

VIRGINIA INSTITUTE OF MARINE SCIENCE

2020-2026 SIX-YEAR PLAN: NARRATIVE

OVERVIEW:

The totality of the six-year plan should describe the institution's goals as they relate to goals of The Virginia Plan for Higher Education, the Higher Education Opportunity Act of 2011 (TJ21) and the Restructured Higher Education Financial and Administrative Operations Act of 2005. The instructions under institutional mission and alignment to state goals, below, ask for specific strategies around four priority areas. Other sections will offer institutions the opportunity to describe additional strategies to advance institutional goals and state needs. *Please be as concise as possible with responses and save this narrative document with your institution's name added to the file name.*

Section A. Institutional Mission, Vision, Goals, Strategies, and Alignment to State Goals: Provide a statement of institutional mission and indicate if there are plans to change the mission over the six-year period.

Provide a brief description of your institutional vision and goals over the next six years, including numeric targets where appropriate. Include specific strategies (from Part 3 – Academic-Financial Plan and Part 4 – General Fund Request) related to the following areas: (1) access and enrollment, particularly for underrepresented students; (2) retention, completion and time to degree; (3) affordability and funding; and (4) workforce alignment and retention of graduates. Strategies also can cross several state goals, notably those related to improved two-year and four-year transfer, and should be included here. If applicable, include a short summary of strategies related to research. The description of any strategy should be one-half page or less in length. Be sure to use the same short title as used in the Part 3 and Part 4 worksheets.

RESPONSE:

The Mission of the Virginia Institute of Marine Science is to seek and broadly communicate knowledge in marine and coastal science to the Commonwealth of Virginia, the nation, and the world through research, education, and advisory service.

As a nationally and internationally recognized premier marine science institute, our overarching goals in the VIMS Vision are to (1) make seminal advances in understanding marine and coastal systems through research and discovery, (2) translate research findings into practical solutions to complex issues of societal importance, and (3) provide new generations of researchers, educators, problem solvers, and managers with a marine-science education of unsurpassed quality.

Restore Saltwater Fisheries Survey Funding. Long-standing fisheries surveys by VIMS provide the scientific data on which saltwater fisheries in the Commonwealth of Virginia are managed. These surveys have been supported by a combination of state dollars and federal grants. Recent reductions in the state and federal funds resulted in five of our most important surveys being dramatically cut. Beginning in 2018, federal funding from the US Fish and Wildlife Service that flows through the Virginia Marine Resources Commission (VMRC) was reduced from \$1.8M to \$1.13M, largely as a result of a federal decision to alter the percentage split between freshwater and saltwater fish survey support provided to Virginia. At the same time, VMRC's source for providing their share of a 33% state match requirement (historically VMRC provided \$300K and VIMS provided \$300K of the required \$600K match for \$1.8M of federal funds) was reduced by the General Assembly so that most of those dollars could be used to support the Saltwater Fishing Tournament.

Secretary Strickler and the Commissioner Bowman managed to negotiate a slightly more favorable split in federal funds that resulted in a federal funding of \$1.4 M going to saltwater fisheries surveys, but the total loss between the state and federal sources was approximately \$700K. VIMS implemented

austere cuts to these surveys, reduced personnel, and combined surveys to gain efficiency, but still fell \$230K short of having funding needed to sustain the surveys at a level to meet the needs of the Commonwealth. We are seeking to recover this lost support to maintain these surveys that are critical to wise management and economic viability of Virginia's saltwater fisheries.

