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

FaCeT

Fisheries and Climate Toolkit

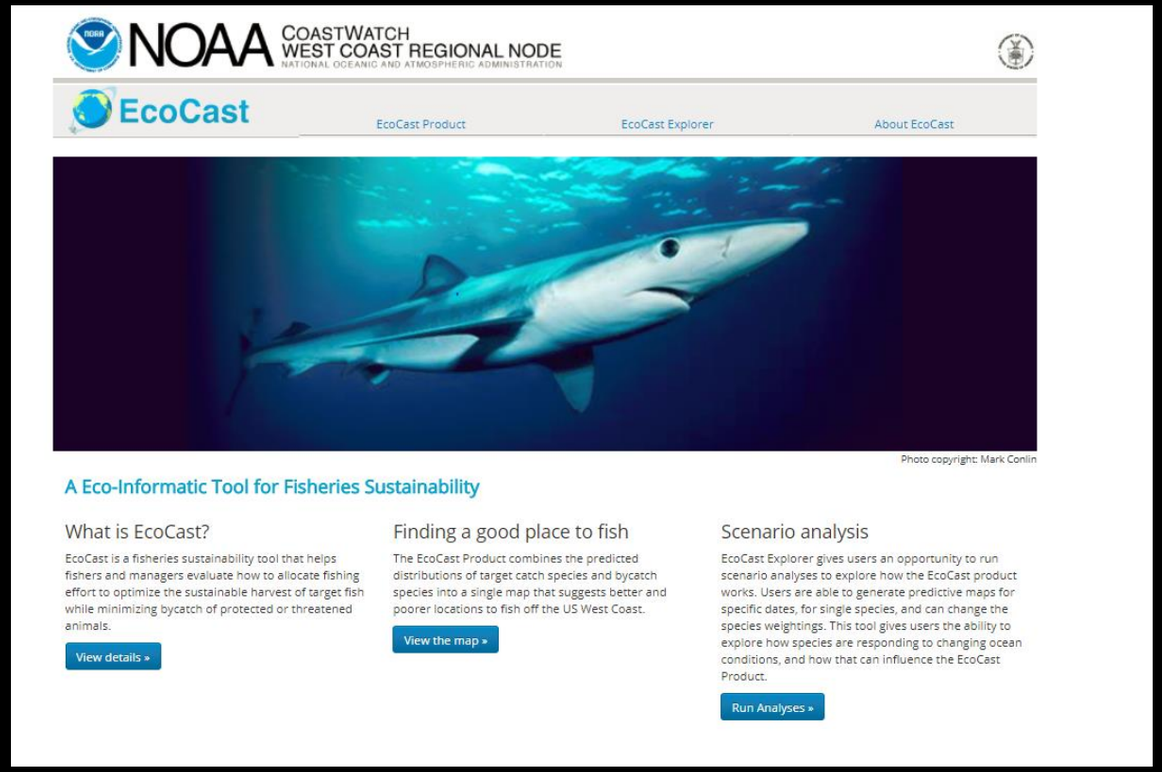
Camrin D. Braun (WHOI)
Rebecca Lewison (SDSU)

SAN DIEGO STATE UNIVERSITY

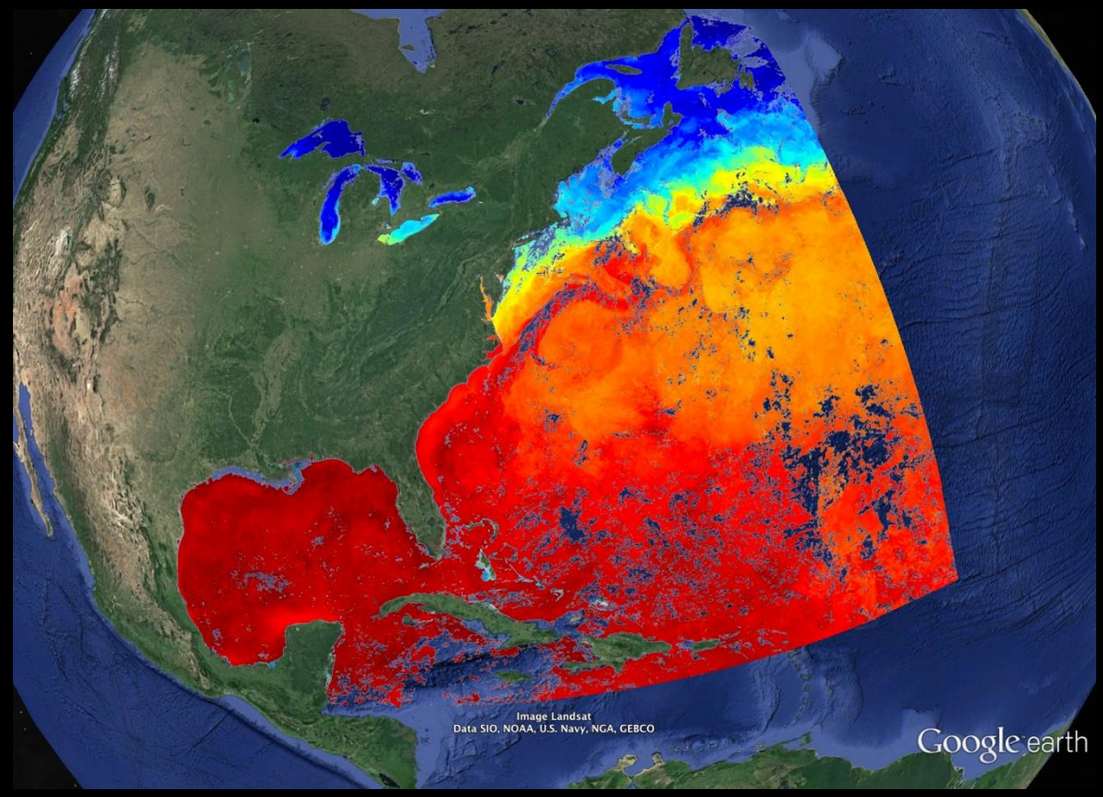
WOODS HOLE OCEANOGRAPHIC INSTITUTION

NASA BDEC team meeting
May 2025

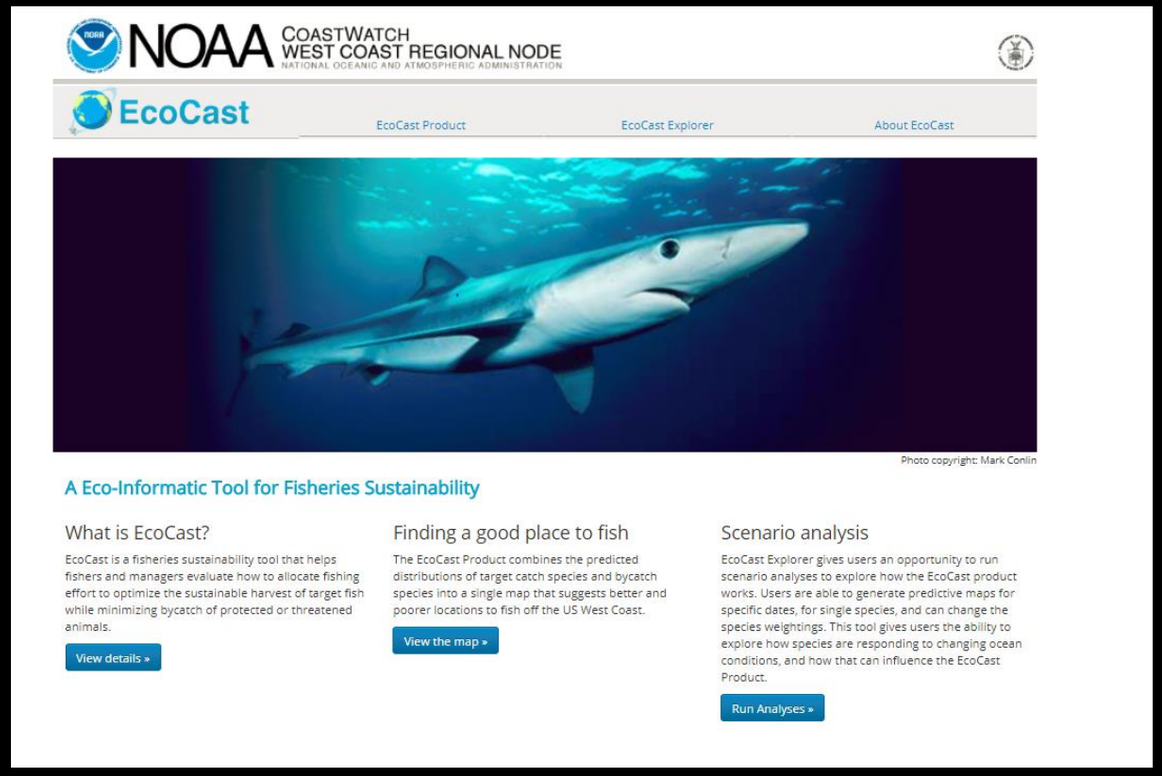
Build on a history of
use-inspired NASA products



Leverage satellites + “big” data



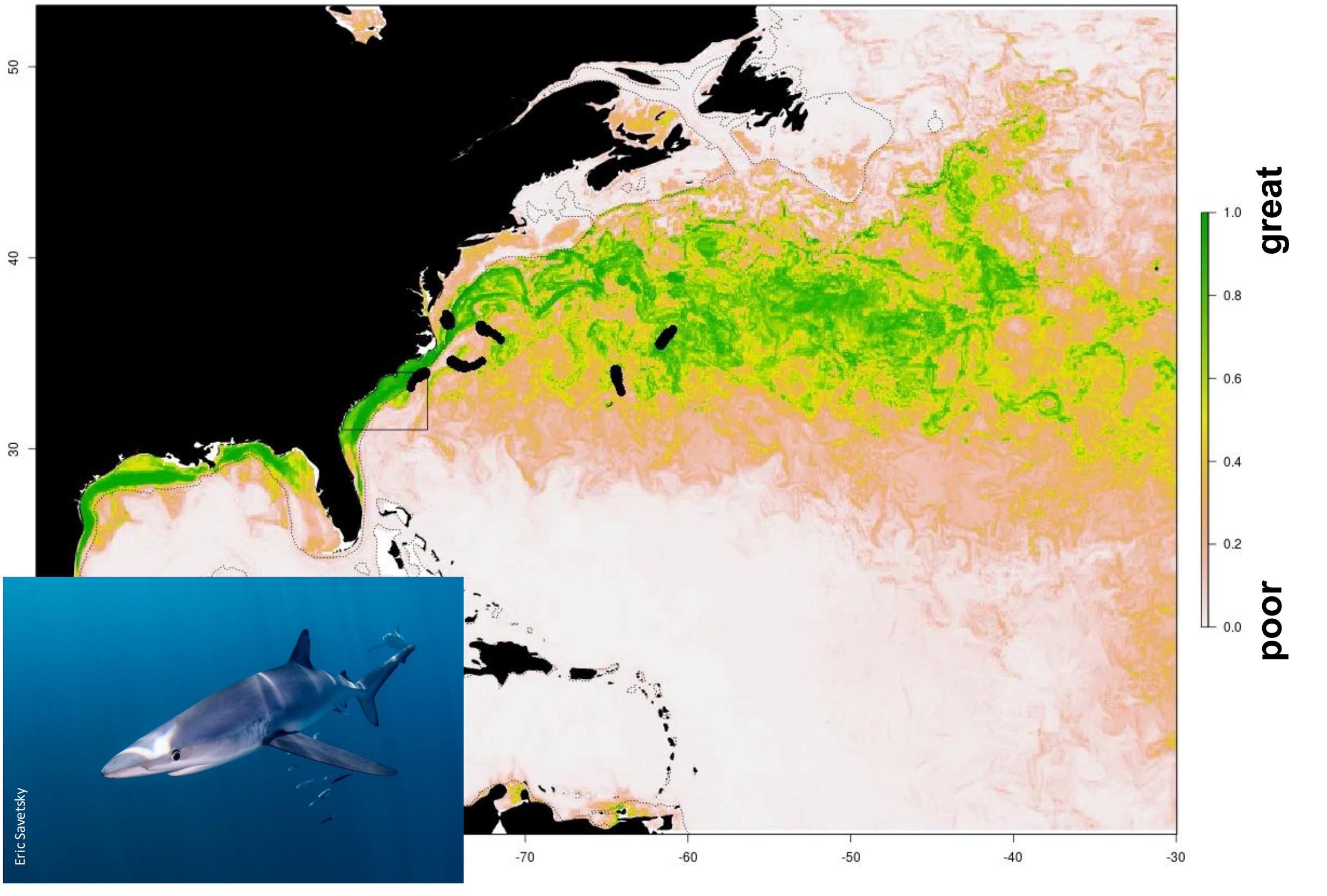
Build on a history of use-inspired NASA products

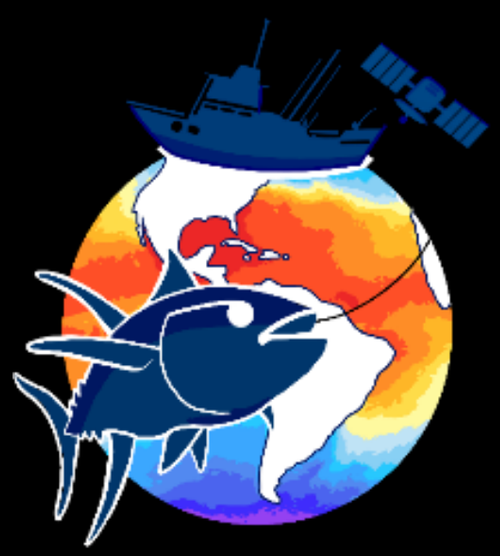


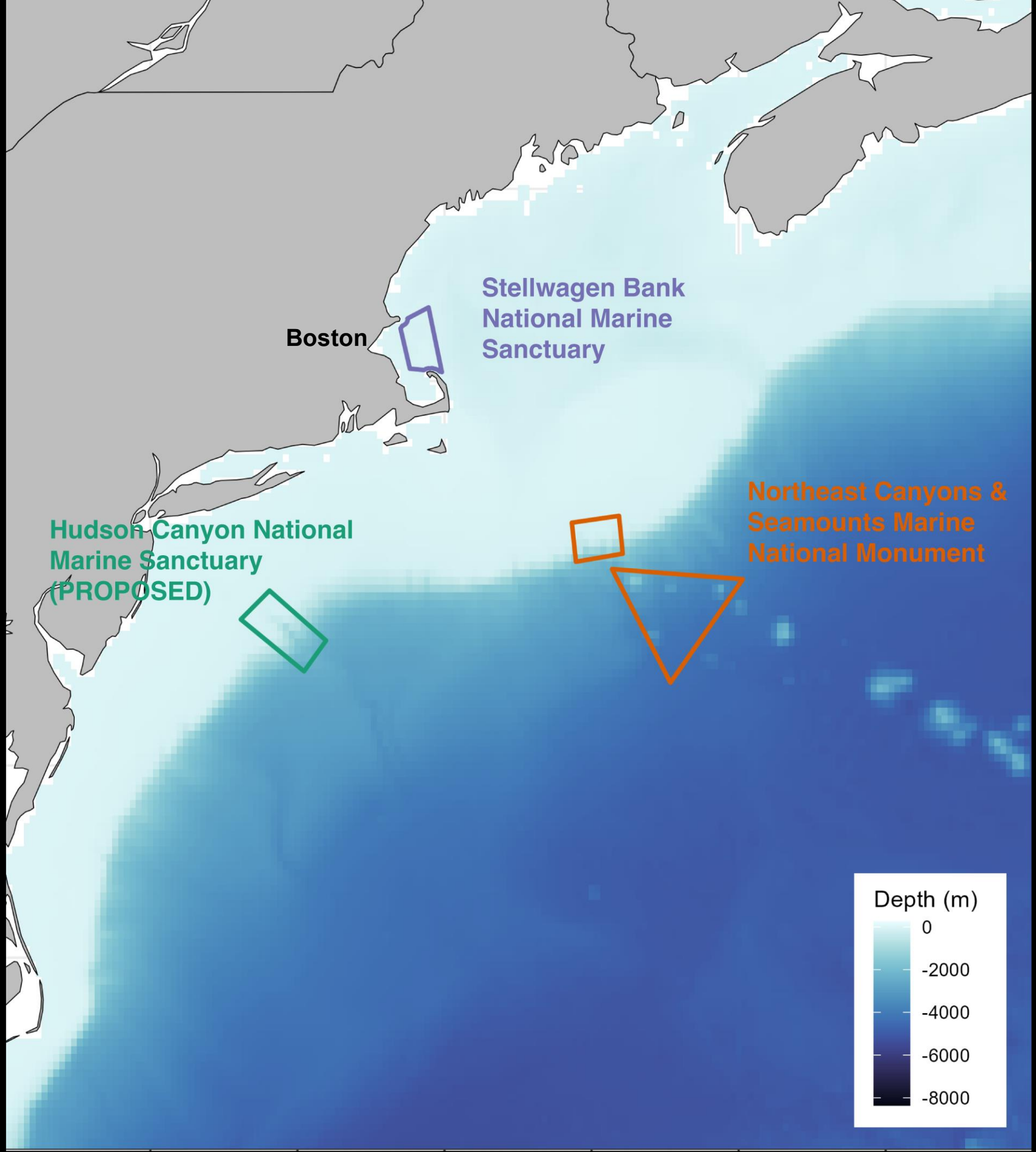
Co-developing actionable products for decision making

Predict suitable habitat

shark tracking!





