Disentangling the effects of group size on the speed and accuracy of decisions by fish shoals
Lily Carlisle

Living in groups is widespread among a range of taxa, and larger groups are often faster and more accurate when making key decisions. There are multiple documented effects to explain this, notably swarm intelligence, ‘pool-of-competence’, and lower predator vigilance providing more cognitive ‘space’ for decision making. The aim of this project was to test the hypothesis that improved performance (decision making accuracy and speed) in larger groups is primarily due to swarm intelligence, rather than other effects of group size on individual performance. Three-spined sticklebacks (Gasterosteus aculeatus) were tested in shoals of 2 to 12 in a T-maze choice arena, where one arm contained a plant refuge and the other did not. This T-maze design made it possible to determine which group members were informed (i.e. could see the choices) and which were uninformed, and thus analyse speed and accuracy for the total group sizes and informed subgroup sizes separately. It was found that the informed subgroup size was the best predictor for decision accuracy, but there was no notable effect of either group size on decision making speed. However, the smaller subgroups were in fact the most accurate, which is inconsistent with a swarm intelligence effect which would predict larger informed subgroups would be the most accurate. Instead, accurate decisions may be made by a particularly bold subset of individuals, and most effectively when there is less interference from other trailing individuals. This result implicates the potential power of small informed decision-making subgroups in group living taxa.
Does it matter where you develop? The effect of location within an egg mass on predator avoidance in *Lymnaea stagnalis*

Ashleigh Fair

This research investigated how embryo location within an egg mass may alter its subsequent anti-predator behaviour. Predator avoidance behaviour was analysed in juvenile *Lymnaea stagnalis* that had hatched from three locations within an egg mass. Half of the egg masses were exposed to a combination of predator/crushed conspecific cue and half were not, in a paired design where two egg masses were collected from twelve different snails. At day 21 after laying, four hatchlings from the front, middle and rear of each egg mass were selected for behavioural testing. For this, half of the hatchlings were exposed to cue water and half to clean water individually in a cell well plate. Crawl-out behaviour was recorded of each hatchling every 5 min for 1 h. In total there were four treatments (1) hatchlings exposed to cue during development and during the behavioural trial, (2) hatchlings exposed only during development, (3) hatchlings exposed only during the behavioural trial, (4) hatchlings not exposed to cue. Embryonic exposure to the cue reduced hatching time, and developmental location within the egg mass and cue exposure affected shell morphology. Individuals from the front of control masses were larger than individuals from the middle of masses and in exposed masses, hatchlings from the front were smaller than those in the middle. Hatchlings exposed only during the behavioural trial from the middle of egg masses, spent significantly more time above the waterline than those from the front of the same egg masses. Statistical analysis is ongoing for these data to further understand how location affected predator avoidance behaviour. However, it is clear that developmental location does have a significant impact on an individual which can alter its subsequent behaviour.
Do xanthine alkaloids affect learning and memory in honey bees?

Joseph Leonard Gillson

Previous research has shown that caffeine found in floral nectar improves the memory of forager honeybees. I tested whether theophylline, a purine xanthine found in the nectar of some plant species, had an influence on the learning and memory of bees. I found that theophylline enhanced learning slightly, but did not affect memory formation. I also tested whether a mixture of caffeine and theophylline affected learning and memory. I found that caffeine slowed down the rate of memory extinction, theophylline and the mixture of caffeine and theophylline did not have a significant effect. I also had the opportunity to learn a completely different technique to the ones I originally proposed to test if nicotine affected learning and memory in bumblebees. In this experiment, I trained foraging worker bumblebees to associate a coloured artificial flower with a food reward. We tested whether bees were more likely to learn to prefer flowers with nicotine laced nectar over other sugar-rewarding flowers. In these experiments, nicotine did not produce a learned preference nor did it alter the rate of reversal learning.