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Thesis Project  
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# Wounded

# Waters

The Rising Tide of Ocean Noise

San José State University  
BFA Graphic Design  
Senior Thesis 2023

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# Waters

The Rising Tide  
of Ocean Noise

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# Thesis Abstract

Ocean noise pollution is a growing environmental concern that has received increasing attention in recent years. It refers to the increase in underwater sound levels caused by human activities, such as shipping, oil and gas exploration, construction, and military sonar. This increase in noise levels can have a significant impact on marine life, particularly on species that rely on sound for communication, navigation, and finding food. The effects of ocean noise pollution can range from temporary hearing loss to permanent physical damage and even death.

One of the main causes of ocean noise pollution is the increase in shipping traffic, as larger and faster ships produce more underwater noise. This can interfere with the ability of whales, dolphins, and other marine mammals to communicate, leading to a disruption of their social structures and affecting their ability to find mates and raise their young. And the use of military sonar has been linked to mass strandings of whales and other marine mammals, as the intense underwater sound waves can cause physical damage and disorientation. To address the issue of ocean noise pollution, it is important to increase public awareness and promote research on the effects of underwater sound on marine life.

# Statement

It is important that people realize the impact of their actions on the ocean. By recognizing the harm, people can make conscious choices to reduce their impact and **protect the ocean** and the marine life.

climate  
change  
oil spills  
plastic  
over-  
fishing  
ocean  
noise

### The initial idea

Create an immersive and interactive 3D installation. There would be 5 rooms for 5 harmful activities, such as, climate change, oil spills, plastic, overfishing, ocean noise.

### Feedback

The professors liked the shell of the idea, which was a good start. Their further comments made me realize that there was not much on the inside of it because I did not think through the aftermath of the installation. I want people to leave with strong feelings and the urge to change and help marine life. The problem is that I did not think of the pathway for it. Professor Kim said I need to decide whether my goal is to educate or make people take action. He then added that if it is the latter, they should leave with a reminder, a specific plan, or a to-do list they can follow at home.

Another thing is the range. Professor Sexton said I should shrink the scope of the installation because, for example, climate change is too big of a topic for one installation room. I should dive deeper into each topic I aim to cover and be very specific. It will help me create a clear, direct, and well-crafted installation.

Overall, the general idea is good. I just need to be more thorough and specific for this project to be successful.

- define the goal
- decide on aftermath
- narrow down
- be very specific
- tell a story
- think through more

# Locating Thesis Range

Create an immersive and interactive 3D installation that focuses on **ocean noise pollution**.

## The final idea

### There are 3 rooms:

intro

The first one is an introduction to the problem. It addresses the questions like "what is ocean noise pollution?" and "how does it affect marine life?"

impact

The second one shows the difference between the healthy ocean noise and the disrupted, artificial one.

The third one presents possible solutions to the noise pollution problem.

solution

# Questions

- one What is ocean noise pollution and what are its major causes?
- two How does ocean noise pollution affect marine life?
- three What can we do about it?

ocean  
noise  
pollution  
major  
causes  
importance  
of sound  
damage  
solutions

# Research

## What is ocean noise pollution

It is sounds made by human activities that can interfere with or obscure the ability of marine animals to hear natural sounds in the ocean.

## and what are its major causes?

- Offshore constructions
- Seismic blasts and surveys
- Oil and gas explorations
- Ships and speedboats
- Dynamite fishing
- Drilling platforms
- Military activities
- Artificial sonars
- Wind farms
- Air guns
- Engines
- Trolling

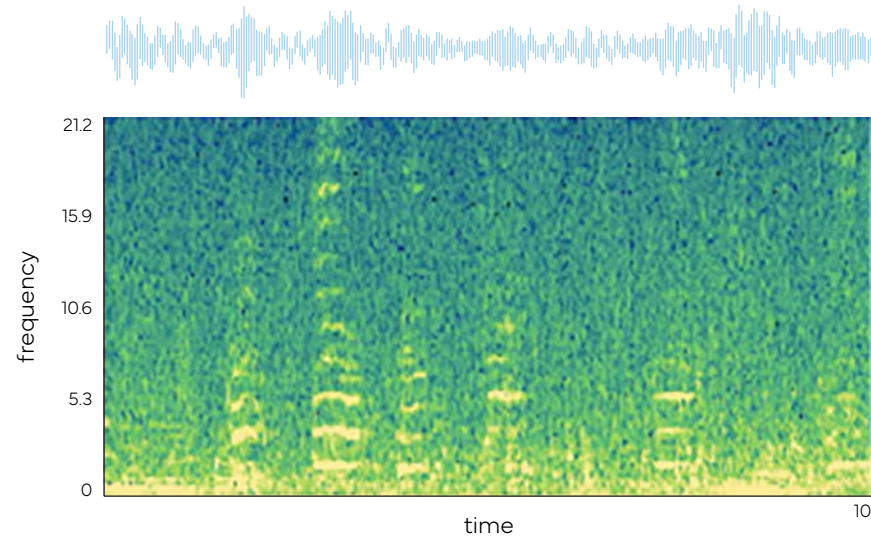
## Why is sound so important?

In the ocean, visual cues disappear after tens of yards, and chemical ones do after hundreds of yards. But sound can travel thousands of miles and link animals across oceanic basins and in darkness. As a result, many marine species are impeccably adapted to detect and communicate with sound.

- Marine animals use sound for:
  - Maintain a group structure
  - Ward off predators
  - Communication
  - Locating food
  - Reproduction
  - Echolocation
  - Territoriality
- Dolphins call one another by unique names.  
Bearded seals trill.  
Toadfish hum.  
Whales sing.

