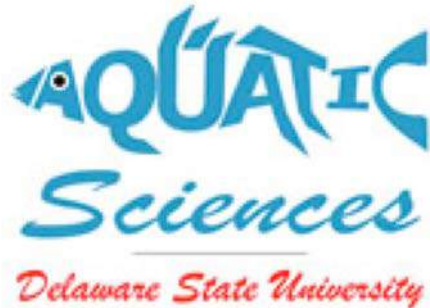


A Satellite-Based Mobile Warning System to Reduce Atlantic Sturgeon Interactions in Delaware waters

Grant No. NNX17AG34G

**Matthew Oliver, Matthew Breece, Dewayne Fox,
Steven Bograd, Elliot Hazen, Heather Welch, Ed Hale**

<http://basin.ceoe.udel.edu/shiny/sample-apps/sturgeon/>



NOAA FISHERIES

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



Applied Sciences Program

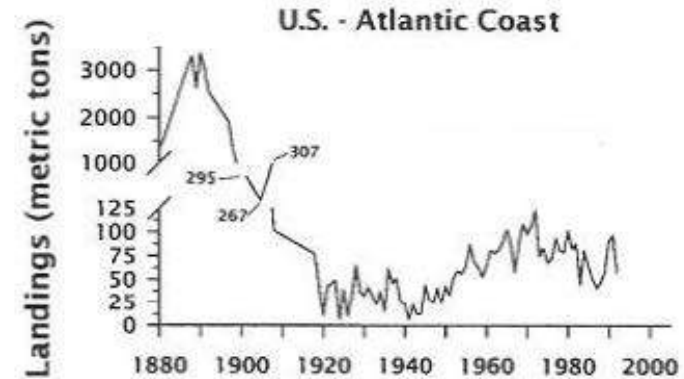
NASA Earth Science

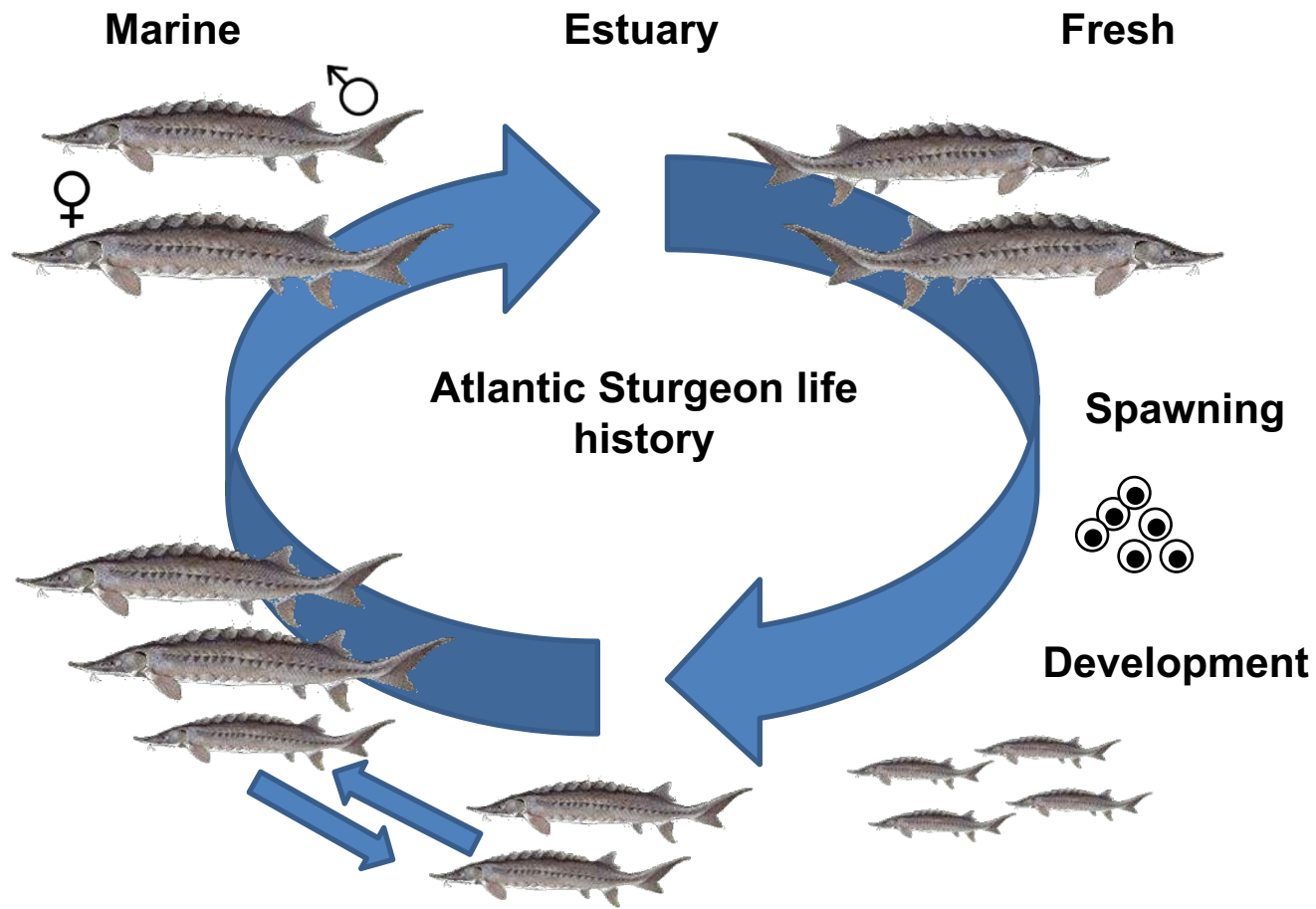


Historic Fisheries



- Delaware River Fishery
 - Peak of 2700mt harvest 1888
 - Largest sturgeon fishery in the United States (75% of landings)
 - Collapsed ~1900
- Minimal take, no recovery
 - Coast wide moratorium since 1998
 - Listed under the ESA in 2012

