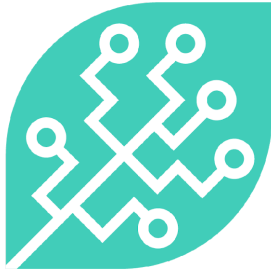


Subject to change



MAMBO

MODERN APPROACHES TO THE
MONITORING OF BIODIVERSITY

D2.3 Deliver framework and its technical implementation of MAMBO tools and technology supporting EU Pollinator Initiative

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D2.3 MAMBO tools and technology supporting the EU Pollinator Initiative

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Preface

The preservation of pollinators is crucial for maintaining biodiversity, ecosystem stability, and agricultural productivity within the European Union. Recognizing the significance of these invaluable species, the European Commission has launched the EU Pollinators Initiative (EU PI), aimed at addressing the alarming decline in pollinator populations across Europe. This initiative underscores the urgent need for innovative tools and strategies to monitor, protect, and enhance pollinator habitats. The EU PI, sets long-term objectives (towards 2030), and short-term actions under three priorities: i) improving knowledge of pollinator decline, its causes and consequences, ii) tackling the causes of pollinator decline, and iii) raising awareness, engaging society at large and promoting collaboration.

In alignment with these objectives, the development and deployment of MAMBO tools represent a significant advancement in our collective efforts to safeguard pollinators. The MAMBO tools provide a comprehensive suite of solutions designed to support the EU PI by offering advanced monitoring, data collection, and analytical capabilities. These tools leverage state-of-the-art technology to deliver precise, real-time insights into pollinator health, behaviour, and habitat conditions, thereby enabling informed decision-making and targeted conservation actions.

The importance of pollinators and the threats they currently face is widely recognised and many Research Infrastructures (RIs) and projects operate in the pollinator domain. This specific MAMBO task 2.3 is set out to link existing and new knowledge to the development of the MAMBO tools to maximise their importance to the EU PI. Furthermore, we will liaise with identified RIs and pollinator projects to determine what progress is needed in the data and technology domain to make progress on pollinator monitoring and conservation in Europe.



Summary

In order to link existing and new knowledge to the development of the MAMBO tools to maximise their importance for the EU PI we started with identifying and mapping all RIs and projects that are engaged in some way with pollinators. We made extensive use of the involvement in, and knowledge about these RIs and projects through the MAMBO consortium partners. We were able to identify 30 stakeholders in the domain of pollinators. We contacted these stakeholders through email and invited them to participate in an interview. Together with the email invitation we provided background information about the MAMBO project, and specifically the six tools that are currently under development and which are being designed to a large extent to speed-up insect monitoring and their habitats, including pollinators. Additionally to the MAMBO background information we shared the six questions that we had prepared to capture the perceived importance of the MAMBO tools to contribute to the priorities of the EU PI, what additional functionality is needed from the MAMBO tools to make them useful for the stakeholders, and what is needed from the wider data and technology domain.

We received a positive reply from 17 stakeholders for an interview which is a good representation of stakeholder groups ranging from the policy domain and RIs, to pollinator projects. All, but the acoustic AI tool to identify species from sounds, were perceived as being relevant to contribute to the priorities of the EU PI. The MAMBO tools that are relevant to the EU PI range from tools that deploy AI algorithms to identify insects, and specifically day and night active pollinators, to automated monitoring devices and tools that monitor the habitat quality and habitat extent through drone, LiDAR and remote sensing data.

We collected a wide array of recommendations for the different MAMBO tools related to the diverse background of stakeholders that were interviewed. The implementation of metadata, data standards and open or public available data across various disciplines (ranging from taxonomy to remote sensing) was mentioned a lot. These aspects are also known as FAIR data principles that make data Findable, Accessible, Interoperable and Reusable. Other important aspects are the requirement for high-resolution images to be able to identify insects, intuitive user interfaces in multiple languages to make the tools available for a wide range of end-users, facilitate stand-alone operation of the tools in areas without 4G/5G coverage, consider international standards to facilitate the use of the MAMBO tools beyond Europe, and develop solutions to integrate historical baseline data to facilitate trend analyses, among others. All points raised will be given consideration in the further development of the MAMBO tools and aim at maximising their contribution to the aims and priorities set by the EU PI.

Introduction

The objective of MAMBO task 2.3 is that the 'Tools and data related to the EU Pollinator Initiative (EU PI) and the monitoring of pollinators are linked up and easy to find'; the EU Pollinator Initiative was set up to reverse the decline of wild pollinators in the EU and contribute to global action¹. More specifically task 2.3 will 'make Research Infrastructures (RIs), data and technology work for EU pollinators'. This will ensure that the MAMBO tools will be interoperable with existing Research Infrastructures (RI) and data sources that are relevant for EU pollinators and that the six MAMBO tools will be accessible even beyond the life-span of the project (See MAMBO Tools). The first version of the EU PI was released in 2018 and in 2023 a revised version was published². The revised EU PI outlines three priority areas which are:

- I: Improving knowledge of pollinator decline, its causes, and its consequences (3/11).
- II: Improving pollinator conservation and tackling the causes of their decline (6/23).
- III: Mobilising society and promoting strategic planning and cooperation at all levels (2/8)

Linked to these three priority areas the EU PI describes the objectives of the three priority areas, and 11 related actions, and 42 sub-actions (between brackets behind the priority areas respectively).

As MAMBO partners are among the lead authors of the EU Pollinator Monitoring Scheme (EU-PoMS; Potts et al. 2021), were leading SPRING (Strengthening Pollinator Recovery through INdicators and monitorinG), are partners in ORBIT, and are linked to TAXOFLY that will deliver taxonomic and ecological knowledge on EU bees and hoverflies, respectively, enables us to link existing (e.g. EU red list of bees, climate change atlas of bumblebees, JRC) and new knowledge to the development of the MAMBO tools which will be of great importance to the EU PI. By liaising with these partners and the wider pollinator stakeholder community we aim to determine what progress is needed further in the data and technology domain concerning the six MAMBO tools to make progress on pollinator monitoring and conservation in Europe as outlined in the EU PI.

MAMBO Tools

Each of the six MAMBO tools is developed to contribute to ecological restoration as its tools make monitoring of all biodiversity (species and habitats, focusing on EU directive targets) easier and more accurate, providing decision-support for nature conservation, and guidance of nature restoration and development.

Tool 1. Image recognition software for species on the annexes of the Habitats Directive (WP3)

Artificial Intelligence (AI) algorithms that recognize all species listed on the annexes of the EU Habitat Directive will be developed and made available for integration within other applications such as mobile apps or websites. The benefit of doing this at an EU level is not only cost efficiency but also results in a much higher quality of classification algorithms due

¹ https://environment.ec.europa.eu/topics/nature-and-biodiversity/pollinators_en

² <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A35%3AFIN&qid=1674555285177>



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to the involvement of a wide pool of leading taxonomic experts and the shared access to training data.

An AI image recognition algorithm for smartphones or desktop devices can significantly contribute to the EU PI's Priority 1 and 2, *when extended to pollinator groups*, by enhancing data collection. By developing a user-friendly app, citizens can photograph and upload images of pollinators, providing real-time identification and valuable location data. This data can be integrated into existing databases, enabling large-scale monitoring and analysis of pollinator populations.

Researchers can then study patterns, trends, and correlations with environmental factors such as pesticide use and habitat loss. Making this data publicly available can enhance collaborative research efforts and inform policymakers on evidence-based decisions for pollinator protection.

In terms of tackling the causes of pollinator decline, the app can identify critical habitats for protection and facilitate public awareness campaigns, encouraging broader community engagement. By collaborating with environmental organisations, research institutions, and government agencies, the app can ensure wide participation and data integration, thus effectively contributing to the EU Pollinator Initiative's goals of understanding and addressing pollinator decline.

Tool 2. Sound-recognition software for birds, bats, marine mammals, crickets, and grasshoppers (WP3)

MAMBO Tool 2 is of less relevance to the EU PI.

Tool 3. Insect camera for monitoring nocturnal insects (WP3)

The AI algorithms developed to identify nocturnal insects will be designed in a generic way, meaning that the developed algorithms can be used on different camera systems and applied throughout Europe. The tool will (1) detect night-flying insects on a screen, (2) use AI to identify insects, and (3) estimate the biomass of the insect on the screen.

The Insect Camera for monitoring nocturnal insects can significantly contribute to the EU PI's Priorities 1 and 2 by providing critical data on nocturnal pollinator species, which are often underrepresented in traditional monitoring efforts. By capturing and analysing images of these insects, the camera can help track population trends, identify species, and study their behaviours and interactions with the environment. This data enhances understanding of nocturnal pollinators' roles and their responses to factors like habitat loss and pesticide use (Priority 1). Additionally, the insights gained can inform conservation strategies and sustainable practices to protect and restore habitats for these essential pollinators (Priority 2).

Tool 4. Insect camera for monitoring pollinators (WP3)

This tool will detect day-flying pollinators on vegetation. To detect individual insects deep-learning-based object detection networks will be used. Part of the project is to investigate how object detection networks can be modified to better deal with different appearances and overlapping objects. To prevent the same individual from being counted twice we will investigate (1) the tracking (and subsequent deduplication) of individual insects across images in time and (2) statistical methods to correct for duplication. AI algorithms will be developed to identify species.



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The Insect camera for monitoring pollinators can significantly contribute to the EU PI's Priorities 1 and 2 by providing continuous, detailed data on pollinator populations and behaviours. By capturing high-resolution images and videos of pollinators, the camera helps track species diversity, population trends, and activity patterns, enhancing our understanding of pollinator decline and its causes (Priority 1). This technology also aids in identifying critical habitats and the impact of environmental factors, informing targeted conservation efforts, and promoting sustainable practices to protect and restore pollinator habitats (Priority 2).

Tool 5. Habitat extent mapping tools (WP4)

By leveraging high-resolution satellite imagery, these tools provide detailed and accurate maps of diverse habitats across the EU, enabling comprehensive monitoring of habitat changes, fragmentation, and degradation over time. This detailed spatial data allows researchers to track how pollinator habitats evolve in response to various environmental pressures and human activities, thereby enhancing our understanding of the factors contributing to pollinator decline (Priority 1).

Additionally, the high-resolution maps generated from satellite images can identify specific areas where pollinator-friendly habitats are lacking or under threat. This information is crucial for prioritising conservation efforts, guiding habitat restoration projects, and optimising land management practices. By pinpointing critical habitats that need protection and areas suitable for creating new pollinator habitats, these tools support targeted and effective interventions to improve habitat quality and connectivity, ultimately promoting sustainable agricultural practices and urban planning that benefit pollinators (Priority 2).

Tool 6. Habitat condition metric derivation from airborne LiDAR and/or drone data (WP4)

Focusing on developing habitat condition-related metrics from airborne LiDAR and drone imagery for local, site-specific (Natura 2000) monitoring, providing precise, detailed data on habitat structures and conditions. This technology helps assess and track habitat suitability for pollinators, offering insights into habitat degradation or restoration progress, thereby improving knowledge of pollinator decline and its causes (Priority 1). Furthermore, it enables targeted conservation and habitat restoration efforts, ensuring optimal conditions for pollinators and promoting sustainable land management practices (Priority 2).

EU Pollinator Initiative (EU PI)

On August 18, 2024, the EU Nature Restoration Law entered into force³. The EU Nature Restoration Law includes a legally binding target for EU Member States to reverse the decline of pollinator populations by 2030, and to maintain increasing trends thereafter. The Nature Restoration Law and this revised EU PI go hand-in-hand: the legislative proposal gives Member States the flexibility to decide, in their National Restoration Plans, the most effective measures to achieve the target. The MAMBO tools aim to contribute to the assessment of this target and facilitate the monitoring of pollinators throughout Europe. From the full list of actions and sub-actions that are defined under the three priorities areas of the EU PI we identified those where one or more of the MAMBO tools can make a contribution based on identified needs for each of the sub-actions (Table 1). Among actions

³ https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-law_en



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that are not considered are e.g. ‘6. Mitigate the impacts of pesticide use on pollinators’ and ‘8. Reduce the impact of invasive alien species on pollinators’, which do not have direct links to the MAMBO Tools. Check the annex of the EU PI for a full overview of actions and sub-actions under the EU PI⁴.

Table 1. EU Pollinator Initiative - Selected priorities, actions, and sub-actions with relevance to the MAMBO tools, their specific needs and the MAMBO tools that will answer to these needs.

Priorities / Actions	Subactions	Needs	MAMBO Tool
PRIORITY I: Improving knowledge of pollinator decline, its causes and consequences			
1. Establish a comprehensive monitoring system	1.1a <i>Development and testing of a standardised methodology for an EU pollinator monitoring scheme (EU-PoMS).</i>	Map pollinator distribution, state and trends in abundance at adequately accurate spatial and temporal detail.	3 & 4
	1.1b <i>Delivery of annual datasets on the abundance and diversity of pollinator species.</i>	Monitor pollinator species annually according to a standardised methodology.	1, 3 & 4
	1.2 <i>Devise an integrated framework for monitoring pollinator decline, its causes and consequences. Systematic collection of data on major threats to pollinators, in particular through the EMBAL (European Monitoring of Biodiversity in Agricultural Landscapes) and Insignia (Pollution Monitoring) initiatives.</i>	Monitor the main threats to pollinator decline.	5 & 6
	1.3a <i>Develop indicators on the state of pollinator populations and the pressures they face.</i>	Develop indicators on the state of pollinator populations.	3 & 4
	1.3b <i>Explore options for developing indicators on the impacts of pollinators on ecosystem health, the economy and human wellbeing.</i>	Develop indicators for ecosystem health.	6
2. Support research and assessment	2.1 <i>Promote research and innovation on the state of pollinators, the causes and the consequences of their decline, as well as effective mitigation measures.</i>	Generate actionable knowledge based on systematically collected data and information. To better understand the threats to pollinators and their interactions.	1, 3 & 4
	2.2 <i>Finalise the European Red List assessment for key insect pollinator groups – bees, hoverflies, butterflies, and moths.</i>	To better understand the taxonomic and functional diversity of pollinator communities and their distribution.	3 & 4
	2.3 <i>Identify and map Key Pollinator Areas in the EU, which should become the focus of conservation and restoration efforts.</i>	EU-wide mapping of key pollinator areas, in order to enable targeted conservation and restoration measures.	5 & 6
PRIORITY II: Improving pollinator conservation and tackling the causes of their decline			

⁴ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A35%3AFIN&qid=1674555285177>

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4. Improve conservation of pollinator species and habitats	<i>4.1 Devise a blueprint for a network of ecological corridors for pollinators – “Buzz Lines” – and develop a plan of measures for implementing it. The plan will build on the mapping of Key Pollinator Areas and the creation of new habitat areas through restoration. To support the implementation of the Buzz Lines network Member States should integrate pollinator conservation into spatial planning policies at national, regional, and local levels.</i>	Spatial planning processes at all governance levels for the successful implementation of the Buzz Lines network.	5 & 6
	<i>5.4 Development of a pollinator indicator with a view to integrating it into the CAP’s performance monitoring and evaluation framework, once the EU pollinator monitoring scheme (EU-PoMS) is sufficiently implemented.</i>	Develop a pollinator indicator that can be integrated into the common agricultural policy (CAP).	3 & 4
PRIORITY III: Mobilising society and promoting strategic planning and cooperation at all levels			

We provide a graphical representation of the proposed use of the MAMBO tools to answer to the needs dictated by the sub-actions of the EU PI (Fig. 1). This shows that especially tools 3 & 4 to monitor night and day flying insects are best suited to contribute to the EU PI, followed by the habitat condition mapping and habitat extent mapping tools, and tool 1, which only covers a small portion of pollinators.



