Woods Hole Oceanographic Institution

Economic and research impacts

Presentation Overview

I. Introduction
II. Background
III. Economic Contributions
IV. The Blue Technology Economy in Massachusetts
V. Research Partnerships
VI. Educating Future Scientists and Engineers
VII. Knowledge Translation and Community Outreach

Introduction

Ocean Health and Massachusetts

- Recognition of the oceans and its health is increasing
- A changing ocean requires more research and mitigation strategies
- The state's economy is dependent on the ocean

Ocean Health and WHOI

- WHOI is driven by curiosity and increasingly, necessity.
- WHOI is dedicated to the study of the marine environment and its future.

WHOI's Track Record

- Founded in 1930, WHOI is the world's largest non-profit dedicated to ocean research, exploration, and education.
- WHOI's reputation attracts:
  - The best and brightest scientists and technical experts
  - Federal, industry, and philanthropic funding

WHOI's work substantially impacts Massachusetts

A central part of the burgeoning Blue Economy

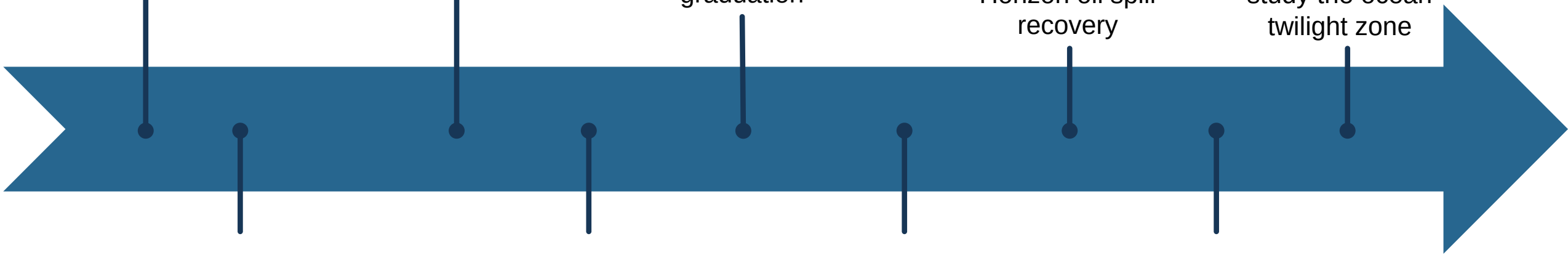
An economic driver attracting research dollars and talent

A source of new knowledge for researchers and the public around the world

Background

WHOI’s history, activities, and staff

Timeline of Notable Events



1930
WHOI founded with a Rockefeller grant

WWII-Cold War
WHOI begins its ongoing work with US Navy for oceanographic applications for defense

1952
WHOI received its first NSF grant

1950s-60s
WHOI's work on the *Alvin* human submersible

1970
First MIT/WHOI joint program graduation

1985
Discovery of the *Titanic* by WHOI using *Alvin*

2011
WHOI's work on the Deepwater Horizon oil spill recovery

2013
WHOI established the Center for Marine Robotics

2018
WHOI wins $35 million grant to study the ocean twilight zone

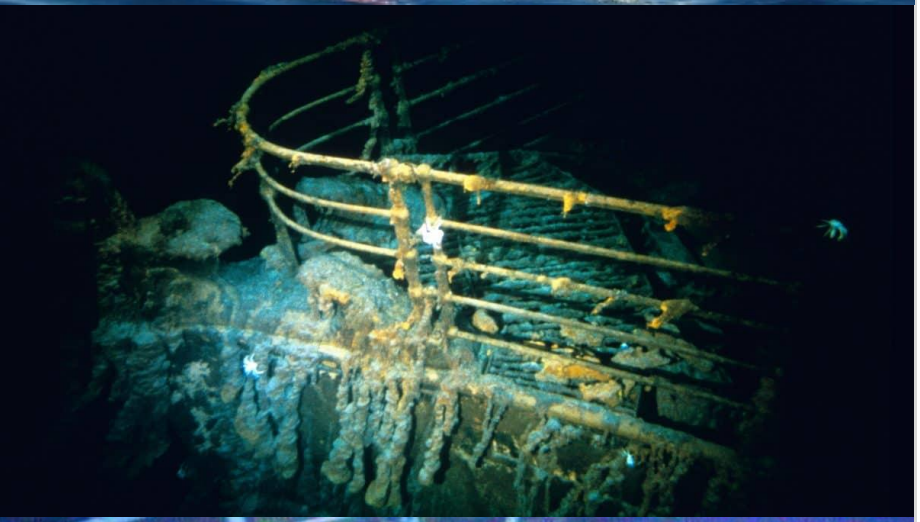
WHOI's Basic Assets

WHOI is the largest employer on Cape Cod after Cape Cod Healthcare.

- 1,000 employees, plus robust student population
- Unparalleled access to the sea with acre-large port facility
- Two full ocean-going ships, 1 coastal ship
- 100 other ocean-based vehicles and vessels
- Rapid prototyping center, on-site design and testing
- Pressure test center, in-water test tanks, scientific dive program
- Mass spectrometry, ion microprobe, CT centers
- Only research-focused offshore fixed tower in the U.S.

The Founding of Woods Hole Oceanographic Institution

- Discussions began in 1927 about enhancing U.S. oceanographic research.
- These discussions led to the founding of WHOI in 1930.
- First institution of its kind on the east coast.



Historical Moments

- WHOI began a close relationship with the U.S. Navy in the 1940s
- In 1985 WHOI and a team of French researchers discovered the wreck of the *Titanic*
- Recently, the Institution was involved with the Deepwater Horizon Spill, Air France Flight 447, and the El Faro

Current Initiatives Close to Home

Fisheries, ocean acidification, toxic algae

Harnessing ocean resources for food and clean energy

Cutting-Edge Marine Robotics and Technology

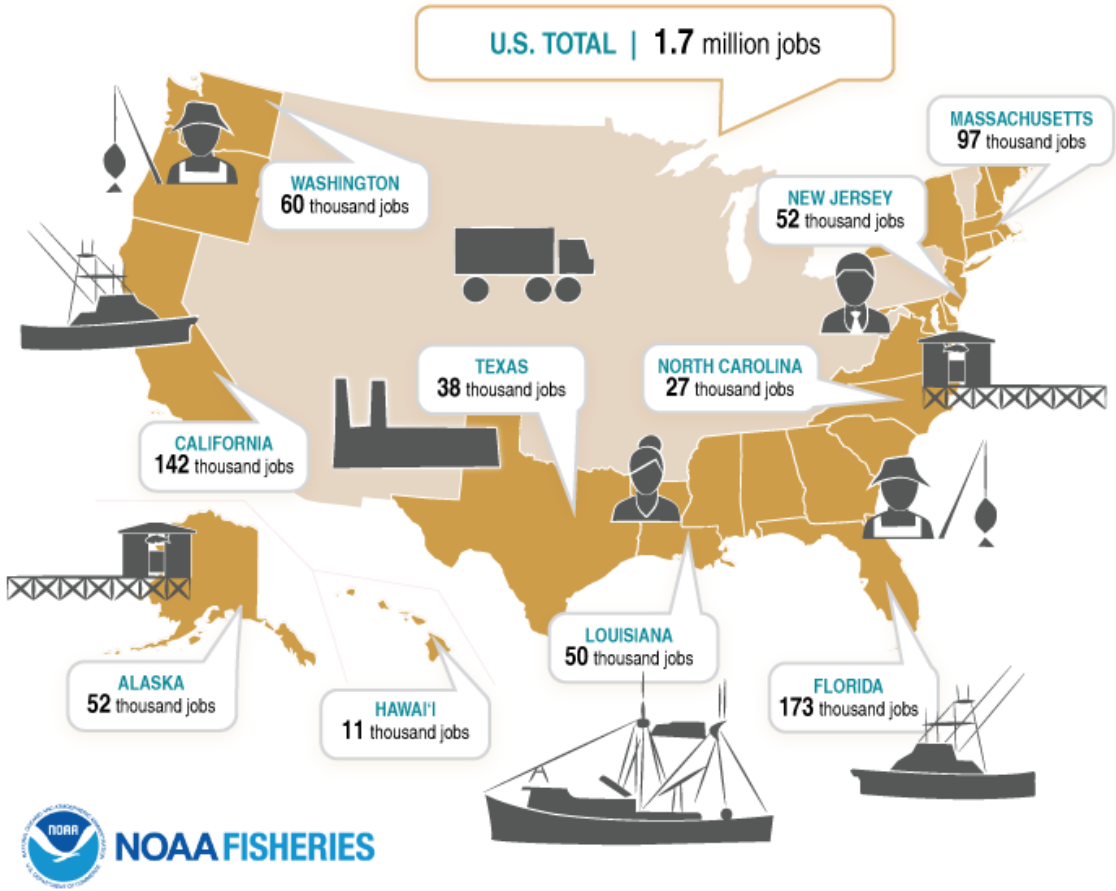
Offshore wind assets and initiatives

Protecting critically-endangered wildlife

Understanding climate change and sea-level rise

Spotlight on the Fishing Industry

Total Jobs supported by Commercial and Recreational Fishing Industries, 2016



Total Sales* Generated by the U.S. Seafood Industry by State, 2016

1	CALIFORNIA	$22.8 billion
2	FLORIDA	$16.9 billion
3	MASSACHUSETTS	$7.7 billion
4	WASHINGTON	$7.5 billion
5	NEW JERSEY	$6.2 billion
6	NEW YORK	$4.4 billion
7	ALASKA	$3.9 billion
8	MAINE	$2.6 billion
9	TEXAS	$2.1 billion
10	LOUISIANA	$2.0 billion

NOAA FISHERIES

* **Total sales** — The combined value of sales by businesses within the state affected by the seafood industry.

