The Global Insect Decline Phenomenon

Moderators and Organizers: David Wagner[2], Eliza Grames[3] and Heikki Hokkanen[1], [1]Organizer, Finland, [2]University of Connecticut, United States, [3]University of Nevada, Reno

Symposium 3:
Consequences of Declines and Solutions

13:35 **0132** The Global Insect Decline Phenomenon: Consequences of Declines and Solutions

13:40 **0133** Pollinator decline – a case study of the need for transformative change to avert biodiversity loss. **Lynn Dicks**, University of Cambridge

13:50 **0134** Green is good, grey is bad? - Landscape-level drivers of flying insect biomass. **Cecilie Svenningsen[2]**, Anders Tøttrup[2] and Diana Bowler[1], [1] German Centre for Integrative Biodiversity Research (iDiv), [2]Natural History Museum of Denmark

14:05 **0135** Cascading effects of insect decline on insectivorous birds. **Chris Elphick[1]**, Eliza Grames[2], [1]University of Connecticut, [2]University of Nevada, Reno

14:20 **0136** Abundance decline corresponds with reduced biodiversity in hoverflies, but not in aquatic insects. **Eelke Jongejans**, Radboud University

14:35 **0137** Habitat management to enhance insect adaptation to climate change and climatic extremes. **Jeffrey Harvey**, Netherlands Institute of Ecology

14:50 **0138** Integrating heterogenous data sources to assess the status and risk of butterflies to Anthropogenic threats in the western United States. **Christopher Halsch[4]**, Arthur Shapiro[3], Cas Carroll[4], Eliza Grames[5], Jeffrey Glassberg[1], Jing Zhang[7], Joshua Jahner[9], Katherine Bell[4], Kevin Burls[10], Matthew Forister[4], Nick Grishin[6], Qian Cong[8], Taylor Bradford[4] and Thomas Riecke[2], [10]Xerces Society for Insect Conservation, [1]North American Butterfly Association, [2]Swiss Ornithological Institute, [3]University of California Davis, [4]University of Nevada Reno, [5]University of Nevada, Reno, [6]University of Texas Southwest Medical Center, [7]University of Texas Southwest Medical Centerriculture, Key Laboratory of Natural Pesticide and Chemical Biology, [8]University of Washington, [9]University of Wyoming

15:05 **0139** Time-series to study insect decline. **Jan Christian Habel**, University of Salzburg

15:20 **0140** Eight simple actions that individuals can take to save insects from global declines. **Akito Kawahara**, Florida Museum of Natural History

15:35 **0141** Closing remarks

15:40 **0142** Afternoon break

16:00 **0143** Panel discussion

Available Abstracts from Symposium 3 of ”The Global Insect Decline Phenomenon” [from the ICE2022 Book of Abstracts]

Pollinator decline – a case study of the need for transformative change to avert biodiversity loss

Authors: Dicks Lynn, University of Cambridge, United Kingdom

Abstract: Decline in pollinating animals has become a prominent example of how biodiversity loss can affect humanity, usually with reference to the potential impacts of pollinator decline on food production. This talk will provide an overview of the state of knowledge on pollinators, including their conservation status, drivers of pollinator declines, and the policy responses underway through national and international strategies and action plans. I will present a global assessment of the relative importance of direct drivers of pollinator decline and ten consequent risks to human well-being, based on a formal expert elicitation process. Our results indicate that policy responses should focus on reducing pressure from changes in land cover, land management and pesticides. We reveal how the risks from pollinator decline differ among regions, with perceived risks substantially higher in the Global South. I will argue that the focus on food production, while providing an important economic argument for looking after some pollinators, does not address all aspects of the problem. Rather, addressing and reversing pollinator declines requires a multi-scale, hierarchical response that tackles both direct and indirect drivers of decline, and takes into account the many values of pollinating animals, beyond their direct contributions to food production.

