The Ocean Sound Atlas

Measuring the Pulse of the World's Oceans

Developing a Marine Stethoscope

Artwork by Lindsay Olson and Photo Credit Cindy Trim. Inspired by ADEON NOPP contracted by BOEM M16PC00003

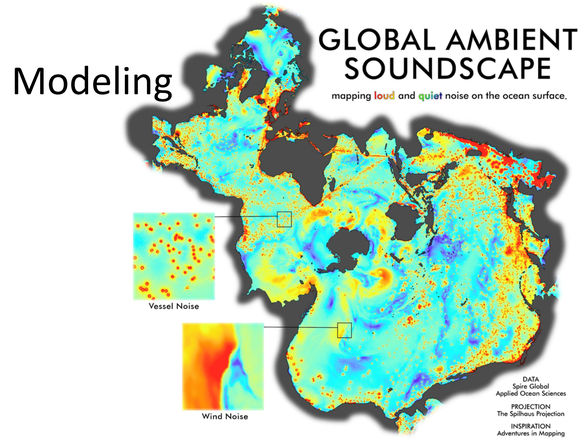
Circular Sounds: Passive Acoustics by Lindsay Olson 36"x36" cotton, beads, on silk background

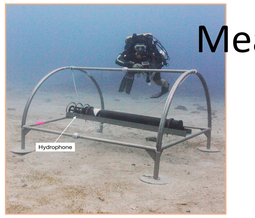
"Ocean-Shot" Concepts related to

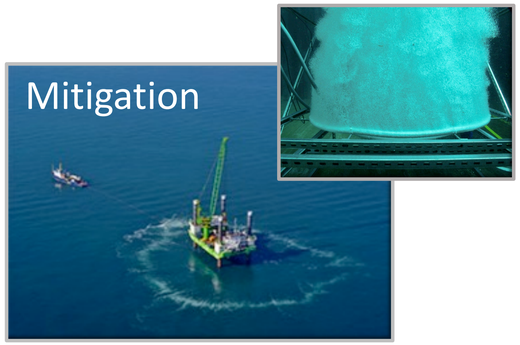
Ocean Sound

Intro

Interagency Working Group on Ocean Sound and Marine Life







The Vision

Sound is fundamental to ocean ecosystems – many species rely upon sound to find food and mates and to warn them of danger. Both natural (e.g., rain, waves) and human activities (e.g., shipping, offshore energy production) produce sound.

The ***Ocean Sound Atlas*** will be a digital global ocean sound map. This interactive system will compile and integrate passive acoustic data by location of recording, for use by researchers, educators, policy-makers, engineers, explorers, sound artists, and other stakeholder groups.

Simple to use and open source, OSA will serve as a repository for federal and federally-funded project data, with additional contributions from academia, industry, and other sectors to achieve a more complete picture of ocean soundscapes and allow the easy identification and pinpointing of areas where anthropogenic sound may be a problem, that needs to be addressed.

Connections to existing infrastructure & partnerships

The time is right for the *Ocean Sound Atlas*

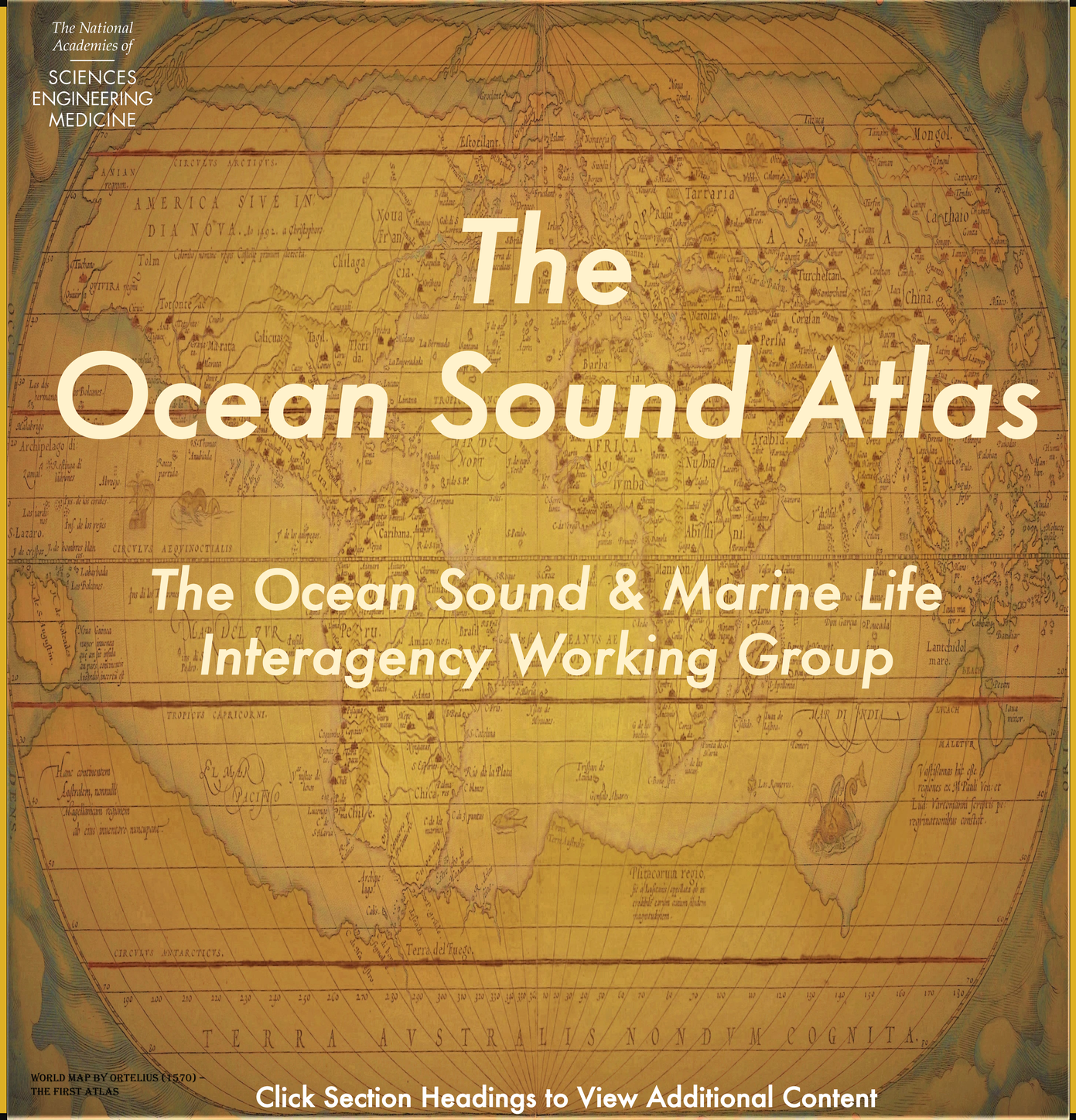
Bodies from different countries have already made steps towards recording and mapping ocean sound. The aim of this project is to pull these bodies and sound collection networks together, to help standardize and quality control information collected, and to use cutting edge mapping software to display the data in a form that is valuable for a wide range of sectors.

