



# Environmental CHALLENGES *of the 21<sup>st</sup> Century*

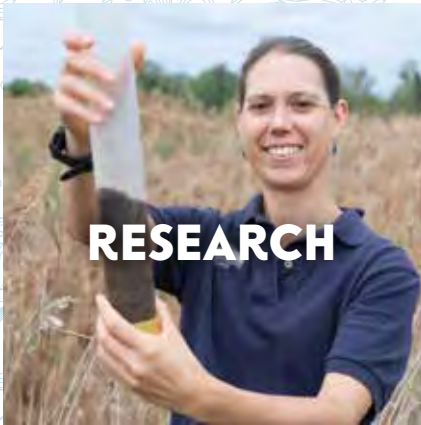


University of Maryland  
CENTER FOR ENVIRONMENTAL SCIENCE

2019 ANNUAL REPORT

# HARNESSING THE POWER OF SCIENCE TO TRANSFORM THE WAY SOCIETY UNDERSTANDS AND MANAGES THE ENVIRONMENT

The University of Maryland Center for Environmental Science has led the way toward better management of Maryland's natural resources and the protection and restoration of the Chesapeake Bay since 1925. From a network of laboratories located across the state, our scientists provide sound advice to help state and national leaders manage the environment and prepare future scientists to meet the global challenges of the 21st century.



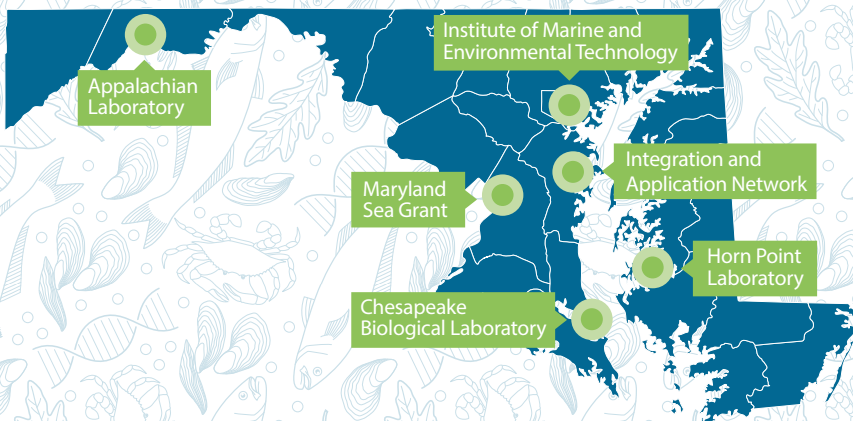
We work across disciplines and in diverse settings—from the Appalachian Mountains to the Arctic—seeking solutions that improve people's lives and sustain the natural world.



As trusted scientific advisors, our faculty provide unbiased research to inform management decisions and public policy on pressing environmental issues in our communities and around the world.



Our renowned faculty train the next generation of environmental leaders as part of the University System of Maryland's nationally ranked graduate program in marine and environmental science.



**Headquarters:** Cambridge, Maryland

**Year founded:** 1925

**Faculty members:** 70

**Graduate students:** 95

**Research laboratories:** 4



# MESSAGE FROM THE PRESIDENT

Dear friends,

Thanks to your support, we have begun a significant transformation of the University of Maryland Center for Environmental Science. We publicly launched our new Strategic Initiatives at the UMCES Environmental Summit at the end of 2018, and we've begun to take some meaningful strides in 2019.



Dr. Peter Goodwin

Our focus is on four critical environmental challenges in which we will be targeting our research investment and effort—maintaining sustainable landscapes and seascapes; building coastal resilience; creating healthy urban waterfronts; and accelerating the science of changing oceans and climate—and four areas in which we will work to strengthen our capacity and deepen our service to Maryland and to the nation. These include expanding and strengthening our educational offerings, deepening our engagement with citizens and decision makers, diversifying the field of environmental science, and contributing to Maryland's innovation economy.

We expect that clearly articulating and pursuing these priority commitments will strengthen collaborative work across the University, elevate and sharpen our public profile, and ultimately improve our ability to secure expanded support for the great work we do. Over the last year, we've spent time sharing our Strategic Initiatives with various constituencies, and their feedback convinces us that we are on the right track and have not time to lose.

Our scientists are producing cutting-edge research that asks and answers critical environmental questions; we are training an increasingly diverse set of excellent students to carry on that research as the next generation of environmental scientists; we are informing and advising decision-makers to help them effectively navigate the most important environmental challenges; and we are educating and inspiring citizens so that they can and will hold themselves and others to high standards of environmental stewardship.

