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UNDERSTANDING GLOBAL CHANGE

VIMS is deploying multidisciplinary teams — enhanced by stellar junior faculty — to investigate the effects of global change and develop pioneering strategies in response.

The "O" in H_2O

VIMS' annual "Hypoxia Report Card" grades water quality in the Chesapeake Bay

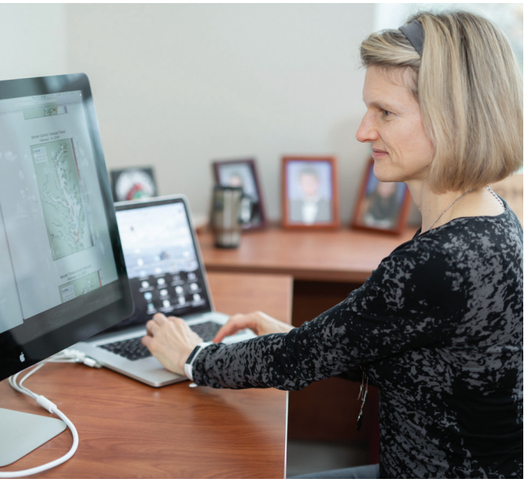
Like terrestrial creatures, marine organisms need oxygen to survive. Because there's far less oxygen in water, however, and it diffuses far more slowly, even small decreases have a big impact on the marine food chain.

VIMS pioneered the global study of so-called "dead zones" — low-oxygen waters — which have doubled in frequency each decade since the 1960s. These hypoxic areas are prevalent in the Chesapeake Bay throughout the summer.

To aid policymakers, VIMS introduced an annual "Hypoxia Report Card" for the bay in 2017. The report card was created by VIMS Research Professor Marjy Friedrichs with her former postdoctoral investigator, Aaron Bever Ph.D. '10 of Anchor QEA consulting company.

The report cards are based on forecast models developed by Friedrichs, Bever, and University of Maryland Professor Raleigh Hood. They incorporate real-time information as well as historical data collected by VIMS since 1985. "Observations collected only every two weeks can miss some important high-frequency changes. That's what we bring to the table," Friedrichs says. She notes that charter boat captains especially appreciate the daily "NowCast" to find the best spot for stripers.

VIMS is a national leader in studying harmful algal blooms (HABs), which can pose a danger to marine life and human health.



The report offers invaluable comparative data: for example, state environmental agencies can see whether efforts to reduce fertilizer runoff, a major culprit in causing hypoxia, have been effectively improving water quality. However, the situation is complicated by the changing climate.

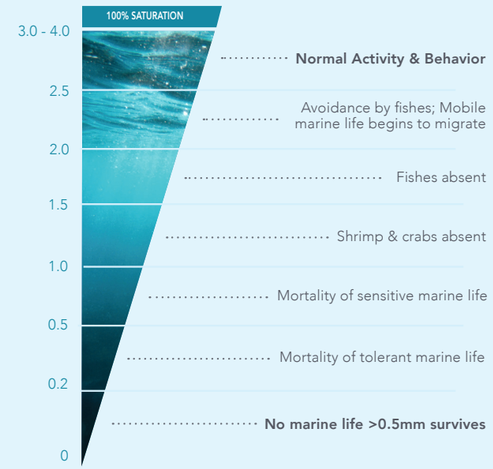
"Observations collected only every two weeks can miss some of these important changes. That's what we bring to the table."

"What I'm most interested in, and the ultimate question, is trying to figure out how much of the change we're seeing in the bay is due to management actions and how much is due to climate change," Friedrichs says. "Warming in particular is causing there to be less oxygen in the water. So we're using a mechanistic model to try to tease apart the counteracting forces."

"Sea-level rise is also very interesting," she adds. "More ocean water brings more oxygen, but it also brings more salt, which limits mixing, so you can't get as much oxygen down to the bottom."

Friedrichs and Hood are also beginning work on harmful algal bloom forecasts — drawing on VIMS' leading research on HABs (see page 12). "I like to emphasize that it's a partnership between Virginia and Maryland," Friedrichs says. "From a data standpoint, it's one bay. There's no wall in between."

OXYGEN LEVELS (MG/L) AND THEIR EFFECTS ON MARINE LIFE



Marjy Friedrichs (top left) leads a team quantifying the impacts of climate and land-use changes on the Chesapeake Bay.

