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MEETING NOTICE AND AGENDA

ENVIRONMENTAL MITIGATION PROGRAM WORKING GROUP

The Environmental Mitigation Program Working Group may take action on any item appearing on this agenda.

Tuesday, July 12, 2016

1 to 3 p.m.

SANDAG, 7th Floor Conference Room
401 B Street
San Diego, CA 92101-4231

Staff Contact: Keith Greer
(619) 699-7390
keith.greer@sandag.org

AGENDA HIGHLIGHTS

- **AD HOC COMMITTEE RECOMMENDATION: FY 2017-2018 WORK PLAN AND FY 2017 ANNUAL FUNDING**
- **SHOT HOLE BORER BEETLE: WHAT IS NEXT?**
- **MEASURING ECOSYSTEM HEALTH: A REVIEW OF OTHER REGIONS**

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ENVIRONMENTAL MITIGATION PROGRAM WORKING GROUP

Tuesday, July 12, 2016

ITEM NO. **RECOMMENDATION**

1. WELCOME AND INTRODUCTIONS (Vice Chair, Mike Grim, City of Carlsbad)

+2. APPROVAL OF MEETING MINUTES — APPROVE

The Environmental Mitigation Program Working Group (EMPWG) is asked to review and approve the minutes from its May 10, 2016, meetings.

Estimated Start Time: 1:00 – 1:05 p.m.

3. PUBLIC COMMENTS AND COMMUNICATIONS — COMMENT

Members of the public will have the opportunity to address the EMPWG on any issue within the jurisdiction of the Working Group. Speakers are limited to three minutes each.

Estimated Start Time: 1:05 – 1:10 p.m.

CONSENT

4. AD HOC COMMITTEE RECOMMENDATION*:* FY 2017-2018 WORK PLAN AND FY 2017 ANNUAL FUNDING (Susan Wynn, U.S. Fish and Wildlife Service) — INFORMATION

Estimated Start Time: 1:10 – 1:40 p.m.

The EMPWG formed an ad hoc committee to review and recommend updates to the FY 2016-2017 Work Plan for regional management and monitoring, and annual allocations of regional land management and monitoring funding for FY 2017. Ms. Wynn chaired the ad hoc committee and will report out on the recommendations.

REPORTS

5. SHOT HOLE BORER BEETLE: WHAT IS NEXT? (Gail Sevrens, California Department of Fish and Wildlife) — INFORMATION/ DISCUSSION

Ms. Sevrens will provide a status update regarding coordination of natural resource issues involving the invasive Shot Hole Borer (SHB) beetle, including the formation of a collaborative group that could liaison with other groups and the possible integration into the Emerging Tree Pest Group of San Diego County. She also will address the status of a working draft of a strategic plan to address the SHB.

Estimated Start Time: 1:40 – 2:10 p.m.

6. MSP PORTAL DEMONSTRATION (Yvonne Moore and Emily Perkins, San Diego Management and Monitoring Program) — INFORMATION

The San Diego Management and Monitoring Program has been working on an interactive, data-driven website that is connected to the Management Strategic Plan (MSP) and can be queried by land managers, jurisdictions, agencies, and the general public to address questions on the status of MSP species, objectives, and projects. Ms. Moore and Ms. Perkins will provide a mini demonstration of Phase 2 of the MSP Portal (project data entry).

Estimated Start Time: 2:10 – 2:30 p.m.

+7. MEASURING ECOSYSTEM HEALTH: A REVIEW OF OTHER REGIONS (Kyle Rice, SANDAG)

INFORMATION/ DISCUSSION

Estimated Start Time: 2:30 – 2:55 p.m.

It has been a long-held belief that certain key indicators or metrics could be established to determine the "health" of the ecosystem. This is similar to doctors using a blood test to evaluate your personal health, or the financial markets using the DOW Jones or S&P 500 to gauge the stock market. Even regional transportation agencies use trends in traffic and road conditions to determine where maintenance and improvements would be most effective. Mr. Rice will provide an overview of measuring ecosystem health and provide examples from other regions. These case studies could serve as a model for creating an assessment of the Natural Communities Conservation Planning Preserves.

8. NEXT MEETING DATE AND ADJOURNMENT

INFORMATION

Estimated Start Time: 2:55 – 3:00 p.m.

The next meeting of the EMPWG is scheduled for September 13, 2016, from 1 to 3 p.m.

Tentative Topics:

Ad Committee's Recommendation on Land Management Grants
Summary of 2016 Rare Plant Monitoring

+ next to an item indicates an attachment

San Diego Association of Governments

ENVIRONMENTAL MITIGATION PROGRAM WORKING GROUP

July 12, 2016

AGENDA ITEM NO.: **2**

Action Requested: APPROVE

MAY 10, 2016, MEETING MINUTES

File Number 3200100

The meeting of the Environmental Mitigation Program Working Group (EMPWG) was called to order by Vice Chair Mike Grim (City of Carlsbad) at 1:03 p.m.

1. WELCOME AND INTRODUCTIONS

Attendance sheet is attached.

3. PUBLIC COMMENTS/COMMUNICATIONS/MEMBER COMMENTS (COMMENT)

Members of the public shall have the opportunity to address the EMPWG on any issue within the jurisdiction of SANDAG that is not on this agenda. Anyone desiring to speak shall reserve time by completing a "Request to Speak" form and giving it to the EMPWG Coordinator prior to speaking. Public speakers should notify the EMPWG Coordinator if they have a handout for distribution to EMPWG members. Public speakers are limited to three minutes or less per person. EMPWG members also may provide information and announcements under this agenda item.

There were no public comments.

2. JANUARY 12, 2016, MEETING MINUTES (APPROVE)

Action: Michael Beck (Endangered Habitats League) motioned to approve the meeting minutes for January 12, 2016, and James Whalen (Alliance for Habitat Conservation) seconded the motion. The motion carried without opposition.

Yes: Mike Grim (City of Carlsbad), Michael Beck (Endangered Habitats League), Robert Fisher (USGS), Anne Harvey (San Diego Conservation Network), James Whalen (Alliance for Habitat Conservation), Susan Wynn (U.S. Fish and Wildlife Service), Bridget Strickland (The San Diego Foundation), Teri Muzik (Wildlife Conservation Board), Melanie Kush (City of Santee), Jeanne Krosch (City of San Diego), Kim Smith (Caltrans), LeAnn Carmichael (County of San Diego), Trish Smith (The Nature Conservancy), David Mayer (Department of Fish and Wildlife). No - None. Abstain – None. Absent - City of Chula Vista, California Coastal Conservancy, City of Del Mar, Building Industry Association, City of Poway, U.S. Army Corps of Engineers. Vacant - City of Escondido.

REPORTS

4. REQUEST FOR FORMATION OF AD HOC COMMITTEES FOR FY 2017 FUNDING AND LAND MANAGEMENT GRANT REVIEW (KEITH GREER, SANDAG) (DISCUSSION/POSSIBLE ACTION)

The EMPWG has previously formed ad hoc committees to develop recommendations for the annual allocation of regional land management and monitoring funding and for the review of land management grants. SANDAG staff would request the formation of an ad hoc committee(s) for development of the FY 2017 funding allocations, and for the review and prioritization of the eighth cycle of Land Management Program grants. The committees will meet in June and July, respectively, day and time to be determined.

The ad hoc committee for FY 2017 annual funding includes: Chair Susan Wynn (U.S. Fish and Wildlife Service), Robert Fisher (USGS), Mike Grim (City of Carlsbad), David Mayer (Department of Fish and Wildlife), Trish Smith (The Nature Conservancy), LeAnn Carmichael (County of San Diego), James Whalen (Alliance for Habitat Conservation), Michael Beck (Endangered Habitats League).

The ad hoc committee for Land Management Grant review includes: Chair Mike Grim (City of Carlsbad), Susan Wynn (U.S. Fish and Wildlife Service), David Mayer (Department of Fish and Wildlife), LeAnn Carmichael (County of San Diego), Bridget Strickland (The San Diego Foundation), James Whalen (Alliance for Habitat Conservation) and Robert Fisher (USGS).

5. CHANGE IN ENVIRONMENTAL MITIGATION PROGRAM WORKING GROUP CHARTER (KEITH GREER, SANDAG) (RECOMMENDATION)

SANDAG staff has received two requests regarding membership on the EMPWG. The first request comes from the U.S. Forest Service, which has requested to join the EMPWG. The second request comes from the California Coastal Conservancy, which has indicated its desire to leave the EMPWG due to staffing. Changes to the EMPWG membership require a change in the Charter, as reflected in the attachment, and approval by the Regional Planning Committee.

Action: LeAnn Carmichael (County of San Diego) motioned to approve the recommendation and Teri Muzik (Wildlife Conservation Board) seconded the motion. The motion passed unanimously.

Yes: Mike Grim (City of Carlsbad), Michael Beck (Endangered Habitats League), Robert Fisher (USGS), Anne Harvey (San Diego Conservation Network), James Whalen (Alliance for Habitat Conservation), Susan Wynn (U.S. Fish and Wildlife Service), Bridget Strickland (The San Diego Foundation), Teri Muzik (Wildlife Conservation Board), Melanie Kush (City of Santee), Jeanne Krosch (City of San Diego), Kim Smith (Caltrans), LeAnn Carmichael (County of San Diego), Trish Smith (The Nature Conservancy), David Mayer (Department of Fish and Wildlife). No - None. Abstain – None. Absent - City of Chula Vista, California Coastal Conservancy, City of Del Mar, Building Industry Association, City of Poway, U.S. Army Corps of Engineers. Vacant - City of Escondido

6. BOARD OF DIRECTORS ACTION ON REGIONAL FUNDING MEASURE (ROB RUNDLE, SANDAG) (INFORMATION)

The Board of Directors has discussed a potential regional funding measure over several meetings throughout the year. Mr. Rundle will provide a report on the status of the potential funding measure and the SANDAG Board of Directors actions.

7. IMPLEMENTATION OF THE INVASIVE PLANT SPECIES STRATEGIC PLAN (JASON GIESSOW, DENDRA; RYAN WANN, COUNTY AGRICULTURE) (INFORMATION)

In September 2012, an Invasive Plant Management Strategy was developed through *TransNet* Environmental Mitigation Program (EMP) funding. After reviewing multiple options, SANDAG entered into a contract with the County of San Diego Agriculture, Weights and Measures, to utilize their network and skills to implement this plan. Mr. Giessow and Mr. Wann will provide a status report on this effort, including the successes and challenges.

8. BIOTELEMETRY DATA FOR GOLDEN EAGLES (DR. ROBERT FISHER, USGS) (INFORMATION)

Funded in part through *TransNet* EMP, the United States Geological Survey has been collecting data on the golden eagle in coastal southern California since 2014. This work has provided the best-available data on the behavior and range of golden eagles. Dr. Robert Fisher will present the interim results of the study, and insights on the eagle behavior and implications for management.

9. NEXT MEETING DATE AND ADJOURNMENT (INFORMATION)

The next meeting of the EMPWG is scheduled for Tuesday, July 12, 2016, from 1 to 3pm. Vice Chair Mike Grim (City of Carlsbad) adjourned the meeting at 3:03 p.m.

AUDIO OF THE MAY 10, 2016, EMPWG MEETING IS AVAILABLE AT:
http://www.sandag.org/index.asp?committeeid=78&fuseaction=committees.detail

REPRESENTATION	JURISDICTION / ORGANIZATION	NAME	MEMBER / ALTERNATE	ATTENDING
Environmental Mitigation Program Working Group Chair	Councilmember, City of Del Mar	Hon. Terry Sinnott	Chair	NO
South County Subregion	City of Chula Vista	Cheryl Goddard	Member	NO
	City of Chula Vista	Scott Donaghe	Alternate	NO
North County Coastal Subregion	City of Carlsbad	Mike Grim	Vice Chair/ Member	YES
	City of Oceanside	Vacant	Alternate	N/A
North County Inland Subregion	City of Poway	Oda Ausidh	Member	NO
	City of Poway	Carol Rosas	Alternate	NO
East County Subregion	City of Santee	Melanie Kush	Member	YES
	City of Santee	Christina Rios	Alternate	NO
City of San Diego Subregion	City of San Diego	Jeanne Krosch	Member	YES
		Kristen Forburger	Alternate	NO
County of San Diego Subregion	County of San Diego	LeAnn Carmichael	Member	YES
		Vacant	Alternate	N/A
Other Public Agencies	Army Corps of Engineers	Richard Van Sant	Member	NO
		Vacant	Alternate	N/A
	California Coastal Conservancy	Joan Cardellino	Member	NO
		Megan Cooper	Alternate	NO
	Caltrans	Bruce April	Member	NO
		Kim Smith	Alternate	YES
	Department of Fish and Wildlife	David Mayer	Member	NO
		Gail Sevrens	Alternate	YES
	U.S. Fish and Wildlife Service	Susan Wynn	Member	YES
		David Zoutendyk	Alternate	NO
	USGS	Robert Fisher	Member	YES
		Carlton Rochester	Alternate	NO
	Wildlife Conservation Board	John P. Donnelly	Member	NO
		Teri Muzik	Alternate	YES
Non-Profits	Endangered Habitats League	Michael Beck	Member	YES
		Scott Grimes	Alternate	NO
	San Diego Conservation Network	Anne Harvey	Member	YES
		Vacant	Alternate	N/A
	The Nature Conservancy	Trish Smith	Member	YES
		Vacant	Alternate	N/A
	The San Diego Foundation	Bridget Strickland	Member	YES
		Nicola Hedge	Alternate	NO
Business	Alliance for Habitat Conservation	James Whalen	Member	YES
		Nick Doenges	Alternate	NO
	Building Industry Association	Matt Adams	Member	NO
		Vacant	Alternate	N/A

Metrics of Ecosystem Health: A Review of Other Efforts

By Kyle Rice and Keith Greer, SANDAG

July 2016

Introduction

Motivation

Since the adoption of the Natural Communities Conservation Planning (NCCP) Act in 1991, California has become an epicenter of landscape level, multiple species conservation planning. Yet almost 20 years after the adoption of some of these plans, we still struggle to answer one of the basic questions posed by laymen and policy makers: *Are the NCCP Preserves working?*

While this question is simplistic on the surface, the overwhelming complexities of these systems and the multiple threats and drivers that govern their condition makes the answer much more complicated than would be expected. For example, years after the devastating 2003 and 2007 wildfires, comprehensive research by the USGS indicated that some species declined, some increased and some were unaffected. These complexities are further complicated by the spatial and temporal variability of the systems in question. Even terminology gets in our way as we struggle to define resiliency, sustainability, ecosystem integrity, and other key terms.

It has been a long health presumption that certain key indicators or metrics could be established to determine the "health" of the ecosystem. This is similar to a doctor using a a blood test to evaluate your personal health, or the financial markets using the DOW Jones or S&P 500 to gage the stock market. Even regional transportation agencies use trends in traffic and road conditions to determine where maintenance and improvements would be most effective.

Is it possible to come up with a set of metrics that could be obtained and tracked to reflect the condition of regional habitat conservation plans in San Diego, and possibly across the State?

Prior to embarking on such an effort, it is prudent to conduct a literature review and to highlight what other areas have done. This report provides the results of that research.

Ecosystem Health Background

Ecosystem health is a convenient metaphor used to describe the condition of an ecosystem (Rapport, 1998). The term "ecosystem health" has a somewhat controversial background which played out in the literature through the late 1980's and 1990's. Early papers by Schaeffer (1988) and Rapport (1985) advocated analogizing ecosystem health to human/organismal health and response to stress. It was suggested that for any given metric within an ecosystem there existed a range of values that could be considered "healthy". This concept was later criticized by Calow (1992) on

the basis that ecosystems do not have an optimal range of health, and thus the "health" of an ecosystem cannot be determined due to the lack of a reference condition needed for comparison.

