

2020 Virginia estuarine HABs: marine biotoxins update

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Division of Shellfish Safety
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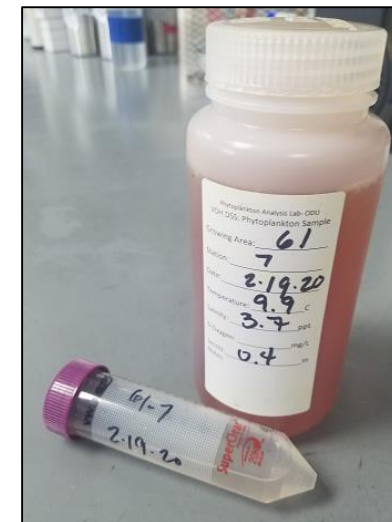
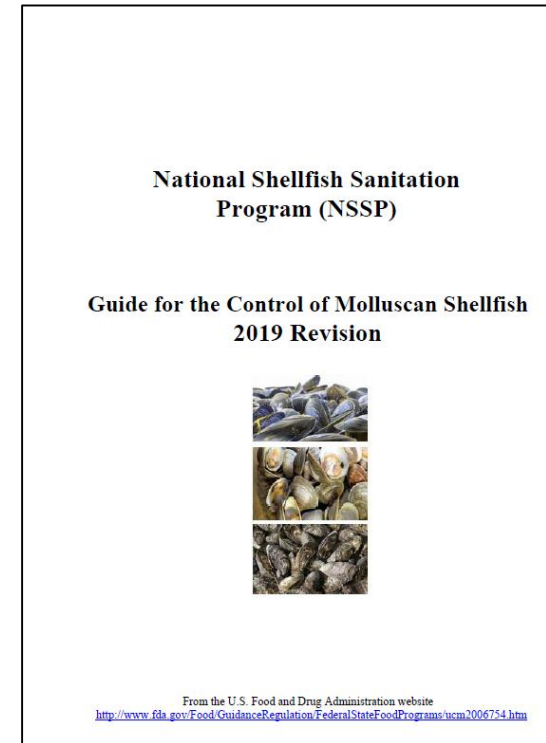
VA HAB Taskforce Meeting
Zoom-VIMS
1/15/2021



www.SwimHealthyVA.com

Shellfish marine biotoxin control

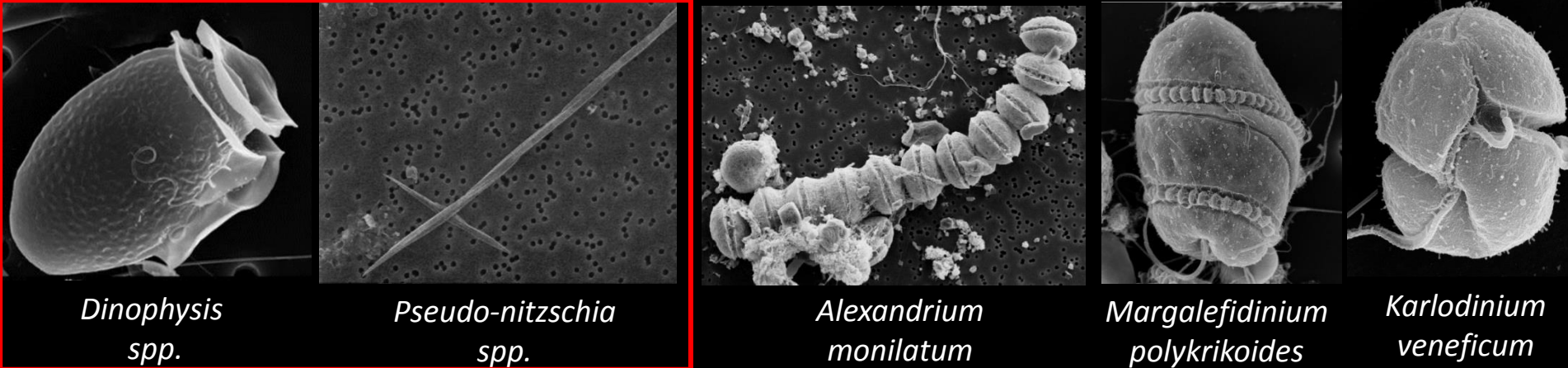
- Biotoxin contingency plan for:
 - Paralytic shellfish poisoning (PSP)
 - Amnesic shellfish poisoning (ASP)
 - Neurotoxic shellfish poisoning (NSP)
 - Diarrhetic shellfish poisoning (DSP)
 - Azaspiracid shellfish poisoning (AZP)
- VDH:DSS Biotoxin plan and flow chart:
<http://www.vdh.virginia.gov/content/uploads/sites/20/2016/05/BiotoxinControlPlan.pdf>
- Monthly collections- routine fixed sites
 - Lugol's solution (250mL) – phytoplankton analyses (ODU)
 - Screened at VDH field offices
 - Unpreserved frozen sample (50mL)- ELISA/PP2A screening (VDH)
 - Unpreserved frozen filter sample (100mL)- qPCR (VIMS)
- Bloom samples
 - Response to bloom reports or visual observation by field staff



Phyto Kit: Extra bottles, vials, lugol's, rubber gloves, marker



2020 Updates



Dinophysis
spp.

