Safeguard – Safeguarding European Wild Pollinators

Deliverable Number: 1.6
National and Regional IUCN Red Lists of European Pollinators

Safeguard
Safeguarding European wild pollinators

This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003476.

Prepared under contract from the European Commission

Grant agreement No. 101003476.

EU Horizon 2020 Research and Innovation action

Project acronym	**Safeguard**
Project full title	**Safeguarding European wild pollinators**
Start of the project	**September 2021**
Duration	**48 months**
Project coordinator	**Ingolf Steffan-Dewenter** **Julius-Maximilians-Universität Würzburg** **https://www.safeguard.biozentrum.uni-wuerzburg.de/**
Delivery Date	**28.03.2025**
Actual submission date	
Abstract	This deliverable (D1.6) presents the outcomes of the Safeguard project's work to update and standardize National and Regional IUCN Red Lists (NRLs) for European pollinators, including bees, butterflies, moths, and hoverflies. Based on over 18 million records and involving more than 100 experts, this report details the progress of Red List assessments in six target countries and at regional (Mediterranean) and continental (European) levels. It highlights key achievements such as the identification of threatened species, significant reductions in data deficiency, and the integration of Red Lists into conservation policy frameworks. The results aim to support science-based biodiversity strategies and ensure the long-term protection of wild pollinators across Europe.

Document Revision History			
Version	**Date**	**Author(s)**	**Summary of changes**
1.0	xxx		

Executive summary

Pollinators are fundamental to Europe's biodiversity, ecosystem stability, and food security. However, wild pollinators—including bees, butterflies, moths, and hoverflies—face increasing threats from habitat loss, climate change, pollution, and land-use changes. Recognizing the urgent need for conservation measures, the **Safeguard** project, funded by the **EU Horizon 2020** program, has prioritized updating and harmonizing data to ensure national and regional Red Lists using the **IUCN Red List Categories and Criteria**.

This deliverable (**D1.6**) presents the progress and findings of the project's efforts to develop and update **National Red Lists (NRLs)** and **Regional IUCN Red Lists** for European pollinators. It builds on extensive data collection, taxonomic assessments, and expert consultations to provide a standardized and scientifically rigorous evaluation of pollinator conservation status.

Key Achievements

- **Expansion of Pollinator Databases:** The project compiled a **comprehensive dataset of over 18 million records**, covering **9,349 species** of pollinators across Europe, with **97% of bees, 99% of hoverflies, 79% of butterflies, and 70% of moths** assessed.
- **Reduction of Data Deficiency:** Through standardized assessments, the proportion of **Data Deficient (DD) species** has significantly decreased from over 50% in previous assessments to **below 20% for bees** and **to 5% for hoverflies**.
- **Threatened Species Identification:** Approximately **9% of bees**, **37% of hoverflies**, and **9% of butterflies** are classified as threatened (Critically Endangered, Endangered, or Vulnerable) according to European Red List assessments, underscoring the urgent need for targeted and coordinated conservation actions.
- **Completion of the European Red List of Pollinators:** Updated Red Lists for **hoverflies (2022), bees (2024), and butterflies (2024)** have been completed, while assessments for moths remain ongoing.
- **National Red Lists Progress:** Significant advancements have been made in **France, Italy, Cyprus, Spain, Portugal, and Hungary**, with comprehensive national databases established to support conservation planning.
- **Advancing Policy and Conservation Strategies:** The integration of NRLs into national biodiversity strategies and alignment with **EU and global conservation policies** has been emphasized to enhance long-term pollinator protection.

Future Directions

To ensure the long-term success of National Red Lists and pollinator conservation efforts, the following **policy and research priorities** have been identified:

- **Integrate Red Lists into National Conservation Plans** to guide policy development, habitat protection, and funding allocation.
- **Align NRLs with EU Policies**, including the **EU Pollinators Initiative and the EU Biodiversity Strategy for 2030**.
- **Expand Data Collection and Monitoring** through systematic pollinator surveys, **citizen science engagement, and AI-based biodiversity assessments**.
- **Enhance Research on Pollinator Decline**, focusing on key threats such as **climate change, pesticide exposure, and habitat fragmentation**.
- **Capacity Building and Knowledge Exchange** among experts, institutions, and policymakers to foster a collaborative approach to pollinator conservation.