# Soundwaves

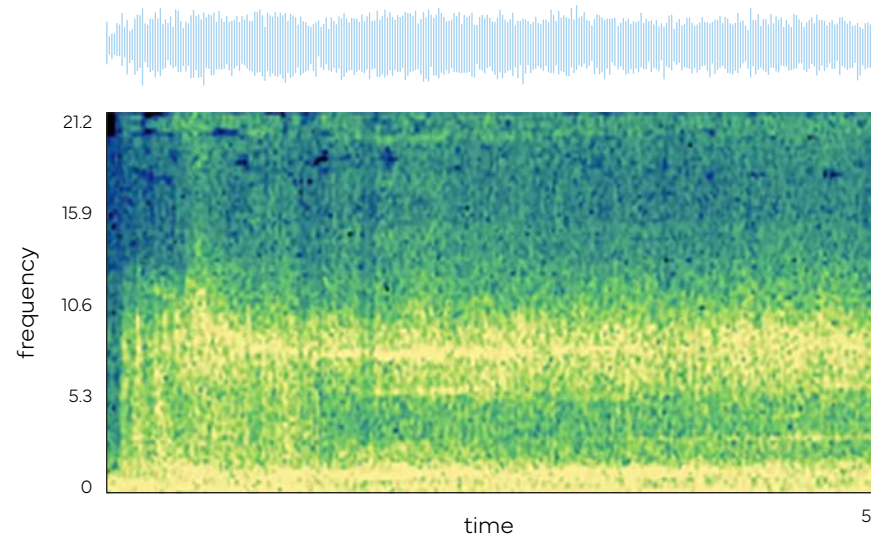
## California Sea Lion



Underwater sea lion barks recorded near Soquel Canyon in Monterey Bay, CA. Humpback whales and sea lions were feeding on sardines when this sound was recorded.

Sound ©Thomas R. Kieckhefer. Released under Creative Commons License, non-commercial attribution.

## Torpedo



This recording is of a live torpedo shot taken on an American submarine. The clip includes sounds of the launch, the closing of the torpedo hatch and the explosion of the torpedo.

Sound Courtesy of Sonatech, Inc. Released under Creative Commons License, non-commercial attribution. sonatech.com.

## How does it damage marine life?

Even temporary sounds can cause chronic hearing damage in the sea creatures by the acoustic wake. Both fish and marine mammals have hair cells, sensory receptors for hearing. Fish can regrow these cells, but it is unlikely for marine mammals.

Anthropogenic noise often drowns out the natural soundscapes, putting marine life under immense stress.

- Hearing loss
- Scare off fish
- Physiological stress
- Disrupted feeding
- Mothers cannot find their young

## What can we do?

Many solutions to anthropogenic noise pollution already exist, and are even quite simple.

- Move the shipping lane
- Avoid sensitive areas
- Slow down the ships
- Change propellers

Many ships rely on propellers that cause a great deal of cavitation: Tiny bubbles form around the propeller blade and produce a horrible screeching noise. But quieter designs exist, or are in the works.

“Noise is about the easiest problem to solve in the ocean.”



**physical places where  
my thesis can be found**

Point Lobos, Lands End  
Georgia Aquarium, Atlanta  
UN headquarters

**huge objects related to  
my thinking**

Ecosystems  
Soundwaves  
Oceans

**supermarket items that  
can nourish my thesis**

Sponges  
Mirrors  
Shells

**designers who could give  
you a workshop**

Ouchhh  
Valentino Vettori  
Chris Engman

**films that are the start of  
curated thesis film series**

Sonic Sea, 2016  
Noise, 2007  
The Silence That Remains, 2019

**blue-collar jobs that my  
thesis performs**

Light technicians  
Operators  
Repairers

**organizations that can  
commission my thesis**

World Wild Fund  
Oceana  
Monterey Bay Aquarium

**historical events that give  
my thesis context**

Technological Revolution  
COVID 19  
Tsar Bomb

**news items where my  
thesis lives in the present**

Orca Moms Pay a High Price to  
Feed Large Adult Sons  
<https://www.nytimes.com/2023/02/08/science/orcas-sons-mothers.html>

The Antarctic and Arctic sounds  
rarely heard before  
<https://www.bbc.com/news/science-environment-64514258>

Noise pollution is killing whales,  
but this technology could help  
[cnn.com/2022/09/26/world/whales-noise-pollution-anti-collision-c2e-spc-intl-scn/index.html](https://www.cnn.com/2022/09/26/world/whales-noise-pollution-anti-collision-c2e-spc-intl-scn/index.html)

# Places, People, Things

**tiny objects related  
to my thinking**

Scales  
Bubbles  
Water droplets

**physical qualities  
to my thesis**

Texture  
3D  
Light

**abstract qualities  
to my thesis**

Aesthetic  
Immersive  
Noisy

aesthetic  
immersive  
responsive  
sound  
waves  
bubbles  
ocean  
light

# Framing

Who might I approach for the interview, and what is their level of expertise?

Ocean activists or NOAA scientists would be a good choice. The latter ones research the effects of sounds made by human activities on marine mammals' abilities to "hear" and navigate the ocean environment.

How would I interview them?

Talking on Zoom or via email would be the best. I would start with asking them what ocean noise pollution is to make sure we are on the same page, and then just keep asking them in—depth questions.

# Reference

What do you need to know that you don't already know?

They know a lot more about marine life suffering and daily challenges. I would like to confirm my research and dive deeper into the effects ocean noise pollution has. Another thing that I am very interested in is how I can visually translate marine life experience in a way that we, people, understand, for example, using metaphors.

marine  
animals  
senses  
human  
presence  
making  
things  
right

# Interview

How would you describe or define the ocean noise pollution?

How does the noise affect marine life's senses?

