No Insectinction - how to solve the insect declines crisis

buglife

Introduction from Steve Backshall MBE

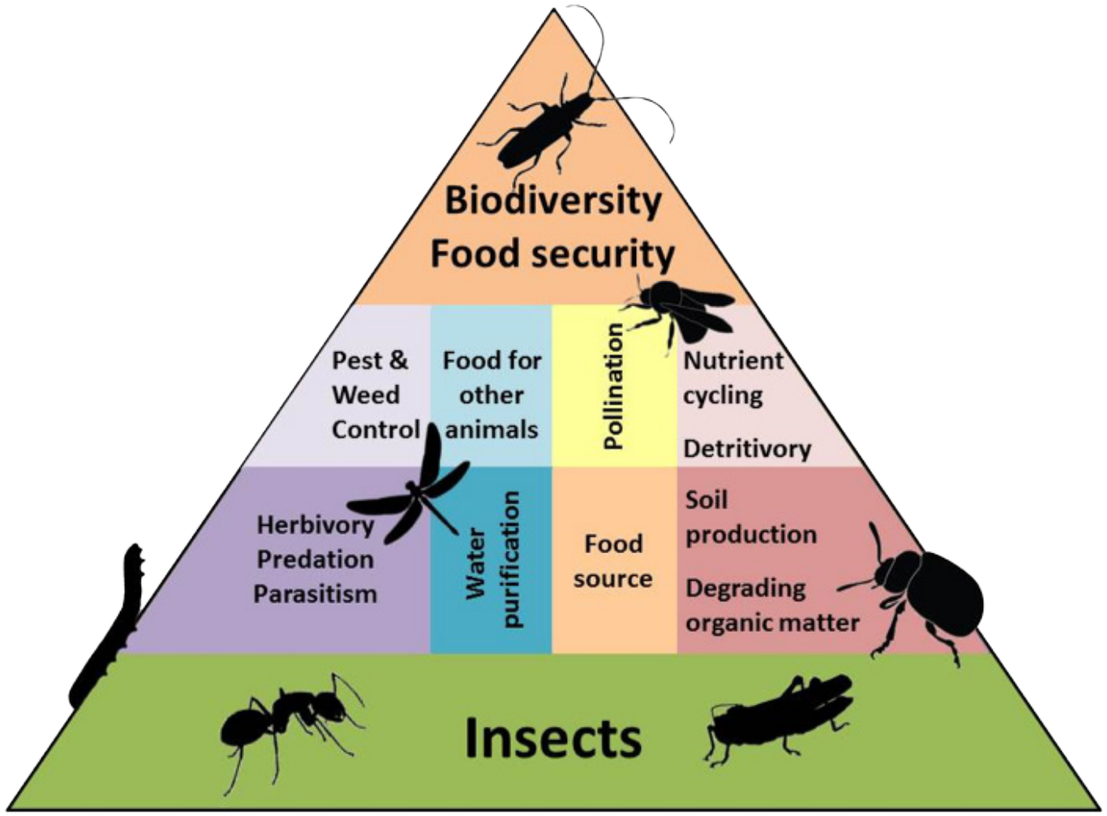
Front Cover: Black-tailed Skimmer © Dr David Chesmore. Page 2: Steve Backshall © Adam White

Tansy Beetle (Chrysolina graminis) © Steven Falk

For many years biologists and conservationists have been talking about the 'Sixth Extinction'; a cataclysmic event of anthropogenic origin that is bringing our ecosystems to the brink of collapse. This phrase has now entered the common lexicon, and the parlance of everyone from parliament to playground. But while we all switch on to the tragedy of the bushfire-blighted koala, the perils of the polar bear and the disintegration of the ice caps, the truth is that we as a society are yet to grasp the implications of a quiet decline, with far greater consequences.

When I was a kid, driving at night down the lanes of Devon or Dorset (my parents were doing the driving, not me!) the summer snow of moths and other nightcrawlers would dot our beams, and a bug blizzard would smear across our windscreen. But no longer. Summer meadows would chime to the calls of a dozen different grasshoppers and crickets, and butterflies would swarm the back garden bloom. That these are all distant memories is just a suggestion that something is wrong. And while one could argue that many decorative and obvious species may not be integral to the function of ecosystems, there are others that are critical. And we're losing them, at a terrifying rate. Buglife's motto is 'Saving the small things that run the Planet.' Anyone who disagrees should chat to the Chinese farmers who now pollinate their crops by hand with tiny paintbrushes; to the apiarists losing their hives to colony collapse disorder; or to the farmers looking at a dismal decline in the natural productivity of their land. Buglife's campaign sets out what we all need to achieve to solve these growing problems. I truly hope that come New Year 2021, the Oxford English Dictionary's word of the year, is 'Insectinction'.

