OCEAN EXPLORATION ADVISORY BOARD | SEPTEMBER 13, 2016

DR. ROBERT BALLARD

PRESIDENT, OCEAN EXPLORATION TRUST
DIRECTOR, URI GSO CENTER FOR OCEAN EXPLORATION

OCEAN EXPLORATION TRUST

Graduate School of Oceanography
R/V Endeavor
University of Rhode Island


OCEAN NETWORKS CANADA
CASCADIA MARGIN
GREATER FARALLONES
NATIONAL MARINE SANCTUARY
CENTRAL CALIFORNIA
CALIFORNIA BORDERLAND MAPPING
CHANNEL ISLANDS
NATIONAL MARINE SANCTUARY
SOUTHERN CALIFORNIA
NAUTILUS LIVE
2016

NOAA Office of Ocean Exploration & Research

Amanda Netburn
Central California (NA073)
Sea Grant Fellow, NOAA/OER

Nikolai Pawlenko
Channel Islands NMS (NA074)
NOAA Corps, NOAA/OER

Mashkoor Malik
Southern California (NA075)
Physical Scientist, NOAA/OER

Kelley Elliott
Greater Farallones (NA077)
Sr Expedition Manager, NOAA/OER

NA072: Cascadia Margin

Robert Embley
Nautilus Lead Scientist
Sr Research Scientist, NOAA/PMEL

Tamara Baumberger
Nautilus Science Team
NRC Postdoc, NOAA/PMEL

Steve Hammond
Nautilus Lead Scientist Ashore
Senior Scientist, NOAA/PMEL

Susan Merle
Nautilus Science Team
Sr Research Assistant, OSU/NOAA
EOI Cooperative Institute for Marine Resources Studies

Meredith Everett
Nautilus Science Team
Postdoc, NOAA/NWFSC

Liz Clarke
Nautilus Watch Leader Ashore
Senior Scientist, NOAA/NWFSC
(chartered 1 day of shiptime)

NA077: Channel Islands National Marine Sanctuary

Chris Mobley
Nautilus Watch Leader
Superintendent, CINMS

Julie Bursek
Nautilus Co-Lead Scientist
Education & Outreach Lead, CINMS

Chris Caldow
Nautilus Co-Lead Scientist
Research Coordinator, CINMS

Will Sautter
Nautilus Science Team
Marine GIS Analyst, NOAA/NCCOS

Peter Etnoyer
Nautilus Science Team
Marine Biologist, NOAA

Not pictured *Nautilus* Science Team Members:
Ryan Freedman, Research Ops Specialist, CINMS
Marilena Cajandig, Intern, CINMS
Ryan Hartnett, Intern, CINMS

NA077: Greater Farallones National Marine Sanctuary

Maria Brown
Nautilus Science Team
Superintendent, GFNMS

Jim Delgado
Nautilus Co-Lead Scientist
Director of Maritime Heritage, NOAA/ONMS

Jan Roletto
Nautilus Co-Lead Scientist
Research Coordinator,GFNMS

US Navy & US Coast Guard

RADM Timothy Gallaudet
NAVO
NA077: Greater Farallones NMS

Dr. Thomas Drake
ONR
NA077: Greater Farallones NMS

LT Tara Elliott
NAVO
NA077: Greater Farallones NMS

Letha Demont
NAVO
NA078: California Mapping

CDR(s) Jason Fahy
CNO Strategic Studies Group
NA073: Central California
NA074: Channel Islands NMS

CAPT Emil Petruncio
US Naval Academy
NA073: Central California

Olivia Czerewko
Midshipman, US Naval Academy
NA074: Channel Islands NMS

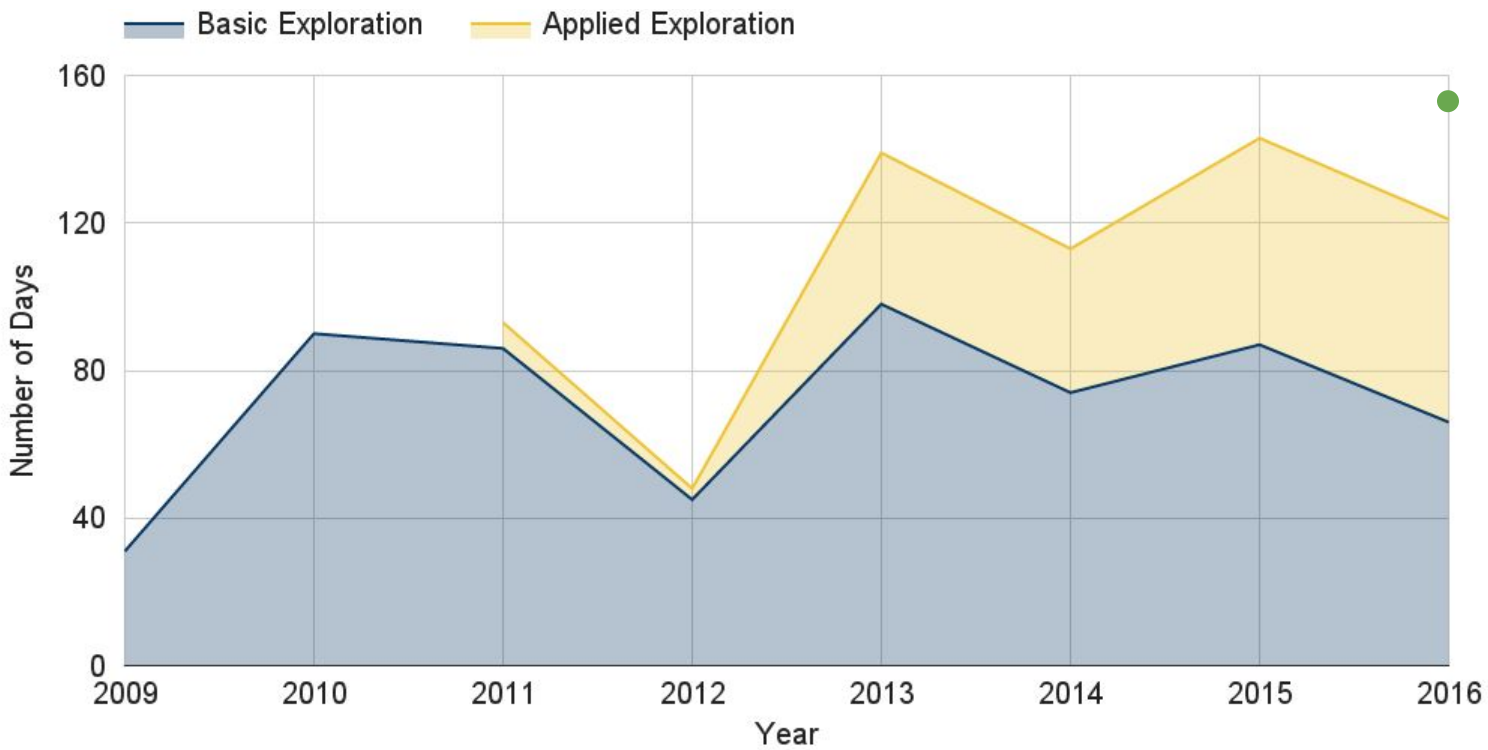
Alexander Simpson
Cadet, US Coast Guard Academy
NA073: Central California
NA074: Channel Islands NMS

US Congress

Rep John Culberson
Houston, TX
Chairman of the House Appropriations Subcommittee for Commerce, Justice, Science, and Related Agencies

