

# **NOAA Office of Ocean Exploration and Research Update**

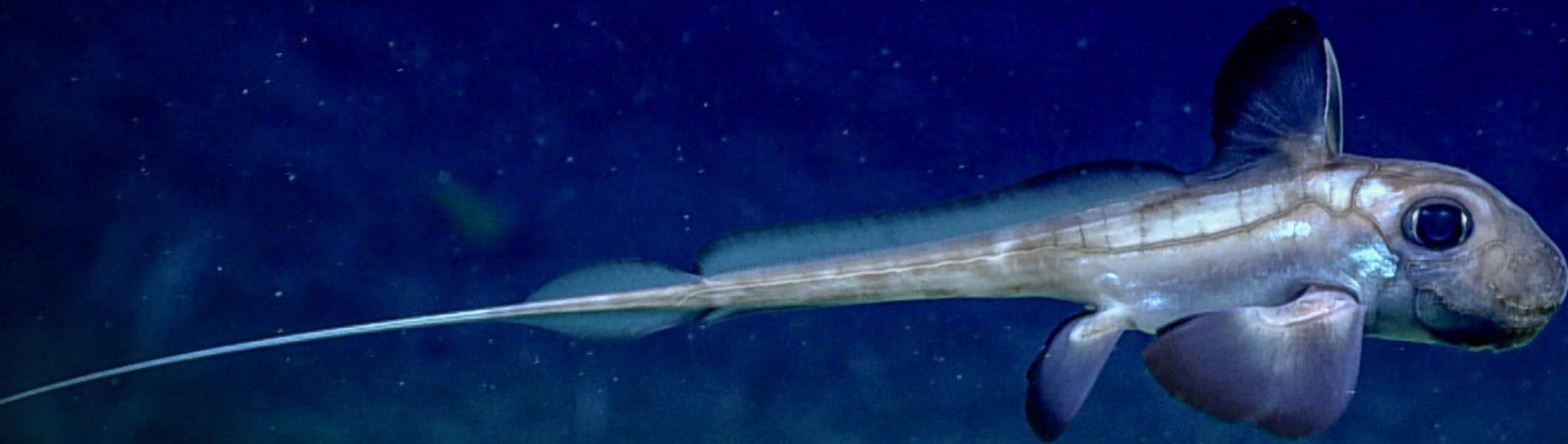
Alan Leonardi, Director  
Fourteenth Meeting, Ocean Exploration Advisory Board  
Washington, DC, December 3-4, 2019



**Ocean Exploration  
and Research**



*By leading national efforts to explore our ocean, NOAA Office of Ocean Exploration and Research is filling gaps in our understanding of U.S. deep waters and seafloor, providing the critical data and awareness needed to sustain and accelerate the economy, health, and security of our nation*



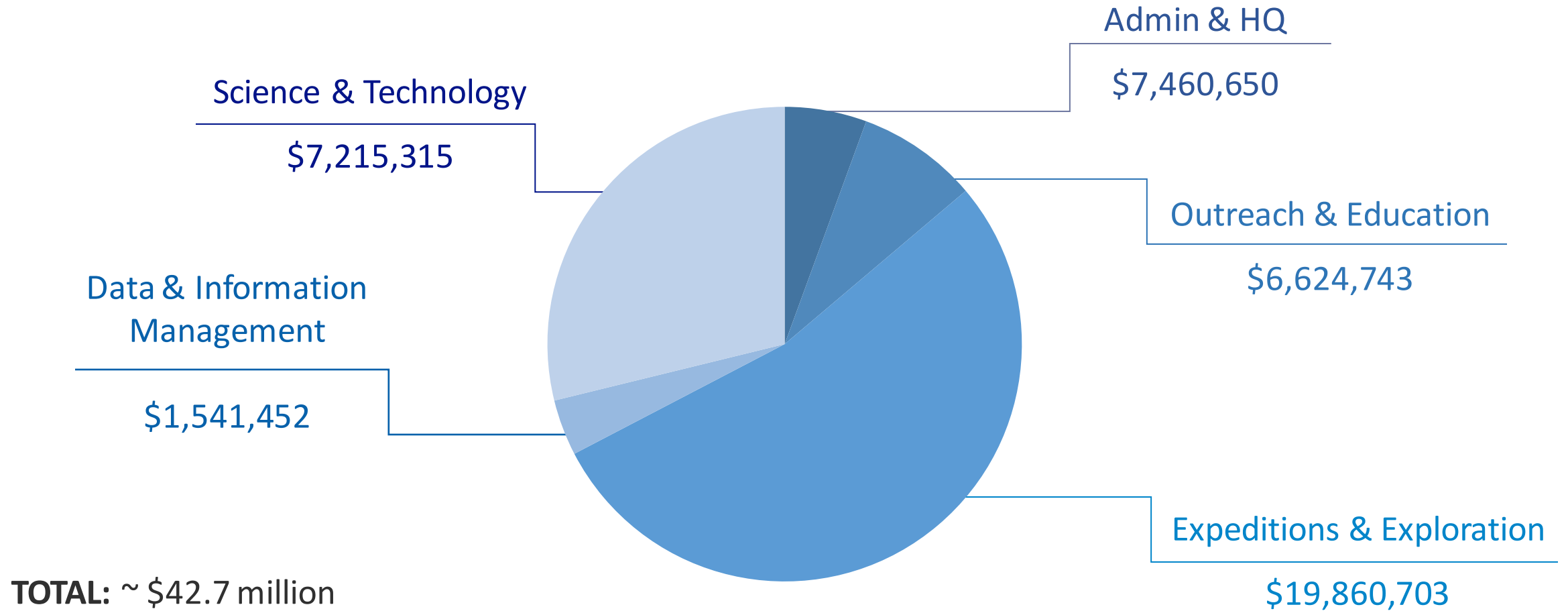
Ocean Exploration  
and Research

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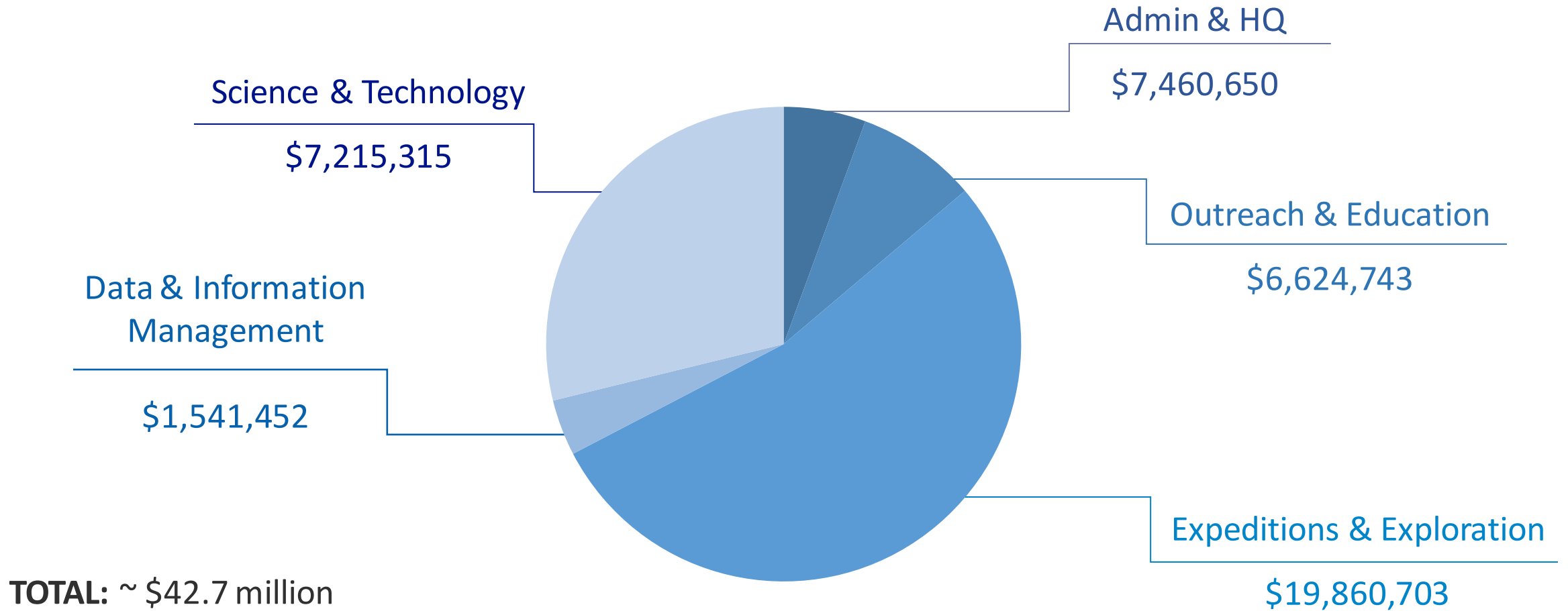
- FY19 and FY20 Budget Overview
- 2019 in Review
  - OER Modes of Exploration and Updates
    - NOAA Ship *Okeanos Explorer*
    - E/V *Nautilus*
    - DEEP SEARCH
    - EXPRESS
    - Atlantic Seafloor Partnership for Integrated Research and Exploration
    - Competitive Grants 2019
    - National Oceanographic Partnership Program
    - Extended Continental Shelf
    - New Ocean Exploration Cooperative Institute
- 2020 Outlook
  - Competitive Grants 2020
  - 2020 Expeditions



# Final Budget Execution for FY19 by Strategic Category



# FY20 OER Continuing Resolution by Strategic Category





# 2019

## A Year in Review





# Modes of Exploration

- NOAA Ship *Okeanos Explorer*
- Ocean Exploration Trust funding in support of E/V *Nautilus*
- Alliances: Schmidt Ocean Institute
- Partnerships: DEEP SEARCH, EXPRESS
- Competitive grants
- Extended Continental Shelf Project (ECS)
- National Oceanographic Partnership Program (NOPP)
- Ocean Exploration Cooperative Institute (OECI)





