

Research Digest

Issue No. 4 (July - September 2022)



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Cover photo credit: Emily Hein, VIMS

Photo description: Aerial photo of shoreline stabilization features and aquaculture cages. Cape Charles, Northampton County, VA. August 2022.

Message from the Associate Dean of Research and Advisory Services

In addition to peer reviewed publications, this issue of the VIMS Research Digest includes, and subsequent issues will also include, annual survey reports, white papers, and technical reports authored by VIMS researchers or co-authored by VIMS and W&M graduate students. The inclusion of “gray literature”, like the inclusion of peer reviewed publications, is intended to inform external VIMS partners of relevant and timely research that informs advisory services, support and inform conservation and restoration activities in marine systems and contribute to the body of knowledge in the field of marine science.

Annual survey reports, white papers, and technical reports authored by VIMS researchers can be found in William & Mary (W&M) ScholarWorks. W&M ScholarWorks is an open access repository and online publishing platform administered by W&M Libraries. It provides global access to the work of W&M faculty, staff, and students. In addition to survey reports, white papers, and technical reports, the repository contains a wide range of materials including, but not limited to, unpublished scholarly work, final grant reports, data sets, and much more. Links to reports in ScholarWorks are provided throughout the VIMS Research Digest and access to the database is open and free of charge.

We hope the Research Digest continues to be a useful source of information and a conduit to the breadth of research conducted at VIMS.

Mark W. Luckenbach, Associate Dean

A handwritten signature in cursive script that reads "Mark Luckenbach".

Office of Research & Advisory Services
Virginia Institute of Marine Science, William & Mary

Title	Detection of toxins and harmful algal bloom cells in shellfish hatcheries and efforts toward removal
Authors	Sanderson M.P., Hudson K.L., Gregg L.S., Chesler-Poole A.B., Small J.M., Reece K.S., Carnegie R.B., Smith J.L.
Journal	Aquaculture, 562, art. no. 738714
Link	https://doi.org/10.1016/j.aquaculture.2022.738714
Summary	Studies were conducted to determine if harmful algal bloom (HAB) cells and toxins break through the water-treatment process at shellfish hatcheries and which treatment steps are effective at removing HAB cells or toxins. The breakthrough of HAB toxins and cells (DNA) was detected and two water-treatment steps proved more effective. Toxin concentrations were reduced 49-62% by sand filtration and 87-99% by charcoal filtration.

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(VIMS authors in **bold**, asterisk indicates VIMS student)

Title A phenology- and trend-based approach for accurate mapping of sea-level driven coastal forest retreat

Authors **Chen Y.**, **Kirwan M.L.**

Journal Remote Sensing of Environment, 281, art. no. 113229 (2022)

Link <https://doi.org/10.1016/j.rse.2022.113229>

Summary The rapid replacement of upland forest by encroaching marshland is a striking manifestation of global sea-level rise. We developed a novel algorithm to accurately map SLR-driven marsh transgression. The study offers a scalable solution for consistent tracking of coastal landscape reorganization that is urgently needed for sustainable ecosystem management.

Title Processes and mechanisms of coastal woody-plant mortality

Authors McDowell N.G., Ball M., Bond-Lamberty B., **Kirwan M.L.**, Krauss K.W., Magonigal J.P., Mencuccini M., Ward N.D., Weintraub M.N., Bailey V.

Journal Global Change Biology, 28, pp. 5881-5900

Link <https://doi.org/10.1111/gcb.16297>

Summary Globally, observations of woody plant mortality in coastal ecosystems are widespread. The key emergent mechanisms underlying mortality include hypoxic, osmotic, and ionic-driven reductions in whole-plant hydraulic conductance and photosynthesis that ultimately drive the coupled processes of hydraulic failure and carbon starvation. Models of coastal forests that incorporate the frequency and duration of inundation, the role of climatic drivers, and the processes of hydraulic failure and carbon starvation can yield improved estimates of inundation-induced woody-plant mortality.

