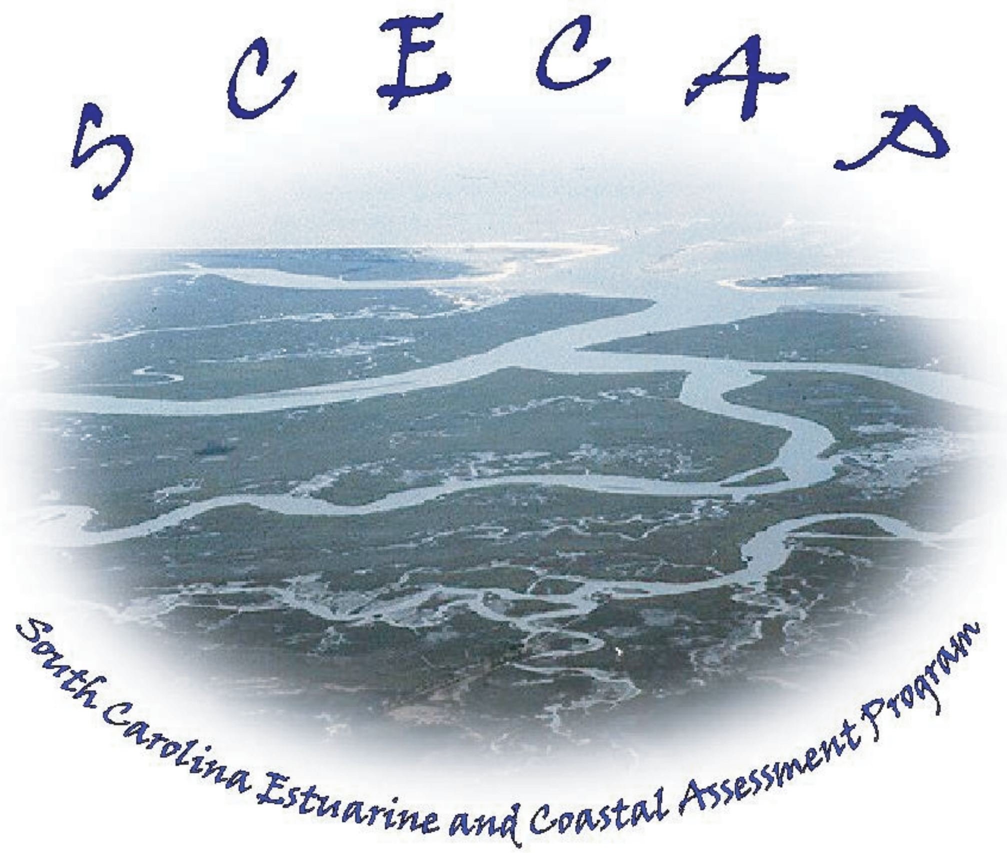
The Condition of South Carolina's Estuarine and Coastal Habitats During 1999-2000

Technical Report



An Interagency Assessment of South Carolina's Coastal Zone

South Carolina Department of Natural Resources

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

United States Environmental Protection Agency

National Oceanic and Atmospheric Administration, U.S. Department of Commerce

U.S. Fish & Wildlife Service, Department of the Interior

The Condition of South Carolina’s Estuarine and Coastal Habitats During 1999 - 2000

Technical Report

Prepared by:

R.F. Van Dolah, P.C. Jutte, G.H.M. Riekerk,
M.V. Levisen, L.E. Zimmerman, J.D. Jones, A.J. Lewitus

Marine Resources Division
South Carolina Department of Natural Resources
P.O. Box 12559
Charleston, SC 29412

D.E. Chestnut, W. McDermott

Bureau of Water
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

D. Bearden, G.I. Scott, M.H. Fulton

Center for Coastal Environmental Health and Biomolecular Research
NOAA NOS CCEHBR Laboratory
219 Ft. Johnson Rd
Charleston, SC

Technical Report No. 90

2002

This document should be cited as follows:

Van Dolah, R.F., P.C. Jutte, G.H.M. Riekerk, M.V. Levisen, L.E. Zimmerman, J.D. Jones, A.J. Lewitus, D.E. Chestnut, W. McDermott, D. Bearden, G.I. Scott, M.H. Fulton. 2002. The Condition of South Carolina's Estuarine and Coastal Habitats During 1999-2000: Technical Report. Charleston, SC: South Carolina Marine Resources Division. Technical Report No. 90. 132p.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

In 1999, the South Carolina Department of Natural Resources (SCDNR) and the South Carolina Department of Health and Environmental Control (SCDHEC) initiated a collaborative coastal monitoring program entitled the "South Carolina Estuarine and Coastal Assessment Program" (SCECAP). The goal of SCECAP is to monitor the condition of the state's estuarine habitats and associated biological resources on an annual basis. This program significantly expands ongoing monitoring efforts by each agency and draws upon the expertise of both in a cooperative effort. SCECAP integrates measures of water quality, sediment quality and biological condition at a large number of sites throughout the state's coastal zone. It also expands historical monitoring activities that have primarily focused on open water habitats (e.g. bays, sounds, tidal rivers) to include an assessment of conditions in tidal creeks, which serve as important nursery habitat for most of the economically valuable species. Many of these tidal creeks are also the first point of entry for non-point source runoff from upland areas and therefore provide an early indication of anthropogenic stress (Holland *et al.*, 1997; Sanger *et al.*, 1999a,b; Lerberg *et al*, 2000; Van Dolah *et al.*, 2000).

The SCECAP initiative was developed as an outgrowth of other SCDHEC and SCDNR monitoring activities. From 1993 through 1995, SCDNR participated in the Environmental Monitoring and Assessment Program (EMAP) conducted in the southeast by the U.S. Environmental Protection Agency (USEPA) and the National Atmospheric and Oceanic Administration (NOAA) (Ringwood *et al*., 1995; Hyland *et al*., 1996, 1998). While that program provided valuable information on the overall environmental quality of southeastern estuaries using a combination of water, sediment, and biological condition measures, the number of sites within South Carolina was too limited to make adequate assessments at the state level. Additionally, it did not include measures of some water quality parameters desired by both SCDHEC and SCDNR. In 1998, SCDHEC redesigned its Ambient Surface Water Quality Monitoring Network to include a probability-based component and to expand its estuarine monitoring effort. At the same time, SCDNR expanded its efforts to assess the condition of South Carolina estuaries. Following planning meetings to incorporate the joint interests and expertise of both agencies and improve efficiency by eliminating redundancy in sampling effort, SCECAP was launched.

The 1999 sampling effort represented a pilot sampling period to test the feasibility of completing all sampling at approximately 60 stations located throughout the state's coastal waters within a restricted (summer) index period. The summer period was selected since it represents a period when some water quality variables may be limiting to biota and it is a period when many of the fish and crustacean species of concern are utilizing the estuary for nursery habitat. The program was expanded slightly in 2000 to include additional measures desired by the USEPA National Coastal Assessment Program (formerly designated as the Coastal 2000 Program).

This technical report is the first of a series planned to provide periodic updated information on the condition of South Carolina's estuarine habitats. The data highlight the value of evaluating tidal creek habitats separately from larger open water bodies due to significant differences noted in many of the parameters measured. The report also includes newly developed integrated measures of water quality, sediment quality and biological condition to better evaluate overall habitat condition at each site and for the estuarine and coastal waters of the whole state. As the program continues, the parameters and threshold criteria used for these integrated measures may be modified to better reflect natural differences among habitats based on deviations from normal conditions or relative to published criteria or guidelines.

2. METHODS

The sampling and analytical methods used for SCECAP are similar to those described for the EMAP estuarine surveys completed in the Carolinian Province (Hyland *et al*., 1996, 1998), but include many supplemental water quality measures that were not part of that program. These supplemental measures utilize methods consistent with SCDHEC's water quality monitoring program (SCDHEC, 2001) and the National Coastal Assessment Program.

2.1. Sampling Design

Approximately 60 stations were selected for sampling each year, with all sites located in the coastal zone extending from the saltwater – freshwater interface to near the mouth of each estuarine drainage basin and extending from the Little River Inlet at the South Carolina - North Carolina border to the Wright River near the South Carolina - Georgia border. The Savannah River is not included in the SCECAP initiative, but is being sampled by the Georgia Coastal Resources Division as part of the USEPA National Coastal Assessment Program.

Approximately 50% of the stations were located in tidal creeks and the remainder were located in the larger open water bodies that form South Carolina's tidal rivers, bays and sounds. Tidal creeks are defined as those estuarine water bodies less than 100 m wide from marsh bank to marsh bank. Portions of the state's coastal waters that are too shallow to sample at low tide were excluded from the station selection process. Each habitat was defined using one or more of the following Geographic Information System (GIS) coverages: Hydrographic Digital Line Graphs (DLG), National Wetland Inventory (NWI) 1994 database, USGS Digital 7.5' Topographic Quadrangle Maps, and the Coastal Change Analysis Program (CCAP) 1995 database. Using this approach, approximately 17% of the state's estuarine waters represent creek habitat, with the remaining 83% representing the larger open water areas (Figure 2.1). Intertidal flats, including both mud flats and vegetated salt marsh, were excluded from the estimates of both habitats.

Stations within each habitat type (tidal creeks, open water) were selected using a probability-based, random tessellation, stratified sampling design (Stevens, 1997; Stevens and Olsen, 1999), with new station locations picked each year. Actual sampling locations were recorded using a Global Positioning System (GPS). All stations had to have a minimum water depth of approximately 1 m since some sampling components required visits that cannot be limited by tidal stage, and other sampling components are limited to periods within three hours of low tide.

All stations were sampled once during the summer months (mid June through August) for the core monitoring program described in this report. Most of the measures were collected within a 2-3 hr time period; however, some of the water quality data include time-series measures collected over a longer time period (up to 25 hrs).

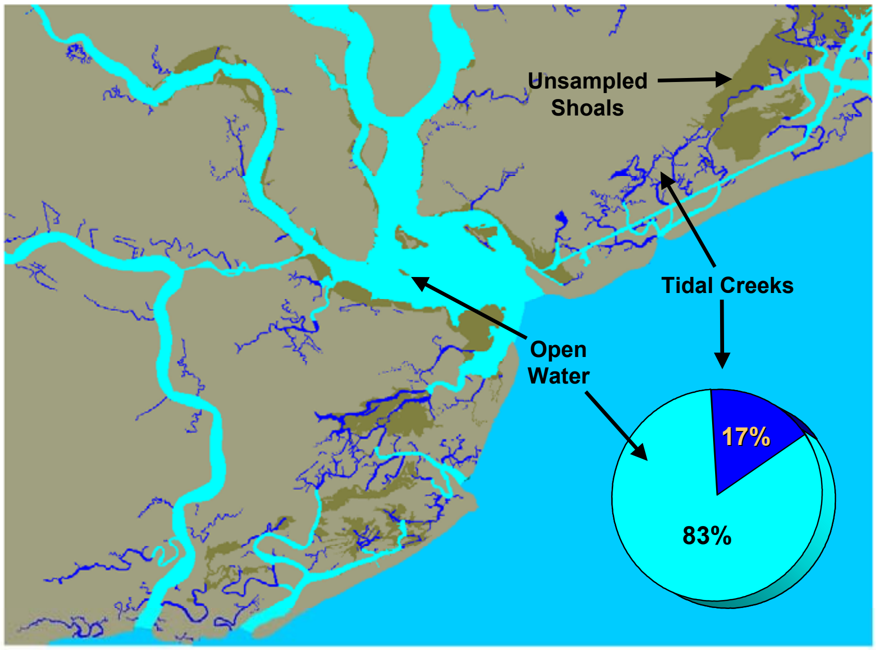


Figure 2.1. Depiction of tidal creek and open water habitats in the Charleston Harbor area. The pie chart shows the percentage of each habitat for the whole coastal zone, excluding the un-sampled shoals (primarily mud flats) and vegetated salt marsh.

During each station visit, sampling crews noted whether there were any urban/suburban development or industrial sites visible within 1 km or greater than 1 km from the station. The presence of litter was also recorded.

2.2. Water Quality Measurements

Water quality measurements and samples were generally collected prior to deployment of other sampling gear to ensure that bottom disturbance did not affect these measures. When water sampling did not occur first, the sampling crews waited until tidal currents had removed any effects of bottom disturbance before collecting water quality measures that would be affected by this disturbance.

Instantaneous water quality measurements included near-surface and near-bottom measurements of dissolved oxygen, salinity, and temperature using Yellow Springs Instrument (YSI) Inc. Model 85 water quality meters and near-surface measures of pH using a pHep® 3 field microprocessor meter. The near-surface measurements were collected approximately 0.3 meters below the surface and the near-bottom measurements were collected approximately 0.3 meters above the bottom. More complete time-profile measurements of all four parameters were also obtained from the near-bottom waters of each site using either YSI Model 6920 multiprobes or Hydrolab DS-3 and DS-4 datasondes. Measurements were logged at 15 min intervals for a minimum of 25 hrs to record readings over two complete tidal cycles.

Secchi disk readings were collected beginning in 2000. All readings were taken to the nearest 0.1 m using a solid white disk with measurement protocols standardized to reduce or eliminate readings that may be affected by surface wave chop or glare.

Water quality samples included near-surface measures of total nitrate/nitrite nitrogen, total Kjeldahl nitrogen (TKN), ammonia, total phosphorus, total organic carbon (TOC), total alkalinity, turbidity, five-day biochemical oxygen demand (BOD_5), and fecal coliform concentration. In 2000, additional measures of dissolved nutrients were collected. These included ammonia, inorganic nitrogen (DIN), organic nitrogen (DON), inorganic phosphorus (orthophosphate or OP), organic phosphorous (DOP), organic and inorganic carbon (DOC, DIC), and silica (DS). All samples were collected by inserting pre-cleaned water bottles to a depth of 0.3 m depth inverted and then filling the bottle directly at that depth. Dissolved nutrient samples were either filtered in the field through a 0.45 μm pore cellulose acetate filter or in the laboratory through pre-combusted GF/F glass-fiber filters or 0.045 μm cellulose acetate filters, depending on the analysis. The bottles were then stored on ice until brought to the laboratory for further processing. Total nutrients, total organic carbon, total alkalinity, turbidity, BOD_5 and fecal coliform bacteria samples were processed using standardized procedures described by SCDHEC (1997, 1998b). Dissolved nutrients were processed through the University of South Carolina using a Technicon AutoAnalyzer and standardized procedures described by Lewitus *et al.* (in press). DOC and DIC were measured using a Shimazu TOC 500, and DON and DOP were calculated by subtracting total inorganic from total dissolved N or P, measured by the persulfate oxidation technique (D'Elia *et al.,* 1977).

2.3. Biological and Sediment Sampling

Estimates of phytoplankton biomass were made using chlorophyll measurements. In 1999, two 50 ml samples of water were collected approximately 0.3 m below the surface. Following agitation to homogenize the sample, 50 ml were removed using a syringe and filtered through a Whatman GFC filter to concentrate the sample. The filter was immediately placed in a labeled centrifuge tube with 25 ml of acetone with $MgCO_3$ and stored on ice in the dark for transport to the laboratory where they were frozen until processed. Processing generally occurred within 48 hours of collection by centrifuging the thawed sample extraction and quantifying the supernatant on a Turner Model 10-AU fluorometer. Chlorophyll-a sample collection and laboratory measurements completed for the 2000 sampling period followed standardized protocols described by SCDHEC (2000). A subset of duplicate samples were collected in 1999 and processed by the SCDHEC using their standardized protocols to ensure that both methods were consistent.

Following the water sample collections, several replicate grab samples were collected at each station to evaluate sediment characteristics, sediment contaminant levels, and benthic community composition. A total of 8-10 grab samples (dependent on volume/grab) were collected at each site using a stainless steel 0.04 m^2 Young grab sampler from an anchored boat, with the boat repositioned between each sample to ensure that the same bottom was not sampled twice, and to spread the samples over a 10-20 m^2 bottom area. Grab samplers were thoroughly cleaned prior to field sampling and were rinsed with isopropyl alcohol between stations.

Three of the grab samples were collected for analysis of benthic community composition. These samples were washed through a 0.5 mm sieve to collect the benthic fauna and preserved in a 10% buffered formalin-seawater solution containing rose bengal stain. The remaining grab samples were used to obtain a sediment composite sample for analysis of sediment composition, contaminants, and sediment toxicity. Only the surficial sediments (upper 5 cm) were collected from these grabs and combined to produce a composite sample that was thoroughly stirred and subdivided into separate containers for use in sediment bioassays (amphipod, seed clam, microtox tests), sediment characterization analyses (sand vs. silt/clay content, total organic carbon), porewater analyses (pH, salinity, and ammonia), and analysis of sediment contaminants (metals, organic compounds). The composite samples were kept on ice until brought to the laboratory, and then stored either at 4^{o}C (toxicity, porewater) or frozen (contaminants, sediment composition, TOC) until analyzed.

Particle size analyses were performed using a modification of the pipette method described by Plumb (1981). Percentages of sand ($\geq$ 63 μm) were determined by separation through a 63 μm sieve. Silt and clay fractions (< 63 μm) were determined through timed pipette extractions. Pore water ammonia was measured using a Hach Model 700 colorimeter and TOC was measured on a Perkin Elmer Model 2400 CHNS Analyzer.

Contaminants measured in the sediments included 14 metals, 25 polycyclic aromatic hydrocarbons (PAHs), 30 polychlorinated biphenyls (PCBs), and 23 pesticides. All contaminants were analyzed by the NOAA-NOS Center for Coastal Environmental Health and Biomolecular Research (CCEHBR) using the following protocols. Extraction and sample preparation for organic compounds were similar to those described by Krahn *et al.* (1988) and Fortner *et al.* (1996). Samples were then extracted with CH_2Cl_2 using accelerated solvent extraction, concentrated by nitrogen blow-down, and cleaned by gel permeation chromatography solid phase fractionation, where necessary. PAHs were quantified by capillary gas chromatograph-ion trap mass spectrophotometry. Organochlorine pesticides and PCBs were analyzed using dual column gas chromatography with electron capture detection using methods similar to those described by Kucklick *et al*. (1997). Trace metals were analyzed using methods similar to those described by Long *et al.* (1997) using inductively coupled plasma mass spectrometry for Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Ni, Sn, Zn and by graphite furnace atomic absorption for Ag and Se. Mercury was analyzed by cold-vapor atomic absorption.

Sediment toxicity was measured using two assays in 1999 and three in 2000. The Microtox solid-phase assay and a 7-day seed clam growth assay were used in 1999. The Microtox assay utilizes a photoluminescent bacterium, *Vibrio fischeri*, to provide a toxicity measure based on the attenuation of light production by the bacterial cells due to toxicant exposure. Protocols described by the Microbics Corporation (1992) were used. Toxicity was based on criteria described by Ringwood *et al.* (1997), which accounts for variations in response due to sediment composition. The seed clam assay exposed juvenile *Mercenaria mercenaria* to sediments for a 7-day period using protocols described by Ringwood and Keppler (1998). Sediments were considered to be toxic if growth (dry weight) was < 80% of that observed in control sediments and there was a statistically significant difference ($p < 0.05$). A 10-day whole sediment amphipod assay was included in 2000. This assay used *Ampelisca abdita* and followed standard ASTM protocols (ASTM, 1993). Sediments were considered toxic if survival was < 80% of that observed in control sediments and the difference was statistically significant ($p < 0.05$).

Benthic samples were sorted in the laboratory to separate organisms from the sediment remaining in the sample. All organisms were then identified to the species level, or the lowest practical level possible if the specimen was damaged or too immature for accurate identification. A reference collection of all benthic species collected for this program is being maintained at the SCDNR Marine Resources Research Institute.

Fish and large crustaceans (primarily penaeid shrimp and blue crabs) were collected at each site following the benthic sampling to evaluate community composition. Two replicate tows were made at each site using a 4-seam trawl (18 ft foot rope, 15 ft head rope and ¾ in. bar mesh throughout). Trawl tow lengths were standardized to 0.5 km for open-water sites and 0.25 km for creek sites. Tows were made only during daylight hours with the current, and boat speed standardized as much as possible. Tows made in tidal creeks were limited to periods when the marsh was not flooded (approx. 3 hrs ± mean low water). This limitation was also generally applied to open water sites. Catches were sorted to lowest practical taxonomic level, counted, and checked for gross pathologies, deformities or external parasites. All organisms were measured to the nearest centimeter and weighed to the nearest gram, although accuracy was considered to be no better than ± 20% due to problems with wave action and wind affecting the scale in some situations. When more than 25 individuals of a species were collected, the species was subsampled. Mean abundance and biomass of finfish and crustaceans were corrected for the total area swept by the two trawls, using the following formula (Krebs, 1972):

$$\text{Area swept (A)} = \frac{\text{Distance (D) x (0.6 Head rope length (H))}}{10{,}000\ \text{m}^2\ \text{ha}^{-1}}$$

In 2000, fish samples were also obtained from the trawl samples for contaminant analyses. Species targeted included silver perch (*Bairdiella chrysoura*), spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonius undulatus*), and weakfish (*Cynoscion regalis*). All fish samples were wrapped in foil and stored on ice in plastic bags until they could be frozen in the laboratory. Sample analyses included the entire fish, which were rinsed and then homogenized in a stainless blender. Extraction and analytical procedures were similar to those described for sediments.

2.4. Habitat Evaluation

Observations were made at each site prior to departure to document the presence of litter (within the limits of the trawled area), and to note the proximity of the site to urban/suburban development, industrial development, or marinas/private docks.

2.5. Quality Assurance

The SCECAP initiative includes a rigorous quality assurance and quality control program to ensure that the database is of high quality. A copy of the Quality Assurance

Project Plan is maintained at the SCDNR Marine Resources Research Institute and has been approved by the USEPA National Coastal Assessment Program.

2.6. Data Analyses

Comparisons of most water quality, sediment quality and biological measures were completed using standard parametric tests or non-parametric tests where the values could not be transformed to meet parametric test assumptions. Since our primary comparisons were between tidal creek and open water habitats within each year, a t-test or non-parametric Mann-Whitney U test was typically used. Comparisons involving more than two station groups or multiple years were generally completed using ANOVA or Kruskal-Wallis non-parametric tests when data could not be adequately transformed.

Use of the probability-based sampling design provides an opportunity to statistically estimate, with confidence limits, the proportion of South Carolina's overall creek and open water habitat that falls within ranges of values that were selected based either on (1) state water quality criteria, (2) historical measurements collected by SCDHEC from 1993-1997 in the state's larger open water bodies (SCDHEC, 1998a), or (3) other thresholds indicative of stress based on sediment chemistry or biological condition (Hyland *et al*., 1999; Van Dolah *et al,* 1999). These estimates are obtained through analysis of the cumulative distribution function (CDF) using procedures described by Diaz-Ramos *et al*. (1996). An example of the output from the CDF analysis is shown in Figure 2.2.

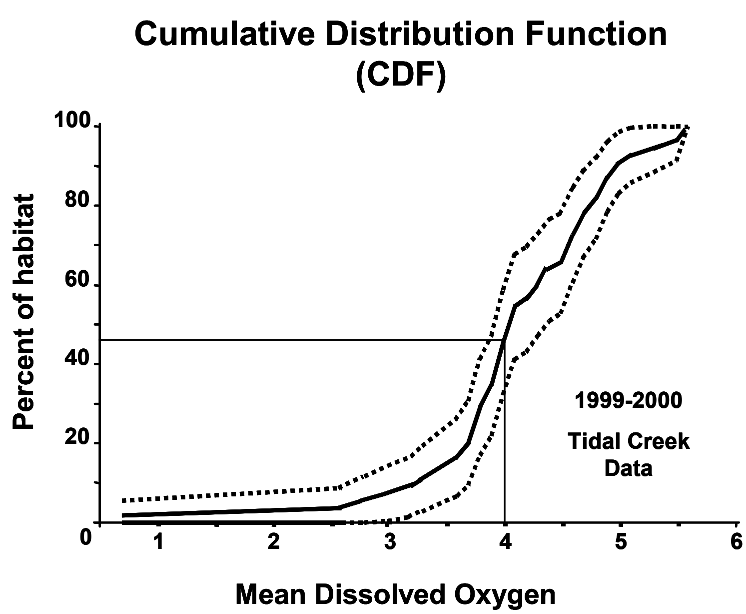


Figure 2.2. Example of a CDF analysis using dissolved oxygen data from tidal creeks. The dotted line shows upper and lower 95% confidence limits. Based on these data, 46% of the state's tidal creek habitat has a daily average bottom dissolved oxygen concentration ≤ 4 mg / L during the summer index sampling period.

3. RESULTS AND DISCUSSION

3.1. Station Array

Samples were collected from 56 stations in 1999 and 60 stations in 2000. Fifty-seven of the sites were tidal creeks and 59 were in larger open water bodies. Specific site locations and sampling dates are provided in Figures 3.1.1 - 3.1.4 and Appendix 1.1. The average depth of the open water sites sampled during the two-year period was 4.8 m and ranged from 1 – 15 m (Appendix 1.1). Average depth of the tidal creek sites was 2.2 m and ranged from approximately 1 to 6 m.

3.2. Water Quality

A summary of both the instantaneous and continuous measures of the basic water quality parameters (temperature, salinity, dissolved oxygen, pH,) obtained during each year are provided in Appendix 2.1. The data obtained from the 25-hr instrument deployments provided comprehensive information on basic water quality conditions. Measurements were made at 15 minute intervals over two complete tidal cycles and included both day and night readings. These data are treated as the primary data set in our analyses of basic water quality. Comparisons were made with the instantaneous readings to identify where differences occur. Appendices 2.2 - 2.4 summarize the other measures of water quality (total and dissolved nutrients, biological oxygen demand, turbidity, total alkalinity, fecal coliform bacteria, and total organic carbon) obtained at each site by year.

The SCDHEC has developed State regulations 61-68 and 61-69 to protect the water quality of the state (SCDHEC, 2001b). The water quality standards include numeric and narrative criteria that are used for setting permit limits on discharges to waters of the State, with the intent of maintaining and improving surface waters "to a level to provide for the survival and propagation of a balanced indigenous aquatic community of flora and fauna and to provide for recreation in and on the water." Occasional short-term departures from these conditions will not automatically result in adverse effects to the biological community. The standards also recognize that deviations from these criteria may occur due solely to natural conditions and that the aquatic community is adapted to such conditions. In such circumstances the variations do not represent standards violations, and critical conditions of the natural situation, e.g. low flow, high temperature, minimum dissolved oxygen, etc., are used as the basis of permit limits.

All data collected by SCECAP from field observations and water samples are related to water quality standards for the state's saltwaters (SCDHEC, 2001b) where possible. Because SCECAP samples are limited to a summer index period and generally do not include multiple samples over time, the data are not appropriate for use in USEPA 303(d) or 305(b) reporting requirements. Additionally, there are no USEPA or state water quality standards for many of the parameters measured in this program. For those measures,

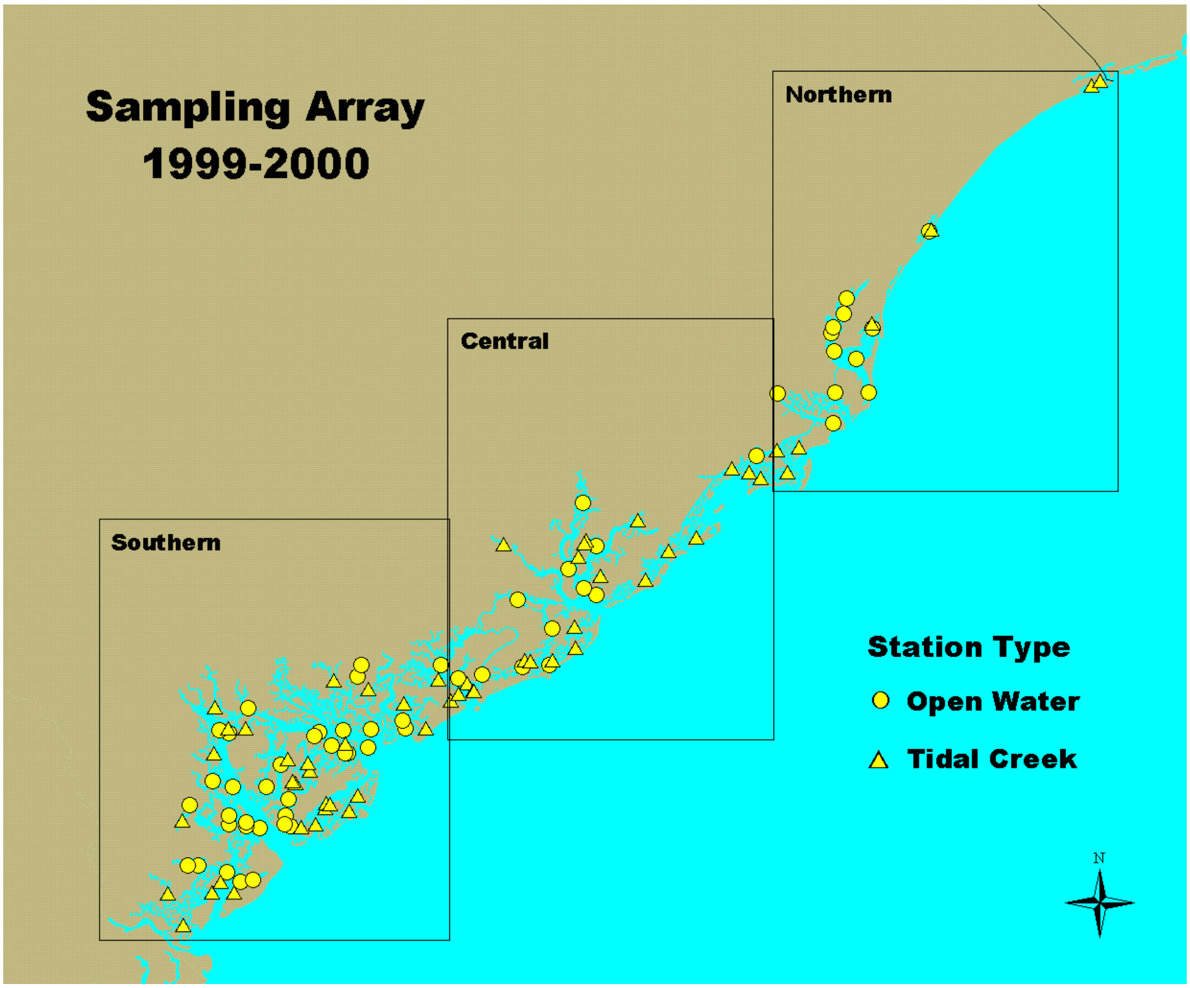


Figure 3.1.1. Distribution of open water and tidal creek stations sampled throughout South Carolina's coastal zone during 1999 – 2000.

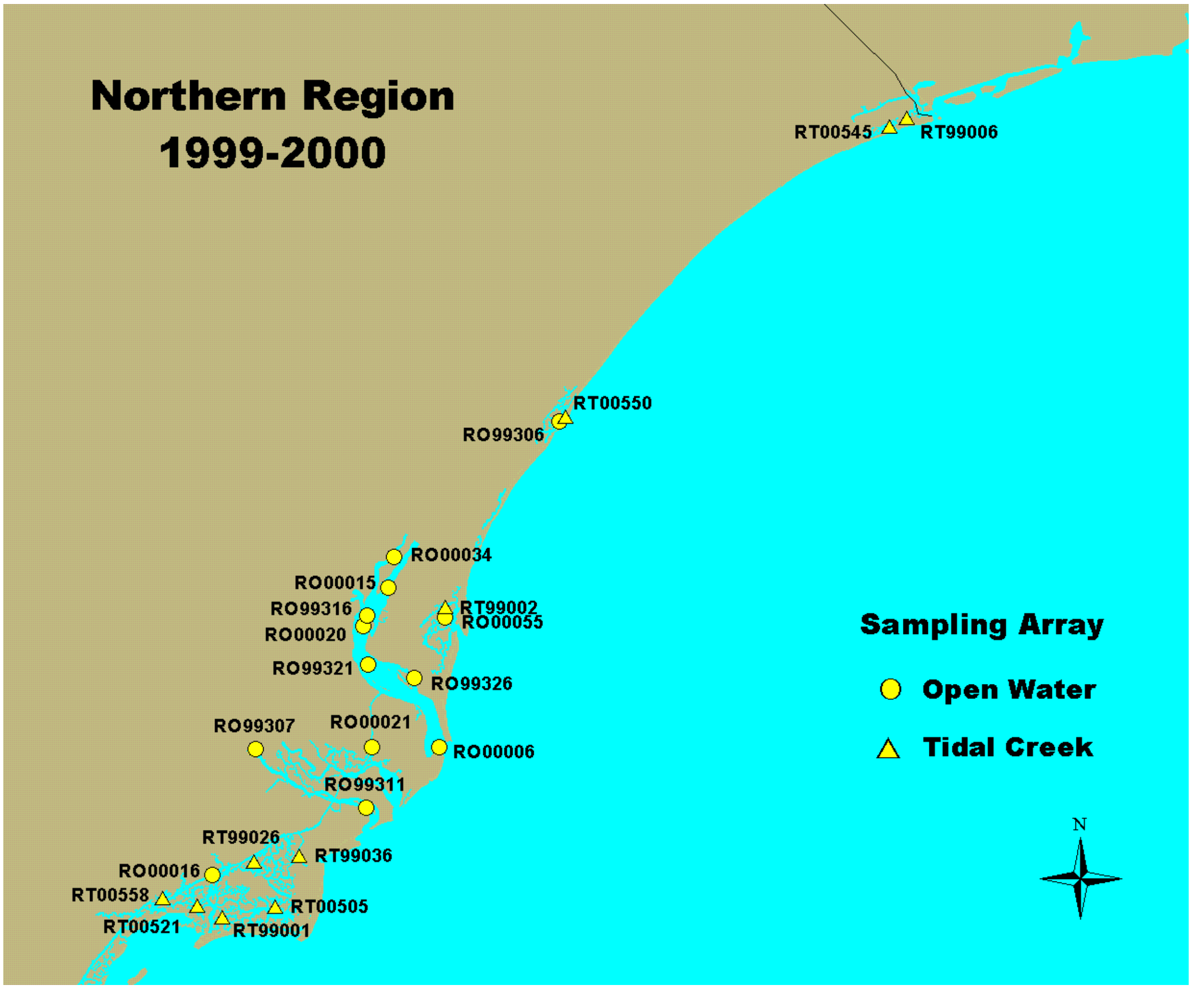


Figure 3.1.2. Distribution of open water and tidal creek stations sampled in the northern portion of the state during 1999 – 2000.

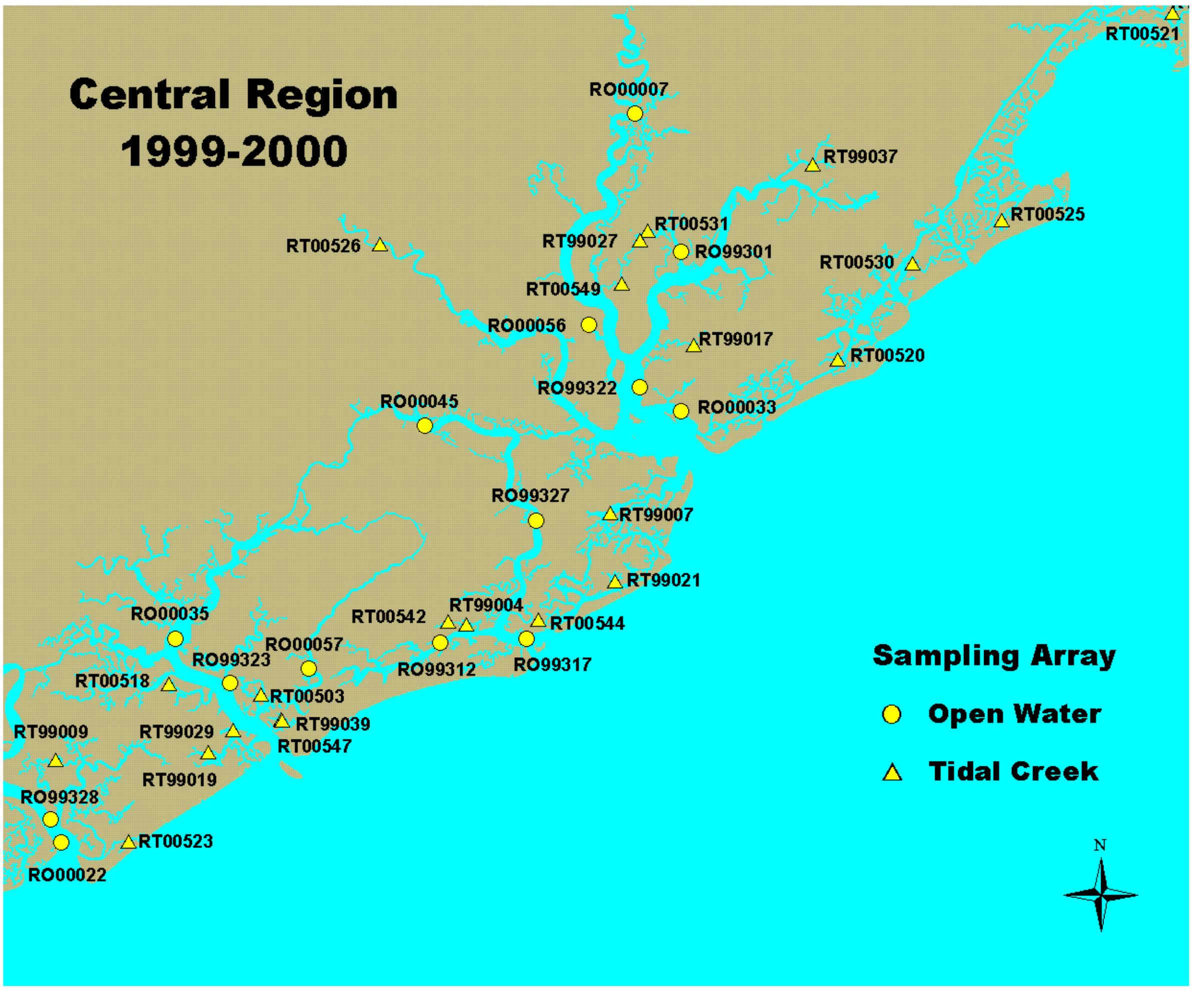


Figure 3.1.3. Distribution of open water and tidal creek stations sampled in the central portion of the state during 1999 – 2000.

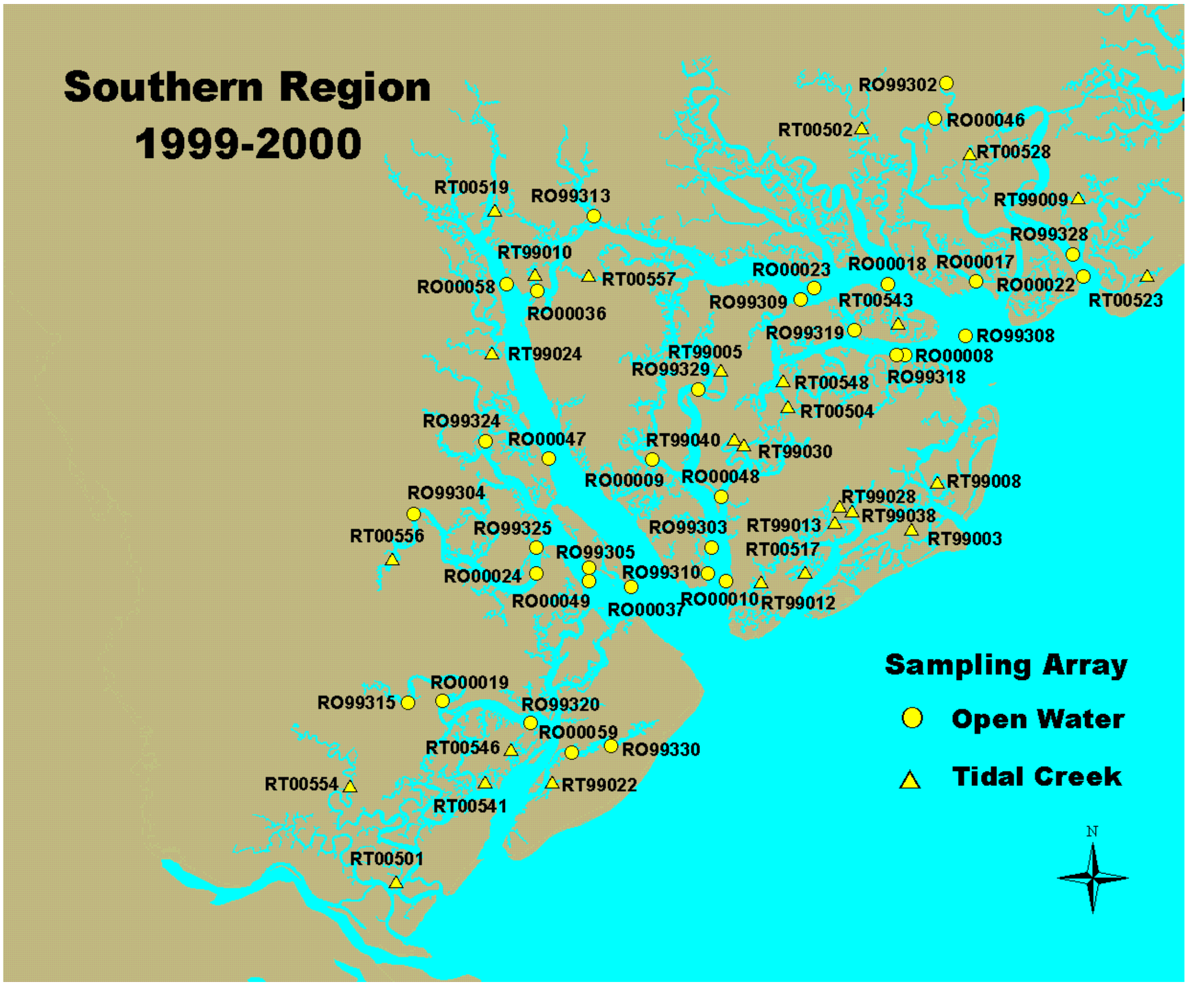


Figure 3.1.4. Distribution of open water and tidal creek stations sampled in the southern portion of the state during 1999 – 2000.

values are compared to data compiled for a 5-year period (1993-1997) by the SCDHEC Bureau of Water Quality in their routine statewide Fixed Ambient Surface Water Monitoring Network (SCDHEC, 1998a). For this report, values exceeding the 75th percentile of all values measured ($\geq$ method detection limit) in the state's saltwaters indicate evidence of elevated concentrations and values exceeding the 90th percentile of all saltwater measures indicate high concentrations. The SCDHEC historical database on water quality was primarily obtained from the larger open water bodies. Therefore, caution should be used in interpreting data obtained from tidal creek sites since high or low values observed for some parameters may represent "normal" conditions. In the future, the SCECAP database can be used to identify normal conditions in tidal creeks using protocols similar to those described for the existing saltwater database (SCDHEC, 1998a).

Temperature

Temperature data are primarily collected to relate with other water quality variables that are affected by this parameter, such as dissolved oxygen conditions. The average of the continuous 25 hr water temperature data observed at tidal creek sites (29.9^{o}C) was comparable to the average observed at the open water sites (29.8^{o}C) and ranged from 25 to 33^{o}C (Appendix 2.1). The average temperature observed at sites sampled in 1999 was within 1 ^{o}C of the average values observed in 2000 for both habitats. Variations observed among sites within each year reflected the normal temperature variation typically observed between summer months. As expected, the average variation in bottom water temperature over the 25-hr monitoring period was greater in the shallow creek habitats (2.5^{o}C) than in the open water areas (1.3^{o}C). Instantaneous measures of water temperature correlated moderately well with the mean 25-hr measure obtained at each site (r^2 = 0.66). Additionally, the average difference between surface and bottom readings was $\leq$ 0.2^{o}C at both creek and open water sites. The fauna inhabiting both types of habitats are generally well adapted to the temperature ranges observed in this program.

Salinity

Salinity is measured because of its influence on the distribution and diversity of many invertebrate and fish species. Changes in salinity at a site can also provide a measure of stressful conditions if there is a large variation in concentrations over short time periods. The mean bottom salinity values observed in tidal creek sites during 1999-2000 was 31.3 ppt and ranged from 5.5 – 37.1 ppt based on the 25-hr instrument deployment data (Figure 3.2.1, Appendix 2.1). Mean bottom salinity values among the open water sites was 27.2 ppt and ranged from 2.1 – 36.7 ppt. Mean bottom values observed at each site showed a strong correlation to the instantaneous measures collected during the primary site visit (r^2 = 0.9). Mean instantaneous surface salinities observed in the creeks and open water sites were 30.4 and 26.0 ppt, respectively. As with temperature, the mean difference between the instantaneous surface and bottom salinities was $\leq$ 0.5 ppt at both creek and open water stations within each year (Appendix 2.1).

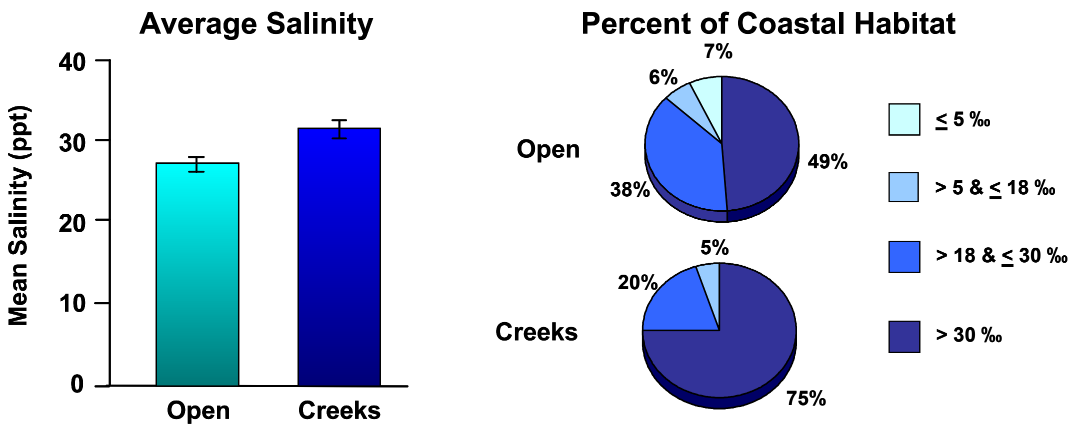


Figure 3.2.1. Comparison of the average salinity concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat that represented various salinity ranges based the average of measurements obtained over 25-hrs at each station.

Due to the drought conditions experienced in both years, approximately 95% of the state's tidal creek habitat and 87% of the open water habitat represented polyhaline waters (> 18 ppt; Figure 3.2.1, Appendix 2.5). Salinity ranges observed at each site were also generally small during the sampling period (< 10 ppt) except at five open water locations (Appendix 2.1). Until additional data are available, no criteria have been established by the SCECAP program to identify stressful conditions using salinity. However, the five open water sites with high salinity ranges (10.3 - 21.3 ppt) may represent stressful conditions to the organisms inhabiting those areas.