Introduction and justification

Pollinators are key elements for Europe's biodiversity and the provision of essential ecosystem services. Wild pollinators, including bees, butterflies, moths, and hoverflies—play a critical role not only in sustaining natural habitats but also in supporting the economic and cultural fabric of rural communities in Europe

Previous assessments, such as the European Bee Red List (Nieto et al. 2014), revealed significant data gaps; a substantial proportion of species were classified as Data Deficient. This lack of comprehensive information hindered effective conservation planning and the capacity to track long-term population trends. Without standardized methodologies, national assessments often varied in scope and criteria, limiting the comparability of species' extinction risks across different regions.

Recognizing these shortcomings, the Safeguard project prioritized updating and harmonizing national and regional Red Lists using the IUCN Red List Categories and Criteria. Extensive, georeferenced databases have been compiled from historical records, museum collections, and citizen science initiatives to form a robust foundation for these updated assessments. As a result, the project is producing IUCN-compliant national, European, and Mediterranean Red Lists that offer a standardized baseline. These updated assessments not only reduce the proportion of Data Deficient species but also enhance our ability to monitor population trends and inform targeted conservation policies and resource allocation across Europe.

Establishing up-to-date IUCN Red Lists for European pollinators—focusing specifically on national red lists—is crucial for several reasons. First, standardized, scientifically rigorous assessments using the IUCN Red List Categories and Criteria provide a clear and objective baseline for determining extinction risks. This uniform approach allows conservationists and policymakers to accurately compare species status across different regions and to identify which species are most at risk. Second, national red lists serve as indispensable tools for setting conservation priorities, guiding resource allocation, and informing legislative action. With robust national data, governments can better target conservation efforts, secure funding, and implement policies that protect pollinators and the critical services they provide. Lastly, updating these lists helps reduce the proportion of Data Deficient species, transforming conservation needs into actionable insights that drive local and national biodiversity strategies.

WP1 is organized into a series of tasks, from **Task 1.1** (distributional data) to **Task 1.5** (plant–pollinator interactions), culminating in **Task 1.6**, which develops National and Regional IUCN Red Lists of European pollinators. The figure below shows how Tasks 1.1–1.5 collectively provide the data, methods, and analyses that feed into Task 1.6 for standardized conservation assessments.

Deliverable 1.6 focuses on the development and updating of National Red Lists for European pollinators using the IUCN Red List methodology. The specific aims are:

- Standardize conservation assessments using IUCN Red List criteria to significantly reduce the Data Deficient percentage in pollinators datasets.

- Compile and validate a comprehensive, high-quality distribution database from historical records, taxonomists, museum collections, and national champions.
- Provide a robust baseline to inform national conservation policy and strategic planning.
- Enhance technical capacity and collaborative exchange among experts.
- Identify priority species and geographic areas for targeted conservation actions.

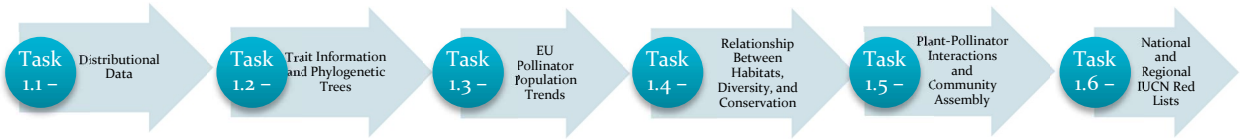

Figure 1. Re-assessing the status and trends of European pollinators: From distributional data to national and regional IUCN Red Lists

Methodology and Data Sources

Data Collection: Compiling distributional data on European pollinators at EU and national levels (Task 1.1)

The first task of Safeguard was to deliver the most comprehensive open database of European pollinator distribution, aiming to achieve detailed maps for all bees (i.e. >2,000 species), butterflies (>450 species), most of moths (>2,000 species) and hoverflies (>1000 species). The combined maps will represent a comprehensive database of >5,700 species of pollinators. This information from T1.1 will be essential to support data syntheses and predictive modelling of drivers and pressures (WP2), assessing impacts of pollinator loss (WP3) and to identify target species for the implementation of mitigation strategies (WP5).