Pseudo-nitzschia
spp.

Alexandrium
monilatum

Margalefidinium
polykrikoides

Karlodinium
veneficum

Algal species	Impacts	Main Toxin	NSSP shellfish growing area closure level (toxin w/in meat)	working regional bloom density (cell density in water column)
<i>Alexandrium tamarense</i> species complex	Paralytic Shellfish Poisoning	Saxitoxin	80µg /100g	presence
<i>Karenia brevis</i>	Neurotoxic Shellfish Poisoning	Brevetoxin	0.8mg /kg	presence
<i>Dinophysis</i> spp.	Diarrhetic Shellfish Poisoning	Okadaic acid	0.16 mg/kg	≥5 cells/ml
<i>Pseudo-nitzschia</i> spp.	Amnesic Shellfish Poising	Domoic acid	2mg/100g	* ≥ 1,000 cells/ml
<i>Alexandrium monilatum</i>	Fish/invertebrate mortality	Goniodomin A	NA	≥ 1,000 cells/ml
<i>Margalefidinium polykrikoides</i>	Fish/invertebrate mortality	ichthyotoxin	NA	≥ 1,000 cells/ml
<i>Karlodinium veneficum</i>	Fish mortality	Karlotoxins	NA	≥ 10,000 cells/ml

- Year-round sampling
- qPCR analysis of all DSS collections for marine Biotoxin producers
- Screening for *Dinophysis* and *Pseudo-nitzschia* in each VDH:DSS field office
- Screened within days of collection (avg. 2.5)

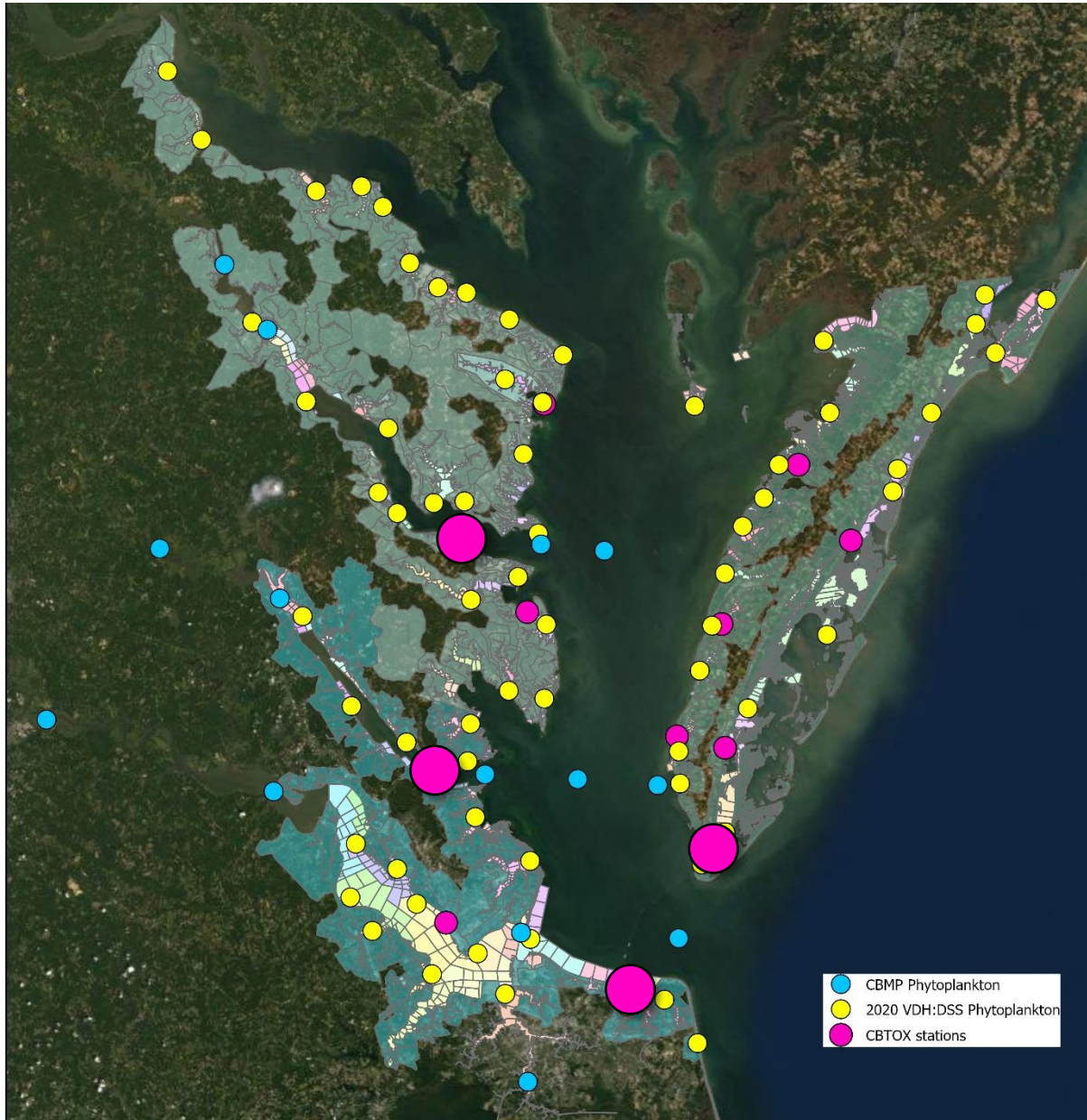
*Differentiating thick and thin *Pseudo-nitzschia* +/- 5µm width



