***
- ***Identifies percentage of impaired habitat with statistical confidence limits***
- ***Allows for trends analyses***
- ***Spatially extensive station array with many uses***

Monitoring Approach

- ***Targets two major habitat types***
  - ***Tidal creeks, larger open water bodies***

Monitoring Approach



- ***Targets two major habitat types***
  - *Tidal creeks, larger open water bodies*
- ***Random, probability based design***
  - *Stations relocated each year*
- ***Sample 50-60 stations each year***
  - *Summer sampling period*
  - *Subset (30) sampled monthly*
    - *Water quality only*

Sampling Components

Water Quality

- Continuous monitoring for salinity, DO, pH, temp
- Turbidity, TOC
- Nutrients (total & dissolved nitrogen, phosphorus)
- BOD, fecal coliform bacteria, metals
- Phytoplankton (Chl-a)

Sediment Quality

- Contaminants (85 + analytes)
- Toxicity (3 assays)

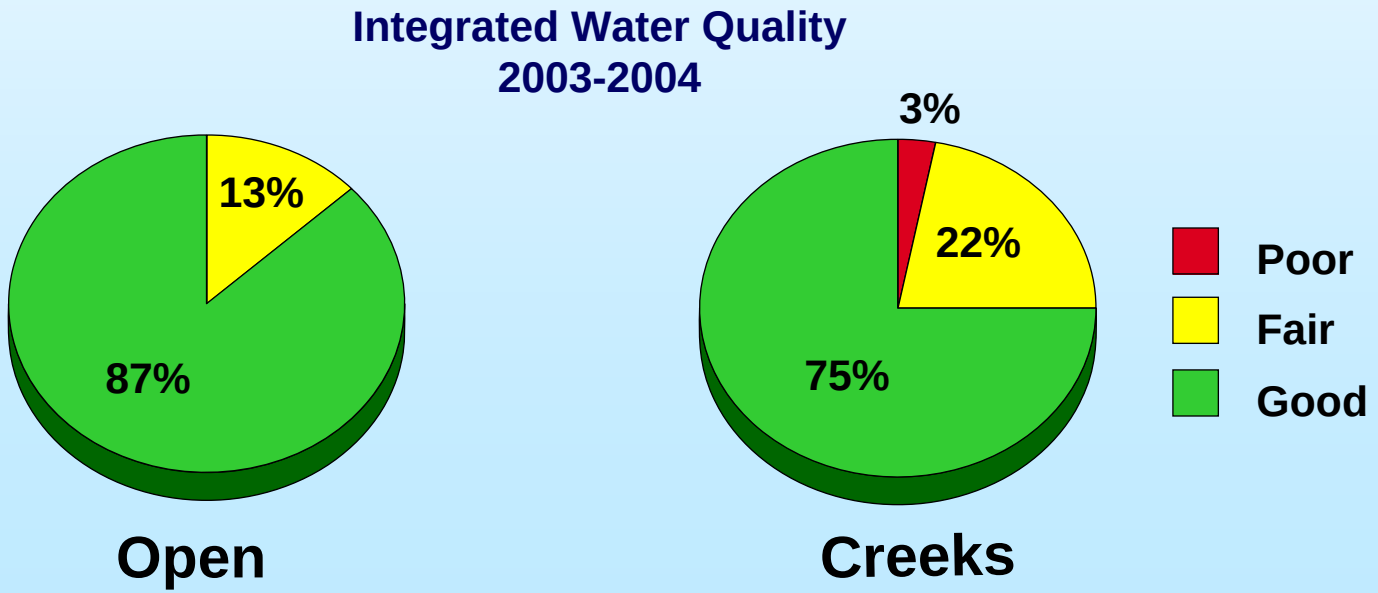
Biological Condition

- Benthos
- Phytoplankton composition
- Finfish and crustaceans

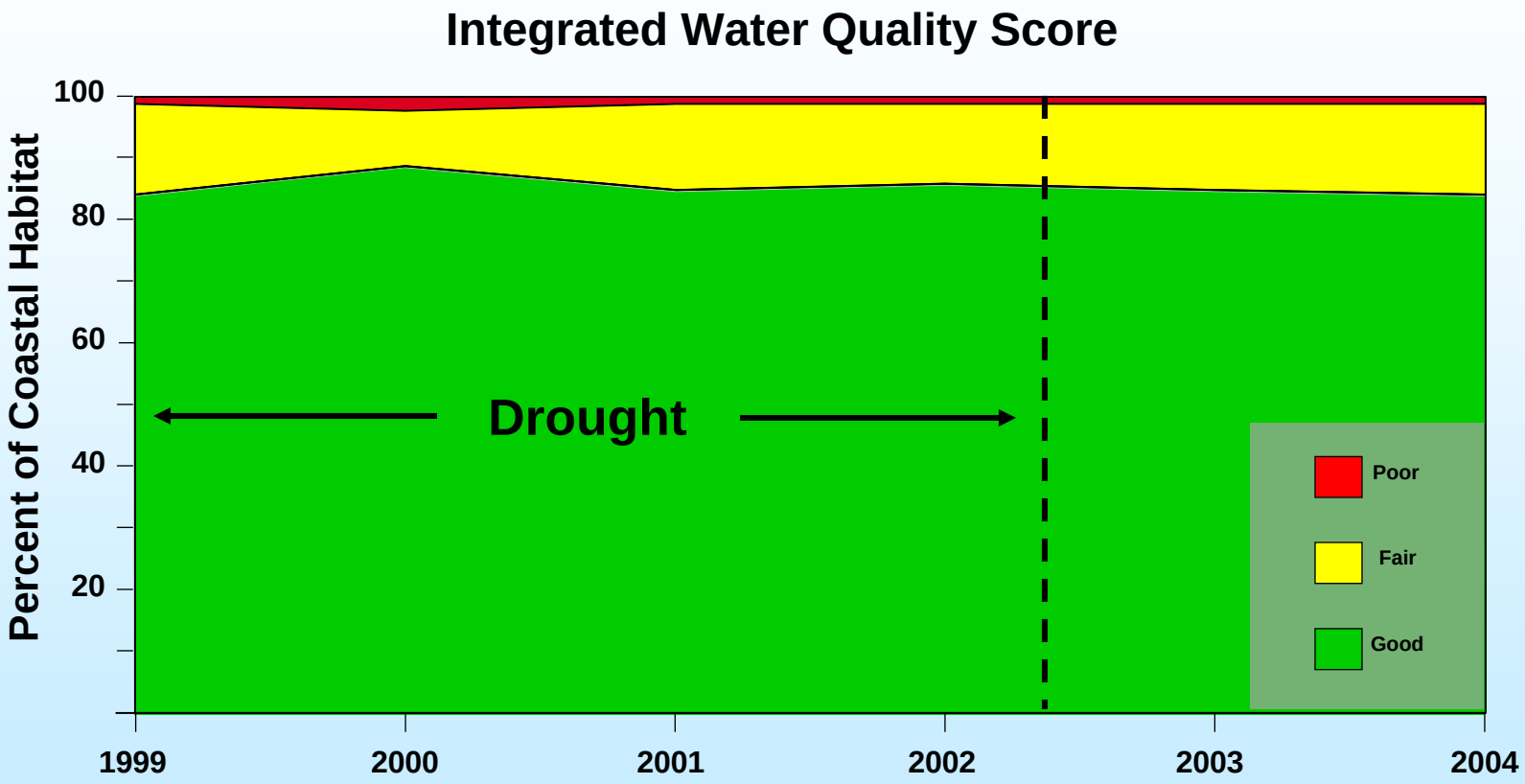
Integrated Measures

Water Quality

- **Six primary measures (DO, pH, fecal coliform bacteria, TN, TP, Chla)**
- **Each measure scored based on water quality criteria or historical data** (thresholds 75th and 90th percentiles)
- **Scores averaged for integrated water quality measure**