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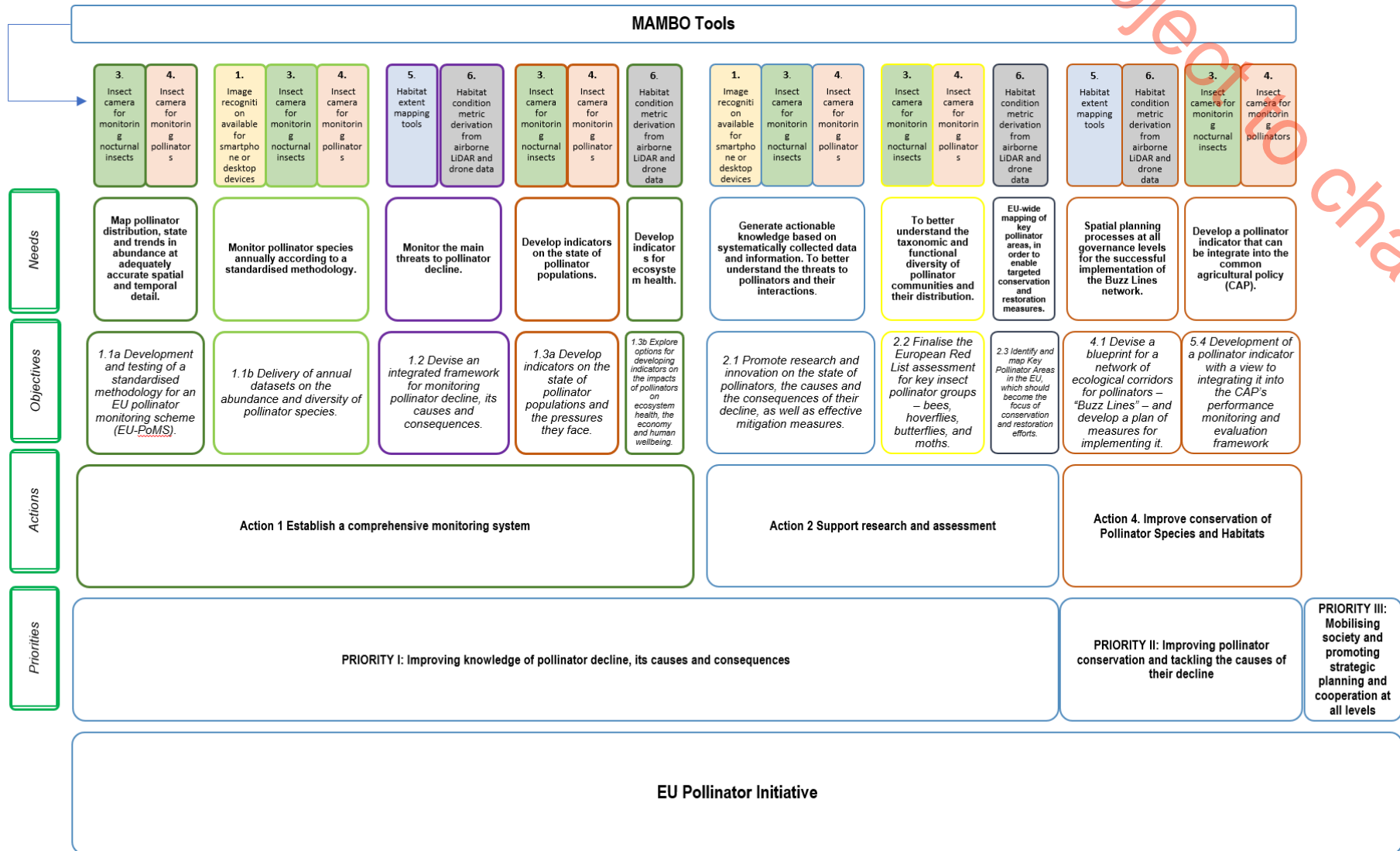


Figure 1. The identified needs in the data and infrastructure domain of the EU PI actions and sub-actions and the MAMBO tools that contribute to these needs.

Making Research Infrastructures (RIs), data, and technology work for EU Pollinators (T2.3)

Pollinators are under severe pressure and therefore receive much attention, with many projects and initiatives developing data and tools to boost pollinators and pollination. In this task, we will support the EU PI by making sense of the data and tools for pollinators. MAMBO stakeholders are leading in innovative research infrastructures and projects related to European pollinators ranging from areas such as monitoring, taxonomic and ecological knowledge on EU bees, hoverflies, and bumblebees, to mapping and monitoring of habitats based on various sources of remote sensing data. Through this network of experts, we will identify relevant research infrastructures, projects, data providers, and data resources in the EU pollinator domain with a potential interest in the MAMBO tools. These stakeholders will be consulted via in-person interviews to capture their thoughts and opinions on the usefulness and requirements of the MAMBO tools to ensure that the MAMBO tools support the actions and sub-actions defined in the EU PI and can be adopted by the wider stakeholder landscape. The results will be summarised and shared with the respective work packages that lead the development of the MAMBO tools.



Methodology

To determine the requirements of the MAMBO tools to make a significant contribution to the EU PI we consulted the wider EU pollinator stakeholder community. We first identified all relevant RIs, projects, and data infrastructures and identified their representatives, through the lists of stakeholders included in the EU Pollinator Initiative, as well as the MAMBO project members, and according to information provided by experts. Secondly, we prepared in-person interviews with six questions that were shared with 30 representatives together with an invitation for an interview. Based on the returned information of 17 stakeholders, we provide recommendations for the MAMBO tools to maximise their relevance for the EU PI.

Identifying stakeholders related to the EU Pollinator Initiative

To develop a database of Research Infrastructures, projects, and data providers that are engaged with EU pollinators we took the following approach.

1. We first listed the MAMBO partners and the pollinator projects in which they are involved, e.g. DiSSCo (Distributed System of Scientific Collections), STING (Science and Technology for Pollinating Insects), SPRING (Strengthening Pollinator Recovery through Indicators and Monitoring).
2. We added all RIs, projects, and data providers that are specifically mentioned in the revised version of the EU PI, e.g. eLTER (Long-Term Ecosystem Research in Europe), Joint Research Centre (JRC), EU Pollinator Monitoring Scheme (EU-PoMS).
3. We complemented the list with institutions/organisations suggested by decision-makers or experts in the pollinator domain using internet searches, scientific papers, and the EU portal.

For each identified stakeholder we documented the following information: Acronym, fullName, URL, contact, contactEmail, contactProfile, Leading, Type of Initiative, Main Fields, Approach, Data types, Data Requirement, Software Requirement, Remarks, Date_Data Request contact, Request_Interview, Date_Interview, Additional sources / Data, and Metadata.

Invitation for interview and questions

To maximise positive replies on our invitation for an interview we shared some background information on the MAMBO Tools and the selection of actions and sub-actions of the EU PI which are relevant for the MAMBO tools (Box. 1). We also shared the six questions of the interview (see below) and indicated that the interview would not take more than 30 minutes of their time.



Box 1. Email that was sent to identified stakeholders.

Subject: MAMBO Project - Making RIs, Data, and MAMBO Technology Work for EU Pollinators - Request for Interview -

Good morning,

Dear

I hope this email finds you well,

Naturalis Biodiversity Center and the MAMBO Project "Modern Approaches to the Monitoring of Biodiversity" [<https://www.mambo-project.eu/>] have the honor to invite you to a brief interview as a representative of (name of the institution). The interview will take not more than half an hour and below we give some information on the questions to be answered during the interview.

The interview aims to generate the optimal design of the MAMBO monitoring tools. We will explain the six MAMBO tools (described below) and explore how they can be aligned with various existing tools and infrastructures and fulfill the priorities of the [EU Pollinator Initiative](#).

Table 1. Description of each of the MAMBO Tools. Priorities refer to the PI priorities that are displayed below the table.

MAMBO Tool	Priorities
1. Image recognition available for smartphone or desktop devices (species of EU Habitats and Bird directive, EU pollinator initiative, EU Red lists, EU Invasive Alien Species)	Priority 1 & 2
2. Sound recognition of animals available for smartphone or desktop devices (European birds, bats, marine mammals, pollinating insects)	NA
3. Insect camera for monitoring nocturnal insects	Priority 1 & 2
4. Insect camera for monitoring pollinators	Priority 1 & 2
5. Habitat extent mapping tools	Priority 1 & 2
6. Habitat condition metric derivation from airborne LiDAR and drone data	Priority 1 & 2

The revised Pollinators Initiative sets objectives for 2030 and related actions under three priorities:

- I Improving knowledge of pollinator decline, its causes, and consequences
- II Improving pollinator conservation and tackling the causes of their decline
- III Mobilising society and promoting strategic planning and cooperation at all levels

Underneath these priorities, the EU PI lists 11 actions and 41 sub-actions with specific deadlines. From the 41, we have identified 8 sub-actions that are directly relevant to one or more MAMBO tools. This selection is delivered as MAMBO Milestone M2.6 and presented in the table below.



Table 2. Selected priorities, actions, and sub-actions with relevance to the MAMBO tools, their specific needs, and the MAMBO tools that will answer these needs.

Priorities / Actions	Subactions	NEEDS	MAMBO Tool
PRIORITY I: Improving knowledge of pollinator decline, its causes and consequences			
1. ESTABLISH A COMPREHENSIVE MONITORING SYSTEM	1.1a Development and testing of a standardized methodology for an EU pollinator monitoring scheme (EU-PoMS).	Map pollinator distribution, state, and trends in abundance at adequately accurate spatial and temporal detail.	3 & 4
	1.1b Delivery of annual datasets on the abundance and diversity of pollinator species.	Monitor pollinator species annually according to a standardized methodology.	1, 3 & 4
	1.2 Devise an integrated framework for monitoring pollinator decline, its causes, and consequences. Systematic collection of data on major threats to pollinators, in particular through the EMBAL (European Monitoring of Biodiversity in Agricultural Landscapes) and Insignia (Pollution Monitoring) initiatives.	Monitor the main threats to pollinator decline.	3, 4, 5 & 6
	1.3a Develop indicators on the state of pollinator populations and the pressures they face.	Develop indicators on the state of pollinator populations.	3 & 4
	1.3b Explore options for developing indicators on the impacts of pollinators on ecosystem health, the economy, and human wellbeing.	Develop indicators for ecosystem health.	5 & 6
	2. SUPPORT RESEARCH AND ASSESSMENT	2.1 Promote research and innovation on the state of pollinators, the causes and the consequences of their decline, as well as effective mitigation measures.	Generate actionable knowledge based on systematically collected data and information. To better understand the threats to pollinators and their interactions.
2.2 Finalise the European Red List assessment for key insect pollinator groups – bees, hoverflies, butterflies, and moths.		To better understand the taxonomic and functional diversity of pollinator communities and their distribution.	3 & 4
2.3 Identify and map Key Pollinator Areas in the EU, which should become the focus of conservation and restoration efforts.		EU-wide mapping of key pollinator areas, in order to enable targeted conservation and restoration measures.	6
PRIORITY II: Improving pollinator conservation and tackling the causes of their decline			
4. IMPROVE CONSERVATION OF POLLINATOR SPECIES AND HABITATS	4.1 Devise a blueprint for a network of ecological corridors for pollinators – “Buzz Lines” – and develop a plan of measures for implementing it. The plan will build on the mapping of Key Pollinator Areas and the creation of new habitat areas through restoration. To support the implementation of the Buzz Lines network Member States should integrate pollinator conservation into spatial planning policies at national, regional, and local levels.	Spatial planning processes at all governance levels for the successful implementation of the Buzz Lines network.	5 & 6

	5.4 Development of a pollinator indicator with a view to integrating it into the CAP's performance monitoring and evaluation framework, once the EU pollinator monitoring scheme (EU-PoMS) is sufficiently implemented.	Develop a pollinator indicator that can be integrated into the common agricultural policy (CAP).	3 & 4
PRIORITY III: Mobilising society and promoting strategic planning and cooperation at all levels			
NA	NA	NA	NA

Questions:

1. Which of the above [MAMBO Tools](#) (Table 1) are relevant for your RI and in relation to the EU Pollinator Initiative?
2. What challenges or obstacles have you encountered *when using existing tools* and technologies in supporting the EU Pollinator Initiative (e.g. interoperability, outdated file formats, etc.)?
3. What technical features or capabilities are essential for the MAMBO tools to effectively support your work with the EU Pollinator Initiative?
4. What are the 3 most important (sub)actions of the EU pollinator initiative for your RI (see Table 2)?
5. What else is needed in the data and technology domain to make progress on pollinator monitoring and conservation in Europe?
6. Do you have any additional questions or suggestions for the MAMBO Project?

We anticipate that the interview will take between approximately 30 minutes of your time and the collected information is for the exclusive use of the MAMBO project, and will not be shared for other purposes.

Google-calender (Dates)

Please, find here the tentative dates, in case the proposal dates are not available for you, don't hesitate to suggest other dates, or times.

Thank you very much in advance.

Kind regards,

Ana Maria Feijoo Quezada
 Project Officer
 Naturalis Biodiversity Center
 MAMBO receives funding from the European Union's Horizon Europe research and innovation programme under grant agreement No.10106063

We carefully constructed the six questions to collect as much relevant information as possible within 30 minutes of the interview. These questions are also shown in Box 1.

Question 1 - Which of the above MAMBO Tools are relevant for your RI and in relation to the EU Pollinator Initiative? From this question, we collect quantitative results on the relevance of the MAMBO tools for the EU PI. Initially, only a 1/0 rating was considered, with 1 for relevant and 0 for not relevant, however, some stakeholders consider giving a rating of 0.5, indicating that it may be partially relevant.



Question 2 - What challenges or obstacles have you encountered when using existing tools and technologies in supporting the EU Pollinator Initiative (e.g. interoperability, outdated file formats, etc.)? This question adds information where the MAMBO tools can make significant contributions compared to existing tools that are used by the stakeholder community in relation to the EU PI.

Question 3 - What technical features or capabilities are essential for the MAMBO tools to effectively support your work with the EU Pollinator Initiative? This question identifies key features for the MAMBO tools with relevance to the EU PI which are considered relevant by the stakeholder community.

Question 4 - What are the 3 most important actions of the EU pollinator initiative for your RI? This question provides quantitative input on which actions and sub-actions of the EU PI are considered most relevant by the stakeholder community and which should be considered with priority in the development of the MAMBO tools.

Question 5 - What further progress is needed in the data and technology domain to make progress on pollinator monitoring and conservation in Europe? This question provides insights on what is needed to effectively monitor pollinators in Europe.

Question 6 - Do you have any additional questions or suggestions for the MAMBO Project? This question harvests overlooked information.

Conducting Interviews

The interviews were conducted online or face-to-face and with permission, were recorded (to keep concordance with the project, obtaining all the necessary information, avoiding omission of important details, and retention of information for no longer than three months after the final delivery of the report). Notes and statistics were written down in real time, and additional information was updated afterward.



Results

Identified stakeholders in the EU pollinator domain

We were able to identify 30 stakeholders and initiatives that are to some extent engaged with the conservation of pollinators in Europe and which were invited for an interview (Table 2).

Table 2: List of identified stakeholders in the pollinator domain, colour coded by those interviewed in green, responded by email in blue, closed projects in orange, those not available to be interviewed in grey, and those that could not be reached in red.

ID	Acronym	FullName	URL	Contact	ContactEmail
1	ANTENNA	Making Technology work for monitoring pollinators	https://darsa.info/project/antenna/	Oliver Schweiger	oliver.schweiger@ufz.de
				Leon Marshall	leon.marshall@naturalis.nl
2	BeeLife	Solution-oriented non-profit organisation working to improve conditions for bees and pollinators	https://www.bee-life.eu/about	Frank Alétru	frank.aletru@snapiculture.fr
3	CETAF	Consortium of European Taxonomic Facilities	https://cetaf.org/	Ana Casino	ana.casino@cetaf.org
4	DiSSCo	Distributed System of Scientific Collections	https://www.dissco.eu/	Eva Alonso	eva.alonso@naturalis.nl
5	DRUID	Drivers & Repercussions of UK Insect Declines	https://druidproject.org.uk/	William Kunin	W.E.Kunin@leeds.ac.uk
6	eBMS	European Butterfly Monitoring	https://butterfly-monitoring.net/	David Roy	dbr@ceh.ac.uk



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		Scheme - eBMS			
7	ECSITE	Ecsite - European Network Science Centers and Museums	https://www.ecsite.eu/	Bruno Maquart	bmaquart@yahoo.fr
8	EEA	European Environment Agency	https://www.eea.europa.eu/en	Irina Levinsky Jan-Erik Petersen	Irina.Levinsky@eea.europa.eu Jan-Erik.Petersen@eea.europa.eu
9	eLTER	Integrated European Long-Term Ecosystem, critical zone and socio-ecological Research	https://elter-ri.eu/	Michael Mirtl Mark Frenzel	office@elter-ri.eu
10	EU Commision	Integration of biodiversity into sectoral policies - European monitoring of biodiversity in agricultural landscapes (EMBAL)	https://www.consilium.europa.eu/en/policies/biodiversity/	Vujadin Kovacevic	Vujadin.KOVACEVIC@ec.europa.eu
11	EUROPABON	Europa Biodiversity Observation Network	https://europabon.org/	Henrique Pereira	hpereira@idiv.de
12	IDMYBEES	Improvement and Diffusion of Methods to identify BEES	https://anr.fr/Project-ANR-22-CE02-0028	Adrien Perrard	adrien.perrard@u-paris.fr Adrien.Perrard@univ-paris-



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					diderot.fr
13	IPBES	Intergovernmental Platform of Biodiversity and Ecosystem Services	https://www.ipbes.net/	Alvaro D' Antona	alvaro.danton a@fca.unicam p.br
14	Joint Research Centre (JRC) European Commission	European Pollinator Monitoring Scheme	https://wikis.ec.europa.eu/pages/viewpage.action?pageId=23462107	Chiara Polce	Chiara.POLCE @ext.ec.europa.eu
15	LTER-LIFE	A research infrastructure to develop Digital Twins of ecosystems in a changing world	https://lter-life.nl/en	Geerten Hengeveld	g.hengeveld@ nioo.knaw.nl
16	National Bee Strategy	National Bee Strategy	https://www.nationalebijenstrategie.nl/home	Marten Schoonman	marten.schoon man@naturalis.nl
17	Naturalis Biodiversity Center	Naturalis Biodiversity Center	https://www.naturalis.nl/en	Thomas Wood	thomas.wood @naturalis.nl
18	National Biodiversity Data Centre	National Biodiversity Data Centre	https://biodiversityireland.ie/	Michelle Larkin	mlarkin@biodiversityireland .ie
19	ORBIT	Taxonomic resources for European bees	https://orbitproject.wordpress.com/	Denis Michez	denis.michez @umons.ac.be
20	PI@ntNET	PI@ntNet	https://plantnet.org/en/	Pierre Bonnet	pierre.bonnet@cirad.fr
21	Pollinator Academy	Pollinator Academy	https://pollinatoracademy.eu	Merel Bozua	merel.bozua @naturalis.nl



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			u/		
22	Pollinator Partnership	Pollinator Partnership	https://www.pollinator.org/	Billy Synk	billy@pollinator.org
23	POSHBEE - finished May 2023	Pan-European Assessment, Monitoring, and Mitigation of Stressors on the Health of Bees	https://poshbee.eu/	Mark Brown	Mark.Brown@rhul.ac.uk
24	SafeGUARD	Safeguarding European Wild Pollinators	https://www.safe-guard.biozentrum.uni-wuerzburg.de/	Steffan Ingolf	ingolf.steffan@uni-wuerzburg.de
25	Showcase	Showcase	https://showcase-project.eu/	David Kleijn	david.kleijn@wur.nl
26	SPRING	Strengthening Pollinator Recovery through INDicators and monitoring	https://www.ufz.de/spring-pollination/	Mark van Nieuwstadt	mark.vannieuwstadt@naturalis.nl
27	STING	Science and Technology for Pollinating Insects	https://knowledge4policy.ec.europa.eu/projects-activities/sting-project_en	Simon Potts	s.g.potts@reading.ac.uk
28	SURPASS	Safeguarding pollination services in changing world	https://bee-surpass.org/	France Gerard	ffg@ceh.ac.uk
29	TAXO-FLY	Taxonomic resources for European hoverflies	https://tietopankki.luomus.fi/wp-content/uploads/202	Gunilla Stahls	gunilla.stahls@helsinki.fi

			3/11/Luomus-Taxo-Fly-project-an-EU-funded-Service-Contract.pdf		
30	WILDLABS	The conservation technology network	https://wildlabs.net/	Toke Hoyer	tth@ecos.au.dk

Interviews

Each of the 30 identified stakeholders was invited for an interview. If they did not respond, a reminder was sent by email. In total, 17 (56.7%) stakeholders responded positively to our invitations (15 interviewed (50%) and 2 stakeholders responded by email (6.7%)), one stakeholder (3.3%) indicated that the project ended in May 2023, and the other 12 stakeholders (40%) were not interviewed (one stakeholder indicated that they were not available for interview and did not provide further details (3.3%), and 11 stakeholders (36.7%) did not respond).

