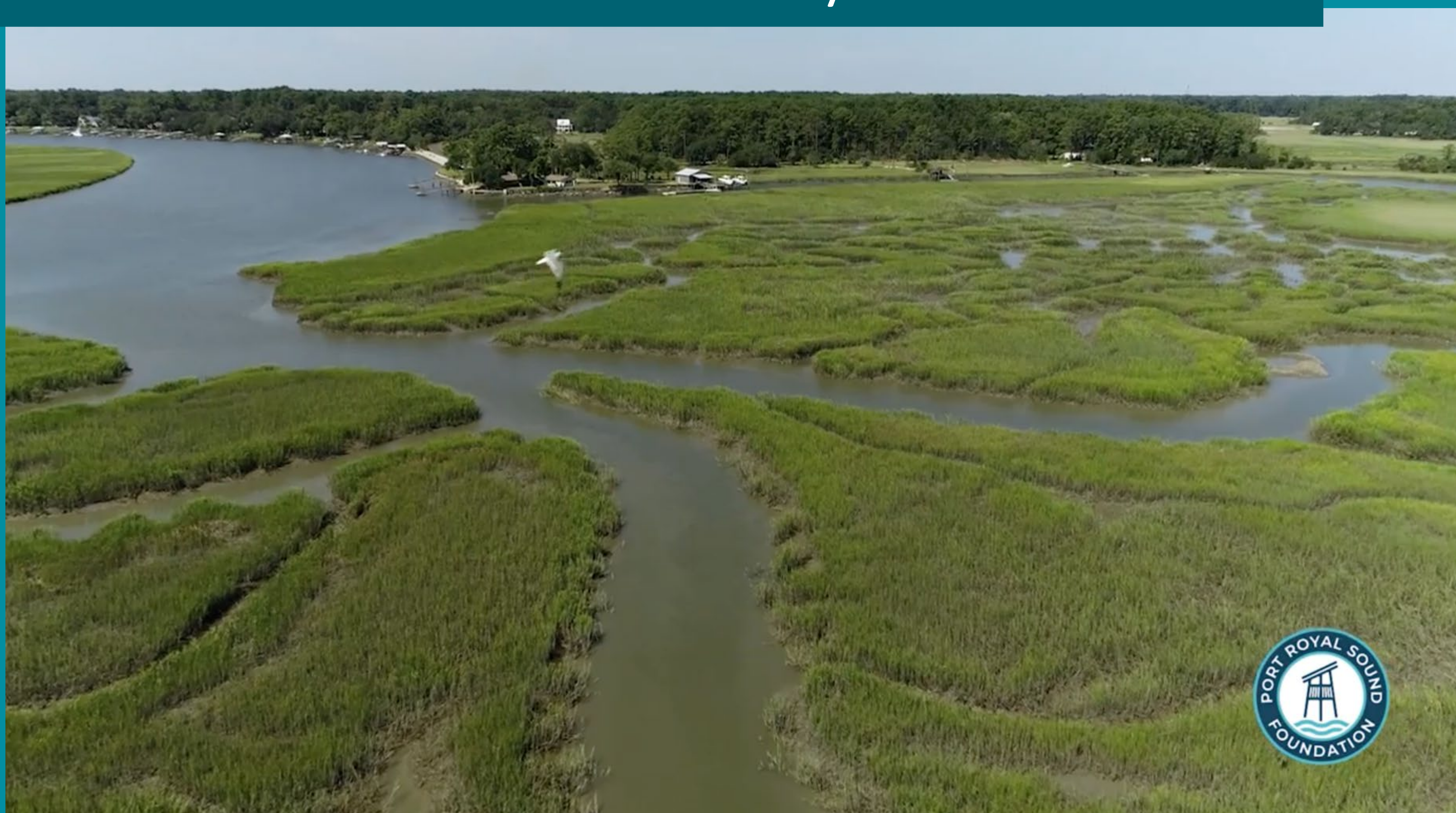
Port Royal Sound Foundation State of the Sound Series
PRSF-22-01

2022

Port Royal Sound Environmental Quality Assessment



Denise M. Sanger, Sharleen P. Johnson, Andrew W. Tweel, Joseph G. Cowan and Catharine E. Parker

SC Department of Natural Resources

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Foreword

Port Royal Sound is a unique system in South Carolina that hosts an abundance of marine life. The Port Royal Sound Foundation seeks to preserve the Sound for the environmental, cultural, and economic well-being of our area by providing and supporting education, research, and conservation initiatives to protect it. In 2021, the Port Royal Sound Foundation collaborated with SC Department of Natural Resources (SCDNR) to conduct a region-specific summary of the wealth of data collected by the South Carolina Estuarine and Coastal Assessment Program (SCECAP). The goal of this report is to provide an overview of the estuarine habitat quality data collected at SCECAP sites located within Port Royal Sound watershed as a State of the Sound report. Ultimately, a more concise and public-facing State of the Sound report will also be developed. In addition to SCECAP data, landscape information was summarized for the full watershed to provide context for the SCECAP environmental quality. It is anticipated that subsequent State of the Sound reports will feature additional topics as existing and new data are evaluated.

To streamline and focus the central document, Appendices containing supplemental in-depth information have been provided. The Appendices include more detailed information about methods, relevant references, scores from each site, and additional maps.

SCECAP was established in 1999 to evaluate the overall health of the state's estuarine habitats on a periodic basis using a combination of water quality, sediment quality, and biological condition measures. SCECAP is a SC coast-wide effort that has sampled over 800 stations since its inception. The program mirrors the US Environmental Protection Agency (USEPA) National Coastal Condition Assessment, which collects coastal aquatic environmental data throughout coastal and Great Lake states every five years. We are fortunate in SC to sample and report data on estuarine habitat health on an annual basis. SCECAP has been funded by several sources including the US Fish and Wildlife Service Dingell-Johnson Sport Fish Restoration Act, SCDNR, SC Department of Health and Environmental Quality (SCDHEC), and the USEPA. In addition to the authors of this report a number of talented scientists have served as SCECAP Principal Investigators over the course of the project including Robert Van Dolah (SCDNR), Derk Bergquist (SCDNR), Pamela Cox Jutte (SCDNR), David Chestnut (SCDHEC), Bryan Rabon (SCDHEC), Edward Wirth (NOAA), and Michael Fulton (NOAA). Also, over 125 staff members have contributed to the monitoring program, and without their hard work this valuable dataset would not exist.

Setting the Stage

The Port Royal Sound is one of the most productive estuarine systems on the South Carolina coast and home to a myriad of terrestrial and marine life. The Sound is the southernmost major estuarine system in South Carolina and falls within Beaufort, Jasper, and Hampton counties. The Sound has minimal freshwater input, primarily from the small Coosawhatchie River and stormwater runoff. Naturally deep channels of up to 18 meters (60 feet) can be found within the Sound. The system is dominated by tidal water from the Atlantic Ocean with an impressive mean tidal range of 2.6 meters (8.5 feet). Together, estuarine wetlands and tidal waters comprise approximately 22% of the total watershed (*Figure 1*).

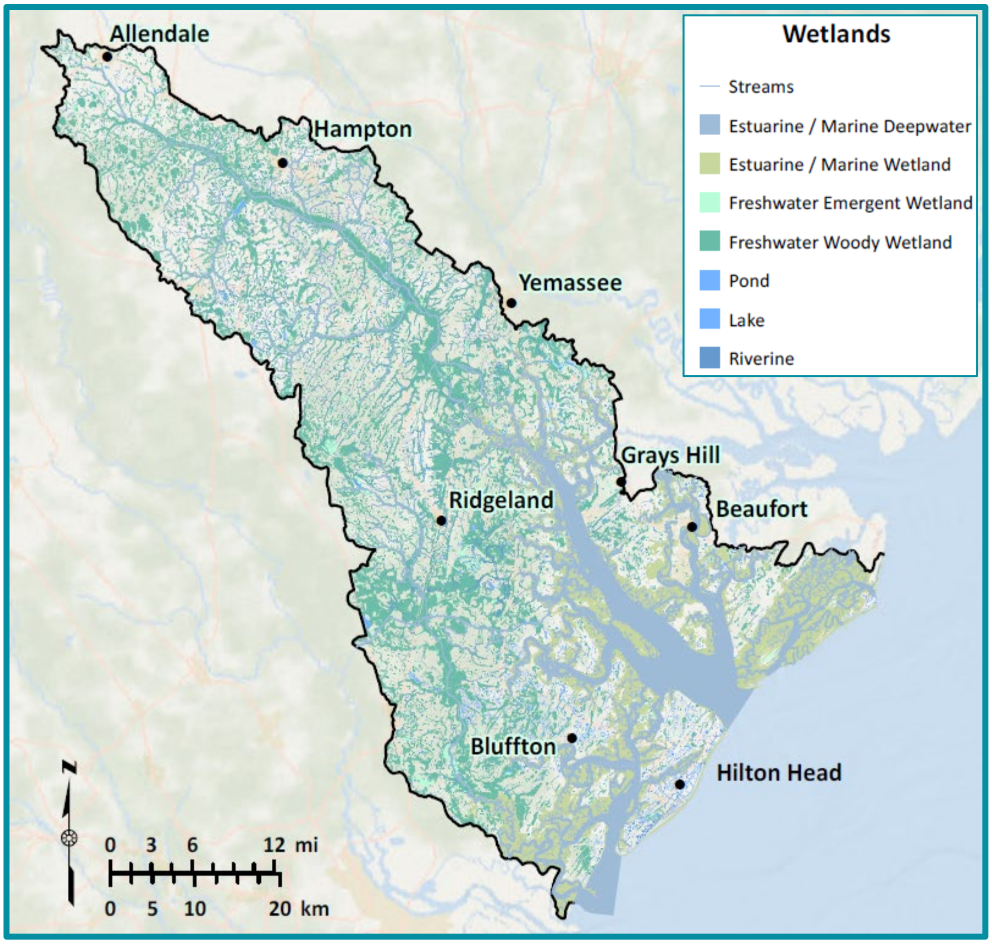


Figure 1. The Port Royal Sound Watershed with the US Fish and Wildlife Service (USFWS) National Wetlands Inventory (updated in 2016).