Steve Backshall MBE



Insects play fundamental roles in the ecosystem, so maintaining insets populations is essential. From: We are losing the "Little things that run the world" UN Environment 2019

Insect populations are in crisis

Recent studies paint a grim picture of the decline of insects across the planet (see Appendix). A well-publicised review[26] recently concluded that current rates of decline could lead to the extinction of 41% of the world's insect species over the next few decades. Butterflies, moths, bees, wasps, and dung beetles are amongst the most at risk, along with freshwater insects such as stoneflies, caddisflies and mayflies. A small number of unfussy, very mobile and pollutant-tolerant species are able to cope with the damage that humans are doing to our planet. These generalist species are replacing the rich diversity of species that make up the fabric of life on Earth.

It is becoming increasingly clear that our planet's ecological balance is breaking and there is an urgent need for an intense and global effort to halt and reverse these dreadful trends. Allowing the insect eradication crisis to become a catastrophe is not a rational option for anyone.

Insects make up over half the species on Earth, our planet's health depends on them, so their enduring disappearance is intensely concerning. The rate of loss of insect life is much faster than that of higher profile wildlife like birds and mammals – the local extinction rate for insects is eight times higher! There are many causes, and they all need to be addressed, but the evidence is clear, we will not halt the crisis without urgently reversing habitat loss and degradation, preventing and mitigating climate change, cleaning-up polluted waters, and replacing pesticide dependency with sustainable farming methods.

We believe that there should be sustainable populations of all insects. 'No Insectinction' is Buglife's response to the current crisis – a prescription for healing our planet, by restoring our depleted and devastated insect populations (and indeed all other invertebrates such as earthworms, spiders and snails).

We must achieve three things:

1. **Room for insects to thrive**
2. **Safe spaces for insects**
3. **Friendlier relationship with insects.**

More detailed actions are listed below, some of which can be addressed by Buglife and our existing member organisations and partners, but most will require the assistance of people across society.

'No Insectinction' is a call for action, a coming together of people and organisations with a shared endeavour to heal our planet's life support system.

Leading by example in the UK and EU, we call upon governments and decision makers around the world to take decisive action to tackle this ecological crisis.

We can stop, and reverse the global declines in our insects, but only if everyone pulls together to do their bit.

Room for insects to thrive

Dark-edged bee-fly (*Bombylius major*) © Kim Taylor

We all need room to thrive but, like other wildlife, insect populations have been pinned into tiny fragments of habitat where their needs are not being looked after.

The first priority to achieve 'No Insectinction' is to protect and expand the best areas, and restore sufficient additional habitat so that there is enough room for insects to thrive and to move into.

We must repair connections through our damaged landscapes, ultimately restoring a vibrant land where insects are abundant, where they can fulfil their important ecological roles, and where they will continue to delight and inspire future generations.

Room for insects to thrive

Seven-spot ladybird (*Coccinella septempunctata*) © Dominik Stodulski

Protecting the most important areas for insects

Many of our most threatened insects are only found in a small number of places. These places are often remnants of once widespread wildlife-rich habitats such as flower-rich grassland, ancient woodlands, dunes, heathlands and wetlands. Yet agricultural intensification, and the pressure for new development, means that we are continuing to lose these irreplaceable wildlife refuges at an alarming rate.

The current suite of protected areas in the UK includes many sites that are important for insects; however, equally important areas receive no protection and continue to be damaged and destroyed by urbanisation, changing agricultural and land management practices, environmental pollution, invasive non-native species, and many other factors.

The most important places must be identified and recognised – given formal protection to prevent their loss, or damage. It is vitally important that these places, and the special species that call them home, are protected from harm and managed in the right way to protect and enhance their wildlife riches.

The most important places for insects either support nationally or globally important populations of species of conservation concern; exhibit exceptional species richness; are home to a particularly rare or restricted (e.g. highly specialised) invertebrate assemblage; or feature an exceptional example of a habitat of national or global importance to invertebrate conservation.

Working with the leading experts and other conservation charities, good progress has been made to identify the UK's Important Invertebrate Areas that must be given protection from development and other land-use changes. However, we don't want more 'paper parks' – Important Invertebrate Areas must be appropriately protected, and time and effort invested into ensuring they are safe and well-managed.

What has to happen?

- **Remaining areas of wildlife-rich habitat and existing High Nature Value agriculture must be managed to protect and enhance their invertebrate wildlife.**
- **Protected areas for insects must be restored, managed and monitored to achieve and maintain them, and the species that live there, in favourable condition.**
- **The best remaining wildlife sites must be properly protected and managed in the right way to sustain their wildlife interest.**
- **The most important refuges for invertebrates must be added to the current suite of protected sites.**
- **Local plans must direct development away from Important Invertebrate Areas.**

Room for insects to thrive

Connecting landscapes and wildlife

Wildlife-rich landscapes and the vibrant populations of insects and other wildlife that they support are incredibly important for people – our lives, and our descendants' lives, will be richer and healthier by making more space for wildlife in the countryside.

