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# NMFS Regulatory Approach to Underwater Noise

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**DOSITS  
July 22, 2020**



# Overview

- Key statutes and regulatory processes through which NOAA addresses noise impacts
- Overview of the impacts of noise
- Methods and tools for quantifying “take” from acoustic stressors
- What does “take” mean? Assessing effects on individual fitness and populations
- Mitigation and monitoring
- Efficiencies in regulatory compliance
- Outside of the Regulatory box (e.g., Shipping noise, NOAA Ocean Noise Strategy)

# Federal Statutes and Conservation at NOAA

- **Marine Mammal Protection Act (NMFS)**
  - Protect and conserve all marine mammals
- **Endangered Species Act (NMFS)**
  - Protect, conserve, and recover marine species listed as endangered or threatened, as well as Critical Habitat
- **National Marine Sanctuaries Act (NOS)**
  - +600,000 mi<sup>2</sup> of underwater parks, Washington state to Florida Keys, Lake Huron to American Samoa, with 14 national marine sanctuaries and Papahānaumokuākea and Rose Atoll marine national monuments
  - Protects and conserves sanctuary resources, including marine mammals
- **Magnuson–Stevens Fishery Conservation and Management Act (NMFS)**
  - Essential Fish Habitat: protects all types of aquatic habitat where fish spawn, breed, feed, or grow to maturity, such as: wetlands, coral reefs, seagrasses, and rivers, and especially Habitat Areas of Particular Concern.



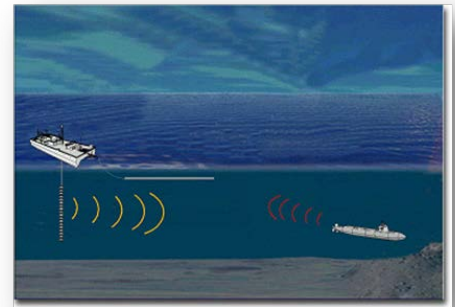
# Noise and Regulatory Compliance

## Primary Regulatory Mechanisms for Noise Impacts

- **ESA:** Section 7 Consultations
- **MMPA:** 101(a)(5)(A&D) Incidental Take Authorizations

## Diverse Range of Activities, including

- Underwater geophysical exploration (industry, academic)
- Active sonar (military training and testing, scientific applications, site characterization)
- Explosive detonations (military training and testing, UXO removal, construction, demolition, channel deepening)
- Pile driving (bridge and port construction; offshore alternative energy development)
- Activities disturbing seals and sea lions on land or ice (e.g., rocket launches, scientific research)
- Other industry (e.g., drilling, cable-laying)



# Endangered Species Act Overview

## Protection, Conservation, and Recovery

### What the Endangered Species Act (ESA) Protects

- **Endangered species:** in danger of extinction throughout all or a significant portion of its range (*some* marine mammals, also sea turtles, fish, invertebrates, plants)
- **Threatened species:** likely to become an endangered
- **Critical Habitat:** specific areas on which are found physical or biological features essential to the conservation of the species, and which may require special management considerations or protection

### How the ESA Protects, Conserves, and Recovers

- Identification and “**Listing**” of endangered, threatened, critical Habitat
- **Recovery Plans** – roadmap to recovery, threats, specific management actions
- **Prohibition** on “Take” of listed species (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect), with **exceptions**
  - **Permits** (research, enhancement, incidental take)
  - **Consultation** with Federal agencies
- **State** cooperation and funding
- **International** coordination



# MMPA Overview

## Protection, Conservation, and Recovery

### What the Marine Mammal Protection Act (MMPA) Protects

- All marine mammals



### How the MMPA Protects and Conserves

- **Prohibition on “take”** of listed species (to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal), with **exceptions**
  - **Permits** (research, enhancement) and **Incidental take authorizations**
  - **Commercial Fishing**
  - ***Allows for take from Subsistence uses*** (and protects it)
- **Marine Mammal Health and Stranding Program** – coordinates emergency responses to sick, injured, distressed, or dead marine mammals. Program focuses on: 1) Stranding and entanglement networks, 2) Unusual mortality event response, 3) Biosurveillance, and baseline health research, and 4) John H. Prescott Marine Mammal Rescue Assistance Grant Program.
- **Formation of the Marine Mammal Commission** - Independent government agency provides science-based oversight of domestic and international policies and actions of federal agencies addressing human impacts on marine mammals and their habitat



# Regulatory Implementation

- Shared Jurisdiction MMPA & ESA
  - National Marine Fisheries Service (NMFS)
    - All cetaceans and pinnipeds except walrus
    - Sea turtles at sea
    - Marine and anadromous fish
    - Marine invertebrates and plants
  - U.S. Fish and Wildlife Service (USFWS)
    - Polar bears, sea otters, walruses, dugongs & manatees
    - Sea turtles on nesting beaches
    - Freshwater and catadromous fish
- NMFS Regulatory Compliance
  - **MMPA:** NMFS Headquarters (HQ), Silver Spring MD
  - **ESA:** NMFS HQ and Regional Offices (GARFO, SERO, WCRO, AKRO, and PIRO)



# ESA Interagency Cooperation Process

**Trigger:** *Federal agencies are required to consult* under Section 7 when activities authorized, funded, or carried out *may affect listed species*, formal consultation necessary when adverse effects (take) are likely

## Key Findings and Components for Formal Consultation

- **Issuance Criteria:**
  - Not likely to *jeopardize* the continued existence of listed species
  - Not likely to *destroy or adversely modify* Critical Habitat
- **Reasonable and Prudent Measures:** basis for mandatory terms & conditions to minimize impact of take (mitigation & monitoring)
- **Conservation Recs:** Discretionary measures to minimize effects

## Documentation

- **Biological Opinion**, no inherent time limit
- Incidental Take Statement (ITS)



[https://www.fisheries.noaa.gov/national/endangered-species-conservation/endangered-species-act-guidance-policies-and-regulations#interagency-consultation-\(esa-section-7\)](https://www.fisheries.noaa.gov/national/endangered-species-conservation/endangered-species-act-guidance-policies-and-regulations#interagency-consultation-(esa-section-7))



