Smithsonian Environmental Research Center

Strategic Plan

2005-2010

Vision

As a critical component of the Smithsonian Institution's science enterprise, the Smithsonian Environmental Research Center over the next five years will:

* Strengthen its role as the nation's leading center for research on linkages of terrestrial and aquatic ecosystems in the coastal zone, where human populations and impacts will be most concentrated in the twenty-first century.

* Increase in national stature as a major center for training the next generation of environmental scientists.

* Extend educational outreach to new and diverse audiences throughout the U.S.

* Advance environmental science for the benefit of society.

Mission

The Smithsonian Environmental Research Center (SERC) leads the nation in research on linkages of land and water ecosystems in the coastal zone, and provides society with knowledge to meet critical environmental challenges in the twenty-first century.

Meeting the Environmental Challenges of the Twenty-First Century

SERC is uniquely positioned to make extraordinary contributions toward meeting the environmental challenges of the twenty-first century. The interdisciplinary team of SERC scientists has a long record of research achievements in advancing the understanding of what the National Research Council (NRC) calls the "Grand Challenges in Environmental Sciences." Grand challenges addressed by SERC research include:

1. Human alterations of the atmosphere causing changes in climate, sea level, ultraviolet radiation, and ecosystem carbon balance.

2. Over-enrichment of coastal waters with nutrients causing harmful algal blooms, depletion of oxygen, and destruction of submerged vegetation.

3. Disruption of coastal food webs by pollution and overfishing.

4. Invasions of non-indigenous species, including introductions of disease organisms and viruses.

5. Widespread human modifications of landscape structure due to agriculture and urbanization.

Advances in basic science are urgently needed to address these environmental challenges. For example, the fundamental controls of primary production, the cycles of essential elements, and population dynamics over landscape and regional scales are still poorly understood. Understanding the functioning of natural ecosystems is necessary to assess disturbances caused by human activities and to discover unanticipated challenges. Therefore, basic research in environmental science, driven by the compelling human desire to understand the workings of the natural world, provides knowledge relevant to pressing societal concerns. SERC research exemplifies the power of combining basic and applied aspects of environmental research. The value of SERC research to both science and society is highlighted by SERC's consistent success in obtaining peer-reviewed research grants.

SERC research reflects the Smithsonian Institution's long-held commitment to discover and understand life's diversity. Research on interactions of organisms and their environment, the organization of biological communities, and the function of ecosystems is critically important for understanding the origin and sustainability of biological diversity. By pursuing such research SERC plays a central role in the mission of the Smithsonian Institution.

SERC is a national leader in studying the interactions of terrestrial and aquatic ecosystems at the land-sea margin. This strength grew from the establishment of SERC on the shore of Chesapeake Bay on 2800 acres of land including croplands, pastures, forests, freshwater wetlands, brackish tidal marshes, and estuarine waters. This unique core study-site and the balance of expertise across land and water ecosystems have given SERC a special place in environmental science. Exceptionally long-running studies at SERC continue to provide critical perspectives on the causes and consequences of ecological change, showing how alterations of the atmosphere and of the land affect the watershed and the estuary. SERC's long-term research on its home site pioneered the NRC-recommended use of living laboratories to investigate the

complex interactions that govern environmental responses to multiple stresses. As SERC's research focus expanded beyond its home site, SERC made major contributions to understanding the Chesapeake Bay and its watershed, which the NRC has cited as an ideal model system for environmental research. Today much of SERC's research reaches beyond the Chesapeake Bay region. SERC research uses the facilities of the Smithsonian Marine Science Network for comparative studies at various latitudes along the East Coast of North America. SERC studies impacts of ultraviolet radiation in Arctic and Antarctic waters, the dynamics of mangrove ecosystems throughout the tropics, and species invasions along coasts throughout the world.