Recent insect declines are part of a long-term loss of diversity and abundance caused by habitat loss and fragmentation. The very latest research shows that many of the best wildlife sites are now very isolated, and that a lack of connected habitat across landscapes means that species are marooned on islands of suitable habitat, unable to move in response to environmental pressures such as climate change, and vulnerable to local extinction [1]. Habitats must be made bigger, better and, crucially, more joined up. Restoring networks for insects is now a top priority.

Fragmentation of woodland (particularly ancient woodland), wetlands, and wildflower meadows is particularly harmful for invertebrate life. 97% of wildflower-rich grasslands in England have gone since the 1930s, similar losses have occurred in the rest of the UK.

There is a vicious cycle that magnifies the impact of fragmentation on small animals. Not only does it get harder for them to leave one fragment and find another to populate, eventually the likelihood of surviving dispersal attempts becomes very low, and over generations their wings and flight muscles shrink and they stop dispersing [2]. Climate change may also drive reductions in dispersal ability [3]. It is not surprising that around the world bumblebee distributions are shrinking; many can no longer survive in southern parts of their ranges, but are not able to move north [4]. It also seems that the smaller the animal, the more severely habitat fragmentation reduces its dispersal ability [5].

Agri-environmental measures have been slow to reverse these declines in habitat extent and much of the action has been diffused across the countryside and not targeted in a structured or cost-effective manner.

Habitat restoration must be at a big scale – leaving field edges and corners to nature plays its part, and indeed helps to produce more robust and productive agriculture, but to adequately tackle the insectinction crisis and to restore wildlife to our countryside we must be far more ambitious – large areas of high-quality habitat must be created, restored and connected.

Wildlife-friendly habitat mosaics must be reinstated at a landscape scale, in some places 'rewilding' would help to create more varied and complex habitats that favour many insect species.

It is essential that habitat restoration creates networks for nature, otherwise we won't achieve sufficient connectivity to save species from extinction.

Northern February Red stonefly © Gus Jones

What has to happen?

- **Reconnect isolated wildlife-rich sites at a landscape scale. Habitat-linking corridors, and stepping stones including B-Lines, must be integrated into new and existing schemes and policies to target habitat creation and increase opportunities for species to move.**
- **Expand our best wildlife sites, identify and act upon opportunities to increase the size of the remaining areas of nature-rich habitats.**
- **Agri-environment schemes must include adequately funded insect-friendly habitat options and these have to be targeted to deliver connected insect habitats.**

Room for insects to thrive

Accommodating aquatic insects

Over 4,100 invertebrate species in the UK spend at least part of their lifecycle in freshwater [6] – and they deserve more of our attention. These include well-known freshwater invertebrates like dragonflies, mayflies, pond skaters and water beetles. They play a vital role in maintaining clean water, recycling organic matter, and in providing a food source for fish, birds and mammals. The presence of aquatic insects is the standard indicator of the health of freshwaters.

However, aquatic insects have been just as squeezed for room to live as terrestrial species, and freshwaters are haemorrhaging biological diversity faster than any other ecosystem on Earth. Small water-bodies are particularly important for small animals, but their wellbeing has been largely ignored by regulators and policy makers. There have been big losses of ponds and small waterbodies in the countryside. A combination of climate change and over-abstraction has led to chalk streams and other headwaters suffering from drying out in many places, while naturally temporary streams, such as winterbournes are flowing for shorter periods. There is an urgent need to restore freshwater habitats and improve the quality of rivers, streams, ditches, springs, seepages, ponds and lakes up to the point where the freshwater insects can thrive again.

Peat bogs straddle the aquatic and terrestrial environment; not only do they form an important habitat for many aquatic and semi-aquatic insect species, they are also play a crucial role in storing carbon, which is essential for tackling climate change. Despite this, the past damage from drainage of bogs and peat extraction has not been rectified, and indeed is still being allowed to continue, and Government commitments have failed to stop the use of peat in gardening. It is essential that we stop removing peat from bogs and phase out the sale of peat for gardening and horticulture.

What has to happen?