WHOI's Relationship with the Fishing Industry

TRENDS IN FISHING

Fishing is big business in MA

- MA fishermen landed over 244 million pounds in 2016
- 57% of U.S. sea scallops are harvested in MA
- Fishing contributes over **$3 billion** to gross state product incl. **$380** million of exports

Globally, 20% of protein demand is met by seafood.

- Landings in MA have been trending downward due partly to catch limits.
- Ongoing environmental impacts can further reduce local and global harvests

WHOI'S RELEVANT INITIATIVES

Catch limits depend on science on fish populations and lifecycles

WHOI scientists are studying:

- Harmful algal blooms
- Aquaculture
- Ocean acidification
- Marine protected zones
- Microplastics
- Ocean food chains

Marine Robotics Initiatives

- ROV Jason begins operations in **2002**
- REMUS vehicles used during Operation Iraqi Freedom to detect mines in **2003**, and continues to locate shipwrecks and monitor marine life
- Spray Glider launches in **2004**
- AUV Sentry launches in **2008**
- In **2009**, One-of-a-kind WHOI robot Nereus makes historic dive to the deepest part of the ocean.
- WHOI deploys robots and sensors to gather real-time genetic information of toxic algae in the Gulf of Maine
- In **2013**, WHOI establishes the **Center for Marine Robotics**

Recent Research Initiatives

Climate change, deep sea exploration, and ocean patterns

- Offshore wind environmental impact
- Microplastics in the ocean
- Twilight Zone
- Ocean Worlds
- Super Reefs
- Ocean and river observatories
- Fresh water resources under the coastal seafloor
- Marine life monitoring with robotics and sensors

Economic Contributions

WHOI’s federal funding and economic impacts

Bringing Federal Dollars to Massachusetts

$200M

Total federal funding

$650,000

Average funding award

#70

Rank among over 4,000 US academic institutions

#5

Rank among all Massachusetts academic institutions

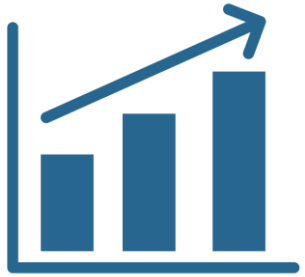
7.5%

Share of all academic research funding in MA among over 100 institutions

Annual Economic Contributions of WHOI's Operations

3,898
Jobs

$186.5 M
in Compensation



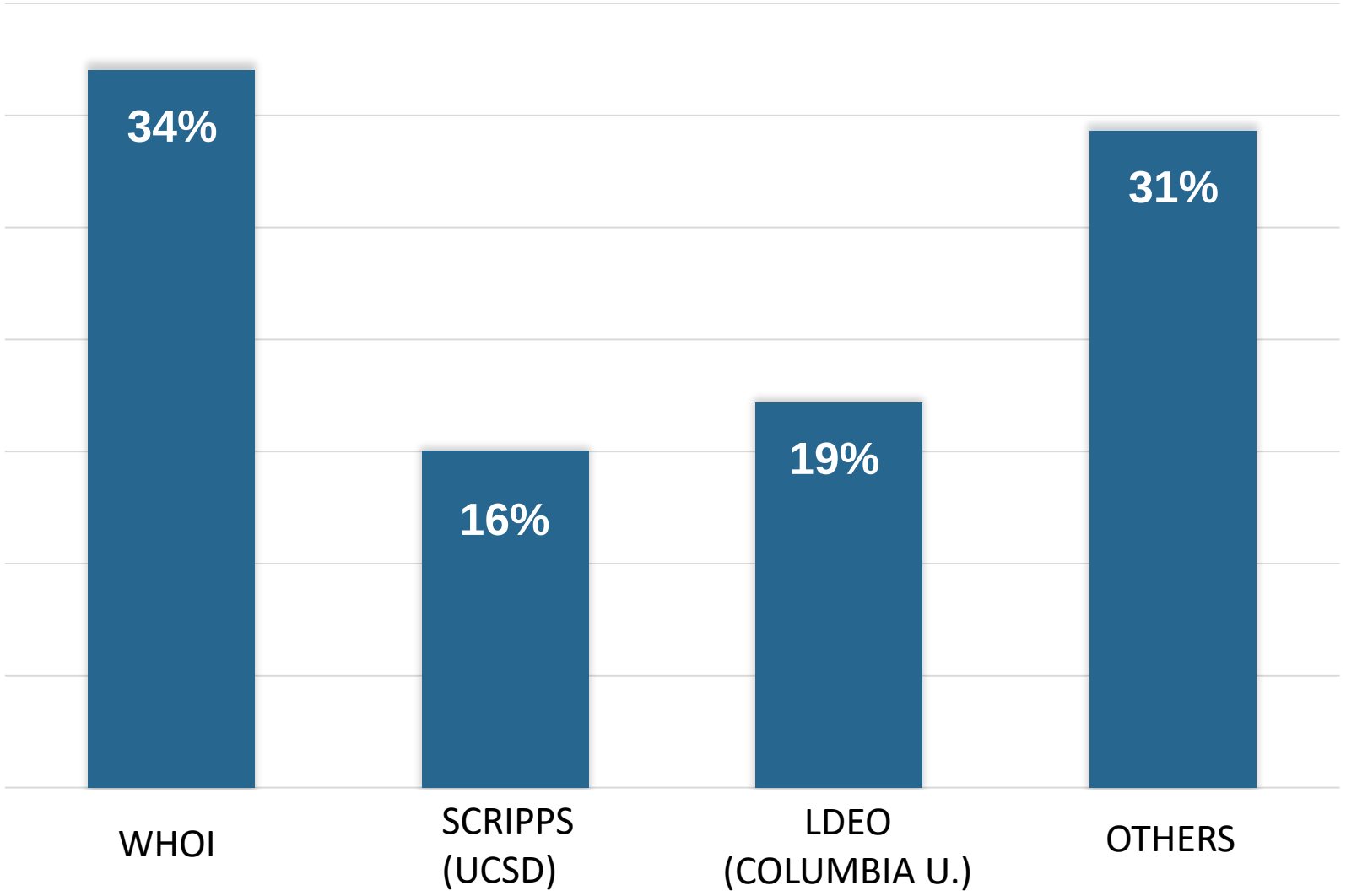
$333.7 M
in Value Added (GDP)

$603.8 M
in Biz. Revenue

Source: Kite-Powell & Di Jin, "WHOI Economic Impact," Marine Policy Center, July 2018

WHOI's Share of NSF Ocean Research Funding in FY17

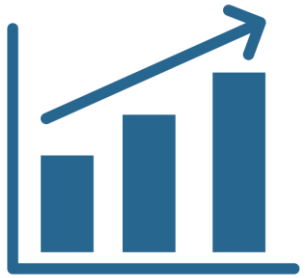
WHOI wins one of every three dollars of NSF funding, often through successful collaborations



Annual Economic Contributions of WHOI's Visits

10
Jobs

$388k
in Compensation



$781k
in Value Added (GDP)

