Evolution on the fast lane—One flounder species became two

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Flounders with different spawning behaviors are two species with distinct evolutionary histories. Credit: left: Mats Westerbom. right: Alf Norkko.

A research group at the University of Helsinki discovered the fastest event of speciation in any marine vertebrate when studying flounders in an international research collaboration project. This finding has an important implication on how we understand evolution in the sea.

The researchers found out the pace at which two groups of flounders in the Baltic Sea became distinct species had been extraordinarily fast, approximately 2400 generations. This is by far the fastest event of speciation in any marine vertebrate to date.

"This is possibly one of the best examples of ecological speciation, that is the process by which selection generates new species, in the marine environment because the species evolved by adapting to different ecological niches, rather than by being separated by geographic barriers for a very long time," says Paolo Momigliano, post-doctoral researcher from the Ecological Genetics Research Unit.

What makes this finding important is that in the marine environment barriers to dispersal are rarely absolute, in other words currents can move larvae around and adult fish swim around. Hence, models of speciation which can act in the absence of complete geographical isolation, such as ecological speciation, have likely played an important role in the evolution of marine biodiversity. Yet, to date, evidence of ecological speciation in the sea is scarce.

"Our study has important implications on how we understand evolution in the sea," confirms Momigliano.

There are new interesting questions for the researchers to solve, such as how are species arising, in some cases at a speed that once would have been thought to be unimaginably fast.

"The answer may lay in so called magic traits, meaning traits that are under selection which at the same time cause reproductive isolation as a byproduct. In theory, selection on such traits could play a central role in rapid speciation events. The mating strategies and reproductive traits of the two flounder species could act as magic traits," clarifies Momigliano.

As the study confirms that there are two species of flounders instead of one, how can you distinguish them from each other?

"They are morphologically nearly indistinguishable but have different spawning behaviors and adaptations. Both species winter in deeper

waters and feed in shallow coastal waters in the summer. In spring, however, one species spawns pelagic eggs in deep water basins, where salinity is high enough and eggs can become neutrally buoyant. The second species spawns smaller, but tougher, eggs in shallow coastal waters. These differences have been known for some time, but only now we realize that flounders with different spawning behaviors are two species with distinct evolutionary histories," describes Momigliano.

The flounders are economically important for fishing and their numbers have declined markedly on the Finnish coast. Today, the percentage of pelagic flounders is very small on the Finnish coast, but an ongoing research suggests that in the 1970s and 1980s they made up the majority of the population. The pelagic flounders could not have spawned successfully on the Finnish coast because they require higher salinity. They were probably spawned in the south when conditions were more suitable, and transported to the Finnish coast by the currents. I.e. the Finnish coast was a sink population for the southern type of flounders, much as was the case for cods during the same period. Today we almost exclusively get the demersal species.

More information: Paolo Momigliano et al, Extraordinarily rapid speciation in a marine fish, *Proceedings of the National Academy of Sciences* (2017). DOI: 10.1073/pnas.1615109114

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