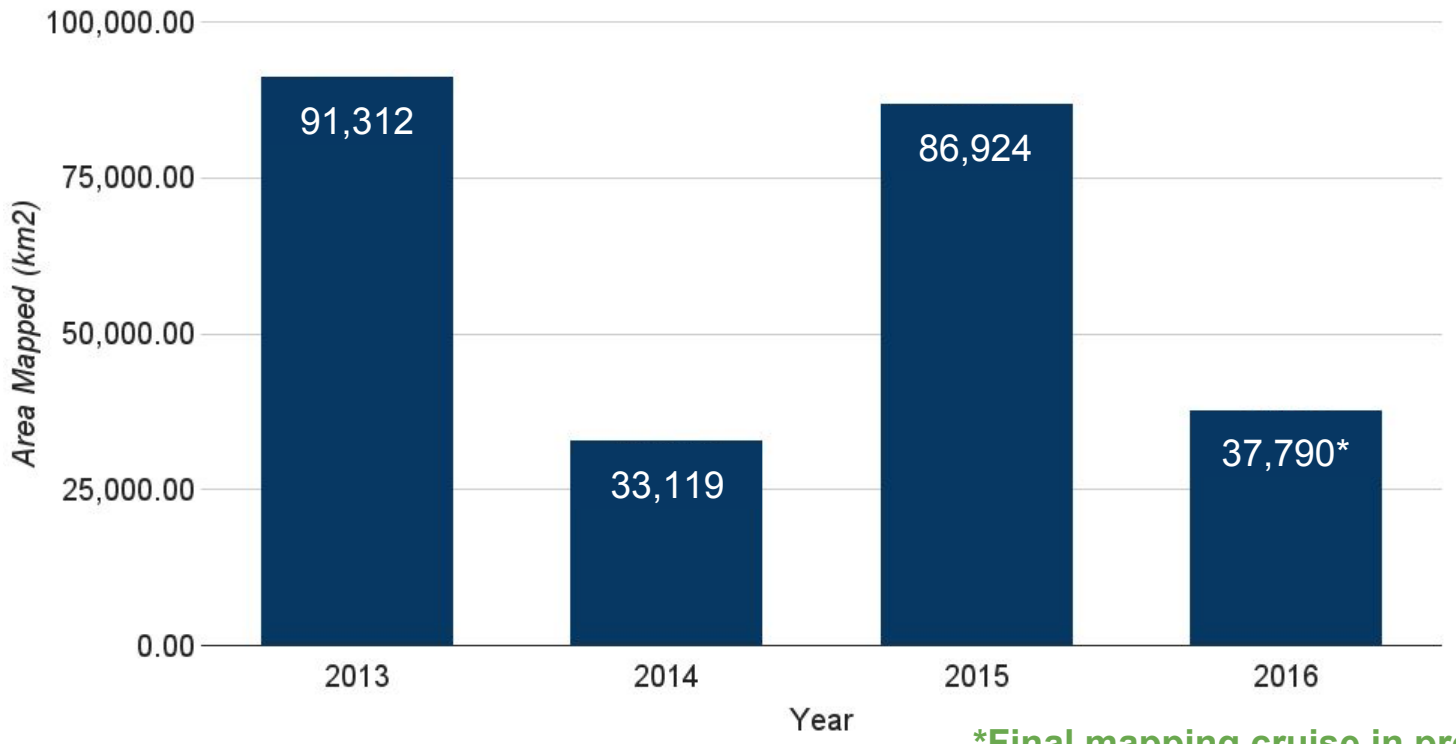
Jeremy Weirich
Clerk for Senate Appropriations Subcommittee for Commerce, Justice, Science, and Related Agencies

Nautilus Days at Sea



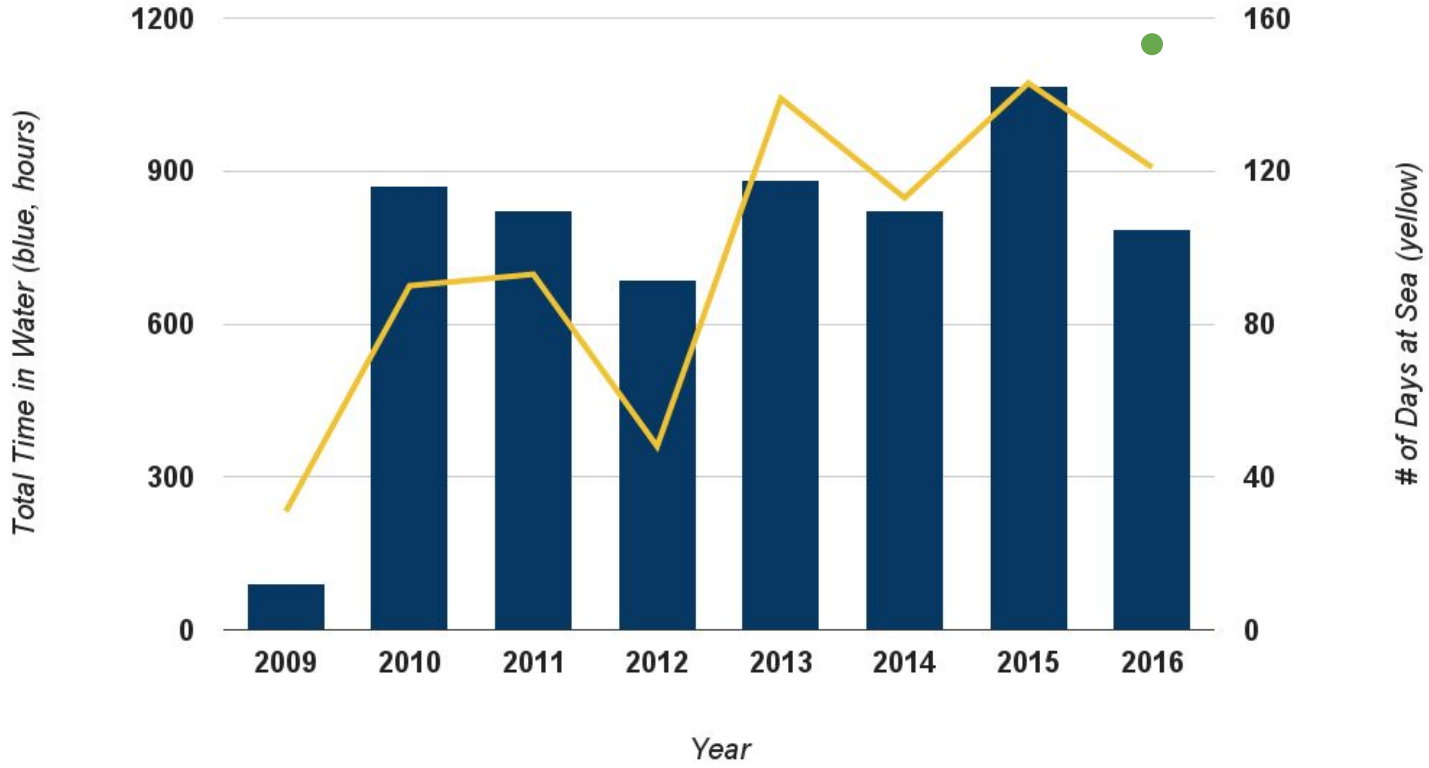
Note: Rolling 34.5 days from FY16 grant into CY17 field season

Seafloor Mapping with EM302 (km^2)