# MMMPA Incidental Take Process

Trigger: *US citizens may request* authorization for incidental take

## Key Findings and Components

- **Issuance Criteria:**
  - *negligible impact* on affected species/stocks
  - no *unmitigable adverse impact* on Alaskan **subsistence uses**
- **Small Numbers:** allowable amount of authorized take
- **Mitigation:** Least practicable adverse impact standard
- **Monitoring and reporting** measures are required



## Documentation (includes public comment period)

- Incidental harassment authorization (**IHA**), 1 year, harassment only (no mortality) OR
- Incidental take regulations (**ITR**) and Letter(s) of Authorization (**LOA**), up to 5 years, may authorize mortality

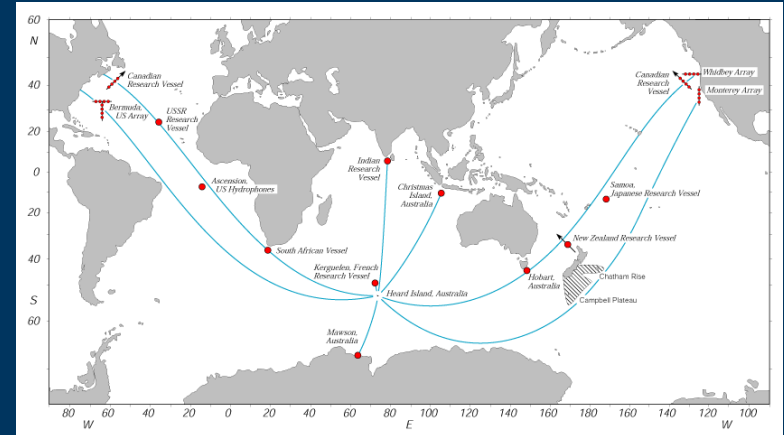
<https://www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act>



# Sound is Critical to Aquatic Animals

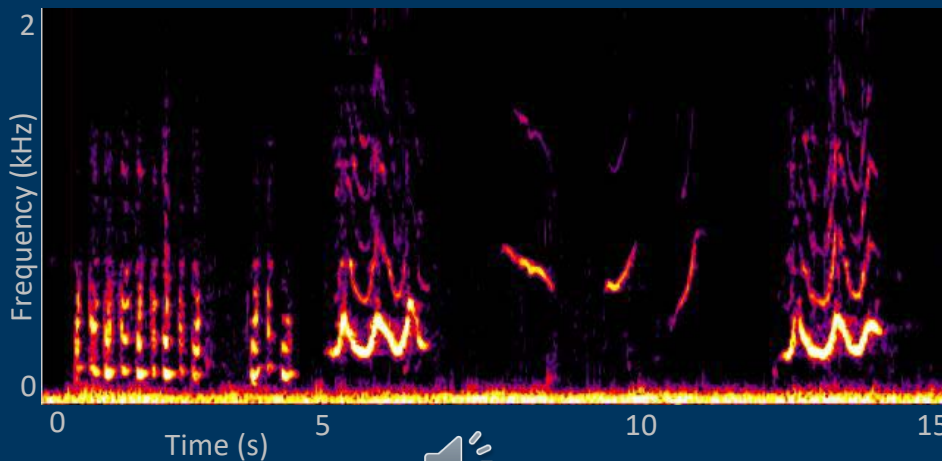
## Why?:

- Hearing is the most effective means of gathering information underwater over a range of distances
- Sound is the most efficient means to communicate underwater over a range of distances

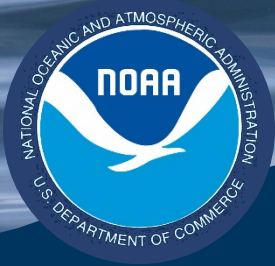


## How is sound used:

- To locate & select mates
- To find food
- To maintain group structure & relationships
- To avoid predators
- To navigate
- More as we learn!



# Anthropogenic Underwater Noise



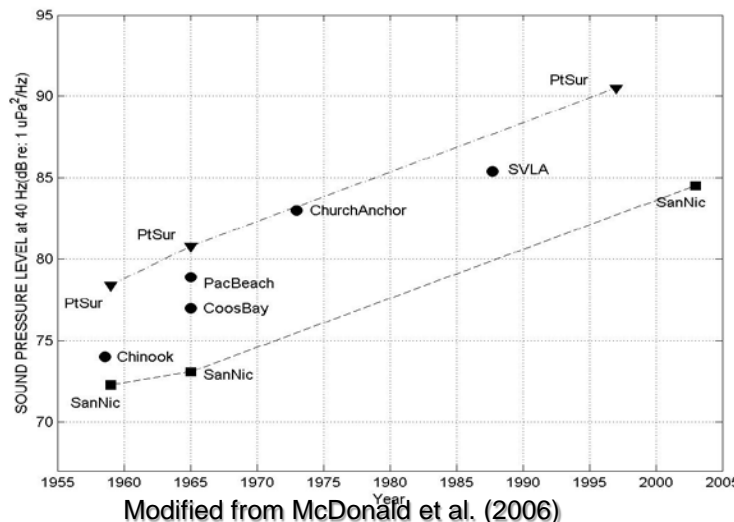
## Reality:

- Human activities produce noise, potentially chronically, and over very large areas
  - More human activities in more coastal and ocean areas means noisier waters
- **Ocean noise is a growing global problem for marine ecosystems**



## Environmental Impact:

- **Acute:** Intense noise events can have adverse physical and behavioral impacts that affect health and fitness
- **Chronic:** Rising background noise limits marine animals' communication range and ability to sense their environment





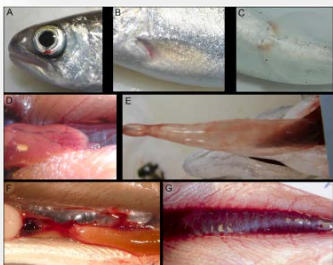
# Assessing Noise Impacts under ESA & MMPA

- Both necessitate some quantification of take (defined similarly):
  - ESA - to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct
  - MMPA - is to harass, hunt, capture, or kill or attempt to harass, hunt, capture or kill any marine mammal
- Both require a species, population, or stock-level finding
- Both require the inclusions of measures to minimize and monitor impacts to the species they protect
- Both require use of the best available information
- Both consider similar information and impacts, and use utilize similar analyses and tools, to predict the amount of take and assess its impacts on individual fitness, habitat, and, ultimately, the species, population, or stock.