Stakeholders Interviews

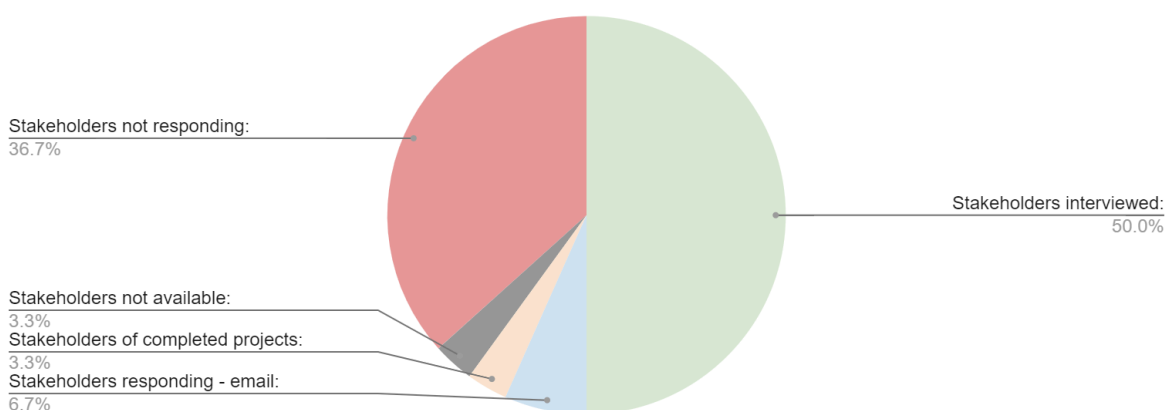


Figure 2. Statistics of the identified stakeholders in the pollinator domain.

Importance of MAMBO tools for the EU PI

The first question of the interview was “Which of the MAMBO Tools do you think will be relevant for your RI in relation to your activities for the EU Pollinator Initiative?” (Fig. 3). Many of the 17 respondents indicated that most tools are of relevance to their RI or project, except for tool 2 which is the development of AI for species identification from sounds. Sounds made by insects and pollinators specifically are not species specific and are more indicative of the size of the individual. The development of AI algorithms (tools 1, 3, and 4) for species identification in combination with hardware monitoring tools (tools 3 and 4) are important for the pollinator stakeholder community.



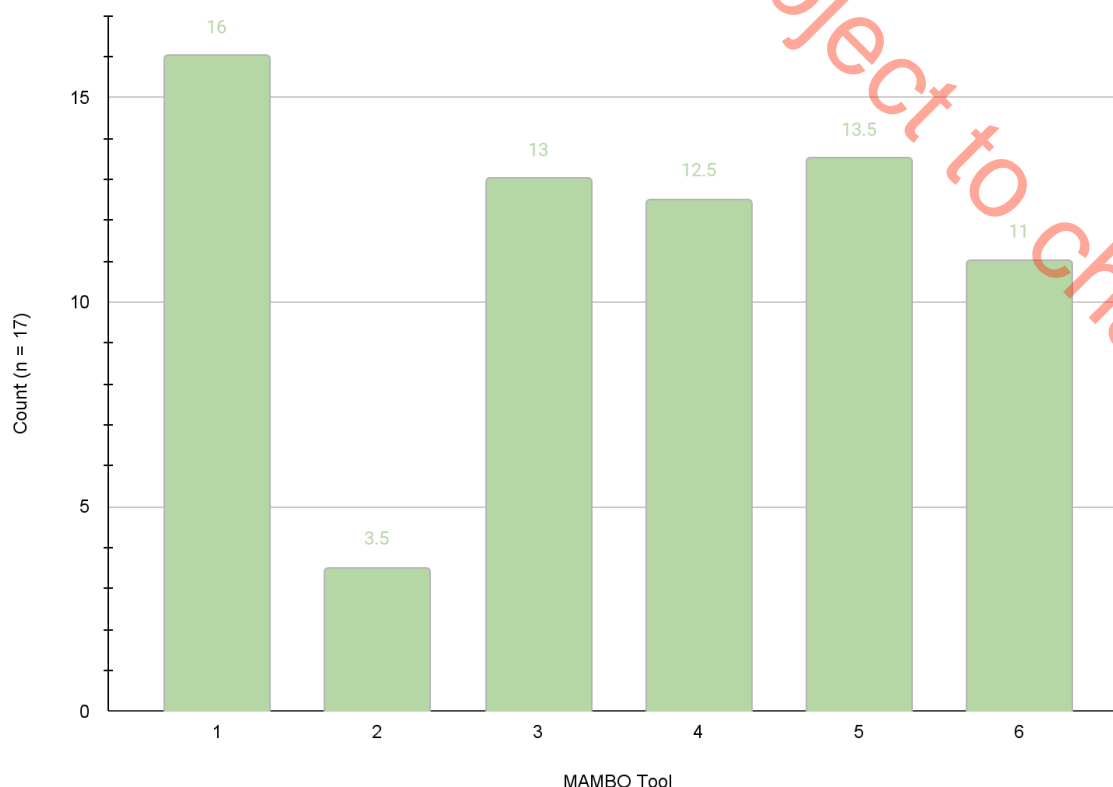


Figure 3. Perceived importance of the MAMBO tools for the EU PI from 17 interviews.

Challenges and obstacles of existing tools

The second interview question aimed to identify the challenges and obstacles of existing tools to support EU PI and how MAMBO should address these issues, where stakeholders responded to this question using as a basis experiences with the management of existing tools, or alternatively according to their own projects.

Table 3. List of challenges and obstacles of existing tools to support the EU PI.

Stakeholders	List of challenges	List of obstacles	List of existing tools / Additional data
ANTENNA	N/A	N/A	N/A
DiSSCo	<ul style="list-style-type: none"> - Accessibility of databases with different specimens and species by different user types e.g. students, communities, not only researchers and organisations. - Interoperability between different research infrastructures - Databases should contain collected historical data, including their metadata. 	N/A	N/A

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DRUID	<ul style="list-style-type: none"> - Image recognition in terms of pollinator monitoring, only few species can be identified, not for all species will be useful, maybe with AI these problems can be solved and the tool can be more powerful. - Acoustic pan traps can help to recognize different sizes and frequencies sound (size variation of species) 	<ul style="list-style-type: none"> - Malaise traps do not catch pollinators - Don't capture rare species, hence red list species are difficult to monitor. 	<ul style="list-style-type: none"> - Malaise traps - Pan traps (work well for pollinators) - Acoustic pan traps
eLTER	<ul style="list-style-type: none"> - There are new methods, AI and other tools under development every day, it would be necessary to take advantage of synergies between projects and not to reinvent tools. - The method being applied is insect traps and subsequent metabarcoding. 	N/A	<ul style="list-style-type: none"> - Malaise traps - Metabarcoding; barcoding of DNA/RNA (or eDNA/eRNA) in a manner that allows for the simultaneous identification of many taxa within the same sample
EU Commission	<ul style="list-style-type: none"> - Granularity of data, without errors of a few metres (satellite images don't provide precise information). - Proof of concept (Method or principle in order to demonstrate its feasibility) - Need of tools that can recognize insects at species level 	<ul style="list-style-type: none"> - Image recognition is only available for butterflies and wasps, but not for all pollinator species. 	<ul style="list-style-type: none"> - Copernicus - Natura 2000 - Grassland Watch Project - Remote sensing - Image recognition - Satellite images
EUROPABON	<ul style="list-style-type: none"> - Incorporate trend analyses. - Identify solutions to integrate historical and new data. 	<ul style="list-style-type: none"> - Not (better) taking into account historical data will hinder the implementation of the EU PI. 	N/A
IDMYBEES	<ul style="list-style-type: none"> - User interface to camera images to allow specialists to identify species for AI algorithm training 	N/A	N/A
Joint Research Centre - European Commission	<ul style="list-style-type: none"> - Remote sensing approaches to monitor pollinator habitats, including floral resources, hold immense potential to provide crucial ecological context data to augment pollinator monitoring efforts in the future (MAMBO tools 5 & 	N/A	



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	6).		
National Bees Strategy	<ul style="list-style-type: none"> - Monitor pollinator trends (the presence the population the health of natives at a certain date at a certain place - How reliable is the technology level structure & data. - Important the interpretation of the data (Trends, prospects and raw data) - Obtaining immediate results (mandatory) - Advanced data Artificial Intelligence (AI), machine learning creating algorithms advanced data analysis to be able for interpretation - Insect chamber (local only) 	N/A	N/A
Naturalis Biodiversity Center	<ul style="list-style-type: none"> - At present, BOLD has completed 40% of the pollinators, and is expected to have completed 90% in one to two years. 	N/A	<ul style="list-style-type: none"> - DNA Barcoding - Barcode of life Project - EU BOLD mirror - BOLD Systems (Biodiversity Genomics Europe)
ORBIT	<ul style="list-style-type: none"> - Taxonomic limits of the tools - Species level (how far we can go) - Developing powerful tools - AI Training is really important - Some regions are easier than others to obtain insects images; EU-PoMS (North - South is really different collecting data) - These tools can help taxonomy with data. - Museum specimens can be useful for the training of AI. - Key is to connect taxonomic experts to AI algorithm training. 	N/A	N/A

Subject to change



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<p>PI@ntNET</p>	<ul style="list-style-type: none"> - Computational constraints related to knowledge transfer for plant species. - Avoid high energy consumption and provide efficient service and high balance. 	<ul style="list-style-type: none"> - MAMBO will use EUNIS habitat classification, but PI@ntNET wants to characterise habitats at a global scale. It is difficult for PI@ntNET and the end-user community that the same habitat classification is not used at global level, but only at European level. - PI@ntNET has a global community that will have difficulties connecting with MAMBO that develops its tools at the European level. 	<p>N/A</p>
<p>Pollinator Academy</p>	<ul style="list-style-type: none"> - Don't exist many tools for pollinators - Lack of tools and keys - Create tools that everybody can use (without been experts or taxonomist) 	<ul style="list-style-type: none"> - Not specific for the regions - Traditional identification - The platforms needs to have language variety - It is difficult to create a specific tool for a variety of species. 	<p>N/A</p>
<p>SPRING</p>	<ul style="list-style-type: none"> - Integration into a portable tool - Improve AI for species identification from images - Ensure that the tool is available nationally and throughout Europe. - Standard data production and interface in Europe 	<p>N/A</p>	<p>N/A</p>
<p>STING</p>	<ul style="list-style-type: none"> - Image-based recognition in an App or in the field will be incredibly useful (butterflies, hoverflies, wild bees and moths). - Increased capacity to locate species in the future, especially when information is shared with citizen science and voluntary contribution to the system. 	<ul style="list-style-type: none"> -Tools are not region specific, some of the tools are outdated. - Lack of keys and the availability of keys in different languages. - The variety of pollinators (bees and hoverflies) makes it difficult to create a powerful tool (without laboratories and specimen extraction). - Future technologies need to be improved. - Limitation of the existence of tools. 	<p>N/A</p>



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SURPASS	<ul style="list-style-type: none"> - Translation of apps/ languages - Adapt code / south american - Plan Pollinators standards / Darwin Core - Standardisation/ testing in situ methods effective - Mapping the flowers resources (Drone information can provide the inputs to solve these issues) 	N/A	<ul style="list-style-type: none"> - Pollinator chambers - Acoustics - Moth traps
TAXO-FLY	<ul style="list-style-type: none"> - Habitat mapping could be potentially used, for the taxonomic data (habitat conditions) - Distribution maps - EU RedList hoverflies - Habitat for distribution map 	N/A	N/A

Technical features or capabilities for the MAMBO tools to effectively support the EU Pollinator Initiative

In order to achieve the objective of “Providing a framework and technical implementation of MAMBO tools and technology to support the EU Pollinator Initiative”, all stakeholders were asked to list the most important technical features or capabilities according to their knowledge and experience.

Table 4. List of technical features or capabilities for the MAMBO tools to effectively support the EU Pollinator Initiative

Stakeholders	Technical features or capabilities
ANTENNA	N/A
DiSSCo	<ul style="list-style-type: none"> - Use metadata and data standards - Making data and results publicly available - Use a common taxonomy
DRUID	<ul style="list-style-type: none"> - Need for stand-alone operation in areas without 4G/5G coverage. - Possibility of combining image and sound recognition to distinguish cryptic species.
eLTER	<ul style="list-style-type: none"> - Metadata standards are the key to retrieving data, reusing data and creating common databases.
EU Commision	<ul style="list-style-type: none"> - Metadata standards are essential - Collecting data not only at species level, but also at community level is essential for biodiversity

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EUROPABON	<ul style="list-style-type: none"> - AI algorithms to identify individual species are indeed relevant, but the challenge is their quality compared to other algorithms. - Challenge: The main problem is to obtain valid images. Some platforms facing the same problem (massive data management) are Google and Microsoft. - Real-time processing - Automated detection tools will be really relevant - Include metadata - GBIF should be linked to EU PI - Species identification (total biomass of pollinators - count of individuals.)
IDMYBEES	<ul style="list-style-type: none"> - Standardise EU PoMS methodology - Standard metadata (camera traps) - Insect images require high resolution
Joint Research Centre - European Commission	<ul style="list-style-type: none"> - The tools must be effectively deployable in each EU Member State for the 4 main groups of target insect taxa (bees, flutterers, butterflies and moths) to support the EU PoMS.
National Bees Strategy	<ul style="list-style-type: none"> - Clear pipeline on raw data collecting - Document data handling processes and metadata. - Document additional data such as: habitat type, existing pollutants, weather and climate conditions.
Naturalis Biodiversity Center	<ul style="list-style-type: none"> - If photographic identification is achieved, the number of specimens to be collected is drastically reduced, even if it is only half of the specimens, then massively will reduce workflow, even if the percentage gets to an acceptable level of the collected species, the efficiency will be increased. (AI identification, and recognition of species.) - Robots or camera traps can contribute with quantitative analysis, but they are not really of interest as taxonomists in terms of the pollinator monitoring scheme, because the methodology the EU Commission selected is based on walking transects, which cannot fit into the scheme.
ORBIT	<ul style="list-style-type: none"> - User-friendly tools (platforms) - Support different languages (citizen science) - Develop demonstration videos to help understand how to use the tools. - Use key persons to make the community understand the importance of the tools for end users - Use inexpensive technologies - Non-lethal monitoring of species
PI@ntNET	<ul style="list-style-type: none"> - Achieve accurate data and visualisation (at habitat and species level) - Automate and efficiently manage large volumes of data
Pollinator Academy	<ul style="list-style-type: none"> - Challenges: The technical characteristics or capabilities of MAMBO tools should be: Clear images, freely available, easily accessible, intuitive, not too scientific, therefore open to a wider audience. - EU-POMS, monitoring in the field will be carried out by a wide variety of people, some more knowledgeable than others, so it is important that the tools are accessible and understandable for anyone.