*Final mapping cruise in progress, 2016 mapping primarily in shallow water

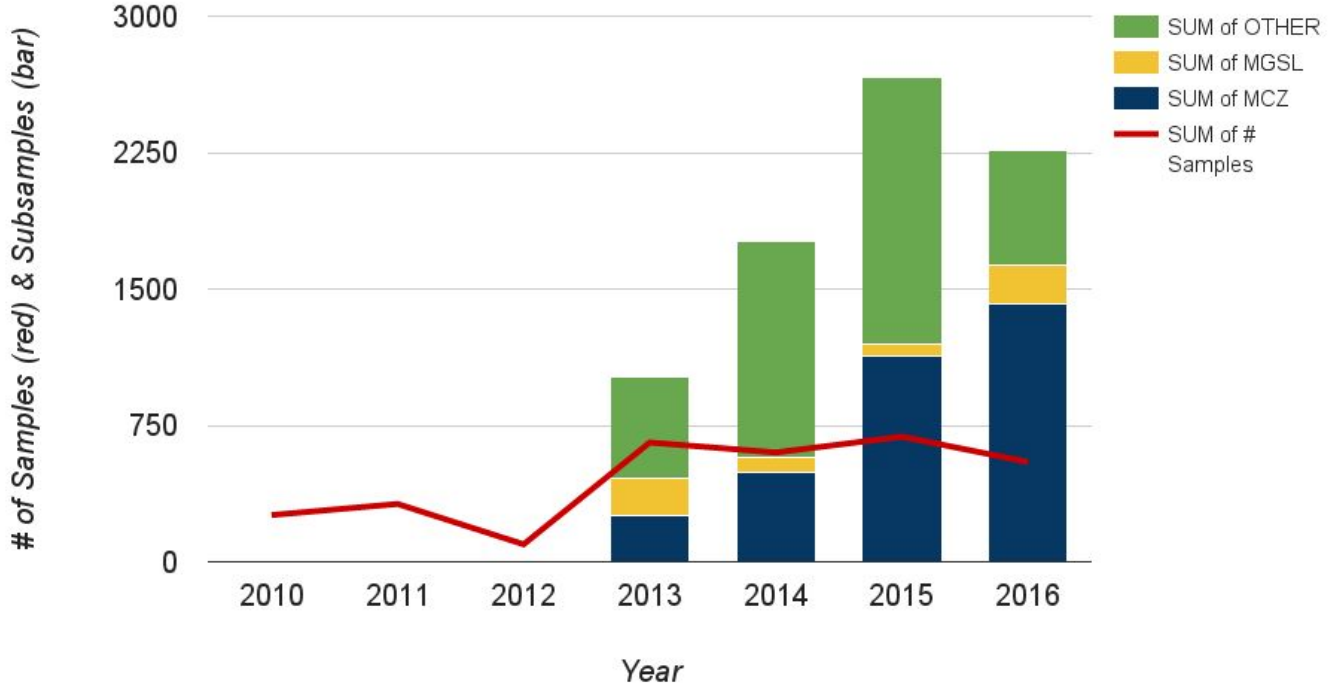
ROV Operations



Approx 83% of time in water is spent on the seafloor

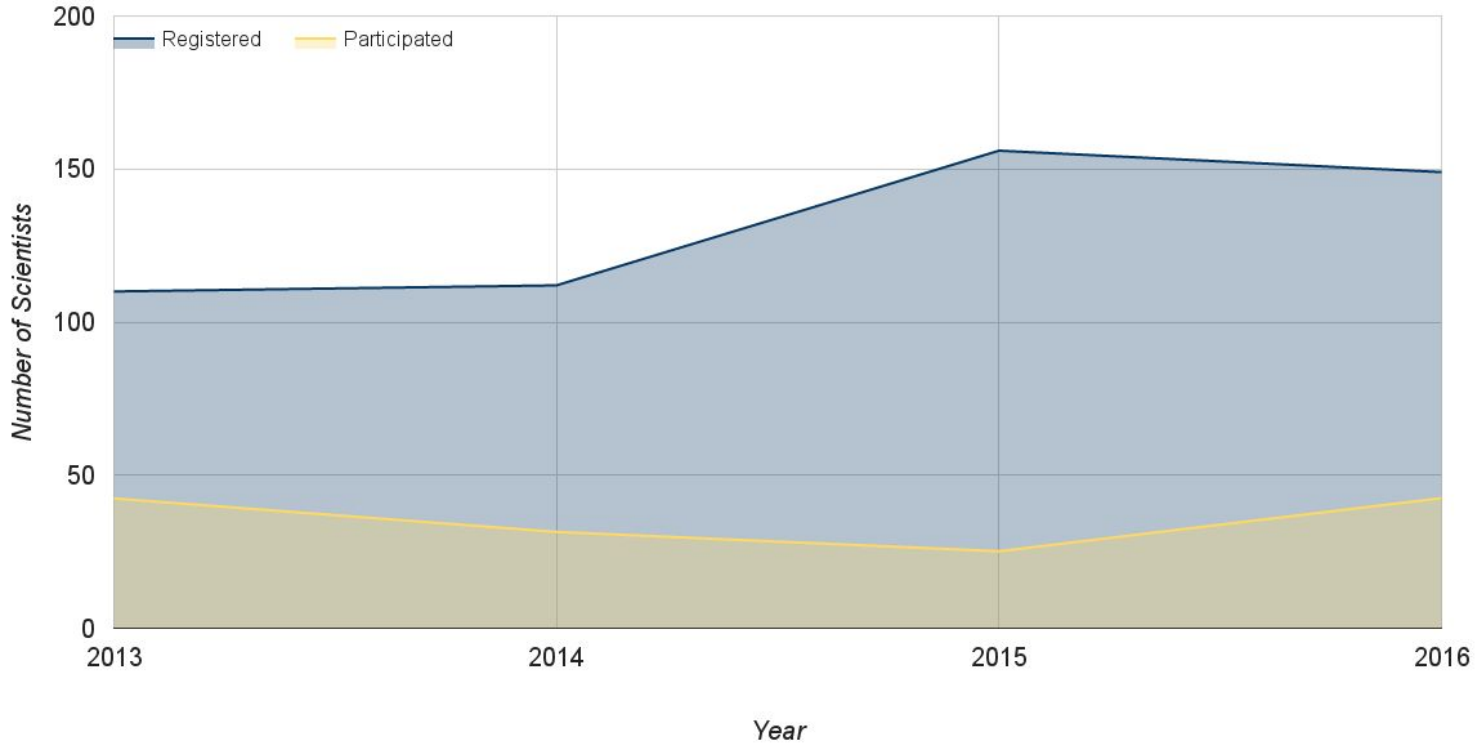
- **34.5 days rolled into CY17**

Basic Exploration Sampling



Geological samples are archived at the URI Marine Geological Samples Lab (MGSL).
Biological samples are archived at the Harvard Museum of Comparative Zoology (MCZ).