What happens when humans' presence in the oceans becomes too prominent? What happens to the marine life?

Was there a successful experience of people making things right in the oceans? What can we do to improve the situation?

Is the issue getting worse or better lately? And how can we translate what marine life goes through to our lives?

Sensory pollution is the pollution of disconnection. It detaches from the cosmos. It drowns out the stimuli that link animals to their surroundings and to each other. In making the planet brighter and louder, we have also fragmented it.

Our influence is not inherently destructive, but it is often homogenizing. In pushing out sensitive species that cannot abide our sensory onslaught, we leave behind smaller and less diverse communities. As species extinct, so do their Umwelten. With every creature that vanishes, we lose a way of making sense of the world.

Our sensory bubbles shield us from the knowledge of those losses, but they don't protect us from the consequences.

A team of scientists from the UK and Australia used underwater loudspeakers to try and entice fish back to dead coral reefs and potentially help them recover. By replicating the sounds of healthy reefs, according to a study recently published in Nature Communications, the scientists used a process called "acoustic enrichment." They placed loudspeakers on patches of dead coral in the Great Barrier Reef and discovered that twice as many fish arrived – and stayed – compared to equivalent patches where no sound was played.

Between WWII and 2008 global shipping fleet more than tripled and began moving 10 times more cargo at higher speeds. Large vessels, including container ships, cruise ships, and military vessels, generate noise at lower frequencies than smaller vessels. Low frequency sounds travel much farther underwater than high frequency ones. Ship traffic, which has been steadily increasing over the last few decades, is responsible for the sustained rise in low frequency ambient noise in the 10 to 100 Hz range in many of the world's oceans. OSHA (Occupational Safety and Health Administration) requires hearing protection when the noise level is 85 decibels and greater.

# Manifesto

one research comes first

two tell a story

three be specific and precise

four prioritize the goal over aesthetics

five be gentle yet assertive

six let the outcome be simple yet intriguing

# Repository of Insight

“Sensory pollution is the pollution of disconnection.”

The quote sheds light on the adverse effects of excessive, in this case, noise in the marine ecosystem. With the ever-increasing human activity in our oceans, the levels of noise in the ocean have risen to unprecedented levels. This noise pollution can lead to a breakdown in communication among marine creatures, causing disorientation and stress, and even physical harm in some cases.

The impact of noise pollution in the ocean extends beyond marine life, affecting our ability to connect with and appreciate the beauty of the underwater world. As the human-made noise obscures the natural sounds of the ocean, it becomes increasingly difficult to immerse ourselves in the environment and connect with the natural world.

To tackle noise pollution in the ocean and establish a deeper connection with the underwater world, there is a need for concerted efforts. Initiatives to reduce the levels of human-made noise in the ocean could include a reduction in shipping traffic and regulating the use of sonar by the military. Creating marine protected areas with controlled noise levels can offer a haven for marine life and a space for people to appreciate the natural sounds of the ocean.

The consequences of noise pollution in the ocean have become a major concern for scientists, policymakers, and environmentalists globally. A number of research studies have been conducted to better understand the impact of noise pollution on marine life. These studies have highlighted the impact of noise pollution on communication, stress levels, feeding habits, and navigation.

The pollution of disconnection resulting from noise pollution in the ocean can be addressed by raising awareness among the general public and implementing measures to reduce human-made noise in the marine ecosystem. By doing so, we can create a healthy and harmonious relationship with the underwater world, enhancing our appreciation and understanding of this unique environment.

“Sound is as important to whales as all of our senses put together. They can feel it vibrating throughout their whole body.”

Rib Williams, marine biologist and founder of Oceans Initiative, BBC

“Marine animals use underwater clicks, whistles and songs, but these naturally occurring sounds can be drowned out by human-made cacophony.”

World Wildlife Fund

“The creatures were sending message all along, but humans had never thought to listen to them.”

Mr Jorgewich-Cohen, a PhD student at University of Zurich, BBC

“Giant whales can live for a century or more, so they are likely the individuals alive today who have witnessed this growing underwater racket and who only hear over a tenth of their former range.”

An Immense World by Ed Young

“Sensory pollution is the pollution of disconnection.”

An Immense World by Ed Young

“The soundtrack of home is now hard to hear, and in many cases has disappeared.”

Carlos Duarte, a marine ecologist at the King Abdullah University of Science and Technology in Saudi Arabia

“Noise shrinks an animals perceptual world.”

An Immense World by Ed Young

“In making the planet brighter and louder, we have also fragmented it.”

An Immense World by Ed Young

“With every creature that vanishes, we lose a way of making sense of the world.”

An Immense World by Ed Young

“The U.N. had an ocean noise week where they sat down and listened to it and then went on to another topic.”

Dr. Seger of Applied Ocean Sciences, The New York Times

“The top environmental problems are selfishness, greed and apathy, and to deal with these we need a cultural and spiritual transformation. And we scientists don't know how to do that.”

Dr. Seger of Applied Ocean Sciences, The New York Times

“Noise is about the easiest problem to solve in the ocean.”

Dr. Simpson, The New York Times

“Recovery can be almost immediate.”

Dr. Simpson, The New York Times

# Exhibition form

## Location

Point Lobos, Lands End,  
San Francisco, CA 94121

## Target Audience

Everyone.

## Outcome

3D immersive and interactive installation.