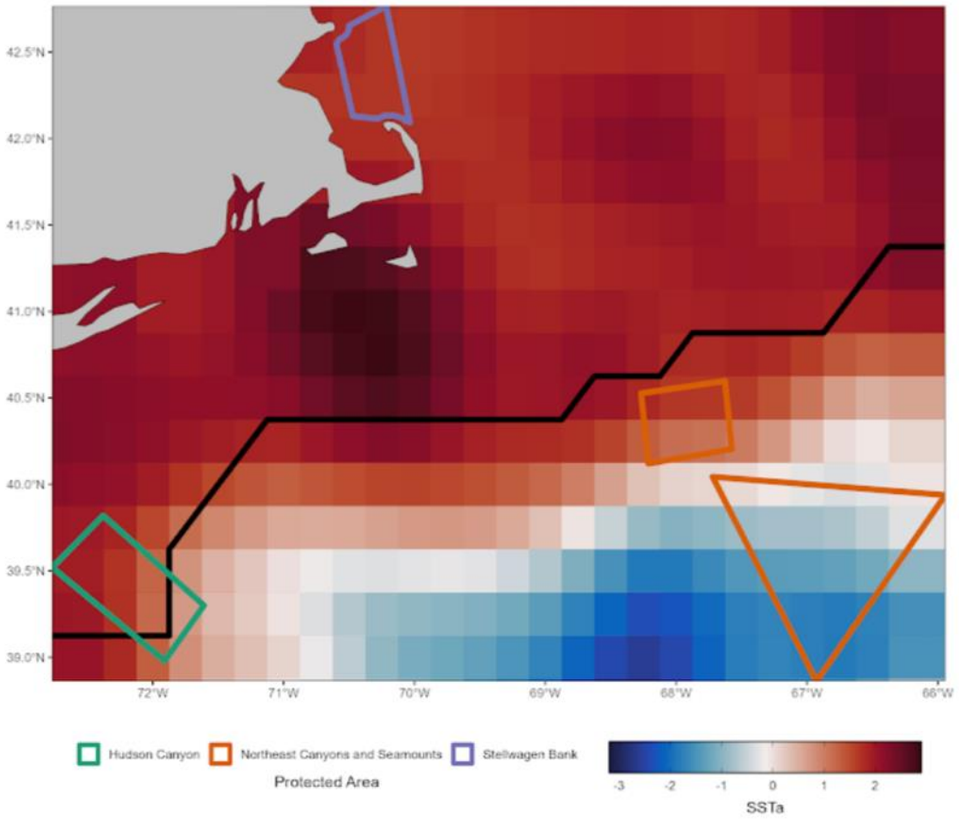

Boston
Stellwagen Bank
National Marine
Sanctuary
Hudson Canyon National
Marine Sanctuary
(PROPOSED)
Northeast Canyons &
Seamounts Marine
National Monument
Depth (m)
0
-2000
-4000
-6000
-8000

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) *

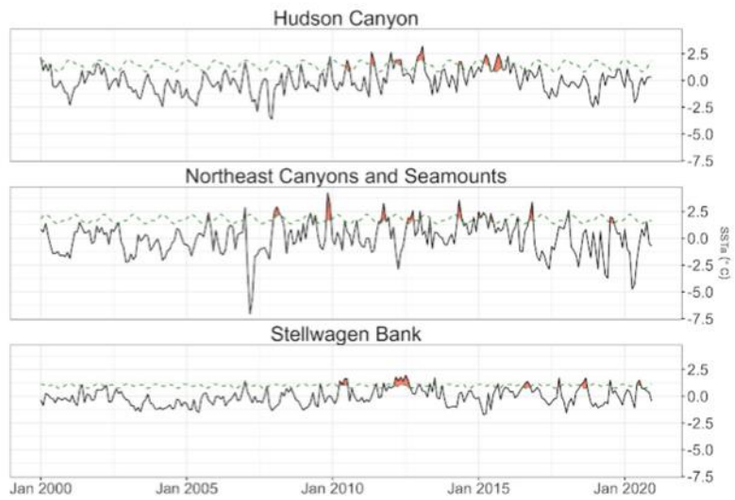
Map of a MHW event on May 2012 (black line represents the boundary of MHW)



1 2 3 4 5

Very useful ○ ○ ○ ○ ○ Not useful

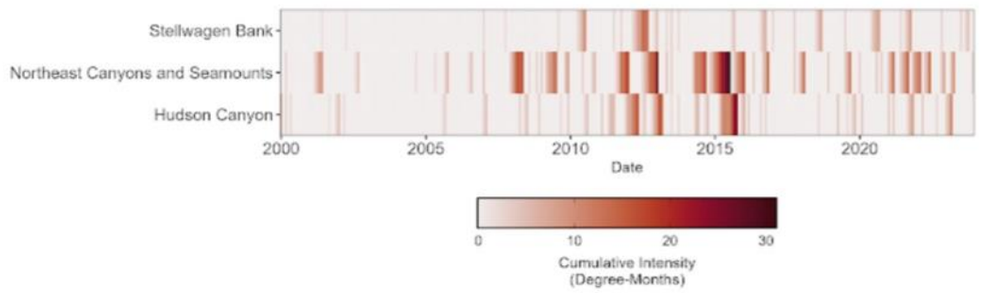
Time series of MHW intensity over time across protected areas (black line indicates SSTa; red indicates MHW; green line is the seasonal threshold)



1 2 3 4 5

Very useful ○ ○ ○ ○ ○ Not useful

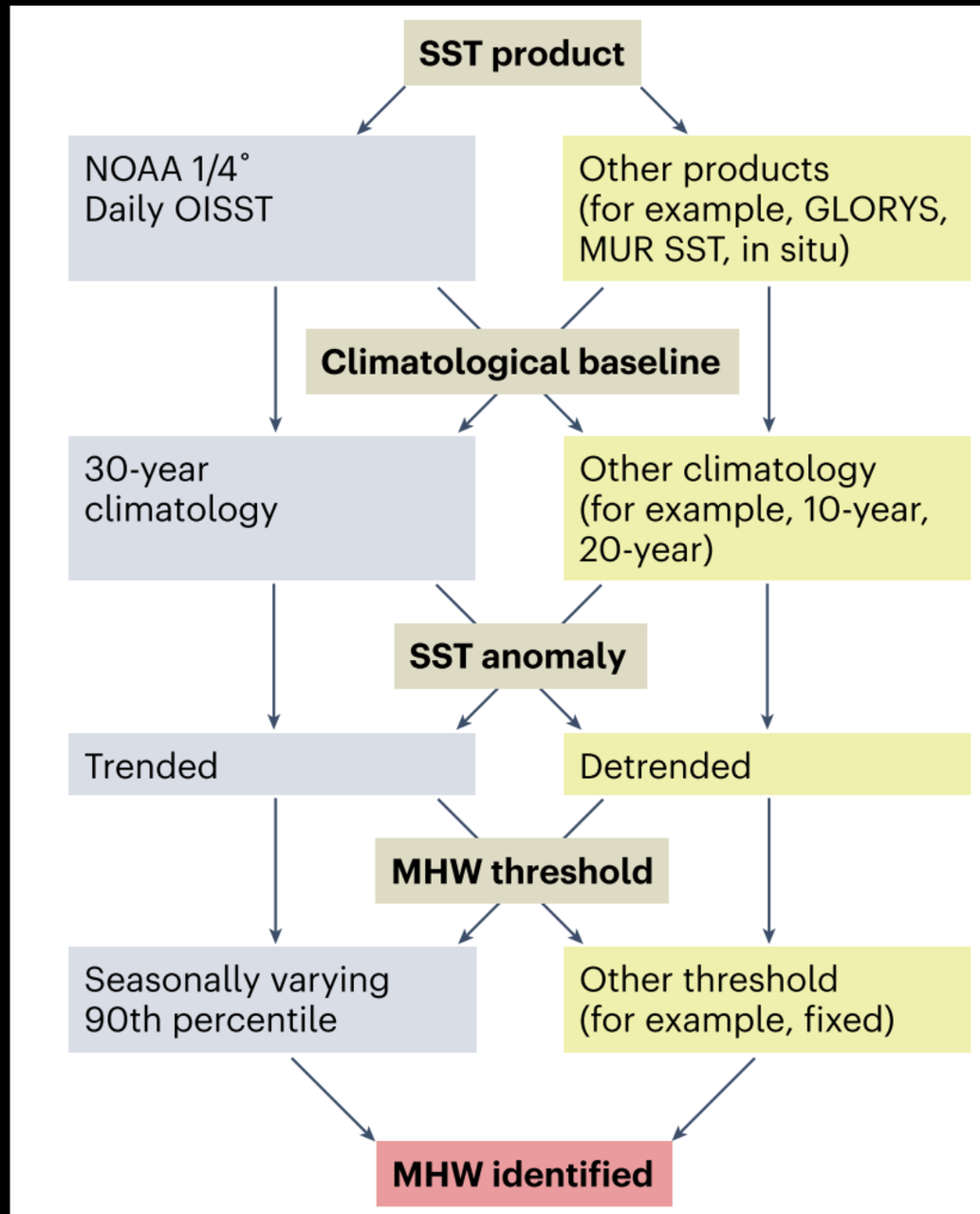
Cumulative intensity of MHWs across protected areas

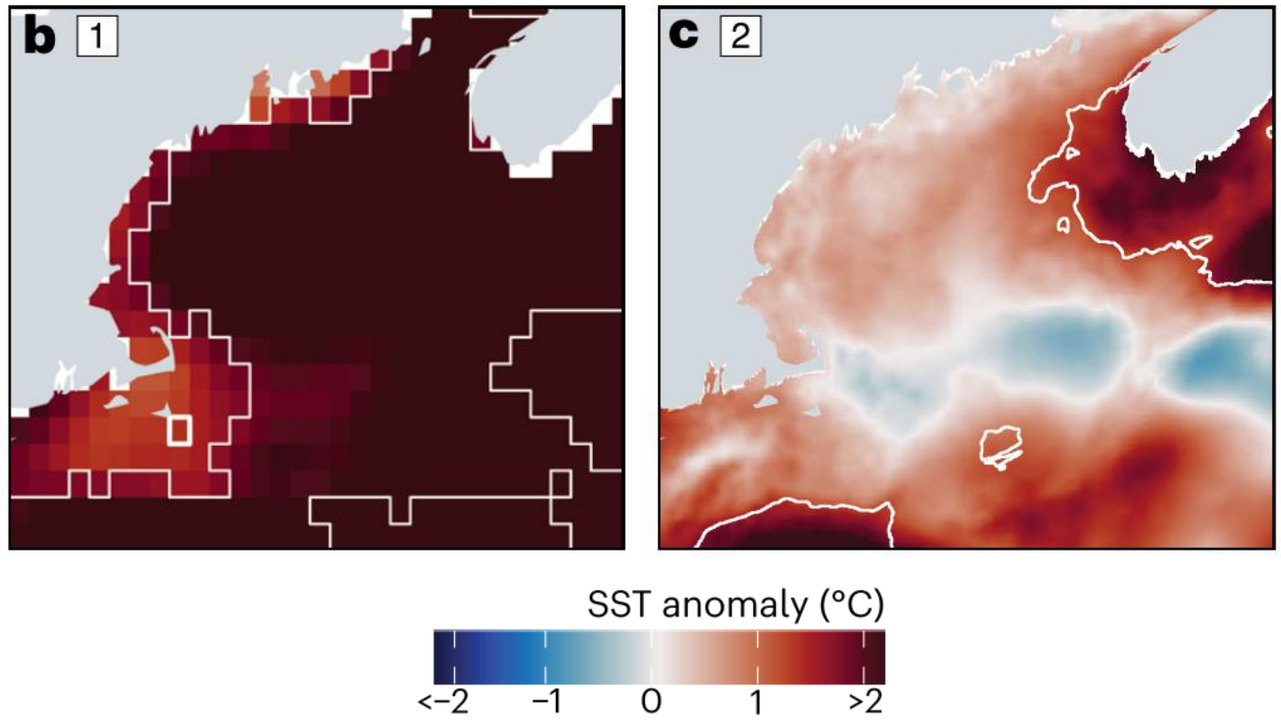


1 2 3 4 5

Very useful ○ ○ ○ ○ ○ Not useful

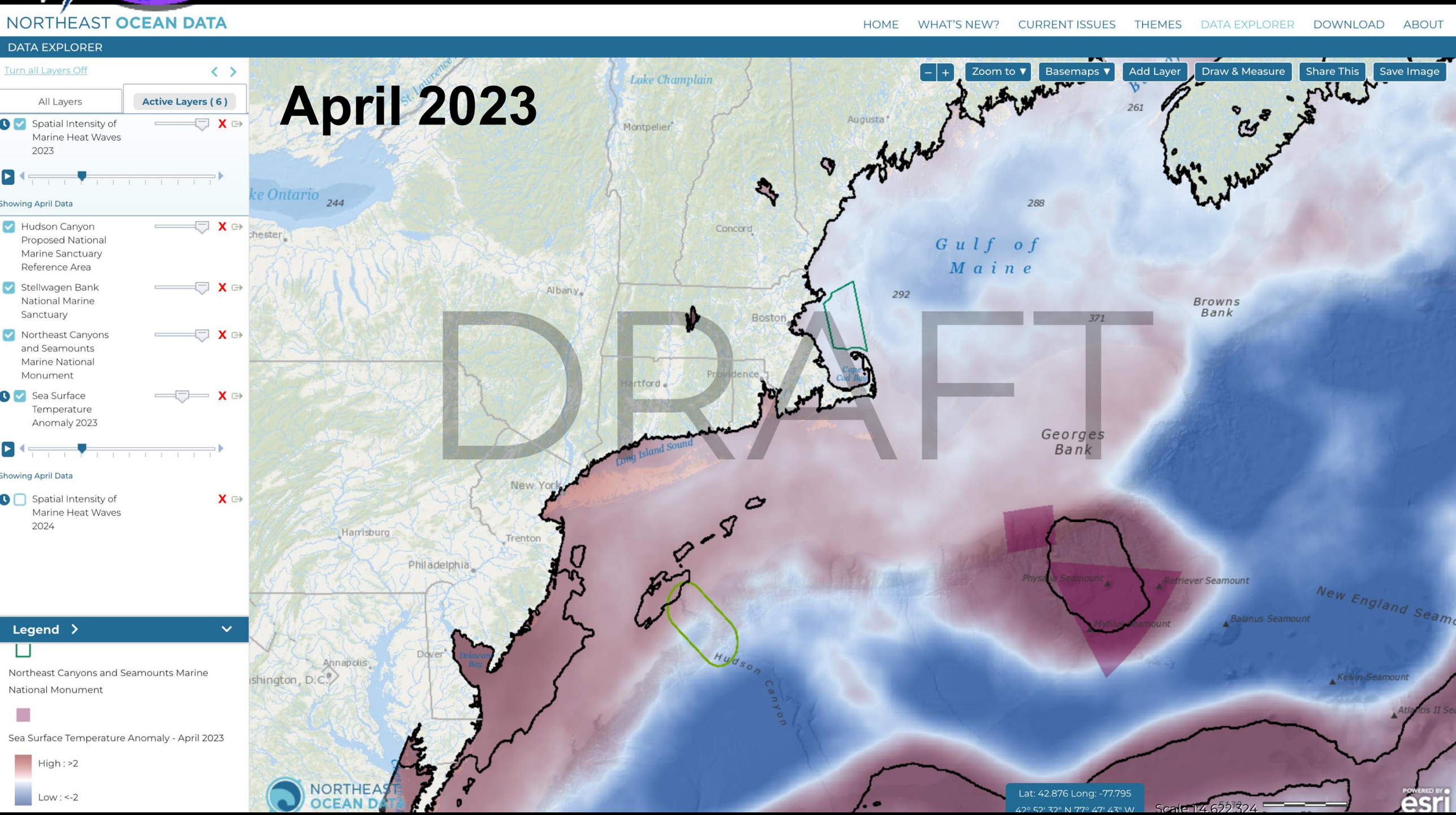
Stakeholder-driven marine heatwave products: advancing science and env literacy