- **Small water-bodies such as headwaters and ponds must be higher up the agenda, with much more sensitive management of water resources to prevent them drying up and more action to restore temporary and permanent ponds to the countryside.**
- **Freshwater insects are particularly at risk from climate change. Mitigation such as bankside planting to shade watercourses should be rolled out.**
- **Less than a third of rivers worldwide are free-flowing. River restoration must enable rivers to reclaim their natural forms, allow rivers to use their flood-plain and ensure that the water environment, in, around, and under the river is healthy.**
- **Remaining licences for extracting peat from bogs must be cancelled, peat sales in bags and pot plants phased out, and all degraded bogs rewetted and restored.**

Mayfly (*Ecdyonurus*) © Matt Eastman

Room for insects to thrive

Insect havens in towns and cities

Our wildlife is not limited to the countryside. Many insect species share our urban areas with us, and some are increasingly found nowhere else. Local authorities, businesses and individuals can all take action that will help the recovery of insect populations and make space for wildlife in towns and cities. Our spatial planning system must be much more insect-friendly. Increased use of green infrastructure such as green roofs, wildflower grasslands, ponds, hedgerows and rain gardens in development proposals will provide habitat and stepping stones for insects, allowing them to move and disperse to urban green-space and the wider landscape.

Brownfield sites can support a huge diversity of wildlife, often providing refuges for insects that have been lost elsewhere. Brownfields can include quarries, disused railway lines, spoil heaps, and former industrial sites that have been allowed to return to nature. Often these are the only wildlife-rich areas left in our towns and cities. However, development pressure is threatening the future of many key sites.

Urban green-space can include a wide variety of land uses including parks, cemeteries, communal ground in residential areas, school grounds, road verges, gardens, golf courses, business parks, hospitals, company premises, brownfield sites, river banks, and railway lines – all of which offer opportunities to be managed for people and wildlife. There are good examples of public green-space being managed for insects, but we must ensure that this becomes the norm.

What has to happen?

- **Local and national planning guidance must be clear that developments are expected to incorporate wildlife-friendly green infrastructure.**
- **Local plans must direct development away from existing wildlife-rich habitats and refer to maps showing where wildlife-rich habitats will be restored or created in the future – incorporating B-Lines and Important Invertebrate Areas.**
- **Planning applications must include surveys and assessments of impacts of invertebrates.**
- **On-line tools such as the 'Wildlife Assessment Check [7]' and 'Buglife Planning Hub [8]' should be used to ensure that developments are insect-friendly.**
- **Brownfield sites of high environmental quality should be identified in the local plan, protected from development, and managed to ensure that they continue to provide suitable habitat for insects and other wildlife.**
- **Management of public open space must provide more shelter and nesting areas for insects. Wildflowers and insect-friendly formal planting and management should be the norm in urban green-space. Advice on producing local pollinator action plans is available [9].**
- **Individuals, families and businesses can all help insects by planting pollen-and nectar-rich flowers, by maintaining areas of wildflowers and shrubs, by creating ponds or wetlands, by providing nest sites for solitary and bumblebees such as areas of long grass, bare ground, dead wood and bee hotels, and by avoiding the use of insecticides.**

Safe Spaces for Insects

Colletes species © Rory Dimond

Having enough space is not enough to reverse the decline in insects if those spaces are poisoned by chemicals, or other pollution, emitted by humans, or are being invaded by environmentally harmful species that we have irresponsibly or carelessly introduced into their habitats.

Freeing our land and waters from pollutants and invasive species that are driving widespread declines in biodiversity is the second priority of 'No Insectinction'.

Safe from harmful chemicals

Recent history is peppered with cases of pesticides causing huge damage to wildlife, most recently pollinator declines caused by neonicotinoid insecticides, but also cypermethrin sheep dip, which ravaged freshwater systems and may have caused the extinction of a rare caddisfly species. By improving pre-approval testing and being much more careful and prudent about their use we can reduce the damage these chemicals cause to ecosystems and wildlife. Currently there are over four hundred pesticides approved for use in the EU. Since the approval process started in 1991, over a hundred products have been banned due to their detrimental effect on the environment or human health, despite being, until very recently, deemed safe and used extensively. This shows that the current testing procedure for approval is inadequate, again demonstrated by the EU introducing a ban on the use of neonicotinoid insecticides in 2018.

There are numerous issues surrounding the pesticide testing procedure, including the limited taxonomic scope of testing, and no account being taken of the 'cocktail' effect where pesticides can have more dramatic effects when working in combination. Detrimental effects that become apparent after a pesticide is approved are not taken into account quickly enough and when environmental impacts of pesticides, and other chemicals, are called into question, the precautionary principle must be applied, and their use suspended. There is too much emphasis on proving harm, rather than the onus being on the chemical companies to prove that they are safe. Pre-approval studies on the toxicity of new pesticides must be made publicly available and should be scientifically robust so that the statistical significance of the results can be relied upon.