3 domes. 3 rooms. 3 parts of the journey:

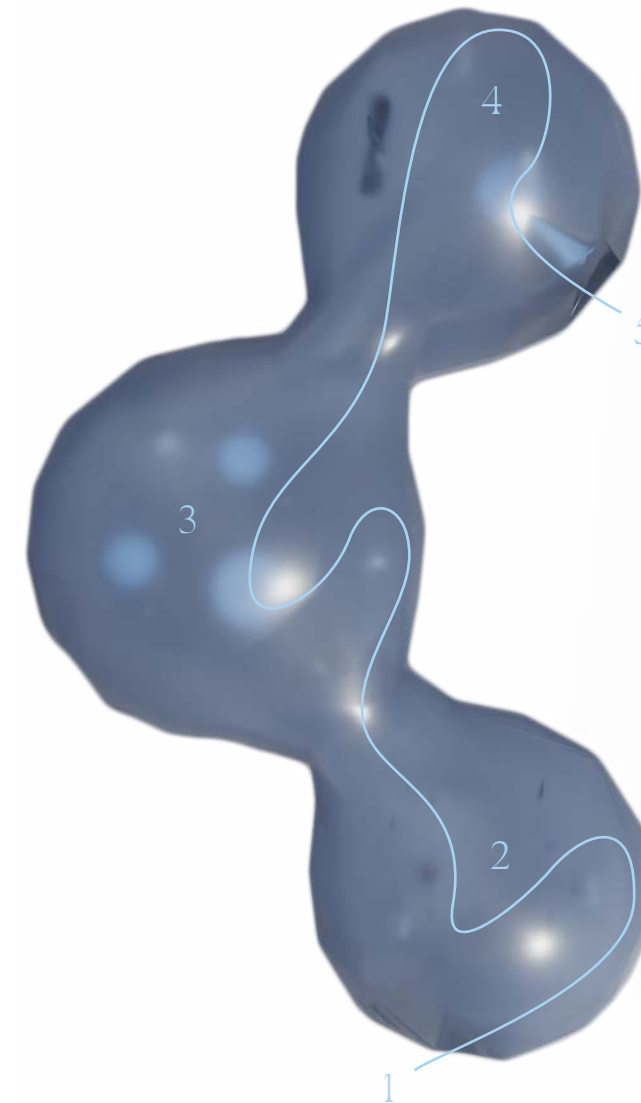
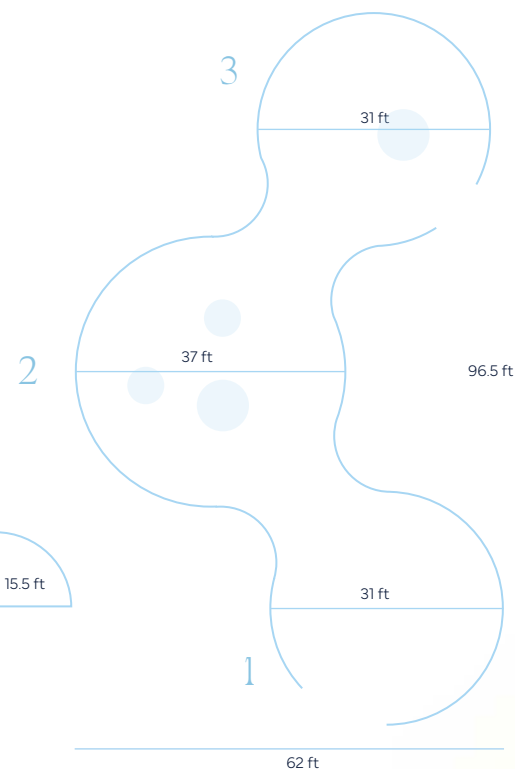
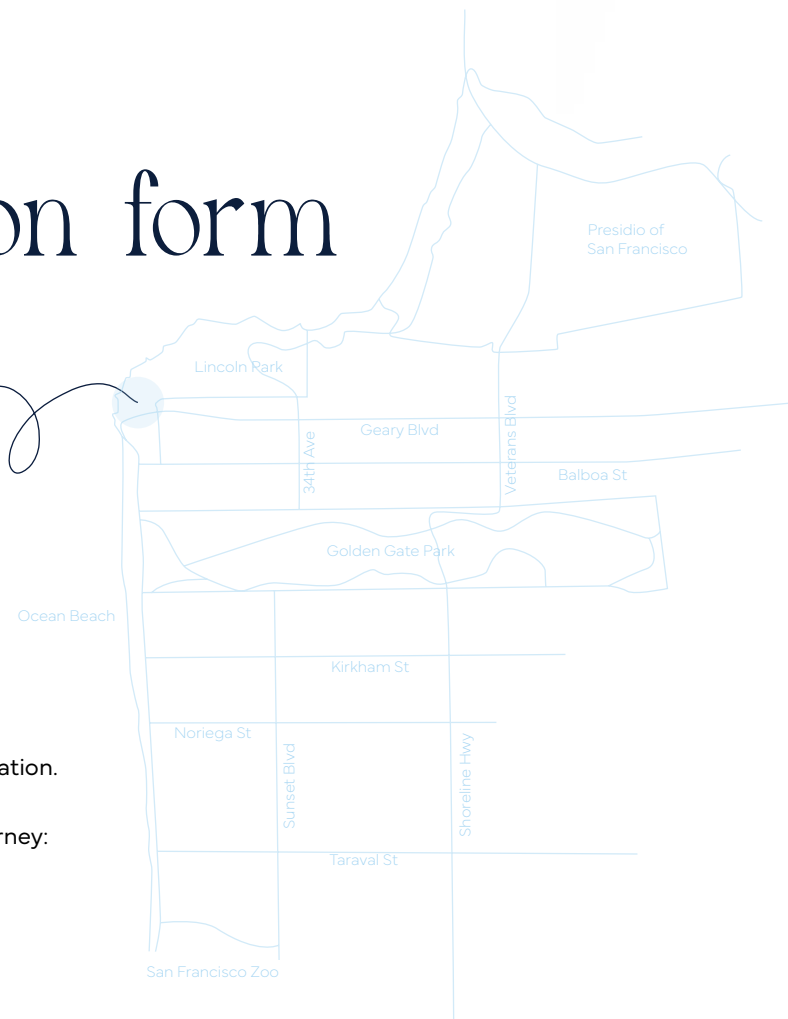
- 1 — introduction: Ocean Symphony
- 2 — impact: Luminous Noise
- 3 — solution: Quieter Propulsion