Green is good, grey is bad? - Landscape-level drivers of flying insect biomass

Authors: Svenningsen Cecilie[3], Tøttrup Anders[2] and Bowler Diana[1], [1] German Centre for Integrative Biodiversity Research (iDiv), [2]Natural History Museum of Denmark, [3]Natural History Museum of Denmark, Denmark

Abstract: The proportion of the Earth that is actively managed by humans continues to increase, with at least three-quarters of the global land area currently affected by human activities. Although biodiversity decline is linked to human activities, most evidence is derived from studies on plants and vertebrates with large data gaps on insects.

In this study, we investigated how land cover and land use affects flying insect biomass. To examine landscape level effects, we engaged citizen scientists in Denmark and Germany to sample flying insects using car nets along five km routes during the summer of 2018. We then extracted land use data from various sources, to examine how urban, farmland, grassland, wetland and forest affect flying insect biomass from a local (50 m) to a landscape (1000 m) scale.

By sampling across long transects of both grey and green urban areas, we show clear effects of reduced biomass associated with urban cover that were not evidenced before across a spatial large scale. In addition, we find that semi-natural areas, especially grassland and wetland, have higher insect biomass per relative percentage cover than both urban and farmland areas, signaling their importance for insect conservation.

Cascading effects of insect decline on insectivorous birds

Authors: Elphick Chris[1] and Grames Eliza[2], [1]University of Connecticut, United States, [2]University of Nevada, Reno, United States

Abstract: Declines in the abundance and biomass of insects and other invertebrates could have profound impacts on insectivorous species and disrupt population processes at higher trophic levels. Many birds feed on insects throughout their annual cycle, especially during reproduction when invertebrates provide necessary protein for chick rearing. It is, perhaps, no surprise then, that concurrent with declines in insect abundance and diversity over the past half century there have been parallel declines in insectivorous birds. Through a systematic review and meta-analysis, we investigated the potential for insect decline to result in parallel declines in insectivorous birds through the proximate mechanisms of reproductive success and chick body condition, the latter of which is linked to annual survival and juvenile recruitment. We found a strong positive effect of insect food availability on bird body condition and reproductive success, providing strong evidence for what has long been assumed: protein food is limiting for many songbirds during the breeding season. The results of our meta-analysis suggest that recent downward trends in insectivorous bird populations can be partially attributed to insect declines, and that future declines in insect abundance and diversity could cause severe consequences for insectivores.

Abundance decline corresponds with reduced biodiversity in hoverflies, but not in aquatic insects

Authors: Jongejans Eelke, Radboud University, Netherlands

Abstract: Whether declines in insect abundance reflect biodiversity loss is still an open question. We analyse the abundance of hoverflies, at six locations in wet or tall perennial meadows in the German Wahnbachtal in 1989 and 2014, and over multiple years since 1982 in a Dutch forest. We show isometric decline rates between total insect biomass and total hoverfly abundance and a scale-dependent decline in species richness, ranging between –23% over the season to –82% at the daily level. Observed persistence rates were disproportionately lower than expected for species of intermediate abundance, while the rarest species showed decline and appearance rates consistent with random expectation. Contrastingly, aquatic insect communities in the Netherlands showed increasing richness and diversity since 1990, even though abundance declined by -55%. Improved water quality after heavily polluted and eutrophic conditions by the 1980s, can explain much of these patterns. Abundant taxa that tolerate poor water quality declined strongly, while positive indicator taxa were found more often and increased in abundance. This suggests that insect communities can bounce back at least partially when proper management is applied. Adequate target values for pristine communities are lacking though, while water quality is still insufficient in half of the samples.

