

TETTRIs

Taxonomy for Transformation: A Blueprint for Bridging Science, Capacity, and Biodiversity Action

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TETTRIs

Transforming European Taxonomy through Training, Research and Innovations

Taxonomy for Transformation: A Blueprint for Bridging Science, Capacity, and Biodiversity Action

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Abstract

The TETTRIs project sets out to strengthen Europe's taxonomic capacity by equipping both current and future taxonomists with the tools, skills, and infrastructures needed to meet growing biodiversity challenges. Building on an extensive suite of project outputs, this Blueprint for Taxonomy for Transformation: Bridging Science, Capacity, and Biodiversity Action (the Blueprint) translates TETTRIs' results into a practical, forward-looking guide designed to support capacity building in taxonomy, sustained professional development, and knowledge transfer across the taxonomic community and beyond to a variety of actors involved in biodiversity conservation. It offers strategic direction for policymakers and funders, and actionable guidance for practitioners of different backgrounds and expertise level working to secure and expand taxonomic expertise. As a core piece of this Blueprint, the TETTRIs Cookbook provides adaptable, hands-on "recipes" that enable institutions, researchers, citizen scientists, and other stakeholders to replicate and extend successful approaches, fostering new initiatives and collaborations to increase taxonomic capacity across geographical, disciplinary and expertise boundaries. Together, these resources outline a vision for a modern, interoperable **European system for integrative taxonomy** capable of producing FAIR, up to date species-level data for science, policy, and society that anchors in robust and skilled human capacities. By showcasing pathways, practical models, and satellite project case studies, the Blueprint establishes a roadmap for long-term sustainability and cross-sector partnerships for capacity building, ensuring taxonomy remains a cornerstone of biodiversity knowledge and governance in Europe.

Keywords: Taxonomic Capacity Building, Biodiversity Research, Integrative Taxonomy, FAIR Data, Species-Level Information, Taxonomic Tools, Training and Skills Development, European System for Integrative Taxonomy, Knowledge Transfer, Sustainable Taxonomic Infrastructure


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Executive summary

SYNOPSIS

The taxonomic capacity in Europe needs to be strengthened through a coordinated system that combines training, digital tools and infrastructure, and through the consolidated and structural mainstreaming of taxonomy within biodiversity-related policies and strategies, supported by targeted funding and collaborative participation. Together, these mutually reinforcing elements can create a sustainable, modern, and inclusive European system for integrative taxonomy.

The problem: Europe lacks taxonomic capacity. Multiple reports and studies provide thorough evidence that human capacity in taxonomy is both progressively shrinking and unevenly distributed across Europe. Moreover, existing expertise is not sufficient to identify and monitor biodiversity, with many taxonomic groups remaining poorly covered, especially invertebrates and less charismatic taxa. The discipline is at risk and all indicators lead to a **long-term capacity problem**, not just a temporary gap, that is also **institutional and organisational**, not just numerical, with a shortage of experts where the need is more urgent, near biodiversity hotspots and protected areas. While overall responsibility to halt biodiversity loss and implement conservation measures constitute a priority in Europe, the lack of professional experts and well supported, sustained taxonomic capacity building strategies, along with a systemic underinvestment, are provoking a critical mismatch between biodiversity knowledge needs and available expertise.

The solution: practical responses validated through TETTRIs. The project *Transforming European Taxonomy through Training Research and Innovations* - TETTRIs - has shown that tackling biodiversity challenges is impossible without strong, shared and up-to-date taxonomic capacity. Thanks to the core work and satellite projects, the TETTRIs consortium has not only produced tools, courses, reference systems and engagement formats; it has also strengthened a committed European community of institutions and facilities, taxonomic researchers and citizens. Together, they learn with and from each other in real contexts **and build competences and skills in taxonomy to address biodiversity loss across borders and fields of expertise**, with the specific approach of "**integrative taxonomy**", understood here as the **integration of traditional taxonomic, molecular, and ecological evidence in the delimitation and description of species.**

Building on the practical responses validated through TETTRIs, the Blueprint sets out the next stage of coordinated action. It draws together the project's experience, evidence, and lessons learned into a practical, multi-stakeholder tool for strengthening taxonomic capacity across Europe. This Blueprint distils the TETTRIs project's experience into practical pathways and a Cookbook formed by operational Recipes and inspirational Videos.

