Fast Fish, Slow Fish, Little Fish, Big Fish

Sarah Schembri

SEAGRASS MEADOWS support a diverse range of organisms. When this habitat is fragmented all species suffer. Fish that previously had large stretches of seagrass meadows to forage in would have to face the prospect of swimming to a different patch more often and this exposes them to predators. One of these species is that fish and chips staple, the cod (*Gadus spp.*), which as a juvenile uses eelgrass (*Zostera marina*) meadows as nursery areas in the North West Atlantic. A series of experiments were performed in 2009 at the Memorial University of Newfoundland, Canada in a tank with two fake grass patches. Researchers observed the gap crossing behaviour of juvenile cod when alone and in the presence of other cod. Then the data was analysed by Sarah Schembri (supervised by Dr Shaun Killen and

A Greener Chemical Pot

John Gabarretta

CHEMISTRY seems to inspire awe, scepticism, and mild disgust, followed by the utterance of something along the lines of 'that must be complicated'. Conversely, chemistry is an elegant science. One of the most elegant chemical reactions is the one-pot synthesis or multi-component reactions (MCRs).

MCRs are chemical reactions which make use of three or more molecules within the same 'pot' to create a more complex structure. At face value, this might sound unimpressive, but traditional chemistry takes much longer to carry out; one-pot synthesis is much simpler. Their 'simplicity' makes them much 'greener'. They save time and effort while providing very high yielding results with minor by-products. With a little thought and planning it is very easy to produce complex and functional molecules with much less effort than traditional methods, all in one pot.

John Gabarretta (supervised by Prof. Giovanna Bosica) sought to highlight the versatility and efficiency of the one-pot synthesis. His work focused on a reaction termed A^3-Coupling, standing for amines, aldehydes, and alkynes—the three basic starting ingredients—which produces structures called propargylamines: highly useful precursors to pharmaceutical compounds. Their structural backbone exists within a number of bioactive substances such as Rasagiline (used to treat Parkinson's Disease) and Dynemicin A (an antibiotic).

Green Chemistry is a more sustainable approach to industrial reactions.

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Prof. Jason Matthiopoulos) using statistical models and turned into a computer simulation for fish movement in the tank.

Repeated simulations showed that fish grow bolder in crossing from one grass patch to another both when there are more fish present in the tank as well as when they are larger in size. However, the simulations allowed the researchers to distinguish a difference in this response; larger fish tend to be bolder and less decisive, they are quicker to leave the release patch but slower to enter the destination patch, while groups of fish tend to leave a release patch and swim quickly to the destination patch as a group. There was another difference. The total number of fish in the tank had an impact on gap crossing behaviour but not on the number of fish in the immediate vicinity. Juvenile cod communicate to coordinate their movement even at distances that seem relatively large compared to their size.

The conclusions drawn in this study could form the basis of hypothesis for larger studies, such as those to determine marine habitats that qualify for Marine Protected Area status. ●

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Gabarretta's work managed to make the A^3-Coupling reaction 'greener' in three ways. Firstly, the only by-product of the reaction is water, with all the other starting materials being incorporated in the final products. Secondly, with the help of a copper-based catalyst over 90% of the starting materials were turned into the final products in many cases. Finally, the reaction did not require any harmful solvents and the catalyst could easily be recovered and reused several times. A small library of nearly 20 compounds was amassed by varying the different starting materials with the synthesised examples being just a small fraction of the compounds possible through the reaction.

Overall the A^3-Coupling reaction in this study shows the flexibility of MCRs and their utility in ensuring efficient yet environmentally-friendly chemical processes ranging from food production to pharmaceutical products. ●

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