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TRILOBITES

# *Glass Eels: See-Through, Slippery and Guided by Magnetism and Tides*

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European eels are born and die in the North Atlantic Ocean, but spend most of their lives in rivers or estuaries across Europe and North Africa.

In between, they traverse thousands of miles of ocean, where it's often unclear which way is up or down. Scientists have therefore long suspected that these critically endangered fish use magnetism to help guide them.

A study published Friday in Science Advances shows, for the first time, that European eels might link magnetic cues with the tides to navigate. Studying juveniles during the crucial stage when they move toward land from open ocean, the authors found that eels faced different directions based on whether the tide was flowing in (flood tide) or out (ebb tide).

Changing orientation might help eels take advantage of tides to travel from the ocean to the coast, and into fresh water, more efficiently, said Alessandro Cresci, a graduate student at the University of Miami and lead author of the study.

Previous studies have shown that eels can detect magnetic fields, but how they use this sixth sense "has remained a matter of speculation" until now, said Michael J. Miller, an eel biologist at Nihon University in Japan who was not involved in the study.

When transitioning from sea to coast, European eels are in a stage of their lives where they are about the size of a finger and transparent along their bodies, thus the name "glass eels."



Mr. Cresci's group studied glass eels from the coast of Norway, observing the animals in the field by putting 54 slippery, see-through eels, one by one, in a drifting chamber equipped with cameras and compasses. When the tide ebbed, these animals generally faced south, but when it flowed in, they showed no consistent orientation.

The researchers then studied 49 of the same eels in laboratory tanks. They subjected some of the eels to reoriented magnetic fields, rotating magnetic north to the east, south or west.

During the time of day corresponding to ebb tide, eels still tended to face whichever direction meant south to them under their assigned magnetic field, even though there was no change in the water around them — suggesting they paired a biological compass with an internal tide clock to maintain a consistent behavior. During flood tide, they tended to face magnetic north.

Changing direction between tides fits with a strategy commonly observed in marine animals: Many try to catch free rides upstream as the tide flows in, but then dart down to the sea bottom so as not to get swept back to sea as the tide ebbs.

It's unknown whether facing south during ebb tide is a universal behavior, or whether glass eels in different regions orient differently, said Caroline Durif, a senior researcher at the Institute of Marine Research in Norway and an author of the study.

If the latter is the case, she added, that might have implications for restoration programs that relocate glass eels from heavily to sparsely populated areas. It's possible relocating them could "disturb their orientation system," Dr. Durif said.

This study deepens scientific understanding of glass eels, an important and historically overfished life stage, said David Righton, an eel expert at the Center for Environment, Fisheries and Aquaculture Science in Britain who was not involved in the study.

It remains unclear, however, how eels use magnetism in other life stages. They behave almost like several different species in their lifetime, Dr. Righton said. "The mystery of eel migration is not going to be solved with one study."