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INTRODUCTION

Oceans cover about 70% of the Earth's surface, account for over 97% of the world's water, and harbor an estimated 1 to 2 million species (Mora et al., 2011, www.coml.org/about), only 230,000-250,000 of which have been described by science (Appeltans et al., 2012; Bouchet, 2012). Conservation and management of the oceans' resources has become an urgent cause for concern as the impacts of overfishing, global warming, pollution, invasive species and development increasingly threaten the health of ocean ecosystems and species and the essential benefits they provide to people around the world.

Effective marine conservation requires biodiversity information, but that information is often lacking or in a form impractical for many conservation activities (See Appendix for background on the current state of marine biodiversity information). Developing the needed information requires new conservation assessment and planning methods and tools that are created within the context of deep engagement between information users and scientists, to ensure that they are appropriate for the coastal and marine realms. In our [2012-2016 Strategic Plan](#), NatureServe committed to developing a marine strategy that identifies how best to expand on NatureServe's core strengths and complement the work of others by involving the coastal and marine community in creating the information, methods, and tools that conservation practitioners need to reduce threats to and ultimately improve conservation of coastal and marine biodiversity.

In 1974, NatureServe initiated a movement to improve the conservation of terrestrial and freshwater species and terrestrial ecosystems of the United States by developing the partnerships, inventory and mapping methodologies, data models, and software tools to produce consistent, comparable results. NatureServe serves as the hub of an international network



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of more than 80 biodiversity information centers (our “member programs”) operating throughout the Western Hemisphere. Together and individually, we work closely with a broad suite of partners to collect and manage detailed scientific information on the location and status of at-risk plants and animals and the ecosystems that support all life. The products of this ambitious enterprise now embody the most comprehensive data available on the locations of rare species and important ecosystems in the Americas. NatureServe has also become a leader in developing methods and tools to assess invasive species, climate change vulnerability, and ecosystem integrity, as well as ecosystem classification and conservation planning.

In 2001, NatureServe began work in the marine realm by partnering with the National Oceanographic and Atmospheric Administration (NOAA) to develop the Coastal and Marine Ecological Classification Standard (CMECS), a framework and standard terminology for describing the components of marine ecosystems. This work was recently endorsed as a federal standard by the U.S. Federal Geographic Data Committee (FGDC, 2012, www.cmeccatalog.org). In 2006, NatureServe convened the Ecosystem-Based Management Tools program, which has become the premier source of information about coastal and marine planning and management tools (www.ebmtools.org). In addition, NatureServe has demonstrated our capabilities in coastal and marine conservation planning by leading and participating in several “integrated land-sea” projects.

Many of NatureServe’s other methods and tools are applicable or could be adapted for the coasts and oceans. This strategy outlines how we plan to extend NatureServe’s expertise further into the marine realm over the next five years.

Stakeholders and Users of Coastal Marine Conservation Science

Practitioners and policymakers need marine biodiversity information and associated physical data to support resource assessments, emergency response, evaluation of climate change impacts and adaptation strategies, conservation and resource planning, and ecosystem-based management. The types of data needed to support conservation action in the marine realm are similar to those used in terrestrial and freshwater realms. In general, marine conservation practitioners require information about vulnerable species and ecosystems, where they are located, their risk of extinction, the major threats to their survival, the trends in their distribution and condition, and how to assess the health of a given occurrence over time. They also need to know how ecosystems function, how systems are connected, and what benefits humans derive from a given ecosystem. This basic information helps conservation practitioners determine priorities for conservation, strategies for protection or risk abatement, and plans for management and restoration of biodiversity resources.

Many sectors of society rely on NatureServe’s tools, information, and expertise to meet pressing challenges. Past and current partners and stakeholders with an interest in marine issues include:

Managers of Economically Important Coastal Resources. Coastal and marine spatial planning is promoted as a means of balancing economic and conservation interests, but these planning efforts are hampered by the lack of consistently mapped habitats. Coastal and marine spatial planners need ecological data comparable to those available for the terrestrial realm to consistently evaluate tradeoffs among management options.

Advocates for Coastal Conservation. Citizens and communities that value the recreational, cultural, and ecological services provided by natural coastline often seek protection for coastal and marine areas. By providing a consistent baseline for understanding which ecosystems are under-represented in existing protected areas, information developed by NatureServe and its partners is essential in setting conservation priorities that address gaps in the current protected areas system. Effective conservation planning

requires an understanding of the impacts of landscape patterns, processes, and threats on coastal and nearshore environments. As we gain understanding of the ecological characteristics of high-integrity ecosystems, we will also become more effective at setting restoration and recovery goals for priority conservation areas that were degraded in the past.

Managers of Marine Protected Areas. Without the consistent use of an ecological classification system to map coastal and marine resources, managers of marine protected areas do not have the necessary tools to establish baseline ecological conditions. Another effect of this gap is the inability to measure progress towards effective restoration and recovery based on a set of broadly recognized ecological metrics.

Coastal Communities Facing Rapid Change.

Whether the changes are driven by changes in local land use, alterations of the upstream watershed, the spread of invasive species, or the impacts of climate change, coastal communities will benefit from working with NatureServe to assess their vulnerabilities, plan for a more resilient future, and mitigate the impacts of economically important development.

Proponents of Offshore Energy Development.

At present, private companies and governmental agencies seeking to increase use of offshore habitats for energy production struggle to identify, map, and monitor these environments as well as impacts to avoid or abate during development. Both regulators and regulated companies will value the greater certainty provided by NatureServe's information, tools, and expertise when planning and implementing projects.

Emergency Responders. Events like Superstorm Sandy, Hurricane Katrina, and the Deepwater Horizon oil spill have made it clear that coastal and nearshore ecosystems are increasingly at risk from disasters. We can expect more regular rearrangement of our coastlines as sea levels rise and extreme weather events increasingly batter the shoreline as a result of climate change (Nicholls et al., 2007). Importantly, these impacts can include loss of built environments as well as critical green infrastructure —marshes, mangroves, seagrass beds and reefs— that are known to help protect coastal communities and infrastructure from these same threats. Emergency responders

need better baseline information to anticipate and respond to the harm these disasters wreak on sensitive species and ecosystems. The same resources can also help them avoid causing further harm to imperiled resources during emergency response activities. Efforts to effectively restore these ecosystems and build more resilient coastlines need to be informed by specific measures of ecosystem composition and condition.