Records were gathered from multiple sources, including historical biogeographical databases from previous projects, contributions from taxonomists and local experts, published literature, field work, and data from online platforms (e.g., GBIF, FinBIF for moths). For bees and hoverflies, a two-step taxonomic cleaning process was applied: first, a taxonomic backbone was created using the latest bee taxonomy (Ghisbain et al. 2023) covering 2,138 species, and the checklist was used to replace junior synonyms with accepted senior ones. Second, a supplementary list was generated to capture typographical errors, spacing issues, orthographic variants, and outdated synonyms. Expert taxonomists reviewed and corrected this list, and records with unresolved or incomplete names were flagged and removed.

A validation process involved splitting records with spatial coordinates into groups by family or tribe and creating static maps for each species along with an Excel file containing associated record information and a validation column. The maps were assigned to groups of experts who reviewed the maps, flagged suspicious records, and suggested additions to fill distribution gaps. Spatial information was iteratively updating the maps and data files until a final version was approved.

For butterflies, data were sourced from a comprehensive expert database (hosted at UFZ within the LepiDiv project) with quality control at a maximum resolution of 1 km. For moths, GBIF data were downloaded with specific criteria (human observations, coordinate uncertainty ≤1 km, within specified geographic bounds, and dates from 2000–2022) and cleaned using the R package CoordinateCleaner.

Data Compilation Process: Compiling trait information and building phylogenetic trees of European pollinators (Task 1.2)

The existing trait dataset for bees and hoverflies including 7 basic traits, primarily focused on categorical specie-level data was expanded by increasing the number of traits from 7 to 18. This involved adding nine new traits (e.g., plant taxa, host, detailed nesting characteristics) and refining existing ones (e.g., splitting hairiness into hair length and hair density). Data were collected from literature, direct specimen measurements, published databases, and inputs from other work packages. Validation was performed through virtual and in-person workshops with expert taxonomists to review, correct, and fill in missing data.

Compiling EU Pollinator population trends (Task 1.3)

The analysis was based on the comprehensive distribution database from Task 1.1, comprising historical and contemporary records, to assess population trends of European pollinators at multiple spatial scales. It involved modeling these opportunistically collected data with models weighted by collection effort (following Bartomeus et al. 2019), allowing to perform a unified analysis across regional and national levels. In addition, a species-sensitivity characterization was made by correlating population trends with fine-scale traits to identify which traits were associated with declining trends. Species-specific occupancy models were also run at the EU level using a non-deterministic Bayesian framework on a high-performance computing cluster, to further capture changes in species distributions.

Identifying the relationship between habitats, diversity and conservation of European pollinators (Task 1.4)

To analyse the relationship between habitats, diversity, and conservation of European pollinators, data for bees and syrphids from Task 1.1 were used. Records collected before 1990 were removed to match the age of the habitat data available at the European scale. The remaining records with spatial coordinates were then aggregated into a 10 km grid using the official European Biogeographical Regions (EBRs) map. Each grid cell was categorized into habitat mosaics. Species richness and node strength (which measured the degree of species dependence on specific habitats) were computed for each habitat-region combination using a network approach. Additionally, habitat preferences for each species were assessed by generating 1000 random null models of the European meta-network and classifying species as “exploiters” (occurring above the 95th percentile) or “avoiders” (occurring below the 5th percentile). Finally, sample coverage and beta diversity were evaluated on a 50 km grid using the Local Contribution to Beta Diversity (LCBD) index through 999 permutations to identify areas with unique pollinator communities.

Mapping plant – pollinator interactions and community assembly (Task 1.5)

To map plant–pollinator interactions and community assembly across Europe, data on plant–pollinator networks were compiled into the EuPPollNet database. More than 2,000 well-described networks were gathered from published and unpublished studies (conducted between 2004 and 2021 across 17 countries) that provided time- and geo-referenced records with quantitative visitation data. These studies were selected based on rigorous quality criteria to ensure the inclusion of phyto-centric, spatially and temporally explicit interaction data. All collected data were harmonized into a fully open, reproducible database with standardized taxonomic and ecological information, allowing the tracking of data-curation decisions through an open workflow. Subsequent analyses focused on evaluating key structural properties of the networks, including network motifs, connectance, and nestedness.

