“Ecological Armageddon” – more evidence for the drastic decline in insect numbers

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"Ecological Armageddon" – more evidence for the drastic decline in insect numbers

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Four years ago a group of German entomologists reported that there had been a huge reduction in the biomass of insects caught using Malaise traps sited in 63 German nature reserves since 1989 (Sorg *et al*., 2013). This shocking observation went almost unnoticed until a reanalysis of the data appeared recently (Hallmann *et al.,* 2017). The later paper generated a flurry of media activity and the phrase "*Ecological Armageddon*" swiftly circled the globe. Although not denying the decline reported, there are a number of caveats that should be considered when reading the two papers; the data are based on biomass, not species, the sites were not sampled continuously and are not globally representative (Saunders, 2017). The authors of the German study were not able to link the observed decline to climate change or pesticide use; although agricultural intensification and the practices associated with it, were however, suggested as likely to be involved in some way. The link between habitat, insect diversity and abundance has been recognised for more than a century as illustrated by the following quotation,

"*Men all around were clearing available land. The trees fell wherever corn would grow. The swamp was broken by several gravel roads…Wherever the trees fell the moisture dried, the creeks ceased to flow, the river ran low, and at times the bed was dry. From coming in with two or three dozen rare moths a day, in three years time Elnora had grown to be delighted with finding two or three. Big pursy caterpillars could not be picked from their favourite bushes, where there were no bushes. Dragonflies could not hover over dry places and butterflies became scare in proportion to the flowers"* (Stratton-Porter, 1909).

What puzzled me about the global media response was why this particular study attracted so much attention. We have known for a long time that some insect groups have been in decline for many years. The massive decline in the abundance of UK butterflies and moths has been highlighted on more than one occasion over the last couple of decades (e.g. Conrad *et al*., 2004; Thomas *et al*., 2004; Fox *et al*., 2013), similarly, that of the charismatic dragonflies (Clausnitzer *et al*., 2009) and the beneficial carabid beetles (Brooks *et al.,* 2012).

Most studies on insect decline have, as shown from the previous examples, focused on those insects that we love and cherish. What about the less charismatic insects for example the once ubiquitous and pestiferous Bibionid flies (Morris, 1921; D'Arcy-Burt & Blackshaw, 1987)? In the UK we are fortunate that a long-term source of insect data exists, courtesy of Rothamsted Research, the longest running agricultural research station in the world. Data have been collected from a nationwide network of suction and light traps for more than 50 years (Storkey *et al*., 2016). Most of the publications arising from the survey have tended to focus on aphids (Bell *et al*., 2015) and moths (Conrad *et al*., 2004), although the traps do of course, catch many other types of insect (Knowler *et al*., 2016) including Bibionid flies (Shortall *et al*., 2009). A study examining other flying insects using data from four of the Rothamsted Insect Survey traps, showed that three of the four traps analysed showed downward trends in insect biomass over the 30 years (1973-2002) examined, of which only the Hereford trap showed a significant decline (Shortall *et al*., 2009). Another remarkable study

that seemed to escape media attention, this time on ground-based sampling, described a 42-year data set looking at the invertebrates found in cereal fields in southern England (Ewald *et al*., 2015). The authors found that of the 26 invertebrate taxa studied less than half showed a decrease in abundance, e.g. spiders, Braconid wasps, carabid beetles, *Tachyporus* (staphylinid beetles, *Enicmus* (scavenger beetles), Cryptophagid fungus beetles, leaf mining flies (Agromyzids), *Drosophila*, Lonchopteridae (pointed wing flies), and surprisingly, or perhaps not, aphids. The other orders showed no consistent patterns, although Hemiptera, excluding aphids, increased over the study period. Cereal fields are of course not a natural habitat and are intensely managed, with a number of inputs, including pesticides, being applied, so are perhaps not likely to be the most biodiverse or representative habitats to be found in the UK. Neither of these two studies are conclusive and are limited in their geographic coverage; we do not know how representative the results are of the whole country, although anecdotally, people of my age will all tell you that insects are less abundant than when we were children (Leather, 2016).

Insects are of course not the only organisms on the planet. They do however, vastly outnumber all other animal species (Mora *et al*., 2011), yet the extinction of vertebrates receives much more attention (e.g. Briggs, 2017; Ceballos *et al*., 2017). Vertebrate extinction although a serious problem is probably however, not as damaging to the planet as that of plants. As with insects our knowledge of plant extinction rates is limited, but the evidence appears to indicate that they too are suffering significant declines in abundance (Thomas *et al*., 2004) although a recent study shows that at a local level, total biodiversity seems unaffected (Vellend *et al*., 2017). Fungi too are important parts of the ecosystem upon which life as we know it depends (e.g. Jönsson *et al*., 2017) and here too, as with soil fauna and flora, long-term data sets regarding their distribution and abundance are lacking. We know too little about the majority of the organisms with which we share our planet and which affect our food production and in turn, are affected by our agricultural practices.

I strongly suspect that the current "*Ecological Armageddon*" scenario will not result in a huge injection of funding into long-term insect data collection projects. It may however, stimulate funding bodies worldwide to think seriously about supporting more research into sustainable agriculture and for governments to encourage farmers to adopt farming strategies that encourage more wildlife and use fewer inputs. At the same time, given the increasing number of studies that implicate urbanisation (e.g. Jones & Leather, 2012; Dennis *et al*., 2017) and vehicle traffic (Baxter-Gilbert et al., 2015) as major factors in the decline of insect numbers, an awareness of this by local planning authorities might lead them to increase their efforts to provide much-needed green spaces in our towns and cities.

What it does highlight as Manu Saunders said in her blog (Saunders, 2017), is that we desperately need funding for more long-term studies, particularly of invertebrates and plants. Unfortunately, this may however, be a case of locking the stable door after the horse has bolted. We also need to find instances where the data already exist but have not yet been analysed; amateur records and citizen science projects may be of use here. Alternatively, as demonstrated by a recent study in France (Alignier, 2018), it is possible, using the identical protocol, to resample a site after a gap of decades, to see what changes have occurred.

I hope for the sake of our descendants that the reports of an "*Ecological Armageddon*" have been exaggerated. This should, however, be a wake-up call to all those with the power to do something to mitigate the decline in biodiversity worldwide. Governments need to respond quickly and to think long-term and responsibly. The current attitude of governments to think in terms of the

outcomes of the next election is no longer a viable one for the planet. It is precisely that attitude that got us into the situation that we find ourselves in now.

The *Annals of Applied Biology* encourages submissions addressing any of the topics raised here, either as original research articles or for our *Forum* section.

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