$1.4 M
in Biz. Revenue

The Blue Technology Economy in Massachusetts

WHOI sits at the center of a burgeoning field

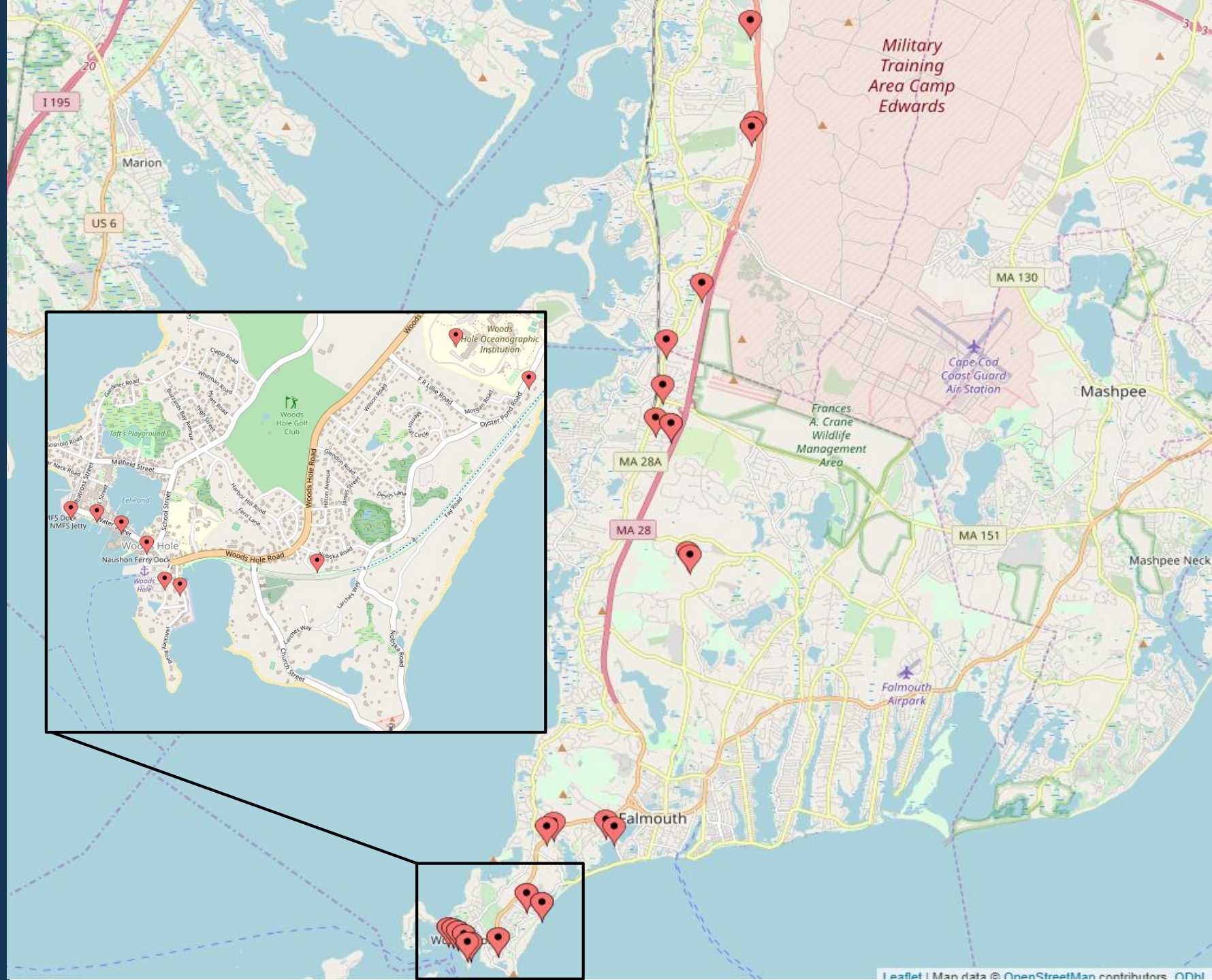
The Growing Ocean Economy

There are both opportunities and risks as humans reach further and deeper into the blue

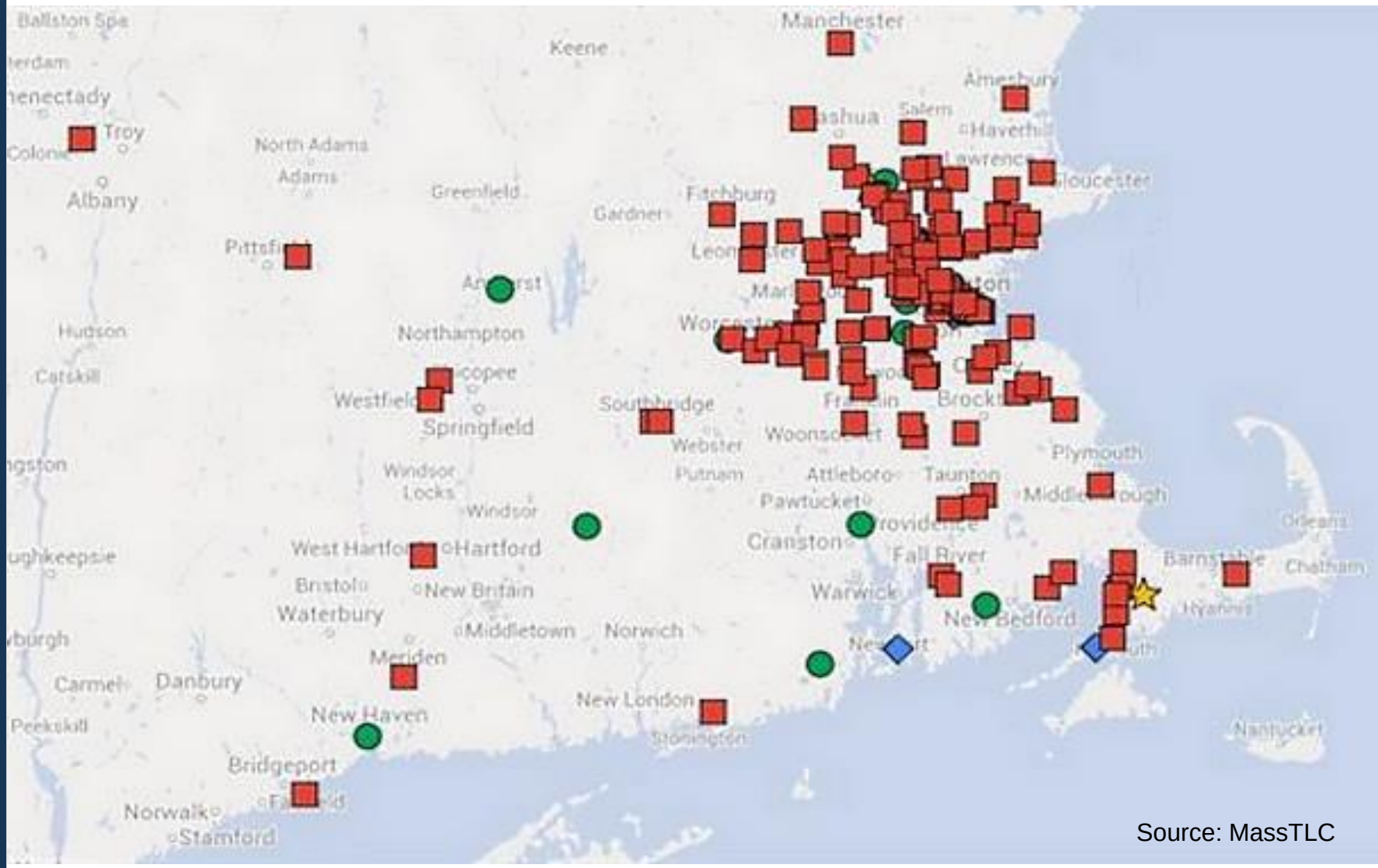
As ocean-based industries grow, they also create risks