Trend in Water Quality Condition



Integrated Water Quality Index

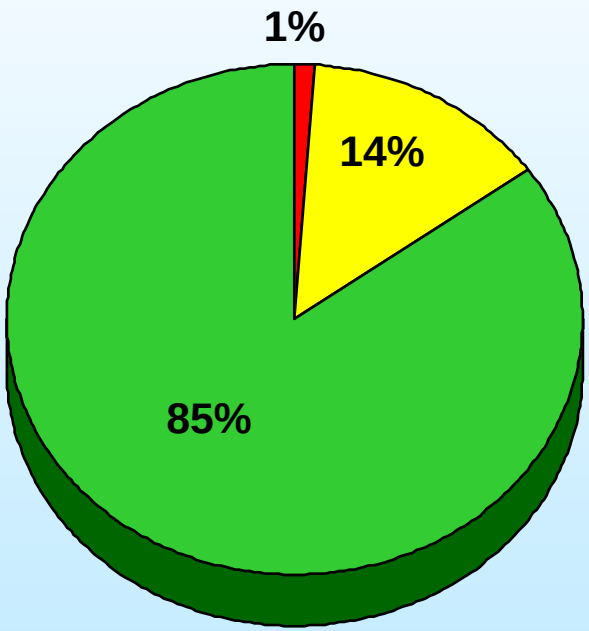
Potential Issues:

- **Are summer only vs. year round measures comparable?**
- **What is the right mix of water quality variables?**
  - Number and type
- **Right thresholds?**