## Measurements

1 & 3 domes:  
diameter — 31 ft  
radius — 15.5 ft

2 dome:  
diameter — 37 ft  
radius — 18.5 ft

Overall:  
width — 96.5 ft  
depth — 62 ft



## Visitor's journey

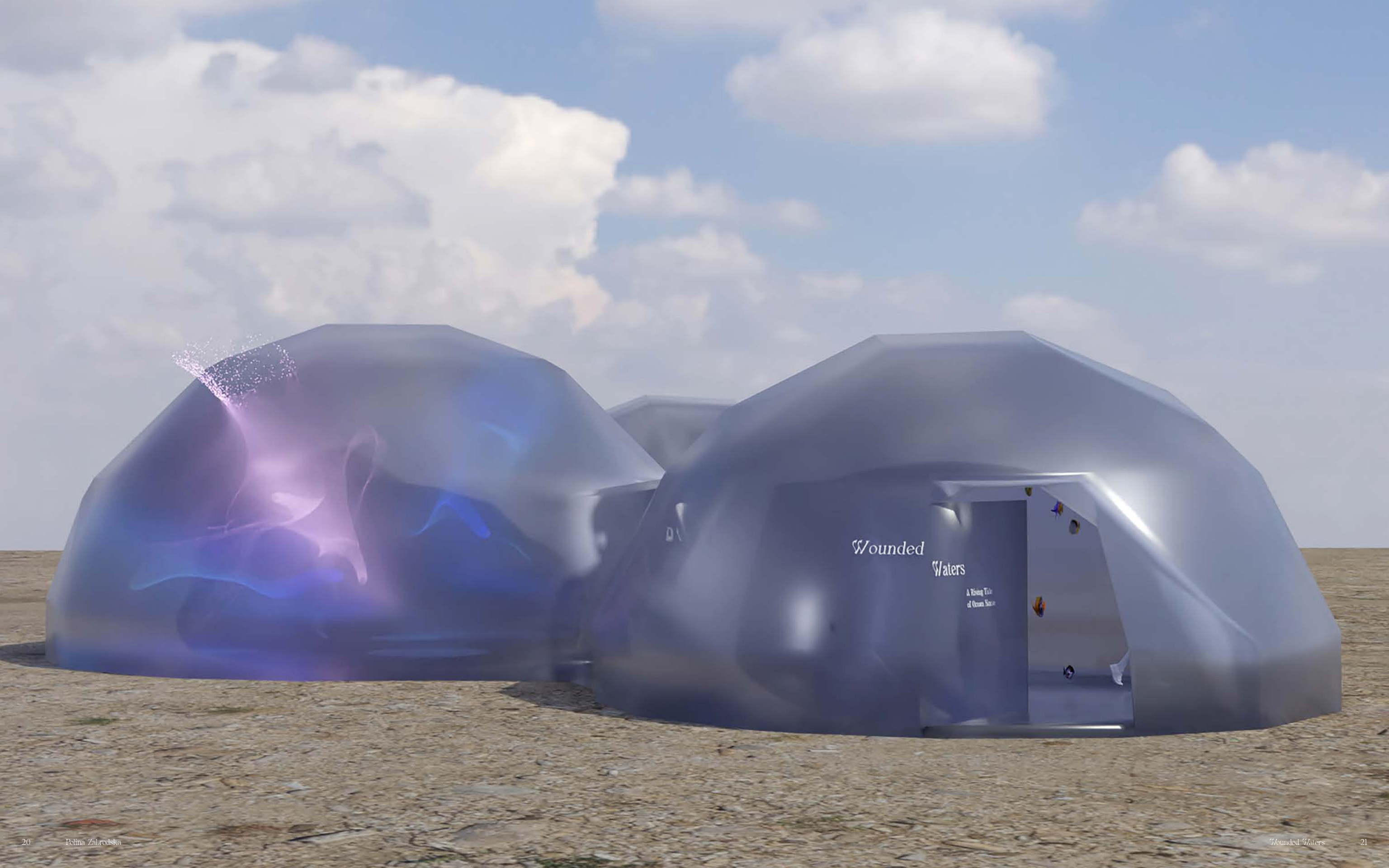
1 — The entrance where a person has a chance to read the title, subtitle, and a description of the exhibition.

2 — The first room, Ocean Symphony, shows the importance of the natural sounds and silence.

3 — The second room, Luminous Noise, shows the difference between healthy and disrupted noise.

4 — The third room, Quieter Propulsion, shows an improved propeller and a QR code with a petition to move the shipping lanes away from the sensitive areas.

5 — Exit.



Wounded  
Waters

A Rising Tide  
of Ocean Space



*Wounded*

*Waters*

*A Rising Tide  
of Ocean Noise*





# Room 1

## Ocean Symphony

This room is an introduction to the problem of the ocean noise pollution.

Marine animals swim away and avoid loud and noisy areas of the oceans and seas.

The concept of the room is simple yet clear: the louder it gets in the room, the less fish fish is there.



Ocean Sympho

Section of text on the panel, illegible.