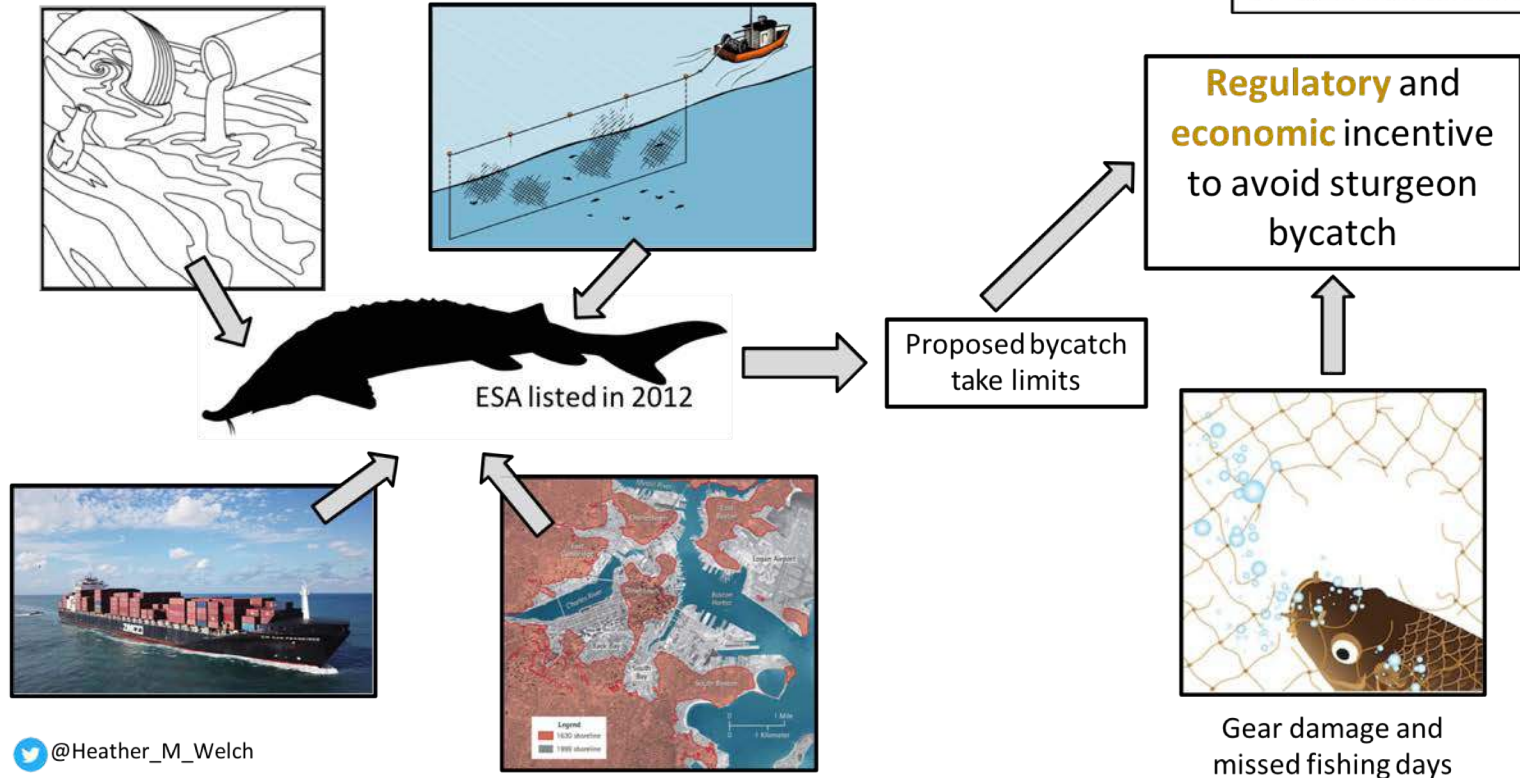





The Atlantic Sturgeon Risk Model



Project motivation

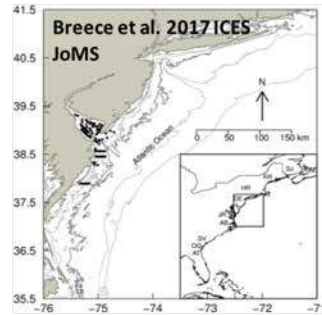


 @Heather_M_Welch

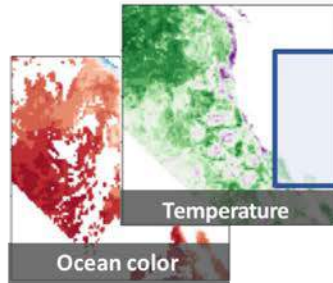
The Atlantic Sturgeon Risk Model



Science behind the tool

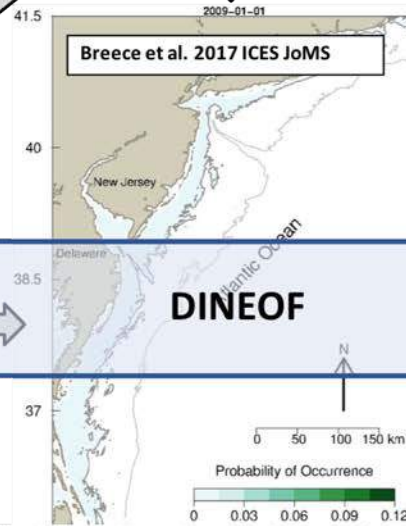
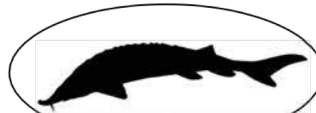


1. Acoustic detections



2. Environmental data from satellites

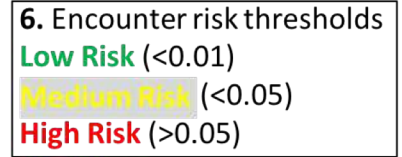
3. Species distribution model



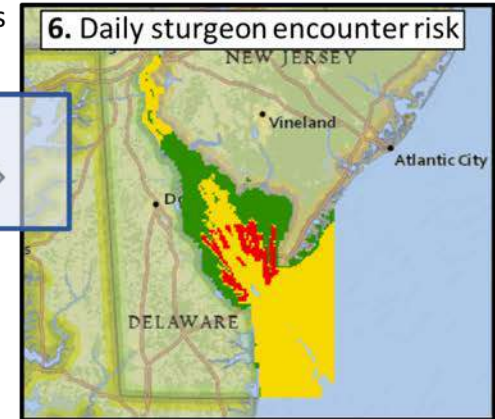
4. Daily predicted probability of occurrence