Water Quality – Habitats Combined

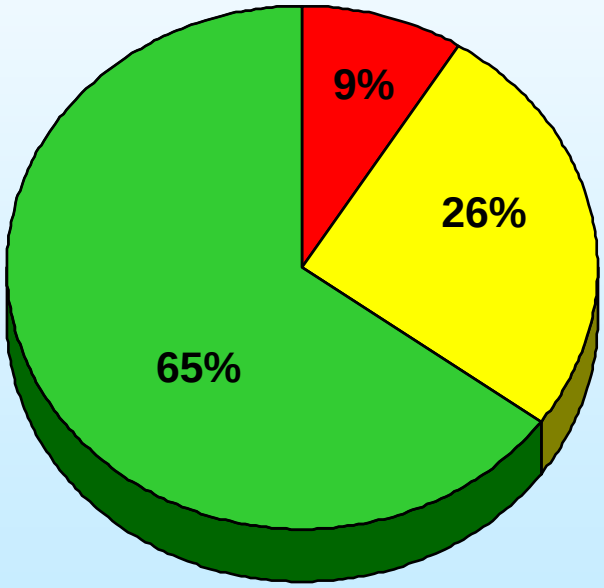
SCECAP Criteria Summer Only

2003-2004



SCECAP Criteria Monthly

2003-2004

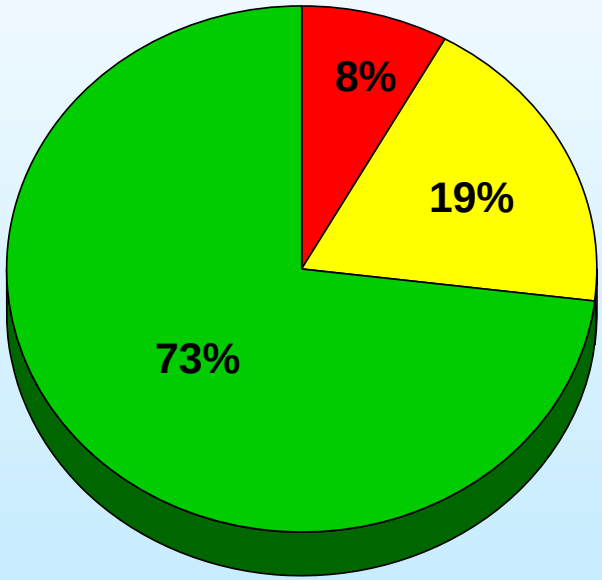


Good Fair Poor

Water Quality – Habitats Combined

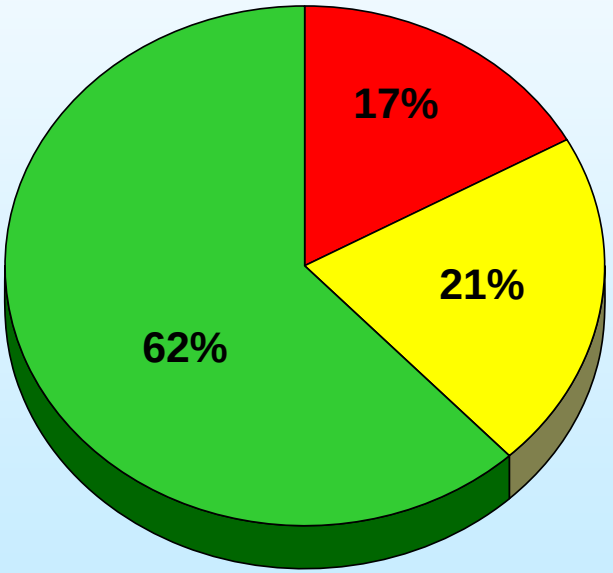
DO, pH, Fecals Summer Only

2003-2004



DO, pH, Fecals Monthly – One Year

2003-2004



Good Fair Poor

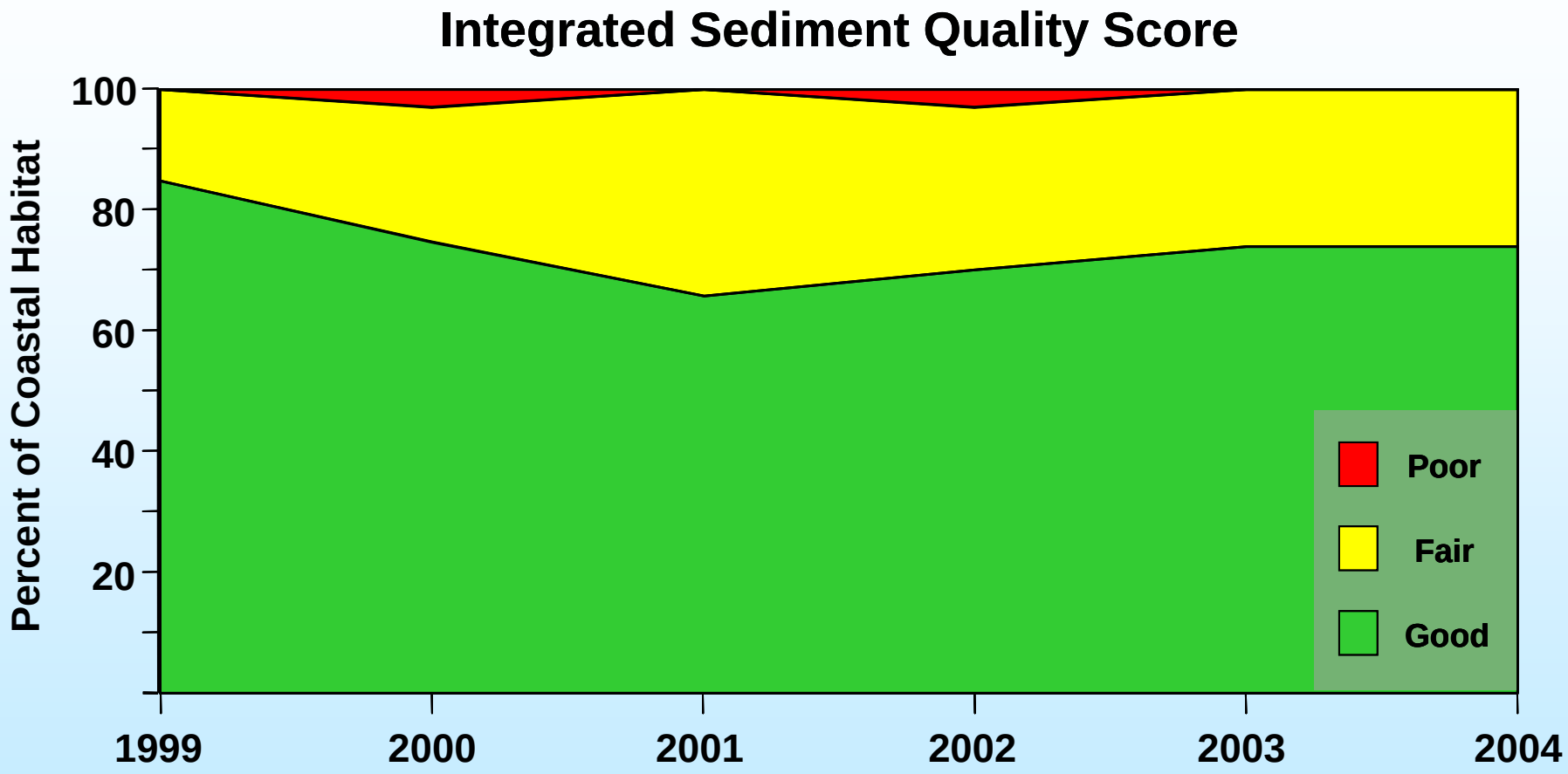
Integrated Measures

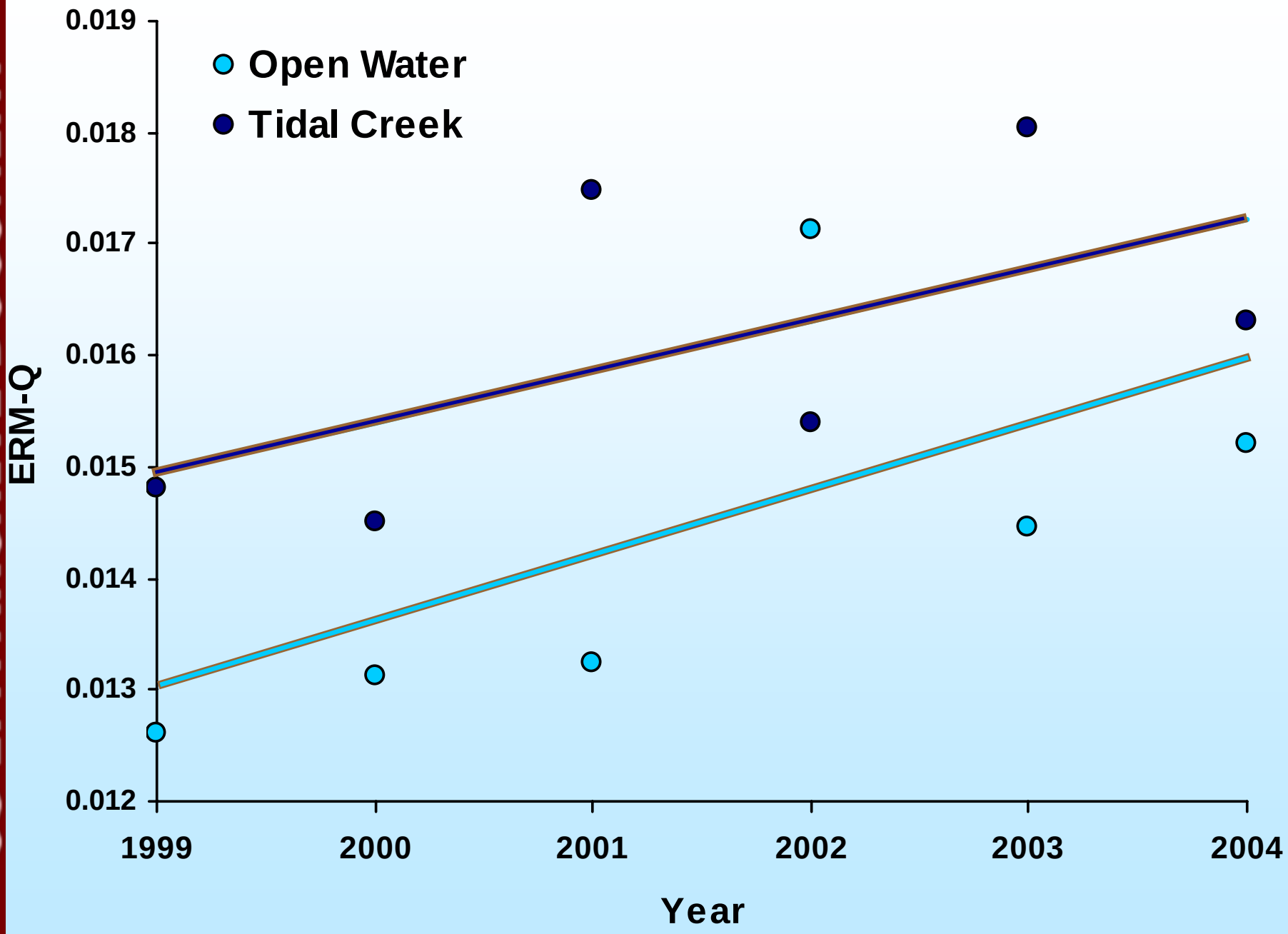
Sediment Quality

