HORIZON 2020

Protect butterflies across Europe through climate refugia

Results in Brief

New high-resolution maps to predict changing butterfly distributions

Fundamental questions about Earth's biodiversity like 'how many species exist?', 'where are they found?' and 'why are they there?' remain hard to answer. New models help bridge this gap for pollinator insects across Europe, helping map where species are likely to be found under future climate and land use conditions.





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Despite accelerating climate change, little is still known about the ecology and distribution of insects, which are vital for services like pollination. Being cold-blooded, short-lived and often specialised, these species are highly sensitive to environmental changes, making it crucial to identify areas most at risk from climate shifts and habitat loss. This insight will help guide effective conservation efforts to protect these insects and the essential roles they play.

Funded by the Marie Sklodowska-Curie Actions programme \checkmark , the PROBAE project was designed to identify regions where conservation efforts will have the greatest impact for butterflies, ensuring resources are invested wisely to protect biodiversity. Using advanced mathematical models, the project focused on creating hundreds of high-resolution maps to predict current and future redistributions of butterfly species across continental Europe.

"This effort is critical for countries striving to meet the Global Biodiversity

Framework's '30 by 30' goal of dedicating 30 % of land to nature by 2030," notes Federico Riva, project coordinator. "Achieving this requires a data-driven approach grounded in empirical evidence to ensure the most efficient and effective resource use." By providing valuable insights into both the present and potential future distribution of butterflies, PROBAE will inform the establishment of new protected areas that address immediate conservation needs while preparing for future challenges.

Pioneering research into butterfly responses and landscape dynamics

During its 8-month duration, PROBAE project produced two major outputs. First, the largest assessment of how all Italian butterflies (representing almost half of Europe's butterfly species) respond to land use and climate change. In conjunction with this, the researchers developed a framework detailing how species distribution models can more accurately incorporate sophisticated aspects of land use patterns, such as habitat fragmentation and other critical aspects. The studies have been published in <u>Global Change Biology</u> and <u>Journal of Ecology</u>, respectively.

These achievements help improve understanding of the effects of landscape patchiness on butterfly populations, a crucial factor for the analyses undertaken by PROBAE. "Our initial findings highlighted that butterflies are often restricted to small habitat patches, making them ideal indicators for studying the impacts of human activities in fragmented landscapes," states Riva.

PROBAE's influence extends beyond these outputs; it has also supported the publication of two notable articles, one exploring <u>ecological complexity</u> and another examining <u>biodiversity changes in the Swiss Alps</u>.

Using butterfly mapping to spotlight and safeguard overlooked invertebrates

Although PROBAE officially concluded after Riva took up a position as assistant professor in Amsterdam, work on a Europe-wide analysis of all butterfly species continues under a new collaboration. Early results from this ongoing research will be presented at the upcoming <u>'International Symposium: Future for Butterflies & Moths'</u>.

"By the end of 2025, we aim to publish openly accessible 1-km resolution maps for all butterfly species across Europe. These high-resolution models are expected to play a critical role in supporting the EU's efforts to establish new protected areas and define a robust ecological infrastructure network," states Riva. The project team hopes that these maps will help bridge the gap and ensure invertebrates gain the attention they deserve in biodiversity conservation efforts. "Historically, invertebrates have often been overlooked in conservation planning, but butterflies – being a widely recognised and charismatic group – serve as powerful advocates for highlighting the critical importance of these creatures," concludes Riva.

Keywords

PROBAE, butterflies, conservation, maps, biodiversity, pollinator insects, species distribution models

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PROBAE

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