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Index

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Cover Picture: Mediterranean Potter Wasp, *Rhynchium oculatus*, photographed by Ian Spilsbury in Penkridge, England. Submitted to the Society's Insect Identification Service (see article, page 48).

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External Meeting



Parnassius apollo (Photo: Martin Partridge)

Saving the apollos and their allies: An online conference

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In June 2024, we organised an online conference to draw international attention to the lesser-known swallowtail butterflies in the monotypic subfamily Baroniinae (*Baronia* of Mexico) and the eight genera belonging to the subfamily Parnassiinae (apollos and their allies) (SBBT, 2024). This was a challenging topic to choose, with researchers and conservationists relatively few and far between. Nevertheless, in addition to a welcome presentation and an introductory overview, nine international video presentations were secured in time for *World Swallowtail Day* on 8th June and launched on the Swallowtail and Birdwing Butterfly Trust's (SBBT) YouTube channel. This article summarises the presentations to build interest in the ecology and conservation of these often-threatened butterflies and to draw attention to the excellent research being conducted around the globe.

The conference followed a pioneering online event held in 2021, where 15 speakers shared their firsthand experiences in grassroots swallowtail conservation and research – protecting habitats and food plants, preventing commercial exploitation, planning conservation strategies, advocating for change, and educating young people. Most species discussed in that first event belonged to the subfamily Papilioninae, from the tribes Leptocircini and Troidini, which includes *Parides* and the birdwings, and their allies, and the Papilionini, the so-called 'true' swallowtails in the much-divided genus *Papilio*. The talks remain available online and are summarised in an earlier report in *Antenna* (Collins, 2021).

Many rare papilionids are confined to small islands where agriculture and deforestation threaten tiny areas of remaining habitat (Collins & Morris, 1985). As

we shall see from the data gathered during this conference, the Parnassiinae are not denizens of islands, at least not islands surrounded by sea, but they often do inhabit the equivalent of islands, confined to isolated forests, valleys or mountains surrounded by vast continents in the northern hemisphere. This makes them vulnerable to the localised floods, droughts, landslides and forest fires that all too often result from climate change. Over time, many will be forced to retreat, together with their foodplants, to more northerly latitudes or higher altitudes, assuming suitable habitat is available for them.

Commercial collecting has long been another problem for the apollos and their allies, and it remains so today despite the work of the Convention on International Trade in Endangered Species (CITES), which listed *Parnassius apollo* in Appendix II as long ago as 1977. Many



Parnassius stubbendorfi (Photo: Mike Friel)

parnassians sell for significant sums on the international market – money that would generally be better spent on research and conservation.

Below are short summaries of the presentations, but they are no substitute for the talks themselves, which are of excellent quality. Many of them discuss poorly studied species and habitats, often in rugged, hard-to-reach locations. They are a tribute to the perseverance and conscientiousness of our swallowtail conservation and research community and show us the way forward for future research and action.

Diversity and geography of the apollos and their allies, by Dr Dick Vane-Wright, University of Kent and the Natural History Museum London, UK

This talk provides an overview of the evolutionary history and global distribution of the Papilionidae. The speaker relates how this family, which originated in the mid-Cretaceous, some 100 million years ago, shows an overall latitudinal diversity pattern, with species richness highest near the equator and declining at higher latitudes, both north and south of the Equator (Scriber, 1973). Dick discusses the

significance of butterfly–plant relations, questioning if butterflies coevolved with flowering plants or merely radiated onto them as a pre-existing resource (Condamine *et al.*, 2018). He highlights the challenge of extinction in a biogeographical context, stressing the importance of conservation and the need to prevent the loss of these ecologically important insects through human activities. He introduces the subfamilies Baroniinae (now only represented by the monotypic Mexican endemic, *Baronia*) (Marino *et al.*, 2023) and the Parnassiinae, which are entirely confined to the Northern Hemisphere. The latter comprise the numerous apollos (genus *Parnassius*) found in temperate North America and Eurasia, and seven much smaller, exclusively Old World genera: the western *Zerynthia*, *Archon*, *Allancastris* and *Hypermnestra*, and the eastern *Sericanus*, *Luehdorfia* and *Bhutanitis*.