Assessing the risk of extinction at regional and national levels (Task 1.6)

The application of the IUCN Red List of Threatened Species methodology was promoted to develop national and regional Red Lists for European pollinators. Each pollinator species was assessed by applying the IUCN Red List Categories and Criteria (version 3.1), which provide a globally recognized framework for determining extinction risk. Key metrics such as the Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated, and species population trends, habitat requirements, and potential threats were thoroughly evaluated.

Data collected in Tasks 1.1 through 1.5 were integrated to assess the conservation status of over **5,700 pollinator species**. Six national Red Lists, one European Red List, and one Mediterranean Red List are planned. In total, 18 workshops were conducted in 2023 and 2024 in collaboration with IUCN and the Pulse project—to cover all European bee taxa.

Experts used standardized IUCN criteria to reassess species, with a particular focus on groups that had previously exhibited high proportions of Data Deficient (DD) species, aiming to reduce the DD percentage from over 50% to below 20%.

Buzzing Table on National Red Lists of Pollinators:

The organization of a “Buzzing Table” focused on National Red Lists (NRL) for pollinators brought together conservation experts, taxonomists, and policymakers to discuss and share best practices for developing national Red Lists using the IUCN methodology. During the Buzzing Table, participants reviewed current challenges and explored strategies to harmonize data collection, assessment procedures, and reporting standards across Member States. The discussions yielded valuable outcomes, including the recommendation to develop a comprehensive “kit” of tools to guide national NRL assessments, identify key funding opportunities, and build capacity among national experts. This recommendation aligns with the launch of the new IUCN National Red List Platform, which was presented during the same IUCN European Forum where the Buzzing Table and a dedicated workshop on insect Red Listing also took place.

Results and Analysis

The comprehensive database resulting from Task 1.1 now comprises a total of 18,041,732 data rows covering **9,349 European pollinator species** (Table 1). In detail, the bee database includes 5,332,781 records for 2,069 species (97% coverage of European bees), hoverflies comprise 1,034,875 records for 884 species (99% coverage), moths have 6,862,835 records for 6,003 species (70% coverage), and butterflies consist of 4,811,241 records for 393 species (79% coverage). The complete trait database is publicly available via DOI 10.5281/zenodo.8300431.

The enhanced trait database (Task 1,2) now provides comprehensive coverage of ecological, phenotypic, and phylogenetic traits for European bees and hoverflies. Key improvements include increased species coverage for critical traits such as intertegular distance (ITD) and derived tongue length, along with the integration of detailed nesting and floral preference data. This enriched dataset serves as a vital resource for analyzing trait correlations of population decline and the dynamic relationships between plants and pollinators, supporting subsequent predictive modeling and conservation planning.

Table 1. Summary of species data coverage in the European pollinator database

Taxonomic Group	Total Records	Species Covered	Coverage (%)
Bees	5,332,781	2,069	97%
Hoverflies	1,034,875	884	99%
Moths	6,862,835	6,003	70%
Butterflies	4,811,241	393	79%

The analysis of species-level trends between 1951–1985 and 1986–2021 revealed that among 353 bee species analyzed, **149 showed declines in relative abundance**, while only 57 showed increases (task 1.3). Notably, declining species were predominantly **specialists, parasitic, or cold-adapted taxa** (e.g., *Dufourea*, *Rhodanthidium*, *Stelis*). These findings provide critical evidence of **population-level declines** in sensitive groups and offer valuable insights to support **IUCN Red List assessments and conservation prioritization**.

Identifying relationships between habitats, diversity, and conservation (Task 1.4), the Mediterranean region emerged as a key hotspot for bee diversity, with complex mosaic habitats exhibiting the highest species richness and node strength, while agricultural-dominated clusters showed lower diversity and strength. For hoverflies, forest habitats, especially in the Alpine and Mediterranean regions, displayed higher diversity compared to other habitat types. The null model analysis revealed that approximately 50% of bee species in Mediterranean habitats were classified as specialists, whereas other regions, such as the Atlantic and Boreal zones, exhibited much lower proportions of specialists. The LCBD analysis on a 50 km grid identified significant contributions to beta diversity in regions such as Portugal, Spain, France, Italy, Greece, and the Balkan Peninsula, thereby highlighting these areas as conservation priorities. Conversely, well-sampled regions such as the British Isles and Central Europe showed

lower uniqueness in species assemblages. These findings provided a comprehensive, spatially explicit synthesis of habitat importance and species preferences, offering essential insights for targeted conservation strategies.