We are very proud of the work that we have accomplished, but we also recognize that there is more that we can do—indeed, more that we must do—to help meet the profound environmental challenges facing our state, our nation, and the world. Thank you for your continued support to help us to continue and build upon our record of achievement.

Regards,

A handwritten signature in black ink that reads "P. Goodwin". The signature is written in a cursive, flowing style.

Dr. Peter Goodwin  
President

---

MISSION: The University of Maryland Center for Environmental Science has a unique statutory mandate to conduct a comprehensive scientific program and apply predictive ecology for the improvement and preservation of Maryland's physical environment. This mission is accomplished through research, education, and public service.

---

# TACKLING PRESSING ENVIRONMENTAL CHALLENGES

University of Maryland Center for Environmental Science faculty work across disciplines and in diverse settings—from the Appalachian Mountains to the Arctic, and from fisheries to climate change—to understand and discover solutions to challenges in the Chesapeake Bay and around the world. As trusted advisors to state and national leaders, we

provide the scientific basis to address pressing environmental issues in our communities and around the globe.

**We've recently identified four critical challenges in which we will be focusing our research investment and effort in the coming years:**

## BUILDING COASTAL RESILIENCE

1



UMCES scientists provide modeling for local governments to plan for flooding and impacts of sea-level rise to coastal communities.

Coastal resilience is the ability of coastal communities and coastal ecosystems to adapt to external disturbances such as hurricanes, flooding and coastal inundation, and extreme heat and precipitation events. Adaptation can reduce the net cost of climate change and its associated consequences, such as, sea-level rise and extreme weather events. Leading research on green restoration activities can help increase the protection of shorelines and coastal communities while maintaining ecosystem services.

**OYSTER BREAKWATERS:** Scientists are building an oyster breakwater to understand how these manmade structures, working in partnership with nature, could help stabilize shorelines around Chesapeake Bay as the threat of shoreline erosion and property loss is increasing.

**SEA-LEVEL RISE:** An UMCES-led group of scientists provides sea-level rise projections every five years (expected to range from 0.8 to 1.6 feet from 2000 and 2050) to aid managers in planning for changes to Maryland's 3,000+ miles of coastline. Scientists are developing new high-resolution models to predict the effects of storms and sea-level rise on Maryland's coastal communities.

## MAINTAINING SUSTAINABLE LANDSCAPES AND SEASCAPES

2



State-of-the-art advances at oyster cultivation facility have led to record-breaking numbers of spat-on-shell being used to help restore the Bay ecosystem and aid in aquaculture efforts.

The iconic Chesapeake Bay and its multi-state watershed and airshed provide a living laboratory for UMCES scientists to understand water- and land-use. Improved management practices offer opportunities to meet ambitious goals to reduce greenhouse gas emissions, improve soil health, and improve water quality in Maryland and beyond.

**SUSTAINABLE AGRICULTURE:** UMCES scientists are leading an international effort to develop a sustainable agriculture matrix, a collection of indicators measuring nutrient use and agricultural practices from environmental, social, and economic dimensions on a national scale to help guide evolving international policies.

**OYSTERS FOR RESTORATION:** UMCES' oyster expertise maintains a vital role in improving the management of the Bay's iconic species, the Eastern oyster. Recently scientists led the first oyster stock assessment in 135 years to help natural resource managers form a plan for oyster restoration in Chesapeake Bay, and state-of-the-art advances at oyster cultivation facility at Horn Point Laboratory have led to record-breaking numbers of oysters produced to help restore the Bay ecosystem, aid in aquaculture efforts, and support the wild fishery.

## ACCELERATING THE SCIENCE OF CHANGING OCEANS AND CLIMATE

3



UMCES oceanographers and fisheries scientists are at the forefront of what is one of the most globally integrated and interdisciplinary scientific fields.

The oceans are an important driver of climate. Already the impacts of sea level rise, ocean acidification, extreme weather events, and declining oxygen levels are evident. UMCES oceanographers and fisheries scientists are at the forefront of a global effort to resolve and ultimately safeguard the impacts of a changing climate on our global ocean.

**OCEANS LOSING OXYGEN:** UMCES experts authored chapters on ocean deoxygenation and its significance for estuarine and coastal plankton, the basis of marine ecosystem's food web, and on fisheries in a ground-breaking new report by the International Union for Conservation of Nature (IUCN) that explores the causes and consequences of ocean deoxygenation and how we, as a planet, must react.