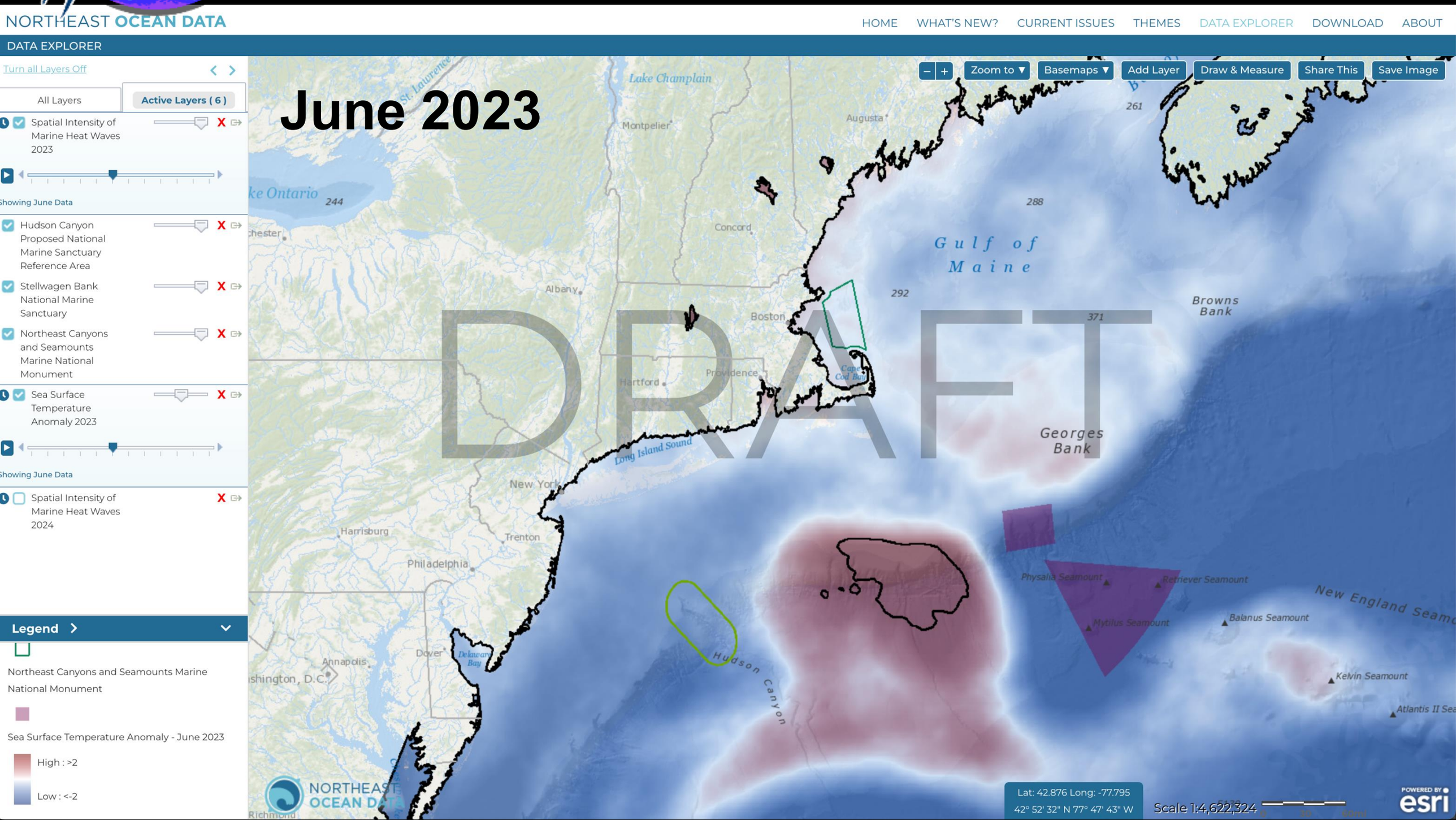


Farchadi, McDonnell, et al., 2025. Nature Clim. Change

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



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



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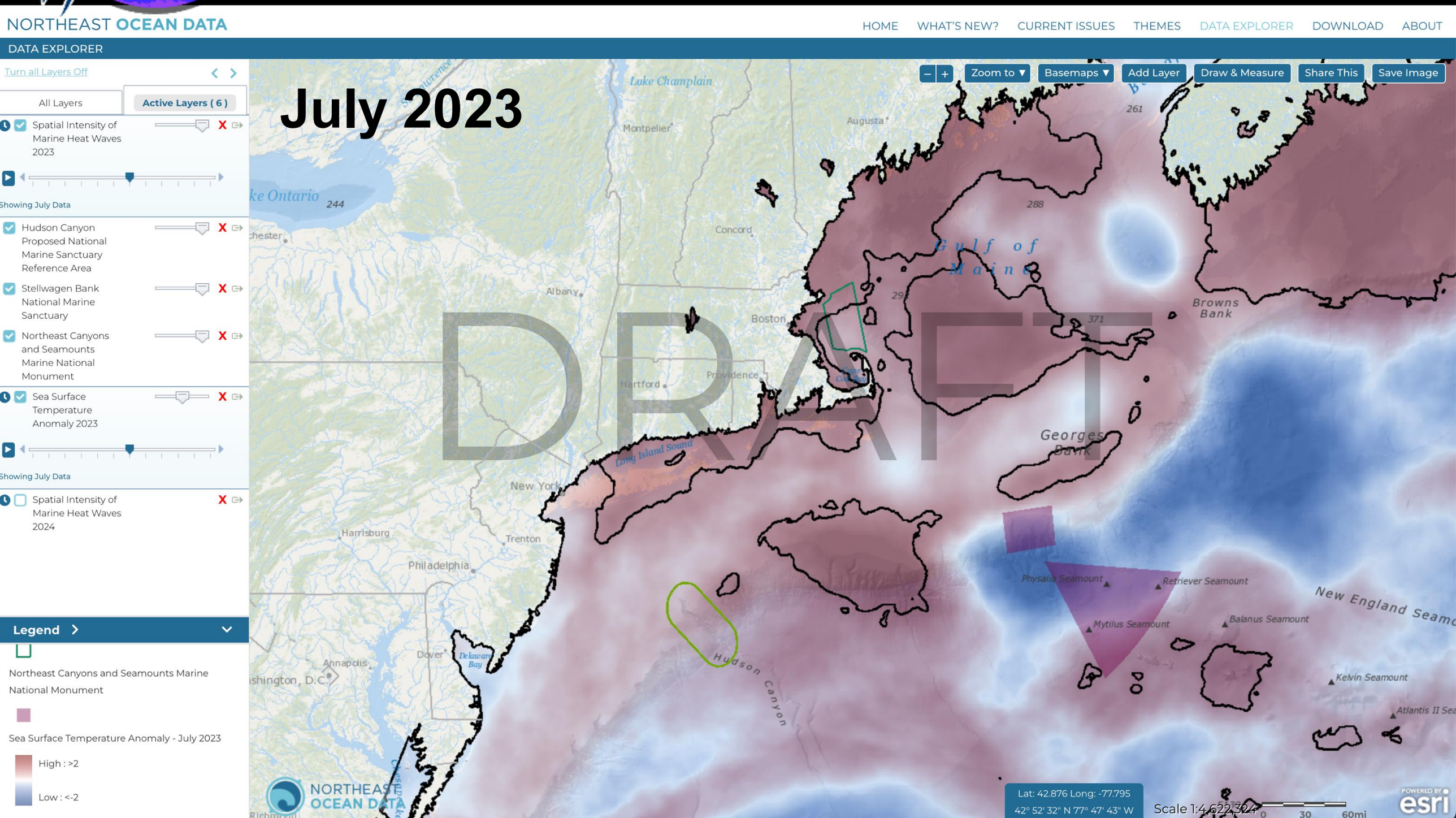
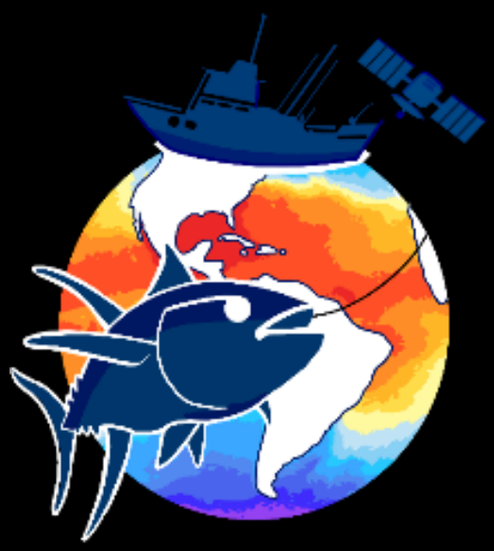




