Preface

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"It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us."

Charles Darwin (1859) "On the Origin of Species," p. 489.

Butterflies are perhaps the most appealing of invertebrates to amateurs. They're not spiky like ants and praying mantids, or hard-looking like beetles, or slimy like slugs and snails, or even wriggly like worms (except for the caterpillars, of course). And they're beautiful, and fly mostly in sunny, warm weather when human spirits are raised.

Butterflies are also diverse, having maybe as many as three times the numbers of species globally that birds have. Butterflies represent about a tenth of the ~170,000 described species of Lepidoptera, which themselves form about 10% of the ~1.9 million described species of living organisms. Thus, butterflies represent around 1% of the diversity of known life on our planet.

For both these reasons, butterflies have become extremely important in conservation. In my native Britain, Butterfly Conservation is the second biggest conservation-oriented society, after the Royal Society for the Preservation of Birds. In Britain also, butterflies have shown rather strong declines in population size (Thomas et al. 2004), particularly because many of them are attached to increasingly fragmented and endangered habitat types such as chalk grasslands or scrubby woodlands. While the situation in Britain is particularly dire, the same problems exist, though perhaps at a somewhat earlier stage of destruction, across Europe. Both butterflies and birds are important flagships of conservation. Today we are increasingly concerned with conservation, not just of endangered species, but of the entire diversity of the ecosystems to which these flagship species belong.

People have been in Europe for a long time, and an astonishingly high proportion of butterflies seem to be addicted to habitats that have been traditionally altered by humans. For example, grasslands grazed by sheep seem important for many butterflies, including the flagship species, the Large Blue *Maculinea* [*Phengaris*] *arion*, which after many years of decline finally went extinct probably as a result of our ignorance of its biology. The caterpillar of this species is an obligate nest parasite of a particular *Myrmica* ant species. In late instars, it is taken into the nest by the ant workers, where it survives by eating ant larvae. This particular ant can only survive in our chilly climate on the sunniest and most highly grazed grasslands. Conservationists thought that by buying land with the remaining populations of the Large Blue from farmers, they would save the species. Unfortunately, the link with sheep-grazing was not known at the time, and the loss of the farmers' sheep led to the final extinction. Today, the link is understood, largely due to the detailed ecological studies of Jeremy Thomas performed during the final gasp of the species' survival in England (Thomas 1980). Since then, Large Blues have been reintroduced from mainland Europe into the original English range, and appropriate grazing pressure applied. The new butterfly population is now spreading across its former range. The Large Blue work shows how detailed ecological and biological study can enable a conservation success story.

While this conservation success is of course mainly about a single, endangered species at the edge of its range, the conservation effort for the Large Blue has many ecosystem-scale conservation benefits. Many, perhaps most plants specific to chalk downlands also thrive only in well-grazed sites. Suites of other butterfly species also show increases in population size on land managed specifically for the Large Blue across Europe. For example, the Pearl-bordered Fritillaries (*Boloria euphrosyne*) and other violet-feeding butterflies do better on land under Large Blue conservation management. The link is again through the ants, but this time involves plants as well. Ants collect violet seeds, which have special oily parts (elaiosomes) that the ants find nutritious. From the plant's point of view, this is advantageous because it leads to seed dispersal by the ants. The seeds tend to germinate best in abandoned ants nests, and the Large Blue parasitism can cause greater levels of ant nest desertion, so speeding germination of more violets. The Pearl-bordered Fritillary also prefers to lay on violets growing on deserted ants' nests, and so these various associations lead to a higher population of the butterflies (Spitzer et al. 2009).

This is just one example of the extraordinary links between species typical of Darwin's "entangled bank". Darwin wrote "On the Origin of Species" when he was living in the village of Downe just outside London. Every day, he would walk around a particular route ("the sand walk") through a wood lot he planted beyond the end of his garden. It might not be an accident that his wooded walkway overlooked a diverse chalk hillside, patches of which are still preserved, and to which a few iconic chalk downland species still cling. Today, however, the majority of the grasslands at Downe have been converted to fields. The only preserved patches now form part of a golf course.

Conservation in the Large Blue is perhaps the best known example where knowledge of butterfly biology is useful. But in many other species, much less is known about habitat requirements. However, it is known that conservation of traditionally grazed chalk downlands aids the preservation of many of our rarest species. In general, conservation of sites containing rare species will tend to enhance the diversity of microhabitats that other species, both common and rare, inhabit. In butterflies, it generally tends to be true that sites with high diversity of one butterfly group tend also to have high diversity of other butterfly groups (Beccaloni and Gaston 1994). There are, of course, limits to the generalization that butterflies form a useful "indicator" group for conservation value. For example, high bird diversity does not necessarily indicate high butterfly diversity or vice-versa (Prendergast et al. 1993). Just as we need to study the biology of individual species to understand their specific ecological requirements for conservation, we will also have to study in great detail the many ecological links between species to understand the conservation of biodiversity in general.

In Europe as a whole, our understanding of butterfly ecology and butterfly conservation is perhaps the strongest in the world. The current volume, a monograph on a particularly attractive European butterfly Violet Copper *Lycaena helle*, is going to be very useful in this regard. The butterfly exists in scattered populations across its range, many of which are under threat. The detailed studies collected in this volume will inform conservation efforts for this species, and contribute to the understanding of the biodiversity of Europe in general. The studies presented here of this beautiful little species will help us preserve for our descendants a few of those tangled banks that were inspirations to our ancestors as well as ourselves.

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