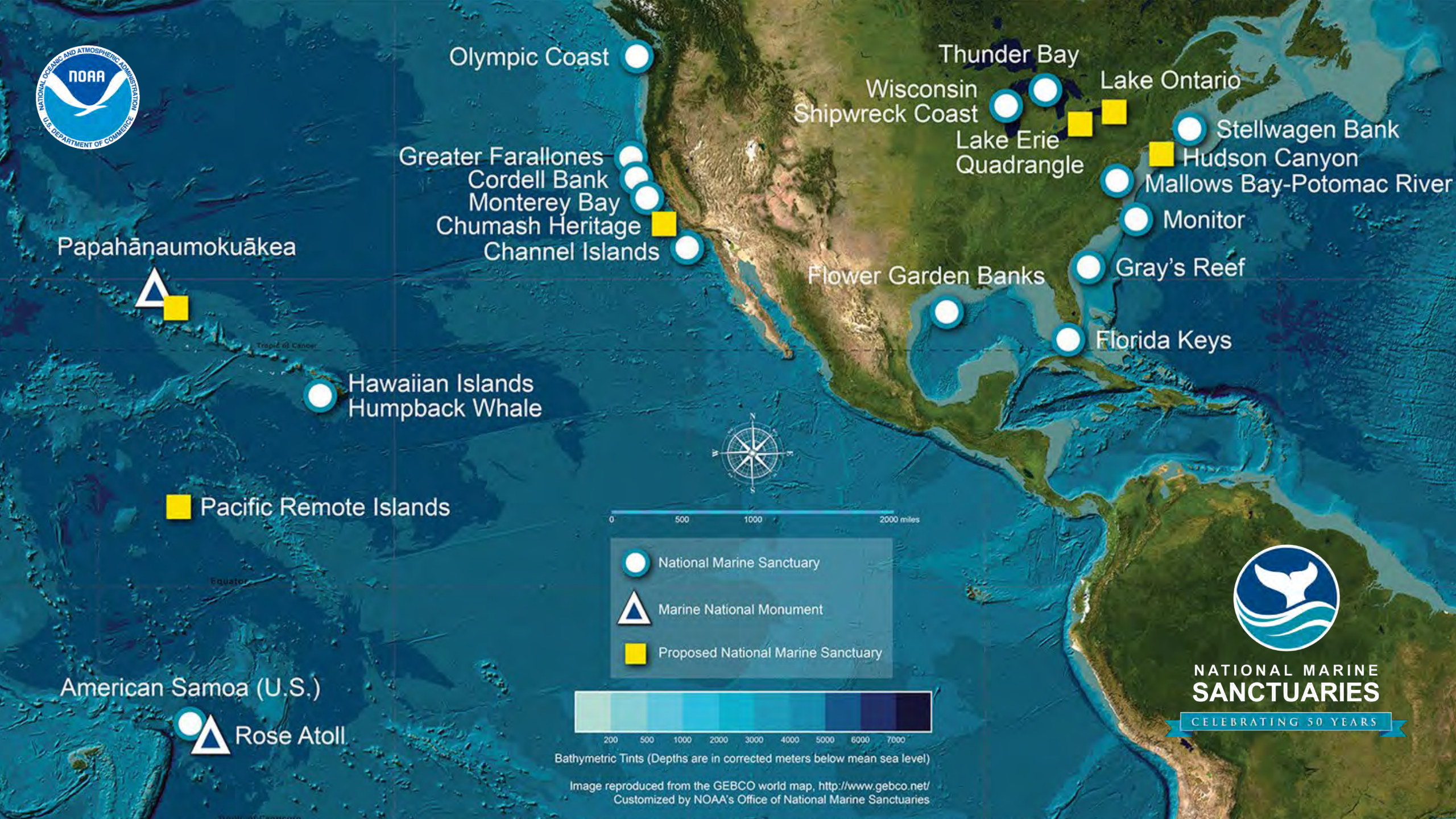
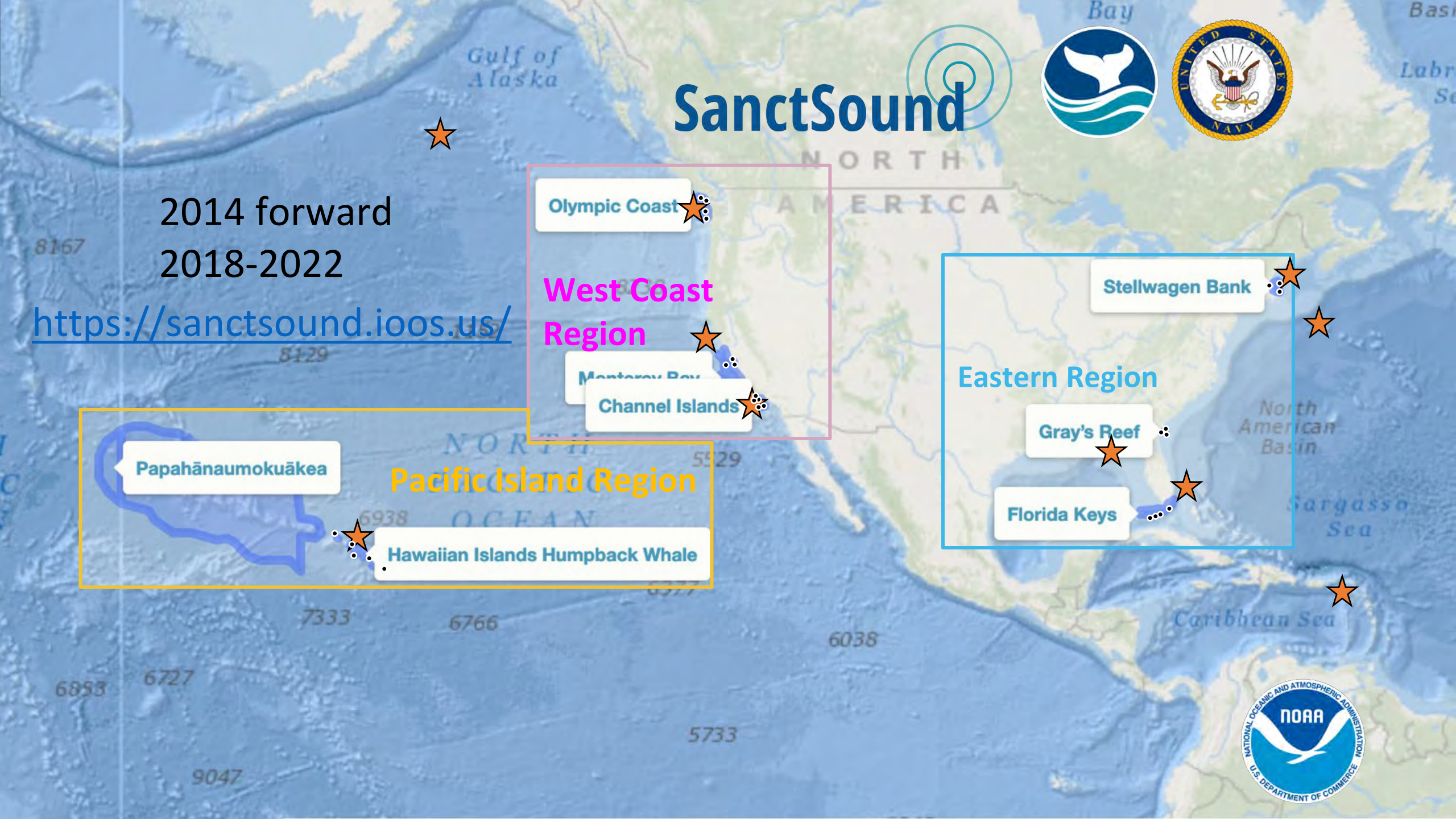
Sound

Essential Observations in and around Protected Areas

June 27, 2023

IOOS Advisory Committee meeting


Olympic Coast
Thunder Bay
Wisconsin Shipwreck Coast
Lake Ontario
Lake Erie Quadrangle
Stellwagen Bank
Hudson Canyon
Mallows Bay-Potomac River
Monitor
Greater Farallones
Cordell Bank
Monterey Bay
Chumash Heritage
Channel Islands
Papahānaumokuākea
Flower Garden Banks
Gray's Reef
Florida Keys
Hawaiian Islands Humpback Whale
Pacific Remote Islands
American Samoa (U.S.)
Rose Atoll
Tropic of Cancer
Equator
0 500 1000 2000 miles
National Marine Sanctuary
Marine National Monument
Proposed National Marine Sanctuary
200 500 1000 2000 3000 4000 5000 6000 7000
Bathymetric Tints (Depths are in corrected meters below mean sea level)
Image reproduced from the GEBCO world map, http://www.gebco.net/
Customized by NOAA's Office of National Marine Sanctuaries
NATIONAL MARINE
SANCTUARIES
CELEBRATING 50 YEARS