# Okeanos Explorer 2019 Highlights



## Windows to the Deep: Deep-sea Habitats of the Southeastern U.S.

- First exploration of the central Blake Plateau
- Extensive, previously unknown deep-sea coral and sponge habitat
- 25% of onboard mission and crew were women
  - Women held all onboard leadership positions

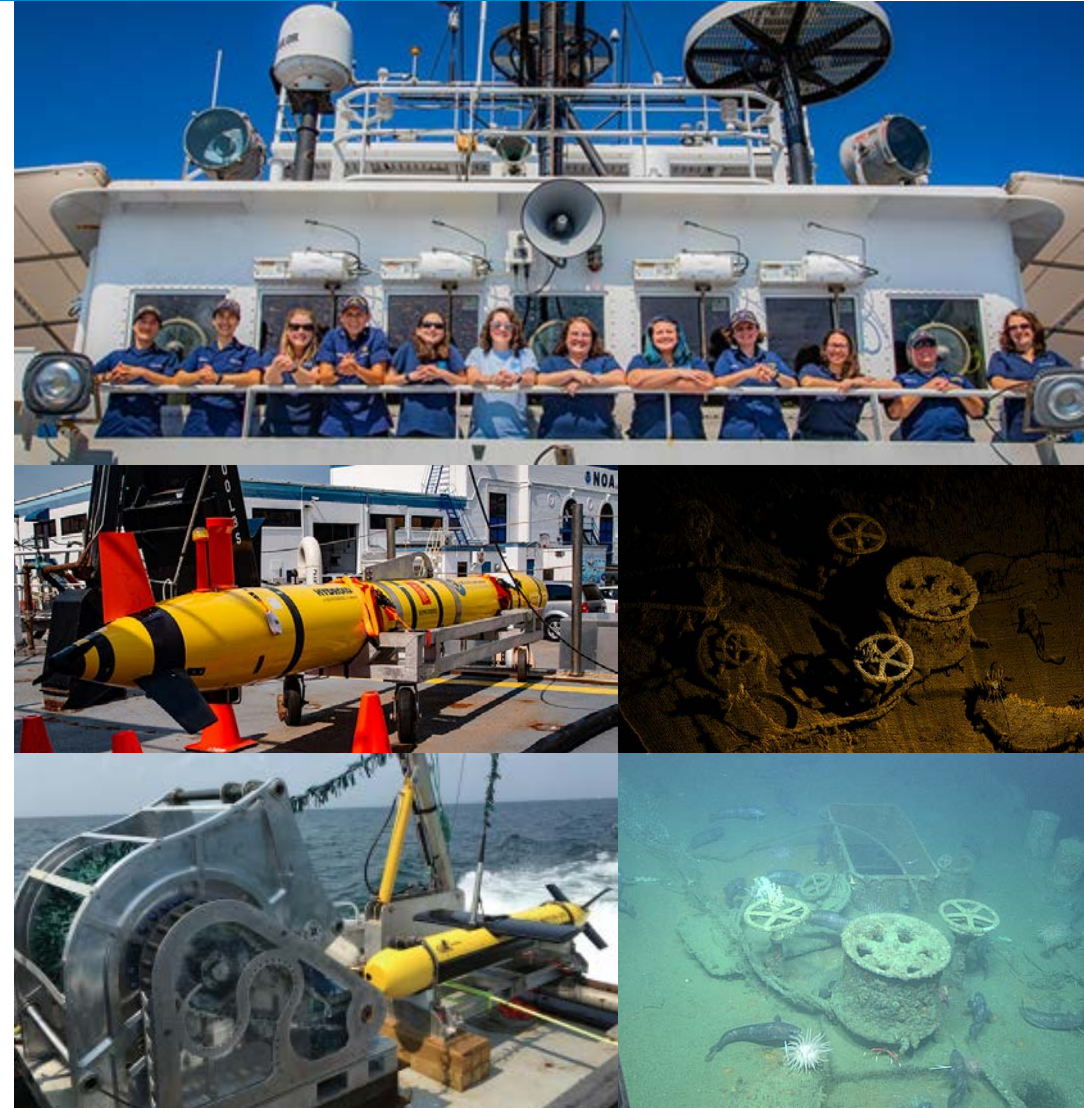
## 2019 Technology Demonstration

- Test new and emerging technologies; evaluate potential integration into NOAA operations
- Encourage collaboration with other institutions, including private partners



KRAKEN

Woods Hole  
Oceanographic  
Institution



Okeanos Explorer	OET	DEEP SEARCH	EXPRESS	Comp. grants	ECS	NOPP	OECI
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and Research



# *Okeanos Explorer* 2019 Highlights

## Deep Connections: Atlantic Canyons and Seamounts of the U.S. and Canada

- Six dives in three marine managed areas
- Transboundary U.S.-Canada expedition to improve understanding of biogeography and connectivity across Atlantic margin
- Endangered Atlantic halibut documented in deep-sea canyon off northeast coast – possibly critical habitat for species



<i>Okeanos Explorer</i>	OET	DEEP SEARCH	EXPRESS	Comp. grants	ECS	NOPP	OECI
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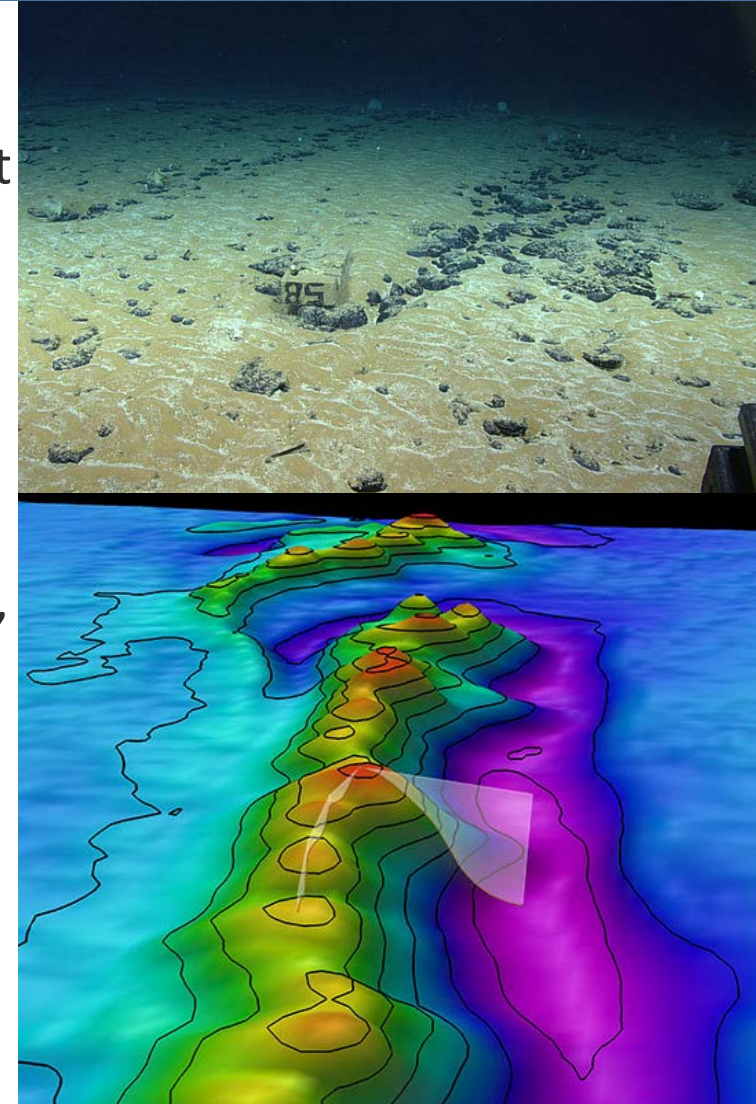


Ocean Exploration and Research

# *Okeanos Explorer* 2019 Highlights

## 2019 Southeastern U.S. Deep-sea Exploration

- Explored connectivity within and beyond Stetson-Miami Terrace Habitat Area of Particular Concern, including sites of interest to:
  - South Atlantic Fisheries Management Council
  - NOAA's Deep Sea Coral Research and Technology Program (DSCRTP)
- Investigation into long-term impacts of deep-sea mining. Partners:
  - U.S. Geological Survey (USGS)
  - Bureau of Ocean Energy Management (BOEM)
- Mapped and explored possible easternmost extent of "Million Mounds"
  - One of the largest areas of deep-sea coral reef habitat discovered in U.S. waters



<i>Okeanos Explorer</i>	OET	DEEP SEARCH	EXPRESS	Comp. grants	ECS	NOPP	OECI
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Ocean Exploration  
and Research





## A long-lost shipwreck was found by accident as NOAA tested equipment

By Gianluca Mezzofiore, CNN  
Updated 4:55 PM ET, Thu May 30, 2019

Scientists discovered 85 miles of deep-sea coral reef hidden off the US East Coast — here's what it looks like