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SPRING	<ul style="list-style-type: none"> - Particularly it will be used for moths (transcribed textually). - Depending on how well the tool works (image recognition), depending on the taxonomic group, aggregate the observations data to a high taxonomic level. E.g. (It is easy to count hoverflies, if you do not know the species, it still allows you to count or record moon flies, record observations at a high taxonomic level).
STING	<p>Fundamental:</p> <ul style="list-style-type: none"> - Use species level data - Use the knowledge to train technologies.
SURPASS	<ul style="list-style-type: none"> - Focus on recent experience with the MAMBO tool on the UK site. - Failing internet connection stops uploading data directly to the cloud (How can these problems be solved?). - Access to electricity because some of the tools do not have solar panels and as a result then requires being close to buildings. - No feedback regarding the installation of tools (pollinator chambers, acoustics, moth traps). - Hard disk needed to add all the information.
TAXO-FLY	<p>Challenges:</p> <p>Using these tools for hoverflies:</p> <ul style="list-style-type: none"> - Mapping the habitat distribution. - Image recognition could be useful for monitoring hoverflies. - Insect camera traps could be useful for density or communities of hoverflies and other groups. - Recognition of pollinator images that could be useful for monitoring (density, conditions). - Potential use of cameras to identify different hoverfly species. - Drone and LIDAR can be useful in case these tools can identify vegetation, flowers, and plants and assess which of the plants are producing nectar or not, because most of these species are nectarivores. - For hoverflies visiting flowers (Include plants that include nectar, pollen or none).

Prioritising EU Pollinator Initiative action and subactions

Each stakeholder was asked to identify the three most relevant actions and sub-actions that were identified to have relevance for the EU PI. We summed how often a sub-action was ranked priority 1, 2 and 3 (Table 5). Maybe not surprisingly is that action '1 Establish a comprehensive monitoring system', and sub-action '1.1a Development and testing of a standardised methodology for an EU pollinator monitoring scheme (EU-PoMS)' and '1.1b Delivery of annual datasets on the abundance and diversity of pollinator species' were identified as being most important (Table 5 - Priority 1 - green shading). MAMBO tools 1, 3, and 4 contribute to the needs of the MAMBO tools that were identified to contribute to the action. Second-most often sub-actions '1.3a Develop indicators on the state of pollinator populations and the pressures they face' and '1.3b Explore options for developing indicators on the impacts of pollinators on ecosystem health, the economy and human wellbeing' were identified (Table 5 - Priority 1 - orange shading). And thirdly '5.4 Development of a pollinator indicator with a view to integrating it into the CAP's performance monitoring and evaluation framework, once the EU pollinator monitoring scheme (EU-PoMS) is sufficiently implemented' was identified as most important. Most related to the automated monitoring tools and their AI algorithms for species identification.

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As Priority 2, the sub-action '1.2 Develop an integrated framework for monitoring pollinator decline, its causes and consequences' was selected most frequently by stakeholders. Systematic collection of data on major threats to pollinators, in particular through the EMBAL (European Monitoring of Biodiversity in Agricultural Landscapes) and Insignia (Pollution Monitoring) initiatives' was identified. This sub-action relates to MAMBO tools 5 and 6 and remote sensing data.

Table 5. Statistics on the prioritisation of sub-actions of the EU Pollinator Initiative by 17 stakeholders (n = 17). Green - highest number of votes, orange - second highest, yellow - third highest for priorities 1 to 3.

Priorities / Actions	Subactions	Needs	MAMBO Tool	Priority 1	Priority 2	Priority 3
PRIORITY I: Improving knowledge of pollinator decline, its causes and consequences						
1. Establish a comprehensive monitoring system	<i>1.1a Development and testing of a standardised methodology for an EU pollinator monitoring scheme (EU-PoMS).</i>	Map pollinator distribution, state and trends in abundance at adequately accurate spatial and temporal detail.	3 & 4	10	3	1
	<i>1.1b Delivery of annual datasets on the abundance and diversity of pollinator species.</i>	Monitor pollinator species annually according to a standardised methodology.	1, 3 & 4			
	<i>1.2 Devise an integrated framework for monitoring pollinator decline, its causes and consequences. Systematic collection of data on major threats to pollinators, in particular through the EMBAL (European Monitoring of Biodiversity in Agricultural Landscapes) and Insignia (Pollution Monitoring) initiatives.</i>	Monitor the main threats to pollinator decline.	5 & 6	0	7	3
	<i>1.3a Develop indicators on the state of pollinator populations and the pressures they face.</i>	Develop indicators on the state of pollinator populations.	3 & 4	3	1	4
	<i>1.3b Explore options for developing indicators on the impacts of pollinators on ecosystem health, the economy and human wellbeing.</i>	Develop indicators for ecosystem health.	6			
2. Support research and assessment	<i>2.1 Promote research and innovation on the state of pollinators, the causes and the consequences of their decline, as well as effective mitigation measures.</i>	Generate actionable knowledge based on systematically collected data and information. To better understand the threats to pollinators and their interactions.	1, 3 & 4	1	2	2
	<i>2.2 Finalise the European Red List assessment for key insect pollinator groups – bees, hoverflies, butterflies, and moths.</i>	To better understand the taxonomic and functional diversity of pollinator communities and their distribution.	3 & 4	0	2	1



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	2.3 Identify and map Key Pollinator Areas in the EU, which should become the focus of conservation and restoration efforts.	EU-wide mapping of key pollinator areas, in order to enable targeted conservation and restoration measures.	6	0	1	3
PRIORITY II: Improving pollinator conservation and tackling the causes of their decline						
4. Improve conservator of pollinator species and habitats	4.1 Devise a blueprint for a network of ecological corridors for pollinators – “Buzz Lines” – and develop a plan of measures for implementing it. The plan will build on the mapping of Key Pollinator Areas and the creation of new habitat areas through restoration. To support the implementation of the Buzz Lines network Member States should integrate pollinator conservation into spatial planning policies at national, regional, and local levels.	Spatial planning processes at all governance levels for the successful implementation of the Buzz Lines network.	5 & 6	0	0	2
	5.4 Development of a pollinator indicator with a view to integrating it into the CAP's performance monitoring and evaluation framework, once the EU pollinator monitoring scheme (EU-PoMS) is sufficiently implemented.	Develop a pollinator indicator that can be integrated into the common agricultural policy (CAP).	3 & 4	2	0	0
PRIORITY III: Mobilising society and promoting strategic planning and cooperation at all levels						
N/A						

Data and technology requirements to advance pollinator monitoring and conservation in Europe

Stakeholders were asked to provide additional information on the requirements in the data and technology domain to advance pollinator monitoring and conservation in Europe based on their own experiences. The answers on this question are captured in Table 6.

Table 6. List of needs on data and technology to advance pollinator monitoring and conservation in Europe.

Stakeholders	Needs of Data
ANTENNA	N/A
DiSSCo	- Data FAIRness
DRUID	- Link local-scale sampling data with remotely sensed data to train models recursively. Note: Correlates are not necessarily drivers.

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eLTER	<ul style="list-style-type: none"> - Interoperability of data - Harmonisation of data - Easy to use technology and user interfaces - Not too expensive - Technology that doesn't need frequent maintenance and updates - Using these criterias: Cheap, reliable, easy and meaningful.
EU Commission	<ul style="list-style-type: none"> - Related to the remote sense technology: Develop tools that can provide biodiversity information on: species level, habitat level, ecosystems level, then can provide some information structure elements between the habitats, such as plants, trees, forest with differences between species. - DNA based technologies: High reliability of markers (country locations), and need classic morphological anatomical approaches.
EUROPABON	<ul style="list-style-type: none"> - Integrate historical data into current models (modelling) - Calculate trends - Baseline data are essential - Identify good frameworks for drivers of change (historical and modelling)
IDMYBEES	<ul style="list-style-type: none"> - To increase the existing information regarding pollinators and their threats for the scientific community and the general public by raising awareness of the importance of pollinating insects. - Problems in understanding insect threats and the relationship between insects and pollinators
JRC	<ul style="list-style-type: none"> - Currently none of the tools proposed by MAMBO can fulfil the requirements of the EU PoMS specifically. - It is acknowledged by the STING expert pool that emerging tools (image recognition, DNA analyses or others) need further development and testing before they can be widely deployed.
National Bees Strategy	<p>MAMBO tools need a pipeline with interfaces and visualisation to make them understandable, and linked for daily activities .</p> <ul style="list-style-type: none"> - Key factor: Standardisation of methodologies, standardisation of metadata, resolution and quality, available data/applicable technologies. - Multiple stakeholders can use the tools for multiple purposes, quality control, data cleansing is essential. - Ideally be able to access raw and processed data / licences / processes in managing all data. - Open data / Metadata / Share all data on this information / version of algorithms / data space where it can be accessed.
Naturalis Biodiversity Center	<ul style="list-style-type: none"> - It is not lack of technology, it is lack of people with knowledge - Human infrastructure is important to validate model results.
ORBIT	<ul style="list-style-type: none"> - Identifying rare species (Semi-natural habitats) - Camera trap: High resolution images are required for the identification of the small species.
Pl@ntNET	<ul style="list-style-type: none"> - Large volume of freely available data on plant community characteristics and plant-insect interactions are required - International standards and terminology - Establishment of a taxonomic standard for insect species in EU - Increasing the level of training - testing EUNIS classification



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Pollinator Academy	<ul style="list-style-type: none"> - Having basic tools available in a short time (available images organised in a simple way, including species descriptions) will be very important for training and teaching. - Basic database with species level information (images of one species) available. - Accessibility to a wider group of people - Tools should enable learning - The functionality to compare images of different species with each other (annotations of morphological parts of different species). - Collecting references is the most important starting point respect to the pollinators.
SPRING	- Developing standards for monitoring and data analysis at EU Level
STING	<ul style="list-style-type: none"> - Increase the deployment of technological tools for habitat conservation: - The camera in the short term only needs a strong push, other tools in the medium term require much more innovation in research.
SURPASS	N/A
TAXO-FLY	<ul style="list-style-type: none"> - For image recognition, it is suggested to focus on alpine regions as these are heavily impacted by climate change and grazing. - For pollinator monitoring the use of malaise traps is considered to be more effective - Improve metabarcoding protocols and procedures.

Additional questions or suggestions for the MAMBO Project.

This question was added with the purpose to clarify doubts and obtain more information about the MAMBO Project for each of the stakeholders.

Table 7. List of additional questions or suggestions of each of the stakeholders related to the MAMBO Tools.

Stakeholders	Answers
ANTENNA	N/A
DiSSCo	- Continue to strengthen relations with the communities to strengthen the project and the use of tools
DRUID	- Continue in contact with MAMBO Project
eLTER	N/A
EU Commision	<ul style="list-style-type: none"> - It is very important and valuable to link all pollinator-related projects. - Continue to strengthen the pollinator community across Europe, not only at the scientific level, but at all levels. - By 2030 to have a consolidated community.
EUROPABON	<ul style="list-style-type: none"> - There are no specific requirements for tools. - The main and important thing, push to link with GBIF and the use of the Humboldt extension⁵ to capture sampling event data.

⁵ <https://eco.tdwg.org/>

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IDMYBEES	<ul style="list-style-type: none"> - To make the MAMBO community and all of the tools under development more visible. - It is a really interesting project, and it will be important working together and pooling knowledge and skills. - IDMYBEES suggests thinking about development of new applications for inexpensive smartphones, integrating better cameras into pollinator-specific tracking tools that can be easily accessible and easy to use.
JRC	<ul style="list-style-type: none"> - The further technological developments needed to contribute to EU PoMS are covered in the upcoming STING report. - Regarding data, the need for further pollinator reference databases for DNA barcoding and metabarcoding has been recognized as a priority.
Nationale Bijenstrategie	- N/A
Naturalis Biodiversity Center	- They recommend more communication between EU projects to avoid duplication or redistribution between projects.
ORBIT	<ul style="list-style-type: none"> - Increasing contact with taxonomic experts to incorporate relevant data into the project. - Continue to connect partners and stakeholders to the MAMBO Project. - EU-POMS - Verification of technology against policy.
PI@ntNET	<ul style="list-style-type: none"> - Support wide access to MAMBO sensors against moderate cost of use. - Design adequate training and material regarding MAMBO tools.
Pollinator Academy	<ul style="list-style-type: none"> - Test the tools for the capacity building - Test the developing tools in the further months
SPRING	N/A
STING	- This part of the project is crucial for the good development of the community and the inclusion of contributions from the different stakeholders.
SURPASS	<ul style="list-style-type: none"> - Technology is really important - Soundscape (acoustic environments - Decrease buzz) - Community engagement - Promoting the continuity of projects
TAXO-FLY	- Image recognition tools are really important for the community, using standardised methodology and data.



Discussion

Stakeholder representation

We received input from 17 MAMBO stakeholders from the full list of 30 identified stakeholders that are engaged with pollinators. We consider the response rate of 56.7% very good and the results that were harvested for this deliverable “D2.3 Deliver framework and its technical implementation of MAMBO tools and technology supporting EU Pollinator Initiative” representative for the entire stakeholder community (Figure 2). We received an balanced input from stakeholders from the policy domain (i.e. EU Commission and JRC), the RI domain (e.g. DiSSCo and eLTER), and from pollinator projects and data infrastructures (Tables 3-7). By reaching out to the thirty identified stakeholders through email (Box 1) with a short description of the MAMBO project, the MAMBO tools that are developed to monitor pollinators and their environment, and the relationship to the EU Pollinator Initiative, we have significantly raised the awareness of MAMBO and its tools within the wider stakeholder community landscape. Providing this background information together with the six questions that we asked the stakeholders allowed them to prepare for the interview and to set the expectations of the interview. This methodology might have contributed to the relatively high response rate. Additionally the recognised importance of the EU Pollinator Initiative has likely contributed. For the convenience of the interview we included a summary of the EU PI priorities, actions and sub-actions that were identified as of relevance for one or MAMBO tools in the invitation for the interview (Box 1, Table 1 & Fig. 1).

The relevance of MAMBO tools for the EU PI

As part of linking the MAMBO tools to the EU PI we assessed which MAMBO tools contribute to the identified needs of the EU PI actions and subactions in the data and infrastructure domain (Fig. 1). This figure illustrates that MAMBO tool 3 on ‘Insect camera for monitoring nocturnal insects’ and MAMBO tool 4 on ‘Insect camera for monitoring pollinators’ both contribute to six sub-actions of the EU PI. We identified MAMBO tool 6 on ‘Habitat condition metric derivation from airborne LiDAR and/or drone data’ contributes to four sub-actions and MAMBO tool 1 on ‘Image recognition software for species on the annexes of the Habitats Directive’ and tool 5 on ‘Habitat extent mapping tools’ were identified both to contribute to two sub-actions. The perceived importance of the MAMBO tools by the stakeholders (question 1) showed a slightly different pattern (Fig. 3). The majority (16/17) indicated that tool 1 is very important. It might be that the addition ‘... for species on the annexes of the Habitats Directive’ was overlooked. Many of them indicated that the availability of AI species identification algorithms for smartphones and desktop devices was very relevant to them. Where we identified tool 2 on ‘Sound-recognition software for birds, bats, marine mammals, crickets, and grasshoppers’ as not important for the EU PI, still four stakeholders found sounds useful for the identification of pollinators, e.g. the combination of AI image and sound recognition might distinguish cryptic species. Between 11-13.5 out of the 17 stakeholders rated MAMBO tools 3-6 as relevant for the EU PI. This includes automated monitoring of day (tool 4) and night (tool 3) pollinating insects and habitat and habitat quality monitoring through drones (tool 5), LiDAR (tool 5) and remote sensing (tool 6) data, which makes all MAMBO tools, but tool 2, important to contribute to the EU PI.



Challenges and obstacles of existing tools

The answers to our second question on ‘What challenges or obstacles have you encountered *when using existing tools* and technologies in supporting the EU Pollinator Initiative’ have garnered a wide array of different answers (Table 3). Among the responses obtained were:

- Creating tools that are easy to use and accessible to a wider community not only for researchers, including a variety of languages;
- Consider the use of international habitat classification and not only at the European level;
- Increase the granularity of remote sensing data, avoiding errors of metres;
- Including floral resources in remote sensing data has the potential to provide crucial ecological context data;
- With respect to image recognition, currently, tools are only available for butterflies and wasps and should be expanded to other pollinator species;
- Identify solutions for integrating historical baseline data and new automated high-throughput data including metadata;
- It would be important that the results obtained by the MAMBO tools can provide useful information for taxonomic experts.

Each of the identified challenges and obstacles have their own values and will be considered for each of the MAMBO tools. We were not able to identify specific challenges that stood out to be included in the MAMBO tool development.

Required technical features of MAMBO tools in support of the EU PI

The question on ‘What technical features or capabilities are essential for the MAMBO tools to effectively support your work with the EU Pollinator Initiative?’ resulted in some clear recommendations (Table 4). The **use of metadata and implementation of data standards** is considered as being very important by many of the interviewed stakeholders. Other relevant considerations are:

- insect images require high resolution for AI identification
- data and results should be publicly available
- need for standalone operation of the MAMBO tools in areas without 4G/5G coverage
- combination of image and sound recognition might distinguish cryptic species
- develop demonstration videos to help understand how to use the MAMBO tools and get the community to understand the importance of the tools for end users
- automate and efficiently manage large volumes of data

In addition, recent experiences of SURPASS working with MAMBO tools in the UK recommend improving and finding solutions related to internet connectivity and power supplies. Disruptions of the internet connection and power outage results in problems with uploading data to the cloud and operation of the tools. See table 4 - SURPASS for all details.