**HARMFUL ALGAL BLOOMS:** UMCES researchers have been working on developing a new model to better predict the long-term occurrences of dangerous and costly harmful algal blooms in the Chesapeake Bay and have joined a six-institution team to investigate how climate change and extreme precipitation events exacerbate harmful algal blooms, such as red tide, in the eastern Gulf of Mexico.

**CHESAPEAKE DOLPHINWATCH:** Using "citizen scientists," over than 5,000 users have signed up to help researchers track dolphins in Chesapeake Bay. Over 2,000 sightings were reported since 2017, and scientists are beginning to link dolphin movement to the temperature, salinity, and oxygen in the water.

**FUTURE URBAN CLIMATES:** This interactive web app reveals how 540 urban areas will feel in 60 years has helped more than half a billion people visualize the impact of climate change on their lives. UMCES and National Geographic have partnered to develop a global cities app.

## CREATING HEALTHY URBAN WATERFRONTS

4



Urban waterfronts like Baltimore's Inner Harbor are particularly vulnerable to intensified coastal development, storms, and flooding.

Urbanized and industrial waterfronts must prepare for and adapt to environmental and climate change to ensure their ecological, environmental, and economic sustainability. UMCES research can help understand how to improve ecosystem function and biological biodiversity while increasing resilience to coastal inundation due to sea-level rise and storm surge.

**HARBOR HEALTH:** Scientists are using DNA barcoding to understand and identify what is living in urban waterways, such as Baltimore's Inner Harbor, to be able to have a baseline to judge ecosystem health.

**GREEN HARBORS:** UMCES brings together expertise to address green ship issues in the Chesapeake Bay and around the world, including vessel biofouling, alternative fuels, and methods to reduce air emissions and is dedicated to developing effective and reliable sensors and platforms for monitoring water quality.

### CORE RESEARCH AREAS

- Biodiversity & Invasive Species
- Climate & Energy
- Coastal & Estuarine Science
- Environmental Chemistry & Toxicology
- Fisheries & Aquaculture
- Genes & Microbes
- Ocean Science
- Restoring & Sustaining Ecosystems
- Terrestrial Ecology & Land Management
- Water Resources & Watersheds



# STRATEGIC DIRECTIONS

UMCES seeks to strengthen our capacity and deepen our service to Maryland and to the nation in the following areas:



## LOCAL AND GLOBAL ENGAGEMENT TO IMPROVE DECISION-MAKING

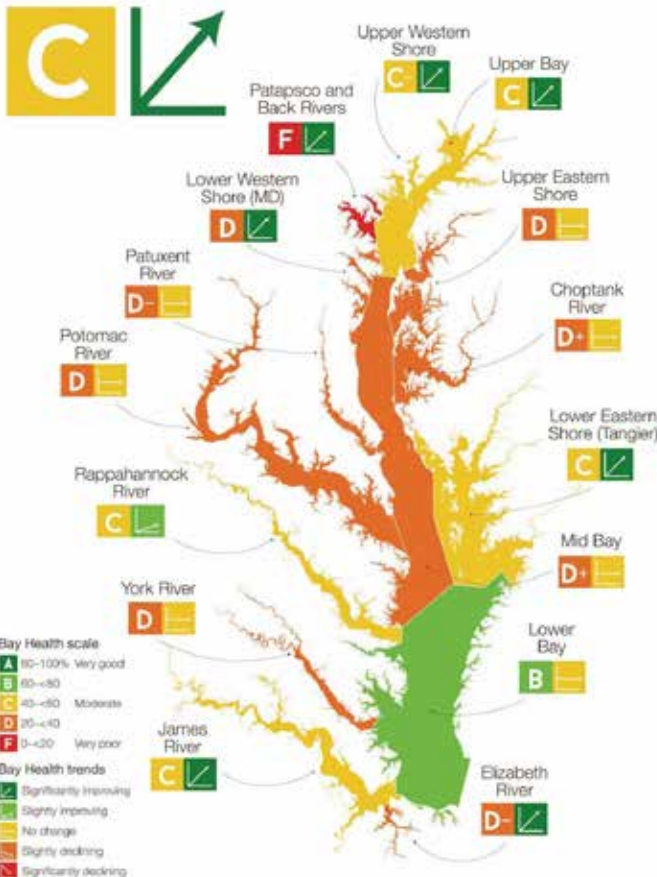
*UMCES provides the science for policymakers to address the pressing environmental issues in our communities*

Over the years UMCES has become an indispensable component of the policy-making process for Chesapeake Bay restoration, improving decision-makers' understanding of the challenges and potential solutions before them. As awareness and the urgency of the climate crisis has grown, so has our role in helping Maryland identify, develop, and employ measures to reduce our greenhouse gas emissions and our vulnerability to climate impacts.

