Bumbling, Butterflying and Monitoring 2.0: The Rise of the Citizen Scientist

The sheer diversity and abundance of invertebrates is astounding, but much of this spectacular display of life remains hidden and out of sight in our soils, grasses, shrubs and trees, as well as our coasts, cold-water corals and ocean depths. Since 1750, over 1.9 million species have been described globally and over 75% of these are invertebrates. Similarly, of the 31,500 species known to occur in Ireland, 62% are invertebrates in comparison to only 10% being the more 'familiar' groups of plants, birds and mammals. Therefore, invertebrates are the very foundation of ecosystems worldwide and in Ireland, supplying us with many essential services which play a vital, but largely unappreciated, role in our day-to-day lives.

In some cases, the services provided by our invertebrates are apparent, such as bees, where the pollination services of plants we consume and the maintenance of those we don't are intuitively beneficial to our society. Farmers and gardeners also appreciate the contribution of earthworms and other soil invertebrates in the provision of aerated and fertile soils. However, many of the other services provided are less obvious but equally critical. For example, larva of stoneflies and mayflies in our rivers and lakes underpin the decomposition of plant and other waste material with the resulting benefit of clean and healthy freshwater habitats. Overall, evidence supporting the fundamental role of invertebrates in our land- and seascapes continues to accumulate and makes monitoring changes in their populations all the more important if we are to protect Ireland's nature and the services it provides.

Consequently, the gauntlet has been thrown down to ecologists to accurately describe trends in our invertebrates and communicate this information to the public and policy makers. In order to achieve this, the key tool in our ecological toolbox is monitoring. Ecological monitoring involves periodically measuring the state of a community of species. Monitoring before and after a management intervention, such as the introduction of wildlife areas in a Tidy Town scheme or the national implementation of an agri-environment option, can demonstrate the effectiveness of that intervention and inform decisions on how to improve the intervention in the future. Over longer periods of time and larger areas, monitoring can also track changes in whole communities of invertebrates across the Irish landscape. This information can then tell us how changes in our environment, both in how we use the land and climate change, impacts Ireland's ecosystems and the consequences for Irish society.

Given the increasing need for national-scale monitoring of wildlife and, in parallel, a growing interest in Irish society in nature and environmental protection, 'citizen science' is becoming an increasingly popular approach to undertaking monitoring and other scientific research. Citizen science is described as the involvement of volunteers in science, where the volunteers themselves are typically not scientists by profession. Therefore, it has the dual benefit of making a contribution to 'real' science and expanding our knowledge of the natural environment, whilst also engaging many people with science and conservation in general. The rise in popularity of citizen science is being driven by:

1. Excellent engagement. Citizen science provides a way for people to become directly involved with science and their environment. Participants in our citizen science schemes often describe them as both fun and a way of empowering them to do something "valuable" for Irish nature and society.

2. Cost-effective large-scale data collection. Given the limited resources available for conservation, citizen science projects can sustainably collect data over large areas and for long periods of time. Even if other means are available, citizen-science can frequently be more cost-effective whilst also providing the opportunity for a broader section of society to become directly involved in environmental protection.

3. Technological advances. Advances in internet access, IT skills, social media and smartphone usage have all made it much easier to set-up and promote citizen science projects. Data collection and feedback to the participants is also much more straightforward.

4. The data can be trusted. A key step in all citizen science projects is data validation, whereby in order to provide data of the highest quality, all records are validated and/or the accuracy of each record quantified by a professional scientists so that any errors can be account for in analyses. The proliferation of cameras on smartphones in particular has greatly accelerated the validation process and helps volunteers identify species.

5. Diversity of approaches. Different types of citizen science appeal to different people. Therefore, not all projects are designed for mass participation; some projects are tailored to 'expert' volunteer naturalists, specific communities or specific locations.