Businesses and Communities Dependent on Coastal Ecosystems. Ecosystem-based management principles are becoming an important cornerstone for the emerging field of ecosystem services. As businesses and communities become increasingly aware of their dependencies on coastal and marine ecosystems for services such as disaster protection, fish nurseries, water purification, and recreational values, they need expertise and tools that support systematic assessments of their dependencies and manage these resources for enhances societal benefit. NatureServe's products and services are an essential part of any toolkit to ensure that ecosystem services are managed in a sustainable manner.





OUR APPROACH

NatureServe and our member programs are uniquely positioned to bring together the methods, tools, and data that governments and coastal communities need to respond to disasters, understand and abate threats, restore ecosystems and rebuild resilient coastlines. NatureServe, with our member programs, can also build on our partnerships to assist conservation practitioners plan for conservation of coastal and nearshore marine ecosystems and species. We have already developed many of the methods and tools needed, and will expand on our strengths to further our work in the coastal and nearshore marine realm.

The following sections describe near-term focus areas for engaging in the coastal and marine realm. The activities described below represent a core NatureServe and/or member program strength, have potential to be adapted for the coastal and marine realm, will have high conservation impact, and are achievable. Our goal is to initiate or continue ongoing work and make significant progress in each of these areas over the next five years using the listed core activities as a guide for our work. Some of the core activities will be completed during the five year period while others will take longer to accomplish.



STRATEGY DEVELOPMENT PROCESS

Our process in developing this strategy was to first identify NatureServe's and our member program's core strengths that could potentially be adapted for work in coastal (including Great Lakes) and marine systems. We then used the guiding principles (below) to prioritize the list along with input from NatureServe's science advisory panel, NatureServe staff, NatureServe member program staff, and external experts and partners. The following strategies are those that aligned the best with these principles.

Guiding Principles

- Focus on activities where there is a strong conservation need and that align with NatureServe's strategic plan.
- Focus on areas that will have high conservation impact and the highest probability of success.
- Build on areas where NatureServe has existing strengths, partnerships and presence.
- Focus on activities that can be initiated in the five year span of the strategy, but with a vision toward adding activities in the long term that will bring marine biodiversity data, methods and tools up to the same level of quality as is available for terrestrial species and ecosystem data.
- Identify priorities, but allow for flexible response based on opportunities and needs that arise.
- Focus on estuarine and marine coastal and nearshore areas, not the open ocean (with some exceptions).

DEVELOP SCIENTIFIC KNOWLEDGE

NatureServe is a leader in developing the methodologies and tools for ecosystem assessment in a variety of geographies, ecosystem types, and at a number of scales from local, to national, to global. Our overall assessment methodology includes developing classifications, mapping, assessing conservation status, threats, and condition, and monitoring. Our approach is to adapt and implement all aspects of our ecosystem assessment methodologies in the coastal and marine realms.

Coastal & Marine Ecosystem Classification

Promote the widespread use and adoption of CMECS by providing the content, tools, and training that will help users easily adopt the standard.

The Coastal and Marine Ecological Classification Standard (CMECS) provides a common language for the identification and description of coastal and marine ecosystems and habitats. CMECS is the only marine ecosystem classification that is globally applicable, accepted as a standard within the United States, and designed to blend seamlessly with terrestrial and coastal classifications. Use of this standard lexicon will increase the efficiency of aggregating coastal and marine ecosystem data needed to facilitate local, regional, and national coastal and marine assessments and conservation planning efforts.

New users will need support as they apply CMECS to their work. They will need training as they learn the new language. They will need data-entry and data-management tools that comply with CMECS. And they will need a means to update the standard as new ecosystems are identified.

As one of the primary authors of the CMECS classification (FGDC, 2012, www.cmeccatalog.org), NatureServe has the expertise to work with partners to continue to manage the dynamic content of the classification. NatureServe is also a leader in developing observation data models and tools that are needed to support the collection of CMECS compliant data. NatureServe has also been a leader in the development of the National Vegetation Classification (NVC) for more than 20 years, a terrestrial classification

analogous to CMECS. As such we have the expertise needed to keep CMECS content error-free, up to date, and widely available to users. We have already developed and maintain the CMECS Unit Catalog, the online database that contains the list and description of all CMECS units

CORE ACTIVITIES

- Promote the use of CMECS by a wide audience of practitioners.
- Expand CMECS content by describe new units at the lowest level of the classification, the biotope and by including terms to better describe Great Lakes ecosystems.
- Create a process, including peer review and software tools that allow users to propose changes to the classification based on new information.
- Create CMECS-compliant data-entry and data-management tools, data sharing processes, and crosswalking tools that allow users to collect and manage new CMECS data and integrate it with existing data from other sources. Evaluate the potential for NatureServe's data template library, Kestrel and Biotics software to meet these needs.
- Develop user support, outreach and training materials, and publications.
- Continue to manage and provide the list of classification units through the online CMECS Catalog.

Ecosystem Data Collection & Mapping

Promote and support the collection and mapping of regional and national ecosystem spatial data by providing expertise in the application of the classification and developing methods and tools.

Conservation practitioners and emergency responders have time and again identified baseline spatial ecosystem information as a critical need. Most current coastal and marine assessment and mapping efforts occur at local scales using local, user-developed classifications. As a result, coordinated assessment and mapping at broader geographic scales are rare. CMECS can provide the thread that unifies various mapping approaches while enabling consistent, regional and national cataloging of marine ecosystems.