Phylogenomics of Parnassiinae, by Noémie Hévin, CNRS, Montpellier, France

The speaker focuses on her research on the phylogenomics and diversification of the Parnassiinae, particularly exploring their evolutionary history

using genomic data. The subfamily includes eight genera and upwards of 70 species (Nazari *et al.*, 2007), with *Parnassius* being the most diverse. In most cases, the larvae are specialists on toxic host plants, particularly *Aristolochia* and other genera in the Aristolochiaceae, but *Hypermnestra* favours the Zygophyllaceae, while *Parnassius* species feed on Papaveraceae and Crassulaceae. Parnassiines are remarkable for their adaptation to high-altitude environments, particularly around the Tibetan plateau and the Himalayas. Hévin's study focuses on reconstructing a comprehensive phylogeny of these butterflies using both short-read Illumina and long-read Nanopore sequencing methods. So far, her team has collected 400 specimens and sequenced five high-quality reference genomes and 140 short-read genomes. Preliminary phylogenetic trees, based on mitochondrial and nuclear genomes, offer some insights into species relationships and possible cryptic species within the group. The study aims to refine the understanding of species boundaries and contribute to conservation efforts, particularly as some species face clear threats from climate change.

Population dynamics of alpine *Parnassius smintheus* butterflies, by Prof. Jens Roland, University of Alberta, Canada

Prof. Roland presents his long-term study on the population dynamics of Alpine *Parnassius smintheus* butterflies in the Rocky Mountains of Canada, focusing on habitat fragmentation and climate change impacts (Roland & Matter, 2007). The research, spanning 29 years, in collaboration with Drs Steve Matter (University of Cincinnati) and Nusha Keyghobadi (Western University), has involved over 24,000 individual butterflies from 21 subpopulations. Roland highlighted how rising treelines due to climate warming reduce connectivity among butterfly populations, limiting dispersal and gene flow. Mark-recapture methods revealed that forests hinder movement more than do open meadows, potentially increasing the risk of local extinctions due to reduced recolonisation. Additionally, he explored the influence of weather, particularly winter conditions, on population change. Using models and machine learning, his team found that November temperatures and winter snowfall are key survival indicators. A seven-year experiment confirmed that snow cover influences egg survival, significantly impacting populations (Roland & Matter, 2016). Overall, Roland's findings emphasise the critical role of habitat connectivity and winter weather in butterfly population dynamics amidst a changing alpine environment.

Metapopulation context in Apollo butterfly conservation – a case from the Pieniny National Park, by Pawel Adamski, Institute of Nature Conservation, Poland

The speaker discusses his 50-year project to restore Apollo butterfly populations in Poland's Pieniny National Park. He highlights the importance of metapopulation dynamics for this species, which thrives in mountainous habitats. Due to climate change and land-use shifts, suitable areas for the butterflies have drastically shrunk in size and become fragmented. By the early 1990s, the population dwindled to just 30 individuals. A restoration programme began in



Bhutanitis lidderdalii (Photo: Sonam Dorji)

1992, aiming to restore Apollo populations to levels seen in the 1950s and 1960s. The effort involved improving habitat structure and reintroducing interpopulation movement to maintain genetic diversity and dispersal (Adamski & Witkowski, 2007). Key challenges included reversing behavioural changes that reduced migration tendencies. The project saw success by introducing individuals from other viable populations, which re-established migration behaviour. The author emphasises that conservation efforts must consider both habitat restoration and behavioural mechanisms if species like the Apollo butterfly are to thrive (Adamski & Ćmiel, 2022).

Challenges and limitations in managing the Apollo butterfly in Mediterranean habitats, by Joaquín Baxeras, University of Valencia, Spain

The speaker discusses the conservation of *Parnassius*

apollo, the Apollo butterfly, in Mediterranean habitats, particularly at high altitudes around Valencia in Spain. This butterfly has been protected since the 1930s and is classified as vulnerable in regional and international conservation assessments. The presentation highlights the distribution, biology and conservation challenges faced by the species, emphasising threats such as habitat loss, pollution and climate change, which impact its food plants and reproductive cycles. Conservation efforts, including population monitoring and reintroduction programmes, have been implemented to restore populations. The speaker concludes by stressing the need for ongoing research and habitat management to support the butterfly's recovery and lifecycle, highlighting the importance of nectar availability and the removal of competing vegetation (Nakonieczny *et al.*, 2007).