SERC's expertise in environmental science at the land-sea margin is especially important because this is where the biggest environmental challenges will be confronted in the twenty-first century. As noted by the Pew Ocean Commission and the U. S. Oceans Report, the coastal zone is of immense economic and environmental importance and is now facing unprecedented environmental stresses. Coastal waters include the earth's most biologically productive ecosystems, support the majority of the world's fisheries, and provide vast reserves of oil, gas, and other non-living resources. Coastal lands include most major centers of transportation and commerce and support farming and forestry as well. Moreover, as home to over 70 percent of the world's human population, the coastal zone receives the brunt of human impacts on the environment. As a result, the ecosystems of the coastal zone have been degraded by pollution, habitat destruction, overfishing, species invasions, reduced biodiversity, climate change, and sea level rise. SERC's focus on these crucial ecosystems and on today's greatest environmental challenges uniquely positions SERC to advance environmental science for the benefit of society.

SERC Research: Land-Sea, Large-Scale, Long-Term

SERC's expertise is uniquely land-sea, large-scale, and long-term. Our land-sea orientation derives from our extraordinary core study-site, which includes interlinked land, wetland, and estuarine ecosystems on the shore of one of the world's largest estuaries. Our land-sea perspective is maintained by our balance of expertise in both land and water ecosystems and by our particular research strengths in coastal biological communities, wetlands, estuaries, and the linkages between watersheds and estuaries.

SERC's large-scale view encompasses phenomena at landscape-, regional-, and global-scales. At landscape scales, our research focuses on the interactions of ecosystems and the effects of landscape structure on habitat value and on the movements of organisms and chemical elements. At regional-scales, our research includes studies of discharges from watersheds throughout the Chesapeake Bay drainage basin, comparisons of estuaries with differing watersheds, and analyses of nutrient budgets for major U.S. watersheds. At global-scales, our research compares coastal ecosystems throughout the world and studies the effects of global environmental changes. Global coast-line research includes comparisons of mangrove ecosystems and studies the spread of invasive marine species. Research on global change includes studies of the effects of increases in atmospheric carbon dioxide and increases in UVB radiation.

SERC's long-term research perspective has been fostered by its unique core study-site and its long-term base funding from the Smithsonian Institution. Our ongoing studies have produced exceptionally long-running data on UV radiation, the chemistry of atmospheric precipitation, forest development, watershed discharges, and linked changes in estuarine water quality, phytoplankton, and fauna. Our ongoing field experiment on the effects of increased

carbon dioxide on a salt marsh is the longest of its kind. All of these long-term studies have produced insights that would not be possible with conventional short-term studies.

Strong Research Program Areas

SERC's present scientific staff spans a broad array of disciplines with a unified research focus but certain program areas have emerged as particular strengths. For example, SERC has notable expertise in biological communities of the coastal zone. The largest single research program at SERC studies the causes and consequences of marine species invasions on coasts around the world and has established SERC as an international leader in this field. Several other programs focus on the ecology of coastal macro-fauna, especially the commercially important blue crab, but also sessile fauna such as found in oyster reef communities. Other programs examine the ecology of jellyfish and the effects of oxygen depletion on fish populations. Besides these studies of macro-fauna, SERC is known for research on coastal phytoplankton ecology, especially on the ecology of phytoplankton blooms and relationships to underwater light, both visible and ultraviolet. SERC research emphasizes crucial ecosystems of the land-sea margin. Most of SERC's research on coastal biological communities focuses on estuaries, the critical transition zones between freshwater and marine environments. SERC also has considerable expertise in wetland ecology, including freshwater wetlands, salt marshes, and mangrove ecosystems. Wetlands are of special interest to SERC because they are important transitions between land and water ecosystems. SERC studies the ecology of wetland plants, the interactions of wetland plants and animals, and the role of wetlands in trapping atmospheric carbon dioxide and in reducing nutrient flow through watersheds and coastal waters. Studies of carbon and nutrient flow are aspects of biogeochemistry, which is another strong area of research at SERC. SERC has made significant contributions to understanding the controls of nitrogen and phosphorus flow through watersheds and the long-term effects of increases in atmospheric carbon dioxide on ecosystems. SERC scientists have also advanced knowledge of the biogeochemistry of trace elements and toxic metals, notably mercury. Research on flows of chemicals through watersheds views ecosystems in the context of the surrounding landscape. This landscape ecology perspective, which considers interactions of ecosystems such as forests, wetlands, agricultural lands, and urban lands, is another strong aspect of SERC research, not only related to nutrient flow, but also related to forest development and migratory bird habitat. The ecology of urbanized landscapes is emerging as an increasing interest at SERC. Another emerging area of interest at SERC is the ecology of disease organisms such as cholera bacteria and the West Nile virus.