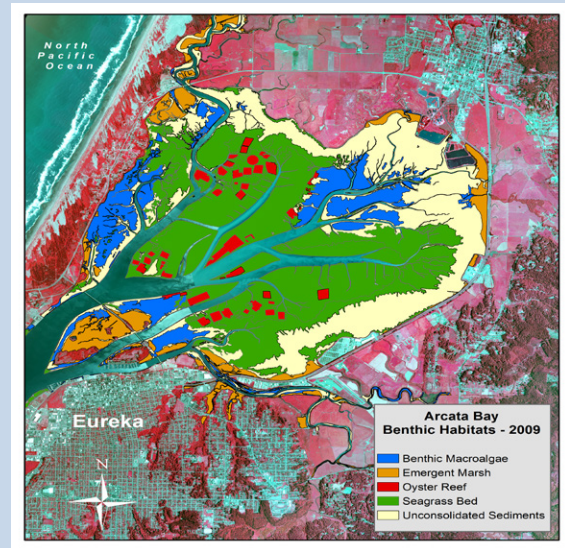
THE COASTAL AND MARINE ECOLOGICAL CLASSIFICATION STANDARD (CMECS)

Practical Applications of CMECS

- Ecosystem inventory and mapping
- Coastal and marine spatial planning
- Marine Protected Area selection, evaluation & assessment
- Resource management & monitoring
- Conservation status assessment
- Habitat modeling
- Ecosystem services evaluation

CMECS offers a simple, standard framework and common terminology for classifying natural and human influenced ecosystems from the upper tidal reaches of estuaries to the deepest portions of the ocean. The framework is organized into two settings (biogeographic and aquatic) and four components (water column, geoform, substrate, and biotic). Each describes a separate aspect of the environment and biota. The design of CMECS aspires to meet the needs of many users, including coastal resource managers and planners, development interests, engineers, mappers, and researchers from government, industry, and academia.

NatureServe, The National Oceanic and Atmospheric Administration, the U.S. Environmental Protection Agency, and the U.S. Geological Survey have worked with over a hundred scientists and coastal managers to develop and implement the standard. CMECS has been implemented in projects in a variety of geographies. The use and application of CMECS will improve our knowledge of marine ecosystems and may bring to light other necessary additions and adjustments to the standard. Users will be encouraged to propose changes to CMECS within a regular peer review and revision cycle.



NatureServe and our member programs have focused on biodiversity data collection and mapping for nearly forty years. Our specialized expertise in field sampling, mapping, and observations methodologies and our existing data collection and management tools are readily adaptable to the marine realm.

CORE ACTIVITIES

- Establish and promote coastal and nearshore marine ecosystem data collection and mapping based on CMECS, using a consistent methodology.
- Develop field methods and database tools needed to consistently aggregate spatial ecosystem data collected through a wide variety of observation methods (e.g., grab samples, photos, video, LIDAR, aerial photos, satellite data products, etc.) and to integrate new and existing data.
- Develop tools that allow local maps to be viewed in a national framework.
- Work with partners to develop methods and tools that help users translate and “crosswalk” existing classifications and data into the CMECS language.
- Develop a technical mapping guide to ensure that users are mapping consistently across projects.
- Compile existing spatial data, and using CMECS develop integrated maps.
- Manage geospatial ecosystem data from a variety of providers.
- Produce and support the production of maps at different scales from local to global and for various ecosystem types (e.g., corals, seagrass, oysters, etc.).
- Document habitat loss and range shifts by developing a monitoring methodology for assessing changes in coastal and nearshore ecosystem distribution.
- Provide user training and support.
- Use CMECS to develop a consistent spatial methodology for use in identifying species-specific habitat needs by life history stage.

Ecosystem Conservation Status Assessment

Develop and apply methods for coastal and marine ecosystem conservation status assessment.

Assessments of threat and irreplaceability are the cornerstones of conservation planning. Status assessments are critical for establishing conservation priorities as well as ensuring the implementation of appropriate measures for securing their future. Conservation status assessment ranks are not available for coastal and marine ecosystems, but are critically needed to help guide conservation action.

Currently NatureServe is working with IUCN to develop Red List assessment criteria for terrestrial ecosystems. An extension of this work into the coastal and marine realm is an obvious next step for NatureServe.

CORE ACTIVITIES

- Develop a set of practical national-scale conservation assessment units based on CMECS.
- Adapt NatureServe's Global Ranking and IUCN Red Listing methodologies for coastal and marine ecosystems.
- Assign conservation status assessment ranks to priority ecosystems.

Threats Assessment & Mapping

Build on efforts to compile and map data on threats to coastal and nearshore ecosystems.

Effective management and conservation planning requires an understanding of how human activities on land and in the water impact the condition and conservation status of coastal and nearshore ecosystems. This baseline information on threats such as coastal development, water pollution and vulnerability to sea-level rise is needed to develop landscape condition models, assess ecological integrity of coastal and nearshore ecosystems, and conduct integrated land-sea planning.

NatureServe has experience mapping key threats to coastal ecosystems such as sea-level rise, hardening of shorelines, invasive species, and agricultural/urban runoff, and our coastal network members have experience with local management issues. Nature-



Serve also possesses expertise in characterization and forecasting of threats, especially in the context of coastal integrated land-sea planning through projects in places such as Puerto Rico, Georgia, Texas and California.

CORE ACTIVITIES

- Map spatial data on coastal and nearshore threats including invasive species, infrastructure, near-shore motorized vehicle use intensity, point and non-point source pollution, trend in nearshore water chemistry (acidification), forecasted sea-level rise and storm surge (e.g., for year 2060).

Ecosystem Condition & Monitoring Standards Development & Application

Apply the Ecological Integrity Assessment framework to develop methods, specific metrics, and thresholds for assessing condition of coastal and marine ecosystems within the CMECS classification.

To be effective in ecosystem restoration, management, and conservation planning, conservation practitioners need to have an understanding of what defines a “healthy” ecosystem. NatureServe's Ecological Integrity Assessment methodology (Faber-Langendoen et al., 2008) advances our network's historic approaches to assessing condition by using multi-metric, quantitative, remote-sensing, and field-based approaches to understand ecosystem condition. The framework uses a flexible, tiered approach that allows for condition assessments using remote sensing data



at the highest level and intensive field data collection at the lowest level. This framework has earned recognition as a cost-effective means for establishing benchmarks for ecosystem restoration and long-term condition monitoring, and can also help plan for coastal resilience. The framework has been applied in the United States for evaluating wetland and forest condition, but it is equally applicable to coastal and marine ecosystems. We can add value to the field of ecosystem condition assessment because existing efforts do not all use a common framework.