On the Edge: *Archon*, *Allancastris* and *Zerynthia* in Eastern Europe, by Dr Michael de Courcy Williams, Independent Entomologist, Greece

The speaker focuses on the diversity and ecology of three butterfly genera: *Archon*, the False Apollo, and *Allancastris* and *Zerynthia*, the festoons, all of which have striking colour patterns, and many of which are narrowly endemic, with limited geographical distribution across Europe and the Middle East (von Stetten & Bozano, 2021). The talk explores their evolutionary relationships through phylogenetic analysis based on genetic sequencing. Dr de Courcy Williams also delves into their ecological significance, particularly their reliance on *Aristolochia* plants as food sources. He describes the unique pollination mechanism of these foodplants, which attract specific fly species using mimics of alarm pheromones produced by insects attacked by other insect

predators (Oelschlägel *et al.*, 2014). The talk concludes by addressing conservation concerns, particularly the threats posed by habitat loss due to wildfires, exemplified by the devastating fire in Greece in 2023, which severely impacted the habitats and populations of *Archon apollinus*, *Allancastris cerysi* and *Zerynthia polyzena*.

***Bhutanitis* in China – conservation and challenges, by Dr Shao-Ji Hu, Yunnan University, China**

The butterfly genus *Bhutanitis* demonstrates and exemplifies Sino-Himalayan biodiversity, being distributed across China, India, Bhutan, Nepal and Thailand, with distinct populations affected by habitat degradation and extinction events, such as the 1983 forest fire in Thailand (von Stetten & Bozano, 2021). Four species exist in China, with their habitats primarily in medium and low-altitude evergreen forests (Wu and Hsu, 2017). Despite their national protection since 1989, illegal collecting and habitat loss due to agriculture and construction pose significant threats. Climate change exacerbates these issues, isolating populations and limiting genetic diversity (Hu *et al.*, 2019). Although conservation efforts have improved the appreciation of *Bhutanitis*, challenges remain,

including the need for further research on genetic diversity, human impact, and ecological resilience to climate change (Wang *et al.*, 2020). Effective conservation strategies must involve local communities and address sustainable collection practices to protect these vulnerable species from ongoing threats.

The Ecology and Conservation of *Parnassius*, *Luehdorfia* and *Sericanus* in Japan, by Motoki Saito, Butterfly Society of Japan

The speaker, a TV journalist and long-term butterfly enthusiast, discusses the ecology and conservation of Japanese parnassiine butterflies, focusing on the genera *Parnassius*, *Luehdorfia* and *Sericanus* (Park *et al.*, 2023). He provides a brief overview of Japan's diverse butterfly species, highlighting the country's rich biodiversity due to its varying climate. He details the three *Parnassius* species (Nagata, 2024), emphasising their unique wing patterns and their abundance, requiring no conservation efforts. Saito introduces *Luehdorfia* and its two species, *L. japonica*, endemic to Honshu, Japan, and *L. puziloi*, introduced from Korea. Neither species is considered to be threatened. He focuses on two species that are in less happy circumstances, *Parnassius*



Sericanus montella (Photo: Mike Friel)

eversmanni and *Luehdorfia japonica*, detailing their limited distributions, life cycles, and threats from climate change and deer overpopulation (Suzuki *et al.*, 2023). Saito stresses the urgent need for comprehensive conservation efforts to protect these butterflies, citing habitat loss and ecological challenges. He concludes by inviting further engagement and exploration of Japan's extraordinary butterfly diversity.

***Baronia brevicornis*: ecology and conservation, by Prof. Jorge Contreras Garduño, ENES Morelia, UNAM, Mexico**

This talk focuses on research into *Baronia brevicornis*, an endangered butterfly inhabiting tropical dry forests in Mexico. The speaker highlights its intriguing biology, including colour variation in males and females, and its larvae, which feed on *Pithecellobium dulce* (Fabaceae). The pupae remain underground for up to two years, although fewer butterflies emerge in the second year compared to the first year (Galicia-Mendoza *et al.* 2021). The research examines *Baronia*'s immune memory, a phenomenon previously thought to exist only in vertebrates, showing that butterflies with immune memory had higher survival rates when challenged with pathogens. The study also monitored *Baronia* populations, finding that precipitation, not temperature, significantly affects butterfly emergence, with optimal emergence rates between 120

and 140 mm of rainfall. The talk also discusses yearly morph variation and ongoing conservation efforts. The speaker acknowledges the support of local communities, who have embraced the conservation of *Baronia* and assisted in long-term monitoring efforts. Future research will continue to explore immune responses and environmental factors influencing the butterfly's distribution.

