

Operationalizing dynamic ocean management tools to support climate-ready marine protected areas



FaCeT

Fisheries and Climate Toolkit



Camrin D. Braun (WHOI)

Rebecca Lewison (SDSU)



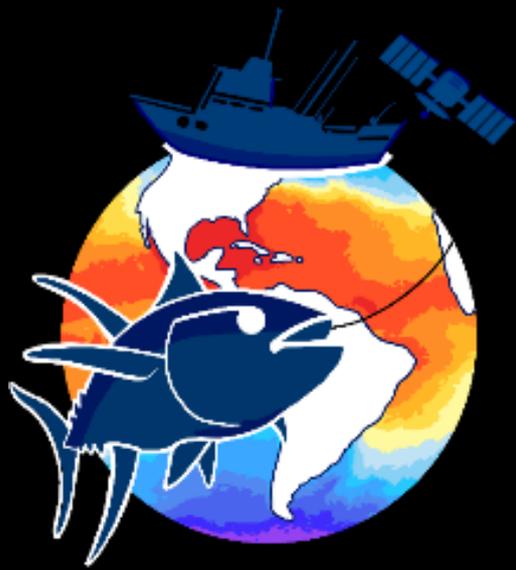
SAN DIEGO STATE
UNIVERSITY

NASA BDEC team meeting
May 2025



WOODS HOLE
OCEANOGRAPHIC
INSTITUTION





Build on a history of use-inspired NASA products

**NOAA** COASTWATCH
WEST COAST REGIONAL NODE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

 [EcoCast Product](#) [EcoCast Explorer](#) [About EcoCast](#)

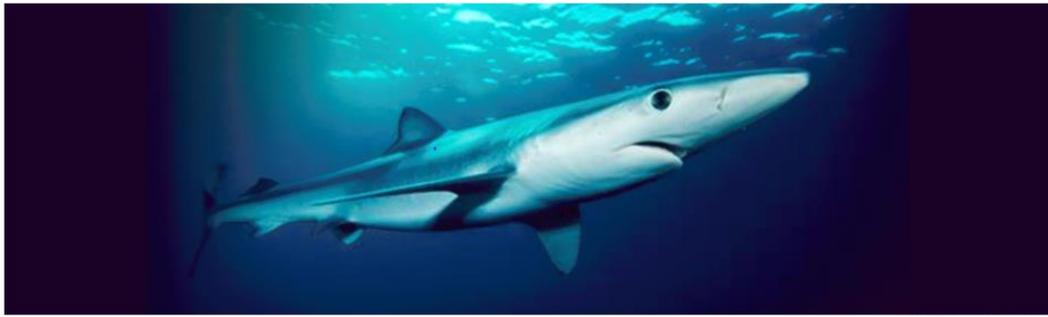


Photo copyright: Mark Conlin

A Eco-Informatic Tool for Fisheries Sustainability

What is EcoCast?

EcoCast is a fisheries sustainability tool that helps fishers and managers evaluate how to allocate fishing effort to optimize the sustainable harvest of target fish while minimizing bycatch of protected or threatened animals.

[View details »](#)

Finding a good place to fish

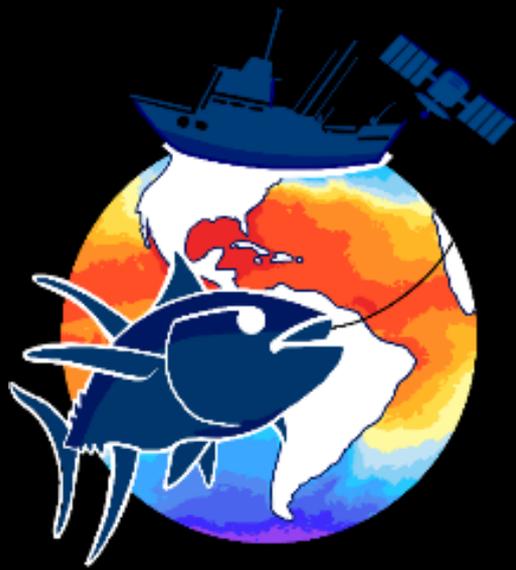
The EcoCast Product combines the predicted distributions of target catch species and bycatch species into a single map that suggests better and poorer locations to fish off the US West Coast.

[View the map »](#)

Scenario analysis

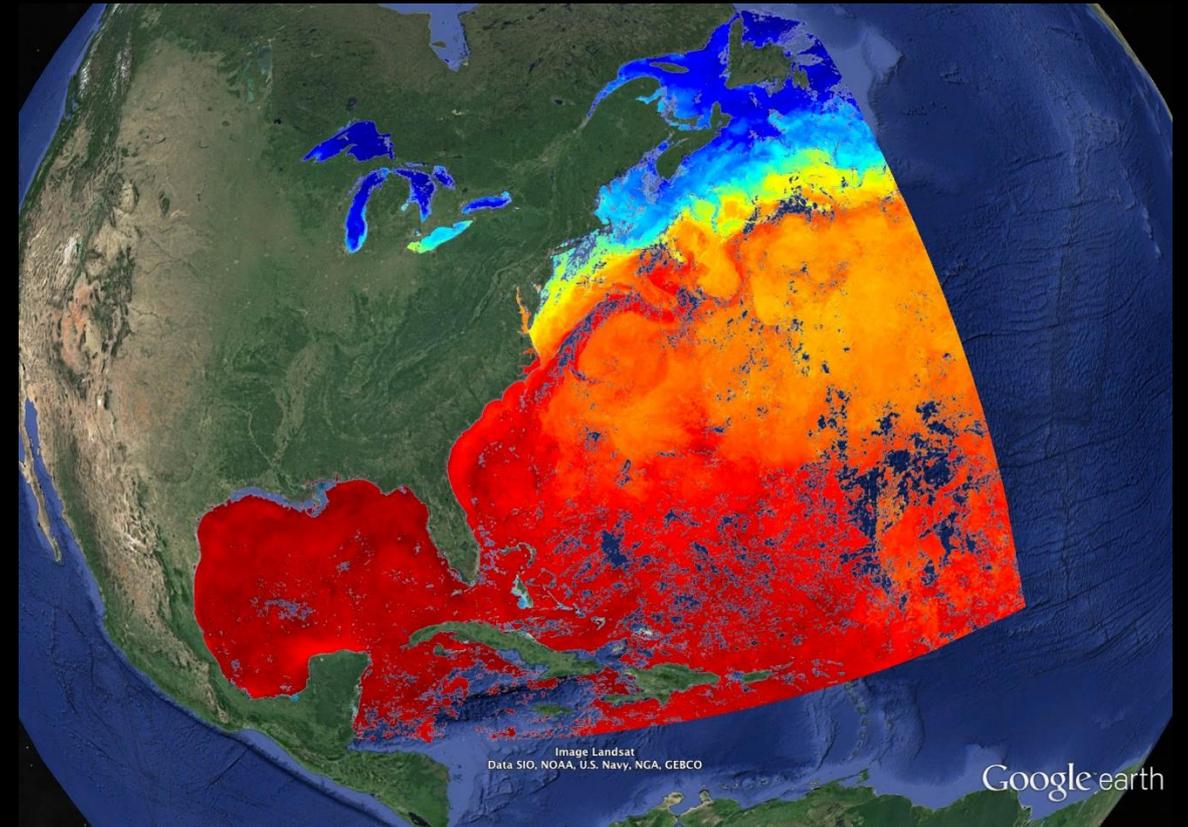
EcoCast Explorer gives users an opportunity to run scenario analyses to explore how the EcoCast product works. Users are able to generate predictive maps for specific dates, for single species, and can change the species weightings. This tool gives users the ability to explore how species are responding to changing ocean conditions, and how that can influence the EcoCast Product.

[Run Analyses »](#)



Leverage satellites + “big” data

Build on a history of use-inspired NASA products



NOAA COASTWATCH WEST COAST REGIONAL NODE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

EcoCast EcoCast Product EcoCast Explorer About EcoCast

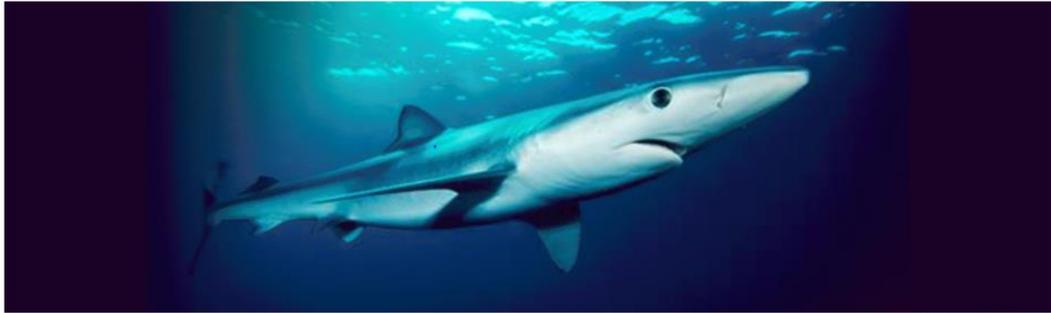


Photo copyright: Mark Conlin

A Eco-Informatic Tool for Fisheries Sustainability

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Finding a good place to fish
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Scenario analysis
EcoCast Explorer gives users an opportunity to run scenario analyses to explore how the EcoCast product works. Users are able to generate predictive maps for specific dates, for single species, and can change the species weightings. This tool gives users the ability to explore how species are responding to changing ocean conditions, and how that can influence the EcoCast Product.
[Run Analyses »](#)

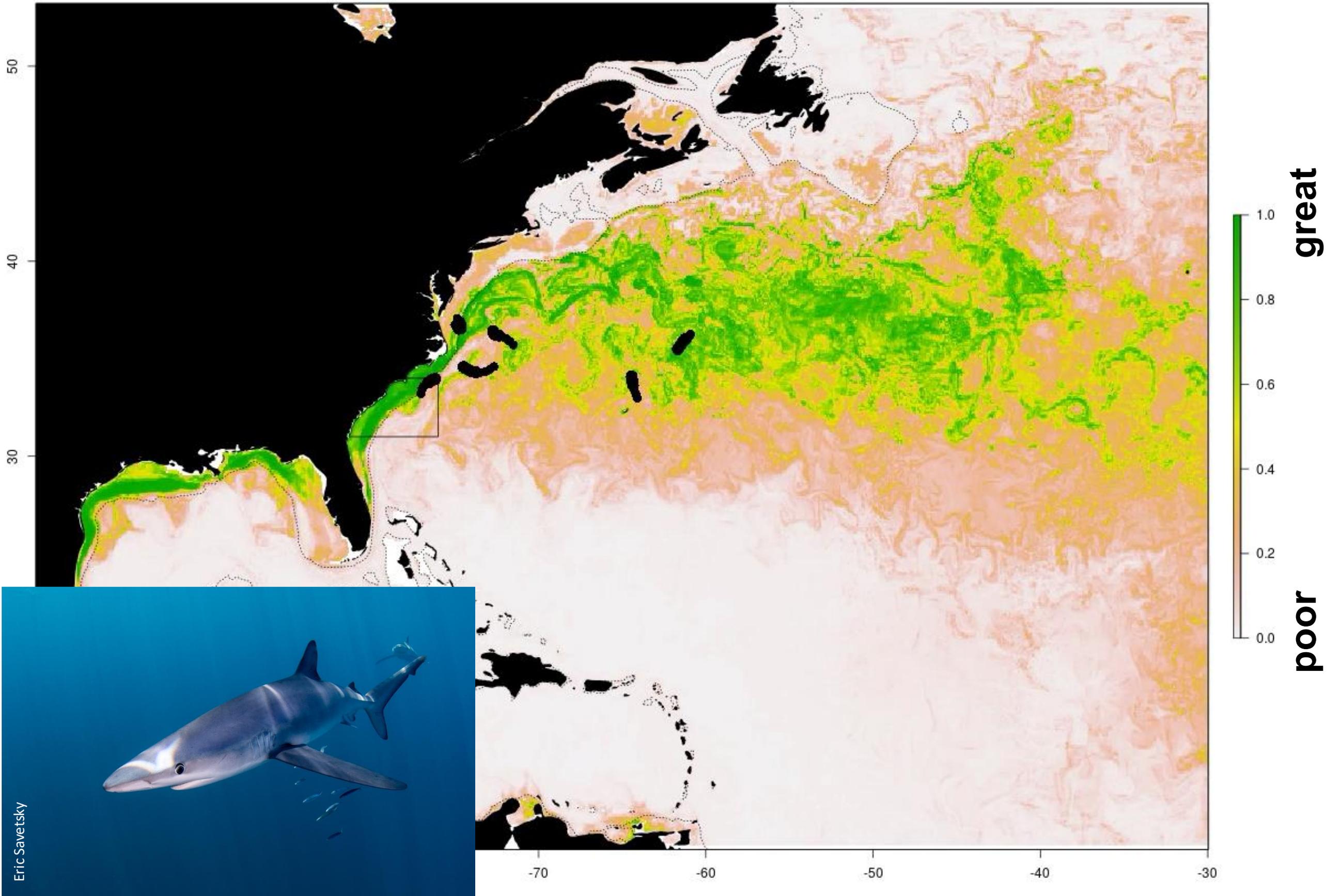


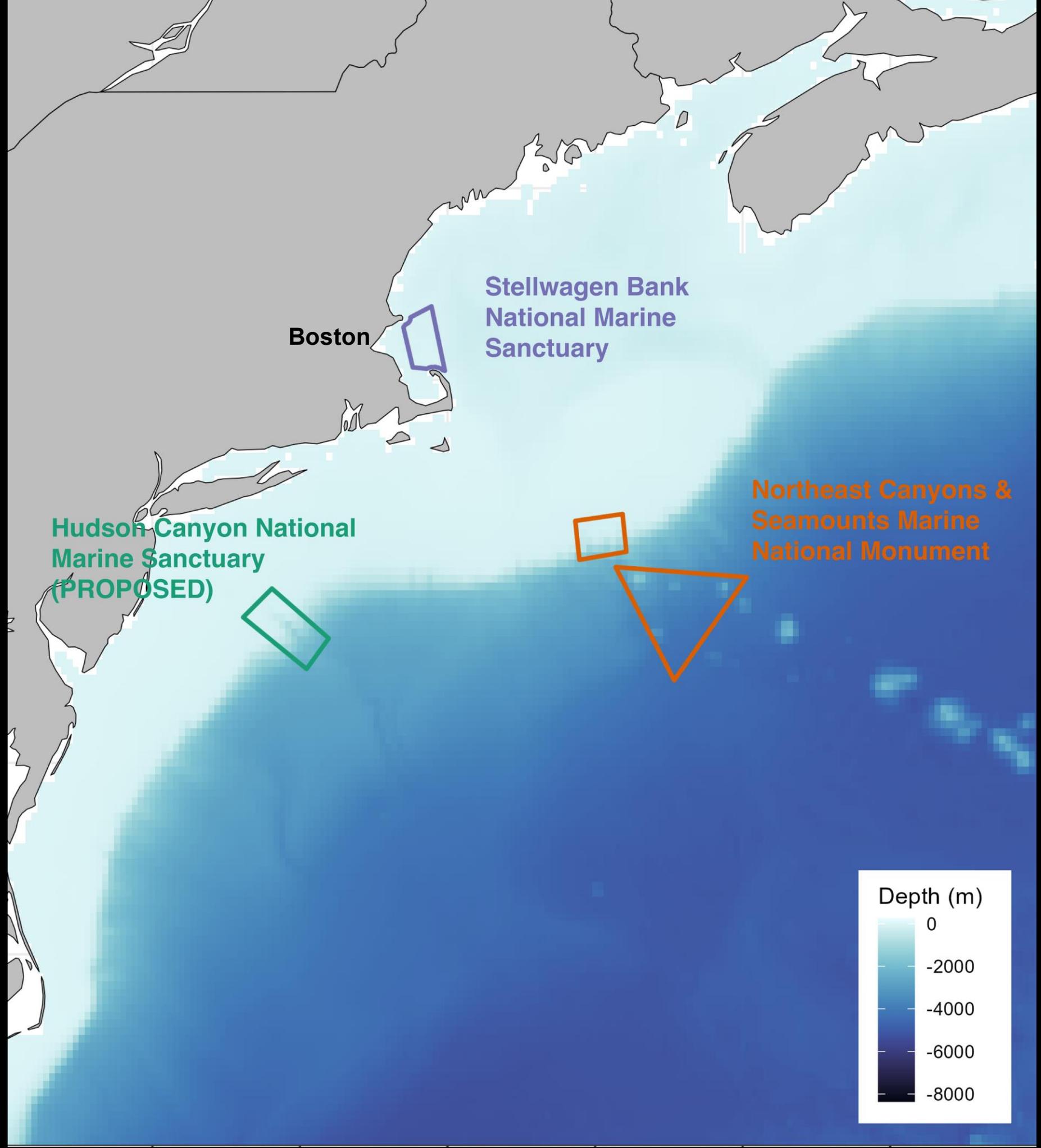
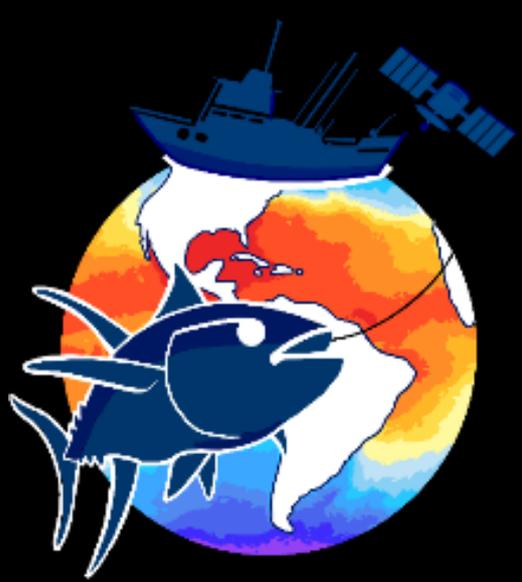
Co-developing actionable products for decision making

Predict suitable habitat

2015-04-25 | N tags = 7

● shark tracking!