CORE ACTIVITIES

- Adapt and apply NatureServe's Ecological Integrity Assessment framework to priority marine ecosystems (e.g., salt marsh, seagrass, oysters, etc.) to establish condition benchmarks for restoration and monitoring based on CMECS.
- Promote use of the approach within the restoration community.

Species Extinction Risk Assessment

Complete Red List assessments for select marine taxonomic groups.

As stated above, understanding the relative risk of extinction of a species is critical information for directing and prioritizing conservation action. The past four decades have seen the development of systematic approaches for assessing species extinction risks, resulting in the publication of their conservation status via NatureServe Explorer and the IUCN Red List. In 2000, the IUCN, NatureServe, and other leading scientific institutions established the Red List Partnership, which has since demonstrated the feasibility and value of comprehensive, repeated, global assessments on major groups of species, including mammals, birds, and amphibians. As a founding member of the partnership, NatureServe has led the implementation of many of these assessments in the Americas.

ECOLOGICAL INTEGRITY ASSESSMENT FRAMEWORK

Practitioners can select indicators to assess ecological integrity at three levels of intensity, depending on the purpose and design of the project.

Level 1 Remote Assessments rely almost entirely on Geographic Information Systems (GIS) and remote sensing data to obtain information about landscape condition and stressors in and around an occurrence.

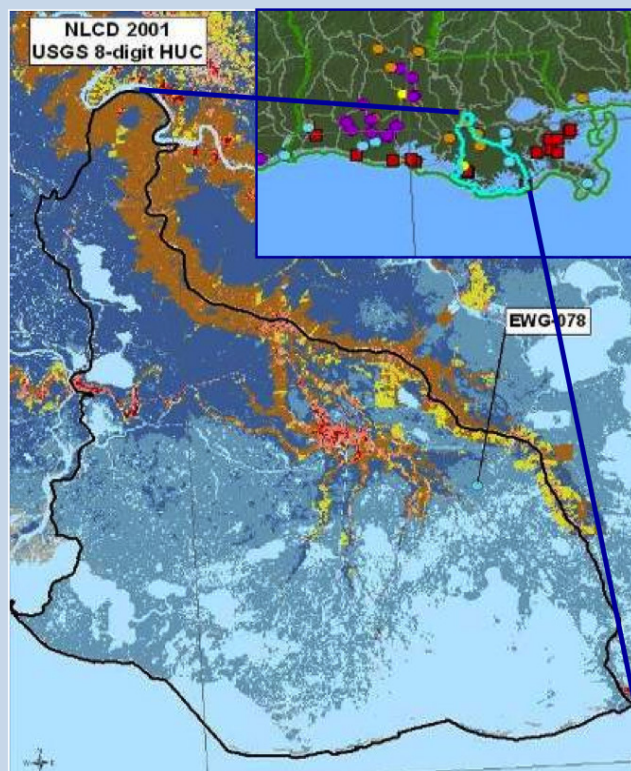
Level 2 Rapid Assessments use relatively simple field indicators for collecting data on specific occurrences and will often require considerable professional judgment.

Level 3 Intensive Assessments require more rigorous, field-based methods that provide higher-resolution information on the occurrence, often employing quantitative assessment procedures coupled with a sampling design.

This three-level approach to assessments provides flexibility for collecting indicators at sites that are difficult to visit or study intensively, permits more widespread assessment, and still allows for detailed monitoring of selected sites.

Level 1 Wetland Remote Assessment Indicators, Gulf of Mexico Pilot Study (courtesy of US EPA)

- **Composition and Connectivity:** Land Cover Percentage, Slope Metrics, Patch Metrics
- **Stressors:** Impervious Surface, Population, Nutrient Loading, Point-Source Pollution, Hydrologic alterations
- **Physical Characteristics:** Elevation, Stream length, Density
- **Hydrology:** Precipitation, Runoff, Discharge, Tide gauge data



Information on marine species extinction risk, however, is still extremely limited; with less than 5% of all described marine species (and less than 1% of marine invertebrates) having IUCN Red List Assessments completed (Collen et al., 2012). To date the Global Marine Species Assessment (GMSA) program has completed IUCN Red List Assessments for 10,500 marine species toward their goal of 20,000 (http://sci.odu.edu/gmsa/GMSA_progress.html).

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CORE ACTIVITIES

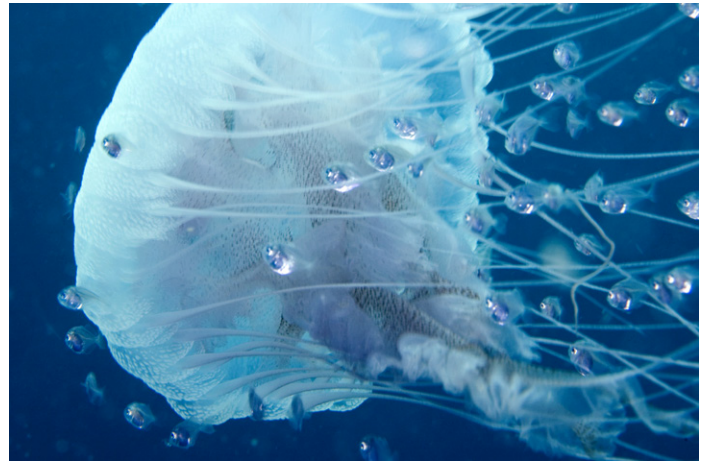
- Develop Red List assessments/NatureServe global ranks in partnership with IUCN's Global Marine Species Assessment for fish, selected plants, and invertebrate groups which have not yet been assessed (especially for North American species).
- Develop metrics for understanding trends in conservation status over time or as the result of specific conservation actions.
- Evaluate monitoring protocols and programs to enable trend assessment.
- Work with experts to develop species range maps and distribution models as part of the assessment process.