UMCES helps provide the scientific foundation behind this statewide effort to track and communicate the Bay's health and restoration. Our annual **Bay Health Report Card** serves as the primary scientific communications tool for reaching watershed residents about the health of their local waters.

UMCES scientists recently completed a study to understand the potential impacts of nutrient pollution associated with sediment transported from behind **Conowingo Dam** to the Chesapeake Bay. This synthesis is important for bringing the best science to Bay management decisions by considering the entire Susquehanna-Conowingo-upper Bay system.

UMCES had the unique opportunity to host and facilitate a public forum on the **climate crisis** featuring participants from a European Union delegation to Maryland. The European Union Member State Ambassadors from France, Portugal, Sweden, and Spain shared climate policies that their countries are implementing and opened lines of communication about potential collaborative projects in the future.





## BUILDING A DIVERSE ENVIRONMENTAL SCIENCE PIPELINE

*UMCES strives to be an exemplar of environmental science professionals reflecting the face of the communities served by our work.*

UMCES and Maryland Sea Grant College have been awarded a \$2.5 million grant from the National Science Foundation (NSF) to help grow the number and diversity of students who are interested in education and careers in Science, Technology, Engineering and Mathematics (STEM) fields. This grant is part of a \$10 million, eight-institution **SEAS Islands Alliance** that will engage underrepresented minority students from the U.S. Virgin Islands, Puerto Rico, and Guam in marine and environmental sciences. The funded work will help to illuminate a full career pathway from middle school to graduate school and job placement.



## PROMOTING ENVIRONMENTAL ENTREPRENEURSHIP

*UMCES' research and researchers have the capacity and the opportunity to make significant contributions to Maryland's innovation economy.*

Through the **Ratcliffe Environmental Entrepreneurs Fellowship**, local business leaders train students to be science entrepreneurs. Recent graduate Suzan Sharestani has completed seed funding for her startup Minnowtech, an aquaculture technology company that helps shrimp farmers around the world determine the number and size of the shrimp they can harvest from ponds with low visibility, thanks in part to investments by the University System of Maryland's Momentum Fund.



## TRANSFORMING LIVES THROUGH EDUCATION

*UMCES offers research-based graduate programs, internships for undergraduates, outreach for K-12 students and teachers, and informal learning programs for the public.*

UMCES scientists train and inspire the nation's **next generation of environmental leaders** as part of the University System of Maryland's nationally ranked graduate program in marine and environmental science. Graduates conduct research at major universities, manage natural resources in public agencies, and drive entrepreneurial innovation in the private sector.

Four of our graduate students received highly prestigious **John A. Knauss Marine Policy Fellowship** enabling them to apply their expertise to policy issues in the executive and legislative branches of the federal government.

**Wave of Plastic**, the NOAA-sponsored education partnership at Chesapeake Biological Laboratory will help Southern Maryland students understand the connections between actions on land, plastic pollution in local waterways and the Chesapeake Bay, and student environmental stewardship.

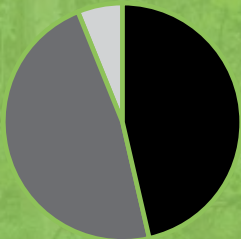
The annual **summer undergraduate internship** at the Institute of Marine and Environmental Technology celebrated its 17th year supporting increased diversity in STEM fields. Each summer, IMET offers undergraduates the opportunity to conduct a nine-week project research in marine sciences applying molecular tools.

**Public outreach** of UMCES' campuses across the state has brought science of the environment to more than 23,000 people through lectures with faculty experts, campus tours, special events and open houses and local K-12 programs.



# 2019 FINANCIALS

## SOURCES OF EXPENDITURES



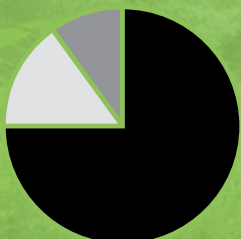
■ State Appropriations: \$22.8M (45%)

■ Grants: \$23.6M (47%)

■ Other: \$3.8M (8%)

**\$50.2 million**

## SOURCES OF GRANTS



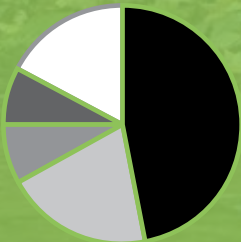
■ Federal: \$15.7M (75%)

■ State: \$3.2M (15%)

■ Private: \$2.1M (10%)

**\$21 million**

## SOURCES OF FEDERAL GRANTS



■ National Oceanic and Atmospheric Administration (NOAA): \$7.4M (47%)

■ Environmental Protection Agency (EPA): \$3.2M (20%)

■ National Science Foundation (NSF): \$1.2M (8%)

■ NASA: \$1.2M (8%)

■ Other: \$2.7M (17%)

**\$15.7 million**





# CONTRIBUTORS

UMCES' work is made possible by the generosity of our donors. Thank you.

