Research Digest

Issue No. 9 (October - December 2023)

VIMS | William & Mary
Virginia Institute of Marine Science
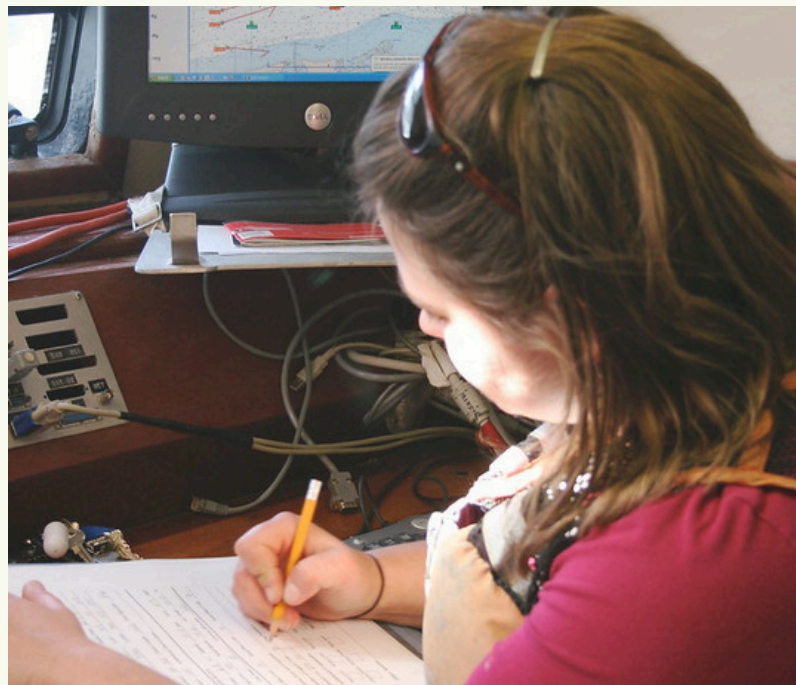
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Photo description: Five photos of VIMS staff conducting the annual Blue Crab Winter Dredge Survey.

From top left to right:
1. VIMS researchers monitor the dredge as it's pulled onboard the R/V Bay Eagle.
2. VIMS staff, Katie Knick and Alison Smith, sort through the contents of the last dredge for blue crabs.
3. The blue crab (*Callinectes sapidus*) is the target of the Winter Dredge Survey.
4. Mike Seebo and Kathleen Knick use a probe to collect data on board the R/V Bay Eagle.
5. Kathleen Knick records survey data aboard the R/V Bay Eagle following a dredge tow.

Topics In This Issue

(click topic heading below to jump to desired section)

Navigating this document

Click on one of the headings listed above to jump to the desired section. Alternatively, search the document using keywords or an author's name. To search for words or names, simultaneously press the 'ctrl' and 'F' keys, type the desired word or name in the search field, then press 'enter' or 'return'. If the search term is in the document, it will be highlighted.

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(Listed alphabetically by last name. An asterisk (*) indicates VIMS student.)

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Title	Increased terrestrial carbon export and CO_2 evasion from global inland waters since the preindustrial era
Author(s)	Tian H., Yao Y., Li Y., Shi H., Pan S., Najjar R.G., Pan N., Bian Z., Ciais P., Cai W.J., Dai M., **Friedrichs M.A.M.**, Li H.Y., Lohrenz S., Leung L.R.
Journal	Global Biogeochemical Cycles, 37(1): e2023GB007776 (2023)
Link	https://doi.org/10.1029/2023GB007776
Summary	Using a terrestrial–aquatic model, we assess how climate, land use, atmospheric-CO_2, and nitrogen enrichment have affected global CO_2 evasion and riverine carbon export. We estimate a 25% increase in terrestrial C loading since the 1800s, of which 59% was released into the atmosphere and 23% was exported to the ocean. This is primarily due to increased atmospheric-CO_2 and nitrogen loading.