Products in each project focus area

marine heatwaves & their impacts

habitat change

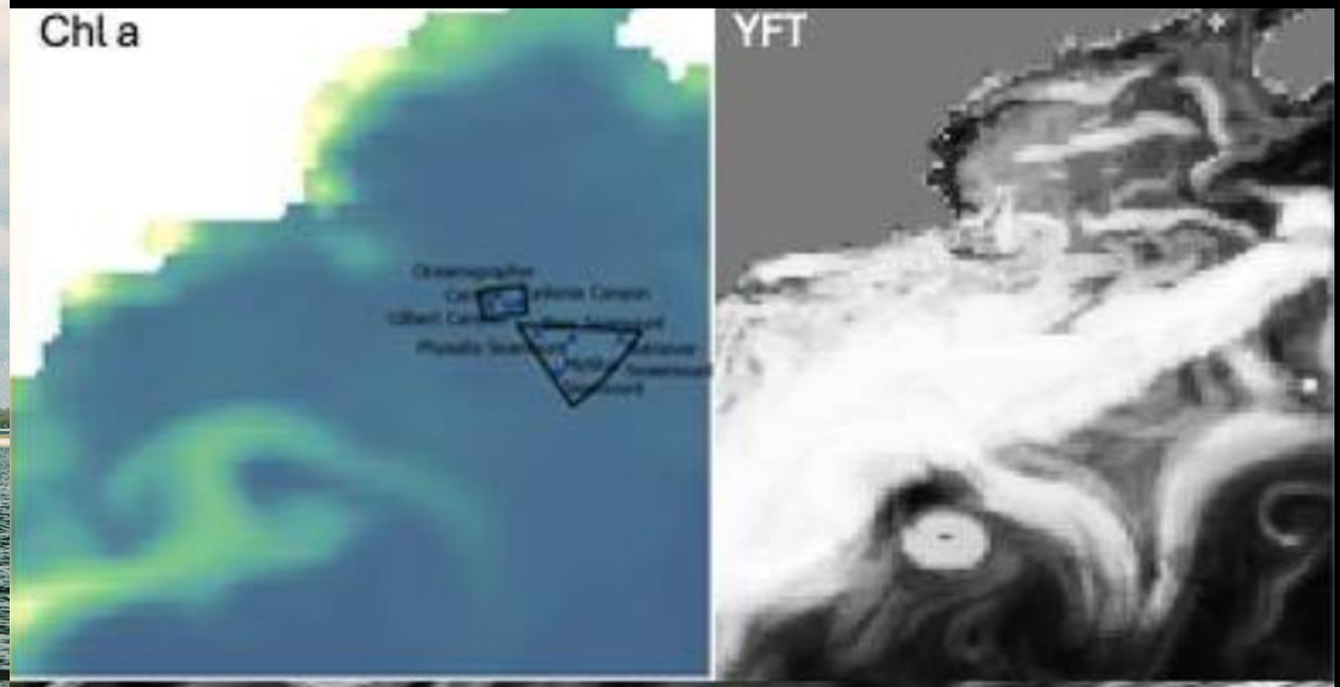
species phenology / timing

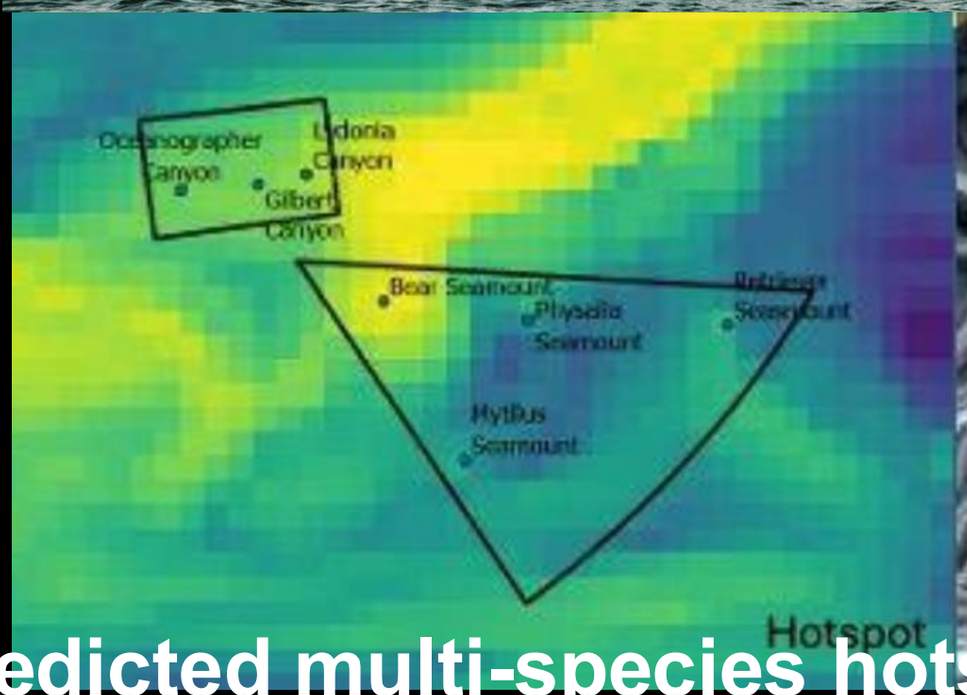
refugial capacity of protected areas

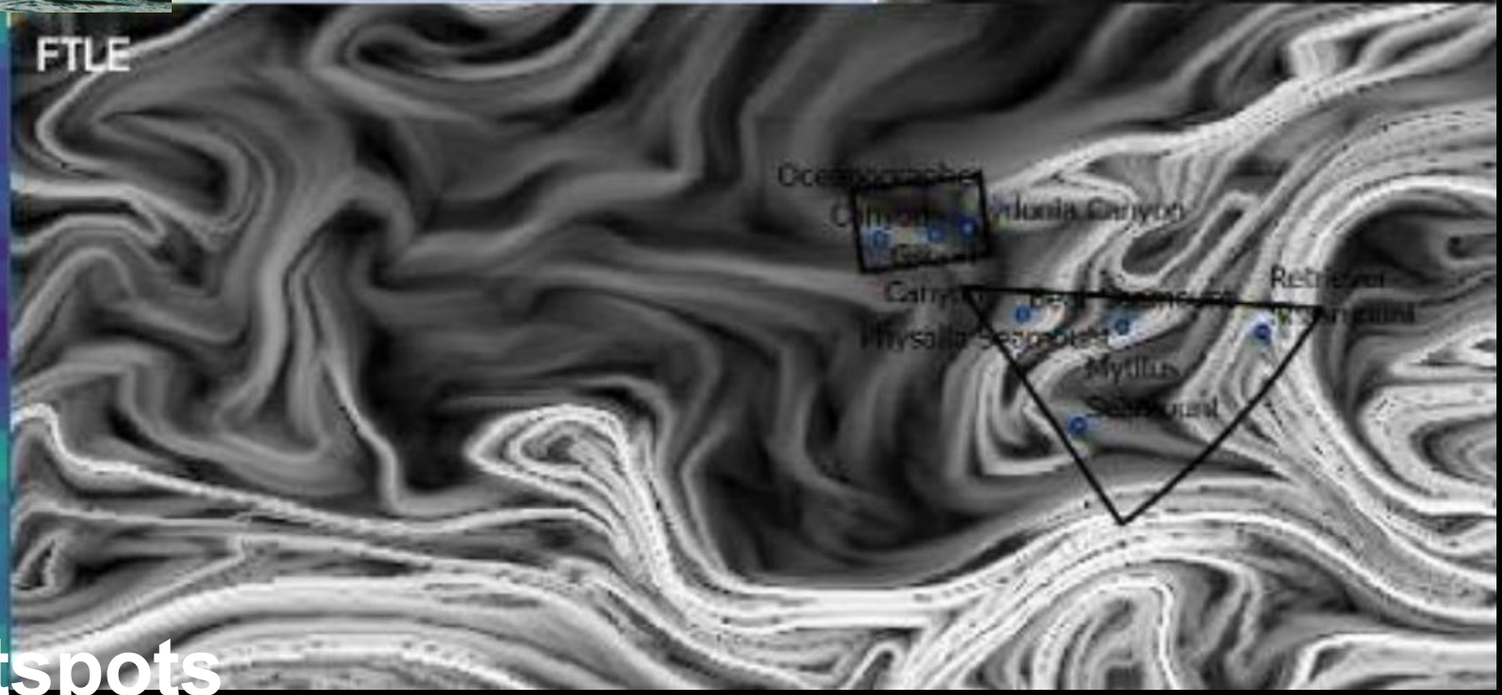
biodiversity monitoring / cruise support

Facilitate marine spatial planning through co-development

Real-time products support monitoring cruise planning and operational awareness

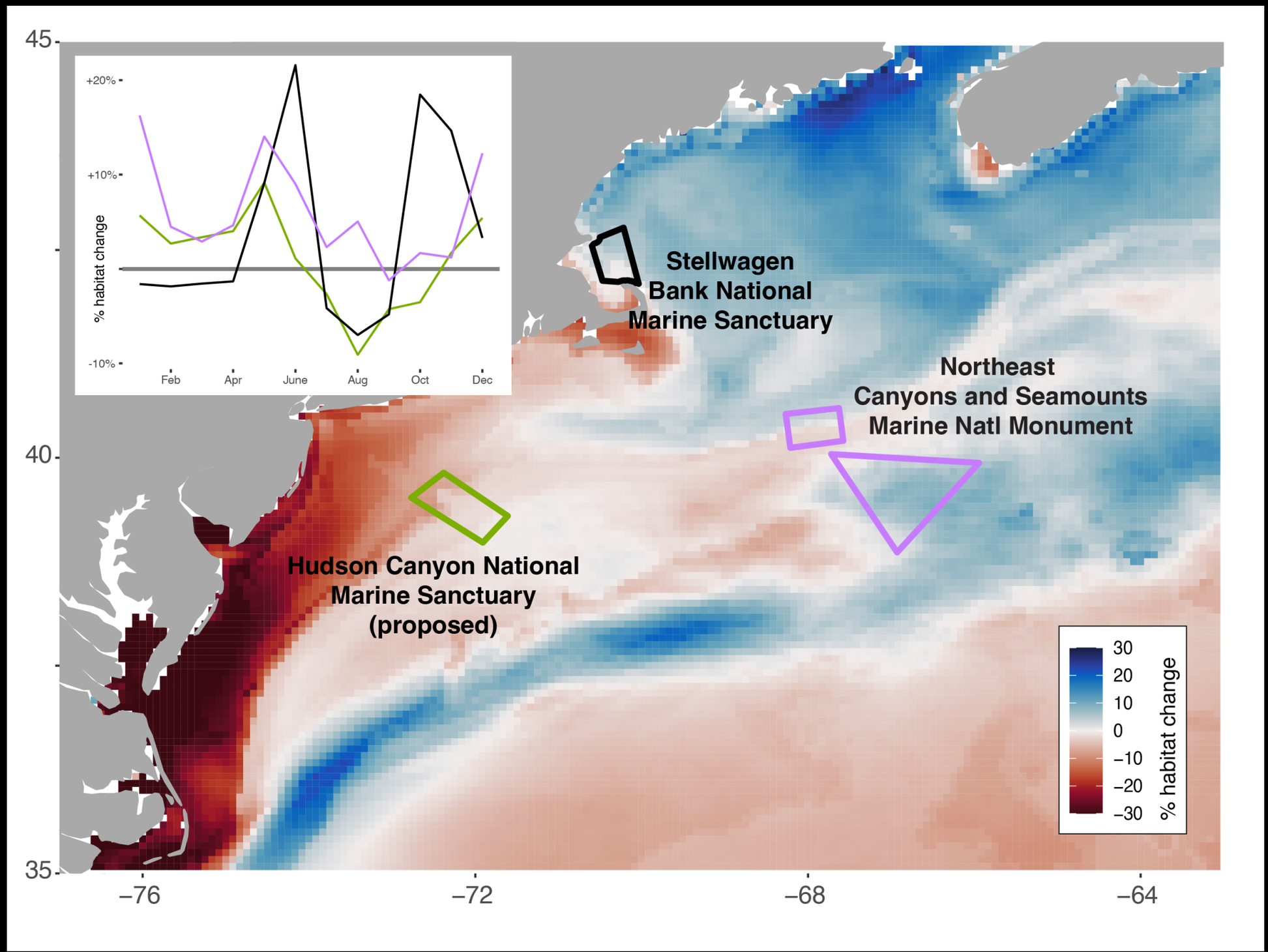






predicted multi-species hotspots

Species-climate products support protected area designation process



Outreach across academia, industry, and the public

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 metho
heatwave dete
different result
methods that a
to advance ma
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 Farchadi[4], Martin C. Arostegui[1],

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

DOI: 10.1111/faf.12828

P. Crear[7],

ORIGINAL ARTICLE

FISH and FISHERIES WILEY

Marine heatwaves redistribute pelagic fishing fleets

Nima Farchadi[1,2]
Steven J. Bograd[3,4]
Nerea Lezama-Och
Rebecca L. Lewison

, a trend that is

Diversity and Distributions WILEY

RESEARCH ARTICLE

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

legan Cimino[1,2] |
.. Forney[6,7] |
0 |

ARTICLE

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

Camrin D. Braun[1] | Martin C. Arostegui[1] | Nima Farchadi[2] |
Michael Alexander[3] | Pedro Afonso[1,4] | Andrew Allyn[5] | Steven J. Bograd[6] |

stakeholder engagement

ARCNEWS

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

Scientific Currents
Spring 2025

Dr. Camrin Braun
Dr. Rebecca Lewison

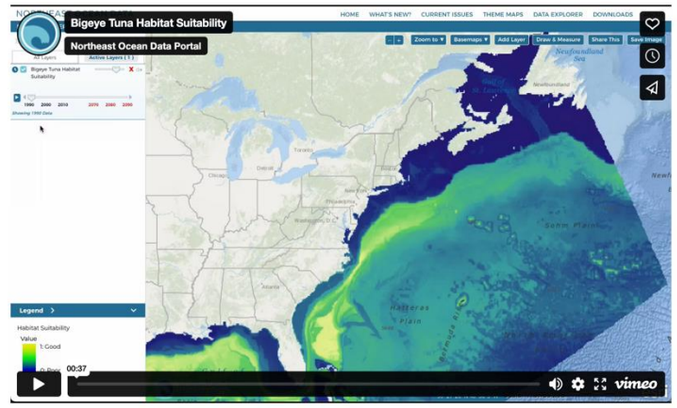
It is no secret that the world's oceans are undergoing sweeping changes. The signs are apparent in shifting ocean currents, changing distributions of marine

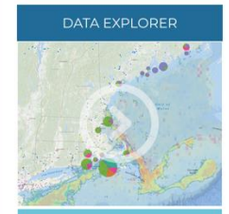
NORTHEAST OCEAN DATA
Maps and Data for Ocean Planning in the Northeastern United States

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

Past and Future Habitat Suitability of Highly Migratory Species

January 8, 2025





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

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Rebecca Lewison

rlewison@sdsu.edu

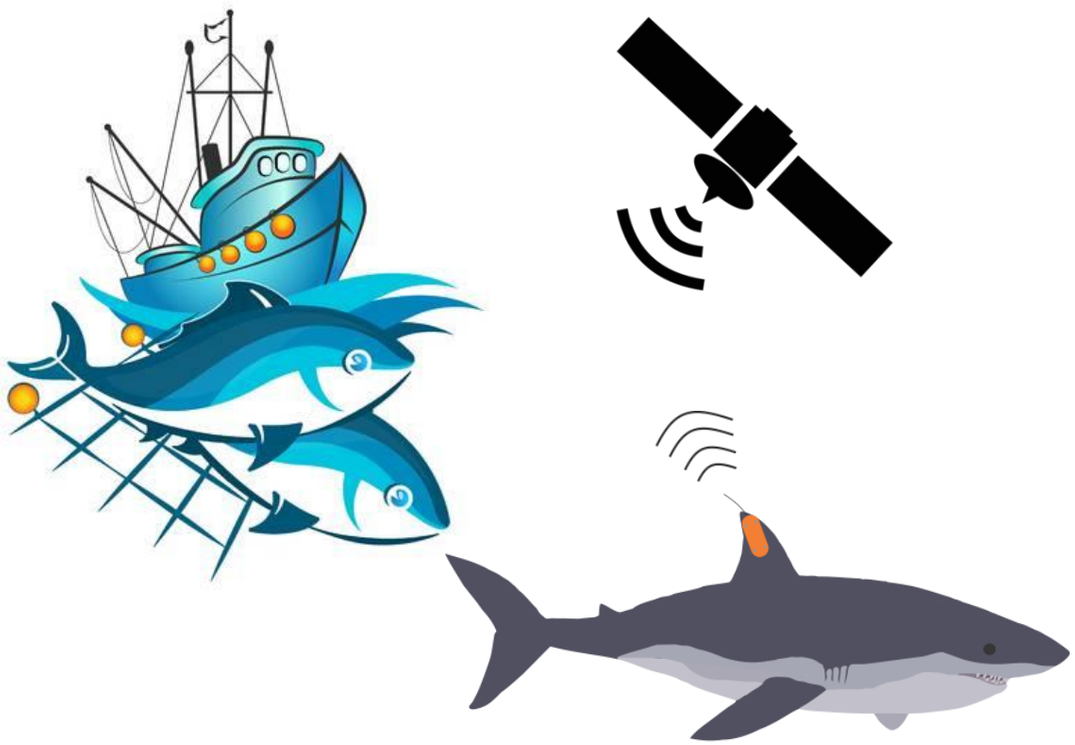
SAN DIEGO STATE UNIVERSITY

M. Bennett-Smith

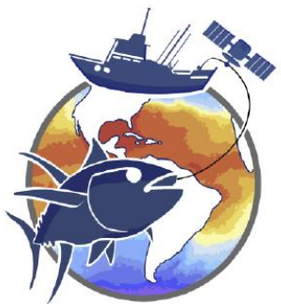
https://fisheriesclimatetoolkit.sdsu.edu/

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

DTU

The Nature Conservancy

NASA

CSIRO

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

CIAT IATTC

California Ocean Science Trust

Scripps Institution of Oceanography

Ocean Conservancy

Gulf of Maine Research Institute
Science. Education. Community.