3µm Isopore filters
5mL Eppendorf tubes

Cellvis P12-1.5H-N

Virginia Estuarine Phytoplankton monitoring

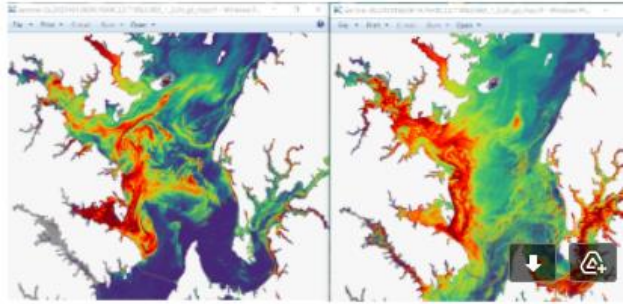
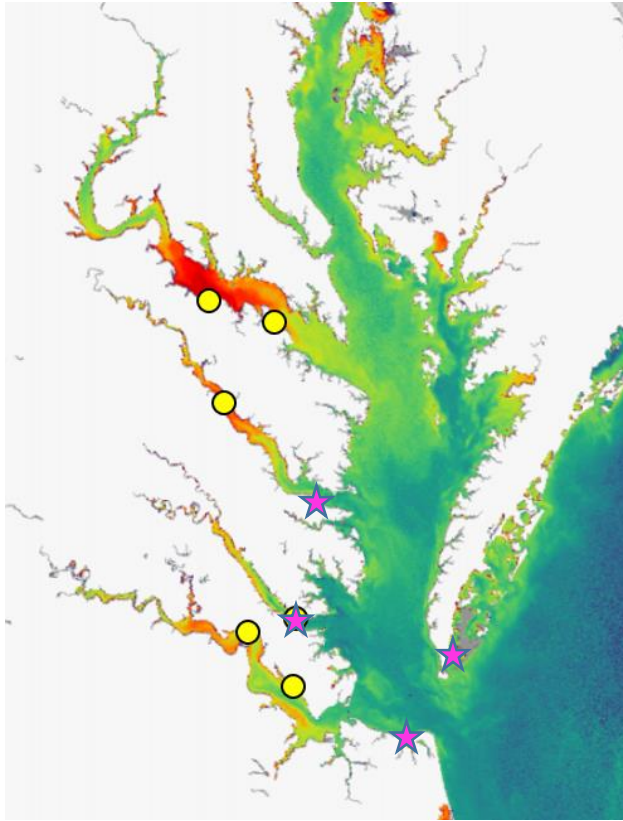
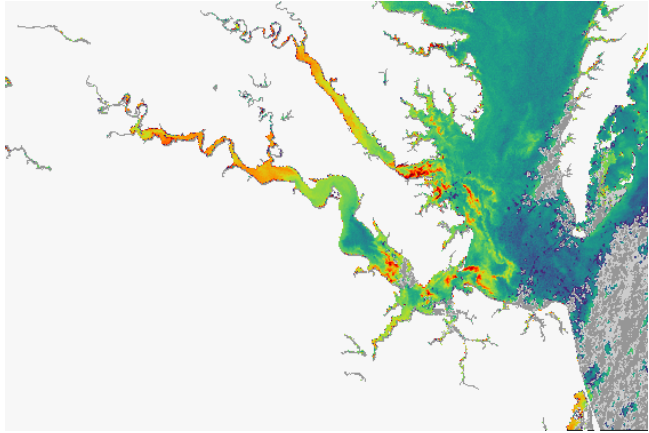


- Chesapeake Bay Monitoring Program (DEQ/ODU)
 - 14 stations
 - 7-Chesapeake Bay monthly year-round
 - 7-Tidal tributaries monthly March-October
- VDH: Shellfish (DSS&WHC/ ODU)
 - 69 stations
 - **Monthly year-round**
 - Targeted HAB identification
 - Targeted toxin screening (based on cell counts)
 - **Targeted qPCR analyses**
- CBTOX (VDH:DSS/ VIMS)
 - 12 stations (2017-2018)
 - **4 stations (2019-2020)**
 - Bi-weekly sampling
 - Targeted HAB identification
 - Routine toxin analyses



Additional monitoring: ODU and HRSD James River & research (Mulholland et al), VIMS (Reece, Smith, et al.)