The Sound watershed, as defined in this study, is approximately 348,000 hectares (1,340 square miles). In 2019, 3% of the upland area (excluding open water and estuarine/marine wetlands) of the entire watershed was estimated to be covered by impervious cover (e.g., roofs, roads, parking lots that do not allow rain infiltration) (*Figure 2*). Interstate-95 (I-95) divides the watershed into the following two fairly discrete components.

Upper Watershed which is non-tidal and freshwater

Lower Watershed which is tidally-driven and estuarine

Overall, the upper watershed is rural and ribboned with small freshwater streams and rivers. The upper watershed represents 44% of the overall area, and only 6% of that area is considered to have developed land cover, primarily consisting of low intensity development (*Figure 3*). In addition, only 1.4% of the upland area is covered by impervious surfaces (*Figure 2*). The upper watershed is dominated by forested freshwater wetlands and agricultural uses (primarily forestry). Water from the upper watershed flows downstream into the lower watershed; however, the relatively small scale of the rivers results in limited freshwater input to the lower watershed.

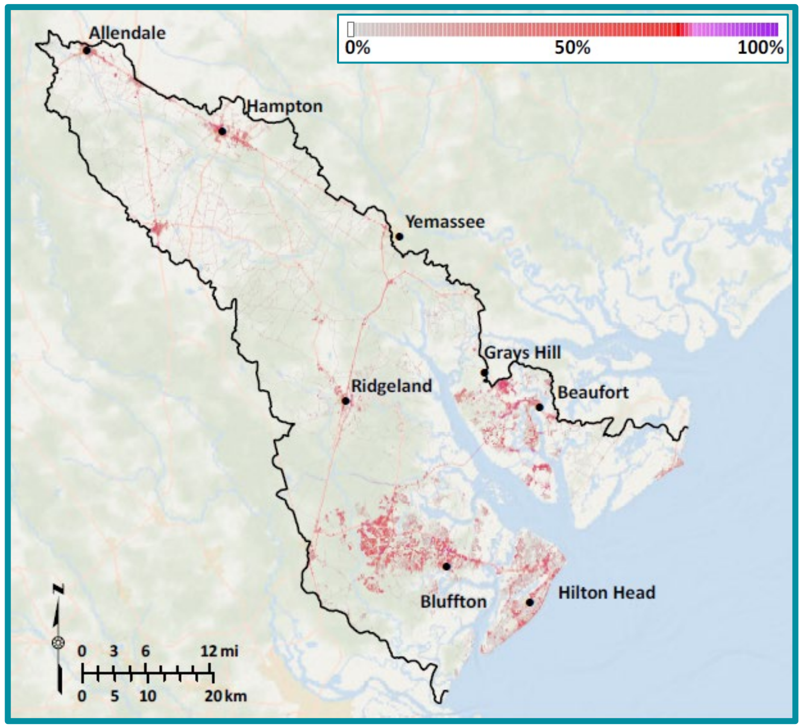


Figure 2. The Sound watershed with impervious cover from the 2019 National Land Cover Dataset (NLCD). The red color indicates impervious cover. Interstate-95 is visible as the red line from Yemassee through Ridgeland.

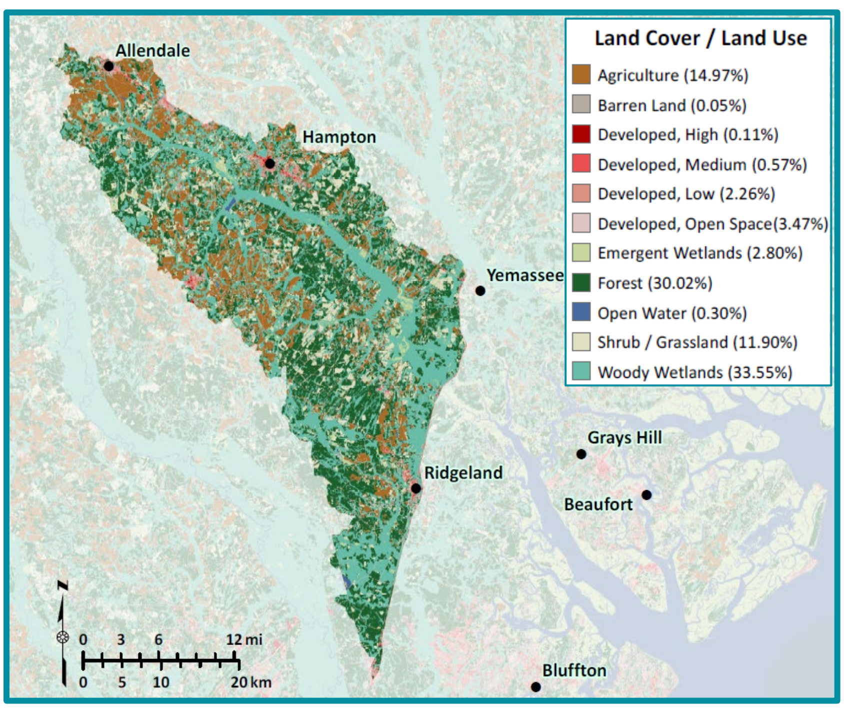
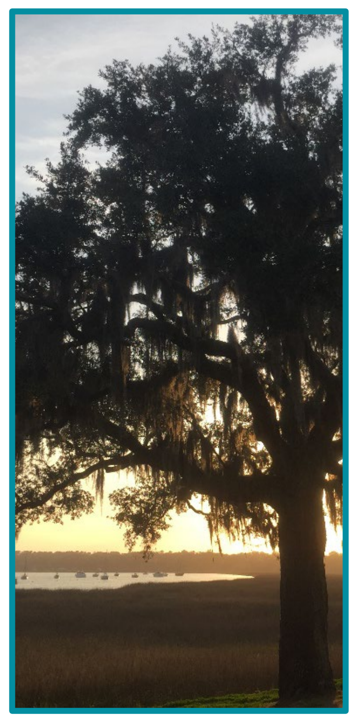


Figure 3. The Sound's upper watershed with the land cover/land use classifications and percentage of area for 2019 (NLCD).



The lower watershed represents 56% of the overall area or approximately 195,000 hectares (750 square miles). The lower watershed is dominated by open water, emergent wetlands (primarily salt marsh), and woody wetlands (*Figure 4*). Thirteen percent of the lower watershed is designated as developed, primarily consisting of low intensity development, and 5% of the upland area is covered by impervious surfaces (*Figure 2*). The lower watershed includes a set of relatively concentrated areas of development around Bluffton, Hilton Head and Beaufort, and impervious cover in these developed areas is locally much higher than in the watershed as a whole.