The arguments presented by Calow along with others by Suter (1993) and Wicklum and Davies (1995) raise questions about how to deal with inherent properties of ecosystems such as disturbance and succession when attempting assessments of ecosystem health. Other concerns involving system heterogeneity make it difficult to determine if Schaeffer's healthy range even exists or if that range is instead unique to each individual community and its location, with each stand varying based on the particular abiotic and biotic factors that have influenced it. Perhaps one of the most difficult questions to answer, however, involves who or for which species the health of the system is being determined for. The range of a given metric necessary for survival of one individual may be entirely different than what is required for other species even within the same taxon. This is supported by the shift away from single species indicators in favor of multi-taxon approaches as measures of biological integrity and the realization that responses to disturbance can be highly variable within a system. Diffendorfer et al's. (2007) application of Karr's (1981) Index of Biological Integrity (IBI) to coastal sage scrub communities demonstrated that multi-taxon IBI's can indeed be a valuable tool for evaluation of biological integrity within southern Californian ecosystems, potentially addressing some of the concerns surrounding these assessments.

Controversies pedagogical interests aside, it is recognized that assessments of ecosystem health, which for purposes of this review can be considered synonymous with ecosystem integrity (although that is an argument in itself), can be extremely useful in guiding management at larger scales and for disseminating information to the general public. These monitoring and reporting programs can provide easier access to information for decision-makers who may lack a scientific background, increase efficiency of funding direction, and provide managers and researchers with valuable information about the state of habitats (Lovett et al. 2007). The practice is more common in aquatic habitats (Chesapeake 2014, "EcoCheck" 2015); however, the concept has been successfully applied to terrestrial systems as well (Mordecai et al. 2015, Wheeler et al. 2015, Tierney et al. 2009).

Although the development of such a program locally may appear difficult to undertake given the concerns discussed above, ecosystem evaluations performed by other regions are currently available and can be used to guide creation of this program. Below is a summary of these existing reports as well as a framework that can be used to possibly answer the laypersons question: How are these *NCCP Preserves working*?

Case Examples

Chesapeake Bay (Appendix A)

The Chesapeake Bay annual report is a product of the collective efforts of many individuals and organizations within the Chesapeake Bay scientific and management community to evaluate the condition of the bay ecosystem. It uses a typical academic

grading system to evaluate 15 individual geographic sub-regions of the bay which are used to generate a final overall score for the bay as a whole. Biotic indicators and water quality indicators are measured and compared to target thresholds that are derived from scientific literature and technical reports from the region. Measurements are evaluated by calculating the percentage of samples taken that meet the threshold assigned to the indicator. The percentages are averaged for water quality indicators and for biotic indicators to produce two indices that are used to calculate a score for each reporting geographic sub-region. These regional evaluations are then used to determine an overall Bay Health Index (Figure 1).

The biotic indicators included in the report span multiple trophic levels and include aquatic grasses, benthic community members, blue crab, bay anchovy, and sea bass. This multi-trophic approach enables researchers and managers to understand how impacts at one trophic level may be transmitted throughout the food web. Often these trophic level changes can be caused by fluctuations in water quality and nutrient levels, highlighting the importance of including both sets of indicators in the assessment. Measurements of nitrogen, phosphorous, dissolved oxygen and water clarity comprise the water quality index and when used in conjunction with the biotic indicators, they provide a comprehensive illustration of the functional health of the Chesapeake Bay ecosystem.

Recently, collaborators have begun to develop indicators that can be used to evaluate the Bay's resiliency to climate change. A similar approach could be included in any local effort to evaluate San Diego's ecosystems since sea level rise, drought, and increased warming may drastically alter the natural processes of the region's habitats. These indicators would be unique to each system since the threats associated with climate change can vary considerably and their inclusion could be part of the overall ecosystem score or as a separate grade strictly concerned with potential climate change impacts.

In general, the Chesapeake Bay report card template gives the local scientific and management community a simple yet comprehensive method to evaluate San Diego's ecosystems. It incorporates measurements of biotic and abiotic indicators and uses a multi-trophic approach to determine a final grade for each geographic sub-region. Trending graphics are also included to provide users information on how the scores for a given indicator are progressing (i.e. up, down, static) at that point in time. The main weakness of this system lies in the separation of grade scores by sub-region of the bay rather than ecosystem, a strategy that is useful for relatively homogenous aquatic systems but is less than ideal for San Diego's heterogeneous terrestrial landscape.

There are also obvious disadvantages associated with categorization of originally quantitative data for reporting purposes which is a common theme in these assessments. Fortunately, the developers of the Chesapeake Bay program have addressed this issue by providing users with an interactive web based system (see http://ecoreportcard.org/report-cards/chesapeake-bay/health/), in addition to the hard copy report, that allows for viewing of indicator data. The inclusion of this information is necessary prevent these monitoring programs from losing their scientific value but, depending on the target audience, such a level of detail may not be required. In the

next section, the Northeast Temperate Network monitoring program goes one step further and includes a detailed and thorough annual report in addition to a categorical ecological integrity scorecard. This approach greatly increases the amount of information immediately available to the user, but this comes at a cost in the form of increased effort and funding required for the program.

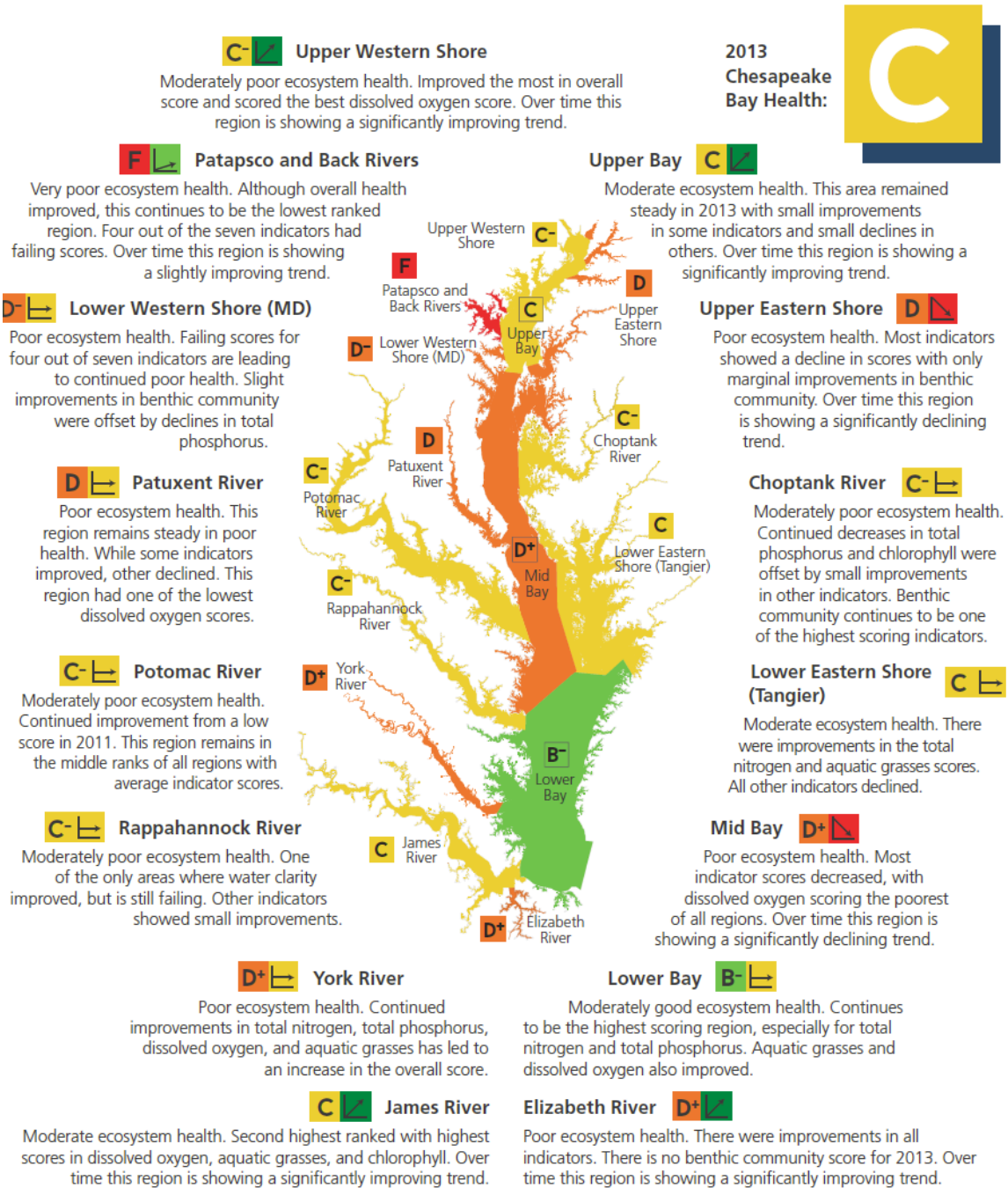

Figure 1: Chesapeake Bay Report card with grades separated by region and showing trending information. Overall the bay received a "C" when both water quality indicators and biotic indicators were combined (Chesapeake 2014).

Northeast Temperate Network (Appendix B)

The Northeast Temperate Network (NETN) was created as part of a larger program launched by the National Park Service (NPS) to establish Vital Signs Monitoring Networks that would link together parks with similar natural resources and geographic characteristics. This linking allows for larger scale analyses without an increase in overall monitoring effort and facilitates collaboration among park stewards. The NETN includes 10 parks scattered throughout the northeastern United States and uses a standardized long-term monitoring protocol that considers compositional, structural, and functional metrics to evaluate forest condition. These measurements are then compared to acceptable ranges that are based on scientific understanding and historic variation.

Sampling is done using a rotating four panel design so that all plots are measured every four years (Wheeler et al. 2015). This allows for the inclusion of an increased number of plots necessary to effectively capture network changes while not simultaneously leading to an unreasonable amount of monitoring effort. Results are reported in an "ecological integrity scorecard" (Figure 2), with more detailed analysis included in an annual report. The scorecard is designed to be readily accessible to the public and provides a snapshot of the current condition of the selected metrics. It uses an approach similar to the report card issued by the Chesapeake Bay group and categorizes monitoring results. Three categories are used including: Good, Caution, and Significant Concern. A score of "good" indicates the forest meets desired or acceptable conditions for that metric. "Caution" means that a problem exists and "significant concern" tells users that the forest conditions are undesirable for that metric and management action may be necessary.

Park	Structural Stage Distribution	CWD Ratio	Snag Abundance	Invasive Exotic Plants	Tree Condition/ Forest Pests	Tree Regeneration	Deer Browse Indicator Species	Tree Growth and Mortality	Soil Ca:Al	Soi C:N
Acadia National Park	Caution	Caution	Caution	Good		Good / Caution	Good	Good	Caution	Good
Marsh-Billings-Rockefeller NHP	Caution	Caution	Sign. Conc.	Caution			Good	Caution	Good	Sign. Conc.
Minute Man NHP	Good	Sign. Conc.	Caution	Sign. Conc.			Good	Good	Caution	Sign. Conc.
Morristown NHP	Good	Caution	Sign. Conc.	Sign. Conc.			Caution	Caution	Good	Sign. Conc.
Eleanor Roosevelt NHS & Home of FDR NHS	Good	Good	Caution	Caution			Caution	Caution	Good	Sign. Conc.
Vanderbilt Mansion NHS	Good	Good	Caution	Sign. Conc.			Caution	Caution	Good	Caution
Saint Gaudens NHS	Caution	Caution	Caution	Caution			Good	Caution	Sign. Conc.	Sign. Conc.
Saratoga NHP	Caution	Caution	Caution	Caution			Caution	Caution	Good	Sign. Conc.
Weir Farm NHS	Good	Caution	Caution	Sign. Conc.			Caution	Caution	Caution	Sign. Conc.

Figure 2: NETN ecological integrity scorecard. Each metric is given a categorical evaluation for each park. Pie charts represent the proportion of plots in each category (Wheeler et al. 2015).

In contrast to the scorecard, the annual report follows a structure more common in scientific literature. For each indicator, background information about the indicator is provided followed by a detailed results and discussion section that expands on the scores reported and elaborates on the implications associated with them. This helps promote collaboration among those involved and can elevate the level of discussion regarding appropriate management and policy options. Categorical results can also be misleading when reported alone. By including the original results the NETN, like the Chesapeake Bay group, is able to support their categorical findings and allow for interpretation of potential trends that may be hidden in the categorical reporting. This also promotes earlier responses and action to these trends if deemed necessary.

Evaluations are made by the NETN for other park resources such as Wetlands and Air Quality, and each resource has a separate monitoring protocol that is used for its assessment. Similar to the forest health monitoring, the metrics included in these protocols are reported using the three category scorecard shown above and are associated with either the composition, structure or function of the ecosystem. The protocols associated with these resources can also be used during development of local evaluation methodologies however they are not fully included in this review.

The NETN evaluation and reporting system has few apparent weaknesses however there are some points to consider before adopting or incorporating the strategy. Primarily, the amount of effort that is required to maintain and generate final reports and complete the monitoring surveys may be unrealistic depending on funding availability. Use of volunteer hours may alleviate some of the effort required but final reporting and analysis will still require involvement of scientific experts in the region. The system also fails to synthesize the information into a single overall score even within a resource. Each park is treated as a discreet unit and an evaluation for the entire system is lacking. This requires the user to combine metric assessments in order to understand the overall state of the resource and/or network which may prove difficult for those individuals who lack a scientific background. Lastly, the system does not include any interregional metrics such as network connectivity or resilience to climate change which are valuable when assessing from a larger scale perspective. Although these shortcomings must be considered, this program is extremely extensive and if the financial resources are available, a protocol that resembles the Network's efforts would provide valuable and comprehensive information about the current state of San Diego's terrestrial landscapes.

State of the South Atlantic (Appendix C)

The final reporting system that will be evaluated is the State of the South Atlantic report. Similar to the NETN and Chesapeake Bay documents, this report simplifies ecosystem evaluations into categorical, easily interpreted scores. This is a region wide annual evaluation that includes aquatic and terrestrial measurements, as well as landscape level metrics of connectivity. The information is synthesized into a final overall score for the entire South Atlantic region, something that was missing in the NETN evaluations.

The State of the South Atlantic considers the condition of seven separate sub-regions, 9 ecosystems and two regional connectivity metrics (landscapes and waterscapes).

Indicators are evaluated for each ecosystem or connectivity metric as well as each sub-region providing users two levels of evaluation. For example, the beach and dune ecosystem is evaluated for five indicators which include an index of beach birds, an indicator focused on miles of altered beach and three indicators concentrated on connectivity within the beach and dune ecosystem. Individual grade scores are provided for each indicator in reference to the entire beach and dune ecosystem throughout the South Atlantic region and a final overall score for the ecosystem is generated. The indicators are also evaluated for those sub-regions which contain beach and dune ecosystems providing an overall score for those sub-regions (Figures 3 and 4). Individual indicator scores are not available for the specific sub-regions in the hard copy report; however, more information regarding sub-region scoring can be found using their website's interactive map viewer.

Grade scores (A through F) are calculated based on the percent area of the system that is in good condition for the indicator and the range of values that is considered healthy for an indicator is determined using best available science. All the indicators can be modeled using existing data, and accurately reflect other components of healthy ecosystems, minimizing any additional effort required for program implementation. More than 200 people from at least 50 organizations were involved in selecting, testing, and providing data for the ecosystem indicators which are provided on their website (http://www.southatlanticlcc.org/indicators).

