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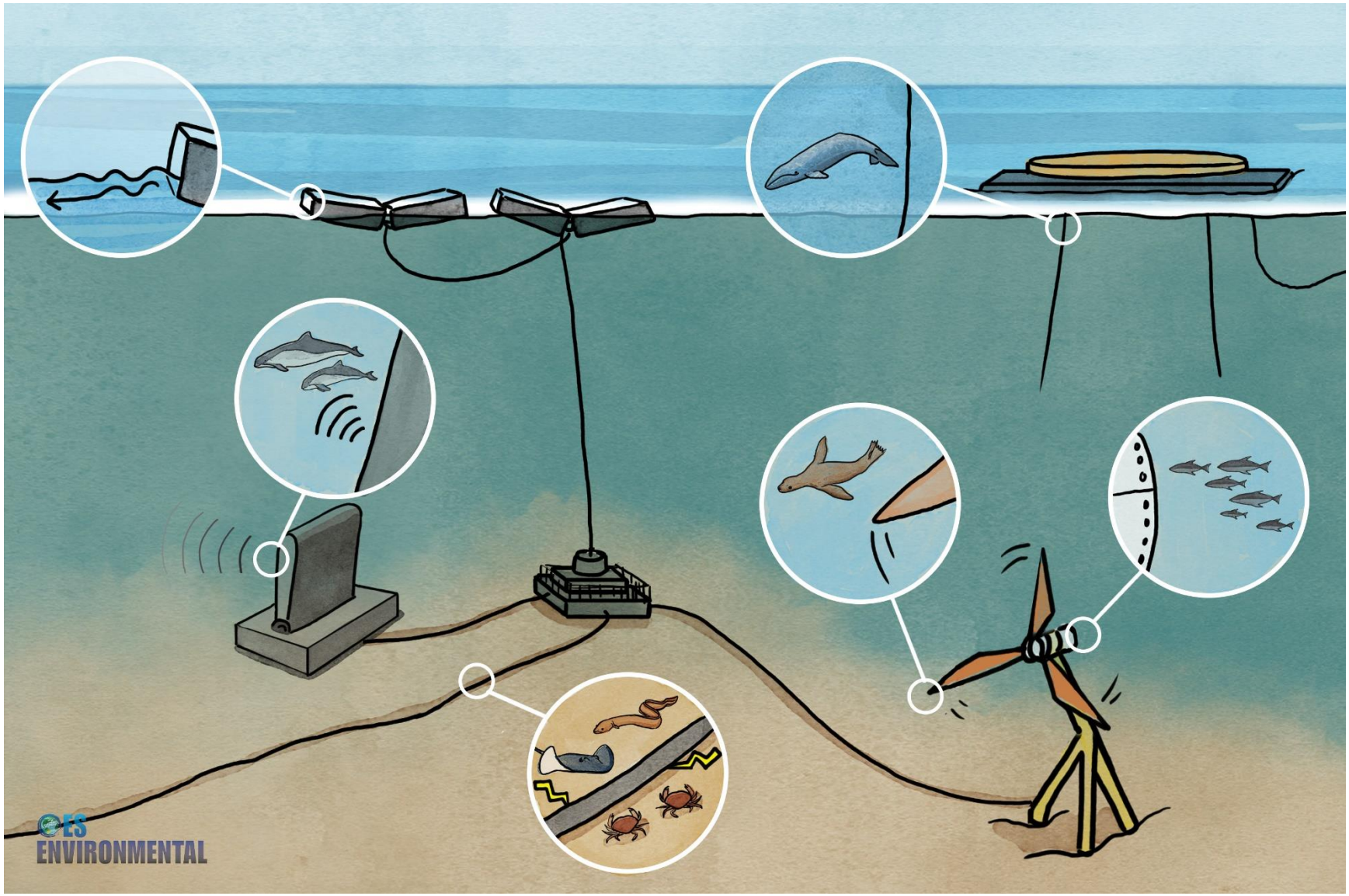
Marine Renewable Energy and the Environment: A Coloring Book



U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

Pacific Northwest NATIONAL LABORATORY

For more information and educational materials, see
https://tethys.pnnl.gov/marine-renewable-energy-educational-resources
Illustrations by Rose Perry and Stephanie King