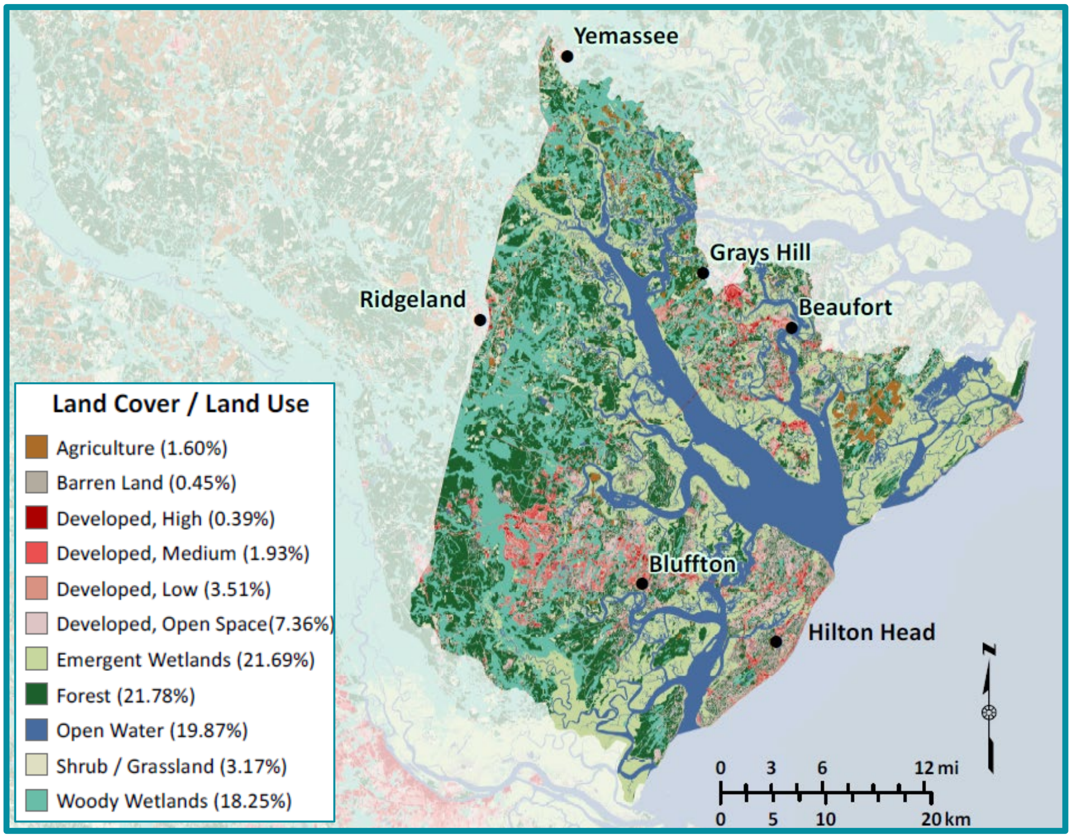


Figure 4. The Sound's lower watershed with the land cover/land use classifications and percentage of area for 2019 (NLCD).

The dominance of estuarine habitats is evident in the Sound's lower watershed which includes extensive marine tidally driven habitats including salt marshes, tidal creeks, tidal rivers, and open water areas. The health and extent of these habitats are critical to the biodiversity and abundance of fish, crustaceans, birds, and other wildlife. Much of the Sound's biological productivity comes from estuarine habitats, which also provide upland protection from storm surge by reducing the height and erosive energy of wind-driven waves before the waves reach the upland.

Throughout the Sound watershed, each estuarine habitat type plays a critical role. Deeper open water areas within the Sound provide foraging habitat for large marine organisms as they travel along the coast, whereas tidal creeks and salt marshes provide smaller organisms necessary shelter and protection from predators. *Spartina alterniflora* or smooth cordgrass also serves as an important primary food source within the greater food web. Greater numbers of invertebrate and smaller vertebrate fauna, therefore, are commonly found in tidal creeks compared to open water areas. However, due to their close linkage to surrounding land use, tidal creeks can be stressful environments. Large, subtidally-dominated (covered by water all the time) tidal creeks transition to shallow, intertidally-dominated (covered by water at high tide, exposed at low tide) tidal creeks which flood and drain salt marshes. As one of the primary linkages between stormwater runoff and the open estuary, receiving the initial input of pollutants and nutrients from the land, intertidally-dominated (also known as small or headwater) tidal creeks expose organisms to particularly stressful conditions (e.g., low oxygen or hypoxia and highly variable temperature conditions).

Quality Assessment

The South Carolina Estuarine and Coastal Assessment Program (SCECAP) was initiated in 1999 to monitor the health of estuarine open water and tidal creek habitats throughout the state, from the saltwater-freshwater interface to the mouth of each estuary, (*Figure 5*). The Program is a SC Department of Natural Resources (SCDNR), SC Department of Health and Environmental Control (SCDHEC), and National Oceanographic and Atmospheric Administration's National Ocean Service (NOAA/NOS) partnership. Over 800 tidal creek and open water sites throughout coastal SC have been sampled to assess water quality, sediment quality, biological condition, which are combined into an overall estuarine habitat quality (*see Appendix for more details, Figure 6*). Thus, SCECAP provides a unique opportunity to comprehensively assess overall estuarine environmental health in the lower Sound watershed by summarizing the data collected at the 279 stations within the Sound watershed between 1999 and 2020 (*Figure 7*). To assess potential changes in estuarine habitat quality over time, SCECAP stations were divided into the following two 11-year time periods.

1999-2009*: 77 tidal creek stations*
100 open water stations

2010-2020*: 46 tidal creek stations*
56 open water stations

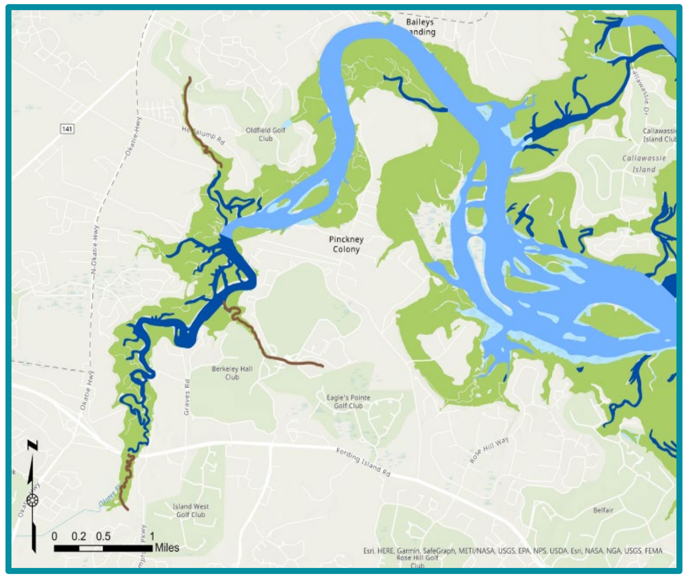


Figure 5. An example from the Okatie River of the open water (light blue), defined by SCECAP) as water bodies greater than 100 m wide from marsh bank to marsh bank; and tidal creek (dark blue), defined by SCECAP as water bodies ~10 to 100 m wide from marsh bank to marsh bank. In addition, the salt marsh is shown in green and three example headwater or intertidally-dominated creeks are shown in brown.

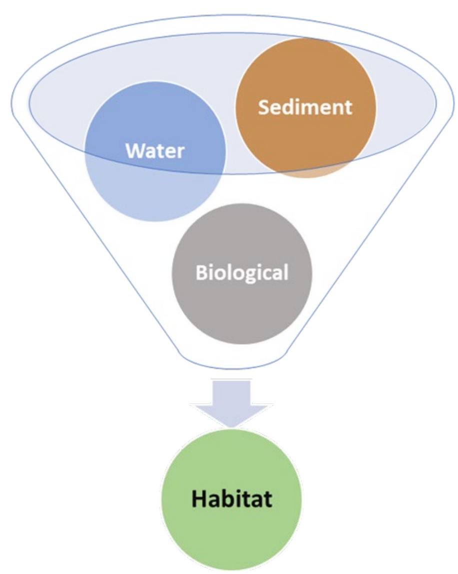


Figure 6. The combination of multiple quality metrics into a single habitat quality.

SCECAP uses an integrated measures of estuarine condition approach to synthesize the program's large and complex environmental datasets. Integrated measures provide natural resource managers and the general public with simplified statements about the status and trends of the condition of South Carolina's coastal zone. SCECAP computes four integrated indices describing different components of the estuarine ecosystem: Water Quality, Sediment Quality, Biological Condition and overall Habitat Quality (*Figure 6*). The Water Quality Index combines four measures, the Sediment Quality Index combines three measures, and the Biological Condition Index includes only the Benthic-Index of Biotic Integrity (*Figure 8*). These three indices are then combined into a single integrated Habitat Index. The use of integrated indices facilitates communication of multi-variable environmental data to the public and provides a more reliable tool than individual measures (such as dissolved oxygen, pH, etc.) for assessing estuarine condition. For example, one location may have degraded dissolved oxygen but normal values for all other measures of water quality, while a second location has degraded levels for the majority of water quality measures. If dissolved oxygen were the only measure of water quality, both locations would be classified as having degraded condition with no basis for distinguishing between the two locations. However, an index that integrates multiple measures would likely not classify the first location as degraded yet detect the relatively greater degradation at the second location.