Species and Ecosystem Climate Change Vulnerability Assessment

Adapt NatureServe's Climate Change Vulnerability tool for the assessment of coastal and marine species and ecosystems.

Natural-resource professionals are increasingly asked to identify which of the species that inhabit the areas they manage are most vulnerable to the impacts of climate change. But the many factors that influence the exposure and response of any given species make these assessments complex.

No marine-specific, rapid, climate change vulnerability assessment tool currently exists, despite repeated requests for one. The NatureServe Climate Change Vulnerability Index developed for terrestrial species translates research findings into useful guidelines that enable practitioners and policymakers to identify emerging and anticipated threats to biodiversity.



The Index helps prioritize management strategies for climate change adaptation and develop actions that increase the resilience of species to climate change. While the complexity of the marine environment and the current state of marine data and climate models present significant challenges, NatureServe can provide the leadership and experience to convene the experts needed to develop a Climate Change Vulnerability Index tool for coastal and nearshore species.

Ecosystem response to climate change is equally complex. NatureServe has developed a prototype Habitat Climate Change Vulnerability Index (HCCVI) that considers direct and indirect effects of climate on a given ecosystem type and measures of inherent adaptive capacity to evaluate resilience and sensitivity that together are used to assess overall vulnerability. This emerging methodology can be adapted and implemented for the coastal and marine ecosystems.

CORE ACTIVITIES

- Develop, test, and implement a modified Climate Change Vulnerability Index (CCVI) tool to focus on coastal and nearshore species.
- Expand on the NatureServe's emerging habitat CCVI and adapt it (in combination with CMECS) for application in coastal and marine ecosystems.



ENHANCE EFFECTIVENESS

Collaboration and Coordination with Partners

Capitalize on our network experience in coordination and standardization, work effectively with partners with complementary strengths, and avoid competition and duplication of efforts wherever possible.

There are hundreds of individual local, state, regional, federal, and international agencies, NGOs, and academic groups that are working on various aspects of marine biodiversity science, though few share NatureServe's specific range of skills (including species and ecosystem inventory, mapping, ecological classification, conservation status assessments, data storage, data delivery, and interpreted data products). The risk of real or perceived competition with other groups exists as we expand our work in this realm. The activities outlined in this plan were chosen because they represent a core NatureServe strength and because we see an opportunity for NatureServe to add value to existing efforts. To be successful, we will need to work effectively with partners that have complementary strengths and avoid competition and duplication of efforts wherever possible.

Coordination among the many organizations working on coastal and marine biodiversity issues is vital to make most efficient use of limited marine conservation funds. This can be difficult, but NatureServe will capitalize on its experience of developing and coordinating networks to lead coordination and standardization efforts among the various groups. As we establish new standards and build new tools, we will build in the flexibility for individual users to meet their own objectives while adhering to the standards.

CORE ACTIVITIES

- Seek partnerships with organizations active in marine conservation to capitalize on each organization's strengths.
- Build (or enhance existing) efficient, flexible methods and tools that promote standardization, while advancing objectives of specific stakeholders.

NatureServe Staff Capacity Building

Increase expertise and staff capacity to expand our core systems to accommodate coastal and marine methods and data in activities like database, tool, and website maintenance and enhancement; partner outreach; training; and methodology research and development.

NatureServe staff have specific coastal and marine expertise in the areas of ecological classification and ecosystem-based management tools, but developing the new methods and tools described in this strategy will require additional expertise and staff capacity to grow the program. Enhancements to our core systems that accommodate coastal and marine methods and data will also require additional capacity to support core activities like database, tool, and website maintenance and enhancement; partner outreach; training; and methodology research and development. We will need capacity to keep the new tools up to date. Support must be sufficient such that existing funds are not diverted away from other key NatureServe programs.

CORE ACTIVITIES

- Raise funds to support program growth at NatureServe and in our member programs and to enhance core capabilities to meet new needs for coastal/marine applications.
- Identify funding opportunities from federal agencies and U.S. regional planning bodies especially to support project work.
- Cultivate support from foundations and other granting institutions with coastal and marine biodiversity interests, especially for support for program growth and for support for core activities.
- Develop a communications strategy that helps establish NatureServe as a leader in this field.
- Continue to promote (through publications and presentations) CMECS, the EBM Tools program, and Conservation Planning to raise awareness of NatureServe's leadership in these areas.



NatureServe Network Capacity Building & Expansion

Enhance NatureServe member program capacity to collect, manage and disseminate coastal and marine data and establish a broader suite of partners that can support coastal and marine data development.

The NatureServe network's model for collecting and managing biodiversity data is based on having geographically-based members in place to lead biodiversity data collection and management for their jurisdiction. But the national and subnational government agencies that house these members often have jurisdiction over only a small fraction of the ocean area. Under the United Nations Convention on the Law of the Sea (UNCLOS) (http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm), nations have jurisdiction of their (EEZ), defined as the area of the ocean extending 200 nautical miles beyond their coastline and in the US, state territorial waters extend only 3 nautical miles from the coast (except Texas, Puerto Rico, and Florida, for which territorial waters extend 9 nautical miles).

Moreover, subtidal and intertidal biodiversity data fall outside of the jurisdiction of some of our existing national and subnational member programs. Authority for these data may reside within other state agencies, typically within state fisheries or coastal zone management agencies. A 2009 survey of NatureServe

members asked about their involvement in collecting and managing coastal and marine biodiversity information, and of the 17 members that responded, only nine reported collecting or having collected intertidal or subtidal species or habitat data. Moreover, these efforts were confined to small projects, a given species (e.g. octopuses in the Gulf of California), or on a given habitat (e.g., mangroves). No network members conduct comprehensive intertidal or subtidal inventory or mapping programs.

Our expansion into the coastal and marine realm will require additional capacity for existing member programs to collect and manage coastal and marine data. New expertise and partnerships beyond our traditional network to address coastal and marine data development may also be necessary.