Conclusion

The subject matter of the papers presented at this SBBT online conference extends across the entire range of the papilionid subfamilies Baroniinae and Parnassiinae, which are found only in the northern hemisphere. Life strategies for these species emphasise narrow foodplant and habitat preferences that can be very vulnerable to short-term change, such as climate warming and the consequences in terms of fire, drought, flood and ecological displacement. Fragmentation and isolation of habitats impact the genetic mixing required for healthy metapopulations and can even lead to altered behavioural traits, such as weakened ability to migrate, that render species more vulnerable to unpredictable change.

Engagement with local communities is a frequent theme, emphasising the importance of community involvement and education in building a strong base for conservation action, political support, national and international regulation, and the

prevention of unsustainable exploitation by unscrupulous collectors.

The success or failure of governments and civil society to safeguard the planet will decide the fate of many species, including our own. Describing the predicament of swallowtails, searching for solutions, and understanding and monitoring their interactions with the changing environment can help reveal and illustrate the bigger picture and the risks we face. Forty years ago, nobody saw climate change coming with such force. Who can predict where we, or these lovely butterflies, will be in another forty years?

Acknowledgements

In 1985, the Red Data Book *Threatened Swallowtail Butterflies of the World* (Collins & Morris, 1985) evaluated all 573 species of Papilionidae known at that time, found that one in ten was at risk, and followed up with an action plan (New & Collins, 1991). It was not until 2017 that the Swallowtail & Birdwing Butterfly Trust (SBBT) was formed to build networks of people and projects to promote a global movement for the protection of these beautiful insects. The trustees organised this second online conference voluntarily without external financial support. We thank all conference contributors for their dedication and determination to conserve butterflies such as these, often under very difficult and demanding conditions.

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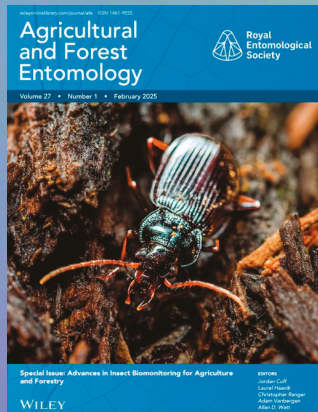
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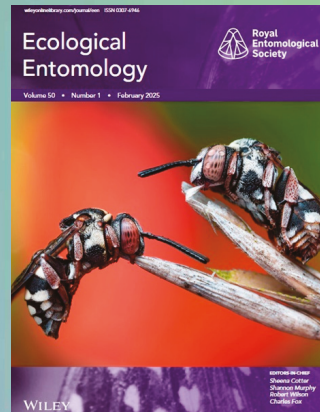
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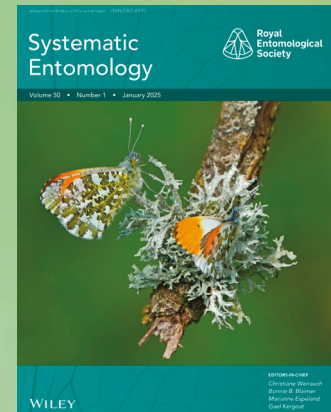
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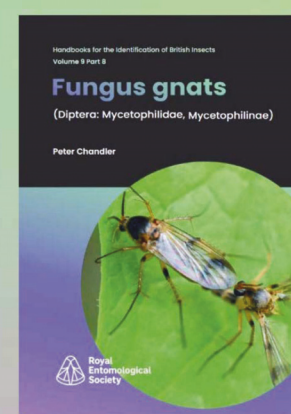
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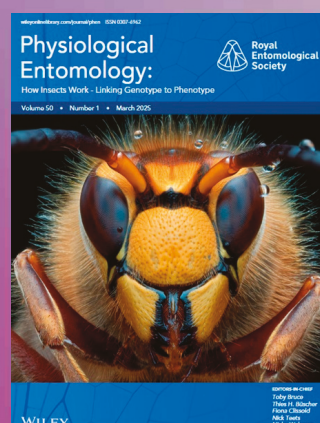
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