SanctSound
2014 forward
2018-2022
https://sanctsound.ioos.us/
West Coast Region
Olympic Coast
Channel Islands
Eastern Region
Stellwagen Bank
Gray's Reef
Florida Keys
Pacific Island Region
Papahānaumokuākea
Hawaiian Islands Humpback Whale
Gulf of Alaska
NORTH AMERICA
North American Basin
Sargasso Sea
Caribbean Sea
NOAA

2014 forward
2018-2022
2022 forward
Olympic Coast
West Coast Region
Chumash Heritage
Channel Islands
Stellwagen Bank
Eastern Region
Flower Garden Banks
Gray's Reef
Florida Keys
Papahānaumokuākea
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Hawaiian Islands Humpback Whale
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NORTH AMERICA
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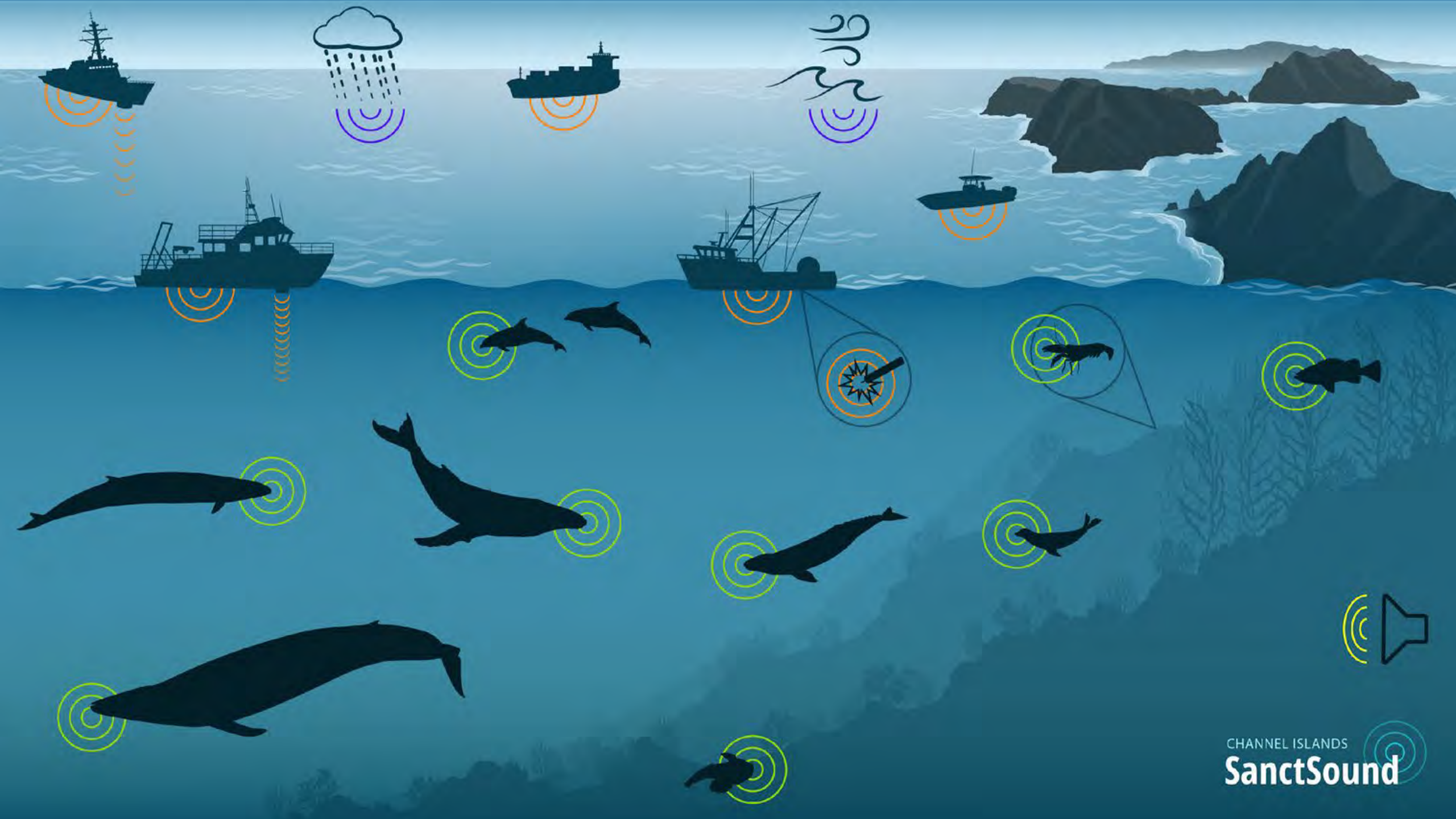
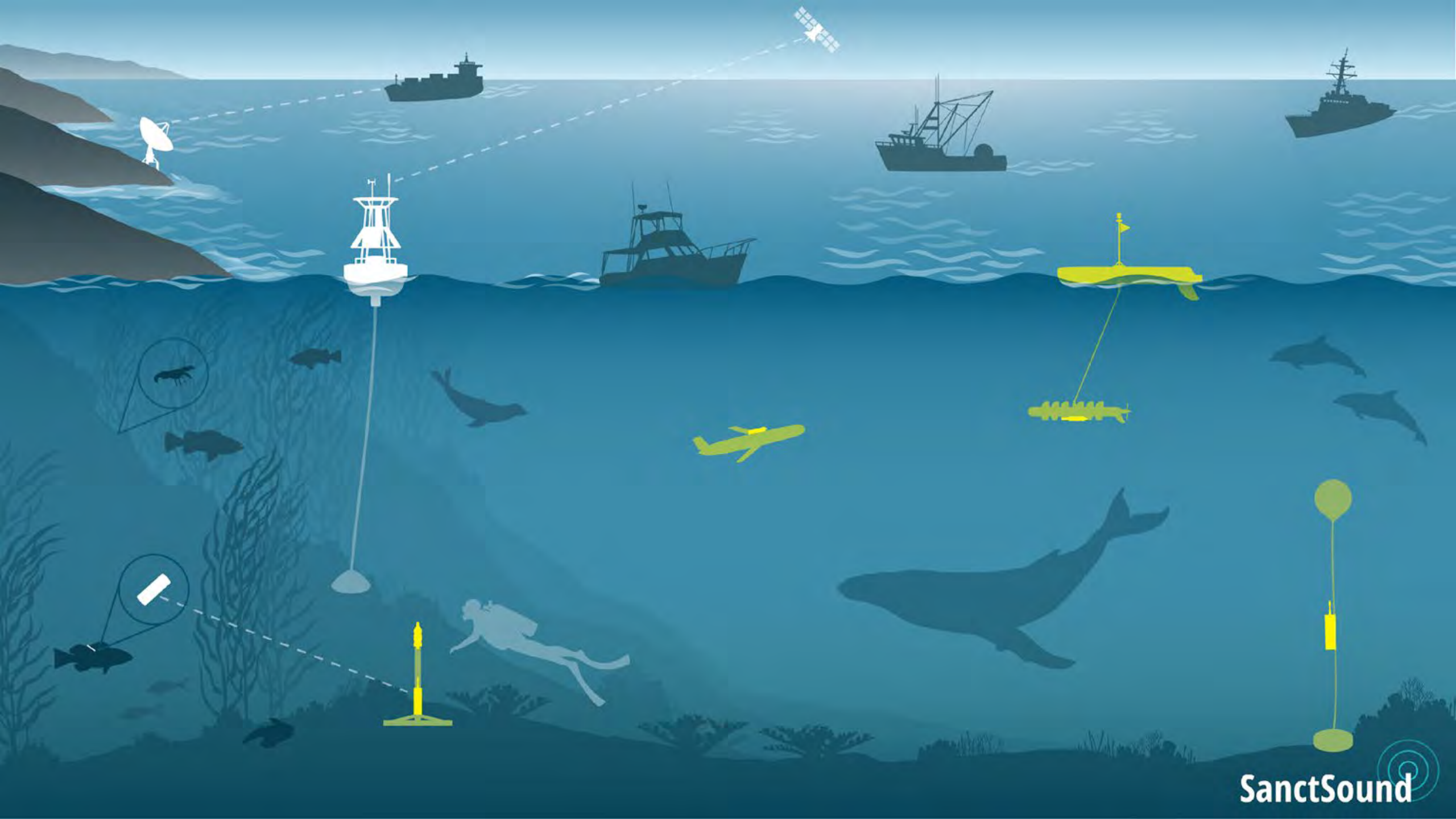
NOAA