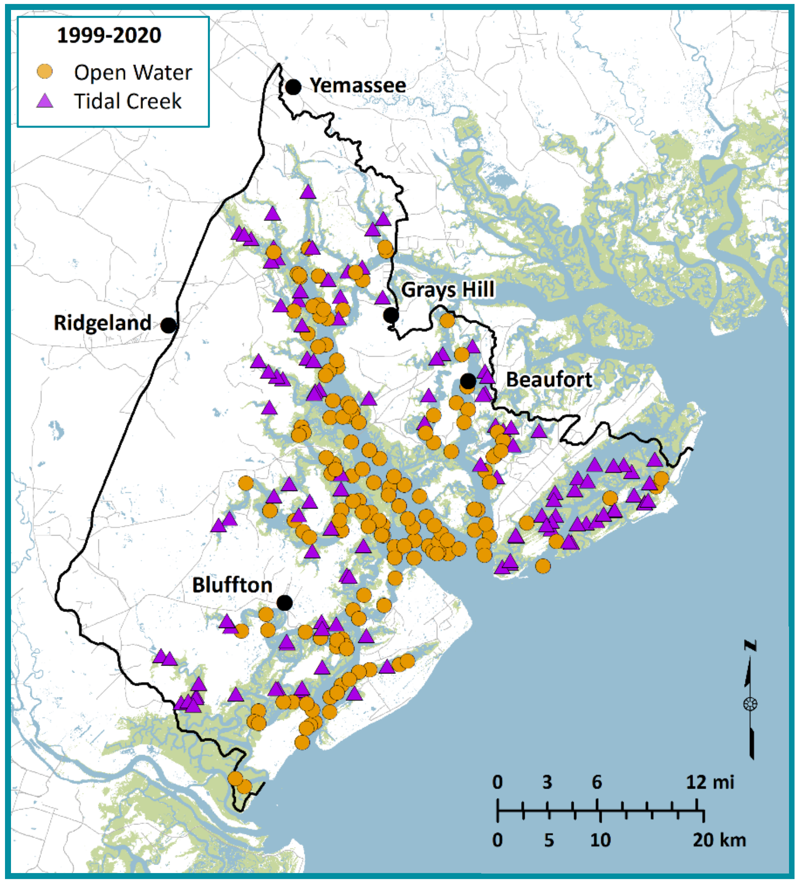


Figure 7. The 279 SCECAP stations from 1999-2020 that fall within the Port Royal Sound lower watershed: 123 tidal creek stations (purple triangles) and 156 open water stations (orange circles).

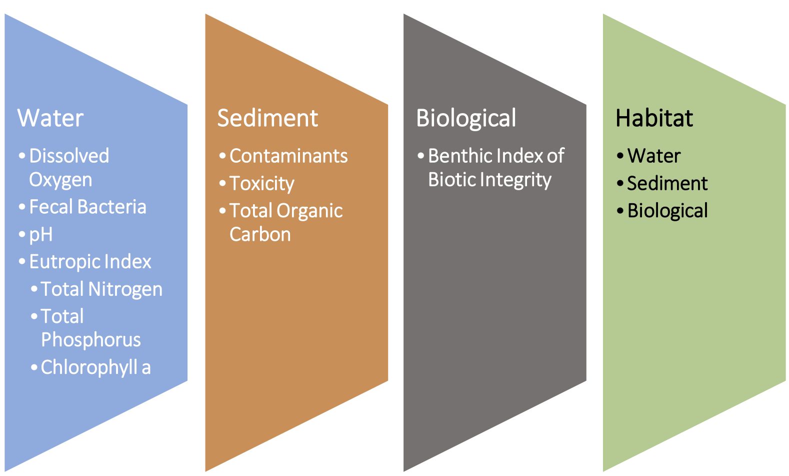


Figure 8. The measures used in each of the quality indices.

The four integrated indices are calculated by assigning each individual measure taken at a sampled station a score of “good,” “fair,” or “poor.” In the various graphics and tables of this report, these scores are depicted as green, yellow, and red, respectively. The thresholds used for scoring each measure are based on 2008 state water quality standards, published findings, or percentiles from SCECAP measurements collected from 1999-2006 (*see Appendix for more details*).

Each measure is given a numerical score (5, 3, or 0 for scores of good, fair, or poor, respectively) and the numerical scores of the individual measures are averaged into an integrated index value. The Water Quality, Sediment Quality, and Biological Condition indices are likewise given a score of good (5), fair (3), or poor (0) (*Table 1*). The resulting numerical scores for the three indices are then averaged into an overall Habitat Quality Index.

Table 1. The possible index values and scores for the integrated Habitat Quality Index, based on combinations of scores from the Water Quality Index, the Sediment Quality Index, and the Biological Condition Index.

Component Index Scores			Habitat index (average)	Habitat Score
A	B	C		
0	0	0	0.0	0
3	0	0	1.0	0
5	0	0	1.7	0
3	3	0	2.0	0
5	3	0	2.7	3
3	3	3	3.0	3
5	5	0	3.3	3
5	3	3	3.7	3
5	5	3	4.3	5
5	5	5	5.0	5

The random survey design utilized by SCECAP provides an opportunity to estimate the overall proportion of estuarine water classified as being in good, fair, or poor condition within specific time periods. The percent of Port Royal Sound’s overall estuarine habitat scoring as good, fair, or poor for individual measures and for each of the indices can also be calculated after weighting the analysis by the proportion of Port Royal Sound estuarine habitat represented by tidal creek (20%) and open water (80%) habitat (see Appendix for combined index scores).

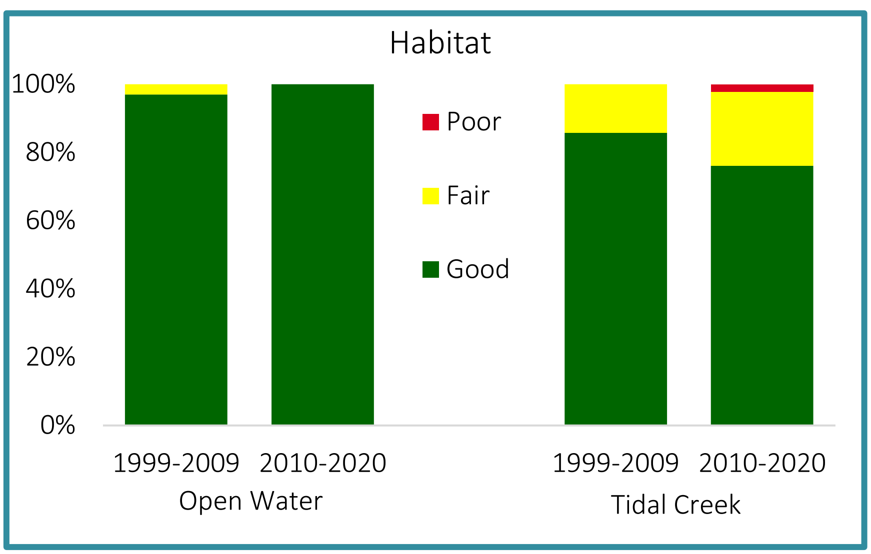


Figure 9. Percent of open water (left) and tidal creek (right) corresponding to each Habitat Quality Index classification by survey period.

The overall Habitat Quality score for the open water and tidal creek Sound ecosystem types were summarized for the two eleven-year time periods (1999-2009 and 2010-2020) with a focus on the more recent time frame. Similar to what was observed for the statewide coast of South Carolina, the percentage of the Sound Habitat Quality classified as good was higher in the open water areas compared to the tidal creek areas (*Figure 9*). For open water areas, a slightly higher percentage of good Habitat Quality was observed in 2010-2020 (100%) compared to 1999-2009 (97%). For tidal creek areas, the 2010-2020 time frame had a higher percentage of poor (2%) and fair (22%) Habitat Quality compared to the 1999-2009 time frame which had no sites classified as poor and only 14% classified as fair. The Habitat Quality in open water areas for the 2010-2020 time frame classified as 100% good and only showed impaired quality for Biological Condition (7% fair). Water Quality and Sediment Quality both classified as 100% good (*Figure 10*).

The Habitat Quality in tidal creek areas for the 2010-2020 time frame was classified as 76% good, 22% fair, and 2% poor (*Figure 10*). The Habitat Quality in the tidal creek areas was most impaired for Water Quality followed by the Biological Condition. The Water Quality in Sound tidal creeks was 70% good, 17% fair and 13% poor. The Biological Condition of tidal creeks was 76% good, 20% fair, and 4% poor and the Sediment Quality was 87% good, 11% fair and 2% poor.