Diffusion of Knowledge

Knowledge of the findings and practice of environmental research must be widely disseminated to enable society to meet the environmental challenges of the twenty-first century. To maximize the benefits of its research, SERC transfers knowledge to scientists in training, decision makers, and the public. SERC integrates research and education by involving undergraduate interns, graduate students, postdoctoral fellows, and visiting scientists as active participants in all its scientific endeavors. SERC provides expert knowledge to environmental managers, government agencies, and policymakers, thus promoting informed decision making on regional, national, and international environmental issues. SERC reaches the local public with

field-based hands-on learning programs and reaches national and international audiences via distance-learning and internet-based technologies to diffuse knowledge about the environment, the scientific process, and the value of ecosystems.

The Future

Here we present a strategic plan to grow and strengthen SERC, building on our strong base of research achievement and our nationally recognized programs in professional training and public education. Because research is our core function at SERC, our first goal is to enhance our research capabilities by adding expertise in particular scientific disciplines and by adding new research methodologies. This will strengthen our ability for comparative studies at multiple ecological scales in the coastal zone. Increasing research capabilities will by itself enhance the linked training programs for undergraduates, graduate students, and postdoctoral researchers. However, we also plan to extend the reach of these training programs by increasing participation of underrepresented groups as well as students and scientists from developing countries. To strengthen the utility of our research findings, we will move toward greater transfer of new knowledge to environmental managers and decision makers. We will also strive to educate a broader segment of the public about environmental science and the scientific process. Our success in pursuing these goals critically depends on expanding SERC's physical facilities to serve the science and education programs. Therefore, facility development is an essential over-arching goal in our strategic plan.

Strategic Goals

1. **Increase SERC's capabilities for advancing basic science to address major environmental challenges in the coastal zone.**

2. **Enhance opportunities for teachers, graduate students, postdoctoral researchers, and visiting scientists while sustaining our nationally-recognized professional training program for undergraduates.**

3. **Promote greater transfer of expert scientific knowledge to environmental managers and policy makers to enable informed decision making.**

4. **Educate a broader segment of the public about the environment, the scientific process, and the value of ecosystems.**

5. **Build state-of-the-art laboratories and support facilities to serve the world-class science and education programs.**

Objectives Toward Strategic Goals

Goal 1:
Increase SERC's capabilities for advancing basic science to address major environmental challenges in the coastal zone.

Objectives:

1.1. Add expertise in selected scientific disciplines to build synergism by bridging and extending research strengths.

Almost all SERC research is interdisciplinary and collaborative. SERC scientists collaborate with each other and with non-SERC scientists to assemble research teams with the necessary experience to address particular research questions. A mixture of internal and external collaborations is essential to a vigorous research program. However, there are advantages of synergy from having the right mixture of expertise on staff. For example, ideas for new projects spring forth most readily from the interactions of people working in proximity.

We hope to increase the numbers of scientists at SERC to bridge areas of current expertise and to extend our research strength into new areas. We recognize the constraints on adding new staff but we feel it is important to identify the areas where added expertise would best enhance our research capabilities. To fill these areas, we will also explore alternatives to hiring new staff, such as hosting visiting scientists, forging partnerships for long-term collaboration, and using fellowships and internal funds to bring new research expertise to SERC. We will also enhance our capacity for comparative studies of the communities, ecosystems, and landscapes of the land-sea margin by using the Smithsonian Marine Science Network and by developing other national networks for environmental research.