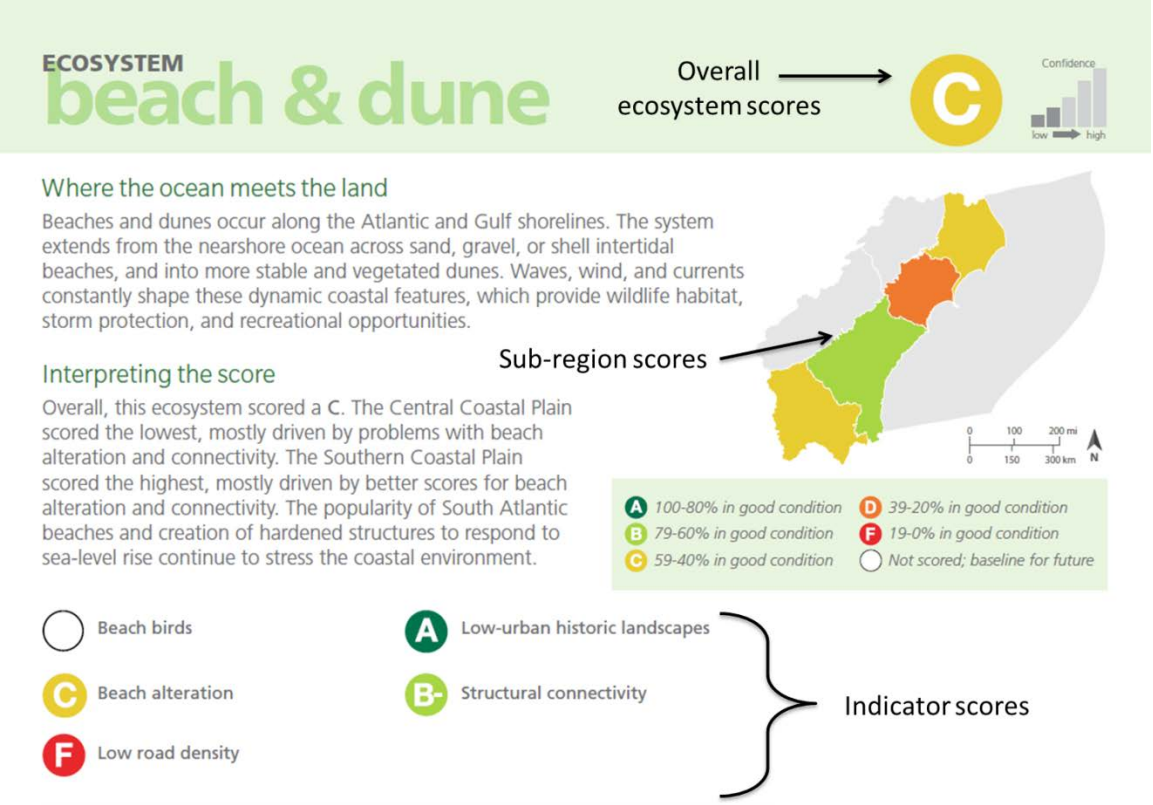

Figure 3: State of the South Atlantic ecosystem scoring. Each ecosystem breakdown provides grade scores for the ecosystem indicators, an overall ecosystem score and gives an overall grade for each sub-region that contains that ecosystem (Mordecai et al. 2015).

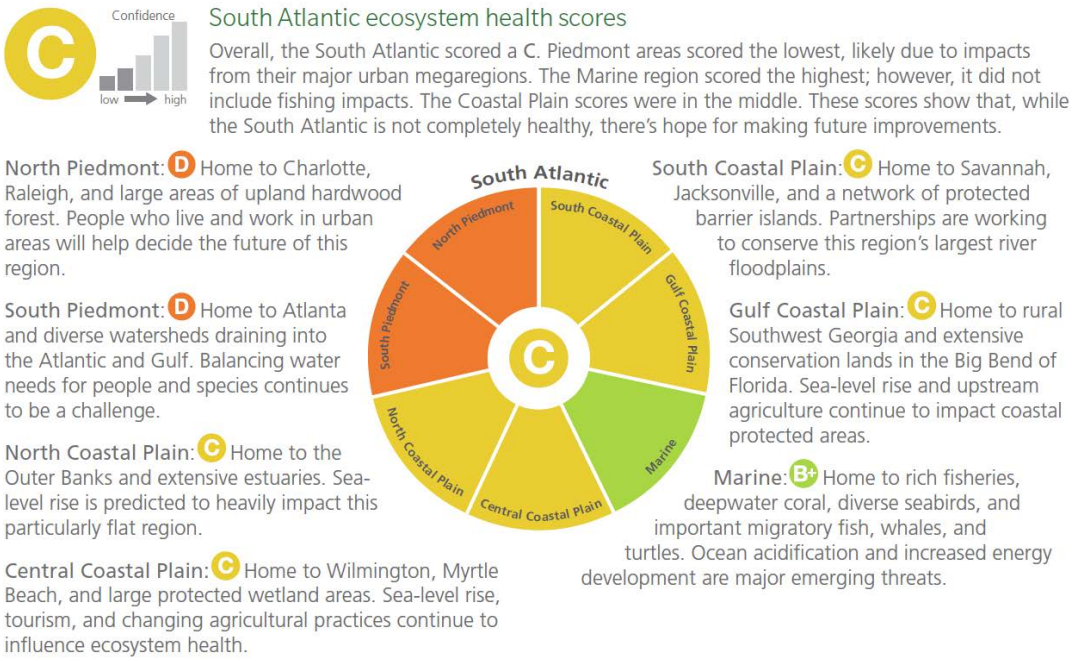

Figure 4: Sub-region overall report card. The sub-regional scoring for each ecosystem is used to generate the overall sub-regional scores (Mordecai et al. 2015).

The organization of this reporting system could be valuable in structuring a similar program for San Diego. Specifically, the separation of the evaluations by ecosystem and sub-region allows for location based or system based interpretation of the results, providing users flexibility in utilizing the information. For example, Regional or State organizations may be concerned with the overall condition of an entire community type, whereas a local leader or land manager may be only interested in the state of that community type that lies within their boundaries or the condition of their sub-region. The structure of this reporting system quickly provides both users the information they seek without requiring in depth independent review of original data. This approach may be more applicable to San Diego as compared to the resource separation performed by the NETN or the exclusively geographic separation performed by the Chesapeake Bay group since it can help to organize evaluations within heterogeneous landscapes. Including connectivity measurements at the landscape level is also a valuable feature that can provide information regarding potential wildlife utilization of conserved lands, identification of corridors and help guide future conservation planning. Its inclusion highlights the importance of including higher level measurements during evaluations since certain functional characteristics may be overlooked by focusing measurements at a single level (i.e. within a single ecosystem).

The most notable weakness with this reporting system lies in the difficulty encountered while trying to obtain the original data used to calculate the categorical scoring. The absence of this information can limit third-party scientific evaluation and interpretation of system condition and constrain discussions regarding management and policy action. It can also reduce trend detection, especially at early stages since trends may be able to develop within a categorical range for a given indicator depending on the thresholds set. It's possible that the reporting system was developed under the discretion that this

information was not necessary to include based on the targeted audience. However, any program implemented locally would likely benefit from providing this data given the extensive preserve system established in San Diego and high potential for use of this reporting tool by land managers and conservation groups alike. As demonstrated by the Chesapeake Bay group, there are methods of including this information without excessively adding to the efforts required for report generation and distribution.

Considerations for Implementation

Collectively, these reports as well as others not included in this review give collaborators in San Diego a starting point to begin developing an evaluation report for the San Diego preserve system. Each report has its own strengths and weaknesses that can be incorporated into local efforts. In addition to the weaknesses found in the examples provided, local groups will also need to address the general difficulties associated with ecosystem health measurements established in the introduction. These questions will only be answered through collective discussion and collaboration by individuals and organizations with experience in southern California's ecosystems. In the following section, the methods and suggestions provided by the organizers of current reporting programs are compiled into a general framework that can be used to organize the workshops necessary to begin addressing these questions and move toward development of a region wide reporting system for San Diego.

Determine Structure of the Evaluations

Prior to establishing a reporting system, participants will first need to agree upon the overall structure of the evaluations. What are the objectives of the reporting system? What categories or areas of interest will be evaluated? How will the various geographies be treated across the evaluation area? What specific indicators will be used? Will the report try to assign letter grades or use an alternative approach?

Other factors to consider when deciding on an overall structure include scalability, in the event other regions are included in this assessment, and flexibility, allowing the program to be adaptable to changes in priority or identification of new threats or indicators. The information needs to be able to provide useable information to broad audience without being overly complex. Addressing these questions up front will lead to a fundamentally stronger evaluation.

Develop Conceptual Model(s)

Conceptual models are useful tools for determining what aspects of the preserve area or regional landscape should be evaluated and for choosing appropriate indicators. They are important for focusing both monitoring and management actions (Atkinson et al. 2004) as can be seen in the example provided below (Figure 5). This figure was created by incorporating components of models provided by Tierney et al. (2009) and McKinney et al. (2011) and adapted to represent local coastal sage scrub communities. These models are useful to establish the main drivers of composition, structure and function, as well as identifying the threats and stressors associated with each system. Conceptual models have already been created for some vegetation communities and

species in San Diego County (Hierl et al. 2005) that could serve as a starting point for local organizers.

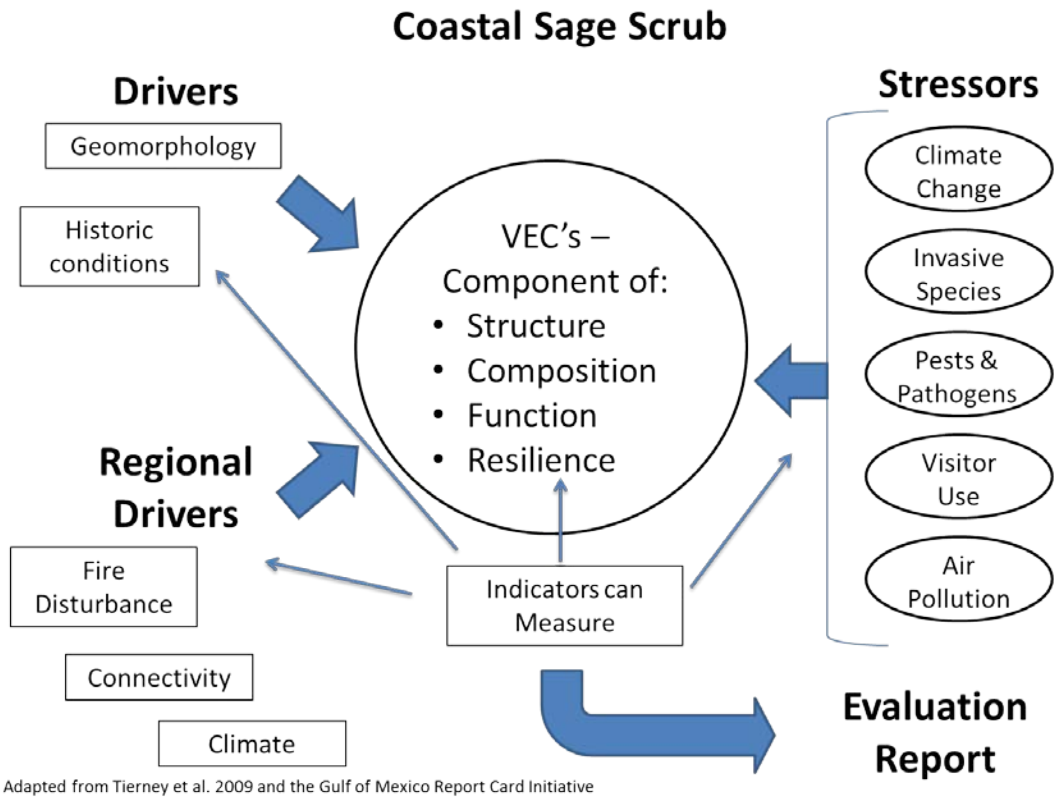

Figure 5: Theoretical conceptual model for the coastal sage scrub community. The model is presented as a representation assuming a system based structure is used for reporting and is not inclusive of all components.

During the structure development process, participants will have already considered how detailed the division of systems will be. This is important since the conceptual models will be dependent on this scaling and how systems are classified. As an example, if a system based on plant communities is used, then conceptual models could conceivably be developed for coastal sage scrub, chaparral, etc. Alternatively the scale could be coarser and focused on ecoregions, or more refined to capture information about individual species. These conceptual models could also be generated for landscape level processes such as connectivity or climate change resilience, or as in the figure above, these could instead be included as a separate element such as regional level drivers to be included in all system models.

Identify Indicators for Measurement, Create scoring system

The conceptual models should lead into a discussion of what indicators or metrics are the most important for monitoring. The South Atlantic effort has identified roughly thirty (30) indicators across eleven systems (nine ecosystems and two regional connectivity measurements) and seven sub-regions for monitoring (see Figure 6 and http://www.southatlanticlcc.org/indicators/ for details). These metrics correspond either

to a specific ecosystem or are intended to capture information about the connections across terrestrial and aquatic systems. They provide a roadmap for indicator development, testing and revision that could be mimicked by any effort in San Diego.

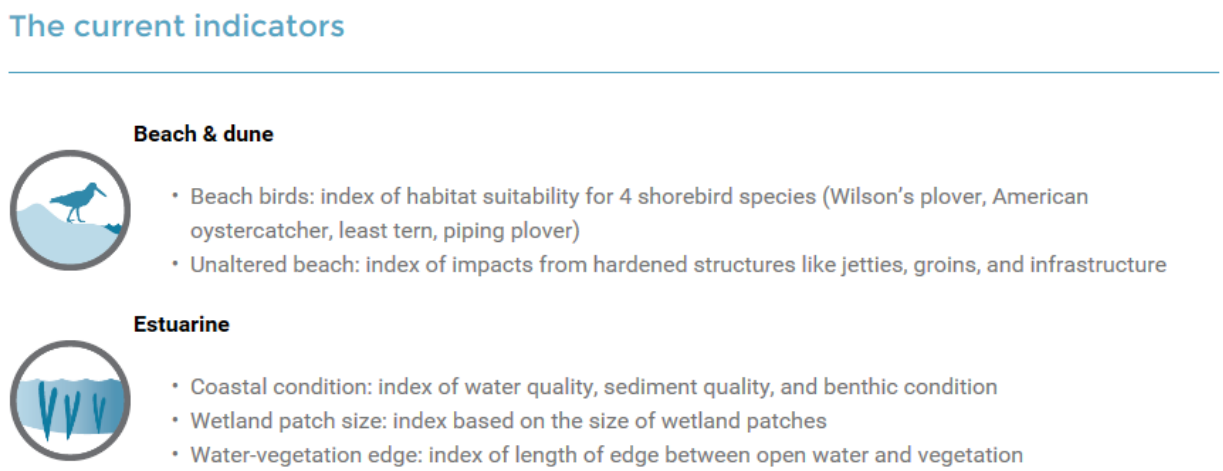

Figure 6: Partial list of categories and indicators utilized in the South Atlantic Landscape Conservation Cooperative reporting

After determining which indicators will be used, the most difficult task in this process, and often the most controversial, is to determine the range of values for the indicator that is considered "healthy". The range assigned to each indicator may change seasonally or through time, making it necessary to periodically re-evaluate the thresholds set using the most recent information. As seen in the examples provided, these ranges are often determined using the best available scientific literature, but this is a vague description and the process may be more complicated. Using only peer-reviewed literature to establish these ranges also inadvertently imposes a limit to what can be used as an indicator since few metrics have been sufficiently examined to allow determination of a healthy range. Understanding these limitations may eventually become a tool for driving future research but during the early stages of program development, these limitations will only contribute to the difficulties of this task.