Existing sources:

- NOAA's SoundMap program
- NOMEC
- OceanReports
- inter-agency working groups (e.g., IWG OCM & OEC)
- Government Agency data (e.g., BOEM, Navy etc.)

Partnerships:

- acoustic research community
- marine conservation community
- small business
- citizen science,
- industry (oil and gas, shipping, technology developers), and
- indigenous communities.



Engaging different sectors

Ocean sound has obvious links to physical/ biological oceanography - yet mapping and using ocean sound data incorporates a wide range of disciplines and sectors.

- Sensor development involves physicists, acousticians, engineers and communications technologists. Mapping and analysis involves computer scientists, geospatial analysts, statisticians and geographers.
- Graphic designers, social scientists and communications experts could ensure that the OSA is easily understood, intuitive, and is in a format that can be used by multiple stakeholders.
- The sounds themselves would be used by researchers, regulators, and other marine stakeholders, musicians, artists, educators, radio broadcasters and podcasters.

Opportunities for collaboration

Numerous international projects would feed into or partner with the OSA such as:

- International Quiet Ocean Experiment;
- Discovery of Sound in the Sea;
- MERIDIAN Ocean Soundscape Atlas (Canada); Pandemic Silence Project;
- Native Land;
- World Forum for Acoustic Ecology.

International treaty bodies and projects with interest or focus on underwater sound include:

UNCLOS; UNEP; International Whaling Commission; IMO; ACCOBAMS and ASCOBANS agreements of the Bonn Convention; CCAMLR and the Antarctic Treaty; and MARPOL.

International bodies have called for the study, assessment and management underwater sound, including the UN (e.g., para. 107 in Res. 61/222; para. 120 in Res. 62/215; Res. 71/257).

Building capacity & inspiration

- The Ocean Sound Atlas will provide internationally accessible information, including resources to groups and regions without strong acoustics programs and technology.
- The OSA will supply data to educators of various levels, already in a more accessible format.
- Likewise, sounds will be available to the media.
- The available data and accessible map will allow the OSA to connect across governmental and disciplinary boundaries, to reach a large audience and inspire curiosity, inquiry and action on underwater sound.

Click to go Back to Introduction

The Vision

Sound is fundamental to ocean ecosystems – many species rely upon sound to find food and mates and to warn them of danger. Both natural (e.g., rain, waves) and human activities (e.g., shipping, offshore energy production) produce sound.

The ***Ocean Sound Atlas*** will be a digital global ocean sound map. This interactive system will compile and integrate passive acoustic data by location of recording, for use by researchers, educators, policy-makers, engineers, explorers, sound artists, and other stakeholder groups.

Simple to use and open source, OSA will serve as a repository for federal and federally-funded project data, with additional contributions from academia, industry, and other sectors to achieve a more complete picture of ocean soundscapes and allow the easy identification and pinpointing of areas where anthropogenic sound may be a problem, that needs to be addressed.

Connections to existing infrastructure & partnerships

The time is right for the *Ocean Sound Atlas*

Bodies from different countries have already made steps towards recording and mapping ocean sound. The aim of this project is to pull these bodies and sound collection networks together, to help standardize and quality control information collected, and to use cutting edge mapping software to display the data in a form that is valuable for a wide range of sectors.

Existing sources:

- NOAA's SoundMap program
- NOMEC
- OceanReports
- inter-agency working groups (e.g., IWG OCM & OEC)
- Government Agency data (e.g., BOEM, Navy etc.)

Partnerships:

- acoustic research community
- marine conservation community
- small business
- citizen science,
- industry (oil and gas, shipping, technology developers), and
- indigenous communities.