AES Warrior Run, Inc.  
Anonymous  
Calvert Nature Society Inc.  
Frostburg Vision Center  
Southern Maryland Audubon Society  
Akridge Family Foundation  
Allegany College of Maryland  
Miike Allen  
Alliance Coal, LLC/Mettiki Coal, LLC  
Thomas T. and Catherine Alspach  
Robert and Lucy Anderson  
Bruce C. and Blenda Armistead  
Atlantic Concrete Co., Inc.  
Atlantic Tractor, LLC  
James Attlee  
B.A.S. Construction Inc.  
Bailey Wildlife Foundation  
Russel and Ida Jane Baker  
David and Pamela Baker  
Steve and Dawn Balinski  
John N. and Karen M. Bambacus  
Martin Barley  
Judith Ann Barnes  
Matthew Bash  
David J. Bates  
Duane W. Beckhorn  
Ivan and Pat Behel  
Rebecca Benton  
Alice Besterman  
Jay and Wendy Johnson Bilas  
Brian Bills  
Wendy B. Bishop  
Neal W. and Mrs. Karin K. Blizzard  
Shelby W. and Francesca Blythe  
Donald and Michaelyn Boesch  
Sara Schofield Booker  
John P. and Anne Marie Borneman  
Barabra Boyd  
Walter and Mary Ellen Boynton  
Kenneth L. and  
Dr. Ann R. Bristow Braitman  
Leslie J. Brodnik  
Gaylord and Mrs. Shirley Brooks, III  
Diana H. Brooks  
Omer F. Brown and  
Sandra Cannon-Brown  
Kevin and Cathy Bruce  
Kenneth Bruchey  
Mr. Thomas L. and  
Sheila Buckmaster  
Rachel Budd  
Sarah Beth Burdette  
James and Mary Campbell  
Patrick Campfield  
Donna F. Cantor  
Robert L. Case  
Linda Cherkassky  
Chesapeake Bay Seafood Industries Association  
Chesapeake Garden Club  
Mrs. Victoria W. Childs  
Carolyn Chuatiuco  
John B. Churchill  
Lorraine Claggett  
Howard L. Clark  
Larry Clark  
William and Juniata Clarke  
Stephen R. and Lin Clineburg  
George and Eleanor Cogswell  
Victoria J. Coles  
Rita R. Colwell  
Community Foundation of Greenville Inc.  
Community Foundation of New Jersey  
Community Foundation of Southern MD Inc.  
Doug Cook  
Cooper-Grebmeier Family Fund  
Shirley Coops  
Jeffery and Deborah Cornwell  
Ms. Patricia C. Crane  
James and Betty Crothers  
Kiersten L. Curti  
Moira Daly  
Eric A. Davidson and Jean Talbert  
Anne B. Davis  
Deerbrook Charitable Trust  
George Degnon  
Patrick R. Delaney  
William C. Dennison  
John and Martha Detweiler  
Dominion Energy Service, Inc.  
Dorchester Soil Conservation District  
Andrew and Mary Dowdell  
Michael J. Dowdy  
Aimee Doyle  
Martin H. Duby  
Jay Dumont  
William H. Dunton  
Chuck and Natalie Durney  
EA Engineering Science & Technology, Inc., PBC  
The Honorable Adelaide C. Eckardt  
W.B. and Beverly C. Edgell  
A. H. and Suzanne L. Edwards  
Craig R. Ellis  
Willard and Elaine Entwisle  
Gary and Jeri Epstein  
Charles C.G. Evans, Jr.  
Ron Evans  
George P.A. and  
Jocelyn Eysymontt  
Tiffany D. Farrell  
Edward W. Fedosky  
Richard Feit  
Robert H. Feldhuhn and  
Barbara Rosenbaum  
Fidelity Brokerage Services, LLC  
Fidelity Charitable Gift Fund  
Gabriel Filippelli  
Thomas B. Finan, Jr.  
Douglas and Rebecca Firth  
William and Joyce Fletcher  
Karen Fornwalt and  
Sherman Severson  
George and Julie Fox  
France-Merrick Foundation, Inc.  
Jerry and Kerri Thompson Frank  
Howard S. and Liz Freedlander  
Curtis and Nancy Friedenber  
John and Barbara Fringer  
Sara Furr  
Jerry and Julie Gaff  
Frank P. Gallagher, III  
Anne L. Gauzens  
George B. Todd Fund  
Doreen Getsinger  
Keith and Lisa Marie Ghezzi  
David M. Gillespie  
Albert B. Gipe  
Dagmar Dunn Pickens Gipe  
Eliot Girsang  
Richard and Janice Gnospelius  
Milton and Delores Goldberg  
Mariano A. and  
Brenda E. Gonzalez  
Chris Goodreau  
Peter and Michal Goodwin  
Wesley M. and  
Katherine D. Gordon  
Mr. Barry P. Gossett  
Chris and Janice Goudreau  
Donald and Tami Graf  
Lindsay Grasso  
Grayce B. Kerr Fund, Inc.  
Jane H. Greene  
Gary Michael Greenwood  
Mr. Peter Gross  
Jan Gustin  
Douglas Hackney  
Alice E. Hadley  
Hamilton Chaney Herrington  
Barbour N. Marina  
Alan Hammond  
Meredith Bullamore Hanna  
Dan M. and Amy L. Harman  
Jerrold B. and Bobette Harris  
Anne L. Harrison  
Harry R. Hughes Center for  
Agro-Ecology  
Vicki S. Hatch  
Chip and Patty Heaps  
Harold H. Hipsley  
Marjorie Wax and  
Brian P. Hochheimer  
Thomas L. Hollingshead  
Home Ground Inc.  
Jerry Hook and Jacqueline Smith  
Porter and Patty Hopkins  
Steven and Susie Hopkins  
Martha F. Horner  
Edward D. Houde  
Nina R. Houghton  
Ann Houpt  
Michael Housley  
Michael Housley  
Richard and Sue Hu  
Donna A. Huggins  
Hutchison Brothers  
Richard and Jan Hynson  
Steven E. Icardi  
Norma Imershein  
IWLA Mid-Shore Chapter  
Jen Edgell  
JES Avanti Foundation  
Christopher A. Johnson  
Barbara M. Johnson  
Donald F. and Joan Johnson  
Beth Ann Johnson  
Dawn A. Jones  
Elisabeth Kaemmerlen  
Martha C. Keating  
Janice S. Keene  
Keith Campbell Foundation for  
the Environment  
Margaret D. Keller  
Robert Kelly and Sarah Ramsey  
Patrick Kennedy and Jill Timmons  
Lauren E. Kenworthy  
Wells Fargo Community Support  
Campaign  
Laura W. Keohane  
Iffat Khan  
Robert Killius  
Houston M. and  
Mrs. Yvonne M. Kimbrough, Jr.  
Jerome F. and Mary K. Kinney, IV  
Toni Knisley  
John P. Knud-Hansen, MD  
Koolhof Earth, Inc.  
William H. and Gabrielle Korab  
Dr. Jonathan G. Kramer  
Ronald M. and Marianne Kreitner  
Marcia Lapham  
Laura L. Lapham  
R. Jason Larson  
Richard H. Leavy



