# The Kindergarten Diaries

Stephen Simpson lifts the lid on the growing pains of coral reef fishes in their first few weeks of life.

Imagine if your entire destiny rested on the first month of your existence. Imagine if, in that first month alone, you had to decide where to spend the rest of your life, what community to live in, and whether to live near to your family or never see them again. Oh, and you also have to focus on staying alive.

That is the tumultuous world facing coral reef fishes when they hatch from their eggs. We are only now starting to discover the behaviour of these amazing larvae, and understanding how they make crucial decisions, including choosing which reef they would like to call home.

While plants have evolved all sorts of cunning and bizarre mechanisms to help their seeds disperse and colonise new habitats, ocean currents should mean that dispersing is not such a challenge for the larvae of reef fishes. Until recently we thought that dispersal was inevitable and led to much genetic mixing, reducing the number of genetically distinct sub-populations on coral reefs. It was unthinkable that these tiny plankton-eating fry, whose parents deliberately send them out to sea away from the predators on the reefs, could do more than drift around on ocean currents, hoping to be washed onto some welcoming reef.

Over the past 20 years, scientists have learned some important lessons about making simplifying assumptions when it comes to behaviour. (Nothing is ever simple!) Nowadays, larval fish researchers around the world continue to notch up the latest 'world record' for burst swimming (sprinting) and cruising (long distance) speeds, and document amazing feats of endurance for our little fishy friends. With these surprising talents, we have now started to study whether they might also have some idea where in the oceans they actually want to go.

For the past few years, I have worked at Lizard Island on the Australian Great Barrier Reef trying to understand how the behaviour of larvae plays a part in dispersal. We focus our efforts on the nights of the new moon periods of the Austral summer because reef fish spawn in the warmer waters during the summer months. Their larvae tend to arrive on reefs weeks later, in the five days centred around new moons – presumably because it is dark enough to stand some chance against the predators waiting to gobble them up.

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It occurred to our team that noises from the reef could attract fish larvae. Working with collaborators from the Australian Institute of Marine Science and the University of Auckland, we studied the influence of reef noise on larvae as they settle into the reef habitat.

Reefs, like any crowded city, are hugely noisy places compared to the tranquillity of the open ocean. Fish make popping, whooping and banging noises and on top of that you've got snapping shrimps and grazing urchins. We set up pairs of traps to compare catches of larvae: one was silent, the other had a speaker suspended above it playing a recording of reef noises. We found that the noisy traps attracted twice as many reef fish from several different families, suggesting a general attraction to reef noise.

Buoyed by our results, we then asked the same question in a more natural setting. We laid 24 artificial reefs made from dead coral rubble on sand flats in front of the research station. Armed with speakers normally used by synchronised swimming teams we played reef noise around some of the reefs, and studied the recruitment of fish. The results showed that noise alone was enough to convince larvae from some of the most common families to set up home on our reefs.*

In our Australian reef study, we went on to split the sound spectrum in two: low frequency – the pops and bangs from fish – and high frequency – clicking invertebrates. The results suggested that high-pitched clicking of invertebrates had a greater affect on the behaviour of damselfish larvae than fish noise. Our noisy reefs also attracted both adult and juvenile fish, suggesting that reef noise may be an important cue in later life as well as at the larval stage. To confirm these findings we returned to the light traps and this time fished them in trios: high frequency noises, low frequency noises or silence. This time six families showed a preference for the high frequency noises compared with one which actively avoided it.

> “Fish make popping, whooping and banging noises.

So what is it about reef noise that drives preferences and orientation of reef fish larvae? Well, the inhabitants produce the noise, so we are now starting to look at how noise varies in time and space. Our hypothesis is that reefs may sound different and that these differences may indicate specific habitats or communities, which would allow settling fish to pick a neighbourhood before ever having to encounter its predators. To test this, I have sent hydrophones to the Caribbean, the Indian and the Pacific oceans. We are combining recordings with habitat and fish surveys to look for general patterns, which if emergent would greatly benefit fisheries managers and surveyors.

If fish do show preferences, the question over evolutionary timescales is (as always) so what? We have adopted a new approach to understand the outcomes of this selective behaviour. Studies of fish populations over the past ten years have identified a surprising amount of structuring of populations into sub-populations which we can tell apart by their genetics. In addition, we have evidence of self-recruitment – fish returning to their natal reef in order to settle. So for some fish, despite spending weeks at sea, amazingly their overall displacement is zero.

To study how behaviour drives the dynamics of populations, we have looked at the charismatic and endemic Omani clownfish. Last Christmas, I led a team from the University of Edinburgh to Oman for a four-week expedition where 24 undergraduates, postgraduates and a few specialists travelled in convoys of 4x4s from the Yemen border to Masirah Island off the coast of Oman, sleeping on beaches and diving each day. We caught over 350 clownfish and (harmlessly) took tiny tissue samples from each specimen at sites along the entire species range. We are just beginning to analyse these samples. The results will provide an insight into how oceanography, behaviour, habitat availability and community composition affect the genetic structure of the populations that make up a whole species.

We are still some way from fully understanding the importance of larval behaviour during dispersal, and the consequence for genetic structure, but we are now beginning to see these processes from the fishes' perspective. By incorporating the behaviour of larvae into dispersal models we will soon develop far more effective strategies for fisheries and conservation management. ❖

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*Adel Heenan's NERC-funded PhD at the University of Edinburgh is looking at how we can use these kind of cues to manipulate behaviour.*