# Ocean Symphony

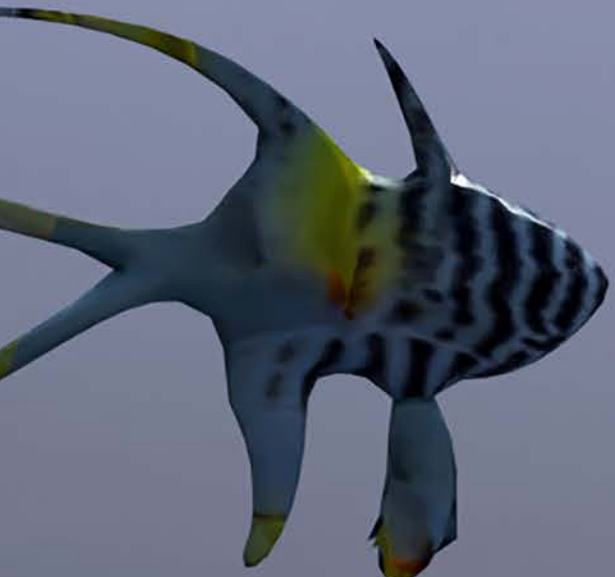
## *Impact of Anthropogenic Noise on Marine Life*

### **Healthy**

Healthy marine ecosystems are the result of complex interactions of the ocean, which includes a variety of physical processes by waves, organisms and natural phenomena such as storms, wind, and tides. The ocean is an important component of the earth's ecosystem and plays a vital role in climate processes, such as temperature, humidity, and heating.

### **Disturbed**

Disturbance events, such as hurricanes, tsunamis, and other natural events, can cause significant damage to marine ecosystems. These disturbances can be caused by human activities, such as overfishing, oil and gas extraction, and climate change. These disturbances can also be caused by natural events, such as hurricanes, tsunamis, and other natural events. Disturbance events can cause significant damage to marine ecosystems and can also be caused by human activities.







*Ocean Symphony*

It got loud in the room, so the fish swam away.

## Room 2

### Luminous Noise

The second room is all about the ocean sounds that are visualized as light particles.

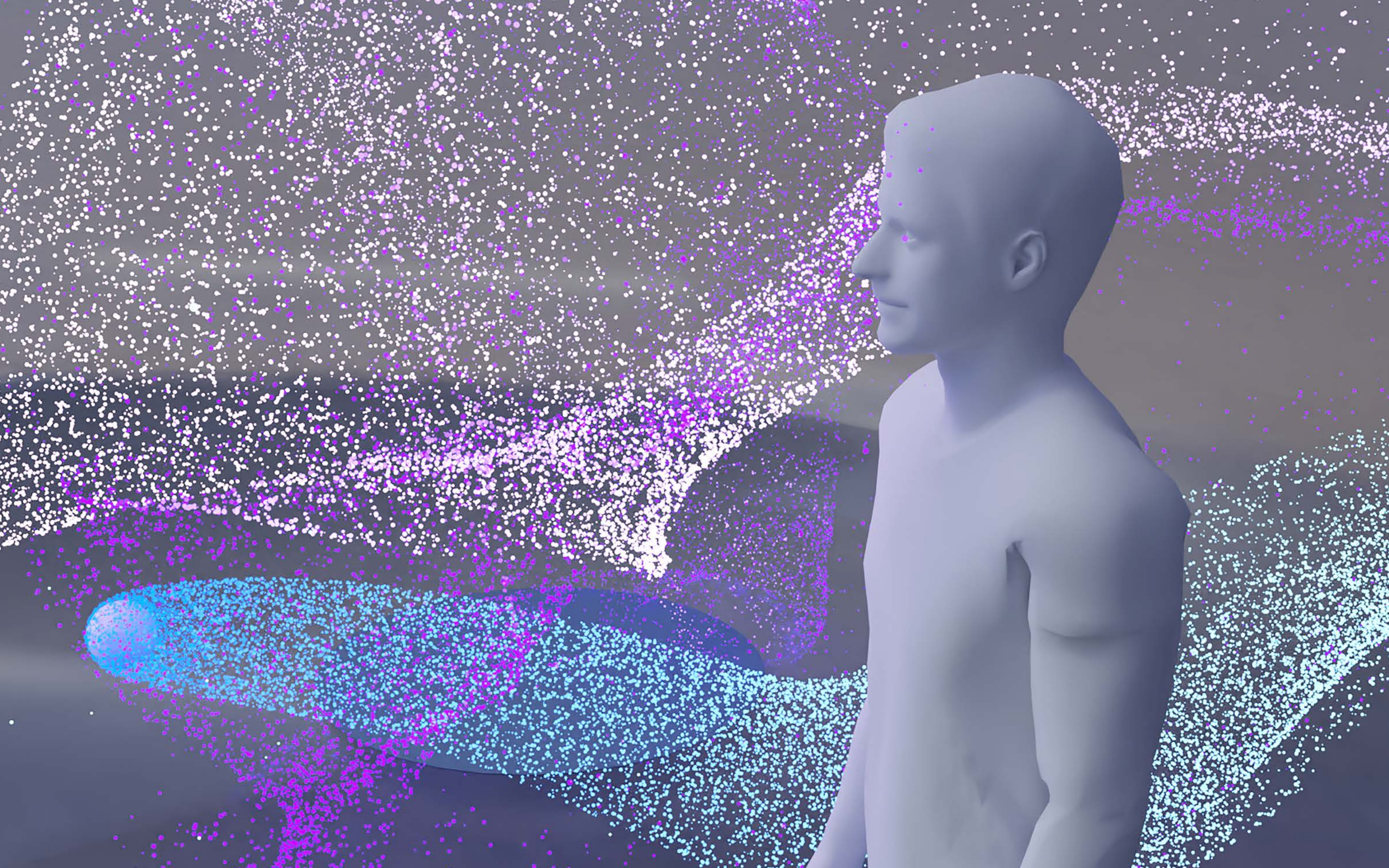
The concept of the room is to show the difference between healthy and disrupted noise in an interactive way. If a person steps on one of the spots on the floor, the room changes and shows the disrupted particles that are bigger, darker, and hectic, just as in the oceans.