Philip Lemkau  
 Mark J. Levine and Sara Imershein  
 Stacy Levinrad  
 Ming Li  
 Dong Liang  
 Thomas L. Lilly  
 Kathleen M. Linehan and  
 Ed Gabriel  
 Kyle J. and Jenna E. Linhart  
 Llandaff Family TR  
 Mr. Robert A. and Joan Locastro  
 Steven M. Long  
 Amy Haines and Richard Marks  
 Lowell Martin  
 Stanley Martin, Jr.  
 Richard J. Mason  
 Thomas P. and  
 Mrs. Carolyn A. Mathews  
 Jacques and Kennie Mauche  
 Joseph and Sally Mayasich  
 Mike and Margot McConnel  
 Joe R. and Carol A. McDaniel  
 Liz A. McDowell and  
 Ronald C. Boyer  
 Stacy M. McElhinry  
 David McGowan  
 Pamela Aall McPherson  
 Edward Melisky  
 Michael H. Mertz  
 J. Bradley and Barbara S. Metzger  
 Jack and Jill Meyerhoff  
 Mid Atlantic Farm Credit  
 Mid-Shore Community  
 Foundation Inc.  
 Sarah Joy Milbourne  
 Donna D. Miller  
 Thomas and Gail Miller  
 Robert G. Miller  
 Monet Family Fund  
 Kenneth A. Moore