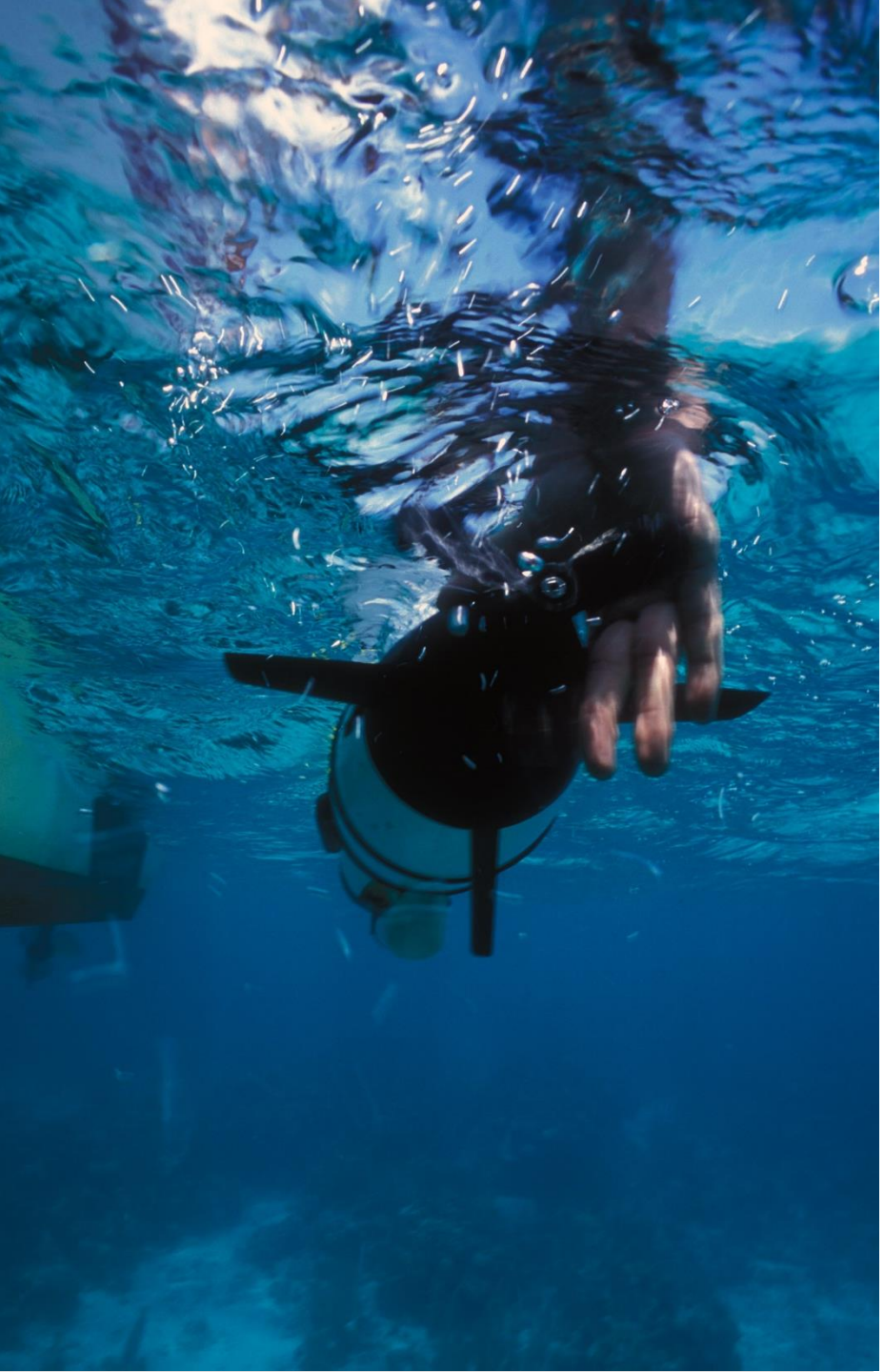
At the intersection of understanding the opportunities and risks is the research being done at WHOI.

Ocean-Based Blue Tech Economy Cluster



Robotics Cluster in New England





Spotlight on the Center for Marine Robotics

- CMR enables transformative marine robotics activities
- Over 100 organizations participate
- A growing number of companies support and access cutting-edge research being done in WHOI engineering labs
- CMR is leading the renovation and creation of test facilities at WHOI

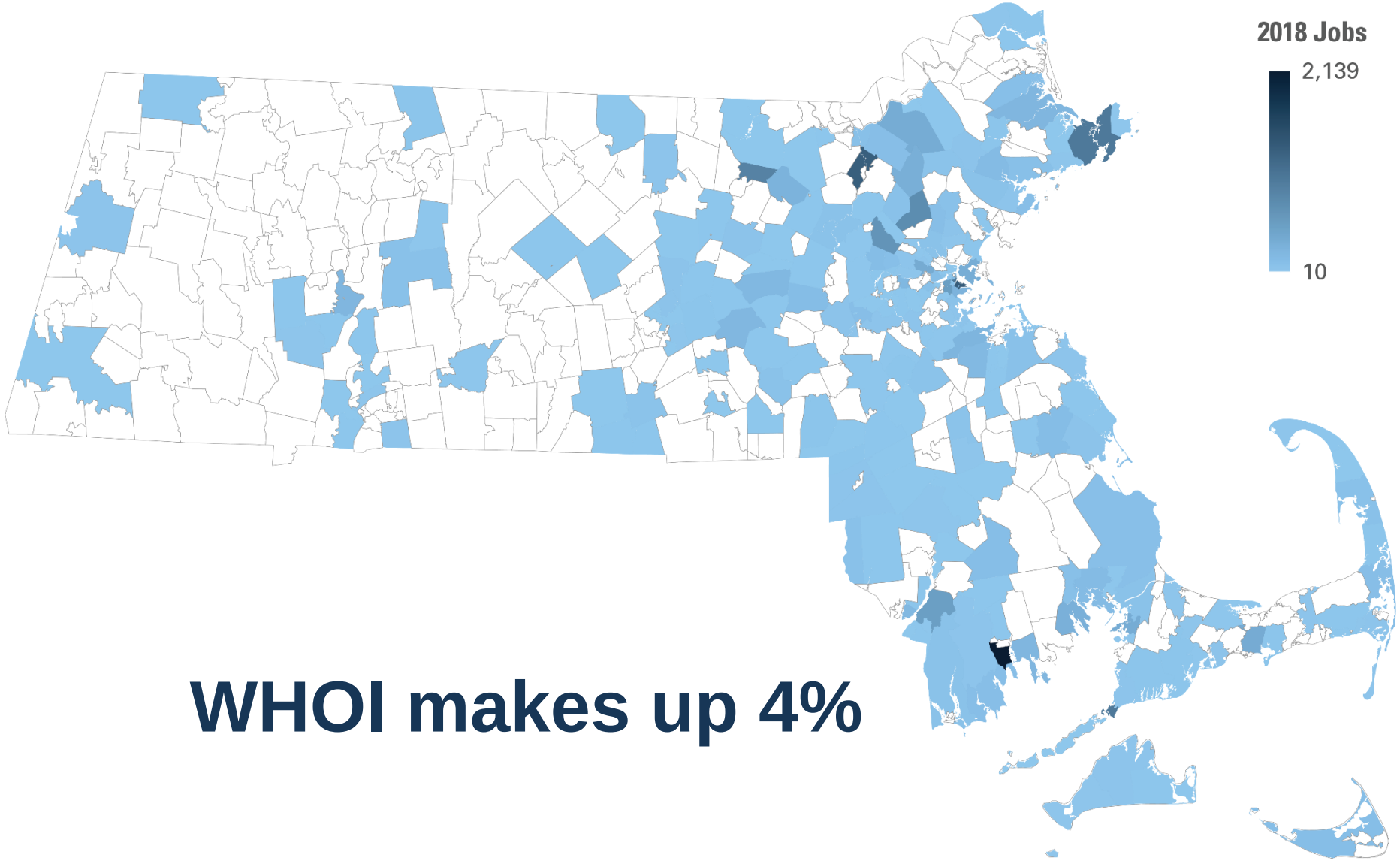
WHOI’s relationship with the

Blue Tech Economy

begins with pursuing fundamental science

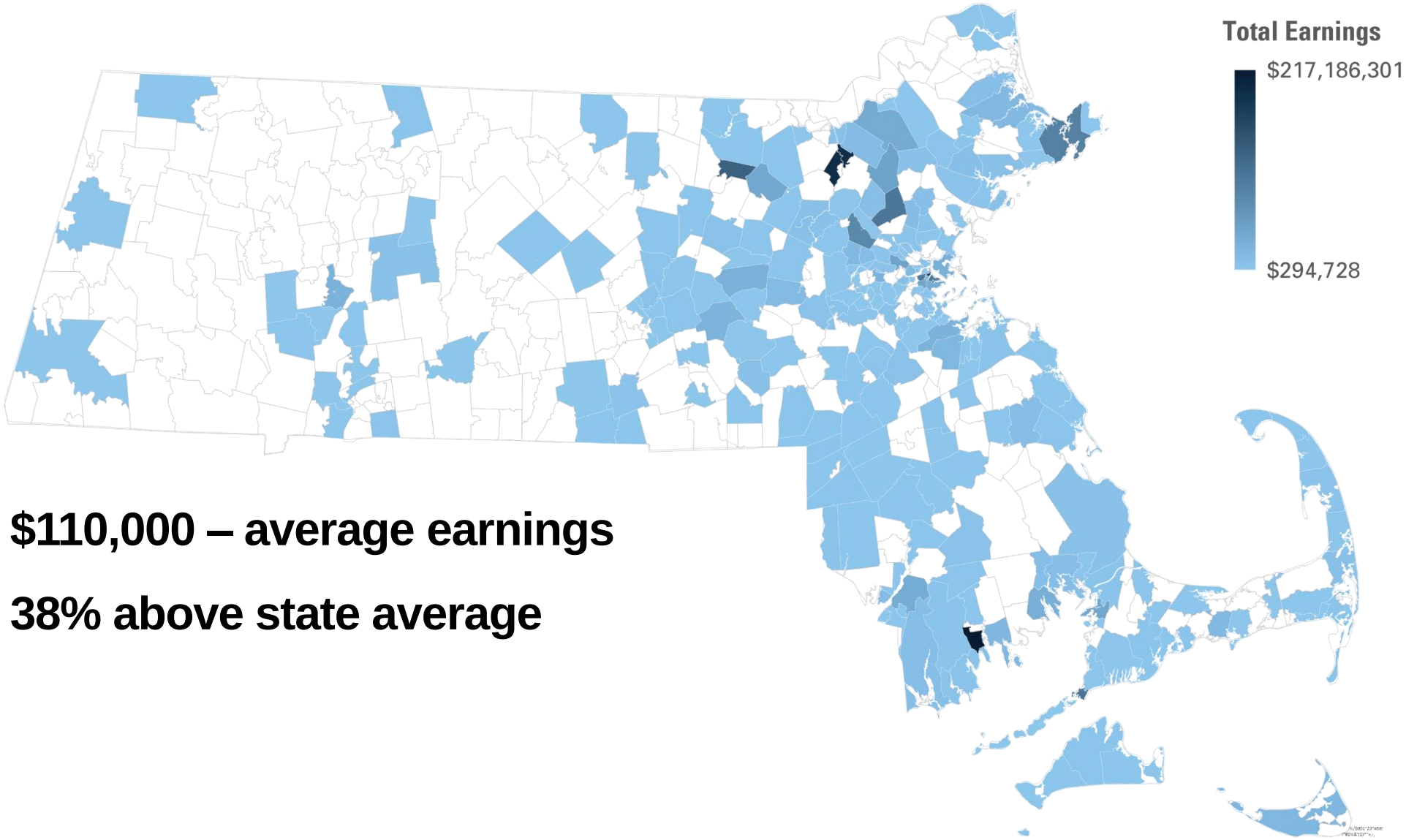
and continues to developing technical and engineering solutions that improve ocean health, forecasting, sensing, and navigation.