Title	Climate-driven tradeoffs between landscape connectivity and the maintenance of the coastal carbon sink
Author(s)	**Valentine K.**, **Herbert E.R.**, **Walters D.C.**, **Chen Y.**, **Smith A.J.***, **Kirwan M.L.**
Journal	Nature Communications 14(1): art no. 1137 (2023)
Link	https://doi.org/10.1038/s41467-023-36803-7
Summary	Connectivity of water, organisms, and sediment is generally thought to increase the resilience of ecosystems to disturbance. We apply concepts of connectivity in ecological theory to the broader coastal landscape, which is comprised of barrier islands, marshes, seagrass meadows, mudflats, and coastal forests.

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Title	Reproductive potential of the blue crab spawning stock in Chesapeake Bay across eras and exploitation rates using nemertean worms as biomarkers
Author(s)	**Schneider A.K.***, **Fabrizio M.C.**, **Lipcius R.N.**
Journal	Marine Ecology Progress Series, 716: 77-91 (2023)
Link	https://doi.org/10.3354/meps14365
Summary	We assessed the spawning history (i.e., if a female has reproduced previously or not) of female blue crabs in Chesapeake Bay from 1992 to 1996 and 2020 to 2022. The years in the 1990s represent a period of high exploitation on female crabs, while the years in the 2020s represent a period of low exploitation, allowing us to compare the proportion of females that have already spawned across varying exploitation levels.

Title	The reproductive biology and fecundity of female Atlantic Menhaden
Author(s)	**Latour R.J.**, **Gartland J.**, Schueller A.M.
Journal	Marine and Coastal Fisheries, 15(5): e10269 (2023)
Link	https://doi.org/10.1002/mcf2.10269
Summary	This study found that the reproductive biology of female Atlantic menhaden is characterized by indeterminate batch spawning, increased fecundity with length, and a seven-month spawning season. Annual fecundity was notably higher than previous estimates, and these new findings have been incorporated into an updated stock assessment for this species.

Title	Harnessing a mesopelagic predator as a biological sampler reveals taxonomic and vertical resource partitioning among three poorly known deep-sea fishes.
Author(s)	Portner E.J., **Mowatt-Larssen T.**, Carretero A.C.L., Contreras E.A., Woodworth-Jefcoats P.A., Frable B.W., Choy C.A.
Journal	Scientific Reports, 13: 16078 (2023)
Link	https://doi.org/10.1038/s41598-023-41298-9
Summary	Open-ocean predators are effective biological samplers of deep-sea animals that frequently evade capture with conventional methods. In this study, the authors examined specimens sampled from the stomachs of longnose lancetfish, *Alepisaurus ferox*, to describe the diets and foraging behaviors of three common, but poorly known deep-sea fishes: the hammerjaw (*Omosudis lowii*), juvenile common fangtooth (*Anoplogaster cornuta*), and juvenile *A. ferox*.

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Title	Juvenile Striped Bass consume diverse prey in Chesapeake Bay tributaries
Author(s)	Pagenkopp Lohan K.M., Aguilar R., DiMaria R., Heggie K., **Tuckey T.D.**, **Fabrizio M.C.**, Ogburn M.B.
Journal	Marine and Coastal Fisheries, 15(5): e10259 (2023)
Link	https://doi.org/10.1002/mcf2.10259
Summary	Diets of age-0 and juvenile striped bass vary spatially in Chesapeake Bay and change as young fish grow and move into higher salinity waters. Using traditional and genetic analysis of stomach contents, additional prey items were identified as being important in the production of young striped bass. In particular, insect larvae were found to be more important than previously known for age-0 striped bass located in tidal freshwater habitats.