Below we describe areas that we identify as priorities for expansion of SERC's research capabilities. We plan to maintain flexibility in filling these priority areas or in filling areas not listed below to exploit unpredictable opportunities or track new research trends that may arise in the ever-changing fields of environmental science. However, we will consistently seek researchers in the following areas who value collaborative synergy and engage in comparative approaches emphasizing land-sea interactions.

Estuarine zooplankton: SERC's expertise in coastal biological communities focuses on phytoplankton and estuarine macro-fauna such as crabs and fish. However, SERC lacks expertise in zooplankton species, which are essential links in coastal food webs between phytoplankton and macro-fauna. A new SERC scientist has added critically-needed expertise in gelatinous zooplankton (jellyfish), but expertise in other types of zooplankton is needed to achieve complete understanding of food web structure in coastal biological communities.

Microbial ecology in sediment and soil: SERC has expertise in the microbial ecology of plankton organisms suspended in water but not in the microbial ecology of organisms that live in solid substrates such as sediments and soils. This is a critical gap given SERC's current expertise in nutrient and carbon cycling processes that are driven by microbes in soil and sediments. Increasing expertise in this area will help with investigations of human alterations of major biogeochemical cycles.

Stream ecology: Although SERC has significantly advanced knowledge about the discharges of nutrients from watersheds and their effects on estuaries, SERC currently lacks expertise in the ecology of streams, which link watersheds and estuaries and which may remove significant amounts of nutrients in transit from watersheds to coastal waters. Recent studies by SERC postdoctoral researchers have found important linkages between watersheds and stream biota. SERC research programs would benefit from increasing efforts in stream ecology.

Hydrology and hydrodynamics: Understanding the movements of groundwater, stream water, and coastal waters is essential to understanding the transport and fate of nutrients released from land and afflicting the health of coastal waters. A number of important SERC studies have applied simple analyses of groundwater flow, stream hydrology, and estuarine circulation to calculate transport of water-borne materials. Further progress in this area has been hindered by lack of SERC expertise in hydrology and hydrodynamics. Addition of staff or long-term collaborators in these fields is therefore desirable.

Biogeography of coastal waters: As a part of the Smithsonian Marine Science Network and with its studies of biological invasions on coasts around the world, SERC is positioned to become a world leader in biogeography of marine species with the addition of science staff dedicated to this field. A strengthened emphasis on marine biogeography would link ecology, systematics, and evolutionary biology in a way possible only at the Smithsonian Institution.

Urban and suburban ecosystems: Worldwide increases in human habitation of coastal urban and suburban areas points to the need for increased research on these ecosystems. Funding agencies are responding to this need. Research on the effects of urbanization is growing at SERC with current studies of bird ecology in suburban habitats and the effects of developed land on discharges from watersheds. This work complements SERC's historical strengths in studying the impacts of agriculture. Adding expertise in urban ecosystems would accelerate the growth of this emerging research strength at SERC.

Host-parasite interactions and disease ecology: These areas are gaining attention from funding agencies now due to the increasing awareness of species invasions and the impacts of environmental issues on public health. SERC research on parasites of oysters and of phytoplankton, and on the ecology of cholera bacteria and West Nile virus provides a foundation for growth in the areas of parasite and disease ecology.

1.2. Acquire new technical research tools and methodologies.

The development of new research tools and methodologies can lead to rapid advances in knowledge. Having certain technical capabilities in-house can be a big advantage to a research center. Below we describe five methodological areas of priority for increased capability.

Stable isotope analysis: The analysis of stable (non-radioactive) isotopes is a powerful technique with applications to all fields of environmental science. The natural abundance of stable isotopes can be used to trace biogeochemical cycles, food web connections, and animal migration pathways. Changes in isotope abundances can also indicate biogeochemical transformations. Stable isotopes, unlike radioactive isotopes, can be safely released in field

experiments to test hypotheses about the flows of elements through ecosystems. All these applications of stable isotope analysis have the advantage of revealing processes covering large spatial scales. Several SERC research projects have used stable isotope analysis by collaborating with other research centers that have the necessary analytical capabilities. It would facilitate SERC research to have isotope analysis capabilities in-house. This would require high-precision mass spectrometry instruments and personnel to run them.