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# Acoustic Impacts

- **Mortality**
  - Marine mammal strandings
  - Explosives
- **Injury**
  - Tissue damage (e.g., g.i., lung)
  - Barotrauma in fishes
- **Hearing impairment**
  - Permanent
  - Temporary
- **Behavioral disturbance**
  - Avoidance, changes in foraging, vocalizations, distribution, flushing
  - Highly variable and context specific
- **Masking and Acoustic Habitat**
  - Rising background noise, harder to hear critical cues
- **Stress**
- **Other**



# Complex Issue



## Source

- Source level
- Frequency
- Stationary/mobile
- Directivity/beamwidth
- Temporal characteristics
- Location
- Number of sources



## Path

- Scattering/reflection/reverberation
- Wavelength
- Surface/sediments
- Bathymetry
- Absorption
- Temperature/salinity/pressure
- Ambient noise



## Receiver

- Hearing
- Frequency
- Transient/resident
- Location (distance from source)
- Context
- Previous exposure
- Demographics





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# Quantifying Take from Noise

Considers the overlay of animals with sound levels expected to result in certain impacts.

Information (or assumptions) needed:

- Animal:
  - Occurrence, density, distribution
  - Behavior, life history, hearing
- Sound propagation:
  - Sound source
  - Path/environment
- Acoustic thresholds identify at what received levels, or distances, different taxa will incur certain impacts that are considered “take”



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# Current NMFS Thresholds

- **Marine Mammals**

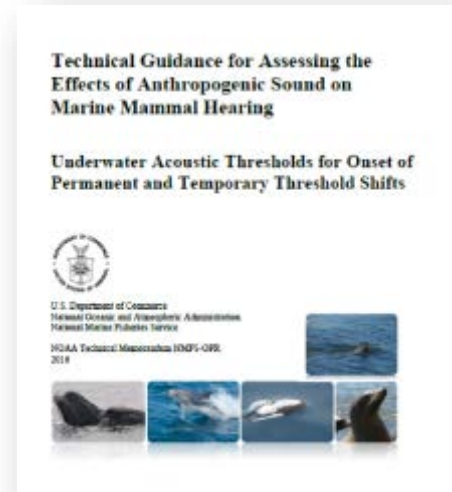
- PTS thresholds & weighting functions
- Behavioral thresholds
  - “Generic” (continuous/impulsive or intermittent sounds)
  - Navy (tactical sonar)
  - Airborne (pinnipeds)
- Lung & G.I. tract injury (explosives)

- **Protected Fishes**

- Interim recommended injury and behavioral thresholds

- **Sea Turtles**

- Limited data
- Surrogate species (whales, pinnipeds, fishes)



<http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm>



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# Take Estimation

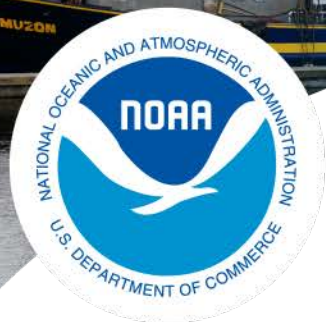
## Multiple mechanisms for estimating take of marine mammals, e.g.

- Animal and/or source movement models allow for refined consideration of the comparative positions of animals and sound sources, as well as environmental variables and thresholds, in the 3D underwater environment
- User Spreadsheet and Manual, zone overlaid with animal density
- Pinniped counts in vicinity of activity
- Qualitative considerations and other methods



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# Some Tools to Help with Take Estimation



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- User Spreadsheet and Manual (PTS, marine mammals): <https://www.fisheries.noaa.gov/action/user-manual-optional-spreadsheet-tool-2018-acoustic-technical-guidance>
- Tool for consideration of frequency and beamwidth for higher frequency sources (e.g., some HRG)
- Pile driving source level compilation and tool (in development)
- Take assessment tool to inform evaluations of whether take of marine mammals is likely to result (in development)



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# Masking and Cumulative Effects



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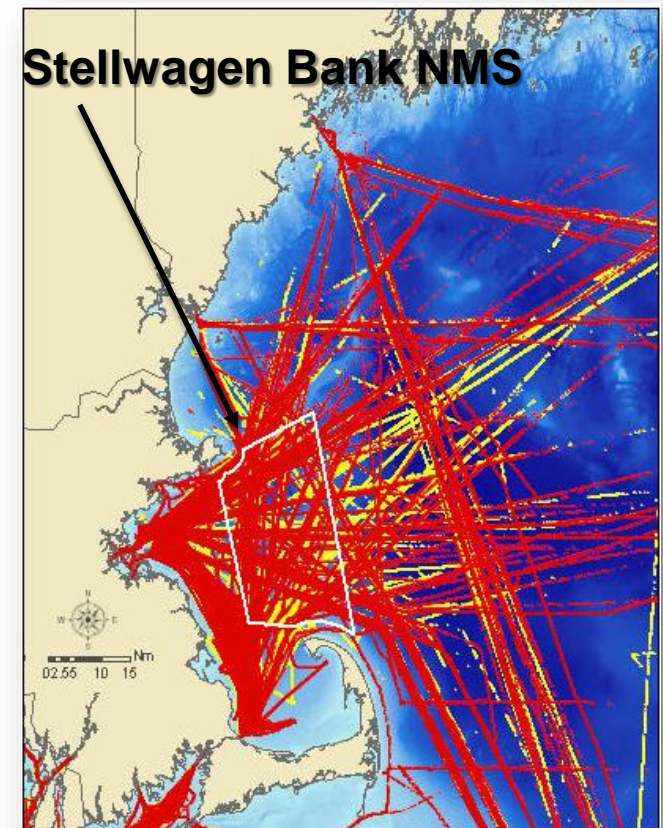


Pre-Industrialization



Post-Industrialization

**Loss of  
Communication Space  
for Low-  
Frequency  
Whales**



Stellwagen Bank NMS



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# Acoustic Impacts Continued Contextualizing the Take

- **Potential individual fitness consequences**
  - *Reproduction*: Mating/spawning behavior, energetics (calving intervals)
  - *Survival*: Stranding events, separation of calf/pup
  - *Growth*: Feeding and energetics
- **Population-Level Impacts**
  - How do effects to individuals translate to higher level effects?