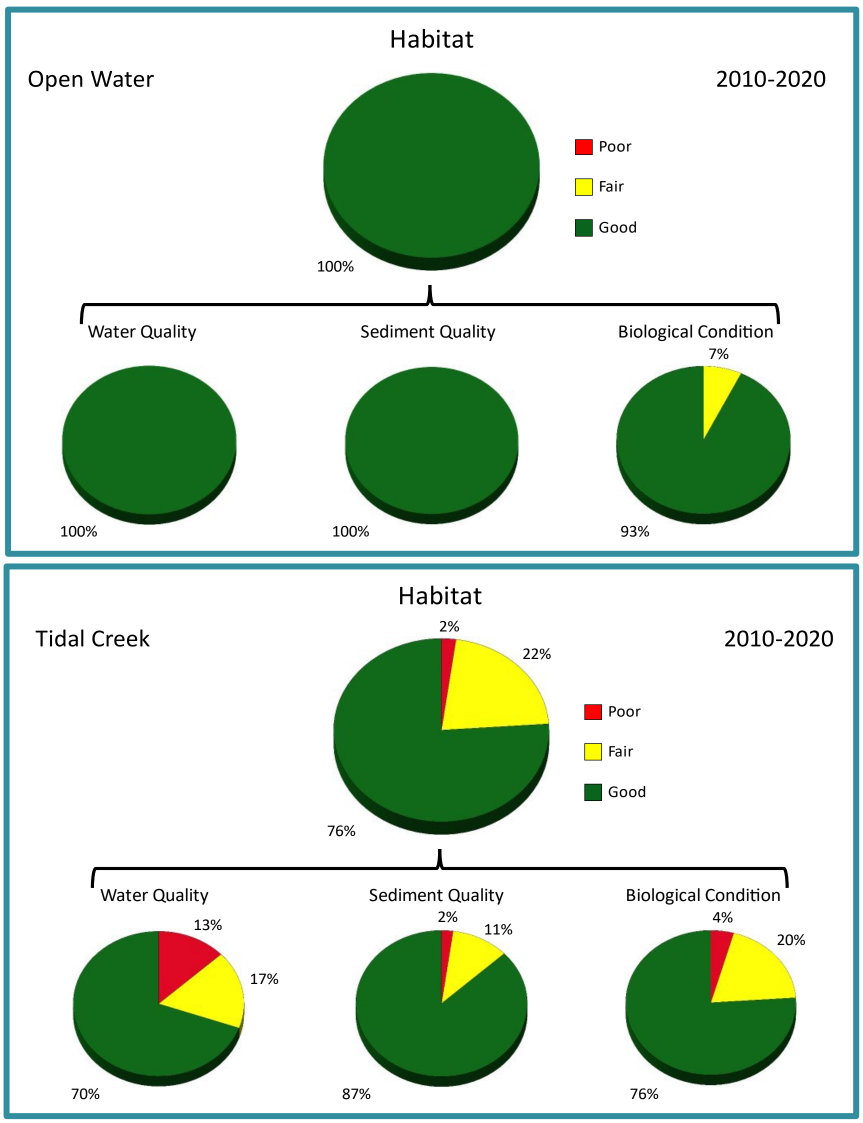


Figure 10. The three quality indices that comprise the Habitat Quality for the open water (top) and tidal creek (bottom) areas in 2010-2020.

The Biological Condition Index consists of one metric which is based on several aspects of the benthic macroinvertebrate community. This benthic community consists of small animals that live in the sediment and serve as an important component of the food web as prey for fish, shrimp, crabs, and birds. For both time periods, Biological Condition was lower in tidal creek areas relative to open water areas. Biological Condition was slightly lower in the 2010-2020 time period compared to the 1999-2009 period (*Figure 11*). In 1999-2009, open water areas had 5% of sites classified as fair and none as poor, while tidal creek areas had 14% classified as fair and 1% classified as poor. In 2010-2020, the percentage of fair sites increased to 7% in open water areas and to 20% in tidal creek areas. Tidal creeks also experienced an increase in sites with poor quality (from 1% to 4%).

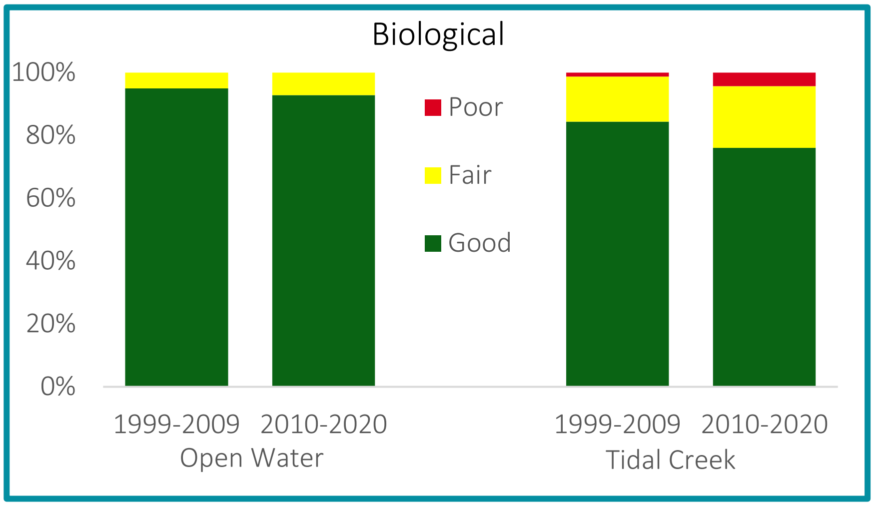


Figure 11. Percent of open water (left) and tidal creek (right) areas corresponding to each Biological Quality Index classification by survey period.

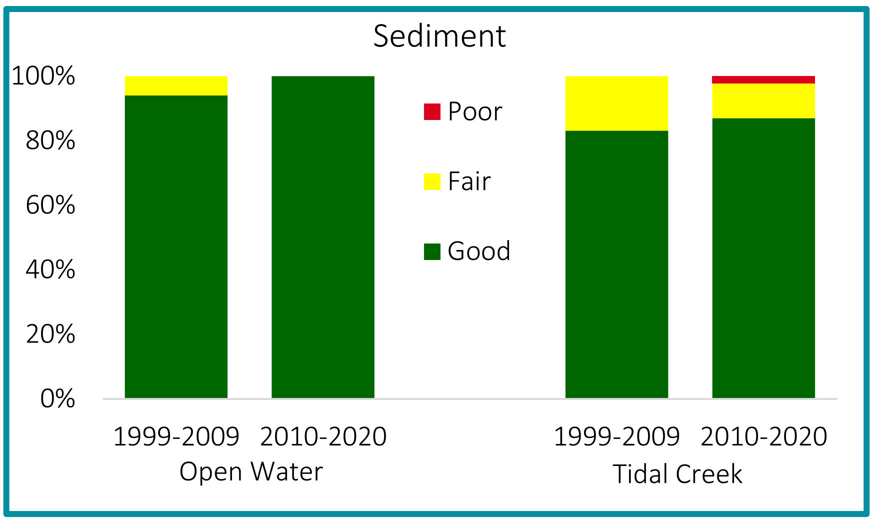


Figure 12. Percent of open water (left) and tidal creek (right) corresponding to each Sediment Quality Index category by survey period.

The proportion of estuarine habitat with good Sediment Quality was slightly higher in the most recent survey period than in the 1999-2009 time frame. As seen with Habitat Quality and Biological Condition, the proportion of tidal creek area with fair and poor Sediment Quality was higher than in the open water areas (*Figure 12*). In 1999-2009, 6% of open water area and 17% of tidal creek area was classified as fair, whereas in 2010-2020, no open water sites and only 11% of tidal creek sites were classified as fair; however, 2% of tidal creek sites were classified as poor which was not observed historically.

Sediment Quality can be further evaluated by looking at the three individual measures that comprise the index: 1) the percentage of the sediment that is total organic carbon; 2) the toxicity of the sediment using a bacterial luminescence assay; and 3) the chemical contaminants using the mERMq which is a suite of 24 contaminants (metals, PAHs, PCBs and DDT) summarized using a biologically-based standardization method. Across open water areas from 2010-2020, the Sediment Quality component scores were fairly similar with 2% classified as fair for total organic carbon, and 5% and 7% for contaminants and toxicity, respectively (*Figure 13*). Across tidal creek habitats from 2010-2020, the component measurements were also fairly similar in regard to the proportion of areas that were fair (13% to 17%) and only for total organic carbon were any tidal creek areas considered poor (2%) (*Figure 13*).

For the Water Quality Index, tidal creek areas were more variable and had overall lower Water Quality compared to open water areas. In addition, there was a decrease in water quality in the tidal creek areas, with a higher proportion classified as poor in 2010-2020 compared to 1999-2009. A decrease in the tidal creek area classified as fair was offset by the increase in poor quality. In contrast, open water areas improved from 92% good water quality to 100% good in 1999-2009 to 2010-2020. As was observed in the Habitat and Sediment Quality indices, the proportion of tidal creek areas with fair and poor Water Quality was higher than in the open water habitat (*Figure 14*).