These offer concrete ways to design training, turn infrastructures into learning environments, involve citizens and stakeholders, and connect taxonomic expertise to biodiversity policy and practice. Used together, they point towards a **sustainable, scalable and inclusive European system for integrative taxonomy** that can deliver FAIR, actionable species-level knowledge where it is most needed.

The action ahead: three recommended programmes presented in the Blueprint. By turning these insights into three areas of critical recommendations, the Blueprint aims to guide coordinated action, sustainable investment, and long-term integration of taxonomy into Europe's biodiversity agenda by supporting the creation of knowledge, the development of systems and the generation of sustainable impact.

The recommendations in each of those areas converge on subsequent **three new coordinated programmes - Training and Skills, Tools and Infrastructure, and Policy and Community Integration** - supported by targeted funding and sustained scientific and community collaboration. Together, these actions will enlarge and skill Europe's taxonomic workforce, improve the reliability and interoperability of biodiversity data, modernise supporting research infrastructures, and create the condition for long-term biodiversity knowledge generation and application. In this way, the Blueprint will accelerate Europe's ability to document, understand, and protect biodiversity, while connecting scientific expertise with societal needs.

Keeping this system alive is dependent on the continued investment in learning and collaboration. Taxonomists, educators, collections, infrastructures, citizen-science groups, policy makers and funders each have a role in extending and adapting the models presented here. By treating **taxonomy as shared capacity** that has been built over time through reflexive, collective learning, Europe can strengthen the foundations of biodiversity conservation and ensure that the gains made in TETTRIs, and continued in TETTRIX and other sister complementary initiatives, grow into a lasting community of practice that is able to respond to future challenges.



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STRATEGIC OVERVIEW

The TETTRIs Blueprint is titled *Taxonomy for Transformation*: *A Blueprint for Bridging Science, Capacity, and Biodiversity Action*, to outline the comprehensive set of actions developed under TETTRIs across three strategic areas - Knowledge Creation, Development of Systems, and Sustainable Impact - designed to build, sustain, and modernise taxonomic capacity through interlinked programmes aiming to not only produce, but equally support and further exploit taxonomic capacities. In each of the three areas, the recommendations are based on the TETTRIs key findings and further deployed in a set of actions that create the expected impact.

Knowledge creation

Key findings:

- There is a **structural gap in taxonomic expertise** due to insufficient specialised training opportunities and weak integration between academic, professional, and citizen science learning pathways.
- The existing landscape of training initiatives is **fragmented,** and the resources are poorly coordinated across Europe.
- **Hands-on experience** (field and collections) remains essential but is not systematically embedded in training programmes.
- **Digital learning** and virtual resources can significantly expand access to taxonomic education but are underused.
- **Citizen scientists** represent an untapped capacity, but mechanisms to ensure data quality and structured participation are still limited.

> “There is a **structural** gap in **taxonomic expertise**”

Recommendations:

Develop stronger training pathways in taxonomy: Support expert-led, practical training in specimen collection, analysis, and identification, while embedding taxonomy more firmly in university curricula and vocational training.

1

Support mentorship, networks, and inclusive participation: Build mentorship programmes and communities of practice that link early-career and senior taxonomists, while also creating structured ways for citizen scientists to contribute and improve data quality.

2

Make learning more accessible across settings: Use a mix of field, museum, and digital training, supported by open-access platforms, virtual collections, and taxonomic databases, to widen access to skills development.

3

Expected impact:

An overarching **Programme for Training and Skills** will foster a coordinated European learning ecosystem by delivering:

- Sustained **European career progression** and access to expertise across career stages.
- Increased **capacity to generate reliable biodiversity data** needed for conservation and monitoring.
- Stronger **integration between academia, research institutions, museums, and citizen science communities.**
- Greater **geographical and social inclusivity in taxonomy training**, supported by digital learning platforms.
- Improved **quality and quantity of biodiversity observations and taxonomic data.**



Development of systems

Key findings:

- Taxonomic infrastructure remains **scattered** across platforms and services, limiting interoperability and accessibility.
- Digitisation and stable identifier **systems** are essential for ensuring reliable and reusable biodiversity data.
- **Virtual collections and digital platforms** are critical for expanding access to taxonomic resources.
- New **technologies and applications** such as AI-assisted identification tools offer significant potential but require governance and expert validation.
- **Accessibility barriers** persist due to language limitations and uneven access to digital infrastructure.