HAB monitoring in the time of COVID



- Limited number sentinel sites
 - CBTOX collaboration w/VIMS
- Remote sensing
 - National Centers for Coastal Oceans Science
 - Chlorophyll a
 - Specific wavelengths focused on dinoflagellate, cyanobacteria
 - Email updates and communications with interstate partners
- Targeted limited field work
 - Sampling from shore
 - Solo field/lab crews
 - Phone check-ins
 - Masks/PPE
- Return to field work
 - Masks
 - Limited contact
 - Social distancing
 - Cleaning surfaces/vehicles

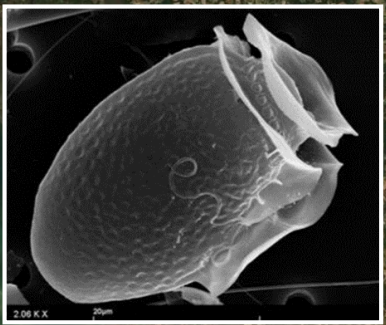


The National Oceanic and Atmospheric Administration

NOAA: Stumpf, Tomlinson

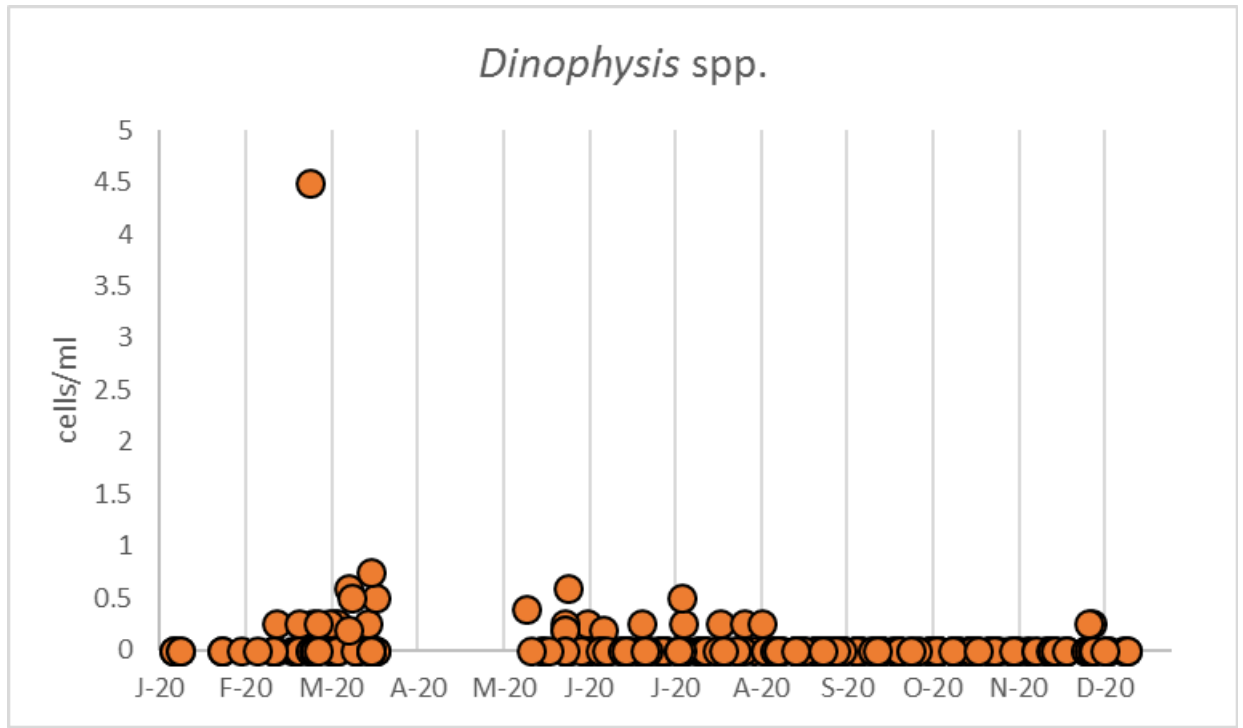
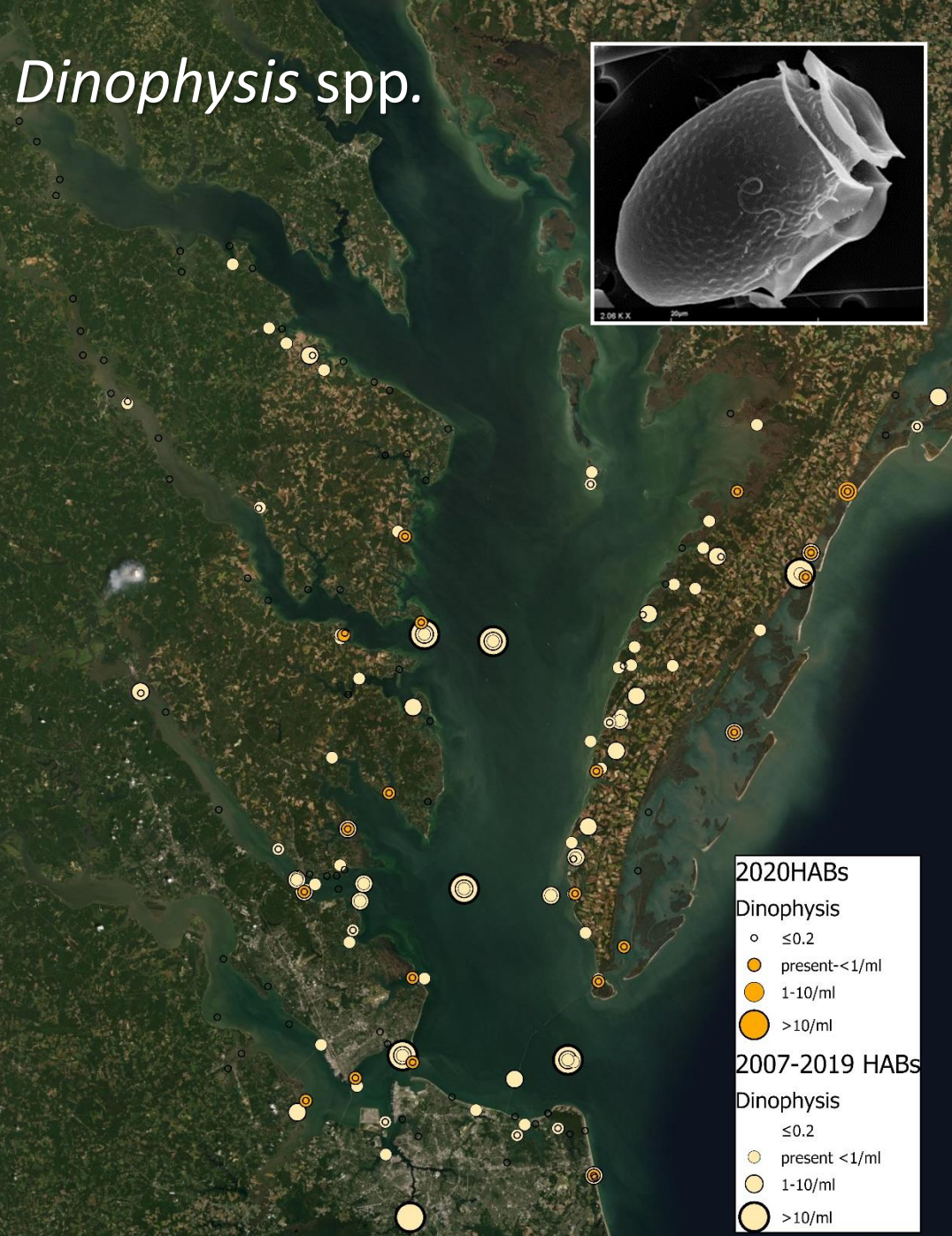
https://coastwatch.noaa.gov/cw_html/NCCOS.html

Dinophysis spp.



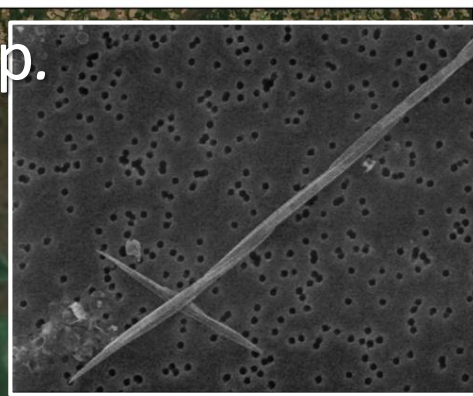
DSP- *Dinophysis*

- Widespread distribution in Chesapeake Bay and seaside E. Shore
 - Generally low cell densities
 - Present in ~ 7% of 2020 samples (<0.25 cells/ml)
 - 0.2-4.5 cells/ml
- Okadaic Acid PP2A on 31 seawater samples
- **All samples below detection limit (<0.5ppb)**
 - Widespread OA/DTXs reported using SPATTs- 2017-2018 (CBTOX- Onofrio et al. 2021)