5. Bay regions and depth bins



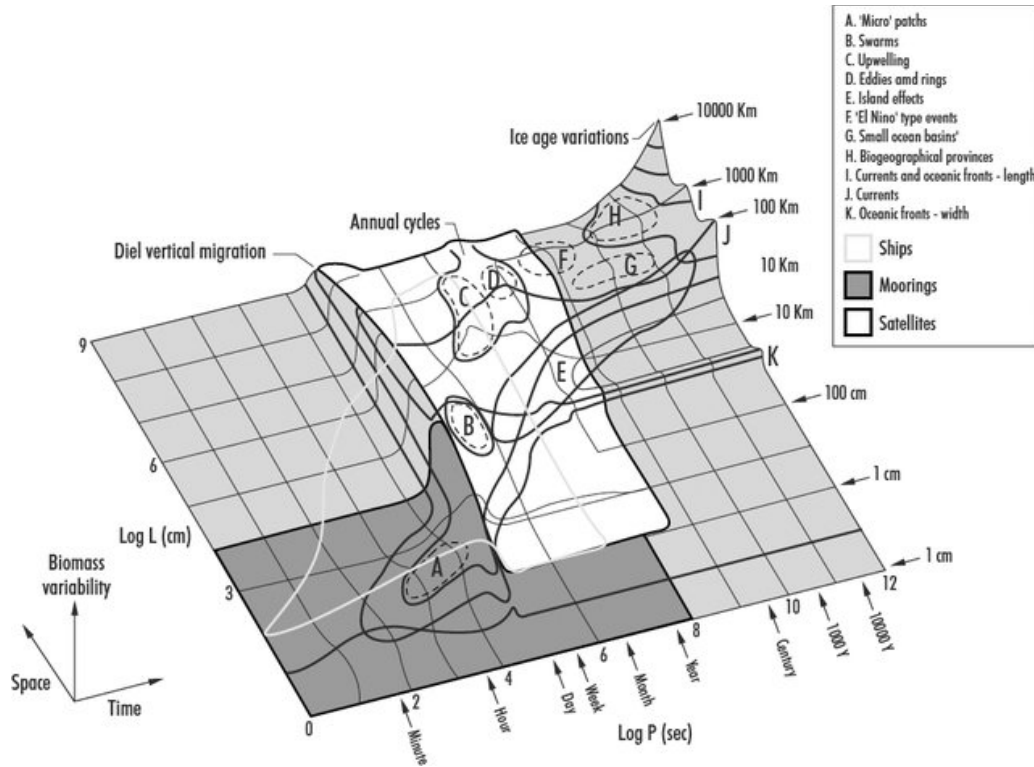
6. Encounter risk thresholds
Low Risk (<0.01)
Medium Risk (<0.05)
High Risk (>0.05)



6. Daily sturgeon encounter risk

Breece et al. A Satellite-Based Mobile Warning System to Reduce Interactions with an Endangered Species. Front. Ecol. Evol. In review.

What Time-Space Signals are Dominant?