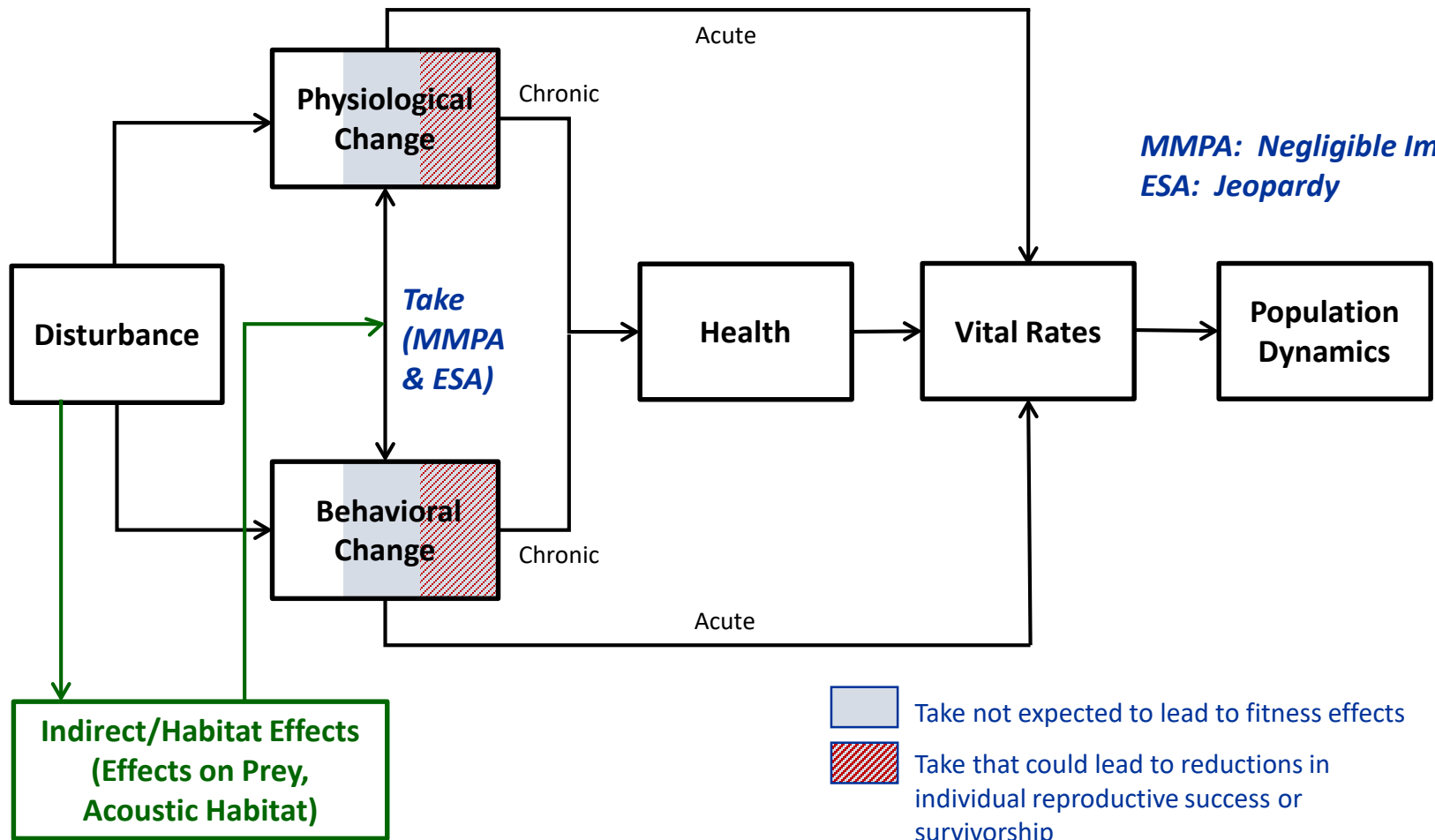
Disturbance Severity	5					
	4					
	3					
	2					
	1					
	Rating	1	2	3	4	5
Vulnerability						
Key	Color	Adverse Effects Rating				
	Red	Very High				
	Orange	High				
	Yellow	Moderate				
	Green	Low				
	Blue	Very Low				



# Regulatory Context for Impact Analysis

*MMPA: Small Numbers  
(Take of Individuals)*

*MMPA: Negligible Impact  
ESA: Jeopardy*





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# Assessing Likelihood of Impacts to Individual Fitness

- Areas and times of known biological importance, e.g., breeding or calving areas, feeding aggregations, migratory corridors
- Behaviors, sensitivities, and vulnerabilities of affected individuals
- Magnitude and severity of impacts, e.g.
  - Duration of continuous exposure
  - Repeated exposures over sequential days
  - Higher received levels, disturbance vs. PTS
- Mitigation effectiveness



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# Assessing Impacts on Populations



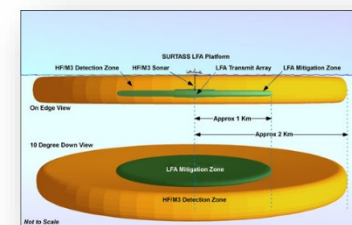
- Number of individuals incurring effects on fitness
- Size of the affected population (species, stock, DPS, is it small resident population?)
- Status of the species
- Population vulnerability (e.g., UME, oil spill, other reproductive rate suppression)
- **Potential Biological Removal** (metric to assess mortality, more applicable under MMPA)



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# Mitigation Measures (Acute Effects)

- Real-time detection and action (to limit acute/direct impacts)
  - Protected Species Observers - visual (shore, ship and aerial, unmanned crafts) and/or passive acoustic to support real-time measures
  - Shutdown zones – minimize injury/more severe behavioral harassment (broadly and target to species/action of concern (mother/calf pairs, feeding aggregations, etc)
  - Daytime operations or nighttime-specific technology to enhance detection
- Sound source verification to ensure adequate mitigation zones and prediction of effects



# Mitigation Measures

## (Chronic and Acute Effects)

- Seasonal/Area Limitations
  - Avoidance/minimization of operations in seasons and/or areas of biological importance or with particularly sensitive species or habitat (e.g., feeding or breeding areas, sanctuaries, HAPCs, salmon migration routes, critical habitat)
- Noise abatement/reduction
  - Sound attenuation methods for pile driving (bubble curtains, pile caps, etc.)
  - Ramp-up procedures with airguns (and sometimes pile driving)
  - Quieter sources when feasible