CORE ACTIVITIES

- Facilitate and support efforts of network members to inventory and monitor a broader suite of coastal and marine species and ecosystems.
- Increase partnerships between existing NatureServe network member program and other agencies that focus on coastal and marine issues.
- Identify opportunities for member programs to manage coastal and marine species and ecosystem data collected by other agencies or partners (some standards development such as element occurrence standards for wide ranging marine species may be necessary).
- Encourage greater NatureServe network participation in EBM Tools Network activities (e.g., listserv, webinars, chats, workshops) that promote connections and information sharing among coastal-marine conservation practitioners.
- Use EBM Tools Network contacts to connect member programs with key partners for coastal and marine data development.
- Share examples of innovative, local partnerships that support sharing of coastal and marine data.
- Explore opportunities for inviting other subnational, national, and international partners with marine conservation expertise to become associate members of the NatureServe network.



Communication & Outreach about Coastal & Marine Planning Tools & Methods

Continue to coordinate the Ecosystem-Based Management Tools Network.

As a founder and coordinator of the Ecosystem-Based Management (EBM) Tools Network, NatureServe has been involved in coastal-marine planning for the past six years. The EBM Tools Network is a major disseminator of information about tools and methods for coastal-marine spatial planning, building an extensive knowledge base and spurring further use and improvements by connecting tool users and developers. For the coastal-marine practitioner and policy community, the EBM Tools Network has come to play an important role as a trusted source of information about ways to improve coastal and marine management and conservation.

More recently, the Tools Network has broadened its focus to include methods and resources as well as software tools. Participants in the Tools Network represent a wide swath of the coastal and marine management and conservation communities, including policy makers, on-the-ground policy implementers, and technicians. Participants come from diverse geographies and all levels of government, NGOs, and academia. With a participant base of over 4,800 the Tools Network is highly diverse and engaged.

CORE ACTIVITIES

- Continue to coordinate a network of EBM tool developers and users.
- Strengthen the EBM Tools network by expanding opportunities and venues (physical and virtual) for training on specific EBM tools, methods and resources.

Coastal and Marine Methods and Tools Training

Expand our training programs to include a more explicit coastal and marine component, especially in the subject areas of ecosystem classification, conservation status assessments, inventory and mapping, and conservation planning.

There is a need to provide NatureServe network

THE EBM TOOLS NETWORK FACILITATES CONSERVATION



“I attended an EBM Tools training in 2008 and was connected with [collaborators]. We are now actively involved in two projects: 1) optimizing MPA network design to maximize fisheries benefits while minimizing costs to fishers and 2) identifying opportunities to scale up protection through the Locally Managed Marine Area network to meet national biodiversity targets.”

—**Stacy Jupiter**, Fiji Country Program Director,
Wildlife Conservation Society

“As a result of the EBM Tools Network webinar we presented, we’re now doing trainings about analyzing social networks for projects working with watershed groups in the lower Hudson Valley, isolated resource-dependent coastal communities in the Great Northern Peninsula of Newfoundland, and the ecological and cultural sustainability dynamics of the Kalahari bushman community. If not for the network, none of this activity would ever have occurred.”

—**Ken Vance-Borland**, Executive Director
Conservation Planning Institute

members and other partners with training to adopt NatureServe coastal and marine standards and to implement associated tools. NatureServe has established training programs that include both in-person and remote learning through conferences and webinars.

CORE ACTIVITIES

- Host informational and training sessions about CMECS, coastal vulnerability assessments and coastal planning at NatureServe’s annual Biodiversity Without Boundaries conference.
- Motivate greater network member participation in EBM Tools Network webinars and training opportunities (see above).

PUBLISH ANALYSES AND SYNTHESSES

Marine Species & Ecosystem Information Publishing

Expand key publishing tools like NatureServe Explorer, LandScope America, and NatureServe Surveyor to capture and disseminate coastal and marine biodiversity data.

Practitioners and policy-makers need reliable, easy to use sources for high-quality data, maps, and other information that directly support their conservation goals. NatureServe Explorer has made the best available conservation data publicly available for 12 years and is the single, most-used source for species status and distribution information in the Americas. LandScope America is a web-based resource that brings together more than 200 map layers from dozens of partners to inform strategic conservation. And NatureServe Surveyor, our newest tool, is specifically designed to guide land and water developers away from sensitive resources early in the planning

process. These online tools have experienced annual increases in website visits, content publishers/partners, number of spatial datasets, and number of species and ecosystem types covered, and each can readily accept and disseminate coastal and marine information. The current LandScope Chesapeake initiative provides a specific opportunity for expanding into the coastal-marine realm.

CORE ACTIVITIES

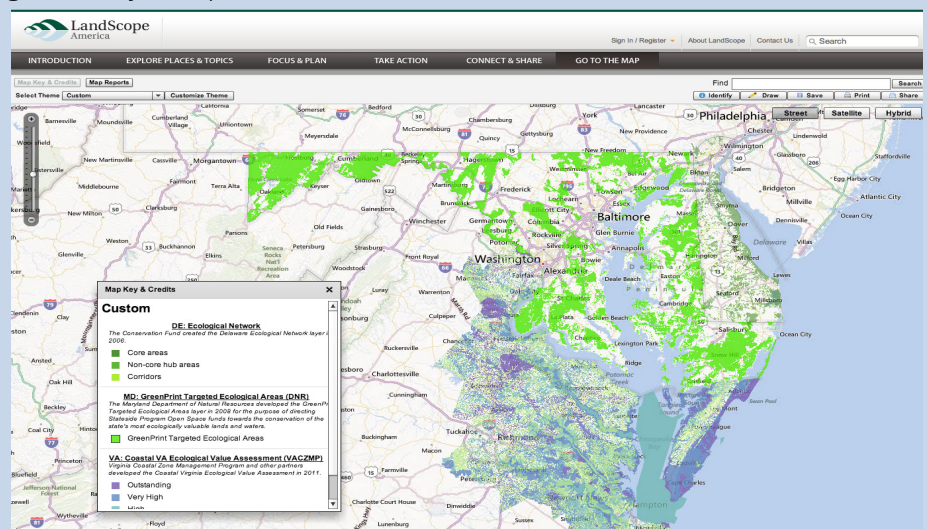
- Publish results of coastal-marine mapping, planning, and prioritization by NatureServe and partners in LandScope America.
- Publish marine species status via NatureServe Explorer and disseminate it widely through partnerships with other publishing outlets (e.g., Encyclopedia of Life, IUCN Red List).
- Inform ocean planning efforts by including marine protected areas in NatureServe Surveyor.
- Inform ocean planning efforts by including marine protected areas in NatureServe Surveyor.