24,700 Ocean-Related Jobs in Massachusetts



WHOI makes up 4%

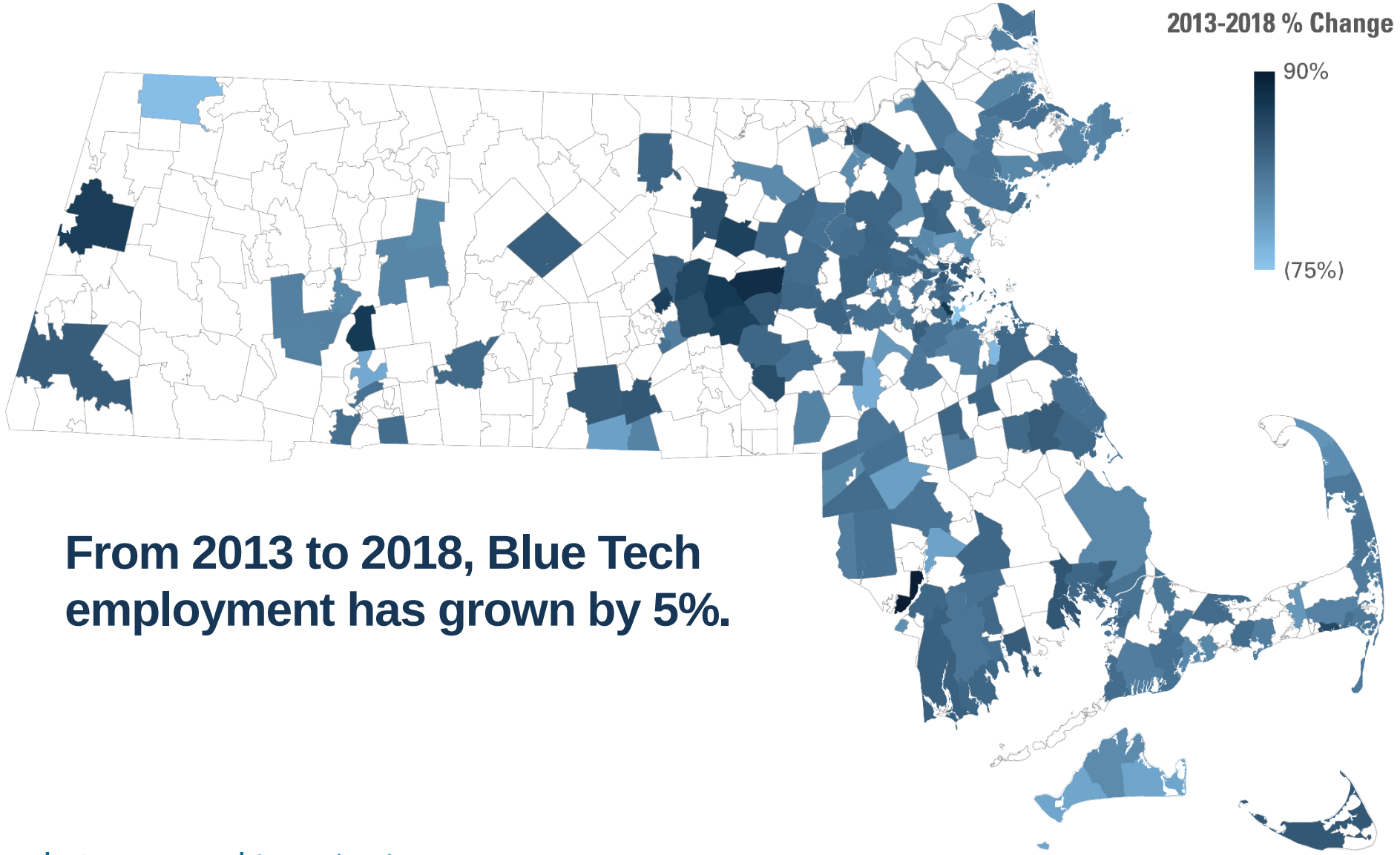
Blue Tech Jobs Contribute $2.6 Billion in Earnings



$110,000 – average earnings

38% above state average

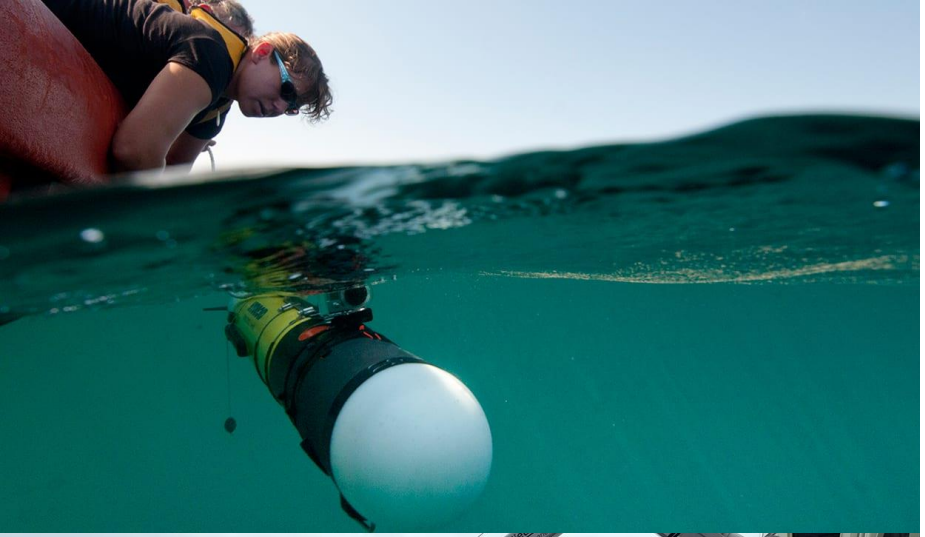
The Blue Tech Economy is Growing

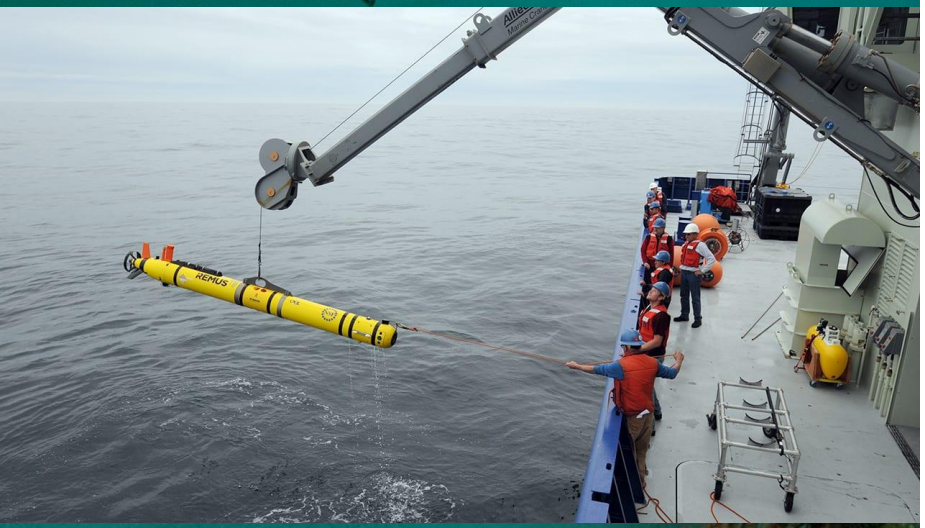


From 2013 to 2018, Blue Tech employment has grown by 5%.