> "**Taxonomic infrastructure** remains **scattered** across platforms"

Recommendations:

Build a robust, interoperable digital infrastructure in support of taxonomic work through high-quality digitisation, stable identifier systems, consolidated (virtual) reference collections and libraries, and interoperable architectures to ensure taxonomic FAIR data are connected and reusable across platforms.

4

Advance smart tools, automation, and AI integration for the development of user-friendly integration tools (as SpartExplorer) and AI-assisted workflows for species identification and analysis, combining automated data ingestion and algorithm development with expert validation and clear data governance to enhance efficiency and scientific rigor.

5

Strengthen access, community services, and global inclusion, through the development and maintenance of shared platforms such as the marketplace for expertise and e-services, while promoting accessibility through multilingual tools, training, and inclusive design to ensure broad, equitable participation across regions and communities, and efficient use, mobilisation and exploitation of taxonomic resources.

6

Expected impact:

A **Programme for Tools and Infrastructure** will strengthen and modernise Europe's taxonomic resources by delivering:

- A modern, interoperable **European taxonomic infrastructure** aligned with FAIR data principles.
- Enhanced access to biodiversity knowledge through **virtual collections and integrated platforms.**
- Faster and more efficient species identification and taxonomic analysis through **automation and AI-assisted tools.**
- Increased **participation** from under-resourced regions and linguistic communities.
- Reduced duplication of efforts and improved **coordination** across taxonomic services.



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Sustainable impact

Key findings:

- Taxonomy remains **under-recognised in policy frameworks and funding structures**, despite its central role in biodiversity knowledge.
- Innovative funding models such as **cascade funding** can stimulate decentralised innovation and support smaller actors.
- Public engagement initiatives can **increase awareness of the taxonomy's role in biodiversity conservation.**
- Ethical standards, gender equality, and inclusiveness are **not consistently integrated into capacity-building efforts.**
- Demonstrating measurable outcomes remains crucial to **justify sustained investment in taxonomy.**

> **"Taxonomy** remains **under-recognised** in policy frameworks"

Recommendations:

Enable inclusive funding, capacity building, and ethical practice: Expand cascade funding to support decentralized innovation (e.g., SMEs, local groups), while embedding ethics, gender sensitivity, and inclusive capacity-building into training, funding, and research practices.

Strengthen open science, engagement, and societal uptake by facilitating open access taxonomic publishing with practical and clear identification tools (such as keys, barcodes) to support broader learning, expand citizen contributions to conservation activities and foster co-creation of knowledge by linking science and society.

Mainstream taxonomy into policy frameworks and demonstrate impact: Strengthen position of taxonomy within broader biodiversity strategies, at national and European level, by using the emerging capacity-building TETTRIX system as a long-term anchor for taxonomy in EU policy and funding.

Demonstrate impact across actors and actions: Leverage narratives like #NameItToSaveIt (under the umbrella of the CETAF Taxonomy Recognition Day) and promote sustained public engagement initiatives (e.g., bioblitzes, awareness campaigns) while developing transparent impact tracking mechanisms to evidence value, and inform policy and funding decisions.

Expected impact:

A long-term, scalable taxonomic capacity **Programme for Policy, Funding and Community Integration** will help to sustain, encourage exploitation of TETTRIs outcomes and amplify the impact of TETTRIs outcomes by delivering:

- Stronger **integration** of taxonomy into European biodiversity policy and environmental strategies.
- A more **diverse and inclusive** taxonomic community.
- Increased **innovation and participation** from SMEs, local research groups, and emerging actors.
- Greater **public recognition** of taxonomy and its role in conservation.
- Improved **evidence of societal and scientific impact** through systematic monitoring.