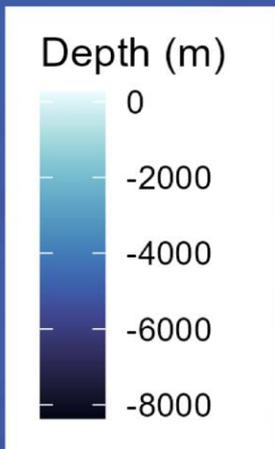


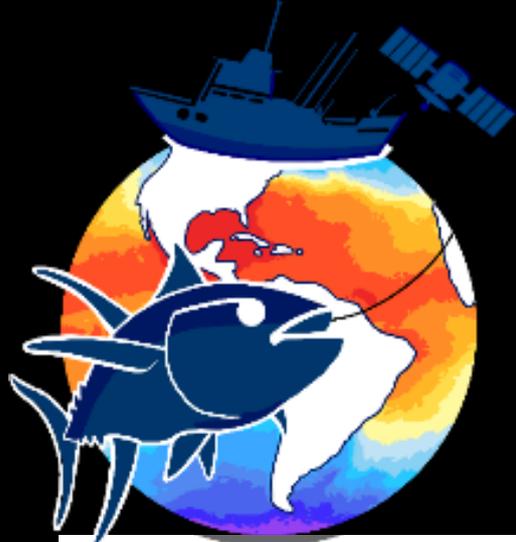
Boston

Stellwagen Bank
National Marine
Sanctuary

Hudson Canyon National
Marine Sanctuary
(PROPOSED)

Northeast Canyons &
Seamounts Marine
National Monument



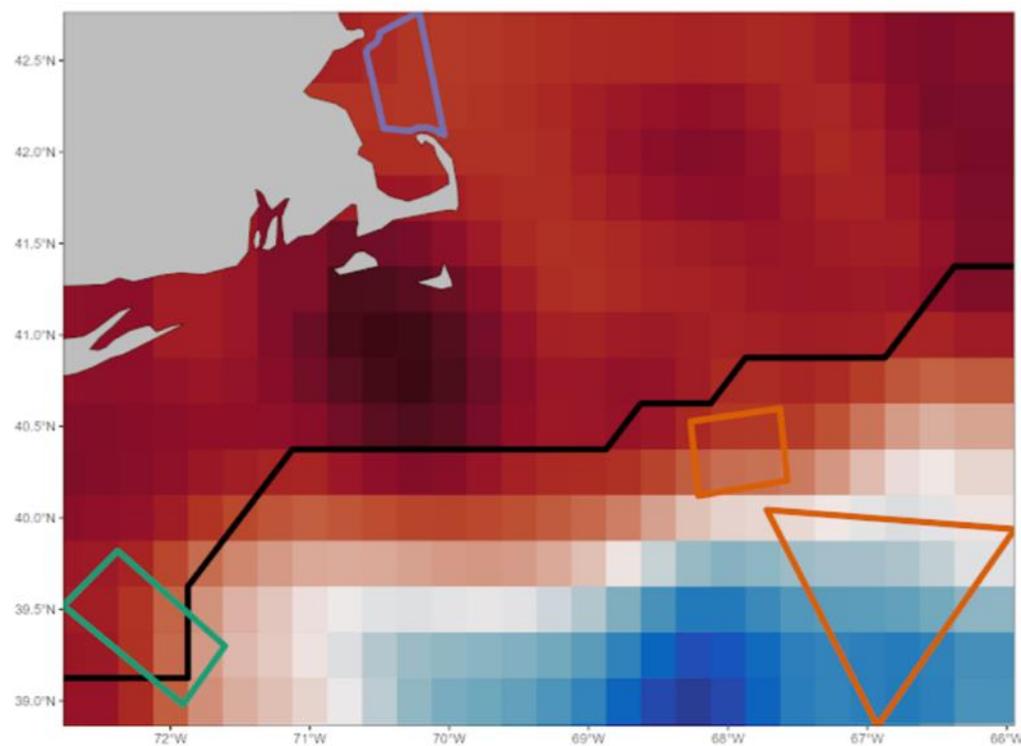


Simple surveys support rapid, iterative feedback

Examples of marine heatwave survey questions

How useful is this figure for understanding marine heatwaves to facilitate making ^{*} management decisions? Rank from very useful (1) to not useful (5)

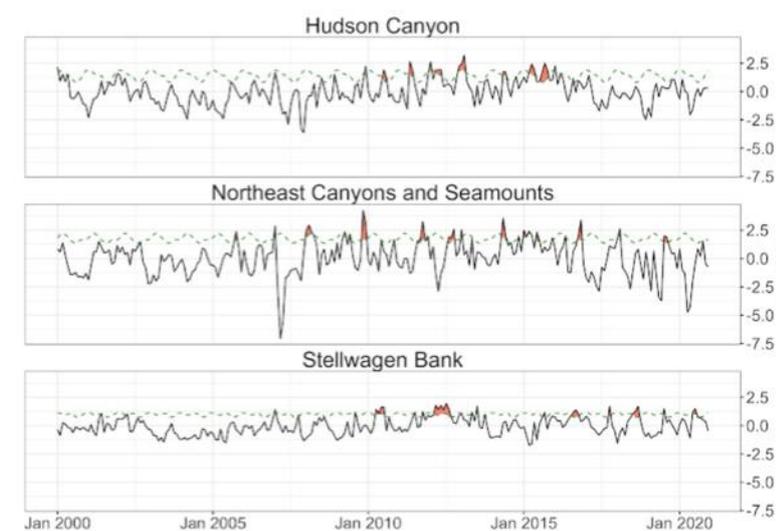
Map of a MHW event on May 2012 (black line represents the boundary of MHW)



1 2 3 4 5

Very useful Not useful

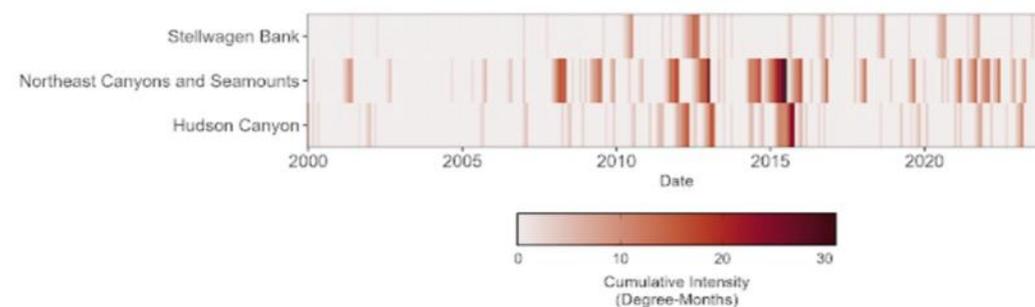
Time series of MHW intensity over time across protected areas (black line indicates SSTa; red indicates MHW; green line is the seasonal threshold)



1 2 3 4 5

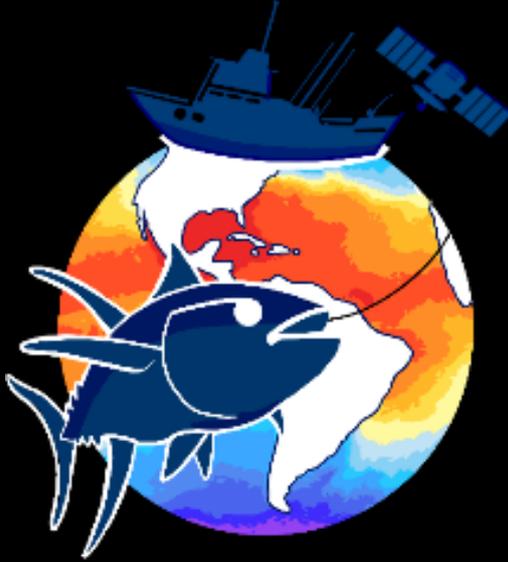
Very useful Not useful

Cumulative intensity of MHWs across protected areas

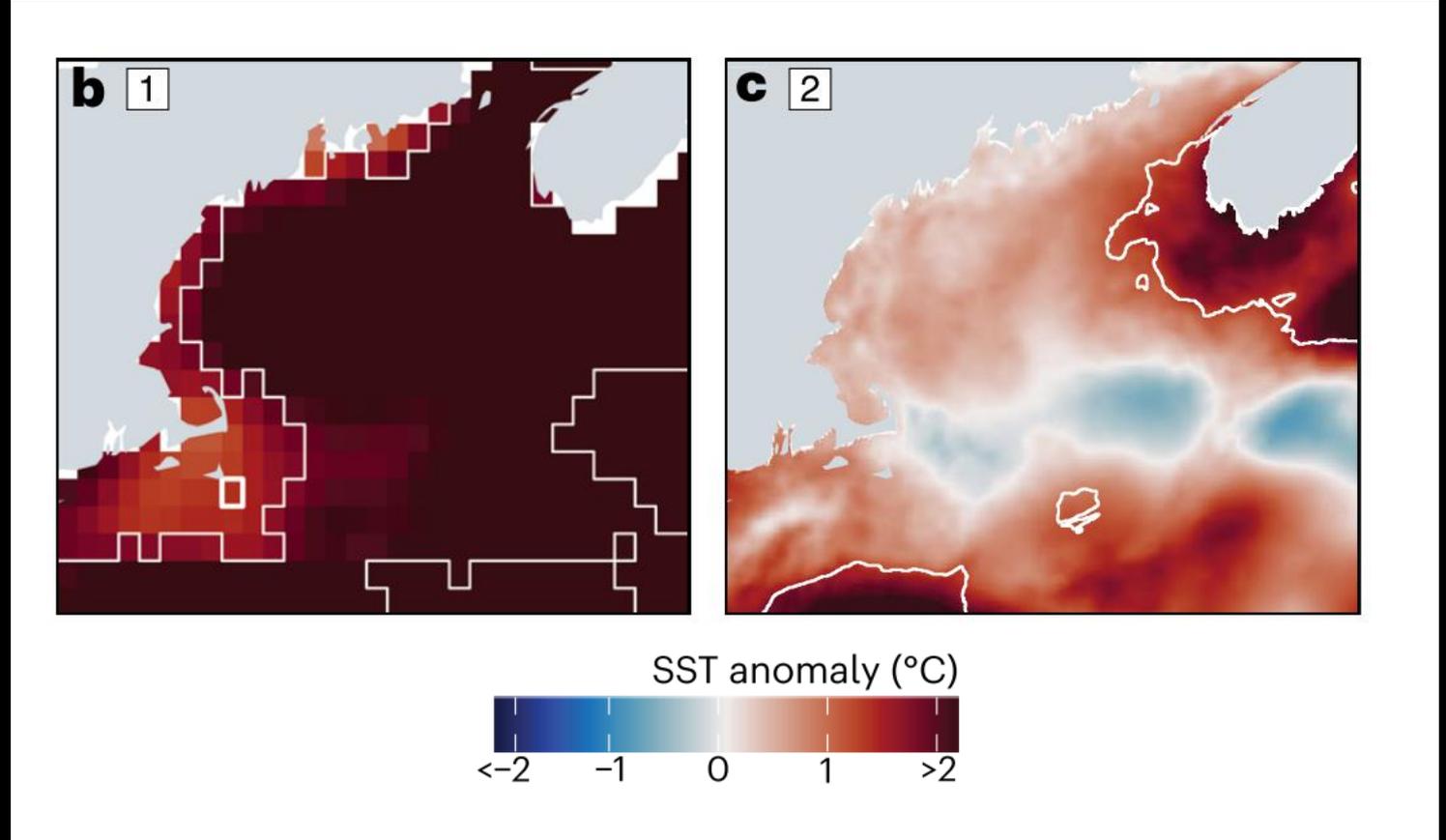
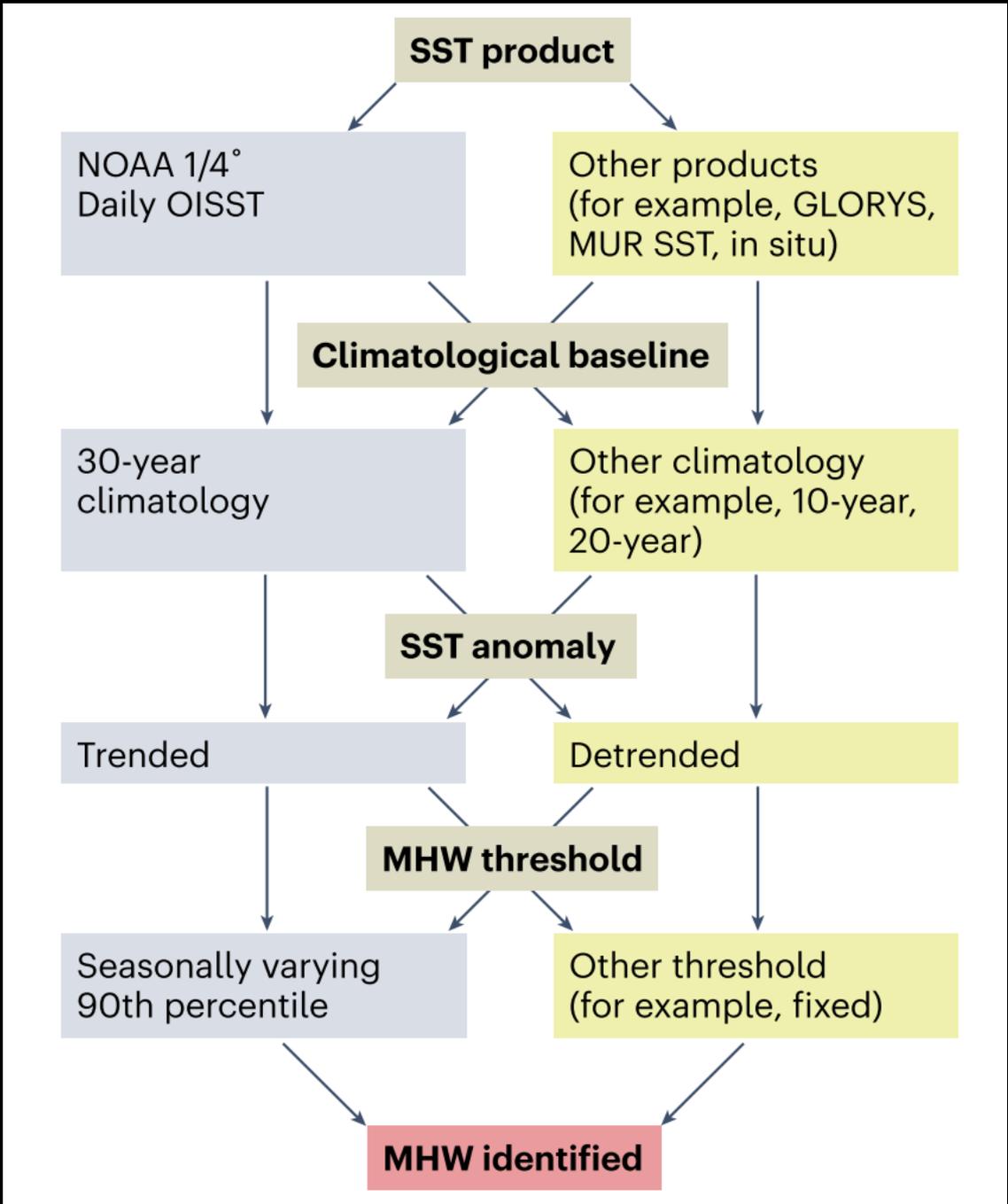


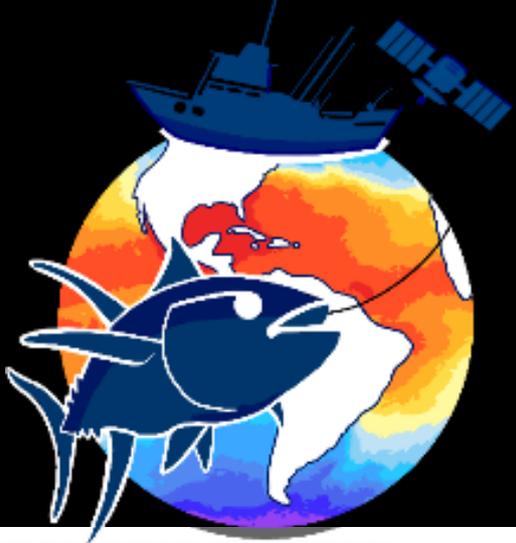
1 2 3 4 5

Very useful Not useful



Stakeholder-driven marine heatwave products: advancing science and env literacy





Stakeholder-driven marine heatwave products: advancing science and env literacy

NORTHEAST OCEAN DATA

HOME WHAT'S NEW? CURRENT ISSUES THEMES DATA EXPLORER DOWNLOAD ABOUT

DATA EXPLORER

Turn all Layers Off

All Layers Active Layers (6)

Spatial Intensity of Marine Heat Waves 2023

Showing April Data

Hudson Canyon Proposed National Marine Sanctuary Reference Area

Stellwagen Bank National Marine Sanctuary

Northeast Canyons and Seamounts Marine National Monument

Sea Surface Temperature Anomaly 2023

Showing April Data

Spatial Intensity of Marine Heat Waves 2024

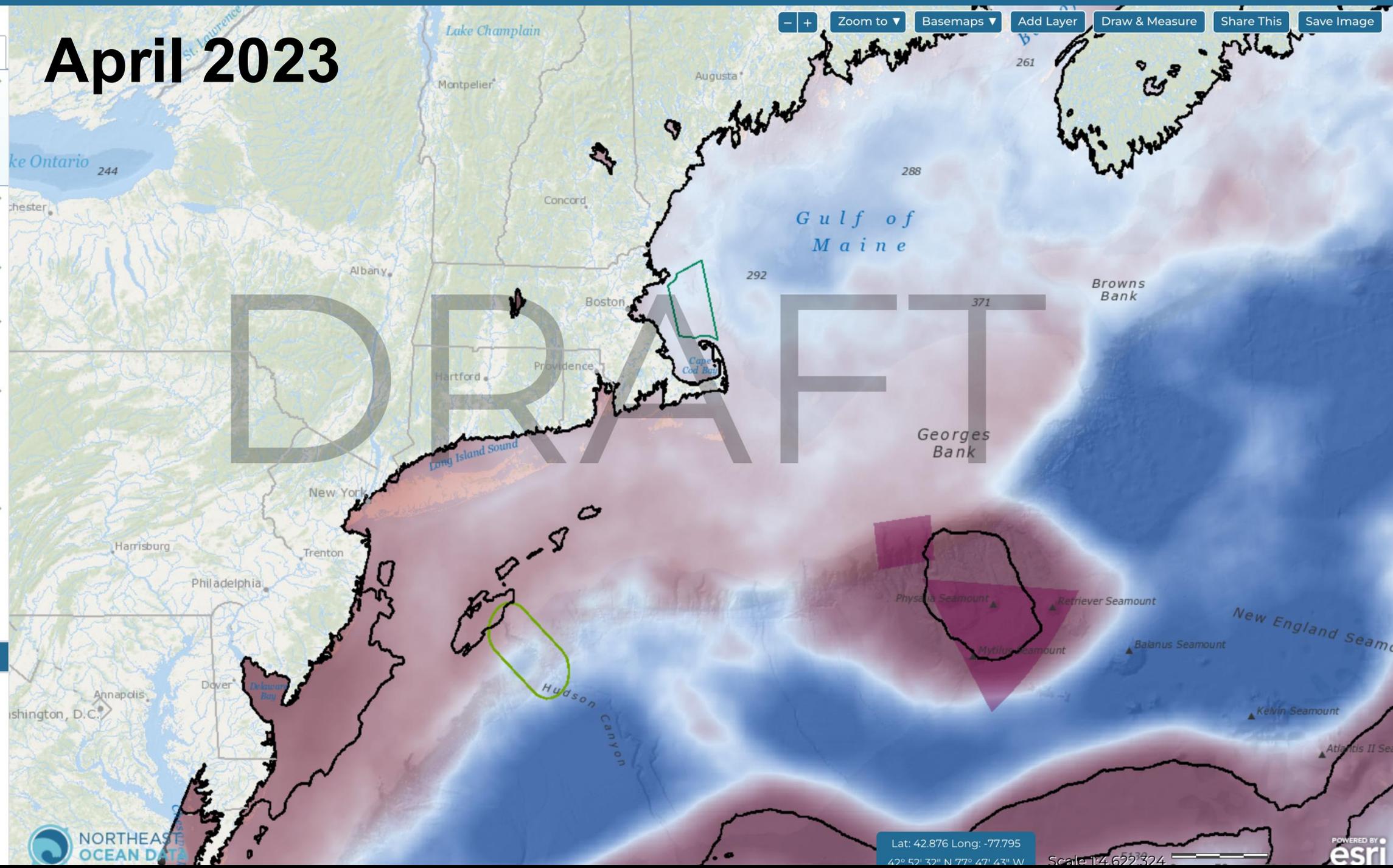
Legend

Northeast Canyons and Seamounts Marine National Monument

Sea Surface Temperature Anomaly - April 2023

High: >2
Low: <-2

April 2023



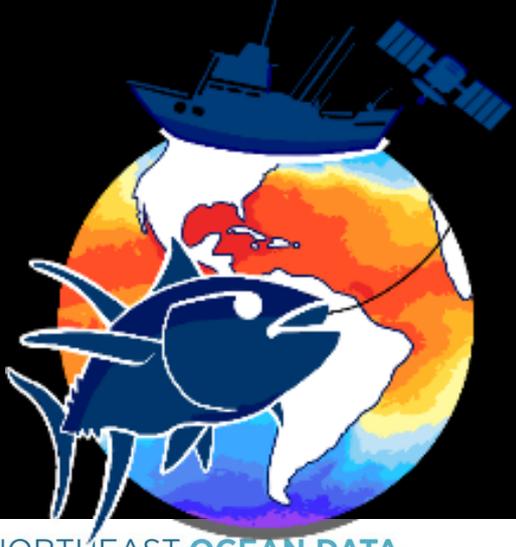
NORTHEAST OCEAN DATA

Lat: 42.876 Long: -77.795

42° 52' 32" N 77° 47' 43" W

Scale: 1:4,622,324

POWERED BY esri



Stakeholder-driven marine heatwave products: advancing science and env literacy

NORTHEAST OCEAN DATA

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Turn all Layers Off

All Layers Active Layers (6)