Dissolved Oxygen

Dissolved oxygen (DO) is one of the most critical water quality parameters measured in this program. Low dissolved oxygen conditions can limit the distribution or survival of most estuarine biota, especially if these conditions persist for extended time periods (see Diaz and Rosenberg, 1995; USEPA, 2001 for reviews). Dissolved oxygen criteria established by the SCDHEC for "Shellfish Harvesting Waters" (SFH) and Class SA saltwaters are a daily average not less than 5.0 mg/L and a low of 4.0 mg/L (SCDHEC, 2001b). Class SB waters should have dissolved oxygen levels not less than 4.0 mg/L. Since the SCECAP program was designed to sample only during a summer index period when DO levels are expected to be at their lowest, DO measurements collected in this program probably represent short-term worst-case conditions that may not reflect conditions during other seasons or longer time-averaging periods. Therefore, these measurements should not be used for regulatory purposes. However, SCECAP data provide useful measures of average DO concentrations occurring in tidal creek and open water habitats during a period when DO levels may be limiting, and it identifies areas within the state where this is occurring. Based on the state water quality standards, mean or instantaneous DO concentrations < 4 mg/L and ≥ 3 mg/L are considered to be marginal (i.e. contravenes one portion of the state standards). Average or instantaneous measures < 3 mg/L are considered to be potentially stressful to many invertebrate and fish species.

The average bottom DO concentration at the open water stations during 1999 and 2000 was 4.9 mg/L, with approximately 91% of the state's open water habitat having a mean DO > 4.0 mg/L based on the 25-hr instrument deployments (Figure 3.2.2; Appendix 2.1, 2.5). No open water sites had an average DO < 3.0 mg/L. In contrast, the average DO concentration observed at tidal creek sites was 4.1 mg/L, and only 54% of this habitat had mean DO values > 4 mg/L. Approximately 7% of the state's tidal creek habitat was estimated to have mean DO levels < 3.0 mg/L. The difference in mean DO values observed among creek versus open water sites was statistically significant ($p < 0.001$). Additionally, tidal creek sites generally had a much greater range in DO concentrations than the open water sites (Figure 3.2.3, Appendix 2.1). Since tidal creek habitats generally supported a greater density and diversity of fish and crustaceans than

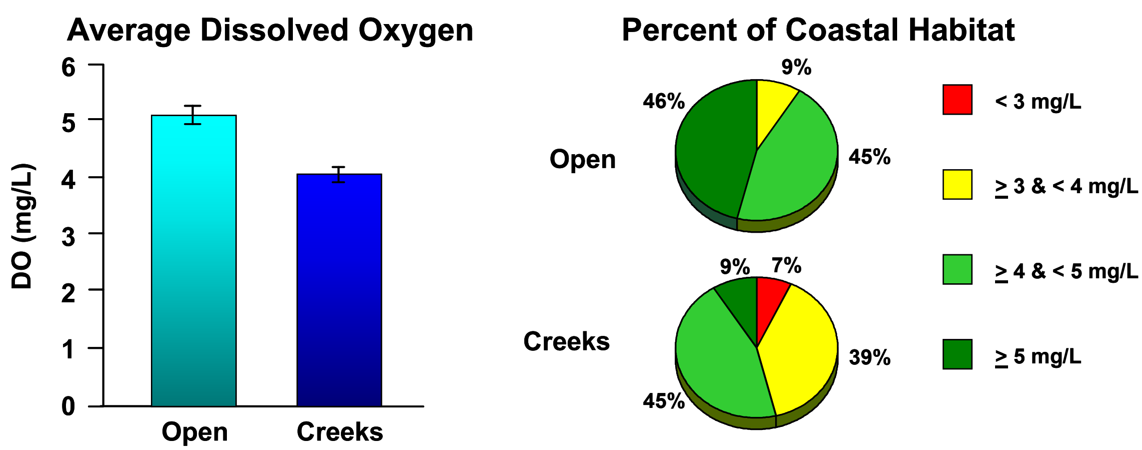


Figure 3.2.2. Comparison of the average dissolved oxygen concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat representing various DO ranges based on the average of measurements obtained over 25-hrs at each station.

the open water sites (see biological analyses), water quality standards established for the larger open water bodies traditionally monitored by the SCDHEC may not be indicative of stressful conditions in creeks. However, creek sites with the mean DO levels < 3 mg/L may not fully support biological assemblages inhabiting those sites, especially during periods when DO levels are less than 2 mg/L (hypoxic conditions). At sites with mean DO < 3 mg/L, approximately 26% of the time series records were < 2 mg/L, which represents hypoxic conditions known to be limiting to many estuarine and marine biota (Gibson et al., 2000).

The instantaneous measures of surface and bottom DO were, on average, slightly lower than the mean DO values obtained from the 25-hr deployment of water quality meters at each site (Appendix 2.1). These differences were not statistically significant

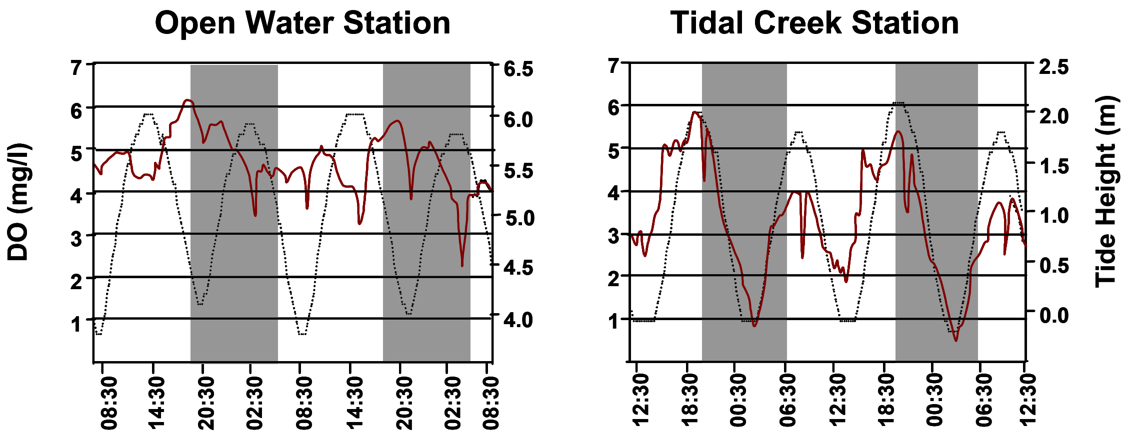


Figure 3.2.3. Typical dissolved oxygen concentrations observed during various tidal and diurnal periods in tidal creek versus open water habitats during 1999-2000. Shaded areas represent night-time periods. Dotted lines show tidal stage.

based on a comparison of the mean versus instantaneous bottom measures ($p > 0.05$). However, the instantaneous DO measures did result in a higher percentage of the state's coastal water habitat coding as marginal or potentially stressful to marine biota (Appendix 2.5). The instantaneous bottom DO measure was also poorly correlated to the mean bottom DO obtained from the 25-hr instrument deployment ($r^2 < 0.41$). These results indicate that a single daytime measure of DO is not as good an indicator of average conditions compared to observations collected over a longer period that includes both day and night measures during all tidal stages (Figure 3.2.3). The SCECAP program will rely on mean values obtained from a 25hr deployment as the best measure of dissolved oxygen conditions.

pH

Measures of pH provide another indicator of water quality in estuarine habitats. Measures of pH are based on a logarithmic scale, so even small changes in the value can result in significant stress to estuarine organisms (Bamber1987, 1990; Ringwood and Keppler, in review). Unusually low or high pH values may indicate the presence of pollutants (e.g. release of acids or caustic materials) or high concentrations of carbon dioxide (Gibson *et al.*, 2000). Because salinity and alkalinity affect the pH of estuarine waters, SCDHEC has established water quality standards that account for these effects. The pH in Class SA and SB tidal saltwaters should not vary more than one-half of a pH unit above or below effluent-free waters in the same geologic area having a similar salinity, alkalinity and temperature, and values should never be lower than 6.5 or higher than 8.5. Shellfish Harvesting waters (SFH) shouldn't deviate more than 0.3 units from effluent-free waters.

Preliminary SCECAP pH Criteria

Analysis of the combined 1999 - 2000 data set for pH values provides a basis for identifying sites that may represent marginal or degraded conditions with respect to pH in polyhaline and euhaline (18 – 40 ppt) environments. In those years, we sampled 62 sites throughout the state that were located more than 1 km from any development or industrial source. The majority of these stations were located in areas considered to be pristine environments (e.g. Cape Romain, ACE and North Inlet National Estuarine Research Reserves, SFH class saltwaters). Using this data set, we found that both salinity and alkalinity accounted for only a small portion of the variance observed when these measures were regressed against pH ($r^2 < 0.3$). The mean pH calculated from this data set was 7.6. Values below 7.4 were in the lowest 10th percentile of all measurements obtained in polyhaline waters and represent marginal pH conditions. Values below 7.1 represent degraded pH conditions in polyhaline waters using the SCDHEC standard ($\pm$ 0.5 pH units from effluent free waters). As more sampling sites are added to the database, we will establish additional criteria for lower salinity waters (<18 ppt).

Measures of pH in 1999-2000

The overall average pH observed in 1999 – 2000 was 7.5 in tidal creek habitats and 7.6 in open water habitats (Figure 3.2.4, Appendix 2.1). Although the average instantaneous surface values measured at all sites (collectively) during the primary station visit was similar to the mean pH value obtained from the 25-hr instrument deployment there was a relatively poor correlation between the instantaneous and mean measures collected at each station ($r^2 < 0.26$). Statistical analyses indicated a significant difference between the mean pH observed in tidal creeks versus open water habitat ($p = 0.013$). None of the stations sampled in 1999-2000 had mean or maximum values that exceeded the 8.5 pH unit criterion during the 25-hr monitoring period conducted at each site (Appendix 2.1). One station (RO00007) had a minimum pH measure of 6.4, which is below the 6.5 minimum criterion.

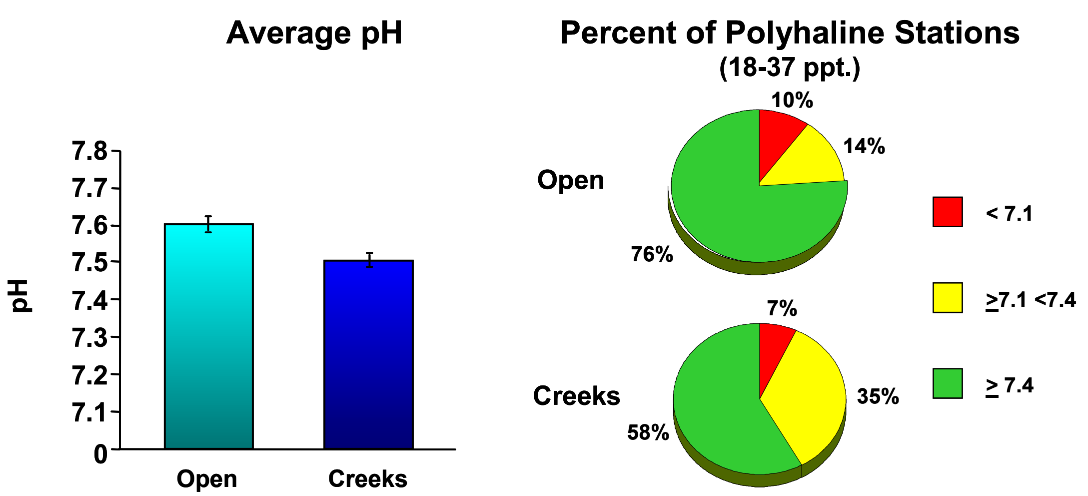


Figure 3.2.4. Comparison of the average pH concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat representing various pH ranges based on the average of measurements obtained over 25-hrs at each station.

Within polyhaline waters of the state, two tidal creek stations (RT00502, RT00526) and five open water stations (RO99302, RO99307, RO00007, RO00015, RO00034,) represented waters where mean pH was less than the 7.1 criterion representing degraded conditions by the SCECAP program (see preceding section). An additional 16 sites (4 in 1999, 12 in 2000) had marginal pH conditions (Appendix 2.1). The pH at these stations may be causing stress for some organisms.

Until additional data are available to identify typical pH levels that occur at pristine sites within other salinity and alkalinity ranges, we are unable to identify where deviations exceeding 0.5 units from "normal" conditions occurred for all salinity zones.

Nutrients

Nutrient loading into estuarine waters has become a major concern due to the rapid development that is occurring in the coastal zone of South Carolina and other states. Other sources of nutrients include runoff from agricultural fields adjacent to estuarine habitats, riverine input of nutrient-rich waters from inland areas, and atmospheric deposition. High nutrient levels can lead to eutrophication of estuarine waters resulting in excessive algal blooms (including harmful algal blooms) decreased dissolved oxygen, and other undesirable effects that adversely affect estuarine biota (Bricker et al, 1999).

There are no state or USEPA standards for the various forms of nitrogen (except ammonia) and phosphorus in estuarine waters. Therefore, the SCECAP data are compared to SCDHEC's historical database (SCDHEC, 1998a) to identify waters showing evidence of elevated nutrients. Dissolved nutrient concentrations (2000 only) are compared with threshold values identified by NOAA using data obtained from all coastal regions of the United States (Bricker *et al.*, 1999).

Nitrogen:

Total nitrogen (TN), as measured by the SCDHEC laboratory, is best represented by the sum of nitrate-nitrite and total Kjeldahl nitrogen (TKN). In 1999-2000, the average concentration of TN was 0.65 mg/L among the tidal creek sites and 0.53 mg/L among the open water sites (Figure 3.2.5). The difference between habitats was statistically significant ($p = 0.009$). Most of the nitrogen was in the form of TKN (organic fraction including ammonia). Average nitrate-nitrite values in the creeks and open water sites were only 0.02 and 0.04 mg/L, respectively. Using the sum of the 75th percentile of detectable values for nitrate-nitrite and TKN as an indication of nutrient enrichment, approximately 12% of the creek habitat and only 4% of the state's open water habitat were enriched (Figure 3.2.5, Appendix 2.2, 2.5). None of the sites sampled in either year had TN concentrations in excess of the 90th percentile value of samples collected from 1993-1997 by SCDHEC (1998a), although five creek sites (4 in 1999, 1 in 2000) exceeded the 90th percentile of detectable values for TKN (Appendix 2.2). Similarly, six creek sites (4 in 1999, 2 in 2000) and one open water site (2000) had ammonia concentrations that exceeded the 90th percentile of historical observations (Appendix 2.2). Statistical comparisons of all 1999-2000 sites indicated that only TKN values were significantly higher in creeks versus open water ($p < 0.0001$).

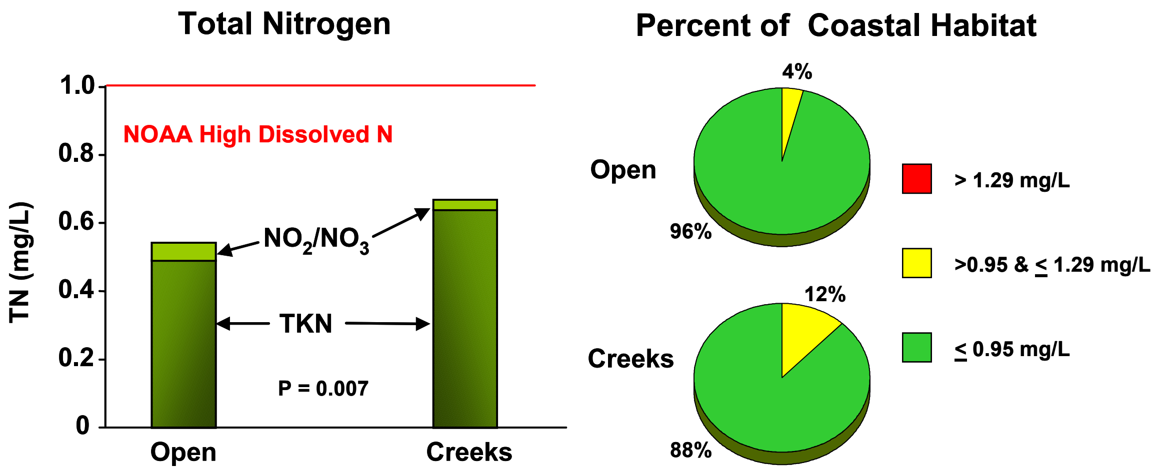


Figure 3.2.5. Comparison of the average total nitrogen (TN) concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat representing various TN ranges that represent normal (green), enriched (yellow), or highly enriched (red) values relative to SCDHEC historical data.

Total dissolved nitrogen (TDN) values observed in 2000 are summarized in Appendix 2.3. Dissolved nutrients were not measured in 1999. Appendix 2.3 also contains a second measure of TN that was collected at the same time as the TDN measured by SCDNR personnel. Average surface TDN concentrations in the creeks and open water sites were 0.62 mg/L and 0.57 mg/L, respectively. None of the sites sampled in 2000 had high TDN concentrations (> 1.0 mg/L) based on the guidelines developed for coastal waters by NOAA (Bricker *et al.*, 1999) and there was no significant difference in TDN between creek versus open water sites.

Most of the dissolved nitrogen was in the form of dissolved organic nitrogen (DON) in both habitats (89% at creek sites, 85% at open water sites; Appendix 2.3). Additionally, average TDN concentrations correlated reasonably well with the TN values from the same sample ($r^2 = 0.69$), with the TDN values representing approximately 68% and 77% of the average TN concentrations measured in the creeks and open water sites, respectively (Appendix 2.3).

Phosphorus:

The average total phosphorus (TP) measured by SCDHEC in 1999-2000 was 0.10 mg/L at the creek sites and 0.07 mg/L at the open water sites (Figure 3.2.6). This difference was statistically significant ($P< 0.001$). Approximately 47% of the state's tidal creek habitat showed moderate phosphorus enrichment when compared to the 1993-1997 SCDHEC database and an additional 8% of the creek habitat was very enriched (Figure 3.2.6; Appendix 2.2, 2.5). In contrast, only 19% of the open water habitat showed moderate enrichment and none of the sites had highly enriched phosphorus levels. The higher phosphorus concentrations may represent natural conditions in creek habitats since

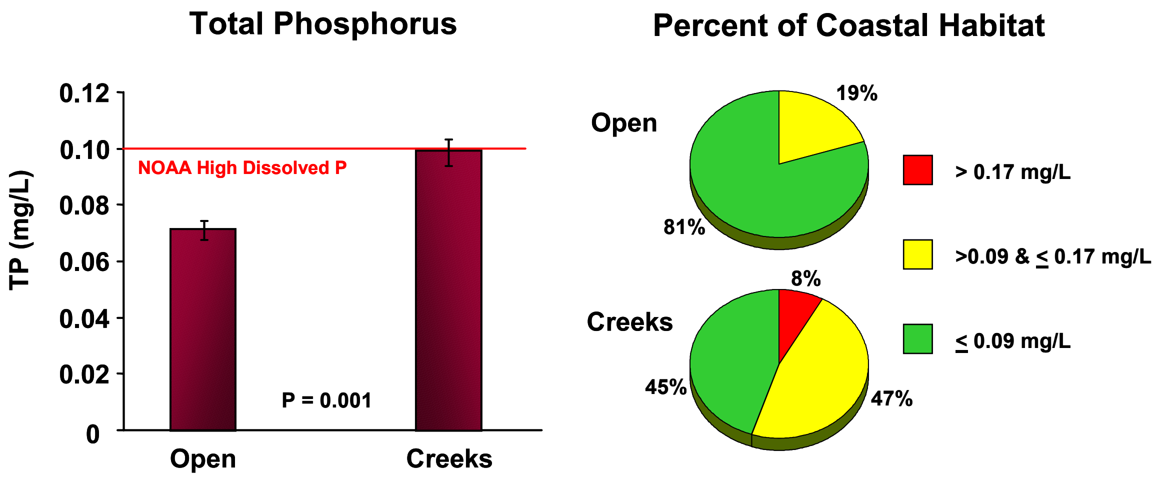


Figure 3.2.6. Comparison of the average total phosphorus (TP) concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat representing various TP ranges that represent normal (green), enriched (yellow), or highly enriched (red) values relative to SCDHEC historical data.

the historical database was based on sampling in larger open water systems. Additional data collected through this program will help to resolve whether new guidelines for TP enrichment should be developed for creek habitats. Until those data are available, the historical SCDHEC database provides the best record of deviations from normal estuarine water quality conditions.

The average total dissolved phosphorus (TDP) concentrations observed in creeks versus open water habitats were 0.044 mg/L and 0.033 mg/L, respectively. This difference was not statistically significant (p = 0.6). Using the NOAA guidelines (0.10 mg/L) as a measure of possible dissolved phosphorus enrichment in coastal waters (Bricker *et al*., 1999), none of the open water sites and only two of the creek sites (RT00502, RT00526) were enriched (Appendix 2.3). The average TDP concentration represented approximately 45% of the average TP concentration in creeks and 49% of the average TP concentration in open water. There was a good correlation between the TDP and TP values (r^2 = 0.73). Inorganic phosphorus (orthophosphate-OP) generally comprised more than 97% of the TDP, on average.

Silica:

Dissolved silica (DS) measurements are primarily collected for the National Coastal Assessment Program and therefore were not collected in 1999. Low silica levels can be a limiting factor in the production of certain forms of phytoplankton, primarily diatoms. Average silica concentrations in 2000 were 2.1 mg/L at tidal creek sites and 1.5 mg/L at open water sites (Appendix 2.3). All of the DS concentrations measured in 2000 represent relatively high values that should not be a limiting nutrient for phytoplankton species in South Carolina waters since the ratio of dissolved inorganic nitrogen to dissolved silica at all sites (mean ratio = 0.05) was well below the 1:1 ratio considered to be critical (Day *et al*., 1989).

Biochemical Oxygen Demand

The five-day Biochemical Oxygen Demand (BOD_5) is a measure of the amount of oxygen consumed by the decomposition of carbonaceous and nitrogenous matter, both natural and man-made wastes, in the water column. Although BOD_5 is regulated on National Pollutant Discharge Elimination System (NPDES) permits to protect instream dissolved oxygen, there are no freshwater or saltwater standards for natural waters. Both the SCDHEC water quality monitoring program and the SCECAP program include measurements of BOD_5 in order to obtain information on areas where unusually high values may occur. Average BOD_5 concentrations found at creeks sites sampled in 1999-2000 were 1.8 mg/L and the average at open water sites was 1.6 mg/L (Figure 3.2.7, Appendix 2.4). The difference between habitats was not statistically significant ($p = 0.4$); however, a slightly higher percentage of the state's creek habitat had elevated BOD_5 levels that exceeded the 75^{th} and 90^{th} percentiles of historical detectable observations when compared to open water habitat (Figure 3.2.7, Appendix 2.5). High BOD_5 concentrations may be indicative of poor water quality.

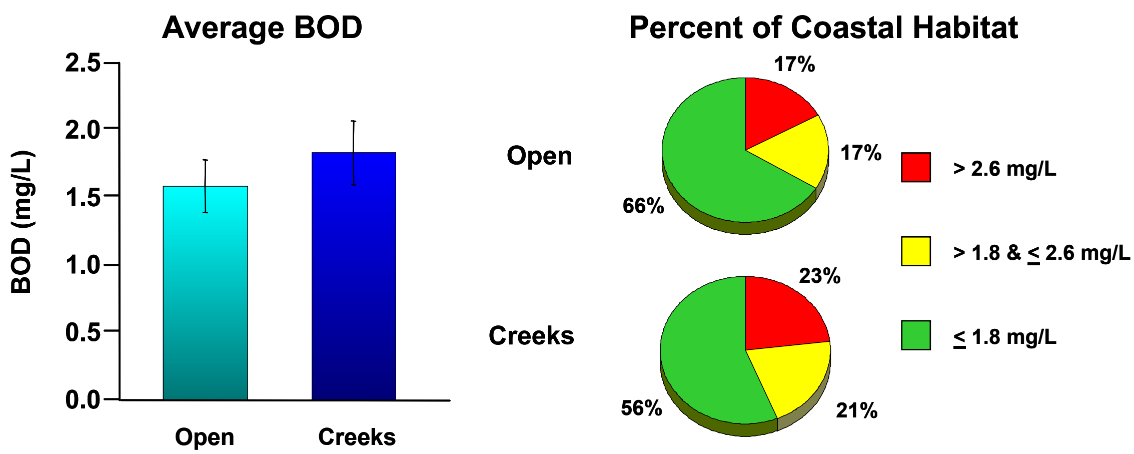


Figure 3.2.7. Comparison of the average five-day biochemical oxygen demand (BOD_5) concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat representing various BOD_5 ranges that represent normal, enriched, or highly enriched values relative to SCDHEC historical data.

Total Organic Carbon

Total organic carbon (TOC) represents another indicator of biological productivity. It reflects the products of organic decomposition and amount of detritus in the water column. There are no state standards for TOC, but values greater than 11 mg/L exceed the 75^{th} percentile of historical data collected in the state's coastal zone from 1993-1997 and values greater than 16 mg/L exceed the 90^{th} percentile (SCDHEC, 1998a). Average TOC concentrations observed during 1999-2000 were 3.6 mg/L at the creek sites and 4.0 mg/L at the open water sites (Figure 3.2.8; Appendix 2.4, 2.5). Only 3% of the creek habitat and 1% of the open water habitat had concentrations that exceeded the 75^{th} percentile of historical observations. None exceeded the 90^{th} percentile concentration. Due to the consistently low TOC values observed at the sites sampled during the first two

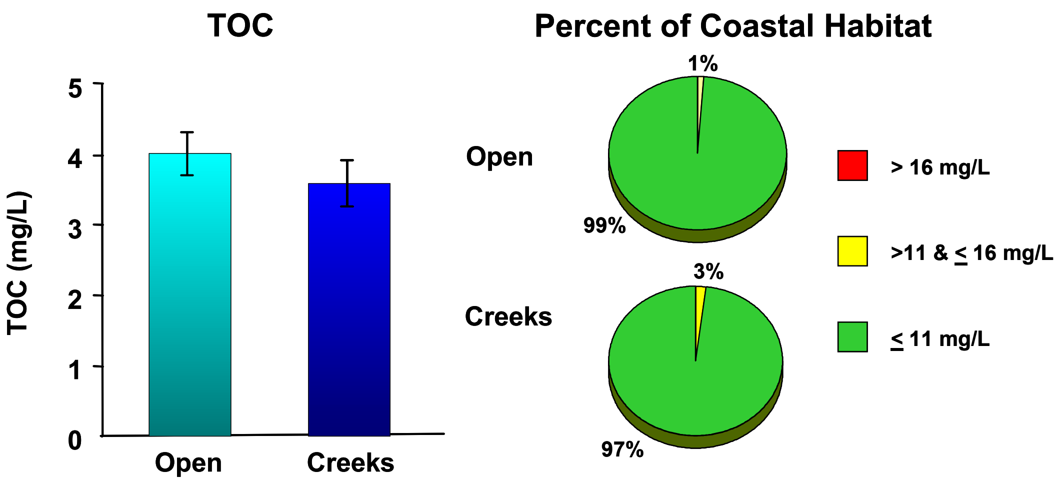


Figure 3.2.8. Comparison of the average total organic carbon (TOC) concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat representing various TOC ranges that represent normal, enriched, or highly enriched values relative to SCDHEC historical data

years of this program, TOC measurement are not included in the integrated measure of overall water quality.

Fecal Coliform Bacteria

Coliform bacteria are present in the digestive tracts and feces of all warm-blooded animals and public health studies have established correlations between adverse human health effects and the concentration of fecal coliform bacteria in recreational, drinking, and shellfish harvesting waters. State fecal coliform standards to protect primary contact recreation requires a geometric mean count that does not exceed 200 colonies/100 mL based on five consecutive samples in a 30 day period and no more than 10% of the samples can exceed 400 colonies/100 mL. To protect for shellfish consumption, the geometric mean shall not exceed 14 colonies/100 mL and no more than 10% of the samples can exceed 43 colonies/100 mL (SCDHEC, 2001b). Since only a single fecal coliform count was collected at each site, compliance with the standards cannot be strictly determined, but the data can provide some indication of whether the water body is likely to meet standards. For the SCECAP program, we consider any sample with > 43 colonies/100 mL to represent marginal conditions (i.e. potentially not supporting shellfish harvesting) and any sample with > 400 colonies/100 mL to represent degraded conditions (i.e. potentially not supporting primary contact recreation).

The average of fecal coliform measurements obtained during the 1999-2000 statewide assessments were 43 colonies / 100 mL in the creeks and 27 colonies / 100 mL at open water sites (Figure 3.2.9). This difference was statistically significant ($p = 0.05$). The relatively high averages were largely due to counts at three sites that were $\geq$ 300 colonies/100 mL. Using the SCECAP criteria and CDF analyses, approximately 17% of the state's creek habitat was marginal and 1% was degraded with respect to fecal coliform concentrations. In contrast, only 5% of the open water habitat was marginal and

1% was degraded. Sites not meeting SCECAP criteria are summarized in Appendix 2.4. The higher fecal coliform counts observed in creek habitats is most likely due to the proximity of these small drainage systems to upland runoff from both human and domestic wastes as well as wildlife sources, combined with the lower dilution capacity of creeks compared to larger water bodies. Greater protection of tidal creek habitats is warranted in areas where upland sources of waste can be identified and controlled.

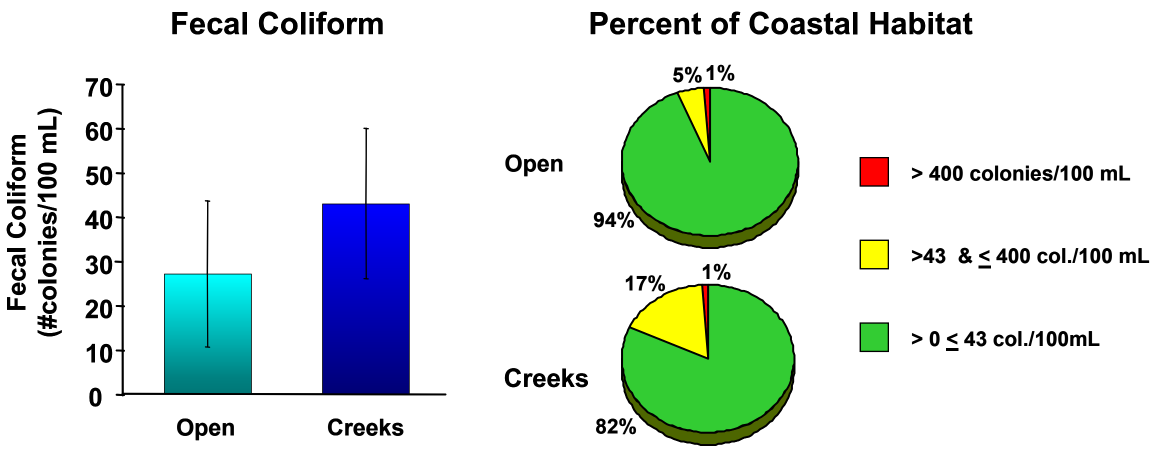


Figure 3.2.9. Comparison of the average fecal coliform concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat representing various concentrations that are acceptable, indicative of possible unsuitability for shellfish harvest (yellow) or indicative of possible unsuitability for primary contact recreation (red).

Turbidity

Measures of water clarity provide an indication of the amount of suspended particulate matter in the water column. South Carolina's estuarine waters are naturally turbid compared to many other states. Exceptionally high turbidity levels may be harmful to marine life. SCDHEC has recently developed a maximum saltwater state standard for turbidity of 25 NTU. This corresponds to the 90th percentile of the SCDHEC saltwater database, which was obtained primarily from the larger estuarine water bodies. The 75th percentile, representing partially elevated levels, is 15 NTU (Appendix 2.5).

Average turbidities measured in 1999-2000 by this program were 21 NTU in the tidal creeks and 14 NTU in the open water habitat (Figure 3.2.10; Appendix 2.4). This difference was statistically significant ($p < 0.001$). Based on the single measure of turbidity taken at each station, approximately 23% of the tidal creek habitat exceeded the State standard, whereas only 8% of the open water habitat exceeded the standard (Figure 3.2.10, Appendix 2.4, 2.5). Turbidity levels in tidal creeks may be naturally higher due to the shallow depths of these systems (i.e. surface samples are often within 1-2 m of the bottom) combined with re-suspension of the bottom sediments due to tidal currents. Further sampling by this program will determine whether the turbidity criteria accurately reflects excessive conditions in tidal creeks.

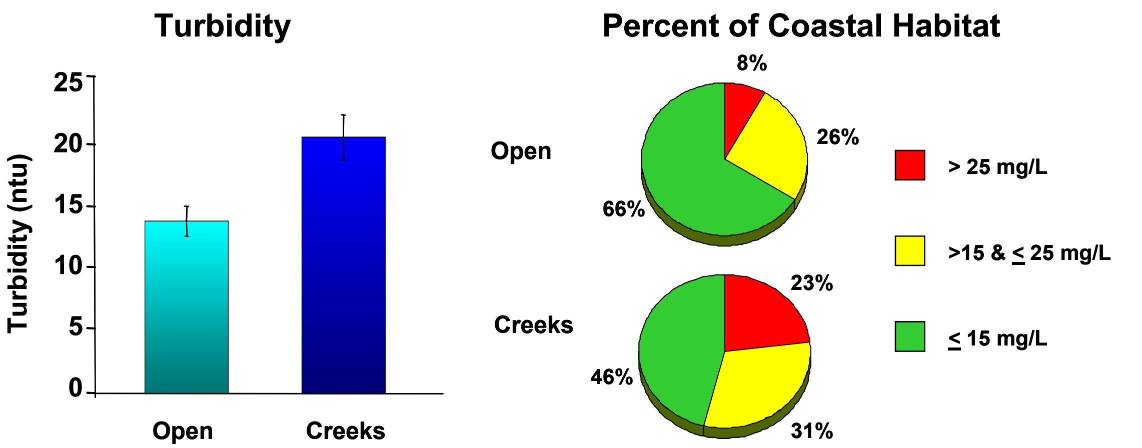


Figure 3.2.10. Comparison of the average turbidity concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat representing various turbidity ranges that represent normal, enriched, or highly enriched values relative to SCDHEC historical data.

Alkalinity

Alkalinity measurements were collected for the SCECAP program to be consistent with SCDHEC's larger water quality monitoring program. There are no state standards for alkalinity in saltwater and research is lacking on how high or low alkalinity values affect estuarine biota. Until additional data are gathered for this parameter in the SCECAP program, combined with better information on how alkalinity should be interpreted, the data are only summarized in Appendix 2.4.

Integrated Water Quality Measure

One of the goals of SCECAP is to develop integrated measures of habitat quality using multiple parameters that are combined into a single index value. To develop an integrated water quality measure, six parameters were selected: dissolved oxygen, biochemical oxygen demand, fecal coliform bacteria, total nitrogen, total phosphorus, and pH. The oxygen measures provide an indication of both oxygen availability and consumption. The nitrogen and phosphorus measures provide the best indication of possible nutrient enrichment (eutrophication). Fecal coliform concentrations provide an indication of the suitability of the water for shellfish harvesting and primary contact recreation, and the pH measure provides information on levels that may be stressful for many marine species. Other parameters, such as turbidity, may be included in the future once additional sampling and analyses have been completed.

The six water quality variables were each given a score of 1, 3, or 5. Parameters with a score of 1 (coded as red) indicate either an exceedance of state water quality standards, or if no standards existed, they represent values exceeding the 90th percentile of SCDHEC's historical database (SCDHEC, 1998a). Parameters with a score of 3 (coded as yellow) represent conditions that may be marginal since they either exceeded a portion of the water quality standard or the 75th percentile of SCDHEC's historical database (except for pH - see previous section for criteria used). Parameters with a score of 5 (coded as green) had values that did not exceed a state standard or were below the 75th percentile of the records for that parameter in the historical database.

The integrated water quality score is derived by averaging all six parameter scores (Figure 3.2.11). The results are summarized in Figure 3.2.12 and Appendix 5.1. For the SCECAP program, an integrated score ≤ 3 was considered to represent relatively poor water quality conditions. Based on the 1999-2000 data, all of the sites that had an integrated score ≤ 3 had 75% or more of the water quality variables coding as poor or marginal. Approximately 5% of the state's creek habitat had poor water quality in 1999-2000 whereas none of the open water habitat had poor water quality (Figure 3.2.12).

An integrated score > 3 and ≤ 4 was considered to represent marginal water quality conditions. Stations with values in this range had 2-3 parameters coding as marginal or poor. Approximately 33% of the state's creek habitat had marginal water quality conditions compared to approximately 11% of the open water habitat (Figure 3.2.12). The higher percentage of poor and marginal water quality conditions in creeks indicates that these habitats are often more stressful environments, especially since many of these sites were in relatively pristine locations. The higher percentage of creek habitat with poor or marginal conditions may also, in part, reflect the relatively greater effect of anthropogenic runoff into these smaller water bodies due to their proximity to upland sources and their lower dilution capacity. It may also be the result of using thresholds derived from SCDHEC's historic database, which is composed predominantly of data from open water habitats. Once a larger database is available, our threshold criteria for some of the water quality parameters measured in creek habitats may be changed from those used in this report to reflect the greater natural variability in these habitats.

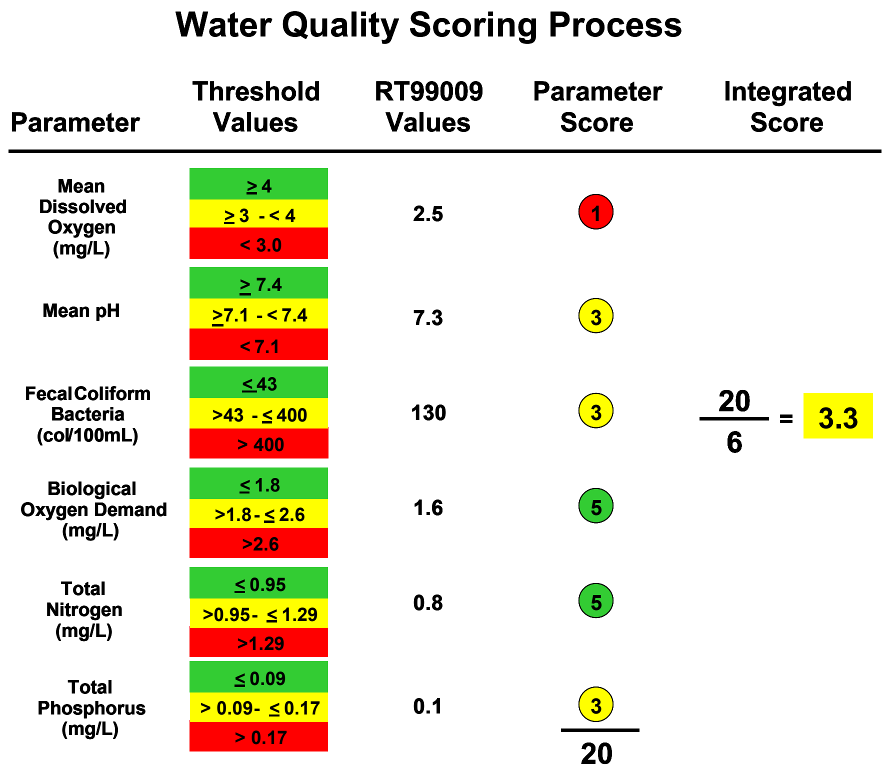


Figure 3.2.11. Summary of water quality threshold values and scoring process used to obtain the integrated water quality score. Values obtained from station RT99009 were used in this example. Green indicates good water quality measures, yellow indicates values that are considered to be marginal relative to state standards or historical data obtained by SCDHEC, and red indicates poor water quality relative to state standards or historical data. An integrated score ≤ 4.0 represents marginal overall water quality, and scores ≤ 3.0 represent poor water quality for the purposes of the SCECAP program.

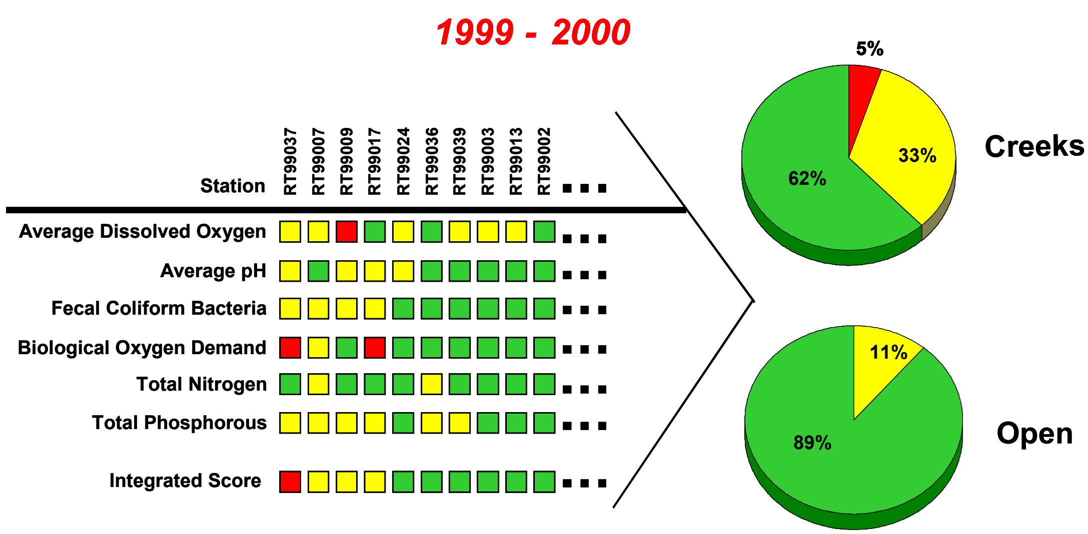


Figure 3.2.12. Proportion of the South Carolina's estuarine habitat that ranks as good (green), marginal (yellow) or poor (red) using the integrated water quality score developed for the SCECAP program. This measure of overall water quality incorporates the six water quality parameters shown.

3.3 Sediment Quality

Sediment Composition

The percentage of mud (silt/clay) in estuarine sediments can impact both the structure of the biotic assemblage as well as the bioavailability of certain contaminants to local biota. The average percentage of mud in both open water and tidal creek sites was less than 50% (Figure 3.3.1; Appendix 3.1), with open water sites having a mean of 19% silt/clay compared to a mean of 32% silt/clay in tidal creeks. This difference was statistically significant ($p < 0.001$). However, there was considerable variability in the percent of silt/clay observed among the stations sampled in both habitats (< 2% to > 95% in both habitats; Appendix 3.1).

Approximately 72% of the open water habitat sampled in 1999 – 2000 was composed predominantly of sand (< 20% silt/clay) while only 49% of tidal creek habitats contained predominantly sandy sediments (Figure 3.3.1; Appendix 2.5, 3.1). Less than 10% of both habitats had primarily muddy sediments (> 80% silt/clay).

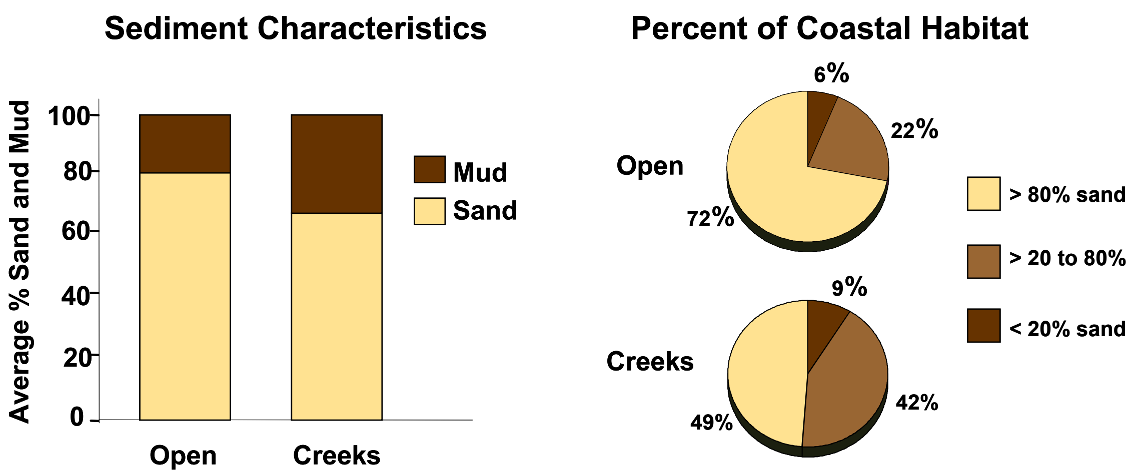


Figure 3.3.1. Average percent of sand versus mud (silt/clay) at open water and tidal creek sites sampled in 1999 – 2000 and estimates of the proportion of the state's coastal habitat that has predominantly sandy (> 80% sand), mixed (20-80% sand), or muddy (< 20% sand) sediments.

TOC

Total Organic Carbon (TOC) provides a measure of how much organic matter occurs in sediments. The TOC of sediments in tidal creeks ranged from 0.0 to 5.4% with a mean of 1.2% (Appendix 3.1). Sediments in open water habitats contained less TOC with a mean of 0.8% and a range of 0.04 to 6.6% (Figure. 3.3.2). The difference between total organic carbon content in tidal creeks and open water sites was statistically significant ($p < 0.001$). The proximity to decomposing salt marsh plants and upland runoff probably explains the higher organic content in tidal creeks compared to the more distant open water sites. Total organic carbon was significantly correlated with the amount of silt/clay in the sediments ($r^2 = 0.86$, $p < 0.001$). As the percentage of silt/clay increased in sediments the total organic content increased.

Hyland *et al.* (2000) found that extreme concentrations of TOC can have adverse effects on benthic communities. TOC levels below 0.5 mg/g (0.05%) and above 30 mg/g (3.0%) were related to decreased benthic abundance and biomass. Approximately 15% of the tidal creek habitats in the SCECAP study had TOC levels that were either less than 0.05% or greater than 3%, which may be indicative of a stressful environment for the benthos. Approximately 13% of the open water habitats had TOC levels that were indicative of possible stress (Figure 3.3.2, Appendix 2.5).

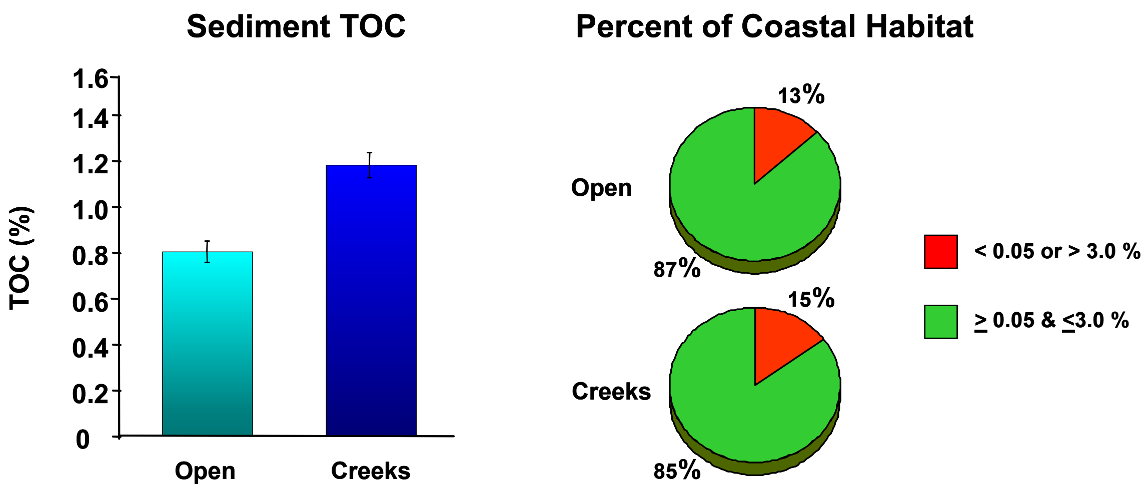


Figure 3.3.2. Average percent total organic carbon (TOC) concentration in sediments at open water and tidal creek sites sampled in 1999 – 2000 and estimates of the proportion of the state's coastal habitat having TOC levels (< 0.05 or > 3%), which may cause stress in benthic communities.