CHANNEL ISLANDS
SanctSound


SanctSound

Olympic Coast

West Coast Region

Chumash Heritage

Channel Islands

Papahānaumokuākea

Pacific Island Region

Hawaiian Islands Humpback Whale

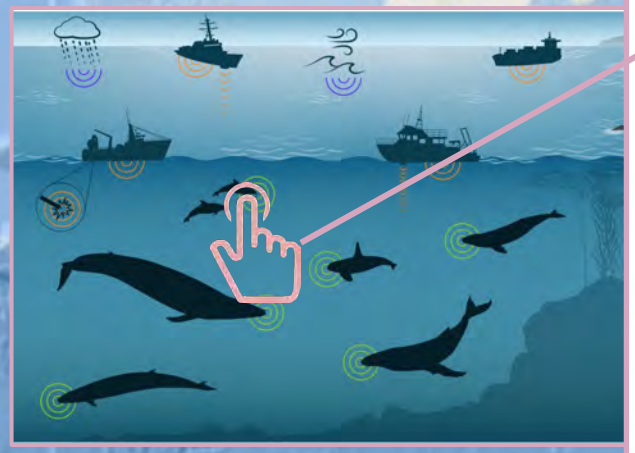
Stellwagen Bank

Eastern Region

Flower Garden Banks

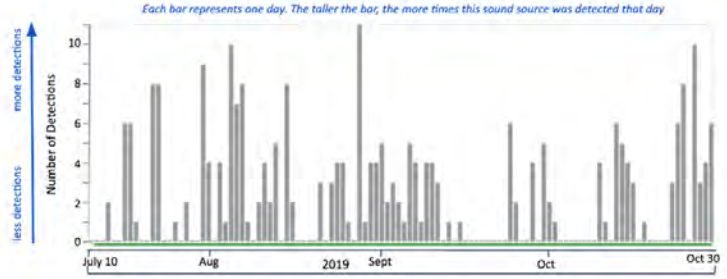
Gray's Reef

Florida Keys



Dolphins

Sights & Sounds | **Time series** | Monthly Patterns | Hourly Patterns



Of the four time periods of analyzed data at the shipping lanes listening station on the northern end of Olympic Coast sanctuary, only one recorded dolphins acoustically active: July through October 2019.

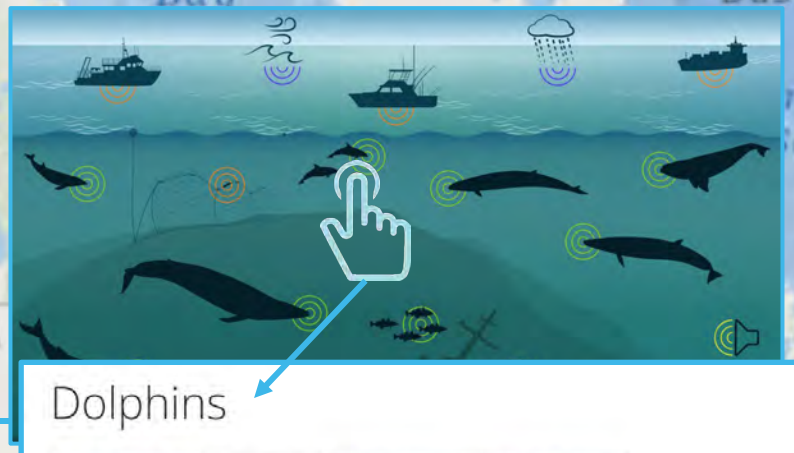
West Coast Region

Chumash Heritage

Channel Islands

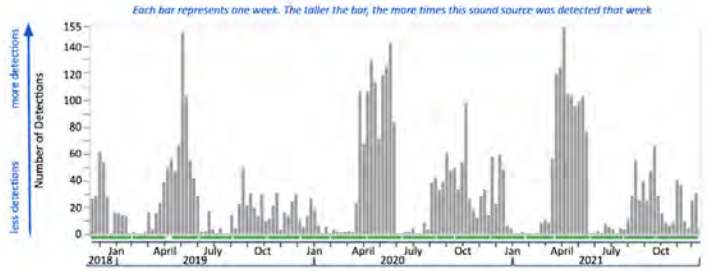
Flower Garden Banks

Florida Keys



Dolphins

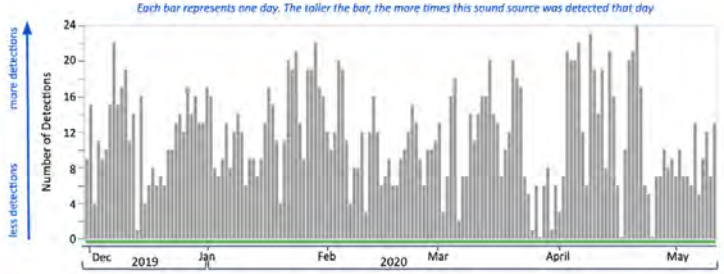
Sights & Sounds | **Time series** | Monthly Patterns | Hourly Patterns



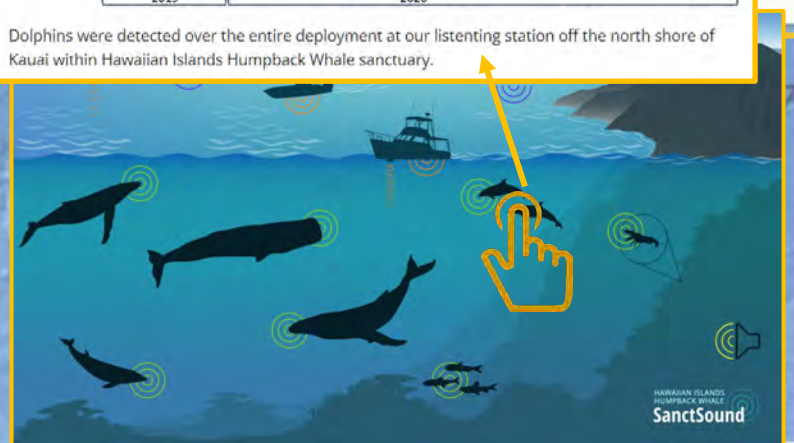
Dolphins were often detected off the northwest corner of Stellwagen Bank and across multiple seasons over the three year project.

Dolphins

Sights & Sounds | **Time series** | Monthly Patterns

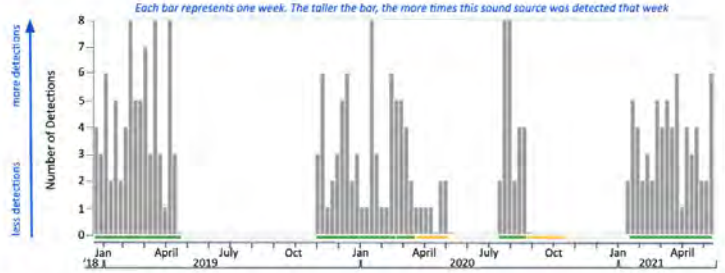


Dolphins were detected over the entire deployment at our listenting station off the north shore of Kauai within Hawaiian Islands Humpback Whale sanctuary.



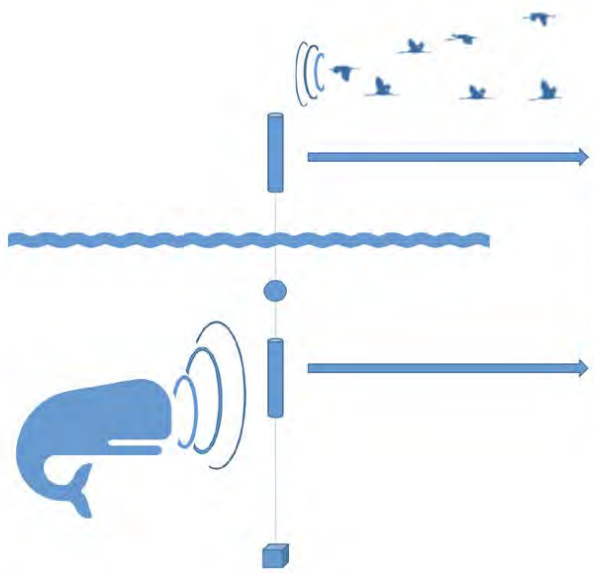
Dolphins

Sights & Sounds | **Time series** | Monthly Patterns | Hourly Patterns

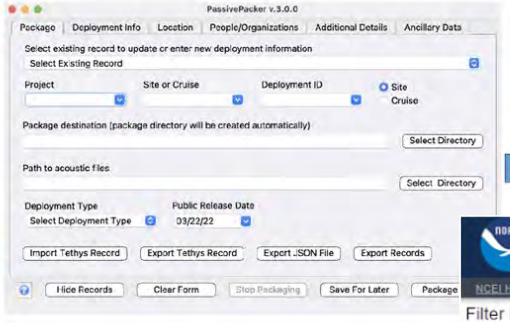


Dolphins were often detected south of Key West in Florida Keys sanctuary over the three year project.