Title Lag in response of coastal barrier-island retreat to sea-level rise

Authors Mariotti G., **Hein C.J.**

Journal Nature Geoscience, 15, pp. 633-638 (2022)

Link <https://doi.org/10.1038/s41561-022-00980-9>

Summary Using a numerical model, validated against historical data from Virginia's Eastern Shore, this study found that the modern rate of barrier-island erosion or landward movement reflects sea-level-rise rates from decades ago. This implies that—even if sea-level rise stops today—erosion and migration of islands such as the Virginia Barrier Islands will continue to accelerate for decades.

(VIMS authors in **bold**, asterisk indicates VIMS student)

Title	Constraints on the adjustment of tidal marshes to accelerating sea level rise
Authors	Saintilan N., Kovalenko K.E., Guntenspergen G., Rogers K., Lynch J.C., Cahoon D.R., Lovelock C.E., Friess D.A., Ashe E., Krauss K.W., Cormier N., Spencer T., Adams J., Raw J., Ibanez C., Scarton F., Temmerman S., Meire P., Maris T., Thorne K., Brazner J., Chmura G.L., Bowron T., Gamage V.P., Cressman K., Endris C., Marconi C., Marcum P., St. Laurent K., Reay W. , Raposa K.B., Garwood J.A., Khan N.
Journal	Science, 377(6605), pp. 523-527 (2022)
Link	https://doi.org/10.1126/science.abo7872
Summary	Contemporary rates of marsh sediment accretion increase in parity with sea level rise (SLR), suggesting a robust capacity to respond to projected SLR (>10 mm yr ⁻¹) in contrast to thresholds (<7 mm yr ⁻¹) derived from Holocene palaeo-stratigraphic record. Substrate subsidence reconciles instrumental and palaeo assessments of marsh vulnerability to SLR.

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Title Population genetic structure in Channeled Whelk (*Busycotypus canaliculatus*) along the U.S. Atlantic Coast

Authors **Askin S.E.***, **Fisher R.A.**, **Biesack E.E.**, Robins R., **McDowell J.R.**

Journal Transactions of the American Fisheries Society, 151, pp. 543-558

Link <https://doi.org/10.1002/tafs.10374>

Summary The life history characteristics of channeled whelk *Busycotypus canaliculatus*, including slow growth, late maturation, and direct development paired with unsuitable minimum landing size, make this species vulnerable to overexploitation. Currently, the population genetic structure of channeled whelk is unknown. This study used 2,570 single nucleotide polymorphisms to elucidate the population genetic structure of channeled whelk sampled from 10 locations ranging from Massachusetts to South Carolina.

Title Diving into the vertical dimension of elasmobranch movement ecology

Authors Andrzejczek S., Lucas T.C.D., Goodman M.C., Hussey N.E., Armstrong A.J., Carlisle A., Coffey D.M., Gleiss A.C., Huveneers C., Jacoby D.M.P., Meekan M.G., Mourier J., Peel L.R., Abrantes K., Afonso A.S., Ajemian M.J., Anderson B.N., Anderson S.D., Araujo G., Armstrong A.O., Bach P., Barnett A., Bennett M.B., Bezerra N.A., Bonfil R., Boustany A.M., Bowlby H.D., Branco I., Braun C.D., Brooks E.J., Brown J., Burke P.J., Butcher P., Castleton M., Chapple T.K., Chateau O., Clarke M., Coelho R., Cortes E., Couturier L.I.E., Cowley P.D., Croll D.A., Cuevas J.M., Curtis T.H., Dagorn L., Dale J.J., Daly R., Dewar H., Doherty P.D., Domingo A., **Weng K.C.**, *et al.*

Journal Science Advances, 8(33) 2022

Link <https://doi.org/10.1126/sciadv.abo1754>

Summary Most studies of animal movement consider the geographic (horizontal) movements of animals, and how this may result in overlap with threats from humans such as fishing or development. However, the oceans are not two-dimensional. There is an entire world of vertical habitat and movement that ocean animals utilize. This study considered vertical habitat and movement for sharks and found that many species overlap with the depth ranges of fishing.