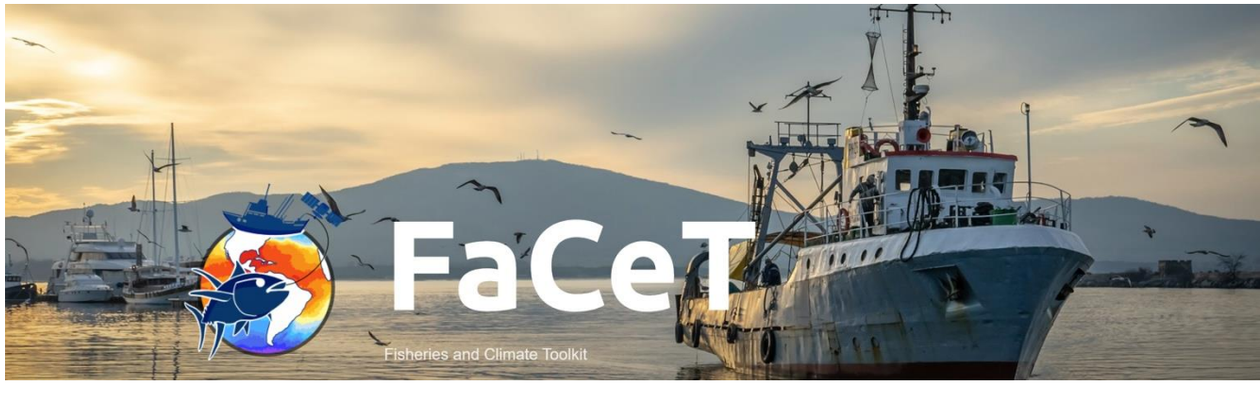
Oregon State University

Global Fishing Watch

Accessible, online products

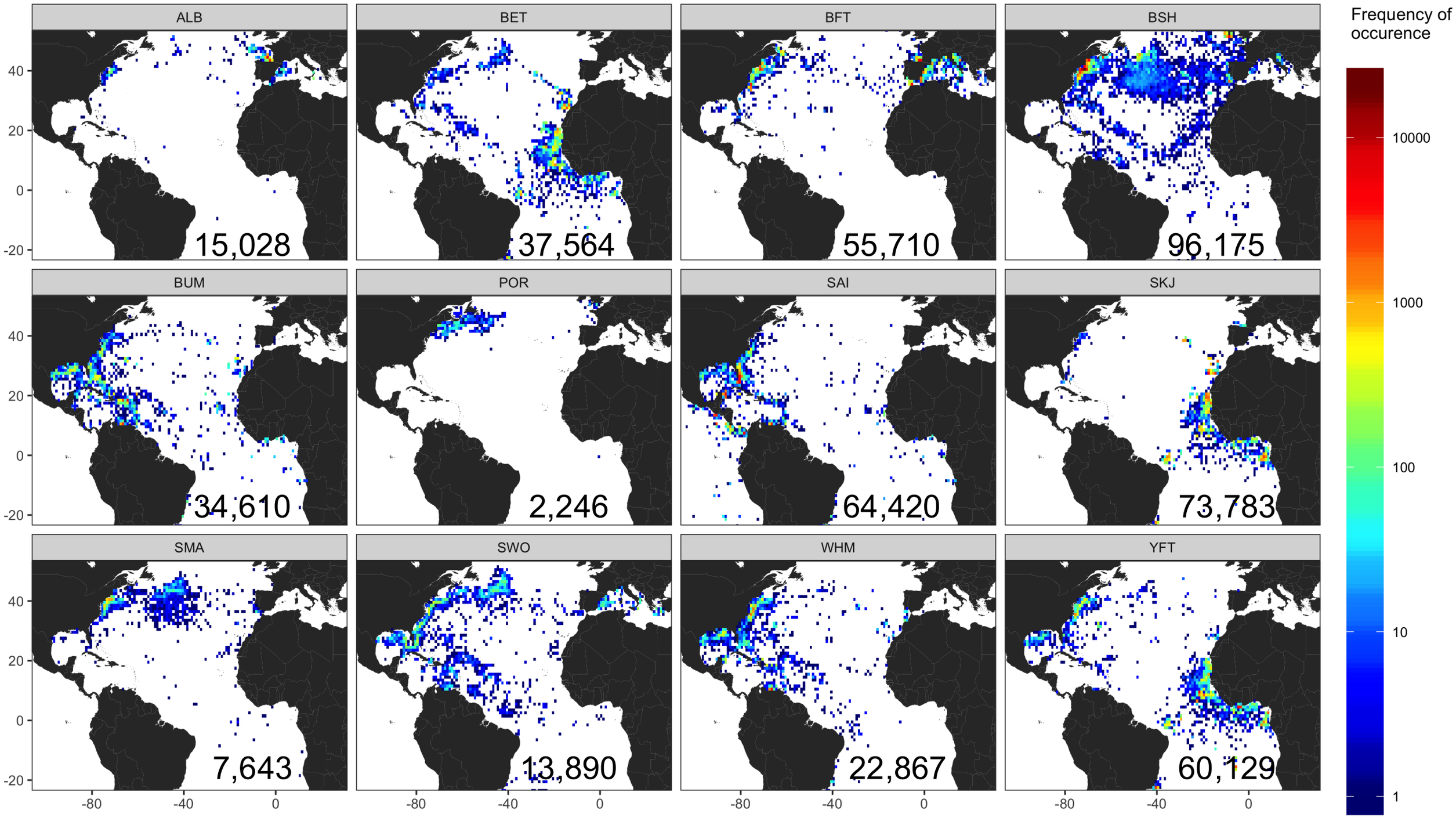
Relevant timely data viz

Build and expand capacity



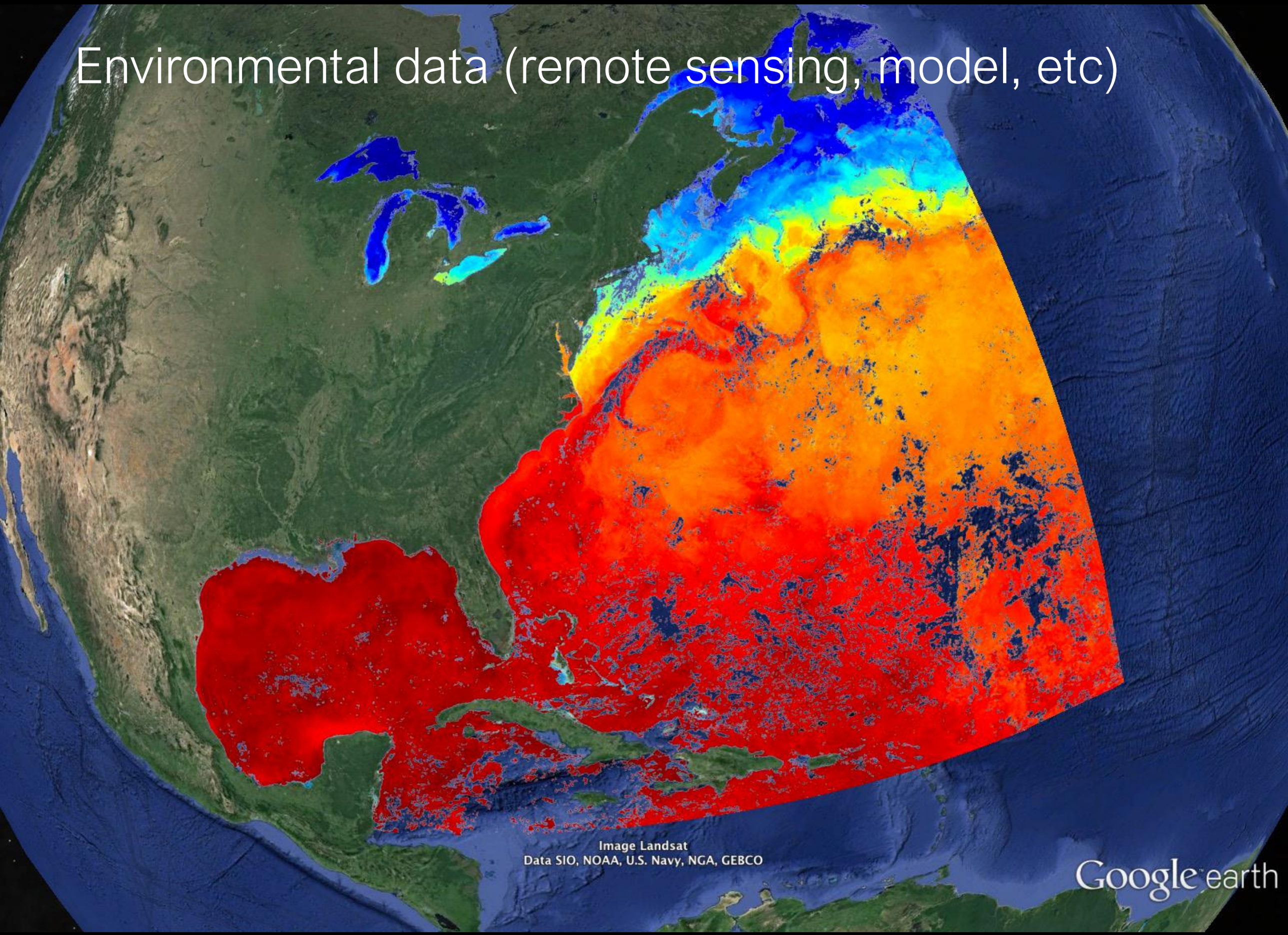
Fishery independent data, incl satellite tracking

Fisheries provide unique “big data” opportunity



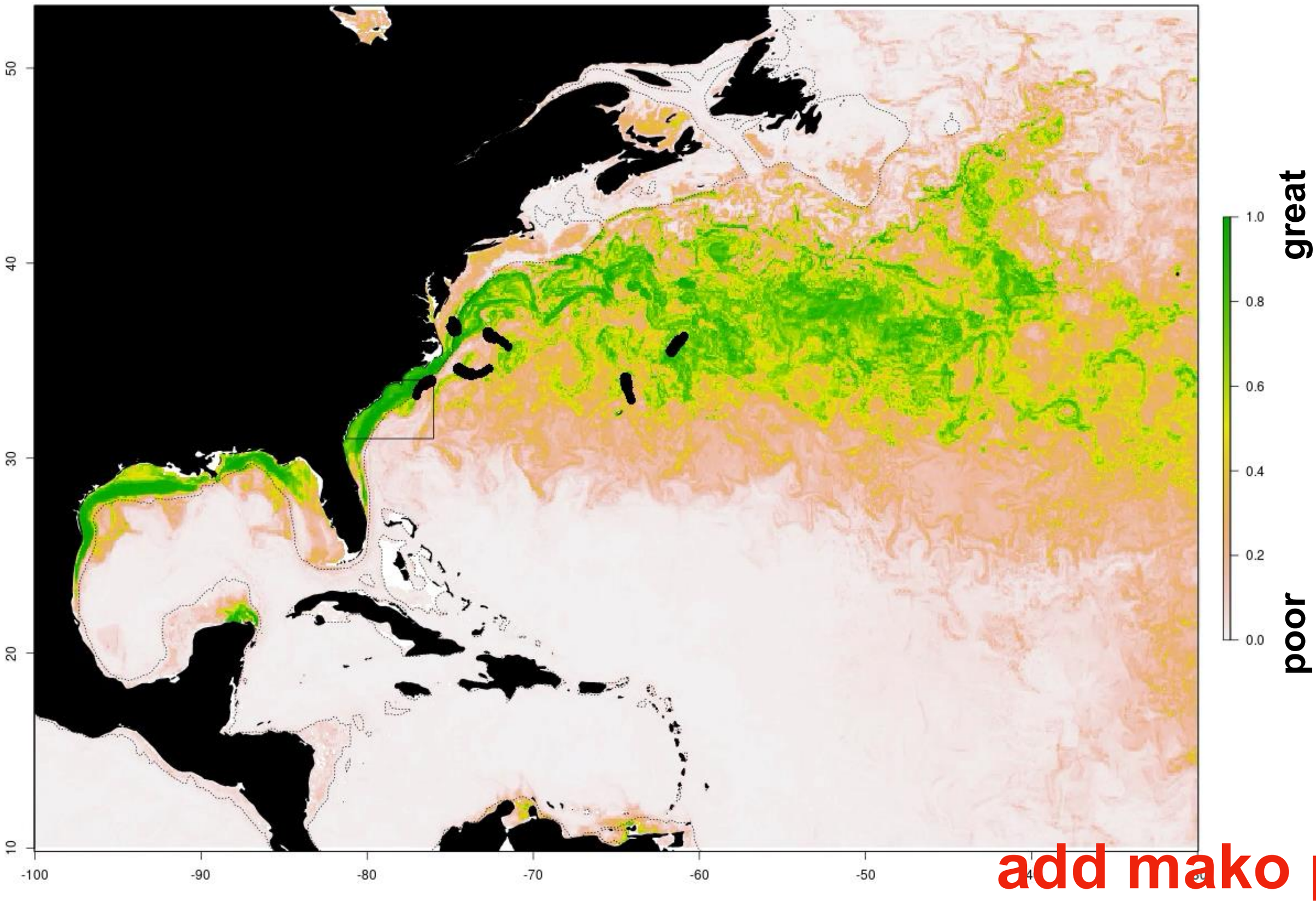
NW Atlantic (N = 194,756) | Total ICCAT (N = 484,065)

Environmental data (remote sensing, model, etc)

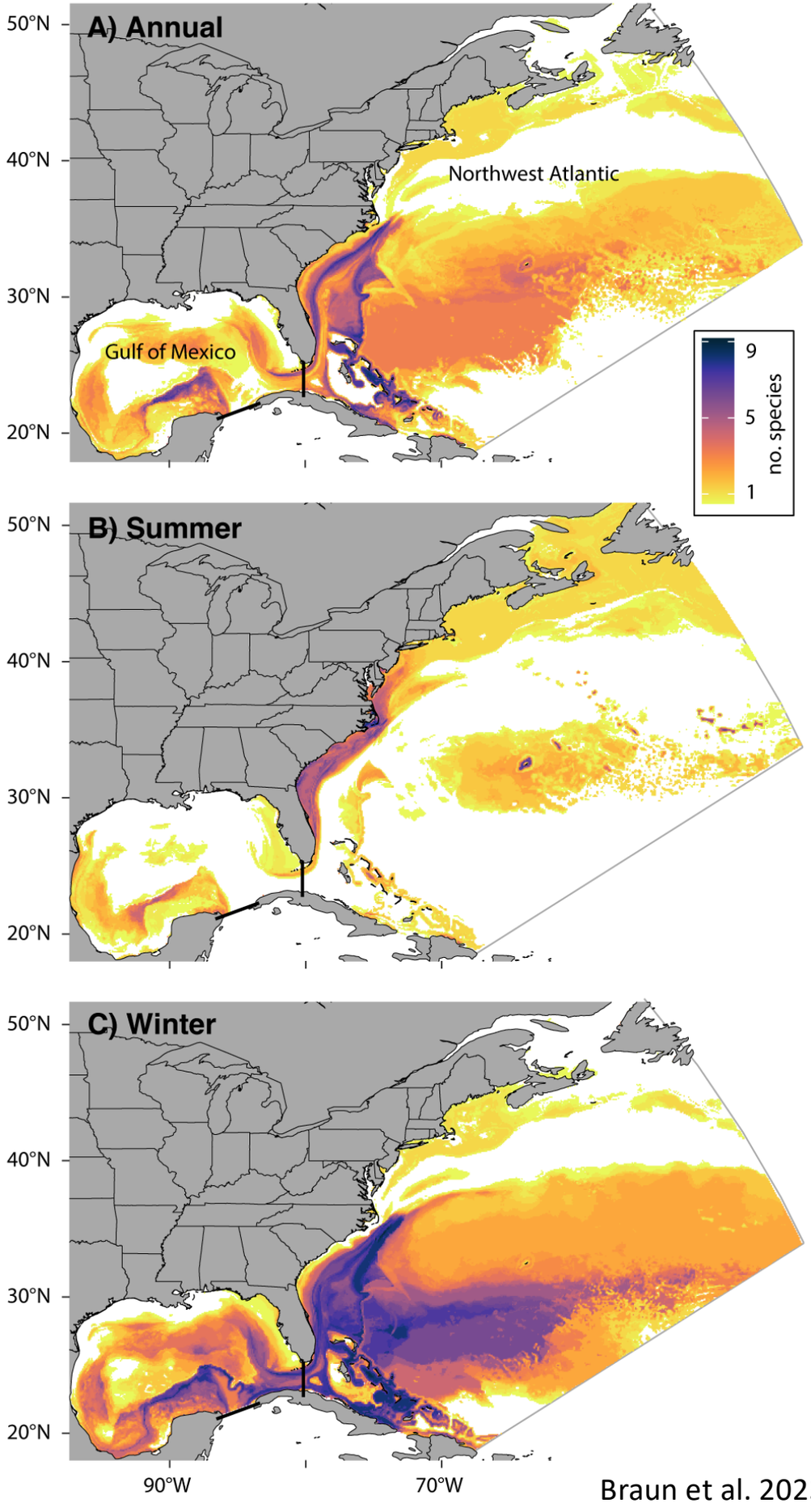


Predict suitable habitat

shark tracking!