Sturgeon life span ~50 years

Sturgeon maturity ~10 years

Sturgeon migration into Delaware ~1yr

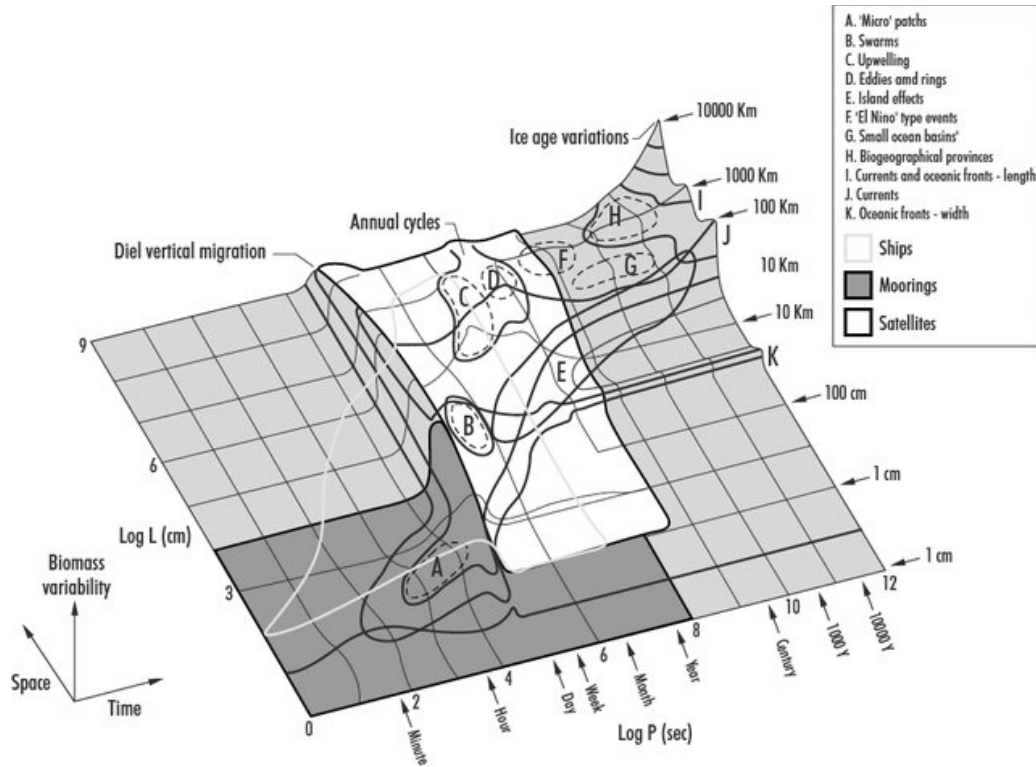
Sturgeon movements ~ 1hr - 1day

Fishing Season ~1 year

Fishing trip ~ 1 day

Gillnet soak ~1hr - 1 day

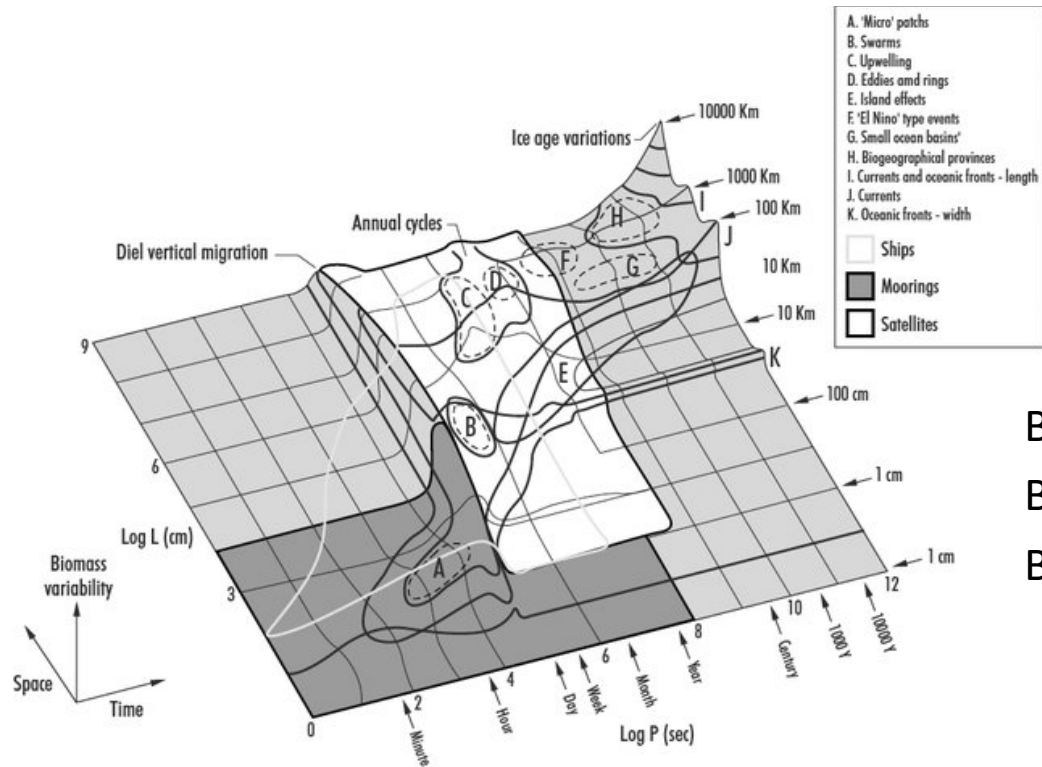
What Time-Space Signals are Dominant?



Delaware Bay Length Scale $\sim 10\text{-}100\text{ km}$
Sturgeon movement scale $\sim 1\text{-}10\text{ km}$

Fishing Length Scale $\sim 1\text{-}10\text{ km}$
Gillnet scale $\sim 0.5 - 1\text{ km}$

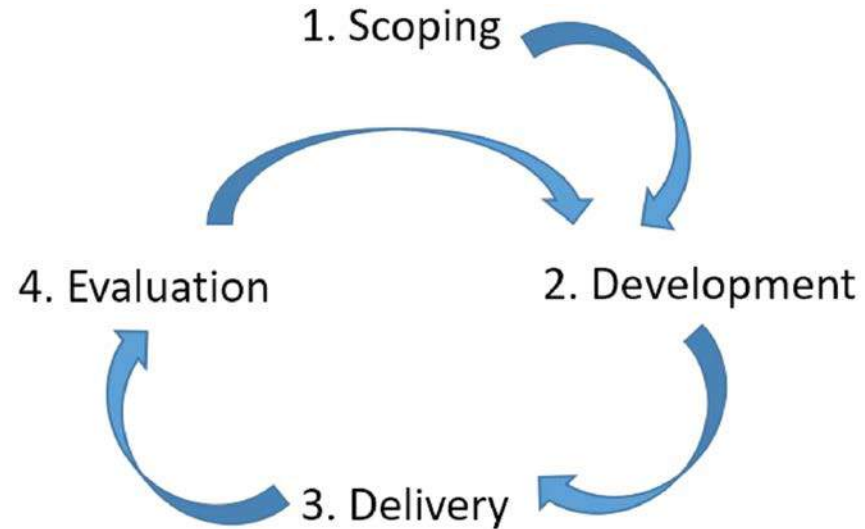
What Kind of Problem Is This?



Bycatch event scale $\sim 1\text{-}10\text{ km}$; $1\text{hr}\text{-}1\text{day}$
 Bycatch population effect scale $\sim 10\text{-}50\text{yr}$
 Bycatch fishing effect scale $\sim 1\text{hr}\text{-}1\text{day}$

So, what kind of problem is this?
Who are our consumers?
What are their expectations?

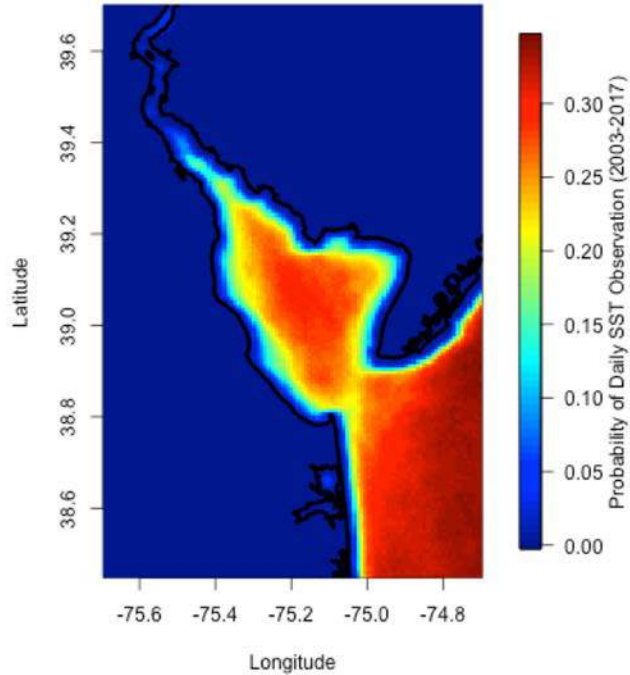
1. Skill Assessment – 89% correct overall
2. Delivery of Products and Delivery Failure
3. Representation of Uncertainty
4. Equity for Users
5. Unintended Consequences



