SYNOPSIS

A focus in evolutionary biology is to understand the drivers of diversity in animal behavioural traits in the living world. Animals facing similar problems in the environment, such as the problem of how much to invest in parental care, can have very different solutions to the same problem. This large diversity in traits can be explained by a reasonable proposition that this diversity is of adaptive value and is a result of selection pressures acting in a given environment. In wild populations, multiple selection pressures are likely to shape trait evolution. While these multiple selection pressures can manifest through different ecological or demographic conditions, these conditions themselves could vary predictably over space or time, or in an unpredictable manner, a relatively less studied form of environmental variability. While predictable variation in the environment could shape traits through adaptive phenotypic plasticity, traits could also be shaped by unpredictable variation in environment. Unpredictable variation in environments could lead to the evolution of strategies, such as evolutionary bet-hedging or spreading the risk. In my thesis, I attempt to understand how oviposition site selection, a behaviour where multiple selection pressure regimes are rarely considered, is shaped by multiple selective factors in a variable environment.

Oviposition site selection is a form of habitat selection where a female chooses a site for laying eggs. This decision can have important fitness consequences for the female because the quality of the site selected can influence the quality (e.g., survival, growth, size at maturation) of her offspring, and thereby their reproductive value (the number of offspring that they are capable of producing). In my thesis, I test how oviposition site selection decisions in the mosquito *Aedes aegypti* are influenced by variation in three important ecological factors, namely risk of larval predation, risk of competition, and risk of pool desiccation. To investigate the factors influencing evolution of oviposition site selection decisions, I first measured fitness trade-offs associated with larval predation risk and conspecific competition risk at potential oviposition sites through experimental manipulation in the laboratory. I found that larval performance reduced substantially under predation, as predicted. I also found surprisingly strong negative effects of competition, and most importantly, an interaction between predation and competition effects such that under high larval densities, predators may have a positive

effect by providing a release from intense effects of competition.

In the next chapter, I investigate female oviposition behaviour in the light of these tradeoffs in an artificial pool experiment conducted in field conditions. My findings indicate that females showed a complex oviposition response towards the risk of predation, displaying attraction towards pools with low predator densities and aversion towards pools with high predator density. I explain this complex oviposition behaviour using my findings concerning a predation competition trade-off. I propose that larval predators can provide positive fitness benefits when coupled with other risks, in this case, conspecific density effects.

I next focussed on spatial and temporal patterns under natural conditions in two risk factors, namely, pool desiccation risk and larval predation risk. I quantified variation in these risk factors across multiple natural breeding sites (rock pools) over the breeding season of *Aedes vexans*, the dominant rock pool breeding species at the field site. I report predictable variation in both risk factors and unpredictable patterns of variability in larval predation risk. I used these patterns of variability in risk factors to predict and test female oviposition site selection response to these varying multiple risk factors through manipulative experiments using natural breeding sites (rock pools) in the field. I found signals of complex oviposition site selection response towards multiple risk factors: larval predation risk and pool desiccation risk. I found that females avoided large pools that permanently harbour predators in natural settings. Females did not show a strong preference for small pools that naturally do not harbour predators, indicating that multiple factors – desiccation risk and larval predation risk - could interact to influence female decision making.

Overall, my findings indicate that oviposition site selection responses are complex, sensitive to interactions between multiple selective factors, and influenced by patterns in variability in some of these factors.