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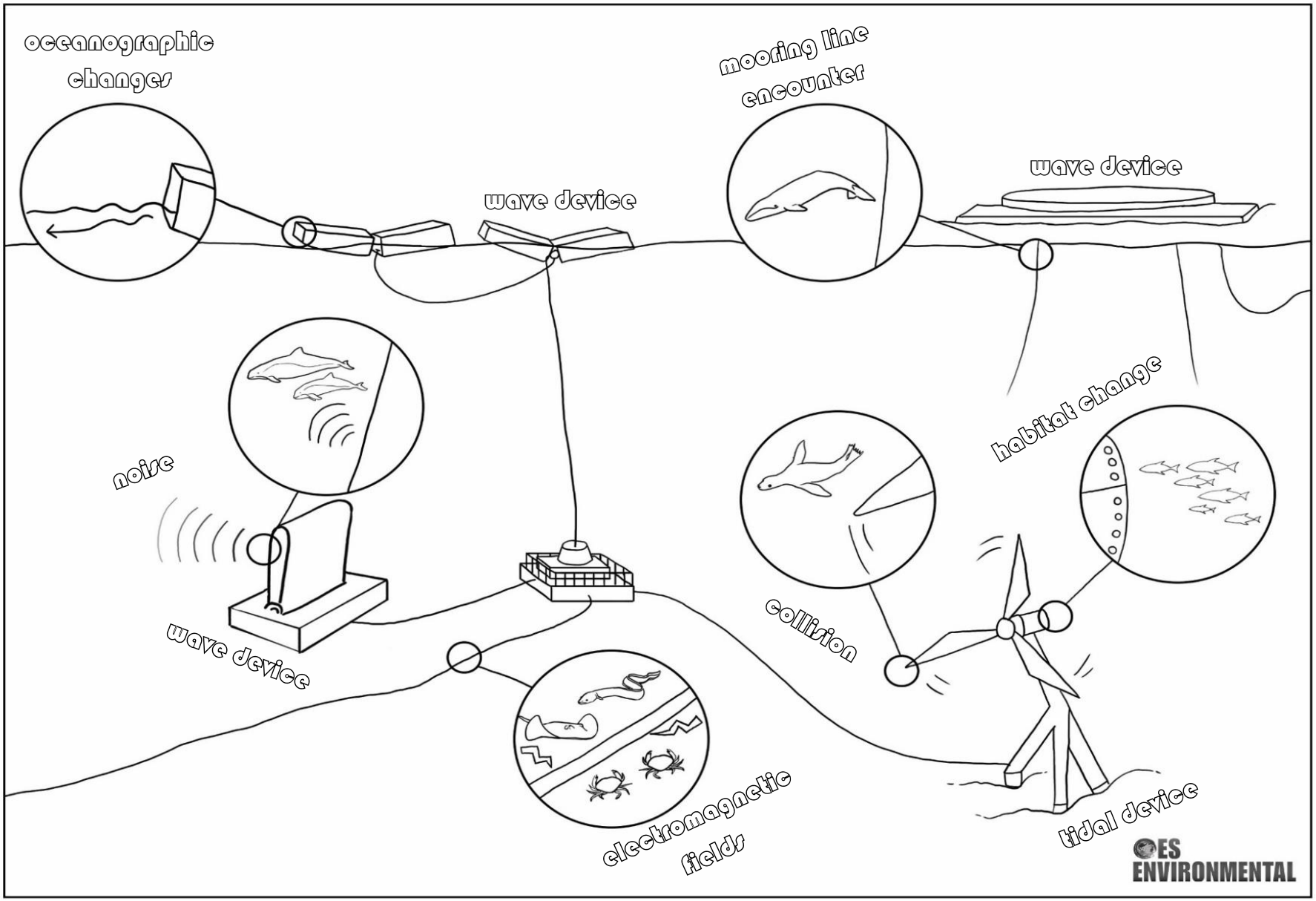
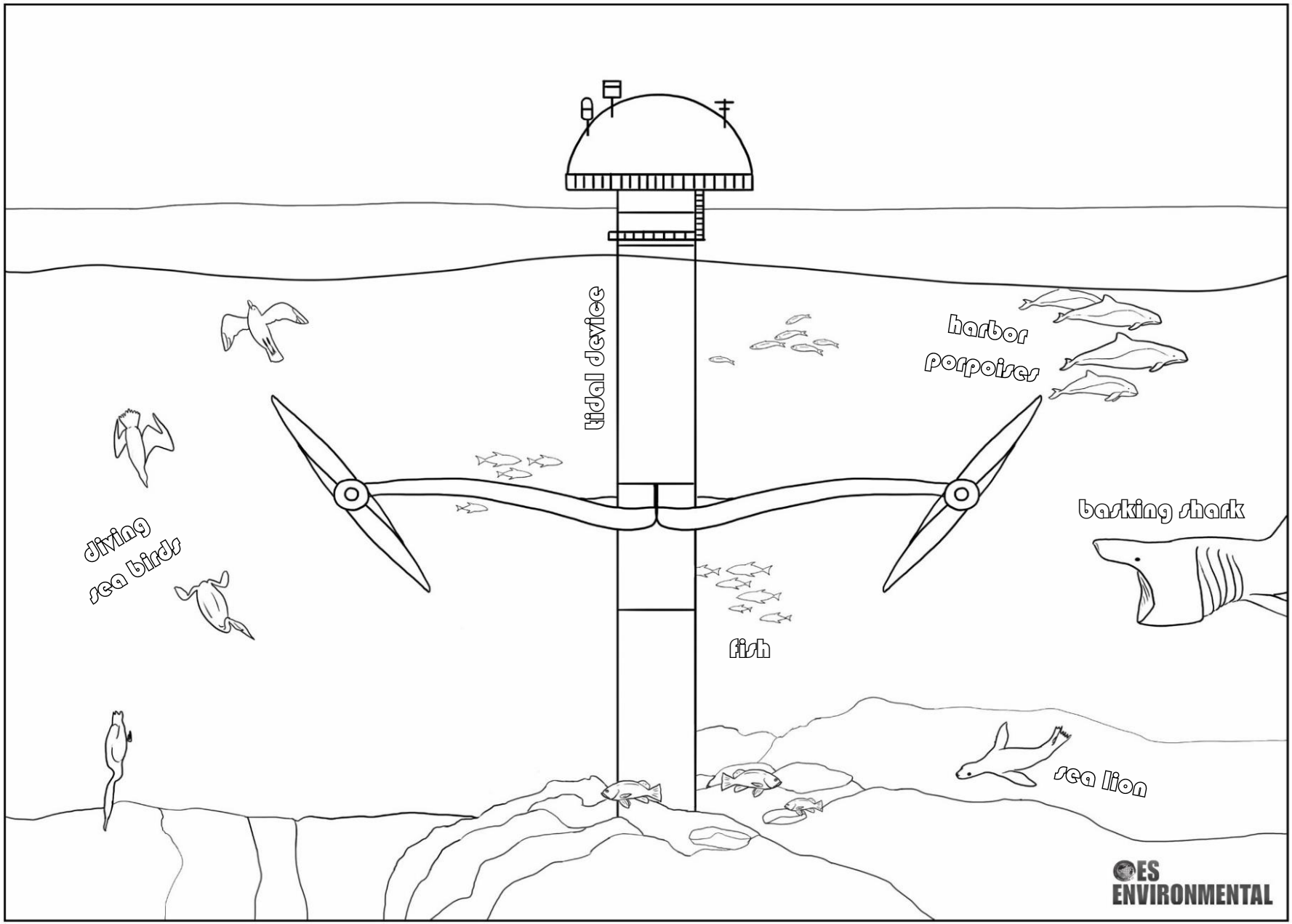
Marine Renewable Energy and the Environment