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SECTION

1 Purpose and features of the blueprint

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1. INTRODUCTION TO THE BLUEPRINT

The TETTRIs project (*Transforming European Taxonomy through Training, Research and Innovation*) aimed to enhance taxonomic capacity in Europe, addressing the growing need for specialised taxonomic expertise in biodiversity research and conservation.

TETTRIs has delivered a broad suite of outcomes that now underpin this Blueprint (Appendix 2: Figure 1) and has helped strengthen Europe's taxonomy learning community. Partners, satellite projects, and stakeholders learned from each other while developing tools, training, infrastructure, and engagement activities in real-world settings. That community is now the core of a more comprehensive, sustainable, scalable, and inclusive **European system for integrative[1] taxonomy.**

The **mission of this Blueprint** is to provide the **strategy and tools** needed to build such a system that will share real-time, FAIR (Findable, Accessible, Interoperable, and Reusable), and actionable species-level data with science, policy, and society.

The Blueprint aims to provide a **critical impact** with a long-term perspective while consolidating the position of the taxonomic community at the core of European biodiversity research, protection, and evidence-based policy.

The Blueprint and its Cookbook are written from within the taxonomic research community and are intended to help others join it, adapt its models and extend this system in their own settings. Rather than a static report, this Blueprint is designed as a **transferable framework for action**. Its primary purpose is to invite the taxonomic community, institutions, and policymakers to **scale up** the verified successes of the TETTRIs project. It serves as a comprehensive guide for others to follow, use, and - crucially - to adapt to their EU, national or local contexts and needs.

[1]TETTRIs did not invent the term integrative taxonomy. Dayrat (2005) defined it as the scientific approach to delimit species (and other units of biodiversity) from multiple and complementary perspectives, including phylogeography, comparative morphology, population genetics, ecology, development, and behaviour. What TETTRIs does offer through this Blueprint is a practical way to organise integrative taxonomy at the European level, by linking species knowledge, digital infrastructure, training, and the use of taxonomic evidence in biodiversity policy and practice.

The Blueprint is structured into three main sections:

1 **Section 1** (Chapters 1-3) is an introduction to the purpose and scope of the Blueprint in the context of TETTRIs, the classification of focus audiences and the guidelines to navigate the Blueprint to make the best use of it. **Taxonomy supports research, conservation, policy, and public engagement**; therefore, the Blueprint is formulated to serve a broad range of users -including researchers, educators, institutions, policymakers, citizen scientists, journalists and digital infrastructure providers. Readers are encouraged to identify themselves under a certain category of user (either as a primary target or related strategic stakeholder) and focus on the sections most applicable to their role, to lead action, keep focus and maintain an applicability-driven perspective.

2 In the **Section 2** (Chapters 4-6), where the outcomes are presented through the three main strategic areas of activities followed in TETTRIs to produce results: knowledge production, development of systems and sustainable impact.

3 Finally, **Section 3** brings together the TETTRIs results in descriptive summaries that gather both, ready-to-use **14 replicable recipes** on how to access and use tools and mechanisms, as well as **18 inspirational videos** that enrich the content of the recipes and illustrate effective performance of the tools and services described in the recipes.

A **'Cookbook' of recipes** has been produced to sustain TETTRIs' contribution to taxonomy and biodiversity within the EU. Although an integral part of this Blueprint, it can function as a **stand-alone document** for ease of use. The TETTRIs '**Cookbook**' was created to enable practitioners, citizen scientists, institutions and other interested parties to take our learnings and recreate projects elsewhere, apply learnings to create new projects, infrastructure and collaborations and build taxonomy expertise and tools above and beyond what TETTRIs has achieved.

1.1 How we developed this Blueprint

Developed through a reflexive, action-learning process embedded within the TETTRIs community, this Blueprint goes beyond simply identifying training needs and opportunities. It captures how **TETTRIs** and more importantly, with the support of the community behind, evolved into a **collaborative, self-reflective system**, one that continuously experimented, learned, and adapted. The Blueprint is a distillation of this shared experience into flexible, reusable models designed to support sustainable taxonomic capacity building elsewhere.