Spatial Intensity of Marine Heat Waves 2023

Showing June Data

Hudson Canyon Proposed National Marine Sanctuary Reference Area

Stellwagen Bank National Marine Sanctuary

Northeast Canyons and Seamounts Marine National Monument

Sea Surface Temperature Anomaly 2023

Showing June Data

Spatial Intensity of Marine Heat Waves 2024

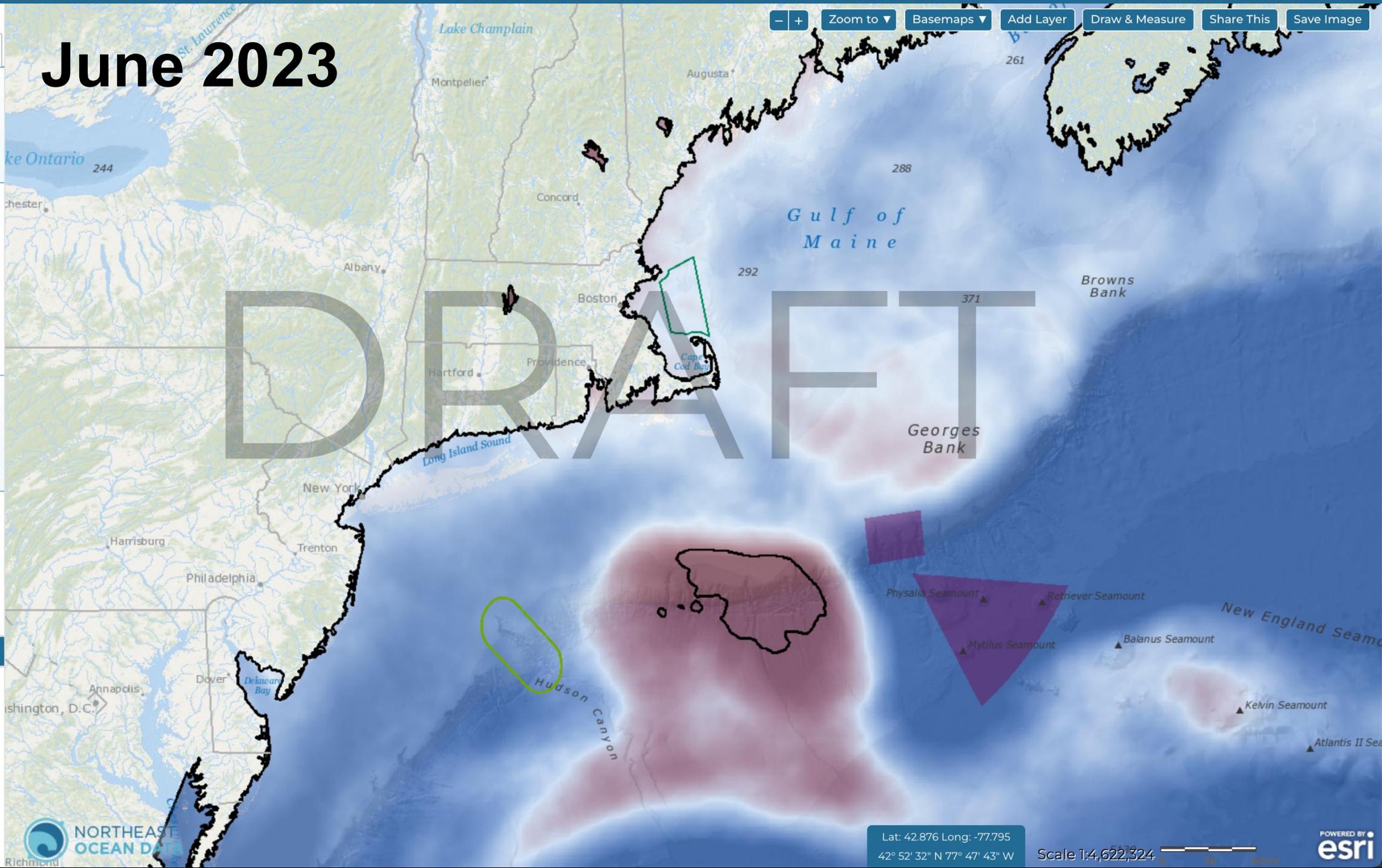
Legend

Northeast Canyons and Seamounts Marine National Monument

Sea Surface Temperature Anomaly - June 2023

High : >2
Low : <-2

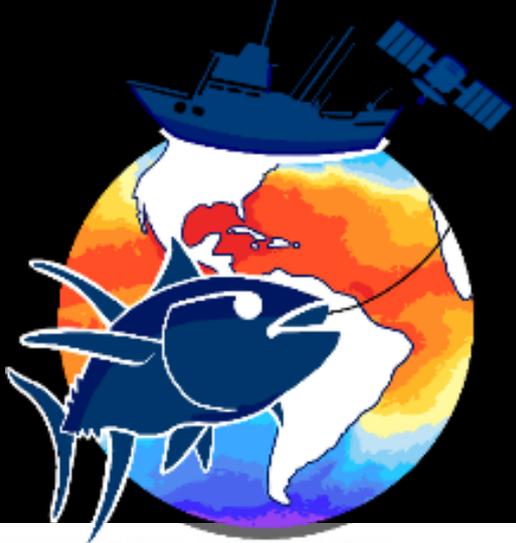
June 2023



Lat: 42.876 Long: -77.795
42° 52' 32" N 77° 47' 43" W

Scale 1:4,622,324

POWERED BY esri



Stakeholder-driven marine heatwave products: advancing science and env literacy

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DATA EXPLORER

Turn all Layers Off

All Layers Active Layers (6)

Spatial Intensity of Marine Heat Waves 2023

Showing July Data

Hudson Canyon Proposed National Marine Sanctuary Reference Area

Stellwagen Bank National Marine Sanctuary

Northeast Canyons and Seamounts Marine National Monument

Sea Surface Temperature Anomaly 2023

Showing July Data

Spatial Intensity of Marine Heat Waves 2024

Legend

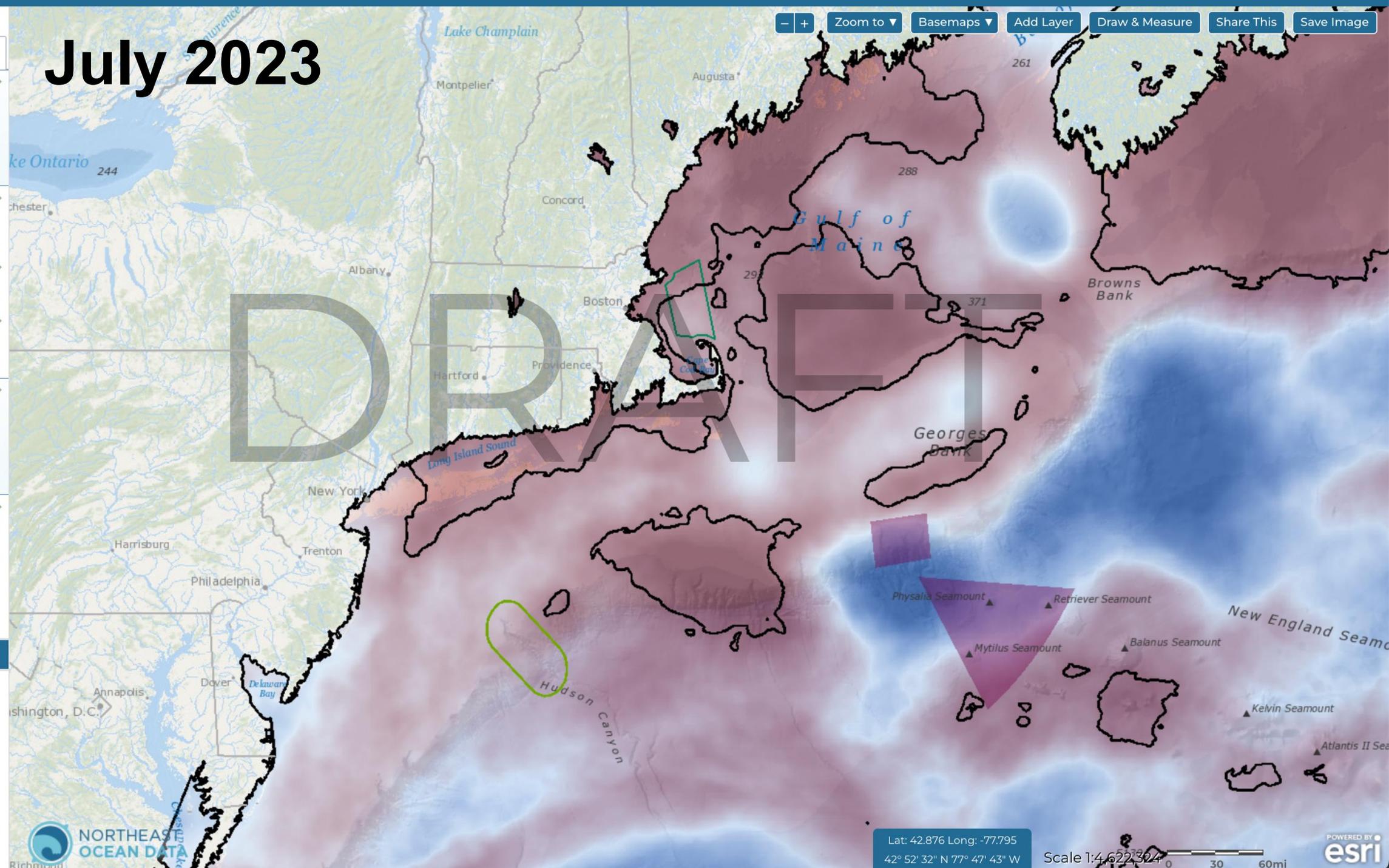
Northeast Canyons and Seamounts Marine National Monument

Sea Surface Temperature Anomaly - July 2023

High : >2

Low : <-2

July 2023

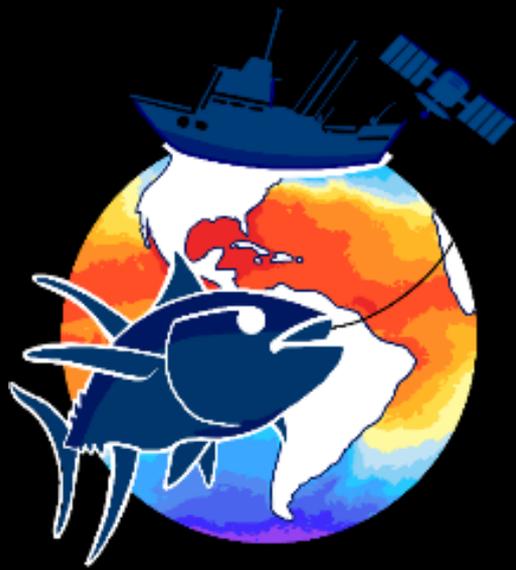


Lat: 42.876 Long: -77.795

42° 52' 32" N 77° 47' 43" W

Scale 1:4,622,304 0 30 60mi

POWERED BY esri



Products in each project focus area

marine heatwaves & their impacts

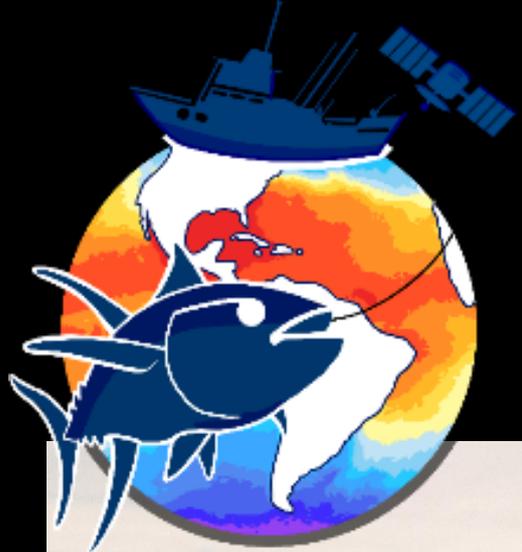
habitat change

species phenology / timing

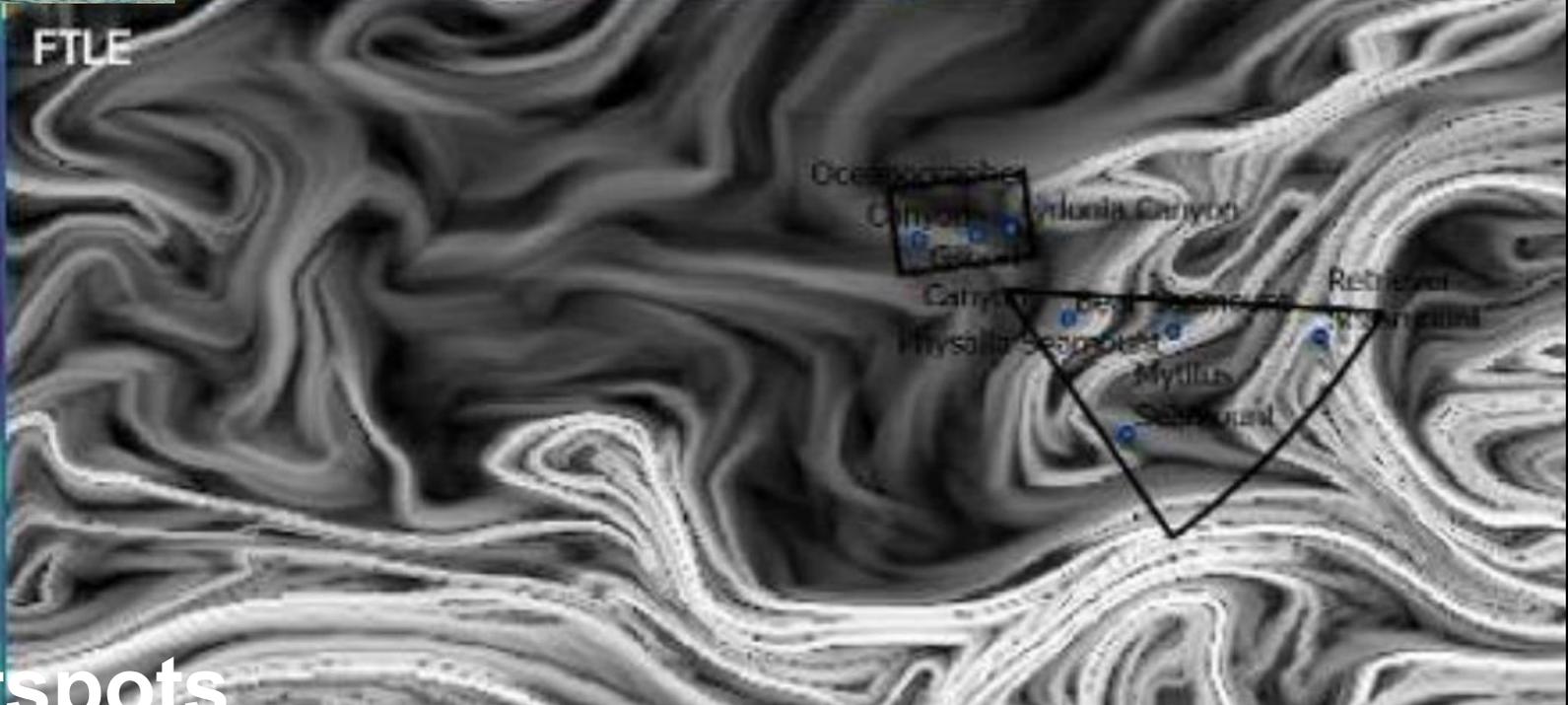
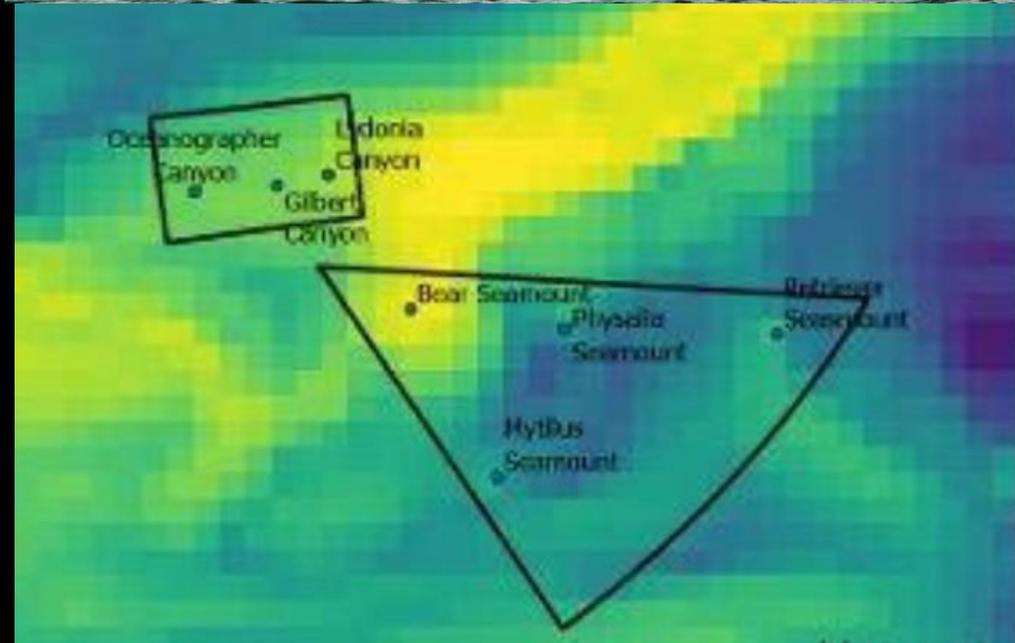
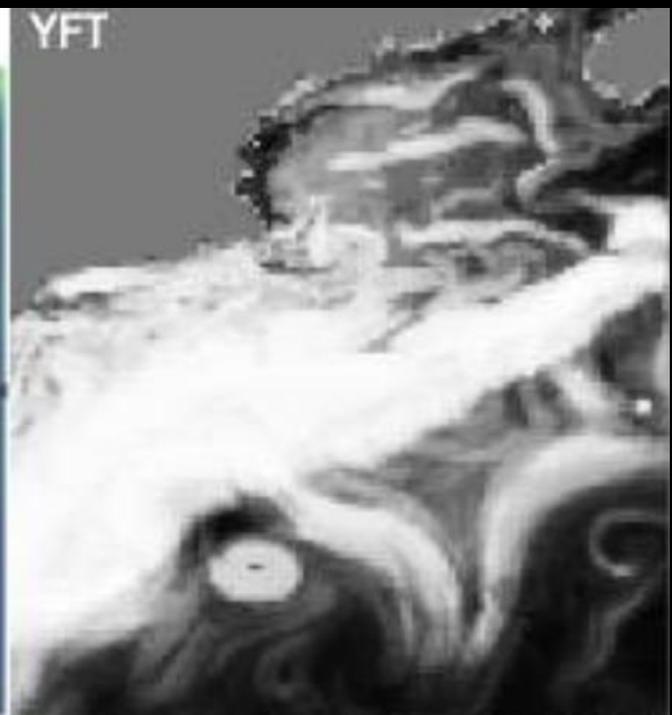
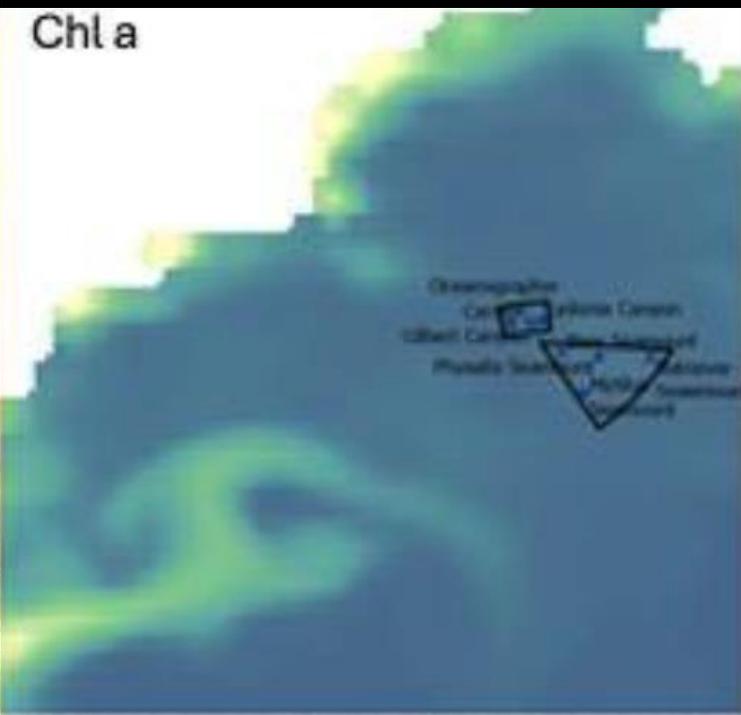
refugial capacity of protected areas