Ray P. and Merry C. Morgan  
 Dr. Fredrika C. Moser  
 Michael and Lorraine  
 Moskewicz  
 Joyce Mumaw  
 Ellen R. Musante  
 Mr. Stephen R. and  
 Diana Mysliwicz  
 Nagel Farm Service Inc.  
 Mr. J. Mitchell Neitzey  
 Mrs. Karen J. Neitzey  
 David A. and Cheryl A. Nemazie  
 Elizabeth Watkins North  
 Northrop Grumman Corp  
 Charity Trust  
 Nuttall Ornithological Club  
 Jan Samet O'leary  
 Judith M. O'Neil  
 Janel Olde  
 Helen Olde  
 Linn W. Ong  
 Elizabeth Oster  
 Jim and Norma Osterhouse  
 James T. and Patricia Palinkas  
 Cynthia Palinkas  
 Lorna Parsons  
 Mark L. Pellerin  
 Joseph E. and Mary Lou Peters  
 Katherine Petty  
 Pioneer Hi-Bred International,  
 Inc.  
 Dan Pirtle  
 PNC Financial Services  
 Group, Inc.  
 Lisa M. Polyak  
 John D. Powell  
 Anna M. Priester  
 Susan C. Priester  
 Princeton Area Community  
 Foundation  
 Corey Pudhorodsky

Mike and Kathy Quattrone  
 Ellen Rajacich  
 Catherine Putnam Rankin  
 Lynn Marie Rehn  
 John and Monika Relman  
 Jimmie Reynolds  
 Thomas H. Reynolds, Jr.  
 Lucy F. Richards  
 Nancy Riddell  
 Anne C. Ridenour  
 Mark and Juanita Rilling  
 Eleanor Ritchie  
 William and Elspeth Ritchie  
 Cynthia Robbins  
 Robert and Dale Rauch  
 Ken and Margie Roberts  
 Jessica Roberts  
 Jessica Roberts  
 Katherine E. Robinson  
 David Robson  
 Bill and Janet Rochow  
 Diane Rohman  
 Reed and Patricia Rollo  
 Michael R. and Jennie L. Roman  
 Scott Romans  
 Kenneth A. and Julie Rose  
 Christopher L. Rowe  
 Raymond Todd Rowley  
 Jeffrey S. Ruark  
 Harriet Russell  
 William F. Ryan  
 Michael Sarin  
 Saul Ewing Arnstein & Lehr LLP  
 Kathleen Burns Scanlon  
 Mary Ann Schindler and  
 Martin Hughes  
 Edward and Marilyn Schmidt  
 Matthew Schneider  
 Jim Schofield  
 Kaherine Schoonover  
 Michael E. and Dale Schrader  
 Rhonda K. Schwinabart  
 David and Eriko Secor  
 Martha C. Sewell  
 Ben Shaw  
 Anita Shepherd  
 Shore United Bank  
 ShoreRivers Inc.  
 Dewees and Kelly Ann Showell  
 John D. Shuman  
 Carol R. Simpson  
 Laurence E. Skinner and  
 Maris Wicker  
 Steven G. Smith  
 Edgar A. Smith  
 Lesley Smith-Morrill  
 Eva M. Smorzaniuk, MD  
 Anna Snow  
 Solomons United Methodist  
 Church  
 Kimbol Soques

Southern Maryland Alumni  
 Network UM  
 Southern Maryland Electric Co-Op  
 Southern Maryland Recreational  
 Fishing Organization  
 Wayne C. and E. Betty Spiggle  
 Milford Sprecher  
 Heather M. Stapleton  
 Mike and Linda Starling  
 Jock Beebe and Carin Starr  
 Kenneth W. and Lorie Staver  
 Mary Stephenson  
 Stephenson Pope Babcock  
 Foundation  
 J. Court and Catherine P. Stevenson  
 George and Mrs. Beverly Stimmel  
 Joseph T. N. Suarez, CFRE  
 Haven Sweet  
 Henry and Dorothy Szymanski  
 Francis and Margaret Tam  
 The Ed and Andy Smith Fund  
 The Foundation for Enhancing  
 Communities (TFEC)  
 The Peoples Bank  
 The Philip E. & Carole R. Ratcliffe  
 Foundation  
 Frances A. Thorington  
 Bonnie Thornton  
 Richard and Beverly Tilghman  
 Toyota of Southern Maryland/  
 Team Hyundai  
 Luther and Cordelia Tucker  
 Alfred Tyler, II and Cleo Braver  
 UMS HPEL Working Fund  
 John R. and Lise Valliant  
 Ms. Elizabeth K. Vanden Heuvel  
 Vanguard Charitable  
 Lisa A. Wainger  
 Wilmer Waller and Michael Hash  
 Walt Disney Company Foundation  
 Frank M. Watkins, MD  
 Stanley P. and Gail Watkins  
 Daniel Watson and Brenda Stone  
 Philip J. and Irmhild G. Webster  
 Dale L. Whalen  
 Jeane Wharton  
 Elizabeth Wheeler  
 Robertson Williams  
 Joseph L. Winters  
 Douglas G. and Margaret Worrall  
 Rochelle Wyatt  
 Mr. David Wye  
 Charles and Ann Yonkers  
 Dottie Yunger  
 David and Lois Zonderman  
 Howard A. Zwemer