Marine renewable energy devices generate electricity from the ocean's waves, tides, and currents. As we install these devices in the ocean to provide clean energy and help combat climate change, it is possible that they could affect the marine environment. However, scientists and engineers are making sure animals and their habitats will not be harmed. As you look through the coloring pages, you will learn more about how marine renewable energy devices interact with the environment. Find and color the animals and the wave and tidal devices in the pictures! How many different animals can you count?



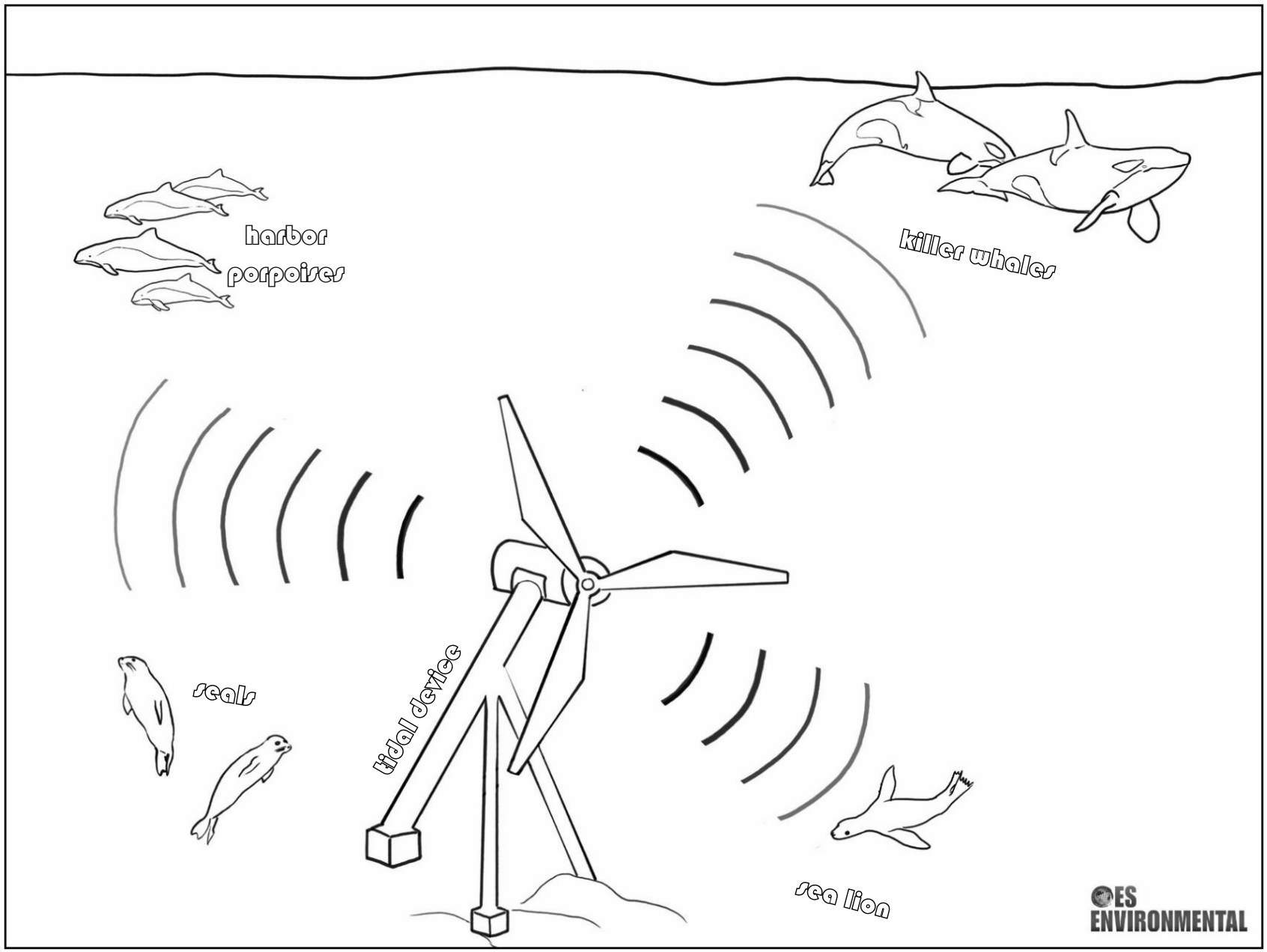
Collision Risk

Marine renewable energy devices have many different parts. Some of them, like the rotating blades of tidal turbines could hurt marine animals if they collide with the slow-moving turbine blades by swimming too close to the device. However, some studies show that marine animals are able to see and/or hear a device and avoid it, even from far away. Also, no scientists have ever seen a collision!