The National Academies of SCIENCES ENGINEERING MEDICINE

The Ocean Sound Atlas

The Ocean Sound & Marine Life Interagency Working Group

The Vision

Sound is fundamental to ocean ecosystems – many species rely upon sound to find food and mates and to warn them of danger. Both natural (e.g., rain, waves) and human activities (e.g., shipping, offshore energy production) produce sound.

<u>The *Ocean Sound Atlas* will be a digital global ocean sound map.</u> This interactive system will compile and integrate passive acoustic data by location of recording, for use by researchers, educators, policy-makers, engineers, explorers, sound artists, and other stakeholder groups.

Simple to use and open source, OSA will serve as a repository for federal and federally-funded project data, with additional contributions from academia, industry, and other sectors to achieve a more complete picture of ocean soundscapes and allow the easy identification and pinpointing of areas where anthropogenic sound may be a problem, that needs to be addressed.

WORLD MAP BY ORTELIUS (1570) – THE FIRST ATLAS

Click Section Headings to View Additional Content

Engaging different sectors

Ocean sound has obvious links to physical/ biological oceanography - yet mapping and using ocean sound data incorporates a wide range of disciplines and sectors.

- Sensor development involves physicists, acousticians, engineers and communications technologists. Mapping and analysis involves computer scientists, geospatial analysts, statisticians and geographers.
- Graphic designers, social scientists and communications experts could ensure that the OSA is easily understood, intuitive, and is in a format that can be used by multiple stakeholders.
- The sounds themselves would be used by researchers, regulators, and other marine stakeholders, musicians, artists, educators, radio broadcasters and podcasters.

Opportunities for collaboration

Numerous international projects would feed into or partner with the OSA such as:

- International Quiet Ocean Experiment;
- Discovery of Sound in the Sea;
- MERIDIAN Ocean Soundscape Atlas (Canada); Pandemic Silence Project;
- Native Land;
- World Forum for Acoustic Ecology.

International treaty bodies and projects with interest or focus on underwater sound include:

UNCLOS; UNEP; International Whaling Commission; IMO; ACCOBAMS and ASCOBANS agreements of the Bonn Convention; CCAMLR and the Antarctic Treaty; and MARPOL.

International bodies have called for the study, assessment and management underwater sound, including the UN

(e.g., para. 107 in Res. 61/222; para. 120 in Res. 62/215; Res. 71/257).

Building capacity & inspiration

- The Ocean Sound Atlas will provide internationally accessible information, including resources to groups and regions without strong acoustics programs and technology.
- The OSA will supply data to educators of various levels, already in a more accessible format.
- Likewise, sounds will be available to the media.
- The available data and accessible map will allow the OSA to connect across governmental and disciplinary boundaries, to reach a large audience and inspire curiosity, inquiry and action on underwater sound.

The Vision

Sound is fundamental to ocean ecosystems – many species rely upon sound to find food and mates and to warn them of danger. Both natural (e.g., rain, waves) and human activities (e.g., shipping, offshore energy production) produce sound.

The ***Ocean Sound Atlas*** will be a digital global ocean sound map. This interactive system will compile and integrate passive acoustic data by location of recording, for use by researchers, educators, policy-makers, engineers, explorers, sound artists, and other stakeholder groups.

Simple to use and open source, OSA will serve as a repository for federal and federally-funded project data, with additional contributions from academia, industry, and other sectors to achieve a more complete picture of ocean soundscapes and allow the easy identification and pinpointing of areas where anthropogenic sound may be a problem, that needs to be addressed.

Connections to existing infrastructure & partnerships

The time is right for the *Ocean Sound Atlas*

Bodies from different countries have already made steps towards recording and mapping ocean sound. The aim of this project is to pull these bodies and sound collection networks together, to help standardize and quality control information collected, and to use cutting edge mapping software to display the data in a form that is valuable for a wide range of sectors.

Existing sources:
- NOAA's SoundMap program
- NOMEC
- OceanReports
- inter-agency working groups (e.g., IWG OCM & OEC)
- Government Agency data (e.g., BOEM, Navy etc.)

Partnerships:
- acoustic research community
- marine conservation community
- small business
- citizen science,
- industry (oil and gas, shipping, technology developers), and
- indigenous communities.

The National Academies of SCIENCES ENGINEERING MEDICINE

The Ocean Sound Atlas

The Ocean Sound & Marine Life Interagency Working Group

Connections to existing infrastructure, programs & partnerships

The time is right for the *Ocean Sound Atlas*

Bodies from different countries have already made steps to record and map ocean sound. The aim of this project is to pull these bodies and sound collection networks together, to help standardize and quality control information collected, and to use cutting edge mapping software to display the data in a form that is valuable for a wide range of sectors.

Existing sources:
- NOAA's SoundMap program
- NOMEC
- OceanReports
- inter-agency working groups (e.g., IWG OCM & OEC)
- Government Agency data (e.g., BOEM, Navy etc.)

Partnerships:
- acoustic research community
- marine conservation community
- small business
- citizen science,
- industry (oil and gas, shipping, technology developers), and
- indigenous communities.

