Evolution in action

Herbarium specimen of York groundsel.

Andrew Lowe and Richard Abbott explain how Britain's newest plant species is an unparalleled opportunity to study evolution.

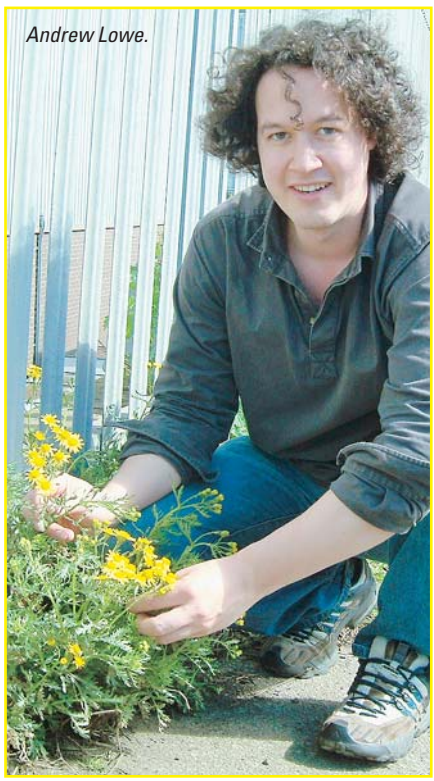
Few people probably notice the scruffy looking weed that is springing up around the city of York. And if they do, most will be trying to pull them up or kill them off with weedkiller. I doubt any imagine they are witnessing nature's most recent product of evolution. For this is the York groundsel, Britain's newest plant species. It has evolved within our lifetimes.

The York groundsel was first discovered in the late 1970s and probably isn't much more than 50 years old. It has already established itself in a number of sites around the city, and been the subject of several studies to establish its parentage and evolutionary significance. Recently, it completed the final steps required by plant biology officialdom: a full formal description and a Latin name, *Senecio eboracensis*, derived from the Roman name for York, *Eboracum*. Not bad for a humble weed.

So what makes a new species? In fact, evolution never stops and is happening all around us. Its principles – the creation of new, advantageous features through genetic mutations – may seem simple, but observing them is very difficult. This is mainly because advantageous mutations tend to be very rare. The origin of a new species within our lifetimes is an exceptional and exciting opportunity to study evolution in action. It poses several burning questions: what did the new plant evolve from, how was it established and why does it continue to survive?

Over the last 15 years, we have been hard at work answering these questions. Traditional taxonomy, based on the physical appearance of plants, has been combined with genetic fingerprinting techniques to demonstrate that the York groundsel is a hybrid between the common groundsel and the Oxford ragwort. That a new species can be created by the hybridisation between two existing ones is nothing new. However, many hybrids are short-lived and few manage to get the combination of desirable parental characteristics just right.

One of the main problems that a new species faces is being able to establish itself and maintain its novel identity.



Andrew Lowe.

Left: Richard Abbott.

Below left: York groundsel flowering in the wild.

Barriers to prevent interbreeding with near relatives are essential to preserve a unique set of features. If barriers do not exist from the very beginning, the exchange of genes with other species will eventually erode genetic identity.

The York groundsel overcame this problem in several ways. Most importantly, although a few plants cross-fertilise, most fertilise themselves. They also flower at different times of the year from their parents, and attract different pollinators. Finally, when the York groundsel is crossed with its parents, most offspring are sterile.

To reduce competition with existing species, new species need to colonise new ecological niches. A niche is the specific part of an ecosystem that a living thing, whether plant, animal, or microbe, lives in. It is charaterised by what is needed for survival – how much sunlight, water and what kind of soil – as well as how the organism survives the hardships of the wild.

One year we discovered to our horror that one of the sites where we were studying the York groundsel had been completely weeded by local council workers, unaware of the significance of the spot. Rather than despair and abandon ship, we decided to use the opportunity to see how seeds from the previous season fared in the germination race. We found that the York groundsel seemed to survive the winter better than common groundsel but could not survive mid-summer droughts as well as the Oxford ragwort. Both are evidence that it has colonised a different ecological niche from its parents.

To put the significance of the discovery of the York groundsel in context, this brings to six the number of new plant species recorded worldwide over the past 100 years. Interestingly three of these have been in Britain, which, with only 1,420 native plant species, is one of the world's poorest floral habitats. All six new species were the result of hybridisations between native and alien plants, demonstrating how the introduction of new species to an ecosystem can contribute to the evolution of new plants.

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Well-documented accounts of hybridisation and the creation of new species inform the debate over the escape of genes from genetically modified crops. The Oxford ragwort is an alien species introduced to Britain from the island of Sicily in the early 18th century. Since, it has interbred promiscuously with the native groundsel, generating two new species: the York groundsel and the Welsh groundsel, also the subject of extensive evolutionary studies. While this remains a very low success rate, it demonstrates that significant evolutionary events can occur when species are introduced to new areas. Thus one important question in the GM debate is not whether genes will escape, because there is plentiful evidence that they can, but what will happen when they do?

The vast majority of species that have ever evolved have gone extinct – probably about 99% of them. The lifetime of species is also highly variable: some exist unchanged over millions of years, while others make only the briefest appearances on the evolutionary stage and may survive only a few decades. And so, the York groundsel's establishment is no guarantee that it will continue to survive. Groundsel do not live for very long (they complete their life cycle in 12 weeks) and need recently disturbed patches of ground to be widely available so they can germinate, grow and flower. They cannot compete on more established ground where long-standing species, such as grasses, grow.

Unfortunately, the central areas of York are being redeveloped, and patches of bare ground and abandoned industrial sites, common in post-war Britain and to which groundsel is adapted, are becoming rare. In addition, York City Council is tidying up public areas. Garden planting and weeding are but two more threats to the York groundsel. It will need to disperse to new locations if it is to survive and proliferate in the future.

Will a planting program ensure our discovery lives on? Whilst the idea is tempting, we think it is best to let nature take its course. The next couple years will show whether the York groundsel becomes part of the established British flora or has been a temporary window into the evolutionary process.

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Richard Abbott supervised his thesis and was the first person to notice the York groundsel, whilst wandering alongside the York railtracks in 1979. He is a reader in Evolutionary Biology at the University of St Andrews.