Typically, scoring systems are developed to evaluate the status of the selected indicators. This can be simplistic and focused on the percent of monitoring sites that fall within the range that is considered healthy, or be more complex with measurements averaged and weighted depending on the value given to a particular system, indicator or component. For example, it may be determined that indicators directly focused on ecosystem function should be weighted more heavily in overall scoring than those focused on composition since the services the system provides are ultimately what people are interested in. Such weighting may be beneficial to certain groups and provide a quick representation of ecosystem integrity but it could also conceal underperforming indicators that indirectly influence overall function. This strategy would need to be used with caution and management attention should be equally given to all indicators even if their weighting suggests otherwise.

Publication/communication

The final step in this process is to decide on a reporting tool that can be used to effectively communicate the results of this monitoring effort to a wide ranging audience. This includes designing and structuring the report(s) as well as determining the best avenues to use to make the reports available to the end user. The easily accessible categorical grading system provides the widest reach; however, the information may be less useful to land managers and the scientific community due to lack of detail. It's possible that information could be released in multiple formats each geared towards a separate demographic/target audience (Mckinney et al. 2011), however this significantly increases the amount of effort required for dissemination purposes which was a concern raised regarding the NETN program.

Making the report available on an interactive web based platform is a cost effective option that can provide the flexibility required to satisfy a variety of users. The Chesapeake Bay group utilizes such a system in their reporting and the State of the South Atlantic offers a limited version however the original indicator scores were not available on the South Atlantic platform. These tools are useful for the average person interested in an overview of the current state of the surrounding landscapes and can be used to report original data without requiring additional scientific reporting, satisfying the requirements of both types of user. It is likely that the most appropriate communication form for use in San Diego will involve a combination of reporting at various spatial scales and levels of detail and the structure of these reports will ultimately depend on the overall objectives outlined by the monitoring program.

Conclusion

This review has summarized multiple efforts to characterize the status of ecological systems using various metrics. Each example discussed has strengths and weaknesses that could serve as starting point to develop an improved program for use in San Diego or southern California. One important aspect of these reporting efforts is to provide a useful way of articulating the status of complex systems to the general public, and tracking these over time. If done correctly, these metrics could use data already being collected by researchers and land managers, limiting the amount of additional effort that is required for implementation of the program. The use of such a reporting tool can be invaluable for future direction of policy and decision making, while also guiding management efforts and funding allocation at a regional scale.

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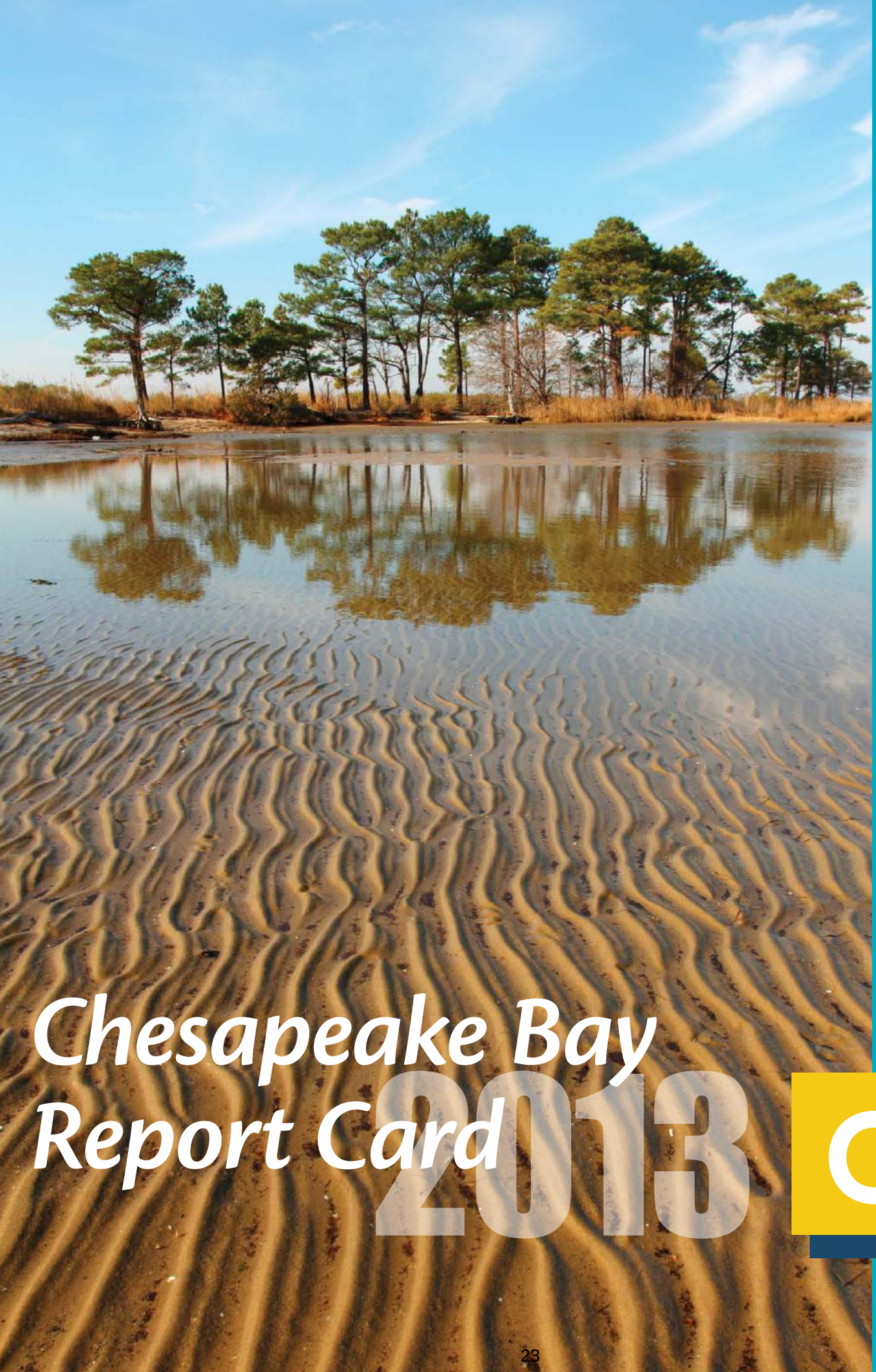


Chesapeake Bay Report Card 2013

C

Climate change impacts

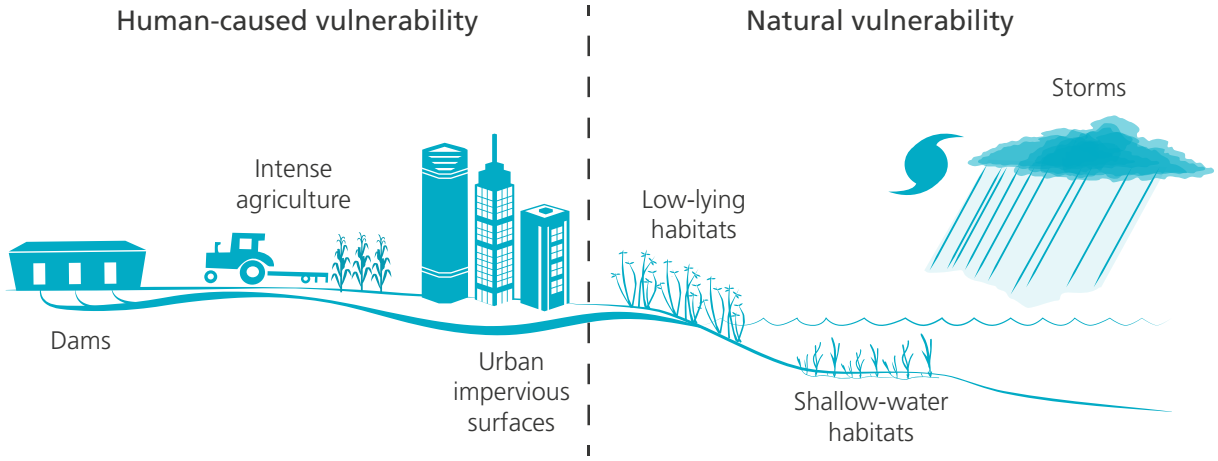
- Sea level rise
- Temperature
- Precipitation
- Storms
- Salinity (NaCl)
- pH

Climate change indicators

- Coastal wetlands
- Submerged aquatic vegetation
- Fish
- Shellfish
- Pathogens

How will Chesapeake Bay respond to climate change?

Protection and restoration of the Chesapeake Bay must account for climate change impacts that we are experiencing now. These impacts include sea level rise, increasing water temperatures and rainfall, increasing storm frequency and intensity, changes in salinity, and ocean acidification (pH). We are currently developing a suite of indicators that will measure resilience of Chesapeake Bay to climate change. These indicators are coastal wetlands, submerged aquatic vegetation, fish, shellfish, and pathogens.

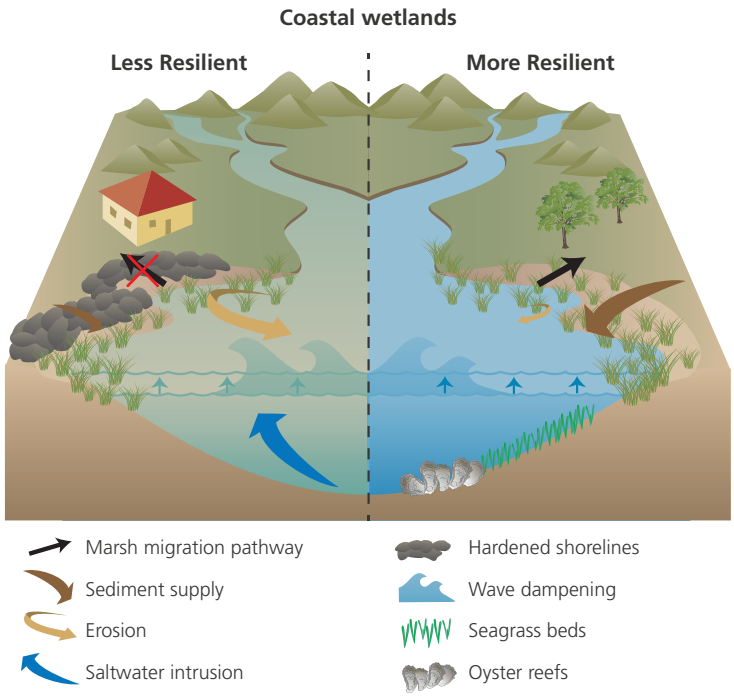


The new Climate Change Resilience Index addresses both human-caused and natural vulnerabilities of Chesapeake Bay to climate impacts.

How can we measure resilience to climate change?

We are creating the Climate Change Resilience Index using a 5-step process:

1. **Conceptualize:** illustrate the ways that climate change may affect resources from sea level rise, increased temperature, precipitation, and storm frequency and intensity, and ocean acidification.
2. **Choose Indicators:** choose indicators that reflect the processes from the conceptualization.
3. **Define Thresholds:** determine the desired condition for each one of the indicators.
4. **Calculate Scores:** compare data to the desired conditions, and combine into an index for climate resilience.
5. **Communicate Results:** the index will be incorporated into the Chesapeake Bay Report Card, and will be highlighted in newsletters and other reports.



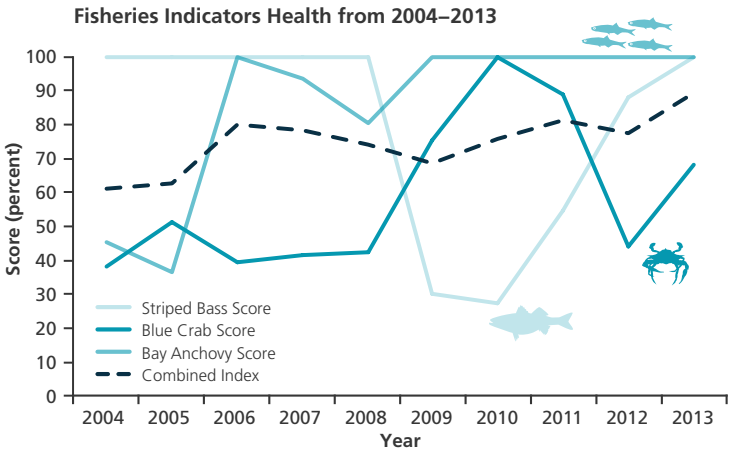
A conceptual diagram shows that coastal wetlands that are protected from erosion have adequate sediment supply to build upwards, and have access to landward migration pathways, will likely be more resilient to climate change effects.

As an example, Conceptualization shows that coastal wetlands are likely to be affected by their ability to migrate landward or grow upwards as sea levels rise, and will be protected by underwater grasses and oyster habitat, which reduce wave action and erosion during storms. Indicators that can be used to measure wetland resilience include migration pathways that will allow the wetlands to migrate landward, and sediment supply, which allows wetlands to grow upward as sea levels rise.

Key fish populations are improving

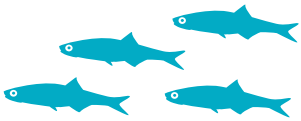
Striped bass, bay anchovy, and blue crabs are ecologically, economically, and socially important fish species in Chesapeake Bay. Analysis of abundance data over the last ten years shows variability but general improvements.

The overall Fisheries Index Score for 2013, which is an average of all three species scores is an 89%. Based on these three fish stocks, there is an improving trend. The data used in this analysis is from the 2012—2013 sampling season for most species.



Fisheries indicators are variable over time, but generally are showing improving scores.

Bay Anchovy



Bay anchovy are one of the most abundant schooling fishes in the Bay, providing an important food source for top predators.

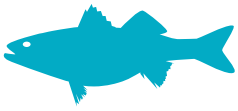
A beach seine survey is conducted throughout Maryland and Virginia to estimate bay anchovy (*Anchoa mitchilli*) abundance throughout the Bay (mean fish per seine). Data for bay anchovy has been collected Baywide since 1980. Bay anchovies have improved since 2004 and in 2013, the bay anchovy score was 100%.

Blue Crab

Blue crabs are both predator and prey in the Bay's food web. They use aquatic grasses as habitat to hide from predators and to mate and molt.

A winter dredge survey is conducted annually since 1980 throughout Maryland and Virginia to assess blue crab (*Callinectes sapidus*) populations (number of adult females). A target of 215 million adult female crabs has been set by Bay managers as the amount needed to keep a sustainable crab population. In 2013, the blue crab score was 68%.

Striped Bass



Striped bass, or rockfish, is a key top predator, and uses the Bay as an important spawning and nursery area. Striped bass is Maryland's state fish and a popular commercial and recreational fishery.

A trawl survey is conducted annually since 2002 throughout Maryland and Virginia to estimate striped bass abundance index (*Morone saxatilis*). Since striped bass are a long lived fish, a three year average of the numerical index is used to determine the score. Striped bass populations are naturally variable, and short-duration declines in the index are not generally a cause for concern. In 2013, the striped bass score was 100%.

Bay health: eastern shore degrading, western shore improving

2013 Chesapeake Bay Health: C

C⁻ Upper Western Shore

Moderately poor ecosystem health. Improved the most in overall score and scored the best dissolved oxygen score. Over time this region is showing a significantly improving trend.

F Patapsco and Back Rivers

Very poor ecosystem health. Although overall health improved, this continues to be the lowest ranked region. Four out of the seven indicators had failing scores. Over time this region is showing a slightly improving trend.

D⁻ Lower Western Shore (MD)

Poor ecosystem health. Failing scores for four out of seven indicators are leading to continued poor health. Slight improvements in benthic community were offset by declines in total phosphorus.