Manage Aquatic Diseases. Recent outbreaks of disease have damaged economically important and ecologically sensitive marine resources in the Commonwealth and nation. Examples include mycobacterial infections in striped bass, dermo and MSX in oysters, *Hematodinium* in blue crabs, morbillivirus in dolphins, wasting disease in seastars, bacterial infections in scallops, and parasitic infections in eels, to name a few. The pathogens responsible for these outbreaks are not well known, their risks to marine life and potential to spread remain understudied, and their ecological impacts have been difficult to assess with existing resources. To meet the challenge of diseases in marine systems, this initiative will provide science-based guidance on the management of existing and emerging disease threats to critical fishery and aquaculture resources in the Commonwealth and Chesapeake Bay region. VIMS scientists have considerable expertise working with diseases of marine animals; however, we aim to leverage this expertise by establishing state and regional response protocols, identifying and liaising with key groups such as state and federal resource managers and public health officials, as well as the fishing and aquaculture industries, serving as a clearinghouse for information to policy makers, and developing modeling tools to mitigate the effects of disease outbreaks. The health of marine resources such as fish and shellfish is fundamental to the growth of industries and the revitalization of coastal communities dependent upon them. This initiative will provide expert guidance on the management and mitigation of existing and emerging disease threats to vital fishery and aquaculture resources in the Commonwealth and Chesapeake Bay region. It will significantly enhance our responses to known pathogens and provide a clear framework, based on state-of-the-art science, for addressing the dangers of emerging diseases.

Support Virginia Department of Health (VDH) and Virginia Marine Resources Commission (VMRC) Needs in Shellfish Aquaculture Management. Shellfish aquaculture in one of the fastest growing economic drivers in coastal Virginia, especially in rural areas. With this growth has come the need for new monitoring and assessment programs to support the work that VDH does in protecting human health and that VMRC does in managing the use of the state's aquatic resources. VIMS has the technical skills to conduct these new programs, but lacks the state-supported personnel to conduct the monitoring and some of the needed field sensors. Federal grant funding, which we employ with great success in supporting our research programs, is typically not available to support such monitoring programs. State support, in three separate monitoring programs, will allow us to meet the needs that have been expressed to us directly by VDH and VMRC.

1. Improve Risk Management of Vibriosis. A key threat to the growth and sustainability of shellfish aquaculture is the association of human-pathogenic *Vibrio* bacteria with product marketed for raw consumption, in particular oysters. Infections by the two *Vibrio* species of concern, *Vibrio vulnificus* and *Vibrio parahaemolyticus* (or vibriosis) are responsible for an estimated 80,000 illnesses and 100 deaths in the U.S. annually, with most of these infections associated with consumption of raw or undercooked shellfish. These bacteria can also have significant repercussions for the shellfish industry through product recall, closure of harvest beds and reduced opportunity for sales associated with negative publicity. With the rise in shellfish production and in consumption of shellfish, particularly oysters, as a raw product, as well as the likelihood for *Vibrio* species abundance to increase with warming seawater, favorable conditions are in place for an increase in vibriosis cases. Because these bacteria occur naturally in shellfish and their surrounding environment, preventing illnesses relies on a robust monitoring program. Within this context, increased monitoring of our local waters and shellfish will enhance our understanding of the factors driving the distribution and abundance of these bacteria in the environment and in shellfish. We will collaborate with VDH to foster science-based risk management strategies.
2. Determine Carrying Capacity for Shell Production. Sustaining Virginia's shellfish aquaculture industry and enabling future expansion are dependent on an adequate food supply for the

shellfish; this supply comes from primary production by phytoplankton which sets the amount of shellfish that can be grown in an area (carrying capacity). Increasingly, VMRC is seeking VIMS' guidance on the carrying capacity of shellfish growing areas throughout Virginia's coastal waters. To satisfy this request, we need accurate, up-to-date measurements of local rates of phytoplankton production, a quantity that changes as nutrient inputs and temperature vary. This initiative will allow us to conduct monthly surveys in shellfish growing waters throughout Tidewater Virginia to build and maintain a spatially-explicit database that can be used to develop carrying capacity estimates for oyster and clam production in these waters. In conjunction with this we will develop user-friendly decision support modeling tools that can be directly used by VMRC and the shellfish aquaculture industry to assess carrying capacity and make informed decisions about the production capacity of a given water body.