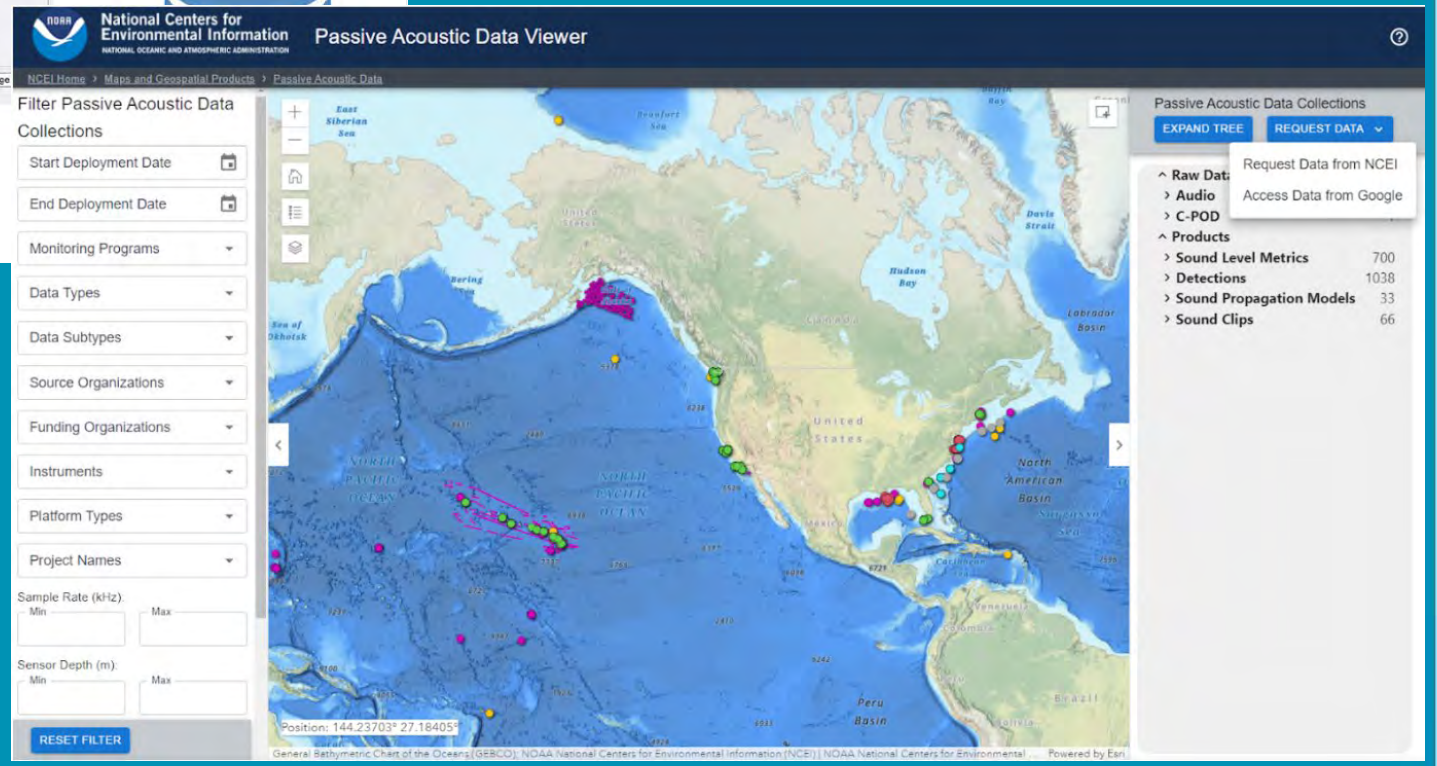
PAM Data Management And Cyberinfrastructure



Standardization, Centralization, Service & Delivery



ncei.noaa.gov/products/passive-acoustic-data

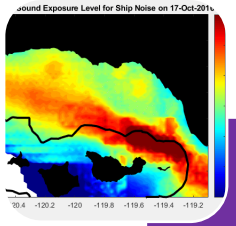


NCEI
NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION

identify mgmt & conservation needs & stakeholder concerns

collaboratively design listening network

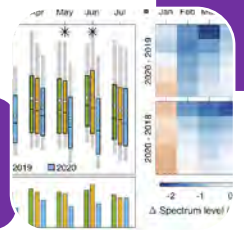
management applications



interactive mgmt tools, stakeholder engagement

education & outreach

publications, reports, presentations



soundscape characterization, variability, biologics, Before-After Control-Impact

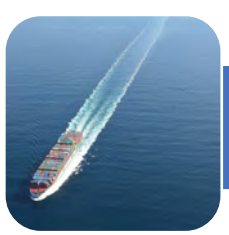
standardized time-series sound levels

Essential Ocean Variable

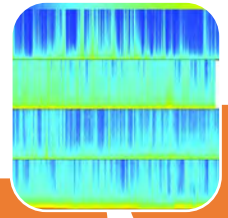
status and trend assessments

long-term, coordinated, standardized PAM data collection

passive acoustic monitoring



ancillary data collection / access



big data processing

QA/QC, standardized processing, archive

data accessibility (NCEI, ERDDAP)

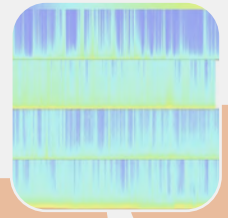
identify mgmt & conservation needs & stakeholder concerns

collaboratively design listening network

passive acoustic monitoring

long-term, coordinated, standardized PAM data collection

ancillary data collection / access



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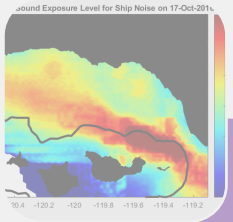
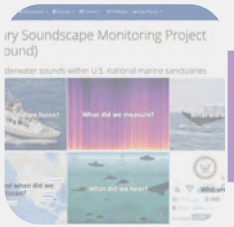
management applications



interactive mgmt tools, stakeholder engagement

Integrated Regional Arrays

Longevity
Coordinated
Standardized
Centralized
Accessible
Supports Mandates
Innovation Opportunities

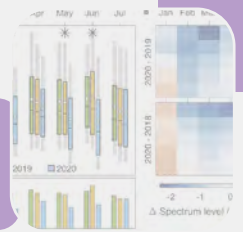


education & outreach

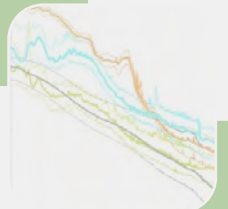
soundscape characterization, variability, biologics, Before-After Control-Impact