Title	2022 Annual report - estimating relative juvenile abundance of ecologically important finfish in the Virginia portion of Chesapeake Bay (1 July 2021 – 30 June 2022)
Authors	Tuckey T.D., Fabrizio M.C.
Database	ScholarWorks, Virginia Institute of Marine Science, William & Mary (2022).
Link	https://doi.org/10.25773/9WV1-PS18
Summary	We completed all planned tows (1,224) from July 2021 to June 2022 and collected 478,313 fishes. Bay Anchovy continues to be the most abundant species observed in the survey, accounting for 58% of all fishes collected. Of the target species, 29 species categories exhibited below-average abundance in 2021 – 2022. Five species categories exhibited average abundance, and only one exhibited above-average abundance.

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Title	Data synthesis for environmental management: A case study of Chesapeake Bay
Authors	Orth R.J. , Dennison W.C., Wilcox D.J. , Batiuk R.A., Landry J.B., Gurbisz C., Keisman J., Hannam M., Lefcheck J.S., Murphy R.R., Moore K.A. , Patrick C.J. , Testa J.M., Weller D.E., Merritt M.F., Hobaugh P.
Journal	Journal of Environmental Management, 321, art. no. 115901 (2022)
Link	https://doi.org/10.1016/j.jenvman.2022.115901
Summary	In Chesapeake Bay, a well-studied and intensively monitored estuary in North America, the challenge of synthesizing submerged aquatic vegetation, water quality and land use data was tackled by a team of scientists and resource managers operating at multiple levels of governance (state, federal).

Title	Oceans of plenty? Challenges, advancements, and future directions for the provision of evidence-based fisheries management advice
Authors	Goethel D.R., Omori K.L. , Punt A.E., Lynch P.D., Berger A.M., de Moor C.L., Plagányi É.E., Cope J.M., Dowling N.A., McGarvey R., Preece A.L., Thorson J.T., Chaloupka M., Gaichas S., Gilman E., Hesp S.A., Longo C., Yao N., Methot R.D.
Journal	Reviews in Fish Biology and Fisheries (2022)
Link	https://doi.org/10.1007/s11160-022-09726-7
Summary	This study uses a combination of in situ, satellite remote sensing data and numerical modeling to investigate the fate of riverine water discharge carrying contaminated sediments into the ocean due to the Mariana iron mine dam collapse in November 2015.

Title	Attitudes and behaviors for understanding compliance in Greenland's Atlantic salmon (<i>Salmo salar</i>) fishery
Authors	Snyder H.T., Oyanedel R., Sneddon C.S., Scheld A.M.
Journal	Conservation Science and Practice, 4(11), e12775 (2022)
Link	https://doi.org/10.1111/csp2.12775
Summary	This study assessed catch reporting compliance, behavior, and attitudes among Greenland's licensed salmon fishers. Responses to an online survey were matched to fisher catch reports. A high level of compliance was documented, and fishers indicated strong moral obligations for catch reporting and trust in fishery management institutions.

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Title Contamination of finescale strain estimates of turbulent kinetic energy dissipation by frontal physics

Authors **Ferris L.***, **Gong D.**, Merrifield S., St. Laurent L.

Journal Journal of Atmospheric and Oceanic Technology, 39(5), pp. 619-640 (2022)

Link <https://doi.org/10.1175/JTECH-D-21-0088.1>

Summary Internal waves propagate through the ocean and collide, causing turbulent mixing. In the absence of turbulence measurements, oceanographers use ripples from these waves to estimate the turbulence resulting from their collisions. In this paper, we show that the ripples in temperature and salinity that naturally occur at sharp fronts masquerade as internal waves, creating the perception of too much turbulence.