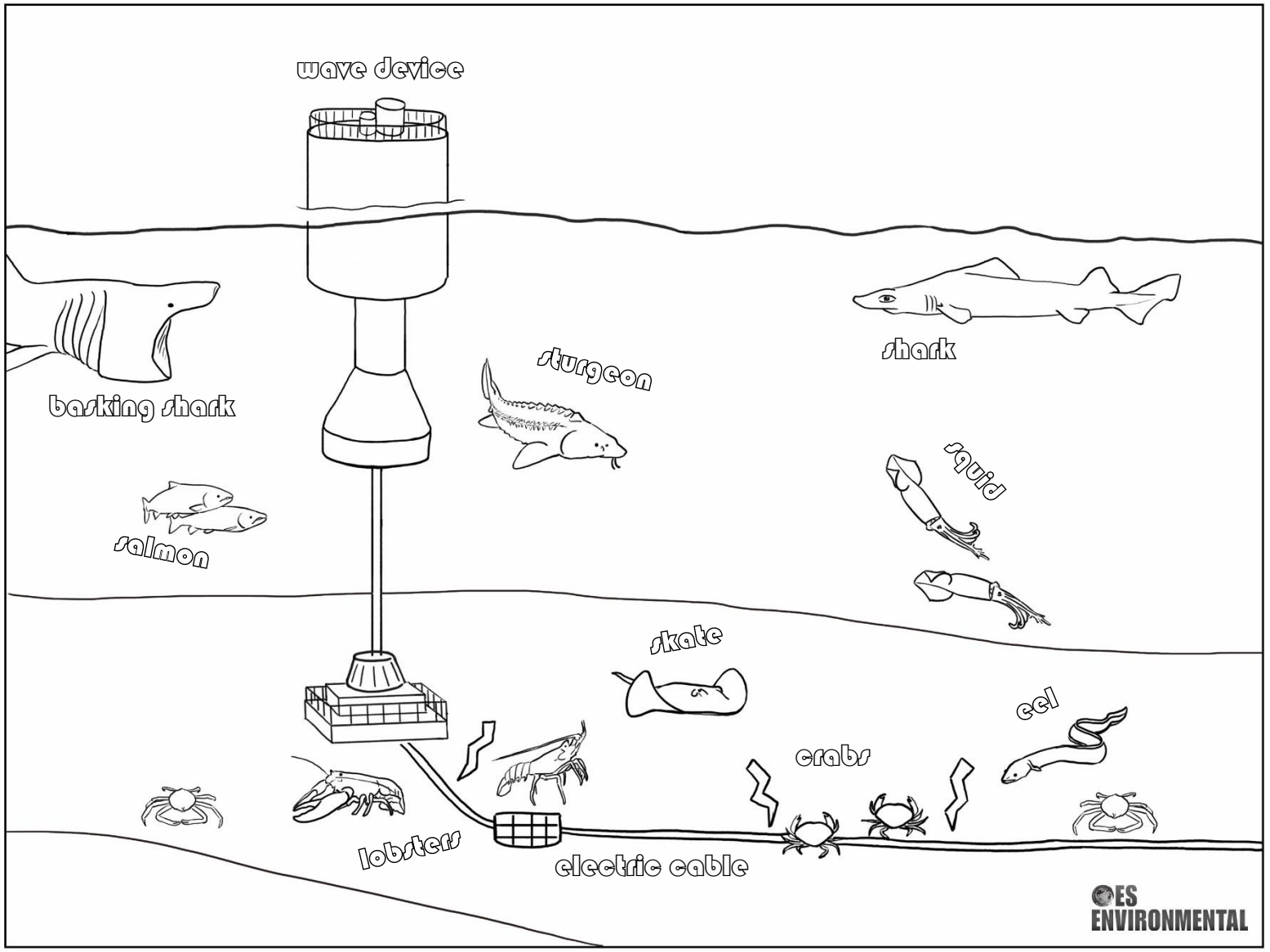
Underwater Noise

In the ocean, many marine animals use sound to communicate, find food, and escape from predators. Marine renewable energy devices in the ocean can add noise that could be heard by marine animals. This additional noise could cover up animal's sounds or cause harm to the animals. Engineers have designed devices to be quiet, and scientists have found most noise from marine renewable energy devices is low enough that it is unlikely to harm marine animals.



