ABSTRACT

Predator recognition and anti-predator responses have been found to vary in populations of the same species from different geographical locations. To date this variation has been explained only in terms of differences in predation regimes experienced at each locality. The present study set out to explore sources of variation in recognition and responses in Australian rainbowfish (*Melanotaenia spp.*) by examining a number of environmental, phylogenetic and demographic variables. Chapter 2 of this thesis considers population variation in timidity and escape responses. Predator-sympatric rainbowfish responded to an active predator by maintaining a large distance between themselves and the potential threat. By contrast, predator-naïve rainbowfish were attracted to the moving predator, probably due to general curiosity. Fish from both populations ignored the less threatening inactive predator, indicating that predator movement is a cue upon which rainbowfish rely heavily to establish the level of threat a predator represents. In a further experiment (Chapter 2) rainbowfish were required to escape from a novel trawl apparatus. Predator-experienced fish initially escaped more quickly than their naïve counterparts. The naïve fish rapidly learnt how to escape but never quite reached the same level of competence. It was determined that the anti-predator response employed by rainbowfish is innate, but it may also be influenced slightly by varying the environment in which the young are raised (Chapter 3). Chapter 4 considers the possibility that fish could learn to avoid locations or microhabitats in which they had last observed a predator. Three species and nine populations were tested. Fish from all but one population were capable of recalling either the location or the microhabitat that the predator had been encountered in. Fish from the various populations appeared to rely on slightly different cues to remember where the predator was, but, this variation in cue use could not be related to any environmental variables at the collection sites. The level of predator pressure experienced in the wild, however, was strongly related to habitat choice. Chapter 4 highlights just one benefit of being familiar with the environment in which the animals live (i.e. being able to avoid dangerous areas). In Chapter 5, I consider whether environmental familiarity enhances escape responses. It was found that rainbowfish that were familiar with the test environment escaped from a novel trawl significantly faster than those that were unfamiliar with the test tank. In most of these experiments only females were used in order to remove the confounding effect of aggressive interactions caused by males. In the next chapter I considered the problem solving skills of males and females. Male rainbowfish consistently escaped from a trawl faster than females. It seems likely that females are more proactive in avoiding predators whereas males are risk takers and, being more prone to attack from predators, appear to rely on last minute escape maneuvers. It was hypothesised that these differences come from the varying life history strategies employed by males and females (Chapter 6). In Chapter 7, I report my attempts to observe predator inspection behaviour and avoidance in the wild. While observation of avoidance responses *in situ* is intrinsically difficult, several interesting observations were made through careful analysis of video footage. The most striking differences between the populations observed concerned the level of curiosity displayed towards the predator model. Much of this variation could not be explained by any environmental variable. However, predator presence and the relative size of the rainbowfish did appear to affect the results. Furthermore, the majority of fish in the wild were singletons, and shoals larger than 5 individuals were relatively rare. This provided compelling support for the use of small shoals in laboratory experiments. In Chapters 8, 9 and 10, I consider some of the advantages of social living. Chapter 8 reveals that rainbowfish, like many other small fish, prefer to shoal with familiar individuals rather than strangers. It has been found in previous studies that shoals of familiar fish show more effective anti-predator responses. However, in this instance, rainbowfish did not significantly alter their preference for familiar individuals in the face of predation threat. Chapter 9 reveals that simply

being part of a social group enhances escape responses probably through the sharing of information amongst group members. In Chapter 10, I consider the possibility that naïve rainbowfish can learn to avoid predators by interacting with predator-wary fish. The results indicated that rainbowfish were capable of learning from their more experienced counterparts, and retained their newly acquired responses when tested alone. However more work is required in this field.

The cognitive abilities of rainbowfish are apparently well developed and highly adapted to local ecological conditions. Variations in behaviour across different geographical areas appear to be fundamentally inherent, but learning provides a degree of flexibility allowing responses to be fine-tuned to suit the prevailing environmental pressures.

Back to Thesis front page