International scientists formulate a roadmap for insect conservation and recovery

To the Editor — A growing number of studies are providing evidence that a suite of anthropogenic stressors — habitat loss and fragmentation, pollution, invasive species, climate change and overharvesting — are seriously reducing insect and other invertebrate abundance, diversity and biomass across the biosphere[1–8]. These declines affect all functional groups: herbivores, detritivores, parasitoids, predators and pollinators. Insects are vitally important in a wide range of ecosystem services[9] of which some are vitally important for food production and security (for example, pollination and pest control)[10]. There is now a strong scientific consensus that the decline of insects, other arthropods and biodiversity as a whole, is a very real and serious threat that society must urgently address[11–13]. In response to the increasing public awareness of the problem, the German government is committing funds to combat and reverse declining insect numbers[13]. This funding should act as a clarion call to other nations across the world — especially wealthier ones — to follow suit and to respond proactively to the crisis by addressing the known and suspected threats and implementing solutions.

We hereby propose a global 'roadmap' for insect conservation and recovery (Fig. 1). This entails the immediate implementation of several 'no-regret' measures (Fig. 1, step 1) that will act to slow or stop insect declines. Among the initiatives we encourage are the following immediate measures:

Taking aggressive steps to reduce greenhouse gas emissions; reversing recent trends in agricultural intensification including reduced application of synthetic pesticides and fertilizers and pursuing their replacement with agro-ecological measures; promoting the diversification and maintenance of locally adapted land-use techniques; increasing landscape heterogeneity through the maintenance of natural areas within the landscape matrix and ensuring the retention and creation of microhabitats within habitats which may be increasingly important for insects during extreme climatic events such as droughts or heatwaves; reducing identified local threats such as light, water or noise pollution, invasive species and so on; prioritizing the import of goods that are not produced at the cost of healthy, species-rich ecosystems; designing and deploying policies (for example, subsidies and taxation) to induce the innovation and adoption of insect-friendly technologies; enforcing stricter measures to reduce the introduction of alien species, and prioritizing nature-based tactics for their (long-term) mitigation; compiling and implementing conservation strategies for species that are vulnerable, threatened or endangered; funding educational and outreach programs, including those tailored to the needs of the wider public, farmers, land managers, decision makers and conservation professionals; enhancing 'citizen science' or 'community science' as a way of obtaining more data on insect diversity and abundance as well as engaging the public, especially in areas where academic or professional infrastructure is lacking; devising and deploying measures across agricultural and food value chains that favour insect-friendly farming, including tracking, labelling, certification and insurance schemes or outcome-based incentives that facilitate behavioural changes, and investing in capacity building to create a new generation of insect conservationists and providing knowledge and skills to existing professionals (particularly in developing countries).

To better understand changes in insect abundance and diversity, research should aim to prioritize the following areas:

Quantifying temporal trends in insect abundance, diversity and biomass by extracting long-term datasets from existing insect collections to inform new censuses; exploring the relative contributions of different anthropogenic stressors causing insect declines within and across different taxa; initiating long-term studies comparing insect abundance and diversity in different habitats and ecosystems along a management-intensity gradient and at the intersection of agricultural and natural habitats; designing and validating insect-friendly techniques that are effective, locally relevant and economically sound in agriculture, managed habitats and urban environments; promoting and applying standardized monitoring protocols globally and establishing long-term monitoring plots or sites based on such protocols, as well as increasing support for existing monitoring efforts; establishing an international governing body under the auspices of existing bodies (for example, the United Nations Environment Programme (UNEP) or the International Union for Conservation of Nature (IUCN)) that is accountable for documenting and monitoring the effects of proposed solutions on insect biodiversity in the longer term; launching public–private partnerships and sustainable financing initiatives with the aim of restoring, protecting and creating new vital insect habitats as well as managing key threats; increasing exploration and research to improve biodiversity assessments, with a focus on regional capacity building in understudied and neglected areas, and performing large-scale assessments of the conservation status of insect groups to help define priority species, areas and issues.