biodiversity monitoring / cruise support

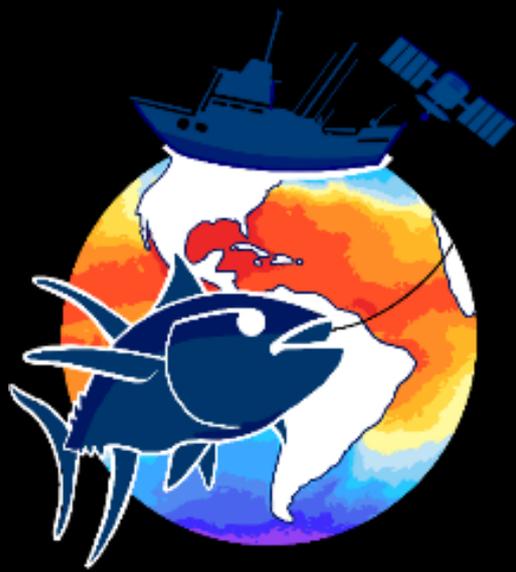
Facilitate marine spatial planning through co-development



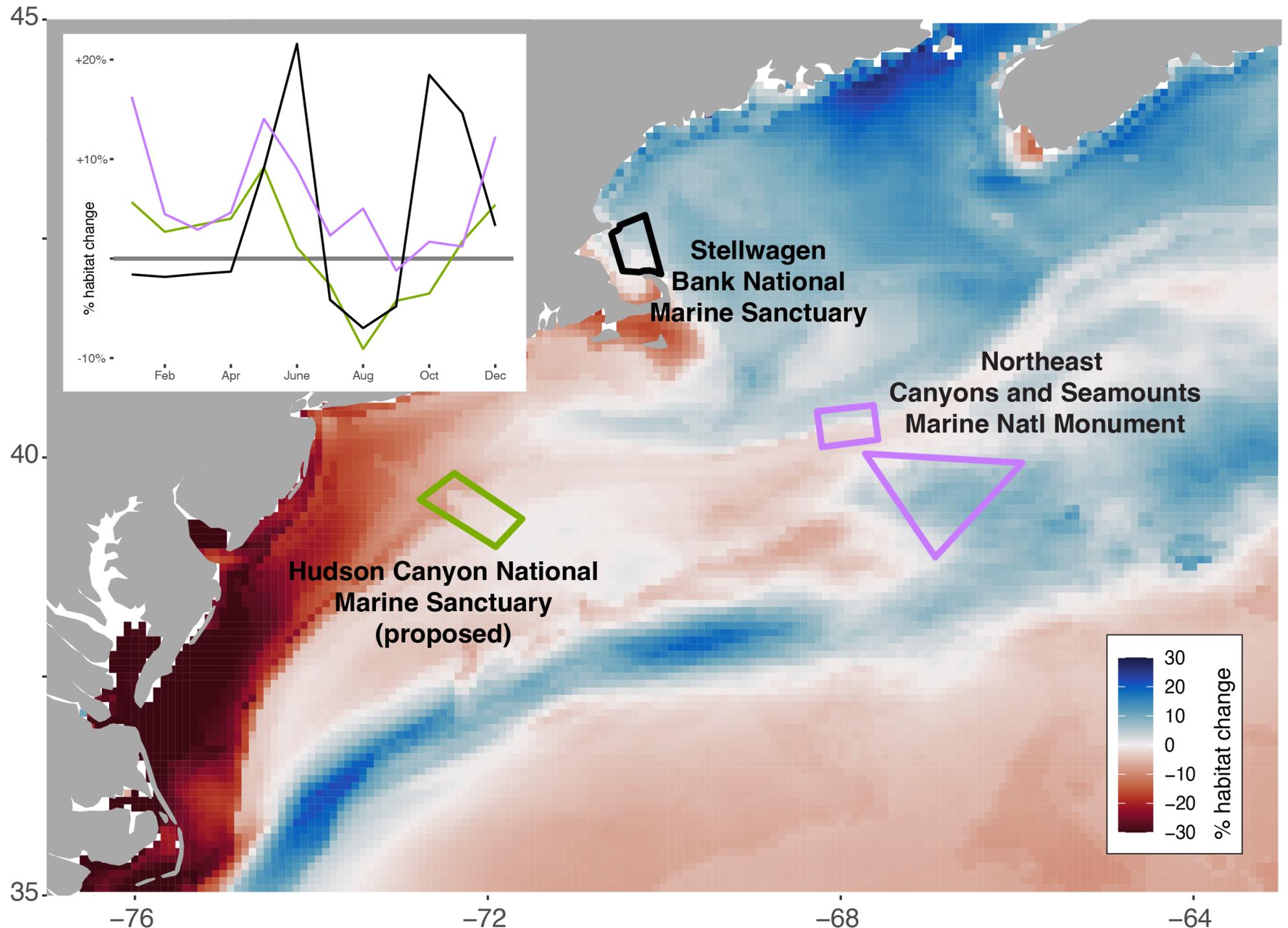
Real-time products support monitoring cruise planning and operational awareness

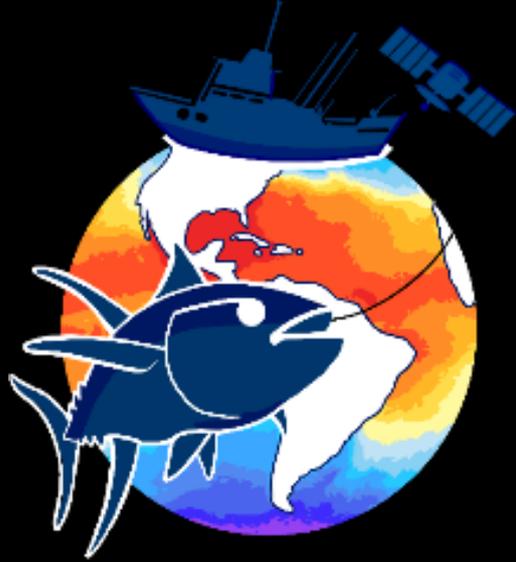


predicted multi-species hotspots



Species-climate products support protected area designation process





Outreach across academia, industry, and the public

stakeholder engagement

science pubs

Comment

<https://doi.org/10.1038/s41558-025-02257-6>

Marine heatwaves are in the eye of the beholder

Nima Farchadi, Laura H. McDonnell, Svenja Ryan, Rebecca L. Lewison & Camrin D. Braun

Check for updates

Critical method heatwave detection different result methods that a to advance marine socio-ecologic

SCIENCE ADVANCES | RESEARCH ARTICLE

ECOLOGY

Widespread habitat loss and redistribution of marine top predators in a changing ocean

Camrin D. Braun^{1*}, Nerea Lezama-Ochoa^{2,3}, Nima Farchadi⁴, Martin C. Arosteaui¹, P. Crear⁷,

Received: 15 August 2023 | Revised: 18 March 2024 | Accepted: 19 March 2024

DOI: 10.1111/faf.12828

FISH and FISHERIES WILEY

ORIGINAL ARTICLE

Marine heatwaves redistribute pelagic fishing fleets

Nima Farchadi^{1,2} | RESEARCH ARTICLE

Steven J. Bograd^{3,4}

Nerea Lezama-Ochoa⁵

Rebecca L. Lewison⁶

Divergent responses of highly migratory species to climate change in the California Current

Received: 1 February 2023 | Accepted: 22 May 2023

DOI: 10.1002/eap.2893

ECOLOGICAL APPLICATIONS ECOLOGICAL SOCIETY OF AMERICA

Iegan Cimino^{1,2} |

Forney^{6,7} |

0 |

Building use-inspired species distribution models: Using multiple data types to examine and improve model performance

Camrin D. Braun¹ | Martin C. Arosteaui¹ | Nima Farchadi² |

Michael Alexander³ | Pedro Afonso^{1,4} | Andrew Allyn⁵ | Steven J. Bograd⁶ |

ARCNEWS

As Oceans Change, Dynamic Data and Technology Pave the Way Forward

Scientific Currents
Spring 2025

Dr. Camrin Braun
Dr. Rebecca Lewison

It is no secret that the world's oceans are undergoing sweeping changes. The signs are apparent in shifting ocean currents, changing distributions of marine

NORTHEAST OCEAN DATA
Maps and Data for Ocean Planning in the Northeastern United States

HOME WHAT'S NEW? CURRENT ISSUES THEME MAPS DATA EXPLORER DOWN

Past and Future Habitat Suitability of Highly Migratory Species

January 8, 2025

Bigeye Tuna Habitat Suitability
Northeast Ocean Data Portal

Launch
Define and view any custom combination of data on one map

FOLLOW US

Join our mailing list

New marine life models show the predicted habitat suitability between 1990-2090 for six species of sharks and large fishes. The model outputs can be found in a new subcategory in the Data Explorer under "Fish" called "Highly Migratory Species Habitat Suitability - Past and Future". The data are derived from the Fisheries and Climate Toolkit. The new layers include:

- Bigeye tuna
- Bluefin tuna
- Blue shark

Questions?



Camrin Braun

cbraun@whoi.edu

Rebecca Lewison

rlewison@sdsu.edu



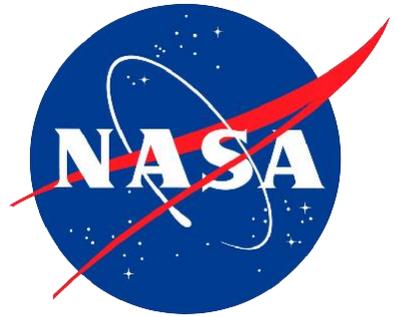
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INSTITUTION



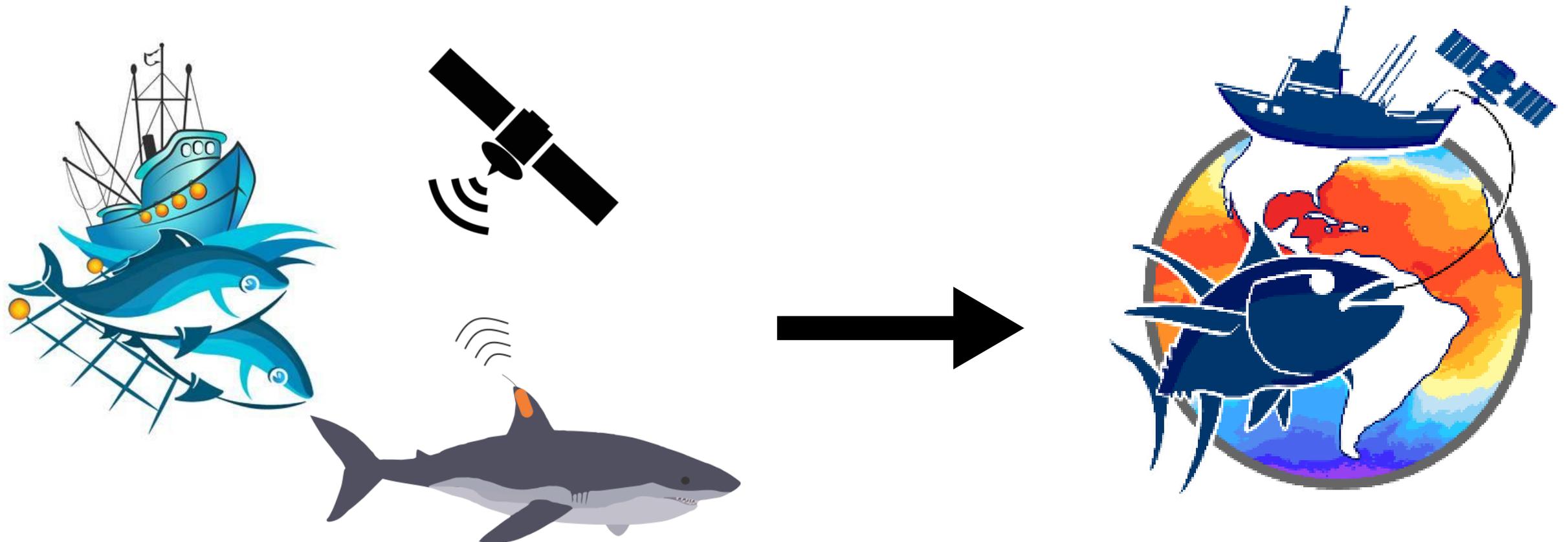
SAN DIEGO STATE
UNIVERSITY

<https://fisheriesclimatetoolkit.sdsu.edu/>

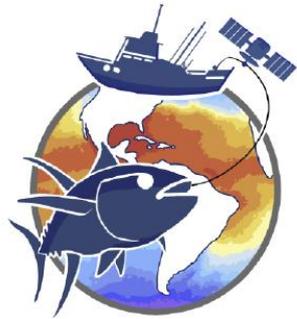
Goals and scope



- **Forecast species and vessel dynamics**
- **Track magnitude / velocity of change**
- **Harness big data and computing pipelines**
- **Communicate fishery-relevant climate change uncertainty**



Stakeholder engagement and communication



Category	People
Business / Industry	4
Government	22
Non-Profit	9
Research / Academia	23
RFMO	4



**Accessible,
online
products**

**Relevant
timely
data viz**

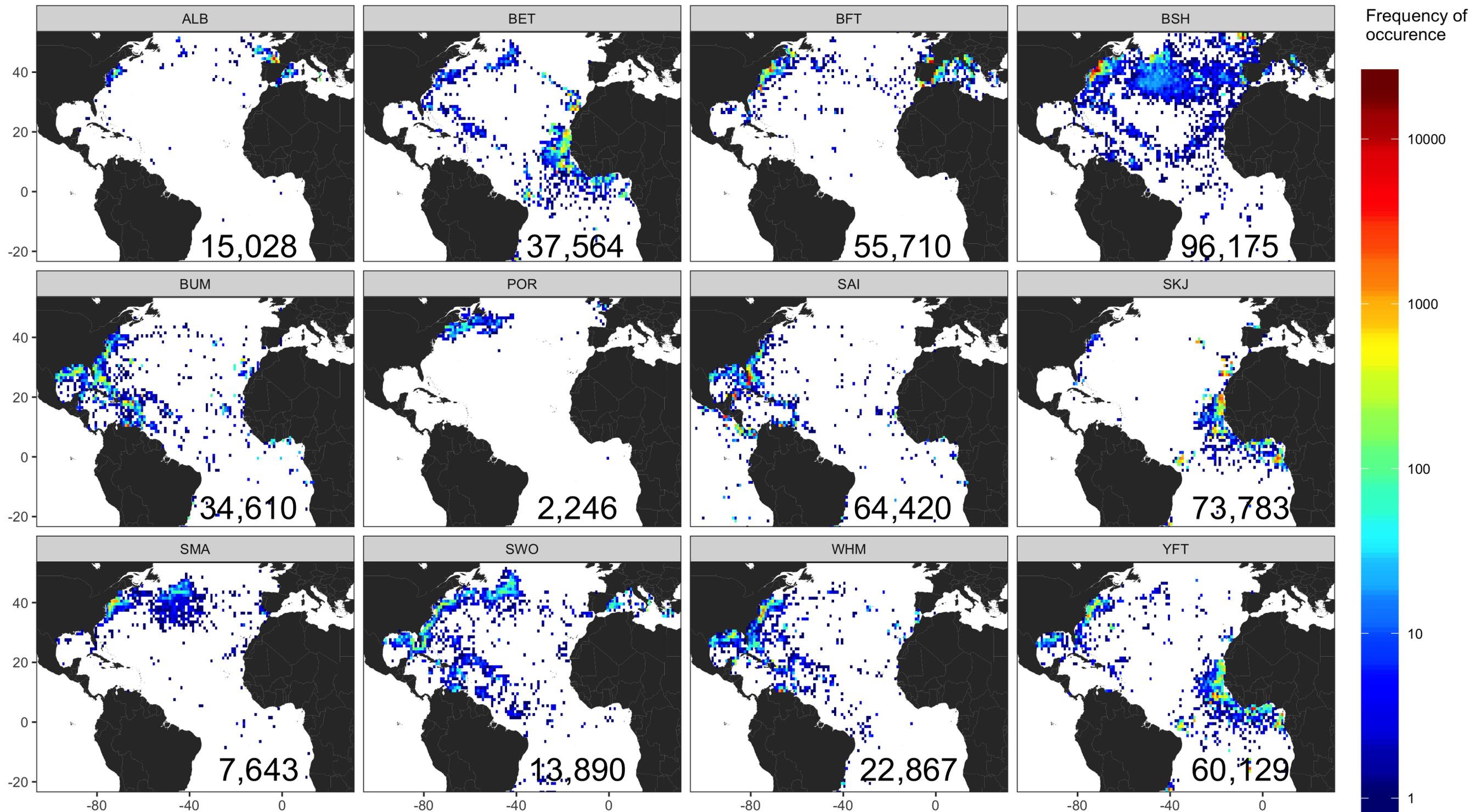
**Build and
expand
capacity**



Fishery independent data, incl satellite tracking



Fisheries provide unique “big data” opportunity



NW Atlantic (N = 194,756) | Total ICCAT (N = 484,065)