The Blueprint connects the landscape analysis of **expertise needs and training gaps** with results and with recommendations emerging from third-party projects and the TETTRIs Advisory body, the Community Implementation Board (CIB).

It organises these inputs into three operational areas – knowledge, systems and sustainable impact – which correspond to **taxonomic competences, learning opportunities and enabling infrastructures.** For each area, it describes who is involved, how learning and capacity building happened in practice, and which concrete tools and formats have been validated in TETTRIs.

Continuous professional development tracks, best practices and supporting procedures are presented in the form of **practical recipes, success stories and recommendations**. Together, they form a sustainable, reflexive mechanism for building taxonomic capacity: one that can be copied, adapted and extended by institutions, projects and policymakers who wish to strengthen taxonomy as a cornerstone of biodiversity knowledge and governance.

2. CONTEXT AND RATIONALE

The Blueprint is grounded in the wider ecological and institutional context in which European taxonomy operates. This chapter first summarises the **external challenges** posed by accelerating biodiversity loss and the shortage of taxonomic expertise and infrastructures (Section 2.1). It then explains how TETTRIs responded by building a taxonomic learning community and the system for integrative taxonomy (Section 2.2), how these efforts connect to **TETTRIs objectives** (Section 2.3), and how reflexivity underpins the sustainability and long-term relevance of the system described in this Blueprint (Section 2.4).

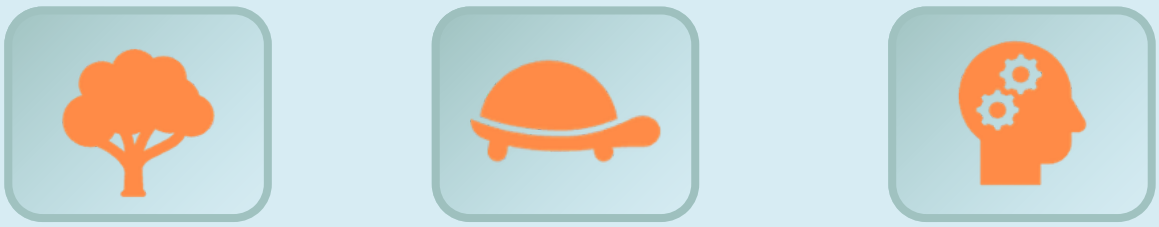


Figure 2: Three key factors limiting effective biodiversity conservation in the European Union

2.1 Challenges for Taxonomy

Biodiversity loss is occurring at an unprecedented rate, driven by habitat destruction, climate change, overexploitation, pollution, and invasive species (IPBES 2019; IPCC2022). Species are disappearing before they are formally described, and **species population declines** often go undetected due to insufficient evidence-based knowledge. This erosion of life on Earth goes beyond pure scientific hurdles and undermines ecosystem functioning, food security, human health, and resilience to environmental change (Karlsson 2025; Mahon et al. 2024; Wudu et al. 2023; WWF 2024; Yixin et al. 2022).

A fundamental challenge in addressing biodiversity loss is the **shortage of taxonomic expertise** (Engel et al., 2021; Löbl et al. 2023; Páll-Gergely et al., 2024), infrastructure, and accessible biodiversity reliable and up-to-date data needed to identify, document and monitor species. Many regions and taxonomic groups remain poorly studied. As a result, conservation **actions and priorities, environmental assessments**, and biodiversity policies are frequently based on incomplete or inaccurate information (Titley et al 2017; Haelewaters et al. 2023).

The global shortage of taxonomic expertise has become a major bottleneck in efforts to understand, monitor, and conserve biodiversity. This shortage is driven by a sustained **decline in trained taxonomists**, as retirement outpaces recruitment and taxonomic disciplines receive diminishing institutional support and overall, financial funding. Many universities and research institutions no longer offer comprehensive taxonomic training, leading to gaps in expertise across numerous organismal groups and geographical regions (Engel et al. 2021; Löbl et al. 2023; Simões et al. 2025).

Compounding this decline is the current **limited access to continuous education and professional training** for early-career and mid-career taxonomists. Opportunities to update skills, adopt integrative taxonomy approach and digital methods, or gain exposure to emerging tools such as molecular techniques and bioinformatics remain unevenly distributed. This restricts the development of a new generation of taxonomists capable of addressing contemporary biodiversity challenges and dramatically reduces attractiveness of this discipline among younger generations.