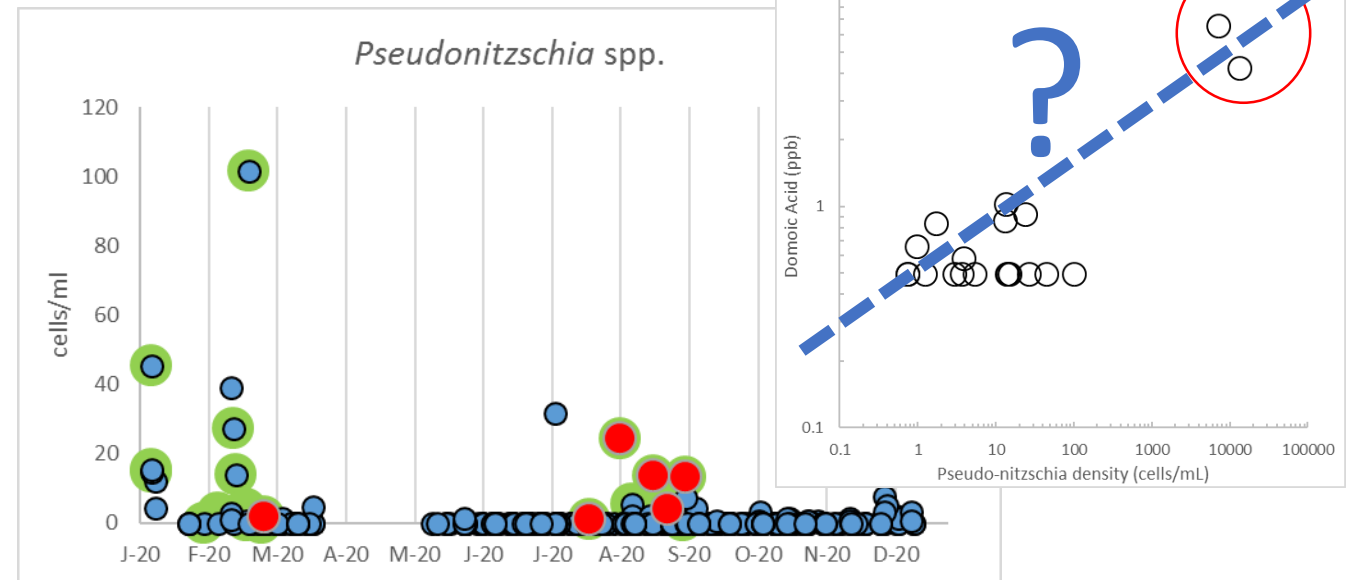
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Pseudo-nitzschia spp.



ASP- *Pseudo-nitzschia*

- Widespread distribution in Chesapeake Bay and Seaside E. Shore
 - Present in ~ 13% of 2020 samples (0.5-102 cells/ml)
- Dense bloom reported offshore MD/DE in late August
 - Over 10,000 cells/mL
 - MD-DNR reported DA of 4.2ppb and 6.5ppb in samples with ~13,000 and ~7000 cells/mL respectively
 - Much lower (<50/mL) in VA waters
- Domoic Acid ELISA on 20 seawater samples
 - **6 samples above detection limit (0.5ppb)**
 - 0.58-1.0 ppb Domoic Acid in seawater
 - DA detected in 2018 in concentrated sample and in CBTOX SPATTs 2017-2018 (Onofrio et al. 2021)



2020 shellfish deployments

CBTOX 2020 (VDH/VIMS- Smith/Reece)

- Shellfish and SPATT deployments
 - VIMS-LCMS/MS
 - VDH-ELISA/PP2A (ASP & DSP)
- Whole water sampling
 - Lugols- cell identification
 - Filter-qPCR
 - Frozen- LCMS/MS