TAN

Total ammonia as nitrogen (TAN) in sediment porewater is a measure of another source of potential toxicity in sediments. The effects of TAN on marine biota are highly variable depending on the species considered (Sims and Moore, 1995; Moore *et al.,* 1997). The No Observable Effects Concentration (NOEC) of TAN in porewater reported for the 7-day seed clam (*M. mercenaria*) assay used in this study program was 14-16 mg/L (Ringwood and Keppler, 1998). The NOEC TAN concentrations for four species of amphipods in 10-day sediment exposures ranged from < 30 to < 60 mg/L dependent on the species used (< 30 mg/L for *A. abdita* used in this study).

In the 1999-2000 survey, TAN levels were similar between open water sites (mean = 2.82 mg/l) and tidal creek sites (mean = 2.93 mg/L), and generally well below levels considered to be toxic (Figure 3.3.3; Appendix 3.1). There was no statistically significant difference between TAN levels in open water and tidal creek habitats. Only 1% of open water or tidal creek habitats had TAN concentrations > 14 mg/L and none of the sites sampled in 1999-2000 had porewater TAN concentrations > 30 mg/L (Appendix 2.5).

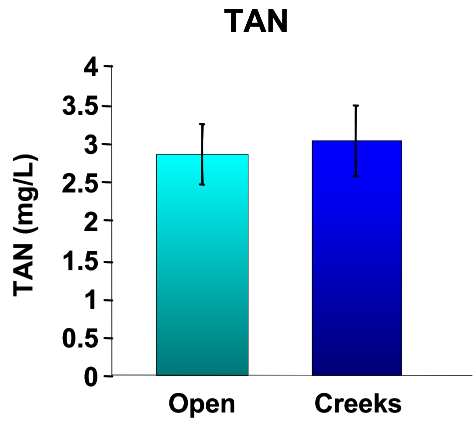


Figure 3.3.3. Average percent total ammonia nitrogen (TAN) concentration in sediment porewater at open water and tidal creek sites sampled in 1999 – 2000.

Contaminants

Sediments collected for SCECAP were examined for a wide range of contaminants including 14 metals, 25 Polycyclic aromatic hydrocarbons (PAHs), 30 Polychorinated byphenyls (PCBs), and 23 pesticides. For many of these contaminants, Long *et al.* (1995) published bioeffects guidelines that reflect the concentration of a contaminant that resulted in adverse bioeffects in 10% of the studies examined (defined as Effects Range-Low or ER-L) and concentrations that resulted in adverse effects in 50% of the studies (defined as Effects Range-Median or ER-M). None of the sites sampled in 1999-2000 by the SCECAP program had contaminant concentrations that exceeded ER-M values. Five open water sites in 1999 and five in 2000 had one or more contaminant concentrations above ER-L values. Five tidal creek sites in 1999 and ten in 2000 had some contaminant concentrations above ER-L values (Appendix 3.1).

ER-L exceedances in the tidal creeks were generally due to high levels of arsenic, except at two tidal creek sites where elevated concentrations of DDT were observed. Both of these creeks (Beresford Creek in Charleston Harbor and Ashley River near Magnolia Gardens) were near residential developments or other sites where pesticides are likely to be used. Among the open water sites, all of the ER-L exceedances in 1999 and two of the five exceedances in 2000 were also due to elevated arsenic levels. Arsenic is naturally elevated in South Carolina estuarine sediments (Scott et al, 1994; 2000) and the values observed are probably not related to anthropogenic stress. Only one open water site sampled in 2000 had elevated concentrations of acenaphthene, a PAH found in effluents from wood preservative and petrochemical industries. This site was located in the May River. Another open water site had elevated cadmium levels. Sediments at one open water station sampled in 2000 were highly contaminated. This station, which was located in the turning basin of Shipyard Creek in Charleston Harbor, had elevated levels of arsenic, copper, and chromium and eight PAHs which exceeded ER-L levels.

While individual contaminants were elevated at some sites, a better assessment of overall contaminant exposure may be derived from the combined concentrations of all contaminants present at a site relative to bioeffects guidelines. The combined measure is calculated by dividing the measured concentration of 24 contaminants by their respective ER-M values, and taking the average of all 24 quotient values. The ERM-Quotient (or ERM-Q) has been evaluated by Hyland *et al.* (1999) at more than 230 estuarine sites throughout the southeast to provide a basis for predicting stress in benthic invertebrate communities. ERM-Q values ≤ 0.02 represent a low risk of observing degraded benthic communities, values >0.02 and ≤ 0.058 represent a moderate risk, and values > 0.058 represent a high risk of observing degraded benthic communities.

The mean ERM-Q among open water stations was 0.013 with a range of 0.001 to 0.163 (Figure 3.3.4; Appendix 3.1). The mean ERM-Q among tidal creek stations was 0.015 with a range of 0.000 to 0.055. This difference was statistically significant ($p = 0.025$). Using the criteria developed by Hyland *et al.* (1999), 12 of the tidal creek habitats sampled (6 in 1999 and 6 in 2000) had ERM-Q values indicative of a moderate risk to benthic assemblages while the remaining stations had ERM-Q values indicative of a healthy benthos. Approximately 50% of these sites were near residential areas. Seven open water stations had ERM-Q values representing a moderate risk to benthos. Six of these were in developed watersheds. Additionally, one station sampled in 2000 had a high ERM-Q (0.163) indicative of high risk to benthic health. This station was located in

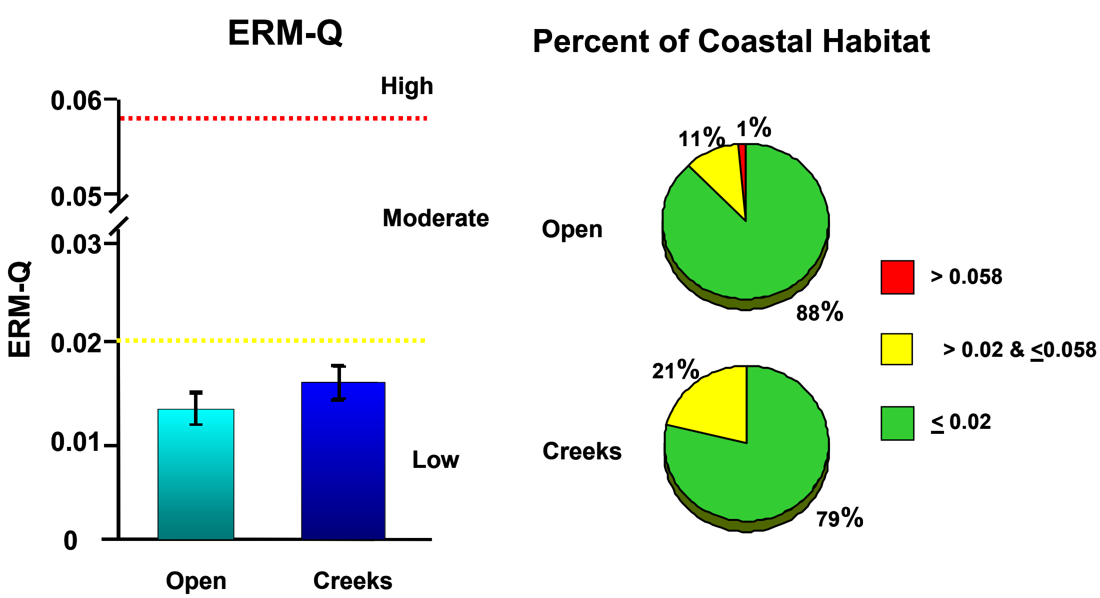


Figure 3.3.4. Average Effects Range-Median Quotient (ERM-Q) value representing the combined contaminant concentration at open water and tidal creek sites sampled in 1999 – 2000 and estimates of the proportion of the state's coastal habitat having ERM-Q values representing a low (≤ 0.02), moderate (> 0.02 - ≤ 0.058), and high (> 0.058) risk of observing stress in benthic communities.

Shipyard Creek in Charleston Harbor, a highly industrial site. The remaining 51 open water stations had low ERM-Q corresponding to healthy benthos (Appendix 3.1).

The estimated percent of the state's tidal creek habitat that had ERM-Q values indicative of moderate risk to benthic health was 21% compared to 1% of the open water habitat. Only 1% of the state's open water habitat had a high ERM-Q (Figure 3.3.4). Although there are several locations in South Carolina's estuarine waters known to be polluted, the areal extent of these polluted areas is localized and not likely to be routinely represented in the 60 sites randomly selected for sampling each year. The lack of widespread contamination in South Carolina's estuaries is a positive indication that our estuaries, overall, are not experiencing extensive chemical degradation. More importantly, the SCECAP database provides valuable data for determining whether conditions at sites where possible anthropogenic insults are occurring result in elevated contaminant concentrations compared with typical conditions found in relatively undeveloped tidal creeks and open water habitats throughout the state.

Toxicity

Even if estuarine sediments have high levels of contaminants, these contaminants may not be available to biota living in the sediments. Laboratory bioassays are used as indicators of contaminant bioavailability (Ringwood and Keppler, 1998). The three bioassays used for the SCECAP study provide useful evidence of probable contaminant effects on benthic species, particularly when two or more of the assays show toxicity.

The seed clam assay identified 11% of the tidal creek stations and 19% of the open water stations as having toxic sediments (Appendix 3.1). One of the tidal creek stations had a porewater ammonia level (21.0 mg/l), which probably accounted for the low clam growth in these sediments. In comparison, the Microtox assay classified 49% of the tidal creek stations and 37% of the open water stations as having toxic sediments, which was much higher than the seed clam assay. This assay may be overly sensitive based on comparisons with the ERM-Q values, with 37 "false positives" observed in sediments that did not have elevated contaminant levels. In comparison, the seed clam assay had only 9 "false positive" tests in sediments where contaminants were not elevated. The amphipod assay, which was completed on the 2000 samples only, was the least sensitive of any of the tests, with no toxicity observed in the 2000 samples (Appendix 3.1) This assay requires contaminants to be high enough to cause significant mortality over a 10-day exposure to sediments compared to the other two assays that reflect sub-lethal effects.

Given the variability in the assay results, we use a weight of evidence approach to define sediment toxicity, with positive tests in two or more of the assays indicating a high probability of toxic sediments, only one positive test indicating possible evidence of toxic sediments, and no positive tests indicating non-toxic sediments. Using this approach, 7% of the state's creek habitat and 14% of the open water habitat had toxic sediments, with an additional 46% and 30%, respectively, showing some evidence of toxicity (Figure 3.3.5).

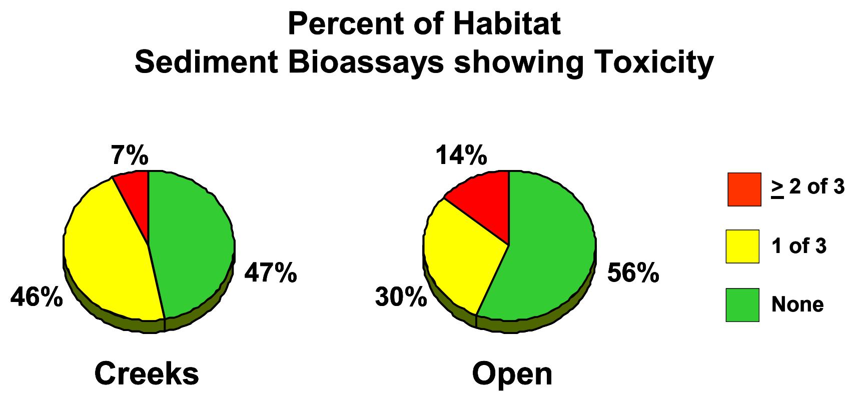


Figure 3.3.5. Summary of sediment bioassay results using multiple assays. Sediments are not considered to be toxic if no significant toxicity was observed in any of the tests, possibly toxic if one of the tests showed positive results, and toxic if two or more of the tests showed positive results.

Integrated Assessment of Sediment Quality

The best estimate of overall sediment quality combines measures of sediment contaminant concentrations (ERM-Q) and sediment bioassay results as evidence of sediment toxicity. The scoring process used for the integrated sediment quality measure was very similar to that described for the integrated water quality score and is shown in Figure 3.3.6.

Results obtained from the state-wide estuarine and coastal assessment of overall sediment quality in 1999-2000 are shown in Figure 3.3.7. Based on these results, none of the state's creek habitat sampled in those years had poor sediment quality and only an estimated 3% of the state's open water habitat had poor sediment quality. A slightly higher percentage of the state's creek habitat had marginal sediment quality compared to open water sites, but this difference was not significant (Appendix 2.5).

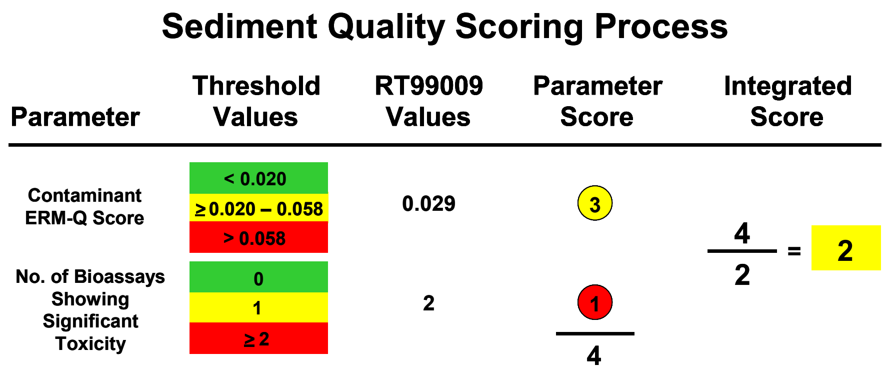


Figure 3.3.6. Summary of sediment quality threshold values and scoring process used to obtain the integrated sediment quality score. Values obtained from station RT99009 were used in this example. Green indicates good sediment quality measures, yellow indicates marginal values that may have some adverse effects on bottom dwelling organisms, and red indicates poor sediment quality measures with a high probability of adverse bioeffects. For the purposes of the SCECAP program, an integrated score < 4.0 represents marginal overall sediment quality, and a score < 2.0 represent poor sediment quality.

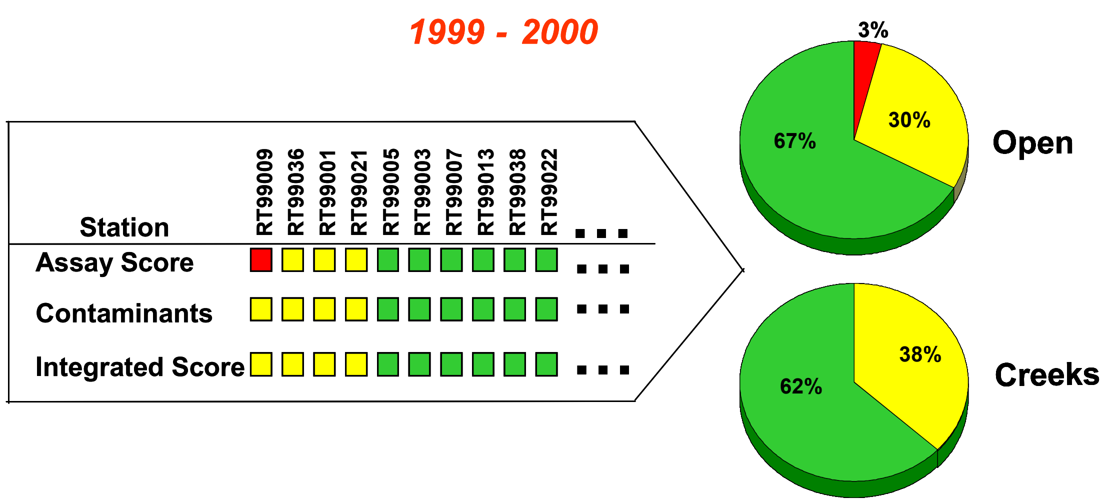


Figure 3.3.7. Proportion of the South Carolina's estuarine habitat that ranks as good (green), marginal (yellow) or poor (red) using the integrated sediment quality score developed for the SCECAP program. This measure of overall sediment quality incorporates the concentration of 24 contaminants relative to known bioeffects levels, and the number of bioassays showing toxicity.

3.4 Biological Condition

Phytoplankton

Our measure of phytoplankton biomass in the water column is based on chlorophyll-a concentrations. Other phytoplankton pigments were also examined using HPLC analyses, but they will not be summarized in this report since further analyses are required before the pigments can be accurately classified as to the type of phytoplankton.

The average chlorophyll-a concentration in creek habitats was 12.8 µg/L compared to an average of 9.7 µg/L at the open water sites (Figure 3.4.1). This difference was statistically significant ($p < 0.02$). Additionally, the CDF analysis indicated that approximately 13% of the state's tidal creek habitat had > 20 µg/L of chlorophyll-a, which is considered to be elevated by Bricker *et al.* (1999). In comparison, only 3% of the open water habitat had elevated chlorophyll-a concentrations. The higher chlorophyll concentrations in tidal creeks may be reflective of the higher nutrient concentrations observed in the creeks. It may also reflect possible re-suspension of benthic algae from the creek bottoms and nearby marsh surfaces.

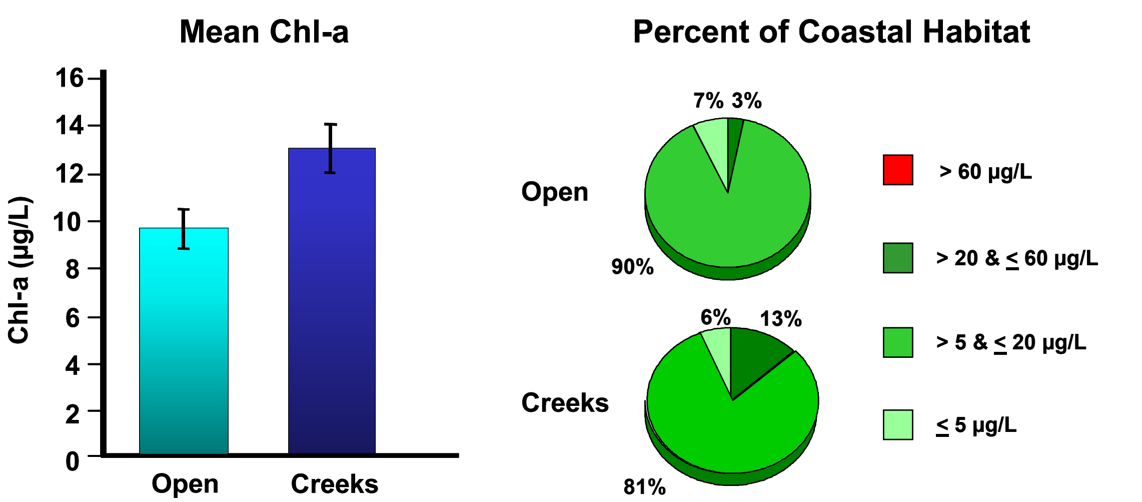


Figure 3.4.1. Comparison of the average chlorophyll-a concentrations observed in tidal creek and open water habitats during 1999-2000, and estimates of the percent of the state's coastal habitat representing various concentrations that are indicative of possible eutrophication (> 20 µg/L ,dark green) based on criteria developed by Bricker *et al*. (1999) in a national study.

In order to evaluate whether nutrient concentrations are influencing the chlorophyll-a concentrations observed, several regression and correlation analyses were conducted. Based on the two-year data set, there were no clear relationships between either TN or TP concentrations and the chlorophyll-a concentrations observed in either the creek or open water habitats, or when both habitats were considered together ($r^2 < 0.1$). Comparison of TDN (measured in 2000 only) did show a stronger positive correlation in creek habitats ($r^2 = 0.6$), but not in open water areas ($R^2 < 0.01$). Neither TP or TDP showed any relationship with chlorophyll-a concentrations in creek or open water habitats, or when both habitats were considered together ($R^2 < 0.01$). The relationship between nutrient concentrations and measures of phytoplankton biomass may become clearer with a larger data set that can be partitioned by tidal stage and time of day. While all of the nutrient and chlorophyll-a samples collected in 2000 were taken simultaneously, this was not always the case in 1999 and chlorophyll-a concentrations are known to vary by both tide stage and time during daylight hours (Day *et al.*, 1989).

Additional chlorophyll-a data collected through this study and through the Harmful Algal Bloom program currently being conducted in South Carolina will provide a much better understanding of what chlorophyll-a concentrations represent "eutrophic" conditions in South Carolina. The NOAA study conducted by Bricker *et al.* (1999) included very little data from either South Carolina or Georgia, which represent two states with very different tidal amplitudes compared to other southeastern states. Until further data are available, we have not incorporated the phytoplankton data in our overall measure of biotic condition for this report, but plan to do so in the future.

Benthic Communities

Benthic organisms are important because they are the primary consumers for many ecosystems and are common prey items for many fish and crustacean species. Benthic organisms are also considered to be excellent indicators of environmental stress because they are sessile and cannot easily avoid exposure to natural or anthropogenic stresses. Characterizing the benthic community in South Carolina coastal habitats is, therefore, essential to the SCECAP program.

More than 43,800 benthic organisms representing 403 taxa were collected from the stations sampled in 1999 and 2000. Species comprising greater than 85% of all organisms collected are listed in Appendix 4.1. Mean abundance of benthic organisms ranged from 6 to 1076 individuals per site (150 to 26,888 individuals/m^2), with a greater mean abundance observed at open water stations (5,825 individuals/m^2) compared to tidal creek stations (3,575 individuals/m^2, Figure 4.3.2). This difference was not statistically significant ($p = 0.19$). Similarly, the mean number of species and Shannon Weiner's index of overall community diversity (H') were also higher at open water stations (24 taxa, H' = 3.05) compared to the tidal creeks stations (17 taxa, H' = 2.73; Figure 3.4.2). The statistical difference in mean number of taxa was $p = 0.08$.

A list of the 50 numerically dominant taxa is provided in Table 3.4.1. The five most abundant taxa collected from tidal creeks comprised more than 46% of all animals collected from that habitat type. These included the polychaete worms *Streblospio benedicti*, *Scoletoma tenuis, Polydora cornuta,* the amphipod *Ampelisca abdita*, and the oligochaete *Tubificoides wasselli*. The five most abundant taxa at open water stations comprised only about 31% of the total fauna from that habitat. These included the polychaetes *Streblospio benedicti, Exogone* sp., *Caulleriella* sp., the amphipod *Ampelisca abdita*, and sea anemones of the order Actinaria. Although Actinaria were dominant in open water stations, 90% of these organisms were collected at one station. Therefore,

Table 3.4.1. Abundance and percent of occurrence of the 50 most abundant benthic organisms collected in 1999 and 2000. A =amphipods, M =mollusks, O =other taxa, P =polychaetes. Mean abundance values represent number / 0.04m^2.

			Open Water		Tidal Creek	
Species Name		**Total Abundance**	**Mean Abundance by Station**	**Percent of Stations**	**Mean Abundance by Station**	**Percent of Stations**
Streblospio benedicti	P	5831	38	73	63	86
Ampelisca abdita	A	2649	24	53	22	44
Actiniaria	O	2091	34	39	2	26
Scoletoma tenuis	P	1856	13	51	19	72
Caulleriella sp.	P	1817	27	34	4	19
Tubificoides wasselli	O	1680	15	42	14	32
Exogone sp.	P	1671	26	46	3	25
Mediomastus sp.	P	1625	19	59	9	67
Polydora cornuta	P	1128	5	32	14	49
Tharyx acutus	P	1116	10	54	9	54
Mediomastus ambiseta	P	1040	9	53	9	49
Scoloplos rubra	P	972	11	39	5	60
Monticellina sp.	P	947	15	37	1	12
Tubificidae	O	884	11	34	4	49
Tubificoides brownae	O	736	4	51	9	70
Protohaustorius deichmannae	A	715	12	14	0	2
Cirratulidae	P	641	5	47	6	58
Tubificidae sp. b	O	627	10	32	1	16
Heteromastus filiformis	P	500	2	44	6	61
Parapionosyllis sp.	P	473	7	27	1	5
Aricidea wassi	P	466	4	36	4	9
Spiochaetopterus costarum oculatus	P	430	4	27	4	46
Carinomella lactea	O	393	4	44	3	42
Tubificidae sp. a	O	364	6	3	0	4
Cirrophorus sp.	P	355	4	46	2	23
Streptosyllis sp.	P	344	5	32	1	19
Nemertinea	O	343	3	76	2	67
Cyathura burbancki	O	340	5	36	1	11
Nereis succinea	P	328	3	41	3	47
Tellina agilis	M	320	3	29	2	18
Sabellaria vulgaris	P	309	5	25	0	7
Rhepoxynius hudsoni	A	298	3	14	2	7
Pelecypoda	M	288	3	56	2	46
Paraprionospio pinnata	P	284	3	20	2	44
Tubificoides heterochaetus	O	244	2	14	2	7
Unciola serrata	A	242	4	14	0	2
Tellinidae	M	235	2	32	2	25
Mediomastus californiensis	P	231	3	34	1	26
Prionospio sp.	P	226	3	25	1	12
Glycera americana	P	196	2	53	1	60
Phoronida	O	194	1	22	3	25
Turbonilla sp.	M	192	3	10	0	2
Ilyanassa obsoleta	M	188	1	5	3	19
Pinnixa sp.	O	186	3	34	0	25
Lepidactylus dytiscus	A	175	2	5	1	4
Clymenella torquata	P	172	3	20	0	2
Chiridotea stenops	O	168	3	7	0	2
Corophium simile	A	152	2	14	1	25
Podarkeopsis levifuscina	P	148	2	34	0	23
Paracaprella tenuis	A	147	2	31	1	19

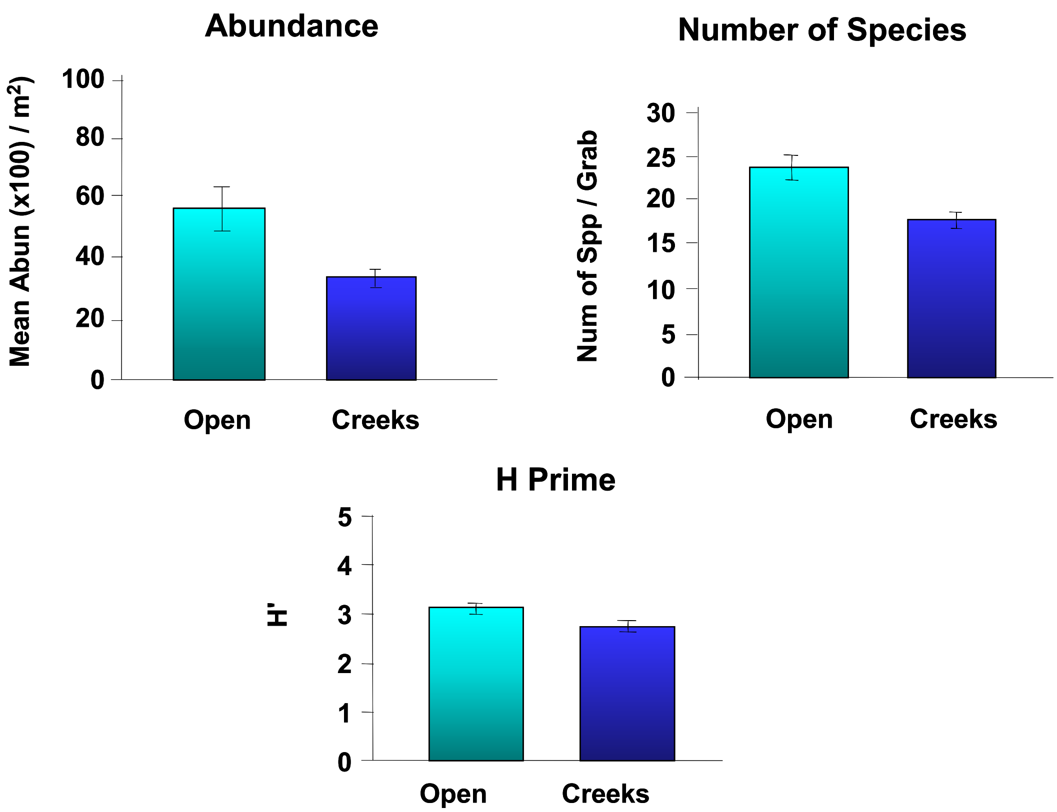


Figure 3.4.2. Mean abundance, number of species, and Shannon-Weiner estimate of community diversity (H') of benthic fauna in bottom grabs (0.04 m^2) collected in open water and tidal creek habitats during 1999-2000.

this taxa is not a good representative of the overall benthic community. The polycheate *Caulleriella* sp. and the oligochaete *Tubificoides wasselli* occurred in only about 30% of stations sampled. Conversely, *Streblospio benedicti* was a numerically dominant organism, especially in creeks, and was present at more than 70% of both open water and tidal creek stations.

Because *Streblospio benedicti* and *Ampelisca abdita* were dominant taxa in both open water and tidal creek habitats, these taxa were analyzed to determine if there was a significant difference in their average abundance between habitat types. The amphipod, *A. abdita*, had similar abundances in open water and tidal creeks habitats (Figure 3.4.3). The polychaete, *S. benedicti*, had significantly greater abundance in tidal creeks than in open water habitats ($p = 0.007$). Tidal creeks had significantly muddier sediments than open water stations (see Sediment Composition section) and *S. benedicti* is known to preferentially inhabit muddy sediments (Levin, 1984).

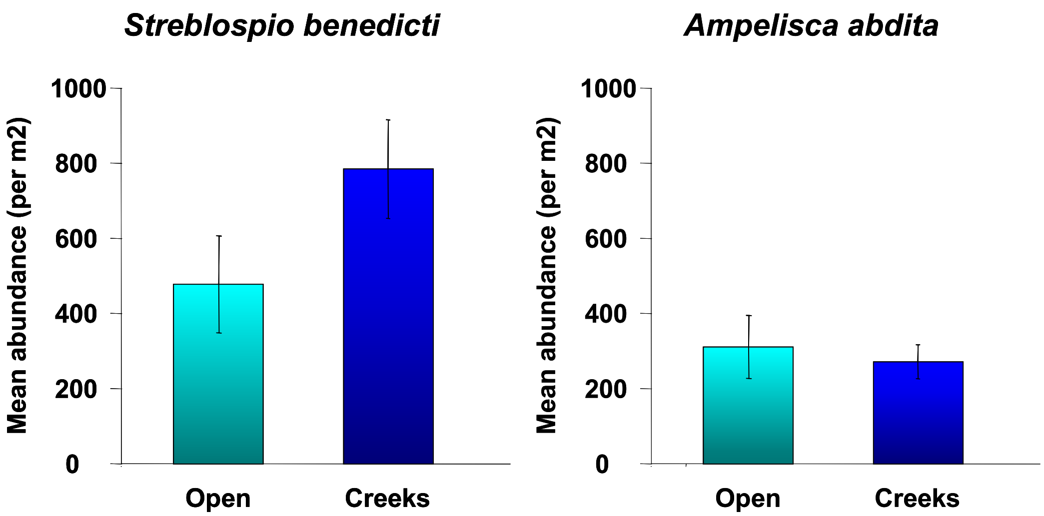


Figure 3.4.3. Abundance of two numerically dominant species, *Streblospio benedicti* and *Ampelisca abdita*, collected in benthic grabs at open water and tidal creek stations during 1999-2000.

To evaluate general taxonomic composition, all benthic species were placed into four groups: polychaetes, amphipods, mollusks, and other taxa. Polychaetes were the dominant taxonomic group in both open water stations and tidal creeks stations, comprising more than 55% of the total abundance. Organisms falling in the "other taxa" category (e.g. oligochaetes, nemerteans, isopods, decapods, etc.) comprised 17% and 23% of the total abundance at creek and open water sites, respectively. Amphipods made up 14% of the total abundance at open water stations and 13% at tidal creeks stations, while mollusks contributed 6% of the total abundance at tidal creek stations and 5% at open water stations (Figure 3.4.4).

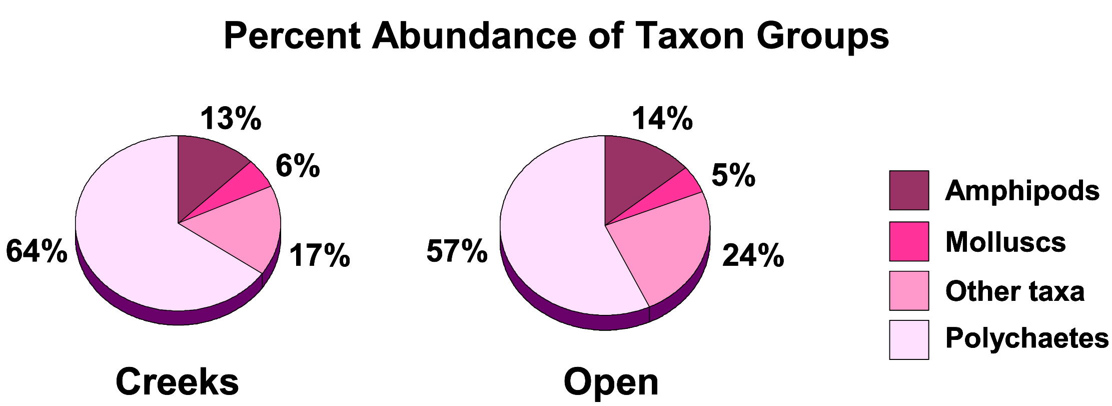


Figure 3.4.4. Percent of total faunal abundance representing general taxonomic groups collected in benthic grabs at open water and tidal creek sites during 1999-2000.

The number of species falling into each taxonomic group varied by station type. Open water stations had 166 polychaete species, 57 mollusk species, 55 amphipod species, and 80 other taxa. Tidal creek stations had 120 polychaete species, 42 mollusk species, and 40 amphipod species and 64 other taxa.

A number of benthic metrics (i.e. abundance, number of species, and abundance of sensitive taxa) have been integrated into a single multi-metric benthic index of biological integrity (B-IBI) that was developed for southeastern estuaries to distinguish between degraded and undegraded environments (Van Dolah *et al.*, 1999). The majority of South Carolina's coastal habitat sampled in 1999-2000 had B-IBI values > 2.5, indicating undegraded benthos. Twelve percent of both tidal creek and open water habitats had B-IBI values of 2 to 2.5, suggesting possible degradation, while only 4% of tidal creek habitat and 2% of open water habitat had degraded benthos (Figure 3.4.5).

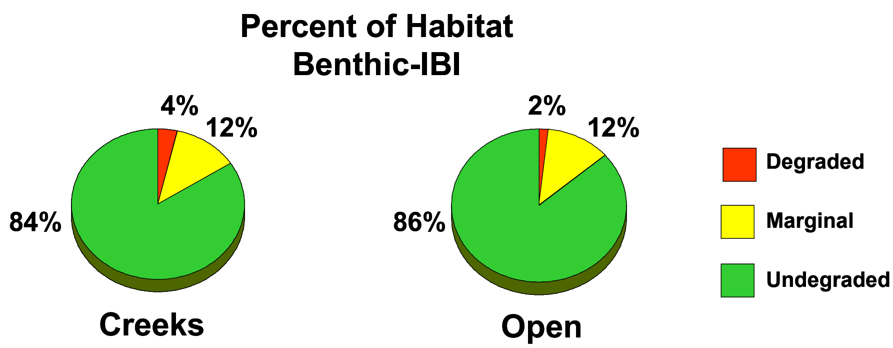


Figure 3.4.5. Estimates of the percent of the state's coastal habitat representing various Benthic IBI values that represent undegraded (>2.5), marginally degraded ($\geq$ 2 and $\leq$ 2.5) or degraded (< 2) benthic communities as developed by Van Dolah *et al.* (1999).

Because organisms inhabiting open water habitats are often exposed to different physical, chemical and biological factors than those living in tidal creek habitats, the biological community might be expected to naturally differ in these two environments. Various benthic metrics (abundance, number of species, and major taxonomic groups) were compared to evaluate benthic community characteristics among the creek and open water habitats. When data were analyzed for both years combined, most of the measures were greater in open water habitat. However, the only statistically significant differences observed were a greater number of species in open water stations ($p < 0.10$) and a higher density of mollusks at open water stations ($p < 0.05$). Substantially higher abundances of *Nucula* sp., *Turbonilla* sp., and undetermined pelecypoda in open water habitats accounted for the higher density of mollusks at open water stations.

The above benthic measures were also compared within each year. In 2000, no statistically significant differences were observed between the two habitats ($p > 0.05$), although most measures were higher at the open water stations compared to tidal creek stations. In 1999, total abundance, number of species, and the percent abundance of mollusks were significantly greater in open water sites than in tidal creeks ($p < 0.05$), while the percent abundance of polychaetes was significantly greater in tidal creeks than in open water ($p < 0.05$).

Most of the differences in benthic measures between habitats were not statistically significant ($p > 0.05$). The lower benthic abundance and diversity in tidal creek habitats versus open water areas may be due to several factors. The most probable contributing factor is the much higher density of fish and crustacean predators present in tidal creeks compared to open water habitats (see next section). Higher predation pressure in tidal creeks would be expected to reduce both the abundance and diversity of the benthic prey species. The relatively poor water quality conditions observed in a higher percentage of tidal creek versus open water stations may also have affected benthic diversity and abundance.

Finfish and Crustacean Communities

Estuarine waters support a diverse and transitory fish assemblage, with many species often present only during certain seasons or stages of development (Ogburn *et al.* 1988). Tidal creeks provide critical habitats for many species because these shallow wetland areas supply food, refuge from predators, and valuable habitats that are utilized by the egg, larval, juvenile, and adult stages of a variety of finfish species (Joseph, 1973; Mann, 1982; Nelson *et al.,* 1991).

Data described for the catch of finfish and crustacean taxa collected during 1999 and 2000 were generally based on organisms that were larger than 2-3 centimeters in size, and slow enough to be caught in the trawl net used for this program. Abundance and biomass values were standardized to the number of individuals per hectare and kilograms per hectare, respectively, and can therefore be compared between habitat types even though trawls were shorter at tidal creek stations compared to the open water stations. Although the number of species collected per trawl cannot be easily normalized using the same process; tidal creeks trawl tows consistently had a greater number of species than observed at open water sites. Preliminary summaries of possible values that may be used to classify station condition are provided in this report, but more data are needed before any index of biotic integrity could be developed using finfish and crustacean species. Species comprising more than 95% of the total catch within each habitat type are listed in Appendix 4.2.

Tidal Creek Stations

In 1999, trawls were successfully completed at 26 of the 27 tidal creek stations sampled, with 2,979 organisms representing 38 species collected. The mean density of finfish and crustaceans collected was 830 organisms/hectare with a mean overall biomass of 7.41 kg/hectare. The mean number of species collected per station was 6.5 species. Diversity and evenness values ranged from 0.61 to 3.11 and from 0.24 to 1.0, respectively.

During 2000, 30 tidal creek stations were sampled with a total of 3,500 organisms representing 53 species collected. The mean density and biomass of fish and crustaceans at the stations sampled in 2000 was slightly greater than observed in 1999 (852 individuals/hectare and 9.10 kg/hectare, respectively). The mean number of species collected per station was 6.8, with diversity values ranging from 0 to 3.61, and evenness values ranging from 0 to 0.95, which was similar to the values observed in 1999. The overall mean abundance, mean biomass and mean number of species collected per station in 1999 versus 2000 were not significantly different ($p > 0.05$).

Over the two-year period, 27 recreationally important species were captured at tidal creek stations (Table 3.4.2, Appendix 4.2). These species comprised 54% of the total abundance. The four most abundant species, which represented 74% of the total abundance, were white shrimp (*Penaeus setiferus*), spot (*Leiostomus xanthurus*), silver perch (*Bairdiella chrysoura*), and brown shrimp (*Penaeus aztecus*). Recreationally important species accounted for 34% of the total biomass collected, with six of these species comprising 72% of the total biomass. Those species were white shrimp, spot, silver perch, blue crabs (*Callinectes sapidus*), brown shrimp, and pinfish (*Lagodon rhomboides*).

Other recreationally important species collected in tidal creek stations were generally not very abundant. They included Atlantic croaker (*Micropogonias undulatus*), weakfish (*Cynoscion regalis*), Atlantic spadefish (*Chaetodipterus faber*), mullet (*Mugil cephalus*), summer flounder (*Paralichthys dentatus*), ladyfish (*Elops saurus*), spotted sea trout (*Cynoscion nebulosus*), pink shrimp (*Penaeus duorarum*), southern flounder (*Paralichthys lethostigma*), white catfish (*Ictalurus catus*), Atlantic sharpnose shark (*Rhizoprionodon terranovae*), sea catfish (*Ariopsis felis*), longnose gar (*Lepisosteus osseus*), Spanish mackerel (*Scomberomorus maculatus*), crevalle jack (*Caranx hippos*), gizzard shad (*Dorosoma cepedianum*), black sea bass (*Centropristis striatus*), gafftopsail catfish (*Bagre marinus*), American shad (*Alosa sapidissima*), and southern kingfish (*Menticirrhus americanus*). Some of these species are not commonly harvested recreationally in South Carolina, but they are considered to be recreationally important in other areas and many are kept as incidental catch by fishermen in this state.

The average biomass of white shrimp collected in 1999 was significantly greater than observed in the 2000 catch ($p < 0.05$), but no other significant differences were found with respect to abundance (organisms/hectare) or biomass (kg/hectare) for catches of spot, silver perch, brown shrimp, blue crab, Atlantic croaker, or pinfish between years

Open Water Stations

The open water stations sampled in 1999 (n = 28) yielded a total catch of 2,541 organisms representing 47 species. The mean abundance per station was 329 organisms/hectare and the mean biomass was 2.45 kg/hectare. An average of 5.8 species were collected per station that year, with diversity and evenness values ranging from 0.51 to 3.23 and 0.20 to 0.92, respectively.

A total of 2,679 organisms representing 44 species were collected at the 30 open water stations sampled in 2000. The mean abundance per station (324 organisms/hectare) was similar to that observed in 1999, but the average catch biomass per station (4.3 kg/hectare) was nearly twice as great. An average of 5.3 species were collected at each station, with diversity values ranging from zero to 3.24, and evenness values ranging from zero to 0.96. These values were similar to those observed in 1999. Statistical comparisons of the mean abundance, biomass, and number of species collected in open water stations between 1999 and 2000 were not significantly different.

A total of 26 recreationally important fish and crustacean species were collected over 1999 and 2000 at open water sites. These taxa represented 57% of the overall abundance and 80% of the overall biomass. Only one of the four most abundant species collected was a recreationally important species (white shrimp), and comprised 18% of the total abundance. The other abundant species included star drum (*Stellifer lanceolatus*), brief squid (*Lolliguncula brevis*), and bay anchovy (*Anchoa mitchilli*). The five species that contributed the most to overall biomass were recreationally important species, and represented 51% of the total biomass. These species were white shrimp, Atlantic croaker, spot, blue catfish (*Ictalurus furcatus*), and brown shrimp.

Other recreationally important species collected in lower abundances in open water stations included longnose gar, northern puffer (*Sphoeroides maculatus*), southern kingfish, summer flounder, gafftopsail catfish, sea catfish, Spanish mackerel, white catfish, American shad, bluefish (*Pomatomus saltatrix*), pink shrimp, white perch (*Morone americana*), Atlantic sharpnose shark, pompano (*Trachinotus carolinus*), and spotted sea trout.

Comparisons of the abundance and biomass of the dominant recreationally important species indicated that both the abundance and biomass of Atlantic croaker collected in the 2000 sampling season were significantly greater than observed in 1999 ($p < 0.05$). No significant differences in abundance or biomass were found between years with respect to the other dominant recreationally important species (silver perch, spot, pinfish, white shrimp, brown shrimp, or blue crabs).

Tidal Creek versus Open Water Habitat

The biological communities sampled by trawls at tidal creek and open water stations displayed a similar array of species (Table 3.4.2). However, the abundance, biomass and diversity of organisms in the two habitat types displayed strong differences (Figure 3.4.6). Tidal creek sites had three times the mean faunal density observed at open water sites ($p < 0.001$). Mean biomass in tidal creeks was also about triple that observed in open water areas ($p < 0.001$). While the difference between habitats in the mean number of species was not as great, it was statistically significant ($p = 0.028$), and as mentioned earlier, trawls in tidal creeks were shorter than at open water sites.

Table 3.4.2. Abundance and percent of occurrence of the most abundant fish and crustaceans collected in trawls during 1999 and 2000. Recreationally important species are in bold text. Abundance values represent No. of organisms / hectare.