WORLD MAP BY ORTELIUS (1570) – THE FIRST ATLAS

Click Section Headings to View Additional Content

Engaging different sectors

Ocean sound has obvious links to physical/ biological oceanography - yet mapping and using ocean sound data incorporates a wide range of disciplines and sectors.
- Sensor development involves physicists, acousticians, engineers and communications technologists. Mapping and analysis involves computer scientists, geospatial analysts, statisticians and geographers.
- Graphic designers, social scientists and communications experts could ensure that the OSA is easily understood, intuitive, and is in a format that can be used by multiple stakeholders.
- The sounds themselves would be used by researchers, regulators, and other marine stakeholders, musicians, artists, educators, radio broadcasters and podcasters.

Opportunities for collaboration

Numerous international projects would feed into or partner with the OSA such as:
- International Quiet Ocean Experiment;
- Discovery of Sound in the Sea;
- MERIDIAN Ocean Soundscape Atlas (Canada); Pandemic Silence Project;
- Native Land;
- World Forum for Acoustic Ecology.

International treaty bodies and projects with interest or focus on underwater sound include:

UNCLOS; UNEP; International Whaling Commission; IMO; ACCOBAMS and ASCOBANS agreements of the Bonn Convention; CCAMLR and the Antarctic Treaty; and MARPOL.

International bodies have called for the study, assessment and management underwater sound, including the UN (e.g., para. 107 in Res. 61/222; para. 120 in Res. 62/215; Res. 71/257).

Building capacity & inspiration

- The Ocean Sound Atlas will provide internationally accessible information, including resources to groups and regions without strong acoustics programs and technology.
- The OSA will supply data to educators of various levels, already in a more accessible format.
- Likewise, sounds will be available to the media.
- The available data and accessible map will allow the OSA to connect across governmental and disciplinary boundaries, to reach a large audience and inspire curiosity, inquiry and action on underwater sound.

The Vision

Sound is fundamental to ocean ecosystems – many species rely upon sound to find food and mates and to warn them of danger. Both natural (e.g., rain, waves) and human activities (e.g., shipping, offshore energy production) produce sound.

The ***Ocean Sound Atlas*** will be a digital global ocean sound map. This interactive system will compile and integrate passive acoustic data by location of recording, for use by researchers, educators, policy-makers, engineers, explorers, sound artists, and other stakeholder groups.

Simple to use and open source, OSA will serve as a repository for federal and federally-funded project data, with additional contributions from academia, industry, and other sectors to achieve a more complete picture of ocean soundscapes and allow the easy identification and pinpointing of areas where anthropogenic sound may be a problem, that needs to be addressed.

Connections to existing infrastructure & partnerships

The time is right for the *Ocean Sound Atlas*

Bodies from different countries have already made steps towards recording and mapping ocean sound. The aim of this project is to pull these bodies and sound collection networks together, to help standardize and quality control information collected, and to use cutting edge mapping software to display the data in a form that is valuable for a wide range of sectors.

Existing sources:

- NOAA's SoundMap program
- NOMEC
- OceanReports
- inter-agency working groups (e.g., IWG OCM & OEC)
- Government Agency data (e.g., BOEM, Navy etc.)

Partnerships:

- acoustic research community
- marine conservation community
- small business
- citizen science,
- industry (oil and gas, shipping, technology developers), and
- indigenous communities.

The National Academies of SCIENCES ENGINEERING MEDICINE

The Ocean Sound Atlas

The Ocean Sound & Marine Life Interagency Working Group

Engaging different sectors & stakeholders

Ocean sound has obvious links to physical/ biological oceanography - yet mapping and using ocean sound data incorporates a wide range of disciplines and sectors.

- Sensor development involves physicists, acousticians, engineers and communications technologists. Mapping and analysis involves computer scientists, geospatial analysts, statisticians and geographers.
- Graphic designers, social scientists and communications experts could ensure that the OSA is easily understood, intuitive, and is in a format that can be used by multiple stakeholders.
- The sounds themselves would be used by researchers, regulators, and other marine stakeholders, musicians, artists, educators, radio broadcasters and podcasters.

WORLD MAP BY ORTELIUS (1570) – THE FIRST ATLAS

Click Section Headings to View Additional Content

Engaging different sectors

Ocean sound has obvious links to physical/ biological oceanography - yet mapping and using ocean sound data incorporates a wide range of disciplines and sectors.

- Sensor development involves physicists, acousticians, engineers and communications technologists. Mapping and analysis involves computer scientists, geospatial analysts, statisticians and geographers.
- Graphic designers, social scientists and communications experts could ensure that the OSA is easily understood, intuitive, and is in a format that can be used by multiple stakeholders.
- The sounds themselves would be used by researchers, regulators, and other marine stakeholders, musicians, artists, educators, radio broadcasters and podcasters.

Opportunities for collaboration

Numerous international projects would feed into or partner with the OSA such as:

- International Quiet Ocean Experiment;
- Discovery of Sound in the Sea;
- MERIDIAN Ocean Soundscape Atlas (Canada); Pandemic Silence Project;
- Native Land;
- World Forum for Acoustic Ecology.

International treaty bodies and projects with interest or focus on underwater sound include:

UNCLOS; UNEP; International Whaling Commission; IMO; ACCOBAMS and ASCOBANS agreements of the Bonn Convention; CCAMLR and the Antarctic Treaty; and MARPOL.

International bodies have called for the study, assessment and management underwater sound, including the UN

(e.g., para. 107 in Res. 61/222; para. 120 in Res. 62/215; Res. 71/257).