While it is illegal for financial advisors to profit from selling products to individuals, agronomy advisors and the companies they work for are still allowed to benefit from commission or sales that arise from their advice to use pesticides. It is well-established that this form of marketing is highly effective at selling products that are either not needed or should be substituted with better approaches [10]. The effect is to strongly bias the advice given to farmers towards chemical solutions and away from agroecology solutions. France has committed to break this link.

Gardens and urban green-space have become refuges for many bees and other insects; the use of insecticides in gardens cannot be justified on food production or other public good grounds and should be banned.

Plant-protection pesticides are not the only chemicals that can harm invertebrate populations; there are also significant risks from veterinary and human medicines. There is relatively little vigilance or targeted regulation to protect wildlife from medicines.

Pollution is a particular problem for water quality, despite the introduction of legislation such as the Water Framework Directive in Europe. Almost half of sites monitored across Europe continue to suffer from chronic chemical pollution leading to long-term negative impacts on freshwater organisms . One in ten sites suffered acute pollution with potential lethal impacts for freshwater organisms [11]. Harmful chemicals, nutrients and plastic fragments are emitted in sewage effluent and run-off from urban and industrial areas, with pesticides from farmland posing the most immediate risk to freshwater ecosystems.

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What has to happen?

- **Robustness of the pesticide approval 'test methods' must be improved and a stronger evidence base developed for a wider range of beneficial insect species.**
- **As part of a review of pesticide uses, the UK must initiate a full assessment of the environmental risks posed by pesticides to bumblebees, solitary bees, hoverflies, moths, and other insects, but also to groups such as earthworms, beetles, snails and aquatic invertebrates through residues in soil and in aquatic habitats. The assessment must enable the application of the precautionary principle.**
- **The link between advice to farmers and pesticide profits must be broken. Farmers deserve truly independent advice from people who are just as motivated and trained in non-chemical and ecological approaches to managing land for the joint outcomes of producing food and conserving biodiversity.**

  Domestic pesticide use and municipal use by Local Authorities must be banned.
- **More monitoring of veterinary and human medicines needs to be introduced; more substantive responses to environmental risks need to be initiated; and a greater role for environmental risk**
- **assessment introduced into the approval process for these potentially very harmful substances.**

  Water quality must be improved – with reductions in the levels of nutrients, plastic and harmful chemicals.
- **Harm from pesticides is a global issue that would benefit from an international convention to establish the principles of protection for people and wildlife, to promote greater transparency, to achieve more protective regulation, and to ensure that pesticide harm is not simply exported from countries with**
- **sophisticated regulation to less fortunate countries.**

Safe from the effects of climate change

Climate change is widely recognised as being one of the major long term threats to biodiversity.

Most recent predictions are that our climate will become warmer, patterns of rainfall will change, and the number and frequency of extreme weather events will increase as a result of climate change, and this will inevitably have an impact on insect populations.

Indeed with the majority of insect species having relatively short life cycles and good powers of mobility they are likely to be one of the first groups to show the impact of a changing climate.

Cold-loving species will retreat northwards and uphill, while warm-loving species will increase their range and species normally found further south in Europe may become established in the UK. Temperature plays a vital role in the breeding success of cold-blooded organisms and therefore the population size and viability of many invertebrate species. It is probable that small changes in temperature will be enough to jeopardise the survival of some invertebrate populations. This effect will most likely be seen in cold-adapted montane species whose very survival may be at stake; however, it is also evident in other habitats.

Extreme events such as sustained warm spells and heavy rain will become more common. Drier, warmer conditions, coupled with increased pressure on water supplies will lead to low flows in chalkstreams and headwaters, or their flow stopping altogether.

Wetter conditions and an increase in the frequency of floods is also likely to have a significant effect on insect populations. Ground-dwelling insects may be drowned or washed away, and for those that survive, the catastrophic loss of their food resource may prove fatal.

What has to happen?

- **Urgent action is required to ensure that we meet the ambitious targets for reductions in emissions.**
- **An assessment of the vulnerability of terrestrial and freshwater invertebrates to climate change should be undertaken.**
- **Climate change adaptation and mitigation plans should be produced for key habitats and species.**

Northwestern Europe at night © VIIRS

Safe from light pollution and other radiation

Technology increasingly emits electromagnetic radiation; it forms a growing and valued part of modern life. Yet we have been failing to consider how this radiation may affect other animals.

Night-time light pollution disrupts the lives of nocturnal insects such as moths, ground beetles and glow-worms. It has been established as a cause of insect decline that can impact on the pollination of plants and the health of ecosystems [12 13 14 15 16]. While the problem of light pollution is widely recognised and there are a number of Dark Sky Reserves/Parks, and although we know what needs to be done to reduce the pollution, there is no coordinated effort to reduce light pollution.