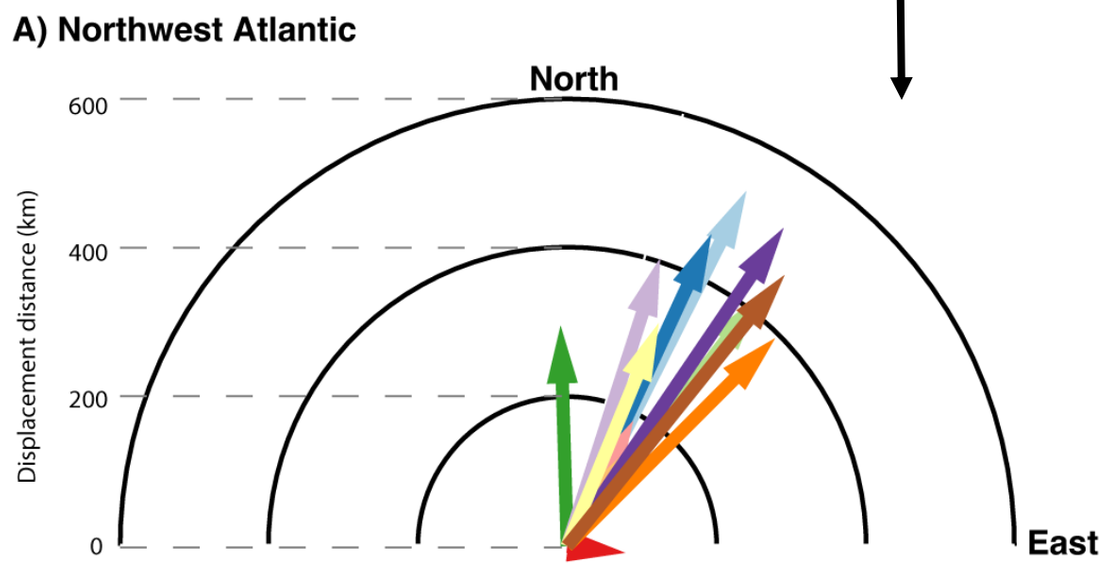


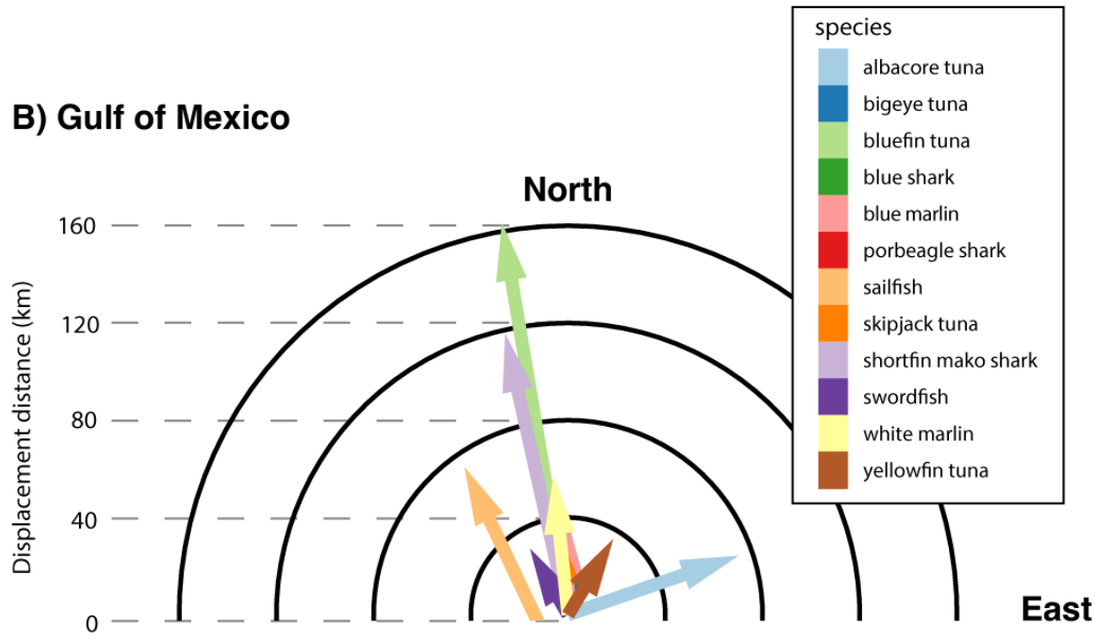
add mako ph



Species will lose habitat…

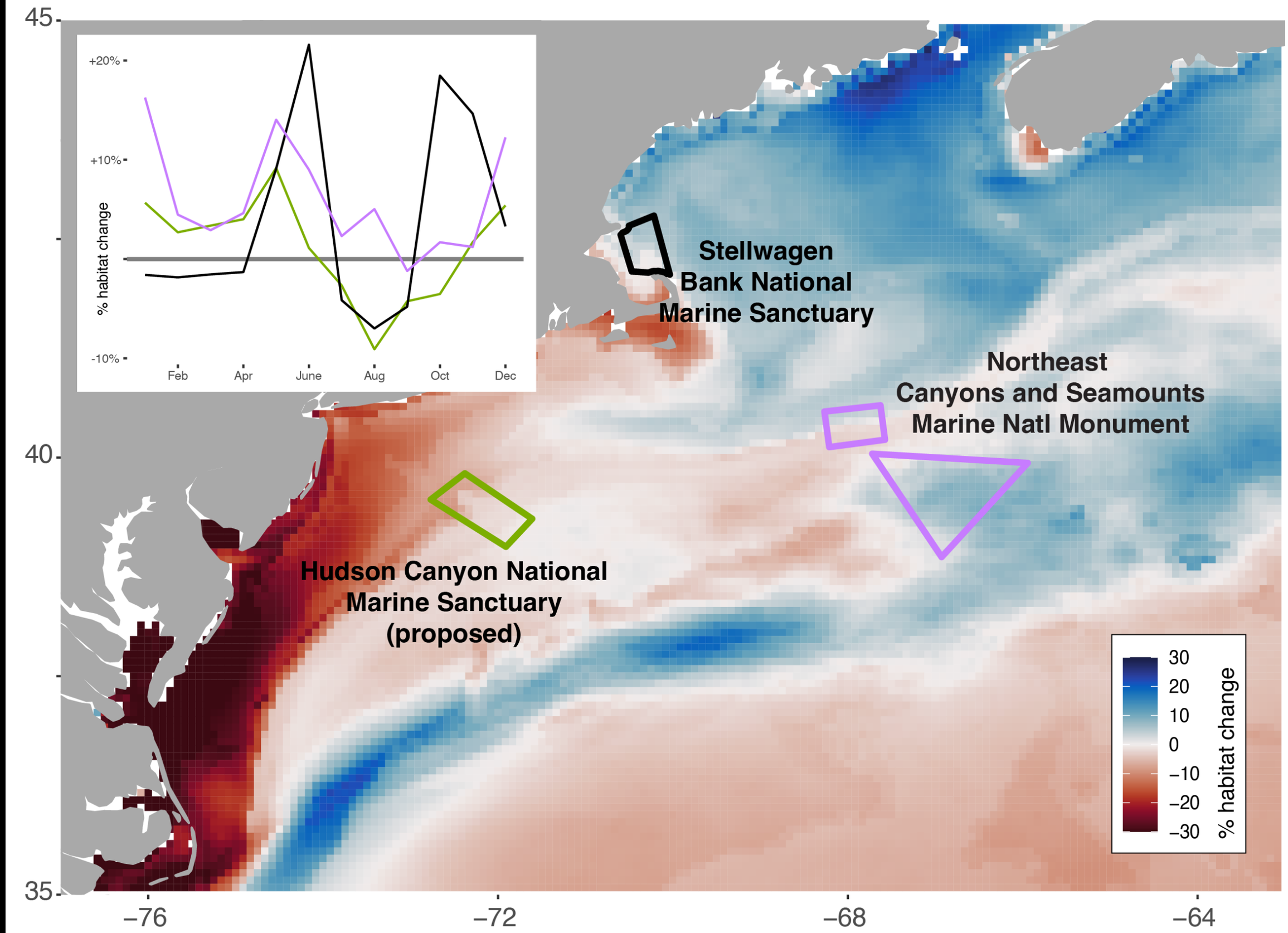
and re-distribute poleward (north)



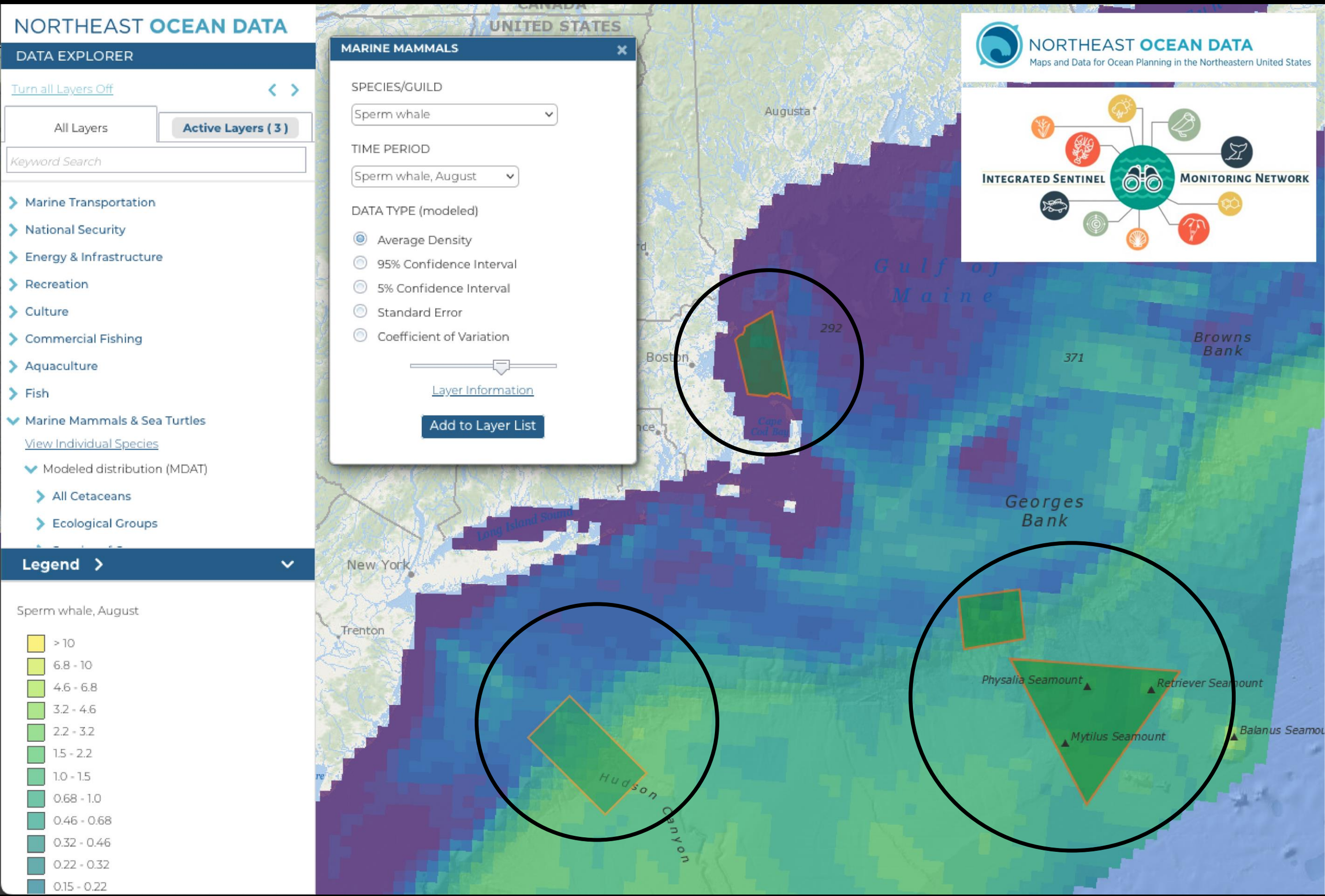


Braun et al. 2023, Sci. Adv.

Building “indicators” for marine spatial planning

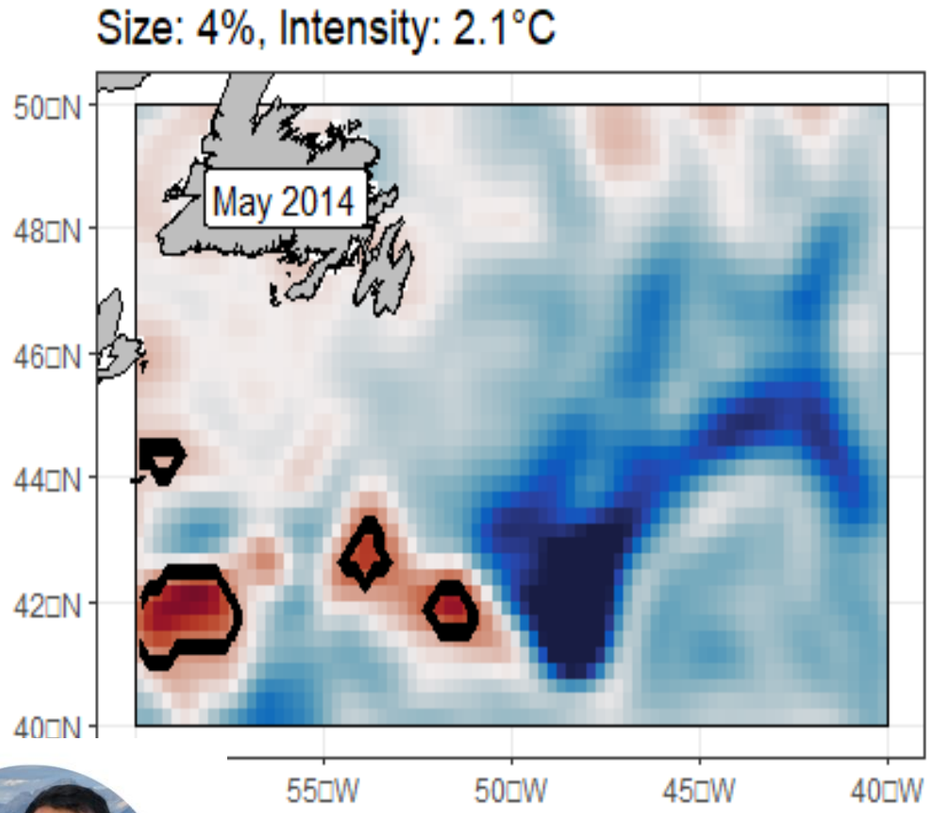


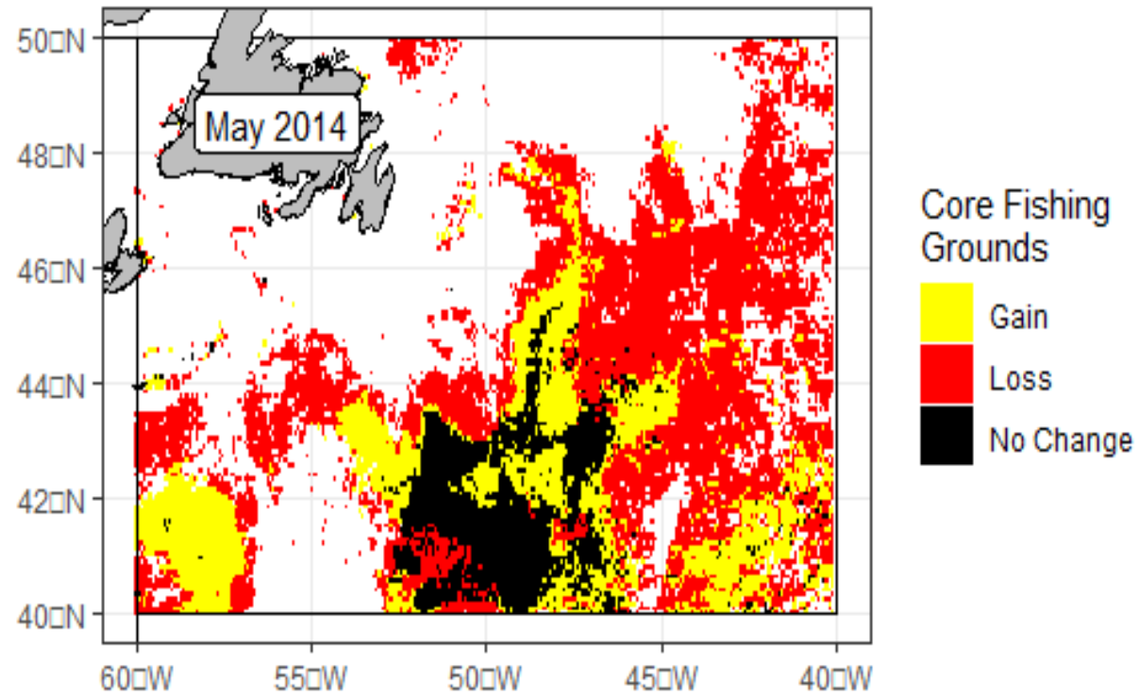
Making products available to stakeholders