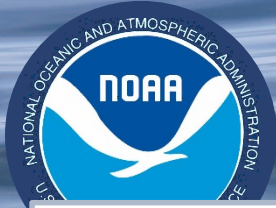


# Monitoring Measures

- MMPA has explicit requirement for monitoring to better understand the impact of authorized activities on marine mammals, ESA similarly monitors take
- Goals of monitoring, contribute to understanding of occurrence, exposure, response, or consequences, and/or impacts on habitat
- Regulated activities range widely in temporal and spatial scope, so do specific required monitoring requirements
- Examples:
  - Visual PSOs identify species numbers and behaviors seen, in relation to associated activity, also compare before and after to during.
  - PAM used to support marine mammal observations and/or better understand source level and/or propagation
  - Large scale activity and impacts: behavioral response studies, tagging (<https://www.navymarinespeciesmonitoring.us/>)
  - Contributions to larger studies (e.g., PACMAPPs, habitat studies)







# Efficiencies in Regulatory Compliance

Executive Order 13771 of January 30, 2017

Reducing Regulation

Executive Order 13777 of February 24, 2017

Enforcing the Regulatory Reform Agenda

Executive Order 13766 of January 24, 2017

Expedited Environmental Review

Executive Order 13795 of April 28, 2017

## Implementing an America-First Offshore Energy Strategy

By the authority vested in me as President by the laws of the United States of America, in the Outer Continental Shelf Lands Act, 43 U.S.C. 1331 *et seq.*, and in the Department of the Interior, in energy innovation, exploration, and production, I hereby order as follows:

**Section 1. Findings.** America must put the interests of our people and businesses first and continue implementing policies that ensure energy security and economic vitality for decades to come. Energy produced from lands and waters under our jurisdiction is critical to a vibrant economy and to our national security. Increasing production on Federal lands and waters and reduces reliance on imported energy, which is driven by an increased American energy demand. Finally, because the Department of Defense is responsible for our Nation's military readiness.

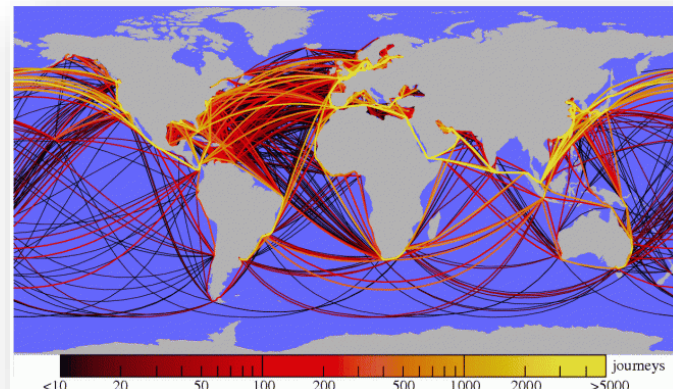
**Sec. 9. Expedited Consideration of Incidental Take, and Seismic Survey Permit Applications.** The Secretary of the Interior and the Secretary of Commerce shall, to the maximum extent permitted by law, expedite all stages of consideration of Incidental Take Authorization requests, including Incidental Harassment Authorizations and Letters of Authorization, and Seismic Survey permit applications under the Outer Continental Shelf Lands Act, 43 U.S.C. 1331 *et seq.*, and the Marine Mammal Protection Act, 16 U.S.C. 1361 *et seq.*

- Executive Orders and DOC/NOAA/NMFS goals to reduce processing timelines and increase efficiency
- Since 2017, with focused effort, have reduced IHA, Sec 7 consultation, and permit timelines by 25% +
- Streamlining efforts include:
  - Programmatic or Expedited Consultations (ESA)
  - CatExs for MMPA authorizations
  - IHA Renewals
  - Coordination with BOEM on interagency efforts to facilitate compliance (e.g., take assessment tool, geophysical survey protocols)
  - Internal measures (templates and other tools)

(c) Accordingly, it is the policy of the United States that executive departments and agencies (agencies) immediately review existing regulations that potentially burden the development or use of domestically produced energy resources and appropriately suspend, revise, or rescind those that unduly burden the development of domestic energy resources beyond the degree necessary to protect the public interest or otherwise comply with the law.

# Commercial Shipping: Broader, Global Issues

- Remember temporal-spatial scale
- Widespread & increasing
  - NMFS doesn't directly regulate
  - 90% global trade carried by sea
  - Opening of NW passage
    - Arctic Marine Shipping Assessment (<http://www.pame.is/amsa>)
- IMO Correspondence Group
  - Voluntary guidelines for ship quieting (2014)
- Port of Vancouver (2017)
  - Incentivizing quiet ships (ECHO program)

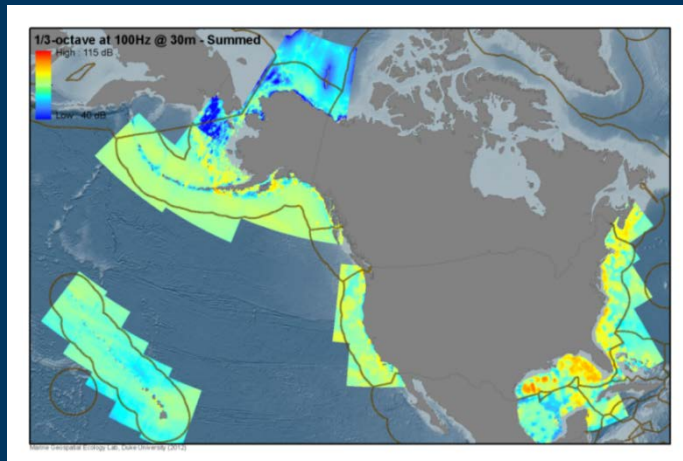






# Ocean Noise Strategy

- 1. MANAGEMENT:** NOAA's actions are integrated across the agency & minimizing the acute, chronic & cumulative effects of noise on marine species and their habitat
- 2. SCIENCE:** NOAA & federal partners are filling common knowledge gaps & building understanding of noise impacts over ecologically-relevant scales



- 3. DECISION SUPPORT TOOLS:** NOAA is developing publically available tools for assessment, planning & mitigation of noise-making activities over ecologically-relevant scales
- 4. OUTREACH:** NOAA is educating the public on noise impacts, engaging with stakeholders & coordinating with related efforts internationally