Species Name	Total Abundance	Open Water		Tidal Creek	
		Mean Abundance by Station	Percent of Stations	Mean Abundance by Station	Percent of Stations
Penaeus setiferus	43850	118	45	661	68
Bairdiella chrysoura	13739	51	36	192	75
Penaeus aztecus	13698	51	59	192	54
Leiostomus xanthurus	13090	25	50	208	75
Anchoa mitchilli	9644	58	45	113	64
Lolliguncula brevis	9265	66	72	97	77
Stellifer lanceolatus	7500	127	21	3	5
Micropogonias undulatus	3973	53	43	16	36
Cynoscion regalis	3167	36	52	20	29
Lagodon rhomboides	2910	5	12	47	43
Callinectes sapidus	2151	10	34	28	46
Callinectes similis	1180	7	33	14	34
Trinectes maculatus	1014	4	17	14	23
Chaetodipterus faber	881	9	24	7	23
Anchoa hepsetus	732	6	17	6	14
Eucinostomus gula	616	0	2	11	16
Selene vomer	511	3	22	6	18
Brevoortia tyrannus	319	0	3	5	7
Chilomycterus schoepfi	301	1	10	5	16
Opsanus tau	283	1	5	4	21
Orthopristis chrysoptera	261	1	14	3	14
Chloroscombrus chrysurus	167	2	12	1	4
Paralichthys dentatus	167	1	10	2	9
Citharichthys spilopterus	167	0	5	3	11
Ictalurus furcatus	159	3	3	0	0
Stephanolepis hispidus	152	1	7	2	4
Etropus crossotus	138	0	2	2	11
Bagre marinus	116	1	9	1	4
Selene setapinnis	109	2	2	0	0
Mugil curema	109	0	2	2	2
Penaeus duorarum	101	0	3	2	5
Menticirrhus americanus	101	1	9	0	2
Mugil cephalus	100	0	0	2	5
Centropristis philadelphica	85	0	0	2	9
Menticirrhus sp.	80	1	5	0	2
Symphurus plagiusa	80	0	3	1	5
Synodus foetens	80	0	2	1	7
Elops saurus	72	0	0	1	5
Gymnura micrura	65	0	2	1	5
Ictalurus catus	58	0	2	1	2
Opisthonema oglinum	58	1	2	0	0
Lepisosteus osseus	58	1	3	0	2
Peprilus alepidotus	58	1	3	0	2
Ariopsis felis	58	0	2	1	4
Scomberomorus maculatus	58	0	5	1	4
Citharichthys macrops	51	0	2	1	4
Cynoscion nebulosus	51	0	2	1	4
Hypsoblennius hentzi	43	0	0	1	4
Rhizoprionodon terraenovae	43	0	3	1	4
Paralichthys lethostigma	43	0	0	1	5

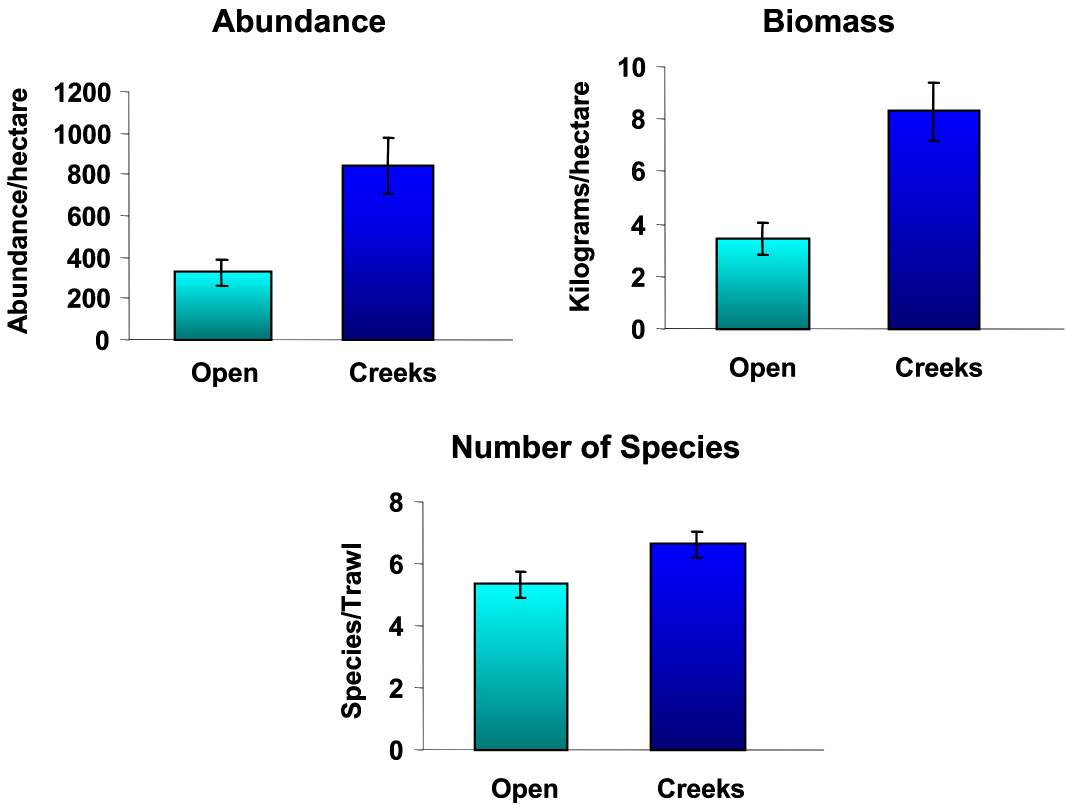


Figure 3.4.6. Mean abundance, biomass, and number of species collected in trawls at open water and tidal creek sites during 1999-2000.

The lower 25th percentile of these three metrics (mean abundance, mean biomass, and mean species numbers) in open water habitats fell at or below the 10th percentile for these metrics in tidal creek habitats (Table 3.4.3). Several recreationally important fish and crustacean species (silver perch, spot, pinfish, white shrimp, and blue crabs) also had

Table 3.4.3. Mean values, and the 10th, 25th, and 50th percentiles for abundance/hectare, biomass/hectare, and number of fish and crustacean species collected in open water and tidal creek habitats.

	Abundance/area		Biomass/area		Species Number	
	Open	Creeks	Open	Creeks	Open	Creeks
mean	326.0	842.1	3.41	8.31	5.3	6.6
10th percentile	21.7	89.9	0.24	0.99	1.50	3.00
25th percentile	84.2	235.5	0.92	2.41	3.00	4.50
50th percentile	157.6	529	1.84	6.17	5.50	6.50

significantly higher abundance and biomass values ($p < 0.05$) in tidal creeks compared to open water habitats. The abundance of two typical species, white shrimp and spot, are presented in Figure 3.4.7. These findings strongly support the need to distinguish between these two habitat types in developing threshold values of concern for these and other measures of species abundance, biomass, and diversity, even though tidal creek habitats comprise only 17% of the state's overall estuarine habitat.

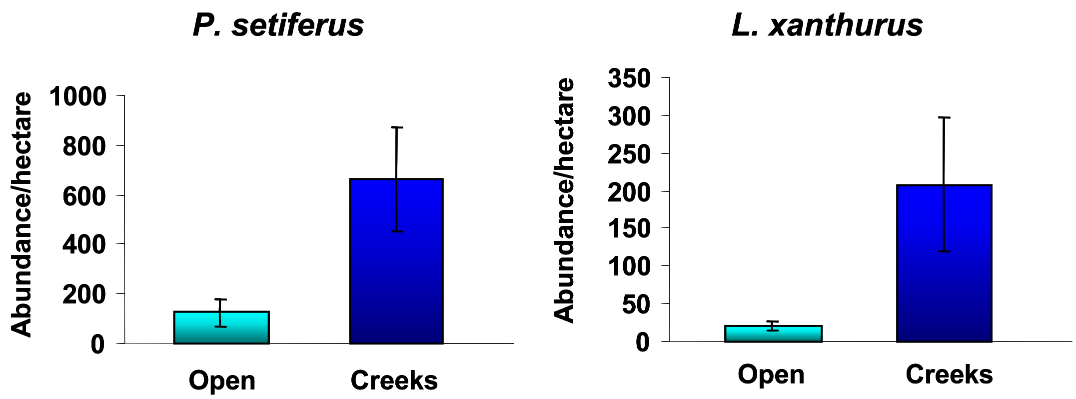


Figure 3.4.7. Abundance of two recreationally important species, white shrimp (*P. setiferus*) and spot (*L. xanthurus*), collected in trawls in open water and tidal creek habitats during 1999-2000.

Three of the stations that fell in the lower 10th percentile for abundance, biomass, and species numbers (RT00502, RO00010, RO99302) had no catch, although both trawls collected at each station were considered to be valid tows by the field crews. The other stations with low trawl catch metrics did not display a consistent reduction in each metric, but rather an even distribution among the sites with low values for a single metric (abundance, biomass, or species number) and stations that were low in more than one metric.

All of the stations with trawl catch metrics ranking in the lower 10th percentile had integrated habitat quality scores greater than 3.5 (see later section), indicating that they were generally considered to be non-degraded sites with respect to overall water quality, sediment quality and/or benthic condition. Station locations were almost evenly split between sites located within drainage basins having residential development nearby (< 1 km) and those located well away from residential development; two stations were in areas with no development. A review of the environmental parameters associated with these stations indicated that one or more parameters at each site showed elevated levels including a toxic microtox or seed clam bioassay, metal contamination exceeding ER-L guidelines, and/or water quality parameters above the 75th or 90th percentile for total nitrogen, total phosphorous, chlorophyll-a concentration, fecal coliform bacteria, alkalinity, turbidity, and BOD_5. In addition, five stations, while falling within the polyhaline range, had salinity values that were below the mean for their respective habitat type. These lower salinity habitats may support a less dense or less diverse fish and crustacean community, resulting in the low abundance, biomass, and species numbers at RT99037, RO99319 and RT00502, low biomass at RT99531, and low abundance and species numbers at RT99309. Finally, the mean salinity of 8.2 at station RT99302 classifies the site as mesohaline; in future analyses, trawl catches with mean salinities falling outside the polyhaline range may be analyzed separately.

Contaminant Levels in Fish Tissue

Fish, crabs, shrimp and other species can be exposed to contaminants through direct contact and consumption of contaminated sediments and/or prey species. These contaminants may be stored in the tissue of the fish over long periods of time. As contaminant levels bioaccumulate, they begin to either have direct effects on the individual animal or are passed on to other species, such as humans, that consume the contaminated organisms. The SCDHEC has placed consumption advisories on specific fish species or specific areas because of high levels of contaminants in fish flesh. In cooperation with the EPA National Coastal Assessment Program (NCA), tissue samples were collected from selected target fish species (spot, Atlantic croaker, silver perch and weakfish) beginning in 2000.

At least one of the target species was collected at 56 of the 60 stations sampled in 2000, with spot being the most common fish collected (38 sites) and Atlantic croaker being the next most common species (10 sites). Weakfish or silver perch were used as the representative species at the remaining 8 sites (Appendix 4.3). All of the whole body tissue samples had detectable levels of some contaminant analytes, but only one site (RO00056 in Shipyard Creek, Charleston Harbor) had levels that were elevated for two PAH analytes (Appendix 4.4). Spot collected from this site had a fluorene wet weight concentration of 15 ng/g and a dry weight concentration of 71 ng/g. The anthracene concentrations in these spot were 78 ng/g (wet weight) and 383 ng/g (dry weight). The recovery rate for fluorene was good based on the analysis of standard reference material (SRM) tissue, but anthracene recovery rates were poor (SRM average recovery rate = 42%). This suggests that the actual anthracene concentration may have been higher than reported. A corrected concentration would be approximately 186 ng/g (wet weight) and 912 ng/g dry weight.

When comparisons were made to NCA database for tissue contaminants (unpublished), only anthracene and fluorine at station RO00056 (anthracene and fluorene) exceeded maximum concentrations observed in other coastal areas of the country. None of the contaminant analytes exceeded Food and Drug Administration (FDA) criteria for safe consumption. It should also be noted that these analyses were done on whole fish, rather than just edible tissue that is used for the consumption advisories.

In order to begin developing criteria on elevated tissue contaminant levels in South Carolina waters, the concentration that represented the 90th percentile value for each analyte was generated using data from all 56 stations (Appendix 4.3). The number of analytes measured that exceeded their respective 90th percentile value was then computed as a measure of chemical enrichment in fish tissue at that site. The Shipyard Creek site (RO00056) had the maximum number of exceedances (35) out of a total possible score of 87 (number of analytes measured). Of the stations with the most analyte exceedances, five sites were close to industrial facilities (RO00056, RO00009, RO00015, RO00020, RT00549) and four sites were close to residential development (RO0006, RT00526, RT00549, RT00550).

Because many of the analytes were below or close to their detection limits, comparisons between the two habitat types (open water and tidal creek) on an analyte by analyte basis would not have provided a meaningful contrast. Comparisons were therefore made on the sum of all analytes in a class using a Mann-Whitney Rank Sum Test. The classes were total DDT, total PAH and total PCB. There were no significant differences between tidal creek and open water habitats for total DDT or total PAH ($p = 0.05$). Total PCBs were significantly higher in open water habitats than in tidal creek habitats ($p = 0.03$).

The USEPA, in a recent report suggested that southeastern estuaries generally had low tissue contaminant levels compared to the northeast, gulf and west coast regions (USEPA, 2001). The results from the SCECAP data set, although limited to only one year of data, support this evaluation.

3.5 Incidence of Litter

An additional measure of habitat quality collected by SCECAP personnel is the incidence of litter. During 1999-2000, only one tidal creek site (RT00544) and two open water sites (RO99317, RO00056) had evidence of litter during the station visit. This represents less than 3% of the state's coastal habitat having evidence of litter.

3.6 Integrated Measure of South Carolina's Estuarine Habitat Quality

A primary goal of the SCECAP program is to combine our measures of water quality, sediment quality and biotic condition into an overall assessment of habitat quality at each site and for the entire coastal zone of South Carolina. A multi-metric measure that integrates measures of water quality, sediment quality, and biological impairment provides a more reliable assessment tool. For example, it is possible for some areas to have poor or marginal water quality based on state standards or historical data, but the conditions do not result in any clear evidence of impaired biotic communities. Many of the state's water quality standards are intentionally conservative to be protective and some contravention of these conditions are not severe enough represent impairment. Similarly, marginal or poor sediment quality may not result in degraded biotic condition because the organisms are either not directly exposed to the sediments (e.g. phytoplankton, fish) or because the contaminants are not readily bioavailable to the animals. Additionally, some of the more motile organisms may only be exposed temporarily due to their transient movements. When two of the three measures (e.g. water quality and biotic condition) are marginal or poor, there is increased certainty and reliability that the habitat may be limiting. When all three measures (e.g. water, sediment, and biota) show evidence of degradation, there is a relatively strong weight of evidence that the habitat is impaired. This "triad" approach to measuring overall habitat quality has been or is being used in many other monitoring programs assessing the health of coastal environments (e.g. Chapman, 1990; Chapman *et al.*, 1991; USEPA, 2001).

Until more biological data can be collected to define water or sediment quality conditions that result in enriched phytoplankton assemblages, or poor conditions in finfish and crustacean assemblages in South Carolina habitats, the SCECAP program will rely primarily on the Benthic Index of Biotic Integrity (B-IBI) developed for the southeastern region as the best measure of biological impairment. As noted previously, benthic invertebrate communities provide an excellent measure of biotic condition because most of the organisms are sessile rather than transient and they have the greatest exposure to poor sediment quality (e.g. elevated contaminants) since they live in the sediments and the bottom waters often exhibit the worst water quality compared to surface waters. Furthermore, the B-IBI developed for this region has been demonstrated to have a high correspondence with sediment quality conditions.

The integrated measure of habitat quality used for the 1999-2000 assessment of South Carolina's coastal zone is computed by taking the average of the integrated water quality score, sediment quality score, and the B-IBI score (Figure 3.6.1). For the purposes of the SCECAP program, sites with an average score ≤ 1.8 are considered poor habitat, and sites with an average score > 1.8 and ≤ 3.2 are considered to represent marginal conditions. Using these criteria, 12% of South Carolina's tidal creek habitat

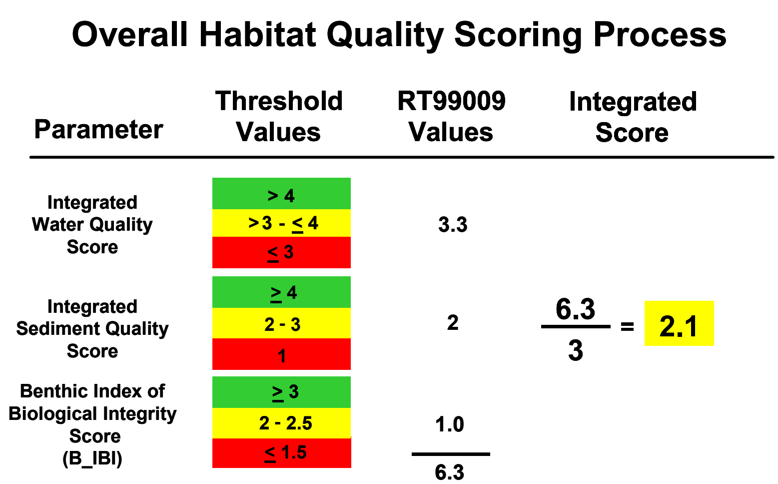


Figure 3.6.1. Summary of threshold values and scoring process used to obtain the overall habitat quality score. Values obtained from station RT99009 were used in this example.

and 8% of the open water habitat coded as marginal in quality (Figure 3.6.2, Appendix 5.1). None of the state's coastal waters coded as poor based on the stations sampled in 1999 and 2000. However, all marginal sites had at least two of the subcategories (water quality, sediment quality, biotic condition) coding as marginal or poor. These locations may deserve additional attention to determine if the causes are due to anthropogenic stress or natural variability.

The higher incidence of marginal tidal creek habitat compared to open water areas is probably due to the more stressful conditions that naturally occur in those habitats. As previously noted, many of the water quality threshold parameters are based on conditions that have been historically observed in the SCDHEC water quality monitoring program, which prior to the addition of SCECAP sampling, did not include many sites located in tidal creeks (as defined by SCECAP). Higher nutrients, and greater oxygen variability may result in some of those sites coding as marginal or poor for water quality, but only about 31% of those stations also had degraded benthic communities. Similarly, only 36% of the stations with marginal or poor sediment quality also had evidence of a degraded benthic community.

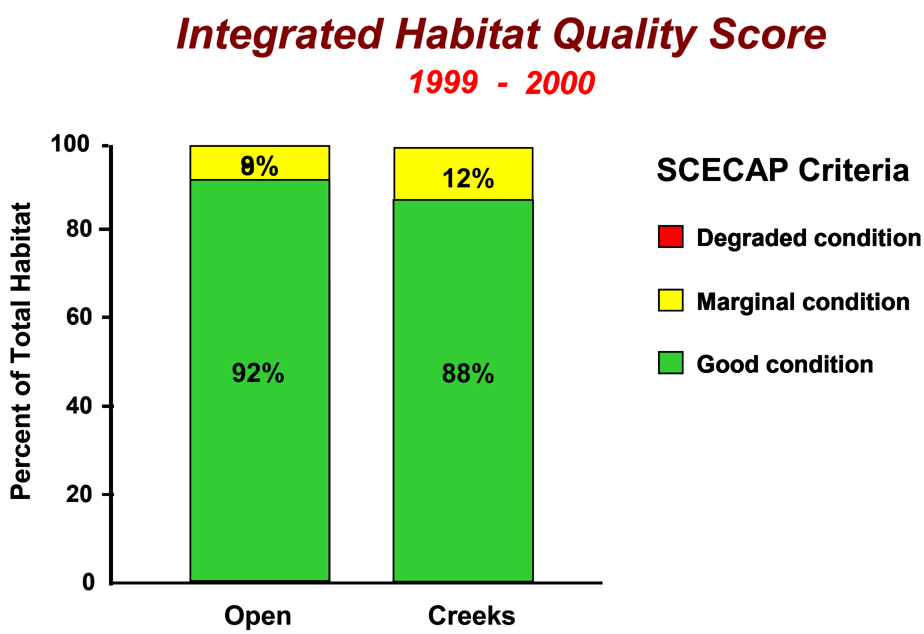


Figure 3.6.2. Estimated percentage of South Carolina's estuarine tidal creek and open water habitat that is in good or marginal condition using an average of water, sediment, and biological quality scores developed for the SCECAP monitoring effort.

The distribution of stations that coded as good or marginal based on the overall integrated score is shown in Figures 3.6.3 – 3.6.5. Four of the five marginal stations found in the northern portion of the state were located in Winyah Bay (Figure 3.6.3). All but one of those had poor sediment quality and marginal or poor benthic condition, but good water quality. The fourth site coded as marginal for water and sediment quality as well as biotic condition (Appendix 5.1). The other site coding as marginal was located in Key Creek off the lower portion of Five Fathom Creek in the Cape Romain area. This site also had marginal water and sediment quality and marginal biotic condition, but there was no clear source of anthropogenic input.

Three of the four sites that coded as marginal in the central portion of the state were located in tidal creeks (Figure 3.6.4). All three had poor or marginal water quality, two had poor sediment quality, and two had poor biotic condition along with either poor water quality and/or poor sediment quality (Appendix 5.1). All three of these sites were sampled in 2000. The one open water site that coded as marginal was located in Shipyard Creek, which had acceptable water quality, but poor sediment quality and a marginal benthic index.

Even though the majority of stations sampled in 1999-2000 were located in the southern portion of the state, only three tidal creek stations coded as having a marginal overall habitat quality. One of these sites was located near upland development in the Beaufort River (RT99005). The other two were not close to developed upland areas and had no clear source of anthropogenic input. The lower incidence of marginal stations in the southern portion of the state may in part be due to the higher tidal flushing in those areas. Additionally, many of the sites sampled in that portion of the state were located in relatively pristine locations, such as the ACE Basin National Estuarine Research Reserve (NERR).

The data obtained from the 1999 – 2000 sampling period, combined with the additional sampling to be conducted by the SCECAP program in subsequent years, provides a valuable database on the current conditions in both tidal creeks and open water habitat that are located in areas with no clear evidence of anthropogenic input, as well as in areas near industrial and residential development. Studies targeting special areas of concern should find the SCECAP database extremely useful for comparison with "normal" conditions representing relatively pristine habitats throughout the state's coastal zone, or in a sub-region of the state. The availability of these data are particularly important for tidal creek habitats, which show clear differences in many of these measures compared to the same measures taken in the larger open water bodies that have been traditionally sampled by the SCDHEC and SCDNR.

The SCECAP database also provides a valuable measure of the proportion of the state's coastal habitat that is showing marginal or poor conditions with respect to the various measures considered. Sampling in subsequent years will provide an indication of whether habitat quality is similar over time, or getting worse with increased coastal development pressures. The program will provide a similar summary of coastal condition every two years to evaluate changes over time. Future sampling will also provide an opportunity to evaluate conditions within some of the larger drainage basins, such as Winyah Bay, Charleston Harbor, Port Royal Sound, or within specific areas of interest, such as Georgetown County, Charleston County, Beaufort County, etc. Criteria for defining marginal or poor conditions with respect to the various water quality, sediment quality, and biological measures will be re-evaluated once a larger data set is available. This re-evaluation may influence the threshold values used in the integrated measures as well.

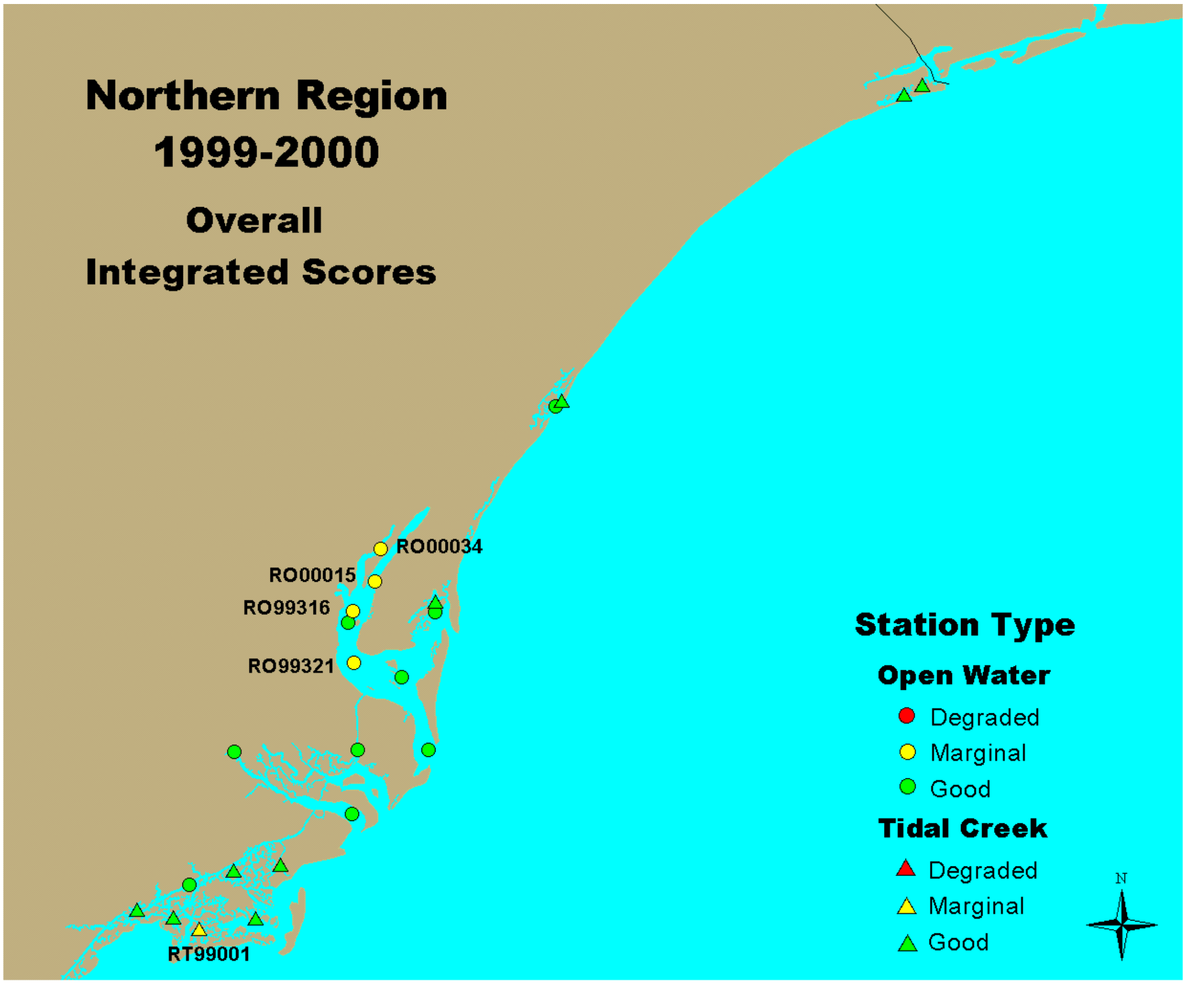


Figure 3.6.3. Distribution of open water and tidal creek stations sampled in the northern portion of the state during 1999-2000 that had an overall habitat quality score of “good”, “marginal”, or “degraded” based on an integrated measure of water quality, sediment quality and biological condition.

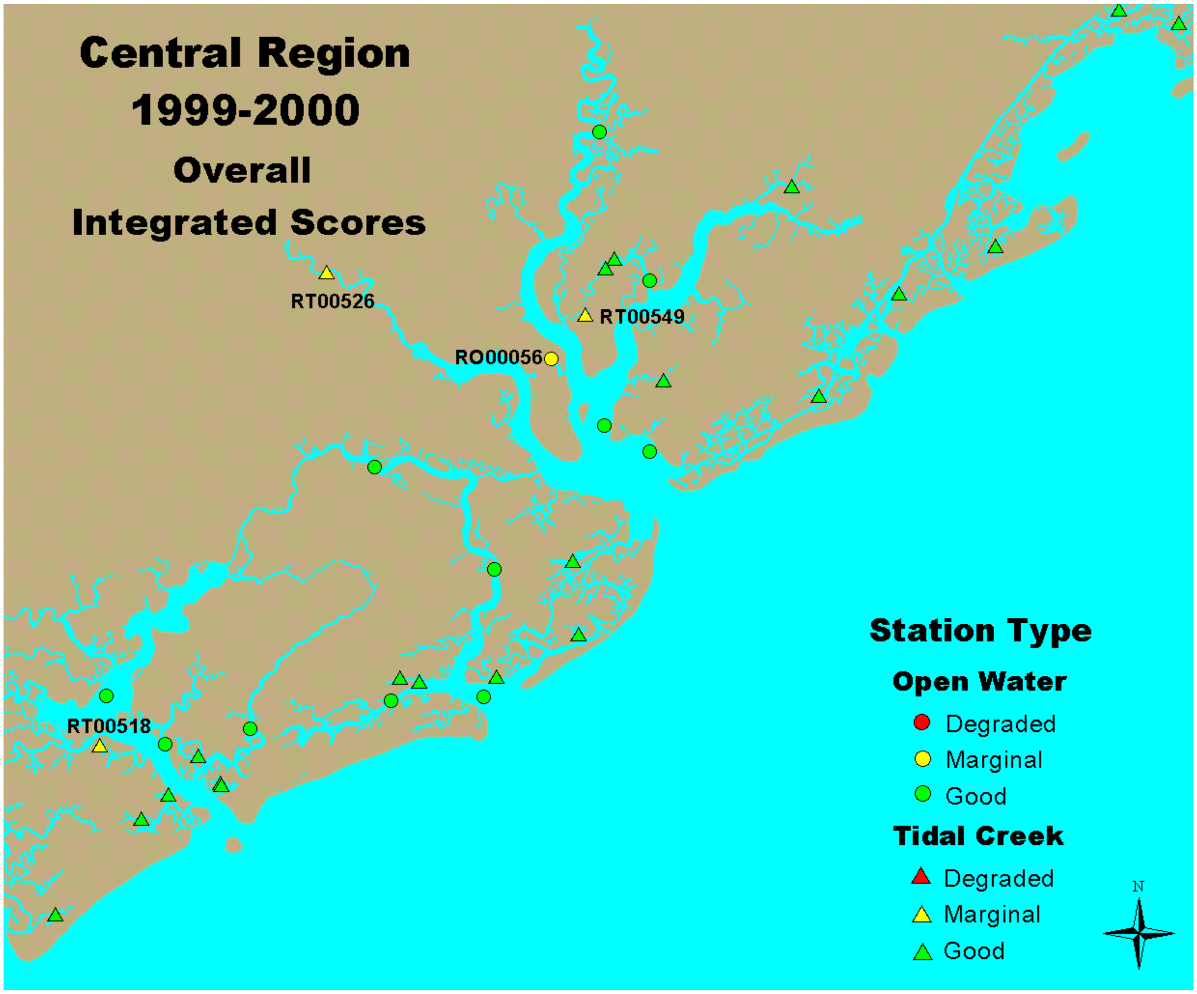


Figure 3.6.4. Distribution of open water and tidal creek stations sampled in the central portion of the State during 1999-2000 that had an overall habitat quality score of "good", "marginal", or "degraded" based on an integrated measure of water quality, sediment quality and biological condition.

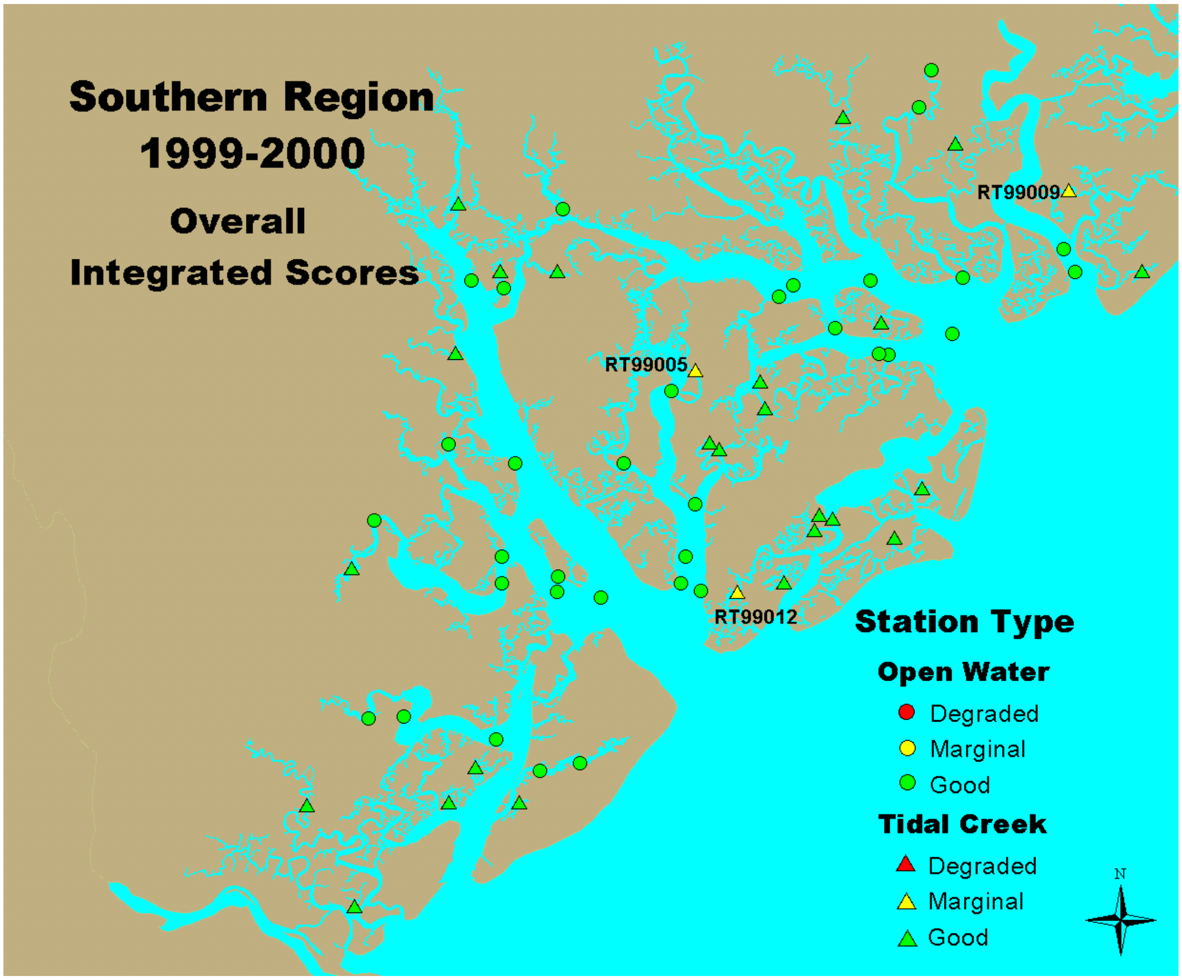


Figure 3.6.5. Distribution of open water and tidal creek stations sampled in the central portion of the state during 1999-2000 that had an overall habitat quality score of "good", "marginal", or "degraded" based on an integrated measure of water quality, sediment quality and biological condition.

ACKNOWLEDGEMENTS

We wish to thank several individuals who assisted in the field and laboratory efforts reported here. They include: J. Bickley, S. Burns, S. Crowe, D. Graves, L. Forbes, M. Giffin, G. Hay, K. Hayes, J. Jefferies, C. Keppler, P. Maier, L. McLean, B. Rabon, A. Ringwood, A. Rourke, T. Snoots, G. Steele, B. Stender, T. Whaley, We also wish to thank the staff of the SCDHEC Bureau of Environmental Services, Analytical Services Division, who completed most of the water chemistry analyses, and staff of the National Ocean Service Center for Coastal Environmental Health and Biomolecular Research (NOS-CCEHBR), who completed the sediment chemistry, tissue chemistry, and Microtox analyses. The CCEHBR staff included A. Clum, K. Chung, A. Dias. P. Jenkins, B. Shaddrix, S. Sivertsen, and E. Strozier. Staff of the Harmful Algal Bloom Program at the SCDNR also helped in the processing and analyses of water samples during the 2000 sampling effort.

Special thanks are due to J. Miglarese and F. Holland with the SCDNR – Marine Resources Division, and A. Boozer with the SCDHEC – Bureau of Water for their support and encouragement in developing this inter-agency program. Much of the monitoring effort could not have been completed without funding from the USEPA National Coastal Assessment Program under Cooperative Agreement R-82847201-0. Dr. K. Summers and J. Harvey have been particularly helpful in assisting with the implementation of the South Carolina component of the NCA. We also thank Dr. T. Olsen and staff at the USEPA NHEERL, Corvallis, OR for their assistance in developing the sampling design and CDF routines. In addition to the funding provided by the SCDNR, SCDHEC and USEPA, supplemental funding was obtained from the U.S. Fish and Wildlife Service Sport Fish Restoration Act Grant No. D70, and from the counties of Beaufort, Charleston, Georgetown, and Horry, which provided funding to purchase water quality instrumentation that is a critical element of this program. We thank C. Farmer for his efforts in coordinating that funding.

Finally, we wish to thank several staff within the SCDNR and SCDHEC who provided technical review of this document. They include: D. Baize, A. Boozer, F. Holland, D. Sanger, and P. Wendt.

LITERATURE CITED

ASTM. 1993. ASTM Standards on Aquatic Toxicology and Hazard Evaluation. Sponsored by ASTM Committee E-47 on Biological Effects and Enviromental Fate. ASTM Publication Code Number (PCN): 03-547093-16. 538p.

Bamber, R.N. 1987. The effects of acidic sea water on young carpet-shell clams *Venerupis decussata* (l.) (Mollusca: Veneracea). Journal of Experimental Marine Biology and Ecology 108:241-260.

Bamber, R.N. 1990. The effects of acidic seawater on three species of lamellibranch mollusks. Journal of Experimental Marine Biology and Ecology 143: 181-191.

Bricker, S. B., C. G. Clement, D. E. Pirhalla, S. P. Orlando and D. R. G. Farrow. 1999. National Estuarine Eutrophication Assessment: Effects of Nutrient Enrichment in the Nation's Estuaries. National Oceanic and Atmospheric Administration, National Ocean Service, Special Projects Office and the National Centers for Coastal Ocean Science. Silver Spring, Maryland. 71p.

Chapman, P.M. 1990. The sediment quality triad approach to determining pollution-induced degradation. The Science of the Total Environment. 97: 815-825.

Chapman, P.M., E.A. Powwer, R.N. Dexter, and G.A. Burton, Jr. 1991. Integrative assessments in aquatic ecocsystems. Pp 313-340 *In* G.A. Burton, Jr. (ed). Contaminant Sediment Toxicity Assessment. Lewis Pubulisher, Chelsea, MI.

Day, J.W. Jr., C.A.S. Hall, W.M. Kemp, and A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley and Sons. New York, NY. 558 p.

D'Elia, C.F., P.A. Steudler, and N. Corwin. 1972. Determination of total nitrogen in aqueous samples using persulfate digestion. Limnology and Oceanography 22:760-764.

Diaz, R.J. and R. Rosenberg. 1995. Marine benthic hypoxia: A review of its ecological effects and the behavioural responses of benthic macrofauna. Oceanography and Marine Biology Annual Review 33:245-303.

Fortner, A.R., M. Sanders, and S.W. Lemire. 1996. Polynuclear aromatic hydrocarbons and trace metal burdens in sediment and the oyster, *Crassostrea virginica* (Gmelin), from two high salinity estuaries in South Carolina. *In*: Sustainable Development in the Southeast Coastal Zone. F.J. Vernberg, W.B. Vernberg and T. Siewicki, eds. University of South Carolina Press, Columbia, SC, USA, pp. 445-477.

Gibson G.R., M.L. Bowman, J.Gerritsen, and B.D. Snyder. 2000. Estuarine and Coastal Marine Waters: Bioassessment and Biocriteria Technical Guidance. EPA 822-B-00-024. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Holland, A.F., G.H.M. Riekerk, S.B. Lerberg, L.E. Zimmerman, and D.M. Sanger. 1997. Assessment of the Impact of Watershed Development on the Nursery Functions of Tidal Creek Habitats. pp. 110-115 In: Management of Atlantic Coastal Marine Fish Habitat: Proceedings of a Workshop for Habitat Managers, ASMFC Habitat Management Series #2, April 1997. 223p.

Hyland, J.L., T.J. Herrlinger, T.R. Snoots, A.H. Ringwood, R.F. Van Dolah, C.T. Hackney, G.A. Nelson, J.S. Rosen, and S.A. Kokkinakis. 1996. Environmental Quality of Estuaries of the Carolinian Province: 1994. Annual Statistical Summary for the 1994 EMAP-Estuaries Demonstration Project in the Carolinian Province. NOAA Technical Memorandum NOS ORCA 97. NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver pring, MD. 102p.

Hyland, J.L., L. Balthis, C.T. Hackney, G. McRae, A.H.Ringwood, T.R. Snoots, R.F. Van Dolah, and T.L. Wade. 1998. Environmental Quality of Estuaries of the Carolinian Province: 1995. Annual Statistical Summary for the 1995 EMAP Estuaries Demonstration Project in the Carolinian Province. NOAA Technical Memorandum NOS ORCA 123 NOAA/NOS, Office of Ocean Resources Conservation and Assessment, Silver Spring, M.D. 143p.

Hyland, J.L. R.F. Van Dolah, and T.R. Snoots. 1999. Predicting stress in benthic communities of southeastern U.S. estuaries in relation to chemical contamination of sediments. Environmental Toxicology and Chemistry 18(11): 2557-2564

Hyland J., Karakassis, I., Magni, P, Petrov, A. Shine J. 2000. Summary Report: Results of initial planning meeting of the United Nations Educational, Scientific and Cultural Organization (UNESCO) Benthic Indicator Group. 70p.

Joseph, E.B. 1973. Analysis of a nursery ground. *In* Pacheco, A.L. (ed.) Proceedings of a Workshop on Egg, Larval, and Juvenile Stages of Fish in Atlantic Coast Estuaries.

Krahn, M.M., C.A. Wigren, R.W. Pearce, L.K. Moore, R.G. Boger, W.D. McLeod, Jr., S.L. Chan, and D.W. Brown. 1988. New HPLC cleanup and revised extraction procedures for organic contaminants, National Oceanic and Atmospheric Administration Technical Memorandum NMFS F/NWC-153: 23-47.

Kucklick, J.R., S. Sivertsen, M. Sanders and G. Scott. 1997. Factors influencing polycyclic aromatic hydrocarbon concentrations and patterns in South Carolina sediments. Journal of Experimental Marine Biology and Ecology 213: 13-29.

Krebs, C.J. 1972. The experimental analysis of distribution and abundance. Ecology. New York: Harper and Row.

Lerberg, S.B., A.F. Holland, and D.M. Sanger. 2000. Responses of tidal creek macrobenthic communities to the effects of watershed development. Estuaries 23: 838-853.

Levin, L.A. 1984. Multiple patterns of development in *Streblospio benedicti* Webster (Spionidae) from three coasts of North America. Biological Bulletin. 166:494-508.

Lewitus, A.J., K.C. Hayes, S.G. Gransden, H.B. Glasgow, Jr., J.M. Burkholder, P.M. Glibert and S.L. Morton (in press) Ecological characterization of a widespread red tide in South Carolina estuaries: a newly observed phenomenon. Proc. of the Ninth International Conference on Harmful Algal Blooms, G.M. Hallegraeff, S. Blackburn, C. Bolch & R. Lewis (Eds.). IOC UNESCO, Paris.

Long, E.R. G.I. Scott, J. Kucklick, M. Fulton, B. Thompson, R.S. Carr, K.J. Scott, G.B. Thursby, G.T. Chandler, J.W. Anderson, and G.M. Sloane. 1997. Final Report. Magnitude and extent of sediment toxicity in selected estuaries of South Carolina and Georgia. NOAA Technical Memorandum NOS ORCA: 178p.

Mann, K.H. 1982. Ecology of coastal waters. University of California Press, Los Angeles, California. 322 pp.

Microbics Corporation. 1992. Microtox® Manual. Vol. 1. 1992 Edition. Carlsbad, CA.

Moore, D.W., T.S. Bridges, B.R. Gray, and B.M. Duke. 1997. Risk of ammonia toxicity during sediment bioassays with the estuarine amphipod *Leptocheirus plumulosus*. Environmental Toxicology and Chemistry 16(5): 1020-1027.

Nelson, D.M., E.A. Irlandi, L.R. Settle, M.E. Monaco, L. Coston-Clements. 1991. Distribution and abundance of fishes and invertebrates in Southeast estuaries. ELMR Rep. No. 9. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, Maryland. 167 pp.

Ogburn, M.V., D.M. Allen, W.K. Michener. 1988. Fishes, shrimps, and crabs of North Inlet Estuary, SC: A four-year seine and trawl survey. Baruch Institute Technical Report. No. 88-1. 299 pp. University of South Carolina. Columbia, South Carolina.

Plumb, R.H. Jr. 1981. Procedures for handling and chemical analyses of sediment and water samples. Tech. Rept. EPA ICE-81-1 prepared by Great Lakes Laboratory, State University College at Buffalo, NY, for the U.S. Environmental Protection Agency/Corps of Engineers Technical Committee on Criteria for Dredge and Fill Material. Published by the U.S. Army Engineer WatWaterways Experiment Station, Vicksburg, MS.

Ringwood, A.H., A.F. Holland, R. Kneib, and P. Ross. 1996. EMAP/NS&T pilot studies in the Carolinian Province: Indicator testing and evaluation in southeastern estuaries. NOAA Technical Memorandum NOS ORCA 102. 113p.

Ringwood, A.H. M.E. DeLorenzo, P.E. Ross, and A.F. Holland. 1997. Interpretation of microtox solid phase toxicity tests: The effects of sediment composition. Environmental Toxicology and Chemistry 16(6): 1135-1140.

Ringwood, A.H. and C.J. Keppler. 1998. Seed clam growth: An alternative sediment bioassay developed during EMAP in the Carolinian Province. Environmental Monitoring and Assessment 511: 247-257.

Ringwood, A.H. and C.J. Keppler. In review. Is pH really a "non-issue" in estuaries. Estuaries.

Sanger, D.M., A.F. Holland, and G.I. Scott. 1999a. Tidal creek and salt marsh sediments in South Carolina Coastal Estuaries. I. Distribution of trace metals. Archives of Environmental Contamination and Toxicology 37:445-457

Sanger, D.M., A.F. Holland, and G.I. Scott. 1999b. Tidal creek and salt marsh sediments in South Carolina Coastal estuaries. II. Distribution of organic contaminants. Archives of Environmental Contamination and Toxicology 37:458-471.

Scott, G.I. M.H. Fulton, G.T. Chandler, P.B. Key, E.D. Strozier, B.C. Thomposn, J.W. Daugomah, P. Pennington, Sl Layman. 1994. A survey of sediment toxicityin Charleston Harbor, Winyah Bay, North Edisto River and North Inlet estuaries of South Carolina. Final Report to NOAA, National Status and Trend Program, Bioeffects Division, Seattle, Washington: 80p + appendices.

Scott, G.I., M.H. Fulton, D. Bearden, K.W.Chung, M.Sanders, A. Dias, L.A. Reed, S. Sivertsen, E. D. Strozier, P.B. Jenkins, J.W. Daugomah, P. Pennington, J. DeVane, P.B. Key, A.K.Leight, and W. Ellenbery. 2000. Chemical contaminant levels in estuarine sediment of the Ashepooo-Combahee-Edisto River (ACE) Basin National Estuarine Reseearch Reserve and Sanctuary Site. 104 p.

Sims, J.G. and D.W. Moore. 1995. Risk of pore water ammonia toxicity in dredged material bioassays. U.S. Army Corps of Engineers, Miscellaneous paper D-95-3. 66p.

South Carolina Department of Health and Environmental Control. 1997. Procedures and Quality Control Manual for Chemistry Laboratories. Bureau of Environmental Services, Columbia, S.C.

South Carolina Department of Health and Environmental Control. 1998a. Summary of Selected Water Quality Parameter Concentrations in South Carolina Waters and

Sediments January 1, 1993 - December 31, 1997. Technical Report 004-98. Bureau of Water, Columbia, S.C.

South Carolina Department of Health and Environmental Control. 1998b. Laboratory Procedures Manual for Environmental Microbiology. Bureau of Environmental Services, Columbia, S.C.

South Carolina Department of Health and Environmental Control. 2000. Standard Operating and Quality Control Procedures for Phytoplankton and Chlorophyll a. Technical Report No. 014-00. Bureau of Water, Columbia, S.C.

South Carolina Department of Health and Environmental Control. 2001a. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Office of Environmental Quality Control, Columbia, SC.

South Carolina Department of Health and Environmental Control. 2001b. Water Classifications and Standards (Regulation 61-68) and Classified Waters (Regulation 61-69) for the State of South Carolina. Office of Environmental Quality Control, Columbia, S.C.

Stevens, D.L., Jr. 1997. Variable density grid-based sampling designs for continuous spatial populations. Environmetrics **8**, 167-195.

Stevens, D.L., Jr. and Olsen, A.R. 1999. Spatially restricted surveys over time for aquatic resources. Journal of Agricultural, Biological, and Environmental Statistics 4, 415-428.

Strobel, C.J., H.W. Buffum, S.J. Benyi, E.A. Petrocelli, D.R. Reifsteck and D.J. Kieth. 1995. Statistical Summary EMAP-Estuaries Virginian Province – 1990 to 1993. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Narragansett, RI. EPA/620/R-94/026. 72p.

Summers, J.K., J.M. Macauley, P.T Heitmuller, V.D. Engle, A.M. Adams, and G.T Brooks. 1993. Annual statistical summary: EMAP – Estuaries Louisianian Province –1991. U.S. EPA Office of Research and Development, Environmetal Research Laboratory, Gulf Breeze, FL. EPA/600/R-93/001. 101 p. plus appendices A-C.

U.S. Environmental Protection Agency. 2001. National Coastal Condition Report. EPA-620-R-01-005. 204 pp.