The EuPPollNet database consolidated data from 51 studies, totaling 1,144,371 distinct interactions (Task 1.5). Taxonomic coverage included roughly 1,000 species from both Hymenoptera and Diptera, with *Apis mellifera* representing 70.68% of the interaction records and accounting for an average of 31% of interactions per network. Analyses revealed that plant–pollinator networks exhibited non-random assembly of network motifs, with consistent structural patterns indicative of common ecological processes. Network metrics showed that connectance ranged from 0.03 to 0.4 (mean = 0.14) and nestedness values ranged from 1.34 to 7.94 (mean = 2.81). Additionally, latitudinal trends were observed, with networks at higher latitudes showing lower residual connectance and higher nestedness. These findings offer a robust basis for future research to quantify the drivers of network change and to inform conservation planning for both plants and pollinators (Lanuza et al. 2025).

The assessment process for the European Pollinator Red Lists (task 1.6) has involved a broad network of taxonomic experts across different groups. In total, **over 100 experts** contributed to these evaluations, ensuring rigorous and standardized species assessments. Specifically, the bee assessments engaged more than 50 specialists, working through 18 workshops organized in collaboration with IUCN and the Pulse project. The hoverfly assessments were completed with the participation of approximately 30 experts, leading to one of the most comprehensive evaluations for this group. The butterfly assessments relied on around 20 specialists, benefiting from prior data availability and well-documented distributions. For moths, the assessment is still in progress, but initial efforts have included contributions from at least 25 experts working on data compilation and validation. The collaborative efforts of these experts have been fundamental in reducing data deficiencies and improving the accuracy of conservation assessments for European pollinators.

The European Red List has been completed for hoverflies (Vujić et al. 2022), bees and butterflies (2021 and 2024); the Red List for moths is in the early stages of data collation (Table 2). The assessment workshops effectively covered all European bee taxa, as detailed in Table2. Early results show a significant reduction in the proportion of DD species compared to the initial assessments (Nieto et al. 2014). Bees and hoverflies have the highest assessment coverage, with 97% and 99% of their respective species evaluated, while butterflies and moths have lower coverage at 79% and 70%, respectively. The proportion of threatened species varies, with hoverflies showing the highest estimate (~37%), followed by butterflies (~10%) and bees (~9%). Efforts to reduce Data Deficient classifications have been particularly successful for bees, where the percentage has decreased from over 50% in 2014 to below 20% in the latest reassessments. For hoverflies, only **5.1%** of species remain Data Deficient, while butterflies have a slightly higher proportion (**5–10%**). Moths are still undergoing evaluation, with further data needed to determine both their threatened and DD status.

Table 2 Summary of European Pollinator Red List Assessments: Species Coverage, Threatened Status, and Data Deficiency

Taxonomic Group	Total Species Assessed	Total European Species	Coverage (%)	Threatened Species (%)	Data Deficient (DD) Species (%)
Bees	2,138	2,069	97%	~9%	<20%
Hoverflies	884	913	99%	37%	5%
Butterflies	393	500	79%	~10%	5-10%
Moths	6,003	8,500	70%	(Data ongoing)	(Data ongoing)

Species checklists

Species checklists for European pollinators by integrating data from historical projects (e.g., ALARM, STEP), expert taxonomists, national champions, and museum collections have been successfully compiled. The resulting database now includes records for approximately 9,349 species across key pollinator groups, with an impressive coverage of 97% for bees, 99% for hoverflies, 70% for moths, and 79% for butterflies. These checklists have undergone rigorous taxonomic cleaning and spatial validation, ensuring high-quality, standardized data across multiple countries. This robust baseline not only enhances our understanding of pollinator diversity in Europe but also serves as a critical foundation for updating National Red Lists, thereby directly informing conservation policies and targeted management strategies (Bartomeus et al. 2022, Ghisbain et al 2023, Reverté et al. 2023, Lanuza et al. 2025).