standardized time-series sound levels

Essential Ocean Variable

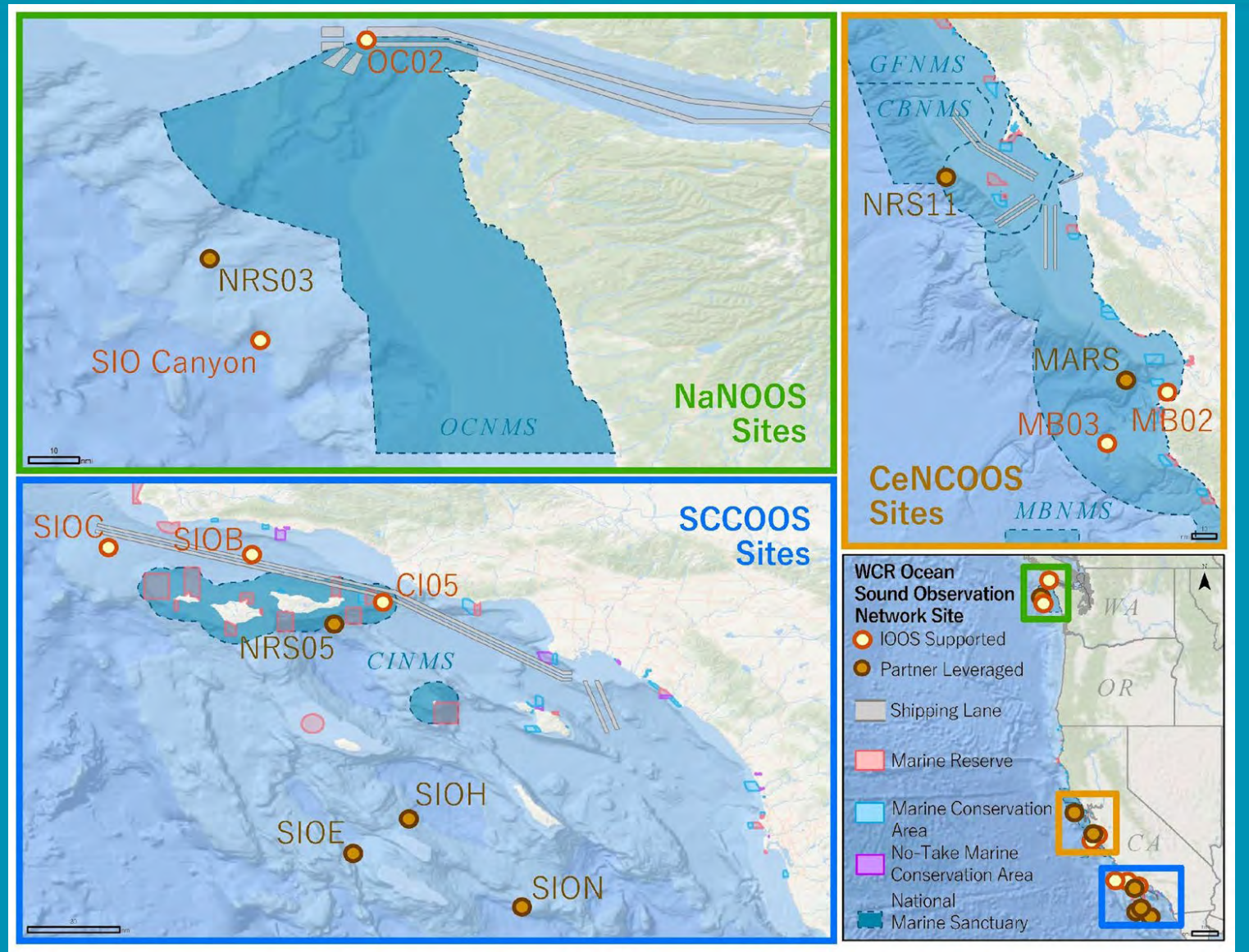


publications, reports, presentations

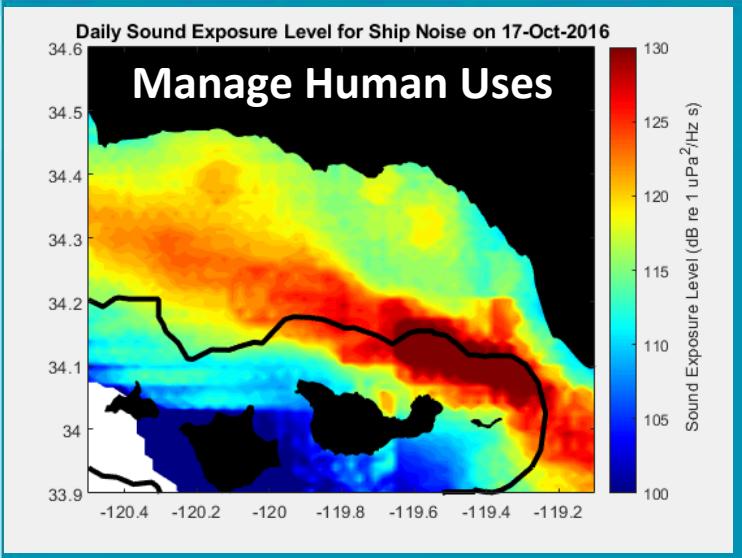


status and trend assessments

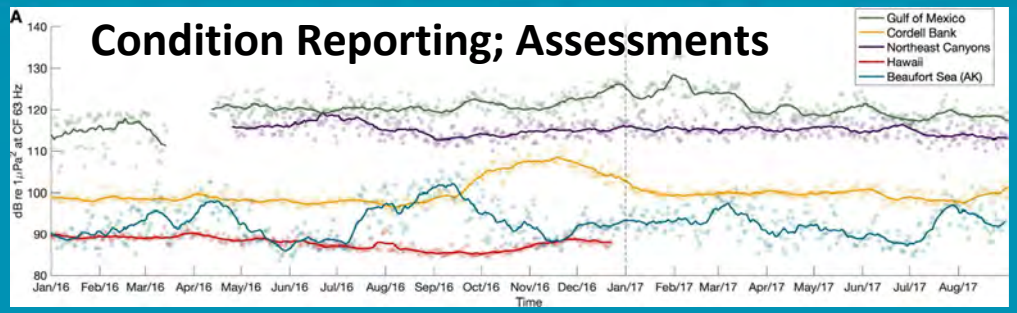
Ocean Sound Observation Network



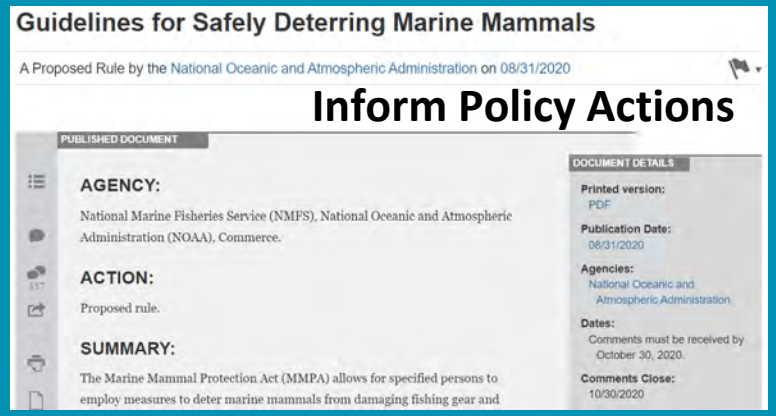
PAM Supporting Management

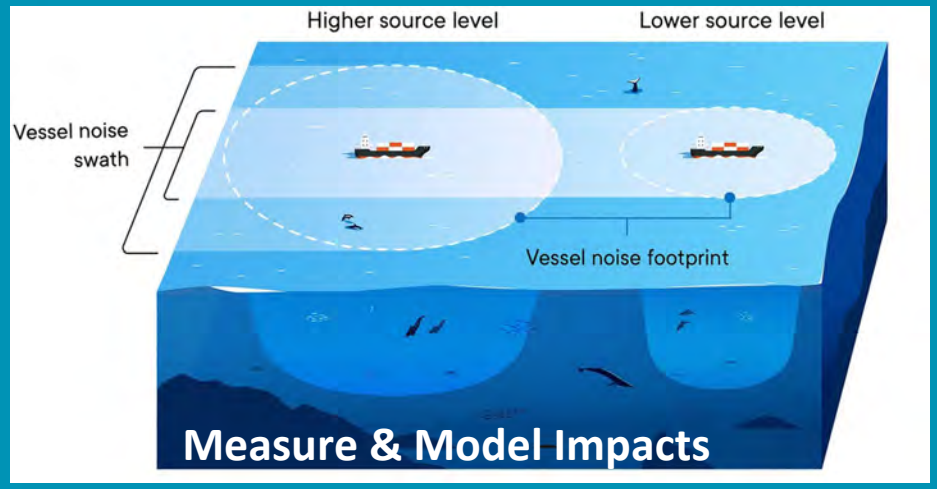


(Zobell et al. *in prep*)



(Haver et al. 2021)



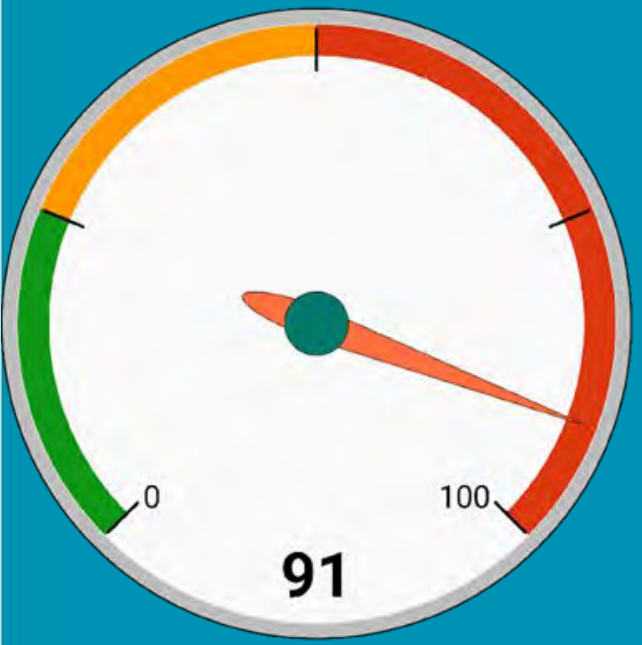


(Findley et al. 2023)

(Palumbi et al. 2019)

Vessel Noise Indicators

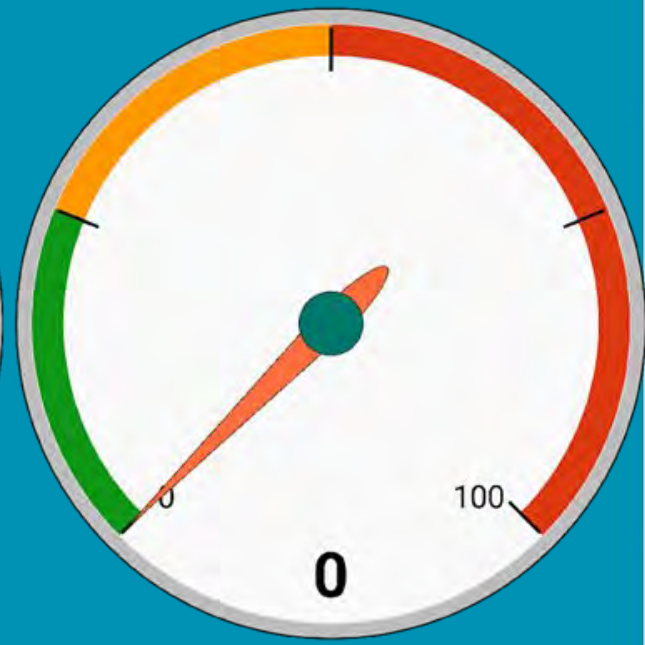
% of hours in a month with vessel noise **dominating** the soundscape



Stellwagen Bank
site 03 (Mar)