Radar, radio, telecommunications and electrical fields pervade the atmosphere. We know that insects can detect, and are affected by, types of electromagnetic radiation and scientists are concerned that this radiation is capable of damaging the environment [17 18 19]. However, there has been insufficient work on understanding how this might affect insect populations and ecosystem health.

What has to happen?

- **A national target for reducing light pollution must establish dark sky reserves and monitor, with tools such as planning regulations used to get pollution levels under control.**
- **Research to establish the effects of electromagnetic radiation on insects must be commissioned and meaningful risk assessment and risk management undertaken for 5G and other radiation-producing technology programmes.**

Safe from invasive species

Invasive Non-Native Species (INNS) are one of the greatest threats to biodiversity across the planet. The introduction of INNS to ecosystems typically leads to a reduction in species richness and abundance, and to the general degradation of the environment. The annual cost of INNS such as Signal crayfish *(Pacifastacus leniusculus)*, Carpet sea squirt *(Didemnum vexillum)* and the Killer shrimp *(Dikerogammarus villosus)* to the British economy is estimated to be at least £1.7 billion.

The international trade in pot plants poses a particular threat. Billions of pounds worth of plants and trees are transported around the world every year. They may bring colour to homes and gardens but with them they bring unwanted organisms in the soil. Non-native species such as New Zealand flatworm *(Arthurdendyus triangulatus)* can wreak havoc on native wildlife, while invasive slugs such as the Spanish slug *(Arion vulgaris)* can harm garden plants and crops.

Local horticulturalists are quite capable of growing plants for domestic markets, so almost all international trade in live plants is unnecessary. Until there is a proven way to sterilise both pot plants and the potting medium, and this is implemented, cross-border trade in pot plants should be prohibited.

Ballast water is another major pathway for non-native species to move around the world. Cruise ships, tankers and freight ships take on water before they set sail and then discharge on their arrival at their destination. Stowaway animals and plants are released into the sea or estuary where they can establish and cause damage to native species and habitats. The Ballast Water Management Convention entered into force in 2017. All ships in international traffic are required to manage their ballast water and sediments to new standards. The UK has yet to comply with these new requirements.

In Europe, North American crayfish species including the Signal crayfish *(Pacifastacus leniusculus)* and Red swamp crayfish *(Procambarus clarkii)* pose a particular threat to native wildlife. An estimated annual cost of €454 million is incurred due to the damage caused by and/or the control of these two crayfish species [20]. The situation is so dire that to save the native crayfish from extinction we must rescue at risk populations from their rivers and streams and translocate them to distant water bodies – Ark Sites – where they will be safer.

Aquatic organisms are accidentally transported between water-bodies by recreational water users. The introduction of invasive non-native species to freshwater ecosystems leads to a reduction in species richness and abundance, with mayflies, caddisflies, snails, freshwater shrimps and other crustaceans being particularly vulnerable – it is also likely that invasive clams have caused the extinction of Witham orb mussel. Many non-native species originate from the region around the Black and Caspian Seas, with over a hundred freshwater species known to have spread from there to date [21].

Water-bodies in South East England are most at risk from invasive invertebrates. The presence of invasive species such as the Quagga mussel *(Dreissena bugensis)* could, by providing a favourable substrate, enable other invasive species to establish more easily [22]. Freshwater species make up almost half of the species identified by Buglife as being of most concern to the UK [23].

Eradicating invasive species after they have become established can be expensive or impossible, and so preventing the spread of invasive non-native species is key to limiting harm. Improved biosecurity practices are essential. For aquatic ecosystems the GB Non-Native Species Secretariat promotes the 'Check, Clean, Dry' message. Whilst there is evidence that some water users are heeding this advice, more needs to be done to spread this message, and the effectiveness of this approach needs to be reviewed regularly and new measures introduced if it is failing to prevent freshwater invasions.

Signal crayfish © Pete Sibley

What has to happen?

- **Biosecurity plans focused on the main pathways of introduction must be implemented to prevent the establishment of INNS, this will require the establishment of a new biosecurity inspectorate.**
- **The importation of live plants in growing media must be halted.**
- **Resources must be made available to implement the Convention on Ballast Water.**
- **The effectiveness of the 'Check, Clean, Dry' message must be reviewed regularly and new measures introduced if it is failing to prevent freshwater invasions.**
- **Recently arrived INNS must be eradicated at the earliest opportunity.**
- **Established INNS must be contained, and eradicated wherever possible.**

Dragonflies in Dew © Lynne Newton

"We will conserve only what we love; we will love only what we understand" Baba Dioum (1968)

We need to act now to stop insectinction. However, the scale and quality of that action is still limited by society's lack of understanding and awareness. Unless we understand the needs of insects we cannot act effectively. If society's attitudes are dominated by prejudice and ignorance, rather than enlightenment and knowledge, then we will fail to achieve a happy coexistence with nature.