National red lists

Facilitate the development of National Red Lists (NRLs) has been a key objective of the Safeguard project, aiming to standardize and improve conservation assessments across European countries. Significant progress has been made in six target countries: France, Italy, Cyprus, Spain, Portugal, and Hungary. National occurrence records from Task 1.1 are now complete for these countries, forming the basis for Red List assessments.

In France, a nationally funded project was launched in 2023, with the goal of completing a bee Red List by 2026. The Safeguard team has supported this initiative by providing data extracted from the global database. French experts are currently consolidating records from museum collections and citizen science sources, with assessments scheduled to begin in 2025.

In Italy, extensive digitization efforts were carried out between 2022 and 2024, focusing on key regional collections from institutions such as the University of Bologna, the University of Naples, and various natural history museums. Over 25,000 records were

digitized, and when combined with other datasets (e.g., BeeNet, ApiParchi), the total dataset for Italy now includes approximately 160,000 records.

In Cyprus, collaboration with national experts has led to the development of a preliminary database based on PhD research and historical collections. Additional funding proposals are in progress to expand this initiative. A recent collection effort in 2024 resulted in 3,755 newly collected specimens, and digitization efforts have added another 8,652 historical records to the national database.

For the Iberian Peninsula (Spain and Portugal), a foundational database has been compiled (Bartomeus et al. 2022), which will serve as the basis for future Red List assessments. Additionally, a synergy has been established with the IUCN National Species Group, which leads the recent national Red List initiative, to mobilize more experts for the assessment of bees in Spain.

In Hungary, discussions with national partners have led to a focus on specific bee groups, such as Megachilidae and bumblebees, due to their ecological importance and conservation concerns. National-level databases for these taxa are currently under development.

Although not one of the target countries, Greece has one of the most comprehensive NRLs in Europe. Over 100 species from the orders Lepidoptera, Hymenoptera, and Diptera (family Syrphidae) have been assessed between 2002 and 2024, of which 237 were pollinators. This includes 69 species of wild bees (families Colletidae, Melittidae, Apidae, Megachilidae, Andrenidae, and Halictidae), with 35% classified in threatened categories and 17% as Data Deficient (DD). Among the 69 evaluated species of potential pollinating Diptera, 37% were classified as threatened and 15% as DD. In Lepidoptera, 122 species of butterflies and 7 species of moths were assessed, with 20% of butterflies classified as threatened and only two species as DD. Among the 7 evaluated moth species, two were classified as DD, while the rest were categorized as Least Concern (LC).

The table 3 below summarizes the progress made in compiling national checklists, data consolidation, and the status of ongoing Red List assessments in each country. These efforts mark a critical step toward improving national conservation policies and aligning regional assessments with European conservation strategies.

Table 3. Progress of National Red Lists for Pollinators by Country

Country	Records Digitized	Recent Specimens Collected	Assessment Start Year	Targeted Groups	Expected Red List Completion
Greece			2021	Bees, Syrphids, Butterflies and Moths	Published in 2024 Home - https://redlist.necca.gov.gr
France	Ongoing	N/A	2025	Bees	2026
Italy	160,000	N/A	Ongoing	Bees	Ongoing
Cyprus	12,407	3,755	Planned	Bees	Future Initiative
Spain	Compiled	N/A	Planned	Bees	Future Initiative
Portugal	Compiled	N/A	Planned	Bees	Future Initiative
Hungary	Ongoing	N/A	Planned	Megachilidae Bumblebees	Future Initiative

Mediterranean Red List of Wild Bees

The Mediterranean assessment was made possible thanks to the information collected for Safeguard WP 1 in Europe and the engagement with experts facilitated by the Safeguard project. In addition to the progress made at the national level, a regional assessment of wild bees in the Mediterranean Basin has been conducted as part of the IUCN Mediterranean Red List initiative. 200 wild bee species endemics to the Mediterranean region and 98 species endemics to Morocco are being assessed for their risk of extinction. In Morocco alone, preliminary assessments show a high proportion categorized as Data Deficient, underscoring the need for region-specific conservation actions.