Stakeholder prioritisation of EU PI actions and sub-actions

With question 4 on ‘What are the 3 most important actions of the EU pollinator initiative for your RI?’ we aimed at finding out which of the selected actions and subactions of the EU PI with relevance to the MAMBO tools are prioritised by the stakeholder community. As priority 1 identified by 10 stakeholders as the most important action was ‘1. Establish a comprehensive monitoring system,’ and subactions ‘1.1a Development of a standardised EU



D2.3 MAMBO tools and technology supporting the EU Pollinator Initiative

pollinator monitoring scheme (EU-PoMS) and ‘1.1b Delivery of annual datasets on pollinator abundance and diversity’ (Table 5). This was considered priority 2 by an additional three stakeholders and priority 3 by one stakeholder. MAMBO tools 1, 3, and 4 were linked to this action and subactions (Table 1 & Fig. 1). This means that the stakeholders consider species level monitoring of pollinators as the most important for the EU PI.

Selected most often as priority 2 by seven of the stakeholders was subaction ‘1.2 Devise an integrated framework for monitoring pollinator decline, its causes, and consequences,’ which is linked to MAMBO tools 5 and 6 that deal with drone, LiDAR and remote sensing data. An additional three stakeholder rates subaction 1.2 as priority 3 (Table 5). From this ranking we conclude that many stakeholders rate monitoring of habitat quality metrics and the extent of habitats as very important contributions of the MAMBO tools to the targets of EU PI.

Most often rated as priority 3 were subactions ‘1.3a Develop indicators on the state of pollinator populations and the pressures they face’ and ‘1.3b Explore options for developing indicators on the impacts of pollinators on ecosystem health, the economy and human wellbeing.’ These subactions were identified by an additional three stakeholders as priority 1 (Table 5). Clearly the development of indicators for both pollinator populations and ecosystem health are considered as important by the stakeholder community. The MAMBO tools 3, 4, and 6 can help by providing data for the indicators. The development of indicators is out of scope for the MAMBO project and requires wider community consultation.

General data and technology needs for pollinator monitoring

The fifth question of the interview relates to more general data and technology requirements that are needed to advance pollinator monitoring and conservation across Europe. Like the answer to question three on the challenges and obstacles were varied, the answers to this question vary widely as well. Many of the stakeholders have their own niche in the pollinator landscape and therefore they try to solve issues in their own niche (Table 6). We can make some generalisations including the need for FAIR data to allow data interoperability and data harmonisation, which requires the provision of appropriate metadata. Graphical user interfaces to the tools should be intuitive for multiple stakeholders, allowing tools to be used for multiple purposes. To further harmonise different datasets requires the establishment of taxonomic standards for insect species in the EU. Finally it can be concluded that data and technology should be open and for free, or not too expensive, and that technology does not require frequent updates.

Other recommendations

Finally, we asked the stakeholders to provide additional suggestions for the MAMBO project, where most stakeholders indicated that MAMBO tools have a huge potential to contribute to the pollinator community and to link with the EU Pollinator Initiative (Table 7). Through the interviews with the identified stakeholders we have harvested a wide array of different answers with specific recommendations for different aspects of pollinator monitoring. This relates to the different MAMBO tools that are designed to monitor different pollinator groups under different circumstances or to assess habitat quality and habitat extent using different sensors. But also because the stakeholder group that contributed to this interview varies on their involvement with pollinators ranging from taxonomic expert communities to long-term ecological sampling of permanent sites.



D2.3 MAMBO tools and technology supporting the EU Pollinator Initiative

Representatives from the EU commission and others indicated that it is important for MAMBO to continue strengthening the relationships with pollinator communities at all levels, not only at the scientific level. Furthermore, they expressed their interest in staying in touch, working together and pooling knowledge and skills, that they follow the evolution of the MAMBO project and the possibilities of linking their platforms and testing the MAMBO tools. Representatives from JRC indicated that it should be explored whether the MAMBO tools can contribute to the aims of the EU Pollinator Monitoring Scheme (EU PoMS) and the related STING project.

Additional comments and recommendations from the stakeholder community include (See Table 7 for all details):

- Consider linking MAMBO Tools with GBIF and using Humboldt extension for sampling events;
- Provide a wide access to MAMBO sensors against low costs;
- Design adequate training and training materials for the use of the MAMBO tools;
- Align the MAMBO tools with requirements defined by EU-PoMS;
- The development of AI image recognition is important for the monitoring of pollinators because it allows a large group of people, including non-experts, to contribute to monitoring of pollinators in many more places than just the experts like to visit.

Conclusions

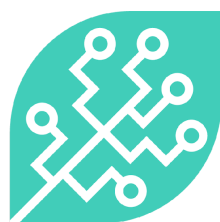
Most of the MAMBO tools contribute to one or more of the actions and sub-actions defined by the EU PI. The exception is MAMBO tool 2 on 'Sound-recognition software for birds, bats, marine mammals, crickets, and grasshoppers'. Although some interviewed stakeholders indicated that the combination of image recognition with sound recognition might allow distinguishing cryptic pollinator species. The other tools can be separated into automated monitoring and species recognition tools for day and night active pollinators (MAMBO tools 1, 3 and 4), and tools that allow monitoring of the extent and quality of pollinator habitats (MAMBO tools 5 and 6). The development of these tools include developments in the field of hardware monitoring equipment, taxonomic expertise on day and night pollinating insects, AI on species identification from images (and sounds), drone footage, LiDAR technology, and remote sensing. Both main categories of tools are highly valued by the stakeholder community and are considered important for meeting the aims of the EU PI. Given that a wide range of expertises that is needed for the development of the MAMBO tools this is also reflected in the stakeholder community which varies from EU policy makers, to ecologists, taxonomists and computer scientists. We have carefully captured all requests and recommendations for the MAMBO tools which can be consulted in the Results section of the report. We summarised the main findings and relations to the MAMBO tools in the Discussion section. If one aspect stood out from the wide range of answers, it is that the implementation of data standards and metadata is essential for the wider use and application of the MAMBO tools. All of the suggestions and recommendations will be taken into consideration for the further development of the MAMBO tools in order to maximise their functionality and user-friendliness for the EU pollinator community, the EU Pollinator Initiative, and beyond.



Acknowledgements

We acknowledge the MAMBO project network for identifying and facilitating connections with our 30 identified stakeholders. We also take this opportunity to thank the 17 RIs/organisations that found the time for the interview, even during the busy summer fieldwork and holiday seasons. Your feedback on delivering the framework and its technical implementation of MAMBO tools and technology supporting EU Pollinator Initiative is a crucial aspect of this project and innovation could not be possible without your involvement.





MAMBO

MODERN APPROACHES TO THE
MONITORING OF BIODIVERSITY

Subject to change




www.mambo-project.eu

Project stakeholders



Annexes

Annex1 - MS 2.5 Agreement with EU Pollinator Initiative and stakeholders on optimal linkage of MAMBO tools and efforts to their aims and needs



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8000 Aarhus C
Denmark

Vujadin Kovacevic
Policy Officer for the European Commission
EU Pollinator Initiative
Directorate-General for Environment
European Commission, 1049 Bruxelles/Brussel
Belgium

Dear Mr. Kovacevic,

Subject: Letter of Intent - Alignment of Deliverables between the MAMBO Project and the EU Pollinator Initiative


I am writing this Letter of Intent to formalize our commitment to the alignment of deliverables between the MAMBO Project and the EU Pollinator Initiative, specifically concerning tools for the monitoring of pollinators. Our goal is to collaborate effectively and strive for optimal alignment, thereby enhancing the success of both projects and contributing to the conservation of pollinators in the European Union.

1. Purpose and Objectives:
The primary purpose of this Letter of Intent is to establish a framework for collaboration, communication, and coordination between the MAMBO Project and the EU Pollinator Initiative. Our shared objectives include, but are not limited to:


- **Regular updates:**
The MAMBO Project commits to providing the EU Pollinator Initiative with regular updates on the development and progress of pollinator monitoring tools.
- **Coordination:**
Both parties will actively seek opportunities for synergy and alignment in the development and application of tools for pollinator monitoring.

2. Areas of Collaboration:
Our collaboration will extend to the following areas:

- **Development of monitoring tools:** Sharing knowledge and expertise to enhance the development of efficient and effective tools for the monitoring of pollinators.



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the European Union



Subject to change

- **Public Outreach:** Coordinating outreach to raise awareness about the application of the tools developed by MAMBO.

3. Duration and Termination:

This Letter of Intent is effective upon the date of signing and will remain in effect until the end of the MAMBO project.

4. Confidentiality:

Both parties recognize the sensitivity of certain information related to their respective projects. We commit to treating any confidential information shared during the collaboration with discretion and will not disclose such information without the written consent of the disclosing party.

5. Exclusions:

This Letter of Intent does not create any legally binding obligations or financial commitments between the MAMBO Project and the EU Pollinator Initiative. It also does not supersede any existing agreements or contracts between the parties.

We believe that this collaboration will significantly contribute to the advancement of pollinator monitoring efforts in the European Union.

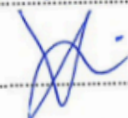
Please signify your agreement to this Letter of Intent by signing below. If you have any questions or require further clarification, please do not hesitate to contact us.

Sincerely,
Toke Thomas Høye

Accepted and agreed:

Vujadin Kovacevic, Policy Officer for the European Commission, Brussels, Belgium

Date: 22/11/2023

Signature: 

Toke Thomas Høye, Project Leader for MAMBO, Aarhus University, Aarhus, Denmark

Date: 22/11/2023

Signature: 



D2.3 MAMBO tools and technology supporting the EU Pollinator Initiative

Annex 2. EU Pollinator Initiative

EU Pollinator Initiative.xlsx

Annex 3. Stakeholders EU Pollinator Initiative

Stakeholders EU Pollinator Initiative.xlsx

Subject to change



Tabs	Description
EU Pollinator Initiative	Pollinators Initiative - A new deal for pollinators
MAMBO EUPollinator Relevance	MAMBO EU Pollinator Relevance
Result interviews	Results of the interviews
Stakeholder priorities for EU PI	Stakeholder priorities for the EU PI

Subject to change

EU Pollinators Initiative - A new deal for pollinators

Priorities / Actions		Objectives to be achieved
PRIORITY I: Improving knowledge of pollinator decline, its causes and consequences		The state of pollinators and the key causes of their decline are regularly monitored by means of an EU-wide monitoring system and regularly assessed. This provides the basis for developing robust indicators to inform on the impacts of relevant national and EU policies on pollinators. Critical knowledge gaps on the decline of pollinators, its causes and consequences for society and the economy are plugged. There is open access to data and information on pollinators.
1. ESTABLISH A COMPREHENSIVE MONITORING SYSTEM	1.1	The Commission and Member States should finalise the development and testing of a standardised methodology for an EU pollinator monitoring scheme (EU-PoMS). The methodology will ensure delivery of annual datasets on the abundance and diversity of pollinator species, with adequate statistical power to assess whether the decline of pollinators has been reversed.
	1.2	The Commission will, with the support of Member States and the European Environment Agency, devise an integrated framework for monitoring pollinator decline, its causes and consequences. The Commission will continue supporting the systematic collection of data on major threats to pollinators, in particular through the EMBAL (European Monitoring of Biodiversity in Agricultural Landscapes) and Insignia (Pollution Monitoring) initiatives.
	1.3	The Commission will develop indicators on the state of pollinator populations and the pressures they face and will explore options for developing indicators on the impacts of pollinators on ecosystem health, the economy and human wellbeing. These indicators will be developed with a view to contributing, among other things, to the evaluation of relevant policies, such as the
2. SUPPORT RESEARCH AND ASSESSMENT	2.1	The Commission and Member States should promote research and innovation on the state of pollinators, the causes and the consequences of their decline, as well as effective mitigation measures. Prioritised basic and applied research, supported through the EU Framework Programme for Research and Innovation – Horizon Europe – and national research efforts, should widen the knowledge base across pollinator groups and improve understanding of emerging threats to pollinators.
	2.2	The Commission will finalise the European Red List assessment for key insect pollinator groups – bees, hoverflies, butterflies, and moths.
	2.3	The Commission will, jointly with Member States and the European Environment Agency, identify and map Key Pollinator Areas in the EU, which should become the focus of conservation and restoration efforts.
3. PROMOTE CAPACITY BUILDING AND KNOWLEDGE SHARING	3.1	Based on an assessment of gaps, the Commission and Member States should support investment to increase the capacity of EU experts in pollinator taxonomy (i.e. the science of naming, describing and classifying those organisms), to meet research and monitoring needs. Member States should increase education efforts and create work opportunities in this area.
	3.2	The Commission will continue to develop a database on pollinator species (including the description, images, and distribution maps of each species) and will support the development of field guides and identification keys to facilitate pollinator monitoring.
	3.3	The Commission and Member States should promote open access to data and information generated by research and monitoring activities, as well as from other relevant data sources such as land-use data under the CAP's Integrated Administration and Control System (IACS).
	3.4	The Commission and the European Environment Agency will continue to facilitate knowledge sharing through the EU Pollinator Information Hive and the Biodiversity Information System for Europe (BISE).
	3.5	The Commission and Member States should support further development of research infrastructure important for improving the knowledge base on pollinators, including by building on existing initiatives such as the Distributed System of Scientific Collections (DiSSCo) and the Long-Term Ecosystem Research in Europe (eLTER)
PRIORITY II: Improving pollinator conservation and tackling the causes of their decline		Appropriate conservation and restoration measures have been identified and implemented for pollinators and their habitats. Pollinator- relevant measures are fully integrated into the common agricultural policy, and Member States are making full use of the funding opportunities to maintain and restore pollinator habitats in rural and urban areas, including under EU cohesion policy. Pollinator habitats are effectively connected in the wider landscape, allowing pollinators to disperse across the territory and respond to adverse climate impacts. Pollinators are safeguarded from the impacts of pesticides, other environmental pollutants, and invasive alien species.
4. IMPROVE CONSERVATION OF POLLINATOR SPECIES AND HABITATS	4.1	The Commission will finalise the development of conservation plans for threatened pollinator species. Two plans will cover agricultural and forest landscapes, and the third will cover the Canary Islands. The Commission and Member States should support their implementation.
	4.2	The Commission will identify pollinators typical of habitats protected under the Habitats Directive. Member States should ensure that the measures implemented for these habitats, in particular under Natura 2000 management plans, take pollinator conservation into account. Member States should secure adequate funding for those measures.

Supplemental

EU Pollinators Initiative - A new deal for pollinators

Priorities / Actions	2024 2025 2026 2027 2028 2030	Objectives to be achieved
	4.3	Member States should address the needs of threatened pollinator species in the management of existing protected areas, and in their pledges for new protected areas under the EU Biodiversity Strategy for 2030.
	4.4	The Commission and Member States, with the support of the European Environment Agency, should devise a blueprint for a network of ecological corridors for pollinators – “Buzz Lines” – and develop a plan of measures for implementing it. The plan will build on the mapping of Key Pollinator Areas and the creation of new habitat areas through restoration. To support the implementation of the Buzz Lines network Member States should integrate pollinator conservation into spatial planning policies at national, regional, and local levels.
	4.5	The Commission and Member States should continue to promote activities for pollinator conservation through the LIFE Programme.
5. RESTORE POLLINATOR HABITATS IN AGRICULTURAL LANDSCAPES	5.1	The Commission will continue to work with Member States to increase support for pollinator-friendly farming under the common agricultural policy (CAP). Member States should develop and implement targeted and strategically planned interventions to reverse the decline of pollinators in agricultural landscapes by 2030, as part of the CAP and other relevant instruments (e.g. national or regional nature conservation measures). They should also ensure consistency and synergies between these different instruments and measures. In view of this need, the Commission will explore options on how best to address pollinator conservation and restoration in the future reform of the CAP.
	5.2	The Commission will continue to encourage Member States and stakeholders to share best practice and organise coordination activities under the current CAP to facilitate the design and uptake of effective instruments that benefit pollinators, such as results-based payment schemes and collective measures by farmers, including through the EU CAP Network and other stakeholder platforms.
	5.3	Member States should enhance the capacity of farm advisory services for pollinator conservation and restoration. Member States should also implement communication and demonstration activities for pollinator- friendly schemes.
	5.4	The Commission will continue the development of a pollinator indicator with a view to integrating it into the CAP’s performance monitoring and evaluation framework, once the EU pollinator monitoring scheme (EU-POMS) is sufficiently implemented.
6. MITIGATE THE IMPACTS OF PESTICIDE USE ON POLLINATORS	6.1	The Commission will require that all Member States establish systems in line with relevant legal requirements to ensure that professional users of plant protection products implement integrated pest management (IPM), with a view to minimising the impact of plant protection products on pollinators.
	6.2	The Commission will assess options for improving the existing harmonised risk indicators, or developing new ones, to better estimate the trends in the risk and use of plant protection products, including the risks for pollinators.
	6.3	The Commission will continue to monitor emergency authorisations for pesticides that are harmful to pollinators and, if considered necessary, ask EFSA to assess the justifications provided by Member States. The Commission will mandate EFSA to develop specific protocols to evaluate those justifications. When emergency authorisations are found to be unjustified, the Commission will continue to adopt decisions to prohibit them. The Commission will monitor the implementation of the guidance document on emergency authorisations, and, if necessary, will consider setting legally binding criteria under Regulation (EC) No 1107/2009 on when emergency authorisations can be granted.
	6.4	Once it is published, the Commission will work with Member States towards full endorsement and implementation of the revised European Food Safety Authority (EFSA) Bee Guidance Document on the assessment of risks to bees from the use of pesticides ⁴³ . The Commission will ask EFSA for another review when new knowledge or modelling tools become available.
	6.5	The Commission, together with Member States, will set up a work plan to develop, validate and ring-test additional test methods for determining the toxicity of pesticides for pollinators, including wild pollinators. This work plan will consider the indicator species that need to be tested and will include sub-lethal and chronic effects of pesticides. It will include support for the international recognition of those methods through new Test Guidelines from the Organisation for Economic Co-operation and Development (OECD).
	6.6	The Commission will prepare an Implementing Regulation setting out a procedure and criteria for identifying unacceptable co-formulants in plant protection products, which will comprise environmental protection criteria that cover pollinators.
7. ENHANCE POLLINATOR HABITATS IN URBAN AREAS	7.1	The Commission and Member States should encourage cities to implement the guide for pollinator-friendly cities.
	7.2	When developing Urban Greening Plans, European cities should take into account pollinator conservation requirements.