Building capacity & inspiration

- The Ocean Sound Atlas will provide internationally accessible information, including resources to groups and regions without strong acoustics programs and technology.
- The OSA will supply data to educators of various levels, already in a more accessible format.
- Likewise, sounds will be available to the media.
- The available data and accessible map will allow the OSA to connect across governmental and disciplinary boundaries, to reach a large audience and inspire curiosity, inquiry and action on underwater sound.

The Ocean Sound Atlas

The National Academies of SCIENCES ENGINEERING MEDICINE

The Ocean Sound & Marine Life Interagency Working Group

The Vision

Sound is fundamental to ocean ecosystems – many species rely upon sound to find food and mates and to warn them of danger. Both natural (e.g., rain, waves) and human activities (e.g., shipping, offshore energy production) produce sound.

The ***Ocean Sound Atlas*** will be a digital global ocean sound map. This interactive system will compile and integrate passive acoustic data by location of recording, for use by researchers, educators, policy-makers, engineers, explorers, sound artists, and other stakeholder groups.

Simple to use and open source, OSA will serve as a repository for federal and federally-funded project data, with additional contributions from academia, industry, and other sectors to achieve a more complete picture of ocean soundscapes and allow the easy identification and pinpointing of areas where anthropogenic sound may be a problem, that needs to be addressed.

Connections to existing infrastructure & partnerships

The time is right for the *Ocean Sound Atlas*

Bodies from different countries have already made steps towards recording and mapping ocean sound. The aim of this project is to pull these bodies and sound collection networks together, to help standardize and quality control information collected, and to use cutting edge mapping software to display the data in a form that is valuable for a wide range of sectors.

Existing sources:

- NOAA's SoundMap program
- NOMEC
- OceanReports
- inter-agency working groups (e.g., IWG OCM & OEC)
- Government Agency data (e.g., BOEM, Navy etc.)

Partnerships:

- acoustic research community
- marine conservation community
- small business
- citizen science,
- industry (oil and gas, shipping, technology developers), and
- indigenous communities.

Opportunities for collaboration

Numerous international projects would feed into or partner with the OSA such as:

- International Quiet Ocean Experiment;
- Discovery of Sound in the Sea;
- MERIDIAN Ocean Soundscape Atlas (Canada);
- Pandemic Silence Project;
- Native Land;
- World Forum for Acoustic Ecology.

International treaty bodies and projects with interest or focus on underwater sound include:

UNCLOS; UNEP; International Whaling Commission; IMO; ACCOBAMS and ASCOBANS agreements of the Bonn Convention; CCAMLR and the Antarctic Treaty; and MARPOL.

International bodies have called for the study, assessment and management underwater sound, including the UN

(e.g., para. 107 in Res. 61/222; para. 120 in Res. 62/215; Res. 71/257).

WORLD MAP BY ORTELIUS (1570) – THE FIRST ATLAS

Click Section Headings to View Additional Content

Engaging different sectors

Ocean sound has obvious links to physical/ biological oceanography - yet mapping and using ocean sound data incorporates a wide range of disciplines and sectors.

- Sensor development involves physicists, acousticians, engineers and communications technologists. Mapping and analysis involves computer scientists, geospatial analysts, statisticians and geographers.
- Graphic designers, social scientists and communications experts could ensure that the OSA is easily understood, intuitive, and is in a format that can be used by multiple stakeholders.
- The sounds themselves would be used by researchers, regulators, and other marine stakeholders, musicians, artists, educators, radio broadcasters and podcasters.

Opportunities for collaboration

Numerous international projects would feed into or partner with the OSA such as:

- International Quiet Ocean Experiment;
- Discovery of Sound in the Sea;
- MERIDIAN Ocean Soundscape Atlas (Canada); Pandemic Silence Project;
- Native Land;
- World Forum for Acoustic Ecology.

International treaty bodies and projects with interest or focus on underwater sound include:

UNCLOS; UNEP; International Whaling Commission; IMO; ACCOBAMS and ASCOBANS agreements of the Bonn Convention; CCAMLR and the Antarctic Treaty; and MARPOL.

International bodies have called for the study, assessment and management underwater sound, including the UN

(e.g., para. 107 in Res. 61/222; para. 120 in Res. 62/215; Res. 71/257).

Building capacity & inspiration

- The Ocean Sound Atlas will provide internationally accessible information, including resources to groups and regions without strong acoustics programs and technology.
- The OSA will supply data to educators of various levels, already in a more accessible format.
- Likewise, sounds will be available to the media.
- The available data and accessible map will allow the OSA to connect across governmental and disciplinary boundaries, to reach a large audience and inspire curiosity, inquiry and action on underwater sound.

The Ocean Sound Atlas

The National Academies of SCIENCES ENGINEERING MEDICINE

The Ocean Sound & Marine Life Interagency Working Group

The Vision

Sound is fundamental to ocean ecosystems – many species rely upon sound to find food and mates and to warn them of danger. Both natural (e.g., rain, waves) and human activities (e.g., shipping, offshore energy production) produce sound.

The ***Ocean Sound Atlas*** will be a digital global ocean sound map. This interactive system will compile and integrate passive acoustic data by location of recording, for use by researchers, educators, policy-makers, engineers, explorers, sound artists, and other stakeholder groups.

Simple to use and open source, OSA will serve as a repository for federal and federally-funded project data, with additional contributions from academia, industry, and other sectors to achieve a more complete picture of ocean soundscapes and allow the easy identification and pinpointing of areas where anthropogenic sound may be a problem, that needs to be addressed.

