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

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http://basin.ceoe.udel.edu/shiny/sample-apps/sturgeon/
**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
Atlantic Sturgeon life history

Marine

♀️

♂️

Estuary

Fresh

Spawned

Development
The Atlantic Sturgeon Risk Model

Project motivation

Regulatory and economic incentive to avoid sturgeon bycatch

Proposed bycatch take limits

ESA listed in 2012

Gear damage and missed fishing days

@Heather_M_Welch
The Atlantic Sturgeon Risk Model

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)

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 ~ 10-100 km
Sturgeon movement scale ~ 1-10 km

Fishing Length Scale ~ 1-10 km
Gillnet scale ~ 0.5 – 1 km
What Kind of Problem Is This?

Bycatch event scale ~ 1-10 km; 1hr-1day
Bycatch population effect scale ~ 10-50yr
Bycatch fishing effect scale ~ 1hr-1day
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
Daily observations from satellites are rare

Clouds are not random
Delivery of Products

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

![Bar Chart](chart.png)

**MODIS-Aqua**

- Upper Bay
- Middle Bay
- Lower Bay
- Ocean

**VIIRS**

- Upper Bay
- Middle Bay
- Lower Bay
- Ocean

- DINEOF Nowcast
- DINEOF 1 Day Forecast
- DINEOF 2 Day Forecast
- DINEOF 3 Day Forecast
- MODIS–Aqua Climatology

**Percent Presences Correctly Classified**

0 20 40 60 80 100
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Uncertainty of Products (Temporally, by region)

All Seasons

- DINEOF Nowcast
- DINEOF 1 Day Forecast
- DINEOF 2 Day Forecast
- DINEOF 3 Day Forecast
- Climatology

Spring

- Percent Correctly Classified Presences

Summer

- Percent Correctly Classified Presences

Fall

- Percent Correctly Classified Presences

Spring = Mar 21 – Jun 21

Summer = Jun 21– Sep 21

Fall = Sep 21-Dec 21
Uncertainty of Products (Spatially, by region)

MODIS-Aqua

Percent Presences Correctly Classified

Upper Bay  Middle Bay  Lower Bay  Ocean

DINEOF Nowcast  DINEOF 1 Day Forecast  DINEOF 2 Day Forecast  DINEOF 3 Day Forecast  MODIS–Aqua Climatology
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?
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!