BUSINESS  
INSIDER

Shipwreck found by accident on bottom of the Gulf of Mexico



ThayerMahan and Kraken Team Up on NOAA Op

yahoo!  
finance

OCEANS  
NOAA is Livestreaming a Deep Sea Expedition and It's Pretty Amazing

By Kevin Stark Jun 28

KQED SCIENCE



HUFFPOST

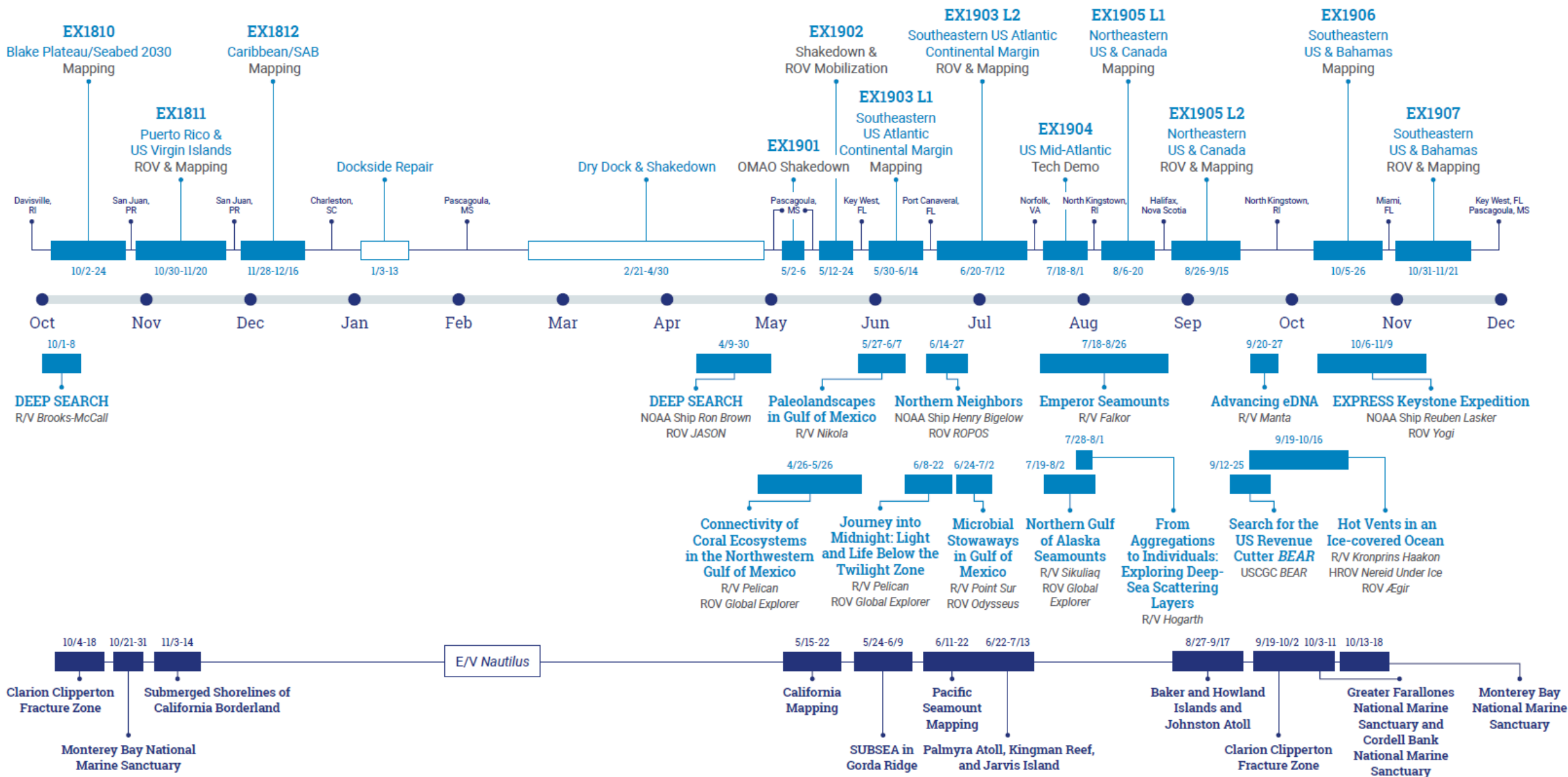
WEIRD NEWS 07/12/2019 05:45 am ET | Updated Jul 12

'No Way!' Stunned Scientists Watch As Wreckfish Eats A Whole Shark

A shark feeding frenzy gets interrupted in the wildest way possible.

SHARKS · Published July 8  
Shark swallowed whole during rare deep-sea feeding frenzy off South Carolina coast, video shows

# 2019 Expeditions





# NAUTILUS LIVE

2 0 1 9

GORDA RIDGE

GREATER FARALLONES  
CORDELL BANK  
MONTEREY BAY  
NATIONAL MARINE SANCTUARIES

CALIFORNIA MAPPING

PACIFIC  
SEAMOUNTS

OSBORN BANK

JOHNSTON ATOLL

CLARION-CLIPPERTON  
FRACTURE ZONE

KINGMAN REEF

PALMYRA ATOLL

HOWLAND ISLAND

BAKER ISLAND

JARVIS ISLAND

AMERICAN SAMOA

NATIONAL MARINE SANCTUARY OF  
AMERICAN SAMOA



# 2019 Expeditions



## NOAA Ship *Okeanos Explorer*

9 cruises

175,480 km<sup>2</sup> mapped  
37,684 linear km mapped

48 ROV dives

440 hours of ROV time

261 hours on bottom

851 hours of video

384 samples collected  
276 subsamples collected

4,998 m depth reached

200+ participating scientists

22 cruises

310,822 km<sup>2</sup> mapped  
65,343 linear km mapped

113 ROV dives

1,484 hours of ROV time

1,236 hours on bottom

1,895 hours of video

1,023 samples collected  
894 subsamples collected

4,998 m depth reached

hundreds of participating  
scientists

## E/V *Nautilus*

13 cruises

135,342 km<sup>2</sup> mapped  
27,659 linear km mapped

65 ROV dives

1,044 hours of ROV time

975 hours on bottom

1,044 hours of video

639 samples collected  
618 subsamples collected

3,384 m depth reached

150+ participating scientists



# 2019 Media



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OCEAN  
EXPLORATION  
TRUST

**590+ OER stories** were shared by international, national, and local media and websites.

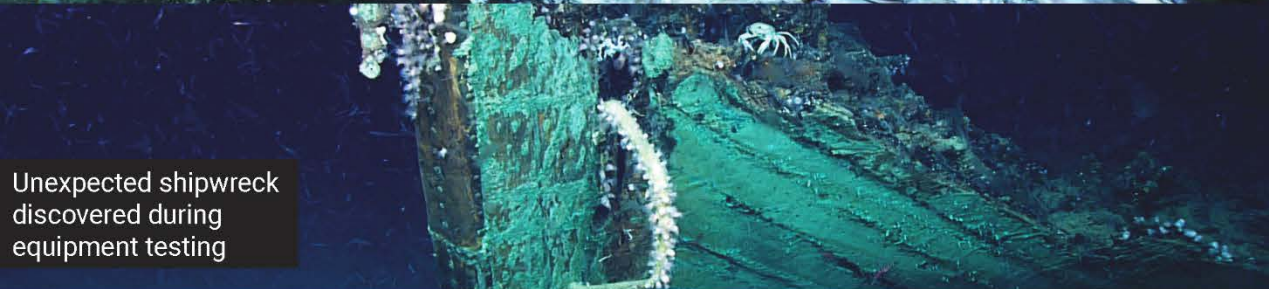
**1,095+ Nautilus-related news reports** were featured in international, national, and local media and websites. Expedition footage licensed for use in over a dozen documentary productions with distribution across National Geographic, BBC, Discovery, and Science Channel networks, and museum exhibitions around the world.



Swordfish fall being fed on by sharks off the coast of South Carolina



Whale fall feeding bonanza in Monterey Bay National Marine Sanctuary



Unexpected shipwreck discovered during equipment testing



Translucent *Deepstaria* jelly with a resident isopod



Giant squid seen in the Gulf of Mexico during a grant-funded expedition



Rarely-seen *Asperoteuthis mangoldae* squid

# 2019 Engagement and Outreach



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and Research



OCEAN  
EXPLORATION  
TRUST

% change from FY18



Website Visits

~4,300,000

~1,300,000

↓ 24.3% decrease



Live Video Views

~535,000

~1,500,000

↓ 26% decrease



Facebook Followers

144,867

104,200

↑ 8.5% increase



Twitter Followers

~188,300

~34,900

↑ 7.2% increase



Instagram Followers

~72,200

~96,400

↑ 106.9% increase



YouTube Views

~4,454,000

~10,000,000

↑ 8.2% increase

YouTube Subscribers

~85,700

~244,000

↑ 44.3% increase

YouTube Minutes Watched

~14,000,000

~6,700,000

↓ 47.5% decrease



Educators Trained

672

753

↑ 39.3% increase

Reached Students

81,312

13,070

↓ 26.1% decrease

Educator Workshops

30

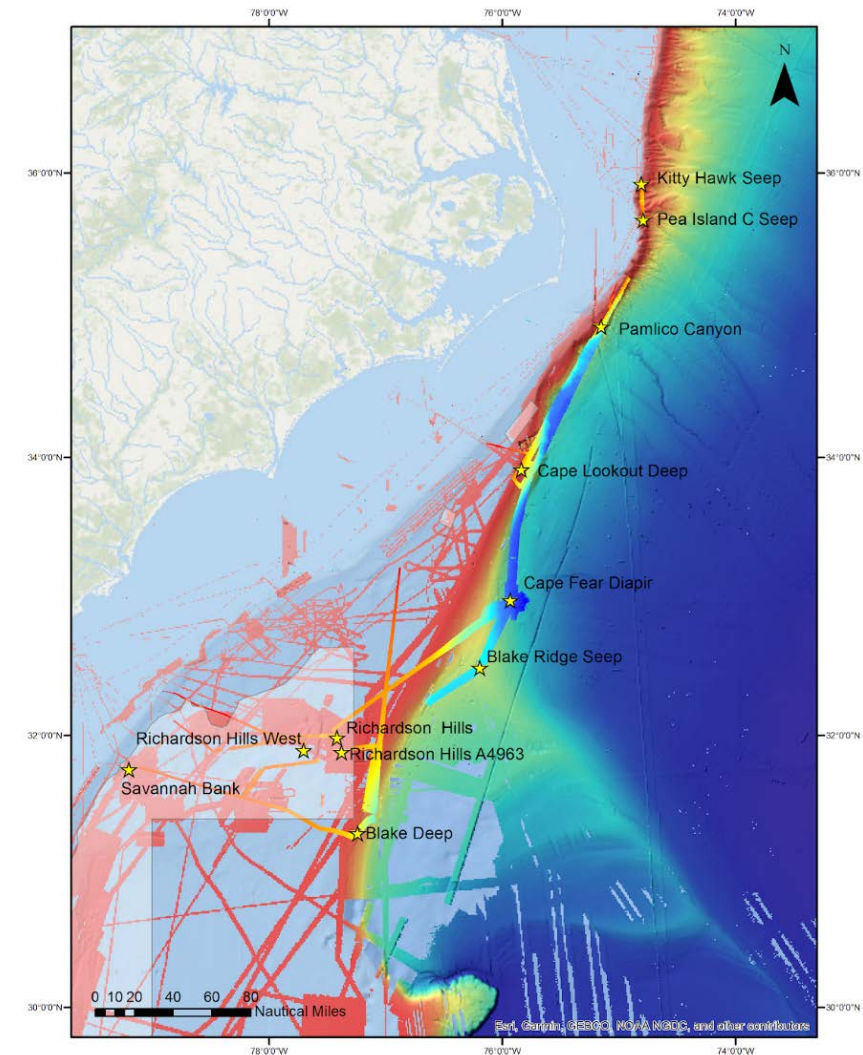
3

↓ 17.5% decrease



# DEEP SEARCH

- \$12M, 4.5-year NOPP-funded BOEM-USGS-NOAA project
- Goal: Document sensitive canyon, seep, and coral habitats off U.S. Atlantic Coast to inform management decisions should offshore resource development occur
- Fieldwork completed 2019; analysis continues through 2021
  - 22-day cruise in April 2019 on NOAA Ship *Ronald H. Brown*
    - 11 ROV dives
    - Over 1,600 biological and geological samples
    - Range extension of vestimentiferan tube worms
  - 9-day cruise in October 2019 on NOAA Ship *Nancy Foster*
    - 8 midwater trawls and 17 CTD casts at three sites
    - Recovered benthic lander from Richardson Hills