D Patuxent River

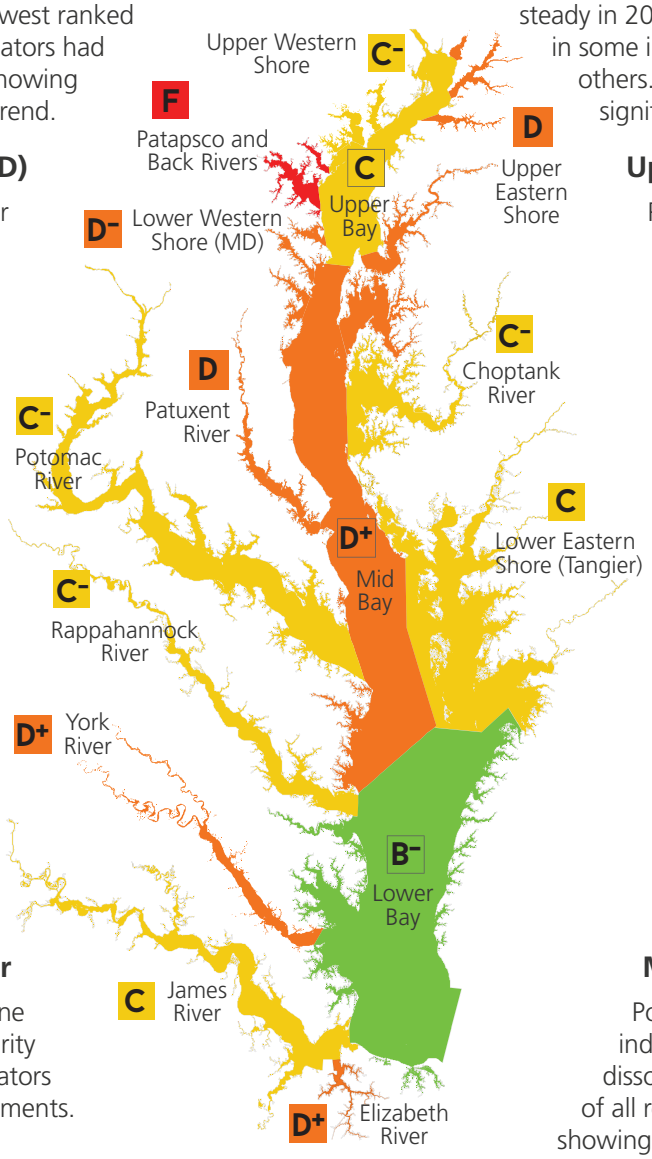
Poor ecosystem health. This region remains steady in poor health. While some indicators improved, other declined. This region had one of the lowest dissolved oxygen scores.

C⁻ Potomac River

Moderately poor ecosystem health. Continued improvement from a low score in 2011. This region remains in the middle ranks of all regions with average indicator scores.

C⁻ Rappahannock River

Moderately poor ecosystem health. One of the only areas where water clarity improved, but is still failing. Other indicators showed small improvements.



Upper Bay C

Moderate ecosystem health. This area remained steady in 2013 with small improvements in some indicators and small declines in others. Over time this region is showing a significantly improving trend.

Upper Eastern Shore D

Poor ecosystem health. Most indicators showed a decline in scores with only marginal improvements in benthic community. Over time this region is showing a significantly declining trend.

Choptank River C⁻

Moderately poor ecosystem health. Continued decreases in total phosphorus and chlorophyll were offset by small improvements in other indicators. Benthic community continues to be one of the highest scoring indicators.

Lower Eastern Shore (Tangier) C

Moderate ecosystem health. There were improvements in the total nitrogen and aquatic grasses scores. All other indicators declined.

Mid Bay D⁺

Poor ecosystem health. Most indicator scores decreased, with dissolved oxygen scoring the poorest of all regions. Over time this region is showing a significantly declining trend.

D⁺ York River

Poor ecosystem health. Continued improvements in total nitrogen, total phosphorus, dissolved oxygen, and aquatic grasses has led to an increase in the overall score.

Lower Bay B⁻

Moderately good ecosystem health. Continues to be the highest scoring region, especially for total nitrogen and total phosphorus. Aquatic grasses and dissolved oxygen also improved.

C James River

Moderate ecosystem health. Second highest ranked with highest scores in dissolved oxygen, aquatic grasses, and chlorophyll. Over time this region is showing a significantly improving trend.

Elizabeth River D⁺

Poor ecosystem health. There were improvements in all indicators. There is no benthic community score for 2013. Over time this region is showing a significantly improving trend.

It's not the rain, it's what the rain carries

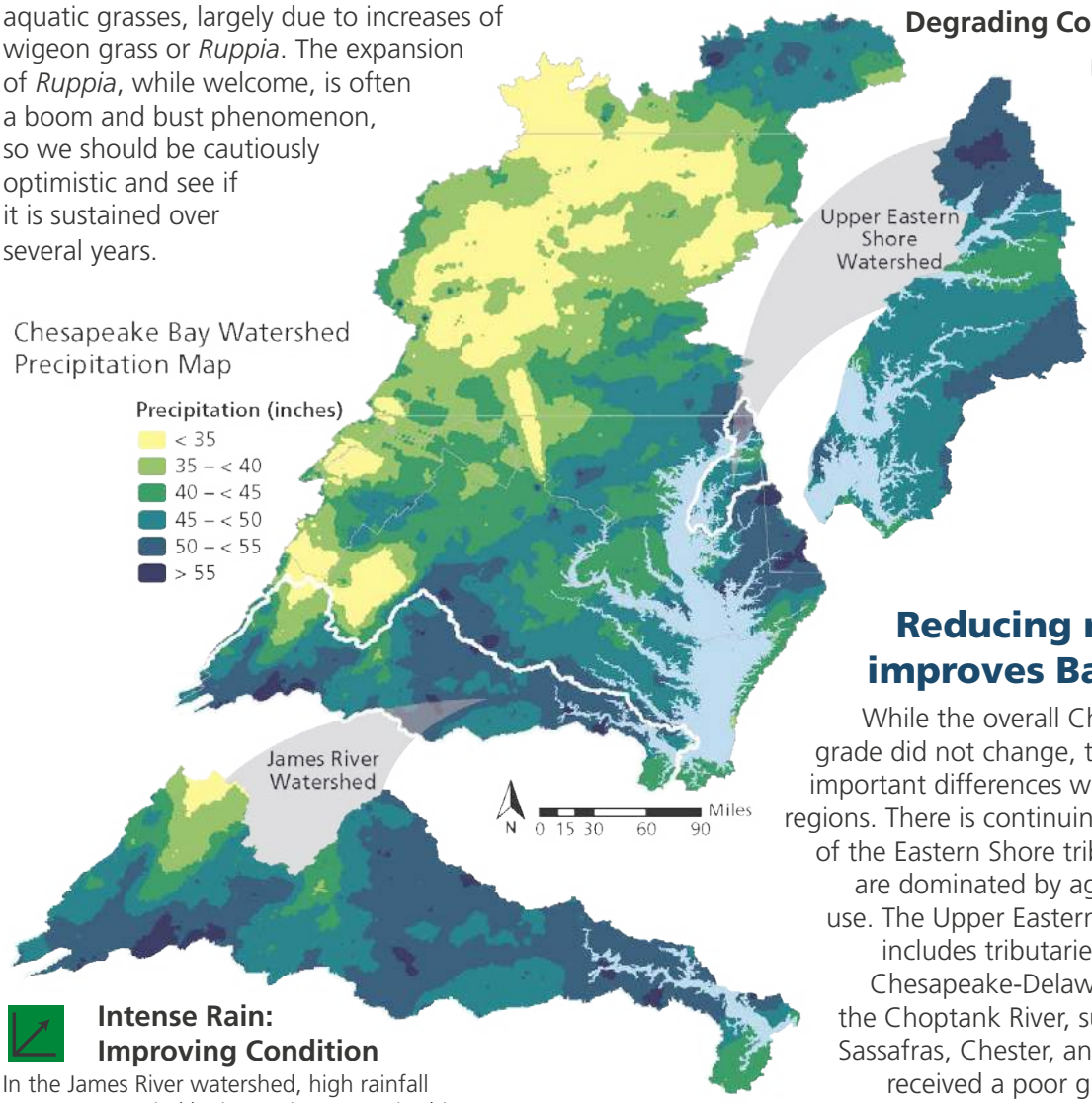
Although it was a quiet year for extreme events like hurricanes, July 2013 was one of the hottest on record, and annual rainfall was above average. Nutrients and sediments carried by stormwater are important factors in Chesapeake Bay Health.

Overall, Chesapeake Bay scored a 45%, a C, which is almost the exact same score as last year even though there was a lot more rain. Water clarity in the Bay is declining; the amount of chlorophyll in the water was also higher, which added to the murkier water conditions.

The indicator with the most improvement was aquatic grasses, largely due to increases of wigeon grass or *Ruppia*. The expansion of *Ruppia*, while welcome, is often a boom and bust phenomenon, so we should be cautiously optimistic and see if it is sustained over several years.

Intense Rain: Degrading Condition

High rainfall was accompanied by degrading scores from nutrient and sediment runoff in the Upper Eastern Shore Watershed.



Intense Rain: Improving Condition

In the James River watershed, high rainfall was accompanied by improving scores in this forested and developed region, due in part from wastewater treatment plant upgrades.

Reducing nutrients improves Bay health

While the overall Chesapeake Bay grade did not change, there are some important differences within reporting regions. There is continuing degradation of the Eastern Shore tributaries which are dominated by agricultural land use. The Upper Eastern Shore, which includes tributaries between the Chesapeake-Delaware Canal and the Choptank River, such as the Elk, Sassafras, Chester, and Miles Rivers, received a poor grade, a D. This region has a negative trajectory, so it is getting worse, not better. The Choptank River and the Lower Eastern Shore regions also had low grades, in part due to rainfall in excess of 50 inches on the Delmarva peninsula, which washed fertilizer and chicken manure from fields into the Bay.

The western shore tributaries generally improved last year, due in part to the success of the sewage treatment upgrades removing nitrogen and phosphorus, and the decline in atmospheric nitrogen deposition noted in the recently released New Insights report (see back page). Of particular note is the James River which has a positive trajectory and whose grade dramatically improved in 2012, despite high rainfall.

Bay health scale

100%	A	Very good
80	B	
60	C	Moderate
40	D	
20	F	Very poor
0%		

Bay health trends

- Significantly improving
- Slightly improving
- No change
- Slightly declining
- Significantly declining

Water quality improvements, challenges, and opportunities

Investments in sewage treatment plants provide rapid water quality improvements.

Upgrades to wastewater treatment plants are effective restoration practices. Wastewater treatment plant upgrades result in decreased nitrogen and phosphorus loadings to the Chesapeake Bay. Reduced nitrogen and phosphorus loads lead to improved water quality and in some cases increased submerged aquatic vegetation.

The Clean Air Act is benefiting the Chesapeake Bay through reducing nitrogen.

Almost one-third of the nitrogen load to the Chesapeake Bay comes from atmospheric deposition. Atmospheric nitrogen originates from power plants, industrial facilities, vehicle emissions, and the volatilization of ammonia from animal waste and ammonia-based fertilizers. Reductions in atmospheric nitrogen deposition are directly linked to improvements in water quality.

Agricultural practices such as cover crops are providing local benefits to streams.

Reducing agricultural nutrient input onto the land and in streams leads to significant water quality and aquatic habitat improvements in as little as one to six years. Winter cover crops decrease the levels of nutrient inputs into shallow groundwater, and consequently, streams. Manure and fertilizer management reduces nutrients and sediment loads. Controlling livestock access to streams decreases sediment, nutrients, and bacteria in streams, and prevents stream bank erosion.

Stormwater management practices need to be implemented as development expands.

Urban and suburban development will continue to expand as population grows, necessitating best management practices. Development is associated with increased impervious surfaces, lawn fertilizer, vehicle emissions, septic systems, gas-powered lawn tools, and construction. Resulting increases in nutrients and sediment reach the Bay through stormwater runoff. Best management practices that reduce stormwater nutrient and sediment loads include above-ground retention ponds, rain gardens, and sand filters.

Photos and text from the New Insights Report; see http://ian.umces.edu/link/newinsights

About the Chesapeake Bay Report Card

Report card produced and released in May 2014 by the Integration and Application Network, University of Maryland Center for Environmental Science.

This report card provides a transparent, timely, and geographically detailed assessment of Chesapeake Bay. The data and methods underpinning this report card represent the collective effort of many individuals and organizations working within the Chesapeake Bay scientific and management community. The following organizations contributed significantly to the development of the report card: Chesapeake Bay Program, University of Maryland Center for Environmental Science, National Oceanic and Atmospheric Administration, Maryland Department of Natural Resources, Virginia Department of Environmental Quality, Virginia Institute of Marine Science (VIMS), Versar Incorporated, U.S. Environmental Protection Agency, Maryland Department of the Environment, Interstate Commission on the Potomac River Basin, Old Dominion University, Morgan State University, and U.S. Geological Survey. Bay anchovy photo from Aimee Comer (VIMS).

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Birch tree with fall foliage in background. Ed Sharron photo

Forest Health Monitoring

Northeast Temperate Network

Program Brief

Right: Hemlock woolly adelgid is one of several pests and pathogens that the Network keeps an eye out for when monitoring forest plots. Cornell fungi photo.

Below: The NETN forest health crew takes plot measurements in Acadia National Park. NPS Photo.

Northeast Temperate Network (NETN) forests range from the central oak-hardwoods of New Jersey to the northern hardwoods and spruce-fir forests of northern New England, and include the pine woodlands of Acadia National Park as well as the plantations and successional habitats found in several of the National Historical Parks and Sites.

Why monitor forest health?

Forest vegetation is a primary component of most NETN parks, and its structure, composition and condition determines habitat for a wide variety of organisms.

Forest vegetation was identified as a high priority vital sign in the early days of the Network. This monitoring program also provides data for three additional high-priority vital signs including the condition of forest soil, white-tailed deer feeding habits, and landscape context. The program's overall goal is to assess the status and trends in the composition, structure, and function of NETN forested ecosystems.

How is the monitoring done?

Permanent forest plots are established in each participating park.

Tree and stand measurements are made every 4 years within permanent forest monitoring plots that were randomly located in participating parks. Tree regeneration is measured within three 2-meter radius circular microplots within each plot. Coarse woody debris (CWD) is assessed using a line intersect sampling method along three 15-meter transects originating at plot center. Understory diversity is monitored within eight 1-meter^2 quadrats, and soil samples are obtained from a location adjacent to the plot so as not to disturb the plot itself. See the illustration on the back page for plot layout, and for a complete description of forest monitoring techniques, including field methods and sample design, download the protocol from NETN's website.

How is the information delivered to parks?

The Ecological Integrity Scorecard tells the story

An Ecological Integrity Scorecard is used to aid the reporting and interpretation of forest condition in NETN parks. The scorecard examines a suite of compositional, structural, and functional measurements in relation to their natural or historical range of variation. The Network recognizes that "ecological integrity" may not be the primary goal of park resource management, particularly at historical parks and historic sites where cultural resource management may the primary motivating factor. Even if this is so, having the ability to compare the condition of park resources to ecological integrity benchmarks is valuable because it provides a deeper understanding of park conditions, as well as a consistent baseline to assess management goals. NETN staff are working with managers at several parks to develop scorecards that more

Park	Structural Stage Distribution	CWD Ratio	Snag Abundance	Invasive Exotic Plants	Tree Condition/ Forest Pests	Tree Regeneration	Deer Browse Indicator Species	Tree Growth and Mortality	Soil Ca:Al	Soi C:N
Acadia National Park	Caution	Caution	Caution	Good		Good / Caution	Good	Good	Caution	Good
Marsh-Billings-Rockefeller NHP	Caution	Caution	Sign. Conc.	Caution			Good	Caution	Good	Sign. Conc.
Minute Man NHP	Good	Sign. Conc.	Caution	Sign. Conc.			Good	Good	Caution	Sign. Conc.
Morristown NHP	Good	Caution	Sign. Conc.	Sign. Conc.			Caution	Caution	Good	Sign. Conc.
Eleanor Roosevelt NHS & Home of FDR NHS	Good	Good	Caution	Caution			Caution	Caution	Good	Sign. Conc.
Vanderbilt Mansion NHS	Good	Good	Caution	Sign. Conc.			Caution	Caution	Good	Caution
Saint Gaudens NHS	Caution	Caution	Caution	Caution			Good	Caution	Sign. Conc.	Sign. Conc.
Saratoga NHP	Caution	Caution	Caution	Caution			Caution	Caution	Good	Sign. Conc.
Weir Farm NHS	Good	Caution	Caution	Sign. Conc.			Caution	Caution	Caution	Sign. Conc.