# MMPA Authorization Tracking Tool

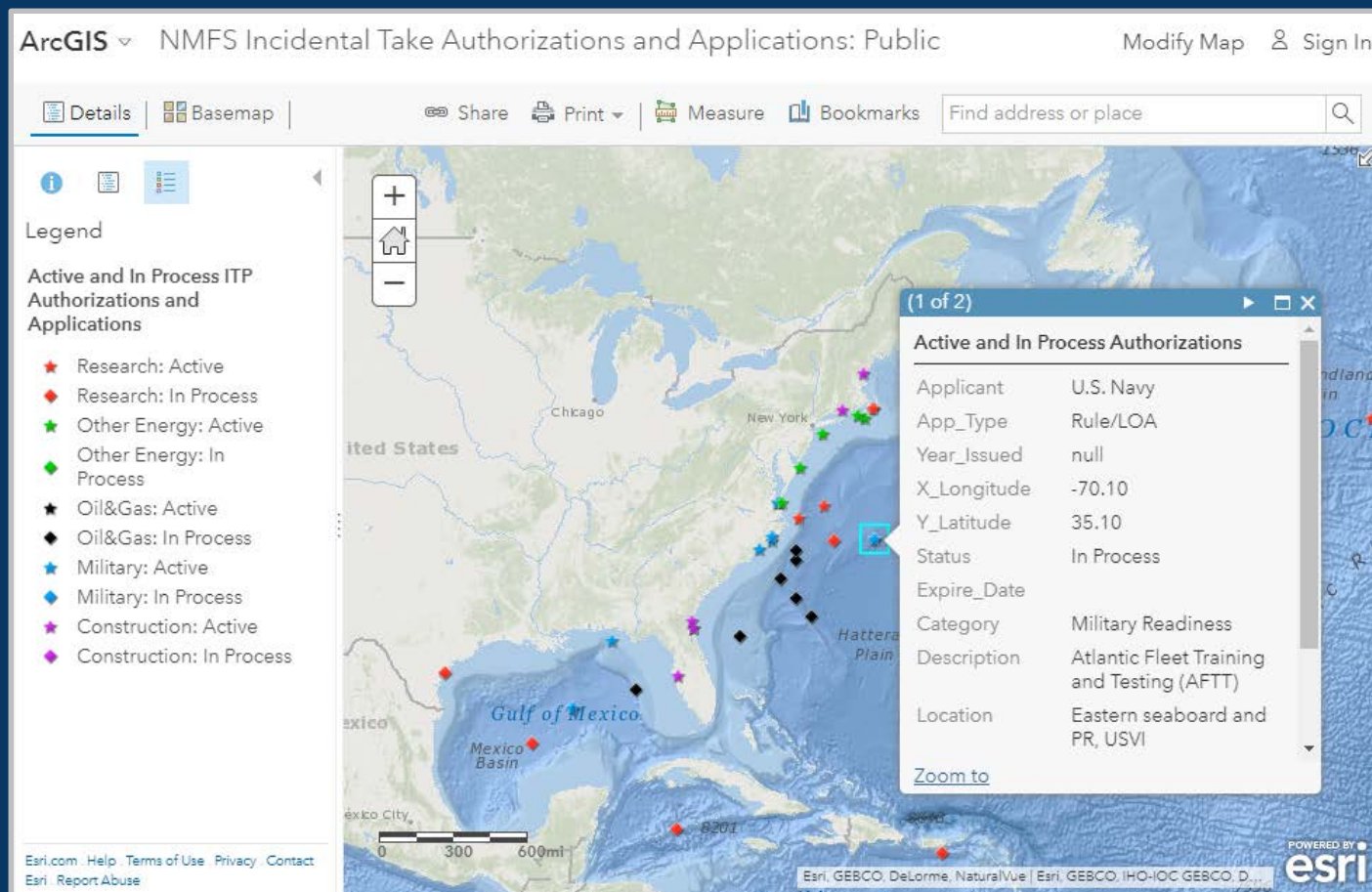
ArcGIS Online:

<https://www.fisheries.noaa.gov/resource/map/incidental-take-authorizations-map>

Other layers included  
(BIAs, HAPCs,  
ESA DPSs)

Research  
permits added  
FY 2019

Marine  
mammal stock  
boundaries  
forthcoming

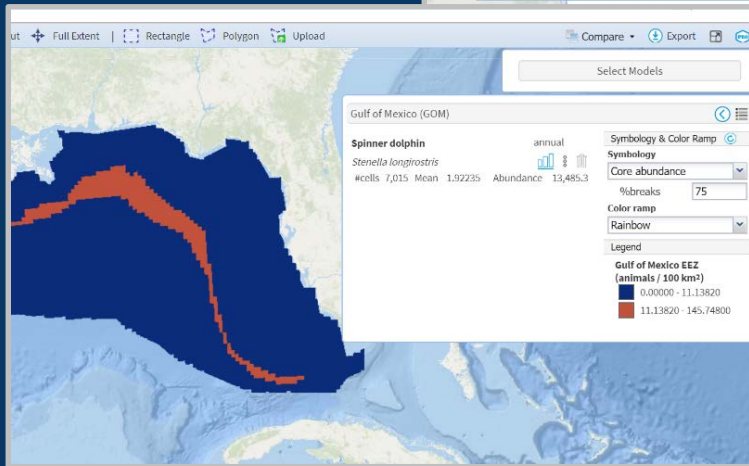
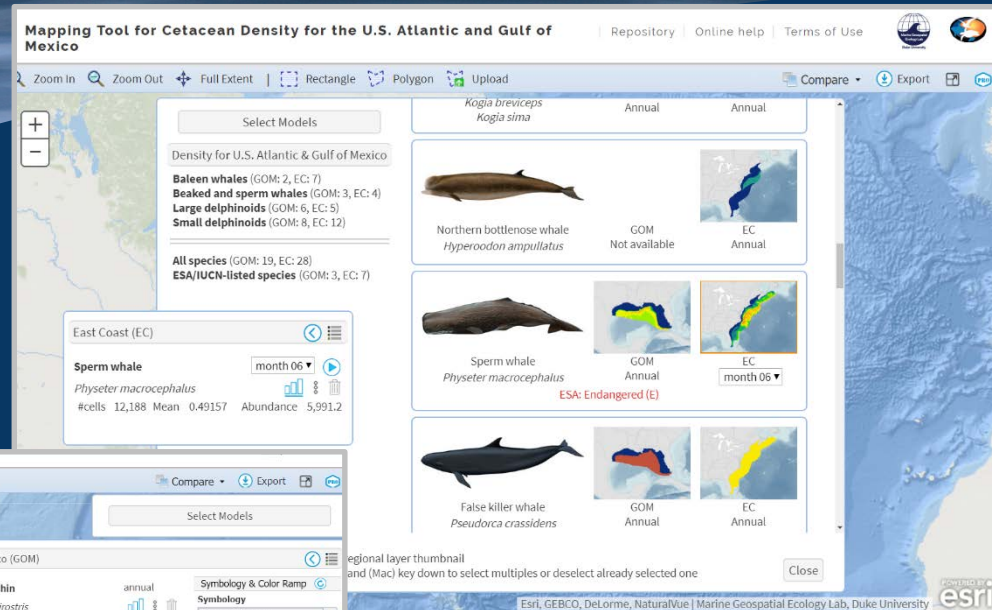