Florida Keys
site 03 (Mar)

Monterey Bay
site 02 (Mar)



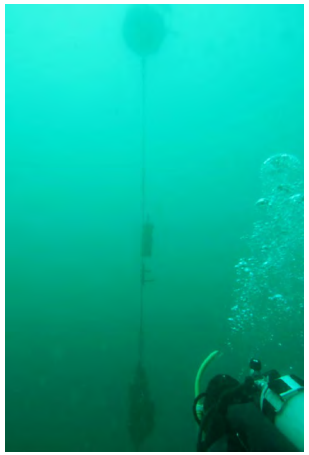
Papahānaumokuākea
(Jan)

McKenna et al. 2022

Lindsey Peavey Reeves
National Marine Sanctuary Foundation
providing assistance to:
NOAA Office of National Marine Sanctuaries
https://sanctsound.ioos.us
Lindsey.Peavey@noaa.gov

Bottom-moored recorders

$-$$



Drifting buoys

$-$$

$$$

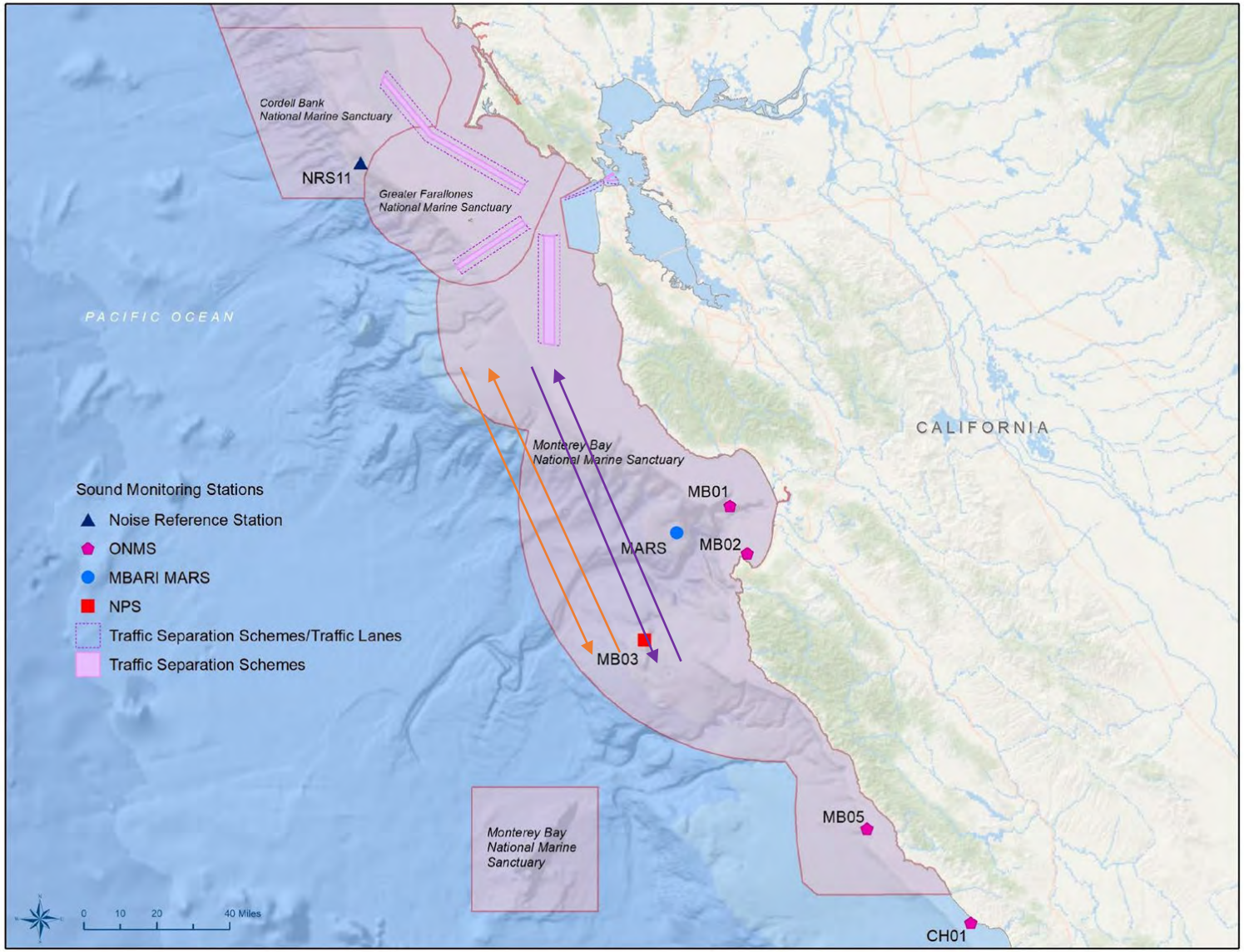
Ship-based surveys

Time

Space

(adapted from a slide by Shannon Rankin, NOAA SWFSC)