# ASPIRE EXPEDITIONS

## Northern Neighbors: Transboundary Exploration of Deepwater Communities

June 2017, June 2019

NOAA NMFS/Dalhousie University, NOAA Ship *Henry B. Bigelow*

## Northeast US Tech Demonstration

July 2019

NOAA OER, NOAA Ship *Okeanos Explorer*

## Carolina Canyons

August 2016, August 2017

NOAA NMFS, NOAA Ship *Pisces*

## DEEP SEARCH

2017-2019

BOEM/USGS/NOAA, Multiple Platforms

## Blake Plateau Mapping

Spring 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

## Southeast US ROV and Mapping

Summer 2018, Spring 2019

NOAA OER/NMFS/ONMS, NOAA Ship *Okeanos Explorer*

## US-Canada ROV and Mapping

Summer 2019

NOAA OER/ONMS, NOAA Ship *Okeanos Explorer*

## Canada Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

## Mid-Atlantic Ridge ROV and Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

## Mid-Atlantic Ridge Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

## Mid-Atlantic Ridge ROV and Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

## Southeast US ROV and Mapping

Fall 2019

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

## US Southeast and Bahama Ridge Mapping

October 2018

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

## ASMIWG Pilot Area Mapping

July 2018

NOAA OER, NOAA Ship *Okeanos Explorer*

## US Caribbean ROV and Mapping

Fall 2018

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

## US Caribbean Tech Demonstration

Spring 2020

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

## US Caribbean Mapping

Spring 2020

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

Last updated: October 8, 2019



# Atlantic Seafloor Partnership for Integrated Research and Exploration: Outcomes to Date

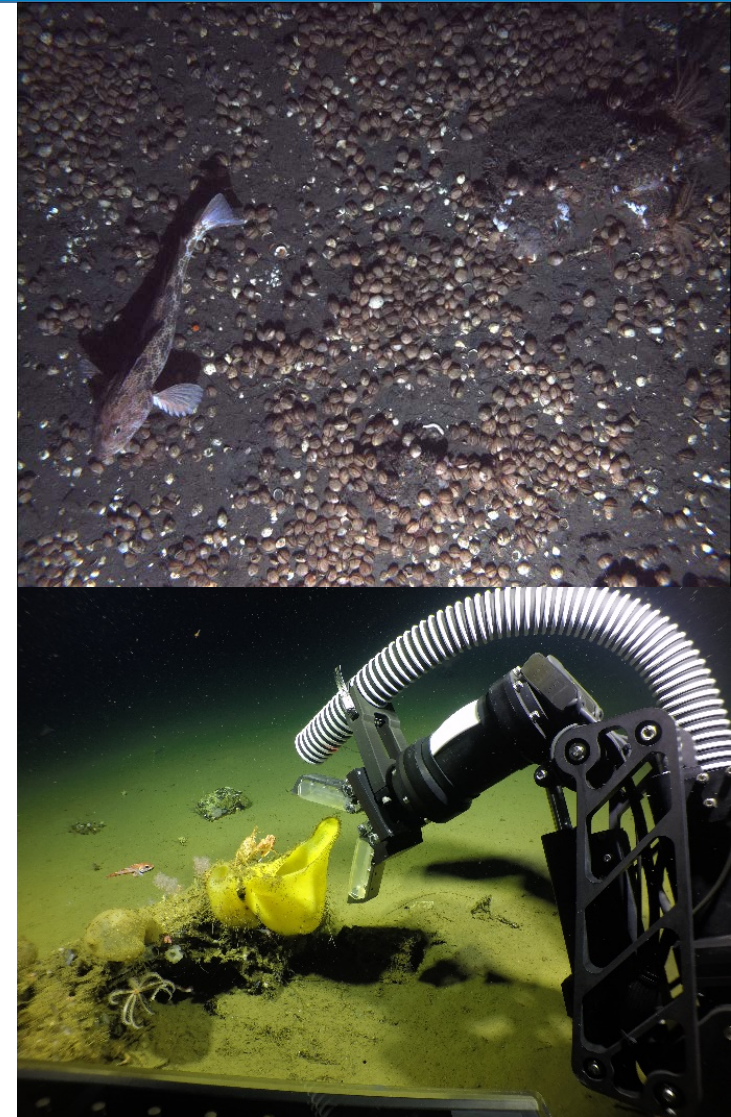


- Mapped over 245,000 square kilometers in support of NOAA goal of mapping U.S. EEZ by 2030
- Prioritized areas of interest to key partners and resource managers, including:
  - Southeast Deep Coral Initiative
  - South Atlantic Fishery Management Council
  - Northeast Canyons and Seamounts Marine National Monument
- Began Canadian and European collaborations for 2019-2020 expeditions
- Contracted Fugro to map ~27,000 square kilometers on Blake Plateau



# EXPRESS

- Ongoing West Coast campaign between BOEM, USGS, NOAA, nongovernmental organizations
- Aligned with NOAA's West Coast Deep-sea Coral Initiative
- Investigations inform:
  - Commercial fisheries
  - Understanding of deep-sea corals and sponges
  - Sanctuary management
  - Potential critical minerals and offshore wind energy siting
  - Cascadia Margin mapping and marine geohazards
  - Testing and development of new technologies





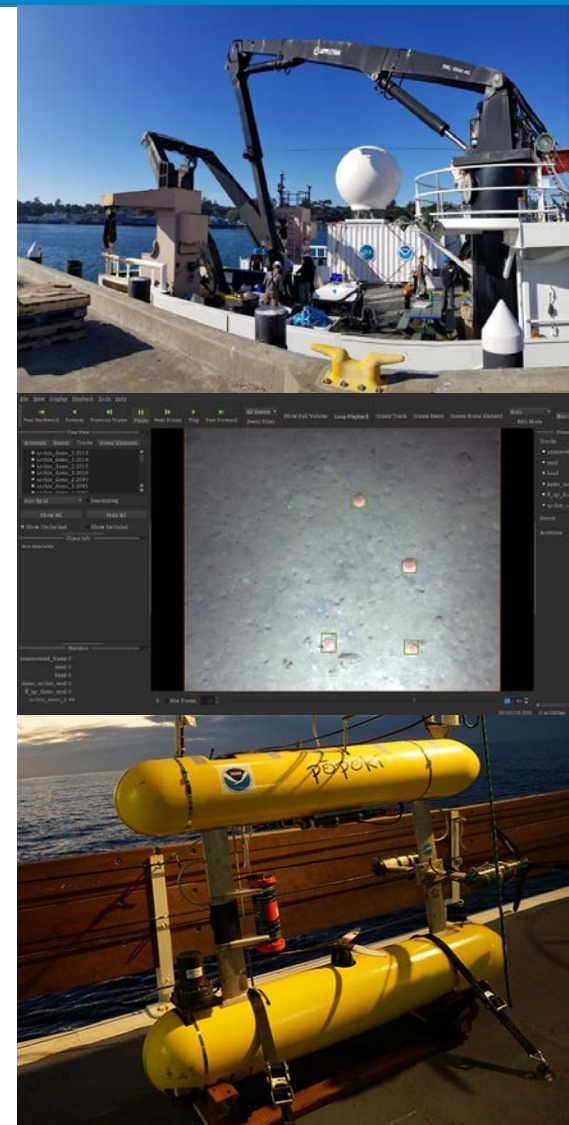
# EXPRESS

## Fall 2019 EXPRESS NOAA Ship *Reuben Lasker* Investments

- OER: \$649K
- NOAA NOPP: \$300K
- NOAA Fisheries DSCRTP: \$170K
- NOAA Office of Marine and Aviation Operations: \$293K
- BOEM: \$146K
- USGS: \$500K

## ROV dives and 20 AUV dives in 15 West Coast locations

- 200,000 AUV images
- 110 corals, sponges, and water samples for eDNA analysis
- 20 CTD casts with monocoar to sample mud core
- First test of OER-sponsored Global Foundation for Ocean Exploration fly-away telepresence
  - First on a NOAA Fisheries survey vessel
  - Three live interactions (Exploratorium, schools)
- Port event with the Exploratorium
- Data will be analyzed to provide coast-wide distribution of deep-sea corals, sponges, fishes, and their associates



*Okeanos  
Explorer*

OET

DEEP  
SEARCH

EXPRESS

Comp.  
grants

ECS

NOPP

OECI



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# Competitive Grants 2019 Highlights

## Blue Holes

- Found two endangered sawfish; unexpected increase in O<sub>2</sub> at 60 meters
- To be featured in an episode of PBS' "Changing Seas"

## Journey into Midnight

- Using the Medusa stealth camera system, recorded first sighting of giant squid in U.S. waters