# Density Mapping Tools (CetMap)

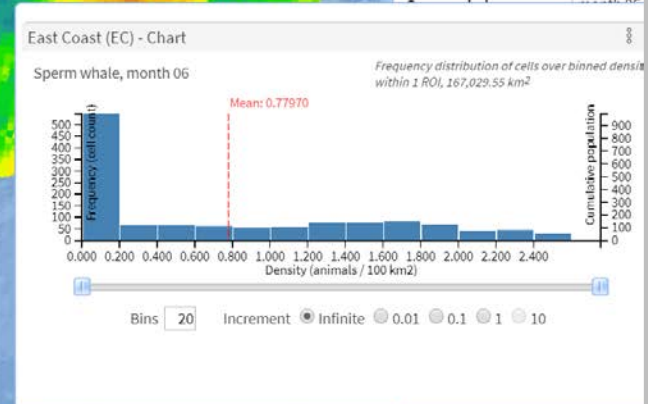
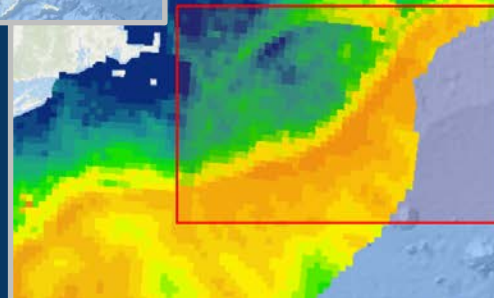


Duke



Updating for GOM & Atlantic this Fall

<https://cetsound.noaa.gov/cetsound>

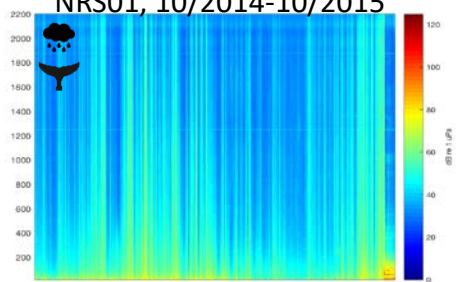




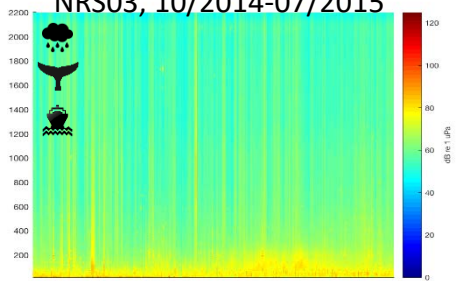
# NOAA Noise Reference Stations (NRS)

OAR/NMFS/NOS/NPS Collaboration -  
Long-term deployment of calibrated recording  
packages to allow comparison between and  
within sites over time