Habitat management to enhance insect adaptation to climate change and climatic extremes

Authors: Harvey Jeffrey, Netherlands Institute of Ecology, Netherlands

Abstract: Climate change is one of the greatest threats to biodiversity at all levels of organization. The biosphere has not only been warming over the past several decades, but short-term climatic extremes – in particular heatwaves – are increasing in frequency, intensity and duration. Warming over variable temporal scales poses different kinds of threats to ectotherms like insects. Over longer timescales, insects need to adjust their life-cycles over the course of a growing season, or else alter their distributions pole-wards or to higher elevations to track increasing temperatures to which they are best adapted. This poses a challenge of ensuring that they are also able to find and exploit resources (i.e. food plants, prey, hosts) that are essential for their survival. Heatwaves pose a more immediate threat to their survival, because they can push insects above thermal limits for survival and reproduction. Here, I discuss habitat management strategies to enhance insect resilience to both incipient, longer-term warming and climatic extremes.

Integrating heterogenous data sources to assess the status and risk of butterflies to Anthropogenic threats in the western United States

Authors: Forister Matthew[4], Halsch Christopher[4], Grames Eliza[4], Burls Kevin[8], Carroll Cas[4], Bell Katherine[4], Jahner Joshua[7], Bradford Taylor[4], Zhang Jing[5], Cong Qian[6], Grishin Nick[5], Glassberg Jeffrey[1], Shapiro Arthur[3] and Riecke Thomas[2], [1]North American Butterfly Association, [2]Swiss Ornithological Institute, [3]University of California Davis, [4]University of Nevada Reno, United States, [5]University of Texas Southwest Medical Center, [6]University of Washington, [7]University of Wyoming, [8]Xerces Society for Insect Conservation

Abstract: Ongoing declines in insect populations have led to calls for action. However, even for relatively well-studied groups, like butterflies, information relevant to species-specific status and risk is mostly scattered in field guides, the scientific literature, and agency reports. Thus much attention and resources have been spent on a vanishingly small fraction of insect diversity, including a few well known butterflies like the monarch (Danaus plexippus). Here we bring together heterogenous sources of information for 396 species to provide what is, to our knowledge, the first regional assessment of butterflies for the 11 western US states. For 183 species, we use observational data (e.g., from monitoring programs) to characterize historical and projected trends in population abundance; for another 213 species (for which observational data is not available), we use exposure to climate change, development, geographic range, host breadth and other factors to rank species for conservation concern. We also organize information relevant to subspecific risk and prioritize a top 30 subspecies for further attention. Notably, many of these species have broad geographic ranges, which perhaps highlights a new era of insect conservation in which small or fragmented ranges will not be the only red flags that attract conservation attention.

Time-series to study insect decline

Authors: Habel Jan Christian, University of Salzburg

Abstract: Historical data sets show a rapid and continuous decline in insect diversity. Large data sets collected over long time periods and across large spatial scales show a dramatic decline in insect diversity as well as abundance and thus biomass during the past decades. In addition, species communities are changing significantly, proving that numerous species are suffering from agricultural intensification. Here, in particular specialist species are vanishing rapidly acorss landscapes. An assessment of the current situation and an estimation of future trends is only possible by considering historical data sets collected over several decades.

Eight simple actions that individuals can take to save insects from global declines

Authors: Kawahara Akito, Florida Museum of Natural History, United States

Abstract: Insects constitute the majority of known animal species and are ubiquitous across terrestrial ecosystems, playing key ecological roles. As prey, they are critical to the survival of countless other species, including the majority of bats, birds, and freshwater fishes. As herbivores, predators, and parasites, they are major determinants of innumerable plants and animals. The majority of flowering plants, the dominant component of most terrestrial ecosystems, depend on insects for pollination and hence reproduction. As consumers of waste products, insects are essential to the recycling of nutrients. Humans and their agriculture rely heavily on such “ecosystem services” provided by insects. Even as insects gain recognition as essential members of ecosystems, a concern has arisen that their diversity and abundance may be in global decline. There is every reason to suspect that such forces, combined with human population growth and urbanization, are leading to declines among insects and many other organisms. To help individuals broaden participation in the conservation of insects and to promote the adoption of behaviors and habits expected to mitigate insect declines, we propose eight simple actions, most with immediate impact, that many people can undertake on their own, regardless of background, occupation, or geographic location.