~60-year time-series at Sur Ridge



MONTEREY BAY NATIONAL MARINE SANCTUARY

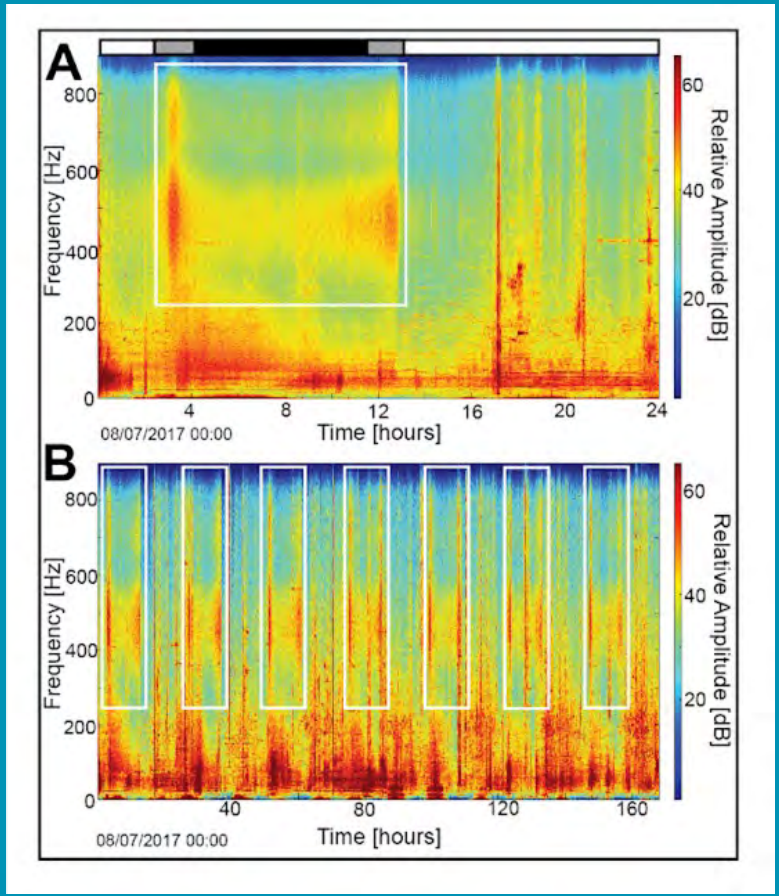
CENTRAL & NORTHERN CALIFORNIA OCEAN OBSERVING SYSTEM

MBARI

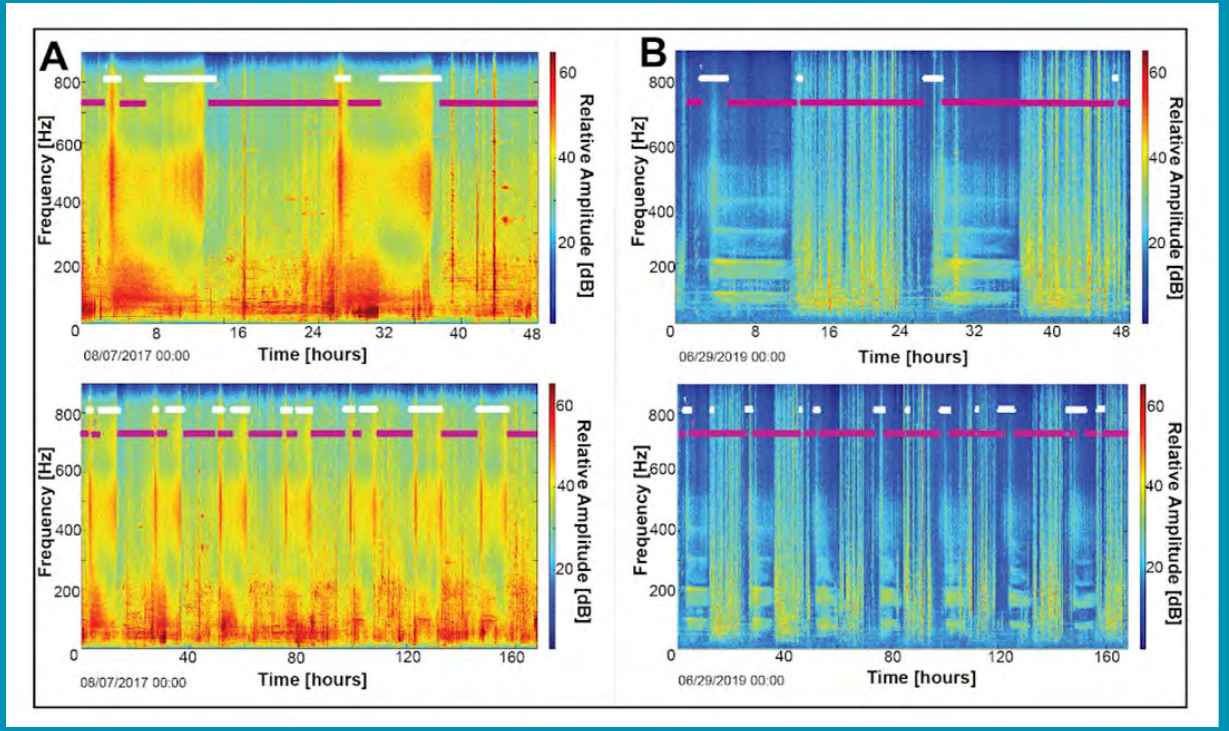
Unsupervised detection of chorusing

SCRIPPS INSTITUTION OF OCEANOGRAPHY
PhD Candidate
ebkim@ucsd.edu

Manual logs of fish chorus (A-day; B-week)



Automated neural network classification of chorus & noise from soundscape data



Integrated method using: Randomized Robust Principal Component Analysis (RRPCA), unsupervised clustering, and a neural network

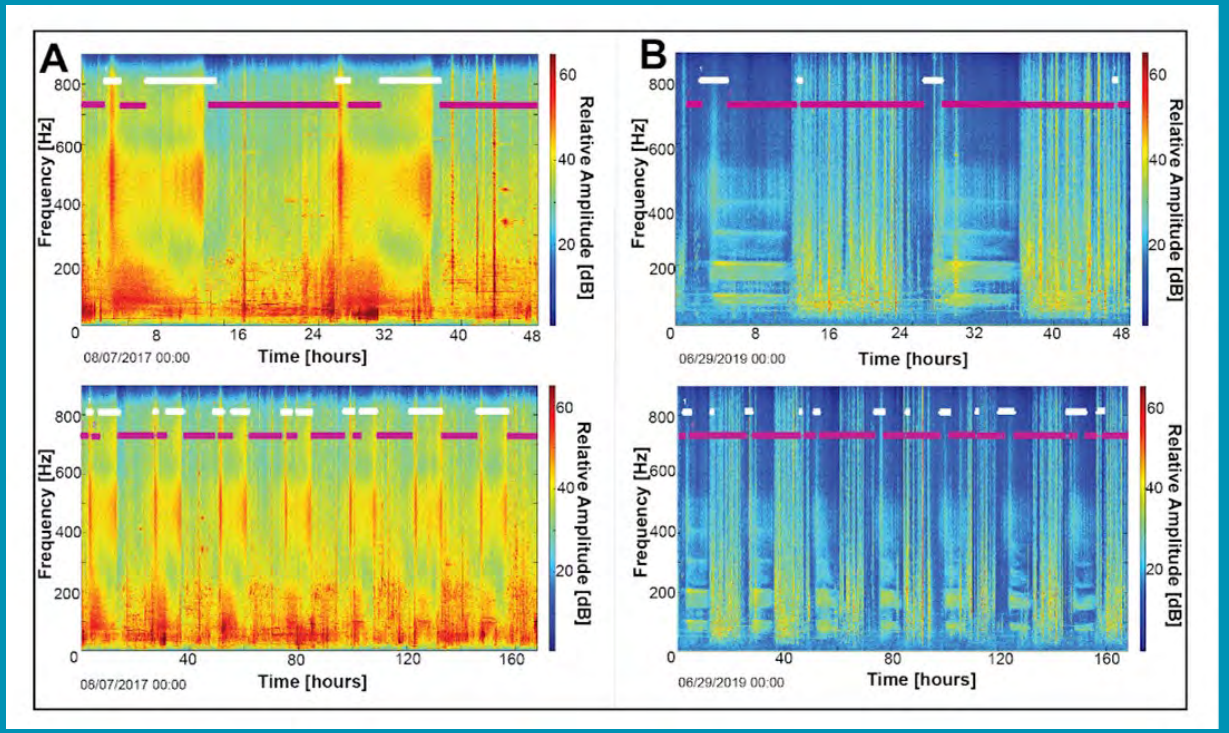
Kim et al. 2023

Climate Change

SCRIPPS INSTITUTION OF OCEANOGRAPHY
PhD Candidate
ebkim@ucsd.edu

(Palumbi et al. 2019)

Automated neural network classification of chorus & noise from soundscape data



Integrated method using: Randomized Robust Principal Component Analysis (RRPCA), unsupervised clustering, and a neural network

JAMES S. BOWER FOUNDATION
Re-envisioning.

Dynamics of seal bomb use in Channel Islands and Monterey Bay National Marine Sanctuaries

In and around CINMS: 2008-2014

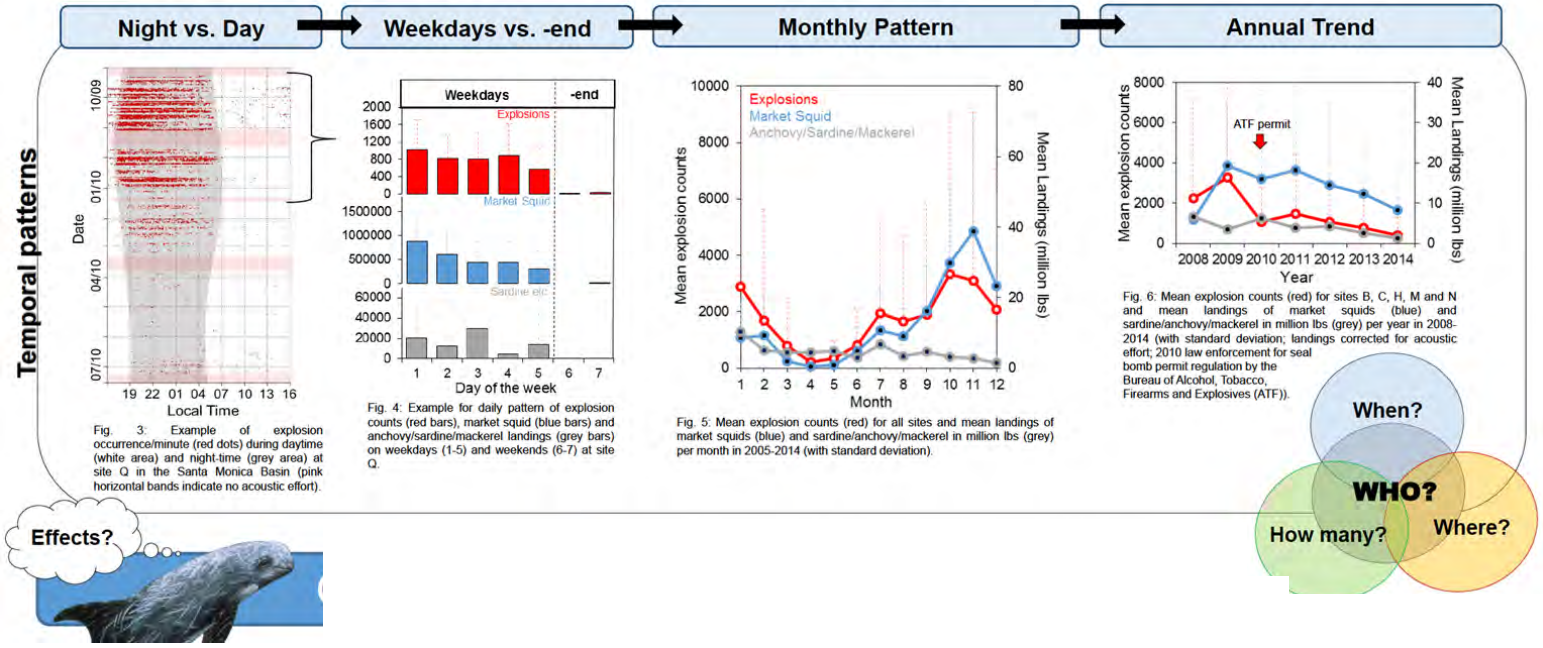


Fig. 3: Example of explosion occurrence/minute (red dots) during daytime (white area) and night-time (grey area) at site Q in the Santa Monica Basin (pink horizontal bands indicate no acoustic effort).