U.S. Environmental Protection Agency. 1994. Methods for assessing the toxicity of sediment-associated contaminants with estuarine and marine amphipods. EPA/600/R-94/025. Final Report. Office of Environmental Protection Agency, Washington DC. 140p.

Van Dolah, R.F., J.L. Hyland, A.F. Holland, J.S. Rosen, and T.R. Snoots. 1999. A benthic index of biological integrity for assessing habitat quality in estuaries of the southeastern United States. Marine Environmental Research 48: 269-283.

Van Dolah, R.F., D.E. Chestnut, and G.I. Scott. 2000. A baseline assessment of environmental and biological conditions in Broad Creek and the Okatee River, Beaufort County, South Carolina. Final Report to the Beaufort County Council, Beaufort County, South Carolina. 115 p. plus appendices.

Weisberg, S.B., J.B. Frithsen, A.F. Holland, J.F. Paul, K.J. Scott, J.K. Summers, H.T. Wilson, R. Valente, D.G. Heimbuch, J. Gerritsen, S.C. Schimmel, and R.W. Latimer. 1992. EMAP-Estuaries Virginian Province 1990 Demonstration Project Report. U.S. EPA Environmental Research Laboratory, Narragansett, R.I. EPA/600/R-92/100.

DATA APPENDICES

Appendix 1.1. Summary of station locations and dates sampled in 1999 and 2000. RO stations designate open water habitat and RT stations designate tidal creek habitats. Development codes: NDV = no development visible, R<1 = Residential less than 1 km away, R>1 = residential greater than 1 km away, I<1 = Industrial site < 1 km away, I>1 = Industrial site located > 1 km away.

SCECAP 1999 Water Quality
Station Information -- Open Water

Station	Station Type	Latitude Decimal Degrees	Longitude Decimal Degrees	Station Depth (meters)	Date Sampled	County	Development Code	Approximate Location
RO99301	Open	32.88486	79.87600	2.0	07/07/1999	Charleston	NDV	Off of Wando River in Nowell Creek
RO99302	Open	32.63618	80.46825	10.0	08/25/1999	Colleton	R<1	Upper Ashepoo River
RO99303	Open	32.31833	80.66026	1.0	08/10/1999	Beaufort	R<1	In Beaufort River off Parris Island
RO99304	Open	32.34213	80.90036	2.5	07/20/1999	Beaufort	R<1	Lower Okatie River
RO99305	Open	32.30514	80.75850	10.0	07/20/1999	Beaufort	R>1	Lower Chechesee River
RO99306	Open	33.53927	79.02963	2.0	08/23/1999	Georgetown	R<1	Lower Murrell's Inlet
RO99307	Open	33.20107	79.41741	2.0	07/13/1999	Georgetown	NDV	South Santee River near Highway 17 bridge
RO99308	Open	32.46280	80.45373	10.0	08/04/1999	Beaufort	R>1	Saint Helena Sound near Morgan Island
RO99309	Open	32.48787	80.58732	5.0	08/04/1999	Beaufort	R<1	Lower Coosaw River near Coosaw Island
RO99310	Open	32.30051	80.66381	5.0	08/10/1999	Beaufort	R>1	Beaufort River near Parris Island
RO99311	Open	33.13766	79.27973	3.0	07/13/1999	Charleston	NDV	Lower South Santee near Murphy Island
RO99312	Open	32.63149	80.06459	6.0	07/08/1999	Charleston	R>1	Kiawah River
RO99313	Open	32.54594	80.75418	2.0	08/03/1999	Beaufort	R>1	Whale Branch Creek
RO99315	Open	32.21238	80.90505	3.0	07/27/1999	Beaufort	R>1	Upper May River
RO99316	Open	33.33951	79.27480	3.5	08/17/1999	Georgetown	I>1	Winyah Bay near City of Georgetown
RO99317	Open	32.63379	79.99789	5.3	07/08/1999	Charleston	NDV	Near confluence of Folly River and Stono River
RO99318	Open	32.44989	80.51007	4.0	08/04/1999	Beaufort	R>1	Lower Morgan River
RO99319	Open	32.46700	80.54373	5.0	08/04/1999	Beaufort	R>1	Parrot Creek on Morgan Island
RO99320	Open	32.19842	80.80661	10.0	07/27/1999	Beaufort	R>1	Lower May River
RO99321	Open	33.28835	79.27434	2.0	08/17/1999	Georgetown	R>1	Winyah Bay
RO99322	Open	32.79702	79.90902	2.8	07/07/1999	Charleston	R<1	Charleston Harbor near Patriots Point
RO99323	Open	32.60660	80.22701	2.0	07/28/1999	Charleston	R>1	North Edisto River near mouth of Leadenwah Creek
RO99324	Open	32.39155	80.84245	5.0	07/20/1999	Beaufort	R>1	Buzzard Creek in Broad River
RO99325	Open	32.31847	80.80146	6.0	07/20/1999	Beaufort	R>1	Lower Chechesee River
RO99326	Open	33.27288	79.21744	2.0	09/01/1999	Georgetown	I>1	Winyah Bay near Marsh Island
RO99327	Open	32.71090	79.98936	2.0	07/08/1999	Charleston	R>1	Stono River
RO99328	Open	32.51798	80.36643	7.0	08/17/1999	Charleston	R>1	Lower South Edisto River near Saint Pierre Creek
RO99329	Open	32.42656	80.67079	5.5	07/21/1999	Beaufort	R<1	Beaufort River near City of Beaufort
RO99330	Open	32.18265	80.74171	4.0	07/27/1999	Beaufort	R<1	Upper Broad Creek on Hilton Head Island

SCECAP 2000 Water Quality
Station Information -- Open Water

Station	Station Type	Latitude Decimal Degrees	Longitude Decimal Degrees	Station Depth (meters)	Date Sampled	County	Development Code	Approximate Location
RO00006	Open	33.20234	79.18721	4.0	08/08/2000	Georgetown	R<1	Winyah Bay near the mouth
RO00007	Open	32.97532	79.91113	15.0	07/11/2000	Berkeley	I>1	Cooper River above Bushy Park
RO00008	Open	32.44977	80.50282	4.3	06/27/2000	Beaufort	R>1	Morgan River north of St Helena Island
RO00009	Open	32.37755	80.70574	2.1	06/20/2000	Beaufort	I>1	Port Royal in Battery Creek
RO00010	Open	32.29549	80.64808	6.4	06/20/2000	Beaufort	R<1	St Helena Sound in mouth of Beaufort River
RO00015	Open	33.36870	79.24757	1.0	08/08/2000	Georgetown	I>1	Waccamaw River just above Hwy 17 Bridge
RO00016	Open	33.06956	79.47421	2.1	07/18/2000	Charleston	R<1	McClellanville area, intersection of ICW and Matthews Creek
RO00017	Open	32.49974	80.44495	5.5	06/28/2000	Colleton	R>1	St Helena Sound in mouth of Rock Creek
RO00018	Open	32.49816	80.51617	8.2	06/28/2000	Beaufort	NDV	Coosaw River just north of Morgan Island
RO00019	Open	32.21329	80.87769	3.0	08/01/2000	Beaufort	R<1	May River just down river from Bluffton
RO00020	Open	33.32670	79.27856	3.0	08/08/2000	Georgetown	I>1	Winyah Bay just below Georgetown
RO00021	Open	33.20249	79.27205	1.0	08/08/2000	Georgetown	NDV	Intracoastal Waterway just north of the North Santee River
RO00022	Open	32.50254	80.35826	10.0	07/26/2000	Colleton	R<1	South Edisto River just east of Pine Island
RO00023	Open	32.49579	80.57587	5.2	06/28/2000	Beaufort	R>1	Coosaw River behind Lady's Island
RO00024	Open	32.30055	80.80145	10.1	06/21/2000	Beaufort	R<1	Colleton River near Victoria Bluff
RO00033	Open	32.78135	79.87691	1.2	07/19/2000	Charleston	R<1	Charleston Harbor behind Crab Bank
RO00034	Open	33.40089	79.24031	4.5	08/09/2000	Georgetown	NDV	Great Pee Dee River above confluence with Black River
RO00035	Open	32.63557	80.26876	7.0	07/25/2000	Charleston	R>1	Wadmalaw River near Bears Bluff
RO00036	Open	32.49446	80.79973	7.0	07/05/2000	Beaufort	R>1	Whale Branch north of Cotton Island
RO00037	Open	32.29158	80.72581	1.8	06/21/2000	Beaufort	R>1	Chechesse River at south tip of Daws Island
RO00045	Open	32.77275	80.07455	3.0	07/12/2000	Charleston	R<1	Stono River west of Ross Marine
RO00046	Open	32.61194	80.47833	7.0	08/15/2000	Colleton	NDV	Ashepoo River above SR 26 bridge
RO00047	Open	32.37838	80.79110	10.4	06/21/2000	Beaufort	R>1	Broad river near SW end of Hwy 170 bridge
RO00048	Open	32.35258	80.65246	6.7	06/20/2000	Beaufort	R<1	Beaufort River in mouth of Cowen Creek
RO00049	Open	32.29581	80.75849	2.7	06/21/2000	Beaufort	R>1	Chechesee River east of Daws Island
RO00055	Open	33.33733	79.17595	5.0	08/09/2000	Georgetown	R>1	North Inlet near mouth of Old Man Creek
RO00056	Open	32.83794	79.94722	6.4	07/11/2000	Charleston	I<1	Cooper River in the turning basin of Shipyard Creek
RO00057	Open	32.61562	80.16614	6.1	08/15/2000	Charleston	R<1	Bohicket Creek near Camp Ho-Non-Wah
RO00058	Open	32.49902	80.82497	5.5	07/05/2000	Beaufort	R>1	Broad River just above Whale Branch
RO00059	Open	32.17809	80.77239	4.9	08/01/2000	Beaufort	R<1	Broad Creek in town of Hilton Head Island

SCECAP 1999 Water Quality
Station Information -- Tidal Creeks

Station	Station Type	Latitude Decimal Degrees	Longitude Decimal Degrees	Station Depth (meters)	Date Sampled	County	Development Code	Approximate Location
RT99001	Creek	33.02613	79.46133	4.0	07/13/1999	Charleston	NDV	Lower Five Fathom Creek near Bull Bay in Key Creek
RT99002	Creek	33.34826	79.17556	1.5	08/31/1999	Georgetown	R>1	Old Man Creek in North Inlet
RT99003	Creek	32.33099	80.49848	4.5	07/14/1999	Beaufort	R>1	Old House Creek behind Hunting Island
RT99004	Creek	32.64392	80.04372	1.3	08/26/1999	Charleston	R>1	Chapin Creek in Kiawah River
RT99005	Creek	32.44043	80.65215	1.0	07/21/1999	Beaufort	R<1	In Beaufort River near City of Beaufort
RT99006	Creek	33.85259	78.58401	1.0	08/23/1999	Horry	R>1	Near Little River, behind Waites Island
RT99007	Creek	32.71620	79.93245	3.3	08/24/1999	Charleston	R<1	Creek on James Island in Clark Sound
RT99008	Creek	32.36264	80.47678	2.8	07/14/1999	Beaufort	NDV	Small creek on Hunting Island
RT99009	Creek	32.55787	80.36176	2.0	08/17/1999	Charleston	R<1	Bailey Creek in South Edisto River
RT99010	Creek	32.50625	80.80200	2.0	08/03/1999	Beaufort	NDV	Tributary of Broad Creek On Hilton Head Island
RT99012	Creek	32.29527	80.62009	4.0	08/18/1999	Beaufort	R>1	Station Creek on Saint Phillips Island
RT99013	Creek	32.33579	80.55986	3.0	07/14/1999	Beaufort	R>1	Club Bridge Creek in front of St. Helena Island
RT99017	Creek	32.82468	79.86668	1.1	07/07/1999	Charleston	R<1	Hobcaw Creek in Wando River
RT99019	Creek	32.56216	80.24406	2.0	07/28/1999	Charleston	R<1	Ocella Creek in North Edisto River
RT99021	Creek	32.67164	79.92906	1.5	07/08/1999	Charleston	R<1	Sol Legare Creek in Folly River
RT99022	Creek	32.15780	80.78822	2.0	07/27/1999	Beaufort	R<1	Tributary of Broad Creek On Hilton Head Island
RT99024	Creek	32.45226	80.83653	3.0	08/03/1999	Beaufort	R>1	Cole Creek in Broad River
RT99026	Creek	33.08434	79.42012	2.0	07/13/1999	Charleston	NDV	Dupre Creek near McClellanville
RT99027	Creek	32.89336	79.90693	2.8	07/07/1999	Charleston	R<1	Nowell Creek in Wando River
RT99028	Creek	32.34623	80.55658	3.0	08/18/1999	Beaufort	R>1	Front of St Helena Island in tributary of Harbor River
RT99029	Creek	32.57622	80.22423	1.0	07/28/1999	Charleston	R>1	Small creek in lower North Edisto
RT99030	Creek	32.38852	80.63335	1.3	08/10/1999	Beaufort	R<1	Cowen Creek in Beaufort River
RT99036	Creek	33.08941	79.36432	2.0	07/13/1999	Charleston	NDV	Alligator Creek near Cape Romain Harbor
RT99037	Creek	32.94183	79.77252	2.0	08/24/1999	Charleston	R>1	Guerin Creek in upper Wando River
RT99038	Creek	32.34355	80.54637	2.0	08/18/1999	Beaufort	R>1	Behind Pritchards Island in tributary of Trenchards Inlet
RT99039	Creek	32.58222	80.18624	3.0	08/11/1999	Charleston	R>1	Privateer Creek in lower North Edisto River
RT99040	Creek	32.39288	80.64129	4.0	08/10/1999	Beaufort	R<1	Cowen Creek in Beaufort River

SCECAP 2000 Water Quality
Station Information -- Tidal Creeks

Station	Station Type	Latitude Decimal Degrees	Longitude Decimal Degrees	Station Depth (meters)	Date Sampled	County	Development Code	Approximate Location
RT00501	Creek	32.08962	80.91504	3.0	08/02/2000	Jasper	NDV	Wright River in creek at Walls Cut
RT00502	Creek	32.60658	80.53689	6.1	07/26/2000	Colleton	R<1	Old Chehaw River below Social Hall Creek
RT00503	Creek	32.59960	80.20279	1.2	07/25/2000	Charleston	R<1	North Edisto River in Adams Creek
RT00504	Creek	32.41529	80.59778	1.2	06/27/2000	Beaufort	R<1	Warsaw Island in Jenkins Creek
RT00505	Creek	33.03596	79.39523	4.3	07/18/2000	Charleston	NDV	Cape Romain in Devils Den Creek
RT00517	Creek	32.30152	80.58416	1.2	06/20/2000	Beaufort	NDV	Trenchard's Inlet in creek behind St Phillips Island
RT00518	Creek	32.60680	80.27374	0.6	07/25/2000	Charleston	R>1	North Edisto River in Westbank Creek
RT00519	Creek	32.55060	80.83434	1.0	07/05/2000	Beaufort	R<1	Pocotaligo River in Haulover Creek
RT00520	Creek	32.81430	79.75468	3.7	07/19/2000	Charleston	R<1	Goat Island, in creek forming east end of island
RT00521	Creek	33.03783	79.49191	4.0	07/18/2000	Charleston	NDV	Bull Bay in Sett Creek
RT00523	Creek	32.50421	80.30581	1.0	07/26/2000	Colleton	R<1	Edisto Island in creek behind island
RT00525	Creek	32.90371	79.62633	2.1	07/19/2000	Charleston	NDV	Bull Island in Summerhouse Creek
RT00526	Creek	32.89260	80.10793	1.0	07/12/2000	Charleston	R<1	Ashley River upriver of Magnolia Plantation
RT00528	Creek	32.58842	80.44940	1.0	06/28/2000	Colleton	NDV	Ashepoo River in Mosquito Creek
RT00530	Creek	32.87613	79.69637	1.2	07/19/2000	Charleston	NDV	Capers Island in creek off of Santee Pass
RT00531	Creek	32.89936	79.90107	3.4	07/11/2000	Berkeley	R<1	Wando River in Nowell Creek
RT00541	Creek	32.15812	80.84277	5.0	08/01/2000	Beaufort	R>1	Calibogue Sound in a creek off of Cooper River
RT00542	Creek	32.64646	80.05758	0.6	07/12/2000	Charleston	R<1	Kiawah River in Chapin Creek
RT00543	Creek	32.47165	80.50820	0.9	06/27/2000	Beaufort	R>1	MorganRiver in center of Morgan Island
RT00544	Creek	32.64661	79.98795	3.4	07/12/2000	Charleston	R<1	Folly River in Cole Creek
RT00545	Creek	33.84368	78.60655	2.1	08/16/2000	Horry	R<1	Town of Cherry Grove Beach near mouth of Hog Inlet
RT00546	Creek	32.18082	80.82148	3.0	08/01/2000	Beaufort	R>1	Calibogue Sound in Bryan Creek
RT00547	Creek	32.58328	80.18727	2.0	07/25/2000	Charleston	NDV	North Edisto River in Privateer Creek
RT00548	Creek	32.43314	80.60137	0.9	06/27/2000	Beaufort	R>1	Morgan River in creek on Dataw Island
RT00549	Creek	32.86501	79.92186	1.0	07/11/2000	Berkeley	R<1	Cooper River in Beresford Creek
RT00550	Creek	33.56575	79.02095	3.0	08/16/2000	Georgetown	R<1	Murrell's Inlet in upper reach
RT00554	Creek	32.15584	80.95174	2.7	08/02/2000	Jasper	I>1	New River behind Daufuskie Island in upper reach
RT00556	Creek	32.31152	80.91724	2.1	08/02/2000	Beaufort	R<1	Okatie River in creek off upper part
RT00557	Creek	32.50571	80.75797	1.0	07/05/2000	Beaufort	R>1	Whale Branch in Middle Creek
RT00558	Creek	33.04655	79.53497	3.0	07/18/2000	Charleston	R<1	Bull Bay, creek off Intracoastal Waterway

Appendix 2.1. Summary of basic water quality data obtained from instanteous and 25 hr continuous time series deployments of water quality meters at sites sampled in 1999 and 2000. Parameters measured included depth, temperature, dissolved oxygen, salinity, and pH. ND = No Data.

SCECAP 1999 Water Quality
25Hr and Instantaneous Records
Temperature

Open Water

Station	depth (m*)	Continuous Temperature (celsius)				Instantaneous Temperature (celsius)		
		mean	min	max	range	surf	bott	diff.
RO99301	2.0	29.1	28.5	30.0	1.5	28.8	28.7	0.1
RO99302	10.0	29.8	29.5	30.1	0.6	29.7	29.6	0.1
RO99303	1.0	30.9	30.2	32.2	2.0	31.6	31.5	0.1
RO99304	2.5	30.5	29.8	31.6	1.8	29.8	29.8	0.0
RO99305	10.0	29.6	29.1	30.7	1.6	29.1	29.1	0.0
RO99306	2.0	29.1	28.5	30.0	1.6	29.0	28.9	0.1
RO99307	2.0	27.0	26.3	27.6	1.3	27.8	27.9	0.1
RO99308	10.0	31.8	31.0	32.4	1.4	31.5	31.6	0.1
RO99309	5.0	32.1	31.4	32.8	1.4	32.0	32.1	0.1
RO99310	5.0	30.8	30.0	31.5	1.4	30.6	30.7	0.1
RO99311	3.0	27.5	26.8	28.2	1.4	27.2	27.2	0.0
RO99312	6.0	30.4	29.6	31.4	1.8	29.2	29.2	0.0
RO99313	2.0	32.8	31.4	33.5	2.0	32.3	32.3	0.0
RO99315	3.0	32.9	32.2	34.0	1.8	33.1	32.7	0.4
RO99316	3.5	30.7	30.5	30.9	0.4	30.5	30.6	0.1
RO99317	5.3	28.8	28.2	29.4	1.2	28.9	28.8	0.1
RO99318	4.0	31.6	30.7	32.8	2.1	31.9	31.9	0.0
RO99319	5.0	31.8	31.0	33.2	2.2	31.6	31.7	0.1
RO99320	10.0	31.3	30.9	33.2	2.3	31.3	31.0	0.3
RO99321	2.0	30.6	30.3	31.2	0.9	30.2	30.3	0.1
RO99322	2.5	28.0	27.8	28.4	0.6	27.5	27.7	0.2
RO99323	2.0	31.1	30.5	31.9	1.4	31.6	31.5	0.1
RO99324	5.0	30.4	29.5	31.1	1.7	29.9	29.3	0.6
RO99325	6.0	29.4	29.1	30.0	0.9	29.3	29.1	0.2
RO99326	2.0	25.2	24.4	25.6	1.2	24.7	24.8	0.1
RO99327	2.0	29.2	28.9	29.9	0.9	29.3	29.3	0.0
RO99328	7.0	30.7	30.2	31.4	1.2	30.8	30.9	0.1
RO99329	5.0	30.9	30.4	31.5	1.1	30.5	30.3	0.2
RO99330	4.0	31.8	31.3	32.6	1.3	31.9	31.6	0.3
Mean	**4.4**	**30.2**	**29.6**	**31.0**	**1.4**	**30.1**	**30.0**	**0.1**

***Depth is water depth at station in meters**

Tidal Creeks

Station	depth (m*)	Continuous Temperature (celsius)				Instantaneous Temperature (celsius)		
		mean	min	max	range	surf	bott	diff.
RT99001	4.0	27.5	26.7	29.0	2.3	27.6	27.7	0.1
RT99002	1.5	25.4	23.2	26.5	3.3	25.9	25.9	0.0
RT99003	4.5	28.8	28.2	30.7	2.5	28.0	28.1	0.1
RT99004	1.3	29.2	28.7	31.0	2.3	29.0	29.1	0.1
RT99005	1.0	31.1	30.2	31.8	1.6	30.1	30.1	0.0
RT99006	1.0	28.9	27.8	30.1	2.3	28.6	28.6	0.0
RT99007	3.3	29.8	29.0	30.9	1.9	29.4	29.3	0.1
RT99008	2.8	29.1	28.1	31.4	3.3	30.2	30.2	0.0
RT99009	2.0	31.7	31.0	32.2	1.2	31.2	31.4	0.2
RT99010	2.0	32.5	30.7	33.6	2.8	31.9	32.0	0.1
RT99012	4.0	31.2	29.4	32.9	3.5	29.9	29.9	0.0
RT99013	3.0	29.5	29.0	30.4	1.4	28.2	28.2	0.0
RT99017	1.1	29.9	28.3	31.5	3.3	28.2	28.1	0.1
RT99019	2.0	32.1	31.2	33.8	2.6	31.9	31.8	0.1
RT99021	1.5	29.2	27.9	30.2	2.3	28.2	28.3	0.1
RT99022	2.0	32.4	31.7	34.6	2.9	30.7	30.6	0.1
RT99024	3.0	32.6	31.2	33.5	2.3	32.4	32.6	0.2
RT99026	2.0	27.5	26.8	28.8	2.0	27.7	27.8	0.1
RT99027	2.5	29.9	29.2	30.7	1.6	28.7	28.7	0.0
RT99028	3.0	30.9	29.8	32.2	2.4	30.0	30.0	0.0
RT99029	1.0	31.7	30.6	33.2	2.6	32.8	32.6	0.2
RT99030	1.3	31.4	30.6	33.6	3.0	32.0	31.6	0.4
RT99036	2.0	27.4	26.2	28.4	2.1	28.2	28.2	0.0
RT99037	2.0	29.3	28.2	30.4	2.1	29.2	29.3	0.1
RT99038	2.0	30.8	29.9	31.7	1.8	30.0	30.1	0.1
RT99039	3.0	31.1	30.5	32.6	2.1	30.7	30.8	0.1
RT99040	4.0	31.3	30.1	33.9	3.8	30.7	30.6	0.1
Mean	**2.3**	**30.1**	**29.0**	**31.5**	**2.4**	**29.7**	**29.7**	**0.1**

***Depth is water depth at station in meters**

SCECAP 2000 Water Quality
25Hr and Instantaneous Records
Temperature

Open Water

Station	depth (m*)	Continuous Temperature (celsius) mean	min	max	range	Instantaneous Temperature (celsius) surf	bott	diff.
RO00006	4.0	29.0	28.6	29.7	1.1	29.2	29.1	0.1
RO00007	15.0	30.3	29.8	30.6	0.8	29.2	29.1	0.1
RO00008	4.3	29.3	28.8	29.6	0.8	29.3	29.4	0.1
RO00009	2.1	29.2	28.8	30.0	1.2	29.3	29.0	0.3
RO00010	6.4	28.9	28.6	29.2	0.6	29.2	28.7	0.5
RO00015	1.0	29.1	28.6	29.4	0.8	28.4	28.5	0.1
RO00016	2.1	30.6	29.8	31.9	2.2	31.5	31.5	0.0
RO00017	5.5	29.1	28.6	29.5	0.9	28.6	28.7	0.1
RO00018	8.2	29.4	29.1	29.7	0.6	29.2	29.2	0.0
RO00019	3.0	30.4	29.1	33.0	3.9	29.8	29.6	0.2
RO00020	3.0	29.3	29.0	29.6	0.5	28.9	29.0	0.1
RO00021	1.0	29.7	29.3	30.2	0.8	28.9	28.9	0.0
RO00022	10.0	29.0	28.7	29.2	0.5	28.8	28.9	0.1
RO00023	5.2	29.5	29.2	29.8	0.6	29.2	32.1	2.9
RO00024	10.1	29.0	28.7	29.3	0.7	29.0	29.0	0.0
RO00033	1.2	30.2	28.8	31.5	2.7	31.4	31.3	0.1
RO00034	4.5	29.6	29.2	30.0	0.8	29.2	29.3	0.1
RO00035	7.0	29.4	28.9	30.4	1.5	28.9	29.6	0.7
RO00036	7.0	29.8	29.3	30.7	1.4	29.6	29.4	0.2
RO00037	1.8	28.5	27.6	29.1	1.5	29.0	29.0	0.0
RO00045	3.0	29.9	29.4	30.4	1.0	29.4	29.5	0.1
RO00046	7.0	29.5	29.1	29.7	0.6	29.5	29.5	0.0
RO00047	10.4	28.6	28.2	29.0	0.8	28.6	28.6	0.0
RO00048	6.7	29.2	28.9	29.9	1.0	29.2	29.1	0.1
RO00049	2.7	28.7	28.5	29.0	0.5	28.8	28.8	0.0
RO00055	5.0	29.6	28.4	30.5	2.1	29.6	29.6	0.0
RO00056	6.4	28.9	28.7	29.2	0.5	29.1	28.7	0.6
RO00057	6.1	29.8	29.4	30.5	1.1	29.8	29.6	0.2
RO00058	5.5	29.6	29.1	30.5	1.3	30.9	29.2	1.7
RO00059	4.9	30.4	29.9	31.1	1.3	30.4	30.3	0.1
Mean	**5.3**	**29.4**	**28.9**	**30.1**	**1.1**	**29.4**	**29.4**	**0.3**

***Depth is water depth at station in meters**

Tidal Creeks

Station	depth (m*)	Continuous Temperature (celsius) mean	min	max	range	Instantaneous Temperature (celsius) surf	bott	diff.
RT00501	3.0	30.5	29.5	33.0	3.5	32.5	32.3	0.2
RT00502	6.1	28.7	28.1	29.6	1.4	28.1	28.1	0.0
RT00503	1.2	29.5	27.7	30.4	2.6	28.5	29.1	0.6
RT00504	1.2	29.4	28.6	29.9	1.3	29.5	29.3	0.2
RT00505	4.3	30.8	29.8	31.9	2.1	30.8	30.7	0.1
RT00517	1.2	29.5	28.6	31.3	2.7	31.1	30.9	0.2
RT00518	0.6	28.7	26.9	30.0	3.1	25.7	25.7	0.0
RT00519	1.0	30.5	29.5	32.9	3.4	31.9	32.0	0.1
RT00520	3.7	30.6	29.5	32.1	2.6	31.2	31.1	0.1
RT00521	1.0	30.6	29.8	31.6	1.8	30.7	30.3	0.6
RT00523	1.0	28.9	27.6	29.8	2.2	26.9	26.9	0.0
RT00525	2.1	30.5	29.1	32.3	3.3	30.3	30.3	0.0
RT00526	1.0	29.6	29.3	30.1	0.8	29.6	29.5	0.1
RT00528	1.0	29.4	28.5	32.5	4.0	28.4	28.5	0.1
RT00530	1.2	30.6	28.6	34.0	5.4	32.3	32.3	0.0
RT00531	3.4	29.6	28.8	30.2	1.4	28.9	28.7	0.2
RT00541	5.0	30.1	29.4	31.7	2.3	30.5	30.4	0.1
RT00542	0.6	29.8	28.5	31.8	3.3	30.4	30.4	0.0
RT00543	0.9	29.6	29.1	30.0	0.9	29.2	29.5	0.3
RT00544	3.4	29.4	28.8	30.4	1.6	28.7	28.8	0.1
RT00545	2.1	28.4	27.1	29.7	2.6	28.0	28.0	0.0
RT00546	3.0	30.0	29.4	31.3	1.9	30.0	29.7	0.3
RT00547	2.0	29.4	27.4	30.7	3.3	26.0	27.5	1.5
RT00548	0.9	29.0	27.4	30.3	2.9	28.1	28.2	0.1
RT00549	1.0	29.9	29.0	30.8	1.8	28.6	28.6	0.0
RT00550	3.0	29.4	28.3	31.2	3.0	29.0	28.9	0.1
RT00554	2.7	29.7	29.1	30.2	1.1	29.5	29.4	0.1
RT00556	2.1	30.7	29.1	32.7	3.6	30.5	30.5	0.0
RT00557	1.0	30.8	29.6	32.9	3.3	32.5	32.5	0.0
RT00558	3.0	30.6	29.8	31.5	1.7	30.9	30.6	0.3
Mean	**2.1**	**29.8**	**28.7**	**31.2**	**2.5**	**29.6**	**29.6**	**0.2**

***Depth is water depth at station in meters**

SCECAP 1999 Water Quality
25Hr and Instantaneous Records
Salinity

Open Water

Station	depth (m*)	Continuous Bottom salinity (ppt) mean	min	max	range	Instantaneous salinity (ppt) surf	bott	diff.
RO99301	2.0	20.5	19.7	21.0	1.3	20.7	20.7	0.0
RO99302	10.0	8.2	4.8	12.6	7.8	9.3	10.1	0.8
RO99303	1.0	32.0	30.7	33.3	2.6	32.2	32.2	0.0
RO99304	2.5	25.3	23.5	26.9	3.4	23.4	23.4	0.0
RO99305	10.0	30.2	29.5	30.6	1.1	29.2	29.4	0.2
RO99306	2.0	36.4	36.3	36.6	0.3	36.2	36.3	0.1
RO99307	2.0	3.0	0.4	10.9	10.5	3.2	3.3	0.1
RO99308	10.0	32.1	27.3	36.2	8.9	27.5	27.9	0.4
RO99309	5.0	25.4	24.6	26.1	1.5	24.6	24.6	0.0
RO99310	5.0	33.6	33.3	34.1	0.8	33.1	33.3	0.2
RO99311	3.0	30.5	24.9	34.6	9.7	33.5	33.5	0.0
RO99312	6.0	30.1	28.6	32.1	3.5	30.8	30.7	0.1
RO99313	2.0	22.8	22.6	23.1	0.5	22.7	22.7	0.0
RO99315	3.0	23.7	22.2	26.0	3.8	21.8	21.9	0.1
RO99316	3.5	17.1	14.4	20.7	6.3	8.5	16.0	7.5
RO99317	5.3	32.1	29.0	34.6	5.6	31.8	32.2	0.4
RO99318	4.0	28.3	25.9	31.2	5.3	25.6	25.7	0.1
RO99319	5.0	26.7	24.8	29.0	4.2	24.1	24.1	0.0
RO99320	10.0	29.7	28.4	30.7	2.3	29.1	29.3	0.2
RO99321	2.0	19.4	13.6	25.1	11.5	15.6	16.0	0.4
RO99322	2.5	23.0	19.3	27.2	7.9	22.5	22.9	0.4
RO99323	2.0	30.1	27.5	32.8	5.3	29.3	29.4	0.1
RO99324	5.0	26.4	24.4	27.3	2.9	25.1	26.7	1.6
RO99325	6.0	29.2	28.1	30.2	2.1	27.8	28.2	0.4
RO99326	2.0	29.0	24.4	34.7	10.3	25.5	25.6	0.1
RO99327	2.0	25.7	21.6	28.8	7.2	25.8	25.8	0.0
RO99328	7.0	32.9	31.1	34.8	3.7	33.0	33.0	0.0
RO99329	5.0	29.8	29.0	30.4	1.4	28.1	28.4	0.3
RO99330	4.0	27.2	26.2	29.1	2.9	25.6	25.8	0.2
Mean	**4.4**	**26.2**	**24.0**	**28.6**	**4.6**	**25.0**	**25.5**	**0.5**

***Depth is water depth at station in meters**

Tidal Creeks

Station	depth (m*)	Continuous Bottom salinity (ppt) mean	min	max	range	Instantaneous salinity (ppt) surf	bott	diff.
RT99001	4.0	33.8	33.2	34.5	1.3	34.1	34.1	0.0
RT99002	1.5	35.7	34.7	36.3	1.6	35.3	35.2	0.4
RT99003	4.5	32.3	31.8	32.8	1.0	32.9	32.9	0.0
RT99004	1.3	34.3	33.7	35.4	1.7	33.5	33.5	0.0
RT99005	1.0	28.7	28.0	29.4	1.4	27.9	27.9	0.0
RT99006	1.0	32.3	29.0	35.5	6.5	31.4	31.4	0.0
RT99007	3.3	34.4	33.6	35.6	2.0	34.8	35.2	0.4
RT99008	2.8	32.1	31.3	33.0	1.7	31.4	31.4	0.0
RT99009	2.0	32.6	32.5	32.8	0.3	31.9	31.9	0.0
RT99010	2.0	24.6	23.5	26.1	2.6	23.8	23.7	0.1
RT99012	4.0	35.3	34.6	36.0	1.4	36.1	36.1	0.0
RT99013	3.0	33.6	33.2	34.2	1.0	32.7	32.6	0.1
RT99017	1.1	18.8	18.1	19.9	1.8	18.3	18.3	0.0
RT99019	2.0	31.5	31.0	32.6	1.6	30.7	30.8	0.1
RT99021	1.5	32.2	31.3	33.2	1.9	33.2	33.2	0.0
RT99022	2.0	30.1	27.5	33.2	5.7	28.4	28.4	0.0
RT99024	3.0	25.7	24.9	26.9	2.0	25.2	25.1	0.1
RT99026	2.0	32.9	32.3	33.7	1.4	32.5	32.4	0.1
RT99027	2.5	20.1	19.7	20.6	0.9	19.2	19.4	0.2
RT99028	3.0	35.9	35.7	36.1	0.4	35.8	35.8	0.0
RT99029	1.0	32.3	30.1	35.3	5.2	29.4	29.4	0.0
RT99030	1.3	32.8	32.4	33.0	0.6	28.3	28.8	0.5
RT99036	2.0	32.4	30.5	34.3	3.8	31.5	31.5	0.0
RT99037	2.0	20.3	16.2	21.5	5.3	21.2	21.2	0.0
RT99038	2.0	35.9	35.5	36.6	1.1	35.6	35.6	0.0
RT99039	3.0	34.2	33.1	35.5	2.4	29.9	34.3	4.4
RT99040	4.0	33.4	33.1	33.9	0.8	32.4	32.5	0.1
Mean	**2.3**	**31.1**	**30.0**	**32.1**	**2.1**	**30.3**	**30.5**	**0.2**

***Depth is water depth at station in meters**

SCECAP 2000 Water Quality
25Hr and Instantaneous Records
Salinity

Open Water

Station	depth (m*)	Continuous Bottom salinity (ppt) mean	min	max	range	Instantaneous salinity (ppt) surf	bott	diff.
RO00006	4.0	29.2	14.5	35.8	21.3	16.8	17.1	0.3
RO00007	15.0	3.9	0.1	11.9	11.8	0.1	0.1	0.0
RO00008	4.3	33.0	32.6	33.7	1.1	32.1	32.1	0.0
RO00009	2.1	34.9	34.7	35.1	0.4	34.1	34.0	0.1
RO00010	6.4	34.8	34.4	35.1	0.7	34.2	34.3	0.1
RO00015	1.0	3.0	0.1	6.9	6.8	1.3	1.5	0.2
RO00016	2.1	36.7	36.3	37.0	0.7	35.9	35.8	0.1
RO00017	5.5	33.2	32.4	34.2	1.8	32.5	32.5	0.0
RO00018	8.2	32.7	32.3	33.3	1.0	31.9	31.9	0.0
RO00019	3.0	34.2	33.8	34.7	0.8	33.7	33.7	0.0
RO00020	3.0	9.8	6.6	14.1	7.5	3.9	8.7	4.8
RO00021	1.0	19.0	16.9	21.0	4.0	18.9	18.9	0.0
RO00022	10.0	35.8	34.1	37.3	3.2	35.5	35.6	0.0
RO00023	5.2	32.6	31.8	33.7	1.9	32.1	32.1	0.0
RO00024	10.1	33.9	33.7	34.1	0.4	33.5	33.5	0.0
RO00033	1.2	27.4	25.8	29.1	3.2	27.9	28.1	0.2
RO00034	4.5	2.1	0.2	7.1	6.9	0.9	1.3	0.4
RO00035	7.0	32.5	30.5	34.8	4.3	30.2	32.3	2.1
RO00036	7.0	33.3	33.1	33.7	0.6	32.3	32.5	0.2
RO00037	1.8	34.6	34.4	35.0	0.7	33.7	33.7	0.0
RO00045	3.0	32.9	31.5	33.7	2.2	32.6	32.6	0.0
RO00046	7.0	20.3	17.4	22.7	5.4	21.3	21.5	0.2
RO00047	10.4	33.6	33.2	33.9	0.7	33.0	33.1	0.1
RO00048	6.7	35.3	35.0	35.7	0.6	34.3	34.3	0.0
RO00049	2.7	33.9	33.6	34.2	0.6	33.2	33.1	0.1
RO00055	5.0	35.2	33.6	36.4	2.8	35.6	35.6	0.0
RO00056	6.4	22.9	17.9	26.9	9.0	17.3	19.1	1.8
RO00057	6.1	32.5	31.3	34.2	2.9	33.0	33.1	0.1
RO00058	5.5	33.6	33.1	34.1	1.0	31.9	31.9	0.0
RO00059	4.9	27.1	24.6	28.6	4.0	33.7	33.7	0.0
Mean	**5.3**	**28.1**	**26.3**	**29.9**	**3.6**	**26.9**	**27.3**	**0.4**

***Depth is water depth at station in meters**

Tidal Creeks

Station	depth (m*)	Continuous Bottom salinity (ppt) mean	min	max	range	Instantaneous salinity (ppt) surf	bott	diff.
RT00501	3.0	30.0	28.5	31.3	2.8	30.3	30.2	0.1
RT00502	6.1	25.6	23.1	29.0	5.8	24.5	24.5	0.0
RT00503	1.2	34.7	31.2	36.8	5.6	32.4	33.9	1.5
RT00504	1.2	33.2	32.4	33.8	1.4	33.6	33.6	0.0
RT00505	4.3	36.2	35.7	36.7	1.0	36.0	36.1	0.1
RT00517	1.2	35.9	35.1	36.4	1.3	35.5	35.4	0.1
RT00518	0.6	28.6	26.6	33.7	7.2	15.3	15.3	0.0
RT00519	1.0	33.8	33.4	34.2	0.9	31.4	31.4	0.0
RT00520	3.7	35.3	34.0	36.1	2.1	35.8	35.9	0.1
RT00521	1.0	36.5	35.7	37.0	1.3	35.8	35.9	0.1
RT00523	1.0	33.1	31.6	35.2	3.6	30.1	30.1	0.0
RT00525	2.1	37.1	36.1	37.7	1.6	36.6	36.6	0.0
RT00526	1.0	5.5	2.2	11.1	8.9	2.4	2.5	0.1
RT00528	1.0	26.6	25.6	28.0	2.4	25.6	25.6	0.0
RT00530	1.2	36.6	35.8	37.0	1.3	36.8	36.8	0.0
RT00531	3.4	23.6	23.5	23.7	0.3	23.0	23.0	0.0
RT00541	5.0	34.5	33.6	35.2	1.7	34.0	33.9	0.1
RT00542	0.6	33.7	28.9	38.2	9.3	37.4	37.4	0.0
RT00543	0.9	31.8	31.0	32.6	1.7	31.7	31.7	0.0
RT00544	3.4	34.7	31.4	36.3	4.9	34.2	34.2	0.0
RT00545	2.1	36.5	36.1	37.0	0.9	37.1	37.1	0.0
RT00546	3.0	34.8	34.4	35.0	0.6	33.7	33.9	0.2
RT00547	2.0	34.7	31.1	37.1	6.0	24.0	30.3	6.3
RT00548	0.9	32.6	29.8	34.4	4.6	33.4	33.4	0.0
RT00549	1.0	16.3	11.9	18.6	6.6	18.1	18.1	0.0
RT00550	3.0	36.2	35.4	36.8	1.5	36.0	36.2	0.2
RT00554	2.7	23.9	20.8	27.1	6.3	26.5	26.6	0.1
RT00556	2.1	33.3	32.0	34.4	2.4	33.1	33.4	0.3
RT00557	1.0	33.9	33.6	34.1	0.5	32.8	32.8	0.0
RT00558	3.0	35.4	34.6	36.4	1.8	36.4	36.4	0.0
Mean	**2.1**	**31.5**	**29.8**	**33.0**	**3.2**	**30.5**	**30.7**	**0.3**

***Depth is water depth at station in meters**

SCECAP 1999 Water Quality
25Hr and Instantaneous Records
Dissolved Oxygen

Open Water

Station	depth (m*)	Continuous Bottom Dissolved Oxygen (mg/l) mean	min	max	range	Instantaneous Dissolved Oxygen (mg/l) surf	bott	diff.
RO99301	2.0	5.4	0.8	7.8	7.0	4.6	4.5	0.1
RO99302	10.0	3.3	1.6	3.8	2.2	4.0	3.8	0.2
RO99303	1.0	4.9	3.3	6.2	2.8	4.2	3.9	0.3
RO99304	2.5	4.9	3.9	5.6	1.8	3.9	3.9	0.0
RO99305	10.0	6.0	4.5	7.5	3.0	4.4	4.4	0.1
RO99306	2.0	5.3	3.8	6.2	2.4	4.8	4.5	0.4
RO99307	2.0	4.9	3.1	5.8	2.8	4.5	4.6	0.1
RO99308	10.0	5.9	4.6	6.6	2.0	4.3	4.3	0.0
RO99309	5.0	4.9	3.4	6.2	2.8	4.2	4.2	0.0
RO99310	5.0	5.0	4.2	5.7	1.5	4.7	4.6	0.1
RO99311	3.0	4.5	3.8	5.4	1.6	4.8	4.9	0.1
RO99312	6.0	4.6	2.3	5.5	3.2	4.7	4.5	0.2
RO99313	2.0	ND	ND	ND	ND	4.0	4.2	0.2
RO99315	3.0	ND	ND	ND	ND	4.6	4.6	0.1
RO99316	3.5	3.7	1.5	4.7	3.3	3.8	3.5	0.2
RO99317	5.3	5.1	3.3	6.1	2.8	5.2	5.1	0.1
RO99318	4.0	4.8	3.1	6.3	3.1	3.8	3.9	0.1
RO99319	5.0	ND	ND	ND	ND	4.2	4.1	0.1
RO99320	10.0	4.4	3.3	5.6	2.3	4.9	4.6	0.3
RO99321	2.0	4.3	2.9	5.3	2.4	4.3	4.4	0.0
RO99322	2.5	6.5	5.4	7.4	2.0	4.9	4.9	0.0
RO99323	2.0	4.9	3.6	6.3	2.7	4.2	3.9	0.3
RO99324	5.0	3.8	1.8	5.2	3.4	4.2	3.7	0.5
RO99325	6.0	5.3	4.0	5.9	1.9	3.9	3.5	0.4
RO99326	2.0	5.6	3.8	6.6	2.8	5.5	5.5	0.0
RO99327	2.0	5.6	4.2	6.3	2.1	5.0	4.9	0.1
RO99328	7.0	4.6	1.9	5.2	3.2	4.4	4.3	0.1
RO99329	5.0	4.5	3.7	5.5	1.9	4.5	4.2	0.3
RO99330	4.0	3.7	2.0	5.1	3.1	4.3	3.6	0.7
Mean	**4.4**	**4.9**	**3.2**	**5.9**	**2.7**	**4.4**	**4.3**	**0.2**

***Depth is water depth at station in meters**

Tidal Creeks

Station	depth (m*)	Continuous Bottom Dissolved Oxygen (mg/l) mean	min	max	range	Instantaneous Dissolved Oxygen (mg/l) surf	bott	diff.
RT99001	4.0	3.9	2.4	5.5	3.2	3.1	3.2	0.1
RT99002	1.5	5.4	3.5	6.1	2.6	6.3	6.3	0.0
RT99003	4.5	3.7	1.6	5.9	4.4	3.7	3.7	0.1
RT99004	1.3	3.7	1.1	5.6	4.5	2.7	2.7	0.0
RT99005	1.0	4.0	1.9	5.8	3.9	3.9	4.0	0.1
RT99006	1.0	4.8	2.6	6.9	4.3	3.4	3.2	0.2
RT99007	3.3	4.0	2.2	6.1	3.9	3.5	3.2	0.3
RT99008	2.8	ND	ND	ND	ND	5.1	4.7	0.4
RT99009	2.0	2.5	0.4	4.0	3.6	2.6	2.7	0.0
RT99010	2.0	4.5	2.4	5.9	3.5	2.4	2.4	0.0
RT99012	4.0	3.9	1.7	5.4	3.7	3.2	3.1	0.0
RT99013	3.0	3.7	1.7	5.0	3.3	3.9	3.9	0.0
RT99017	1.1	5.5	3.4	8.3	4.9	2.1	2.1	0.0
RT99019	2.0	4.0	1.9	6.6	4.7	3.5	3.6	0.2
RT99021	1.5	3.9	2.1	5.7	3.5	3.5	3.6	0.1
RT99022	2.0	3.5	0.8	5.9	5.1	3.7	3.7	0.1
RT99024	3.0	3.5	1.6	4.4	2.8	2.6	2.6	0.0
RT99026	2.0	2.7	1.2	3.7	2.5	2.6	2.6	0.0
RT99027	2.5	4.7	2.6	6.4	3.8	3.3	3.2	0.1
RT99028	3.0	4.5	0.9	6.2	5.4	3.4	3.3	0.1
RT99029	1.0	ND	ND	ND	ND	4.1	4.0	0.1
RT99030	1.3	3.7	1.5	5.7	4.2	4.3	4.1	0.3
RT99036	2.0	4.0	2.6	5.7	3.1	3.2	3.0	0.2
RT99037	2.0	3.1	1.3	4.6	3.2	3.2	3.1	0.0
RT99038	2.0	4.8	2.8	5.7	3.0	3.9	4.0	0.1
RT99039	3.0	3.6	0.0	6.1	6.0	4.0	4.0	0.0
RT99040	4.0	4.4	0.3	7.4	7.2	4.1	4.1	0.1
Mean	**2.3**	**4.0**	**1.8**	**5.8**	**4.0**	**3.5**	**3.5**	**0.1**

