The incredible residents of Holy Loch Nature Reserve

In 2022, I began my Holy Loch Food Web Project to discover the many species that inhabit Holy Loch Nature Reserve, the council roads yard within it, the Loch itself, and adjacent sheep fields. Although I had studied ecology alongside Chris Packham at Southampton in the early 1980s, I went on to a research career in plant breeding and genetics, followed by a spell in the garden centre industry reviving failing businesses. But my love of the intricate interconnections of living things and their physical environment never left me. The young lecturers at Southampton were truly inspirational. One fellow student is now promoting regenerative farming in Argyll, one is a leading wildlife TV presenter and campaigner, and one of our lecturers, while now a crofter, remains an international expert on deer.

The birds we know, and worry about, all depend on healthy ecosystems to sustain them. The value of supplementary bird feeding has dubious benefits to a limited number of species. Of the 138 bird species of bird now listed for the Holy Loch on Ebird, only around a dozen visit seed feeders. The other 125 rely on its ecosystem to survive. Understanding the community of species that supply birds with food is therefore critical to their long-term survival in the face of climate change. In the last two winters, for the first time, some trees at Holy Loch Nature Reserve blew over. During torrential rain in October 2023, caravans in a local park were torn apart by terrifying floods that then deposited their constituent parts along the Eachaig river and around the Holy Loch. Climate change is showing itself around the loch as more energetic weather events. This is not going to improve in any of our lifetimes. And the birds and ecosystem on which they depend, will need to adapt to survive, as will our conservation strategy.

So, as warden of the nature reserve, in 2022, I set out to understand this ecosystem starting by defining its biodiversity. The purest form of measuring this is as species richness, which is simply the inventory of every species living in it. That sounds simple but it is everything but. By the end of that year, I had recorded most of the plants, vertebrates and insects that are easier to identify, such as butterflies, damselflies, dragonflies, hoverflies and bees. That amounted to 850 species which is a pretty decent total I thought at the time. But my understanding of what I was undertaking began to dawn on me when in February I predicted 85 species of flowering plant, only to then discover 245 by November!

In 2023, I moved into new areas. Without studying insects, I was never going to define the entirety of this community of organisms. But a grant from Naturescot funded a library of guide books, microscopes and other equipment that allowed me to take the reserve total to 1400.

In early 2023, quite by accident, I met an ecologist who asked me about my use (or non-use) of eDNA. A simple Web search highlighted Bioscan, a project funded by the Wellcome Foundation at the world-leading Sanger Institute near Cambridge. I thought about it, and in September, signed us up to an incredible project to identify insect species based on their DNA rather than how they look. This was to prove transformational for my developing project.

2024 started with me adding around 300 species to the list from studies of the reserve's aquatic habitats. At the same time, I started to sample insects trapped on the reserve every month for Bioscan. In early July, I sent the first 5000 insects to Sanger for DNA barcoding, and in November, the first barcodes appeared on the Bioscan Report card website. By the end of January 2025, these had been compared with reference barcodes held in the Barcode of Life Database (BOLD) in Guelph, Canada, part of the global Darwin Tree of Life initiative. By the end of 2024, my total number of species by non-DNA methods had nudged 2000. But as the first Bioscan results from the BOLD ID engine appeared online my total jumped to 2400 overnight!

BOLD holds millions of barcodes from all over the planet, and the first step in recognising them is to use complex algorithms to cluster similar barcodes together. It then compares these clusters to the reference library. But many clusters cannot be named because they represent new species to science yet to be addressed by human minds.

My 2400 includes whole families of flies and wasps which have few, if any, resources for identification of named species, let alone new ones. Prior to DNA barcoding, I had managed to identify one species of the reserve's Scuttle Flies (Family: Phoridae) using a guide book published in 1980. Bioscan took that number to 25!

One of our commonest insects is a non-biting midge, Limnophyes ES3. This species is awaiting formal naming and description. And so it is definitely not in the guide book! Only about 60% of all barcodes had a reference match. It's mind blowing to wonder how many species new to science are hidden among the 40% of unidentified data.

DNA barcoding has revealed, for the first time, species of midge that are all-female. In the past, most identifications were based on the unique structure of male genitalia. So, females and, therefore, unknown, all-female species were simply thrown in the bin.

As a result of all of this, I am now bolder in my predictions about species at Holy Loch Nature Reserve. I am almost certain that we conserve species, from many families, that are new to science.

2025 dawned with new agreements with Sanger for niche investigations. A further grant from the William Grant Foundation and Flora and Fauna International has purchased equipment to study life in the loch. I have now started to send marine species to Sanger alongside the usual monthly catch. A batch of specimens caught in leaf litter using a funnel trap is about to be sent off. When you watch birds raking around in leaf litter, have you ever thought of the slugs, spiders, millipedes, beetles, mites and springtails that make up the majority of species responsible for recycling leaves and other debris? And what about the incredible community that inhabits mounds of seaweed piled up during winter?

The first element of understanding the community ecosystem in which our birds live is to understand which other species share their various habitats. The second is much more complex, and scarily, even less well-known. That is which ecological role or roles each species perform/s. Be it pollinating a particular plant, parasitising a specific moth caterpillar, or recycling oak leaves, The third element of ecosystem structure lies with the physical habitat. We were successful in obtaining a grant from the Seachangers charity for equipment to study properties of the water and soils on which our 2400 species depend. Every link between species and between species and their physical environment contributes to the almost unimaginably complex Holy Loch Food Web. This work is bound to uncover even more ecological wonders from our tiny community-led nature reserve and add to ecosystem complexity.

Neil Hammatt

MARCH 2025

Holy Loch Nature Reserve
www.hlnr.org.uk