## Microbial Stowaways

- Discovered two 19th century shipwrecks that will shed light on both history and microbial biodiversity
- Other projects helped advance eDNA testing, soft robotics and deep-sea sampling, long-endurance ocean robots, photothermal interferometry



*Credit: Conor Goulding/Mote Marine Laboratory*



*Credit: Edie Widder and Nathan Robinson*



# National Oceanographic Partnership Program



## 2019 Autonomous Mapping Awards

- \$3 million advancing autonomous mapping in the deep ocean
  - OER leveraged \$1.5 million of OAR NOPP funds
  - Three awards, three different platform types

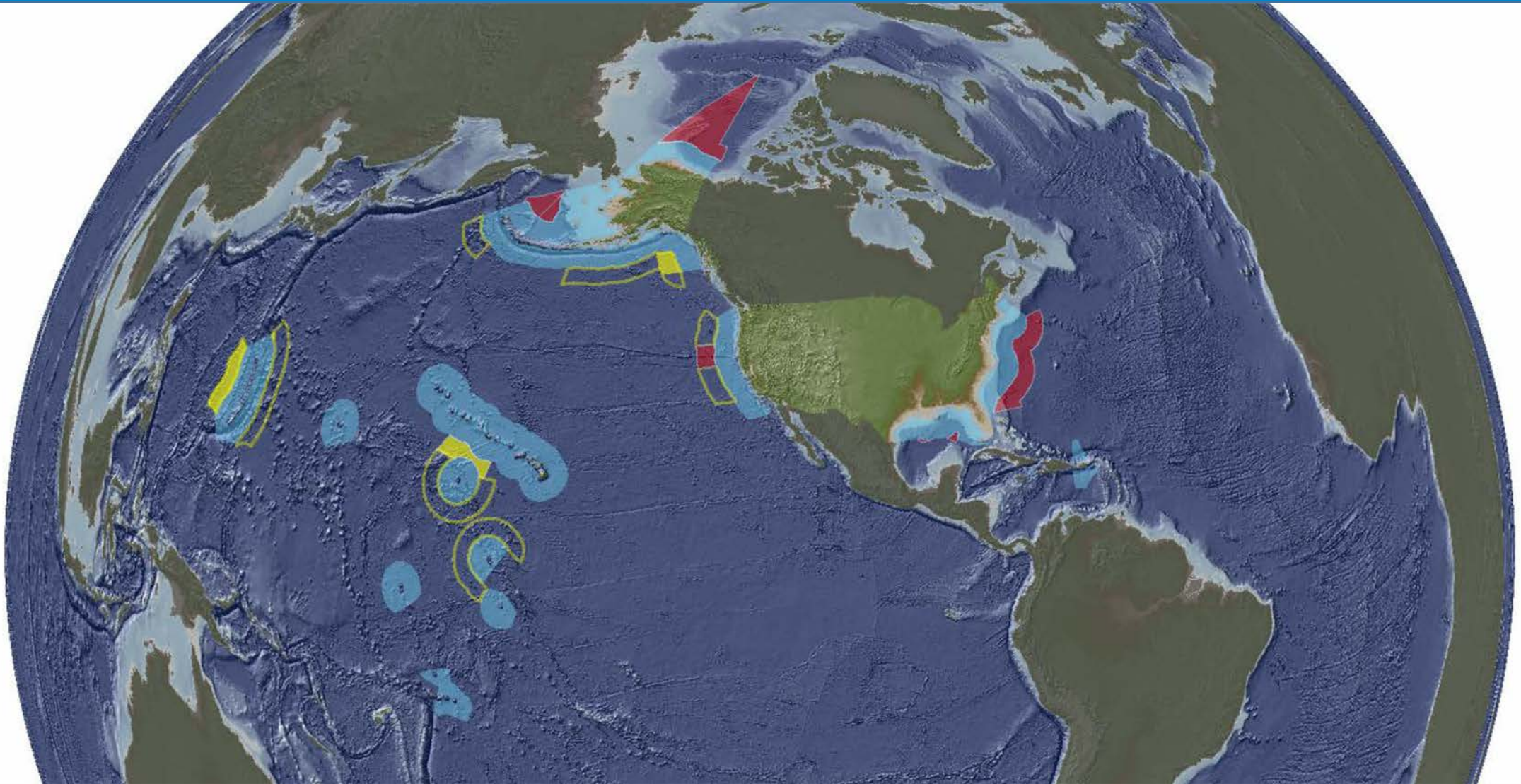


Okeanos Explorer	OET	DEEP SEARCH	EXPRESS	Comp. grants	ECS	NOPP	OECI
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Ocean Exploration and Research

# U.S. Extended Continental Shelf Project





# Extended Continental Shelf in 2019/2020

- Continue management and archiving of ECS data and derived products with U.S. ECS project partners
- Draft regionally specific documents for submission to Commission on the Limits of the Continental Shelf
- No additional at-sea data collection planned
- Contributions to general ocean exploration include:
  - New data management indexing and visualization tools
  - Investigation into the use of ECS multibeam data to classify habitat
  - Data availability for baseline characterization



# New Ocean Exploration Cooperative Institute

- University of Rhode Island is hosting NOAA's Ocean Exploration Cooperative Institute
- OEI will facilitate a long-term collaborative environment between NOAA and the awardees
- A priority is to transition toward development of smaller, less expensive mobile ROVs and AUVs for ocean exploration and mapping
- These next-generation instruments can be launched from a wide variety of oceanographic vessels



THE  
UNIVERSITY  
OF RHODE ISLAND



Woods Hole  
Oceanographic  
INSTITUTION



<i>Okeanos Explorer</i>	OET	DEEP SEARCH	EXPRESS	Comp. grants	ECS	NOPP	OEI
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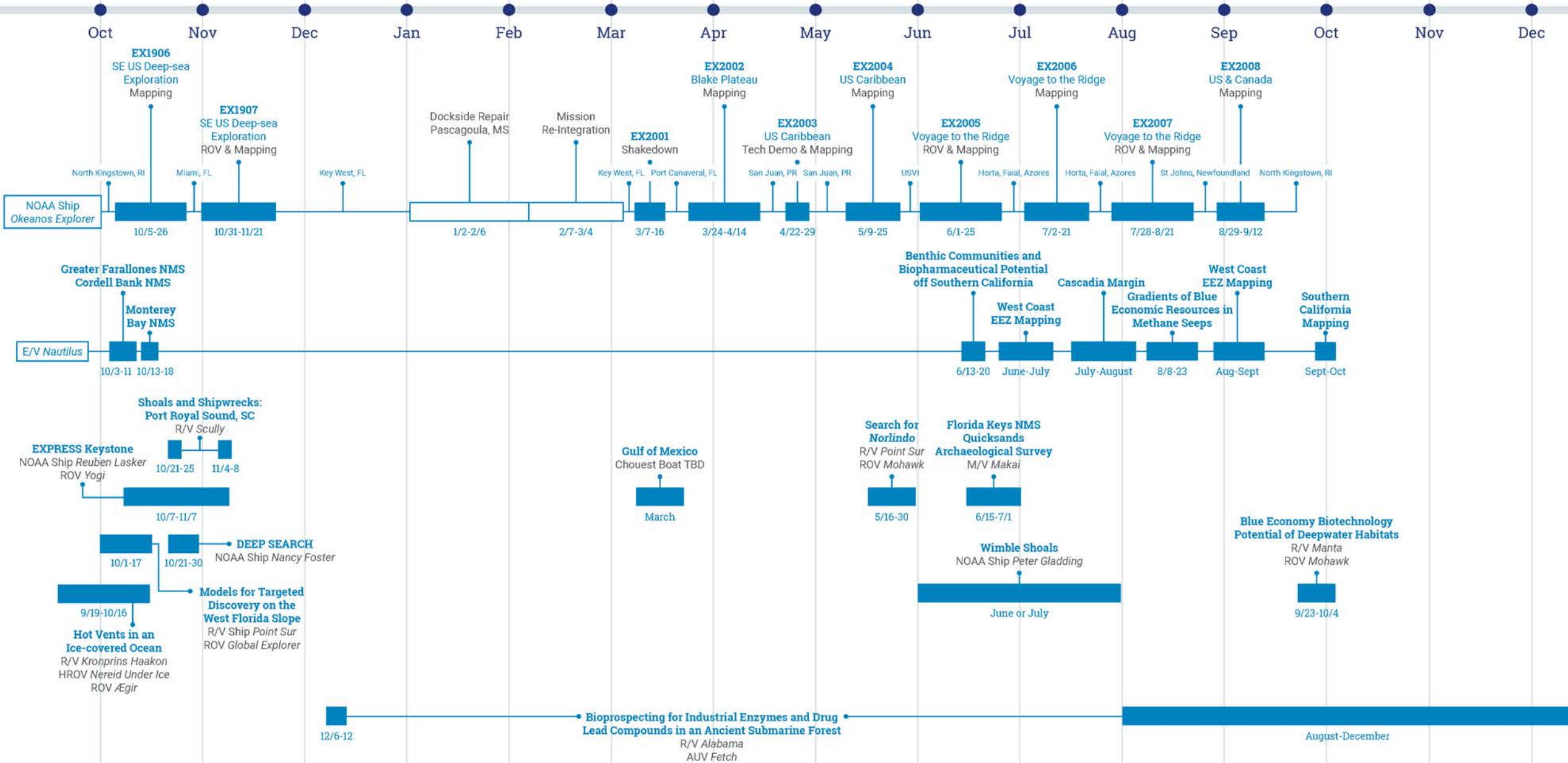
Looking Forward