Submitted for Change

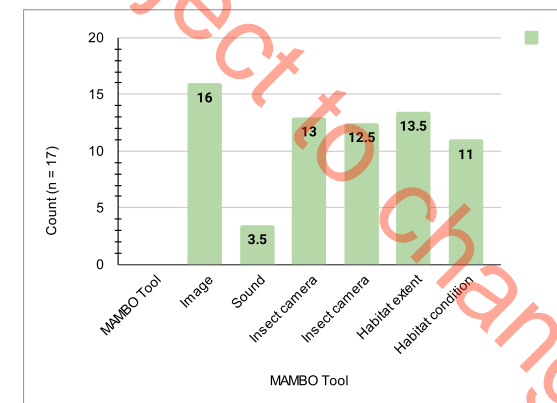
EU Pollinators Initiative - A new deal for pollinators

Priorities / Actions	2024 2025 2026 2027 2028 2030	Objectives to be achieved
8. REDUCE THE IMPACTS OF INVASIVE ALIEN SPECIES ON POLLINATORS	8.1	The Commission will assess threats to pollinators from invasive alien species not yet included in the list of invasive alien species of Union concern under Regulation (EU) No 1143/2014 and prepare risk assessments for the most problematic ones.
	8.2	The Commission will assess management options for invasive alien plant species most harmful to wild pollinators, with a view to increasing the availability, uptake, and effectiveness of non-chemical management options.
	8.3	The Commission will develop guidelines to promote the use of pollinator-friendly native plants and seed mixes in areas including private gardens, public areas, farmland, and forests.
9. TACKLE CLIMATE CHANGE AND OTHER CAUSES OF POLLINATOR DECLINE	9.1	The Commission will, with the support of the European Environment Agency, identify most vulnerable zones for pollinators in the context of climate change, and devise and implement targeted mitigation measures. Member States should consider the impact of climate change on pollinators and on their habitats in their national climate adaptation strategies.
	9.2	Member States should mitigate the impact of light pollution on pollinators through national, regional and local policies. The Commission will promote the uptake of guidance for the public and cities in this regard.
	9.3	The European Chemicals Agency will develop guidelines for assessing the risks of biocides on pollinators.
PRIORITY III: Mobilising society and promoting strategic planning and cooperation at all levels		Action plans for reversing the decline of pollinators have been developed and implemented at national, regional and local level. The impact of public policies has been scaled up by effectively mobilising the general public and businesses. The impact of individual measures has been increased through better collaboration and coordination of relevant actors at all levels. The EU is taking the lead at global level to support and facilitate international action on pollinators.
10. HELP CITIZENS AND BUSINESSES TO ACT	10.1	The Commission and Member States should continue raising public awareness about pollinator decline and engaging the public in action to tackle it, by supporting communication and networking activities.
	10.2	The Commission and Member States should promote citizen science and facilitate public participation in the monitoring and conservation of pollinators, and in particular should support youth engagement and participatory governance.
	10.3	The Commission and Member States should promote the uptake of the guides on action by key business sectors to protect pollinators, including through the EU Business @ Biodiversity Platform.
11. PROMOTE STRATEGIC PLANNING AND COOPERATION AT ALL LEVELS	11.1	Member States should develop, in close collaboration with stakeholders and citizens, national pollinator strategies that will coordinate and stimulate efforts across all relevant sectors and policies to reverse the decline of pollinators by 2030. The Commission will support Member States in this regard, including through the EU Biodiversity Platform's working group on pollinators.
	11.2	The Commission and Member States should support and encourage action for pollinator conservation at regional and local levels, including through the EU cohesion policy funds. Regional and local authorities should develop, in close collaboration with stakeholders and local communities, action plans that contribute to EU and national efforts for reversing the decline of Pollinators by 2030.
	11.3	The European Committee of the Regions should support the implementation of the Pollinators Initiative among local and regional authorities, promoting the sharing of knowledge and best practice on how to protect pollinators. The Commission and the European Committee of the Regions should cooperate to promote involvement of all levels of government, ensuring adequate support, encouragement and coordination for actions implemented at local and regional level.
	11.4	The Commission will continue to facilitate multi-actor collaboration through existing platforms such as the EU Biodiversity Platform's Working Group on Pollinators, the Interreg policy platform, the TAIEX-EIR Peer 2 Peer programme, the EU CAP Network and the EU Urban Greening Platform. The Commission will investigate additional needs for increasing the collaboration capacity between multiple actors at EU level.
	11.5	The Commission and Member States should continue to promote effective international action on pollinators, including in the framework of the UN Food and Agriculture Organisation (FAO), the Convention on Biological Diversity and the OECD.

Priorities / Actions	Objectives to be achieved	NEEDS	MAMBO Tool
PRIORITY I: Improving knowledge of pollinator decline, its causes and consequences			
1. ESTABLISH A COMPREHENSIVE MONITORING SYSTEM	1.1a <i>Development and testing of a standardised methodology for an EU pollinator monitoring scheme (EU-PoMS).</i>	Map pollinator distribution, state and trends in abundance at adequately accurate spatial and temporal detail.	3 & 4
	1.1b <i>Delivery of annual datasets on the abundance and diversity of pollinator species.</i>	Monitor pollinator species annually according to a standardised methodology.	1, 3 & 4
	1.2 <i>Devise an integrated framework for monitoring pollinator decline, its causes and consequences. Systematic collection of data on major threats to pollinators, in particular through the EMBAL (European Monitoring of Biodiversity in Agricultural Landscapes) and Insignia (Pollution Monitoring) initiatives.</i>	Monitor the main threats to pollinator decline.	5 & 6
	1.3a <i>Develop indicators on the state of pollinator populations and the pressures they face.</i>	Develop indicators on the state of pollinator populations.	3 & 4
	1.3b <i>Explore options for developing indicators on the impacts of pollinators on ecosystem health, the economy and human wellbeing.</i>	Develop indicators for ecosystem health.	6
2. SUPPORT RESEARCH AND ASSESSMENT	2.1 <i>Promote research and innovation on the state of pollinators, the causes and the consequences of their decline, as well as effective mitigation measures.</i>	Generate actionable knowledge based on systematically collected data and information. To better understand the threats to pollinators and their interactions.	1, 3 & 4
	2.2 <i>Finalise the European Red List assessment for key insect pollinator groups – bees, hoverflies, butterflies, and moths.</i>	To better understand the taxonomic and functional diversity of pollinator communities and their distribution.	3 & 4
	2.3 <i>Identify and map Key Pollinator Areas in the EU, which should become the focus of conservation and restoration efforts.</i>	EU-wide mapping of key pollinator areas, in order to enable targeted conservation and restoration measures.	6
PRIORITY II: Improving pollinator conservation and tackling the causes of their decline			
4. IMPROVE CONSERVATION OF POLLINATOR SPECIES AND HABITATS	4.1 <i>Devise a blueprint for a network of ecological corridors for pollinators – “Buzz Lines” – and develop a plan of measures for implementing it. The plan will build on the mapping of Key Pollinator Areas and the creation of new habitat areas through restoration. To support the implementation of the Buzz Lines network Member States should integrate pollinator conservation into spatial planning policies at national, regional, and local levels.</i>	Spatial planning processes at all governance levels for the successful implementation of the Buzz Lines network.	5 & 6
	5.4 <i>Development of a pollinator indicator with a view to integrating it into the CAP’s performance monitoring and evaluation framework, once the EU pollinator monitoring scheme (EU-PoMS) is sufficiently implemented.</i>	Develop a pollinator indicator that can be integrate into the common agricultural policy (CAP).	3 & 4
PRIORITY III: Mobilising society and promoting strategic planning and cooperation at all levels			
N/A			

1. Which of the MAMBO Tools do you think will be relevant for your RI in relation to your activities for the EU Pollinator Initiative?

#	MAMBO Tool	Priorities / EU Pollinator Initiative	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17																		
			ANTENNA	DiSSCo	DRUID	eALTER	EU Commission	EUROPA BON	IDMYBEEs	JRC	Nationale Bijenstrategie	Naturals	ORBIT	P@ntNET	Pollinator Academy	SPRING	STING	SURPASS	TAXO-FLY	TOTAL	
1	Image recognition available for smartphone or desktop devices (species of EU Habitats and Bird directive, EU pollinator initiative, EU Red lists, EU Invasive Alien Species)	<p>All the MAMBO TOOLS will be aligned to</p> <p>Priority 1 & 2</p> <p>PRIORITY I: Improving knowledge of pollinator decline, its causes and consequences</p> <p>PRIORITY II: Improving pollinator conservation and tackling the causes of their decline</p>	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	16	
2	Sound recognition of animals available for smartphone or desktop devices (European birds, bats, marine mammals, pollinating insects)		0	0	0.5	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3.5
3	Insect camera for monitoring nocturnal insects		1	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	13
4	Insect camera for monitoring pollinators		1	1	1	0.5	1	1	0	0	0	1	0	1	1	1	1	1	1	1	12.5
5	Habitat extent mapping tools		1	0	1	1	0.5	1	1	0	1	0	1	1	1	1	1	1	1	1	13.5
6	Habitat condition metric derivation from airborne LIDAR and drone data		1	0	1	1	1	0	0	0	1	0	1	1	1	0	1	1	1	1	11
TOTAL			5	3	5.5	5	4	4	4	3	4	0	5	3	5	4	5	6	4	69.5	



2. What challenges or obstacles have you encountered when using existing tools and technologies in supporting the EU Pollinator Initiative, and how do you think MAMBO Tools can address these issues? E.g. Uncertainty of the sustainability of the project, others

Stakeholders	List of challenges	List of obstacles	List of existing tools / Additional data
1 ANTENNA	N/A	N/A	N/A
2 DiSSCo	<ul style="list-style-type: none"> - Accessibility of databases with different specimens and species by different user types e.g. students, communities, not only researchers and organisations. - Interoperability between different research infrastructures - Databases should contain collected historical data, including their metadata. 	N/A	N/A
3 DRUID	<ul style="list-style-type: none"> - Image recognition in term of pollinator monitoring, only few species can be identified, not for all species will be useful, maybe with AI can these problems can be solved and the tool can be more powerful. - Acoustic pan traps can help to recognize different sizes and frequencies sound (size variation of species) 	<ul style="list-style-type: none"> - Malaise traps do not catch pollinators - Don't capture rare species, hence red list species are difficult to monitor. 	<ul style="list-style-type: none"> - Malaise traps - Pan traps (work well for pollinators) - Acoustic pan traps
4 eALTER	<ul style="list-style-type: none"> - There are new methods, AI and other tools under development every day, it would be necessary to take advantage of synergies between projects and not to reinvent tools. - The method being applied is insect traps and subsequent metabarcoding. 	N/A	<ul style="list-style-type: none"> - Malaise traps - Metabarcoding, barcoding of DNA/RNA (or eDNA/eRNA) in a manner that allows for the simultaneous identification of many taxa within the same sample



MAMBO
 MODERN APPROACHES TO THE
 MONITORING OF BIODIVERSITY

Subject to change

5	EU Commission	<ul style="list-style-type: none"> - Granularity of data, without errors of a few meters (satellite images don't provide precise information). - Proof of concept (Method or principle in order to demonstrate its feasibility) - Need of tools that can recognize insects at species level 	<ul style="list-style-type: none"> - Image recognition is only available for butterflies and wasps, but not for all pollinator species. 	<ul style="list-style-type: none"> - Copernicus - Natura 2000 - Grassland Watch Project - Remote sensing - Image recognition - Satellite images
6	EUROPABON	<ul style="list-style-type: none"> - Incorporate trend analyses. - Identify solutions to integrate historical and new data. 	<ul style="list-style-type: none"> - Not (better) taking into account historical data will hinder the implementation of the EU PI. 	N/A
7	IDMYBEES	<ul style="list-style-type: none"> - User interface to camera images to allow specialists to identify species for AI algorithm training 	N/A	N/A
8	Joint Research Centre - European Commission	<ul style="list-style-type: none"> - Remote sensing approaches to monitor pollinator habitats, including floral resources, hold immense potential to provide crucial ecological context data to augment pollinator monitoring efforts in the future (MAMBO tools 5 & 6). 	N/A	
9	National Bees Strategy	<ul style="list-style-type: none"> - Monitor pollinator trends (the presence the population the health of natives at a certain date at a certain place - How reliable is the technology level structure & data. - Important the interpretation of the data (Trends, prospects and raw data) - Obtaining immediate results (mandatory) - Advanced data Artificial Intelligence (AI), machine learning creating algorithms advanced data analysis to be able for interpretation - Insect chamber (local only) 	N/A	Diopsis insect camera
10	Naturalis Biodiversity Center	<ul style="list-style-type: none"> - At present, BOLD has completed 40% of the pollinators, and is expected to have completed 90% in one to two years. 	N/A	<ul style="list-style-type: none"> - DNA Barcoding - Barcode of life Project - EU BOLD mirror - BOLD Systems (Biodiversity Genomics Europe)
11	ORBIT	<ul style="list-style-type: none"> - Taxonomic limits of the tools - Species level (how far we can go) - Developing powerful tools - AI Training is really important - Some regions are easier than others to obtain insects images - EU-PoMS (North - South is really different collecting data) - These tools can help taxonomy with data. - Museum specimens can be useful for the training of AI. - Key is to connect taxonomic experts to AI algorithm training. 	N/A	N/A

Subject to change

12	PI@ntNET	<ul style="list-style-type: none"> - Computational constraints related to knowledge transfer for plant species. - Avoid high energy consumption and provide efficient service and high balance. 	<ul style="list-style-type: none"> - MAMBO will use EUNIS - habitat classification, but PI@ntNET wants to characterise habitats at a global scale. It is difficult for PI@ntNET and the end-user community that the same habitat classification is not used at global level, but only at European level. - PI@ntNET has a global community that will have difficulties to connect with MAMBO that develops its tools at the European level. 	N/A
13	Pollinator Academy	<ul style="list-style-type: none"> - Don't exist many tools for pollinators - Lack of tools and keys - Create tools that everybody can use (without been experts or taxonomist) 	<ul style="list-style-type: none"> - Not specific for the regions - Traditional identification - The platforms needs to have language variety - It is difficult to create a specific tool for a variety of species. 	N/A
14	SPRING	<ul style="list-style-type: none"> - Integration into a portable tool - Improve AI for species identification from images - Ensure that the tool is available nationally and throughout Europe. - Standard data production and interface in Europe 	N/A	N/A
15	STING	<ul style="list-style-type: none"> - Image-based recognition in an App or in the field will be incredibly useful (butterflies, hoverflies, wild bees and moths). - Increased capacity to locate species in the future, especially when information is shared with citizen science and voluntary contribution to the system. 	<ul style="list-style-type: none"> - Tools are not region specific, some of the tools are outdated. - Lack of keys and the availability of keys in different languages. - The variety of pollinators (bees and hoverflies) makes it difficult to create a powerful tool (without laboratories and specimen extraction). - Future technologies need to be improved. - Limitation of the existence of tools. 	N/A
16	SURPASS	<ul style="list-style-type: none"> - Translation of apps/ languages - Adapt code / south american - Plan Pollinators standards / Darwin Core - Standardisation/ testing in situ methods effective - Mapping the flowers resources (Drone information can provide the inputs to solve these issues) 	N/A	<ul style="list-style-type: none"> - Pollinator chambers - Acoustics - Moth traps
17	TAXO-FLY	<ul style="list-style-type: none"> - Habitat mapping could be potentially used, for the taxonomic data (habitat conditions) - Distribution maps - EU RedList hoverflies - Habitat for distribution map 	N/A	N/A

3. What technical features or capabilities are essential for the MAMBO tools to effectively support your work with the EU Pollinator Initiative?

Eg. monitoring methodology (covering bumble bees, solitary bees, hoverflies , moths and butterflies), metadata standards, essential pollinator taxa, others

Stakeholders	Technical features or capabilities
1 ANTENNA	N/A
2 DISSCO	<ul style="list-style-type: none"> - Use metadata and data standards - Making data and results publicly available - Use a common taxonomy

Subject to change

3	DRUID	<ul style="list-style-type: none">- Need for stand-alone operation in areas without 4G/5G coverage.- Possibility of combining image and sound recognition to distinguish cryptic species.
4	eLTER	<ul style="list-style-type: none">- Metadata standards are the key to retrieving data, reusing data and creating common databases.
5	EU Commision	<ul style="list-style-type: none">- Metadata standards are essential- Collecting data not only at species level, but also at community level is essential for biodiversity
6	EUROPABON	<ul style="list-style-type: none">- AI algorithms to identify individual species are indeed relevant, but the challenge is their quality compared to other algorithms.- Challenge: The main problem is to obtain valid images. Some platforms facing the same problem (massive data management) are Google and Microsoft.- Real-time processing- Automated detection tools will be really relevant- Include metadata- GBIF should be linked to EU IP- Species identification (total biomass of pollinators - count of individuals)
7	IDMYBEES	<ul style="list-style-type: none">- Standardise EU PoMS methodology- Standard metadata (camera traps)- Insect images require high resolution
8	Joint Research Centre - European Commission	<ul style="list-style-type: none">- The tools must be effectively deployable in each EU Member State for the 4 main groups of target insect taxa (bees, flutterers, butterflies and moths) to support the EU PoMS.
9	National Bees Strategy	<ul style="list-style-type: none">- Clear pipeline on raw data collecting- Document data handling processes and metadata.- Document additional data such as: habitat type, existing pollutants, weather and climate conditions.