3. Assess Coastal Acidification and its Impact on Shellfish Aquaculture. Coastal acidification, caused by increased atmospheric CO₂, presents a serious and credible threat to the marine resources of the Commonwealth, including shellfish aquaculture industry, fisheries stocks, and health of Chesapeake Bay and the Eastern Shore ecosystems. In September 2018, the Northam administration joined the International Alliance to Combat Ocean Acidification, demonstrating its commitment to ensuring that Virginia is a leader in addressing coastal acidification issues. To meet this commitment, we need to assess the severity of coastal acidification, develop an early warning system for stakeholders, and predict its impacts on living resources. In recent years, VIMS has developed observational capacity, advanced modeling tools, and sophisticated experimental facilities that are capable of supporting the Commonwealth's commitment.

Establish a Molecular Core Lab. Rapidly advancing technology has led to a revolution in the realm of molecular biology and genomics, giving scientists much greater power to address complex problems in marine and estuarine systems. This revolution offers the opportunity for VIMS to improve its capabilities in fulfilling its advisory mission to the Commonwealth in the areas of fisheries and aquaculture, environmental health, and coastal ecology. Extremely large amounts of data can be generated in a relatively short period of time using this technology, offering unparalleled opportunities to create more sustainable environments, bolster regional economies, and protect human health.

Currently, VIMS researchers within three different departments use molecular approaches to address important research questions related to resource management and public health issues in Virginia, including fisheries and aquaculture management, harmful algae blooms, and shellfish health and safety. Key pieces of heavily used shared equipment are scattered across campus and are rapidly becoming outdated. VIMS' ability to accommodate this research, which requires massively high-throughput sequencing, digital PCR, transcriptomics and single cell genomics, is limited by the absence of a centralized facility with support.

We are seeking to upgrade critical instruments and to add technical expertise in advanced bioinformatics analyses, and dedicated technical staff to operate and coordinate the use of specialized equipment, and to advise researchers on appropriate strategies and approaches to answer their research questions. Almost all top-tier marine research institutions, including Woods Hole Oceanographic Institute, Scripps Institution of Oceanography, Rosenstiel School at University of Miami, University of Rhode Island, University of Washington, and others, support these types of core facilities with state-of-the-art equipment and technical expertise. As VIMS is in the process of designing and building a new science laboratory building, it is an excellent opportunity to acquire the needed equipment and additional staff to develop the molecular capabilities to remain competitive in the 21st Century and to provide the Commonwealth with state-of-the-art, science-based advice. VIMS has leveraged its existing molecular genetics capabilities for over \$5M in extramural research funds. Enhancing our capabilities further would expand our capacity to leverage even more extramural money in support of our research, education and advisory missions.

Support Commonwealth Fisheries Collection. The Nunnally Ichthyology Collection at VIMS is a library of preserved fishes from Virginia, the Chesapeake Bay, the North Atlantic, and the world beyond.

The collection supports VIMS' institutional mission of research, education, and advisory service by engaging a broad community of scientists worldwide, providing the foundation for graduate education and research, and inspiring the public by sharing the biodiversity of fishes and the research that is being done to gain a better understanding of the natural world. The collection also serves as the only active, cataloged repository in the Commonwealth for voucher specimens of fishes collected by biologists at VIMS, numerous state (VDGIF, VMRC and DEQ) and federal agencies (NOAA and USFWS), Virginia Parks and Recreation (various counties), and the Virginia Aquarium.

The Nunnally Ichthyology Collection at VIMS also houses approximately 54,000 individual fish from institutions of higher education in Virginia that have divested their collections, including: Virginia Commonwealth University, University of Richmond, College of William & Mary, and George Mason University, and another approximately 52,000 fish formerly from the Chesapeake Biological Laboratory collection in Maryland. It is the only state collection for marine and freshwater fishes, and serves as the state repository for fishes collected in the Commonwealth. VIMS bears the responsibility of ensuring that this valuable resource is maintained on behalf of the Commonwealth. To date we have managed this through some allocation of our existing funds, federal grants and philanthropic gifts. As the size and value of this collection has grown, we lack the resources to ensure that the collection is adequately maintained and that it is available for use by state agencies and academic institutions.