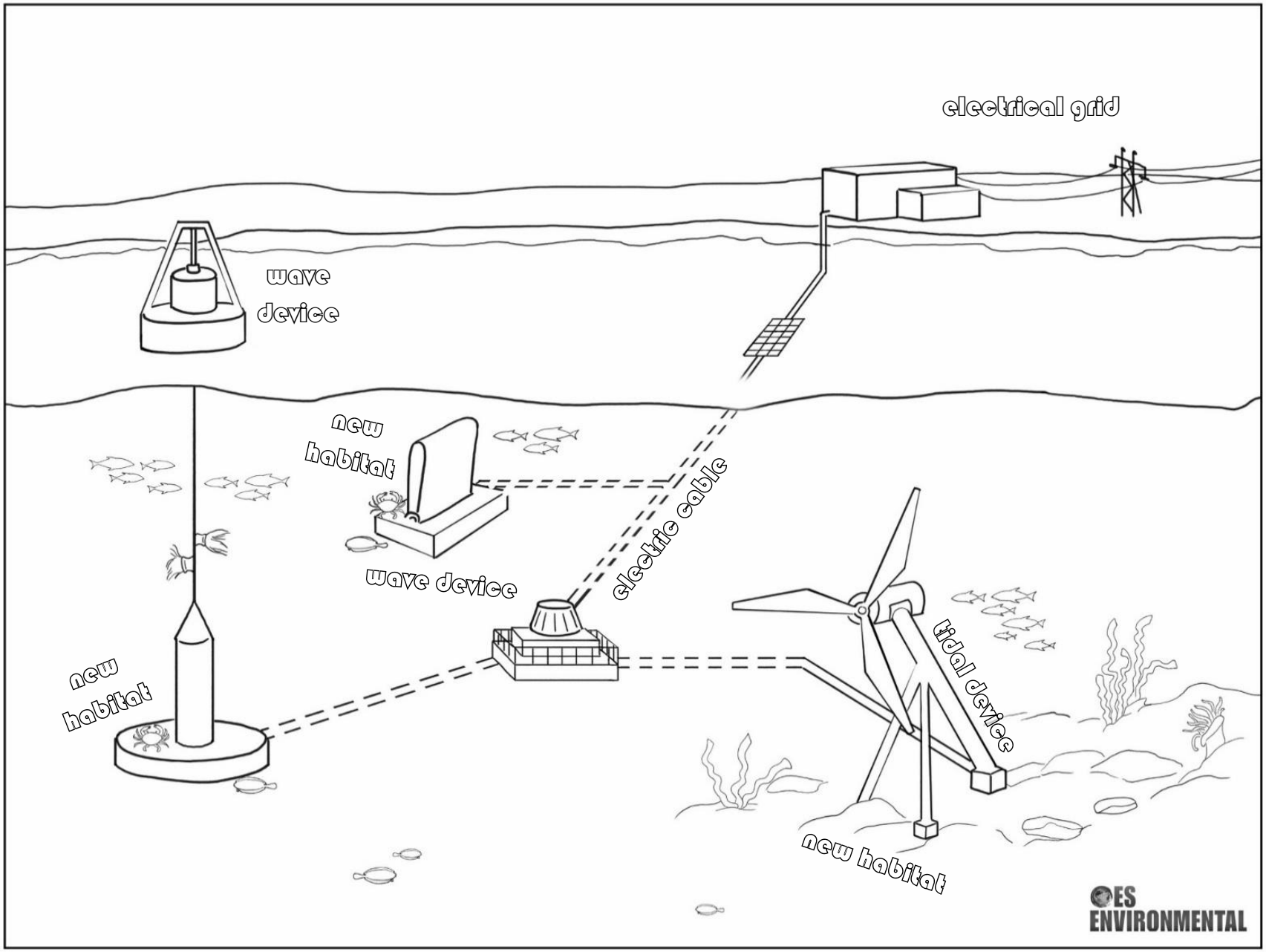
Electromagnetic Fields

Some marine animals, such as crabs and sharks, can sense natural electric and magnetic (or electromagnetic) fields. These animals use electromagnetic fields to find food and explore their environment. Electric cables from marine renewable energy devices can add new electromagnetic signals to the environment, which could confuse the animals that rely on the natural fields. Scientists have studied this, and while some sensitive animals may act differently around marine renewable energy cables, they are unlikely to be harmed. In fact, we can bury cables underneath the seabed or cover them with concrete and other materials to keep animals from coming close to the cables and the electromagnetic fields.