Molecular genetics: Recent advances in molecular genetics have led to a proliferation of new techniques for ecological research. For example, it is now possible to analyze water or soil samples for genes regulating specific biogeochemical transformations. Genetic fingerprints of environmental samples can reveal the composition and diversity of microbial communities. Genetic analyses can be used to identify particular species or strains of organisms that may be pathogenic or invasive. SERC researchers have begun to apply techniques in molecular genetics through external collaborations but progress in this area would be accelerated if SERC acquired more equipment and skills for in-house genetic analyses.

Remote sensing via imagery and automated sensors: Analysis of remotely sensed data is needed to understand large-scale alterations of landscape structure and large-scale patterns of ecosystem function, such as primary production on land and in water. SERC researchers have pioneered remote sensing methods for mapping forest canopy structure. Acquisition of new remote sensing technologies would build upon these past achievements.

Advanced infrastructure for field research: New technologies are providing new ways to access field sites and to sense and record environmental data in the field. Access to forest canopies by cranes has opened up a new realm for scientific exploration. New designs for research vessels and related underwater sampling equipment are improving access to coastal ecosystems. New automated sensors are being developed to monitor hydrological data such as water velocity profiles in streams and estuaries, water flow through trees, and fluctuations in soil moisture and water table slopes. Other sensing systems, such as eddy-flux towers, are being used to monitor exchanges of gases between ecosystems and the atmosphere. SERC has long been engaged in the advancement of environmental sensing, for example, by developing and applying new methods for automated monitoring of watershed discharges, underwater optics, and the movement and behavior of crabs. SERC plans to selectively increase its investment in new infrastructure for field research. Some support for this may be obtained through new funding initiatives of the National Science Foundation (e.g., Long-Term Hydrologic Observatories and the National Ecological Observatory Network) that have been developed specifically to improve the field-based infrastructure of environmental science.

Modeling: SERC research on large-scale ecological processes and interactions among multiple ecosystems requires mathematical modeling. All scientists at SERC apply some degree of modeling in their studies, but it has become increasingly necessary to bring in short-term postdoctoral modelers to supplement modeling efforts by the permanent staff. Turnover of the postdoctoral modelers could impede progress in several projects. With the addition of staff with expertise in the construction of complex, mechanistic models of interacting ecosystems at multiple scales, SERC would be better positioned to make significant new advances toward meeting the environmental challenges of the twenty-first century.

1.3. Ensure the maintenance of SERC's core study-site and of long-term measurements and databases on critical environmental variables.

SERC's unique 2800-acre study site on the shore of Chesapeake Bay has supported long-term studies of interacting terrestrial and aquatic ecosystems. Through more than three decades of research on this site, SERC has amassed long-term data of unmatched duration on the variations of ultraviolet radiation, precipitation chemistry, watershed discharges, forest trees and herbs, estuarine water quality, and populations of estuarine flora and fauna. Analyses of these data have yielded important insights. For example, long-term data have revealed how fluctuations in estuarine water quality and phytoplankton are linked to fluctuations in watershed discharges. Also, at SERC the world's longest-running experimental field enrichment of atmospheric carbon dioxide has shown unexpectedly persistent ecosystem responses to predicted future atmospheric conditions. The continuation of long-term studies at SERC promises to yield further discoveries unobtainable with more conventional short-term studies. Also, the SERC site with its extensive supporting data presents the unique potential for future field experiments to measure decadal or longer-term responses to changes in land use, nutrient loads, or other perturbations. The SERC site is also a key component of the Smithsonian Marine Science Network, an array of marine laboratories spanning the temperate and tropical coasts of North America. Thus, preserving SERC's core site and sustaining the long-term studies and databases is an important investment in the future of SERC, the future of the Smithsonian Marine Science Network, and the future of environmental science.