LANDSCOPE CHESAPEAKE INFORMS STRATEGIC CONSERVATION ACTION

The National Park Service and U.S. Geological Survey have partnered with NatureServe, its network members, and other state agencies to establish LandScope Chesapeake, a publicly accessible tool that helps partners focus collaborative conservation and citizen engagement throughout the Chesapeake Bay watershed.

The partnership leverages the existing LandScope America platform to support initiatives targeting specific land conservation goals spawned by the 2009 Chesapeake Bay Executive Order issued in 2009. Using a flexible, scalable publishing platform that integrates spatial, visual, and narrative content from more than 200 local, state, and national partners, LandScope enables

practitioners and policy-makers to see quickly how and where different conservation values align and overlap. The use of this common watershed-wide system makes it easier for partners in the Chesapeake to prioritize places with the highest conservation value while building public support and directing resources toward them.





SUPPORT CONSERVATION PLANNING

Multi-objective Planning (Integrated Land-Sea Planning & Marine Spatial Planning)

Expand our work in multi-objective planning and focus on building or expanding the tools and processes needed for integrated land-sea planning and marine spatial planning.

Conservation decision makers need to plan strategically to conserve the natural values important to their community within an active landscape of competing uses and priorities. Integrated land-sea planning is especially necessary to help understand the impacts of land use on coastal and nearshore ecosystems and species.

NatureServe has been involved in coastal-marine spatial planning for the past six years through a number of coastal conservation planning projects in multiple U.S. locations including Puerto Rico. Our coastal and marine conservation planning efforts incorporate three closely related strategies often integrated in broad planning projects, and recognition of the need for this work is growing due to climate change concerns like sea-level rise and storm surge. Our experience includes:

- Extensive, relevant terrestrial multi-objective planning.
- A demonstrated software toolkit (NatureServe Vista and associated tools from other sources) for conducting such planning.
- Multiple, integrated, land-sea planning demonstration projects (Mission-Aransas, Tex.; North Charleston, S.C.; Humboldt Bay, Ca.; Eastern Shore of Virginia NWR, Va.; and Coastal Georgia).

CORE ACTIVITIES

- Engage in locally-led, coastal planning projects, and use feedback from the community to guide further development of the NatureServe integrated land-sea planning toolkit.
- Collaborate with coastal resource managers to adapt and conduct pilot demonstration(s) of the toolkit for marine spatial planning, integrating other existing tools as appropriate.
- Based on lessons learned from these collaborations, further develop and promote the Integrated Land-Sea Planning technical guide (Crist et al., 2009) with partners.
- Develop user support, outreach, and training around the toolkit and methods.

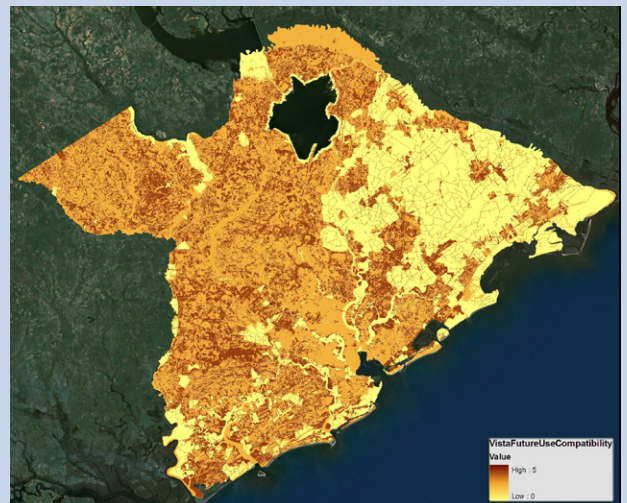
NATURESERVE SUPPORTS INTEGRATED LAND-SEA PLANNING

Integrated land-sea planning accounts for the influences of land-based activities on the nearshore environments and sea-based hazard effects on terrestrial environments. This cross-sector, cross-domain planning adds considerable complexity to traditional single-sector, single-domain planning.

Over the last several years, NatureServe has collaborated with a variety of its network members, researchers, NGOs, and state and federal agencies to develop, apply, and document methods and tools for integrating planning across the land-sea divide. These include:

- A prioritization of terrestrial and marine conservation needs for Puerto Rico
- An integrated land-sea and conservation assessment for the Mission-Aransas region of Texas
- An integrated land use and hazard assessment and alternatives for the greater metro region of Charleston, South Carolina
- A Refuge Vulnerability Assessment and Alternatives study for the Eastern Shore of Virginia National Wildlife Refuge and region
- A cumulative effects assessment of sea level rise and development for Humboldt Bay, California

Several of these projects contributed to publishing of landmark guides for managers and technicians now distributed by NatureServe (see Crist et al., 2012a and 2012b).



Marine Protected Area (MPA) Network Design

Engage in MPA network design and evaluation with a focus on integrating our existing toolkit with other MPA tools.

Establishment of Marine Protected Areas (MPAs) is one of the most frequently used strategies for protecting coastal and marine biodiversity. MPA Network Design is a more specific subset of multi-objective planning (described above). This process incorporates the effects of coastal watersheds into the design of traditional conservation reserve networks, an increasingly important approach for understanding the impacts of watershed-level processes and threats on coastal and nearshore ecosystems. NatureServe's experience in terrestrial conservation planning is readily transferable to marine conservation planning through partnerships with local and regional agencies and scientists, and would likely involve collaboration with organizations specifically experienced in MPA design. NatureServe Vista, our conservation planning tool, has demonstrated its usefulness in coastal and marine planning as well as its integration with Marxan, the most popular MPA tool. Our experience disseminating methods via the EBM Tools Network will be useful in developing the collaborations and outreach venues for implementing associated activities.