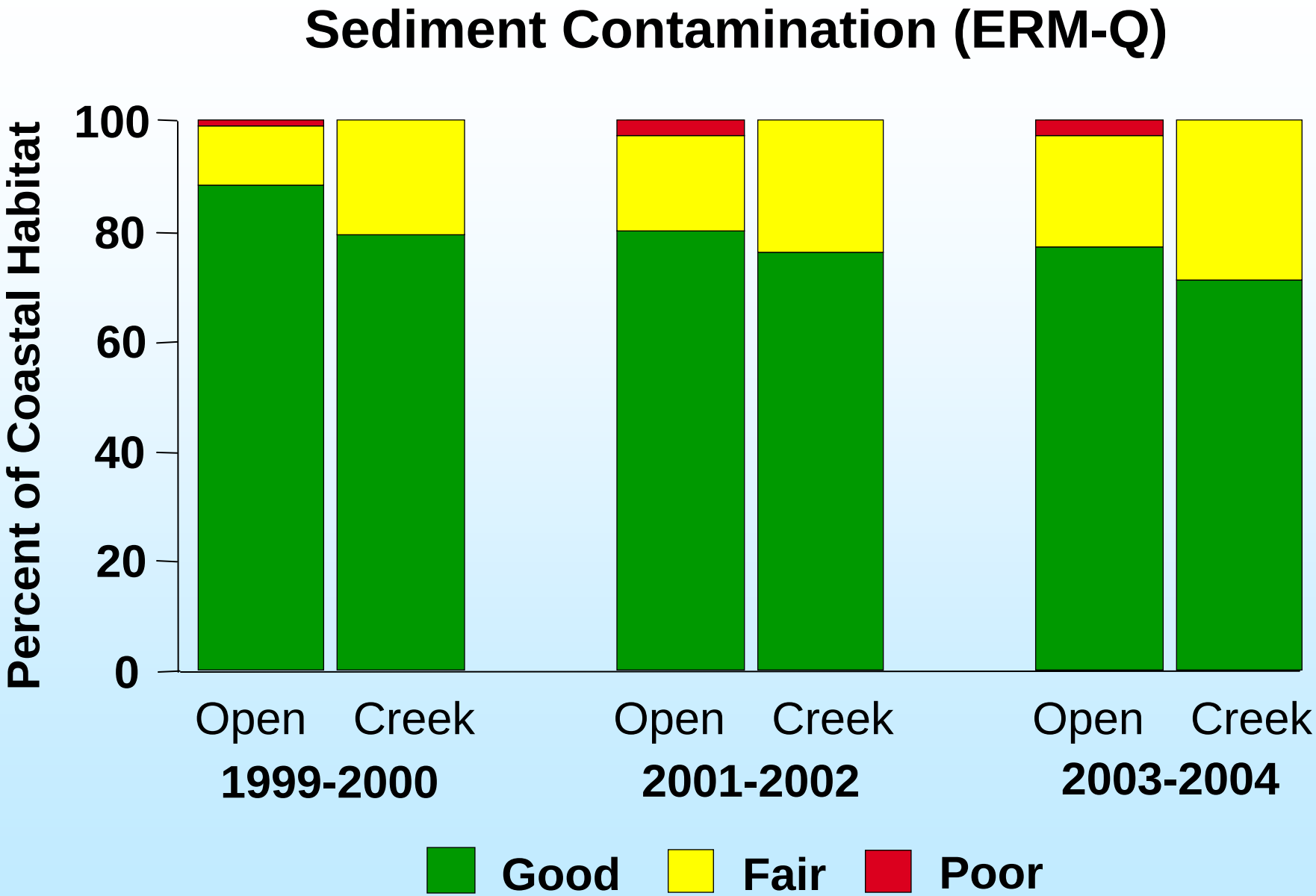
- **Contaminant Concentrations**
  - 24 inorganic and organic
  - ERM-Q (Long et al., 1998)
  - Thresholds related to probability of observing degraded benthos (Hyland et al., 1999)

- **Toxicity Assays**
  - 2-3 whole sediment assays

Trend in Sediment Quality Condition







Integrated Measures

Biological Condition

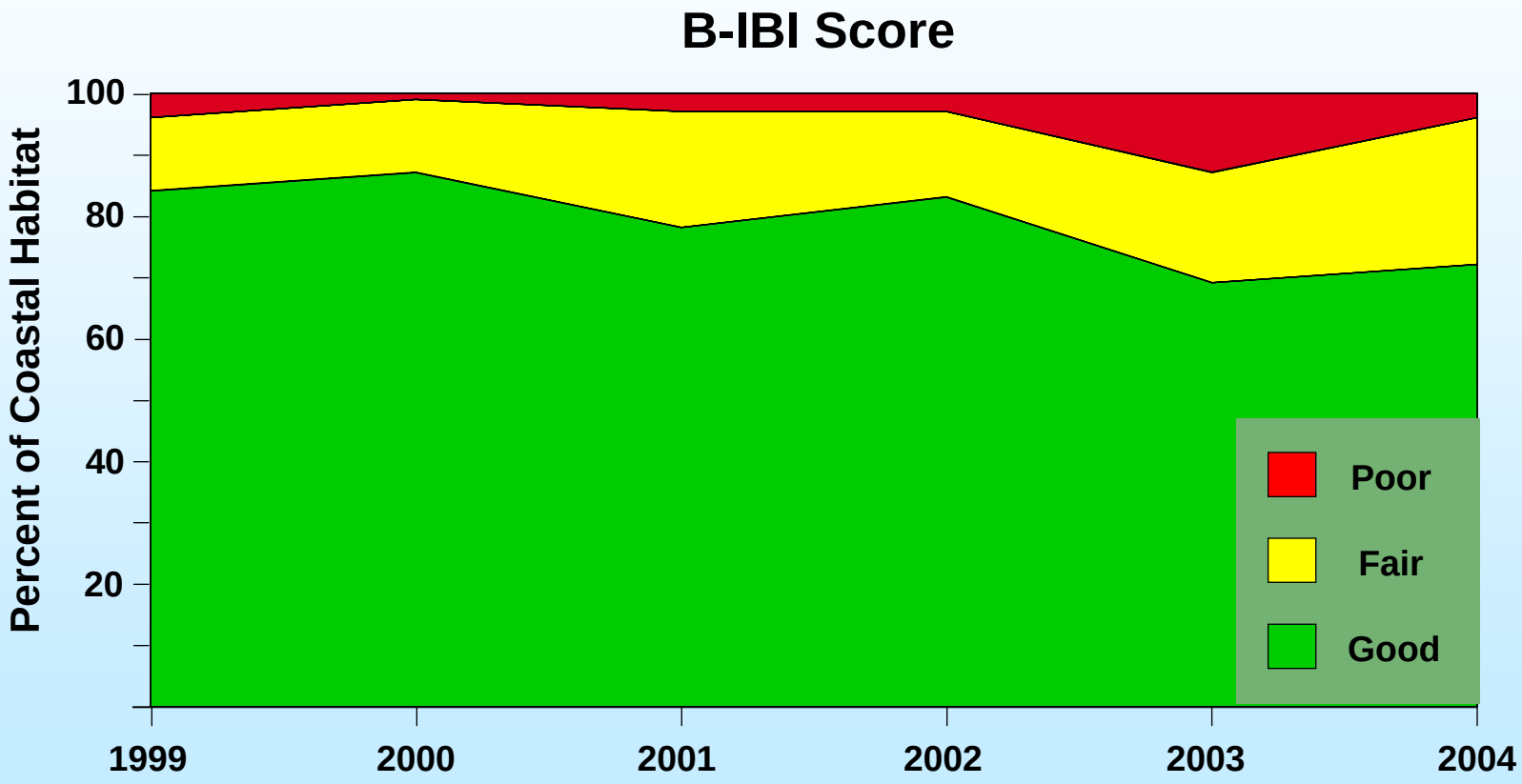
- **Benthic Index of Biotic Integrity (B-IBI) for biological response**
  - ***Described by Van Dolah et al. (1999) for use in Southeast region***