Goal 2:
Enhance opportunities for teachers, graduate students, postdoctoral researchers, and visiting scientists, while sustaining our nationally-recognized professional training program for undergraduates.

Objectives:

2.1. Increase numbers of pre- and post-doctoral appointments funded through internal and external sources to guarantee one pre- and post-doctoral student appointment per principal investigator per year.

SERC continues to be one of the leading institutions in the United States in providing field and laboratory training for the next generation of environmental scientists. Over the years, SERC has trained hundreds of students from the undergraduate through postdoctoral levels in various fields of environmental science. Graduates of our programs have gone on to distinguished careers in the sciences, natural resource management, and public policy.

Professional training is tightly integrated with SERC's research activity, which has increased in recent years and is planned to increase further. As research efforts increase, there is a concomitant increase in the number of pre- and post-doctoral students that can be trained and that are needed to support the research. Although Smithsonian Institution support for pre- and post-doctoral fellowships is increasing, we anticipate that the increase will not cover all of SERC's increasing needs. Therefore, we will seek external as well as internal funding to support a number of pre- and post-doctoral students commensurate with the level of research activity.

2.2. Sustain a high quality undergraduate internship program and guarantee two undergraduate interns per principal investigator per year.

The internship program at SERC continues to provide unique opportunities for undergraduate or recent graduate students to become active members of research teams at the forefront of environmental science. The consistently high number and quality of applicants to the internship program and the reviews from finishing interns indicate that universities are not able to satisfy the demand for research experiences such as those offered by SERC. At large research-oriented universities most of the research opportunities go to graduate students. At SERC, an internationally-recognized cadre of scientists is capable of mentoring undergraduate students and providing access to research facilities and study sites. Undergraduate interns are given a chance to conduct research at a graduate student level and make a real contribution to SERC's research programs.

To maintain the high-quality of the intern experience at SERC, it is important to keep the number of interns appropriate to the number of potential mentors. Therefore, we plan to maintain about two interns per principal investigator per year. Sustaining the intern program will require consistent stable funding to support research, travel, and housing for the students.

2.3. Expand internship program to provide training opportunities for K-12 teachers.

SERC plans to integrate research and education in a new way by providing opportunities for K-12 teachers to participate in environmental research as interns. Internships for teachers will instill excitement about environmental science and knowledge about the scientific process which teachers can convey to their students. Internships will inspire teachers to incorporate new field-based hands-on learning experiences into their teaching. Internships may also foster partnerships between teachers and SERC in working toward our public education objectives (listed below under goal 4).

2.4. Increase professional training for groups that are underrepresented in environmental science in the U. S.

The demography of the United States is rapidly changing, and the scientific profession has an obligation to ensure that the next generation of scientists represents the diversity of society at large. SERC has been a leader in training underrepresented minorities and wishes to enhance these opportunities in the future.

2.5. Increase number of visiting scientists.

SERC offers visiting scientists access to unique facilities and study sites as well as a chance to continue their professional development by collaborating with SERC investigators. In turn, visiting scientists can make important contributions to SERC's research and professional training efforts. Bringing additional visiting scientists to SERC could supplement our expertise in critical areas (see objective 1.1.). Therefore, we plan to increase the number of visiting scientists conducting research at SERC.

2.6. Increase training programs for students and scientists from developing countries.

Environmental research is an international endeavor addressing regional and global problems and comparing ecosystems around the world. SERC has a distinguished record of international collaboration, for example, with scientists from Japan, New Zealand, and The Netherlands. While maintaining these valuable collaborations we plan to increase our collaborations with scientists from developing countries where environmental problems are often exacerbated by economic conditions and by limited educational opportunities for environmental scientists. SERC can contribute to meeting international environmental challenges by training students and scientists from developing countries. The training can be done under various SERC programs including internships, pre- and post-doctoral fellowships, and visiting scientist programs. SERC would benefit by bringing more researchers together at our core site and by developing partnerships offering access to a wider array of international field research sites.