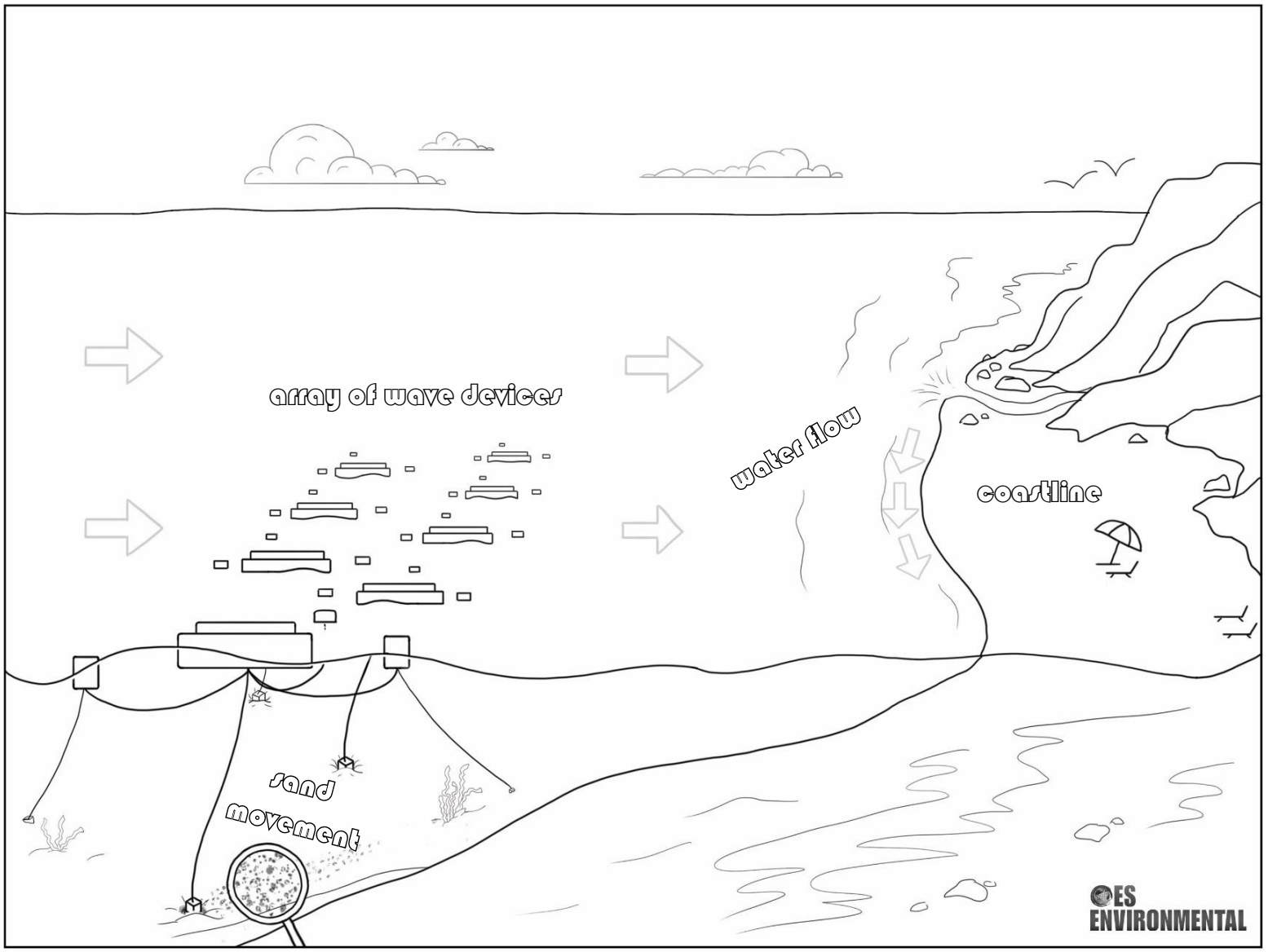
Habitat Change

Adding any human-made structure, such as piers, boat wrecks, or pipelines, to the marine environment can change the habitats that marine animals rely on. Marine renewable energy devices can be placed from the seafloor to the top of the water. While these changes may affect marine animals, scientists have found that habitats often recover over time from any disturbance, and in many cases, can even provide new homes for marine animals and act as marine reserves!



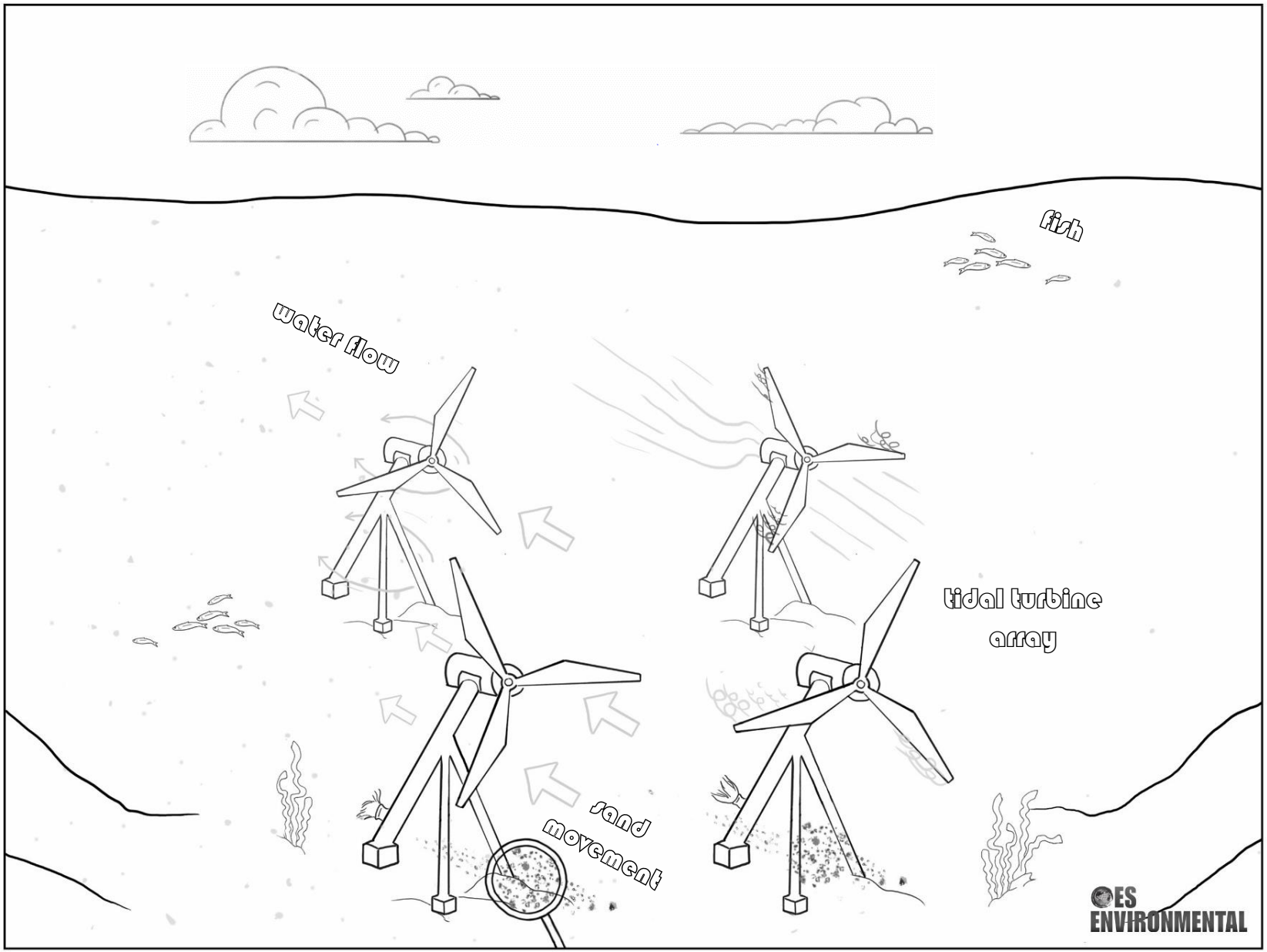
Changes in Oceanographic Systems – Wave Energy