*We greatly appreciate your support and regret any inadvertent omissions. To make a contribution, visit [umces.edu/giving](http://umces.edu/giving) or call 410-221-2001.*



## UNIVERSITY SYSTEM OF MARYLAND

Jay A. Perman, M.D., *Chancellor*

## BOARD OF REGENTS 2020

Linda R. Gooden, *Chair*  
Gary L. Attman  
Joseph Bartenfelder  
Ellen Fish  
Geoff J. Gonella  
Barry P. Gossett  
Michelle A. Gourdine, M.D.  
James Holzapfel  
D'Ana Johnson  
Isiah (Ike) Legett  
Sam Malhotra  
Meredith M. Mears  
Robert R. Neall  
Louis Pope  
Robert D. Rauch  
Kelly M. Schulz, *ex officio*  
Robert L. Wallace  
William T. "Bill" Wood  
Drew M. Needham, *Student Regent*

## LEADERSHIP

Peter Goodwin, *President*

Stuart Clarke  
*Vice President for Strategic Initiatives*

William C. Dennison  
*Vice President for Science Applications*

David A. Nemazie, *Chief of Staff*

Lynn M. Rehn  
*Vice President for Administration*

Lawrence Sanford  
*Vice President for Education*

## LABORATORY DIRECTORS

Eric A. Davidson  
*Appalachian Laboratory*

Russell T. Hill  
*Institute of Marine and Environmental Technology*

Thomas J. Miller  
*Chesapeake Biological Laboratory*

Fredrika C. Moser  
*Maryland Sea Grant College*

Michael R. Roman  
*Horn Point Laboratory*

## BOARD OF VISITORS

Charles O. Monk II, Esq., *Chair*  
Paul J. Allen  
Thomas L. Buckmaster  
Victoria Childs  
Peggy Derrick  
Gary M. Epstein  
Joseph E. Farren  
Donald Graf  
Ronald Kreitner  
Mark Levine  
Thomas Lingan, Esq.  
William (Sandy) McAllister, Jr.  
J. Mitchell Neitzey  
Eileen Straughan  
Joe Suarez

## LOCATIONS

### Center Administration

P.O. Box 775  
Cambridge, MD 21613 | 410-228-9250

### Appalachian Laboratory

301 Braddock Road  
Frostburg, MD 21532 | 301-689-7100

### Chesapeake Biological Laboratory

146 Williams Street  
Solomons, MD 20688 | 410-326-4281

### Horn Point Laboratory

2020 Horns Point Road  
Cambridge, MD 21613 | 410-228-8200

### Institute of Marine and Environmental Technology

701 E. Pratt Street  
Baltimore, MD 21202 | 410-234-8800

### Maryland Sea Grant College

4321 Hartwick Road, Suite 300  
College Park, MD 20740 | 301-405-7500



University of Maryland  
CENTER FOR ENVIRONMENTAL SCIENCE

[umces.edu](http://umces.edu)



This paper contains 100% post-consumer fiber, is certified FSC®, processed chlorine free and manufactured using biogas energy.



University of Maryland  
CENTER FOR ENVIRONMENTAL SCIENCE



The University of Maryland Center for Environmental Science's sixth annual Commencement ceremony featured Professor Vicki Arroyo, Executive Director of the Georgetown Climate Center and Assistant Dean for Centers and Institutes at the Georgetown University Law Center.

Arroyo told graduates, ***"For major environmental challenges—saving Chesapeake Bay, curbing or preparing for climate change, individual institutions (even relatively small ones like UMCES and Georgetown Climate Center)—can play a vital role. And individual people like each of you graduating today can make a difference."***