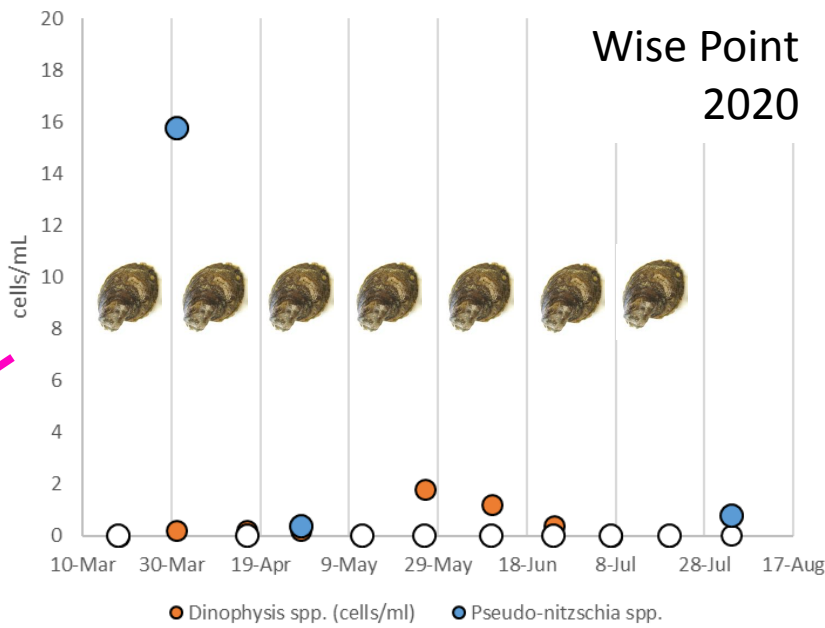
Dinophysis and *Pseudo-nitzschia* present at each site

All shellfish meat samples (n=13) tested so far (Lynnhaven & Wise Point)

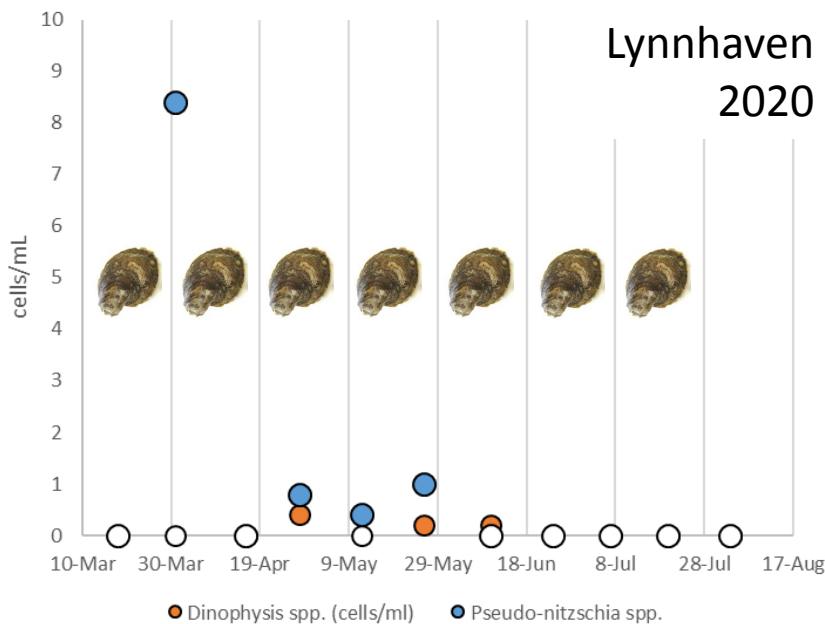
Negative for **DSP** and **ASP** (BDL) (VDH ELISA/PP2A)

Additional results pending from VIMS toxin analyses (additional sites, matrices and toxins)...

Wise Point
2020



Lynnhaven
2020

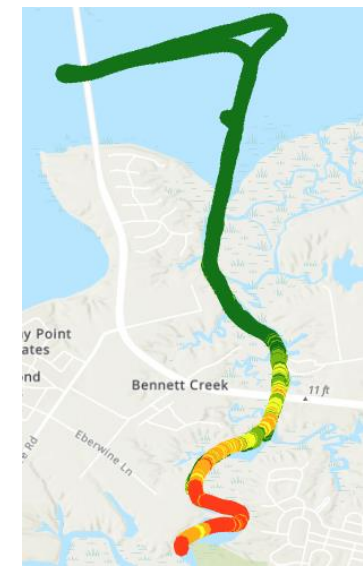
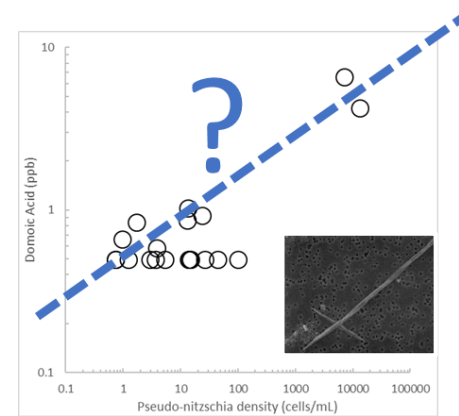


Initial/pre-deployment
James River 3/17/20
(-ASP, -DSP)



2021: ongoing and upcoming projects

- Revisiting cell/toxin relationships and thresholds
- Additional shellfish deployments and toxin testing
 - AFDO Equipment grant funds (toxin kits)
 - modified aquaculture bag method, VDH- SPATTs
- Logistics and data management
 - improved sample logs and standardized data reporting
 - database in development
- ISSC Techniques and Tools for Toxin Management grant
 - funded 2020-2021
 - *Biotoxin monitoring and management using flow-through real-time sampling and toxin tracking.*
 - Field trials and laboratory testing underway