Title	Spatiotemporal patterns in the ecological community of the nearshore Mid-Atlantic Bight
Author(s)	**Gartland J.**, Gaichas S.K., **Latour R.J.**
Journal	Marine Ecology Progress Series, 704: 15-33 (2023)
Link	https://doi.org/10.3354/meps14235
Summary	Species assemblages inhabiting the nearshore Mid-Atlantic Bight, USA exhibit interannual patterns in relative abundance characterized by three common trends and shaped by winter sea surface temperature. Community spatial structure follows a north-to-south gradient with a distinct area of elevated biomass along Long Island, NY.

Title	Nonlinearity and spatial autocorrelation in species distribution modeling: An example based on weakfish (*Cynoscion regalis*) in the Mid-Atlantic Bight
Author(s)	Zhang Y., Jiao Y., **Latour R.J.**
Journal	Fishes, 8(1): 27 (2023)
Link	https://doi.org/10.3390/fishes8010027
Summary	This study highlights the importance of accounting for nonlinearity and spatial autocorrelation in marine species distribution modeling. Using weakfish data from NEAMAP, a delta spatial generalized additive model outperformed other models by reducing spatial autocorrelation and minimizing error. A simulation study demonstrated its applicability across different datasets and scenarios.

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Title	Hard-bottom habitats support commercially important fish species: a systematic review for the North Atlantic Ocean and Baltic Sea
Author(s)	Flávio H, **Seitz R**, Eggleston D, Svendsen J.C., Støttrup J.
Journal	PeerJ, 11: e14681
Link	https://doi.org/10.7717/peerj.14681
Summary	Hard-bottom habitats can include boulders, cobble, and artificial habitats, which can provide ecosystem services. In this study, we systematically reviewed the relationships of various hard-bottom habitats to individual commercially harvested fish species. Hard-bottom habitats were generally better than surrounding habitat types, especially for biomass, density, feeding, and spawning of cod.

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Title	Community health impacts from natural gas pipeline compressor stations
Author(s)	Davis C.D., Frazier C., **Guennouni N.***, **King R.***, Mast H., Plunkett E.M., Quirk Z.J.
Journal	GeoHealth, 7(11): e2023GH000874 (2023)
Link	https://doi.org/10.1029/2023GH000874
Summary	Compressor stations allow natural gas to run smoothly through long pipelines. However, compressor stations release several different types of pollutants and are often located near socially vulnerable communities comprised of low income, non-white, or elderly residents that often bear the burden of the pollution. We examine the shortcomings of current policies and regulations surrounding compressor stations and offer solutions to help protect vulnerable communities.

Title	Clearance of biodegradable polymer and polyethylene films from the rumens of Holstein bull calves
Author(s)	Galyon H., Vibostok S., Duncan J., Ferreira G., Whittington A., **Havens K.**, McDevitt J., Cockrum R.
Journal	Animals, 13(5): 928 (2023)
Link	https://doi.org/10.3390/ani13050928
Summary	Cows and other ruminants are indiscriminate grazers and can ingest plastic products such as haybale netting. Plastic ingestion is detrimental to animal health and is a growing concern in the agricultural community. Replacing conventional plastics with biodegradable polymers can decrease plastic accumulation in animals and reduce plastic ingestion health issues.

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Title	Seasonal and nutrient controls on phytoplankton in the Aransas River tidal freshwater zone, Texas, USA
Author(s)	Wei H., Xu X., Savoie A., Schattle E., **Hardison A.K.**, Erdner D.L., McClelland J.W.
Journal	Hydrobiologia. 851: 1275 - 1290 (2024)
Link	https://doi.org/10.1007/s10750-023-05388-z
Summary	We measured phytoplankton communities in a tidal freshwater zone (TFZ) of a south Texas river. Accessory pigments were used to describe the phytoplankton community and the seasonal and environmental controls on those communities. We highlight how the long residence time of TFZ alters nutrients and phytoplankton, which has implications for downstream estuaries.