Girls catching butterflies © Buglife

Big-up small animals

Although insects and other invertebrates are essential for our survival, and over 99% of species are beneficial, people often first think of harmful or unloved species. While attitudes are changing – in particularly with regard to bees – insects still have an image problem that must be addressed.

It is still the case that huge vested interests make massive profits by killing insects. This can have direct impacts on wildlife, but the PR produced by these industries also serves to taint our attitude towards small animals and encourage prejudice. Newspapers also find that scary stories about small animals sell papers and website visits and they are willing to produce stories that ignore science, evidence and the bigger environmental picture to exploit the fears of individuals.

Collective understanding of the harm caused by habitat loss and damage, light pollution, pesticides, invasive species and other factors will be key to securing behaviour change and support for measures that may have financial and societal implications.

Attitudes can change and raising awareness of the wonder, beauty and essential roles of invertebrates will develop greater tolerance and respect for insects and other invertebrates.

What has to happen?

- **People's awareness, knowledge and appreciation of invertebrates must be improved to counter the negative preconceptions.**
- **The transformation in attitudes and willingness to act that has happened with bees must be spread to other groups of insects and invertebrates.**

Wood ant © Gabor Pozgai

Improve our knowledge

Knowledge is key to people being able to take effective action to protect and sustain insect populations. Insects are a highly diverse group that is subject to variable levels of recording, monitoring and popularity. Some have national recording schemes and are served by good species identification resources (e.g. butterflies, moths, hoverflies, bumblebees). But many key insect groups are not well recorded or monitored and identification resources are either unavailable or difficult to use. The design of monitoring schemes is critical to the type and quality of data collected, and the right sort of monitoring will provide sound information for gauging how insects are faring, and/or determining what we can do to protect and enhance their populations. We must keep track of insect populations, just as we would track any other key environmental or economic asset.

We know that habitat loss and fragmentation, pollution and climate change are major factors working in conjunction to cause declines. However, there remain significant gaps in knowledge and understanding about what aspects of these factors are most significant and which habitats and habitat features are crucial for maintaining and restoring insect populations. In addition the impacts of emerging factors such as imported diseases, invasive species and 5G radiation are poorly understood. A better understanding of insect ecology and the causes of decline will enable the design and implementation of conservation measures.

While general improvements to the room we provide for insects to thrive, and the safety of this space, will help most species, there are many specific interventions required – for instance, providing particular habitat requirements, such as continuity of the right types of dead wood for internationally threatened beetles that survive on a handful of refuges. We have to foster an understanding relationship with the species we have pushed to the edge and make sure that we are looking after them.

The fate of species is the bottom line of nature conservation – their status is the tell-tale for how well we are looking after our land and water.

What has to happen?

- **More investment is needed in the basics – taxonomy and DNA work can define new species and enable them to be easily identified, while ecological research can help us understand how to conserve them.**
- **More funding is required for monitoring schemes for pollinators (particularly PoMS, the national Pollinator Monitoring Scheme), riverflies and other invertebrate groups, so that they can provide the information required for us to know whether our actions are making a difference.**
- **Long-term investment into independent science must be increased so that the causes of decline in individual species, and the loss of bioabundance in different circumstances, can be thoroughly investigated.**
- **Conservation status reviews should be completed for all insect groups and reviewed regularly.**
- **An international conference, involving leading scientists and decision makers, must be convened to exchange and spread knowledge about solving the insect decline crisis.**

Appendix: The evidence of declines

Many scientific studies from countries around the world reveal big declines in insect populations. Knowledge will never be complete and there are several groups of insects that have not been assessed, and many countries with no-data. The bulk of authoritative insect decline reports come from Britain and other European countries.

As early as 2004 a study by Professor Jeremy Thomas and other leading British ecologists suggested that global extinction rates of vertebrate and plant species had a parallel among insects and that these small animals may be in even greater trouble [24].