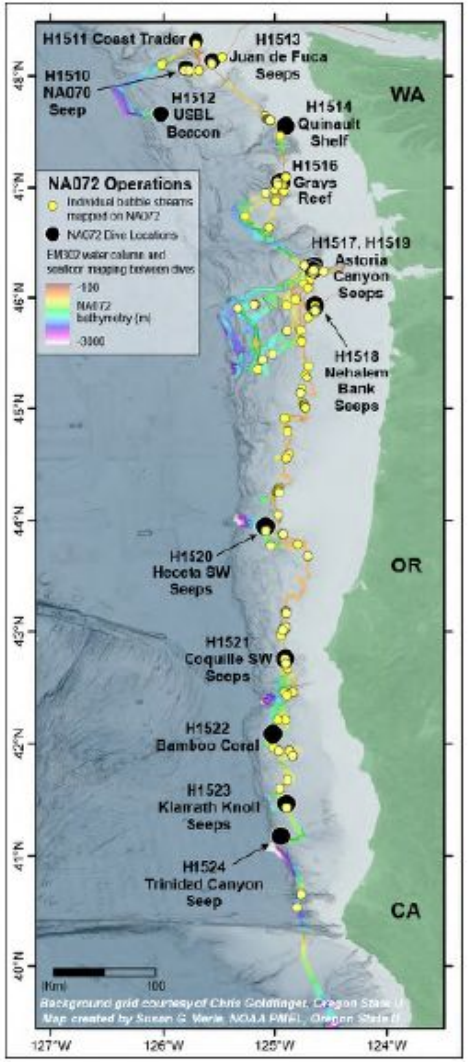
Scientist Ashore Registration



Approx 27% participation of registered Scientists Ashore

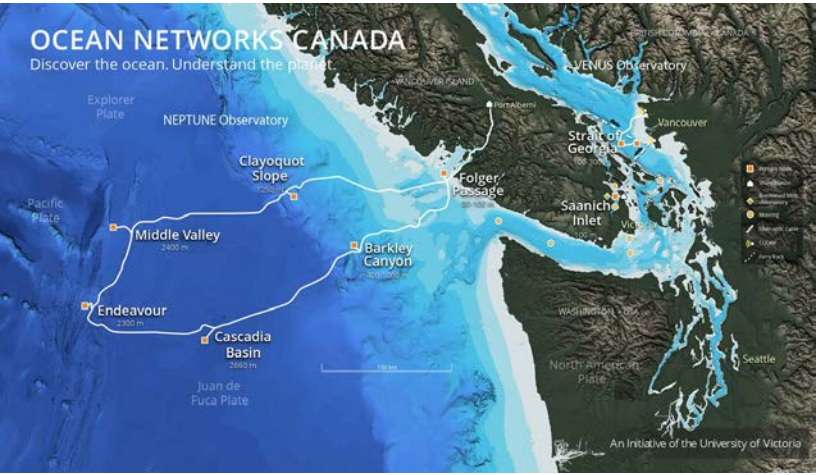
Cascadia Margin Highlights

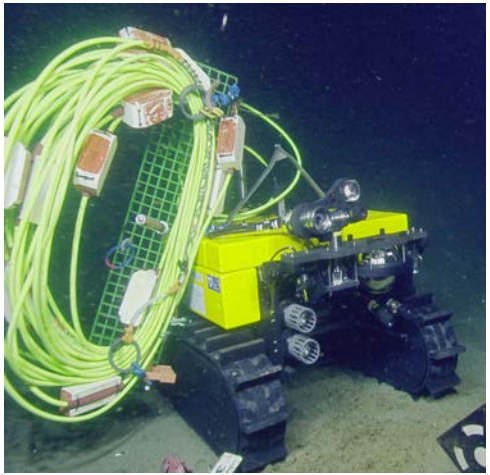
- 450 new seeps discovered with multibeam mapping
- ROV dives characterized seep settings:
  - Canyon heads, shoulders, deep walls
  - Continental shelf
  - Accretionary ridges
  - Continental slopes
- 2 new sites of methane hydrate at 850 & 1250 m depth (only 3 others known in Cascadia Margin region)
- Carbonate reefs: new type of seafloor characterized in region (likely product of methane oxidation)

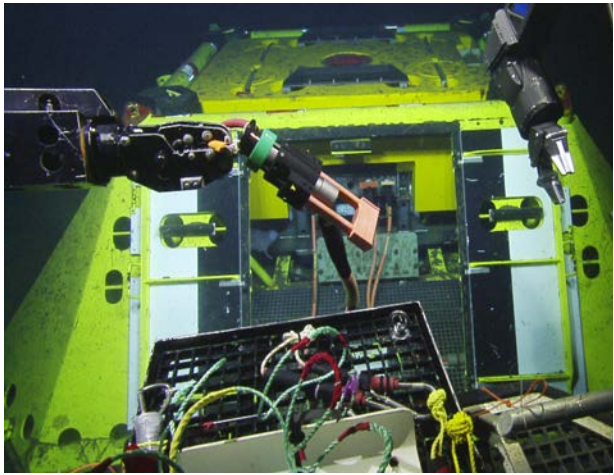


Ocean Networks Canada Highlights

- Conducted dual-ship operations to repair a Node damaged by a fishing trawler 18 months prior and to deploy 4 new primary cables in locations planned for 8+ yrs
- Conducted successful engineering test of Tsunami Array (inoperable since 2009)
- Provided maintenance and connectivity to instruments along the observatory that had not been online and available to community for years.

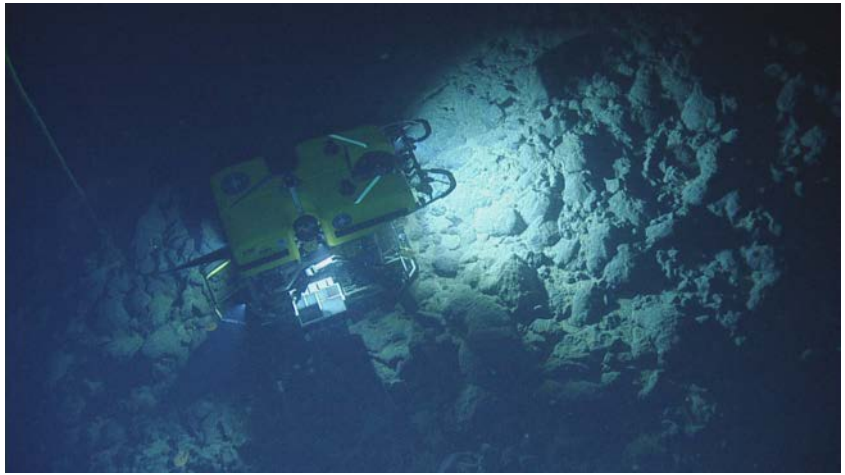


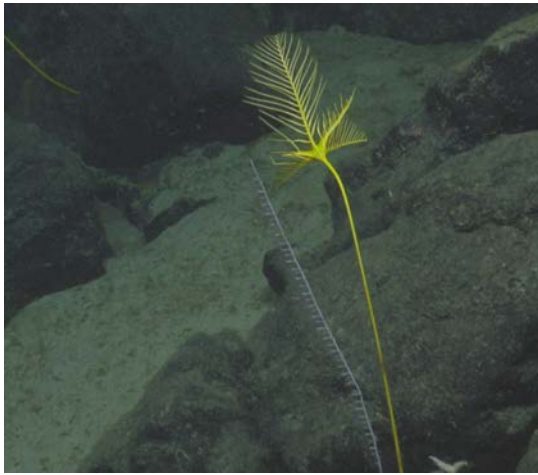




Central California Highlights

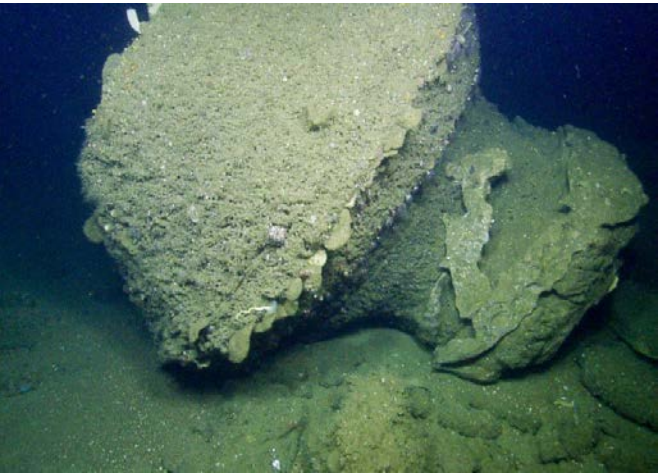
- Point Dume carbonate chimney site geochemical mapping (eH)
- Water column transects in/around OMZs (unexplained organism behavior)
- San Juan Seamount biological characterization (coral communities)