Environmental data (remote sensing, model, etc)

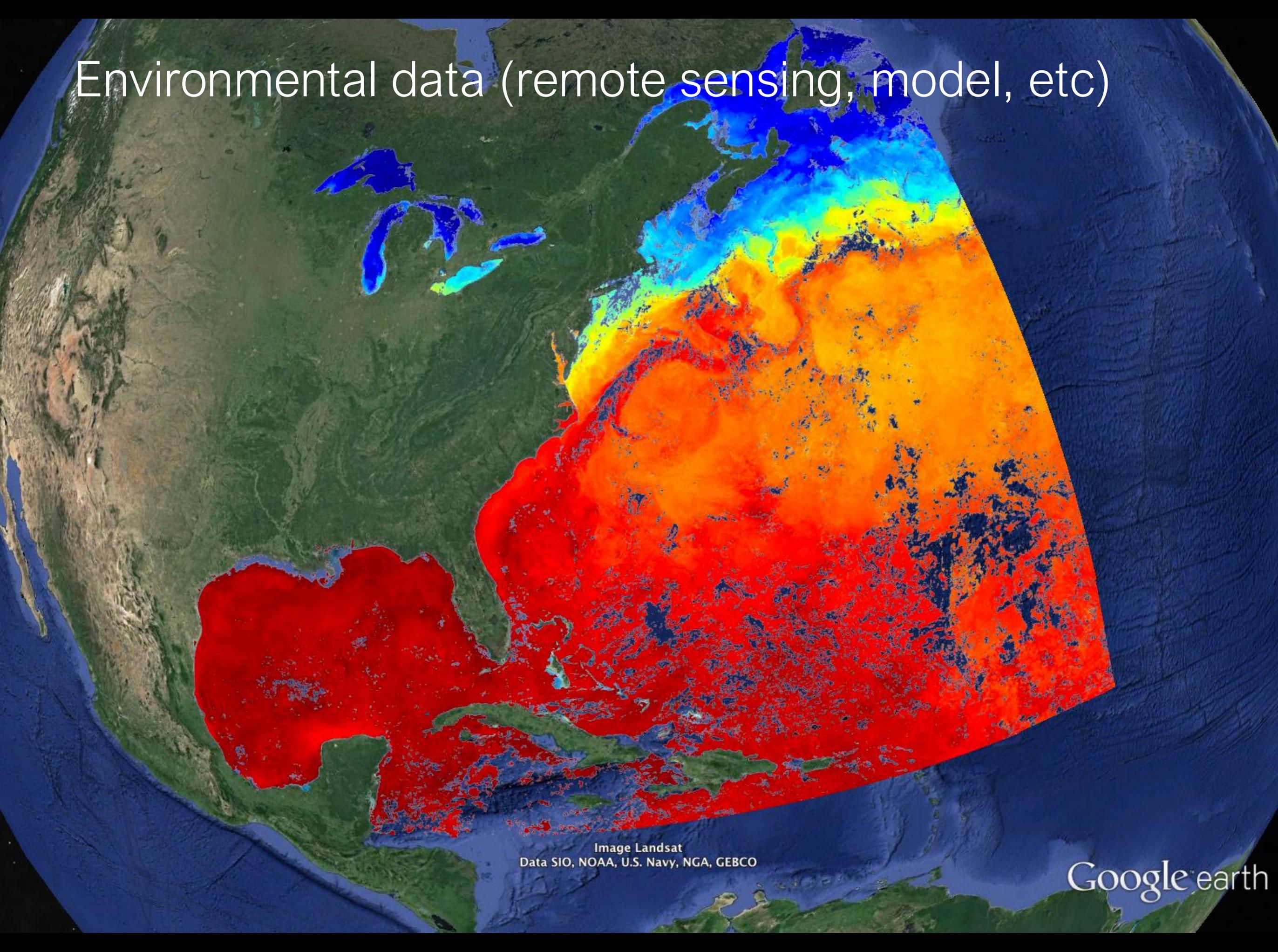


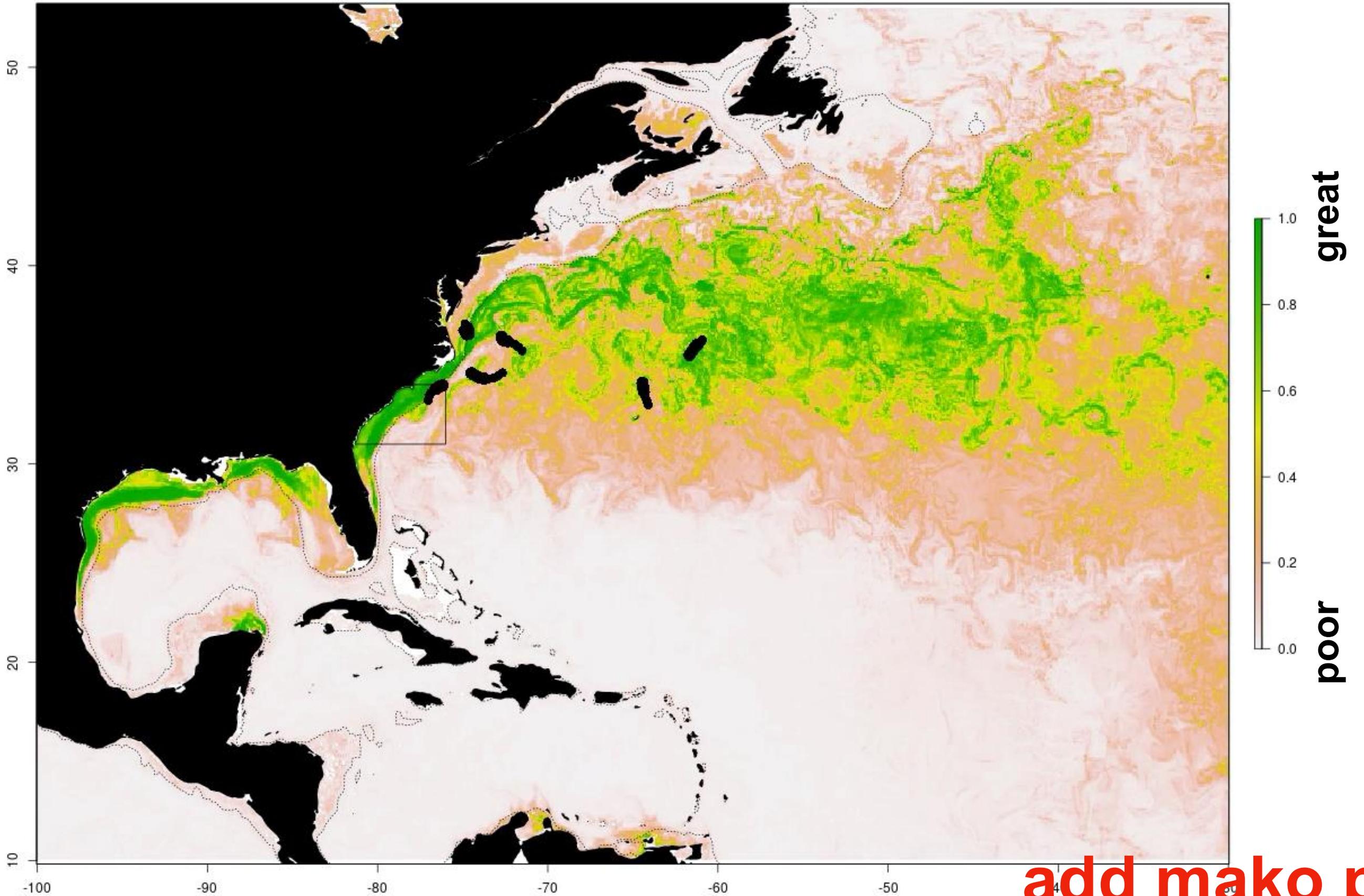
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth

Predict suitable habitat

2015-04-25 | N tags = 7

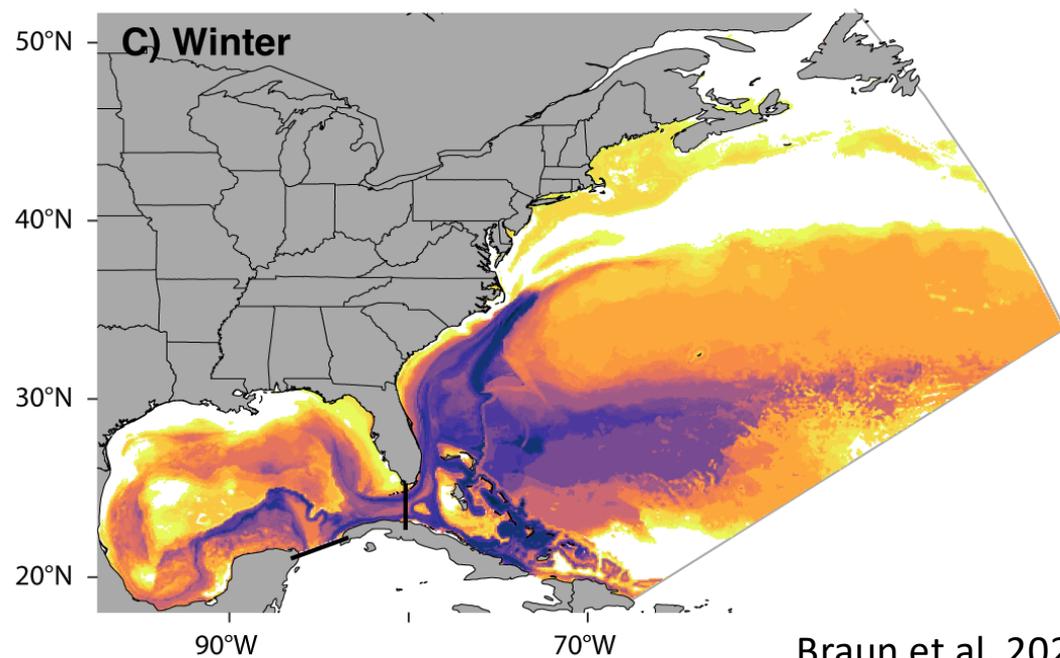
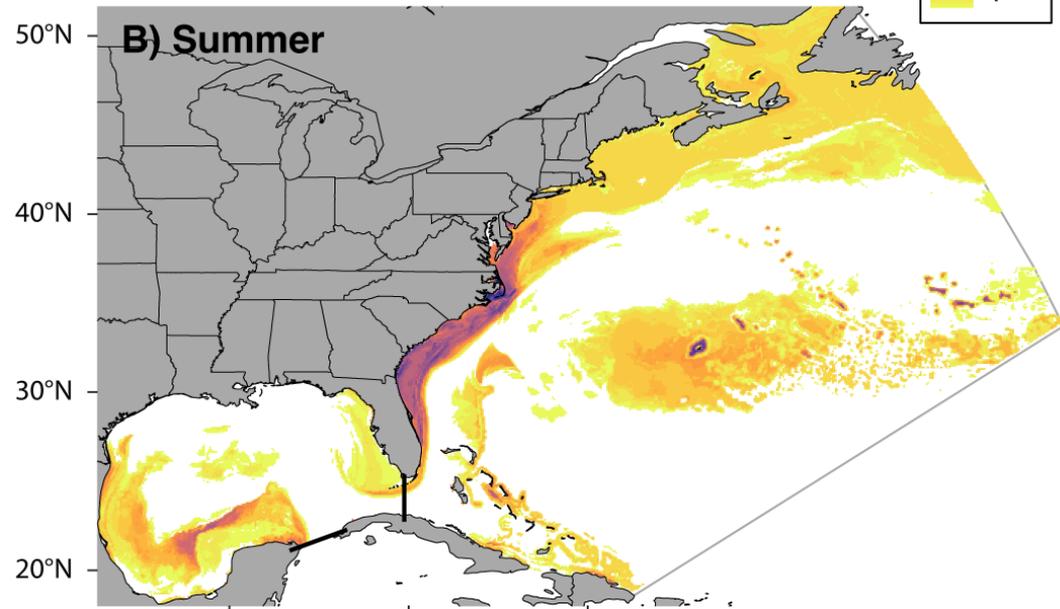
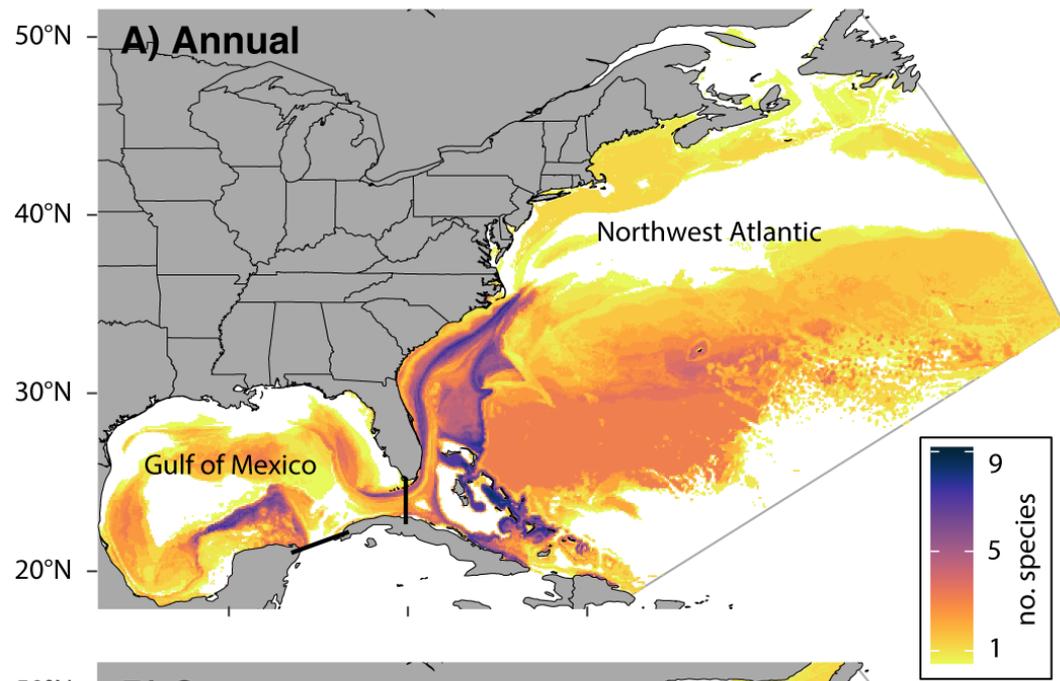
● shark tracking!



add mako ph

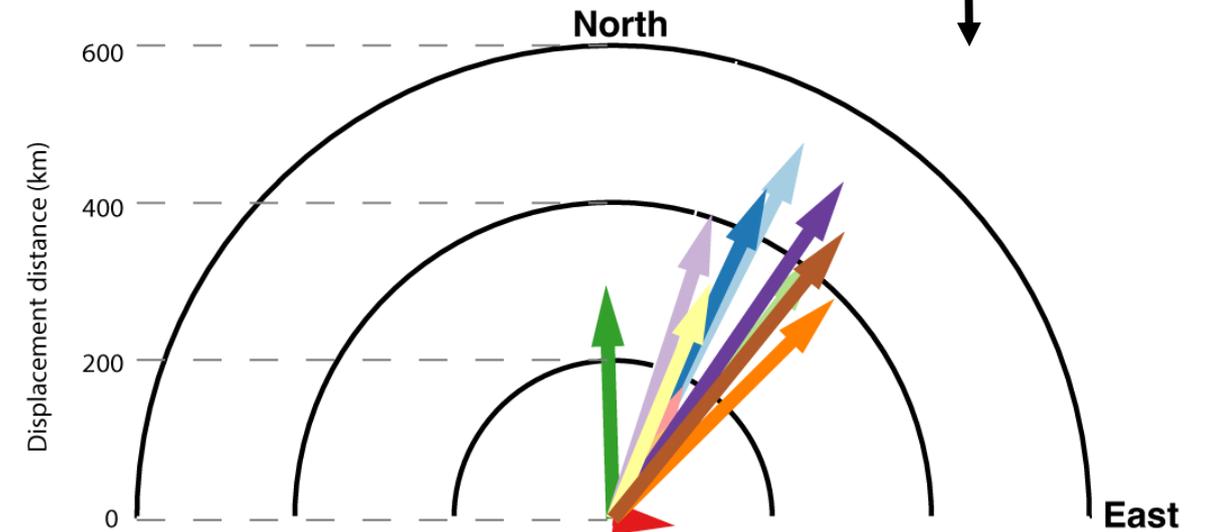
Species will lose habitat...

and re-distribute poleward (north)

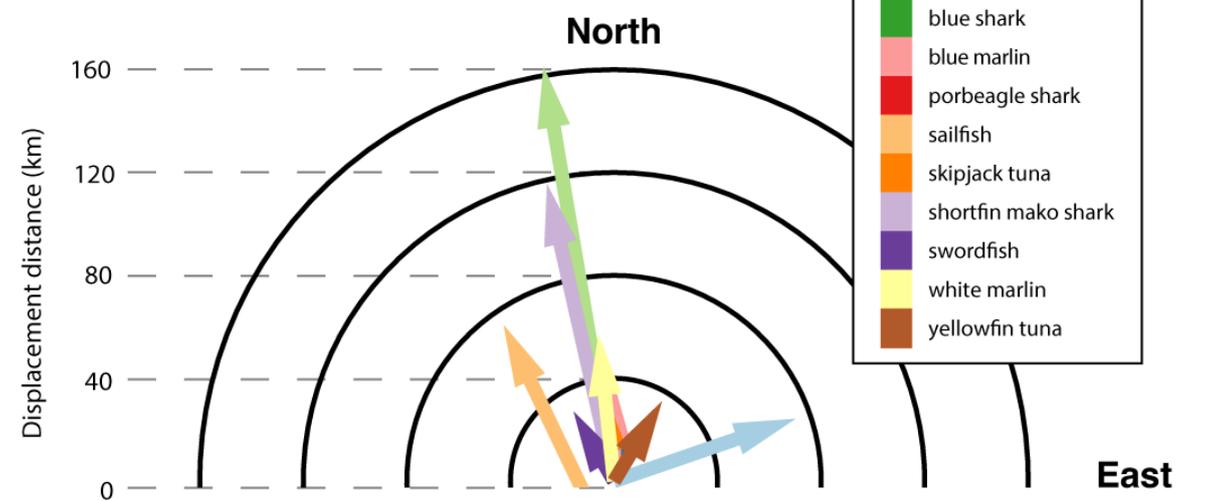


Braun et al. 2023, Sci. Adv.