For those unfamiliar with citizen science, it can be tempting to think that it is a cheap way of fulfilling large-scale monitoring needs. However, this could not be further from the truth as resources are needed to: train volunteers (or 'recorders' as we prefer to call them) through workshops and field meetings; maintain and support the network of recorders; provide an online platform for data collection; manage, validate and analyse the data once collected; report results back to the recorder network and the public. However, despite the cost, citizen science-driven monitoring can still be the most cost-effective way of collecting data over long periods of time and large spatial scales with the key benefit of directly engaging the wider public with science and conservation.

The Data Centre co-ordinates two citizen science-driven monitoring schemes: the Irish Butterfly Monitoring Scheme and the Bumblebee Monitoring Schemes. Starting with the Irish Butterfly Monitoring Scheme, it was established in 2007 with its first full field season in 2008 and now boasts 120 recorders across 120 sites, recording over 64,000 butterflies across 33 species per year. The scheme itself has now matured to the point where we can provide statistical analyses of annual changes each year. We also pool our data with 3,700 other recorders across 22 countries in Europe to produce the European Grassland Butterfly Index, one of the EU biodiversity indicators of the European Environment Agency. So not only are the efforts of our recorders directly informing butterfly conservation status at a national level, but directly contribute to butterfly conservation and policy at a European level too.

Although there have been longer running bumblebee schemes in some nature reserves across eastern Europe, the establishment of the Bumblebee Monitoring Scheme in 2011 as part of the Irish Pollinator Initiative meant that is the world's first national bumblebee monitoring scheme! Now running in collaboration with the Bumblebee Conservation Trust in Northern Ireland, the scheme has grown rapidly and represents a network of 75 recorders monitoring 92 sites. In 2014, over 13,500 bumblebees across 18 different species were recorded, along with the rediscovery of a species not seen in Ireland for 88 years, the Southern cuckoo bee *Bombus vestalis*.

The success of both schemes is a direct result of the efforts and enthusiasm of our network of recorders. We do our best to keep everyone motivated and support our recorders through our series of workshops and field days. In 2014 alone, our recorders spent over 2,350 hours monitoring bumblebees and butterflies across Ireland: an enormous contribution to both our knowledge of Ireland's biodiversity and to Irish society in general for which they cannot be thanked enough.

If you'd like to get involved with the projects, here's how:

Step 1: Get to know your bumblebees and butterflies. There are identification swatches available on our website and beginner identification guides available for download too. Even better, come along to one of our identification workshops or field days (look under the Events section of the pollinator or butterfly websites).

Step 2: The most important step! Choose where you want to walk. The key thing is that you enjoy your walk, so choose somewhere convenient and enjoyable and that way it'll be easy to stay part of the scheme. The route you choose should be 1-2 km in length or a distance you can comfortably do in 40-60 min. That way we can be sure the butterflies or bumblebees you see will be representative of the community in your area.

Step 3: Tell us about your route. You can register your walk with us online at http://monitoring.biodiversityireland.ie/ with 'how-to' guides available on both the pollinator and butterfly websites. If you've any problems or prefer we set-up your account for you, just email/post on a detailed map of where you'll walk and we'll do the rest.

Step 4: Get out there and start recording bumblebees and butterflies! Check our pollinator and butterfly websites for more details on how to record, but never hesitate to email us photographs to double-check identifications. Particularly for those new to the scheme, having a camera or smartphone ready is a great way to rapidly upskill your species identification as you can look back at the photo afterwards and send it on to us to check.

References:

Collen, B., Böhm, M., Kemp, R. & Baillie, J.E.M. (2012). Spineless: status and trends of the world's invertebrates. Zoological Society of London.

Pocock, M.J.O., Chapman, D.S., Sheppard, L.J. & Roy, H.E. (2014). Choosing and Using Citizen Science: a guide to when and how to use citizen science to monitor biodiversity and the environment. Centre for Ecology & Hydrology.

Prather, C.M., Pelini, S.L., Laws, A., Rivest, E., Woltz, M., Bloch, C.P., Del Toro, I., Ho, C.K., Kominoski, J. & Newbold, T. (2013). Invertebrates, ecosystem services and climate change. Biological Reviews, 88, 327-348.