Subject to change

10	Naturalis Biodiversity Center	<ul style="list-style-type: none">- If photographic identification is achieved, the number of specimens to be collected is drastically reduced.- If the percentage reaches an acceptable level in northern Europe (microscopy is used in the south), efficiency will be increased.- Identification robots and camera traps can contribute quantitative data but are not really of interest to the taxonomist, in terms of the pollinator scheme in the sense that the EU Commission methodology selected is based on transect walks and does not fit the design of the scheme. For example: The EU Commission in some of the pilots studies the pan trapping has been removed, then will be 100% transect walks (STING 2 Report - Methodology) This information is based on personal communication.
11	ORBIT	<ul style="list-style-type: none">- User-friendly tools (platforms)- Support different languages (citizen science)- Develop demonstration videos to help understand how to use the tools.- Use key persons to make the community understand the importance of the tools for end users- Use inexpensive technologies- Non-lethal monitoring of species
12	PI@ntNET	<ul style="list-style-type: none">- Achieve accurate data and visualisation (at habitat and species level)- Automate and efficiently manage large volumes of visualisation data
13	Pollinator Academy	<ul style="list-style-type: none">-Challenges: The technical characteristics or capabilities of MAMBO tools should be: Clear images, freely available, easily accessible, intuitive, not too scientific, therefore open to a wider audience.- EU-POMS, monitoring in the field will be carried out by a wide variety of people, some more knowledgeable than others, so it is important that the tools are accessible and understandable. dable for anyone.
14	SPRING	<ul style="list-style-type: none">- Particularly it will be used for moths(transcribed textually).- Depending on how well the tool works (image recognition), depending on the taxonomic group, aggregate the observations data to a high taxonomic level. E.g. (It is easy to count hoverflies, if you do not know the species, it still allows you to count or record moon flies, record observations at a high taxonomic level).
15	STING	<p>Fundamental:</p> <ul style="list-style-type: none">- Use species level data- Use the knowledge to train technologies.

Subject to change

	1.3b Explore options for developing indicators on the impacts of pollinators on ecosystem health, the economy and human wellbeing.	Develop indicators for ecosystem health.	6						3						1			3			2	1	1		3	3			
2. SUPPORT RESEARCH AND ASSESSMENT	2.1 Promote research and innovation on the state of pollinators, the causes and the consequences of their decline, as well as effective mitigation measures.	Generate actionable knowledge based on systematically collected data and information. To better understand the threats to pollinators and their interactions.	1, 2, 3 & 4								1				3			2			3							2	
	2.2 Finalise the European Red List assessment for key insect pollinator groups – bees, hoverflies, butterflies, and moths.	To better understand the taxonomic and functional diversity of pollinator communities and their distribution.	3 & 4								2							2										3	
	2.3 Identify and map Key Pollinator Areas in the EU, which should become the focus of conservation and restoration efforts.	EU-wide mapping of key pollinator areas, in order to enable targeted conservation and restoration measures.	6															3			3			3	2				
PRIORITY II: Improving pollinator conservation and tackling the causes of their decline																													
4. IMPROVE CONSERVATION OF POLLINATOR SPECIES AND HABITATS	4.1 Devise a blueprint for a network of ecological corridors for pollinators – "Buzz Lines" – and develop a plan of measures for implementing it. The plan will build on the mapping of Key Pollinator Areas and the creation of new habitat areas through restoration. To support the implementation of the Buzz Lines network Member States should integrate pollinator conservation into spatial planning policies at national, regional, and local levels.	Spatial planning processes at all governance levels for the successful implementation of the Buzz Lines network.	5 & 6																										
	5.4 Development of a pollinator indicator with a view to integrating it into the CAP's performance monitoring and evaluation framework, once the EU pollinator monitoring scheme (EU-PoMS) is sufficiently implemented.	Develop a pollinator indicator that can be integrate into the common agricultural policy (CAP).	3 & 4																										
0 3																													
PRIORITY III: Mobilising society and promoting strategic planning and cooperation at all levels																													
N/A																													

5. What further progress is needed in the data and technology domain to make progress on pollinator monitoring and conservation in Europe?

Stakeholders	Needs of Data
1 ANTENNA	N/A
2 DISSCo	- Data FAIRness
3 DRUID	- Link local-scale sampling data with remotely sensed data to train models recursively. Note: Correlates are not necessarily drivers.
4 eLTER	- Interoperability of data - Harmonisation of data - Easy to use technology and user interfaces - Not too expensive - Technology that doesn't need frequent maintenance - Using these criterias: Cheap, reliable, easy and meaningful.
5 EU Commission	- Develop tools that can provide Biodiversity information that includes: Habitat types, Plants, Forest with differences between species of plants - High reliability - Classification ADN species - Good markers and libraries. - Taxonomic groups
6 EUROPABON	- Integrate historical data into current models (modelling) - Calculate trends - Baseline data are essential - Identify good frameworks for drivers of change (historical and modelling)

Subject to change

7	IDMYBEES	<ul style="list-style-type: none">- To increase the existing information regarding pollinators and their threats for the knowledge of the whole scientific community and the general public by raising awareness of the importance of these types of insects.- Problems in understanding insect threats and the relationship between insects and pollinators
8	JRC	<ul style="list-style-type: none">- Currently none of the tools proposed by MAMBO can fulfil the requirements of the EU PoMS specifically.- It is acknowledged by the STING expert pool that emerging tools need further development and testing before they can be widely deployed.
9	National Bees Strategy	<p>MAMBO tools need a pipeline with interfaces and visualisation to make them understandable, and linked for daily activities .</p> <ul style="list-style-type: none">- Key factor: Standardisation of methodologies, standardisation of metadata, resolution and quality, available data/applicable technologies.- Multiple stakeholders can use the tools for multiple purposes, quality control, data cleansing is essential.- Ideally be able to access raw and processed data / licences / processes in managing all data.- Open data / Metadata / Share all data on this information / version of algorithms / data space where it can be accessed.
10	Naturalis Biodiversity Center	<ul style="list-style-type: none">- It is not lack of technology, it is lack of people with knowledge- Human infrastructure is important to validate model results.
11	ORBIT	<ul style="list-style-type: none">- Identifying rare species (Semi-natural habitats)- Camera trap: High resolution images are required for the identification of the small species.
12	PI@ntNET	<ul style="list-style-type: none">- Large volume of freely available data on plant community characteristics and plant-insect interactions are required- International standards and terminology- Establishment of a taxonomic standard for insect species in EU- Increasing the level of training- testing EUNIS classification

Subject to change

13	Pollinator Academy	<ul style="list-style-type: none"> - Having basic tools available in a short time (available images organised in a simple way, including species descriptions) will be very important for training and teaching. - Basic database with species level information (images of one species) available. - Accessibility to a wider group of people - Tools should enable learning - The functionality to compare images of different species with each other (annotations of morphological parts of different species). - Collecting references is the most important starting point respect to the pollinators.
14	SPRING	- Developing standards for monitoring and data analysis at EU Level
15	STING	<ul style="list-style-type: none"> - Increase the deployment of technological tools for habitat conservation: - The camera in the short term only needs a strong push, other tools in the medium term require much more innovation in research.
16	SURPASS	N/A
17	TAXO-FLY	<ul style="list-style-type: none"> - For image recognition, it is suggested to focus on alpine regions as these are heavily impacted by climate change and grazing. - For pollinator monitoring the use of malaise traps is considered to be more effective - Improve metabarcoding protocols and procedures.

6. Do you have any additional questions or suggestions for the MAMBO Project?

	Stakeholders	Answers
1	ANTENNA	N/A
2	DiSSCo	- Continue to strengthen relations with the communities to strengthen the project and the use of tools
3	DRUID	- Continue to stay in contact with the MAMBO Project
4	eLTER	N/A
5	EU Commission	<ul style="list-style-type: none"> - It is very important and valuable to link all pollinator-related projects. - Continue to strengthen the pollinator community across Europe, not only at the scientific level, but at all levels. - By 2030 to have a consolidated community.
6	EUROPABON	<ul style="list-style-type: none"> - There are no specific requirements for tools. - The main and important thing, push to link with GBIF and the use of the Humboldt extension to capture sampling event data.

Subject to change

7	IDMYBEES	<ul style="list-style-type: none">- To make the MAMBO community and all of the tools under development more visible.- It is a really interesting project, and it will be important working together and pooling knowledge and skills.- IDMYBEES suggests thinking about the development of new applications for inexpensive smartphones, integrating better cameras into pollinator-specific tracking tools that can be easily accessible and easy to use.
8	JRC	<ul style="list-style-type: none">- The further technological developments needed to contribute to EU PoMS are covered in the upcoming STING report.- Regarding data, the need of further pollinator reference databases for DNA barcoding and metabarcoding has been recognized a priority.
9	Nationale Bijenstrategie	N/A
10	Naturalis Biodiversity Center	<ul style="list-style-type: none">- It's recommended to have an open communication between EU projects to avoid duplication of efforts and to facilitate the reuse of developed technology between projects.
11	ORBIT	<ul style="list-style-type: none">- Increasing contact with taxonomic experts to incorporate relevant data into the project.- Continue to connect partners and stakeholders to the MAMBO Project.- MAMBO tools should be aligned with monitoring requirements defined in EU-PoMS.
12	PI@ntNET	<ul style="list-style-type: none">- Support wide access to MAMBO sensors against moderate cost of use.- Design adequate training and material regarding MAMBO tools.
13	Pollinator Academy	<ul style="list-style-type: none">- Test the tools for the capacity building- Test the developing tools in the further months
14	SPRING	N/A
15	STING	<ul style="list-style-type: none">- Reaching out to the EU pollinator stakeholder community is crucial for the good development of the MAMBO tools and the inclusion of stakeholder requirements for the tools.
16	SURPASS	<ul style="list-style-type: none">- Technology is really important- For soundscapes from acoustic environments it is important to decrease buzz sounds- Community engagement- Promoting the continuity of projects
17	TAXO-FLY	<ul style="list-style-type: none">- Image recognition tools are really important for the community, using standardised methodology and data.

Priorities / Actions	Subactions	Needs	MAMBO Tool	Priority 1	Priority 2	Priority 3
PRIORITY I: Improving knowledge of pollinator decline, its causes and consequences						
1. Establish a comprehensive monitoring system	<i>1.1a Development and testing of a standardised methodology for an EU pollinator monitoring scheme (EU-PoMS).</i>	Map pollinator distribution, state and trends in abundance at adequately accurate spatial and temporal detail.	3 & 4	10	3	1
	<i>1.1b Delivery of annual datasets on the abundance and diversity of pollinator species.</i>	Monitor pollinator species annually according to a standardised methodology.	1, 3 & 4			
	<i>1.2 Devise an integrated framework for monitoring pollinator decline, its causes and consequences. Systematic collection of data on major threats to pollinators, in particular through the EMBAL (European Monitoring of Biodiversity in Agricultural Landscapes) and Insignia (Pollution Monitoring) initiatives.</i>	Monitor the main threats to pollinator decline.	5 & 6	0	7	3
	<i>1.3a Develop indicators on the state of pollinator populations and the pressures they face.</i>	Develop indicators on the state of pollinator populations.	3 & 4	3	1	4
	<i>1.3b Explore options for developing indicators on the impacts of pollinators on ecosystem health, the economy and human wellbeing.</i>	Develop indicators for ecosystem health.	6			
2. Support research and assessment	<i>2.1 Promote research and innovation on the state of pollinators, the causes and the consequences of their decline, as well as effective mitigation measures.</i>	Generate actionable knowledge based on systematically collected data and information. To better understand the threats to pollinators and their interactions.	1, 3 & 4	1	2	2
	<i>2.2 Finalise the European Red List assessment for key insect pollinator groups – bees, hoverflies, butterflies, and moths.</i>	To better understand the taxonomic and functional diversity of pollinator communities and their distribution.	3 & 4	0	2	1
	<i>2.3 Identify and map Key Pollinator Areas in the EU, which should become the focus of conservation and restoration efforts.</i>	EU-wide mapping of key pollinator areas, in order to enable targeted conservation and restoration measures.	6	0	1	3
PRIORITY II: Improving pollinator conservation and tackling the causes of their decline						
4. Improve conservator of pollinator species and habitats	<i>4.1 Devise a blueprint for a network of ecological corridors for pollinators – “Buzz Lines” – and develop a plan of measures for implementing it. The plan will build on the mapping of Key Pollinator Areas and the creation of new habitat areas through restoration. To support the implementation of the Buzz Lines network Member States should integrate pollinator conservation into spatial planning policies at national, regional, and local levels.</i>	Spatial planning processes at all governance levels for the successful implementation of the Buzz Lines network.	5 & 6	0	0	2
	<i>5.4 Development of a pollinator indicator with a view to integrating it into the CAP's performance monitoring and evaluation framework, once the EU pollinator monitoring scheme (EU-PoMS) is sufficiently implemented.</i>	Develop a pollinator indicator that can be integrated into the common agricultural policy (CAP).	3 & 4	2	0	0
PRIORITY III: Mobilising society and promoting strategic planning and cooperation at all levels						

Subject to change

	N/A	
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Subject to change

Tabs	Description
Stakeholders EU PI	List of the 30 partners EU PI
Statistics	Statistics results of the stakeholders