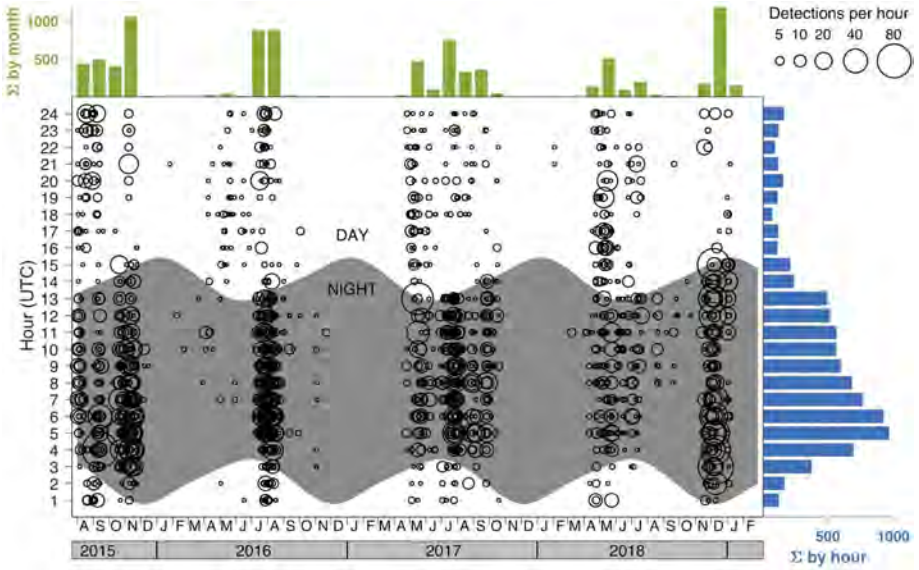
Fig. 4: Example for daily pattern of explosion counts (red bars), market squid (blue bars) and anchovy/sardine/mackerel landings (grey bars) on weekdays (1-5) and weekends (6-7) at site Q.

Fig. 5: Mean explosion counts (red) for all sites and mean landings of market squids (blue) and sardine/anchovy/mackerel in million lbs (grey) per month in 2005-2014 (with standard deviation).

Fig. 6: Mean explosion counts (red) for sites B, C, H, M and N and mean landings of market squids (blue) and sardine/anchovy/mackerel in million lbs (grey) per year in 2008-2014 (with standard deviation; landings corrected for acoustic effort; 2010 law enforcement for seal bomb permit regulation by the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF)).

(Meyer-Loebbecke et al. 2016; Krumpel et al. 2021)

In and around MBNMS: 2015-2018

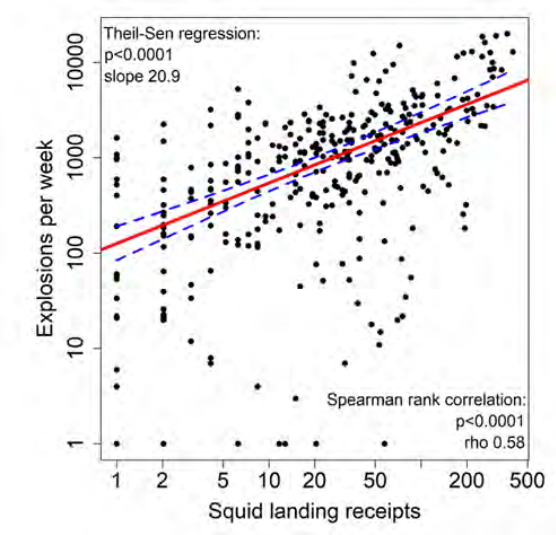


(Simonis et al. 2020)

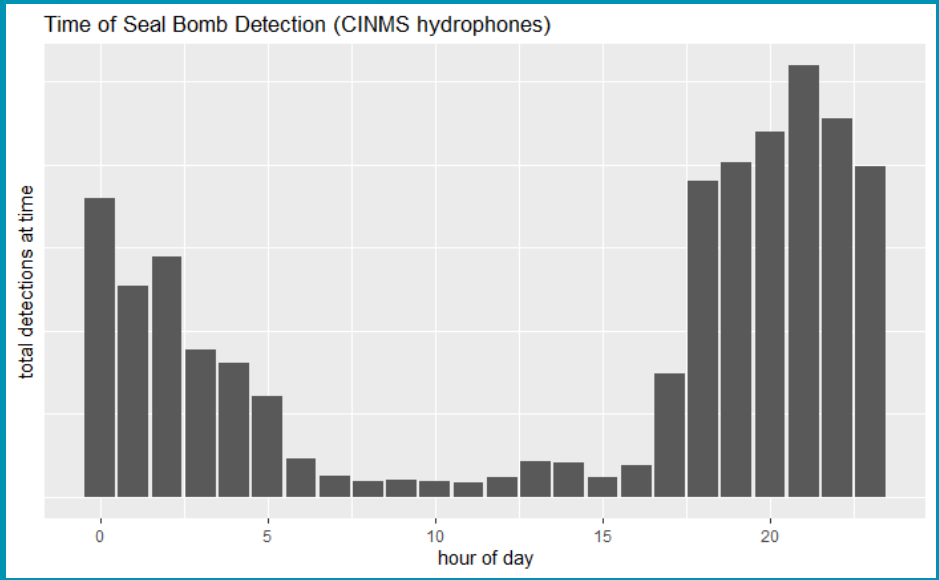
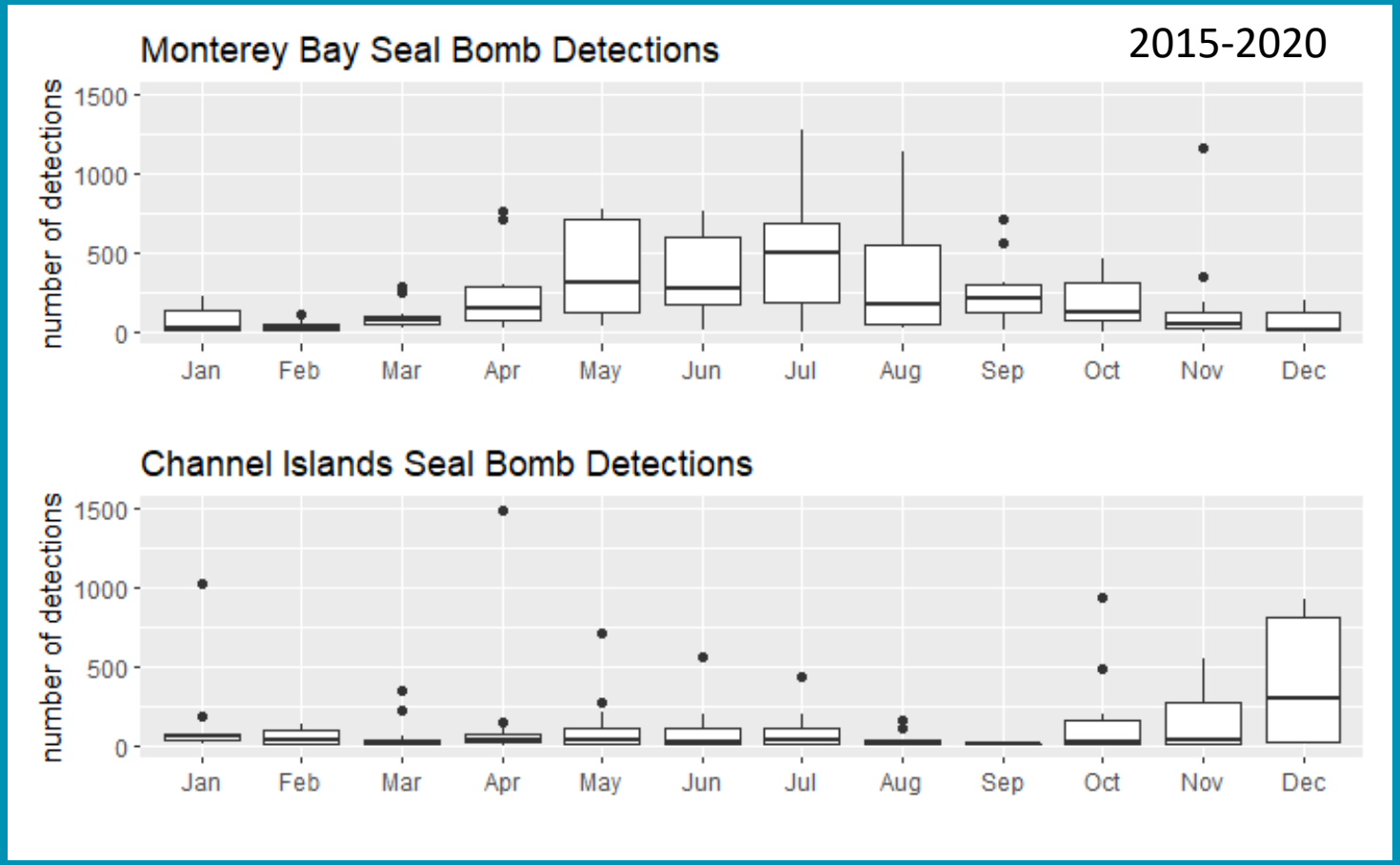
Seal Bomb Explosions

SanctSound

Explosions correlated with squid fishing



Most explosions at night



Monthly patterns