Other Indices of Interest

- **Demersal Finfish / Crustacean IBI**

- **Phytoplankton Composition Index (HABs)**

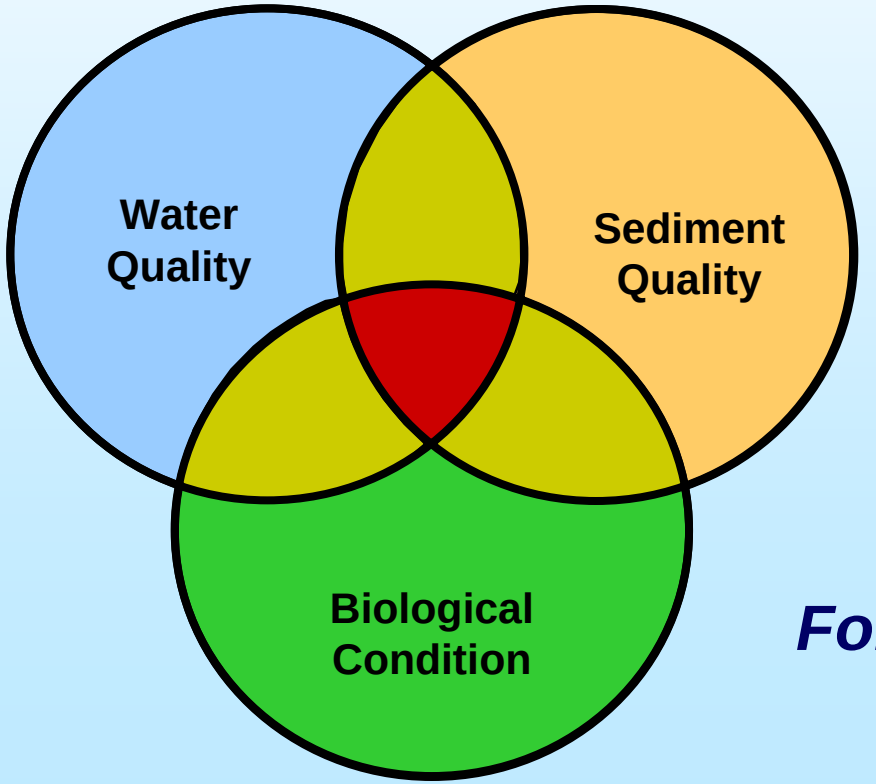
Trend in Benthic Condition Measure



Integrated Measures

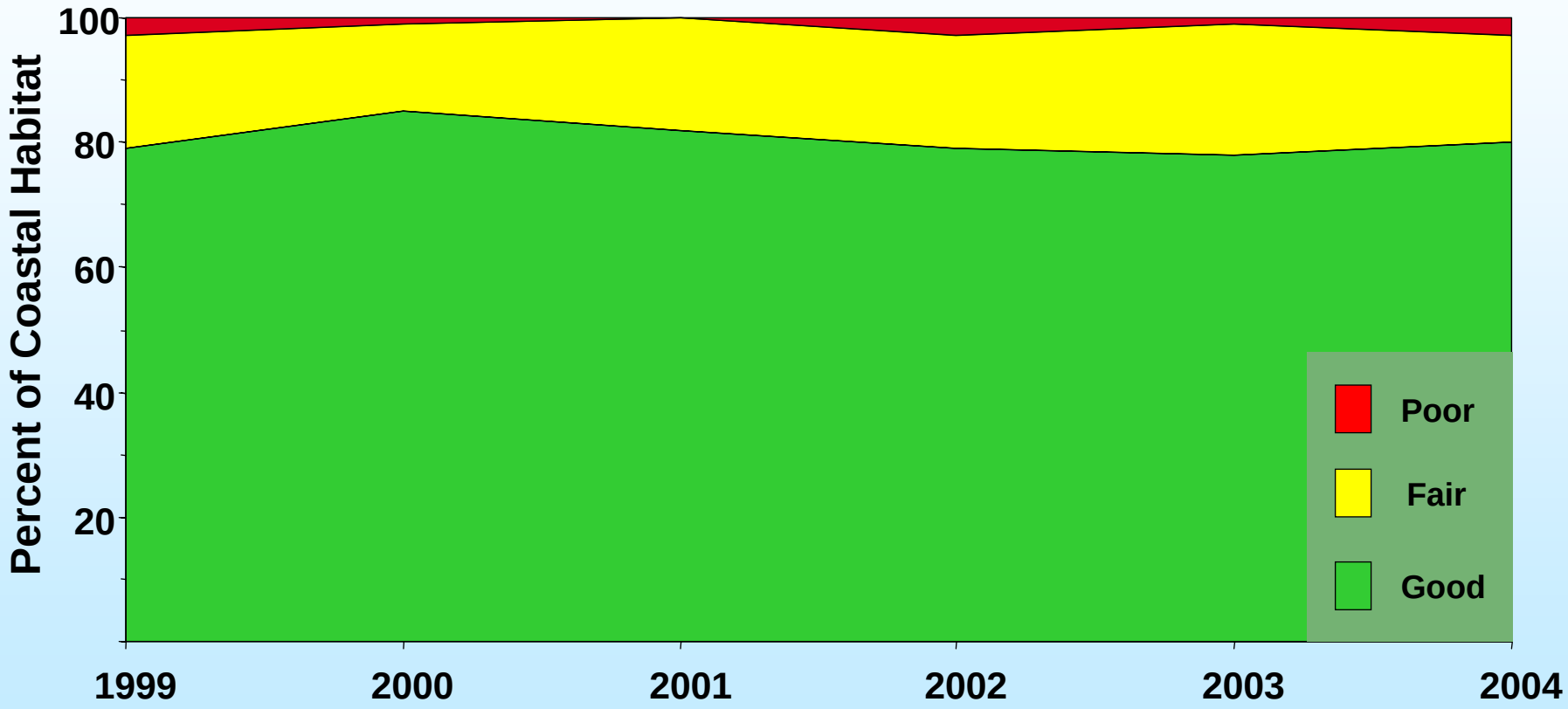
Overall habitat quality

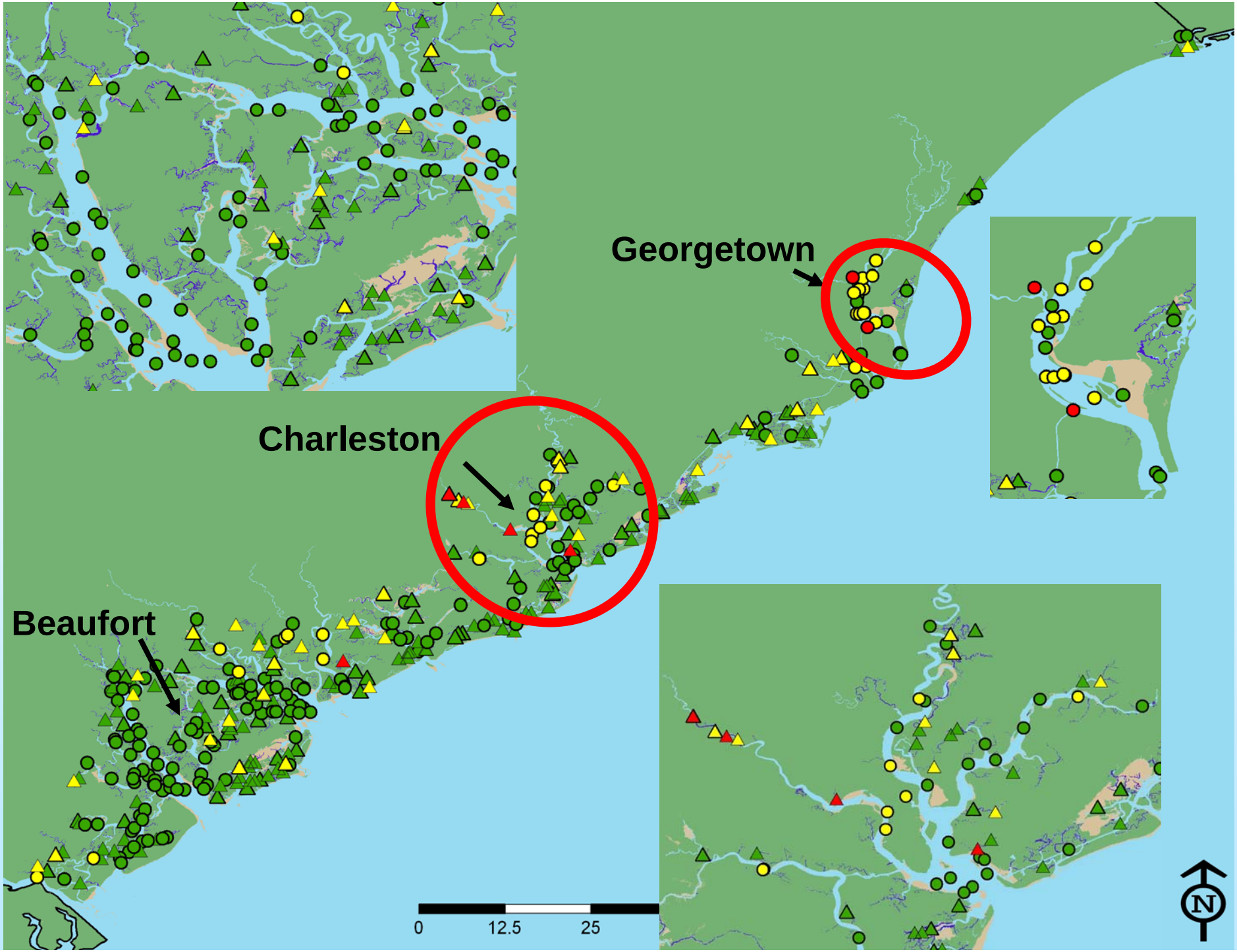
- Averaged scores of each subcomponent into an integrated score for overall habitat quality
- Each component weighted equally