There are many important processes in the ocean, including the movement of the waves and tides, sediment (like sand and rocks), and nutrients – these are oceanographic systems. Marine animals and the environment rely on these processes, and placing marine renewable energy devices in the water can affect them. Both wave energy devices (shown below) and tidal energy devices (shown on the next page) can dampen the power of the waves or the tides as they use those water movements to create energy. This can change the direction and power of waves on the surface, make the water move more slowly or in new ways around the device, or change the movement of sediment.



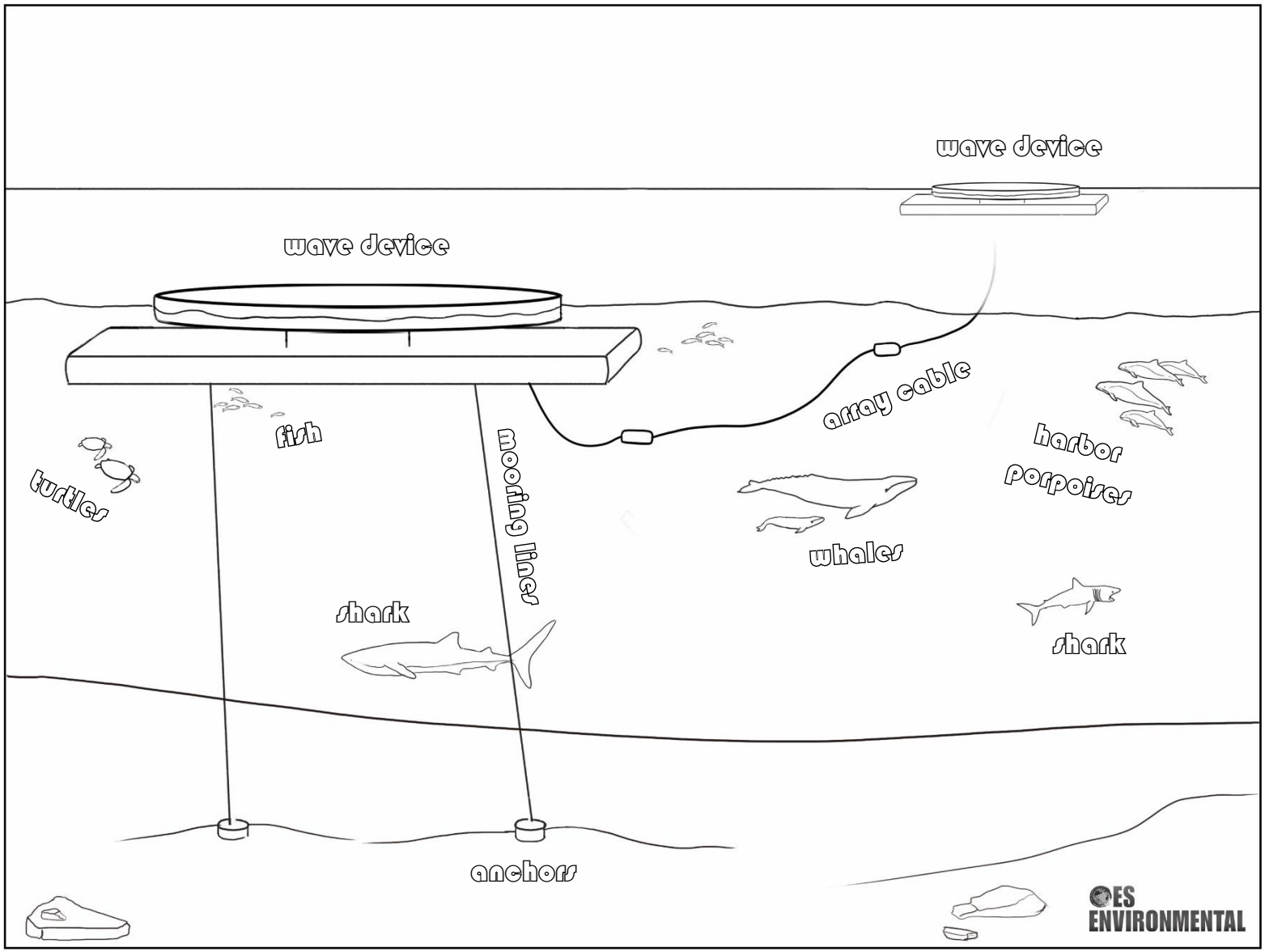
Changes in Oceanographic Systems – Tidal Energy

The changes to oceanographic systems are mostly a concern when there are many devices grouped together (called an "array"). Understanding how water movement, the coastline, and other parts of oceanographic systems will change when new devices are added is important for scientists to keep animals and people safe. Researchers have used computer models to predict potential effects on the environment, but field data collected around arrays of wave and tidal energy devices are needed to better understand these impacts to oceanographic systems.