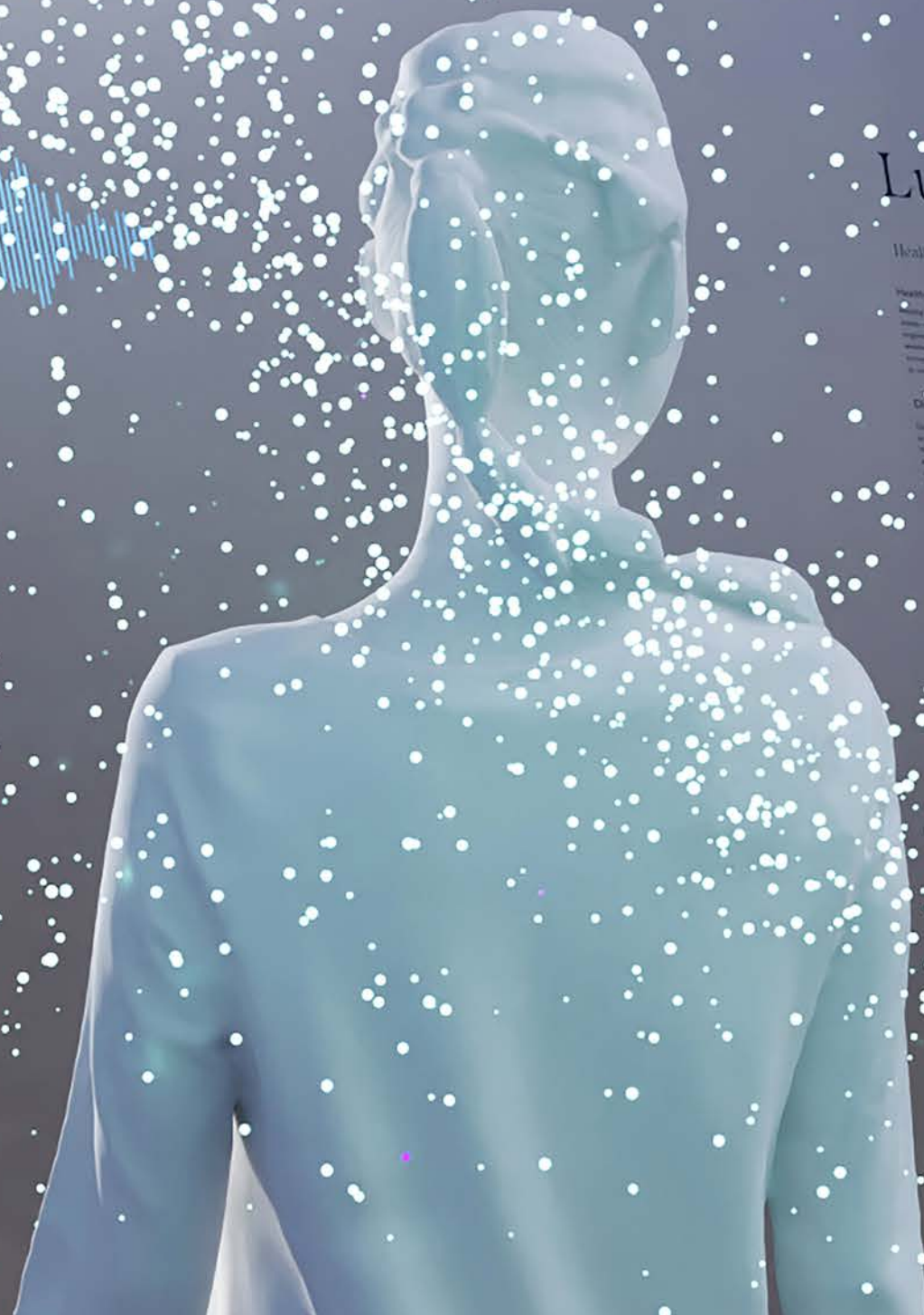
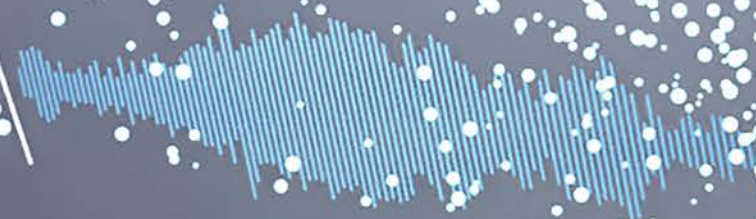
There are also soundwaves of marine animals and human activities (boats, mining, so on) on the wall where a person can see and compare them.











# Luminous Noise

Healthy and Disrupted Ocean Noise as Light Particles

## Healthy

Using computer models to the natural occurrence of the ocean noise, a variety of sounds produced by marine organisms and human activities in the ocean, and the effects of noise on marine life, and the effects of noise on the human ear and the effects of noise on the human ear.

## Disrupted

Computer models are used to study the effects of noise on the human ear and the effects of noise on the human ear. The models are used to study the effects of noise on the human ear and the effects of noise on the human ear. The models are used to study the effects of noise on the human ear and the effects of noise on the human ear.



The man stepped on the spot and triggered the reaction—the disrupted noise visualized as light particles. The particles are now big, dark, and hectic, and the room is darker.



# Room 3

## Quieter Propulsion

The third and the last room is the solution room.

One person cannot fix the problem by themselves, but we can do it collectively as a society. One way to improve the ocean noise pollution problem is to change ship and boat propellers.