Connections to existing infrastructure & partnerships

The time is right for the *Ocean Sound Atlas*

Bodies from different countries have already made steps towards recording and mapping ocean sound. The aim of this project is to pull these bodies and sound collection networks together, to help standardize and quality control information collected, and to use cutting edge mapping software to display the data in a form that is valuable for a wide range of sectors.

Existing sources:

- NOAA's SoundMap program
- NOMEC
- OceanReports
- inter-agency working groups (e.g., IWG OCM & OEC)
- Government Agency data (e.g., BOEM, Navy etc.)

Partnerships:

- acoustic research community
- marine conservation community
- small business
- citizen science,
- industry (oil and gas, shipping, technology developers), and
- indigenous communities.

Building capacity and inspiration

- **The Ocean Sound Atlas will provide internationally accessible information, including resources to groups and regions without strong acoustics programs and technology.**
- **The OSA will supply data to educators of various levels, already in a more accessible format.**
- **Sounds will be available to the media.**
- **The available data and accessible map will allow the OSA to <u>connect across governmental and disciplinary boundaries, to reach a large audience and inspire curiosity, inquiry and action on underwater sound</u>.**

WORLD MAP BY ORTELIUS (1570) – THE FIRST ATLAS

Click Section Headings to View Additional Content

Engaging different sectors

Ocean sound has obvious links to physical/ biological oceanography - yet mapping and using ocean sound data incorporates a wide range of disciplines and sectors.

- Sensor development involves physicists, acousticians, engineers and communications technologists. Mapping and analysis involves computer scientists, geospatial analysts, statisticians and geographers.
- Graphic designers, social scientists and communications experts could ensure that the OSA is easily understood, intuitive, and is in a format that can be used by multiple stakeholders.
- The sounds themselves would be used by researchers, regulators, and other marine stakeholders, musicians, artists, educators, radio broadcasters and podcasters.

Opportunities for collaboration

Numerous international projects would feed into or partner with the OSA such as:

- International Quiet Ocean Experiment;
- Discovery of Sound in the Sea;
- MERIDIAN Ocean Soundscape Atlas (Canada); Pandemic Silence Project;
- Native Land;
- World Forum for Acoustic Ecology.

International treaty bodies and projects with interest or focus on underwater sound include:

UNCLOS; UNEP; International Whaling Commission; IMO; ACCOBAMS and ASCOBANS agreements of the Bonn Convention; CCAMLR and the Antarctic Treaty; and MARPOL.

International bodies have called for the study, assessment and management underwater sound, including the UN (e.g., para. 107 in Res. 61/222; para. 120 in Res. 62/215; Res. 71/257).

Building capacity & inspiration

- The Ocean Sound Atlas will provide internationally accessible information, including resources to groups and regions without strong acoustics programs and technology.
- The OSA will supply data to educators of various levels, already in a more accessible format.
- Likewise, sounds will be available to the media.
- The available data and accessible map will allow the OSA to connect across governmental and disciplinary boundaries, to reach a large audience and inspire curiosity, inquiry and action on underwater sound.

Measuring the pulse of Earth's global ocean

The Ocean Sound & Marine Life Interagency Working Group

The Vision:

Accurate locations of the deepest seafloor areas in each of the Earth's five major ocean basins have only recently been determined.

We plan to deploy a unique, deep-ocean capable hydrophone-lander system at each of these deep-sea sites (>7k meters).

Our goal is to make the first, simultaneous measurement of baseline ocean sound levels in what should be the quietest (i.e., lacking human-made noise) locations on Earth.

Anthropogenic ocean noise is rising worldwide due to increased container shipping in a growing global economy. High ocean noise levels have a deleterious effect on marine animals/ecosystems, impacting fisheries and other marine economic sectors.

The exact location and depth of the deepest spot in each of the world's oceans has been surprisingly unresolved. Erroneous data at these locations have remained uncorrected in literature until recent efforts by Steward and Jamieson [2019]. The deepest spot in each ocean are:

(1) Molloy Hole, Arctic (5,669 m);
(2) Puerto Rico Trench, Atlantic (8,408m);
(3) Java Trench, Indian (7,290 m);
(4) Mariana Trench, Pacific (10,925 m); and
(5) South Sandwich Trench, Southern Ocean (7,385 m).

After Stewart and Jamieson (2019)

Partners & Connections

We will use unique, deep-ocean hydrophone sensors, pressure cases, moorings rated to 11,000 meters depth developed by NOAA-PMEL and several industry partners:

High-Tech Inc., Nautilus Marine, Deep-Sea Power & Light, RBR Inc.

This project will also connect multiple U.S. agencies and departments:

Navy, Army, Coast Guard, USGS, BOEM, NOAA, National Parks, National Science Foundation, and Department of State.