CORE ACTIVITIES

- Demonstrate application of the NatureServe Vista toolkit (with Marxan) to a pilot MPA design project.
- Conduct a regional gap analysis for marine species and ecosystems with respect to marine protected areas, especially threatened taxa and ecosystem.

Coastal Climate Change Adaptation Planning

Engage practitioners in Coastal Climate Change Adaptation Planning with a focus on further developing the necessary tools and methods and on providing training.

Coastal climate change adaptation planning has become a critical need for resource managers in coastal areas. Although it is an integral part of all conservation planning, adaptation planning is



described here separately to clarify the specific strategies and experience required. Through projects like the Refuge Vulnerability Assessment and Alternatives guides (Crist et al., 2012a and Crist et al., 2012b), we have developed relevant expertise in this area. Specific experience and assets include:

- A demonstrated tool (NatureServe Vista) and associated toolkit for conducting climate change vulnerability assessments and adaptation planning.
- Completed demonstration projects in the Eastern Shore of Virginia; the Georgia Coast; Humboldt Bay, CA; and Charleston, SC.
- Extensive experience disseminating methods via the EBM Tools Network.
- Relevant funding initiatives from numerous government agencies and philanthropic funders.
- An established reputation for developing methods and technical guidance.

CORE ACTIVITIES

- Further develop the climate change-specific capabilities of the NatureServe Vista toolkit.
- Work closely with local and regional entities to expand the number and types of applications for which the toolkit can be used, and share lessons learned from these experiences.
- Generalize the guidance from the Refuge Vulnerability Assessment and Alternatives manual for all relevant coastal planning audiences and applications.
- Develop training based on the above guidance and toolkit, and provide the training via a variety of delivery forums (e.g., webinar series, live trainings).

Information on marine species extinction risk is also limited, with fewer than 5% of all described marine



species having IUCN Red List Assessments completed. To date the Global Marine Species Assessment program has completed IUCN Red List Assessments for 10,500 marine species toward their goal of 20,000 by 2012 (http://sci.odu.edu/gmsa/GMSA_progress.html). Of the 1,306 invertebrates assessed; nearly 26% are data deficient, meaning they lack the basic data necessary to assign a rank. (Collen et al., 2012). For sharks, over 47% of the species assessed are data deficient (Polidoro et al., 2008).

While an impressive amount of work is being done in the marine realm, there is still so much unknown. The marine and coastal conservation community needs collaboration and coordination to provide the data and analyses more efficiently and protect our ocean resources more effectively.



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APPENDIX STATE OF MARINE BIODIVERSITY INFORMATION

Although the information needed for marine conservation is similar to that for terrestrial and freshwater systems, data collection is far more challenging and expensive given the immensity of Earth's oceans and their relative inaccessibility to people. Wide-ranging migratory species that are difficult to sample further complicate these challenges.

Recent advancements in acoustic and remote sensing technologies have improved our ability to detect biodiversity in the ocean, but our understanding of patterns of marine biodiversity remains patchy, and is based on compiled data that are “scattered in space and time” (Fautin et al., 2010). Efforts such as the Census of Marine Life (www.coml.org), a 10-year, \$650-million effort to collect and compile new and existing biodiversity data across the globe have contributed greatly to our knowledge of marine biodiversity, and resulted in the description of several thousand new marine species (with more still being described). Many of the Census data are stored in the Ocean Biodiversity Information System (OBIS), a compilation of over 1,125 datasets that provide more than 33 million location records for approximately 162,000 taxa (www.iobis.org/about/statistics). Although OBIS is the best available compilation of marine biodiversity data globally, the effort used a “bottom up” approach to data collection, allowing researchers to pursue relatively uncoordinated inventories of different regions or species groups (Pauly and Froes, 2010). The result is a large dataset that is deep in content for some species and for some areas and yet often ineffective in answering basic questions on the spatial patterns of biodiversity.

There have been a number of recent efforts to compile existing spatial biodiversity information regionally and to make them available in online digital libraries with mapping capabilities (e.g., Florida GAME database <http://myfwc.com/research/gis/game/gulf>; Northern Gulf Institute's Ecosystem Data Assembly Center <http://www.northerngulfinstitute.org/edac/fisheries.php>). These efforts improve access to data that are useful for many conservation applications yet may otherwise go undiscovered. But these



data often have limited utility in helping to identify biodiversity patterns because of the myriad purposes, scattered areas, and different time scales for which the data were collected. For example, the developers of the Gulf GAME database, a product of the Florida Fish and Wildlife Research Institute, have scoured the databases and paper files around the Gulf of Mexico to assemble Gulf-wide spatial data on the ocean's physical, chemical, and biological characteristics. This digital data library is an important first step, but the data themselves need to be compiled in a common database to be useful for assessing biodiversity in the Gulf of Mexico.

Efforts to assemble regional ecosystem data also suffer from patchy data collection at different spatial and temporal scales and the lack of a consistent ecosystem classification. For example, a comprehensive compilation of regional marine ecosystem data was completed by The Nature Conservancy for their Northwest Atlantic Marine Ecoregional Assessment (Greene et al., 2010). The authors compiled 1,200 data files on species, habitats, ecosystems and physical

oceanography from 100 sources. The effort was limited, however, by the lack of precise location data for species and habitats and from the general challenges of compiling data from different spatial and temporal scales. The resulting product provides data at spatial scales coarser than desirable (Greene et al., 2010). In a second phase, TNC is now working with NatureServe to convert the data from this effort into the CMECS framework.

Information on marine species extinction risk is also limited, with fewer than 5% of all described marine species having IUCN Red List Assessments completed. To date the Global Marine Species Assessment program has completed IUCN Red List Assessments for 10,500 marine species toward their goal of 20,000 by 2012 (http://sci.odu.edu/gmsa/GMSA_progress.html). Of the 1,306 invertebrates assessed; nearly 26% are data deficient, meaning they lack the basic data necessary to assign a rank. (Collen et al., 2012). For sharks, over 47% of the species assessed are data deficient (Polidoro et al., 2008).



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