Above: A sample of the Ecological Integrity Scorecard that lets parks get a quick snapshot of their forests overall health, and to see how they compare with other Network parks.

Below: The layout of a Forest Health Monitoring plot for participating Network parks. Tree and stand measurements are made within fixed-area, square plots. The plots in Acadia NP are smaller because tree density is much higher than the other parks.

closely track progress towards specific park resource management goals.

How does the A.T. have its forest monitored?

Trying to tell the tale of the trail

Because of the unique geography and logistical challenges associated with the Appalachian National Scenic Trail (A.T.), a modified version of the NETN long-term forest monitoring protocol was developed to monitor forest vegetation along its length. The changes reduce the gear requirements to a level appropriate for backcountry work, make the protocol cheaper and faster to implement, and more suitable for volunteers to follow. The protocol includes methods for collecting data to assess the health and ecological integrity of forested ecosystems found along the trail. Within A.T. forested systems key stressors include land use change and habitat fragmentation on lands adjacent to the trail's corridor. Other primary concerns include invasive exotic species, atmospheric deposition and ozone pollution, climate change, and visitor impacts.

More information:

For access to the full monitoring protocol, resource briefs, and more - visit NETN's website and click on the Monitoring / Forest Health links. You can also "like" NETN on Facebook where you can view pictures and time lapse videos of monitoring crews in the field.

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C

State of the South Atlantic 2015

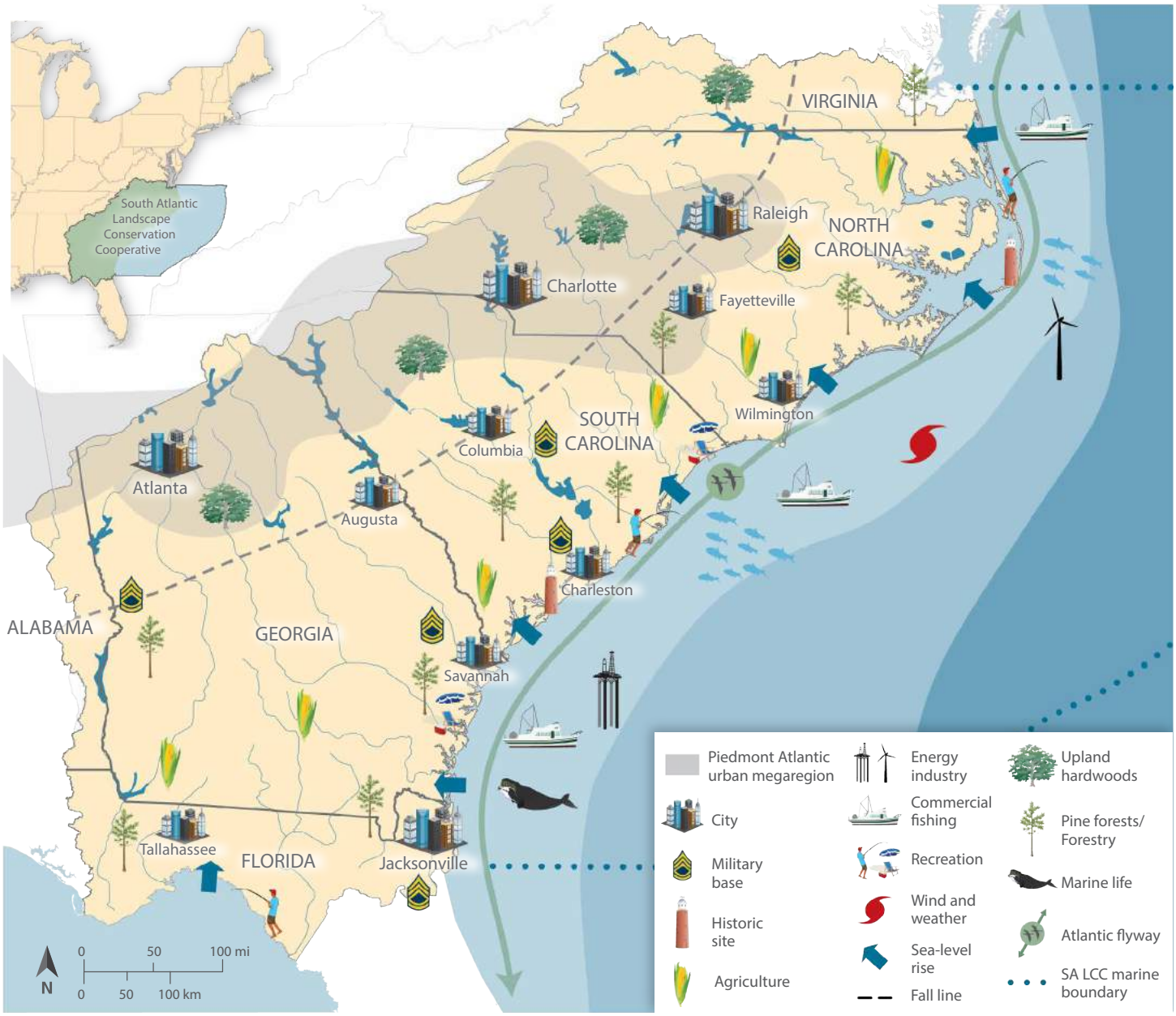
Understanding our living landscapes

Introducing the South Atlantic

The South Atlantic region

The South Atlantic Landscape Conservation Cooperative (LCC) is a partnership of federal, state, nonprofit, and private organizations dedicated to conserving a landscape capable of sustaining natural and cultural resources for current and future generations. Its geography spans parts of six states, from Virginia to Florida, including U.S. waters to 200 miles offshore.

The South Atlantic region supports a complex mix of biological richness and human activity—since over 90% of the land is privately owned, balancing the two poses a challenge. Above the fall line, a geological boundary separating the uplands and Coastal Plain, the Piedmont harbors hardwood forests and amazing aquatic diversity, both threatened by rapid urban growth. Below, agriculture and pine forestry thrive. Many military installations balance mission readiness with rare species habitat. Along the shore, ships unload freight in ports near historic lighthouses and beach-nesting birds—all while sea level rises and storms intensify. Offshore, energy exploration is underway. Recreational and commercial fishermen harvest their catch while whales migrate up the coast.



State of the South Atlantic

South Atlantic ecosystem health scores

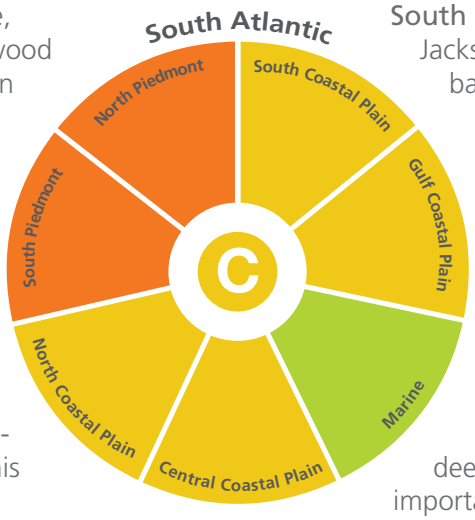
Overall, the South Atlantic scored a **C**. Piedmont areas scored the lowest, likely due to impacts from their major urban megaregions. The Marine region scored the highest; however, it did not include fishing impacts. The Coastal Plain scores were in the middle. These scores show that, while the South Atlantic is not completely healthy, there's hope for making future improvements.

North Piedmont: D Home to Charlotte, Raleigh, and large areas of upland hardwood forest. People who live and work in urban areas will help decide the future of this region.

South Piedmont: D Home to Atlanta and diverse watersheds draining into the Atlantic and Gulf. Balancing water needs for people and species continues to be a challenge.

North Coastal Plain: C Home to the Outer Banks and extensive estuaries. Sea-level rise is predicted to heavily impact this particularly flat region.

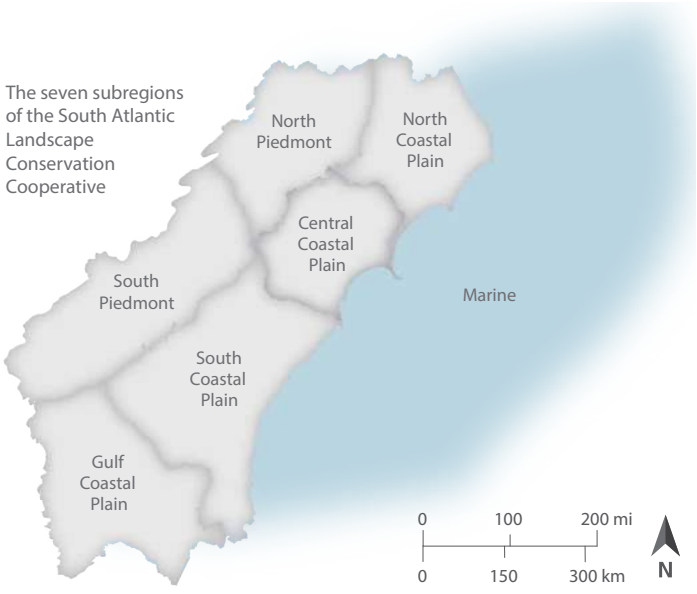
Central Coastal Plain: C Home to Wilmington, Myrtle Beach, and large protected wetland areas. Sea-level rise, tourism, and changing agricultural practices continue to influence ecosystem health.



South Coastal Plain: C Home to Savannah, Jacksonville, and a network of protected barrier islands. Partnerships are working to conserve this region's largest river floodplains.

Gulf Coastal Plain: C Home to rural Southwest Georgia and extensive conservation lands in the Big Bend of Florida. Sea-level rise and upstream agriculture continue to impact coastal protected areas.

Marine: B+ Home to rich fisheries, deepwater coral, diverse seabirds, and important migratory fish, whales, and turtles. Ocean acidification and increased energy development are major emerging threats.



A snapshot in time

This assessment evaluates the ecological integrity of the South Atlantic using natural and cultural resource indicators. The indicators are scored across the entire region, for individual ecosystems, and within subregions following watershed and ecoregional boundaries. All indicators are regularly tested and revised, and this first report uses the best metrics available today.

Toward conservation action

Measuring these indicators communicates the status of the region's land and waters, helping develop a more unified vision for thriving ecosystems that support communities and economies. People and organizations are working together on cross-boundary conservation actions through the South Atlantic LCC to improve ecosystem health in the face of unprecedented changes to the natural world.

Scoring & level of confidence

Each data-driven indicator score is based on the percent of an area in good condition, according to the best available science. Though all indicators were measured, some scores were omitted to provide a baseline for future comparison. Confidence values are qualitative estimates of uncertainty based on known issues with indicators and data sources.

- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ○ *Not scored; baseline for future*

Ecosystem indicators

Indicators provide a simple way to measure the overall condition of the South Atlantic's complex ecosystems. More than 200 people from at least 50 organizations actively participated in selecting, testing, and revising the current indicators. This first report establishes a baseline for evaluating future trends using the best science and region-wide spatial data available today.

Upland hardwood

- **Upland hardwood birds**: index of habitat suitability for seven upland hardwood bird species.
- **Urban open space**: index based on distance of urban areas from open space.

Pine & prairie

- **Longleaf pine extent**: overall acres of longleaf pine.
- **Pine & prairie birds**: index of habitat suitability for three pine and prairie bird species.
- **Pine & prairie amphibians**: Priority Amphibian and Reptile Conservation Areas within pine and prairie.
- **Regularly burned habitat**: acres of fire-maintained, open canopy habitat.

Forested wetland

- **Forested wetland extent**: overall acres of forested wetlands.
- **Forested wetland birds**: index of habitat suitability for six forested wetland bird species.
- **Forested wetland amphibians**: Priority Amphibian and Reptile Conservation Areas within forested wetlands.

Freshwater aquatic

- **Riparian buffers**: index of natural habitat near rivers, streams, and large waterbodies.
- **Impervious surface**: index of impervious surface within each watershed.

Freshwater marsh

- **Freshwater marsh extent**: overall acres of freshwater marsh.
- **Freshwater marsh birds**: index of habitat suitability for five freshwater marsh bird species.

Estuarine

- **Wetland patch size**: index based on the size of wetland patches.
- **Water-vegetation edge**: index of length of edge between open water and vegetation.
- **Coastal condition**: index of water quality, sediment quality, and benthic condition.

Maritime forest

- **Maritime forest extent**: overall acres of maritime forest.

Beach & dune

- **Beach birds**: index of habitat suitability for four shorebird species.
- **Beach alteration**: index of impacts from hardened structures like jetties, groins, and infrastructure.

Marine

- **Marine turtles & mammals**: index of highly productive areas for sea turtles, dolphins, and whales.
- **Potential hardbottom condition**: index of potential condition of deepwater corals and other hardbottom habitats.
- **Primary productivity**: index of ocean ecosystem productivity based on chlorophyll measurements.

Landscapes

- **Structural connectivity**: important hubs and corridors for ecological connectivity.
- **Low road density**: index of areas with few roads.
- **Resilient biodiversity hotspots**: index of mostly natural high-diversity areas potentially resilient to climate change.
- **Low-urban historic landscapes**: index of National Historic Register Sites surrounded by limited urban development.

Waterscapes

- **Fresh & saltwater connectivity**: index of dams preventing fish migration between rivers and the ocean.
- **Resident fish connectivity**: index of local barriers to fish and other aquatic species.

Combining indicators

Every ecosystem has at least one unique indicator. Freshwater aquatic, Landscapes, and Waterscapes indicators (shown in green) also apply to multiple ecosystems. These indicator scores appear on the following pages where relevant to ecosystem condition. All indicators are weighted equally to produce final scores.

For more information

The conservation community, working through the South Atlantic Landscape Conservation Cooperative, regularly tests and improves the indicators. To explore geospatial indicator data and to stay up-to-date on future progress, please visit: *http://StateOf.SouthAtlanticLCC.org*.

ECOSYSTEM

upland hardwood

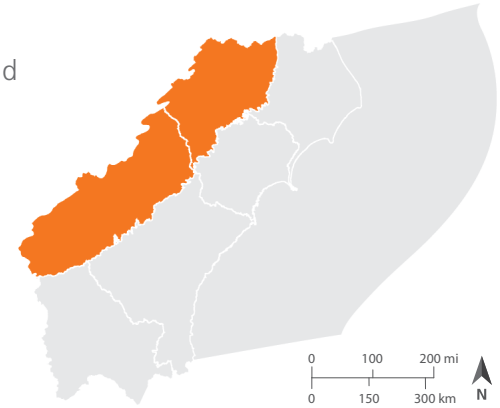
D+

Confidence

low → high

Forests in the foothills

This ecosystem includes Piedmont wooded communities ranging from dry upland forests to moist forests next to floodplains. Deciduous hardwood trees adapted to less frequent fire typically dominate, mixed with pine. Most major urban centers occur in upland hardwood forests, which causes habitat fragmentation but also provides many people opportunities to appreciate nature.