Recent publications and resources:

https://coastwatch.noaa.gov/cw_html/NCCOS.html

NOAA CoastWatch & OceanWatch

The National Oceanic and Atmospheric Administration

NCCOS Algal Bloom Beta/Experimental Products

Search Criteria

Region: Chesapeake Bay

Product: (CTRL-click multiple)

True Color
Chlorophyll-a (Gileron)
Relative Fluorescence
Cyanobacteria Index

Sensor: OLCI CMSI

From: (MMDDYYYY) 01/09/2021

To: (MMDDYYYY) 01/14/2021

Search

Region: CB3 Sensor: OLCI_nccos Product: Datasets dfr	RESET
2021-01-09 (9) 14:40:00	2021-01-09 (9) 15:19:00
Sentinel-3B/OLCI_nccos Chesapeake Bay Chlorophyll-a (Gileron) PNG TIFF	Sentinel-3A/OLCI_nccos Chesapeake Bay Chlorophyll-a (Gileron) PNG TIFF
2021-01-11 (11) 15:28:00	2021-01-12 (12) 15:02:00

Current and Future Remote Sensing of Harmful Algal Blooms in the Chesapeake Bay to Support the Shellfish Industry

Jennifer L. Wolny^{1*}, Michelle C. Tomlinson², Stephanie Schollaert Uz³, Todd A. Egerton⁴, John R. McKay⁵, Andrew Meredith⁶, Kimberly S. Reece⁷, Gail P. Scott⁷ and Richard P. Stumpf²

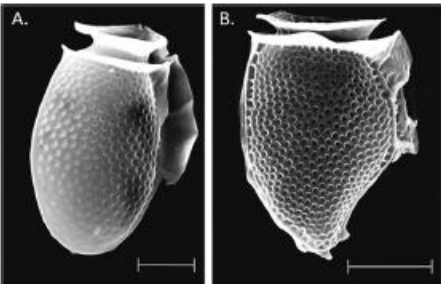
- ¹Resource Assessment Service, Maryland Department of Natural Resources, Annapolis, MD, United States
- ²National Centers for Coastal Ocean Science, National Oceanic and Atmospheric Administration, Silver Spring, MD, United States
- ³Earth Science Division, Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, MD, United States
- ⁴Division of Shellfish Safety, Virginia Department of Health, Norfolk, VA, United States
- ⁵Water and Science Administration, Maryland Department of the Environment, Annapolis, MD, United States
- ⁶Consolidated Safety Services, Inc., Fairfax, VA, United States
- ⁷Aquatic Health Sciences, Virginia Institute of Marine Science, William & Mary, Gloucester Point, VA, United States

May 2020. *Frontiers in Marine Science*, 7, p.337.

Characterization of *Dinophysis* spp. (Dinophyceae, Dinophysiales) from the mid-Atlantic region of the United States¹

Jennifer L. Wolny✉, Todd A. Egerton, Sara M. Handy, Whitney L. Stutts, Juliette L. Smith, Edward B. Whereat, Tsvetan R. Bachvaroff, Darren W. Henrichs, Lisa Campbell, Jonathan R. Deeds

Jan 2020. *Journal of Phycology*, 56(2), pp.404-424.

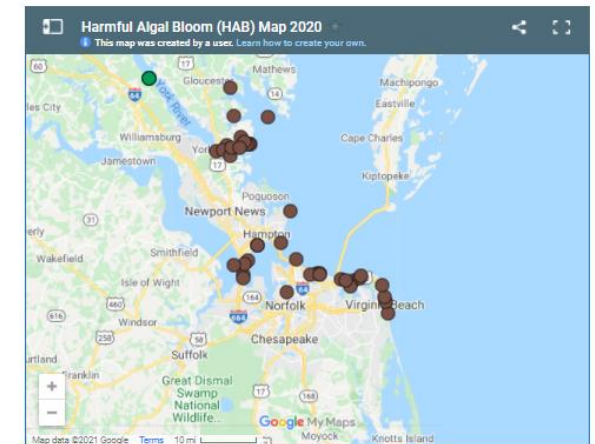


Spatiotemporal distribution of phycotoxins and their co-occurrence within nearshore waters

Michelle D. Onofrio¹, Todd A. Egerton², Kimberly S. Reece¹, Sarah K.D. Pease¹, Marta P. Sanderson¹, William Jones III¹, Evan Yeargan², Amanda Roach², Caroline DeMent¹, William Reay¹ Allen R. Place³ Juliette L. Smith^{1*}

2021. *Harmful Algae*. (accepted)

<https://www.SwimHealthyVA.com>



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