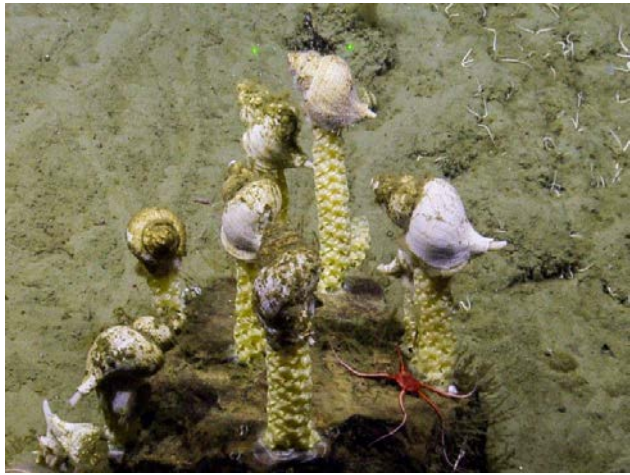




Channel Islands NMS Highlights

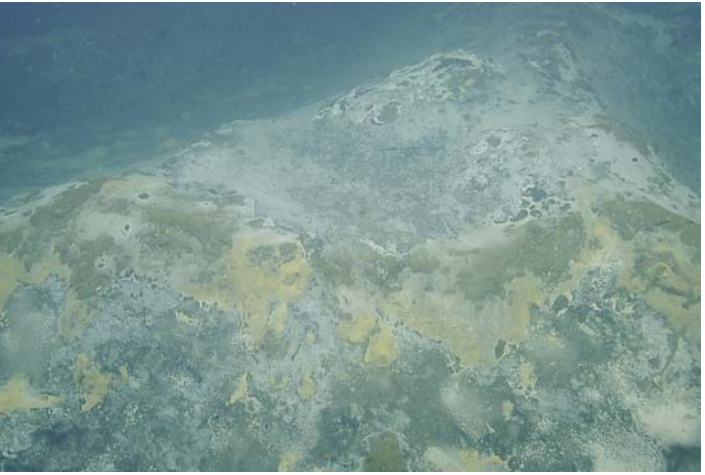
- Possible new pleurobranch species (mysterious purple orb) at 1,616m and discovery of whelk egg nursery at 1,510 m, both in Arguello Canyon
- Investigation of large mudstone concretions
- Nearly doubled multibeam mapping coverage of CINMS





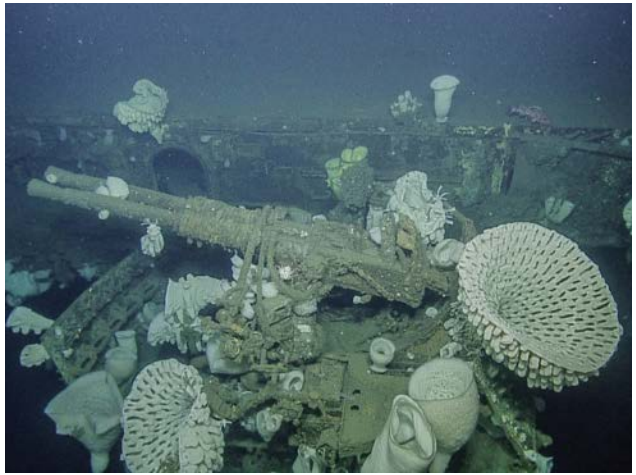
Southern California Highlights

- Discovery of new seep field in Santa Monica Basin
- First spherical (360°) filming in the deep sea
- Observed 3 previously unknown whale falls
- Unsedimented lavas found on Patton Escarpment



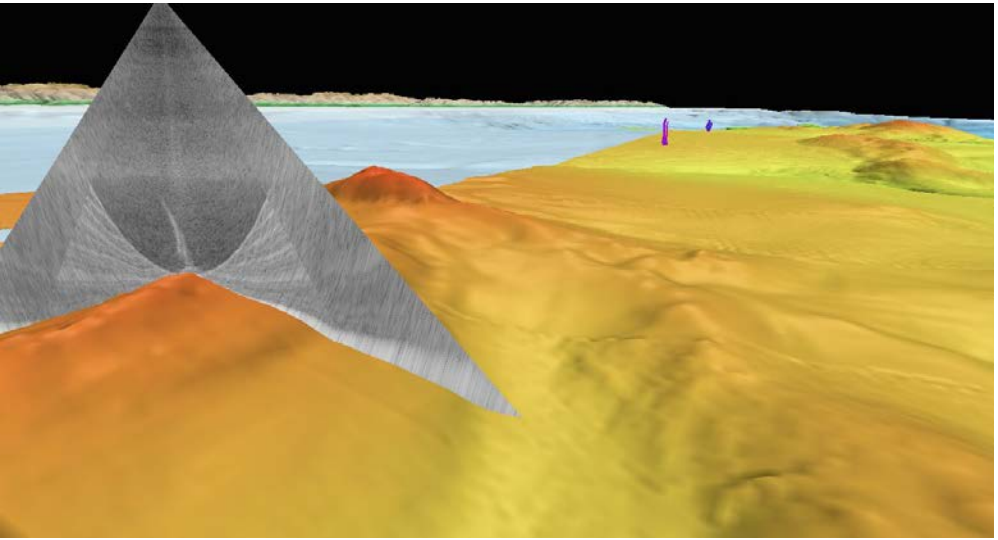
Greater Farallones NMS Highlights

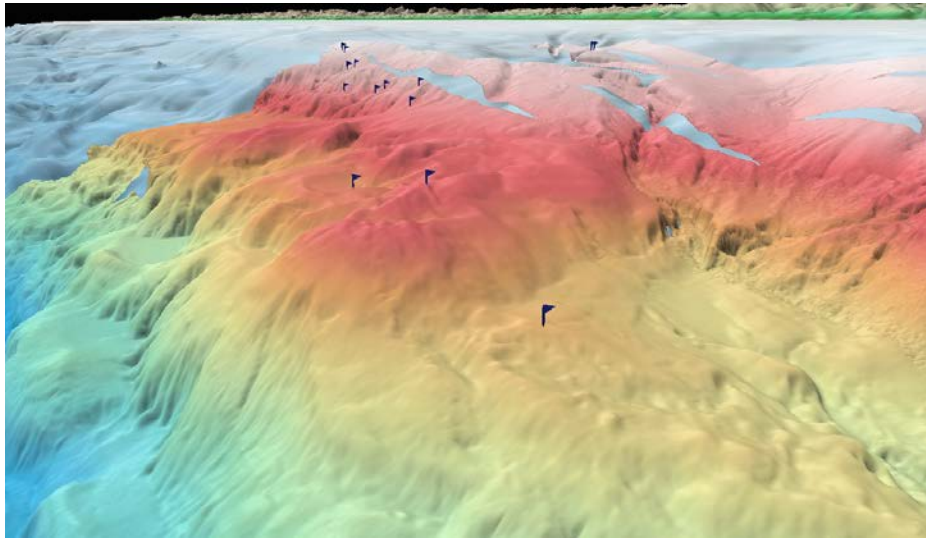
- First ROV dives and high resolution mapping of USS *Independence*
- 1-2 possible new species discovered
- 19 species new to the GFNMS inventory
- Doubled area of seafloor mapped in the GFNMS



California Mapping Highlights (cruise in progress)