Researchers from several academic oceanographic institutions will be involved in the project:

WHOI, Scripps, Washington, and Oregon State University

Additional deep ocean mooring/lander technology will require entraining several private sector entities:

Teledyne, Kongberg, IcListen, Ocean Sonics & Jasco

NGO partners that can contribute regional and global class research vessels to access these deep-ocean sites:

Caladan Oceanic, Ocean Exploration Trust, and Oceanx

The project will work with several international ocean sound monitoring organizations:

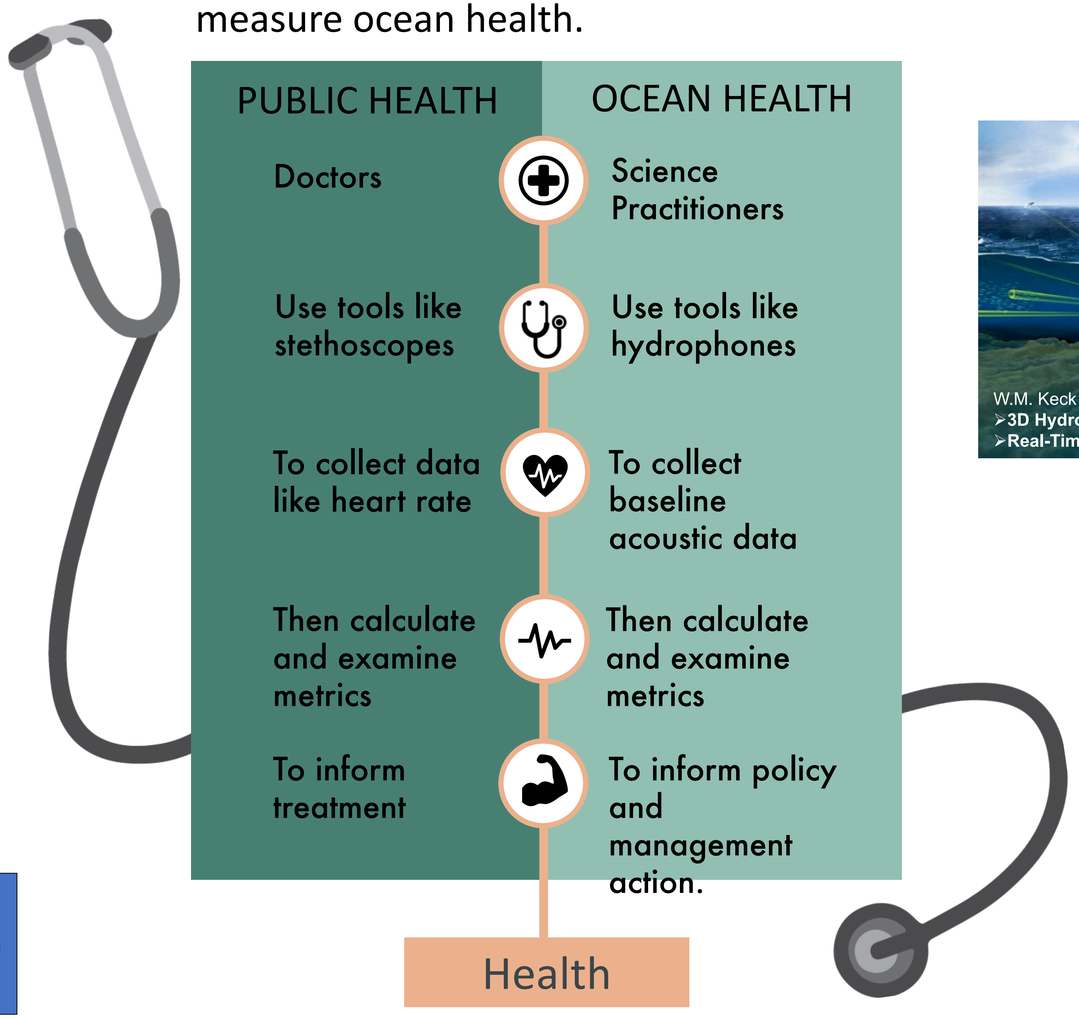
International Quiet Ocean Experiment, JAMOPANS, International Ocean Noise Coalition

Outreach & Engagement

- Our ocean sound program aspires to develop a robust and inclusive education component that partners with Universities, focusing on Minority Serving-Strengthening Institutions, for undergraduate internship and graduate research programs.
- We will engage global academic institutions to develop public outreach programs that work with local communities to build understanding of the impact of human-made noise on the health of marine ecosystems.
- We also plan to engage with national/international museums & aquariums to create exhibits with our unique deep-ocean sound clips to increase public outreach & engagement.

Auscultating the Oceans: Developing a Marine Stethoscope

Auscultate is to examine a patient by listening to sounds. Just like doctors need stethoscopes, we need tools to measure ocean health.



BACKGROUND

Sound travels efficiently in water and carries a rich amount of information.

Sound allows us to peer into vast swatches of our ocean's interior.

These traits make ocean acoustic research an effective ocean health tool.

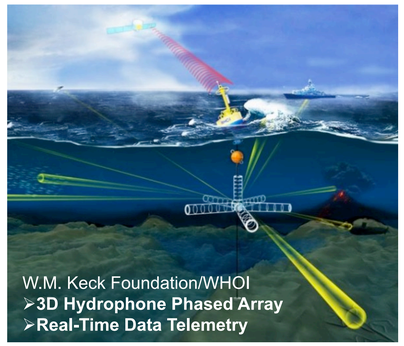
We can listen to the full range of consonant and cacophonous sounds in the ocean and objectively assess its current and future health.

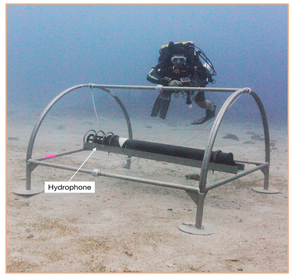
OUTCOMES

Ability to provide activity-based information in and across regions

Data-informed basis for policy and a management of anthropogenic ocean noise

Integrate acoustics into broader ocean communication and outreach.