Data Gaps and Limitations: from the buzzing table

The buzzing table discussions highlighted the importance of national collaboration, policy integration, and scientific rigor in advancing pollinator conservation. The success stories from the Netherlands and Spain demonstrated how well-structured NRLs can effectively guide conservation actions and policy decisions. However, the

discussions also acknowledged key challenges, including data gaps, funding constraints, and the need for standardized methodologies across different countries.

Figure 2. Panellists engaging in discussions during the Buzzing Table on National Red Lists of Pollinators, exchanging insights on best practices, challenges, and policy integration to enhance pollinator conservation efforts across Europe.

The National Red List (NRL) for Pollinators is a crucial tool for assessing the conservation status of pollinators at the national level, providing a foundation for science-based decision-making and conservation policies. Panellists discussed the most critical challenges in developing and maintaining NRLs for pollinators, which include:

- Data Gaps and Taxonomic Uncertainty: Many species, particularly wild bees and hoverflies, still lack sufficient data for assessment. Panelists stressed the need for long-term monitoring programs and citizen science initiatives to bridge these gaps.
- Integration into Policy: Ensuring that NRLs are effectively utilized in policy development at both the national and EU levels remains a challenge. Stronger collaboration between scientists, policymakers, and conservation organizations was identified as essential for mainstreaming NRLs into biodiversity strategies and the EU Pollinators Initiative.
- Funding and Long-Term Support: Sustainable funding mechanisms are crucial for creating and maintaining NRLs. Experts highlighted the need to mobilize resources through national governments, EU funding programs, and public-private partnerships.

- Prioritization of Species: Given the diverse threats faced by pollinators, a strategic prioritization framework is required to focus conservation efforts on the most vulnerable species and ecosystems.

To maximize the impact of National Red Lists on pollinator conservation, it is essential to integrate these assessments into broader national and EU-level policies. The **following recommendations** emerged from the discussions:

- Integration into National Conservation Plans: NRLs should be formally linked to national biodiversity strategies and action plans (NBSAPs), ensuring they guide policy development, habitat protection, and funding allocation.
- Alignment with EU Policies: The NRLs should support and complement the EU Pollinators Initiative, the EU Biodiversity Strategy for 2030, and the Common Agricultural Policy (CAP), promoting pollinator-friendly landscapes and sustainable agricultural practices.
- Harmonization of Red List Methodologies: Standardizing assessment methods across countries will enhance comparability and facilitate coordinated regional conservation strategies.
- Stakeholder Engagement: Governments, conservation organizations, research institutions, and land managers must collaborate more closely to ensure that NRL findings are translated into concrete conservation actions.

Future Directions

To ensure the long-term effectiveness of National Red Lists, **continued efforts** are needed in:

• Expanding **Data Collection and Monitoring**: Establishing systematic pollinator monitoring programs at national levels, integrating citizen science data, and leveraging remote sensing and AI-based biodiversity assessments.
• Enhancing **Research, Knowledge Sharing, and Capacity Building**: Strengthening expertise in pollinator taxonomy and conservation assessment through training programs, international collaboration, and shared methodologies to improve taxonomic knowledge and conservation planning.
• Securing **Sustainable Funding and Institutional Support**: Establishing long-term funding frameworks at national and EU levels, mobilizing resources from government agencies, private sectors, and international organizations to support data collection, assessments, and conservation actions.
• Improving Policy Uptake and Implementation: Encouraging policymakers to actively engage with conservation scientists and Red List experts to ensure that NRLs are effectively integrated into biodiversity conservation frameworks.