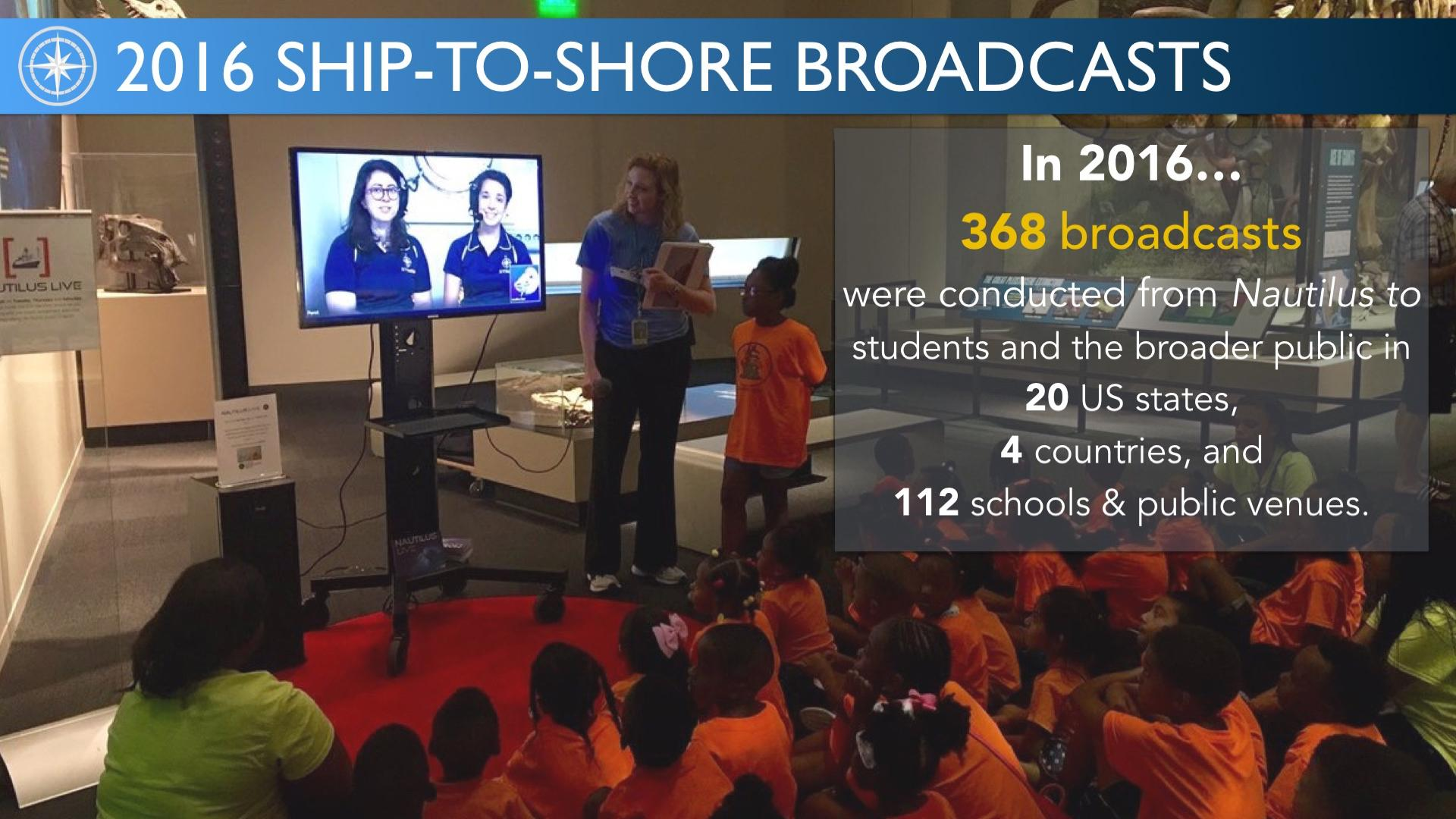
- Cascadia Margin mapping: >50 seeps/seep fields (so far)
- Mapping CINMS priority areas in the Santa Monica Basin






Members of the Corps of Exploration become role models and mentors for the next generation of scientists & engineers

2016 SHIP-TO-SHORE BROADCASTS



In 2016…

368 broadcasts

were conducted from *Nautilus* to students and the broader public in

20 US states,

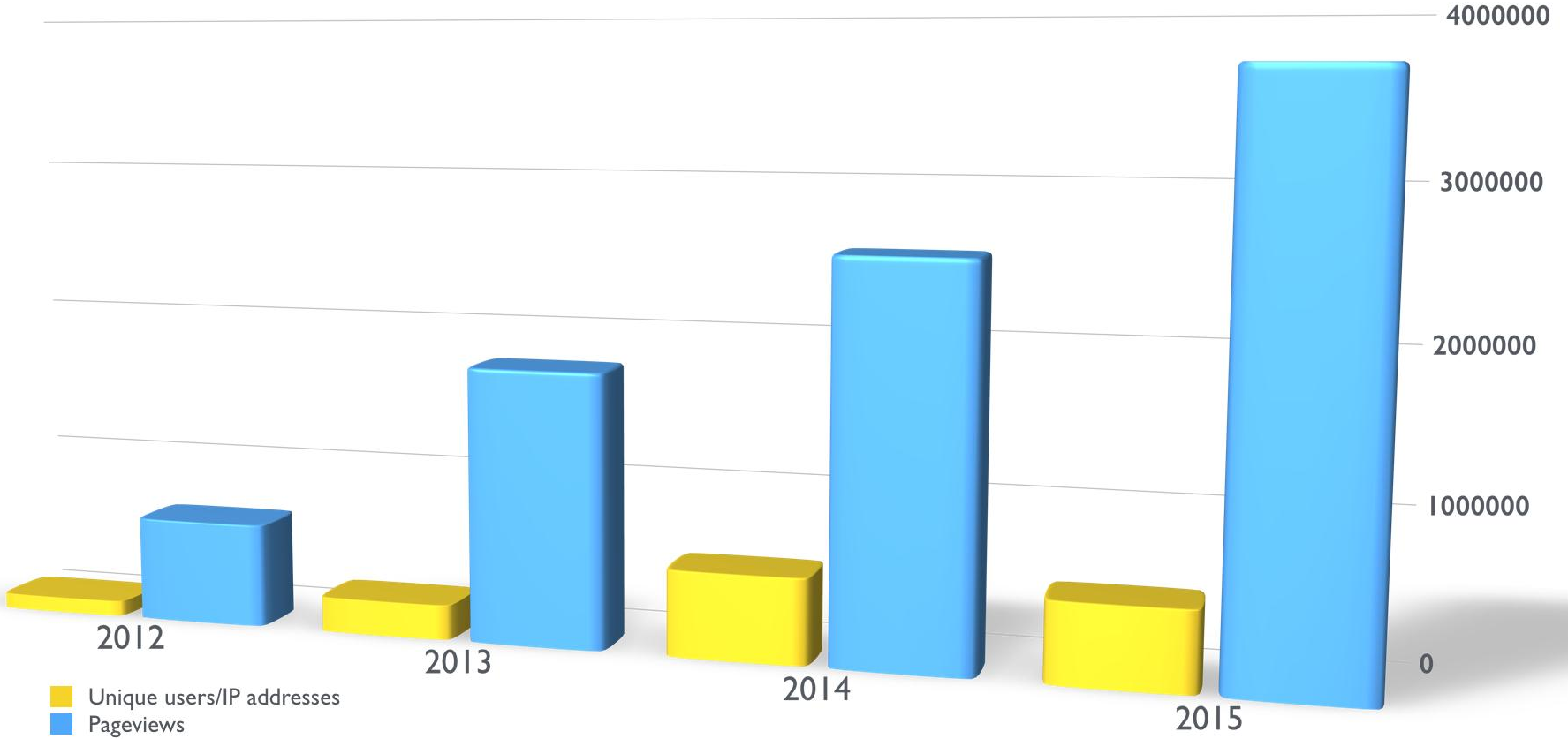
4 countries, and

112 schools & public venues.