A) Northwest Atlantic

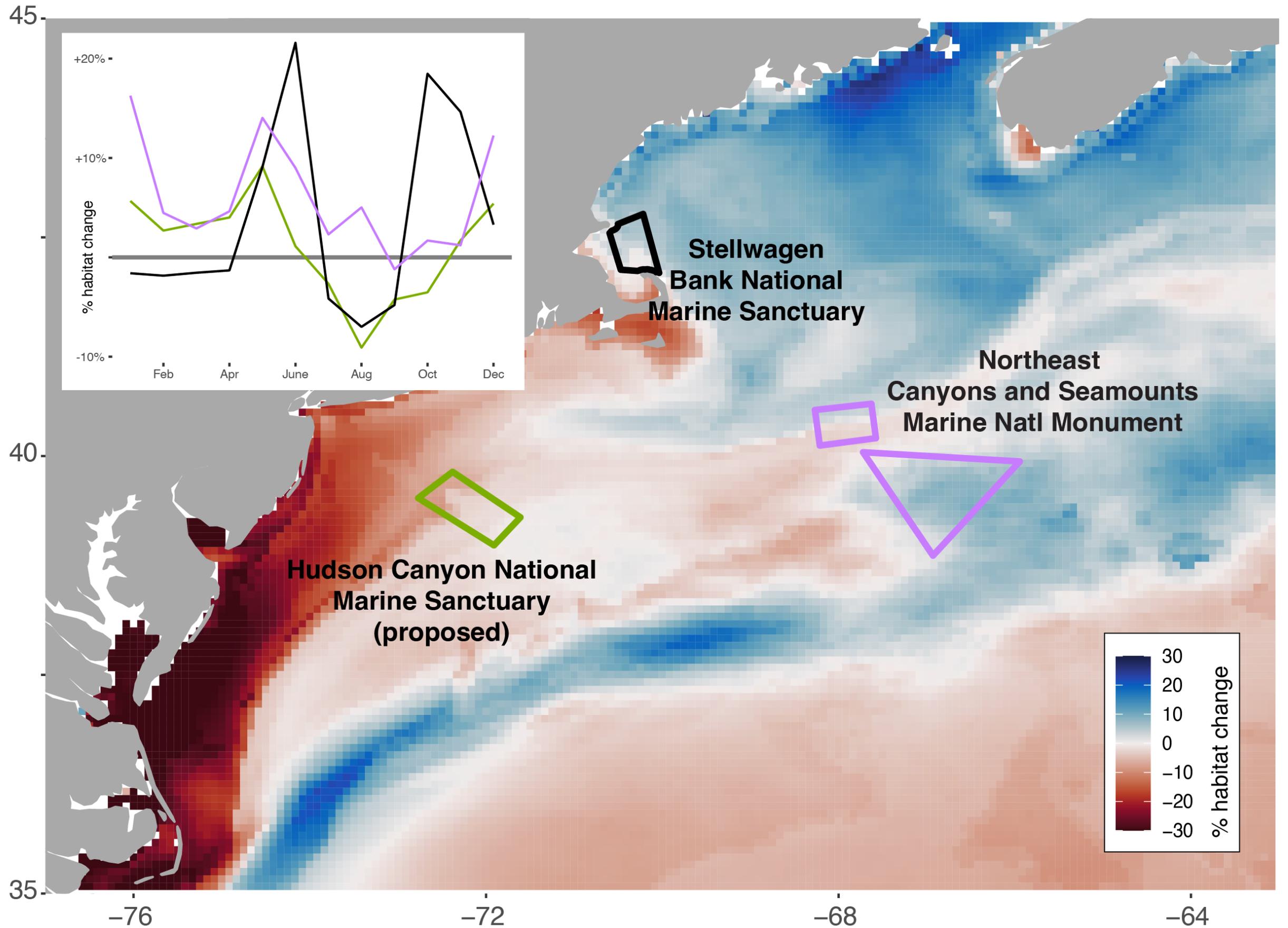


B) Gulf of Mexico



- species
- albacore tuna
 - bigeye tuna
 - bluefin tuna
 - blue shark
 - blue marlin
 - porbeagle shark
 - sailfish
 - skipjack tuna
 - shortfin mako shark
 - swordfish
 - white marlin
 - yellowfin tuna

Building “indicators” for marine spatial planning



Making products available to stakeholders

NORTHEAST OCEAN DATA

DATA EXPLORER

[Turn all Layers Off](#) < >

All Layers | **Active Layers (3)**

Keyword Search

- > Marine Transportation
- > National Security
- > Energy & Infrastructure
- > Recreation
- > Culture
- > Commercial Fishing
- > Aquaculture
- > Fish
- ▼ Marine Mammals & Sea Turtles
 - [View Individual Species](#)
 - ▼ Modeled distribution (MDAT)
 - > All Cetaceans
 - > Ecological Groups

MARINE MAMMALS

SPECIES/GUILD: Sperm whale

TIME PERIOD: Sperm whale, August

DATA TYPE (modeled)

- Average Density
- 95% Confidence Interval
- 5% Confidence Interval
- Standard Error
- Coefficient of Variation

[Layer Information](#)

Add to Layer List

NORTHEAST OCEAN DATA

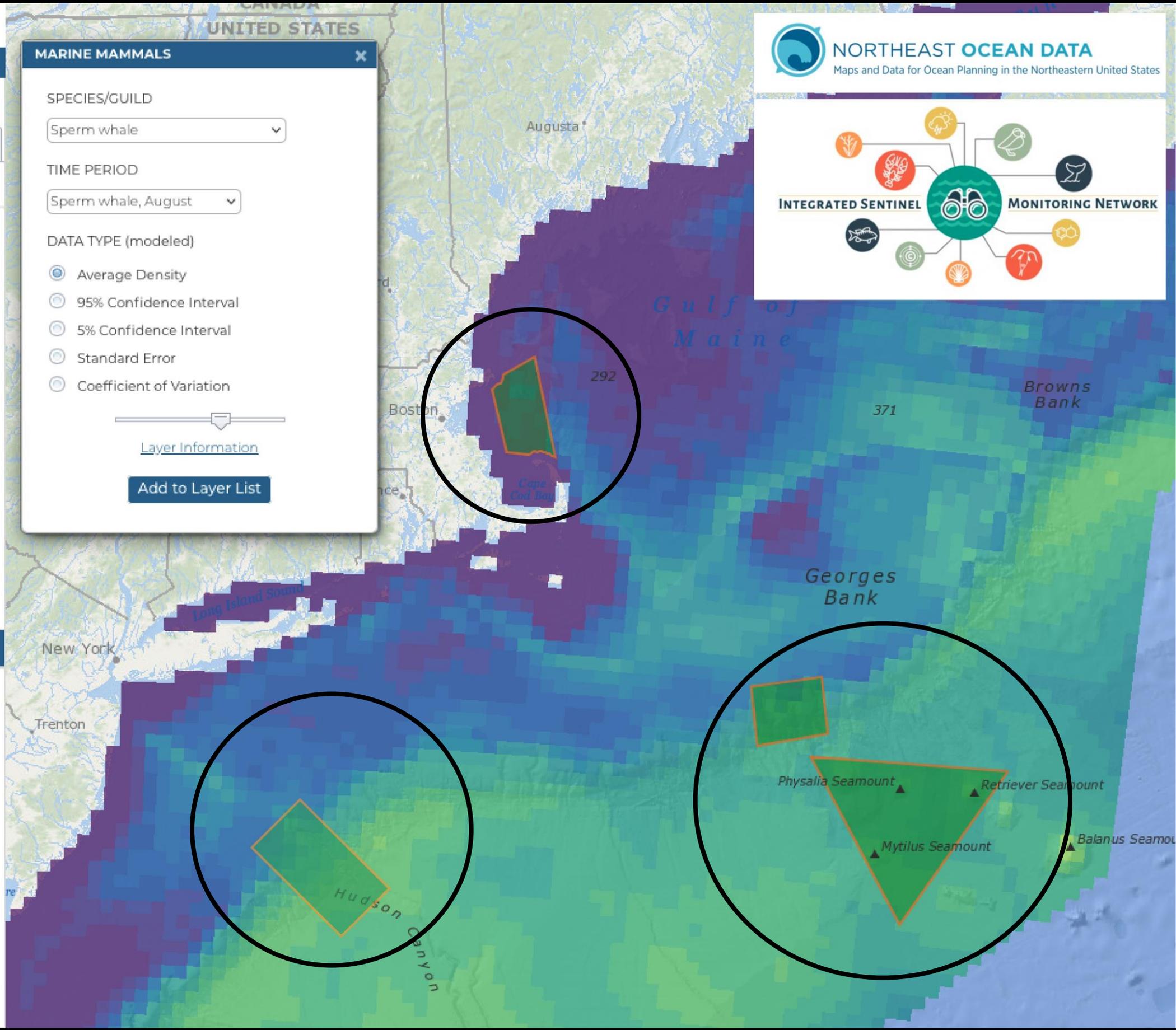
Maps and Data for Ocean Planning in the Northeastern United States

INTEGRATED SENTINEL MONITORING NETWORK

Legend >

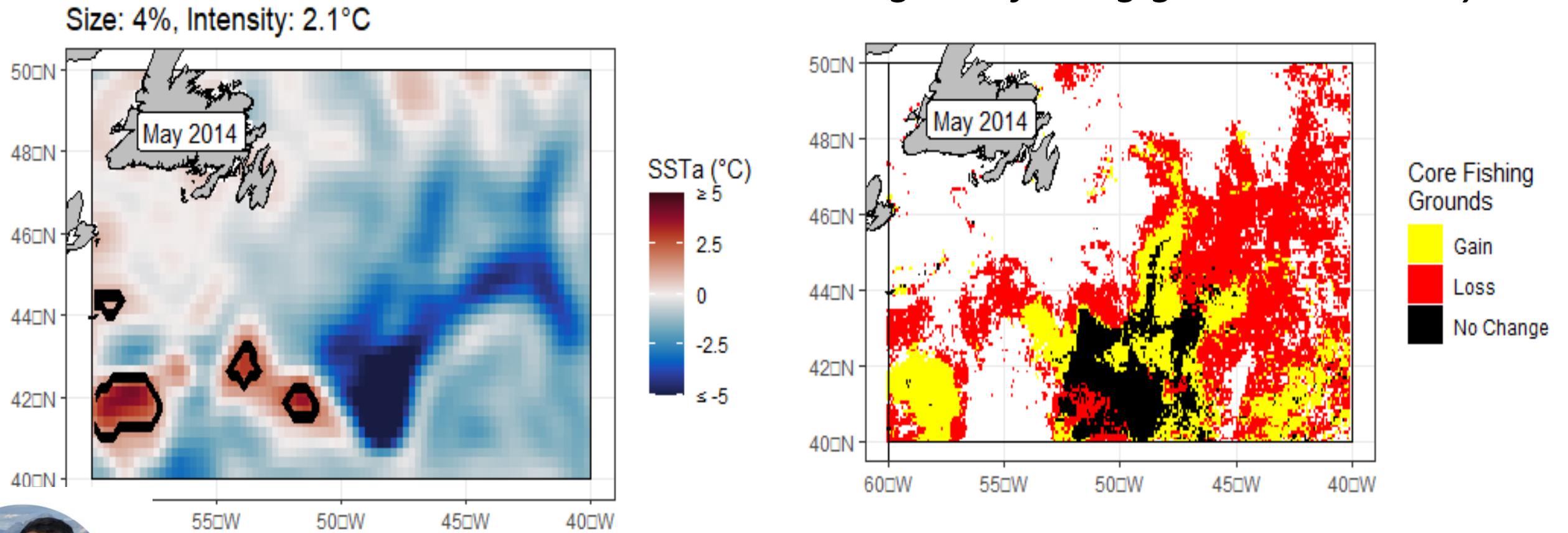
Sperm whale, August

> 10
6.8 - 10
4.6 - 6.8
3.2 - 4.6
2.2 - 3.2
1.5 - 2.2
1.0 - 1.5
0.68 - 1.0
0.46 - 0.68
0.32 - 0.46
0.22 - 0.32
0.15 - 0.22



Impacts of marine heatwaves on fishing fleets

Heatwaves drive changes to fishing ground suitability



Nima Farchadi

Marine heatwave detection and interpretation is a BIG deal!



Nima Farchadi

NCC paper fig

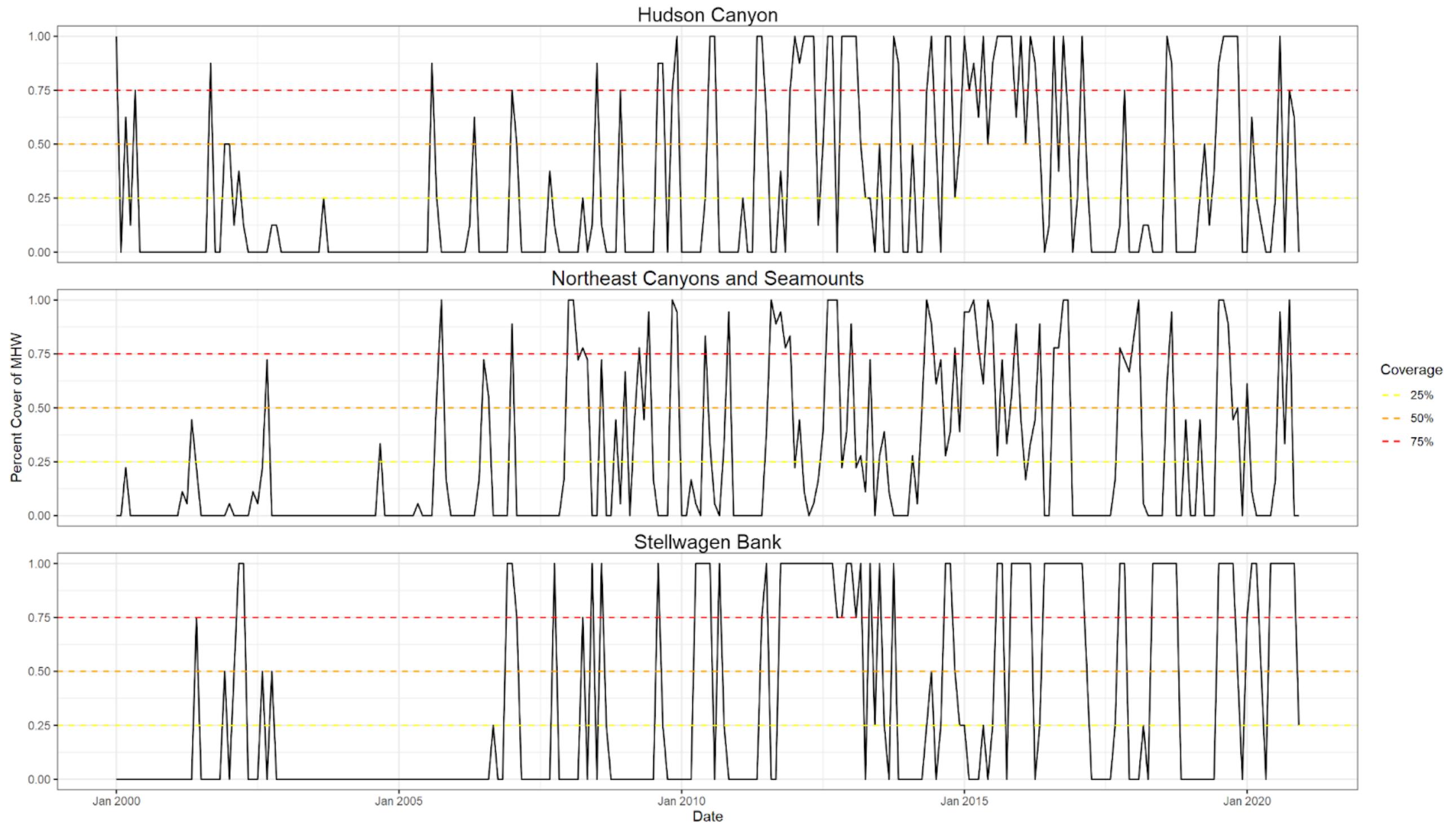
Building “indicators” for marine spatial planning

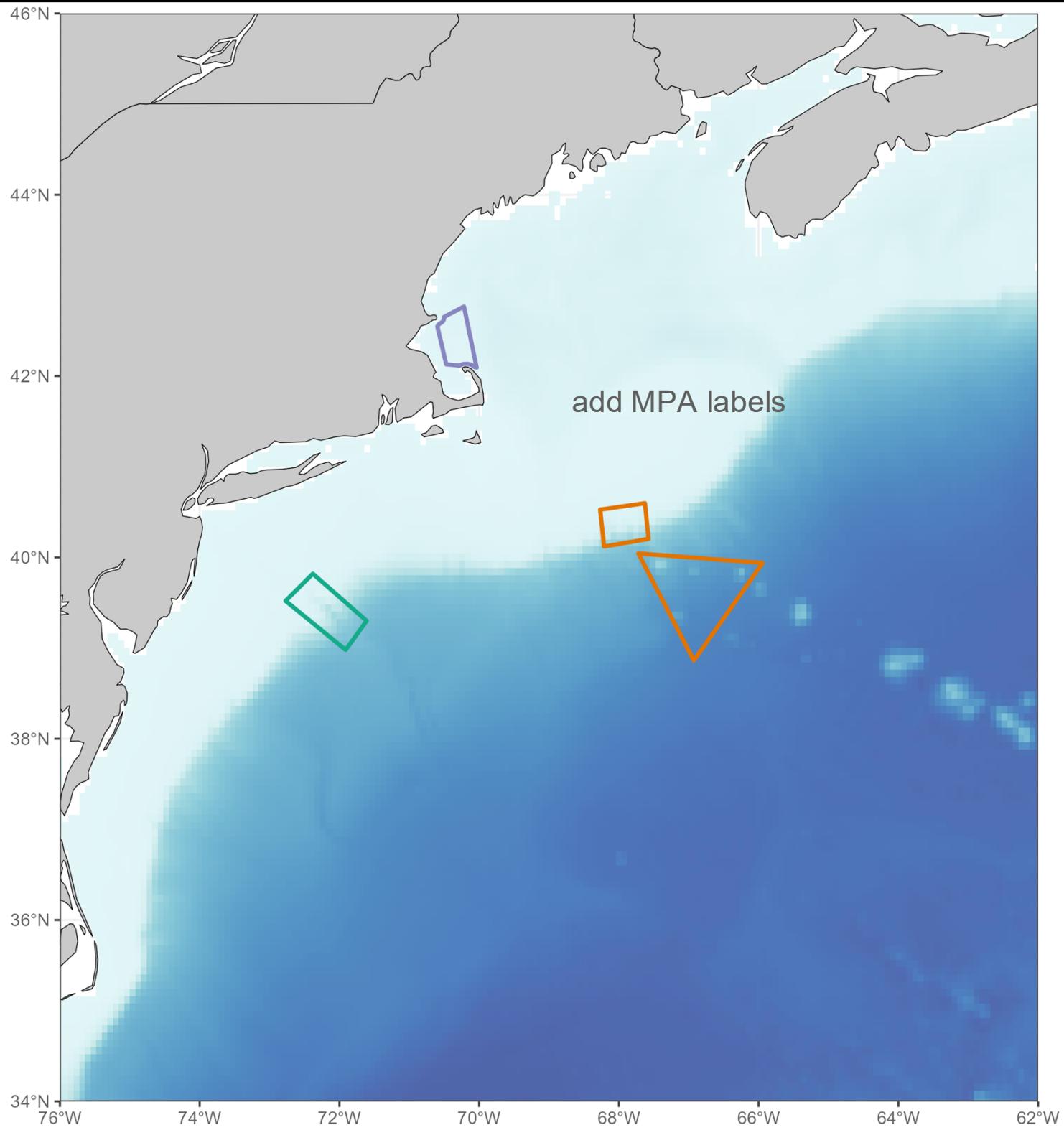
Marine heatwaves - frequency and intensity