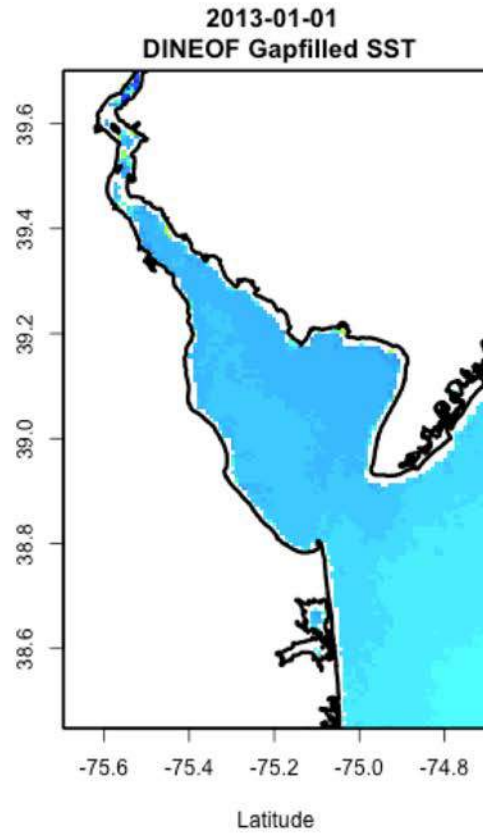
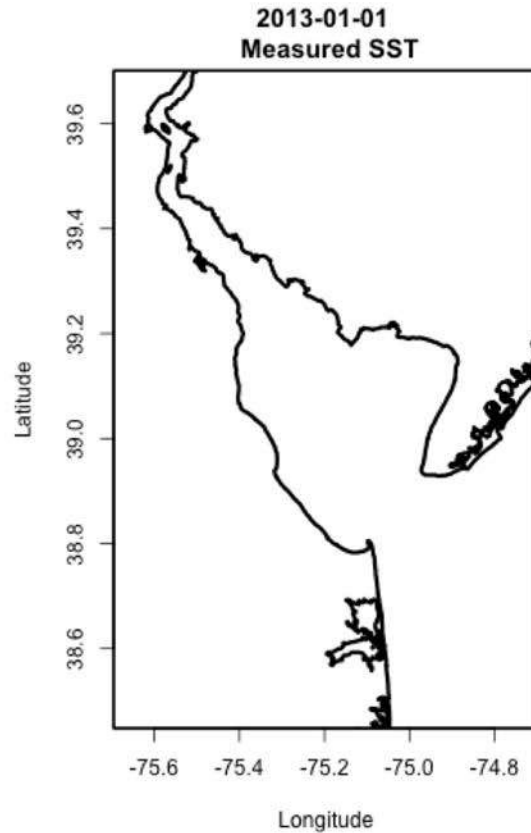
Delivery of Products

Daily observations from satellites are rare

Clouds are not random



Delivery of Products



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Ocean Modelling 9 (2005) 325–346

Ocean
Modelling
www.elsevier.com/locate/oceanmod

Reconstruction of incomplete oceanographic data sets
using empirical orthogonal functions: application to the
Adriatic Sea surface temperature

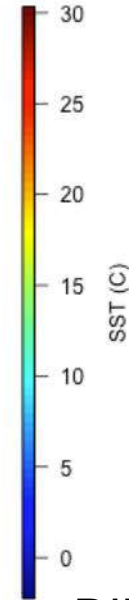
A. Alvera-Azcárate ^{a,*}, A. Barth ^a, M. Rixen ^b, J.M. Beckers ^a

^a GHER, Department of AGO, University of Liège, Allée du 6 Août 17, B5, Sart Tilman, 4000 Liège, Belgium

^b NATO/ACLANT Undersea Research Centre, Viale San Bartolomeo 400, 19138, La Spezia, Italy

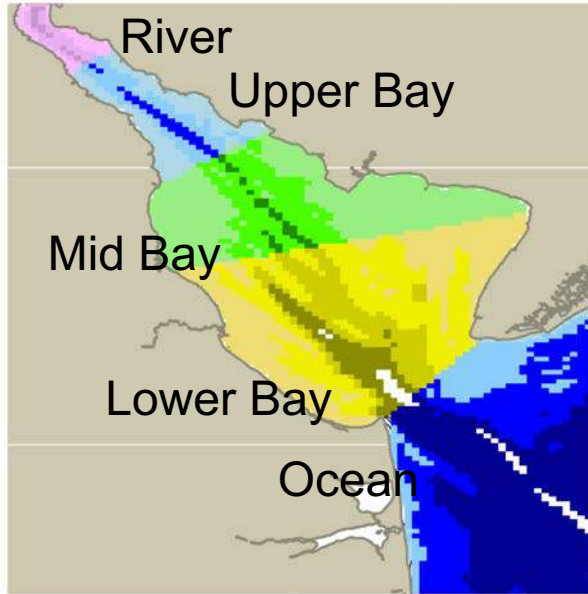
Received 30 March 2004; received in revised form 26 July 2004; accepted 4 August 2004

Available online 16 September 2004



DINEOF to gap-fill data
(Data INTERpolating Empirical
Orthogonal Functions)

Delivery of Products



Atlantic Sturgeon alert zones based on the 2016 ASMFC Delaware River Sustainable Fishing Plan for American Shad. River (pink), Upper Bay (blue), Mid Bay (green), Lower Bay (yellow), Ocean (blue). The regions are divided further by depth bins to make the 17 zones, <5m, 5-10m, 10-15m, >15m (> 15m does not occur in the Mid Bay, Upper Bay and River).

Based on ASMFC SFP for American Shad

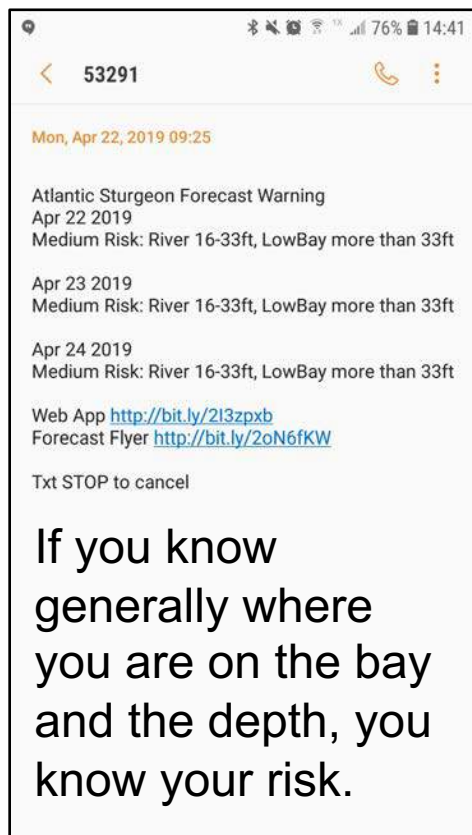
- River – north of Collins Beach
- Upper Bay – Collins Beach to Port Mahon
- Mid Bay – Port Mahon to Bowers Beach
- Lower Bay – South of Bowers Beach to Cape Henlopen
- Ocean – East of Cape Henlopen

Depths

- 0-5 meters
- 5-10 meters
- 10-15 meters
- Above 15 meters

If you know generally where you are on the bay and the depth, you know your risk.