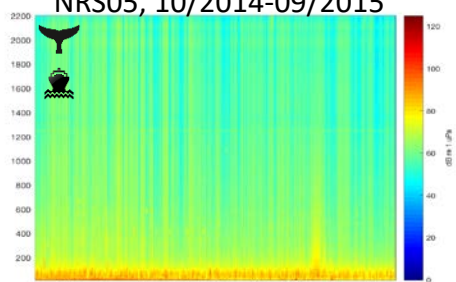
NRS01, 10/2014-10/2015



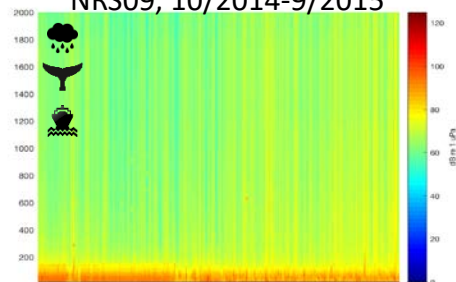
NRS03, 10/2014-07/2015



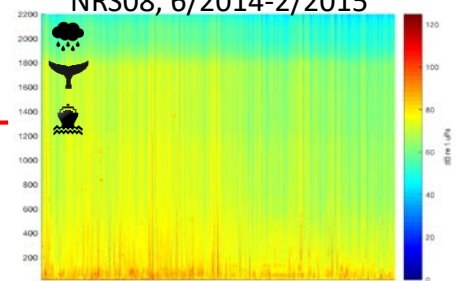
NRS05, 10/2014-09/2015



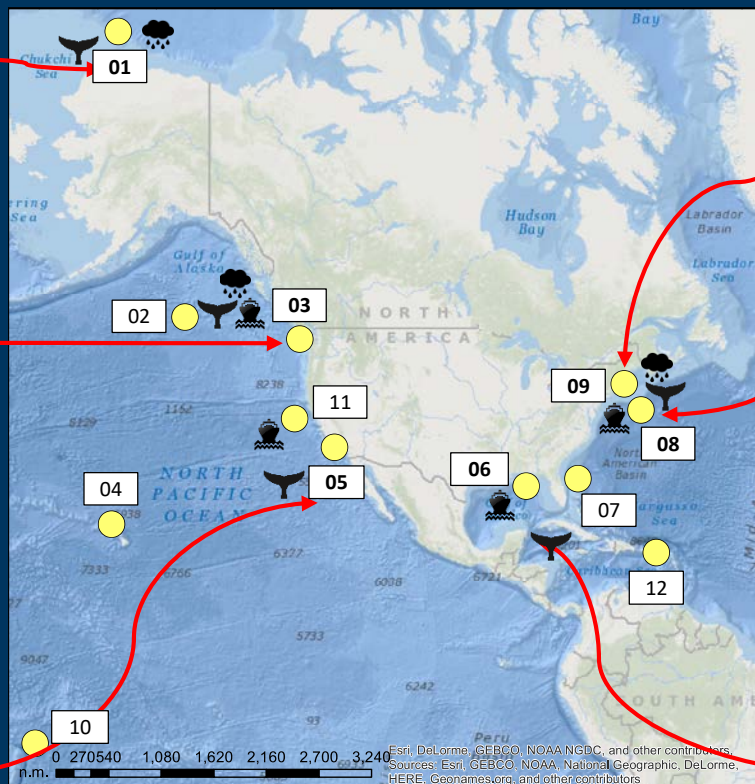
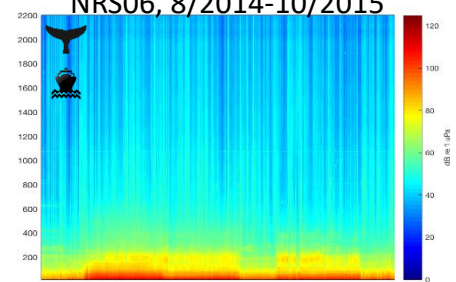
NRS09, 10/2014-9/2015



NRS08, 6/2014-2/2015



NRS06, 8/2014-10/2015



Dominant noise contributors:



Anthropophony,



Biophony,



Geophony

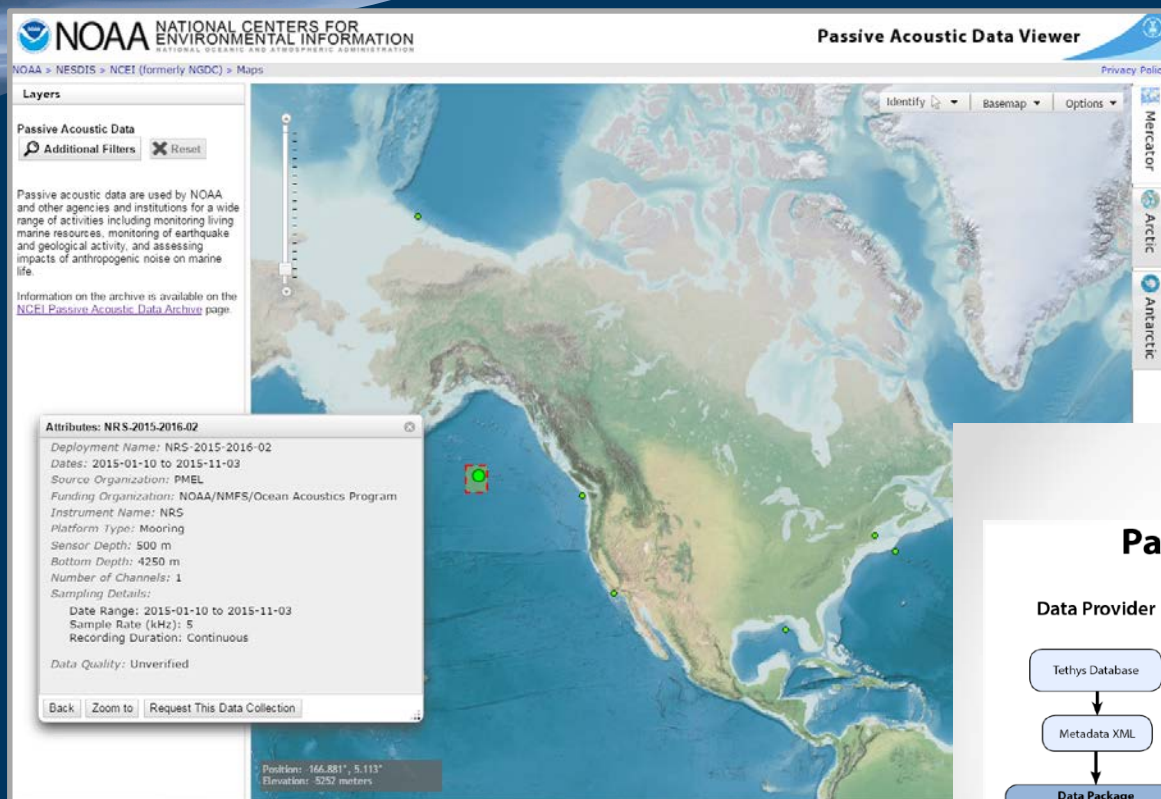
Sources: Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors.  
HERE, Geonames.org, and other contributors





# NCEI Passive Acoustic Data Archive

- Centralized long-term data storage and public exploration and access
- NRS data archived—expanding to include PAM data across NOAA
- Considerable interest from BOEM, Navy, NPS

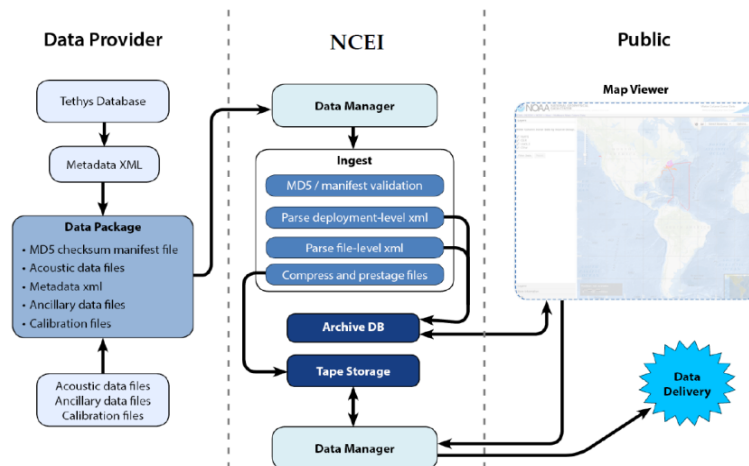


## Public Facing Map Viewer and Data Delivery



**National Centers for  
Environmental Information**  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

## Data Flow Passive Acoustic Data Pipeline





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# Questions?