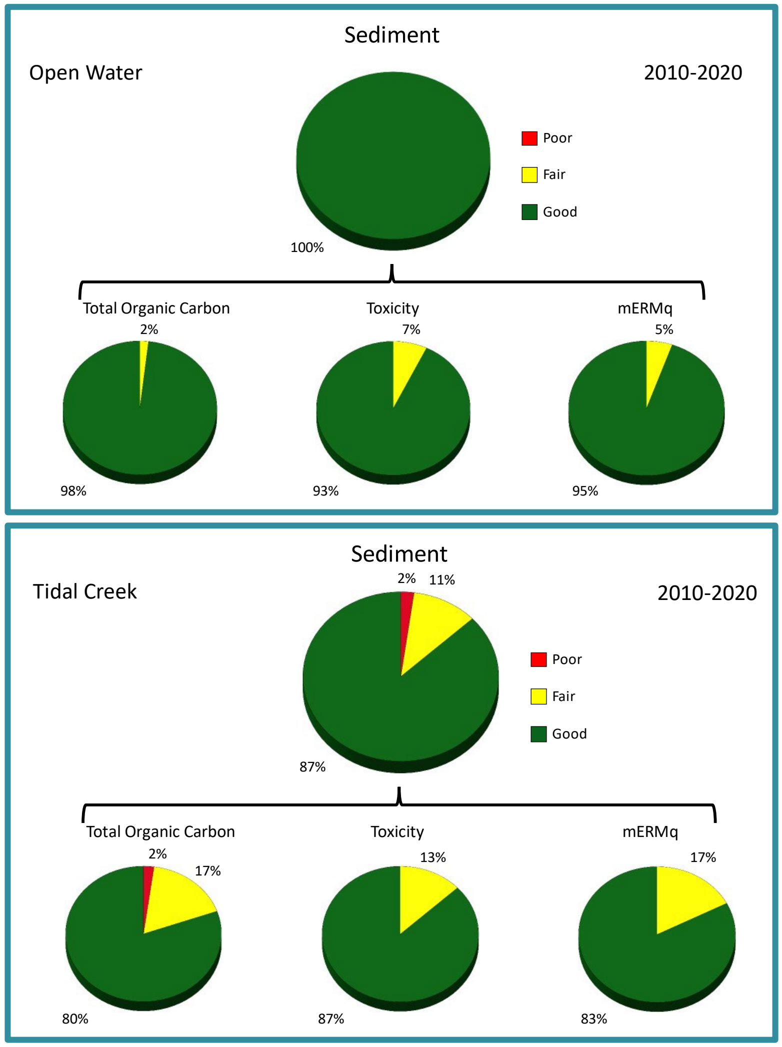


Figure 13. The three quality indices that comprise the sediment quality for the open water (top) and tidal creek (bottom) areas in 2010-2020.

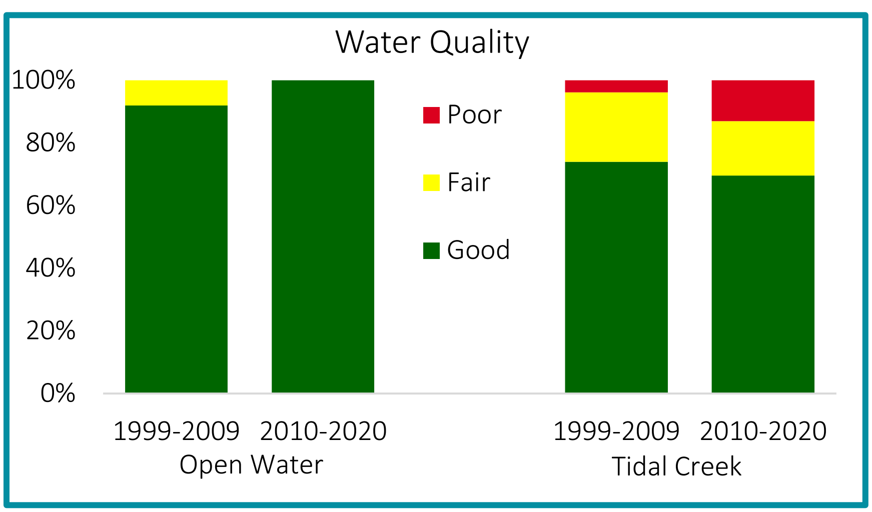


Figure 14. Percent of open water (left) and tidal creek (right) corresponding to each Water Quality Index category by survey period.

Water Quality can be further summarized for each of the component measures which are considered to be the most relevant with respect to biotic health and human uses. These include: 1) dissolved oxygen; 2) pH; 3) fecal coliform bacteria; and 4) an integrated eutrophic metric made up of total nitrogen, total phosphorus, and chlorophyll *a*. Across the open water areas from 2010-2020, 4-7% of sites were considered fair and no sites were considered poor for dissolved oxygen, pH, or fecal coliform, and only 4% of sites were considered fair to poor for each of the eutrophic metrics (*Figure 15*). Across tidal creek areas from 2010-2020, dissolved oxygen and pH exhibited the greatest percentages of fair classifications (33% and 26%, respectively), along with 9% of sites being classified as poor for dissolved oxygen and 20% for pH (*Figure 15*). Fecal coliform was also fair at 17% of sites, although only 2% were classified as poor. More than 80% of tidal creek sites were classified as good with respect to total nitrogen, total phosphorus and chlorophyll *a* while a relatively low proportion of these sites where classified as poor with respect to total phosphorus (9%) and none classified as poor for total nitrogen or chlorophyll *a*.

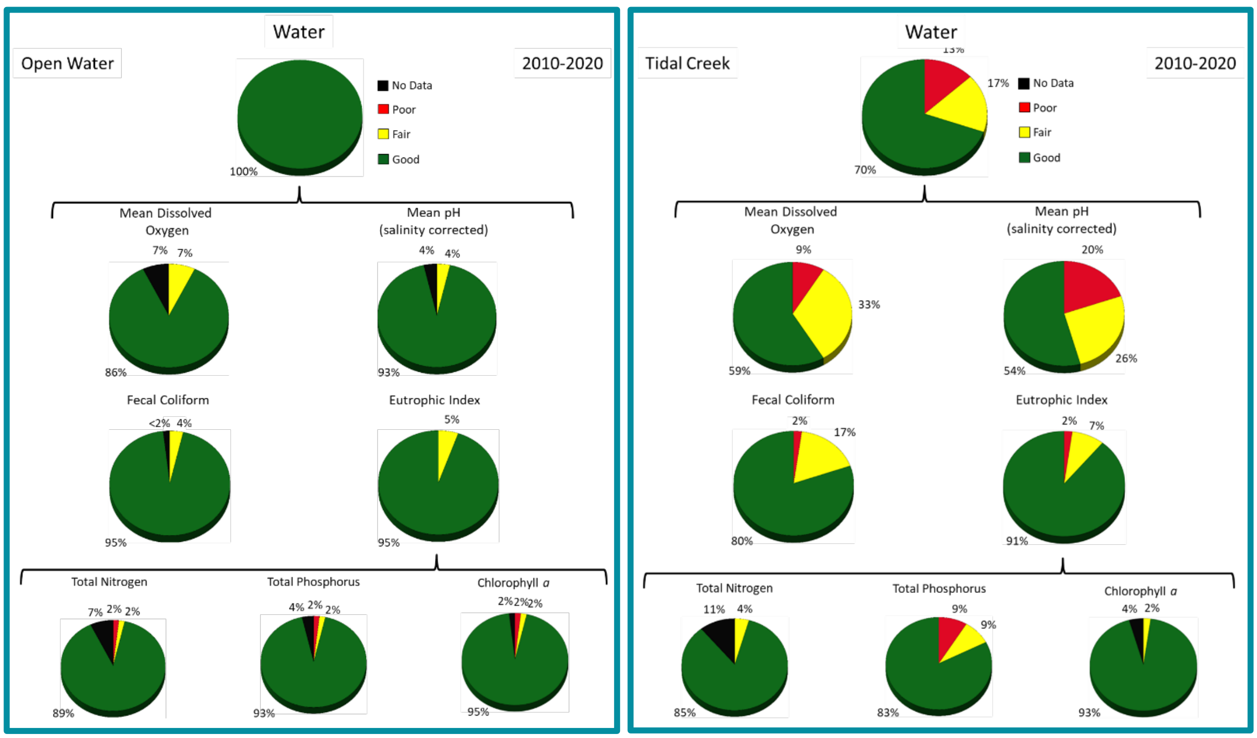


Figure 15. The three measures and 1 metric (made up of 3 measures) that comprise the Water Quality for the open water and tidal creek (right) areas in 2010-2020.

System Evaluations

In addition to assessing the overall environmental health of the Sound, SCECAP data can be utilized to identify areas of potential concern where targeted studies, best management practices, or educational programs may be warranted. A few examples will be highlighted and a full list of the index scores for each site is provided in the Appendices for future consideration. Only one site, tidal creek station RT18171, which was located on the Tulfinny River near Gregorie Neck Road, had a Habitat Quality score of poor (*Figure 16*). The Tulifinny River is surrounded by woody wetlands, forest, and agriculture, and is the only site within this system sampled for SCECAP, resulting in no nearby sites for comparison. This site was designated poor due to poor Biological Condition as well as poor Water Quality (the eutrophic score was fair due to a poor total nitrogen value, fair dissolved oxygen score, poor pH score). The poor Biological Condition score could be related to the low dissolved oxygen and low pH.

Six of the seven sites sampled in the New River from 1999 to 2020 received fair Habitat Quality scores (*Figure 17*). These sites span early and more recent years indicating that this is a consistent pattern. The fair Habitat Quality was due to fair or poor Water Quality along with either fair Sediment Quality or fair Biological Condition, with one site having a poor Biological Condition. Most of these sites were located in lower salinity areas and all of the sites scored fair for fecal coliforms. In addition, most of the sites scored as fair for dissolved oxygen and pH with only one having a poor eutrophic score. The New River headwaters are dominated by freshwater swamps, with a large area historically converted for rice cultivation. The upland surrounding the New River is currently quite rural but is undergoing increasing development. Given that this system already has fair-to-poor estuarine Habitat Quality, which could change by increased development, this area warrants future study to better understand the potential reasons of impairment and use that understanding to evaluate and employ mitigation measures to improve habitat quality.