Title	The importance of winter dinoflagellate blooms in Chesapeake Bay – a missing link in Bay productivity
Author(s)	**Millette N.C.**, Clayton S., Mulholland M.R., Gibala-Smith L., Lane M.
Journal	Estuaries and Coasts, 46: 986-997 (2023)
Link	https://doi.org/10.1007/s12237-023-01191-0
Summary	Phytoplankton blooms commonly occur in Chesapeake Bay during the winter months. However, they are often undocumented because of reduced monitoring during the winter. We analyzed 30 years of data to assess the spatial distribution of phytoplankton blooms throughout Chesapeake Bay. We found high occurrence of winter blooms in Maryland and limited data on these blooms in Virginia, although we know the blooms occur in Virginia as well.

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Title	Cross-shelf exchange associated with a shelf-water streamer at the Mid-Atlantic Bight shelf edge
Author(s)	Zhang W., Alatalo P., Crockford T., Hirzel A.J., **Meyer M.G.**, Oliver H., Peacock E., Petitpas C.M., Sandwith Z., **Smith W.O.**, Sosik H.M., Stanley R.H.R., Stevens B.L.F., Turner J.T., McGillicuddy D.J.
Journal	Progress in Oceanography, 210: 102931 (2023)
Link	https://doi.org/10.1016/j.pocean.2022.102931
Summary	Here, we quantify the influence of cross-shelf current flow in the Mid-Atlantic Bight.

Title	Lake ice simulation using a 3D unstructured grid model
Author(s)	**Zhang Y.J.**, Wu C., Anderson J., Danilov S., Wang Q., Liu Y., Wang Q
Journal	Ocean Dynamics, 73: 219-230 (2023)
Link	https://doi.org/10.1007/s10236-023-01549-9
Summary	We develop a single-class ice and snow model embedded inside a 3D hydrodynamic model on unstructured grids and apply it to lake studies using highly variable mesh resolution. The model can reasonably capture the ice fields observed in both small and large lakes. We also outline challenges developing new process-based capabilities for accurately simulating nearshore ice.

Title	Simulation of compound flooding in Japan using a nationwide model
Author(s)	Huang W., **Zhang Y.J.**, Liu Z., **Yu H.C.**, Liu Y., Lamont S., Zhang Y., Hirpa F., Li T., Baker B., Zhan W., Patel S., Mori N.
Journal	Natural Hazards, 117: 2693-2713 (2023)
Link	https://doi.org/10.1007/s11069-023-05962-7
Summary	A high-resolution, summit-to-sea unstructured-grid model was used to simulate two compound flooding events in Kumamoto City (July 2012) and Okayama City (July 2018), Japan. Sensitivity tests determined the roles and significance of levee structures along major rivers in coastal regions. We quantified the contributions from riverine and oceanic factors as well as levees at different locations. The model has been implemented operationally as the first nationwide 3-day compound flooding forecast system for Japan.

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

Title	A marsh multimodel approach to inform future marsh management under accelerating sea-level rise
Author(s)	**Mitchell M.**, **Nunez K.**, **Herman J.**, **Tombleson C.**, **Mason P.**
Journal	Ecological Solutions and Evidence, 4(4): e12285 (2023)
Link	https://doi.org/10.1002/2688-8319.12285
Summary	The proper management of existing marshes and the conservation of lands for marsh migration requires a synthesis of factors affecting future marsh evolution. We worked with local and regional managers to inform the development of an ensemble methodology that uses results from multiple marsh models in conjunction with social, land use and environmental data to inform marsh management, conservation, and restoration under sea-level rise.

Title	Road network analyses elucidate hidden road flooding impacts under accelerating sea level rise
Author(s)	**Mitchell M.**, **Hendricks J.**, **Schatt D.**
Journal	Frontiers in Environmental Science, 11: 1083282 (2023)
Link	https://doi.org/10.3389/fenvs.2023.1083282
Summary	This study showed that inaccessibility of roads and properties due to road flooding increased nearly twice as much as would be suggested by the length of flooded roads. Overall, the vulnerability of a locality was primarily dependent on its elevation; however, the redundancy of the road network appears to affect the rate at which properties became inaccessible.

