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EDITED AND REVIEWED BY
Darren Norris,
Universidade Federal do Amapá, Brazil

*CORRESPONDENCE
Milton de Souza Mendonça Jr.
milton.mendonca@ufrgs.br

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Editorial: Conservation of the world's butterflies: recent advances in science and practice

Max Post van der Burg[1] and Milton de Souza Mendonça Jr.[2]*

[1]U.S. Geological Survey (USGS), Northern Prairie Wildlife Research Center, Jamestown, ND, United States,
[2]Departament of Ecology, Biosciences Institute, Federal University of Rio Grande do Sul, Porto Alegre, Brazil

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Editorial on the Research Topic
Conservation of the world's butterflies: recent advances in science and practice

Society positively values butterflies as cultural symbols (e.g., symbolize rebirth; van Huis 2019), as aesthetically appealing insects (e.g., diversely colored; Thomas et al. 2024) and as providers of ecosystem services (e.g., pollination; Cardoso et al. 2020). Over time, scientists have pursued a deeper understanding of basic butterfly biology (Santos et al. 2018), as well as how to best manage and conserve butterfly species (Kral et al. 2018). In fact, butterflies are one of the best studied arthropods in research programs involving management and conservation (Warren et al. 2021). Despite this focus, protecting butterfly populations, species, and communities remains a complicated issue. We often lack basic information on many butterfly species (Jue 2015) and how human-mediated ecosystem changes affect them (Longcore & Osborne 2015). Such changes have resulted in declines among insects worldwide (Goulson, 2019), and among butterflies in particular (Warren et al., 2021). The scale and scope of butterfly conservation means that managers will likely need more scientific information, as well as a closer dialogue with the general public, governmental agencies, and non-governmental organizations (New, 2010). To that end, we present a set of articles aimed at practical examples of how science can help advance the conservation goals of natural resource managers focused on butterflies.

Non-governmental and governmental organizations that target butterflies in their conservation efforts make conservation investments in order to achieve the best environmental outcomes possible. However, climate and land use change can reduce the magnitude of those outcomes. This means conservation planners need to understand where to target conservation in the future to ensure they are keeping up with these changes. As an example, the paper by Barnes et al. presents a case study for how to consider the potential effects of climate change on the distribution of an endangered butterfly, the Dakota skipper. Their analysis suggests that, even under the moderate projections of climate change, this species distribution could shift significantly. But, perhaps more importantly, they provide a modeling framework that can be used to make predictions about where Dakota skipper use of the landscape could change. This is important because such predictions can be used to guide future monitoring efforts for this species, as well as suggest where conservation organizations should consider targeting their conservation investments. Analyses like the one by Barnes et al. seemingly inform management in a general sense. However, the effects of specific land use types, such as energy production, often require frameworks that are more specific.

The analysis by Fox et al. focused on mapping habitat for a high-profile migratory butterfly species, the monarch butterfly. The aim of their modeling is similar to the work of Barnes et al. in that they developed a model to spatially represent the distribution of monarch butterfly habitat. But there are some notable differences with the Fox et al. study. Namely, Fox et al. worked at a much broader spatial scale (i.e., the entire United States) and they used expert opinion to fill in data gaps. While there can never be a substitute for data when developing models like these, the inclusion of expert opinion reflects the urgency with which decisions need to be made, even in the absence of data. Formalizing the mental models of experts, who would likely be informally consulting in these decisions, is a step forward. But even more so, the authors directly engaged with industry decision makers to help them translate the model results into more operational guidance to support energy developers. This last step is often lost or ignored in the process of developing scientific information to support conservation decision making.

But even if decisions are made using well-vetted models and data, there is no guarantee that conservation benefits will persist into the future. The analysis by Post van der Burg discusses the problems that can arise from the necessary assumptions, that predictive models inevitably carry. His analysis uses multiple scenarios to examine how land use and climate change may affect a species of conservation concern, the regal fritillary. His results indicate that climate change will likely have a negative effect on regal fritillary persistence. But more importantly, his analysis shows how ignoring errors in model assumptions may lead to unintended conservation outcomes in the future. This suggests that managers may need to consider sources of severe uncertainty when making predictions of the future.

Models are important tools to understand and predict ecological outcomes, but there is still a need for field and laboratory-based methods for generating the data needed to parameterize those models. Conservation genetics is one cutting-edge field that was once deemed difficult to use for butterflies. Heffernan et al. suggest that recent developments in microsatellite technology have made these methods useful for understanding butterfly population genetics. They summarize these technical improvements and review the use and implementation of microsatellite markers in conservation programs. More specifically, they provide a much-needed guide for conservation practitioners to begin incorporating and interpreting population genetics in the context of conservation programs.

As mentioned earlier, a common problem in arthropod conservation is the sheer lack of data about particular species, especially finely detailed data about the distribution of habitats. This can be especially problematic for butterflies since resource needs vary between larvae and adults, or between different migratory phases. Recognizing this, Lukens et al. present a framework for monitoring habitat conditions for the monarch butterfly. Employing crucial habitat metrics such as variation in milkweed density for larvae, floral resources for adults, and including more than a thousand sampling sites, the authors examine the effects of land use across conservation units in space. Their analysis provides a way for managers to measure the relative importance of certain land use types in terms of their habitat value to monarchs. While specific to a species, their framework could provide a useful example for monitoring programs targeting other butterfly species. We hope that readers of this Research Topic find approaches like this, and the others presented in this Research Topic, thought-provoking and useful.

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MP: Writing – original draft, Writing – review & editing. MM: Writing – original draft, Writing – review & editing.

Conflict of interest

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