In recent years, the field of 'eco-evolutionary dynamics' has emerged with the recognition that ecological processes, such as competition and predation, that have long been recognised to drive evolutionary changes can themselves result in feedback that underpins further ecological change. These 'eco-evolutionary feedbacks' have important implications for the resilience of populations and communities to environmental change. As a result, the field of eco-evolutionary dynamics has attracted considerable attention and is proving important in ecology and evolution.

We propose to use an eco-evolutionary approach to understand the evolution of a small fish, the three-spined stickleback. This species is widespread in temperate regions of the northern hemisphere and is a widely used model in research on behaviour, ecology, evolution and genetics. Over most of its range, the three-spined stickleback shows predictable variation in its morphology, with seawater and freshwater forms distinctly different. However, in a small number of locations, they show greater diversity; one location is the island of North Uist in the Scottish Hebrides. This small island, with its over one hundred small lakes ('lochs') and highly variable populations of sticklebacks, offers a unique and intriguing opportunity for our research. These populations have all evolved rapidly from a seawater ancestor since the end of the last ice age, 15,000 years ago (Figure 1).

Figure 1 *Examples of different three-spined stickleback 'ecotypes' from North Uist showing morphological variation in bony armour plates along the body, as well as protective spines and pelvic girdle (stained red). The central fish is the seawater ancestor of the surrounding freshwater ecotypes.*

We have been studying this remarkable diversification of sticklebacks over the past 15 years, which offers a unique opportunity to understand eco-evolutionary dynamics in a natural setting. To date, most research on eco-evolutionary dynamics has been conducted in large-scale 'mesocosms', rather than in natural settings. However, the conclusions that can be drawn from mesocosm studies are limited since it is unrealistic to expect to discover relevant ecological outcomes when responses are measured in artificial settings.

To understand the reasons for this unusual diversification of three-spined sticklebacks on North Uist, we will use an eco-evolutionary framework to investigate a sample of 40 lochs that represent the full range of environmental conditions on North Uist. With methods we have used previously, we will collect data on water chemistry, stickleback diet, morphology, size, reproduction, and abundance. We will also measure the abundance of their prey, competitors and predators, and conduct experiments on swimming ability.

Together, these data will enable us to address key predictions on how loch water chemistry affects loch productivity and, thereby, food availability, how food availability influences body size and armour evolution, and how the eco-evolutionary feedbacks of these adaptations affect stickleback populations, including their risk of extinction, and the composition of loch communities.

Understanding eco-evolutionary dynamics is not just about sticklebacks, and this research has broader implications for how we understand biodiversity in changing environments. By recognising eco-evolutionary feedbacks, we can better predict how ecosystems might respond to environmental change and how resilient they are to that change. This research will shed light on eco-evolutionary dynamics in a natural setting, offering insights for both science and conservation.