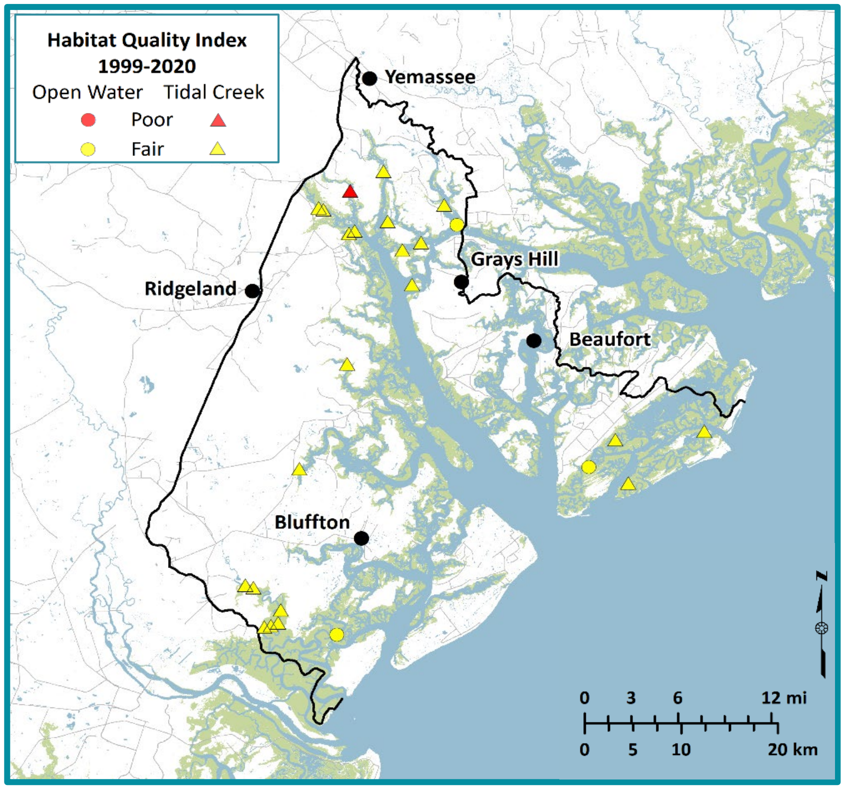


Figure 16. The SCECAP sites within the Sound lower watershed that scored as fair or poor for Habitat Quality.

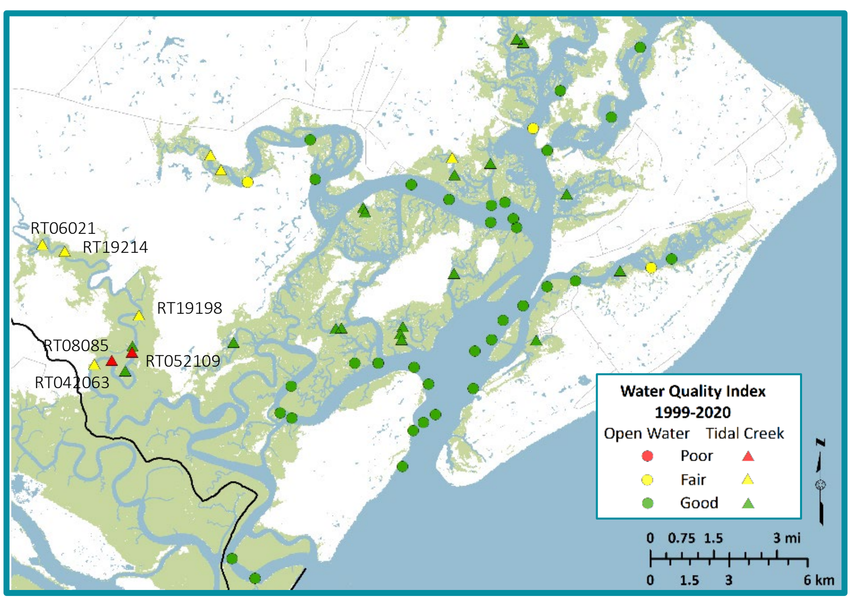


Figure 17. The Water Quality scores in the southwest corner of the lower watershed with the New River sites identified with poor or fair Water Quality scores were found.

A final example of an area for further study is two sites that fall within the Coosawhatchie River (RT12031, RT19207), and two sites that are within a tidal creek connected to the Coosawhatchie River (RT07038, RT13059) which all scored as fair for Habitat Quality (*Figure 18*). The two sets of paired sites span across several years. This indicates that there may be some consistent impairment that warrants further evaluation along with an assessment of the landscape sub-watersheds. All four of these sites scored poor for Water Quality. In particular, the sites in the Coosawhatchie River proper scored as poor for dissolved oxygen and pH in 2012 and fair/poor for dissolved oxygen and pH as well as fair for fecal coliforms in 2019. The sites in the tidal creek off the Coosawhatchie River scored as poor for the eutrophic index and pH as well as fair for dissolved oxygen and fecal coliforms in 2013.

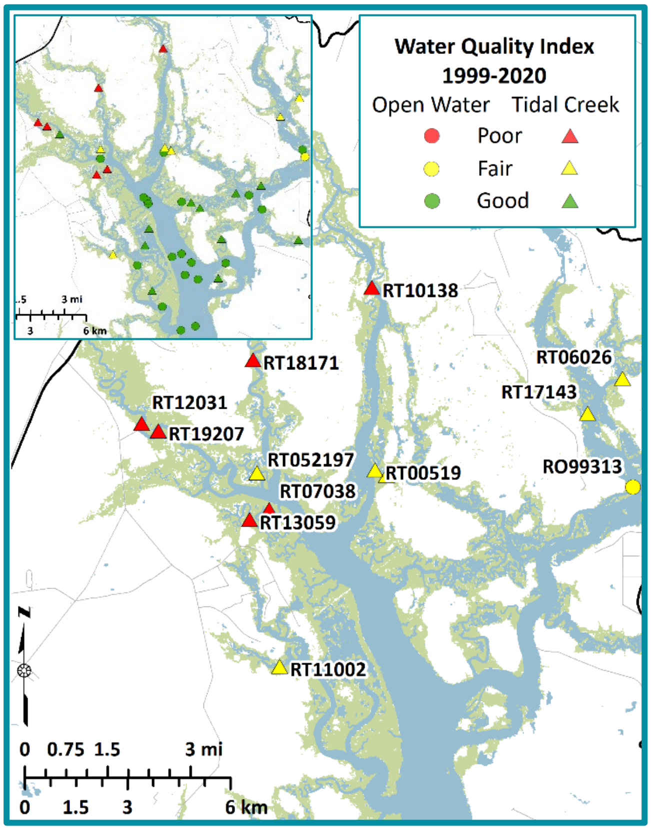
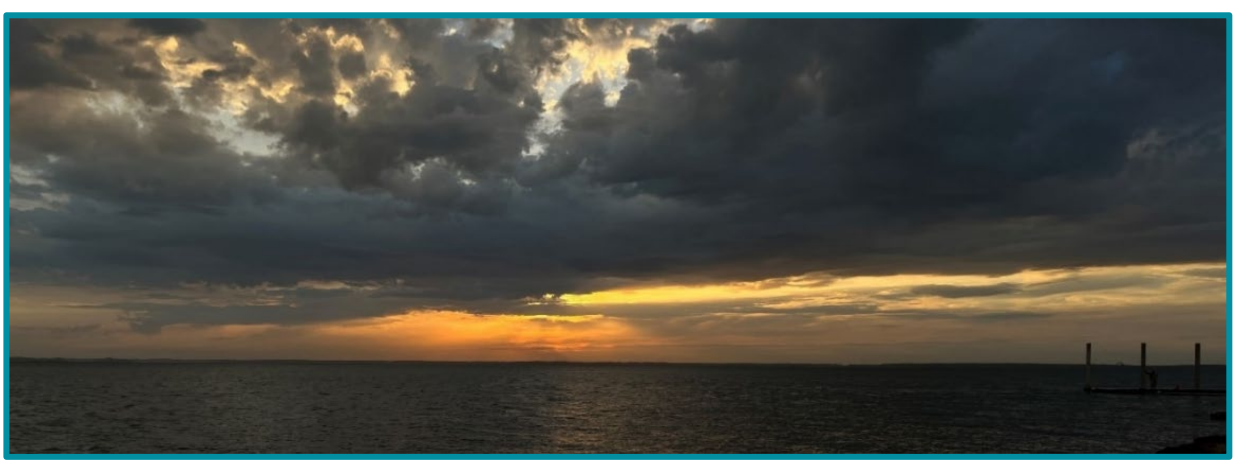


Figure 18. The Water Quality scores in the northwest corner of the lower watershed with all of the sites with poor or fair Water Quality scores identified. The inset shows all of the sites including the good scoring sites.