Delivery of Products (SMS Text)

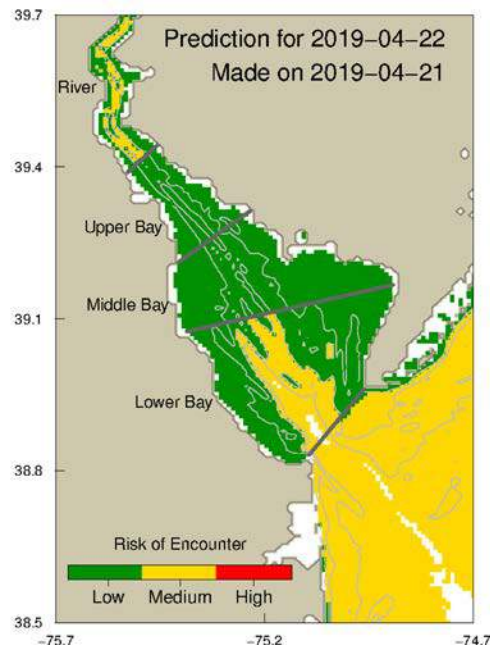


Atlantic Sturgeon Predicted Occurrence

Green indicates low risk of encountering Atlantic Sturgeon

Yellow indicates medium risk of encountering Atlantic Sturgeon

Red indicates high risk of encountering Atlantic Sturgeon



This product is developed for mature Atlantic Sturgeon using historic telemetry observations matched to date, bathymetry, and sea surface temperature and ocean color from NASA's MODIS AQUA satellite. The five regions (Delaware River, Upper Delaware Bay, Middle Delaware Bay, Lower Delaware Bay, and Atlantic Ocean) are divided into 5 meter depth bins.

Contact:

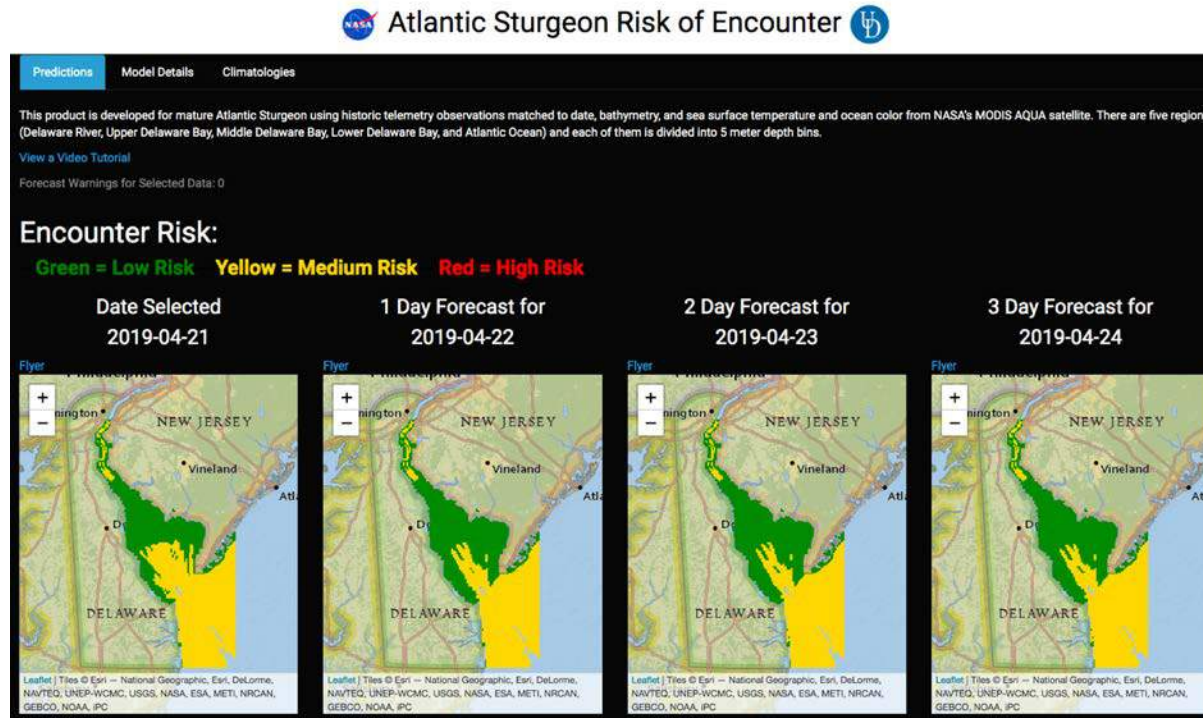
Moliver@udel.edu, and Mwbreece@udel.edu
University of Delaware 700 Pilottown Road
Lewes, DE 19958

Ed.hale@state.de.us Delaware Division of Fish and Wildlife 3002 Bayside Drive Dover, DE 19901

Breece, M. W., D. A. Fox, D. E. Haulsee, I. Wirgin, and M. J. Oliver. 2017. Satellite Driven Distribution Models of Endangered Atlantic Sturgeon Occurrence in the Mid-Atlantic. ICES Journal of Marine Science fsx187.

