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How can marine mammals live with renewable energy?

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Sea mammals of all sizes are always a welcome sight for visitors to the UK coastline. But while they are abundant in British waters, especially in Scotland, they now face a new challenge: coexisting with offshore renewable energy.

Gordon Hastie is a Senior Research Fellow at the Sea Mammal Research Unit (SMRU) at the University of St Andrews. He and colleagues have been tracking sea mammals to discover how they might adapt to the presence of machinery that extracts power from the winds, the tides, and the waves.

But first, how do we know where these intriguing animals are? Hastie explains that he works mainly with two species: the harbour seal and the harbour porpoise. "With harbour seals, we capture them and superglue a small GPS tracker to their fur. It stays in place for up to ten months, and they lose it because they moult once a year. It records their movement, including diving, and sends the data to us via the mobile phone system when the seal is on land."

With harbour porpoises, however, it is much more difficult to attach a tracker. Instead, scientists often use arrays of hydrophones (underwater microphones) to listen for their characteristic clicking sounds. For this research, dozens of animals have been tracked around marine renewable developments.

Research by Hastie and colleagues has focused on tidal power systems, which gather energy from strong ocean currents. The focus is on Orkney, where this technology is now being installed on a commercial scale. He says, "Early studies of animal movements indicate that they may be able to avoid the tidal energy turbines when they are running. That is good, because it avoids the risk of a dangerous collision. But it could deter them from important feeding grounds."

Hastie explains that modern tidal turbines look "very like a wind turbine under the water." In a collision with a moving blade, a seal or porpoise risks severe injury. To find out how severe, he and his colleagues carried out an extraordinary experiment. "We mounted a simulated blade on a jet boat, which allowed us to collide with a seal carcass and see how the injury varied with speed, looking at both skeletal and soft-tissue damage." It turns out that if the velocity of the blade exceeds five metres per second, there is a risk of serious injury. Actual blade velocities tend to be about 12 metres a second. This finding has been fed into policy by the Scottish and Welsh governments and will inform environmental risk models for tidal turbine installations.

Noise nuisance

The technology of seal and porpoise tracking has also been applied to offshore wind farms, a more established and fast-growing source of offshore energy. Hastie notes, "Here the risk seems to be mainly in the construction phase, when they often use a large pneumatic hammer to drive foundations into the seabed." This creates the possibility of hearing damage, a potentially severe hazard for animals that rely heavily on sound in their daily lives. In addition, there is the risk of preventing them from accessing their typical foraging habitats. However, research carried out in The Wash (southeast England) shows that animals avoiding the loud noises often return within a few hours of the work being completed.

This is a striking example of how sea mammals seem capable of living alongside human technology. Another example was uncovered by Hastie's colleague, Debbie Russell, who found that some seals do not avoid human structures on the sea floor. Rather, they prefer to feed at the artificial reefs that are often hosted by these structures. Hastie points out, "The North Sea is one of the most industrialised in the world, and interactions between human activities and marine mammals are inevitable. However, the impact of such activities is multi-faceted and complex."

He adds that future technology, such as wave energy, may complicate matters further. Still, Hastie says, "We have not looked at this in detail because the industry is still in its infancy." It is hard to assess the effects of this industry until more wave machines are deployed at sea, as is now the case for wind and tidal devices. But there is certainly a potential risk if large pieces of equipment with moving parts are installed at the sea surface.

Although most of their work is with smaller animals, Hastie points out that marine energy can also create peril for larger sea mammals, including migrating whales. "Whales are increasingly affected by industrial activities. At the moment the industry has not reached a size where this is a factor. But there are proposals for big offshore wind farms off the East coast of the US, and these could affect the migration of the endangered right whale."

Hastie is clear that these hazards "are not likely to be a show-stopper" for offshore renewable energy. Instead, they point to recommendations that will improve planning and engineering practice. "Every offshore installation requires planning consent," he points out, and this consent comes with conditions. For example, it may be possible to limit how fast a turbine blade can spin under water. For Hastie, "That's the value of having biologists talking to engineers and developers." He adds, "This research also feeds broader policy decisions about how much offshore energy can be developed and where." So, it has a direct effect on Scotland's ambitions to become a world leader for low-carbon energy.

Hastie says that St Andrews is ideally placed to be a global focus for this activity. He points out that the SMRU is probably the biggest centre in the world for pure and applied work both in this area and in terms of sea mammal behaviour. SMRU marine renewables research is funded by the Department of Business, Energy and Industrial Strategy, Natural Environment Research Council, NatureScot and the Scottish Government.

And he is clear that results of this research must be viewed alongside the clear benefits that renewable energy brings: "Marine mammals have a huge amount to lose from climate change and global warming, and that is the context for all this activity."

Find out more

SMRU research website: www.smru.st-andrews.ac.uk/research-policy/human-impacts/

EcoSTAR project website: www.smru.st-andrews.ac.uk/ecostar/

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