Title Wind-modulated western Maine Coastal Current and its connectivity with the eastern Maine Coastal Current

Authors Li D., **Wang Z.**, Xue H., Thomas A.C., Etter R.J.

Journal Journal of Geophysical Research: Oceans 127(6), art. no. e2022JC018469 (2022)

Link <https://doi.org/10.1029/2022JC018469>

Summary Our models showed that the coastal flows in the western Gulf of Maine (GoME) generally exist as an offshore and nearshore core, stemming from the extension of flows in the eastern GoME and local river runoff, respectively. Connectivity between the western and eastern GoME coastal flows generally peaks in winter and again in late spring or early summer, due to the variations of the strength and offshore veering of the Eastern Maine Coastal Current.

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Title Influence of oyster genetic background on levels of human-pathogenic *Vibrio spp.*

Authors **Audemard C., Reece K.S., Latour R.J., Bienlien L.M., Carnegie R.B.**

Journal Aquaculture, 562, art. no. 738763 (2022)

Link <https://doi.org/10.1016/j.aquaculture.2022.738763>

Summary Human-pathogenic *Vibrio* bacteria are common inhabitants of oyster tissues, but our understanding of factors driving the wide range of concentrations found in individual oysters is extremely limited. Our study suggests that the influence of oyster genetic background on levels of human-pathogenic *Vibrio spp.* should be further investigated and that the dynamics of these bacteria in oysters are likely driven by multiple, interacting factors, some of which may be under oyster host genetic control.

Title Results for the 2022 VIMS industry cooperative surveys of the Mid-Atlantic Bight, Nantucket Lightship, Southern Flank, and Closed Area II Resource Areas

Authors Roman S.A., Rudders D.A.

Database Marine Resource Report No. 2022-04. Virginia Institute of Marine Science, William & Mary (2022)

Link <https://doi.org/10.25773/cb1s-3c17>

Summary Results from the 2022 VIMS Marine Advisory Program Fishery Independent Sea Scallop Dredge Survey of the Mid-Atlantic and Georges Bank resources are reported. The spatial distribution, biomass estimates, and length information are provided to inform sea scallop industry stakeholders. The presence and severity of several sea scallop diseases and parasites is also discussed.

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Submerged Aquatic Vegetation (SAV)

(VIMS authors in **bold**, asterisk indicates VIMS student)

Title	Influence of rising water temperature on the temperate seagrass species Eelgrass (<i>Zostera marina</i> L.) in the Northeast USA
Authors	Plaisted H.K., Shields E.C. , Novak A.B., Peck C.P., Schenck F., Carr J., Duffy P.A., Evans N.T., Fox S.E., Heck S.M., Hudson R., Mattera T., Moore K.A. , Neikirk B. , Parrish D.B. , Peterson B.J., Short F.T., Tinoco A.I.
Journal	Frontiers in Marine Science, 9, art. no. 920699 (2022)
Link	https://doi.org/10.3389/fmars.2022.920699
Summary	We investigate regional changes in eelgrass presence and abundance in relation to local water temperature at eight sites from Maryland to New Hampshire. Above-average summer temperatures correspond to an increased probability of eelgrass absence the following year, suggesting the vulnerability of eelgrass meadows in the Northeast USA to climate change.

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Title	Durable Plastic Goods: A Source of Microplastics and Chemical Additives in the Built and Natural Environments
Authors	Hale R.C. , King A.E.* , Ramirez J.M.* , La Guardia M. , Nidel C.
Journal	Environmental Science and Technology Letters, 9, pp. 798-807 (2022)
Link	https://doi.org/10.1021/acs.estlett.2c00417
Summary	Many plastics are designed for long-term uses (e.g., furniture and textiles). These may contain chemical additives and release microplastics indoors, exposing humans. They enter wastewater treatment plants. Removal then transfers them to settled solids, which often are applied on agricultural soils. Effects on soil health and off-site releases merit investigation.