Interpreting the score

Overall, this ecosystem scored a **D+**. While the scores for the Piedmont regions were similar, the North Piedmont scored better on the bird index and poorly on low road density. Coastal Plain regions were not scored due to their small amount of upland hardwood. The Piedmont includes the major urban centers of the South Atlantic, providing challenges and opportunities for improving ecosystem condition and offering access to nature.

A 100-80% in good condition
B 79-60% in good condition
C 59-40% in good condition
D 39-20% in good condition
F 19-0% in good condition
Not scored; baseline for future

C- Upland hardwood birds

B- Low-urban historic landscapes

Urban open space

D Structural connectivity

F Low road density

Resilient biodiversity hotspots

Mature growth forests
Rare plants
Forest birds
Forest mammals
Urban and suburban areas
Habitat fragmentation
Recreation

Bright lights, big city

If growth trends continue, recent research predicts that Southeast urban areas will double in size by 2060, creating a megalopolis connecting Raleigh to Atlanta. Sprawl will likely concentrate in the upland hardwood ecosystem where urban centers already prosper. This forecast emphasizes the importance of smart growth planning to ensure wildlife habitat and recreation opportunities persist into the future.

MMann1988/Flickr

ECOSYSTEM

pine & prairie

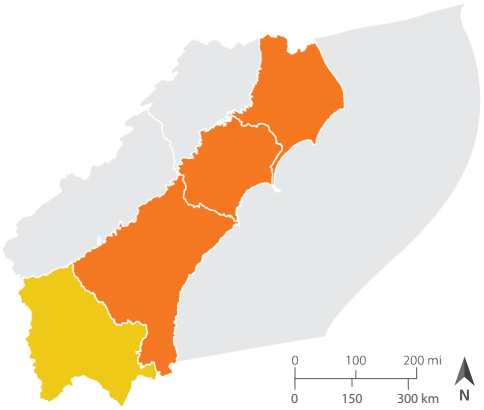
D+

Confidence

low → high

Pine woodlands, savannas, & prairies

Distributed across the Coastal Plain and occasional Piedmont areas, this fire-adapted ecosystem encompasses longleaf, loblolly, and slash forests, as well as open pine savannas and prairies. It is integral to the region's economy, culture, and natural heritage, driving timber production, harboring rare species, and supporting quail hunting and native tribal traditions.

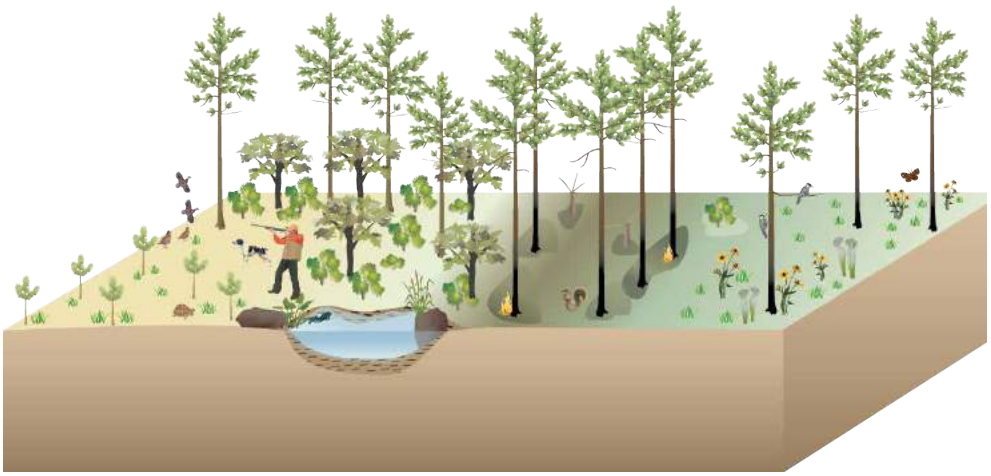


Interpreting the score

Overall, this ecosystem scored a **D+**. The Gulf Coastal Plain scored the highest, mostly driven by better scores on low road density, regularly burned habitat, and connectivity. Piedmont regions were not scored due to their small amount of this ecosystem. Despite years of heavy impacts from incompatible management and urban growth, efforts to restore iconic species like bobwhite quail and longleaf pine are making progress toward improving ecosystem condition.

- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ○ *Not scored; baseline for future*

○ Longleaf pine extent	D- Regularly burned habitat	D Structural connectivity
C+ Pine & prairie birds	F Low road density	○ Resilient biodiversity hotspots
○ Pine & prairie amphibians	B- Low-urban historic landscapes	



- Pine forests
- Seasonal ponds
- Healthy understory
- Overgrown understory
- Prescribed forest burn
- Reptiles and amphibians
- Pine birds
- Recreational hunting

Longleaf makes a comeback

Longleaf pine forests with towering trees and open, grassy understories once spanned 90 million acres from Virginia to Texas. Fire suppression and land use change reduced it to only 3% of its former range by the late 1990s. In response, a coalition of public and private partners began restoring longleaf, and started to reverse the decline during the last decade!

Lark Hayes

ECOSYSTEM

forested wetland

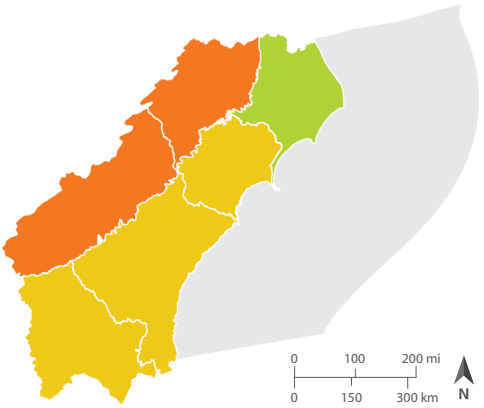
C

Confidence

low → high

Floodplain forests, pocosins, & bays

These frequently flooded swamp forests occur across the region on both organic soils, like peatland pocosins and Carolina Bays, and mineral soils, like bottomland hardwood and floodplain forests. Though historically drained for timber production and agriculture, intact forested wetlands support ecological diversity and enhance water quality by filtering polluted runoff.

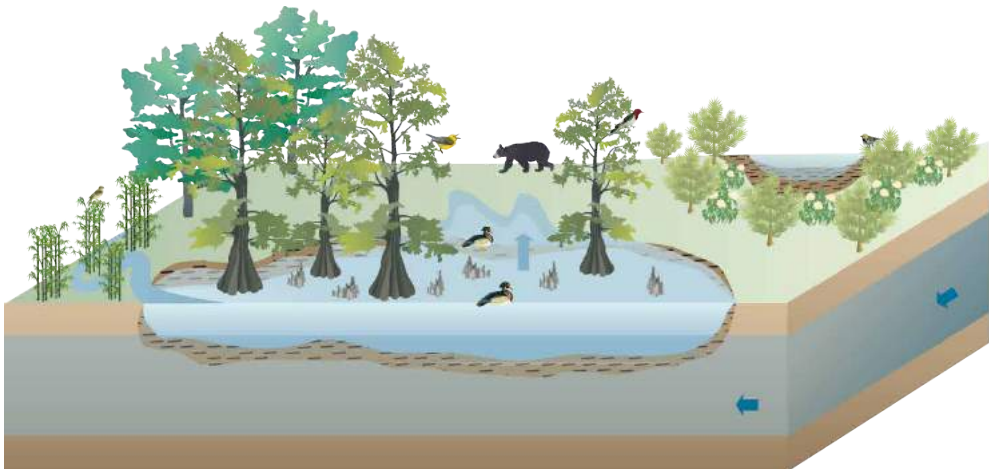


Interpreting the score

Overall, this ecosystem scored a **C**. Piedmont areas scored the lowest, mostly driven by poor scores on low road density, the bird index, and aquatic connectivity. The North Coastal Plain scored the highest, mostly driven by better scores on low road density and aquatic connectivity. These results underscore the importance of efforts to restore the altered hydrology of forested wetlands in the South Atlantic.

- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ○ *Not scored; baseline for future*

○ Forested wetland extent	D Low road density	○ Resilient biodiversity hotspots
B- Forested wetland birds	A Low-urban historic landscapes	D Fresh & saltwater connectivity
○ Forested wetland amphibians	C Structural connectivity	D Resident fish connectivity



- Floodplain forests
- Pocosin wetlands
- Forest birds and waterfowl
- Large mammals
- Native cane
- Temporal flooding
- Saltwater intrusion

Restoring ancient soils

Thirty years ago, the Eastern North Carolina wetlands that now comprise Pocosin Lakes National Wildlife Refuge were drained for peat mining and agriculture. Catastrophic wildfires burned away feet of the resulting dry organic soil. The Refuge has since restored natural hydrology on nearly 30,000 acres, improving habitat quality, protecting against future fires, and sequestering carbon by rebuilding the soil.

Steve Hillebrand/U.S. Fish and Wildlife Service

ECOSYSTEM

freshwater aquatic

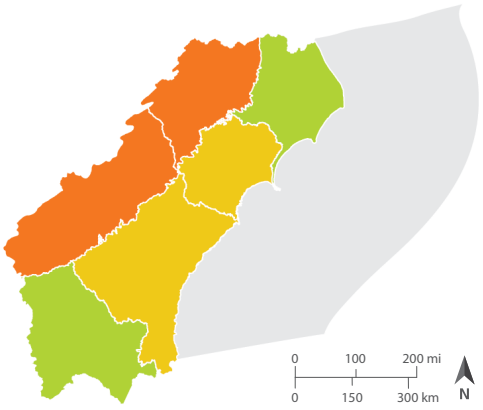
C

Confidence

low → high

Lakes, rivers, & streams

This ecosystem includes the lakes, rivers, and streams throughout the region that drain to the Atlantic Ocean and Gulf of Mexico. Water quality, quantity, and timing define a healthy freshwater environment, which provides clean drinking water and fishable and swimmable streams for human use while also supporting mussel and fish populations.



A *100-80% in good condition*
B *79-60% in good condition*
C *59-40% in good condition*
D *39-20% in good condition*
F *19-0% in good condition*
◯ *Not scored; baseline for future*

Interpreting the score

Overall, this ecosystem scored a **C**. Piedmont areas scored the lowest, driven by poor scores on all indicators. The North Coastal Plain scored the highest, driven by better scores on aquatic connectivity and despite lower scores on riparian buffers. The Piedmont includes the major urban centers of the South Atlantic and many aquatic species found nowhere else. This provides opportunities for proactive conservation measures to sustain both people and biodiversity.

C- Riparian buffers

D Fresh & saltwater connectivity

A Impervious surface

D Resident fish connectivity

Riparian buffers
Benthic species
Native fish
Urban areas
Impervious surface
Dams and culverts
Nutrient and sediment runoff
Recreation

A horse worth betting on

The South Atlantic harbors unparalleled aquatic diversity, including 120 endemic fish, mussel, and crayfish species—all increasingly threatened by human activity. Fortunately, there's still time to make a difference! Scientists rediscovered the robust redhorse, once thought extinct, in the Oconee River in 1991. Now federal and state agencies, utilities, and nonprofits are partnering to recover this native fish.

Valerie Renee/Flickr

ECOSYSTEM

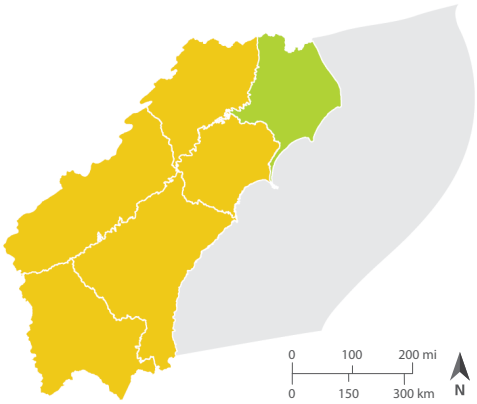
freshwater marsh

C

Confidence low → high

Tidal & nontidal freshwater marshes

Nontidal freshwater marshes occur throughout the geography in poorly-drained depressions, including waterfowl impoundments. Tidal freshwater marshes occur along the upper tidal reaches of coastal rivers. Characterized by regular flooding and low-growing vegetation, freshwater marshes harbor diverse reptile and amphibian populations. They also support recreational hunting and traditional Gullah sweetgrass harvest.

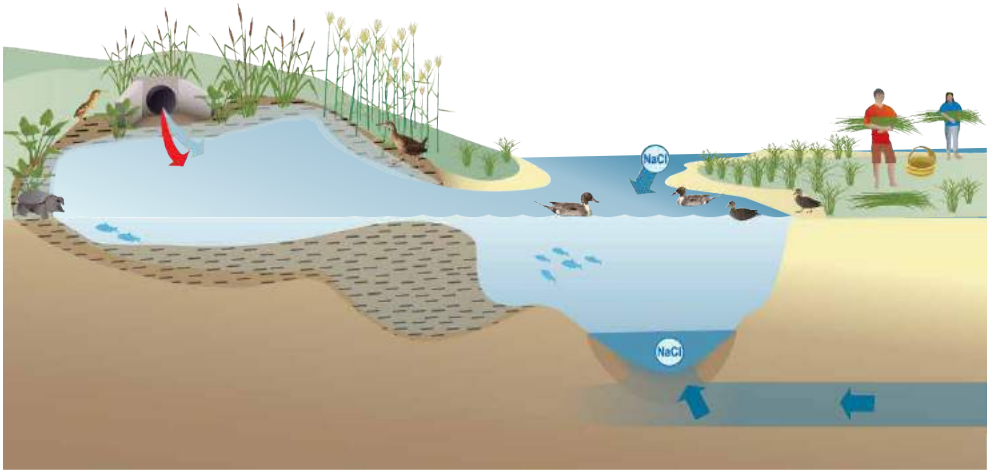


Interpreting the score

Overall, this ecosystem scored a **C**. Piedmont areas scored the lowest, mostly driven by poor scores on riparian buffers, low road density, and aquatic connectivity. The North Coastal Plain scored the highest, mostly driven by better scores on the bird index, low road density, and aquatic connectivity. Much of this ecosystem is threatened by sea-level rise, requiring restoration and protection to keep up with future marsh loss.

- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ○ *Not scored; baseline for future*

○ Freshwater marsh extent	C- Riparian buffers	D+ Structural connectivity
C Freshwater marsh birds	A Impervious surface	○ Resilient biodiversity hotspots
D Fresh & saltwater connectivity	D- Low road density	
D Resident fish connectivity	A Low-urban historic landscapes	



- Freshwater marshes
- Reptiles and amphibians
- Migratory waterfowl
- Marsh birds
- Invasive Phragmites
- Saltwater intrusion
- Culverts
- Stormwater runoff
- Sweetgrass harvest

Saltwater threatens managed marshes

A network of impoundments dots the Atlantic flyway, providing overwintering habitat for migratory waterfowl up and down the East Coast. The influx of saltwater from intrusion and sea-level rise threatens these intensively-managed freshwater marshes, forcing coastal land managers to consider difficult tradeoffs—to repeatedly rebuild damaged dikes or seek new marsh habitat inland through restoration or protection.

KG Schneider/Flickr

ECOSYSTEM

estuarine

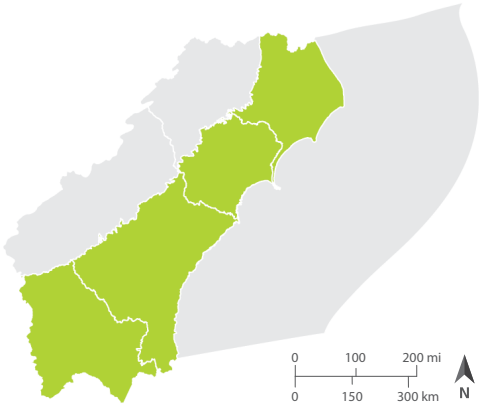
B

Confidence

low → high

A slightly salty sanctuary

Estuaries are partially enclosed coastal water bodies where freshwater rivers meet the ocean. This system extends upstream into tidal flats and salt marshes, and seaward to the estuary mouth. Nutrient-rich sediment and brackish water make estuaries extremely productive fish and crab nurseries, while salt marshes filter water and buffer coastal storms.