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

Laura

NCC paper fig

Farchadi et al., 2024 Fish & Fisheries

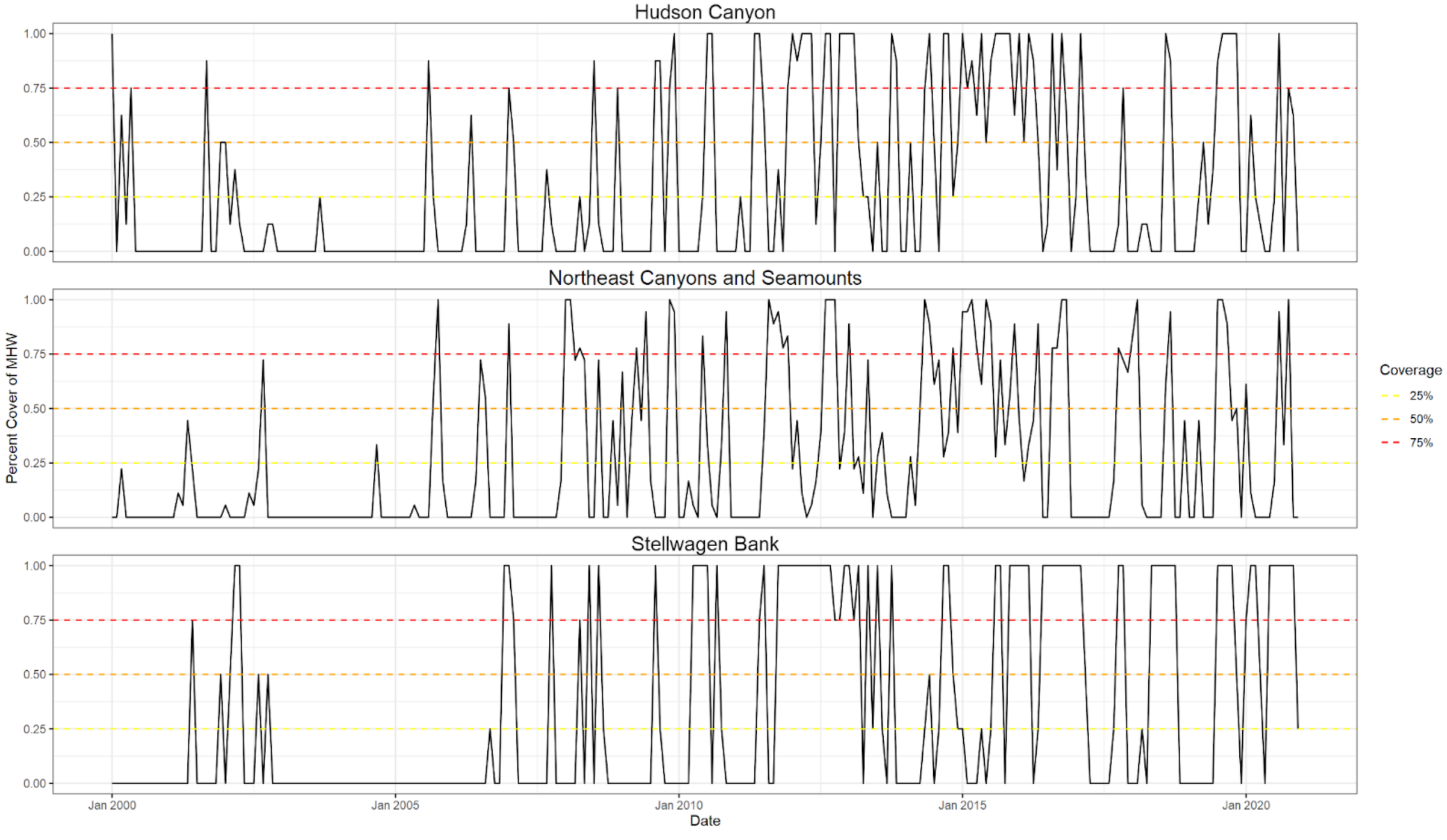
McDonnell, et al., 2025 Nature Climate Change

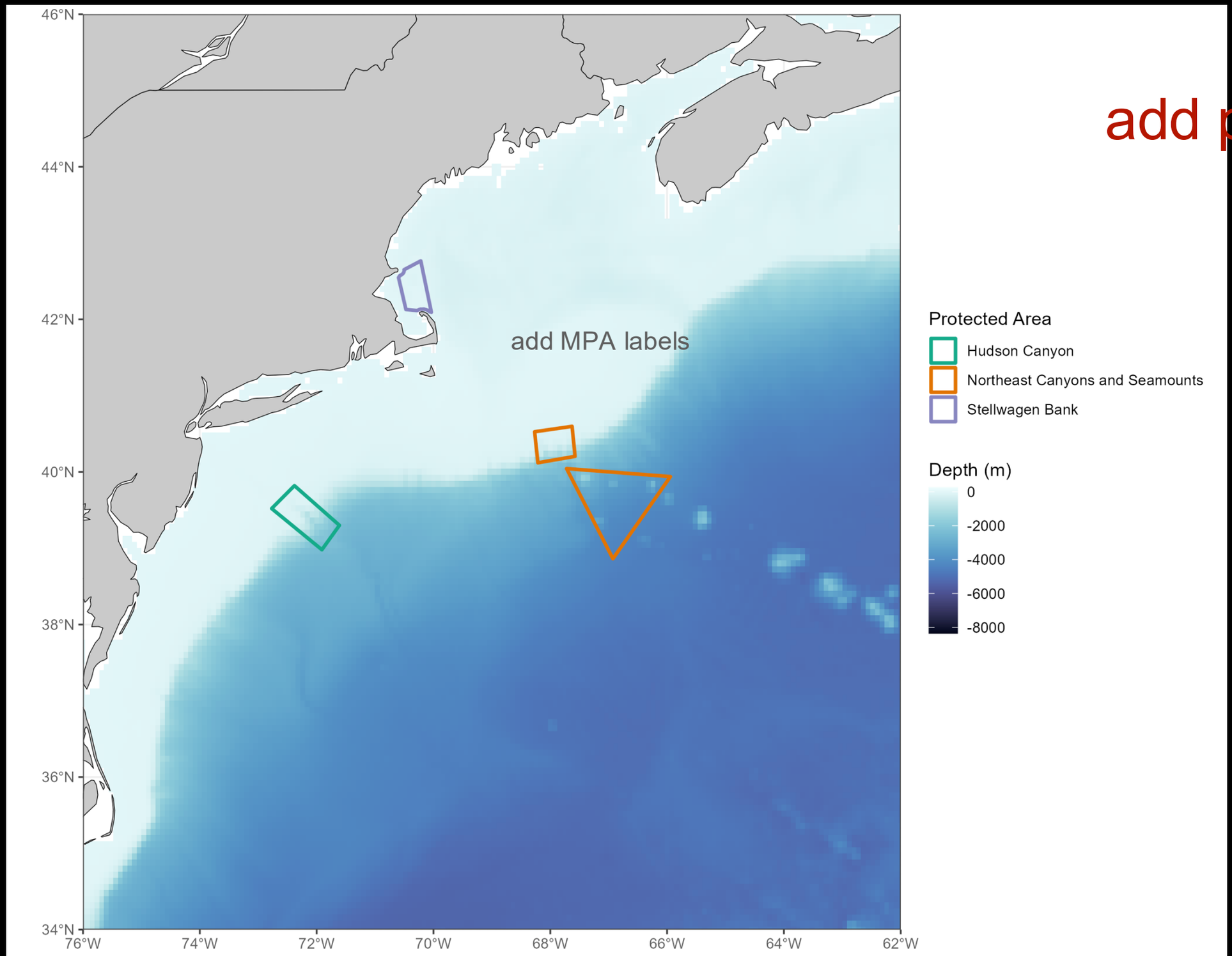
Building “indicators” for marine spatial planning

Marine heatwaves - frequency and intensity

Building “indicators” for marine spatial planning

Marine heatwaves - spatial coverage





add ppl to each mpa

Publications & other resources:

Fisheries and Climate Toolkit:

supporting climate-ready, resilient and sustainable fisheries

Camrin Braun[1], Nima Farchadi[2], Kathy Mills[3], Riley Young Morse[3], Stephanie Brodie[4], Heather Welch[4], Andrew Allyn[3], Elliott Hazen[4,5], Rebecca Lewison[2]

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

Rebecca Lewison

Camrin Braun

Kathy Mills

Elliott Hazen

Stephanie Brodie

Heather Welch

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Andrew Allyn

Riley Young-Morse

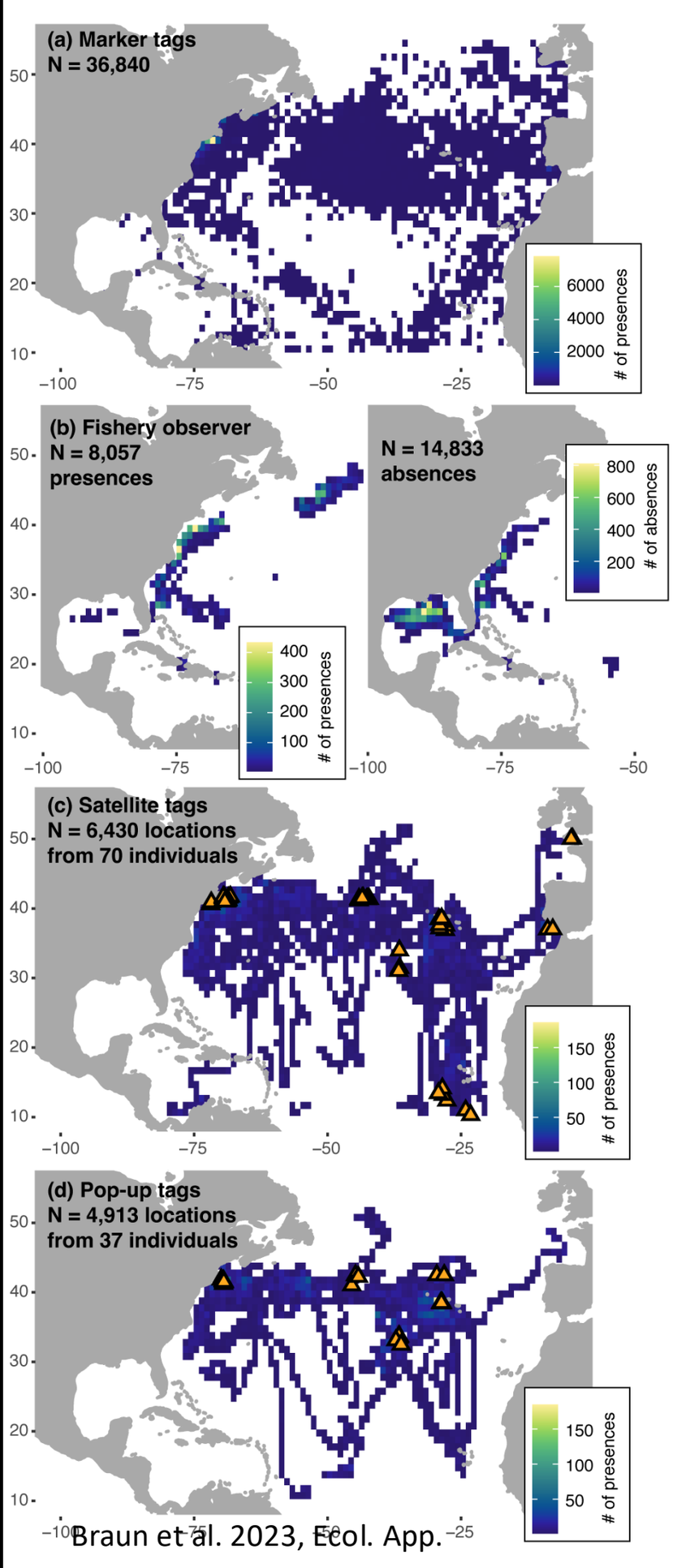
Alex Kerney

Dylan Pugh

Nerea Lezama Ochoa

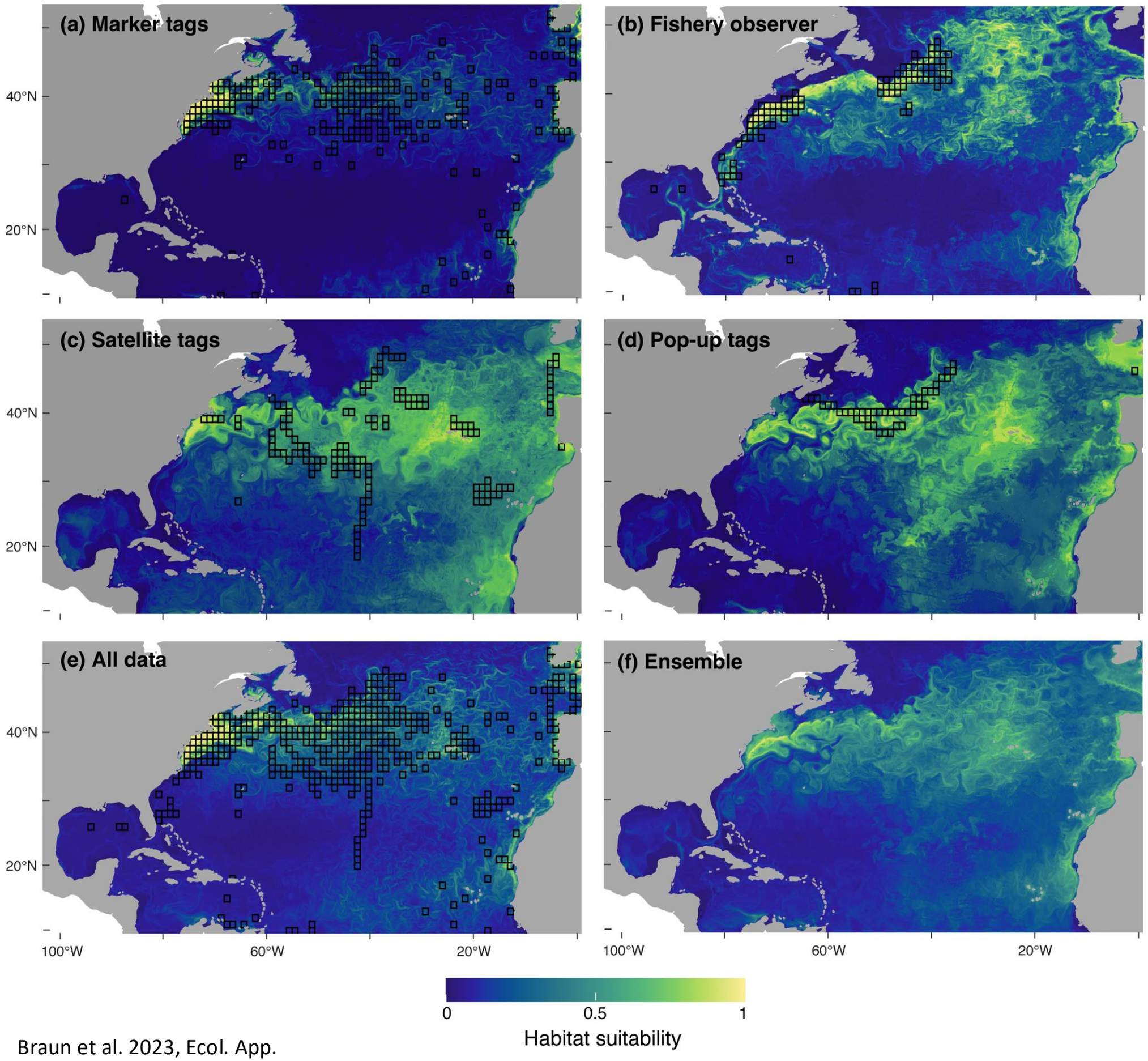
Stephen Bograd

Integrate multiple data types



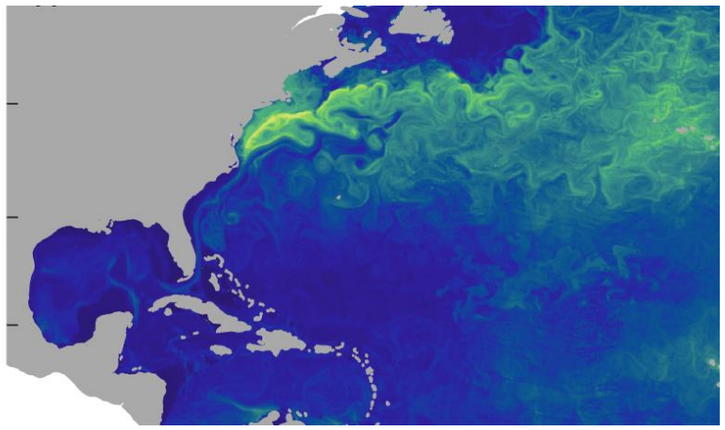
Braun et al. 2023, Ecol. App.

