

INSIDE JEB

Sun guides Atlantic herring youngsters on maiden voyage



Juvenile herring in holding tank. Photo credit: Malien Laurien.

During summer in the northern hemisphere, human hordes journey on vacation, heading to destinations anew to explore and relax. However, when Atlantic herring (*Clupea harengus*) fry living in the western Baltic sea depart on their maiden voyages, many initially head southeast from their spawning grounds (off the coast of northern Germany and Denmark), travelling along the German coast before eventually heading north to their feeding and overwintering grounds. But no one knew how the young fish find their bearings. Might the tiny voyagers keep track of the sun's location through the day for guidance? Lisa Spiecker, Malien Laurien and Gabriele Gerlach from Carl von Ossietzky University Oldenburg, Germany, and colleagues decided to tinker with the young herring's body clock to find out whether they follow the sun's course, adjusting their position relative to the sun as it sweeps across the sky throughout the day, to find their way north to the Swedish coast where they overwinter.

After net dipping for herring youngsters in the Kiel Fjord, Germany, during the young fish's migration season, Catriona Clemmesen (GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany) and Andrea Franke (Helmholtz Institute for Functional Marine Biodiversity, Germany) despatched the juvenile fish to Oldenburg. There, Spiecker, Laurien and Wiebke Dammann (Carl von Ossietzky University Oldenburg) reset the body clocks of 41 fish, as if they were in the same time zone as the Philippines, by switching the lights on at midnight and off again at 2 pm for 7 days. Once the fish had adjusted to their alternative sunrise schedule, the team then placed individual fish in small tanks and transported them outside in the morning – although the fish thought it was afternoon, thanks to their jetlag – to track in which direction they chose to swim over a 20 min period. In addition, the team kept an eye on the cloud cover to find out whether the fish need to see the sun,

or simply a view of the sky, to get a sense of direction.

The researchers discovered that the time-shifted fish misinterpreted the position of the sun, swimming as if it was located in a position that it should occupy 6 h later, orienting in a north-north-easterly direction; unlike real-time fish, which swam in a more south-easterly direction. The young herring were definitely taking their bearings from the sun, knowing where it should be over the course of the day and orienting accordingly. In addition, the fish's accuracy as they selected a direction declined as the cloud cover increased, suggesting that they depend heavily on the position of the sun when selecting the direction in which to migrate.

However, the fish still managed to strike out in roughly the right direction, even when the sun was covered on completely overcast days. 'This could indicate that herring might have further orientation capabilities, such as magnetic orientation or perhaps the use of the skylight polarization pattern', say Spiecker and Laurien, who are keen to discover which other mechanisms herring youngsters depend on when setting their bearings and embarking for pastures new.

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Spiecker, L., Laurien, M., Dammann, W., Franke, A., Clemmesen, C. and Gerlach, G. (2022). Juvenile Atlantic herring (*Clupea harengus*) use a time-compensated sun compass for orientation. *J. Exp. Biol.* **225**, jeb244607. doi:10.1242/jeb.244607.

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