2016 SHIP-TO-SHORE PARTNER VENUES

Aquarium of the Pacific
Connecticut Science Center
Exploratorium
Houston Museum of Natural Science
Perot Museum of Nature and Science
Seacoast Science Center
Submarine Force Library & Museum
Titanic Belfast

NAUTILUS LIVE GROWTH



DIGITAL OUTREACH & PRESS

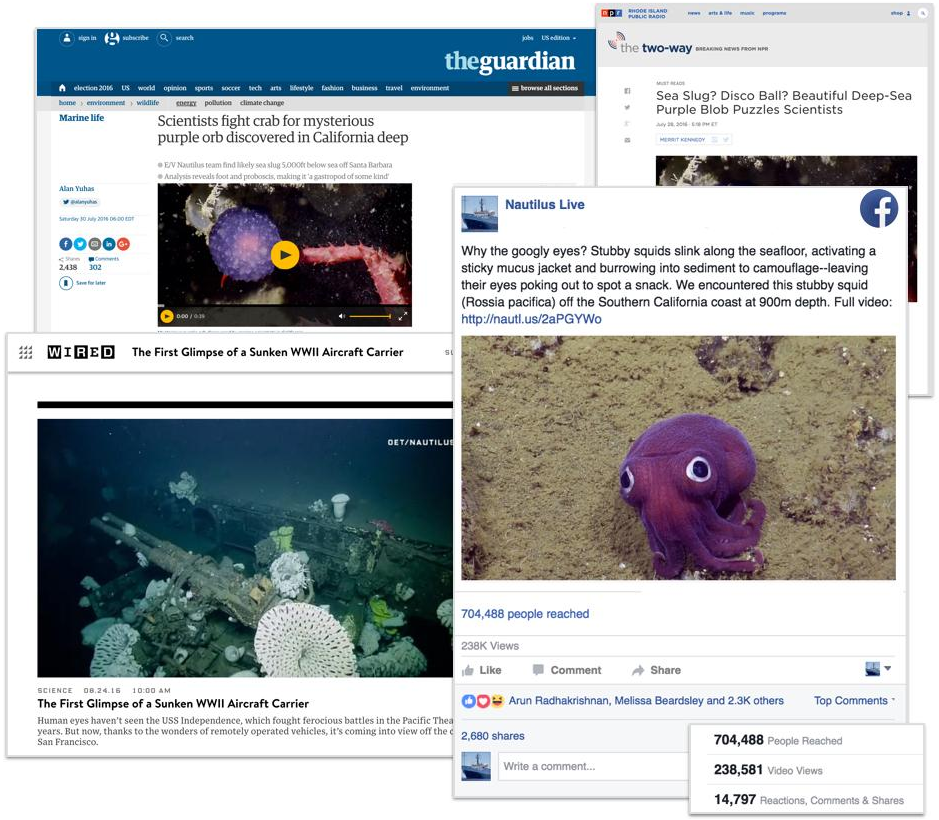
Facebook Followers .. **75K+**
+25% since 2015

Twitter Followers .. **14K+**
+39% since 2015

Instagram Followers .. **7.4K+**
+56% since 2015

YouTube Views .. **20M+**
+40% since 2015

Media & Press Hits · **6.5K+**
estimated reach 400M+



as of 9/6/2016

OET/COE INVESTMENTS IN OCEAN EXPLORATION

OET – Private investments

E/V NAUTILUS	$20 million	
Vehicle systems (ARGUS, HERCULES, DIANA, and ECHO)	$15 million	
STEM Program (Annual contribution now at $2 million)	$10 million	$45 million

COE - State of Rhode Island Investments

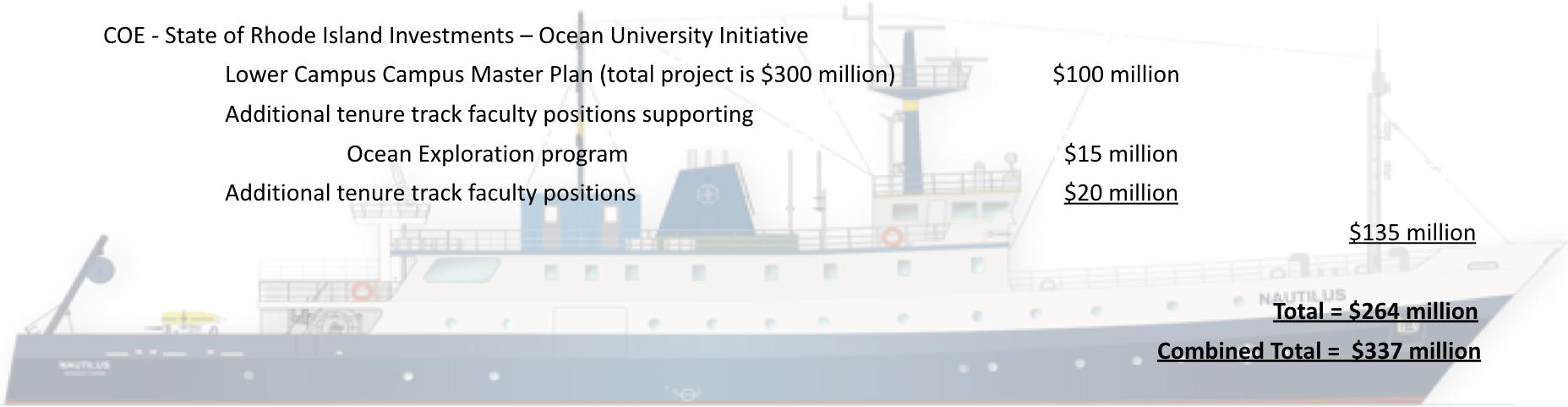
COE/Inner Space Center	$15 million	
Quonset Point Facility for OKEANOS EXPLORER	$5 million	
Tenure Track Faculty Positions assigned to program	$12 million	$28 million
	Total to Date = $73 million	

FUTURE INVESTMENTS IN NATIONAL PROGRAM

OET – Private & Non-NOAA investments		
NAUTILUS	$6 million	
Fly-away system Phase I	$3 million	
Fly-away system Phase II	$5 million	
Public Inner Space Center and Exhibit Complex		
AltaSea Los Angeles(total project is $300 million)	$100 million	
STEM Program and Public Outreach	$15 million	$129 million
COE - State of Rhode Island Investments – Ocean University Initiative		
Lower Campus Campus Master Plan (total project is $300 million)	$100 million	
Additional tenure track faculty positions supporting		
Ocean Exploration program	$15 million	
Additional tenure track faculty positions	$20 million	
		$135 million