Title	Frequent storm surges affect the groundwater of coastal ecosystems
Author(s)	Nordio G., Frederiks R., Hingst M., Carr J., **Kirwan M.**, Gedan K., Michael H., Fagherazzi S.
Journal	Geophysical Research Letters, 50(1): e2022GL100191 (2023)
Link	https://doi.org/10.1029/2022GL100191
Summary	Small but frequent storm events increase the salinity of coastal groundwater. Salinities remain elevated for weeks to months after the storm passes.

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Title	Lethal and sublethal effects of simulated dredged sediment deposition on overwintering blue crabs *Callinectes sapidus*
Author(s)	**Saluta G.G.**, **Ralph G.M.**, **Knick K.E.**, **Seebo M.S.**, **Lipcius R.N.**
Journal	Marine Ecology Progress Series, 719: 65-75 (2023)
Link	https://doi.org/10.3354/meps14383
Summary	Dredged sediment disposal can harm overwintering blue crabs. Deep burial (~10+ cm) causes immediate, high mortality; while crabs exposed to lower sediment loads (~2.5 cm) survive but exhibit reduced activity, signaling sublethal effects. Strategies to reduce overwintering crab mortality focus on disposal where crabs are scarce in time and/or space.

Title	Mass spectrometric characterization of the seco acid formed by cleavage of the macrolide ring of the algal metabolite goniodomin A.
Author(s)	Harris C.M., Hintze L., **Gaillard S.**, Tanniou S., **Small H.**, **Reece K.S.**, Tillmann U., Krock B., **Harris T.M.**
Journal	Toxicon, 231: 107159 (2023)
Link	https://doi.org/10.1016/j.toxicon.2023.107159
Summary	This study highlights the risk that *Alexandrium* blooms can cause marine animals.

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Title	Prioritizing the protection and creation of natural and nature-based features for coastal resilience using a GIS-based ranking framework – an exportable approach
Author(s)	**Hendricks J.**, **Mason P.**, **Herman J.**, **Hershner C.**
Journal	Frontiers in Marine Science, 10: 1005827 (2023)
Link	https://doi.org/10.3389/fmars.2023.1005827
Summary	We present a novel application of the least-cost geospatial modeling approach to generate inundation pathways highlighting landscape connections between natural and nature-based features (NNBF) and vulnerable infrastructure. Inundation pathways are also used to identify target areas for NNBF restoration or creation. Project outputs are available via an interactive map viewer and can be customized for application in any community to identify high-priority NNBF.

Title	pyShore: A deep learning toolkit for shoreline structure mapping with high-resolution orthographic imagery and convolutional neural networks.
Author(s)	**Lv Z.**, **Nunez K.**, Brewer E., Runfola D.
Journal	Computers and Geosciences, 171: 105296 (2023)
Link	https://doi.org/10.1016/j.cageo.2022.105296
Summary	This study explores the application of deep learning to map shoreline armoring structures, focusing on computationally efficient techniques for semi-automated delineation from high-resolution imagery. The ResNet18-based Pyramid Attention Network (PAN) architecture achieved 72% overall accuracy, with 80% and 94% prediction accuracy for breakwaters and groins, respectively, enabling rapid processing of 1.5 kilometers of shoreline in 1.4 s (GPU) to 2.16 s (CPU) in simulated user environments.

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Wetlands

Title	Enhancing assessments of blue carbon stocks in marsh soils using Bayesian mixed-effects modeling with spatial autocorrelation – proof of concept using proxy data
Author(s)	**Chiu G.S.**, **Mitchell M.**, **Herman J.**, **Longo C.***, **Davis K.***
Journal	Frontiers in Marine Science, 9: art no. 1056404 (2023)
Link	https://doi.org/10.3389/fmars.2022.1056404
Summary	Organic carbon stored in marsh soils, or blue carbon (BC), makes marshes a critical conservation target. For robust characterization of spatial variability of carbon, we employ Bayesian linear mixed modeling, with spatial autocorrelation, to predict organic matter (a proxy for carbon) by marsh characteristics.