***Depth is water depth at station in meters**

SCECAP 2000 Water Quality
25Hr and Instantaneous Records
Dissolved Oxygen

Open Water

Station	depth (m*)	Continuous Bottom Dissolved Oxygen (mg/l)				Instantaneous Dissolved Oxygen (mg/l)		
		mean	min	max	range	surf	bott	diff.
RO00006	4.0	5.4	4.8	6.1	1.3	5.9	5.8	0.1
RO00007	15.0	5.0	3.9	6.0	2.1	6.8	6.7	0.1
RO00008	4.3	5.2	4.4	6.3	1.9	4.3	4.2	0.1
RO00009	2.1	4.2	3.6	4.8	1.2	4.6	4.4	0.2
RO00010	6.4	6.0	5.4	6.5	1.1	5.7	5.6	0.1
RO00015	1.0	4.5	4.2	4.9	0.7	4.8	4.5	0.3
RO00016	2.1	4.7	3.8	7.1	3.4	6.6	6.5	0.1
RO00017	5.5	5.6	5.1	6.4	1.4	5.3	5.0	0.3
RO00018	8.2	5.3	4.9	5.9	1.0	5.0	5.0	0.0
RO00019	3.0	4.6	2.9	6.0	3.1	3.8	3.8	0.0
RO00020	3.0	4.5	3.8	5.4	1.6	4.7	4.1	0.6
RO00021	1.0	5.8	4.9	7.2	2.3	5.6	5.6	0.0
RO00022	10.0	5.7	5.0	6.3	1.4	5.4	5.5	0.1
RO00023	5.2	5.3	5.0	5.8	0.8	4.5	4.5	0.0
RO00024	10.1	5.0	4.5	5.6	1.1	4.3	4.4	0.1
RO00033	1.2	6.1	4.7	7.9	3.2	7.5	7.5	0.0
RO00034	4.5	4.1	3.7	4.6	0.9	4.1	3.9	0.2
RO00035	7.0	4.2	3.5	5.6	2.1	4.0	4.0	0.0
RO00036	7.0	5.3	4.5	5.8	1.3	5.1	5.0	0.1
RO00037	1.8	6.1	5.3	7.6	2.3	6.5	6.4	0.1
RO00045	3.0	4.8	4.1	5.7	1.6	4.3	4.2	0.1
RO00046	7.0	4.1	3.9	4.3	0.4	3.9	3.8	0.1
RO00047	10.4	5.3	4.5	5.7	1.2	5.5	5.3	0.2
RO00048	6.7	5.3	4.2	5.8	1.6	5.3	5.2	0.1
RO00049	2.7	5.6	4.9	6.0	1.0	5.6	5.5	0.1
RO00055	5.0	4.8	3.2	6.8	3.6	3.7	3.5	0.2
RO00056	6.4	4.8	4.1	6.0	1.9	6.2	5.2	1.0
RO00057	6.1	3.9	3.3	4.9	1.5	3.7	3.6	0.1
RO00058	5.5	4.9	4.0	5.8	1.8	6.8	6.2	0.6
RO00059	4.9	4.6	3.7	5.9	2.2	4.2	4.2	0.0
Mean	**5.3**	**5.0**	**4.3**	**6.0**	**1.7**	**5.1**	**5.0**	**0.2**

***Depth is water depth at station in meters**

Tidal Creeks

Station	depth (m*)	Continuous Bottom Dissolved Oxygen (mg/l)				Instantaneous Dissolved Oxygen (mg/l)		
		mean	min	max	range	surf	bott	diff.
RT00501	3.0	4.0	2.2	5.8	3.6	4.8	4.7	0.1
RT00502	6.1	3.2	2.8	4.1	1.2	3.1	3.0	0.1
RT00503	1.2	3.8	2.4	4.8	2.5	4.7	4.4	0.3
RT00504	1.2	3.8	2.9	4.8	1.8	3.0	2.8	0.2
RT00505	4.3	3.9	1.9	6.5	4.6	4.0	4.0	0.0
RT00517	1.2	4.2	3.0	5.1	2.1	5.6	5.6	0.0
RT00518	0.6	2.9	0.4	4.8	4.5	2.9	2.9	0.0
RT00519	1.0	4.5	3.5	5.2	1.7	4.8	4.7	0.1
RT00520	3.7	4.8	3.9	5.9	2.0	4.6	4.4	0.2
RT00521	1.0	4.6	3.4	5.9	2.5	4.2	3.7	0.5
RT00523	1.0	3.6	1.9	5.3	3.4	2.2	2.0	0.2
RT00525	2.1	3.5	1.2	4.9	3.7	3.2	3.1	0.1
RT00526	1.0	4.2	3.8	4.6	0.8	4.2	4.2	0.0
RT00528	1.0	4.1	3.3	6.0	2.7	4.0	4.0	0.0
RT00530	1.2	4.7	2.1	6.4	4.3	5.1	5.2	0.1
RT00531	3.4	5.0	4.1	6.6	2.5	4.6	4.1	0.5
RT00541	5.0	4.6	3.0	6.1	3.0	4.4	4.3	0.1
RT00542	0.6	3.7	1.6	6.4	4.8	2.5	2.5	0.0
RT00543	0.9	4.3	3.0	6.1	3.2	4.2	4.1	0.1
RT00544	3.4	4.3	2.7	6.2	3.5	3.3	3.4	0.1
RT00545	2.1	5.5	3.6	6.4	2.8	5.1	5.1	0.0
RT00546	3.0	3.9	2.5	5.1	2.6	5.3	5.5	0.2
RT00547	2.0	3.9	2.1	5.6	3.5	3.5	2.6	0.9
RT00548	0.9	0.6	0.1	3.5	3.4	2.3	2.3	0.0
RT00549	1.0	4.9	3.2	6.7	3.5	4.0	4.0	0.0
RT00550	3.0	5.2	3.6	6.2	2.6	5.2	5.4	0.2
RT00554	2.7	3.8	3.4	4.1	0.7	3.5	3.7	0.2
RT00556	2.1	4.6	3.3	6.7	3.4	4.5	4.4	0.1
RT00557	1.0	4.9	3.0	5.9	2.9	6.0	5.9	0.1
RT00558	3.0	4.5	2.8	6.8	4.0	4.3	3.5	0.8
Mean	**2.1**	**4.1**	**2.7**	**5.6**	**2.9**	**4.1**	**4.0**	**0.2**

***Depth is water depth at station in meters**

SCECAP 1999 Water Quality
25Hr and Instantaneous Records
pH

Open Water

Station	depth (m*)	Continuous Bottom pH mean	min	max	range	Hanna pH surf
RO99301	2.0	7.7	7.4	7.9	0.5	7.4
RO99302	10.0	6.8	6.7	7.0	0.3	7.2
RO99303	1.0	7.8	7.6	8.1	0.5	7.7
RO99304	2.5	7.4	7.2	7.4	0.2	7.3
RO99305	10.0	7.7	7.5	7.9	0.3	7.6
RO99306	2.0	8.0	7.8	8.1	0.4	7.9
RO99307	2.0	6.7	6.5	7.8	1.3	6.8
RO99308	10.0	7.8	7.5	8.0	0.5	7.7
RO99309	5.0	7.6	7.4	7.7	0.3	7.6
RO99310	5.0	7.8	7.7	7.9	0.3	7.7
RO99311	3.0	7.6	7.3	7.9	0.6	7.9
RO99312	6.0	7.7	7.5	7.9	0.3	7.7
RO99313	2.0	7.5	7.4	7.6	0.2	7.3
RO99315	3.0	7.4	7.2	7.5	0.3	7.4
RO99316	3.5	7.4	7.1	7.6	0.5	7.2
RO99317	5.3	7.8	7.7	7.9	0.3	7.8
RO99318	4.0	7.6	7.4	7.8	0.4	7.5
RO99319	5.0	7.5	7.4	7.7	0.3	7.5
RO99320	10.0	7.8	7.7	8.0	0.3	7.7
RO99321	2.0	7.5	7.2	7.7	0.4	7.3
RO99322	2.5	7.8	7.5	7.9	0.4	7.7
RO99323	2.0	7.7	7.4	7.9	0.5	7.6
RO99324	5.0	7.4	7.1	7.5	0.4	7.3
RO99325	6.0	7.6	7.3	7.7	0.4	7.4
RO99326	2.0	7.8	7.7	8.0	0.3	7.7
RO99327	2.0	7.7	7.5	7.8	0.3	7.6
RO99328	7.0	7.8	7.7	8.0	0.4	7.6
RO99329	5.0	7.5	7.4	7.6	0.2	7.5
RO99330	4.0	7.4	7.3	7.7	0.4	7.5
Mean	**4.4**	**7.6**	**7.4**	**7.8**	**0.4**	**7.5**

***Depth is water depth at station in meters**

Tidal Creeks

Station	depth (m*)	Continuous Bottom pH mean	min	max	range	Hanna pH surf
RT99001	4.0	7.6	7.4	7.9	0.5	7.6
RT99002	1.5	7.9	7.6	8.1	0.5	8.0
RT99003	4.5	7.5	7.3	7.8	0.5	7.5
RT99004	1.3	7.6	7.3	8.0	0.7	7.7
RT99005	1.0	7.5	7.3	7.7	0.4	7.4
RT99006	1.0	7.8	7.5	8.1	0.6	7.5
RT99007	3.3	7.6	7.4	7.7	0.3	7.6
RT99008	2.8	7.5	7.3	7.6	0.3	7.6
RT99009	2.0	7.3	7.1	7.4	0.4	7.4
RT99010	2.0	7.4	7.0	7.6	0.6	7.2
RT99012	4.0	7.5	7.3	7.7	0.4	7.5
RT99013	3.0	7.6	7.4	7.9	0.5	7.6
RT99017	1.1	7.4	7.1	7.7	0.6	7.0
RT99019	2.0	7.4	7.2	7.8	0.6	7.5
RT99021	1.5	7.6	7.4	7.9	0.5	7.6
RT99022	2.0	7.6	7.2	8.1	0.9	7.5
RT99024	3.0	7.4	7.0	7.6	0.5	7.1
RT99026	2.0	7.3	7.1	7.6	0.5	7.2
RT99027	2.5	7.3	7.2	7.5	0.3	7.1
RT99028	3.0	7.7	7.5	7.9	0.4	7.6
RT99029	1.0	7.6	7.2	8.0	0.8	7.4
RT99030	1.3	7.5	7.3	7.7	0.4	7.6
RT99036	2.0	7.5	7.2	7.9	0.8	7.3
RT99037	2.0	7.1	7.0	7.4	0.4	7.2
RT99038	2.0	7.8	7.6	8.0	0.4	7.7
RT99039	3.0	7.7	7.3	8.0	0.7	7.8
RT99040	4.0	7.5	7.3	7.6	0.4	7.5
Mean	**2.3**	**7.5**	**7.3**	**7.8**	**0.5**	**7.5**

***Depth is water depth at station in meters**

SCECAP 2000 Water Quality
25Hr and Instantaneous Records
pH

Open Water

Station	depth (m*)	Continuous Bottom pH mean	min	max	range	Hanna pH surf
RO00006	4.0	7.9	7.7	8.0	0.3	7.0
RO00007	15.0	6.9	6.4	7.1	0.7	7.7
RO00008	4.3	7.7	7.5	7.9	0.4	7.5
RO00009	2.1	7.5	7.4	7.7	0.2	7.7
RO00010	6.4	7.9	7.8	8.0	0.3	8.0
RO00015	1.0	7.0	6.8	7.2	0.4	7.0
RO00016	2.1	7.5	7.4	7.7	0.3	7.7
RO00017	5.5	7.6	7.5	7.8	0.3	7.9
RO00018	8.2	7.6	7.5	7.7	0.2	7.7
RO00019	3.0	7.4	7.3	7.6	0.3	7.6
RO00020	3.0	7.2	7.0	7.5	0.5	8.3
RO00021	1.0	7.5	7.4	7.7	0.3	7.6
RO00022	10.0	7.9	7.8	8.1	0.3	8.1
RO00023	5.2	7.6	7.6	7.7	0.2	7.7
RO00024	10.1	7.6	7.5	7.8	0.3	7.6
RO00033	1.2	8.0	7.8	8.1	0.3	8.1
RO00034	4.5	6.7	6.6	7.2	0.6	7.4
RO00035	7.0	7.6	7.4	7.9	0.5	7.7
RO00036	7.0	7.6	7.5	7.7	0.3	7.6
RO00037	1.8	7.8	7.7	8.0	0.3	7.9
RO00045	3.0	7.5	7.4	7.6	0.2	7.6
RO00046	7.0	7.1	7.0	7.2	0.2	7.4
RO00047	10.4	7.7	7.6	7.8	0.2	7.7
RO00048	6.7	7.7	7.5	7.8	0.3	7.8
RO00049	2.7	7.7	7.6	7.8	0.2	7.8
RO00055	5.0	7.8	7.5	8.1	0.6	7.7
RO00056	6.4	7.5	7.4	7.6	0.2	7.8
RO00057	6.1	7.3	7.2	7.6	0.4	7.0
RO00058	5.5	7.6	7.3	7.8	0.5	7.8
RO00059	4.9	7.5	7.4	7.8	0.5	6.9
Mean	**5.3**	**7.5**	**7.4**	**7.7**	**0.3**	**7.6**

***Depth is water depth at station in meters**

Tidal Creeks

Station	depth (m*)	Continuous Bottom pH mean	min	max	range	Hanna pH surf
RT00501	3.0	7.5	7.2	7.7	0.6	7.4
RT00502	6.1	7.0	6.9	7.3	0.3	7.0
RT00503	1.2	7.7	7.4	8.0	0.6	7.0
RT00504	1.2	7.3	7.2	7.4	0.2	8.8
RT00505	4.3	7.5	7.2	7.9	0.7	7.4
RT00517	1.2	7.7	7.4	8.0	0.5	7.6
RT00518	0.6	7.2	7.1	7.4	0.4	7.0
RT00519	1.0	7.2	7.1	7.4	0.3	7.4
RT00520	3.7	7.7	7.6	7.8	0.3	7.8
RT00521	1.0	7.5	7.4	7.7	0.3	7.3
RT00523	1.0	7.4	7.1	7.8	0.7	7.5
RT00525	2.1	7.4	7.2	7.7	0.5	7.5
RT00526	1.0	6.9	6.8	7.4	0.6	7.0
RT00528	1.0	7.2	7.1	7.5	0.4	7.2
RT00530	1.2	7.7	7.4	8.0	0.6	7.8
RT00531	3.4	7.4	7.2	7.7	0.4	7.4
RT00541	5.0	7.7	7.5	7.9	0.5	7.0
RT00542	0.6	7.5	7.2	7.8	0.6	7.5
RT00543	0.9	7.4	7.3	7.7	0.5	7.6
RT00544	3.4	7.8	7.5	8.0	0.5	7.7
RT00545	2.1	7.9	7.7	8.0	0.3	8.0
RT00546	3.0	7.5	7.3	7.8	0.5	6.9
RT00547	2.0	7.5	7.2	7.9	0.8	7.5
RT00548	0.9	7.2	7.0	7.4	0.4	7.3
RT00549	1.0	7.3	7.1	7.7	0.6	7.4
RT00550	3.0	7.8	7.6	7.9	0.3	7.9
RT00554	2.7	7.1	7.0	7.2	0.2	7.2
RT00556	2.1	7.2	7.1	7.4	0.3	7.0
RT00557	1.0	7.4	7.2	7.6	0.3	7.6
RT00558	3.0	7.3	7.1	7.6	0.6	7.5
Mean	**2.1**	**7.4**	**7.2**	**7.7**	**0.5**	**7.4**

***Depth is water depth at station in meters**

Appendix 2.2. Summary of total nutrient and Chlorophyll a concentrations at sites sampled in 1999 and 2000. All laboratory analyses were completed by SCDHEC using their standard laboratory protocols. Values = 0 are below the instrument detection limit.

SCECAP 1999 Water Quality
Total Nutrients -- Open Water

Station	Total Ammonia Nitrogen mg/l as N	Nitrate + Nitrite mg/l as N	Total Kjedahl Nitrogen mg/l as N	Total Nitrogen mg/l as N	Total Phosphorus mg/l as P	Chl-a (Fluorometer) µg/l
RO99301		0.00	0.37	0.37	0.05	12.1
RO99302	0.00	**0.16**	0.82	**0.98**	0.09	11.1
RO99303	0.00	0.03	**1.06**	**1.09**	**0.10**	9.2
RO99304	0.00	0.03	0.57	0.60	0.07	7.0
RO99305	0.00	0.04	0.57	0.61	0.09	4.5
RO99306					**0.13**	8.2
RO99307	0.11	0.00	0.81	0.81	0.06	**22.6**
RO99308	0.00	0.00	0.00	0.00	0.07	9.4
RO99309	0.00	0.00	0.40	0.40	0.08	9.6
RO99310	0.00	0.10	0.55	0.65	**0.14**	9.5
RO99311	**0.43**	0.04	0.64	0.68	0.00	7.6
RO99312		0.00	0.00	0.00	0.08	8.1
RO99313	0.00	0.00	0.75	0.75	**0.16**	17.1
RO99315	**0.48**	0.00	0.67	0.67	**0.11**	**21.9**
RO99316	0.16	0.11			0.06	13.7
RO99317		0.00	0.00	0.00	**0.10**	10.1
RO99318	0.00	0.00	0.28	0.28	0.07	9.8
RO99319	0.00	0.00	0.53	0.53	0.08	9.7
RO99320	0.00	0.00	0.48	0.48	0.00	6.9
RO99321	0.11	0.08			0.08	9.2
RO99322		0.00	0.41	0.41	0.05	6.4
RO99323	0.00	0.00	0.38	0.38	0.00	10.2
RO99324	0.00	0.03	0.54	0.57	0.08	7.4
RO99325	0.00	0.04	0.55	0.59	0.00	4.0
RO99326	0.00	0.09	0.29	0.38	0.06	6.7
RO99327		0.07	0.33	0.40	0.08	13.7
RO99328	0.00	0.00	0.62	0.62	**0.10**	11.6
RO99329	0.00	0.04	0.42	0.46	0.09	5.8
RO99330	0.00	0.00	0.60	0.60	**0.15**	15.5
Mean	**0.06**	**0.03**	**0.49**	**0.51**	**0.08**	**10.3**

Shading represents values that are equal to or exceed 75th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a). Shading for Chl-a represents High >20 µg/l (Bricker et al. 1999).

Shading represents values that are equal to or exceed 90th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997. (SCDHEC 1998a)

SCECAP 1999 Water Quality
Total Nutrients -- Tidal Creeks

Station	Total Ammonia Nitrogen mg/l as N	Nitrate + Nitrite mg/l as N	Total Kjedahl Nitrogen mg/l as N	Total Nitrogen mg/l as N	Total Phosphorus mg/l as P	Chl-a (Fluorometer) µg/l
RT99001	**0.75**	0.00	**1.27**	**1.27**	**0.12**	10.7
RT99002	0.00	0.00	0.49	0.49	0.07	5.9
RT99003	**0.45**	0.03	0.64	0.67	0.00	6.2
RT99004	0.00	0.00	**1.12**	**1.12**	**0.11**	12.4
RT99005	0.00	0.04	0.59	0.63	**0.12**	6.2
RT99006	0.00	0.04	**0.82**	0.86	**0.16**	**23.1**
RT99007	0.00	0.00	**1.12**	**1.12**	**0.10**	13.4
RT99008	**0.33**	0.00	0.80	0.80	**0.10**	7.0
RT99009	0.00	0.00	0.80	0.80	**0.10**	13.6
RT99010	0.00	0.00	0.57	0.57	**0.11**	10.2
RT99012	0.00	0.00	0.44	0.44	**0.10**	10.7
RT99013	**0.47**	0.00	0.79	0.79	0.00	7.9
RT99017	**0.46**	0.07	**0.82**	0.89	**0.11**	**43.0**
RT99019	0.00	0.00	0.70	0.70	0.07	**24.2**
RT99021		0.00	0.32	0.32	0.06	13.2
RT99022	0.00	0.00	0.53	0.53	**0.10**	4.7
RT99024	0.00	0.00	0.35	0.35	0.08	5.1
RT99026	**0.59**	0.04	**0.82**	0.86	0.00	10.9
RT99027	**0.59**		**0.83**		0.05	11.9
RT99028	0.00	0.00	0.21	0.21	**0.10**	10.2
RT99029	0.00	0.00	**0.84**	0.84	0.08	**33.8**
RT99030	0.00	0.00	0.35	0.35	**0.12**	19.9
RT99036	**0.84**	0.00	**1.21**	**1.21**	**0.13**	10.1
RT99037	0.23	0.04	0.40	0.44	**0.10**	7.8
RT99038	0.10	0.00	0.19	0.19	**0.23**	7.9
RT99039	0.00	0.00	0.54	0.54	**0.12**	8.2
RT99040	0.00	0.03	**1.02**	**1.05**	**0.11**	13.9
Mean	**0.19**	**0.01**	**0.69**	**0.69**	**0.09**	**13.05**

Shading represents values that are equal to or exceed 75th percentile of all detectable measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a). Shading for Chl-a represents High >20 µg/l (Bricker et al. 1999).

Shading represents values that are equal to or exceed 90th percentile of all detectable measurements collected by SCDHEC in saltwaters from 1993 - 1997. (SCDHEC 1998a)

SCECAP 2000 Water Quality
Total Nutrients -- Open Water

Station	Total Ammonia Nitrogen mg/l as N	Nitrate + Nitrite mg/l as N	Total Kjedahl Nitrogen mg/l as N	Total Nitrogen mg/l as N	Total Phosphorus mg/l as P	Chl-a (Fluorometer) µg/l
RO00006		0.11	0.51	0.62	0.04	16.0
RO00007	0.00	0.00	0.46	0.46	0.04	10.4
RO00008						8.6
RO00009	**0.30**	0.03	0.39	0.42	0.05	5.2
RO00010		0.00	0.36	0.36	0.05	5.1
RO00015	0.20	**0.20**	0.62	0.82	0.09	6.6
RO00016		0.00	0.46	0.46	0.07	15.5
RO00017	0.16	0.03	0.50	0.53	**0.11**	9.1
RO00018	0.11	0.04	0.42	0.46	0.09	5.0
RO00019		0.03	0.37	0.40	0.06	6.5
RO00020	**0.32**	**0.21**	0.62	0.83	0.08	6.7
RO00021		0.00	0.55	0.55	0.03	**30.8**
RO00022	0.20	0.04	0.35	0.39	0.05	11.2
RO00023	0.28	0.08	0.41	0.49	0.08	5.3
RO00024	0.09	0.00	0.34	0.34	0.03	5.8
RO00033	0.23	0.00	0.38	0.38	0.06	8.7
RO00034	0.18	0.14	0.61	0.75	0.08	15.0
RO00035	**0.48**	0.04	0.49	0.53	0.07	9.2
RO00036		0.03	0.48	0.51	0.08	7.8
RO00037	0.19	0.00	0.30	0.30	0.04	4.8
RO00045		**0.32**	0.51	0.83	0.07	9.2
RO00046	0.25	**0.15**	0.74	0.89	**0.10**	8.8
RO00047	0.22	0.03	0.29	0.32	0.04	4.6
RO00048	**0.59**	0.00	0.81	0.81	0.03	7.3
RO00049	0.19	0.00	0.31	0.31	0.04	5.5
RO00055		0.00	0.33	0.33	0.04	13.8
RO00056	**0.35**	0.05	0.43	0.48	0.05	5.7
RO00057	**0.32**	0.00	**1.04**	**1.04**	0.06	9.9
RO00058	**0.43**	0.03	0.58	0.61	**0.10**	7.5
RO00059		0.00	0.34	0.34	0.06	6.9
Mean	**0.25**	**0.05**	**0.48**	**0.54**	**0.06**	**9.1**

Shading represents values that are equal to or exceed 75th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a). Shading for Chl-a represents High >20 µg/l (Bricker et al. 1999).

Shading represents values that are equal to or exceed 90th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997. (SCDHEC 1998a)

SCECAP 2000 Water Quality
Total Nutrients -- Tidal Creeks

Station	Total Ammonia Nitrogen mg/l as N	Nitrate + Nitrite mg/l as N	Total Kjedahl Nitrogen mg/l as N	Total Nitrogen mg/l as N	Total Phosphorus mg/l as P	Chl-a (Fluorometer) µg/l
RT00501		0.06	0.48	0.54	**0.10**	14.9
RT00502	0.27	0.06	0.55	0.61	**0.20**	6.5
RT00503	**0.43**	0.04	0.46	0.50	0.06	9.0
RT00504						7.0
RT00505		0.00	0.53	0.53	0.06	14.0
RT00517	**0.42**	0.00	0.61	0.61	0.04	6.4
RT00518	**0.48**	0.07	**0.90**	**0.97**	**0.11**	**26.7**
RT00519	**0.58**	0.03	0.77	0.80	**0.10**	7.3
RT00520		0.00	0.35	0.35	0.08	9.3
RT00521		0.00	0.47	0.47	0.06	14.1
RT00523		0.04	0.76	0.80	**0.14**	16.4
RT00525	**0.40**	0.00	0.59	0.59	0.07	9.3
RT00526	0.13	0.04	**0.90**	0.94	**0.41**	4.8
RT00528	**0.32**	0.00	**1.11**	**1.11**	**0.20**	**38.8**
RT00530	0.00	0.00	0.36	0.36	0.08	8.9
RT00531	0.10	0.03	0.63	0.66	0.06	8.2
RT00541		0.03	0.39	0.42	0.06	8.9
RT00542	**0.45**	0.04	0.79	0.83	**0.11**	16.5
RT00543						9.6
RT00544		0.05	0.50	0.55	0.08	10.5
RT00545		0.00	0.18	0.18	0.06	2.9
RT00546		0.00	0.58	0.58	**0.10**	10.5
RT00547	**0.41**	0.04	0.62	0.66	0.07	17.0
RT00548						**23.3**
RT00549	**0.29**	0.00	0.78	0.78	0.07	**21.7**
RT00550	**0.37**	0.00	0.38	0.38	0.05	8.9
RT00554	**0.50**	0.07	0.60	0.67	0.09	4.8
RT00556		0.00	0.42	0.42	0.05	14.9
RT00557	0.27	0.04	0.70	0.74	**0.16**	8.0
RT00558		0.00	0.49	0.49		17.0
Mean	**0.34**	**0.02**	**0.59**	**0.61**	**0.10**	**12.5**

Shading represents values that are equal to or exceed 75th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a). Shading for Chl-a represents High >20 µg/l (Bricker et al. 1999).

Shading represents values that are equal to or exceed 90th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997. (SCDHEC 1998a)

Appendix 2.3. Summary of dissolved nutrient concentrations at sites sampled 2000. All laboratory analyses were completed by the SCDNR using protocols standardized for the Harmful Algal Bloom program. Dissolved nutrients were not measured in 1999.

SCECAP 2000 Water Quality
Dissolved and Total Nutrients -- Open Water

Station	Ammonia (NH4 mg/l)	Nitrate-Nitrite (NO_2-NO_3 mg/l)	Organic Nitrogen (DON mg/l)	Total Diss Nitrogen (TDN mg/l)	Total Nitrogen (TN mg/l)	Organic Phosphate (DOP mg/l)	Ortho-phosphate (OP mg/l)	Total Diss Phos (TDP mg/l)	Total Phosphorus (TP mg/l)	Silica Silicon (DS mg/l)	Organic Carbon (DOC mg/l)	Inorganic Carbon (DIC mg/l)
RO00006	0.068	0.136	0.355	0.559	0.863	0.000	0.048	0.018	0.063	1.591	7.107	
RO00007	0.017	0.005	0.340	0.362	0.483	0.004	0.011	0.013	0.026	3.334	4.037	3.800
RO00008	0.037	0.064	0.529	0.630	0.806	0.000	0.057	0.053	0.087		5.772	36.700
RO00009	0.076	0.038	0.489	0.603	0.756	0.000	0.050	0.040	0.054	1.500	4.471	42.300
RO00010	0.008			0.368	0.545	0.000	0.015	0.009	0.022	0.330	2.969	39.133
RO00015	0.100	0.280	0.526	0.905	1.000	0.050	0.015	0.065	0.128	3.015	11.477	
RO00016		0.000	0.429	0.429	0.791	0.000	0.010	0.006	0.059	1.146	4.237	18.367
RO00017	0.012	0.026	0.532	0.570	0.708	0.000	0.041	0.037	0.074	1.126	6.673	18.333
RO00018	0.005	0.078	0.629	0.712	0.827	0.008	0.053	0.060	0.073	1.633	7.407	18.033
RO00019	0.069	0.023	0.523	0.614	0.820	0.000	0.053	0.051	0.080	2.086	4.771	17.400
RO00020	0.098	0.261	0.436	0.794	0.952	0.017	0.038	0.054	0.107	2.820	10.443	
RO00021	0.092	0.017	0.476	0.584	0.786	0.011	0.000	0.013	0.109	1.959	6.539	
RO00022	0.011	0.002	0.466	0.479	0.941	0.000	0.024	0.019	0.090	0.483	4.254	18.100
RO00023	0.021	0.060	0.565	0.646	0.787	0.000	0.057	0.054	0.093	1.835	7.173	17.433
RO00024	0.043	0.011	0.506	0.561	0.703	0.000	0.035	0.026	0.052	1.662	4.204	37.167
RO00033		0.003	0.408	0.411	0.538	0.000	0.017	0.009	0.033	0.830	3.670	14.567
RO00034	0.044	0.187	0.549	0.780	0.867	0.016	0.034	0.049	0.104	3.007	12.378	8.933
RO00035	0.045	0.031	0.565	0.642	0.870	0.000	0.029	0.029	0.072	1.476	4.638	17.300
RO00036	0.028	0.013	0.479	0.520	0.643	0.000	0.047	0.042	0.076	0.987	3.470	16.967
RO00037	0.025	0.000	0.498	0.505	0.584	0.011	0.020	0.026	0.016	0.622	3.370	36.367
RO00045	0.040	0.005	0.544	0.589	0.698	0.001	0.033	0.032	0.088	1.169	5.238	18.400
RO00046	0.004	0.180			0.956	0.000	0.051		0.064	1.412	11.944	19.133
RO00047	0.040	0.011	0.379	0.430	0.622	0.000	0.032	0.024	0.046	0.975	4.070	37.967
RO00048	0.042	0.021	0.381	0.445	0.693	0.000	0.035	0.030	0.052	0.970	3.603	43.033
RO00049	0.029	0.005	0.524	0.558	0.654	0.000	0.028	0.021	0.033	0.974	3.703	37.533
RO00055	0.062	0.003	0.369	0.434	0.482	0.000	0.013	0.011	0.052	0.706	6.606	27.900
RO00056	0.012	0.058	0.427	0.497	0.547	0.002	0.021	0.021	0.047	1.782	3.103	11.600
RO00057	0.022	0.033	0.577	0.631	0.934	0.002	0.028	0.025	0.053	1.262	5.138	27.567
RO00058	0.021	0.004	0.509	0.535	0.596	0.004	0.041	0.044	0.049	0.737	6.272	17.567
RO00059	0.083	0.024	0.538	0.645	0.717	0.000	0.068	0.063	0.107	2.057	4.437	17.733
Mean	**0.041**	**0.054**	**0.484**	**0.567**	**0.739**	**0.004**	**0.033**	**0.033**	**0.067**	**1.500**	**5.773**	**23.821**

SCECAP 2000 Water Quality
Dissolved and Total Nutrients -- Tidal Creeks

Station	Ammonia (NH4 mg/l)	Nitrate-Nitrite (mg/l)	Organic Nitrogen (DON mg/l)	Total Diss Nitrogen (TDN mg/l)	Total Nitrogen (TN mg/l)	Organic Phosphate (DOP mg/l)	Ortho-phosphate (OP mg/l)	Total Diss Phos (TDP mg/l)	Total Phosphorus (TP mg/l)	Silica Silicon (DS mg/l)	Organic Carbon (DOC mg/l)	Inorganic Carbon (DIC mg/l)
RT00501	0.034	0.064	0.519	0.617	0.832	0.000	0.044	0.041	0.057	2.549	5.505	25.950
RT00502	0.066	0.064	0.745	0.876	1.217	0.002	0.109	0.110	0.192	3.173	10.109	16.067
RT00503	0.069	0.029	0.572	0.669	0.957	0.000	0.026	0.025	0.117	1.659	4.137	17.633
RT00504	0.016	0.000	0.584	0.601	0.844	0.008	0.055	0.063	0.099	3.109	7.373	37.133
RT00505		0.000	0.429	0.429	0.810	0.000	0.011	0.010	0.071	1.185	4.371	18.933
RT00517	0.008			0.565	0.820	0.002	0.052	0.054	0.069		4.771	47.867
RT00518	0.159	0.051	0.579	0.789	1.199	0.014	0.025	0.039	0.159	3.012	3.670	12.400
RT00519	0.030	0.009	0.567	0.605	0.921	0.004	0.058	0.063	0.080	1.491	6.840	16.567
RT00520		0.003	0.428	0.431	0.687	0.000	0.015	0.008	0.066	1.456	3.303	18.000
RT00521		0.005	0.446	0.451	0.702	0.000	0.020	0.009	0.057	1.282	2.769	19.000
RT00523	0.140	0.009	0.619	0.768	1.177	0.000	0.057	0.057	0.150	3.167	6.172	20.933
RT00525		0.004	0.449	0.453	0.762	0.000	0.023	0.020	0.050	2.368	4.137	20.133
RT00526	0.043	0.305	0.601	0.950	1.322	0.021	0.209	0.255	0.105	3.630	16.048	11.533
RT00528	0.006	0.000	0.718	0.842	1.279	0.005	0.065	0.070	0.191	2.515	13.145	19.033
RT00530		0.000	0.385	0.386	0.732	0.002	0.017	0.019	0.084	1.519	3.503	18.900
RT00531	0.037	0.000	0.648	0.686	0.847	0.011	0.010	0.021	0.050	1.976	6.072	15.367
RT00541	0.022	0.019	0.523	0.564	0.760	0.000	0.036	0.033	0.114	1.735	3.937	17.667
RT00542	0.142	0.006	0.680	0.828	1.263	0.008	0.059	0.068	0.178	3.919	5.939	24.267
RT00543	0.033	0.050	0.651	0.735	0.999	0.003	0.057	0.056	0.103		6.940	37.600
RT00544	0.062	0.019	0.431	0.513	0.727	0.000	0.019	0.011	0.072	1.148	2.402	19.000
RT00545	0.038	0.004	0.319	0.361		0.002	0.009	0.007	0.037	0.387	2.969	26.100
RT00546	0.028	0.017	0.596	0.641	0.665	0.000	0.037	0.034	0.100	1.380	3.937	17.200
RT00547	0.076	0.016	0.602	0.693	1.040	0.000	0.027	0.024	0.103	2.251	4.104	20.067
RT00548	0.044	0.005	0.683	0.732	0.919	0.000	0.056	0.047	0.114	3.163	6.906	38.233
RT00549	0.017	0.003	0.542	0.562	0.748	0.008	0.027	0.035	0.095	2.687	6.272	14.867
RT00550	0.005	0.001	0.358	0.364		0.001	0.007	0.010	0.058	0.798	3.470	27.267
RT00554	0.006	0.159	0.596	0.761	0.900	0.002	0.045	0.042	0.127	2.309	8.908	23.650
RT00556	0.017	0.004	0.652	0.673	0.869	0.003	0.033	0.032	0.058	1.176	5.705	16.000
RT00557	0.045	0.000	0.505	0.551	0.802	0.000	0.051	0.044	0.107	1.568	6.139	17.233
RT00558		0.000	0.506	0.507	0.709	0.000	0.024	0.023	0.070	2.025	5.205	19.800
Mean	**0.048**	**0.029**	**0.549**	**0.620**	**0.911**	**0.003**	**0.043**	**0.044**	**0.098**	**2.094**	**5.825**	**21.813**

Shading represents values considered to be high (>0.1 mg/l; Bricker et al., 1999).

Appendix 2.4. Summary of five-day biochemical oxygen demand, turbidity, total alkalinity, fecal coliform bacteria, and total organic carbon concentrations at sites sampled in 1999 and 2000. The SCDHEC laboratory completed all analyses.

SCECAP 1999 Water Quality
Total Nutrients -- Open Water

Station	BOD 5 Day mg/l	Turbidity NTU	Total Alkalinity mg/l	Fecal Coliform per 100 ml	Total Organic Carbon mg/l as C
RO99301	1.6	7.6	94	2	6.9
RO99302	**1.9**	**18.0**	54	23	9.7
RO99303	**2.2**	**20.0**	**116**	11	0.0
RO99304	**4.1**	8.9	91		2.9
RO99305	1.4	5.0	**105**		0.0
RO99306	1.3	7.0	**122**	14	
RO99307	**2.0**	**50.0**	39	**900**	3.7
RO99308	1.6	11.0	**102**	4	10.5
RO99309	**3.1**	11.0	97	0	**12.4**
RO99310	1.1	**22.0**	**116**	2	0.0
RO99311	0.6	**16.0**	**113**	0	0.0
RO99312	1.0	10.0	**118**	0	3.0
RO99313	**2.2**	**50.0**	90	17	8.1
RO99315	**5.5**	**16.0**	97	11	6.0
RO99316	1.6	14.0	55	17	6.4
RO99317	1.1	9.2	**116**	2	0.0
RO99318	**2.0**	7.0	**102**	4	6.0
RO99319	**4.0**	14.0	96	2	2.7
RO99320	1.1	5.6	**106**	2	0.0
RO99321	**2.9**	**23.0**	72	17	6.9
RO99322	0.8	9.0	90	**80**	2.4
RO99323	1.3	13.0	**110**	30	
RO99324	**7.1**	11.0	95		2.2
RO99325	**5.6**	4.4	**102**		0.0
RO99326	**2.8**	**34.0**	96	8	5.8
RO99327	1.1	**20.0**	**102**	4	2.3
RO99328	1.0	**24.0**	**116**	0	2.4
RO99329	1.6	5.9	**106**	2	
RO99330	**2.4**	12.0	**109**	11	3.1
Mean	**2.3**	**15.8**	**97**	**46.52**	**4.0**

Shading represents values that are equal to or exceed 75th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a), or had fecal coliform values that exceeded shellfish standards (43 colonies/100ml).

Shading represents values that are equal to or exceed 90th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a), or had fecal coliform values that exceeded standards for primary contact recreation (400 colonies/100ml).

* indicates value was below detection limit for that parameter

SCECAP 1999 Water Quality
Total Nutrients -- Tidal Creeks

Station	BOD 5 Day mg/l	Turbidity NTU	Total Alkalinity mg/l	Fecal Coliform per 100 ml	Total Organic Carbon mg/l as C
RT99001	1.9	65.0	119	13	0.0
RT99002	1.4	12.0	118	2	0.0
RT99003	1.0	34.0	116	22	
RT99004	1.8	45.0	122	8	0.0
RT99005	7.2	14.0	107		4.9
RT99006	2.3	18.0	120	70	2.4
RT99007	2.2	25.0	124	50	3.2
RT99008	1.4	39.0	113	2	
RT99009	1.6	14.0	123	130	4.6
RT99010	5.5	17.0	92	8	12.9
RT99012	3.8	19.0	126	0	2.9
RT99013	1.3	24.0	113	4	
RT99017	3.4	13.0	100	300	6.2
RT99019	2.3	21.0	128	4	
RT99021	1.3	28.0	122	4	0.0
RT99022	1.3	9.9	112	30	2.2
RT99024	1.3	22.0	94	11	7.2
RT99026	2.2	17.0	123	0	0.0
RT99027	2.2	12.0	96	13	4.8
RT99028	1.2	13.0	123	0	2.4
RT99029	4.5	12.0	130	8	
RT99030	2.1	20.0	118	13	0.0
RT99036	1.4	36.0	117	8	0.0
RT99037	3.6	13.0	108	60	3.7
RT99038	4.1	11.0	121	0	0.0
RT99039	1.1	28.0	118	4	0.0
RT99040	7.7	23.0	118	8	0.0
Mean	**2.6**	**22.4**	**116**	**29.69**	**2.6**

Shading represents values that are equal to or exceed 75th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a), or had fecal coliform values that exceeded shellfish standards (43 colonies/100ml).

Shading represents values that are equal to or exceed 90th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a), or had fecal coliform values that exceeded standards for primary contact recreation (400 colonies/100ml).

* indicates value was below detection limit for that parameter

SCECAP 2000 Water Quality
Total Nutrients -- Open Water

Station	BOD 5 Day mg/l	Turbidity NTU	Total Alkalinity mg/l	Fecal Coliform per 100 ml	Total Organic Carbon mg/l as C
RO00006	**2.8**	**18.0**	75	2	5.3
RO00007	**2.1**	8.5	25	0	3.3
RO00008	1.0	**30.0**	**116**	0	4.6
RO00009	0.8	10.0	**125**	7	3.8
RO00010	0.8	6.7	**119**	0	3.4
RO00015	**2.8**	**16.0**	30	30	7.3
RO00016	0.0	15.0	**125**	0	4.0
RO00017	0.4	**24.0**	**115**	0	4.6
RO00018	0.8	12.0	**117**	0	4.3
RO00019	0.0	8.8	**111**	0	0.0
RO00020	**2.2**	13.0	35	26	6.6
RO00021	0.0	**26.0**	83	13	5.0
RO00022	0.0	7.1	**113**	4	4.3
RO00023	0.5	11.0	**117**	2	4.4
RO00024	0.7	5.5	73	2	3.3
RO00033	0.0	6.3	**100**	0	2.8
RO00034	**3.3**	14.0	30	**44**	7.9
RO00035	0.0	**16.0**	**114**	30	3.9
RO00036	0.0	12.0	**108**	2	3.8
RO00037	1.1	6.6	**115**	0	2.8
RO00045	0.0	11.0	**112**	**140**	6.0
RO00046	0.0	**20.0**	81	0	7.9
RO00047	1.0	4.4	**113**	0	3.2
RO00048	1.2	8.6	**116**	0	2.9
RO00049	1.2	8.8	**116**	0	2.8
RO00055	**2.3**	8.2		4	4.6
RO00056	**2.5**	5.3	76	7	3.2
RO00057	0.0	**18.0**	**123**	13	3.4
RO00058	0.0	**16.0**	**107**	0	3.7
RO00059	0.0	10.0	**114**	2	0.0
Mean	**0.9**	**12.6**	**97**	**11**	**4.1**

Shading represents values that are equal to or exceed 75th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a), or had fecal coliform values that exceeded shellfish standards (43 colonies/100ml).

Shading represents values that are equal to or exceed 90th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a), or had fecal coliform values that exceeded standards for primary contact recreation (400 colonies/100ml).

* indicates value was below detection limit for that parameter

SCECAP 2000 Water Quality
Total Nutrients -- Tidal Creeks

Station	BOD 5 Day mg/l	Turbidity NTU	Total Alkalinity mg/l	Fecal Coliform per 100 ml	Total Organic Carbon mg/l as C
RT00501	0.0	30.0	108	0	3.4
RT00502	0.0	29.0	104	23	7.0
RT00503	0.0	15.0	119	22	3.1
RT00504	1.2	12.0	121	17	5.3
RT00505	0.0	18.0	126	0	2.8
RT00517	1.0	7.8	127	2	3.8
RT00518	2.5	39.0	112	80	2.9
RT00519	0.0	15.0	107	2	4.9
RT00520	0.0	9.1	120	0	2.7
RT00521	0.0	15.0	128	2	2.4
RT00523	0.0	25.0	84	900	4.7
RT00525	0.0	10.0	134	0	3.4
RT00526	0.0	22.0	74	170	11.9
RT00528	2.5	42.0	114	50	8.8
RT00530	0.0	12.0	122	0	2.3
RT00531	2.6	7.3	101	23	5.0
RT00541	0.0	21.0	112	0	0.0
RT00542	3.2	15.0	146	110	6.1
RT00543	1.7	13.0	124	90	6.4
RT00544	3.4	9.3	124	2	3.5
RT00545	3.3	3.3		0	0.0
RT00546	2.1	28.0	114	0	3.5
RT00547	0.0	24.0	124	14	3.9
RT00548	2.6	82.0	132	7	5.7
RT00549	3.1	14.0	94	50	5.4
RT00550	4.3	3.0	130	20	0.0
RT00554	0.0	21.0	95	22	7.8
RT00556	0.0	9.6	111	0	4.2
RT00557	0.0	18.0	114	30	4.2
RT00558	0.0	25.0	125	0	2.5
Mean	**1.1**	**19.8**	**115**	**55**	**4.3**

Shading represents values that are equal to or exceed 75th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a), or had fecal coliform values that exceeded shellfish standards (43 colonies/100ml).

Shading represents values that are equal to or exceed 90th percentile of all measurements collected by SCDHEC in saltwaters from 1993 - 1997 (SCDHEC 1998a), or had fecal coliform values that exceeded standards for primary contact recreation (400 colonies/100ml).

* indicates value was below detection limit for that parameter

Appendix 2.5. Summary of the percent of the state's tidal creek and open water habitat that met various water quality, sediment quality, biological condition measures during 1999 and 2000. The 95% lower and upper confidence limits are also provided.