At the same time, rapid biodiversity loss demands urgent and reliable taxonomic expertise (Löbl et al 2023; Al-Asif & Nerurkar 2024; Páll-Gergely et al., 2024). **Species are being lost faster than they can be documented**, described, or assessed, resulting in irreversible knowledge gaps. Without sufficient taxonomic capacity, conservation planning, environmental impact assessments, and biodiversity indicators are weakened by misidentifications and incomplete species inventories.

The growing **development of Artificial Intelligence (AI)** applications for biomonitoring further highlights the need for taxonomists. AI-based tools depend on high-quality, correctly identified expert-curated trainingdata, which only taxonomic experts can provide. Taxonomists are essential, not only to validate species identifications, but also to curate training datasets, interpret outputs, and guide machine-learning processes to ensure biological accuracy and ecological relevance (Wäldchen & Mäder 2018; Nanni et al. 2024 Valdecasas 2024; Lu et al. 2025).

Finally, the taxonomic shortage is exacerbated by a **lack of mechanisms to enrich taxonomists' networks and enhance collaboration**. Fragmented expertise, limited cross-institutional collaboration, restricted mobility opportunities, and insufficient international cooperation reduce efficiency, slow knowledge transfer, and hinder large-scale biodiversity assessments.



CHALLENGES FOR TAXONOMY

Taxonomy faces a critical **decline in trained experts**, alongside **limited access to continuous education and professional training.** At the same time, **accelerating biodiversity loss** increases the **urgent need for taxonomic expertise.** Emerging AI-based biomonitoring tools depend on **taxonomists for data validation** and machine learning development, yet **opportunities for networking, collaboration, and knowledge exchange among taxonomists remain insufficient.**

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Strengthening collaborative networks is crucial for sharing expertise, mentoring new taxonomists, and integrating taxonomic knowledge into global biodiversity initiatives (Engel et al. 2021; Al-Asif & Nerurkar, 2024).

Addressing the taxonomic shortage therefore requires **coordinated investment in education, capacity building, technological integration, and collaborative infrastructures**. Without such efforts, both traditional biodiversity science and emerging digital monitoring solutions will remain constrained by a fundamental lack of scientific experts. It is not only a scientific task: biodiversity loss can only be tackled effectively if taxonomic expertise is enhanced and built, updated and connected through learning, infrastructures and collaboration. TETTRIs was designed precisely as such a response.

2.2 Towards a sustainable European system for integrative taxonomy

The **challenges outlined above** – accelerating biodiversity loss, shortages of taxonomic expertise, uneven access to training, fragmented infrastructures and weak links between taxonomy and society – cannot be addressed by theory or one-off interventions alone. They require taxonomic communities, institutions and infrastructures to learn while generating the evidence needed for biodiversity conservation and, at the same time, building the human, organisational and infrastructure capacity to keep doing so. TETTRIs has evolved as such a learning community in the making **and as a practical test-bed for a more coherent, system-level response to taxonomic needs** in Europe.

In practice, TETTRIs responded to the taxonomic skills shortage and the urgency of biodiversity loss by creating structured training opportunities for people **to learn in and through real taxonomic work**, rather than only in formal classroom settings. Core partners designed training frameworks, blended courses and field and laboratory schools; satellite projects then implemented and adapted them to local conditions, specific organism groups and concrete conservation contexts. This combination increased expertise in soil fauna, freshwater fauna, pollinators and other taxa, and at the same time revealed what is feasible under real institutional and resource constraints. The Blueprint now captures these tested approaches in three strategic areas and recipes that others in the learning community can pick up, modify and scale.