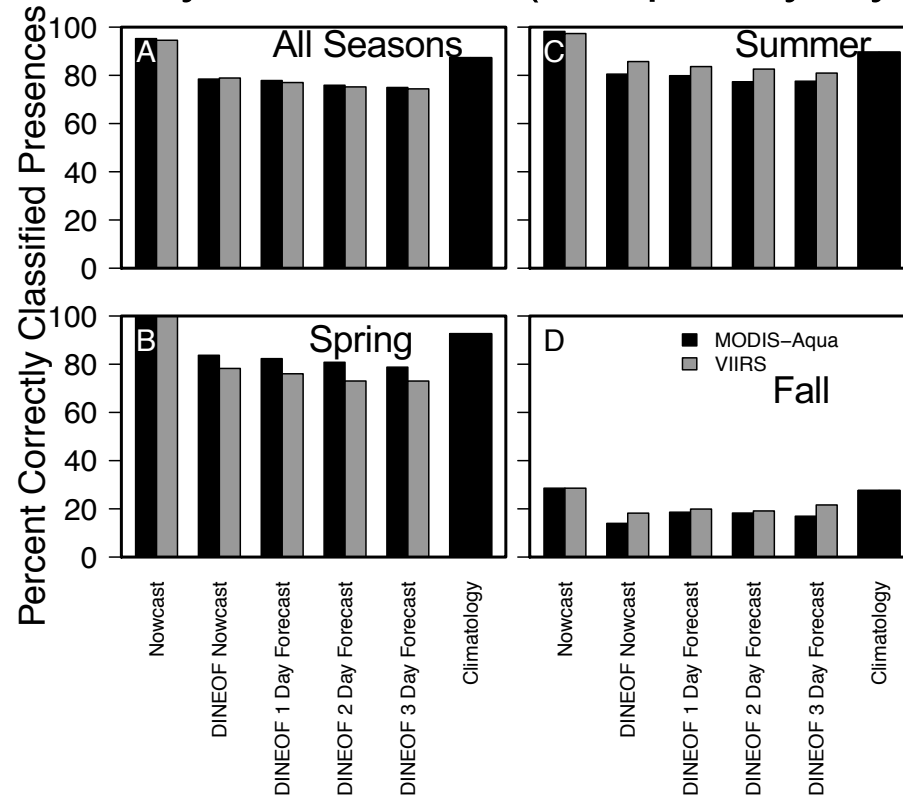


Delivery of Products (Web Application)



<http://basin.ceoe.udel.edu/shiny/sample-apps/sturgeon/>

Uncertainty of Products (Temporally, by pixel)

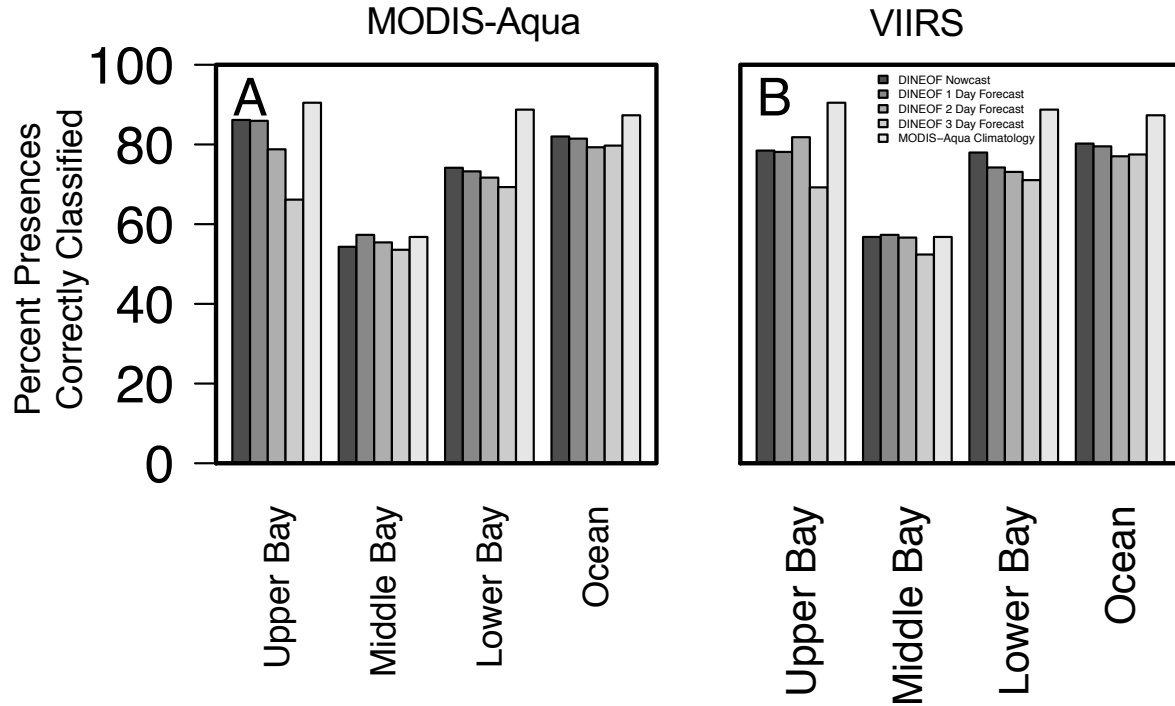


Spring = Mar 21 – Jun 21

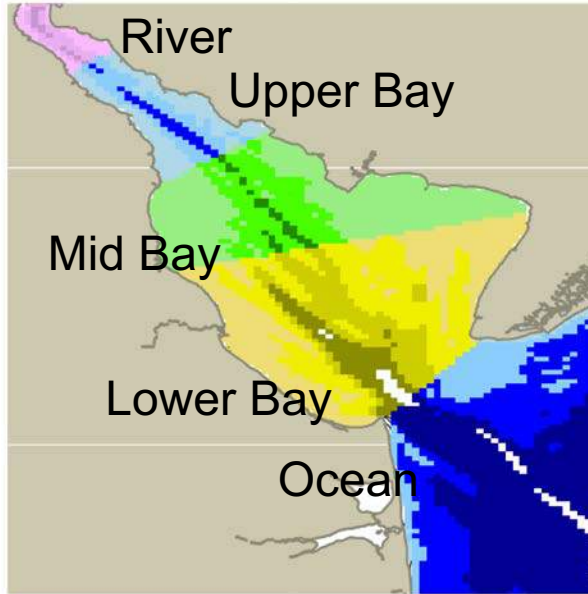
Summer = Jun 21– Sep 21

Fall = Sep 21-Dec 21

Uncertainty of Products (Spatially, by pixel)