Monitor Zooplankton and Larval Fish. Zooplankton (small marine organisms) serve both as trophic links between primary producers and higher trophic levels—such as commercially important fish and invertebrates. Furthermore, most commercially important fish and all shellfish in Chesapeake Bay have a pelagic, larval stage in the plankton—the survival of which exerts key control on the fisheries stock. However, for the past two decades there has been no systematic sampling of spatial and temporal variability in zooplankton or fish larval abundance in Virginia waters. The Commonwealth's current water quality monitoring programs and fisheries stock assessments completely exclude this key link in the estuarine and coastal food web. Indeed, predictive models of Bay water quality and fisheries stocks—if they include mid-trophic levels at all—are based on obsolete zooplankton data. Rising temperatures and changing salinity distributions in the Chesapeake Bay are certain to alter this important link in the food web.

With the Commonwealth's significant investment in the new R/V *Virginia*, recent upgrades and digitization of the Nunnally Ichthyology larval fish collection, and the wide expertise of faculty members including plankton and benthic ecology, ichthyology, and ecosystem modeling, VIMS is now uniquely poised to address this critical gap in our understanding of Bay and coastal food web dynamics. Recent advances in remote observation technology using an Underwater Vision Profiler and machine learning have also increased efficiency of zooplankton sampling, identification, and enumeration. This initiative will complete our fisheries monitoring program.

Establish Virginia Harmful Algal Bloom (HAB) Monitoring Consortium. Harmful algal blooms pose a significant threat to human and animal health, as well as to aquaculture, commercial fisheries, aquatic food webs and safe recreational water use. Recent increases in the frequency, severity and distribution of algal blooms have occurred worldwide and the threats posed by emerging HAB species are predicted to increase. Specifically, in Virginia's waters there are emerging HABs, as well as increases in the severity and distribution of several harmful species. Additional coordinated and intensive monitoring efforts are needed to gain a better understanding of the conditions that lead to blooms of HAB organisms and to more accurately predict the potential human health effects and impacts on aquatic life.

Virginia citizens would be best served by a HAB monitoring consortium where VIMS personnel would work cooperatively with other Virginia state agencies, particularly the Virginia Department of Environmental Quality (DEQ), Virginia Marine Resources Commission (VMRC) and the Virginia Department of Health (VDH). This consortium would coordinate a larger-scale HAB monitoring program in Virginia waters, engage in public education, and develop appropriate response and notification protocols for future HAB events. Currently the stations in VA estuarine and marine waters are typically monitored only monthly and more frequent monitoring is necessary, particularly during the peak bloom

season of summer and early fall. More frequent monitoring is particularly important for shellfish growing areas where there is a risk to human and shellfish health. The role of VIMS scientists in this consortium would be species and toxin identification and quantification.

Expand Tetraploid Technology for Improved Yields of Oyster Aquaculture in Chesapeake Bay.

Virginia leads the east coast in aquaculture production of clams and oysters. These developments have been rooted in scientific advances and transfer of contemporary technologies to the industry by VIMS. In fact, VIMS has become a world leader in shellfish aquaculture technologies. One of those technologies has been a force in driving oyster aquaculture to the forefront: tetraploid technology.

Tetraploid oysters (which have 4 sets of chromosomes as opposed to normal diploid oysters with 2 sets) are used by commercial hatcheries to mate which produce sterile (spawnless) triploid oysters (3 sets of chromosomes), which comprises >90% of farmed oysters in Virginia, and increasingly, east coast states. This technology is part of the Intellectual Property portfolio of the Aquaculture Genetics and Breeding Technology Center at VIMS. To date we have used tetraploids largely for the purpose of mating them with diploids producing sterile oysters, while normal diploids have been the focus of our breeding efforts to produce faster-growing, disease resistant oysters.