Subject to change

ID	Acronym	FullName	URL	Contact	ContactEmail	ContactProfile	Leading	Type of Initiative	Main Fields	Approach	Data Types	Data Requirement	Software Requirement	Remarks	Date_Data Request	Request_Interval	Date_Interval	Additional sources / Data	Metadata		
1	ANTENNA	Making Technology work for monitoring pollinators	https://antenna.be/	Olivier Schwegler Leon Marshall	olivier.schwegler@brf.be leon_marshall@naturlia.be	Head of the ANTENNA Project Project Lead ANTENNA - NaturaLife WP4 Data Standards	Biodiversity+	Non-profit Organizations Biodiversity + Project	ANTENNA will refine ANTENNA to fill key monitoring gaps through advancing innovative methods and be used for near real-time modelling and early warning systems. The project will also develop data pipelines for large scale implementation.	The overarching goal of ANTENNA is to fill key monitoring gaps through advancing innovative technologies that will underpin and complement EU-wide pollinator monitoring schemes, and to provide tested transnational pipelines from monitoring activities to curated datasets and enhanced indicators that support pollinator-relevant policy and end-users.	Artificial Intelligence Models Real-time modelling Data pipelines	N/A	N/A	N/A	Given the early stage that the project is in, I am currently unable to provide comprehensive answers (if the questions you have posed).	N/A	26/02/24 02/07/24	N/A	N/A	N/A	
2	BeeLife	Solution-oriented non-profit organisation working to improve conditions for bees and pollinators	https://www.bee-life.eu/about	Frank Aitnu	frank.aitnu@bee-life.eu	Board Directors Beelife	N/A	BeeLife is a solution-oriented non-profit organisation working to improve conditions for bees and pollinators.	Analysis Campaigns Helping shape the future of pollinators	After years of collaboration, beekeepers and beekeeping associations concerned for their bees and the environment joined together in 2013 to protect the great value of our pollinators in European trees.	N/A	N/A	N/A	N/A	N/A	22/09/24	18/07/2024 05/09/2024	N/A	N/A		
3	CEIAP	Coalition of European Taxonomic Facilities	https://ceiap.org/	Aina Casuso	aina.casuso@ceiap.org	Head of CEIAP Phone: +32 (0)2 427 42 11	N/A	N/A	N/A	CEIAP is Europe's network of biological and geological collections. Collectively, we are the leading European voice for taxonomy and systematic biology.	N/A	N/A	N/A	N/A	N/A	N/A	1/7/2024 05/08/2024	N/A	N/A	N/A	
4	DISCO	Distributed System of Scientific Collections	https://www.disco.eu/	Eva Alonso	eva.alonso@naturlia.be	DISCO Head of Governance Affairs	Naturalis	H2020	Collectors digitisation, databasing and FAIR Digital Object Infrastructure	Natural science collections digitisation and integration	Collections digitization	Code/documentation Persistent identifiers Structure metadata List of essential terms and mapping	Image-recognition software for species on the annexes of the Habitats Directive. Sound-recognition software	The DISCO aims to build one single European Natural Science Collection that digitally unifies all European natural science assets under common access, curation, policies and practices. DISCO is committed to this while ensuring that all the data is easily Findable.	N/A	2/7/2024	18/07/2024	N/A	N/A		
5	DRUID	Drivers & Replications of UK Insect Declines	https://druidproject.org.uk/	William Kunin	W.K.Kunin@leeds.ac.uk	Professor of Ecology, Deputy Head of School	University of Leeds	N/A	Assess the generality of insect declines across UK taxa	Explore how shifts in terrestrial and freshwater insect diversity, functional composition and biomass impact on diverse ecosystem functions	Develop and test mechanistic models based in insect physiology, demography and interactions.	N/A	N/A	N/A	N/A	3/7/2024	12/7/2024	N/A	N/A		
6	eBMS	European Butterfly Monitoring Scheme - eBMS	https://www.ebms.org/	David Roy	droy@ebms.ac.uk	Head of the Biological Records Centre	N/A	N/A	Joint initiative of Butterfly Conservation Europe and the Centre for Ecology & Hydrology	A data system for establishing butterfly monitoring sites in regions currently lacking a national scheme.	N/A	N/A	N/A	N/A	N/A	N/A	2/7/2024	N/A	N/A	N/A	
7	ESITE	EcSite - European Network Science Centres and Museums	https://www.esite.eu/	Bruno Maquart	bmaquart@yahoofr.fr	Chairman and CEO	N/A	N/A	EcSite connects, inspires and empowers science engagement organisations and professionals, extending the reach and strengthening the impact of their work.	N/A	Empower professionals in our network around initiatives where science engagement organisations make a real difference on societal topics: the Climate, equity and trust in science. As such, we work towards our common ambition: to deepen the impact of the crucial role we play in the world.	N/A	N/A	N/A	N/A	N/A	02/07/2024 18/07/2024	24/07/24 05/08/2024	N/A	N/A	
8	EEA	European Environment Agency	https://www.eea.europa.eu/	Ylva Levinaky Jan Erik Petersen	ylva.levinsky@eea.europa.eu jan.erik.petersen@eea.europa.eu	Nature Restoration Lead at European Environment Agency - EEA	EU	Nature Restoration	Nature Restoration	Together with our Eionet network, they provide the knowledge and the data needed to achieve sustainability in Europe.	N/A	N/A	N/A	N/A	N/A	N/A	2/7/2024	05/08/2024	Follow mid august	N/A	
9	eLTER	Integrated European Long-Term Ecosystem, critical zones and socio-ecological Research	https://elter.eu/	Michael Mirtl Mark Franzel	mirtl@elter-ri.eu mfranzel@elter-ri.eu	N/A	UTZ/EEA Germany/Austria	EU-RI	(socio-)Ecological Research	eLTER provides researchers with access to over 3500 sites and 350 larger eLTER Platforms across Europe, including terrestrial and biogeographical regions, establishing and offering harmonised and standardised data, services and training	any field derived data	N/A	N/A	N/A	N/A	N/A	2/7/2024	16/07/2024	N/A	N/A	
10	EU Commission	Integration of biodiversity into sectoral policies - European monitoring of biodiversity in agricultural landscapes (EMBAL)	https://www.consilium.europa.eu/en/press/communications/2023/04/04/2023-04-04-02/	Vujadin Kosovic	KOVACVIC@ec.europa.eu	Policy Officer at European Commission	N/A	European Commission	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4/7/2024	22/07/2024	N/A	N/A	
11	EUROPANON	Europa Biodiversity Observation Network	https://europanon.org/	Henrique Pereira	hpereira@europa.be	N/A	German Centre for Integrative Biodiversity Research (iDiv)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1/7/2024	8/7/2024	N/A	N/A	
12	IBMBEES	Improvement and Diffusion of Methods to identify BEES	https://www.ibmbees.eu/	Adrien Perrard	adrien.perrard@univ-paris.fr adrien.perrard@univ-paris-diderot.fr	N/A	IEES Institut d'écologie et des sciences de l'environnement de Paris	Help of the ANR 2019-789 euros	Develop the DNA Barcode library for French wild bee species. Build an open database of diagnostic morphological traits with illustration of these traits. Use the IPZ database to develop open, online identification tools using the Xper3 software. Develop a field tool for non-lethal identifications by using computer vision.	This project aims at tackling this taxonomic impediment by developing the three methods of explicit species identification: DNA barcoding, identification keys and computer vision through 4 workpackages (WP).	N/A	N/A	N/A	N/A	N/A	N/A	2/7/2024	11/7/2024 15/07/2024	N/A	N/A	
13	IPBES	Intergovernmental Platform of Biodiversity and Ecosystem Services	https://www.ipbes.net/	Alvaro D Antonio	alvaro.dantonio@ica.unicaripr.it	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2/7/2024 05/08/2024	N/A	N/A	N/A	
14	Joint Research Centre (JRC) European Commission	European Pollinator Monitoring Scheme	https://ipbes.ec.europa.eu/european-pollinator-monitoring-scheme-23461307	Chiara Polce	Chiara.POLCE@ec.europa.eu	Researcher Scientific project officer / Senior GIS expert, consultant at the JRC, European Commission	N/A	N/A	The result of STING project was a proposal for an EU Pollinator Monitoring Scheme (EUPOMS), finalized and published in October 2020. This has been a deliverable under the (revised) EU Pollinators Initiative.	Expert proposal for an EU Pollinator Monitoring Scheme. The proposal provides options for a comprehensive methodology for monitoring as well as for policy indicators, including a tailored indicator for the EU Common Agricultural Policy. Experts from national environmental and agricultural authorities were closely involved in this process.	N/A	N/A	N/A	N/A	N/A	N/A	4/7/2024	22/07/2024	N/A	N/A	
15	ITER-LIFE	A research infrastructure to develop Digital Twins of ecosystems in a changing world	https://iter-life.eu/	Geertjen Hengveld	g.hengveld@nioo.knaw.nl	N/A	N/A	N/A	ITER-LIFE is a scientific infrastructure aimed at supporting shared and integrated ecological research - towards the building of digital twins of ecosystems.	Bringing together geographically focused research communities, connecting people that do research on different aspects of the same ecosystem. Creating a portal to find (legacy) data, models, and tools relevant for these regional research communities, helping researchers to share and reuse, and Setting up a virtual research environment where these data, models and tools can be connected and by enabling ease of reuse and development in virtual laboratories.	N/A	N/A	N/A	N/A	N/A	N/A	4/7/2024	N/A	N/A	N/A	
16	National Bee Strategy	National Bee Strategy	https://www.naturalia.be/national-bee-strategy-of-bees/	Marten Schoonman	marten.schoonman@naturlia.be	Senior Policy Officer	Naturalis Biodiversity Center	N/A	As Naturalis Biodiversity Center we are an advising partner of the Dutch National Pollinator Initiative which brings together all of the bee supporting initiatives.	The strategy states what we most achieve in these benchmarks years: More bee species with a stable or positive population trend. More species diversity of bees. Ensuring efficient pollination.	N/A	N/A	N/A	N/A	N/A	N/A	26/06/24	4/7/2024	N/A	N/A	
17	Naturalis Biodiversity Center	Naturalis Biodiversity Center	https://www.naturalia.nl/	Thomas Wood	thomas.wood@naturlia.nl	Bee taxonomist and ecologist - Biodiversity and Society	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4/7/2024	8/7/2024	N/A	N/A	
18	National Biodiversity Data Centre	National Biodiversity Data Centre	https://biodiversitydatacentre.ie/	Michelle Larkin	mirlarkin@biodiversityireland.ie	Project manager for the Irish Pollinator Monitoring Scheme	N/A	N/A	Following a decision of Government, the National Biodiversity Data Centre has been established as a Company Limited by Guarantee.	The main role of the National Biodiversity Data Centre, as set out in its constitution, is to acquire, collate, manage, validate and make available, data in respect of Ireland's biodiversity in order to document wildlife resources and monitor and record changes over time. In doing so, support national initiatives to maintain and enhance biodiversity, including recording of species and habitat information relating to the terrestrial, freshwater, marine, rivers and wetland environments.	The National Biodiversity Data Centre works to make biodiversity data and information more freely available in order to better understand and assist the protection of Ireland's biodiversity.	N/A	N/A	N/A	N/A	N/A	N/A	18/07/24	N/A	N/A	N/A
19	ORBIT	Taxonomic resources for European bees	https://orbitproject.wordpress.com/	Dennis Miché	dennis.miche@umons.ac.be	N/A	N/A	N/A	ORBIT is a three-year project commissioned by the Directorate General for Environment of the European Commission to develop resources for European bee inventory and taxonomy across ecosystems, taxa, and spatial scales in Europe.	Through ORBIT, the European Commission will make tools accessible to researchers to identify European bees to facilitate a generation of large-scale scientific studies on trait-based biodiversity patterns and responses of wild bee communities to environmental changes that are more generalisable across ecosystems, taxa, and spatial scales in Europe.	The overall objective of ORBIT is to create a centralised taxonomic facility that lays the groundwork for the identification of European wild bees that will support other European projects such as the EU Pollinator Monitoring Scheme (EU POMS), the Preparatory Action for EU Pollinator Monitoring Scheme and indicators prepared project, the Horizon 2020 Europe research project PROBEET - SAFEGLAND - national action plan for the beekeeping sector.	N/A	N/A	N/A	N/A	N/A	N/A	2/7/2024	17/07/2024	N/A	N/A
20	Pfl@NET	Pfl@NET	https://pfl@net.org/en/	Penne Bonnet	penne.bonnet@pfl@net.org	Coordinator of the Pfl@NET project	N/A	Citizen science project	Help you identify plants thanks to your pictures	Pfl@NET is a system based on image recognition	World Geographical Scheme for Recording Plant Distributions (WGSRPD) Plant names IUCN status Nomenclature information Geography	How access on a taxonomical scale mainly for plants only, and Genus, Genus/epithet, and Form, that is the taxonomical context.	POST API	Mambo Solutions can provide results based on Latin names because for Pfl@NET are important all these parameters and to give access to all the community in European and European languages.	N/A	23/07/24	30/07/2024	In terms of interoperability, using international standards for plants is really important. Using international standards for languages.	AC / EBW / GLOBON / BIF / INSPIRE / JSDN / ICA/Intan		
21	Pollinator Academy	Pollinator Academy	https://pollinatoracademy.eu/	Mirel Bouca	mirel.bouca@naturlia.nl	Project Support NL Biodiversity and Society	N/A	EU initiative	Open-source platform for sharing taxonomic knowledge.	The Pollinator Academy is a European, open source platform for sharing taxonomic knowledge. It is a learning platform aiming to strengthen taxonomic capacity throughout Europe and was created through close collaboration between specialists and trainers from different institutes.	N/A	N/A	N/A	N/A	N/A	N/A	13/07/24	18/07/24	N/A	N/A	



ID	Acronym	FullName	URL	Contact	ContactEmail	ContactProfile	Leading	Type of Initiative	Main Fields	Approach	Data types	Data Requirement	Software Requirement	Remarks	Date_Data Request contact	Request_Interval	Date_Interval	Additional sources / Data	Metadata	
22	Pollinator Partnership	Pollinator Partnership	https://www.pollinator.org/	Billy Sytk	billy@pollinator.org	Pollinator Habitat Specialist	N/A	Pollinator Partnership works with diverse stakeholders representing various perspectives.	Creating positive change for pollinators.	Working with farmers, gardeners, land managers, scientists, and industry to develop tools and programs that help keep pollinators safe from pesticides, habitat loss, climate change, and other threats.	N/A	N/A	N/A	N/A	28/06/2024	8/7/2024 24/07/24	N/A	N/A	N/A	
23	POSHBEE	Pen-European Assessment, Monitoring, and Mitigation of Stressors on the Health of Bees	https://poshbee.eu/	Mark Brown	Mark.Brown@rnh.ac.uk	PoshBee Coordinator	N/A	EU Initiative	Integrating the knowledge and experience of academics, beekeepers and farmers.	PoshBee aims to support healthy bee populations, sustainable beekeeping and pollination across Europe.	N/A	N/A	N/A	N/A	02/09/2024	2/7/2024	N/A	Ended in May 2023	N/A	
24	SAFEGUARD	Safeguarding European Wild Pollinators	https://www.safeguardpollinators.eu/about-us/about-us.html	Steffen Ingold	ingold.steffen@uni-wuerzburg.de	N/A	N/A	N/A	N/A	Our goal is to inspire the development of management and policy guidelines for the public and private sectors to safeguard wild pollinators and the benefits they provide.	N/A	N/A	N/A	Safeguarding European wild pollinators (PO2023-2024, UREA, UFZ, PEN). Safeguard brings together world-leading researchers, NGOs, industry and policy experts to substantially contribute to Europe's capacity to reverse the losses of wild pollinators. Safeguard will significantly expand current assessments of the status and trends of European wild pollinators including bees, butterflies, flies and other pollinating insects.	N/A	3/7/2024	N/A	N/A	N/A	
25	Showcase	Showcase	https://showcase-project.eu/	David Klejn	david.klejn@wur.nl	Project's coordinator	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3/7/2024	3/7/2024	N/A	N/A	N/A
26	SPRING	Strengthening Pollinator Recovery through Indicators and Monitoring	http://www.ufz.de/en/research/indicators/	Mark van Nieuwstadt	mark.van.nieuwstadt@ufz.de	Program coordinator	The European Pollinator Monitoring Scheme, or EU PoMS	Heinrich Centre for Environmental Research (UFZ)	EU DG Env	The aim is to systematically map insect populations on a large scale in order to provide the scientific basis needed to effectively protect pollinators in Europe.	Contributing data that will directly impact on European Level policy (EU Pollinator Monitoring Scheme)	Pollinators should be considered as part of the species then the tools can be considered useful.	Expand and create new monitoring schemes via Citizen Science Networks	The Commission launched the SPRING project (Strengthening pollinator recovery through indicators and monitoring) with an aim to strengthen taxonomic capacity with regard to pollinating insects, support preparation for the implementation of an EU Pollinator Monitoring Scheme and pilot the scheme in all 27 EU countries. The budget of the project is EUR 5 million. The Science and Technology for Pollinating Insects (STING) is a pool of experts assisting the European Commission with Action 1 of the EU Pollinators Initiative (design of the EU Pollinator Monitoring Scheme). Chaired by IUREAD with Naturalis, UFZ, UKCFH. Major end user for MAMBO technologies and tools.	N/A	3/7/2024	8/9/2024	N/A	Add pollinators for most of the world, otherwise will be not useful / increase butterfly and pollinators baseline / increase the taxonomic terms / larger taxonomic Groups: 500 butterflies, 1000 butterflies.	N/A
27	STING	Science and Technology for Pollinating Insects	http://www.ufz.de/en/research/indicators/	Simon Potts	s.potts@reading.ac.uk	Lead of the STING Project	N/A	European Initiative on Pollinators (COM(2018) 395)	N/A	Consists in raising awareness, engaging society at large and promoting collaboration on pollinators' decline	N/A	N/A	N/A	N/A	N/A	3/7/2024	16/07/2024	N/A	N/A	N/A
28	SURPASS	Safeguarding pollination services in changing world	https://ben.surpass.org/	Franco Gerard	f.g@coih.ac.uk	Senior Scientist, Earth Observation	N/A	Funding Newton Fund Latin America Biodiversity Programme, awarded by the UKRI NERC, in partnership with the CONICET, ANID, and FAPESP	SURPASS is an international partnership between Argentina, Brazil, Chile and the UK, working on pollinators and pollination services in South America.	Our main objectives are to develop knowledge, build capacity and define tangible actions for conservation and sustainable use of pollinators.	N/A	N/A	N/A	Through our research activities, our consortium focus on providing knowledge to food producers, policy-makers, land managers and the public, who need better evidence based tools to support decision making for sustainable outcomes.	N/A	3/7/2024 05/08/2024	6/8/2024	N/A	N/A	N/A
29	TAXO-FLY	Taxonomic resources for European hoverflies	https://taxofly.eu/	Gunilla Stahl	gunilla.stahl@hetuni.fi	University of Helsinki Head of Laboratory, Zoology Unit	N/A	European Commission (EC)	The tasks carried out by Taxo-Fly project members will support other European Commission funded projects, such as the EU Pollinator Monitoring Scheme (EUPOMS), the Preparatory Action for EU Pollinator Monitoring Scheme and Indicators (SPRING project), the Horizon 2020 Europe research projects (POSHBEE, SAFEGUARD), and European National action plans for pollinators.	Create a new taxonomic knowledge base, which lays the ground for the identification of the Hoverflies of Europe.	N/A	ISO standard for language	N/A	Taxo-Fly - an EU funded project gathering taxonomic information for all European hoverfly species	N/A	2/7/2024	12/7/2024	N/A	TAXOFly is working with the data standards for the EU. Creating taxonomic standards for the hoverflies. Catalogue of life	N/A
30	WILDLABS	The conservation technology network	https://wildlabs.net/	Isak Hoye	ih@ecos.au.dk	Professor at Aarhus University Denmark interested in ecological monitoring and the application of computer vision and machine learning to entomology	MAMBO Project	Largest community of conservation tech users and makers in the world	To unite the conservation technology community to maximize the benefits of cross-sector innovation for conservation impact.	Catalyse the conservation technology sector by bringing people together, understanding their needs, and directing resources from across sectors to address shared challenges and realize collective opportunities.	N/A	N/A	N/A	N/A	N/A	23/07/24	N/A	N/A	N/A	N/A

Subject to change

Stakeholders	Total	%
Stakeholders interviewed:	15	50
Stakeholders responding - email:	2	6.7
Stakeholders of completed projects:	1	3.3
Stakeholders not available:	1	3.3
Stakeholders not responding:	11	36.7
Total	30	100