SCECAP 1999-2000
Water, sediment, and biological cut points

Parameter	Criteria	Percent of Tidal Creek Habitat			Percent of Open Water Habitat		
		Lower CL	**Percent**	Lower CL	Lower CL	**Percent**	Upper CL
WATER QUALITY							
Salinity -- ppt	≤ 5	--	**0**	--	1	**7**	14
(25 Hr mean - bottom)	≤ 18	0	**5**	10	4	**13**	21
	≤ 30	13	**25**	37	39	**51**	64
	> 30	--	**75**	--	--	**49**	--
Dissolved Oxygen -- mg/l	< 3	1	**7**	13	--	**0**	--
(25 Hr mean - bottom)	< 4	32	**46**	60	1	**9**	16
	< 5	83	**91**	99	40	**54**	67
	≥ 5	--	**9**	--	--	**46**	--
Dissolved Oxygen -- mg/l	< 3	10	**21**	32	--	**0**	--
(Instantaneous Bottom)	< 4	41	**54**	67	13	**24**	35
	< 5	80	**89**	98	58	**70**	81
	> 5	--	**11**	--	--	**30**	--
Dissolved Oxygen -- mg/l	< 3	8	**18**	28	--	**0**	--
(Instantaneous - surface)	< 4	41	**54**	67	5	**14**	22
	< 5	79	**88**	97	56	**68**	80
	> 5	--	**12**	--		**32**	--
pH	< 7.1	0	**7**	14	2	**10**	18
(25 Hr mean - bottom)	< 7.4	29	**42**	55	13	**24**	35
based on 99_00 pristine creeks only	> 7.4	--	**58**	--	--	**76**	--
Total Kjeldahl Nitrogen	≤ 0.81	72	**82**	92	91	**96**	--
mg/l	≤ 1.06	85	**92**	99	--	**100**	--
	> 1.06	--	**8**	--	--	**0**	--
Nitrate / Nitrite	≤ 0.14	--	**100**	--	84	**91**	99
mg/l	≤ 0.23	--		--	69	**99**	100
	> 0.23	--		--	--		--
Total Nitrogen	≤ 0.95	79	**88**	97	90	**96**	100
(TKN + NOx - mg/l)	≤ 1.29	--	**12**	--	--	**4**	--
	> 1.29	--	**0**	--	--	**0**	--

Parameter	Criteria	Percent of Tidal Creek Habitat			Percent of Open Water Habitat		
Ammonia Nitrogen mg/l	≤ 0.28	41	**56**	71	67	**79**	91
	≤ 0.48	74	**84**	95	94	**98**	100
	≤ 0.60	89	**96**	102	--	**100**	--
	> 0.60	--	**4**	--	--	**0**	--
Total Phosphorus mg/l	≤ 0.09	32	**45**	59	71	**81**	91
	≤ 0.17	85	**92**	99	--	**19**	--
	> 0.17	--	**8**	--	--	**0**	--
BOD$_5$ mg/l	≤ 1.8	43	**56**	69	53	**66**	78
	≤ 2.6	66	**77**	88	73	**83**	93
	> 2.6	--	**23**	--	--	**17**	--
Total Organic Carbon mg/l	≤ 11	93	**97**	101	96	**99**	100
	≤ 16	--	**100**	--	--	**100**	--
	> 16	--	**0**	--	--	**0**	--
Fecal Coliform -- mg/l cells / 100ml	≤ 43	72	**82**	92	88	**94**	100
	≤ 400	96	**99**	102	62	**99**	100
	> 400	--	**1**	--	--	**1**	--
Alkalinity mg/l	≤ 98	4	**13**	22	26	**39**	51
	≤ 110	15	**26**	37	46	**59**	71
	≤ 114	28	**41**	54	59	**71**	83
	≤ 125	72	**82**	92	--	**100**	--
	> 125	--	**18**	--	--	**0**	--
Turbidity NTU	≤ 15	33	**46**	59	54	**66**	78
	≤ 25	66	**77**	88	86	**92**	99
	> 25	--	**23**	--	--	**8**	--
WQ Score (with nutr) continuous	≤ 3.0	0	**5**	10	--	**0**	--
	≤ 4.0	25	**38**	51	3	**11**	19
	> 4.0	--	**62**	--	--	**89**	--
SEDIMENT QUALITY							
Sediment Composition Percent Silt Clay	80	36	**49**	62	61	**72**	84
	20-80	--	**42**	--	--	**22**	--
	20	16	**9**	2	12	**6**	0

Parameter	Criteria	Percent of Tidal Creek Habitat			Percent of Open Water Habitat		
TOC	≤ .05	0	**4**	8	1	**8**	16
	0.05-3	--	**85**	--	--	**87**	--
	>3	3	**11**	19	0	**5**	10
Porewater Ammonia mg/l	≤ 14	96	**99**	102	71	**99**	100
	>14	--	**1**	--	--	**1**	--
Contaminants ERMQ	≤ 0.020	68	**79**	90	79	**88**	96
	≤ 0.058	--	**100**	--	0	**98**	18
	> 0.058	--	**0**	--	--	**2**	--
Toxicity	None	34	**47**	60	43	**56**	69
	1 of 3	33	**46**	59	19	**30**	42
	≥ 2 of 3	3	**7**	11	5	**14**	22
Integrated Sediment Score	1.5	--	**0**	--	0	**3**	8
	1.5-3.5	--	**38**	--	--	**30**	--
	3.5	51	**62**	73	56	**67**	79
BIOLOGY							
Chlorophyll A µg/l	≤ 5	0	**6**	12	0	**7**	14
	≤ 20	78	**87**	96	93	**97**	100
	≤ 60	--	**100**	--	--	**100**	--
	> 60	--	**0**	--	--	**0**	--
Benthic IBI	≤ 1.5	0	**4**	8	0	**2**	5
	≤ 2.5	6	**16**	26	5	**14**	22
	> 2.5	--	**84**	--	--	**86**	--
Overall Integrated Measure Habitat Quality Score	≤ 1.8	--	**0**	--	--	**0**	--
	≤ 3.2	4	**12**	20	1	**8**	26
	> 3.2	--	**88**	--	--	**92**	--

Appendix 3.1. Summary of sediment composition (percent silt/clay versus sand), total organic carbon (TOC) and total ammonia nitrogen (TAN) concentrations, contaminant concentrations, and sediment bioassay results to evaluate for sediment toxicity at sites sampled in 1999 and 2000. All contaminant analyses and the microtox bioassays were completed by the NOAA National Ocean Service CCEHBR laboratory. All other measures were analyzed by the SCDNR MRRI laboratory, except for the amphipod bioassays, were completed by a USEPA subcontractor during the 2000 sampling period.

SCECAP 1999 -- Open Water
Sediment characteristics, contaminants, and toxicity

	Characteristics			Contaminants					Toxicity			
									Microtox® Assay		*Seed Clam Assay*	
Station	Percent Silt/Clay	TOC % of Total	TAN (mg/l)	ERMQ	Metals*	PAHs*	Pest*	PCBs*	EC_{50} Percent	Toxic	Mean Growth	Toxic
RO99301	7.7	0.2	1.3	0.007					0.9		*	
RO99302	96.8	6.6		**0.037**	1				0.3		NA	
RO99303	10.9	0.2	1.7	0.006					0.7		31.2	
RO99304	12.4	0.4	2.3	0.004					0.7		20.1	
RO99305	3.6	0.1	3.6	0.003					1.3		20.9	
RO99306	2.6	0.1	5.8	0.005					15.9		2.8	†
RO99307	2.3	0.1	0.6	0.004					0.5	†	*	
RO99308	93.2	0.2	1.3	0.011					0.3		39.9	
RO99309	11.7	0.3	1.8	0.009					0.4	†	32.3	
RO99310	9.3	0.1	1.3	0.006					1.9		30.7	
RO99311	0.9	0.0		0.005					15.4		*	
RO99312	25.8	1.4	4.8	0.017					0.1	†	*	
RO99313	19.0	0.7	7.0	0.008					0.1	†	25.8	
RO99315	1.5	0.0	1.8	0.002					15.0		40.4	
RO99316	95.4	5.5	6.0	**0.040**	1				0.0	†	2.6	†
RO99317	5.5	0.1	0.4	0.005					4.7		*	
RO99318	4.6	0.1	2.4	0.006					6.2		45.7	
RO99319	16.1	0.6	2.0	0.012					0.4	†	35.8	
RO99320	11.2	0.3	3.4	0.013	1				0.3	†	26.8	
RO99321	63.9	2.8	0.8	**0.024**	1				0.6		5.6	†
RO99322	23.0	1.0	3.7	**0.042**					0.1	†	*	
RO99323	10.9	0.3	3.1	0.012	1				0.5	†	44.0	
RO99324	30.0	0.9	4.8	**0.032**					0.1	†	27.7	
RO99325	8.4	0.1	2.7	0.007					0.7		35.2	
RO99326	34.8	1.0	1.0	0.016					1.2		34.6	
RO99327	6.6	0.3	2.1	0.008					3.1		NA	
RO99328	22.8	0.9	0.5	0.011					1.0		33.5	
RO99329	5.0	0.1	3.8	0.008					2.3		37.7	
RO99330	11.4	0.2	3.4	0.008					0.3	†	25.0	
Mean	**22.3**	**0.9**	**2.7**	**0.013**					**2.6**		**28.5**	

† = Toxic: Microtox, EC50 <0.5 if silt-clay < 20% , <0.2 if silt-clay > 20% (Ringwood et al., 1997, criterion #6); Seed Clam Assay, if mean clam growth is < 80% of mean clam control growth AND significantly different from mean clam control growth

* Number of analytes that exceed Effects Range Low (ER-L) guidelines (Long et al., 1995).

[shaded box] Values exceed threshold representing moderate risk of benthic impacts (Hyland et al., 1999).

SCECAP 1999 -- Tidal Creeks
Sediment characteristics, contaminants, and toxicity

	Characteristics			Contaminants					Toxicity			
									Microtox® Assay		*Seed Clam Assay*	
Station	Percent Silt/Clay	TOC % of Total	TAN (mg/l)	ERMQ	Metals*	PAHs*	Pest*	PCBs*	EC_{50} Percent	Toxic	Mean Growth	Toxic
RT99001	89.5	3.7	11.8	**0.036**	1				0.0	†	**	
RT99002	4.6	0.1	0.9	0.006					2.1		43.9	
RT99003	36.0	1.2	2.8	0.017					0.1	†	**	
RT99004	10.5	0.3	0.2	0.007					0.5		39.8	
RT99005	40.9	1.0	0.5	**0.023**					0.2	†	48.9	
RT99006	8.3	0.2	3.1	0.007					4.5		38.5	
RT99007	26.9	0.7	3.5	0.017					0.1	†	38.7	
RT99008	30.7	1.0	5.5	0.014					0.1	†	**	
RT99009	95.0	3.8	5.0	**0.029**	1				0.0	†	8.2	†
RT99010	31.2	1.2	11.3	0.019					0.4		21.1	
RT99012	15.5	0.5	2.0	0.008					0.3	†	33.2	
RT99013	94.8	2.5	1.3	**0.033**	1				0.2		**	
RT99017	13.4	1.0	1.1	0.015					0.9		**	
RT99019	2.9	0.1	1.5	0.004					3.7		44.1	
RT99021	59.4	2.0	2.6	**0.024**	1				0.1	†	**	
RT99022	34.6	1.3	2.9	0.014					0.7		45.1	
RT99024	4.3	0.1	1.8	0.006					15.6		24.3	
RT99026	12.2	0.4	3.4	0.008					0.2	†	**	
RT99027	15.3	0.3	0.6	0.007					3.3		**	
RT99028	33.7	1.1	2.1	0.013					0.1	†	37.2	
RT99029	9.9	0.3	1.0	0.006					1.3		48.0	
RT99030	26.1	0.6	2.0	0.014					0.1	†	33.9	
RT99036	95.8	4.0	2.5	**0.037**	1				0.0	†	**	
RT99037	5.5	0.4	1.9	0.005					2.1		49.3	
RT99038	41.7	1.3	0.8	0.016					0.3		40.5	
RT99039	9.3	0.2	1.2	0.006					2.4		39.0	
RT99040	14.7	0.3	2.1	0.008					0.2	†	35.0	
Mean	**32.0**	**1.1**	**2.8**	**0.015**					**1.5**		**37.1**	

† = Toxic: Microtox EC50 <0.5 if silt-clay < 20% , <0.2 if silt-clay > 20% (Ringwood et al., 1997, criterion #6); Seed Clam Assay < 80% of mean sediment control growth and less than 95% Lower Confidence Limit (LCL)

Asterisk represents number of analytes that exceed Effects Range Low (ER-L) guidelines (Long et al., 1995).

** = No data due to low clam growth in controls

[shaded box] = Values exceed threshold representing moderate risk of benthic impacts (Hyland et al., 1999).

SCECAP 2000 -- Open Water
Sediment characteristics, contaminants, and toxicity

	Characteristics			Contaminants					Toxicity					
									Microtox® Assay		Amphipod Assay		Seed Clam Assay	
Station	Percent Silt/Clay	TOC % of Total	TAN (mg/l)	ERMQ	Metals*	PAHs*	Pest*	PCBs*	EC_{50} Percent	Toxic	Percent Survival	Toxic	Mean Growth	Toxic
RO00006	10.2	0.6	12.3	0.003					0.1	†	96		32.3	†
RO00007	0.7	0.2	0.0	0.001					15.7		83		18.9	
RO00008	9.7	0.2	1.9	0.004					0.2	†	92		30.1	
RO00009	26.0	0.8	3.4	0.013					0.1	†	96		28.0	
RO00010	6.5	0.1	2.1	0.006					2.7		93		25.6	
RO00015	29.8	2.2	1.9	0.017					0.0	†	89		2.4	†
RO00016	24.5	1.1	1.9	0.008					0.7		87		35.9	
RO00017	4.4	0.1	0.5	0.002					8.1		89		25.9	
RO00018	4.8	0.1	0.0	0.001					0.9		85		29.8	
RO00019	26.7	0.7	2.0	**0.033**		1			0.5		91		41.2	†
RO00020	20.6	0.9	3.0	0.009					0.0	†	98		10.5	†
RO00021	16.5	0.7	1.6	0.005					0.2	†	88		35.1	†
RO00022	2.2	0.6	7.3	0.007					0.1	†	97		39.6	
RO00023	16.3	0.8	1.7	0.014	1				0.9		85		28.7	
RO00024	10.4	0.2	1.7	0.001					1.5		86		29.5	
RO00033	12.1	0.4	1.4	0.008					0.9		93		28.6	
RO00034	37.4	1.8	4.1	**0.021**	1				0.0	†	97		-22.0	†
RO00035	11.3	0.6	1.9	0.013					0.8		91		40.4	
RO00036	5.5	0.3	1.5	0.017	1				4.5		82		20.0	
RO00037	1.3	0.1	0.3	0.004					11.2		92		40.7	
RO00045	6.0	0.1	0.8	0.003					0.9		91		26.6	
RO00046	2.8	0.1	1.0	0.001					13.2		91		42.2	
RO00047	27.4	0.8	3.1	0.010					1.0		90		19.1	
RO00048	13.2	0.4	3.0	0.009					0.5	†	89		33.5	
RO00049	3.2	0.1	1.9	0.002					15.2		95		27.7	
RO00055	1.8	0.1	2.3	0.001					15.4		89		49.4	
RO00056	98.5	4.3	19.3	**0.163**	3	8			0.0	†	87		15.3	†
RO00057	7.5	0.2	1.2	0.005					0.3	†	90		51.4	
RO00058	5.3	0.2	1.6	0.008					3.7		92		27.6	
RO00059	11.9	0.3	2.6	0.005					0.5	†	93		36.3	†
Mean	**15.1**	**0.6**	**2.9**	**0.013**					**3.3**		**90.57**		**28.3**	

† = Toxic: Microtox, EC50 <0.5 if silt-clay < 20% , <0.2 if silt-clay > 20% (Ringwood et al., 1997, criterion #6); Seed Clam Assay, if mean clam growth is < 80% of mean clam control growth AND significantly different from mean clam control growth

(light grey box) Values exceed threshold representing moderate risk of benthic impacts (Hyland et al., 1999).

(dark box) Values exceed threshold representing high risk of benthic impacts (Hyland et al., 1999).

* Number of analytes that exceed Effects Range Low (ER-L) guidelines (Long et al., 1995).

SCECAP 2000 -- Tidal Creeks
Sediment characteristics, contaminants, and toxicity

	Characteristics			Contaminants					Toxicity					
									Microtox® Assay		*Amphipod Assay*		*Seed Clam Assay*	
Station	Percent Silt/Clay	TOC % of Total	TAN (mg/l)	ERMQ	Metals*	PAHs*	Pest*	PCBs*	EC_{50} Percent	Toxic	Percent Survival	Toxic	Mean Growth	Toxic
RT00501	10.3	0.4	0.8	0.009					0.5	†	96		54.0	
RT00502	2.0	0.1	0.4	0.002					15.6		83		25.6	†
RT00503	17.8	0.9	3.3	0.014	1				0.3	†	88		28.1	
RT00504	14.7	0.4	1.6	0.005					0.2	†	87		31.7	
RT00505	32.9	1.5	2.7	0.015	1				0.1	†	88		28.5	
RT00517	3.1	0.1	1.2	0.005					16.8		91		33.9	
RT00518	78.7	5.4	1.6	**0.028**	1				0.6		92		38.7	
RT00519	34.4	1.5	4.4	0.013					0.0	†	91		30.3	
RT00520	15.1	0.4	1.6	0.011					0.2	†	91		30.0	
RT00521	87.9	3.7	6.3	**0.035**	1				0.0	†	92		27.2	
RT00523	70.5	2.4	2.0	0.020	1				0.4		94		36.5	
RT00525	10.2	0.5	0.9	0.009					0.3	†	91		34.5	
RT00526	63.8	4.0	8.7	**0.049**	1		1		0.1	†	89		-12.7	†
RT00528	50.9	2.4	7.4	0.017					0.3		91		22.0	
RT00530	25.6	1.0	4.5	0.013					0.1	†	97		27.0	
RT00531	6.0	0.2	1.2	0.004					0.9		87		25.0	
RT00541	45.7	1.2	0.8	0.017	1				0.8		94		50.0	
RT00542	8.8	0.2	1.0	0.006					0.8		87		28.0	
RT00543	19.3	0.6	2.3	0.005					0.1	†	90		35.4	
RT00544	5.6	0.1	1.7	0.003					7.0		90		18.3	
RT00545	1.5	0.0	0.1	0.000					16.1		90		55.4	
RT00546	6.8	0.3	0.9	0.004					1.2		88		51.5	
RT00547	27.6	1.0	1.8	0.012					0.8		94		30.9	
RT00548	70.5	2.0	0.9	**0.027**	1				0.3		82		22.8	
RT00549	74.3	3.3	2.1	**0.055**	1		1		0.0	†	93		-2.1	†
RT00550	12.8	0.4	3.3	0.003					0.1	†	94		29.1	†
RT00554	34.3	1.5	21.0	0.008					0.4		89		23.8	†
RT00556	17.5	0.7	2.5	0.006					0.1	†	90		52.6	
RT00557	32.9	1.1	3.3	0.009					0.7		90		27.7	
RT00558	72.9	2.7	1.5	**0.031**	1				0.0	†	88		24.3	
Mean	**31.8**	**1.3**	**40.4**	**0.014**					**2.2**		**90.23**		**30.3**	

† = Toxic: Microtox, EC50 <0.5 if silt-clay < 20% , <0.2 if silt-clay > 20% (Ringwood et al., 1997, criterion #6); Seed Clam Assay, if mean clam growth is < 80% of mean clam control growth AND significantly different from mean clam control growth

* Number of analytes that exceed Effects Range Low (ER-L) guidelines (Long et al., 1995).

[shaded box] = Values exceed threshold representing moderate risk of benthic impacts (Hyland et al., 1999).

Appendix 4.1. Abundance of benthic species comprising 85% of the total benthic faunal abundance collected in 1999 and 2000. Abundance values represent the number of individuals per grab ($0.04m^2$). Density represents the number of individuals/ m^2. Higher taxa codes are p = polychaete, A = amphipod, M = mollusk, and O = other taxa. H' = Shannon-Weiner Index of Diversity, J' = H'/H_{max} (number of taxa in sample).

SCECAP 1999 - Open Water
Dominant Benthic Taxa

Species Name	Higher taxa	RO99301	RO99302	RO99303	RO99304	RO99305	RO99306	RO99307	RO99308	RO99309	RO99310	RO99311	RO99312	RO99313	RO99315	RO99316	RO99317	RO99318	RO99319	RO99320	RO99321	RO99322	RO99323	RO99324	RO99325	RO99326	RO99327	RO99328	RO99329	RO99330
Streblospio benedicti	P	43	0	23	45	3	0	18	7	8	0	2	4	3	40	68	0	10	41	238	12	0	6	1	34	26	15	0	12	245
Actiniaria	O	0	0	0	2	50	0	1039	2	8	0	0	7	18	0	0	0	0	2	6	0	0	0	0	3	0	1	2	8	0
Caulleriella sp.	P	0	0	0	0	0	0	0	0	0	0	0	0	0	43	0	0	0	0	6	0	0	0	1	23	0	0	3	173	3
Exogone sp.	P	0	0	0	316	559	7	0	29	9	0	0	8	0	5	0	0	25	12	62	0	0	7	12	1	0	1	1	8	0
Ampelisca abdita	A	14	0	0	57	49	1	0	1	9	2	0	13	0	1	0	0	3	3	50	0	6	2	0	9	0	0	8	226	259
Mediomastus sp.	P	5	0	4	141	4	3	0	5	1	2	0	13	0	0	0	1	12	24	64	0	12	4	67	18	0	0	4	12	9
Monticellina sp.	P	0	0	4	2	2	2	0	11	0	31	0	0	0	4	0	0	0	0	5	0	0	2	1	10	0	0	0	2	0
Tubificoides wasselli	O	0	0	1	3	52	9	0	11	0	0	0	0	0	57	0	0	2	2	6	0	0	0	0	11	0	0	13	53	0
Scoletoma tenuis	P	0	0	22	44	1	0	0	1	3	0	0	2	0	2	0	0	1	50	30	0	0	0	29	9	0	1	0	11	24
Protohaustorius deichmannae	A	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Scoloplos rubra	P	4	0	0	20	0	0	0	0	1	0	0	1	0	1	0	0	0	4	1	0	1	1	313	4	0	0	0	7	37
Tubificidae	O	1	0	0	42	0	0	8	0	0	0	0	11	0	0	0	0	4	7	0	0	0	0	0	0	0	0	1	0	0
Tharyx acutus	P	0	0	35	9	0	0	0	3	0	4	0	4	0	3	0	7	16	10	3	0	0	5	0	74	0	8	12	16	1
Tubificidae sp. B	O	0	0	12	148	46	22	15	24	0	13	0	0	0	40	0	0	1	1	33	0	0	20	61	32	0	0	0	107	0
Mediomastus ambiseta	P	21	0	126	14	2	18	0	1	0	8	0	0	0	1	0	28	27	1	16	0	9	15	9	31	0	9	1	0	0
Parapionosyllis sp.	P	0	0	0	0	99	25	0	0	0	0	0	0	0	143	0	0	0	0	0	0	0	0	0	0	0	0	0	31	2
Tubificidae sp. A	O	0	0	0	0	23	0	334	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polydora cornuta	P	0	0	0	16	5	0	0	18	48	0	0	0	1	0	0	0	35	13	8	0	0	6	0	0	0	1	0	0	5
Cirratulidae	P	0	0	5	11	0	0	0	1	0	2	0	3	0	3	0	2	8	2	1	0	0	0	2	7	0	0	6	12	9
Cyathura burbancki	O	1	3	0	7	81	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	5
Sabellaria vulgaris	P	0	0	0	12	66	2	0	19	0	0	0	0	0	0	0	0	3	2	0	0	0	1	0	0	0	0	0	23	0
Streptosyllis sp.	P	0	0	0	2	9	0	0	0	0	0	0	0	0	101	0	0	0	2	9	0	0	0	0	0	0	0	0	14	1
Tubificoides brownae	O	6	1	38	1	2	3	0	27	0	0	0	3	3	4	0	0	5	11	20	0	4	15	7	47	0	0	2	0	0
Unciola serrata	A	0	0	0	6	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Aricidea wassi	P	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	38	0	1	0	0	1	0	15	0	4	0	1	1
Cirrophorus sp.	P	0	0	6	7	1	1	0	1	0	0	0	0	0	33	0	0	3	2	7	0	0	1	2	10	0	1	0	4	2
Carinomella lactea	O	0	0	12	2	3	10	0	32	0	8	0	35	0	1	0	6	3	2	19	0	11	31	0	2	1	1	5	0	0
Spiochaetopterus costarum oculatus	P	47	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	2	3	0	14	0	0	0	1	0
Nemertinea	O	4	1	0	6	18	0	0	3	0	1	26	1	2	6	7	2	3	2	2	3	2	1	0	0	1	0	3	6	2
Tellina agilis	M	0	0	4	0	0	3	0	7	0	9	0	0	0	0	0	33	9	0	0	0	0	1	0	2	0	0	0	0	0
Pelecypoda	M	0	0	0	3	3	0	12	8	2	0	1	0	0	1	6	0	1	0	2	3	0	6	1	2	0	2	13	2	0
Turbonilla sp.	M	0	0	0	0	0	0	0	74	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	0
Mediomastus californiensis	P	0	0	0	0	1	5	0	5	0	0	0	3	0	0	0	0	3	1	4	0	0	1	1	11	0	0	0	42	1
Rhepoxynius hudsoni	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	0	0	0	0	0	0	0	0	0	1	0	0	0
Prionospio sp.	P	0	0	2	1	5	23	0	2	0	24	0	12	0	0	0	33	0	0	0	0	0	17	2	0	0	0	0	1	0
Paraprionospio pinnata	P	15	0	0	0	0	0	0	3	3	0	0	10	1	0	0	0	0	4	0	0	78	0	6	0	1	0	0	0	0
Clymenella torquata	P	0	0	1	0	0	24	0	12	0	1	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0
Pinnixa sp.	O	0	0	1	0	1	20	0	40	0	1	0	1	0	0	0	10	2	0	2	0	0	0	0	0	0	2	6	1	0
Chiridotea stenops	O	0	0	0	4	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nereis succinea	P	0	3	0	33	0	18	0	1	4	0	0	0	3	2	0	0	1	0	0	5	0	0	1	1	11	0	1	0	2
Corophium aquafuscum	A	0	0	0	0	92	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	9	0	0	0	31	0
Heteromastus filiformis	P	6	11	0	0	0	0	0	0	0	0	5	0	2	3	0	0	1	21	0	1	0	0	0	0	8	1	0	0	0
Maera caroliniana	A	0	0	0	0	123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podarkeopsis levifuscina	P	0	0	0	23	9	3	0	1	0	1	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	1	0	14	0
Nucula sp.	M	0	0	0	0	0	3	0	1	0	2	0	0	0	0	0	0	1	1	3	0	0	3	1	8	0	0	0	0	0
Enchytraeidae	O	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0
Glycera americana	P	0	0	0	4	3	9	0	5	2	2	0	0	0	0	0	3	2	4	9	0	2	2	0	3	0	5	5	2	0
Lepidactylus dytiscus	A	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tubificoides heterochaetus	O	0	4	0	0	0	0	1	0	0	0	0	0	0	0	69	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Tellinidae	M	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	25	1	0	0	0	1	0	5	1	0	0	0	4
Ampelisca verrilli	A	67	0	9	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Corophium simile	A	0	0	0	19	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0
Biffarius biformis	O	0	0	3	0	0	0	0	4	0	6	0	1	0	0	0	5	4	0	0	0	0	3	0	1	0	0	6	0	1
Percent of total abundance		95	61	87	81	75	52	92	74	86	66	61	69	87	90	100	81	76	85	82	71	84	67	79	88	66	76	58	87	96
Mean total abundance (#/0.04m^2)		123	19	180	616	879	204	780	246	61	89	35	98	19	276	75	113	167	137	373	18	76	116	329	227	37	36	79	491	321
Mean density (#/m^2)		3075	475	4488	15400	21975	5100	19488	6138	1513	2225	875	2438	475	6888	1875	2825	4163	3413	9325	438	1888	2900	8213	5663	925	900	1975	12263	8013
Mean number of species (#/0.04m^2)		13	7	23	46	56	50	13	50	18	26	10	29	6	21	4	21	39	27	48	8	13	35	30	37	11	18	30	48	23
H' - diversity		2.89	2.16	3.38	3.84	4.16	4.88	1.57	4.62	3.28	3.92	2.78	4.07	1.9	2.93	1.34	3.28	4.18	3.56	3.94	2.58	2.34	4.45	2.58	4.31	2.79	3.68	4.35	3.87	2.05
J' - diversity		0.79	0.8	0.75	0.7	0.72	0.87	0.43	0.83	0.79	0.84	0.84	0.85	0.78	0.67	0.67	0.75	0.8	0.8	0.71	0.9	0.64	0.88	0.53	0.83	0.81	0.89	0.89	0.69	0.46

SCECAP 1999 - Tidal Creeks
Dominant Benthic Taxa

Species Name	Higher taxa	RT99001	RT99002	RT99003	RT99004	RT99005	RT99006	RT99007	RT99008	RT99009	RT99010	RT99012	RT99013	RT99017	RT99019	RT99021	RT99022	RT99024	RT99026	RT99027	RT99028	RT99029	RT99030	RT99036	RT99037	RT99038	RT99039	RT99040
Streblospio benedicti	P	6	11	42	39	1	227	28	48	0	8	143	0	46	34	0	75	36	254	2	34	74	11	33	0	1	88	216
Ampelisca abdita	A	0	1	0	1	5	0	0	4	0	8	0	8	0	0	2	0	0	3	0	4	0	12	2	0	0	0	0
Scoletoma tenuis	P	1	0	19	69	10	0	31	41	0	3	24	30	0	1	13	3	4	0	0	52	4	19	0	0	12	17	23
Tubificoides wasselli	O	0	7	0	23	0	1	0	0	0	1	0	0	0	2	0	0	52	1	0	0	30	0	1	0	0	0	0
Polydora cornuta	P	0	0	0	0	0	4	90	0	0	0	2	0	0	0	0	8	0	5	0	0	7	67	36	0	0	0	170
Tharyx acutus	P	2	1	6	21	0	4	0	70	0	0	0	1	0	3	0	0	7	73	0	0	0	1	0	0	0	3	2
Tubificoides brownae	O	0	1	9	16	1	1	1	10	5	14	0	4	14	19	0	0	7	18	3	10	1	2	0	0	1	0	9
Mediomastus ambiseta	P	1	43	0	16	0	30	0	0	0	5	0	0	0	0	0	2	0	13	0	0	13	0	0	0	0	11	0
Mediomastus sp.	P	0	5	12	0	1	0	0	19	0	1	4	5	1	0	0	7	9	33	2	9	9	4	3	0	1	1	1
Heteromastus filiformis	P	0	0	4	0	1	0	4	4	0	0	1	0	72	0	1	24	0	7	8	3	0	2	19	10	0	7	0
Cirratulidae	P	0	0	9	28	0	1	0	10	0	0	1	21	0	1	4	2	3	38	0	29	0	3	2	0	0	5	2
Scoloplos rubra	P	0	0	4	0	1	1	2	12	0	1	3	0	0	3	0	0	15	2	6	0	1	4	0	0	0	2	1
Tubificidae	O	0	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	9	2	0	1	0	19	0	1	1
Caulleriella sp.	P	0	0	0	54	0	0	0	0	0	0	0	0	0	17	0	1	0	0	0	0	1	0	0	0	0	0	0
Aricidea wassi	P	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiochaetopterus costarum oculatus	P	0	0	5	1	9	0	4	1	0	1	4	12	0	0	0	5	0	4	0	21	0	31	0	0	6	0	0
Nereis succinea	P	0	0	1	0	2	0	0	2	0	3	0	1	3	0	0	6	0	13	2	0	0	0	40	1	0	0	14
Carinomella lactea	O	1	4	19	10	0	0	3	10	0	0	0	9	0	0	1	5	0	0	0	1	2	1	2	0	2	6	0
Ilyanassa obsoleta	M	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	41	0	34	0	0	0	4	0	0	0	1	0
Exogone sp.	P	0	0	0	7	0	0	3	0	0	0	0	0	0	1	0	2	0	1	0	0	0	10	0	0	0	1	0
Phoronida	O	0	0	4	0	3	0	3	4	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	106	0	1
Nemertinea	O	0	9	1	0	1	0	0	0	1	1	0	4	3	0	0	0	3	1	4	1	0	1	1	0	0	2	5
Tubificoides heterochaetus	O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tellinidae	M	0	4	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	2	0	0	0	0	49	0
Cirrophorus sp.	P	0	1	0	3	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	6	0	0	0	0	0	0
Rhepoxynius hudsoni	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tellina agilis	M	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraprionospio pinnata	P	14	0	2	0	1	0	1	2	6	0	0	5	0	0	6	1	0	1	0	0	0	3	0	0	1	0	0
Actiniaria	O	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	1	0	4	0	0	0	2	0
Pelecypoda	M	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2	2	1	0	0	4	5	1	0	0	0	0	0
Melita nitida	A	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	9	0	1	3	0	0	0	2	0	0	0	20
Glycera americana	P	0	2	1	2	0	1	0	2	0	1	1	4	2	0	0	3	2	4	0	1	0	1	2	0	1	2	0
Monticellina sp.	P	0	0	0	12	0	0	6	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
Lepidactylus dytiscus	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Brania sp.	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptonacea sp.	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Streptosyllis sp.	P	0	0	0	12	0	0	0	0	0	0	0	0	0	2	0	2	1	0	0	0	0	0	0	0	0	0	0
Notomastus lineatus	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percent of total abundance		53	77	88	69	53	92	89	92	100	64	95	70	96	63	60	90	87	95	81	79	90	77	87	52	90	76	95
Mean total abundance (#/0.04m^2)		24	63	78	229	35	147	100	130	6	37	97	75	74	72	29	112	82	266	24	109	86	120	83	31	73	131	244
Mean density (#/m^2)		588	1575	1950	5713	875	3663	2500	3238	150	913	2425	1875	1850	1800	725	2800	2050	6650	600	2725	2150	2988	2063	775	1825	3263	6100
Mean number of species (#/0.04m^2)		6	18	18	31	11	11	18	17	2	11	12	19	8	10	11	23	13	20	9	23	15	28	16	6	10	26	15
H' - diversity		2.24	3.35	3.35	4.02	2.54	1.27	2.53	3.05	0.92	2.5	1.54	3.31	1.93	2.34	3.05	3.09	2.86	2.22	2.88	3.5	2.55	3.58	2.9	1.87	1.6	3.07	2.01
J' - diversity		0.87	0.8	0.81	0.82	0.75	0.37	0.68	0.76	0.92	0.74	0.44	0.87	0.64	0.77	0.89	0.69	0.77	0.51	0.91	0.78	0.7	0.77	0.73	0.76	0.52	0.67	0.53

SCECAP 2000 - Open Water
Dominant Benthic Taxa

Species Name	Higher taxa	RO00006	RO00007	RO00008	RO00009	RO00010	RO00015	RO00016	RO00017	RO00018	RO00019	RO00020	RO00021	RO00022	RO00023	RO00024	RO00033	RO00034	RO00035	RO00036	RO00037	RO00045	RO00046	RO00047	RO00048	RO00049	RO00055	RO00056	RO00057	RO00058	RO00059
Streblospio benedicti	P	4	0	4	0	8	35	42	1	1	1	38	51	0	0	0	374	2	2	1	0	45	0	0	54	0	0	26	135	192	334
Actiniaria	O	0	0	0	0	11	0	0	0	0	0	0	0	0	2	812	2	0	0	5	0	1	0	1	3	0	0	0	0	1	4
Caulleriella sp.	P	0	0	0	0	12	0	0	131	5	0	0	0	0	11	1	0	0	1	112	0	0	0	10	437	0	1	0	218	349	38
Exogone sp.	P	0	0	0	9	1	0	0	15	0	0	0	0	0	44	123	8	0	0	191	0	0	0	2	2	0	0	0	0	47	21
Ampelisca abdita	A	0	0	0	28	2	0	6	40	0	1	0	0	0	96	399	0	0	0	33	1	0	0	20	22	0	0	0	0	3	29
Mediomastus sp.	P	1	0	0	7	55	0	65	33	0	0	0	11	4	9	11	149	0	0	7	0	0	0	1	30	0	0	0	0	5	343
Monticellina sp.	P	0	0	8	0	697	0	0	6	0	8	0	0	0	3	0	24	0	0	1	0	0	0	3	45	0	0	0	0	0	6
Tubificoides wasselli	O	0	0	0	0	2	0	15	134	0	0	0	0	63	0	14	0	0	1	127	0	8	0	0	4	0	0	1	11	248	18
Scoletoma tenuis	P	0	1	0	73	49	0	1	2	0	41	0	0	0	74	112	13	0	0	43	0	0	0	7	65	0	0	0	3	6	63
Protohaustorius deichmannae	A	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	296	0	0	0	0	352	36	0	0	0	0
Scoloplos rubra	P	0	0	0	5	0	0	134	0	0	2	0	1	0	1	3	6	0	0	28	0	0	0	0	0	0	0	0	0	12	88
Tubificidae	O	0	0	1	0	85	0	1	6	0	2	0	15	0	70	233	21	0	0	24	0	0	0	2	0	0	0	0	0	35	61
Tharyx acutus	P	0	0	16	0	35	0	18	2	0	0	0	0	4	5	8	8	0	0	64	0	6	0	1	76	5	0	0	13	20	122
Tubificidae sp. B	O	0	0	9	0	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Mediomastus ambiseta	P	3	0	0	0	112	0	4	3	0	1	0	0	9	3	3	14	0	0	7	0	0	0	0	3	0	0	0	0	3	49
Parapionosyllis sp.	P	0	0	0	0	2	0	0	39	5	0	0	0	0	1	64	1	0	0	4	0	0	0	0	1	0	0	0	3	2	3
Tubificidae sp. A	O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polydora cornuta	P	0	0	0	0	0	0	8	0	0	0	0	2	0	0	0	143	0	0	0	0	0	1	1	0	0	0	0	5	4	4
Cirratulidae	P	0	0	1	1	58	0	1	0	0	0	0	0	0	13	2	0	0	0	13	2	5	0	3	61	0	0	0	0	1	64
Cyathura burbancki	O	0	0	0	0	33	1	8	0	0	2	3	2	0	69	3	11	0	0	18	0	0	0	0	11	0	0	0	0	12	11
Sabellaria vulgaris	P	0	0	0	0	0	0	0	0	0	0	0	2	0	51	19	0	0	0	88	0	0	0	2	0	0	0	0	3	1	0
Streptosyllis sp.	P	0	0	0	0	0	0	1	7	18	0	0	0	7	10	17	0	0	1	35	0	0	0	1	5	0	0	0	0	38	2
Tubificoides brownae	O	3	0	0	0	2	0	5	7	0	0	0	0	7	2	0	2	0	0	1	0	1	0	0	3	0	0	0	0	4	5
Unciola serrata	A	0	0	0	0	0	0	0	29	0	0	0	0	0	83	41	0	0	0	74	0	0	0	1	0	0	0	0	0	0	0
Aricidea wassi	P	0	0	16	0	24	0	0	19	0	0	0	0	13	0	0	0	0	2	1	0	0	0	6	12	2	7	0	16	54	0
Cirrophorus sp.	P	1	0	2	0	1	0	0	6	0	0	0	0	5	10	0	55	0	0	39	0	10	0	1	0	0	0	0	0	16	5
Carinomella lactea	O	0	0	0	0	8	0	0	1	0	0	0	0	0	2	17	11	0	0	0	0	0	0	1	1	0	0	0	0	0	2
Spiochaetopterus costarum oculatus	P	0	0	0	17	0	0	0	0	0	56	0	0	0	0	0	50	0	0	1	0	0	0	0	0	0	0	0	0	1	24
Nemertinea	O	1	2	2	0	5	6	1	3	4	0	13	1	4	17	15	1	3	0	6	0	5	0	1	1	1	6	0	0	1	3
Tellina agilis	M	0	0	0	2	54	0	0	39	0	0	0	0	4	0	0	14	0	0	0	0	0	0	0	8	4	9	0	0	0	1
Pelecypoda	M	0	0	0	0	1	1	0	10	2	0	11	25	0	35	9	1	0	3	4	0	5	0	16	3	0	0	0	0	7	1
Turbonilla sp.	M	0	0	0	0	0	0	2	110	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mediomastus californiensis	P	0	0	0	0	2	0	5	1	0	0	0	0	0	0	23	55	0	0	0	0	0	0	10	2	0	0	0	0	0	3
Rhepoxynius hudsoni	A	0	0	6	0	27	0	0	4	0	0	0	0	0	0	0	0	0	0	0	60	0	0	0	6	19	0	0	0	0	0
Prionospio sp.	P	0	0	0	0	46	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Paraprionospio pinnata	P	0	0	0	5	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	0	0	0
Clymenella torquata	P	0	0	0	1	2	0	0	41	0	0	0	0	0	79	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Pinnixa sp.	O	0	0	21	0	1	0	0	31	0	0	0	0	0	0	0	21	0	0	0	2	0	0	1	1	0	0	0	0	0	3
Chiridotea stenops	O	0	152	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nereis succinea	P	0	0	0	2	1	0	10	0	0	1	1	23	0	4	6	0	0	0	12	0	0	0	0	0	0	0	0	0	4	0
Corophium aquafuscum	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heteromastus filiformis	P	2	0	6	3	1	0	15	15	0	1	9	1	1	2	0	0	0	6	0	0	0	1	0	2	0	0	4	0	0	2
Maera caroliniana	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Podarkeopsis levifuscina	P	0	0	0	1	3	0	5	0	0	0	0	0	0	19	8	1	0	0	12	0	0	0	1	4	0	0	0	0	7	5
Nucula sp.	M	0	0	0	2	0	0	2	7	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	0	81
Enchytraeidae	O	0	0	0	0	0	0	0	8	20	0	0	0	0	55	14	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Glycera americana	P	0	0	1	4	9	0	5	2	0	1	0	0	0	6	1	10	0	0	2	0	0	0	2	5	0	0	0	1	1	5
Lepidactylus dytiscus	A	0	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	0	0	0	0	0	0	0	0
Tubificoides heterochaetus	O	0	0	0	0	0	11	0	0	0	0	14	1	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0
Tellinidae	M	2	0	0	2	2	0	2	0	0	0	0	0	0	0	0	5	0	2	0	0	0	0	2	0	4	0	0	14	30	1
Ampelisca verrilli	A	0	0	0	2	0	0	0	0	0	6	0	0	0	0	1	12	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Corophium simile	A	0	0	0	0	0	0	1	0	0	0	0	0	0	69	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Biffarius biformis	O	3	0	48	0	2	0	0	0	0	1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	2	0	0	0	0	0
Percent of total abundance		82	77	81	73	88	59	89	87	71	66	84	84	90	93	91	85	45	86	93	89	76	87	54	96	94	55	81	92	91	92
Mean total abundance (#/0.04m^2)		14	142	88	113	771	46	201	432	41	99	53	81	68	454	1076	602	15	11	514	205	58	28	94	453	207	54	43	230	605	765
Mean density (#/m^2)		350	3550	2200	2813	19263	1150	5025	10788	1025	2463	1325	2013	1688	11350	26888	15038	363	275	12838	5113	1438	688	2338	11313	5175	1350	1075	5750	15113	19113
Mean number of species (#/0.04m^2)		8	7	20	28	47	7	28	45	12	15	12	14	12	38	49	47	5	7	40	17	13	3	26	30	14	12	6	16	46	51
H' - diversity		2.72	1.38	3.45	3.71	3.32	2.13	3.39	4.31	2.74	2.72	2.78	2.92	2.69	4.15	3.25	3.73	1.91	2.68	3.93	1.55	2.9	0.71	3.81	2.23	1	2.81	1.78	2.19	3.56	3.93
J' - diversity		0.94	0.49	0.81	0.77	0.6	0.79	0.73	0.79	0.8	0.71	0.8	0.77	0.76	0.79	0.58	0.68	0.89	0.96	0.75	0.38	0.84	0.45	0.82	0.44	0.27	0.8	0.72	0.55	0.64	0.7

SCECAP 2000 - Tidal Creeks
Dominant Benthic Taxa

Species Name	Higher taxa	RT00501	RT00502	RT00503	RT00504	RT00505	RT00517	RT00518	RT00519	RT00520	RT00521	RT00523	RT00525	RT00526	RT00528	RT00530	RT00531	RT00541	RT00542	RT00543	RT00544	RT00545	RT00546	RT00547	RT00548	RT00549	RT00550	RT00554	RT00556	RT00557	RT00558
Streblospio benedicti	P	10	0	27	293	142	25	284	100	190	36	91	127	0	2	8	0	154	90	45	177	0	1	36	46	17	13	1	9	20	176
Ampelisca abdita	A	0	0	12	16	964	0	0	17	0	132	1	5	0	0	1	0	1	0	6	0	0	0	9	0	0	0	0	22	16	4
Scoletoma tenuis	P	0	0	68	66	31	5	65	9	6	15	39	11	0	0	34	0	22	14	7	1	0	11	140	121	0	4	0	3	23	2
Tubificoides wasselli	O	546	0	0	9	0	0	0	0	20	0	0	1	0	0	0	0	15	36	0	4	0	0	0	0	0	4	0	0	0	61
Polydora cornuta	P	1	1	0	89	10	0	21	0	4	9	117	1	0	0	0	0	33	19	5	0	0	3	4	1	8	0	0	14	4	71
Tharyx acutus	P	2	0	1	72	1	10	0	0	14	0	4	15	0	0	0	0	20	17	1	32	0	60	17	3	0	0	0	37	1	2
Tubificoides brownae	O	1	14	0	58	7	0	24	64	7	19	3	0	0	0	11	1	2	25	18	0	0	1	0	7	2	2	0	20	63	0
Mediomastus ambiseta	P	3	0	19	6	68	14	0	3	32	33	4	10	0	0	31	0	22	23	10	25	0	19	27	0	0	2	0	4	0	0
Mediomastus sp.	P	5	0	26	0	109	1	2	5	42	14	0	6	0	0	48	0	35	10	2	8	0	0	3	0	0	6	0	2	4	34
Heteromastus filiformis	P	0	0	2	5	35	0	9	0	2	49	9	5	0	10	0	6	1	11	5	0	0	0	11	18	1	0	1	3	1	19
Cirratulidae	P	4	0	22	17	3	10	0	0	14	4	0	10	0	0	1	0	6	27	0	9	0	42	5	6	0	1	0	2	0	0
Scoloplos rubra	P	8	0	0	26	62	27	0	0	1	3	8	16	0	0	3	4	1	1	2	0	0	8	0	3	0	8	0	1	4	53
Tubificidae	O	0	3	16	5	0	2	0	2	24	13	0	6	0	5	102	1	0	1	0	5	0	0	0	6	1	5	0	7	3	6
Caulleriella sp.	P	90	0	0	0	0	20	0	1	6	0	0	0	0	0	0	0	1	0	0	14	0	34	0	0	0	0	0	0	0	0
Aricidea wassi	P	0	0	0	0	0	54	0	0	0	0	0	0	0	0	0	0	0	0	0	109	0	64	0	0	0	0	0	0	0	0
Spiochaetopterus costarum oculatus	P	0	0	38	5	0	2	2	1	2	0	1	4	0	0	3	0	0	0	13	0	0	3	30	0	0	0	0	0	1	0
Nereis succinea	P	1	0	0	18	0	0	5	1	0	1	7	0	0	5	0	0	2	0	1	0	0	0	0	1	24	0	1	14	1	8
Carinomella lactea	O	0	0	14	0	0	0	0	0	28	1	0	1	0	0	16	0	10	6	3	0	0	0	0	0	0	11	0	0	0	0
Ilyanassa obsoleta	M	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	14	2	0	0	0	0	0	0	0	0	46	4	0
Exogone sp.	P	0	0	0	6	0	0	1	0	95	7	0	0	0	0	1	0	9	0	2	0	0	0	0	0	0	0	0	0	0	0
Phoronida	O	0	0	1	0	0	0	0	0	1	0	0	2	0	0	2	0	0	0	0	0	0	0	7	0	0	5	0	0	0	0
Nemertinea	O	2	3	0	4	2	6	2	2	2	1	2	2	0	11	0	0	0	1	0	1	1	3	6	0	6	1	16	15	6	6
Tubificoides heterochaetus	O	0	0	0	0	0	0	0	0	0	0	0	0	108	2	0	0	0	0	0	0	0	0	0	0	1	0	24	0	0	0
Tellinidae	M	0	0	0	20	0	0	0	0	1	5	0	3	0	0	5	0	0	0	6	0	0	30	0	1	0	0	0	0	0	0
Cirrophorus sp.	P	2	0	0	22	0	8	0	0	0	0	0	7	0	0	0	0	1	5	0	26	0	37	1	0	0	0	0	0	0	0
Rhepoxynius hudsoni	A	0	0	0	0	0	37	0	0	0	0	0	1	0	0	0	0	0	0	0	64	0	20	0	0	0	0	0	0	0	0
Tellina agilis	M	0	0	11	0	0	45	0	0	0	0	0	0	0	0	0	0	2	5	0	33	1	3	15	0	0	0	0	0	1	0
Paraprionospio pinnata	P	0	0	4	0	0	0	0	32	3	4	0	1	0	0	4	1	0	0	7	0	0	0	1	3	0	2	5	0	3	0
Actiniaria	O	0	0	0	34	1	0	0	0	32	0	0	0	0	0	1	0	2	0	16	0	0	0	0	0	1	0	0	1	0	1
Pelecypoda	M	0	0	13	3	4	0	0	1	5	0	1	1	0	3	1	0	11	1	3	0	1	0	7	0	0	0	1	3	8	2
Melita nitida	A	0	0	0	25	0	0	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	6	2	0	0	3	2	4
Glycera americana	P	0	1	10	0	3	4	0	0	2	2	5	1	0	0	0	0	5	3	3	1	0	1	2	2	0	1	0	0	0	1
Monticellina sp.	P	0	0	0	0	0	0	0	0	3	0	0	0	0	0	34	0	0	0	0	0	0	0	0	0	0	3	0	0	0	6
Lepidactylus dytiscus	A	0	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brania sp.	P	0	0	0	37	1	0	0	0	16	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7
Leptonacea sp.	M	0	0	60	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0
Streptosyllis sp.	P	3	5	0	0	0	0	0	5	14	0	0	0	0	0	0	0	0	5	0	2	0	0	0	0	0	0	0	0	0	13
Notomastus lineatus	P	0	0	60	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Percent of total abundance		99	92	69	84	95	86	98	84	72	88	95	93	99	72	83	45	79	98	92	94	6	89	83	91	66	60	91	86	71	72
Mean total abundance (#/0.04m^2)		342	49	291	501.5	756.5	157	211.5	145.5	398.5	200.5	154	128	54.5	26.5	184.5	14.5	224.5	160	85	271.5	24.5	191	194.5	123.5	48	58.5	27	120	117	332
Mean density (#/m^2)		8550	1225	7275	12538	18913	3925	5288	3638	9963	5013	3850	3200	1363	663	4613	363	5613	4000	2125	6788	613	4775	4863	3088	1200	1463	675	3000	2925	8300
Mean number of species (#/0.04m^2)		13	8	34	33	25	19	11	20	47	29	16	21	2	9	28	7	29	18	19	22	9	26	24	15	10	23	8	22	22	34
H' - diversity		1.12	1.44	4.23	3.36	1.86	3.45	1.6	2.9	4.07	3.43	2.48	2.81	0.05	2.77	3.5	2.44	3.42	3.13	3.42	2.93	2.63	3.55	3.33	2.41	2.65	3.87	2.18	3.65	3.36	3.49
J' - diversity		0.31	0.52	0.83	0.68	0.4	0.81	0.47	0.68	0.74	0.71	0.62	0.64	0.05	0.88	0.73	0.91	0.71	0.76	0.81	0.66	0.86	0.76	0.73	0.62	0.8	0.87	0.75	0.83	0.76	0.69

Appendix 4.2. Mean abundance of species comprising 95% of the total fauna collected in each habitat type by trawls during 1999 and 2000. Abundance represents the number of individuals per hectare.