Most importantly, we should not wait to act until we have addressed every key knowledge gap. We currently have enough information on some key causes of insect decline to formulate no-regret solutions whilst more data are compiled for lesser-known taxa and regions and long-term data are aggregated and assessed. Implementation should be accompanied by research that examines impacts, the results of which can be used to modify and improve the implementation of effective measures. Furthermore, such a 'learning-by-doing' approach ensures that these conservation strategies are robust to newly emerging pressures and threats. We must act now. ❒

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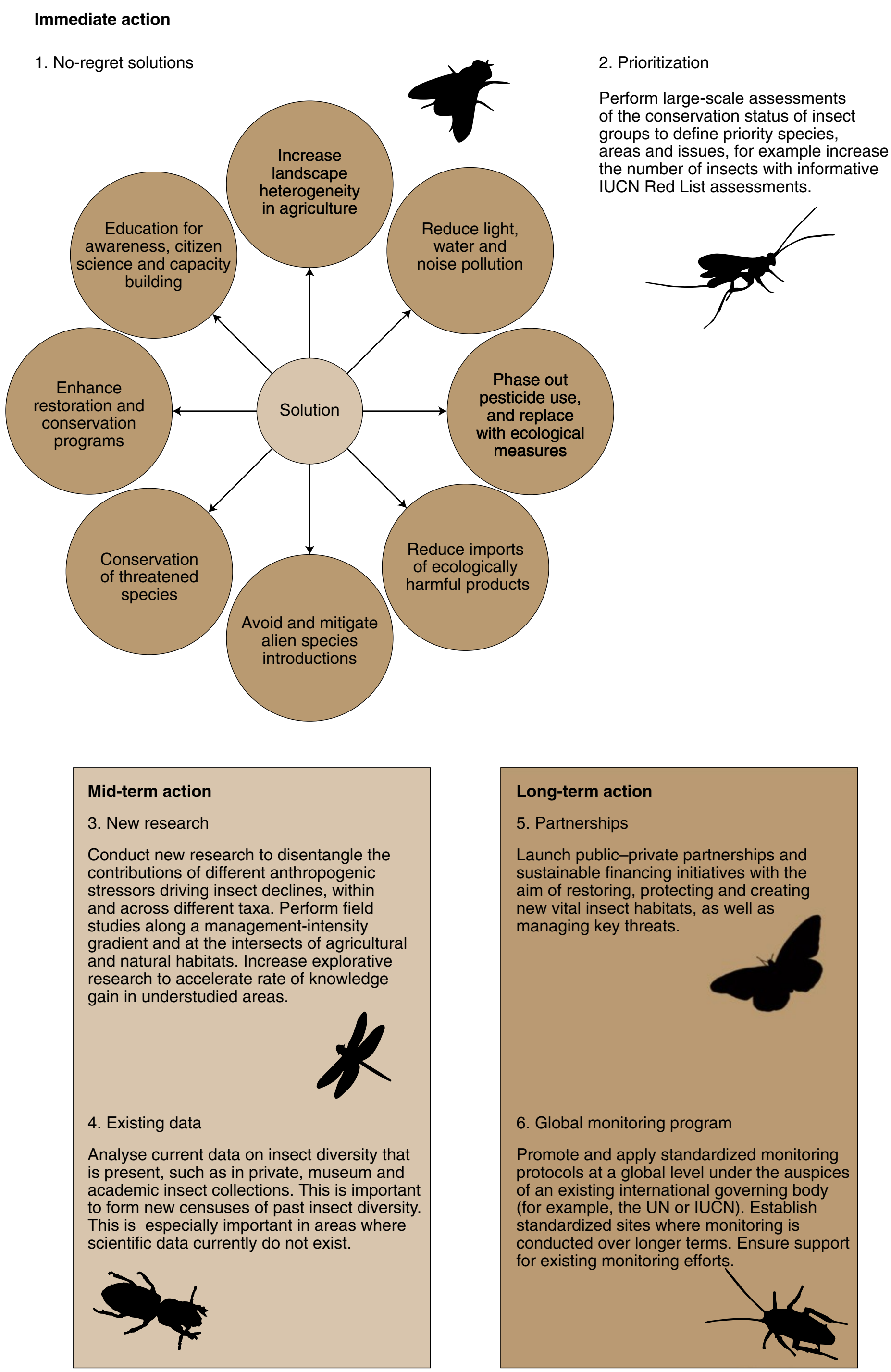

Fig. 1 | Roadmap to insect conservation and recovery, calling for action at short-, intermediate- and long-term timescales. No-regret measures for immediate utilization in insect conservation refer to actions that should be implemented as soon as possible. These solutions will be beneficial to society and biodiversity even if the direct effects on insects are not known as of yet (that is, no-regret solutions). This encompasses utilization of insect-friendly techniques that are effective, locally relevant and economically sound, for example, in farming, habitat management and urban development.

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Competing interests

The authors declare no competing interests.