Total = $264 million

Combined Total = $337 million



The Ocean University Initiative

The University of Rhode Island
Narragansett Bay Campus

The Ocean University Initiative

Campus Master Plan

Graduate School of Oceanography
R/V *Endeavor*
University of Rhode Island

Graduate School of Oceanography

R/V *Endeavor*

University of Rhode Island

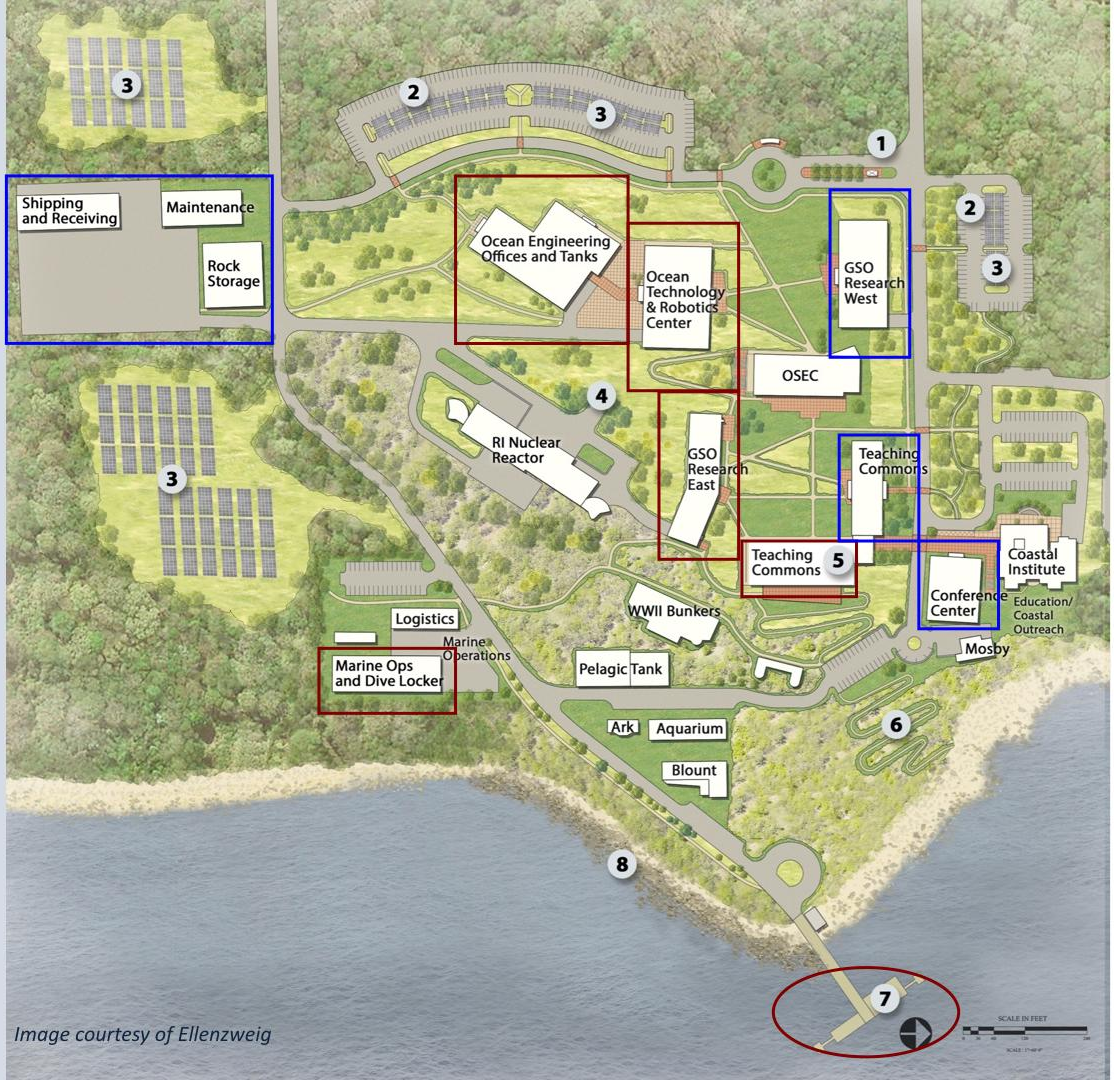
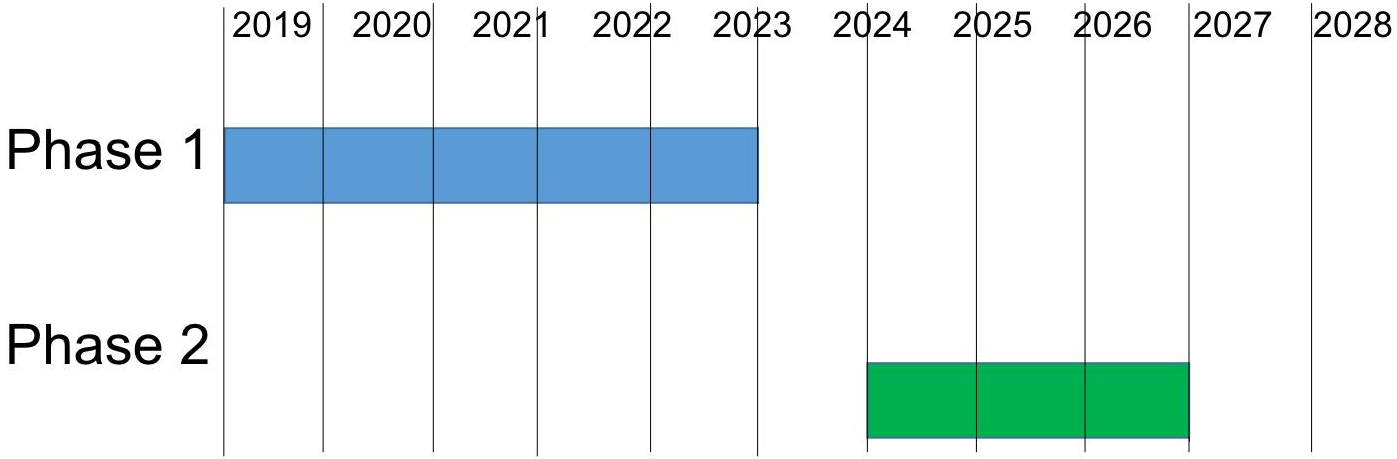


Image courtesy of Ellenzweig

MASTER PLAN: PHASING SCHEDULE



10 year, $288M

OET PARTNERSHIPS

- NOAA Office of Ocean Exploration and Research
- NOAA Office of National Marine Sanctuaries
- NOAA PMEL
- URI/GSO/COE
- Office of Naval Research
- Naval Meteorological and Oceanography Command
- Woods Hole Oceanographic Institution/Ray Dalio Foundation
- University of New Hampshire
- FAU/Harbor Branch
- AltaSea
- National Geographic Society
- Ocean Network Canada
- Cobham – Sea Tel satellite

OET STEM EDUCATION PARTNERSHIPS

- AltaSea
- Office of Naval Research (Submarine Museum, Coast Guard, U.S. Naval Academy)
- University of New Hampshire
- Lyda Hill Foundation (Perot Museum)
- Houston Museum of Natural Science
- Exploratorium
- Ballard Expeditions (Houston STEM)
- Phil Stephenson Foundation
- CITGO
- University of California, Santa Barbara
- Aquarium of the Pacific
- Connecticut Science Center
- TITANIC Belfast
- Infinity Science Center
- More to come

OET/ALTASEA PARTNERSHIP

OET: PRIMARY GOALS

- Extending life of E/V NAUTILUS another 10-15 years – replace main engine (possibly acquiring R/V REVELLE main engine in 2019 from ONR)
- Establish “West Coast Home Base” in Los Angeles to support long-term presence in Pacific Ocean
- Bring Flyaway system on line in two stages – Stage I by late 2017
- Become part of Cooperative Institute for Ocean Exploration in 2019 with WHOI, URI/GSO/COE, UNH, and FAU/ Harbor Branch
- Extend depth capability of HERCULES ROV to 5,500 meters, ANGUS already 6,000 meters
- Continue to broadening user base beyond NOAA OER
- Return to Mediterranean and Black Sea to further delineate Ancient Deep-Water Trade Routes in partnership with RPM NAUTILUS Foundation
- Support URI Ocean University Initiative
- Assist U.S. Navy in Western Pacific
- Continue to expand Educational Outreach and Social Media programs