All WHOI Spinoffs Remained in Massachusetts

WHOI currently offers licensing opportunities for 40 of its patents.





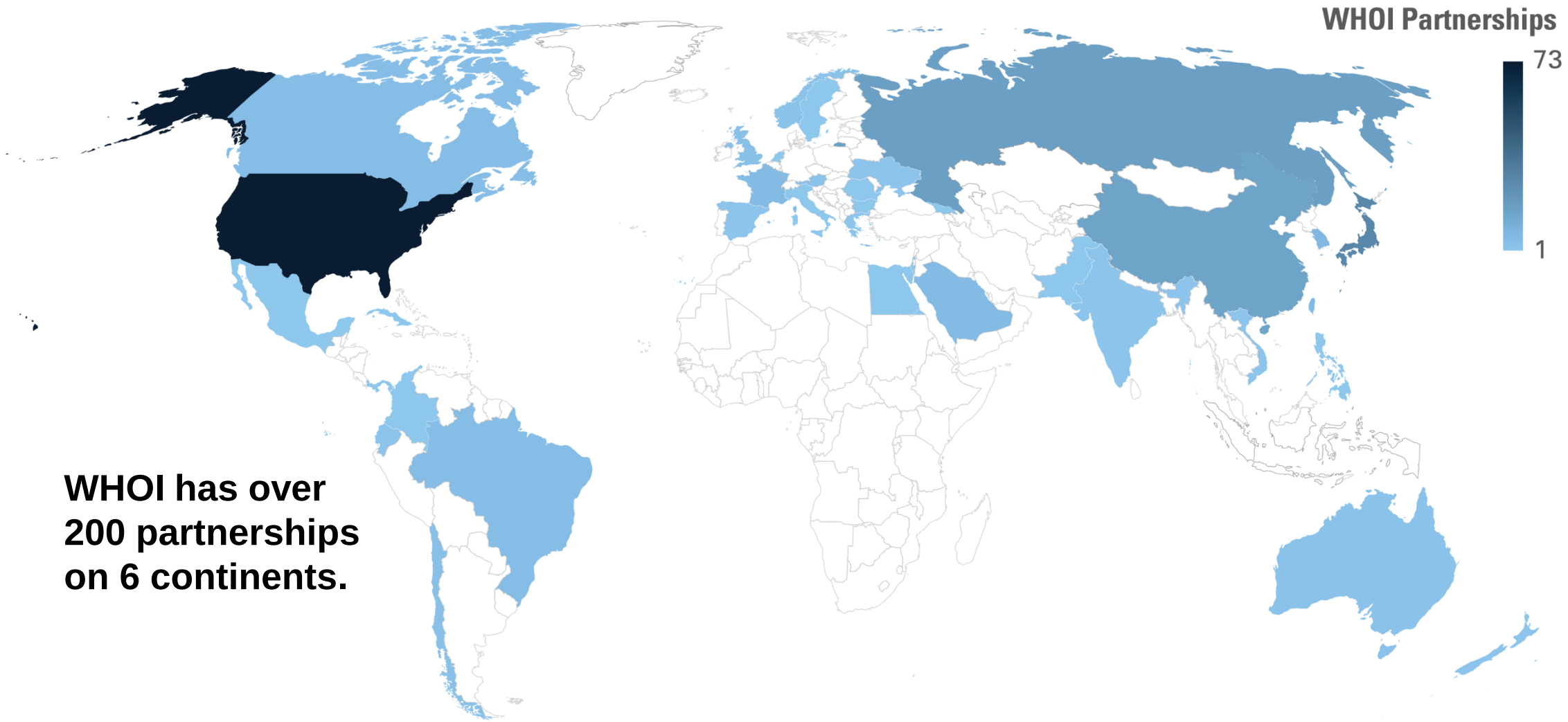
Spotlight on Hydroid

- Hydroid's primary product is the AUV *REMUS*
- Used by civilian and military clients
- Hydroid employs over 175 people
- Hydroid continues to license WHOI technology

Research Partnerships

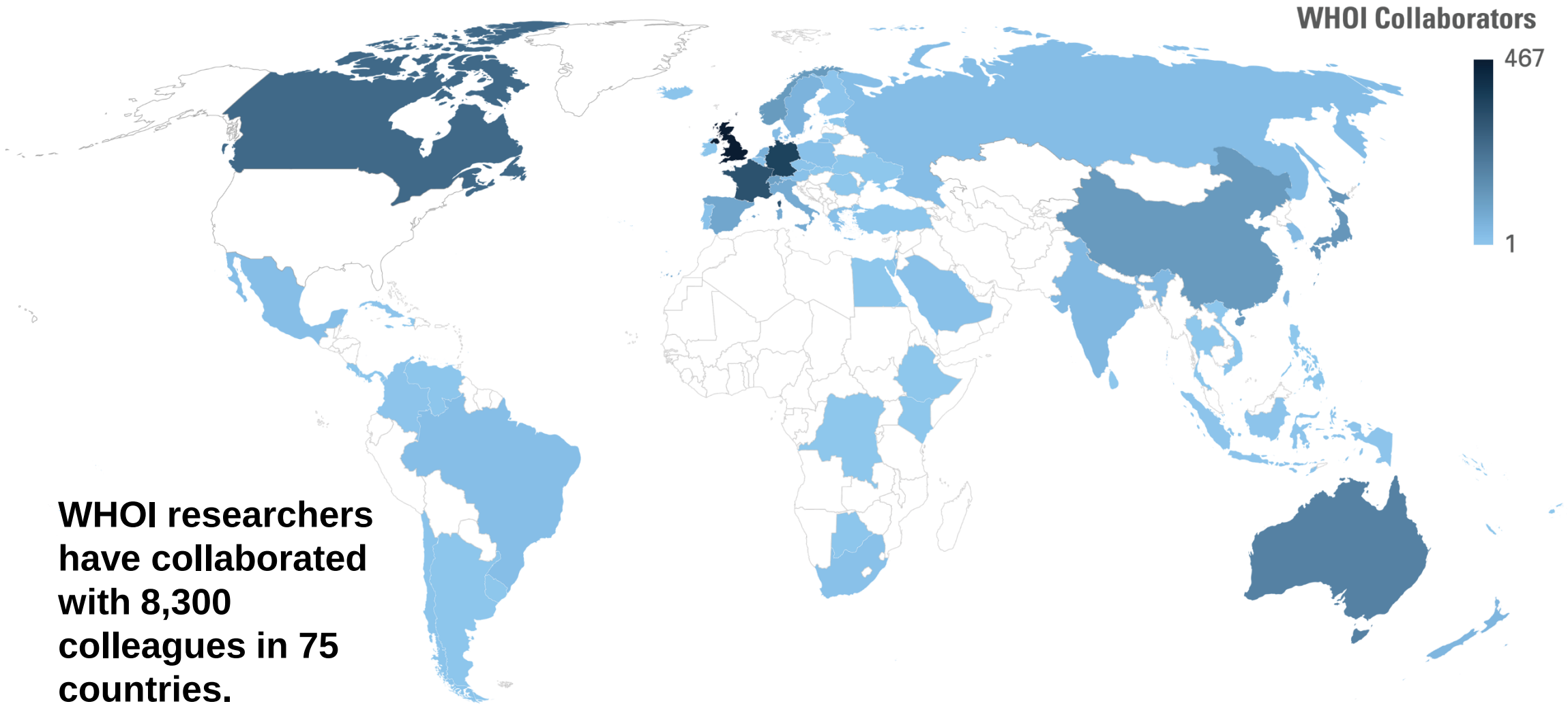
WHOI’s and its scientists connections to other researchers

WHOI's Global Reach in Research Partnerships



WHOI has over 200 partnerships on 6 continents.

WHOI Global Reach in Researcher's Collaborations



WHOI researchers have collaborated with 8,300 colleagues in 75 countries.