Building “indicators” for marine spatial planning

Marine heatwaves - spatial coverage





add ppl to each mpa

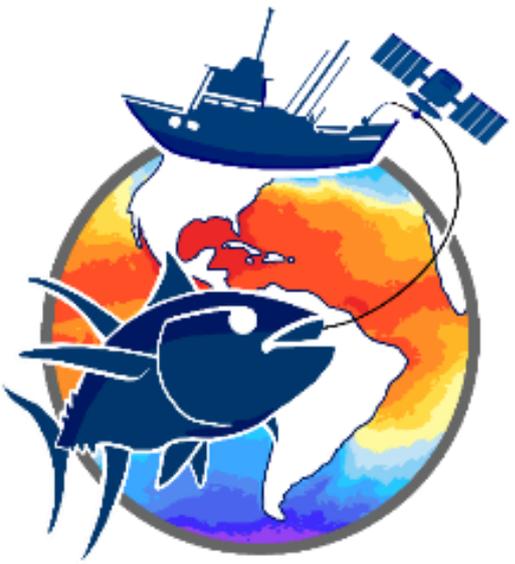
Protected Area

- Hudson Canyon
- Northeast Canyons and Seamounts
- Stellwagen Bank

Depth (m)

- 0
- 2000
- 4000
- 6000
- 8000

Publications & other resources:



Fisheries and Climate Toolkit:

supporting climate-ready, resilient and
sustainable fisheries

Camrin Braun¹, Nima Farchadi², Kathy Mills³, Kiley Young Morse³,
Stephanie Brodie⁴, Heather Welch⁴, Andrew Allyn³,
Elliott Hazen^{4,5}, Rebecca Lewison²

¹University of Washington, ²San Diego State University, ³Gulf of Maine Research Institute,
⁴NOAA SWFSC, Environmental Research Division, ⁵University of California Santa Cruz





Rebecca Lewison



Camrin Braun



Kathy Mills



Elliott Hazen



Stephanie Brodie



Heather Welch



Nima Farchadi



Andrew Allyn



Riley Young-Morse



Alex Kerney



Dylan Pugh

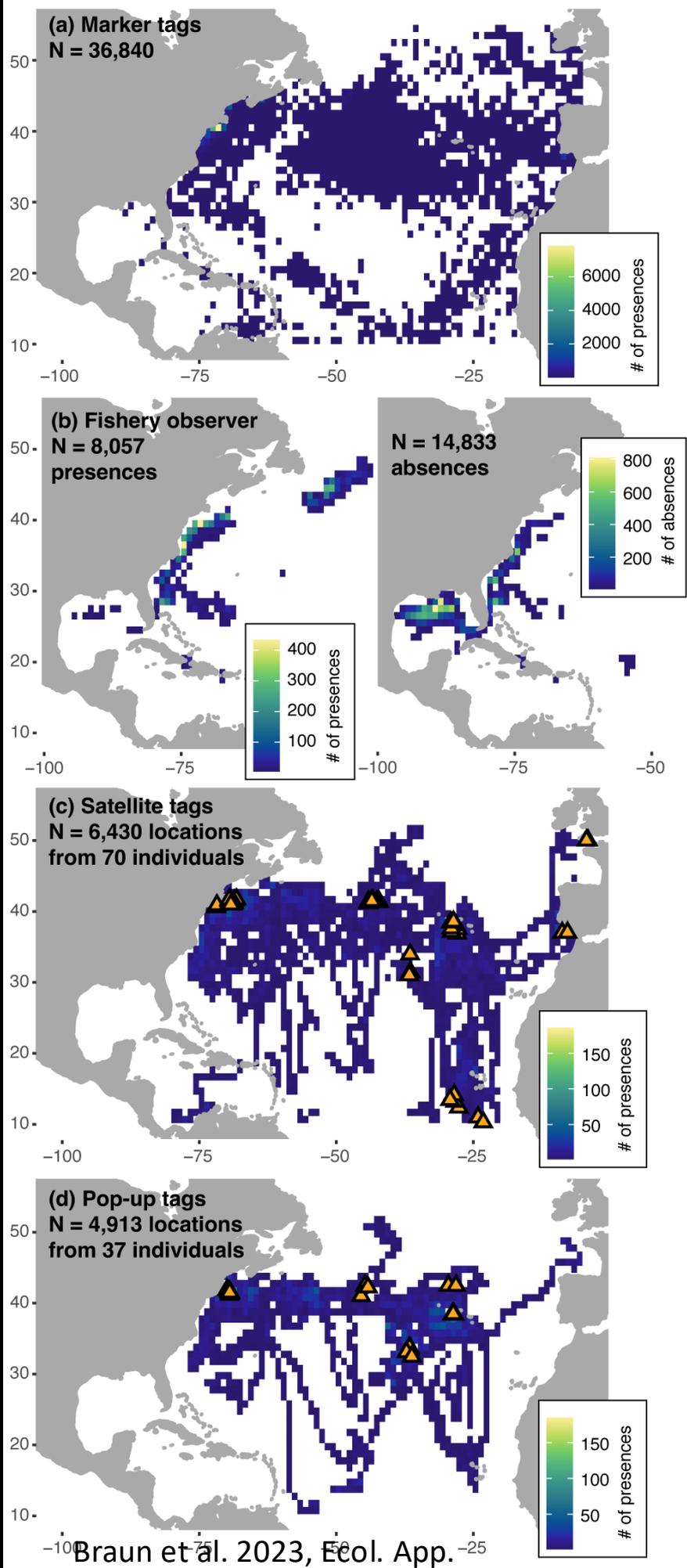


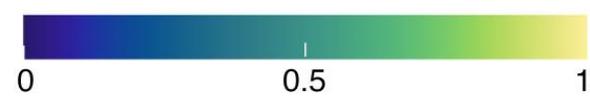
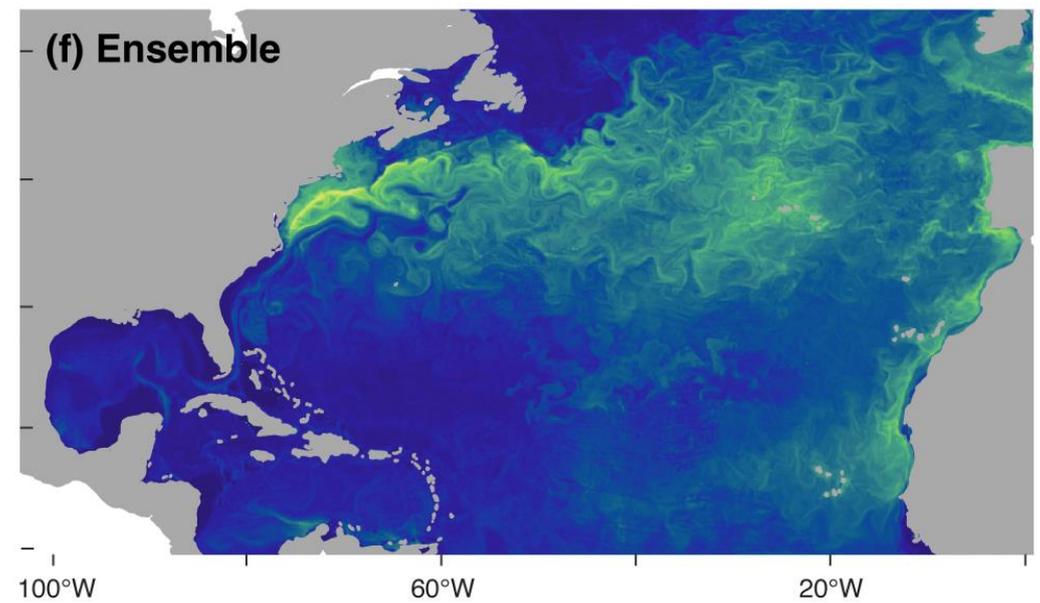
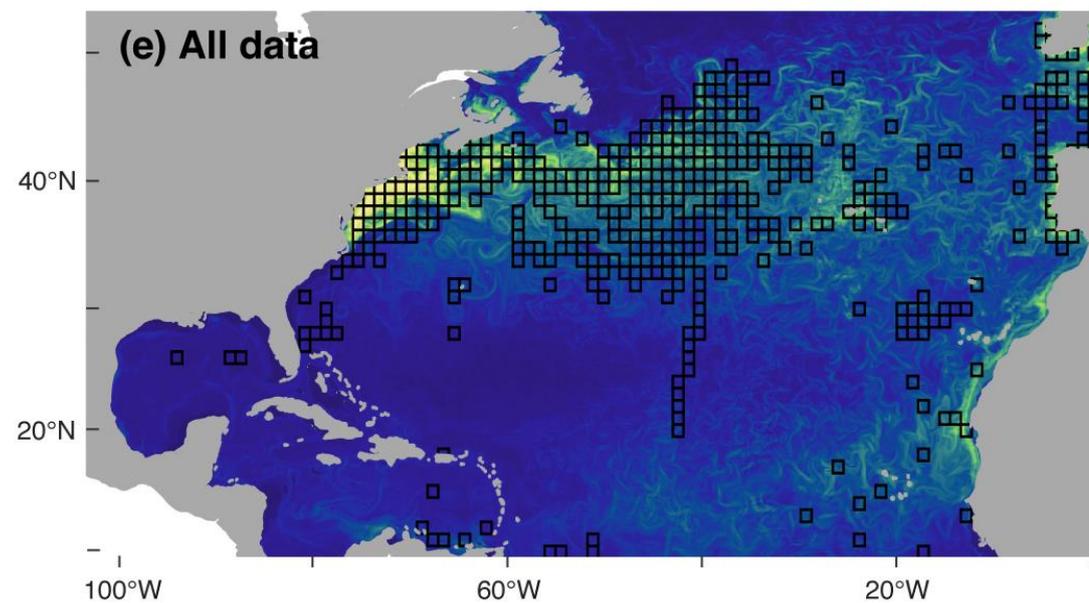
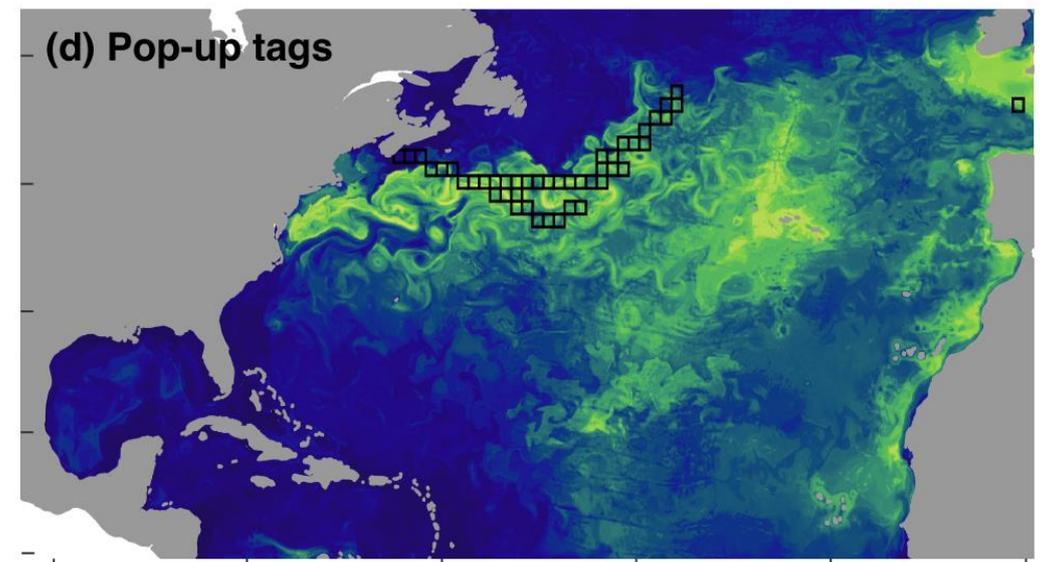
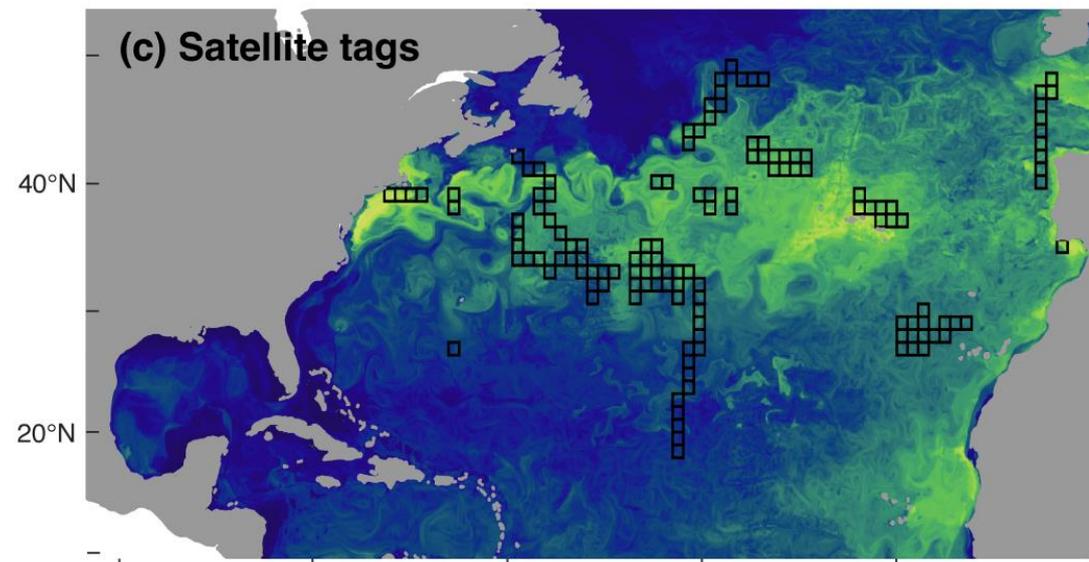
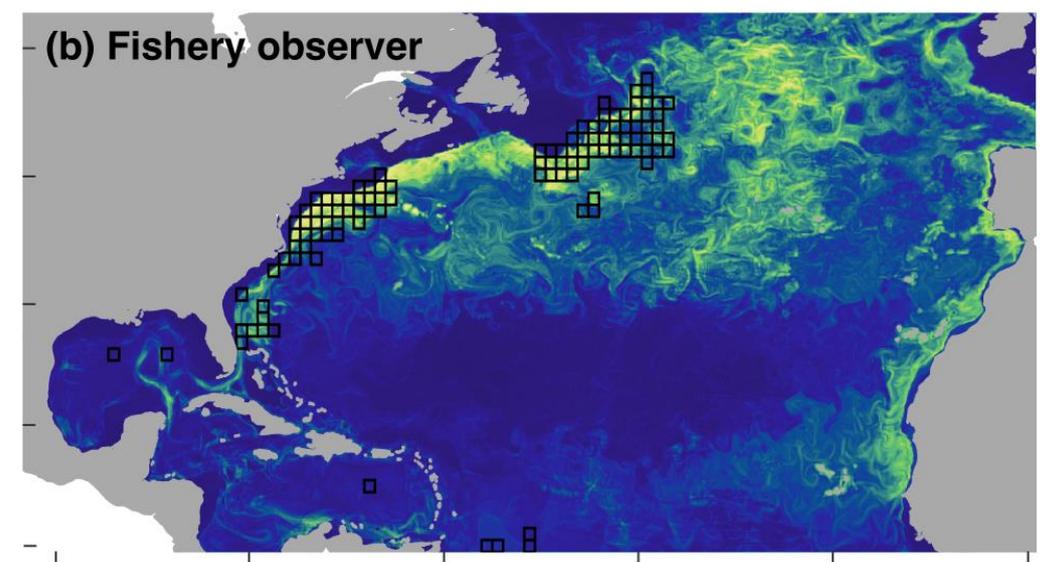
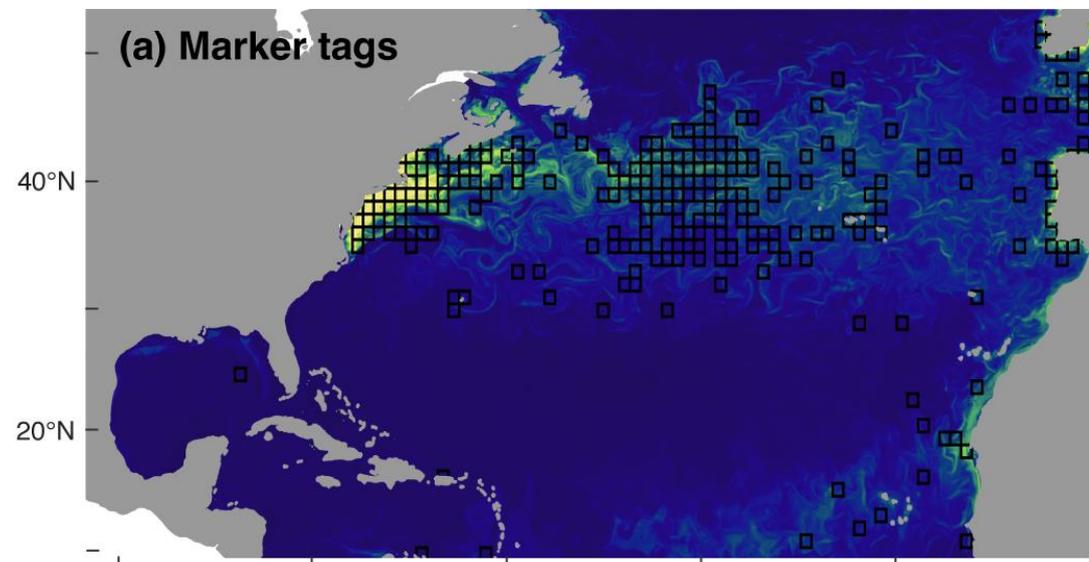
Nerea Lezama Ochoa