These types of summaries are meant to provide examples of how SCECAP data can be explored at a finer-scale to determine if further evaluation is warranted. For SCECAP, each site is only visited once in a single year for the full suite of measures; however, SCDHEC monitors these same sites monthly for the corresponding year as part of their Water Quality monitoring program which samples for nutrients and fecal coliform historically, and Enterococci more recently. Due to the random site selection design, not all tidal creek and open water areas are sampled routinely, and caution should be taken not to over interpret the individual sites. Instead, a weight of evidence approach should be used to determine if further study is warranted.



Summary

The majority of Port Royal Sound's large tidal creeks and open waters, based on SCECAP data, was classified as good or healthy estuarine habitat. Environmental quality is higher in the Sound compared to summaries of the entire SC coastal area. Similar to findings from the coast-wide summaries, tidal creeks in the Sound were observed to be more stressful habitats compared to open water areas. There were a few open water and several tidal creek sites with impairments in the quality of the water, sediment, or biological condition resulting in some sites having impaired habitat quality. In addition, there were some indications of changing quality from the first eleven-year period (1999-2009) compared to the second eleven-year period (2010-2020) resulting in more sites having more impaired environmental quality. The last eleven years have also been a period of significant growth in the watershed.

The existing SCECAP dataset in Port Royal Sound cannot be used to directly assess if coastal development in the Sound's watershed is related to estuarine quality due to the lack of sufficient data in the sub-watersheds experiencing growth; however, a recent statewide synthesis of SCECAP data explored this question. With tidal creek and open water areas combined, the sites with surrounding development exhibited higher fecal coliform and sediment contaminants, while sites in undeveloped areas exhibited healthier dissolved oxygen and pH values. The benthic index was not found to be different between the developed and undeveloped watersheds. Additional targeted sampling of sub-watersheds could provide a greater understanding of potential changes within the Sound.

Other projects have explored the linkages between development (e.g., stormwater runoff) and environmental quality, including the Tidal Creek Project (TCP; initiated in 1994). Small tidal creeks, which are intertidally-dominated, have the closest estuarine connection to the land and serve as sentinels to provide an early warning of changing environmental quality due to land development. Changing the landscape by adding houses, roads, and parking lots increases the amount of impervious cover, resulting in increases in the rate and volume of runoff entering small tidal creeks, and potentially also increasing the delivery of pollutants. Best management practices (BMPs) such as stormwater ponds are designed to mitigate some of these changes. Out of the 43 small tidal creeks sampled throughout the Southeast for the Tidal Creek Project, thirteen were located in the Sound's watershed (Rose Dhu, Stoney, Okatie, Village, Brighton Beach, Palmetto Bluff, Albergotti, Malind, Sawmill, Broad, Bass, Heyward Cove, and MCAS). Unlike SCECAP, which uses randomized site selection designed to assess the condition of the State's overall estuarine habitat, TCP was designed to target a range of systems with varying levels of development from forested to suburban to urban.

A conceptual model was developed to describe the findings of TCP which include linkages between sub-watershed scale stressors (e.g., population, impervious cover) and the physical, chemical, and biological changes in small tidal creeks (*Figure 19*). The level of impervious cover was found to be related to increases in the levels of fecal coliform bacteria, nitrate/nitrite (forms of nitrogen in fertilizer), chemical contamination of sediments; a shift towards a more stress tolerant benthic community; as well as a greater change in salinity. The incorporation of BMPs in recently developed suburban areas may alter the delivery of materials to the tidal creek for particle bound pollutants such as PAHs or fossil fuels. In addition, the straightening of channels in many systems has been observed as the watersheds surrounding them become developed. Pollutants from the small tidal creeks to the larger SCECAP

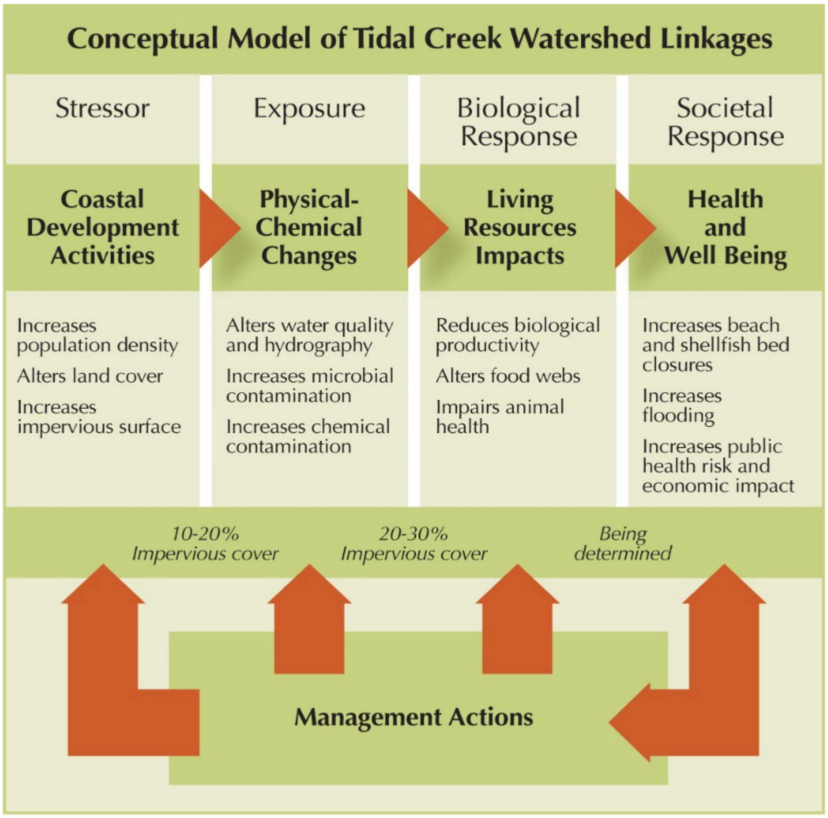


Figure 19. Conceptual model developed to summarize the Tidal Creek Project findings.

sampled tidal creeks has also been found with similar relationships observed in the larger tidal creeks; however, they are not as strong as in the small tidal creeks.

The TCP effort, among other studies, led to another study in Beaufort County with the goal of tracking the translation of freshwater (stormwater runoff) from the sentinel small creeks (headwater creeks), previously shown to be volume "sensitive" along the length to volume "insensitive" downstream waters. A secondary goal was to determine if development or other factors played a role in the translation (in terms of rate and total volume) of stormwater runoff into the estuary. The study systems were the Okatie River, May River, Wallace Creek, Battery Creek, and Huspah Creek. The portions of each creek identified as sensitive were, as expected, in the upper reaches of each creek system but where along the length the system became insensitive varied. When comparing the sensitive headwater portions across watersheds, the order of sensitivity (most to least) was found to be Huspah Creek, Okatie River, May River, Battery Creek, and Wallace Creek. The sensitivity appeared to be related to an increase in coverage of freshwater wetlands, a decrease in creek width, a decrease in coverage of estuarine wetlands, and an increase in imperviousness. Based on a larger analysis of all Port Royal Sound sub-watersheds, the larger coastal sub-watersheds west and northwest of Port Royal Sound were found to be more sensitive than the smaller coastal sub-watersheds east of Port Royal Sound. All creeks are sensitive down to some point along their length; however, this analysis provided insight into which watersheds are expected to be more sensitive over a greater proportion of their length.

With a recognition of the scientific studies, and an appreciation for the numerous aesthetic, cultural, recreational, and commercial connections between residents, visitors, and the Sound, it is particularly important to promote sustainable development and land use practices to ensure long-term protection of this beautiful and productive coastal landscape. In the past 20 years, impervious cover in the full watershed surrounding the Port Royal Sound has increased from 2% in 2001 to 3% in 2019 and the lower watershed has increased from 3% to 5% impervious cover over the same time frame. The change at the large watershed scale is small; however, the concentration of development along specific corridors leads to a number of the sub-watersheds having higher amounts of impervious cover. For example, the Okatie River sub-watershed has 25% of the land being impermeable to water (impervious cover). This level of impervious cover has been found to negatively impact the physical, chemical, and biological condition of tidal creeks.

The combined assessment of landscape alterations and monitoring for potential changes in environmental quality is a critical component in understanding the impacts of growth on the Port Royal Sound region. The interest within Beaufort County to maintain high environmental quality in the Sound dates back to the mid-90s with the Beaufort County Water Quality Task Force. Many of the residents that reside within the Sound's watershed enjoy the natural beauty and abundance of resources that the Sound has to offer. Continued growth in the area has the potential to negatively impact the Sound's estuarine habitat quality, but by working together to monitor the health, educate residents and tourists, plan at a variety of scales, and minimize the amount of stormwater runoff while maximizing the water quality of runoff can help to sustain the quality of life currently enjoyed.

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