Research Collaborations by Region

On average, each WHOI scientist has collaborated with 49 others

Region	Collaborations
North America	5,539
Europe	1,872
Asia	479
Australia/New Zealand	250
Latin America	86
Africa	29
Other	*57*
Total	**8,312**

Spotlight on CWATER

Complex for Waterfront Access to Exploration and Research

CWATER: The Benefits

- Retain existing jobs, create new jobs
- Underpins long-term presence of WHOI
- Positions SE Mass for growth
- Attracts new marine related activity
- Provides direct community involvement
- Provides opportunity for leadership
- Adds workforce development opportunities

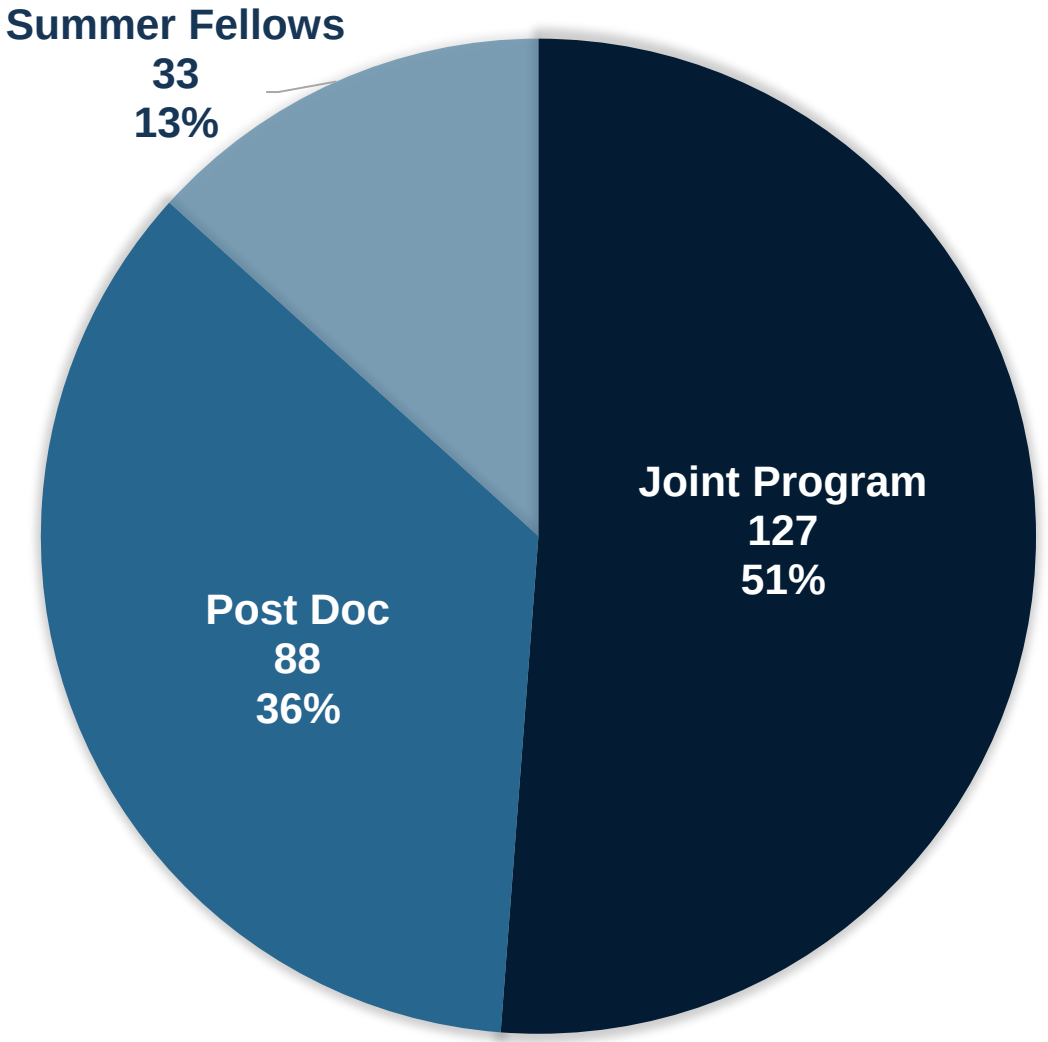
Educating Future Scientists and Engineers