Title	Determining geochemical and microbial parameters underlying geographic patterns of denitrification and anammox rates in the New River Estuary, North Carolina, USA
Authors	Lisa J.A. , Song B. , Semedo M.* , Duernberger K.A., Tobias C.R.
Journal	Estuarine, Coastal and Shelf Science, 275, art. no. 107973 (2022)
Link	https://doi.org/10.1016/j.ecss.2022.107973
Summary	This paper reports the geospatial variability of two microbial nitrogen removal processes, denitrification and anammox, in the New River Estuary. Both denitrification and anammox activities were highest in the upper reaches of the estuary. We also demonstrated both the geochemical and microbial features as predictors of geospatial patterns of N removal across the estuary.

Title	Spreading and accumulation of river-borne sediments in the coastal ocean after the environmental disaster at the Doce River in Brazil
Authors	Lemos A.T., Osadchiv A., Mazzini P.L.F. , Mill G.N., Fonseca S.A.R., Ghisolfi R.D.
Journal	Ocean and Coastal Research, 70, art. no. e22025 (2022)
Link	https://doi.org/10.1590/2675-2824070.21097atl
Summary	This study uses a combination of in situ, satellite remote sensing data and numerical modeling to investigate a fate of the discharge of riverine waters carrying contaminated sediments that were introduced into the ocean as a result of the worst environmental disaster in Brazilian history, the Mariana iron mine dam collapse, which occurred in November 2015.

Title Tidal freshwater zones modify the forms and timing of nitrogen export from rivers to estuaries

Authors Wei H., Xu X., Jones A.E., **Hardison A.K.**, Moffett K.B., McClelland J.W.

Journal Estuaries and Coasts, 45, pp. 2414-2427 (2022)

Link <https://doi.org/10.1007/s12237-022-01112-7>

Summary We present work conducted in the tidal freshwater zones (TFZs) of two south Texas rivers. Our current understanding of the relationship between nitrogen (N) inputs and estuarine responses has not, to date, adequately accounted for losses and transformations within TFZs. Our results highlight the role of TFZs as transformers of N from the watershed, with important implications for management of coastal eutrophication.

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Title	Chesapeake Bay National Estuarine Research Reserve in Virginia management plan: 2022-2027
Authors	Reay W.G., Baber J., Brooks H., Demeo A., Friedrichs C.T., Gonzales C., Kuriawa J., Hooper T., Lerberg S., Miles E.J., Neikirk B., Nuss S., Ott L., Parrish D., Rudo T., Shields E.C., Snyder S., Wood S.
Database	Special Report in Applied Marine Science and Ocean Engineering (SRAMSOE) No. 474. Virginia Institute of Marine Science, William & Mary
Link	https://doi.org/10.25773/5k5f-jf24
Summary	This plan aligns with and complements the NERRS 2017-2022 Strategic Plan and VIMS's 2015-2020 Strategic Plan while building upon previous accomplishments and the desire to address current priority issues and meet future challenges. Its intent is to provide a vision and framework to guide Reserve activities for program undertakings over the five-year period from 2022-2027.

Title	Trends in sedimentary charcoal shapes correspond with broad-scale land-use changes: insights gained from a 300-year lake sediment record from eastern Virginia, USA
Authors	Frank-DePue L., Vachula R.S., Balascio N.L., Cahoon K.* , Kaste J.M.
Journal	Journal of Paleolimnology (2022)
Link	https://doi.org/10.1007/s10933-022-00260-x
Summary	As plants burn, the resulting particles have a characteristic morphology. This study used micron-sized charcoal particles to develop a classification system of charcoal types based on Virginia flora. Charcoal particles from a mill pond in south-east Virginia (Lake Matoaka) were used to develop a local to regional key of charcoal morphometrics allowing for a more nuanced and accurate paleo-ecological reconstruction.

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