Stephen Bograd

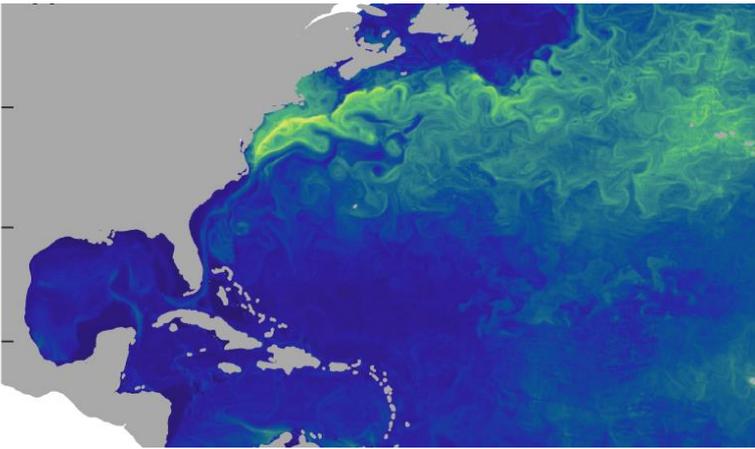
Integrate multiple data types



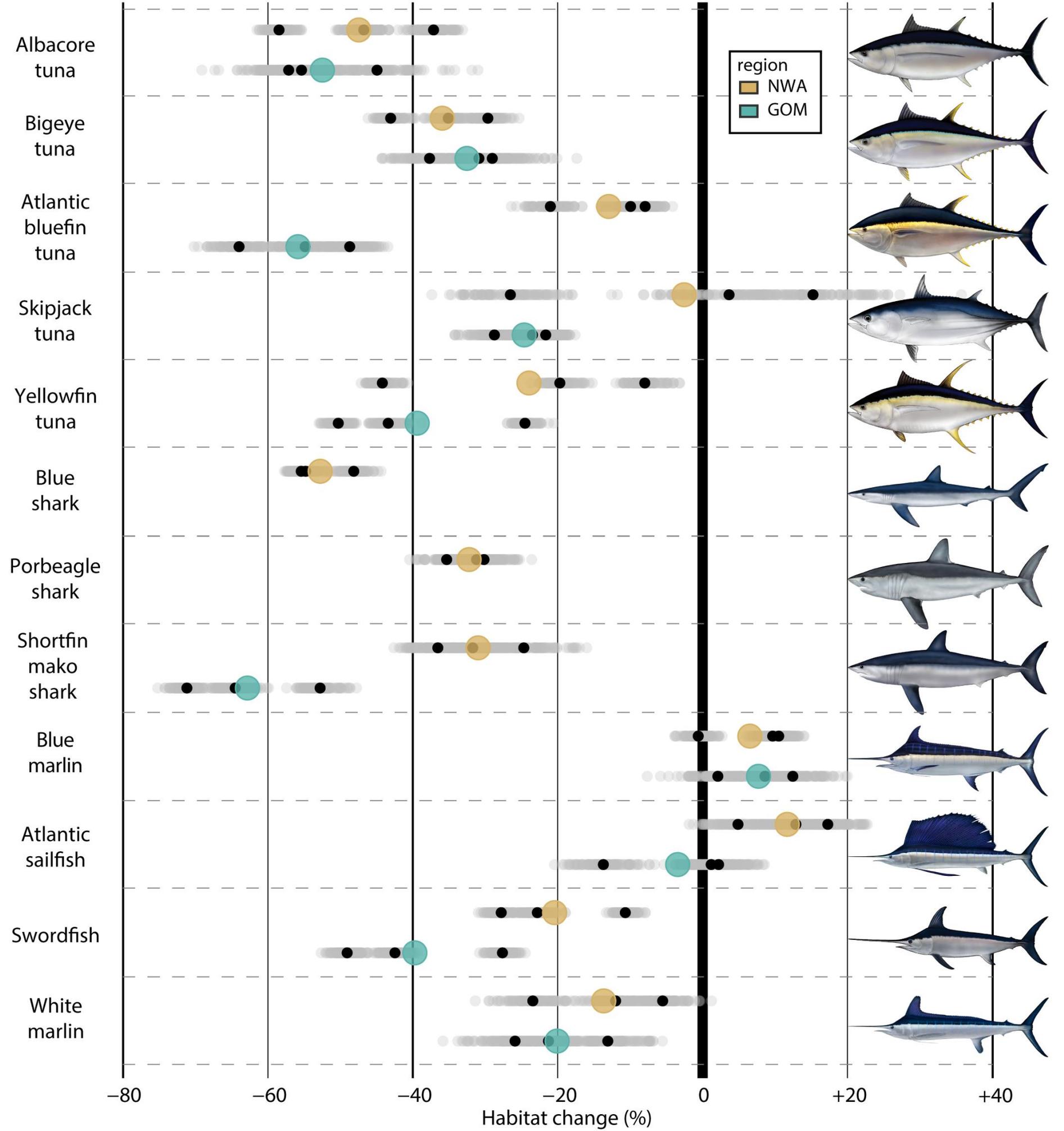


Habitat suitability

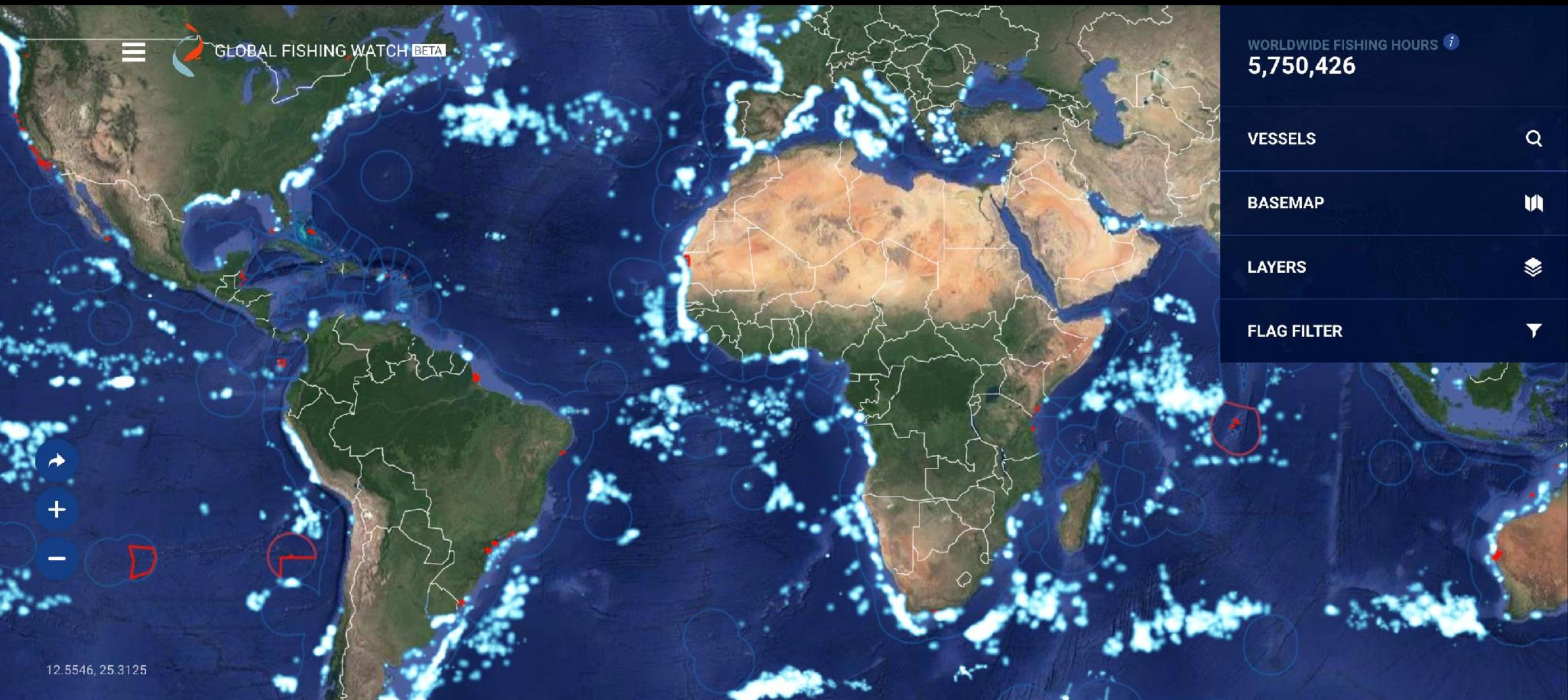
Expected habitat loss for most species



Predict habitat change over time



Mapping vessel traffic, including fishing vessels



Building “indicators” for marine spatial planning

NORTHEAST OCEAN DATA

DATA EXPLORER

[Turn all Layers Off](#) < >

All Layers | **Active Layers (3)**

Keyword Search

- > Marine Transportation
- > National Security
- > Energy & Infrastructure
- > Recreation
- > Culture
- > Commercial Fishing
- > Aquaculture
- > Fish
- ▼ Marine Mammals & Sea Turtles
 - [View Individual Species](#)
 - ▼ Modeled distribution (MDAT)
 - > All Cetaceans
 - > Ecological Groups

MARINE MAMMALS

SPECIES/GUILD: Sperm whale

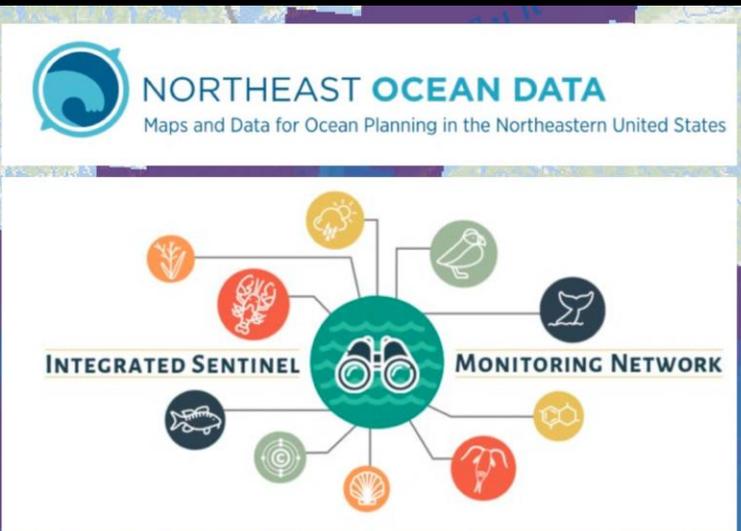
TIME PERIOD: Sperm whale, August

DATA TYPE (modeled)

- Average Density
- 95% Confidence Interval
- 5% Confidence Interval
- Standard Error
- Coefficient of Variation

[Layer Information](#)

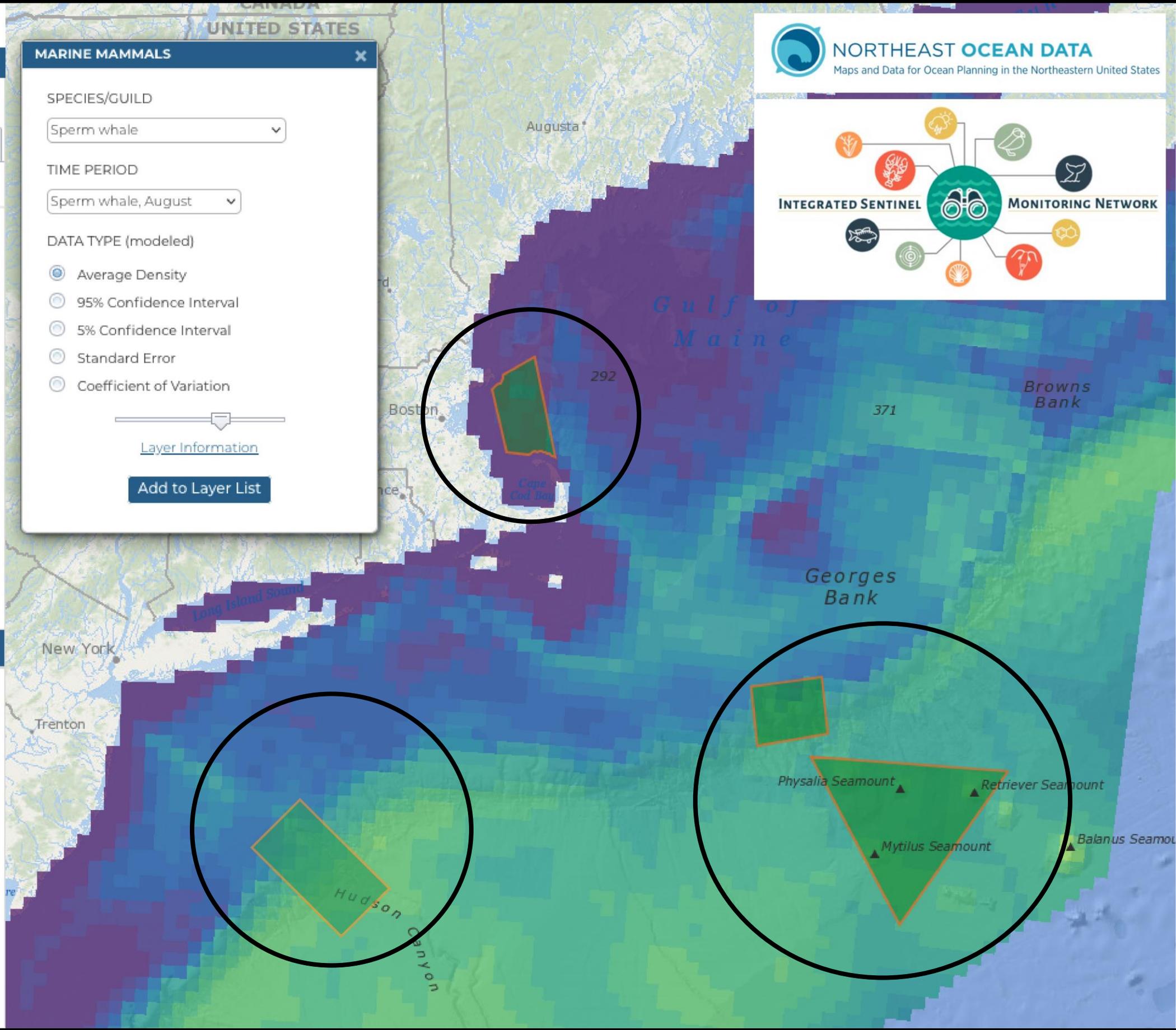
[Add to Layer List](#)



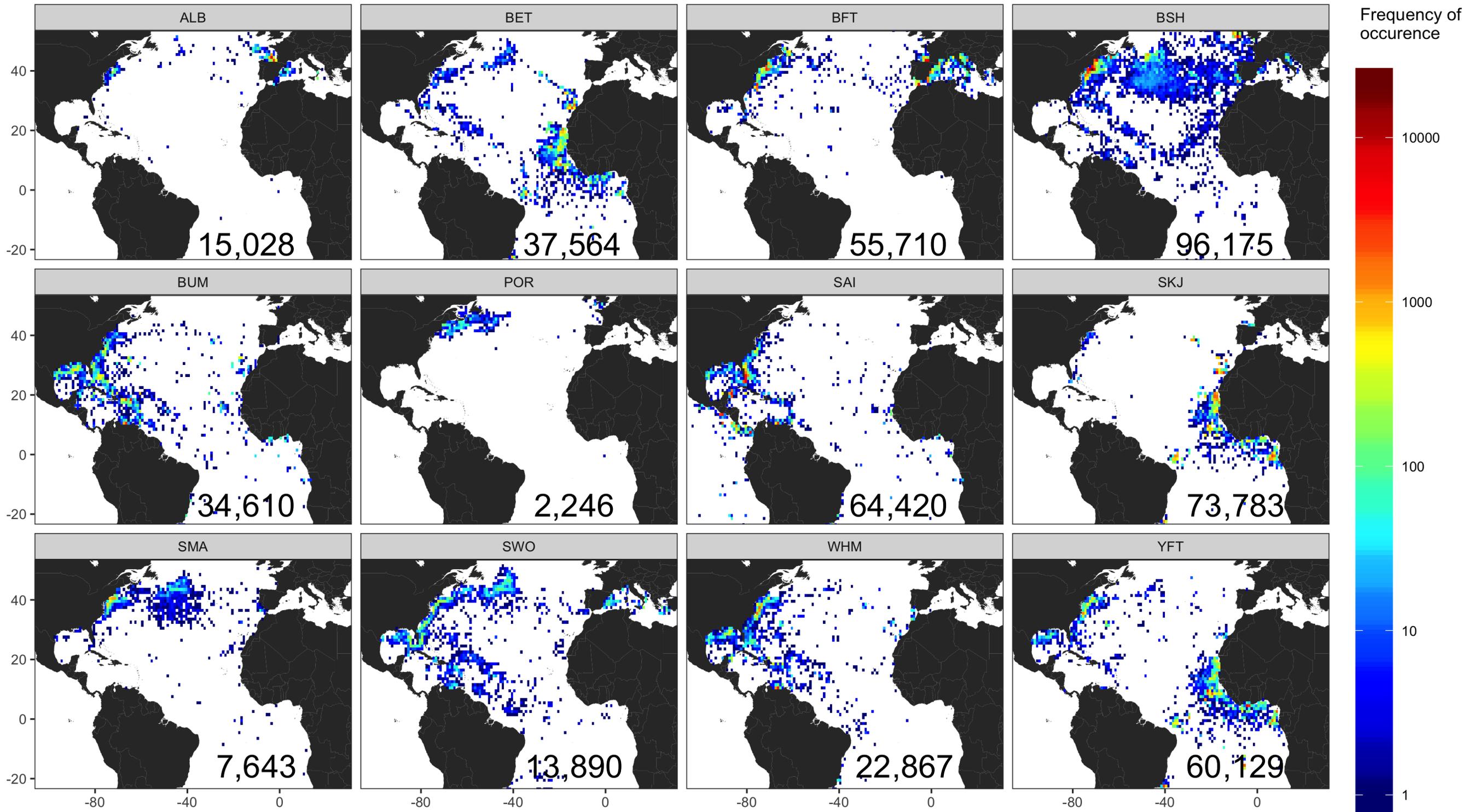
Legend >

Sperm whale, August

> 10
6.8 - 10
4.6 - 6.8
3.2 - 4.6
2.2 - 3.2
1.5 - 2.2
1.0 - 1.5
0.68 - 1.0
0.46 - 0.68
0.32 - 0.46
0.22 - 0.32
0.15 - 0.22



Marker tags provide unique “big data” opportunity



NW Atlantic (N = 194,756) | Total ICCAT (N = 484,065)