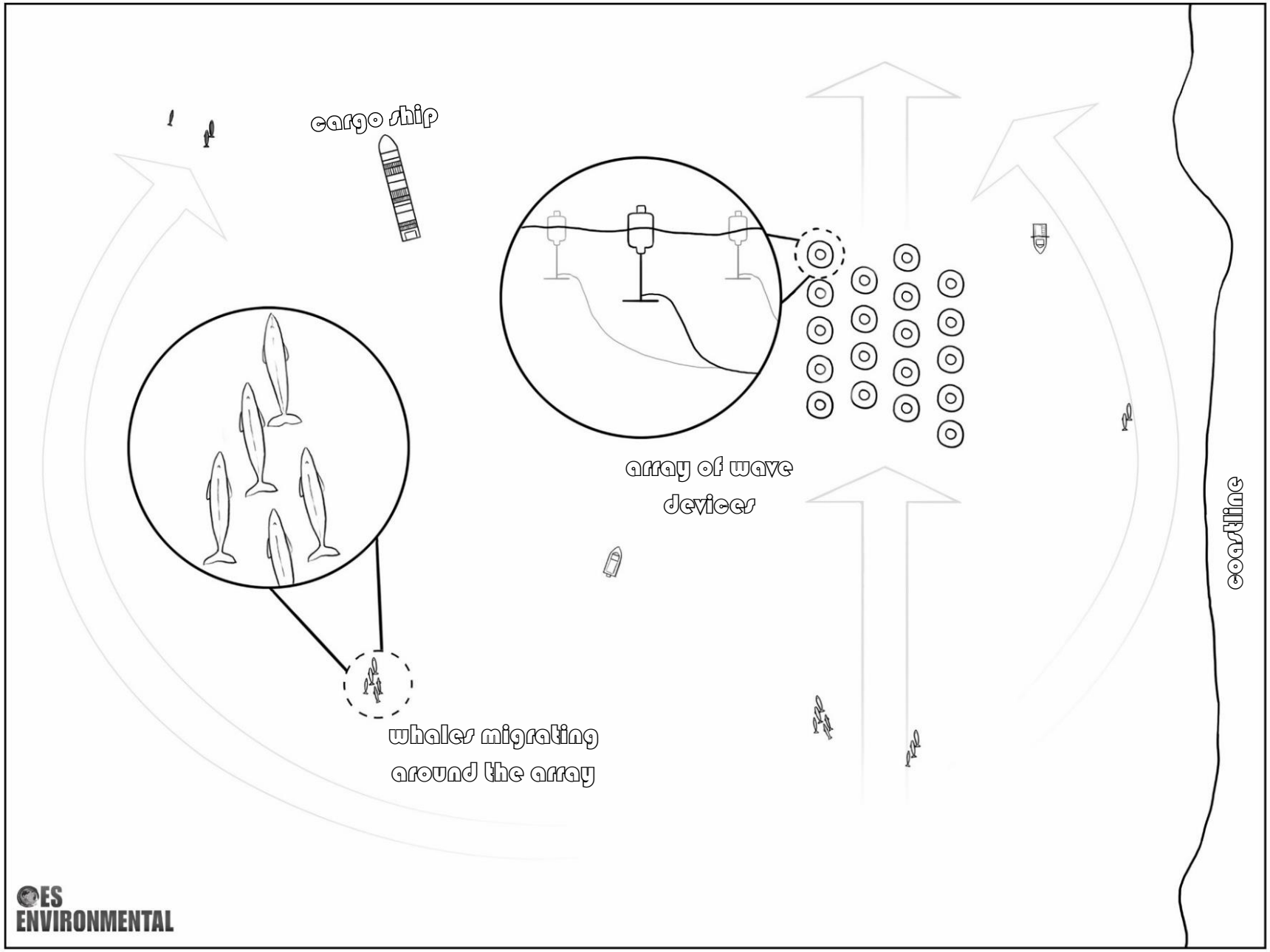
Encounters with Mooring Lines and Cables

Most marine renewable energy devices are attached to the seafloor with mooring lines and anchors to keep them in place. Devices can also be connected to each other with cables under the water. Whales and other large marine animals can encounter these lines or cables while swimming in the ocean. Although there is a chance that animals could become tangled in the lines, engineers have designed the cables to be tight so they will not create loop for animals to be caught in and are as safe as possible. Scientists have not seen any entanglement around marine renewable energy devices and do not expect animals to be harmed.



Displacement

When large numbers of marine renewable energy devices (or “arrays”) are placed in the ocean, they may cause animals such as large migratory fish or whales to avoid the area or be displaced from it. For example, whales may need to swim longer and farther to go around arrays of devices. There are currently no large arrays in the ocean, but scientists are already beginning to study this to understand the ways marine animals could be affected.



Social and Economic Effects

In addition to understanding how marine renewable energy devices interact with the environment, it is also important to understand how it may affect people and communities. Before a device is put in the water, researchers work to understand how new devices and projects could affect the people who live and work in the area. Planning a project carefully can help create new jobs and support the local community while protecting the ways people have already been using the area for work or for fun. And best of all – marine renewable energy helps to fight climate change by using renewable energy for electricity!