References

Bartomeus, I., Lanuza, J. B., Wood, T. J., Carvalheiro, L., Molina, F. P., Collado, M. Ángel, Aguado-Martín, L. O., Alomar, D., Álvarez-Fidalgo, M., Álvarez Fidalgo, P., Arista, M., Arroyo-Correa, B., Asís, J. D., Azpiazu, C., Baños-Picón, L., Beja, P., Boieiro, M., Borges, P. A., González Bornay, G., Carvalho, R., Casimiro-Soriguer, R., Castro, S., Costa, J., Cross, I., De la Rúa, P., de Pablos, L. M., de Paz, V., Díaz-Calafat, J., Ferrero, V., Gaspar, H., Ghisbain, G., Gómez, J. M., Gómez-Martínez, C., González-Estévez, M. Ángel, Heleno, R., Herrera, J. M., Hormaza, J. I., Iriondo, J. M., Kuhlmann, M. ., Laiolo, P., Lara-Romero, C., Lázaro, A., López-Angulo, J., López-Núñez, F. A., Loureiro, J., Magrach, A., Martínez-López, V., Martínez-Núñez, C., Michez, D., Miñarro, M., Montero-Castaño, A., Moreira, B., Morente-López, J., Noval Fonseca, N., Núñez Carbajal, A., Obeso, J. R., Ornosa, C., Ortiz-Sánchez, F. J., Pareja Bonilla, D., Patiny, S., Penado, A., Picanço, A., Ploquin, E. F. ., Rasmont, P., Rego, C., Rey, P. J., Ribas-Marquès, E., Roberts, S. P., Rodriguez, M., Rosas-Ramos, N., Sánchez, A. M., Santamaría, S., Tobajas, E., Tormos, J., Torres, F., Trillo, A., Valverde, J., Vilà, M., & Viñuela, E. (2022) Iberian bee database. *Ecosystems* **31 (3)**: 2380. DOI

Ghisbain G., Rosa P., Bogusch P., Flaminio S., Le Divelec R., Dorchin A., Kasparek M., Kuhlmann M., Litman J., Mignot M., M⎩ller A., Praz C., Radchenko V.G., Rasmont P., Risch S., Roberts S.P.M., Smit J., Wood T.J., Michez D., Revert⎡ S. 2023. The new annotated checklist of the wild bees of Europe (Hymenoptera: Anthophila). *Zootaxa*,, 5327: 1-147.

Lanuza J. B., Knight T. M., Montes-Perez N., Glenny W., Acu⟩a P., Albrecht M., Artamendi M., Badenhausser I., Bennett J. M., Biella P., Bommarco R., Cappellari A., Castro S., Clough Y., Colom P., Costa J., Cyrille N., Manincor N. de, Dominguez-Lapido P., ..., Bartomeus, I. 2025. EuPPollNet: A European database of plant-pollinator networks 2. *Global Ecology and Biogeography*, 34(2): e70000.

Nieto, A., Roberts, S.P.M., Kemp, J., Rasmont, P., Kuhlmann, M., García Criado, M., Biesmeijer, J.C., Bogusch, P., Dathe, H.H., De la Rúa, P., De Meulemeester, T., Dehon, M., Dewulf, A., Ortiz-Sánchez, F.J., Lhomme, P., Pauly, A., Potts, S.G., Praz, C., Quaranta, M., Radchenko, V.G., Scheuchl, E., Smit, J., Straka, J., Terzo, M., Tomozii, B., Window, J. and Michez, D. 2014. European Red List of bees. Luxembourg: Publication Office of the European Union.

Reverté S, Miličić M, Ačanski J, Andrić A, Aracil A, Aubert M et al. (2023) National records of 3000 European bee and hoverfly species: A contribution to pollinator conservation. *Insect Conservation and Diversity* 1-18. DOI

Vujić, A., Gilbert, F., Flinn, G., Englefield, E., Ferreira, C.C., Varga, Z., Eggert, F., Woolcock, S., Böhm, M., Mergy, R., Ssymank, A., van Steenis, W., Aracil, A., Földesi, R., Grković, A., Mazanek, L, Nedeljković, Z., Pennards, G.W.A., Pérez, C., Radenković, S., Ricarte, A., Rojo, S., Ståhls, G., van der Ent, L.-J., van Steenis, J., Barkalov, A., Campoy, A., Janković, M., Likov, L., Lillo, I., Mengual, X., Milić, D., Miličić, M., Nielsen, T., Popov, G., Romig, T., Šebić, A., Speight, M., Tot, T.,

van Eck, A., Veselić, S., Andric, A., Bowles, P., De Groot, M., Marcos-García, M.A., Hadrava, J., Lair, X. , Malidžan, S., Nève, G., Obreht Vidakovic, D., Popov, S., Smit, J.T., Van De Meutter, F., Veličković, N. and Vrba, J. (2022). Pollinators on the edge: our European hoverflies. The European Red List of Hoverflies. Brussels, Belgium: European Commission. https://doi.org/10.2779/359875