2020



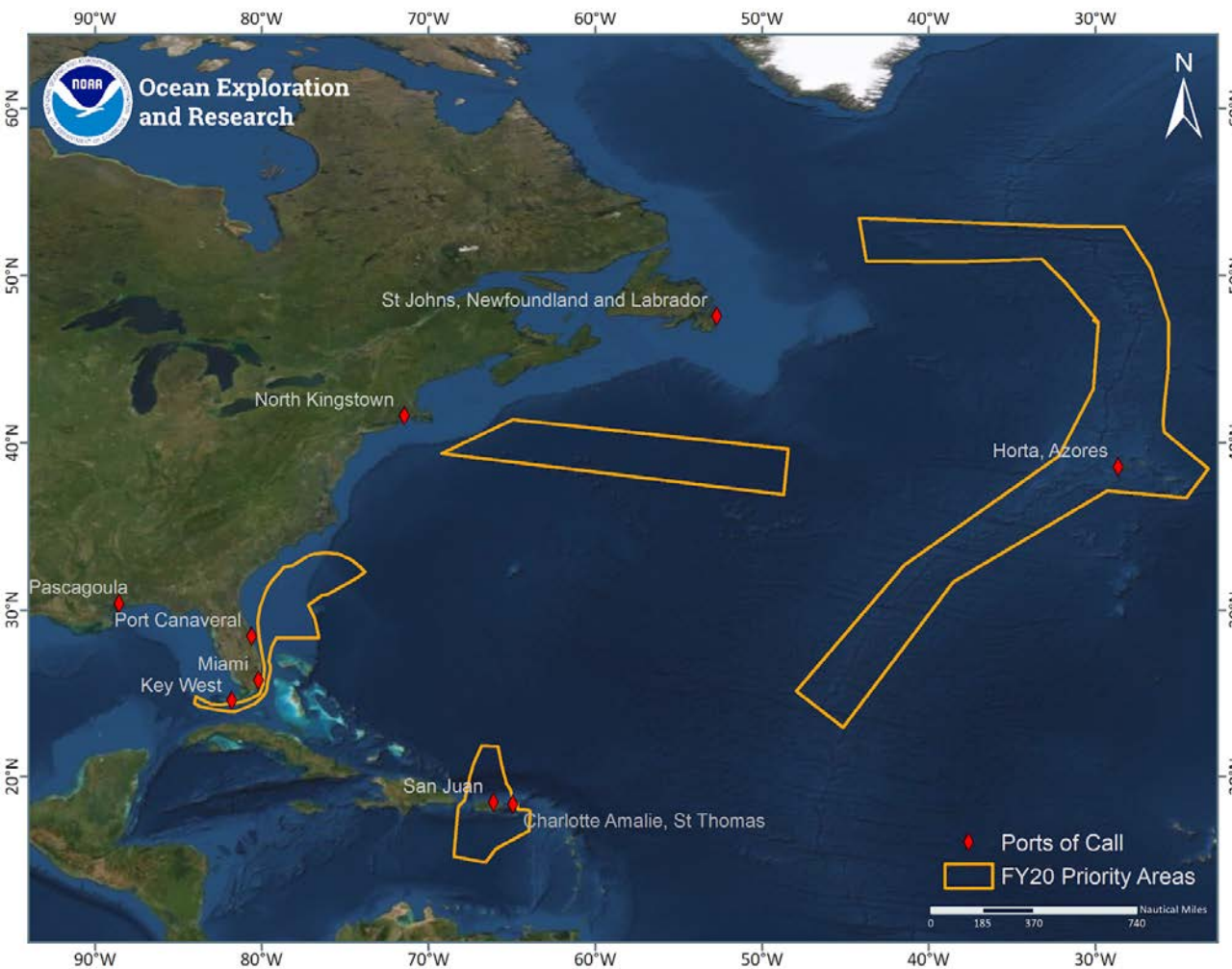


# 2020 Expeditions





# Okeanos Explorer Draft 2020 Schedule



- 195 days at sea (~52% within U.S. EEZ /~47% international waters)
- Intrusive ship repairs, mission demobilization and subsequent reintegration, trials, and shakedown (still developing)
- EM 304 Trials (December-April) - upgrade sonar system
- Caribbean Exploration Mapping
  - Meso-American and Caribbean Sea Hydrographic Commission and NOAA Office of Coast Survey priorities to complete U.S. EEZ mapping
  - Possible technology demonstrations with Woods Hole Oceanographic Institution (AUV *Orpheus*) and University of Puerto Rico (hadal lander) (May)
- Caribbean mapping
- Voyage to the Mid-Atlantic Ridge (June-August)
- U.S.-Canada Mapping (September)

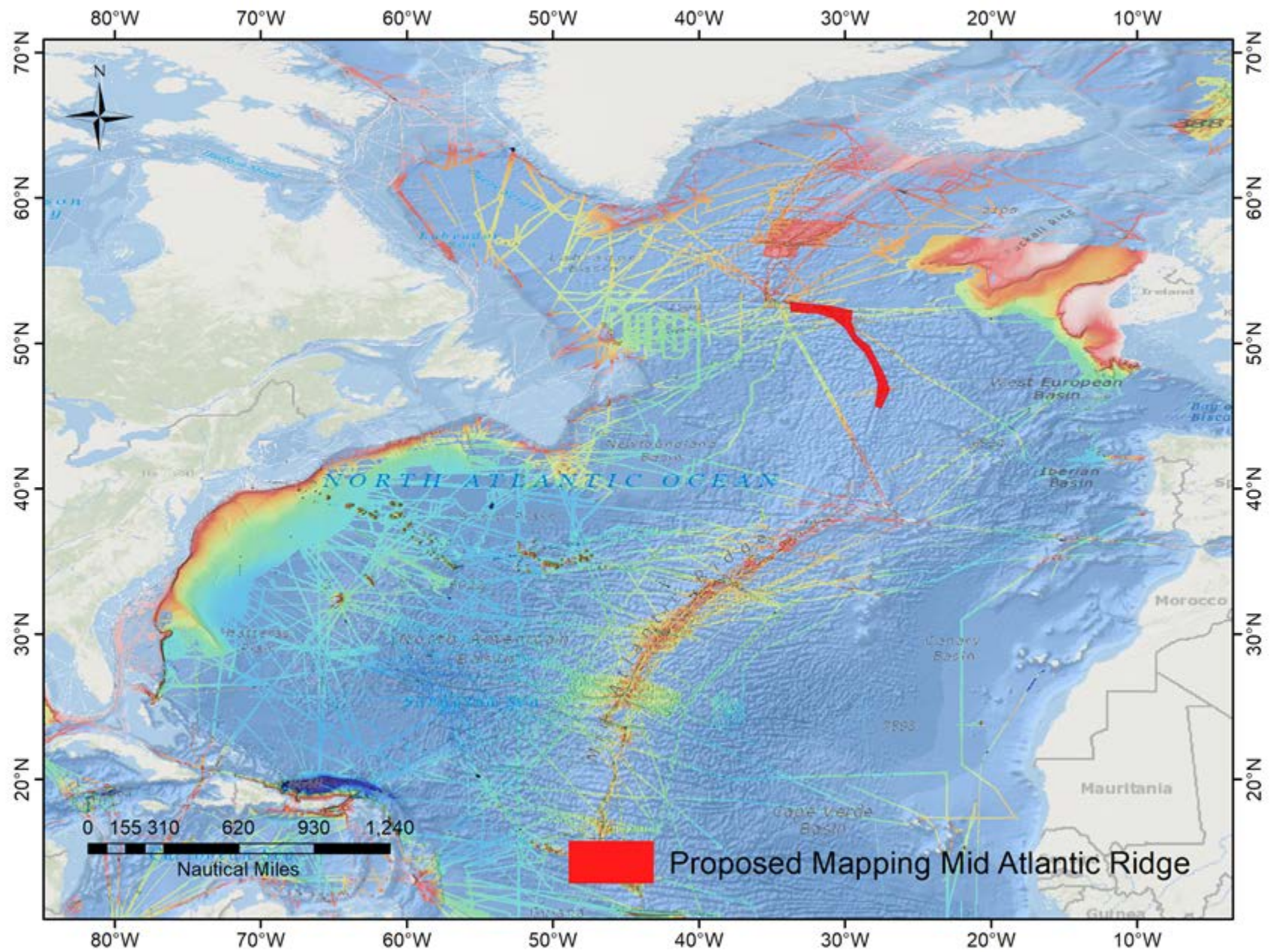
Okeanos Explorer	OET	DEEP SEARCH	EXPRESS	Comp. grants	ECS	NOPP	OECI
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# Voyage to the Ridge 2020

- Three cruises, 70 days at sea
- Science objectives represent priorities from U.S., European, and Canadian federal agencies, international collaborators, nongovernmental organizations, and the broader science community
- Exploration will include hydrothermal vents, fracture zones, deep-sea coral and sponge habitats, rift zones, and areas inside International Seabed Authority lease blocks
- Region is of interest inform understanding of connectivity of sensitive marine habitats across the Atlantic