Delivery of Products



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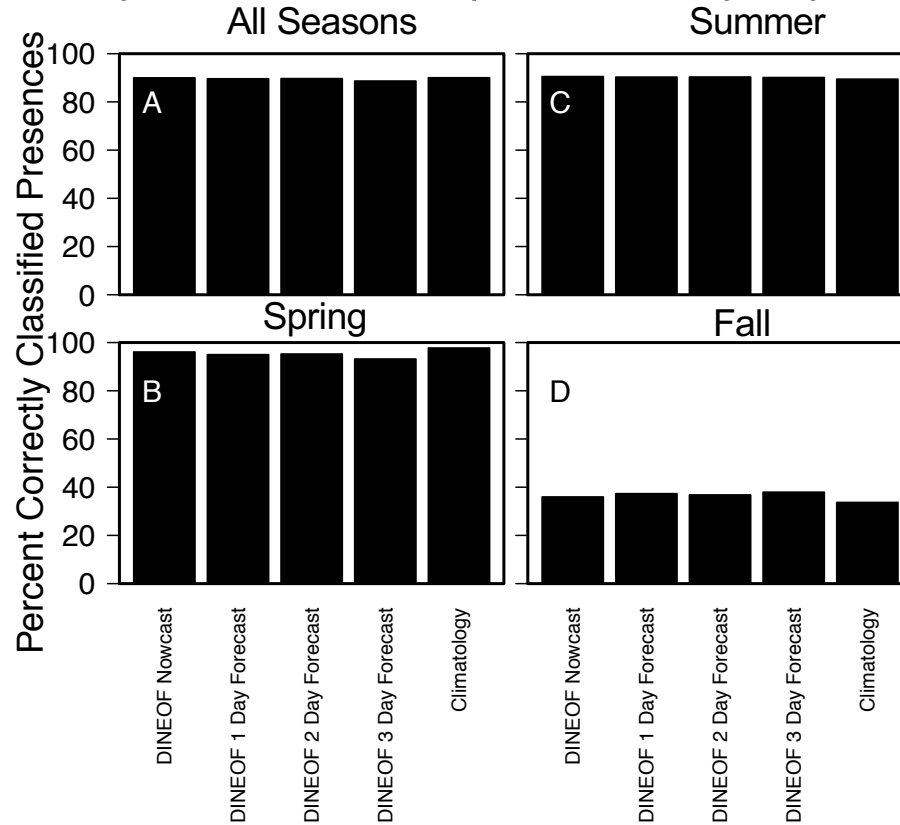
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Uncertainty of Products (Temporally, by region)

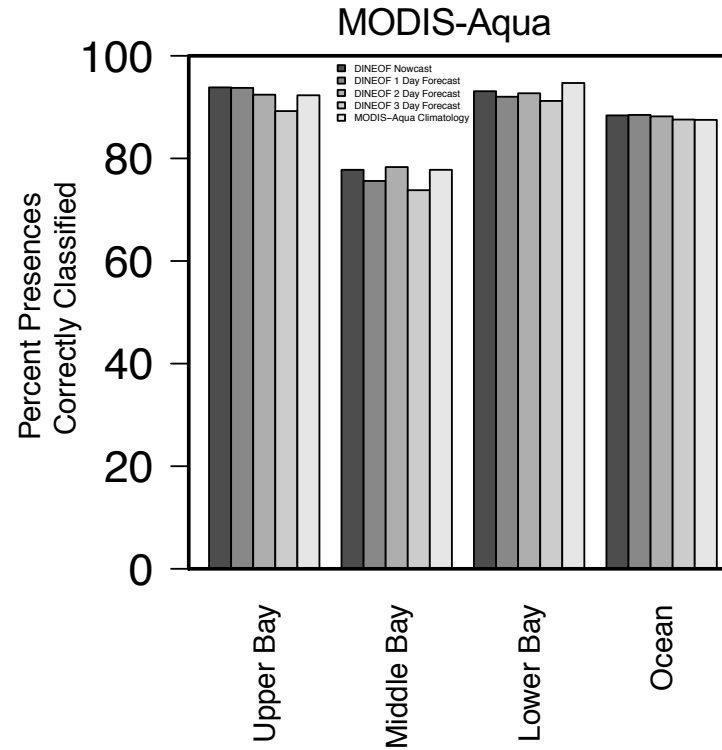


Spring = Mar 21 – Jun 21

Summer = Jun 21– Sep 21

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Uncertainty of Products (Spatially, by region)



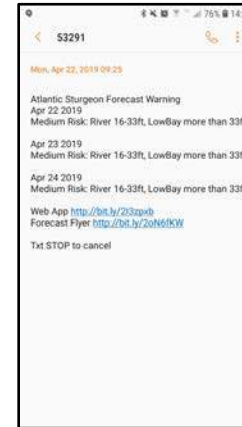
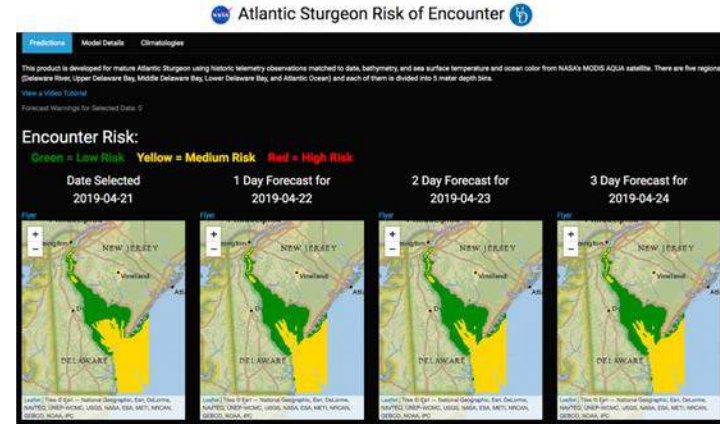
Equity for Users

We have a diversity of content outlets

Each requires access to either cell/internet

High information to low information

What are we asking of the users to understand this?

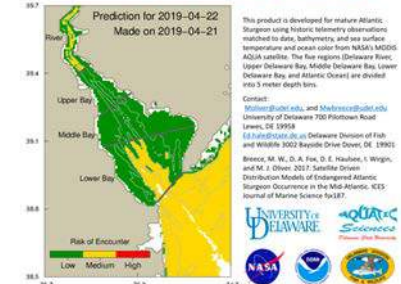


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Unintended Consequences

Why are you doing this? You are giving fishers a road-map to exploit!

Why are you doing this? This is an Orwellian bureaucratic regulative framework!