The PressurePores propeller is the hero of this room. It reduces tip vortex cavitation by applying a small number of strategically placed holes in the propeller blades. Plus these pressure relief holes allow boats to operate with a quieter propeller.

Another way to improve the situation is signing a petition to move the shipping lanes away from the marine life habitats. There is a QR code that leads people to the petition.





# Quieter Propulsion

Reduced Bubble Emissions for a Healthier Ocean Environment

#### Currently Used Propeller

Cavitation is a phenomenon during which a bubble that has formed in a liquid rapidly collapses, releasing a shock wave. This release of energy means less force, less efficiency, and less of noise. Propeller cavitation can generate as much as 180dB of underwater radiated noise and can be heard by marine life 100 miles away. Anything above 140 dB can pose a significant risk to marine life.

#### PressurePores Propeller

PressurePores reduce propeller tip vortex cavitation by adding a small number of strategically placed holes to the propeller blades. This allows holes to operate with a quieter propeller. The new invention has been shown to reduce cavitation by 14% and sound by up to 10dB.

Help make our oceans quieter





Quieter Propulsion



The woman stepped on the spot and triggered the reaction. Now people can observe how much noise and bubbles create regular propellers compared to the improved one.





# Annotated

Imbler, Sabrina. "In the Oceans, the Volume Is Rising as Never Before." *The New York Times*. February 4, 2021. [nytimes.com/2021/02/04/science/ocean-marine-noise-pollution.html](https://www.nytimes.com/2021/02/04/science/ocean-marine-noise-pollution.html)

It is about a study that examined the effects of noise pollution on marine animals and explains how noise from shipping, oil and gas exploration, and other human activities can interfere with the communication and behavior of marine creatures.

Young, Ed. *An Immense World*. Published by Random House. June 21, 2022.

The book explores the wonders of the ocean and the complex and diverse ecosystems that exist there. Through vivid storytelling and illustrations, it takes readers on a journey through the depths of the ocean, highlighting the incredible variety of life that can be found there and the urgent need to protect these vital habitats.

OSPAR. "Underwater Noise." [ospar.org/work-areas/eiha/noise](https://ospar.org/work-areas/eiha/noise)

The OSPAR Commission aims to develop and implement measures to prevent and reduce underwater noise pollution in the North-East Atlantic. Their article "Underwater Noise" provides an overview of the sources of underwater noise, its impacts on marine life, and the efforts being made to address this issue.

# Bibliography

Animal Welfare Institute. "Ocean Noise." [awionline.org/content/ocean-noise](https://awionline.org/content/ocean-noise)

The article explains how human-generated noise from shipping, military activities, and other sources can have a harmful effect on marine animals, including whales, dolphins, and porpoises. It also discusses the efforts being made by the AWI and other organizations to address the issue of ocean noise pollution and protect vulnerable marine species.

Rannard, Georgina. "Secret communication of sea animals discovered." October 25, 2022. [bbc.com/news/science-environment-63380157](https://www.bbc.com/news/science-environment-63380157)

It reports on a new study that has revealed previously unknown forms of communication between marine animals. It explains how the study used underwater acoustic technology to capture and analyze the sounds made by a variety of marine species.

World Wildlife Fund, Inc. "Infographic: Underwater Noise." [arcticwwf.org/the-circle/stories/infographic-underwater-noise/](https://arcticwwf.org/the-circle/stories/infographic-underwater-noise/)

The infographic explains how noise from human activities can disrupt the communication, feeding, and migration patterns of marine animals, leading to negative consequences for individual species and entire ecosystems.

Nauticanews. "PressurePores : New technology that reduces noise generated by propellers." January 15, 2023. [nautica.news/new-technology-that-reduces-noise-generated-by-ship-propellers/](https://nautica.news/new-technology-that-reduces-noise-generated-by-ship-propellers/)

The article discusses the potential benefits of PressurePores propeller for marine life, as well as its potential for reducing the impact of underwater noise pollution on human health.

World Wildlife Fund, Inc. "Underwater Noise." [arcticwwf.org/threats/underwater-noise/](https://arcticwwf.org/threats/underwater-noise/)

The article explains how underwater noise from human activities can cause physical and behavioral harm to marine animals. It also discusses the steps being taken to address the issue of underwater noise pollution and protect vulnerable marine species in the Arctic.

Hirschlag, Ally. "Can we fix our ocean noise problem?" BBC. July 12, 2022. [bbc.com/future/article/20220712-how-to-fix-our-ocean-noise-pollution-problem](https://www.bbc.com/future/article/20220712-how-to-fix-our-ocean-noise-pollution-problem)

The article highlights the importance of reducing noise from shipping and other human activities, and the need for better monitoring and regulation of underwater noise. It discusses innovative approaches to address this issue.

Duarte, Carlos M. and 25 more authors. "The soundscape of the Anthropocene ocean." *Science*. February 5, 2021. Vol 371, Issue 6529. DOI: 10.1126/science.aba4658. [dosits.org/galleries/audio-gallery/](https://dosits.org/galleries/audio-gallery/)

The article presents a comprehensive analysis of the impact of human-generated noise on the oceans and effects on marine life. The authors call for the development of measures to mitigate the impact of noise pollution and protect vulnerable ocean animals.

Phys.org. "Fish exposed to noise pollution likely to die early: study." September 16, 2020. [phys.org/news/2020-09-fish-exposed-noise-pollution-die.html](https://phys.org/news/2020-09-fish-exposed-noise-pollution-die.html)

It reports on a study that found that fish exposed to noise pollution are more likely to die early. The article discusses the implications of these findings for marine ecosystems and highlights the need for increased efforts to address this issue.