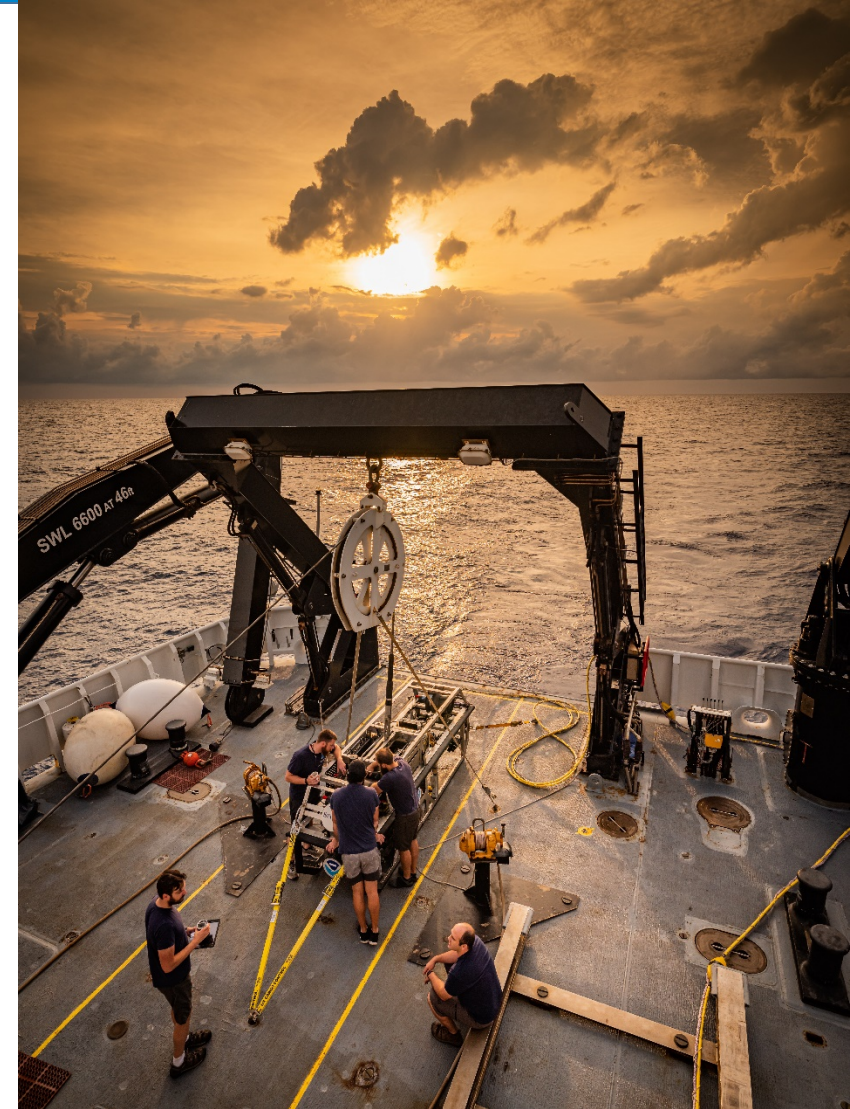






# Opportunities in 2020 and Beyond

- 2020/2021 *Okeanos Explorer* priorities include:
  - U.S. Caribbean
  - Mid-Atlantic Ridge
  - U.S. Southeast and Bahamas
  - Completing ASPIRE work with *Okeanos Explorer*
- Potential for *Okeanos Explorer* to transition from the Atlantic and into the Pacific in 2022
  - Initial scoping with partners underway
- E/V *Nautilus* and Mobile System
  - West Coast work in 2020 in support of EXPRESS
  - Extend and expand the Campaign to Address Pacific monument Science, Technology, and Ocean Needs (CAPSTONE)



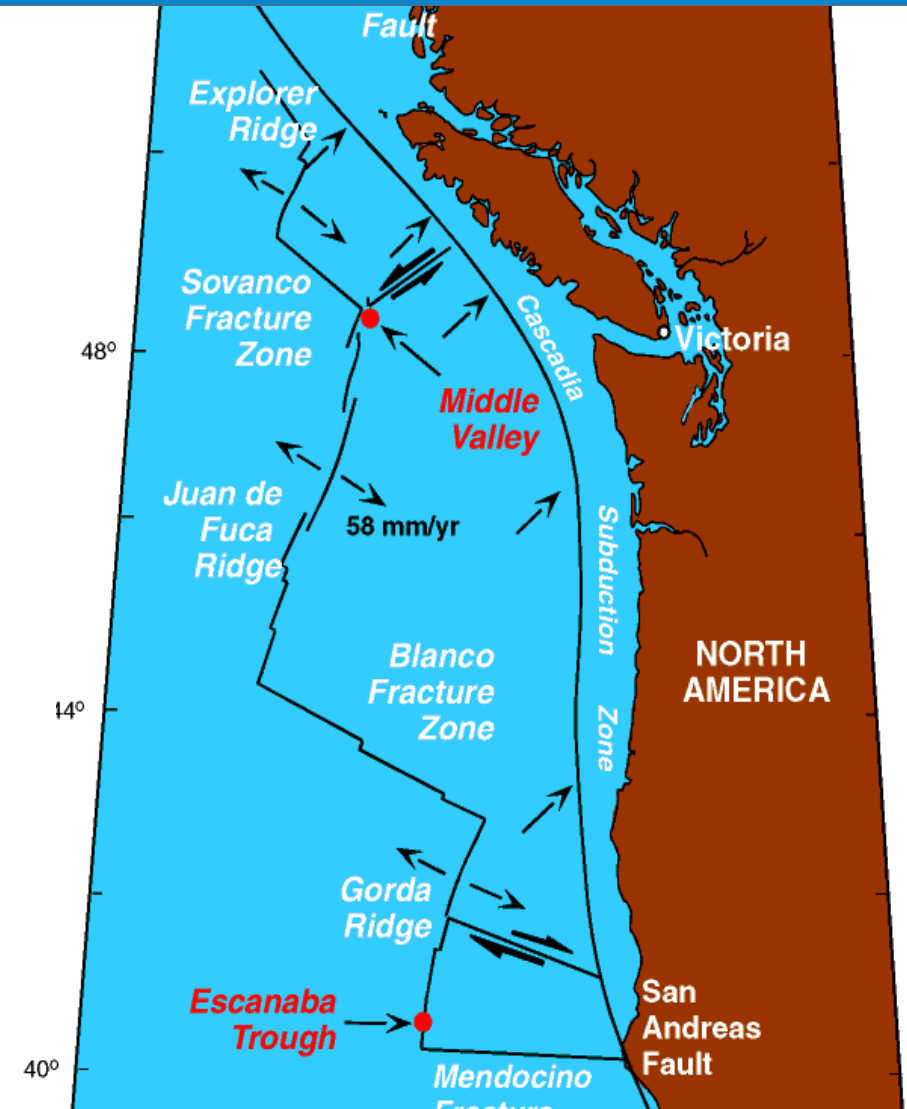
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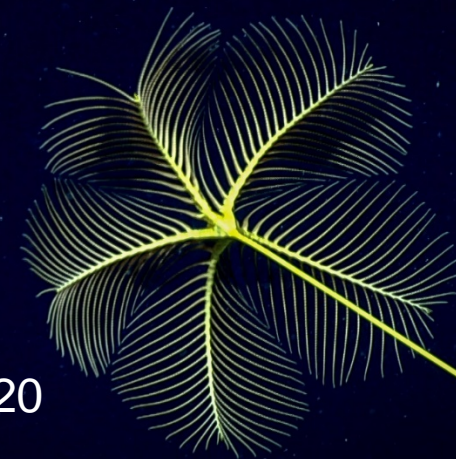
# EXPRESS/NOPP Critical Minerals Expedition 2020

- September 2020: USGS, BOEM, and NOAA partnership on R/V *Roger Revelle* with ROV *Jason*
- Goal: Acquire baseline information on critical minerals within the U.S. Exclusive Economic Zone (EEZ) and their interactions with surrounding ocean environment, including hydrothermal vent and deepwater species
- Responsive to Executive Order 13817 (Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals)



# Competitive Grants for 2020

PI	Institution	Dates
Distel	Northeastern University	December 6-12, 2019; August-December 2020
Spirek	South Carolina Institute of Archaeology and Anthropology, University of South Carolina	October 21-25, 2019; November 4-8, 2019
Diercks	University of Southern Mississippi	May 16-30, 2020
Levin	Scripps Institution of Oceanography/University of California, San Diego	June 13-20, 2020
Hoyt	NOAA Office of National Marine Sanctuaries	June or July 2020
Lawrence	NOAA Office of National Marine Sanctuaries	June 15-July 1, 2020
Thurber	Oregon State University	August 8-23, 2020
Wright	Harbor Branch Oceanographic Institute, Florida Atlantic University	September 23-October 4, 2020



<i>Okeanos Explorer</i>	OET	DEEP SEARCH	EXPRESS	Comp. grants	ECS	NOPP	OECI
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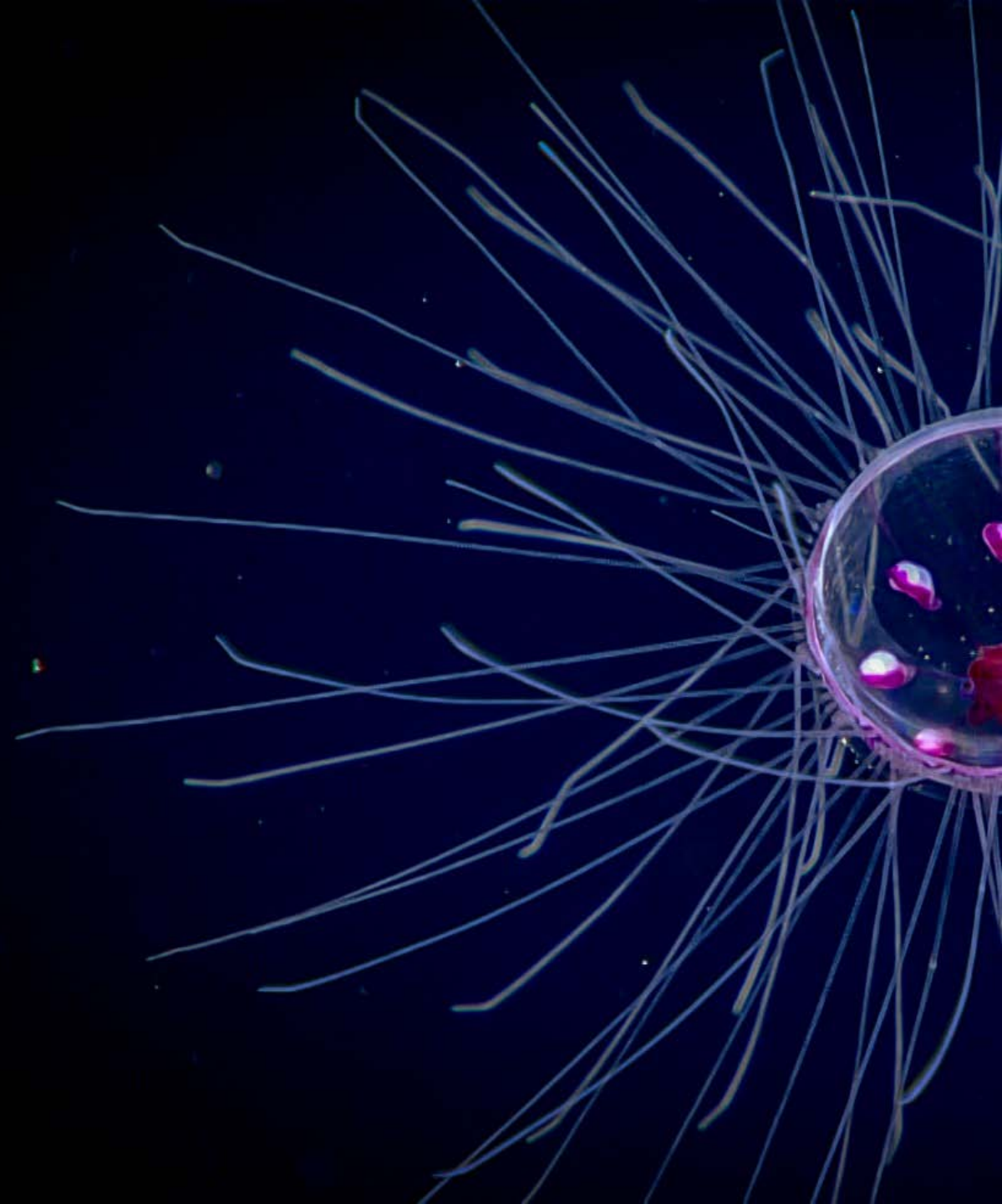