Photo by Eric Savetsky



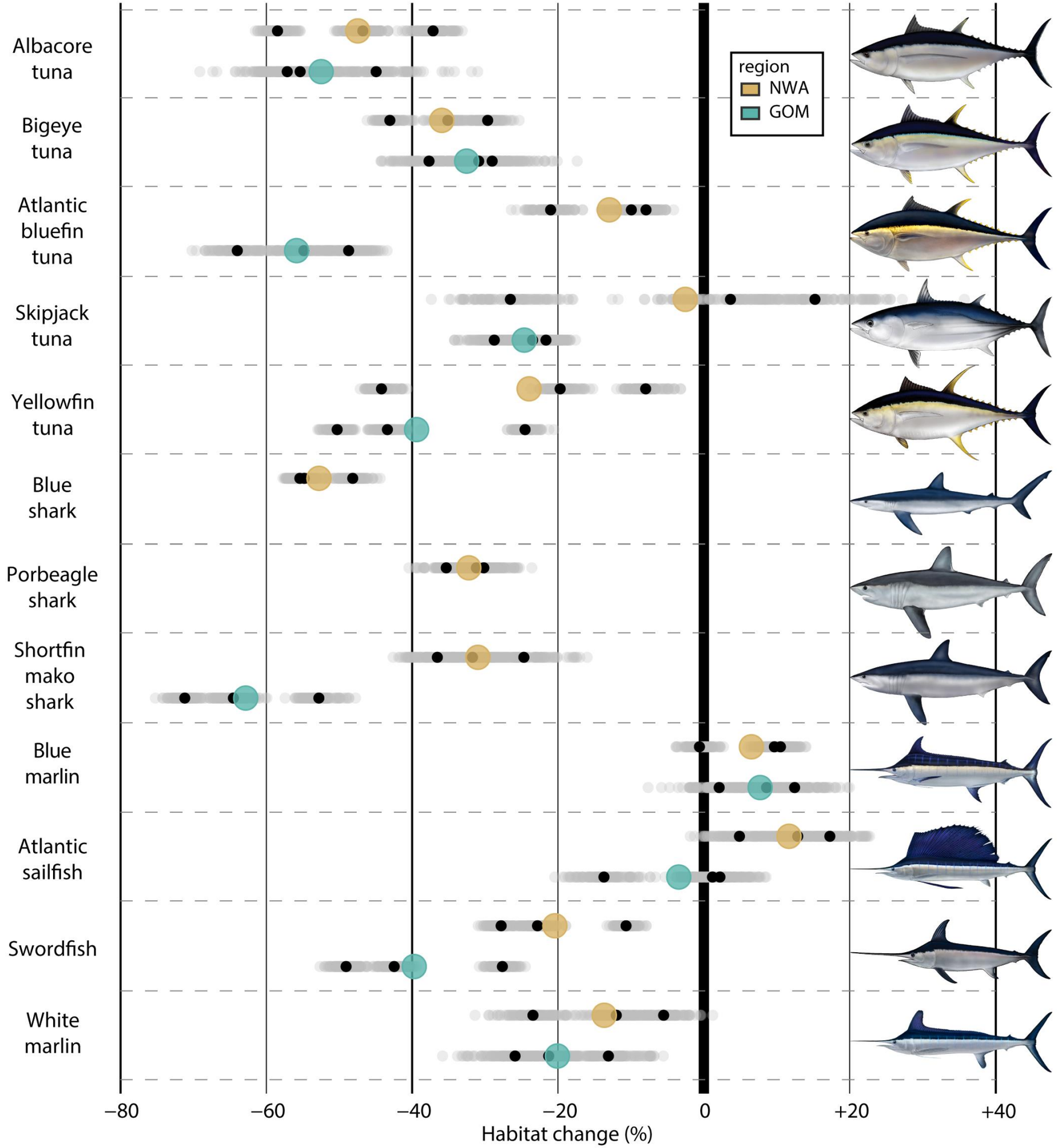
Braun et al. 2023, Ecol. App.

Expected habitat loss for most species

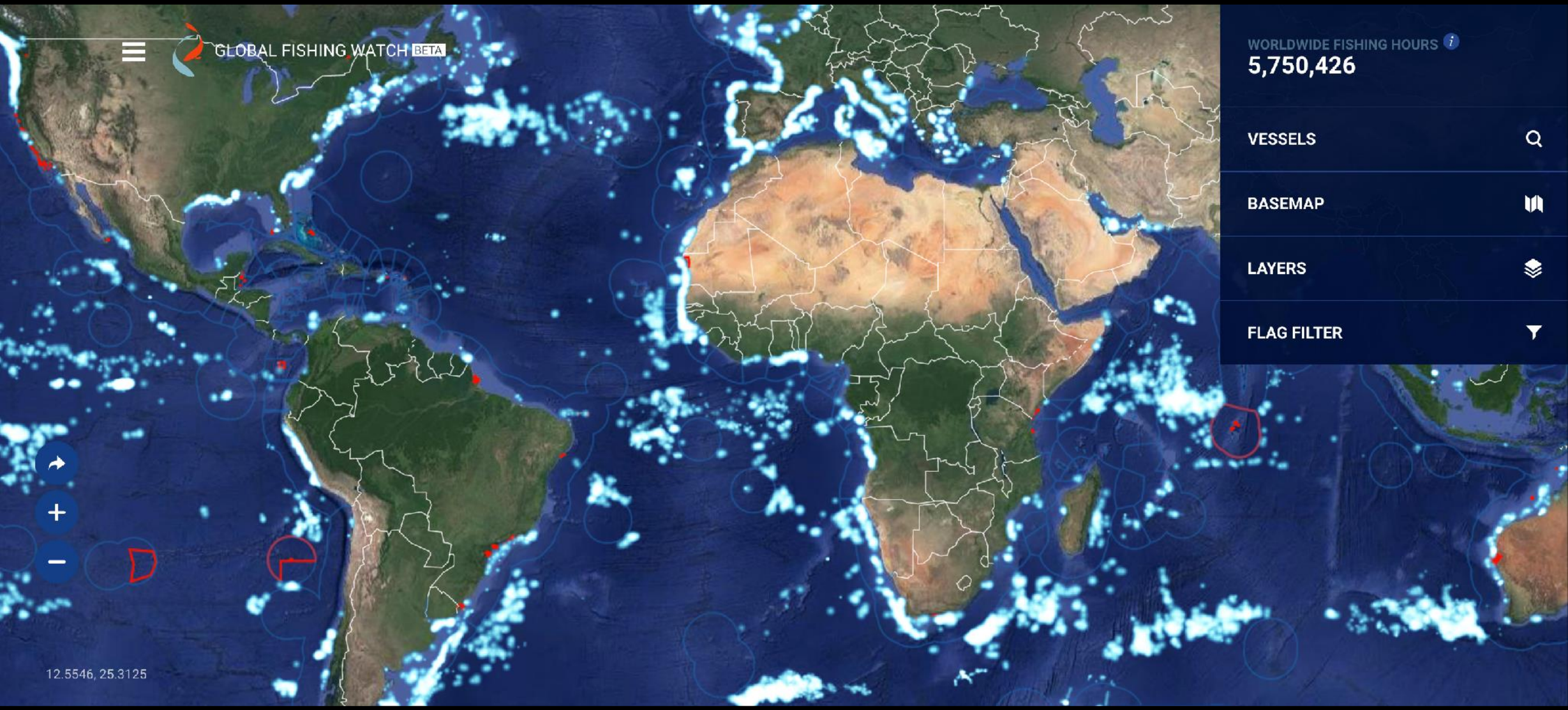


Predict habitat change over time

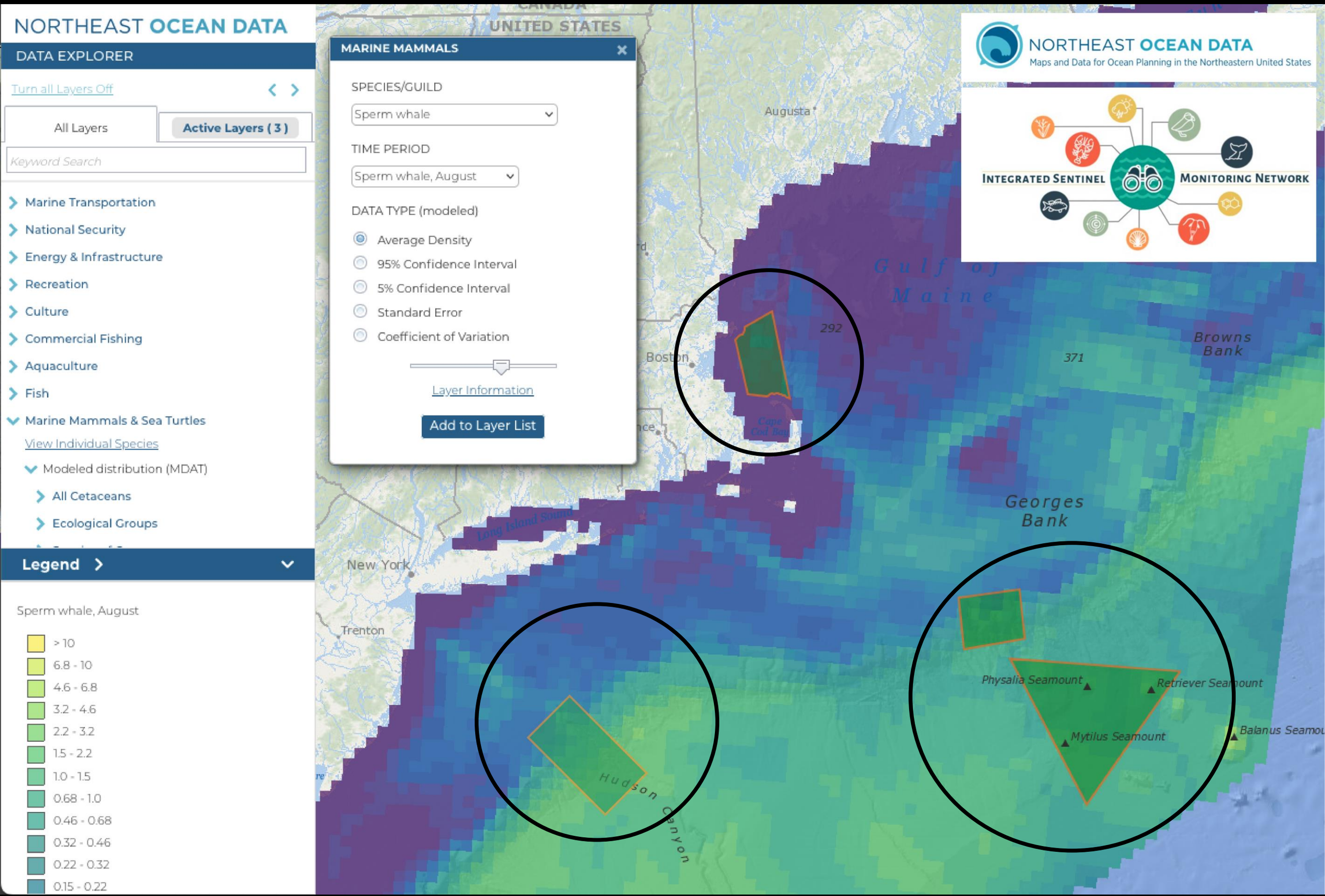
Braun et al. 2023, Sci. Adv.



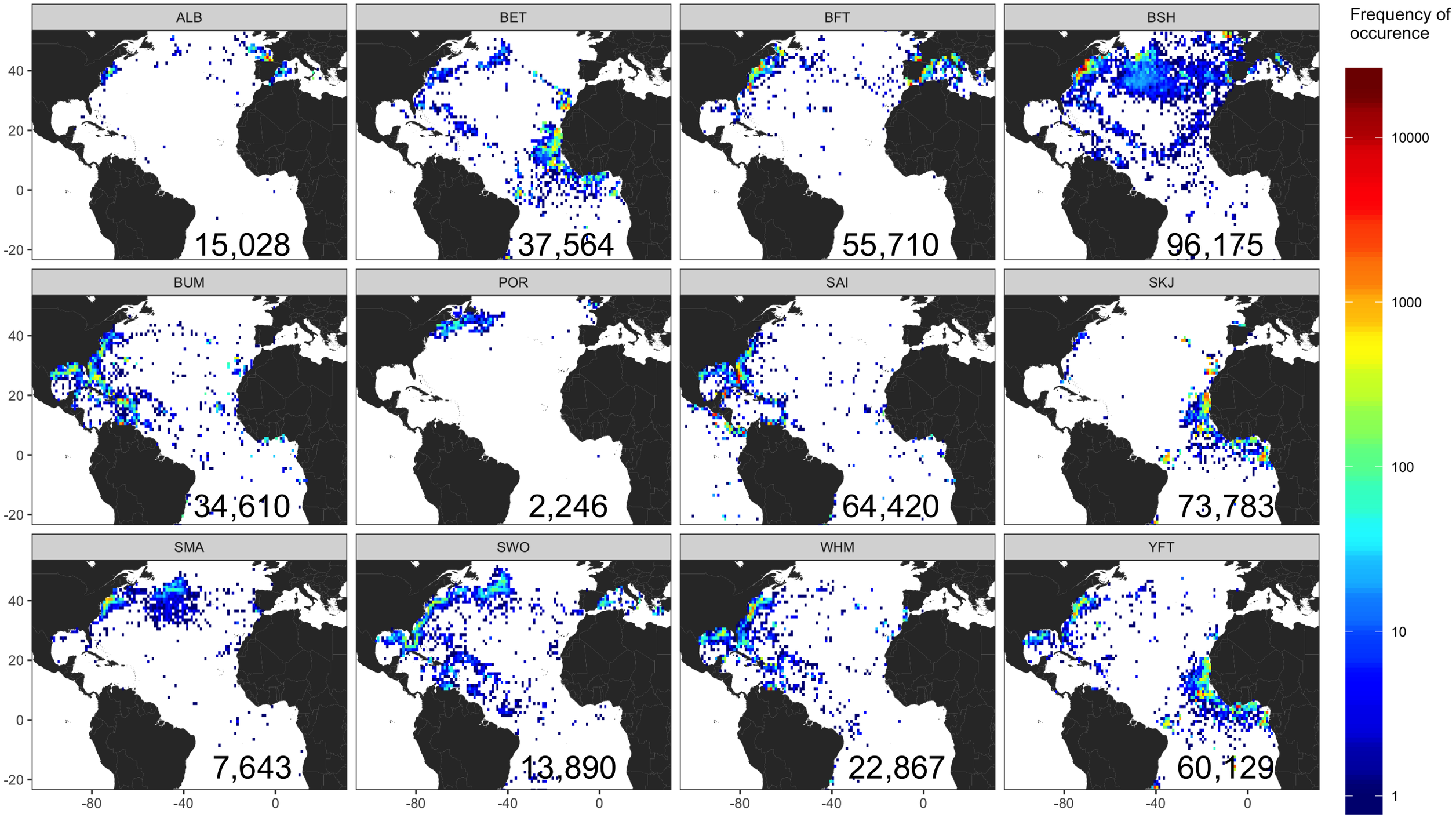
Mapping vessel traffic, including fishing vessels



Building “indicators” for marine spatial planning



Marker tags provide unique “big data” opportunity



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