WHOI’s history of education and current student body

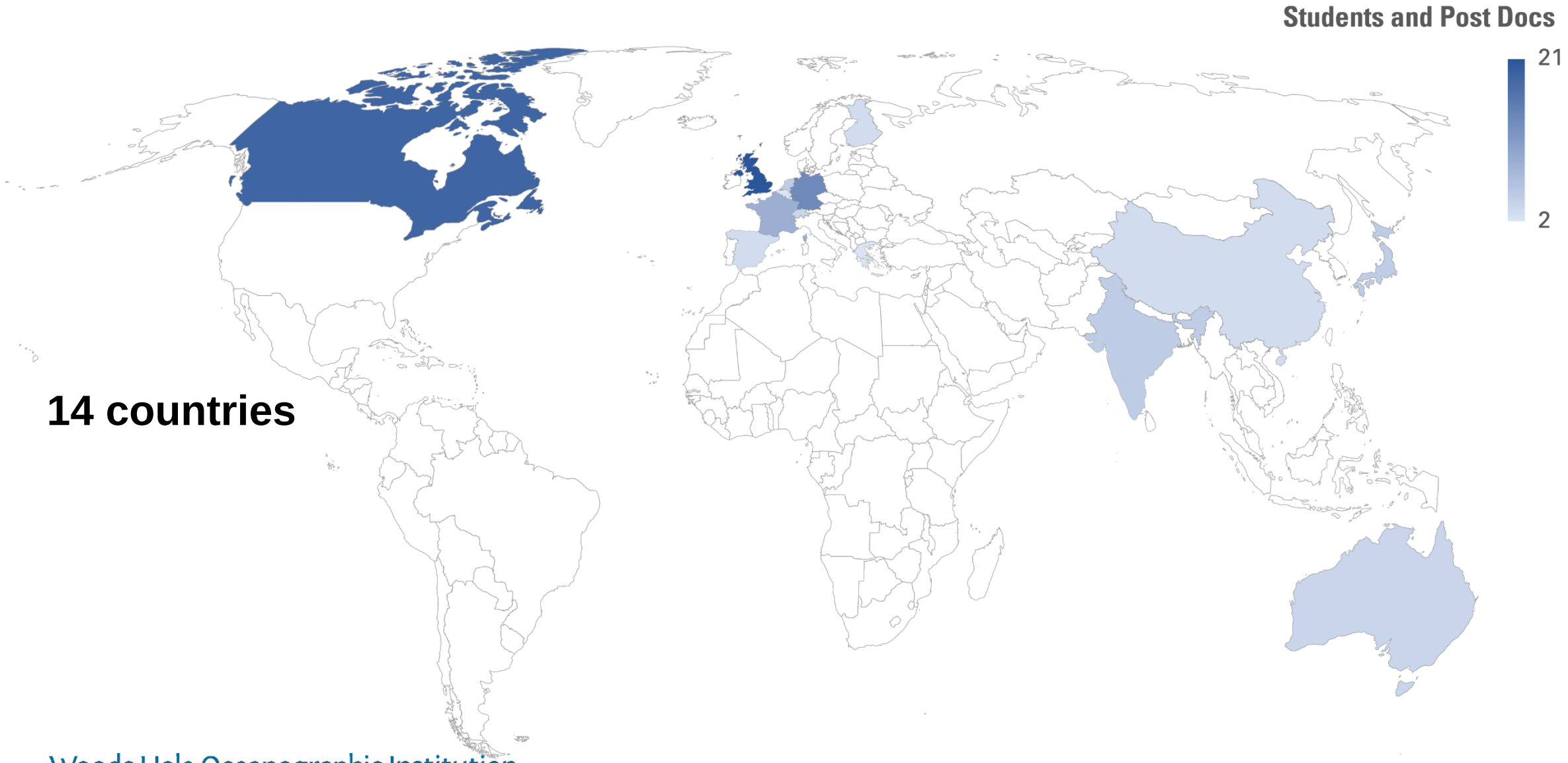
Education Overview

MIT-WHOI recently celebrated its 50th year

An average of 1 of every 6 grads has remained in Massachusetts

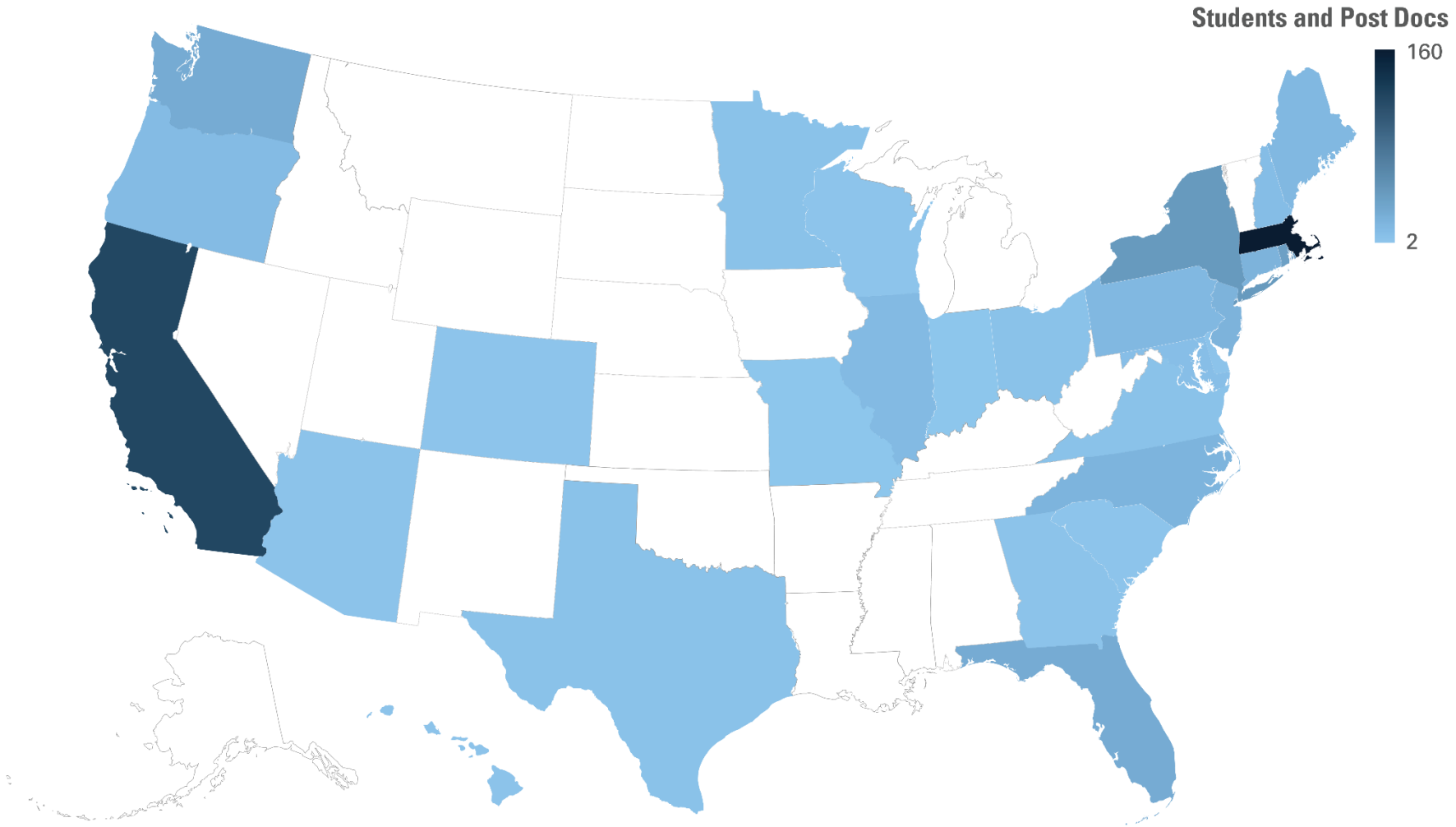


International Education



14 countries

Domestic Education



630 from the U.S.

86% of attendees

160 are from Mass.

WHOI alumni become leaders in their fields:

- Chief of Naval Operations
- Astronaut
- Leaders of other eminent organizations

Knowledge Translation and Community Outreach

Sharing WHOI's knowledge with the public

Public Sector Partners

State Government:

- MassTech Collaborative
- MA Clean Energy Center
- Seaport Economic Council

Local Government:

- Town of Falmouth
- Barnstable County

Universities:

- UMass, Mass Maritime
- MIT, Harvard, and many others

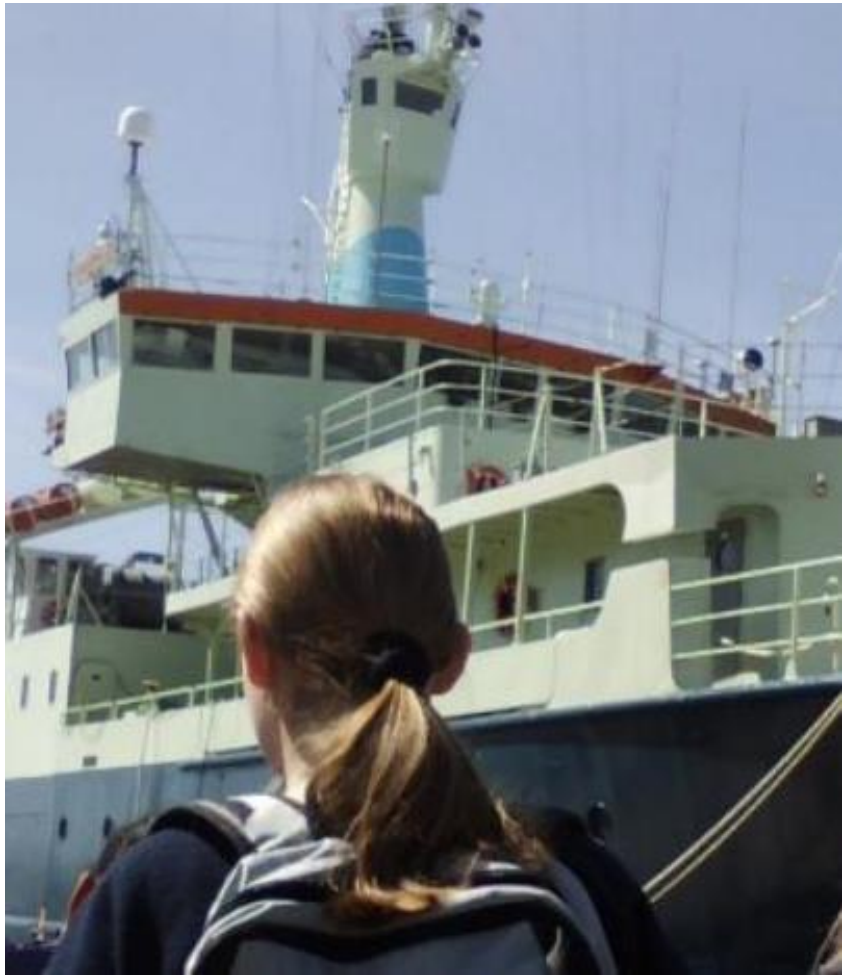
Focus on Sea Grant

- WHOI's Sea Grant programs include:
  - support shellfish aquaculture
  - reduce flood insurance premiums
  - protect coastal dunes and banks.
- 2017 Sea Grant work in MA supported:
  - **$207M** economic impact
  - **900** jobs
  - **360** businesses
  - **5,000** acres of coastal habitat protected or restored

Knowledge translation and outreach

- Over **1,000 student interactions** per year by WHOI researchers
- **Dozens** of classroom visits, museum talks, science cafes, and more
- Up to **1.2 million visitors** saw WHOI's three-year *Alvin* exhibit
- ***Blue Planet*** series was seen by tens of millions in 50 countries

Spotlight on Education Outreach

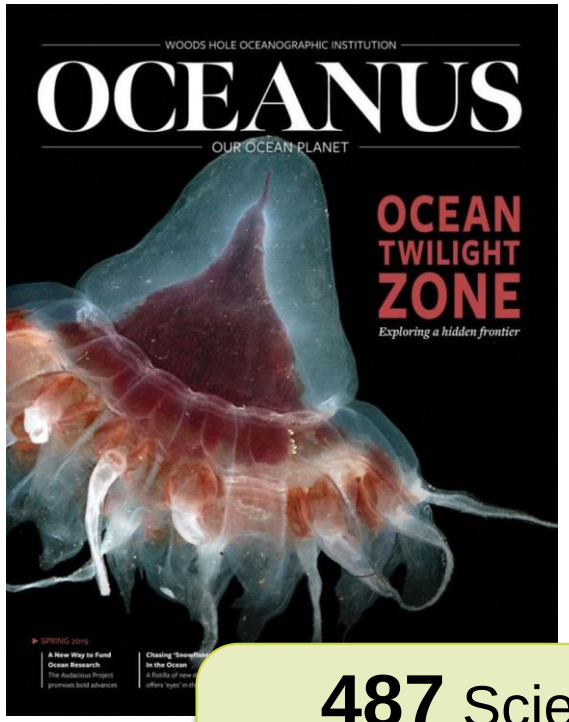


Source: Perkins School for the Blind

Perkins School for the Blind

- Perkins and WHOI have been collaborating for over **13 years**
- Dr. Amy Bower, an oceanographer from WHOI, serves as both teacher and role model for the students.

WHOI is spreading knowledge through media



487 Scientific Publications Issued in 2017

9,218,998 Website Hits

29,515 Instagram Followers

17,000 Twitter Followers

137,759 Facebook Followers

28,063 Newsletter Subscribers

65 Oceanus Articles Published

WHOI's In-Kind Partnerships

Contributing to the community through:

- Partnerships
- Educational programming
- Support for local non-profits
- Indoor and outdoor spaces for events and emergency support services for Falmouth, Naushon Island, and Martha's Vineyard.

Providing supplementary communications links for Naushon and Martha's Vineyard

Summary

- WHOI has been leading ocean research and technological development in Massachusetts and the world for almost 90 years.
- WHOI’s presence in Massachusetts has formed a hub around which the Blue Tech Economy has grown. It spreads knowledge and feeds the larger blue economy.

About this Presentation

This report was produced by the UMass Donahue Institute for WHOI using data from the Woods Hole Oceanographic Institution

Images provided by WHOI

For more information Contact:

Woods Hole Media Relations Office
media@whoi.edu
(508) 289-3340