The Smithsonian Institution has a long history of international research. As a U.S. institution, the Smithsonian can be a scientific ambassador to the world. SERC can play an important part in this international outreach. Besides helping to solve environmental problems, SERC's outreach efforts could enhance international goodwill toward the United States.

Goal 3:
Promote greater transfer of expert scientific knowledge to environmental managers and policy makers to enable informed decision making.

Objectives:

3.1. Increase the number of interactions between SERC staff and environmental managers and policy makers.

Meeting environmental challenges requires timely transfer of research findings to environmental managers, government agencies, and policy makers. SERC has helped inform decision makers on a number of issues including the management of blue crab fisheries, the threat of marine invasive species, and the importance of ecosystem services provided by wetlands and riparian buffers. For the future, SERC is committed to making its research more rapidly and widely available by greater interactions with local, national, and international policy makers in new and innovative ways. One possible new mechanism of information transfer would be SERC-sponsored dialogues between the research and policy communities.

3.2. Collaborate with experts in social sciences, economics, and policy to increase understanding of the social forces driving environmental impacts, to learn the concerns of policy makers, and to anticipate future environmental challenges.

The environmental sciences alone cannot solve all the environmental challenges that are facing society in the twenty-first century. In the future the social sciences and the life sciences must be brought together in innovative ways to provide the solutions to sustain life on earth. Research funding agencies increasingly encourage collaborations between environmental scientists and social scientists. New SERC research projects already include such collaborations.

Social scientists are elucidating the social forces driving environmental impacts, measuring the economic impacts of environmental problems, finding economic solutions to environmental problems, facilitating communication between scientists and policy makers, and forecasting environmental challenges emerging from social trends. SERC is committed to seeking outstanding partners in the social sciences to increase our understanding of human impacts on the environment. Understanding these impacts from a social sciences perspective is central to the study of human diversity and cultural change, a major research theme of the Smithsonian Institution.

Goal 4:
Educate a broader segment of the public about the environment, the scientific process, and the value of ecosystems.

Objectives:

4.1. Sustain the current level of excellence in SERC's education program reaching local students in grades K-12.

Public education is second only to research in SERC's mission. SERC continues to pioneer scientifically-based experiential learning for K-12 students in the environmental sciences. Our on-site educational activities engage school systems from Pennsylvania, Maryland, Virginia, and the District of Columbia on a regular basis. In addition, we periodically host students and teachers from New York and New Jersey. We want to sustain these outstanding regional programs while developing new programs that reach the broadest national audience.

4.2. Expand distance-learning and web-based programs to regularly reach K-12 school groups across the nation.

As a national institution the Smithsonian is obliged to serve all the people of the United States. SERC's goal to educate students across the nation is consistent with the Smithsonian's institution-wide goal to achieve national impact. SERC cannot achieve national impact solely through on-site programs, which can only serve about 16,000 students per year, typically on day trips from their schools. Therefore, we have built upon our field-based learning programs to develop distance-learning activities that use interactive video and internet technology to reach tens of millions of students in their classrooms nationwide. These distance-learning programs are designed to encourage teachers to take their students into the field as we do at SERC to extend the lesson in a true hands-on environment. The distance-learning programs include two-way video conferences that connect SERC with distant classrooms, and widely broadcast electronic field trips that allow viewers to interact with SERC scientists and educators via phone and email. Web-based learning programs transfer educational information from SERC via internet. We plan to expand both types of programs.

4.3. Increase on-site and off-site lectures for the public on selected environmental topics.

In addition to the K-12 audience, SERC has increasingly focused on adults interested in continued learning about the environment. For several years we have held a popular lecture series aimed at adult audiences. We plan to increase both on-site and off-site lectures in environmental science.