For more details click here

The Vision:

Sound carries with it a rich amount of information pertaining to both sources and the environment.

With the efficiency at which it travels in water, sound provides a vantage point for peering into vast swatches of our ocean's interior. Using these traits, envisioned is a capacity for listening to the full range of consonant and cacophonous sounds in the ocean and objectively assessing its current and future state.

The *marine stethoscope* concept is inspired by recent advances, including the use of machine learning, to aid listening to, and labeling, heart and lung sounds as has been done starting with the invention of the stethoscope in 1816.

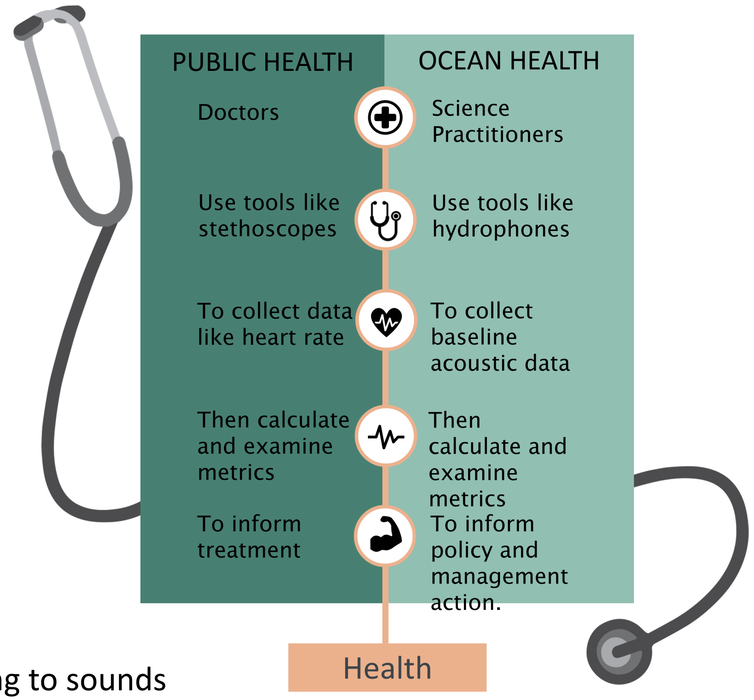
The vision will be enabled by technology, information processing capabilities, and standards for characterizing the undersea acoustic environment at temporal and spatial scales relevant to human and marine life.

These will be used to establish objective baselines for acoustic environments and provide activity-based information in and across regions. It will be transformative in that these newly identified patterns of natural and anthropogenic sound can be monitored and assessed to enable diagnostic capabilities.

This new capability will provide a data-informed basis for recommending policy and management of anthropogenic sound in the context of extant regional soundscapes.

Auscultating the Oceans: Developing a Marine Stethoscope

Just like doctors need stethoscopes, we need a tool to measure ocean health.



BACKGROUND

Sound travels efficiently in water and carries a rich amount of information.

Sound allows us to peer into vast swatches of our ocean's interior.

These traits make ocean acoustic research an effective ocean health tool.

We can listen to the full range of consonant and cacophonous sounds in the ocean and objectively assess its current and future health.

Auscultate: examine a patient by listening to sounds (from the heart, lungs, or other organs)

Connections to existing infrastructure

A recent inventory of federally funded passive acoustic monitoring assets included over 120 entries with support coming from 8 agencies plus NOPP, and the National Fish and Wildlife Foundation, Packard Foundation, Greenland Institute of Natural Resources, and Korea Polar Research Institute. The International Quiet Ocean Experiment (IQOE) has documented a mix of cabled, fixed-autonomous, and mobile-autonomous observation totaling around fifty (50) around the globe having acoustic capabilities. CTBTO provides a good example for low-frequency sound. The Exploration and Production Sound and Marine Life Joint Industry Program (JIP) can provide direct connectivity to the petroleum industry. Communication, coordination, and collaboration among entities to agree upon metrics, measurement and data accessibility practices, and sustainment approaches will bring the vision to realization. This includes developing new technology solutions as required for the benefit of the community. The strategy for mapping, exploring, and characterizing the US EEZ provides an implementation path.

Partners & Connections

Ocean Acoustics is highly intertwined with both the physical and biological aspects of the ocean that define the field of Oceanography, yet it is often underrepresented in the ocean sciences community.

This topic will integrate acoustics into the broader ocean sciences community as well as engage expertise in fields such as Machine Learning, Artificial Intelligence, Pattern Recognition, Signal Processing, Information Theory, Statistics, Geospatial Analysis, and others.

Drawing on people's affinity for music, biology, and exploration a robust and inclusive education/outreach program will encourage development of a multi-disciplinary community with the knowledge and skillset required to understand the ocean through sound.

Outreach & Engagement

- This concept promotes sound as a defining characteristic of the ocean environment that is intertwined with both the physical and biological aspects of oceanography. It reveals a hidden demand signal for needed training in acoustics alongside the physical, biological, mathematical, and engineering sciences required to support the ocean sector.
- Making connections with music, exploration, medicine, and other fields can further encourage development of education/outreach programs to build a diverse community.
- Development of an inexpensive junior ocean stethoscope (akin to what's found in a children's medical kit) could attract the k-12 set and citizen scientists.