Title	Evaluating thin-layer sediment placement as a tool for enhancing tidal marsh resilience: a coordinated experiment across eight US National Estuarine Research Reserves
Author(s)	Raposa K.B., Woolfolk A., Endris C.A., Fountain M.C., Moore G., Tyrrell M., Swerida R., **Lerberg S.**, Puckett B.J., Ferner M.C., Hollister J., Burdick D.M., Champlin L., Krause J.R., Haines D., Gray A.B., Watson E.B., Wasson K.
Journal	Estuaries and Coasts, 46: 595-615 (2023)
Link	https://doi.org/10.1007/s12237-022-01161-y
Summary	Thin-layer placement of sediment (TLP) is an emerging strategy to protect tidal marshes threatened by rising seas. A research team, led by the National Estuarine Research Reserve System (NERRS), tested the use of TLP at eight Reserves and developed guidance to inform future research and restoration projects using this technique.

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Topic	**Chemistry**
Title	Exploring PAH kinetics in wild vs. transplanted triploid and diploid oysters at a contaminated field site using immunological techniques
Author(s)	**Prossner K.M.**, **Harvey E.**, **Unger M.A.**
Journal	Environmental Monitoring and Assessment, 195: art no. 1462 (2023)
Link	https://doi.org/10.1007/s10661-023-12064-1
Summary	Oysters (*Crassostrea virginica*) are well-established for biomonitoring persistent organic pollutants such as polycyclic aromatic hydrocarbons (PAH) in estuaries. This study uses new antibody-based methods to examine differences in contaminant uptake between transplanted oysters (diploid and triploid) and native diploid oysters at a PAH contaminated site in the Elizabeth River, Virginia.

Topic	**K-12 Education**
Title	Enhancing collaborative learning through design for learning
Author(s)	Smucker, A., **Nuss**, **S.**
Journal	William & Mary Educational Review, 8: art no. 1 (2023)
Link	https://scholarworks.wm.edu/wmer/vol8/iss1/1
Summary	Collaborative learning can help students develop deeper understandings of content while building critical life-long skills, and using a design for learning approach provides teachers with a useful framework for planning, implementing, and reflecting on student learning. We recommend several approaches that teachers can use to purposefully create collaborative learning environments.

Topic	**Resiliency**
Title	Socioeconomic vulnerability and climate risk in coastal Virginia
Author(s)	Eghdami S., **Scheld A.M.**, Louis G.
Journal	Climate Risk Management, 39: 100475 (2023)
Link	https://doi.org/10.1016/j.crm.2023.100475
Summary	This research evaluated socioeconomic vulnerability in the context of exposure to flooding risks in coastal Virginia. Flooding risks were found to be higher in areas with increased poverty, higher shares of renters, lower educational attainment, and reduced internet access, though individual associations were variable across cities and counties in the region.

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Additional Topics *(cont.)*

Topic	**Aquaculture**
Title	Development and evaluation of high-density SNP arrays for the Eastern Oyster *Crassostrea virginica*.
Author(s)	Guo X., Puritz J.B., Wang Z., Proestou D., **Allen S.**, **Small J.**, Verbyla K., Zhao H., Haggard J., Chriss N., Zeng D., Lundgren K., Allam B., Bushek D., Gomez-Chiarri M., Hare M., Hollenbeck C., La Peyre J., Liu M., Lotterhos K.E., Plough L., Rawson P., Rikard S., Saillant E., Varney R., Wikfors G., Wilbur A.
Journal	Marine Biotechnology, 25: 174-191 (2023)
Link	https://doi.org/10.1007/s10126-022-10191-3
Summary	SNP markers are a type of genetic marker that can track pedigree in a highly efficient and accurate way. As such, SNPs can be used to assist selective breeding. A consortium of laboratories on the east coast has developed this tool for breeding our native species of oyster.

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