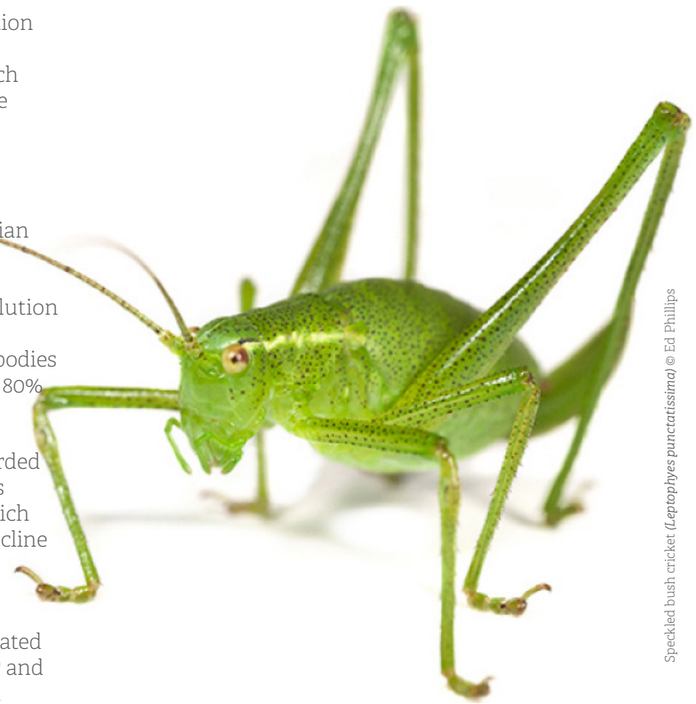
Recent global "meta-studies" and reviews have confirmed the depth of the insect crisis:

- 67% of monitored invertebrate populations with a mean abundance decline of 45% [25].
- A collation of 73 studies which found that the rate of local insect extinction was eight times faster than that of vertebrates, and insects were declining on average by 2.5% each year, with 40 per cent of the world's insect species threatened with extinction in coming decades [26].
- Reports that the current diminishment of insects would lead to the collapse of food webs and accelerate the sixth great extinction [27].
- The abundance and biomass of terrestrial insects is declining by almost 1% per year, with a 25% loss in the last 30 years [28].

Specific studies that raise the greatest alarm for the future of insect populations include:

- The 'Krefeld report' which found a 76% drop in flying insect biomass on nature reserves in Germany in just 27 years [29].
- The EU indicator for grassland butterfly species - abundance across 16 countries and 17 species - fell by 39% between 1990 and 2017 [30].
- The State of the UK's Butterflies showed that 76% of the UK's 59 butterfly species declined in either abundance or distribution between 1976 and 2014 [31].
- 337 moth species caught in UK Rothamsted light traps, 66% were declining: 80 species by 70% and 20 of those by over 90% [32].
- The State of Britain's Larger Moths showed that 66% of Britain's common and widespread larger moths had declined [33].
- The UK national pollinator indicator combines distribution data for 365 UK species of bees and hoverflies. In 2016 the indicator had declined by 31% compared to 1980, with 10% of that in the last 6 years [34].
- Anders Møller systematically counted insects that hit his car windscreen during 1,375 journeys on a 1.2 km route in North Denmark between 1997–2017 and found an 80% decline [35].
- In the Netherlands at single sites, in the previous decade the annual decline rate was 3.8% for macro-moths, beetles 5%, and caddisflies 9.2%, while ground beetle numbers declined by 4.3% per year, 1985-2016 [36].
- 75% of 68 ground beetle species declined over 15 years in the UK [37]. But the big declines in arable populations probably happened decades ago, in Germany arable ground beetle numbers dropped by 81% between 1971 and 1982 [38].
- 82% of dung beetles Spain have declined and 55% in Italy [39 40].
- 56% of UK and 50% of Czech common ladybird species were reported to be in decline [41].
- A study in a Puerto Rican rainforest comparing 1976-77 to 2011-13 found declines of 97 and 98% in the biomass of insects in sweep nets, and 86 and 62% less on sticky traps (July and January data respectively) [42].
- A survey in 2000 of fishermen and their experience with mayflies on southern UK chalk streams indicated that these aquatic insects had declined by 66% since 1945 [43].
- There was a massive decline in the distribution of UK aquatic species from 1970 to 1995, but species have spread again and made up much of the lost ground [44 45]. In addition, across the globe the abundance of aquatic insects is increasing by 11% per decade, but this is based largely on long-term studies of lakes, rivers recovering from mining damage and mosquito populations in America, and Russian reservoirs [28].
- While rivers and lakes benefit from anti-pollution laws, most aquatic insects live in smaller waterbodies. For instance, 97% of UK waterbodies are ponds and a 2010 review concluded that 80% were in poor, or very poor condition [46].
- A 1969–2010 study of a German stream, recorded an insect abundance decline of 81.6% [47]. This appeared to be linked to climate change, which chimes with a study of insect abundance decline in headland streams in central Wales that estimated a 21% decline for every 1°C rise [48].
- In Japan persistent insecticides have devastated once abundant populations of dragonflies [49] and destroyed fly populations and an associated fishery [50].

It is important to note that while many species are increasing, there are no other published studies across many sites and broad groups of insect species that paint a picture that is incompatible with widespread, long-term, declines in the ranges, abundance and biomass of insects.



Speckled bush cricket (*Leptophyes punctatissima*) © Ed Phillips

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