Interpreting the score

Overall, this ecosystem scored a **B**. The Gulf Coastal Plain scored the highest, mostly driven by better scores on riparian buffers and impervious surface. The Central Coastal Plain scored the lowest, mostly driven by poor scores on riparian buffers, coastal condition, and fresh and saltwater connectivity. This ecosystem has one of the higher scores in this assessment, yet still highlights major opportunities for improving ecosystem health.

- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ◯ *Not scored; baseline for future*

- ◯ Wetland patch size
- C+ Riparian buffers
- ◯ Water-vegetation edge
- A Impervious surface
- A Coastal condition
- D Fresh & saltwater connectivity

- Fresh and saltwater flow
- Sea-level rise
- Fish, crustaceans, and mollusks
- Reptiles and amphibians
- Estuarine birds
- Invasive Phragmites
- Impervious surface
- Nutrient and sediment runoff
- Living shoreline
- Recreation

Building living shorelines

Coastal developers often stabilize retreating shorelines using seawalls and bulkheads. However, hard structures worsen coastal erosion and degrade estuarine habitat. Instead of concrete, living shorelines use wetland and aquatic plants, oyster reefs, wood, sand, and stone to protect the intertidal environment. This technique restores beautiful, functional estuaries benefitting people and wildlife. Plus, installation can be fun!

SC DNR SCORE

ECOSYSTEM

maritime forest

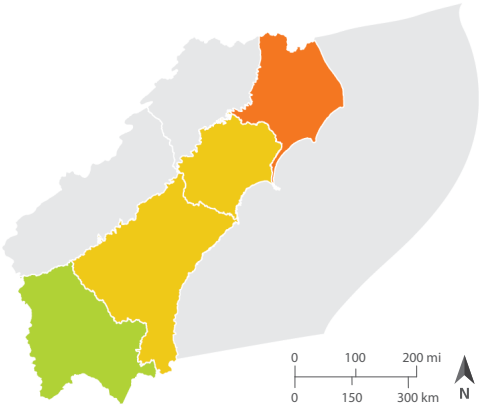
C

Confidence

low → high

Shelter from the storm

Maritime forests are scattered throughout the South Atlantic coast, found on barrier islands and behind estuaries and dunes where migratory songbirds often refuel. Harsh salt spray and wind exposure shape these unique scrub-shrub and wooded communities. They naturally stabilize the coastline and provide critical storm protection, preventing excessive erosion.



Interpreting the score

Overall, this ecosystem scored a **C**. The North Coastal Plain scored the lowest, mostly driven by poor scores on low road density, low-urban historic landscapes, and connectivity. The Gulf Coastal Plain scored the highest, mostly driven by far more low road density and high connectivity. These results underscore the continued impact of human development on this rare coastal ecosystem.

- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ○ *Not scored; baseline for future*

○ Maritime forest extent

A Low-urban historic landscapes

F Low road density

C Structural connectivity

- Live oak forests
- Seasonal ponds
- Migratory birds
- Coastal storms
- Development
- Recreation

A vanishing forest

Maritime forest is one of the South Atlantic's most endangered ecosystems, limited to a tiny fraction of its former range. European settlers once harvested the sprawling live oaks for shipbuilding and fuel. Now, urban development and climate change pose the greatest threats. The remaining isolated protected lands provide a haven for migratory songbirds and buffer against coastal storms.

Derek A Young/Flickr

ECOSYSTEM

beach & dune

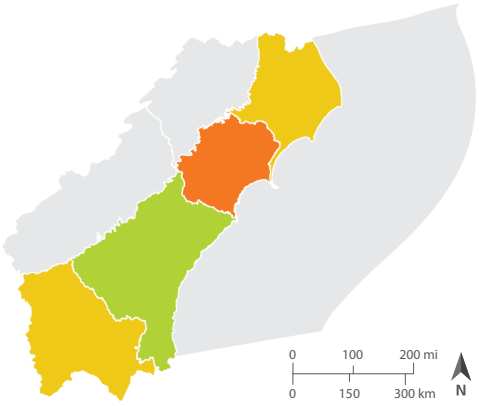
C

Confidence

low → high

Where the ocean meets the land

Beaches and dunes occur along the Atlantic and Gulf shorelines. The system extends from the nearshore ocean across sand, gravel, or shell intertidal beaches, and into more stable and vegetated dunes. Waves, wind, and currents constantly shape these dynamic coastal features, which provide wildlife habitat, storm protection, and recreational opportunities.



Interpreting the score

Overall, this ecosystem scored a **C**. The Central Coastal Plain scored the lowest, mostly driven by problems with beach alteration and connectivity. The Southern Coastal Plain scored the highest, mostly driven by better scores for beach alteration and connectivity. The popularity of South Atlantic beaches and creation of hardened structures to respond to sea-level rise continue to stress the coastal environment.

- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ○ *Not scored; baseline for future*

○ Beach birds

A Low-urban historic landscapes

C Beach alteration

B- Structural connectivity

F Low road density

- Beach grasses
- Migratory shorebirds
- Sea turtle nesting
- Coastal storms and overwash
- Shoreline erosion
- Shoreline alteration
- Artificial sand dunes
- Historic sites
- Development
- Recreation

Living with the rising sea

The South Atlantic shoreline draws numerous people eager to enjoy ocean views from beachfront homes and resorts. Yet, coastal development occurs in a constantly changing environment, as erosion naturally transports sand deeper offshore and further alongshore. Temporary measures like beach renourishment and hardened structures stress the ecosystem and still cannot keep pace with rising sea levels and stronger storms.

David McSpadden/Flickr

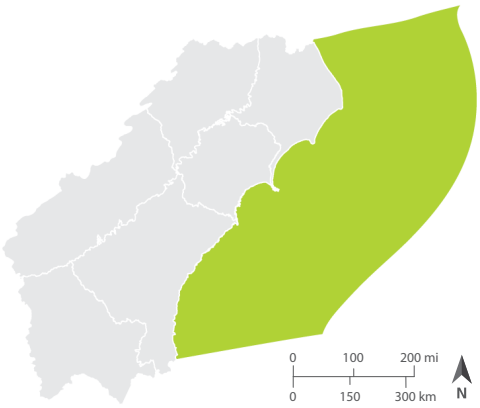
ECOSYSTEM marine

B+

Confidence
low → high

An ocean of possibilities

The marine environment starts at either the estuary mouth or the shoreline and stretches 200 miles into the ocean, covering the extent of U.S. waters. The marine ecosystem comprises about half of the South Atlantic geography! From deepwater coral formations to right whale calving grounds, this vast expanse of open water and benthic habitat sustains coastal tourism, commerce, and fisheries.



Interpreting the score

Overall, this ecosystem scored a **B+**. This is the highest ecosystem score in this assessment, however, it does not include fishing impacts. If included, those would likely lower the score. Productivity and hardbottom indicators were in good condition, but poor connectivity with freshwater brought down the overall score. While this system is relatively healthy, future threats from offshore energy and ocean acidification could significantly impact ecosystem integrity.

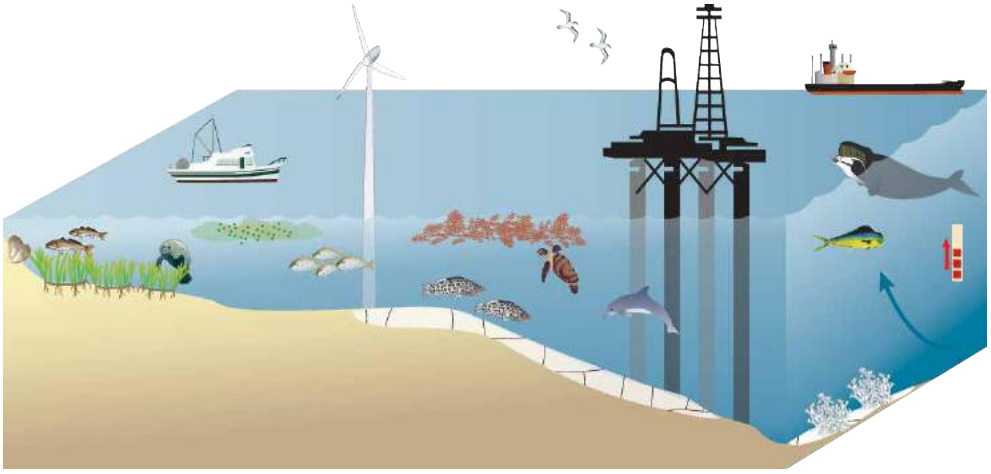
- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ○ *Not scored; baseline for future*

○ Marine turtles & mammals

A Primary productivity

A Potential hardbottom condition

D Fresh & saltwater connectivity



- Shelf break
- Deep ocean upwelling
- Hardbottom and deepwater coral
- Migratory seabirds
- Marine fish and mammals
- Sargassum mats
- Algal blooms
- Marine industry
- Recreational and commercial fishing
- Ocean acidification

Small turtles, big adventures

Sea turtles are iconic marine animals perhaps best-known for nesting on the beach. Not only do adult females famously migrate back to their birthplaces to lay their own eggs, but recent tracking data shows that young green sea turtles, born as far away as Costa Rica, swim thousands of miles to grow up off the South Atlantic coast.

Andy Bruckner/NOAA

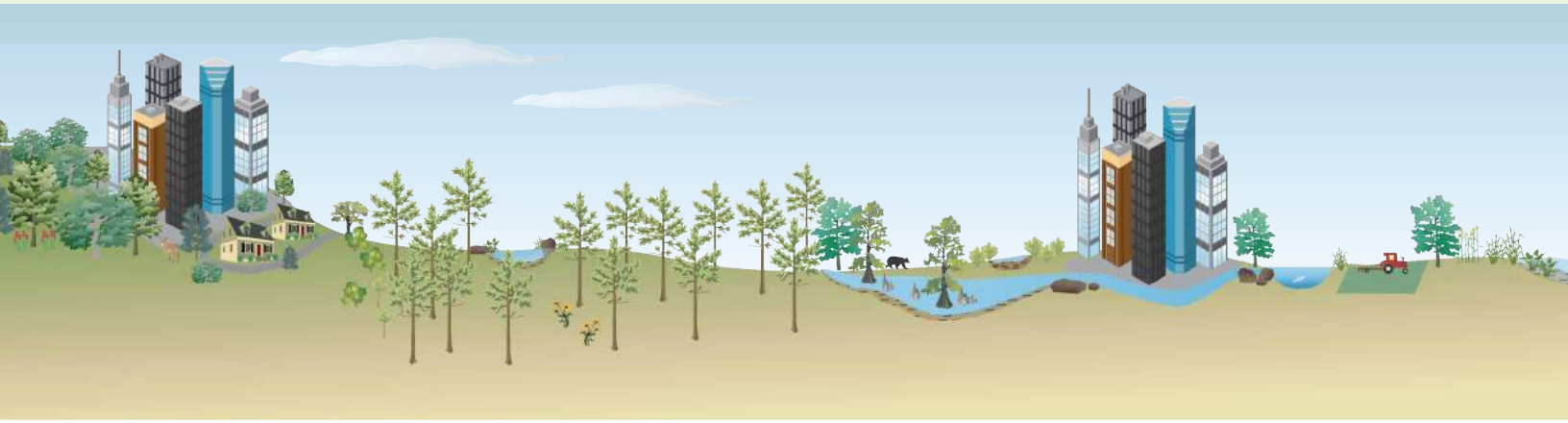
CONNECTIONS

landscapes

C-

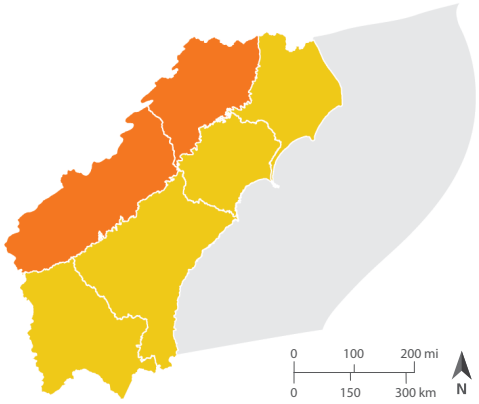
Confidence

low → high



Connecting all terrestrial ecosystems

This system focuses on connections across all terrestrial habitats, from uplands to the shoreline. A functional landscape knits together biodiversity hotspots, large habitat patches, and cultural features. This ecologically connected network creates a healthy environment for wildlife and people alike that is resilient to threats like climate change and urbanization.



Interpreting the score

Overall, connections across terrestrial ecosystems scored a **C-**. The North Piedmont scored the lowest, driven by low scores on all indicators. The South Coastal Plain scored the highest, mostly driven by better scores on low-urban historic landscapes and connectivity. These results show that, while the landscapes of the South Atlantic are fragmented, there is still hope for restoring and protecting an ecologically connected network of natural areas and working forests.

- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ○ *Not scored; baseline for future*

F Low road density

C- Structural connectivity

B Low-urban historic landscapes

○ Resilient biodiversity hotspots

Conserving the Florida wildlife corridor

Florida conservation organizations are working to connect protected lands and waters from the Everglades to Georgia and Alabama. This statewide corridor would sustain working lands, wildlife populations, and healthy watersheds. Sixty percent of 15.8 million available acres have already been secured. To raise awareness, a 2012 expedition trekked over 1,000 miles of the corridor in 100 days.

Nathan McMillan

CONNECTIONS

waterscapes

D

Confidence

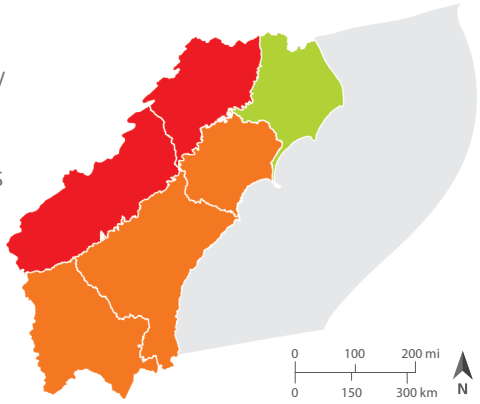
low → high

Connecting fresh, brackish, & saltwater ecosystems

This system focuses on connections between freshwater and saltwater—the flow of water from lakes and rivers, through marshes and estuaries, eventually to the ocean. Energy, agriculture, cities, shipping, and fisheries all depend on water. These competing uses limit water availability and interfere with natural processes like fish passage and natural seasonal flooding.

Interpreting the score

Overall, connections across aquatic systems scored a **D**. Piedmont areas scored the lowest, driven by poor scores on all indicators. The North Coastal Plain scored the highest, driven by better scores on all indicators. Despite this low overall score, ongoing efforts to remove small dams that are old, unsafe, or no longer serving their original purpose provide hope for improving conditions in the future.



- A *100-80% in good condition*
- B *79-60% in good condition*
- C *59-40% in good condition*
- D *39-20% in good condition*
- F *19-0% in good condition*
- ○ *Not scored; baseline for future*

D Fresh & saltwater connectivity

D Resident fish connectivity

Let it flow

Many fish species alternate spending parts of their life cycle in saltwater and freshwater. The thousands of dams in the South Atlantic prevent these diadromous fish from migrating and degrade spawning and foraging habitat. Many small dams are outdated, unsafe, and no longer useful. Conservation partners are now removing these barriers to restore connectivity and enhance habitat quality.

Markemark4/ Flickr

SOUTH ATLANTIC
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