4.4. Develop programs, such as citizen science participation, to educate the public about the scientific process.

It is important to teach the public not only the findings of science but also the process of science. The best way to teach the process of science is by providing opportunities for direct participation in research activities. Through citizen science programs, SERC lets the public do research. For example, the immensely popular Neighborhood Nestwatch invites families to participate in SERC-directed research on bird behavior in their own backyards to investigate the value of suburban landscapes as bird habitat. SERC is constantly being asked to expand such programs because of their high quality, the recognized authority of the Smithsonian Institution, and the lack of comparable programs offered anywhere else. Therefore, we intend to develop new citizen science programs like Neighborhood Nestwatch.

4.5. Enhance educational programs to reach a greater diversity of underrepresented minorities.

SERC is striving to increase the participation of underrepresented minorities in our professional training programs (see objective 2.3.). As an extension of this objective, we also seek to enhance our public education programs to reach a greater diversity of participants. This is intended not only to educate a broader spectrum of our society but also to inspire young people from underrepresented groups to pursue careers related to environmental science.

4.6. Develop and apply methods to assess the impact of SERC educational programs.

As SERC continues to develop innovative educational programs, we must also develop and apply methods to assess the impact of these new programs. Educational impacts can be difficult to quantify. Development of methods for educational assessment is an area of active ongoing research. SERC is engaging expert guidance to achieve this objective.

4.7. Increase SERC's visibility in the news media to inform the public about environmental issues and SERC's research.

The news media present a powerful means to inform the public. SERC plans to cultivate media contacts to increase the visibility of SERC research and environmental issues in general. The recent addition of a staff science communicator will help us achieve this objective to inform both the public and policy makers through the news media.

Goal 5:
Build state-of-the-art laboratories and support facilities to serve the world-class science and education programs.

Objectives:

5.1. Add laboratory space through new construction and remove temporary trailers.

The physical plant at SERC has not kept pace with SERC's successes in research and education. There is insufficient laboratory and office space for the present research staff, which has increased by about 30 percent with the recent addition of four new principal investigators. Even more space will be needed to accommodate the planned increases in visiting scientists and pre- and post-doctoral researchers (see objectives 2.1. and 2.4.). The makeshift labs and offices in trailers that house some of our present staff should be replaced with high-quality work spaces in new buildings that are appropriately designed for research, safety, and flexibility of use. Therefore, a major expansion of permanent facilities is necessary over the next decade.

5.2. Complete planning and begin phased construction of experimental research facilities.

SERC has already begun planning three new experimental research facilities: one with greenhouses to support research in plant ecology, a second with specialized cages for research in animal behavior, and a third with running estuarine water and holding tanks for research on estuarine organisms. Such facilities would not only enhance the capabilities of the present staff but would also help attract visiting scientists to SERC.

5.3. Complete the Green Village for housing students and visiting scientists.

Increasing the number of students and visiting scientists, as planned in objectives 2.1. and 2.4., and sustaining the number of interns, as planned in objective 2.2., will require construction of appropriate accommodations at SERC to avoid costly and inconvenient off-site housing. Having a larger resident community at SERC will also promote synergistic interactions among students and researchers. The new dormitory under construction at SERC, primarily for interns, is only the first phase in the creation of the "Green Village" planned for SERC residents.

5.5. Expand the Reed Center for increased educational activities, especially to accommodate a distance-learning studio.

Planned increases in public education programs under goal 4 will require additional work space beyond that available in the Reed Center, SERC's current public education facility. A distance-learning studio will be needed to support our planned use of video technologies to expand the geographical reach of SERC's educational programs (objective 4.2.).

5.6. Design new facilities to minimize their environmental impact as much as possible.

In adding new facilities SERC should strive to set an example of environmental stewardship. The expansion of SERC presents the opportunity to participate in development of greener design technologies.

Planning for Challenges

The twenty-first century represents the dawn of a new age in which human impact on the global environment rivals that of nature. The challenges posed by this unprecedented change are at the heart of SERC's focus. We have purposefully framed an ambitious agenda for the next five years to match the environmental challenges we face. This five-year plan represents a focused approach to developing the scientific solutions to many of society's most pressing problems in the coastal zone. We are confident as a community that we can meet the challenges that are before us by providing high-quality research and education to society.