# Questions?

[alan.leonardi@noaa.gov](mailto:alan.leonardi@noaa.gov)



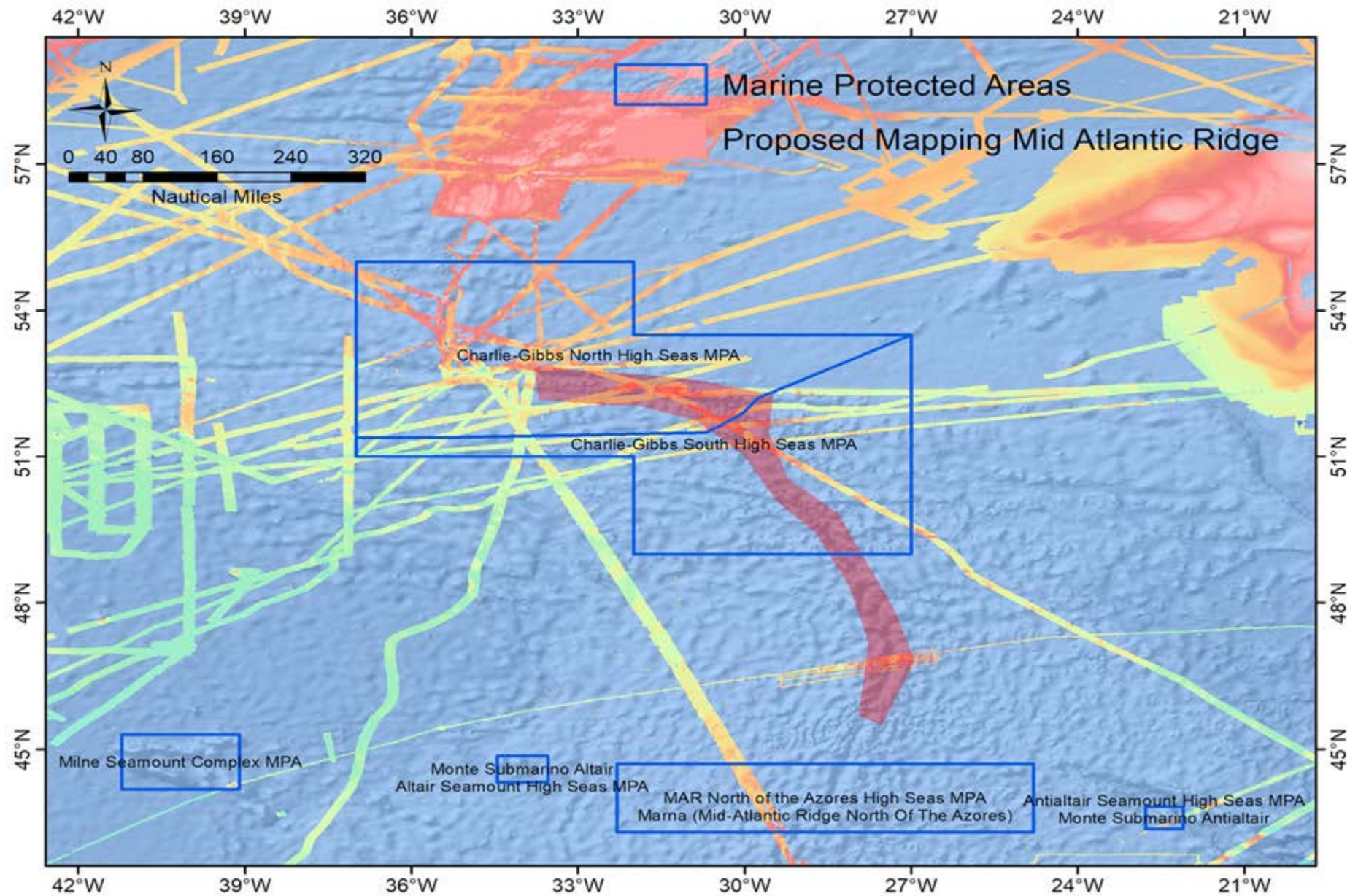
Ocean Exploration  
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# Extra Slides







# U.S. ECS Project Timeline

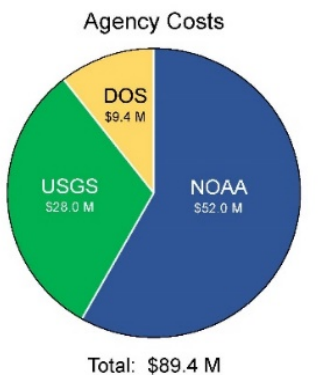
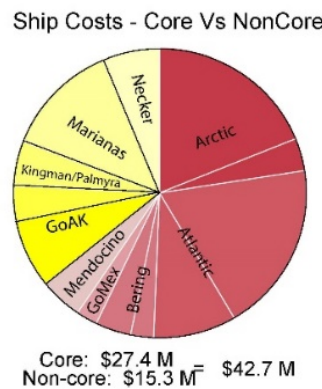
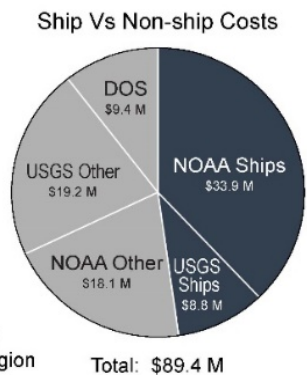
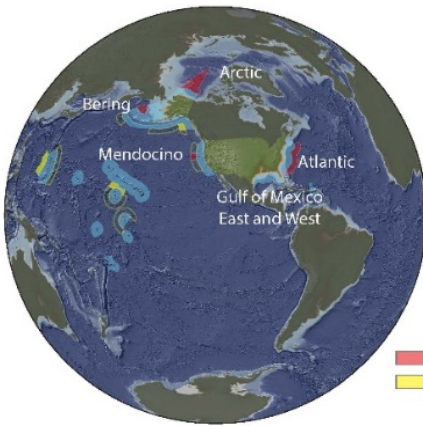
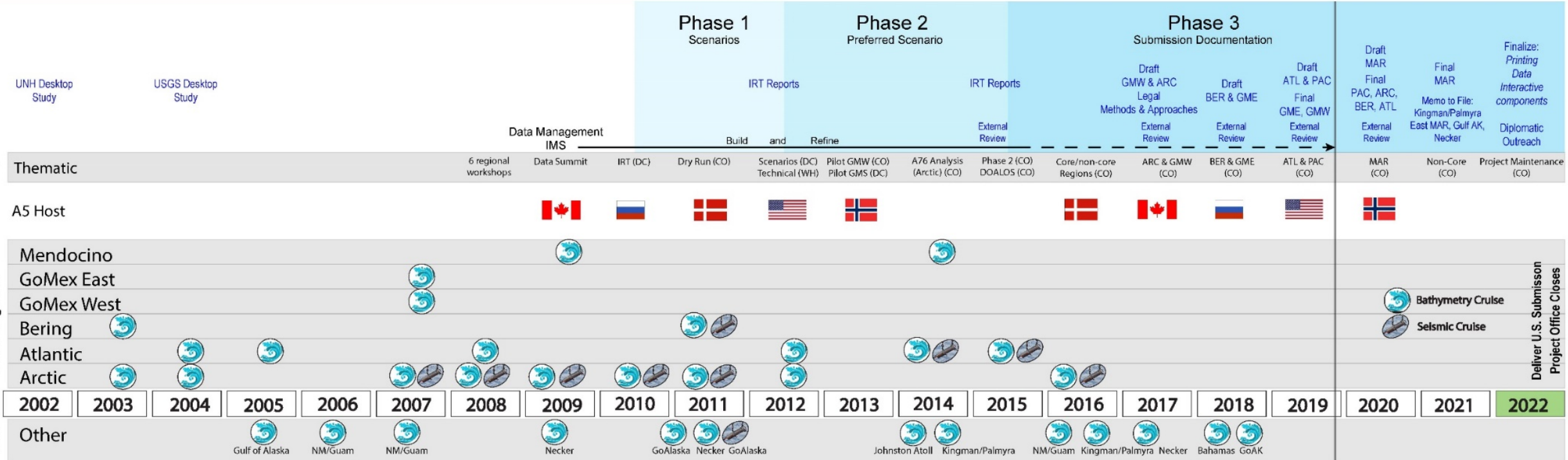
We are here

Workshops ECS Products

Data Collection Core Regions

Non-Core

Task Force



- Coastal States Consulted (including Commissioners)
- Australia
  - Canada
  - Denmark
  - Faroe Islands
  - France
  - Germany
  - Japan
  - Mexico
  - Mozambique
  - New Zealand
  - Norway
  - Russia





# Areas Mapped (km<sup>2</sup>) for ECS Project, FY02-18