For more information: Google South Carolina SCECAP

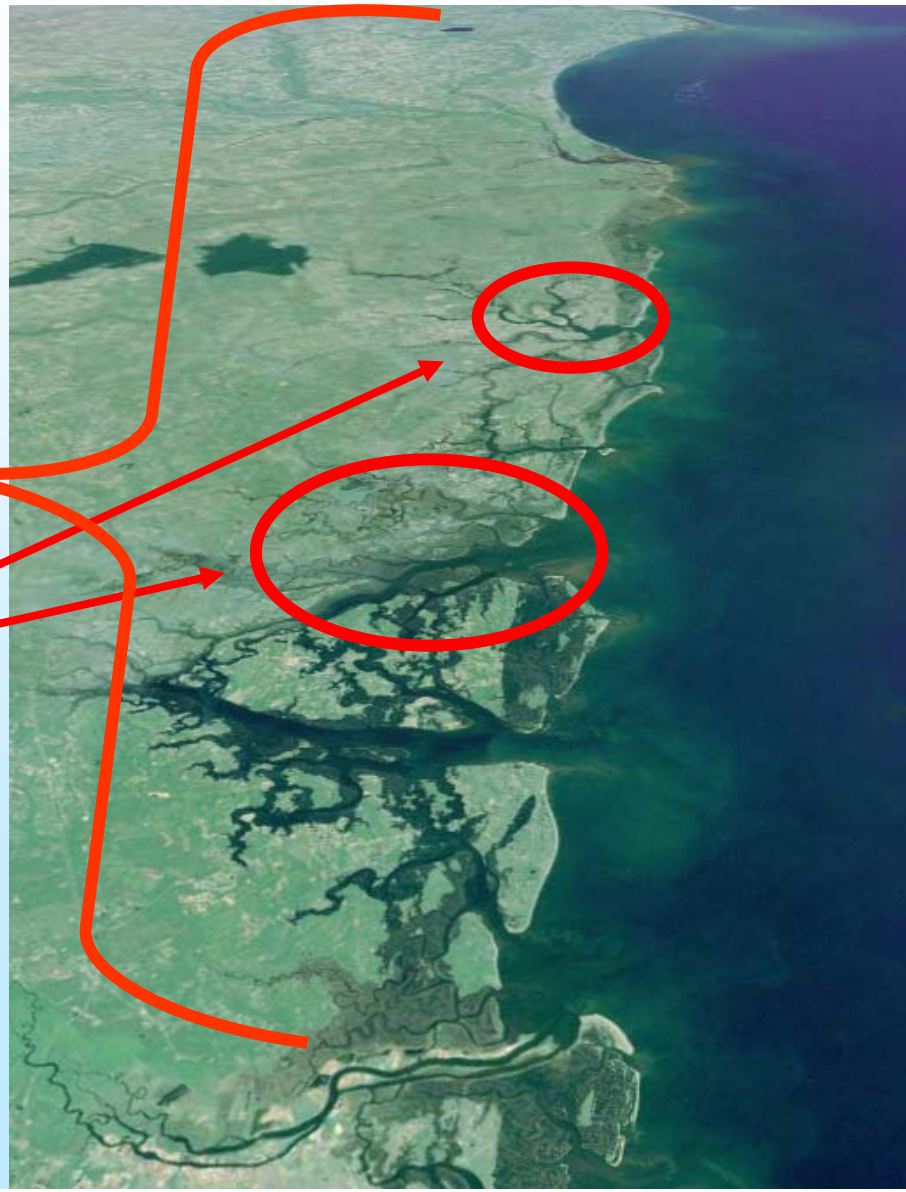
Temporal Change in Overall Habitat Quality Score





Approach Useful at Several Levels

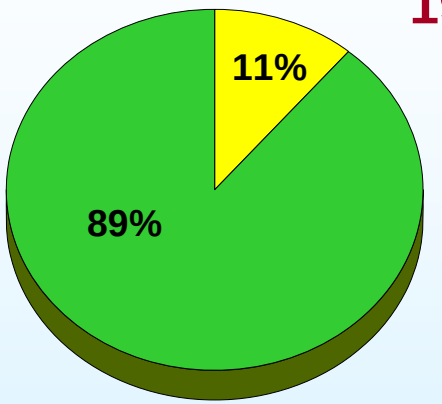
- **State Wide Assessment**
  - Approach used for 305(b), 303(d) reporting
  - Better than index sites
  - Unbiased random sample
  - Represents entire resource
  - Known confidence of estimates
- **Specific watersheds**



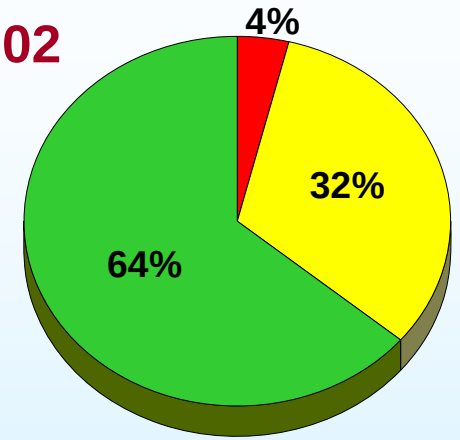
ACE Basin Condition (99-02)