SEAGRASS IN AUSTRALIA

When Professor Gary Kendrick of the University of Western Australia began a seagrass restoration project back in 2013, he knew exactly who to call — VIMS Professor Robert "JJ" Orth. "JJ is an elder in seagrass research, one of the top in the world," Kendrick says. "And he's such a positive fellow."

The project, supported by the Australian government and corporate funding, has resulted in a long-term collaboration with significant implications for threatened seagrasses worldwide. The group led by Kendrick and Orth just published exciting new findings in Nature's *Scientific Reports* on the evolutionary benefits of winged seeds in species of Australian seagrass. "Understanding the basic biology of seeds allows us to optimize our restoration practices," says Kendrick. "We've been incredibly successful in figuring out the science."

Professor JJ Orth preparing to dive off Rottnest Island in Western Australia.

"VIMS focuses on hiring interdisciplinary cohorts of scientists who are adept at collaborating across research areas to produce cutting-edge science. Since 2015, we have welcomed nine outstanding new faculty members to our ranks."

— JOHN WELLS, VIMS DEAN AND DIRECTOR

Assistant Professor Juliette Smith launches the Imaging FlowCytobot off the VIMS pier. Eventually she hopes to deploy a network of cytobots across the Chesapeake Bay.

CREATING A HAB EARLY WARNING SYSTEM

First described as red tides, harmful algal blooms — HABs — are increasing around the world. VIMS scientist Juliette Smith aims to create an early warning system to protect marine and human life from toxins that HABs can produce. She's been given a powerful boost to her work by VIMS supporters Harry and Judy Wason, who funded a state-of-the-art Imaging FlowCytobot to help Smith identify harmful algal species in real time. Smith is now leading a multi-institutional team, supported by a major NOAA grant, working to develop early warning systems in major U.S. shellfish harvesting sites. "The Wasons have given Juliette and her team the technology that will establish them on their long-term career trajectories," says Dean and Director John Wells. "It's an amazing gift."

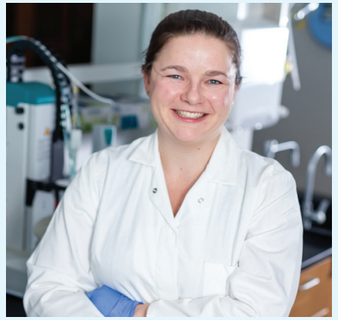
TRAINING CITIZEN SCIENTISTS

Marine organisms are subject to daily changes in water temperature and acidity, sometimes extreme. How will this influence their future response to global change?

That's the question Assistant Professor Emily Rivest is working to answer. Since coming to VIMS in 2016, she's expanded her research from the colorful coral reefs of French Polynesia to the oysters of the Chesapeake Bay. "The landscape here for ocean acidification is really unique — and that means it's a new frontier," Rivest says.

Rivest is taking a multi-pronged approach, including measuring actual conditions in the bay. She's also set up a sophisticated aquarium system to simulate future temperature and/or pH conditions. "It's like a crystal ball," she says.

With support from the Dominion Energy Foundation and NOAA, she's had a small army of



"citizen scientists" from area high schools to help with data collection. In turn, Rivest helps these young people to learn scientific methods and appreciate the effects of environmental conditions on local oysters.

"Our research has a lot of connection to aquaculture and restoration," Rivest says. Farther down the road, growers may be able to custom-design water conditions to maximize success. "It's a glimmer in the eye of where this really exciting research could lead."

RESPONDING TO SEA-LEVEL RISE

Associate Professor Matt Kirwan '02 has received many accolades, but the most recent topped them all — this past July, he was honored by the White House with the Presidential Early Career Award for Scientists and Engineers. Investments in his work from the Herndon Foundation helped pave the way for his success.

Kirwan's current research, which encompasses field, laboratory, and classroom activities, focuses on how the carbon stored in coastal marshlands will respond to sea-level rise. Through the educational component, he is working with local community college students and Indian tribes. "Matt's a scientific rock star," says former VIMS professor Deborah Bronk, now CEO of Bigelow Laboratory. "His stellar research brings benefits to the Chesapeake Bay and the nation."

Matt Kirwan's research on coastal marshes and "ghost forests" created by sea-level rise has garnered national media attention.