That means that the remarkable progress that we have made to date in breeding an improved oyster has been accomplished through genetic selection on only one-third of the genetic material that makes up a triploid oyster. We have now produced thousands of tetraploid oysters and are prepared to make even greater advances by beginning to do selective breeding to improve the tetraploids.

This will increase the operational cost of the breeding program, but we expect it will lead to major advances in Virginia's oyster aquaculture industry. The initiative will allow us to expand the development of tetraploid strains by developing new genetic material for release to industry, all with the goal to ensure that Virginia maintains its world-leading role in research and development in support of oyster aquaculture.

Increase Base Operating Support. The normal formulas the state uses to assess and supply base operating support to higher education institutions does not readily apply to VIMS and, thus, disadvantages the Institute. Specifically, this request includes vital support for 1) service contracts for high tech scientific equipment purchased through the Equipment Trust Fund, 2) inflationary increases in general operating expenses, and 3) support for personnel services in support units.

Continue to Operate as a Year-round Facility. As an independent state agency that is heavily involved in research and graduate education, VIMS also provides advisory service to the Commonwealth in the form of expert scientific advice on marine-related issues throughout Chesapeake Bay and the coastal ocean. All three of our missions, the graduate program, research and advisory programs, are heavily operational for the entire 12-month calendar year, and in fact, all of our faculty hold 12-month appointments. Field research is most active between April and October, but most other activities occur equally throughout the year. VIMS always has been, and will continue to be, a year-round operation.

Section B. Tuition and Fees Predictability Plans: Provide information about the assumptions used to develop tuition and fee charges shown in PART 1. The tuition and fee charges for in-state undergraduate students should reflect the institution's estimate of reasonable and necessary charges to students based on the institution's mission, market capacity and other factors. Include information, if applicable, on tuition increase plans for program- and level-specific charges or on any other alternative tuition and fee arrangement.

RESPONSE:

Not Applicable

Section C. Other Budget Items: This section includes any other budget items for which the institution wishes to provide detail. Descriptions of each of these items should be one-half page or less.

RESPONSE:

Not Applicable

Section D. Programs and Instructional Sites: Provide information on any new academic programs, including credentials and certificates, or new instructional sites, supported by all types of funding, that the institutions will be undertaking during the six-year period. Note that as part of the revised SCHEV program approval process, institutions will be asked to indicate if a proposed new program was included in its six-year plan. Also, provide information on plans to discontinue any programs.

RESPONSE:

Not Applicable

Section E. Financial Aid: TJ21 requires “plans for providing financial aid to help mitigate the impact of tuition and fee increases on low-income and middle-income students and their families, including the projected mix of grants and loans.” Virginia’s definitions of low-income and middle-income under TJ21 are based on HHS Poverty Guidelines. A table that outlines the HHS guidelines and the definitions is attached.

RESPONSE:

Not Applicable

Section F. Capital Outlay: Provide information on your institution’s top two Education and General Programs capital outlay projects, including new construction as well as renovations, that might be proposed over the Six-Year Plan period that could have a significant impact on strategies, funding, student charges, or current square footage. Do not include projects for which construction (not planning) funding has been appropriated.

RESPONSE:

Construct New Fisheries Science Building. This request supports the construction of a new 38,000 square-foot state-of-the-art research laboratory building to replace the 29-year-old Nunnally/Fisheries Science Laboratory. It will include a fish processing laboratory, climate-controlled storage and faculty research offices and laboratories supporting the Department of Fisheries Science. The new building will consolidate most of the Fisheries Science Department into one location, improving the colloquy between faculty, staff and students of the department. Additionally, space for the Nunnally Ichthyology Collection will serve as the largest repository for freshwater, Chesapeake Bay and coastal fishes of Virginia. The New Fisheries Science Building will require a feasibility study to analyze the current program needs and identify opportunities to house complimentary institute programs not currently used by the facility. The building will be required to meet LEED Silver design standards, at a minimum. The total cost for this project is estimated at \$30M.