1999-2002

Overall Quality ACE

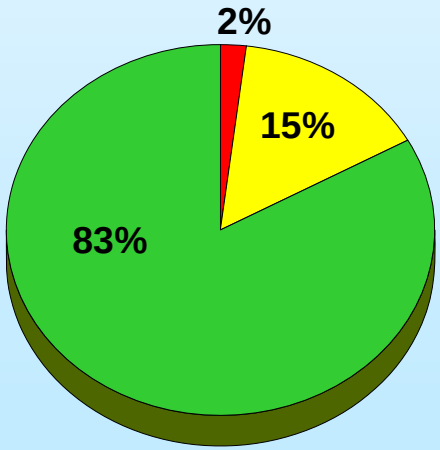


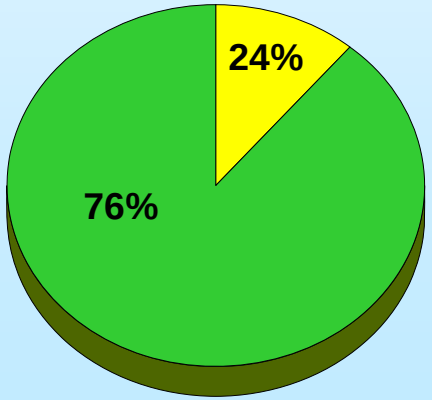
Open

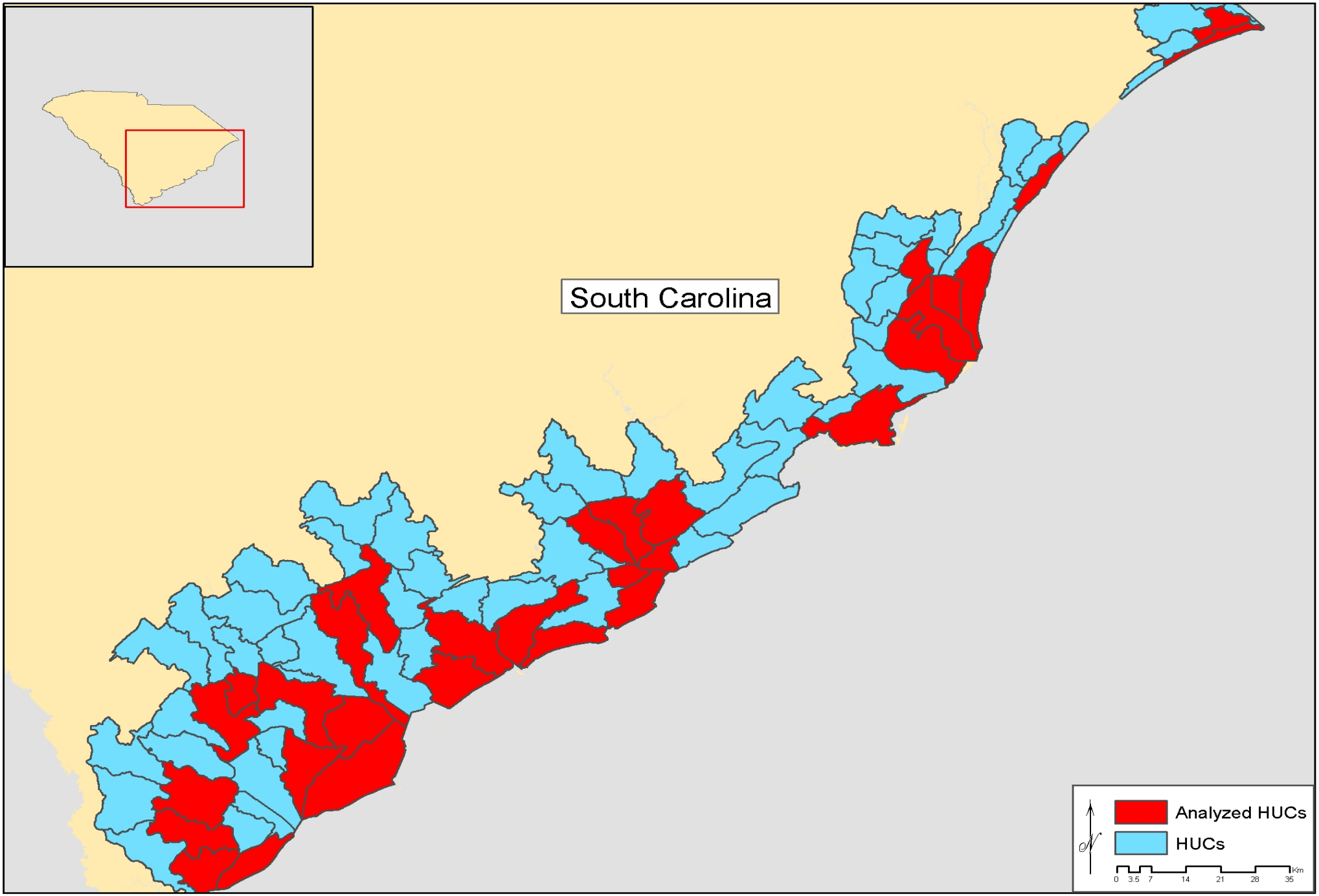


Creeks

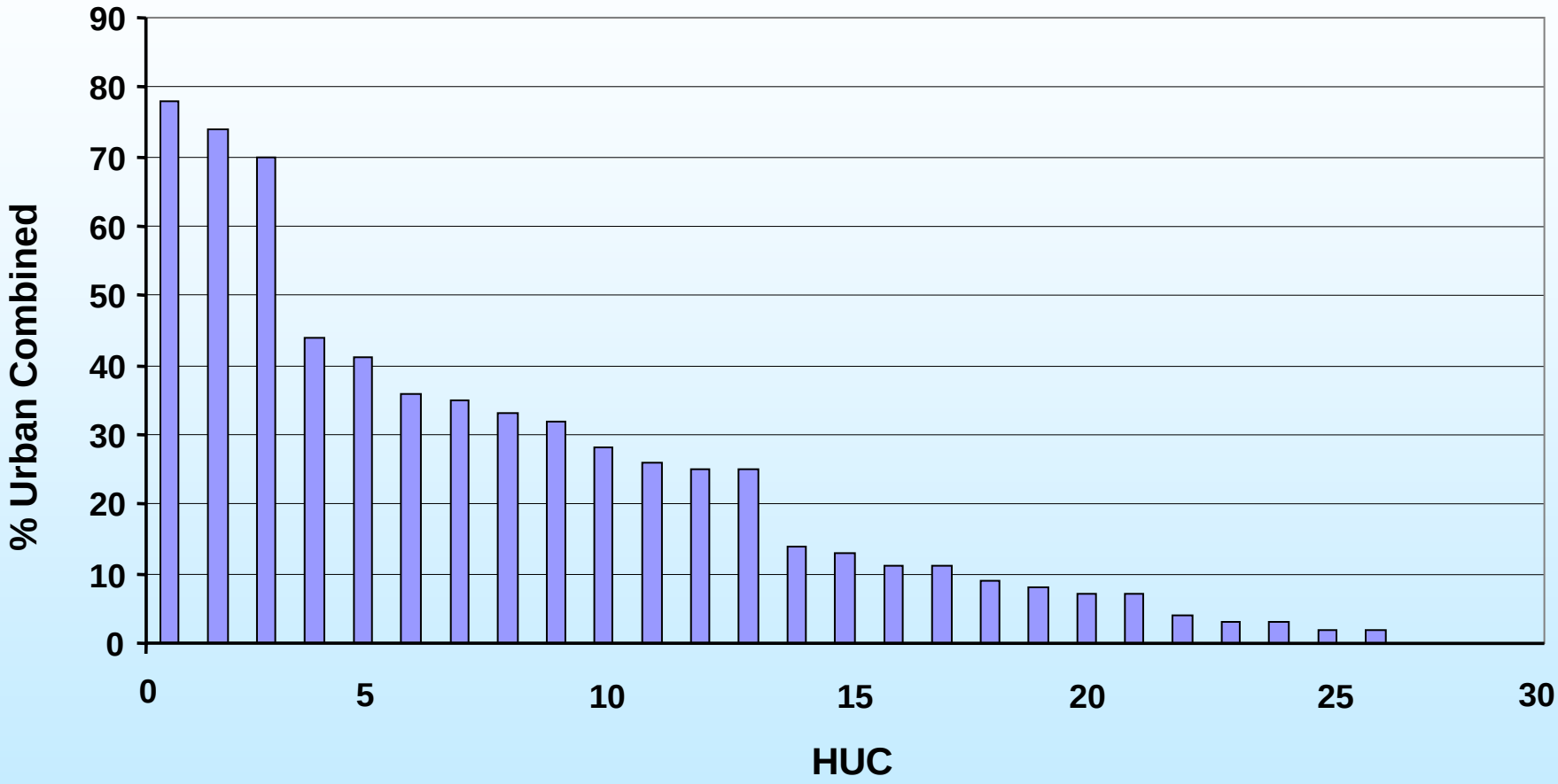
Overall Quality Entire State






South Carolina
Analyzed HUCs
HUCs
0 3.5 7 14 21 28 35
Km

Percent Urban Cover for Analyzed HUCs



Approx.600 Stations with Water and/or Sediment Quality Data

Land Cover vs. Estuarine Sediment Quality

Pearson Correlation Analysis Results

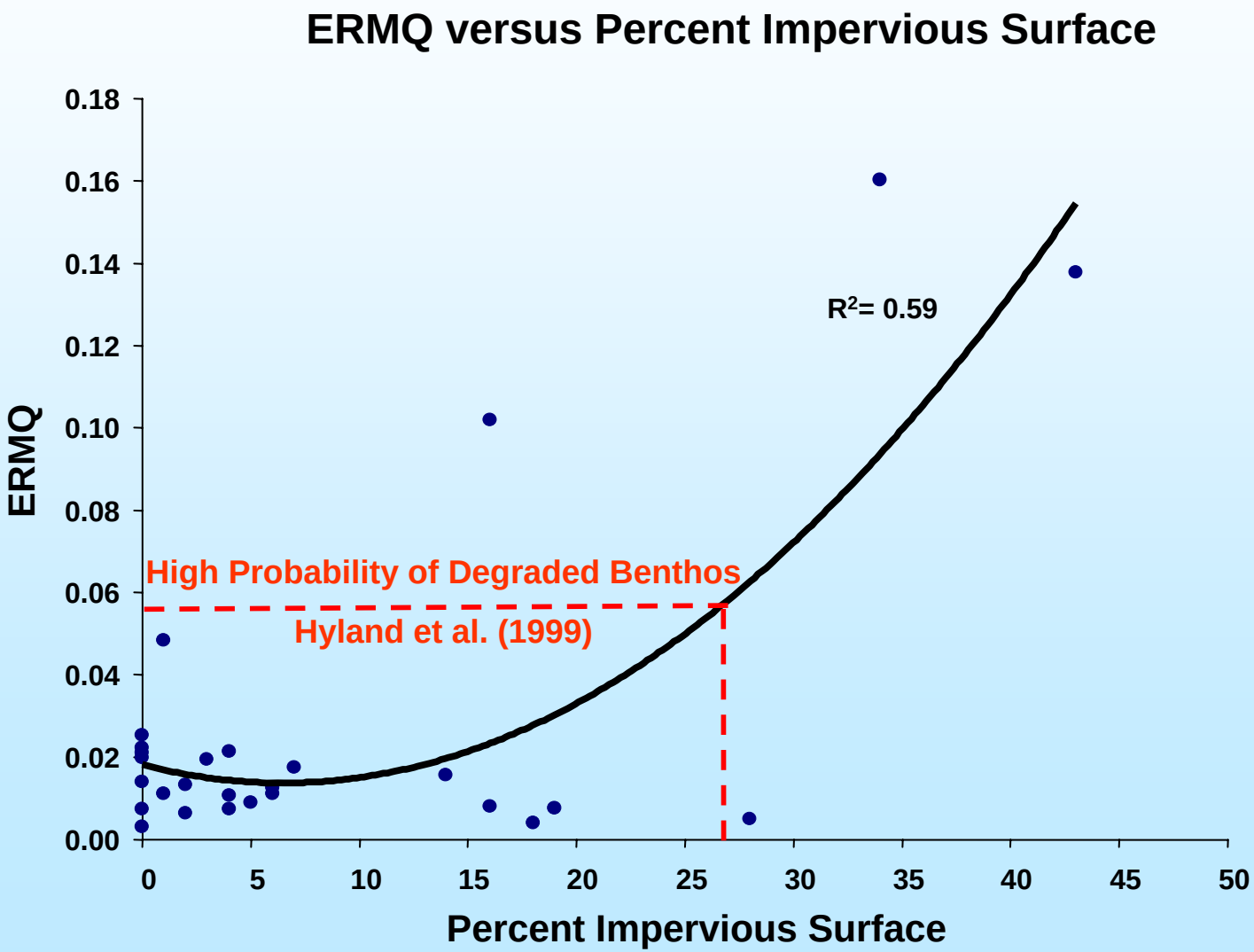
Land Cover Category	Sediment Contaminants					Water
	ERM-Q	PAHs	PCBs	Pest.*	Metals	Fecals
Scrub shrub & forested wetlands	+	-	-	-	+	-
Bare land**	-	-	-	-	-	-
Grassland & pasture & scrub shrub	-	-	-	-	-	-
Deciduous & mixed forest**	-	-	-	-	-	-
Evergreen forest	-	-	-	-	-	-
Cutlivated land	-	-	-	-	-	-
Urban low density	+	+	+	+	+	+
Urban high density	+	+	+	+	+	+
Urban combined	+	+	+	+	+	+
Percent impervious surface	+	+	+	+	+	+

**Spearman rank correlation

P < 0.05

P < 0.10

Land Cover vs. Estuarine Quality



Other Agency Uses

- ***DNR***
  - *Special basin assessments requested by towns, agencies*
  - *Fishery monitoring data (spot, croaker, weakfish)*
- ***DHEC - OCRM***
  - *Assessment of effects of docks in tidal creeks*
- ***NOAA***
  - *Oceans and Human Health Initiative*
  - *Dolphin Health Assessment*
- ***Academic Scientists***

Summary

- ***SCECAP approach is useful to SCDNR and SCDHEC***
  - *Provides unbiased assessment of state's estuarine environmental quality and biotic condition*
  - *Incorporates integrated measures of ecosystem condition*
    - *Unique to most other state monitoring programs*
  - *Useful for evaluating change over time – state wide*
  - *Allows for watershed or county assessments once enough stations*
  - *Robust database useful for basic research in understanding relationships between environmental and biotic condition*

Summary

➢ *State of the Coast - Based on SCECAP*

- *Majority of state's coastal habitat is in good condition*
  - *Water quality index may be refined*
- *Tidal creek habitats tend to be more stressed than larger water bodies*
- *Some evidence of increasing degradation state-wide*
  - *(contaminants, benthos)*
- *Evidence of increased incidence of impaired habitat among sites in developed vs. less developed watersheds*