SCECAP 1999 -- Open Water
Dominant Fish and Crustacean Taxa

Species Name	RO99302	RO99303	RO99304	RO99305	RO99306	RO99307	RO99308	RO99309	RO99310	RO99311	RO99312	RO99313	RO99315	RO99316	RO99317	RO99318	RO99319	RO99320	RO99321	RO99322	RO99323	RO99324	RO99325	RO99326	RO99327	RO99328	RO99329	RO99330
Stellifer lanceolatus	0	0	0	0	0	0	2149	0	18	0	0	0	0	22	0	4	0	0	0	0	0	0	0	0	0	156	0	0
Penaeus setiferus	0	51	0	0	0	94	0	4	7	0	0	98	1402	69	0	11	4	0	65	0	0	7	0	272	0	11	0	69
Bairdiella chrysoura	0	870	0	0	0	0	0	0	0	0	33	14	192	0	0	0	0	22	0	14	0	0	0	0	0	47	0	33
Lolliguncula brevis	0	43	188	4	7	0	7	0	7	0	36	0	14	0	43	43	0	207	0	40	46	149	80	4	7	7	54	43
Anchoa mitchilli	0	0	0	0	0	4	7	0	36	43	7	0	58	62	51	11	0	4	11	0	107	58	0	65	65	0	83	25
Cynoscion regalis	0	65	0	0	0	4	134	0	7	0	33	0	0	0	7	7	0	0	0	0	4	0	0	7	0	54	0	0
Penaeus aztecus	0	25	4	4	0	29	4	11	7	4	22	22	0	0	4	29	0	0	0	11	0	4	0	0	0	0	0	54
Leiostomus xanthurus	0	7	0	0	0	7	0	7	0	0	25	0	14	4	18	4	0	4	4	0	18	58	0	0	4	0	0	11
Anchoa hepsetus	0	4	0	76	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	25	7	0	33	0	0	0	0	4
Chaetodipterus faber	0	36	0	0	7	0	0	0	4	0	0	18	11	0	0	0	0	7	0	0	0	0	0	0	0	43	0	7
Lagodon rhomboides	0	0	0	0	36	0	0	0	0	0	40	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	14
Micropogonias undulatus	0	18	0	0	0	7	36	0	0	0	4	0	0	0	0	0	0	4	0	7	0	0	0	4	0	7	0	0
Callinectes similis	0	14	0	0	0	0	4	0	0	0	0	0	0	0	0	14	0	0	4	0	0	4	0	4	4	11	0	0
Selene setapinnis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	0	0	0	0
Percent of total abundance	n/a	97	95	79	87	91	99	100	86	81	96	98	98	96	97	89	33	92	68	77	93	92	89	99	81	94	97	92
Mean total abundance (#/hectare)	0	1167	203	105	58	159	2362	22	101	58	207	156	1725	163	130	138	11	268	123	127	196	304	127	413	98	359	141	283
Mean total biomass (#/hectare)	0	6.91	2.05	0.24	2.34	2.08	9.43	0.40	0.52	0.23	2.43	1.49	10.61	0.62	1.99	1.37	0.11	1.72	1.00	2.17	1.54	2.11	5.21	3.54	1.29	3.13	1.01	3.24
Mean number of species (#/trawl)	0	11.0	3.0	3.5	2.5	6.5	7.0	1.5	7.5	3.0	8.0	4.0	8.0	4.5	4.5	7.5	1.0	6.5	6.0	6.5	5.5	7.0	2.5	5.5	4.5	9.0	2.5	11.0
H' -- Diversity	0	1.64	0.51	1.51	1.55	2.05	0.60	1.46	2.92	1.31	2.93	1.62	1.07	1.81	2.12	2.97	0.92	1.37	2.16	2.94	1.95	2.18	1.28	1.54	1.83	2.54	1.12	3.12
J' -- Evenness	0	0.42	0.22	0.54	0.77	0.62	0.19	0.92	0.84	0.56	0.88	0.70	0.31	0.70	0.75	0.83	0.92	0.43	0.72	0.85	0.65	0.63	0.81	0.51	0.61	0.74	0.70	0.82
Species richness	0	2.42	0.99	1.78	1.08	2.38	1.23	1.12	3.00	1.44	2.23	1.06	1.62	1.31	1.67	3.02	0.91	1.86	1.99	2.81	1.75	2.26	0.56	1.48	2.12	2.18	0.55	2.98

SCECAP 1999 -- Tidal Creeks
Dominant Fish and Crustacean Taxa

Species Name	RT99001	RT99003	RT99004	RT99005	RT99006	RT99007	RT99008	RT99009	RT99010	RT99012	RT99013	RT99017	RT99019	RT99021	RT99022	RT99024	RT99026	RT99027	RT99028	RT99029	RT99030	RT99036	RT99037	RT99038	RT99039	RT99040
Penaeus setiferus	0	22	297	14	283	536	0	312	993	906	268	36	1703	123	196	775	0	0	14	109	652	0	0	43	29	1493
Penaeus aztecus	152	601	0	7	0	0	43	0	0	0	478	0	0	43	14	0	1826	22	0	0	0	94	0	7	14	0
Bairdiella chrysoura	7	14	29	275	0	116	551	7	36	14	159	43	29	87	29	254	14	116	0	29	420	232	0	58	7	51
Leiostomus xanthurus	7	355	65	14	14	29	101	319	29	0	188	29	58	43	29	0	442	80	0	0	36	0	0	7	22	14
Anchoa mitchilli	0	14	0	0	159	22	94	109	14	7	0	51	65	29	58	290	22	101	145	0	312	14	0	196	0	0
Lolliguncula brevis	0	51	58	101	7	0	210	7	0	14	7	0	29	43	14	0	87	145	43	0	29	14	0	72	7	109
Cynoscion regalis	0	43	14	0	0	0	7	87	0	0	72	0	0	0	0	0	123	0	0	0	0	14	0	0	0	7
Lagodon rhomboides	0	0	29	0	14	43	29	0	0	0	0	58	7	0	0	0	58	65	0	0	0	14	7	0	0	0
Trinectes maculatus	43	65	0	0	0	0	0	0	0	36	87	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0
Micropogonias undulatus	36	58	0	0	7	0	0	36	0	0	43	0	0	0	0	0	7	0	0	29	0	7	0	0	0	0
Percent of total abundance	94	93	83	79	93	94	97	97	99	99	97	75	100	91	84	99	100	99	76	100	97	93	50	72	75	97
Mean total abundance (#/hectare)	261	1312	594	522	522	790	1065	906	1080	993	1326	290	1891	406	406	1333	2587	536	268	167	1493	420	14	536	145	1725
Mean total biomass (#/hectare)	4.80	16.41	5.22	7.87	4.47	7.76	7.01	5.43	11.42	6.58	12.88	6.29	10.15	1.72	3.57	6.93	15.41	2.96	1.64	3.80	14.48	10.20	0.72	6.58	2.88	15.36
Mean number of species (#/trawl)	4.5	12.0	9.0	7.0	6.5	7.0	8.0	8.0	3.0	4.5	8.5	9.0	4.5	6.0	8.5	4.0	7.5	5.5	6.0	3.0	6.5	5.5	1.0	10.0	6.5	6.5
H' -- Diversity	1.85	2.39	2.55	2.06	1.86	1.66	2.13	2.27	0.55	0.61	2.57	3.11	0.67	2.79	2.56	1.47	1.43	2.49	2.06	1.28	1.95	2.06	1.00	3.04	2.95	0.89
J' -- Evenness	0.66	0.65	0.71	0.69	0.56	0.52	0.67	0.66	0.24	0.24	0.77	0.90	0.26	0.84	0.74	0.63	0.45	0.89	0.73	0.81	0.62	0.65	1.00	0.80	0.93	0.27
Species richness	1.67	2.31	2.50	1.64	2.10	1.71	1.60	2.07	0.80	1.02	1.73	2.71	0.90	2.24	2.48	0.77	1.36	1.39	1.66	0.64	1.50	1.97	1.44	3.02	2.67	1.64

SCECAP 2000 -- Open Water
Dominant Fish and Crustacean Taxa

Species Name	RO00006	RO00007	RO00008	RO00009	RO00010	RO00015	RO00016	RO00017	RO00018	RO00019	RO00020	RO00021	RO00022	RO00023	RO00024	RO00033	RO00034	RO00035	RO00036	RO00037	RO00045	RO00046	RO00047	RO00048	RO00049	RO00055	RO00056	RO00057	RO00058	RO00059
Micropogonias undulatus	163	0	0	0	0	7	14	1058	4	0	7	11	0	0	4	0	33	4	4	0	4	69	11	4	0	0	33	0	22	0
Stellifer lanceolatus	51	0	0	0	0	446	0	14	0	0	0	7	254	0	0	0	0	232	0	0	0	326	0	0	0	0	0	0	0	0
Penaeus aztecus	467	0	36	4	0	4	112	373	33	4	62	22	4	0	0	0	0	51	0	7	4	11	22	0	0	0	11	4	25	0
Penaeus setiferus	163	0	0	0	0	54	33	4	0	4	301	127	0	0	0	0	22	4	0	0	0	192	0	0	0	0	33	319	0	0
Anchoa mitchilli	0	0	11	562	0	0	29	4	0	0	80	0	0	0	0	250	0	0	0	0	11	0	11	0	0	0	0	0	14	0
Lolliguncula brevis	25	0	25	181	0	0	105	36	4	105	0	22	0	7	11	4	0	22	47	7	22	0	25	0	29	25	7	33	25	116
Cynoscion regalis	25	0	0	0	0	91	14	167	7	0	65	62	4	7	43	0	83	47	4	4	25	4	4	0	0	0	11	7	36	0
Leiostomus xanthurus	87	7	0	11	0	4	58	7	0	178	0	0	0	0	0	4	0	22	0	0	7	0	18	0	0	0	29	4	109	4
Bairdiella chrysoura	11	0	0	0	0	4	58	0	0	0	0	0	0	4	0	14	58	0	7	7	0	0	11	0	0	22	47	4	11	0
Callinectes sapidus	11	0	0	4	0	80	4	0	4	0	7	4	0	0	0	7	69	43	0	0	0	18	0	0	0	0	0	0	0	0
Callinectes similis	4	0	0	0	0	4	25	62	0	0	4	7	0	0	0	7	0	0	0	0	0	11	4	0	0	0	4	0	4	0
Chaetodipterus faber	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	4	0	0	0	0	11	0	22	0	0
Trinectes maculatus	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	62	4	0	0	0	0	0	0	0	4	4	4	0	0
Percent of total abundance	98	8	95	100	n/a	95	93	98	100	93	100	100	100	83	94	99	100	96	89	64	87	96	94	100	50	50	98	99	99	82
Mean total abundance (#/hectare)	1101	87	76	761	0	725	489	1779	51	312	525	261	261	22	62	290	330	449	69	40	87	659	112	4	58	123	181	399	250	145
Mean total biomass (#/hectare)	18.72	18.62	0.62	1.84	0	10.68	6.63	23.37	0.41	5.84	2.97	2.50	0.71	0.99	1.84	1.75	2.27	3.83	0.69	1.62	1.32	3.45	1.14	0.11	0.33	6.07	1.21	4.71	3.90	1.06
Mean number of species (#/trawl)	12.5	2.0	3.0	4.0	0	8.5	12.0	12.0	3.0	4.5	6.5	6.5	2.0	2.5	3.0	4.5	6.0	9.5	3.5	4.0	5.5	6.5	6.5	0.5	1.5	6.0	7.0	6.0	7.5	3.0
H' -- Diversity	2.65	1.04	1.65	0.98	0	1.90	3.24	1.88	1.63	1.51	1.83	2.16	0.21	1.92	1.28	0.90	2.53	2.40	1.61	2.91	2.76	1.97	2.99	0	1.00	2.76	2.83	1.20	2.51	1.03
J' -- Evenness	0.66	0.66	0.82	0.42	0	0.55	0.79	0.46	0.70	0.54	0.65	0.72	0.13	0.96	0.64	0.32	0.90	0.65	0.62	0.97	0.87	0.62	0.90	0	1.00	0.87	0.85	0.38	0.79	0.44
Species richness	2.62	0.63	0.99	0.75	0	1.89	3.26	2.58	1.52	1.35	1.21	1.64	0.47	1.67	1.06	1.37	1.33	2.49	1.70	2.92	2.52	1.54	2.62	0	0.36	2.27	2.30	1.70	1.89	1.08

SCECAP 2000 -- Tidal Creeks
Dominant Fish and Crustacean Taxa

Species Name	RT00501	RT00502	RT00503	RT00504	RT00505	RT00517	RT00518	RT00519	RT00520	RT00521	RT00523	RT00525	RT00526	RT00528	RT00530	RT00531	RT00541	RT00542	RT00543	RT00544	RT00545	RT00546	RT00547	RT00548	RT00549	RT00550	RT00554	RT00556	RT00557	RT00558
Penaeus setiferus	7	0	22	0	29	0	5159	0	7	36	594	0	275	0	319	0	0	29	0	0	0	7	101	181	420	0	22	1820	652	22
Leiostomus xanthurus	7	0	174	22	7	29	174	22	0	0	87	0	0	196	36	29	7	135	94	51	0	22	181	2457	29	0	0	99	51	22
Bairdiella chrysoura	14	0	196	0	29	0	268	14	79	101	116	29	0	0	29	0	0	14	0	188	0	7	51	1065	14	0	0	280	72	239
Penaeus aztecus	0	0	14	0	0	0	0	36	0	72	188	14	72	797	65	0	0	7	22	72	0	7	65	341	210	0	0	8	43	22
Lolliguncula brevis	36	0	14	51	36	94	14	22	29	14	0	72	0	333	0	43	7	183	58	152	7	0	51	167	0	43	101	33	51	51
Anchoa mitchilli	167	0	0	246	43	87	159	7	0	116	14	0	0	0	0	0	36	14	268	58	0	0	36	58	0	0	36	16	51	36
Lagodon rhomboides	0	0	0	0	7	0	0	0	6	7	22	14	0	7	420	0	0	79	0	116	7	0	0	101	65	109	0	0	0	29
Callinectes sapidus	0	0	7	22	7	0	7	0	0	0	80	0	0	51	7	7	0	35	0	0	0	0	152	36	14	7	14	8	217	0
Callinectes similis	0	0	58	0	0	7	58	0	7	7	0	0	0	7	0	7	0	21	0	58	0	0	0	7	0	0	0	0	29	0
Eucinostomus gula	0	0	0	0	0	0	0	0	0	0	0	14	0	0	94	0	0	0	0	22	0	0	101	0	0	7	0	0	0	0
Micropogonias undulatus	14	0	0	0	0	0	43	0	0	0	14	7	29	43	0	0	0	0	22	0	0	7	14	7	14	0	0	8	0	0
Cynoscion regalis	0	0	29	0	7	0	7	0	0	0	0	0	7	7	0	0	0	0	36	0	0	0	0	0	14	0	72	0	0	0
Brevoortia tyrannus	0	0	0	0	0	0	0	0	0	0	0	0	0	130	0	0	0	0	0	0	0	0	7	0	7	0	0	0	0	0
Percent of total abundance	100	n/a	88	96	96	94	98	100	91	91	92	95	91	100	91	92	64	85	93	87	50	87	83	98	98	77	85	100	94	98
Mean total abundance (#/hectare)	246	0	587	355	174	232	6007	101	142	391	1210	159	420	1572	1065	94	80	606	536	826	29	58	913	4514	804	217	290	2273	1239	428
Mean total biomass (#/hectare)	0.71	0	8.15	3.03	1.60	1.60	46.34	1.09	5.33	2.71	21.03	1.01	4.01	19.62	12.37	0.95	1.83	7.50	6.04	17.54	0.54	1.64	18.58	28.36	8.98	13.48	2.79	17.36	16.39	2.30
Mean number of species (#/trawl)	3.5	0	10.5	5.0	5.5	4.0	11.5	3.0	3.5	7.5	11.0	4.5	5.0	7.0	10.5	3.5	3.5	12.0	6.5	13.0	2.0	3.0	15.0	11.5	7.5	6.5	4.5	6.0	11.0	5.5
H' -- Diversity	1.57	0	2.81	1.49	2.79	1.90	1.00	2.16	1.87	2.64	2.53	2.31	1.64	2.05	2.46	1.89	2.40	3.07	2.28	2.69	1.50	2.41	3.61	2.05	2.06	2.37	2.31	1.05	2.20	2.15
J' -- Evenness	0.61	0	0.72	0.58	0.88	0.74	0.24	0.93	0.72	0.80	0.65	0.82	0.58	0.65	0.69	0.81	0.86	0.77	0.72	0.62	0.95	0.93	0.82	0.54	0.60	0.71	0.89	0.35	0.58	0.72
Species richness	1.42	0	3.19	1.28	2.52	1.44	2.38	1.52	1.64	2.26	2.74	1.94	1.48	1.49	2.20	1.56	2.50	3.34	1.86	3.50	1.44	2.40	4.14	2.02	2.12	2.65	1.36	1.25	2.23	1.72

Appendix 4.3. Summary the average (mean), minimum, standard deviation, and method detection limits for all contaminant analytes measured in fish tissue (whole body) samples collected at sites sampled in 2000.

SCECAP 2000
Tissue contaminant summary: mean, maximum, standard deviation, and method detection limit for all analytes acoss all stations in 2000. Concentrations are expressed as wet weight. Units for metals are ug/g and for PAHs, PCBs and Pesticides are ng/g.

Class	Analyte	Mean	Maximum	Standard Deviation	Method Detection Limit
Metals	Aluminum*	18.509	36.163	7.651	0.070
Metals	Arsenic	1.209	4.282	0.773	0.001
Metals	Cadmium	0.001	0.024	0.004	0.000
Metals	Chromium*	0.306	0.954	0.178	0.009
Metals	Copper	0.741	2.347	0.380	0.004
Metals	Iron	34.663	64.131	8.947	0.179
Metals	Lead	0.092	0.927	0.128	0.001
Metals	Manganese	6.720	17.751	3.032	0.004
Metals	Mercury	0.001	0.012	0.002	0.005
Metals	Nickel	1.185	2.501	0.301	0.001
Metals	Selenium	0.212	0.561	0.090	0.011
Metals	Silver	0.000	0.000	0.000	0.007
Metals	Tin	0.012	0.633	0.085	0.002
Metals	Zinc	15.563	53.156	5.935	0.099
PAH	1,6,7 Trimethylnaphthalene	0.108	6.056	0.809	1.773
PAH	1-Methylnaphthalene*	0.314	7.386	1.354	3.808
PAH	1-Methylphenanthrene	0.000	0.000	0.000	3.517
PAH	2,6 Dimethylnaphthalene	0.512	7.915	1.696	3.546
PAH	2-Methylnaphthalene	1.050	18.044	3.164	5.232
PAH	Acenaphthene	0.000	0.000	0.000	6.134
PAH	Acenaphthylene	0.029	1.650	0.220	1.599
PAH	Anthracene*	1.398	78.293	10.462	3.285
PAH	Benzo(a)anthracene	0.213	11.918	1.593	7.238
PAH	Benzo(a)pyrene	0.000	0.000	0.000	9.186
PAH	Benzo(b)fluoranthene	0.203	11.356	1.517	5.610
PAH	Benzo(e)pyrene	0.141	7.911	1.057	4.243
PAH	Benzo(g,h,i)perylene	0.124	6.961	0.930	5.756
PAH	Benzo(j+k)fluoranthene	0.183	10.272	1.373	4.796
PAH	Biphenyl**	1.983	12.094	3.526	5.989
PAH	Chrysene+Triphenylene	0.315	17.631	2.356	2.064
PAH	Dibenz(a,h+a,c)anthracene	0.000	0.000	0.000	1.541
PAH	Dibenzothiophene	0.060	1.363	0.227	0.184
PAH	Fluoranthene	0.491	22.895	3.110	4.040
PAH	Fluorene	0.318	14.565	1.987	2.646
PAH	Indeno(1,2,3-cd)pyrene	0.000	0.000	0.000	8.926
PAH	Naphthalene	0.000	0.000	0.000	9.535
PAH	PAH_Total	8.231	228.244	30.620	
PAH	Perylene	0.000	0.000	0.000	5.350
PAH	Phenanthrene	0.526	24.622	3.341	3.168
PAH	Pyrene	0.262	11.693	1.606	2.965
PCB	PCB 101	0.171	1.093	0.211	0.022
PCB	PCB 104	0.000	0.000	0.000	0.022
PCB	PCB 105	0.038	0.247	0.051	0.027
PCB	PCB 118	0.158	0.867	0.154	0.015
PCB	PCB 126	0.001	0.029	0.004	0.029
PCB	PCB 128	0.040	0.278	0.057	0.015

Class	Analyte	Mean	Maximum	Standard Deviation	Method Detection Limit
PCB	PCB 138	0.237	3.073	0.443	0.039
PCB	PCB 153	0.839	7.336	1.058	0.022
PCB	PCB 154	0.248	1.296	0.242	0.022
PCB	PCB 170	0.087	0.932	0.158	0.034
PCB	PCB 18	0.038	0.083	0.025	0.033
PCB	PCB 180	0.215	2.082	0.324	0.023
PCB	PCB 187	0.290	3.247	0.448	0.011
PCB	PCB 188	0.000	0.000	0.000	0.022
PCB	PCB 195	0.006	0.146	0.022	0.026
PCB	PCB 201	0.035	0.701	0.095	0.022
PCB	PCB 206	0.147	3.743	0.495	0.021
PCB	PCB 209	0.043	0.736	0.105	0.022
PCB	PCB 28	0.050	0.157	0.053	0.043
PCB	PCB 29	0.031	0.190	0.034	0.022
PCB	PCB 44	0.042	0.121	0.022	0.011
PCB	PCB 50	0.072	0.176	0.034	0.022
PCB	PCB 52	0.137	0.377	0.093	0.015
PCB	PCB 66	0.085	0.425	0.086	0.013
PCB	PCB 77	0.090	0.845	0.220	0.329
PCB	PCB 8	0.151	0.349	0.043	0.028
PCB	PCB 87	0.021	0.147	0.037	0.022
PCB	PCB Total	3.273	27.496	3.950	
Pesticide	2,4'-DDD	0.004	0.067	0.012	0.013
Pesticide	2,4'-DDE	0.009	0.100	0.022	0.013
Pesticide	2,4'-DDT	0.000	0.000	0.000	0.032
Pesticide	4,4'-DDD	0.103	0.607	0.121	0.053
Pesticide	4,4'-DDE	1.632	17.679	2.308	0.007
Pesticide	4,4'-DDT	0.012	0.302	0.052	0.003
Pesticide	Aldrin	0.000	0.009	0.001	0.003
Pesticide	Chlorpyrifos	0.190	1.392	0.278	0.022
Pesticide	Cis-chlordane (alpha-chlordane)	0.000	0.026	0.004	0.018
Pesticide	DDT Total	1.760	18.129	2.385	
Pesticide	Dieldrin	0.099	0.815	0.119	0.040
Pesticide	Endosulfan ether	0.002	0.057	0.009	0.022
Pesticide	Endosulfan I	0.018	0.347	0.058	0.022
Pesticide	Endosulfan II	0.004	0.146	0.022	0.022
Pesticide	Endosulfan Lactone	0.000	0.000	0.000	0.022
Pesticide	Endosulfan Sulfate	0.138	1.718	0.295	0.022
Pesticide	Gamma-HCH (g-BHC, lindane)	0.031	0.075	0.018	0.017
Pesticide	Heptachlor	0.028	0.120	0.018	0.009
Pesticide	Heptachlor epoxide	0.015	0.195	0.034	0.022
Pesticide	Hexachlorobenzene	0.011	0.108	0.017	0.014
Pesticide	Mirex	0.162	3.351	0.543	0.034
Pesticide	Trans-nonachlor	0.074	0.798	0.108	0.021

*Recovery rates for these analytes were low. Actual values are probably higher than indicated by this dataset.

**Recovery rates for these analytes were high. Actual values are probably lower than indicated by this dataset.

Appendix 4.4. Listing of fish species collected for contaminant analyses and contaminant levels found. Contaminant values exceeding the 90th percentile of the entire database are also summarized.

SCECAP 2000 -- Open Water
Tissue Contaminant Levels

	Fish Characteristics			Total Contaminants by Class*				90th Percentile** Exceedences					
Station	Fish Species	Mean Length	N	Metals ug/g	PAHs ng/g	DDTs ng/g	PCBs ng/g	Total	Metals	PAHs	PCBs	Pest	Develop
RO00006	spot	2.3	1	72.32	0.00	2.78	5.17	12	1	0	7	4	R<1
RO00007	spot	1.7	0	81.59	6.47	1.04	3.85	3	2	0	1	0	I>1
RO00008	weakfish	0.9	1	76.19	9.11	1.13	1.76	6	2	1	0	3	R>1
RO00009	spot	2.6	1	62.60	23.03	2.53	3.75	12	0	5	2	5	I>1
RO00015	spot	1.4	0	89.04	0.00	3.46	5.76	17	2	0	9	6	I>1
RO00016	spot	1.9	2	92.18	0.12	0.63	1.40	5	5	0	0	0	R<1
RO00017	atlantic croaker	2.5	1	83.49	0.00	1.12	1.70	6	4	0	0	2	R>1
RO00018	atlantic croaker	2.3	0	90.55	0.00	0.76	1.54	2	1	0	0	1	NDV
RO00019	spot	2.2	1	77.85	0.00	1.23	1.66	0	0	0	0	0	R<1
RO00020	atlantic croaker	2.1	1	71.44	0.00	1.63	5.73	13	0	0	11	2	I>1
RO00021	atlantic croaker	2.6	1	84.46	7.65	1.40	2.59	1	0	1	0	0	NDV
RO00022	weakfish	1.4	0	85.01	16.42	0.78	0.99	4	2	2	0	0	R<1
RO00023	atlantic croaker	2.1	0	56.46	16.82	1.89	4.78	11	1	2	4	4	R>1
RO00024	atlantic croaker	2.8	0	73.65	0.00	0.87	1.73	4	2	0	0	2	R<1
RO00033	spot	2.3	0	64.73	0.00	1.24	4.65	6	1	0	4	1	R<1
RO00034	atlantic croaker	2.2	2	75.68	0.00	2.11	4.43	8	0	0	7	1	NDV
RO00035	spot	2.4	1	72.13	0.00	3.40	2.40	2	0	0	0	2	R>1
RO00036	atlantic croaker	2.5	0	89.05	15.33	1.69	1.77	8	4	2	0	2	R>1
RO00037	weakfish	1.9	0	77.64	0.00	0.70	1.28	2	1	0	1	0	R>1
RO00045	spot	1.9	1	74.81	7.84	1.94	2.07	6	1	3	2	0	R<1
RO00046	atlantic croaker	2.0	2	73.44	12.16	2.13	5.90	13	1	1	10	1	NDV
RO00047	spot	2.1	1	78.72	0.00	1.33	1.61	2	1	0	0	1	R>1
RO00048	spot	2.7	0	70.31	0.00	2.94	4.28	6	0	0	2	4	R<1
RO00055	silver perch	4.8	1	50.51	7.10	0.97	2.28	5	3	0	0	2	R>1
RO00056	spot	1.6	2	67.75	228.24	2.57	11.85	35	1	13	18	3	I<1
RO00057	spot	3.0	0	69.13	0.00	18.13	2.79	4	0	0	0	4	R<1
RO00058	spot	2.4	4	94.85	0.00	2.19	2.86	8	3	0	4	1	R>1
RO00059	spot	2.3	0	78.72	0.00	0.63	1.22	1	1	0	0	0	R<1
90th percentile**				98.13	15.29	2.67	5.74						

*all contaminants are expressed as wet weight

**90th percentile is based on all open water and tidal creek stations. Shading represents stations that exceed the 90th percentile.

† development code: NDV, no development visible. R>1, residential development > 1 km away. R<1, residential development < 1 km away.
I>1, industrial development > 1 km away. I<1, industial development < 1 km away

SCECAP 2000 -- Tidal Creeks
Tissue Contaminant Levels

	Fish Characteristics			Total Contaminants by Class*				90th Percentile** Exceedences					
Station	Fish Species	Mean Length (cm)	N	Metals ug/g	PAHs ng/g	DDTs ng/g	PCBs ng/g	Total	Metals	PAHs	PCBs	Pest	Develop
RT00501	spot	2.2	0	78.06	0.00	0.42	1.05	1	0	0	0	1	NDV
RT00503	spot	2.0	1	68.63	0.00	2.36	2.46	1	1	0	0	0	R<1
RT00504	spot	2.0	1	84.33	6.61	1.17	1.38	6	0	0	1	5	R<1
RT00505	silver perch	2.6	1	71.16	0.00	1.97	3.08	6	1	0	0	5	NDV
RT00517	spot	0.9	1	64.29	0.00	0.63	1.15	0	0	0	0	0	NDV
RT00518	spot	2.1	2	98.43	0.00	1.62	1.07	1	0	0	1	0	R>1
RT00519	spot	2.4	1	67.59	0.23	1.71	2.03	5	3	1	0	1	R<1
RT00520	silver perch	4.2	1	65.00	14.47	1.35	3.14	6	0	2	0	4	R<1
RT00521	silver perch	1.5	8	71.33	12.09	0.95	1.70	2	1	1	0	0	NDV
RT00523	spot	1.9	2	91.30	0.00	0.59	0.87	2	2	0	0	0	R<1
RT00525	spot	1.9	1	93.05	0.20	0.36	1.01	4	3	1	0	0	NDV
RT00526	atlantic croaker	1.3	1	74.60	15.24	2.26	8.13	23	2	2	12	7	R<1
RT00528	spot	1.6	6	117.72	5.95	0.71	0.80	4	4	0	0	0	NDV
RT00530	spot	1.8	1	77.79	5.03	0.64	1.73	2	0	1	1	0	NDV
RT00531	spot	1.6	1	64.43	0.00	1.70	5.63	6	0	0	6	0	R<1
RT00541	spot	2.2	0	62.58	0.00	0.46	0.91	1	0	0	0	1	R>1
RT00542	spot	1.6	4	72.12	0.00	1.47	2.49	0	0	0	0	0	R<1
RT00543	spot	2.1	2	124.53	8.39	0.79	1.38	4	2	1	0	1	R>1
RT00544	spot	2.0	1	116.83	0.00	1.04	4.17	7	2	0	3	2	R<1
RT00546	spot	2.4	0	83.14	5.69	0.69	1.39	2	2	0	0	0	R>1
RT00547	spot	1.7	2	74.98	0.00	0.99	1.52	1	1	0	0	0	NDV
RT00548	spot	1.4	16	97.82	5.20	0.77	1.38	6	2	1	0	3	R>1
RT00549	spot	1.4	2	86.49	0.00	1.77	8.02	13	0	0	13	0	R<1
RT00550	silver perch	3.7	0	53.90	25.43	4.40	27.50	29	2	2	18	7	R<1
RT00554	spot	1.0	0	105.59	0.00	0.90	1.15	8	2	0	1	5	I>1
RT00556	spot	2.5	2	75.64	0.00	1.20	1.57	4	2	0	0	2	R<1
RT00557	spot	1.8	2	61.47	0.21	1.82	4.14	9	1	1	6	1	R>1
RT00558	spot	2.0	1	98.85	5.92	0.61	0.63	2	1	0	1	0	R<1
90th percentile				98.13	15.29	2.67	5.74						

*all contaminants are expressed as wet weight

**90th percentile is based on all open water and tidal creek stations. Shading represents stations that exceed the 90th percentile.

† development code: NDV, no development visible. R>1, residential development > 1 km away. R<1, residential development < 1 km away.
I>1, industrial development > 1 km away. I<1, industial development < 1 km away

Appendix 5.1. Summary of integrated measures of water quality, sediment quality, and biological condition (based on the Benthic Index of Biological Integrity), and the overall integrated measure of habitat quality using a combination of the three measures. Station location information is also provided. Scores coding as green represent good conditions, yellow represents marginal conditions, and red indicates poor conditions. The actual values of the integrated scores are also shown to allow the reader to see where the values falls within the above general coding criteria. See text for further details on ranges of values representing good, marginal and poor for each integrated score.

SCECAP 1999 -- Open Water
Integrated Assessment

Station	Water Quality								Sediment Quality			Biological Condition	Overall	County	Location
	Dissolved Oxygen	Fecal Coliform	pH	Bio. Oxy. Demand	Total Nitrogen	Total Phosphorus	Integrated Score		Toxicity	Contaminants	Integrated Score	Benthic IBI	Integrated Score		
RO99301							5.0				5	4.0	4.7	Charleston	Off of Wando River in Nowell Creek
RO99302							3.8				4	3.0	3.6	Colleton	Upper Ashepoo River
RO99303							4.0				5	4.0	4.3	Beaufort	In Beaufort River off Parris Island
RO99304							4.2				5	4.5	4.6	Beaufort	Lower Okatie River
RO99305							5.0				5	4.5	4.8	Beaufort	Lower Chechesee River
RO99306							4.6				4	4.0	4.2	Georgetown	Lower Murrell's Inlet
RO99307							3.8				4	4.0	3.9	Georgetown	South Santee River near Highway 17 bridge
RO99308							5.0				5	4.0	4.7	Beaufort	Saint Helena Sound near Morgan Island
RO99309							4.3				4	3.5	3.9	Beaufort	Lower Coosaw River near Coosaw Island
RO99310							4.7				5	4.5	4.7	Beaufort	Beaufort River near Parris Island
RO99311							5.0				5	3.0	4.3	Charleston	Lower South Santee near Murphy Island
RO99312							5.0				4	4.0	4.3	Charleston	Kiawah River
RO99313							4.2				4	2.0	3.4	Beaufort	Whale Branch Creek
RO99315							3.8				5	4.0	4.3	Beaufort	Upper May River
RO99316							4.5				2	1.5	2.7	Georgetown	Winyah Bay near City of Georgetown
RO99317							4.7				5	4.0	4.6	Charleston	Near confluence of Folly River and Stono River
RO99318							4.7				5	4.5	4.7	Beaufort	Lower Morgan River
RO99319							4.2				4	4.0	4.1	Beaufort	Parrot Creek on Morgan Island
RO99320							5.0				4	4.5	4.5	Beaufort	Lower May River
RO99321							4.2				3	2.5	3.2	Georgetown	Winyah Bay
RO99322							4.7				3	3.0	3.6	Charleston	Charleston Harbor near Patriots Point
RO99323							5.0				4	4.0	4.3	Charleston	North Edisto River near mouth of Leadenwah Creek
RO99324							3.8				3	3.5	3.4	Beaufort	Buzzard Creek in Broad River
RO99325							4.2				5	4.5	4.6	Beaufort	Lower Chechesee River
RO99326							4.3				5	2.5	3.9	Georgetown	Winyah Bay near Marsh Island
RO99327							5.0				5	4.0	4.7	Charleston	Stono River
RO99328							4.7				5	4.5	4.7	Charleston	Lower South Edisto River near Saint Pierre Creek
RO99329							5.0				5	5.0	5.0	Beaufort	Beaufort River near City of Beaufort
RO99330							4.0				4	4.0	4.0	Beaufort	Upper Broad Creek on Hilton Head Island

SCECAP 1999 -- Tidal Creeks
Integrated Assessment

Station	Water Quality							Sediment Quality			Biological Condition	Overall	County	Location
	Dissolved Oxygen	Fecal Coliform	pH	Bio. Oxy. Demand	Total Nitrogen	Total Phosphorus	Integrated Score	Toxicity	Contaminants	Integrated Score	Benthic IBI	Integrated Score		
RT99001							3.7			3	2.5	3.0	Charleston	Lower Five Fathom Creek near Bull Bay in Key Creek
RT99002							5.0			5	3.5	4.4	Georgetown	Old Man Creek in North Inlet
RT99003							4.7			4	3.5	4.0	Beaufort	Old House Creek behind Hunting Island
RT99004							4.0			5	4.5	4.5	Charleston	Chapin Creek in Kiawah River
RT99005							3.4			3	3.0	3.1	Beaufort	In Beaufort River near City of Beaufort
RT99006							4.0			5	2.5	3.7	Horry	Near Little River, behind Waites Island
RT99007							3.3			4	3.0	3.4	Charleston	Creek on James Island in Clark Sound
RT99008							4.6			4	4.0	4.1	Beaufort	Small creek on Hunting Island
RT99009							3.3			2	1.0	2.1	Charleston	Bailey Creek in South Edisto River
RT99010							4.0			5	4.0	4.3	Beaufort	Tributary of Broad Creek On Hilton Head Island
RT99012							3.7			4	2.0	3.2	Beaufort	Station Creek on Saint Phillips Island
RT99013							4.7			4	4.0	4.1	Beaufort	Club Bridge Creek in front of St. Helena Island
RT99017							3.7			5	2.5	3.6	Charleston	Hobcaw Creek in Wando River
RT99019							4.7			5	3.5	4.2	Charleston	Ocella Creek in North Edisto River
RT99021							4.7			3	4.0	3.8	Charleston	Sol Legare Creek in Folly River
RT99022							4.3			5	3.0	4.1	Beaufort	Tributary of Broad Creek On Hilton Head Island
RT99024							4.7			5	3.0	4.1	Beaufort	Cole Creek in Broad River
RT99026							3.7			4	4.0	3.9	Charleston	Dupre Creek near McClellanville
RT99027							4.2			5	3.0	4.0	Charleston	Nowell Creek in Wando River
RT99028							4.7			4	4.0	4.1	Beaufort	Front of St Helena Island in tributary of Harbor River
RT99029							4.2			5	3.0	3.9	Charleston	Small creek in lower North Edisto
RT99030							4.0			4	4.5	4.1	Beaufort	Cowen Creek in Beaufort River
RT99036							4.3			3	3.5	3.5	Charleston	Alligator Creek near Cape Romain Harbor
RT99037							3.0			5	2.5	3.5	Charleston	Guerin Creek in upper Wando River
RT99038							3.7			5	3.0	3.9	Beaufort	Behind Pritchards Island in tributary of Trenchards Inlet
RT99039							4.3			5	4.0	4.4	Charleston	Privateer Creek in lower North Edisto River
RT99040							3.7			4	2.5	3.4	Beaufort	Cowen Creek in Beaufort River

SCECAP 2000 -- Open Water
Integrated Assessment

Station	Water Quality							Sediment Quality			Biological Condition	Overall	County	Location
	Dissolved Oxygen	Fecal Coliform	pH	Bio. Oxy. Demand	Total Nitrogen	Total Phosphorus	Integrated Score	Toxicity	Contaminants	Integrated Score	Benthic IBI	Integrated Score		
RO00006							4.3			3	3.5	3.6	Georgetown	Winyah Bay near the mouth
RO00007							4.6			5	4.0	4.5	Berkeley	Cooper River above Bushy Park
RO00008							5.0			4	4.0	4.3	Beaufort	Morgan River north of St Helena Island
RO00009							5.0			4	4.5	4.5	Beaufort	Port Royal in Battery Creek
RO00010							5.0			5	4.5	4.8	Beaufort	St Helena Sound in mouth of Beaufort River
RO00015							4.2			3	2.5	3.2	Georgetown	Waccamaw River just above Hwy 17 Bridge
RO00016							5.0			5	3.5	4.5	Charleston	South of McClellanville at intersection of ICW and Matthews Creek
RO00017							4.7			5	5.0	4.9	Colleton	St Helena Sound in mouth of Rock Creek
RO00018							5.0			5	3.5	4.5	Beaufort	Coosaw River just north of Morgan Island
RO00019							5.0			3	3.0	3.7	Beaufort	May River just down river from Bluffton
RO00020							4.6			3	3.5	3.7	Georgetown	Winyah Bay just below Georgetown
RO00021							5.0			3	3.0	3.7	Georgetown	Intracoastal Waterway just north of the North Santee River
RO00022							5.0			4	3.0	4.0	Colleton	South Edisto River just east of Pine Island
RO00023							5.0			5	5.0	5.0	Beaufort	Coosaw River behind Lady's Island
RO00024							5.0			5	4.5	4.8	Beaufort	Colleton River near Victoria Bluff
RO00033							5.0			5	4.5	4.8	Charleston	Charleston Harbor behind Crab Bank
RO00034							3.8			2	2.5	2.8	Georgetown	Great Pee Dee River just above confluence with Black River
RO00035							5.0			5	3.5	4.5	Charleston	Wadmalaw River near Bears Bluff
RO00036							5.0			5	5.0	5.0	Beaufort	Whale Branch north of Cotton Island
RO00037							5.0			5	3.0	4.3	Beaufort	Chechesse River at south tip of Daws Island
RO00045							4.7			5	3.5	4.4	Charleston	Stono River west of Ross Marine
RO00046							4.3			5	2.5	3.9	Colleton	Ashepoo River above SR 26 bridge
RO00047							5.0			5	4.5	4.8	Beaufort	Broad river near SW end of Hwy 170 bridge
RO00048							5.0			4	4.5	4.5	Beaufort	Beaufort River in mouth of Cowen Creek
RO00049							5.0			5	3.0	4.3	Beaufort	Chechesee River east of Daws Island
RO00055							4.7			5	3.5	4.4	Georgetown	North Inlet near mouth of Old Man Creek
RO00056							4.7			1	2.0	2.6	Charleston	Cooper River in the turning basin of Shipyard Creek
RO00057							4.0			4	3.5	3.8	Charleston	Bohicket Creek near Camp Ho-Non-Wah
RO00058							4.7			5	4.5	4.7	Beaufort	Broad River just above Whale Branch
RO00059							5.0			3	5.0	4.3	Beaufort	Broad Creek in town of Hilton Head Island

SCECAP 2000 -- Tidal Creeks
Integrated Assessment

Station	Water Quality							Sediment Quality			Biological Condition	Overall	County	Location
	Dissolved Oxygen	Fecal Coliform	pH	Bio. Oxy. Demand	Total Nitrogen	Total Phosphorus	Integrated Score	Toxicity	Contaminants	Integrated Score	Benthic IBI	Integrated Score		
RT00501							4.7			4	3.5	4.1	Jasper	Wright River in creek at Walls Cut
RT00502							3.3			4	3.5	3.6	Colleton	Old Chehaw River below Social Hall Creek
RT00503							4.7			4	4.5	4.4	Charleston	North Edisto River in Adams Creek
RT00504							4.0			4	5.0	4.3	Beaufort	Warsaw Island in Jenkins Creek
RT00505							4.7			4	4.5	4.4	Charleston	Cape Romain in Devils Den Creek
RT00517							5.0			5	4.0	4.7	Beaufort	Trenchard's Inlet in creek behind St Phillips Island
RT00518							2.7			4	2.5	3.1	Charleston	North Edisto River in Westbank Creek
RT00519							4.3			4	3.0	3.8	Beaufort	Pocotaligo River in Haulover Creek
RT00520							5.0			4	4.5	4.5	Charleston	Goat Island, in creek forming east end of island
RT00521							5.0			3	4.5	4.2	Charleston	Bull Bay in Sett Creek
RT00523							3.7			5	3.0	3.9	Colleton	Edisto Island in creek behind island
RT00525							4.7			4	3.5	4.1	Charleston	Bull Island in Summerhouse Creek
RT00526							3.8			2	1.5	2.4	Charleston	Ashley River upriver of Magnolia Plantation
RT00528							3.0			5	3.5	3.8	Colleton	Ashepoo River in Mosquito Creek
RT00530							5.0			4	4.0	4.3	Charleston	Capers Island in creek off of Santee Pass
RT00531							4.7			5	3.0	4.2	Berkeley	Wando River in Nowell Creek
RT00541							5.0			5	4.0	4.7	Beaufort	Calibogue Sound in a creek off of Cooper River
RT00542							3.3			5	4.0	4.1	Charleston	Kiawah River in Chapin Creek
RT00543							4.5			4	3.5	4.0	Beaufort	MorganRiver in center of Morgan Island
RT00544							4.3			5	4.0	4.4	Charleston	Folly River in Cole Creek
RT00545							4.3			5	3.5	4.3	Horry	Town of Cherry Grove Beach near mouth of Hog Inlet
RT00546							4.0			5	4.5	4.5	Beaufort	Calibogue Sound in Bryan Creek
RT00547							4.7			5	4.5	4.7	Charleston	North Edisto River in Privateer Creek
RT00548							3.0			4	3.0	3.3	Beaufort	Morgan River in creek on Dataw Island
RT00549							3.8	1		2	3.0	2.9	Berkeley	Cooper River in Beresford Creek
RT00550							4.3	1		3	3.5	3.6	Georgetown	Murrell's Inlet in upper reach
RT00554							4.3			4	3.0	3.8	Jasper	New River behind Daufuskie Island in upper reach
RT00556							4.7			4	4.0	4.2	Beaufort	Okatie River in creek off upper part
RT00557							4.7			5	3.5	4.4	Beaufort	Whale Branch in Middle Creek
RT00558							4.0			3	4.5	3.8	Charleston	Bull Bay in Laurel Hill Plantation creek off Intracoastal Waterway