Construct Field Operations Complex. This request supports the construction of a new 10,000 square-foot field operations facility to replace several existing structures that are deteriorated, in need of much repair and, due to their location, prone to flooding during storm and high tide events. The facility will be constructed with a raised elevation that will take into consideration sea level rise and will consist of offices for the department’s administrative staff, a training/instruction classroom, a workshop to support the dive equipment program, a maintenance repair shop to support the field operations equipment repair program, and field and equipment storage. The new Field Operations Complex will require a feasibility study to analyze the current program needs and will be designed to meet LEED Silver standards, at a minimum. The total cost for this project is estimated at \$6.6M.

Section G. Restructuring: Provide information about any plans your institution has to seek an increased level of authority, relief from administrative or operational requirements, or renegotiation of existing management agreements.

RESPONSE:

Not Applicable

Section H. Performance Pilots (optional): For this topic, any institution that wishes to include a Performance Pilot and provided notification by April 1 to relevant parties, should select one or more of the strategies presented in the institution's Academic and Financial plan (PART 3) and General Fund Request (PART 4) that constitute(s) "one innovative proposal" as defined in subsection F of § 23.1-306. Describe the proposal, the proposed performance measures and the requested authority or support from the Commonwealth.

RESPONSE:

Not Applicable

Section I. Evaluation of Previous Six-Year Plan: Briefly summarize progress made in strategies identified in your institution's previous six-year plan. Note how additional general fund support and reallocations were used to further the strategies.

RESPONSE:

Increase Graduate Financial Aid. VIMS faculty continue to aggressively pursue grant support from federal agencies and private donors, and recognize that meeting the need for graduate financial aid will require multiple sources of funds. In the 2019 General Assembly session, VIMS was provided \$200K for Commonwealth Coastal Research Fellows. This funding will support graduate student research to strategically advance areas such as aquaculture, fisheries management, storm surge modeling, shoreline adaptation, water quality research, and resilience management approaches. The additional state support is a critical element if we are to maintain our historic leadership in graduate education in marine science and take advantage of our strategic institutional goal of further increasing enrollment via a professional master's degree program.

Increase Base Operating Support. In the 2018 General Assembly session, VIMS was provided with \$625K in each year of the biennium for operations and maintenance of new facilities coming online. This funding supports service contracts for high tech scientific equipment purchased through the Equipment Trust Fund, inflationary increases in general operating expenses, and technical support personnel.

Enhance Chesapeake Bay Water Quality Modeling and Monitoring. In the 2018 General Assembly session, VIMS was provided with \$893,753, starting in FY 2020, for water quality improvement work. The funding includes \$406,075 for on-going support, \$84,678 for debt service costs under the Master Equipment Leasing Program (MELP) associated with the modeling and assessment technologies, and \$403,000 for development of the State of the Elizabeth River Scorecard for pollution levels in the Elizabeth River.

Monitoring Bay Grasses. In the 2019 General Assembly session, VIMS was funded \$380K to monitor bay grasses, a critical living resource that must co-exist with aquaculture. These funds also provide VIMS with the resources needed to evaluate interactions between oyster aquaculture and bay grasses, and to develop Best Management Practices for this industry to reduce impacts on grasses.

Section J. Economic Development Annual Report (Due October 1): Describe the institution's contributions to stimulate the economic development of the Commonwealth and/or area in which the institution is located. If applicable, the information should include:

1. University-led or public-private partnerships in real estate and/or community redevelopment.
2. State industries to which the institution's research efforts have direct relevance.
3. High-impact programs designed to meet the needs of local families, community partners, and businesses.
4. Business management/consulting assistance.

RESPONSE: