Animal tracking deep underwater

November 27, 2025 | Bärbel Zierl
Topics: Biodiversity | Ecosystems

A new combination of data and statistical algorithms makes it possible for the first time to precisely track the movements of animals deep underwater. An initial study of flapper skate on the seabed around Scotland will help to develop targeted measures to conserve these Critically Endangered animals and designate suitable protected areas. The results have now been published in Science Advances.

Flapper skate (*Dipturus intermedius*), the world's largest skate species measuring over two metres in length, live hidden on the rugged seabed around Scotland. Their life in the darkness, deep underwater, makes it extremely difficult to find out more about their whereabouts and movements. However, there is considerable interest in these animals. As predatory fish at the top of the marine food web, they play a very important role in marine habitats and the balance of marine ecosystems.

However, due to overfishing, skates and their close relatives the sharks, are among the most endangered vertebrates on the planet. This makes it all the more important to conserve the remaining populations and support their recovery. To do this, it is essential to know where they live. However, the approaches currently used to track animal movements quickly reach their limits underwater.

Lighting up the darkness of the seabed

Now, an interdisciplinary team of researchers has succeeded in shedding further light on the lives of animals in the deep using a new combination of data and statistical methods. The results were recently published in Science Advances. In this study, the research team applied the methods to flapper skate in the Loch Sunart to the Sound of Jura Marine Protected Area on the west coast of Scotland. They were able to track the movements of these animals with unprecedented accuracy and map their locations over the seabed.

Überlandstrasse 133
CH-8600 Dübendorf
T +41 58 765 55 11
F +41 58 765 50 28
info@eawag.ch
www.eawag.ch
eawag aquatic research

The mapping shows that skate frequently inhabit the protected area and should benefit from the fishing restrictions in this region. The researchers were also able to locate other hotspots outside the protected area used by skate. Additional protective measures could be beneficial in these areas.

Important basis for the designation of marine protected areas

The lead author of the study, Edward Lavender, until recently a researcher at the Swiss Aquatic Research Institute Eawag and now a member of Edinburgh Napier University's Centre for Conservation and Restoration Science, says: "The refined maps we can provide with this approach are an important basis for nature conservation. They can inform the design of marine protected areas and conservation measures for skates and other animals in a targeted and data-driven manner." The researchers are currently working on further refining their approach to identify critical habitats such as egg nurseries.

Researchers at other institutions, including the European and Ocean Tracking Networks, have expressed great interest in the new approach, which has the potential to support work in animal tracking and marine conservation across the world.

How does the new approach work?

To study the life of animals underwater, including skates, animals can be equipped with acoustic and pressure sensors. The new approach now combines this data with the topography of the seabed and uses complex statistical methods such as Bayesian inference techniques to estimate animal locations. The approach treats the animals as "particles" that swim around and reproduce or dwindle. The distribution of the particles can provide astonishingly accurate maps of the animals' locations.

Cover picture: Flapper skate, a Critically Endangered species, roam the rugged seabed around Scotland. A new approach makes it possible to track their movements precisely and thus take targeted measures to protect them. (Photo: Simon Bradley)

Original publication

Lavender, E.; Scheidegger, A.; Albert, C.; Biber, S. W.; Brodersen, J.; Aleynik, D.; Cole, G.; Dodd, J.; Wright, P. J.; Illian, J.; James, M.; Smout, S.; Thorburn, J.; Moor, H. (2025) Animal tracking with particle algorithms informs protected area design, *Science Advances*, 11(48), eadx0255 (12 pp.), doi:10.1126/sciadv.adx0255, Institutional Repository

Collaborations

The paper was led and funded by the Eawag aquatic research institute based on data collected by the Movement Ecology of Flapper Skate project. It brought together a diverse team of researchers from the fields of biology, statistics, physics, mathematics and ocean modelling, as well as experts in nature conservation and policymakers from leading research institutes, nature conservation authorities and government:

Edinburgh Napier University University of St Andrews University of Glasgow Scottish

Association for Marine Science Royal Zoological Society of Scotland University of Surrey NatureScot Marine Directorate

The study is based on data from projects funded by:

Marine Directorate NatureScot Marine Alliance for Science and Technology for Scotland

Contact

Carlo Albert

Tel. +41 58 765 5244

carlo.albert@eawag.ch

Bärbel Zierl

Science editor

Tel. +41 58 765 6840

baerbel.zierl@eawag.ch

Contact external

Edward Lavender

Edinburgh Napier University, Centre for Conservation and Restoration Science (CCRS)

e.lavender@napier.ac.uk

https://www.eawag.ch/en/info/portal/news/news-detail/animal-tracking-deep-underwater