TETTRIs also **addressed the fragmentation of infrastructures and tools** that hampers evidence-based biodiversity work by embedding learning directly into systems. Platforms such as the TETTRIs e-learning environment, the Expertise and e-Services Marketplace, SpartExplorer, the Taxonomic Resolution Engine (TRE) and virtual collections were not developed as static technical products. They were piloted with users – taxonomists, data stewards, students, citizen scientists and conservation practitioners – who had to navigate interfaces,

NEED FOR LIFE-LONG LEARNING IN TAXONOMY

Life-long learning is essential to **strengthen** and **sustain taxonomic capacity** in Europe by supporting continuous professional development and attracting new generations of taxonomists. Life-long learning **bridges gaps** between academia, industry, and citizen science, **leverages digital tools for accessible** and **inclusive learning**, and enables **knowledge sharing** across borders. Through innovative teaching approaches, mobility, and partnerships, life-long learning **enriches collaboration and reinforces the European taxonomic network.**



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combine tools and apply workflows to real datasets used for monitoring, assessment and research. Their feedback shaped successive iterations and is now distilled into practical guidance on how to implement, maintain and use such systems for capacity building across the community.

At the same time, TETTRIs **tackled the weak connection between taxonomy and wider society** that limits the uptake of biodiversity evidence. Many activities were deliberately positioned at the interface between experts and other actors. Citizen-science initiatives, stakeholder labs, Taxonomy Recognition Days and public-facing exhibitions were used not only to gather data or raise awareness, but as shared learning processes. Taxonomists learned how to communicate their work, co-design protocols and work with non-specialists; participants learned how taxonomic evidence underpins biodiversity policy, nature protection decisions and local management. These mutual learning experiences are now codified into recipes that can be reused by NGOs, authorities, schools and other organisations that wish to join and expand the taxonomic learning community.

Crucially, **TETTRIs treated satellite projects as laboratories for experimentation** rather than as isolated pilots. Each project tested a concrete piece of the broader system – a training course, a reference collection, an AI-supported workflow, or a citizen-science scheme – and reported back on what worked well and what could be improved. In this way, the TETTRIs consortium learned not only from successful models, but also from limitations, gaps and unintended effects that are inherent to real-world biodiversity work.

The Blueprint translates this collective experience into recommendations, so that future initiatives do not have to start from scratch but can build on consolidated, critically assessed practice.

In summary, TETTRIs responded to biodiversity and taxonomic challenges by **coupling action with systematic learning and by nurturing a European taxonomic learning** community: people and organisations who commit to doing, observing, reflecting and redesigning in an iterative way. This Blueprint is the vehicle through which those lessons are shared. It offers concrete formats, tools and stories that institutions, projects and policy makers can copy, adapt and extend, thereby accelerating the development of taxonomic capacity needed to support biodiversity conservation across Europe.



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3. RESULTS APPLICABLE TO PEOPLE AND SKILLS

The previous chapter showed how TETTRIs responded to biodiversity and taxonomic challenges by building an emerging European learning community and by testing more inter-connected ways of strengthening taxonomic capacity.

This chapter takes the next step. It shows how project results (outputs and outcomes) are turned into practical, reusable guidance for people and institutions. In the Blueprint, this happens through the Recipes and inspirational videos that translate selected results into specific, transferable formats for implementation, adaptation and scaling.

3.1 The need for replicable Recipes and inspirational Videos

One of the main ways in which the Blueprint turns TETTRIs results into practical use is through the Cookbook. The Blueprint incorporates a novel users-driven document, the so-called **Cookbook, as a compendium of 14 recipes to guide users** with a concise, simplified and practice-oriented language on how to understand, implement and exploit several key outcomes of the TETTRIs project. Whilst an integral part of the Blueprint, the Cookbook is an independent user-friendly document, written with the end user in mind. The Recipes included in the Blueprint were selected as good practice examples to cover well defined user scenarios. They range from launching local field-based training hubs to integrating modular taxonomy courses into higher education.

The Recipes are intended to be practical supporting tools that could help practitioners to recreate similar projects or innovations to the ones achieved in TETTRIs. Moreover, they are equally useful as guides for more effectively exploiting the mechanisms and infrastructures developed under the project, thus creating a multiplier effect for the TETTRIs results.

The Recipes are marked with the icon of a chef hat, . They will link to the Cookbook (that constitutes the **Section 3** of the Blueprint). These Recipes are complemented with 18 **inspirational videos** that can be watched on YouTube and are listed below the Recipes, marked with the icon of a camera .



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Replicable recipes

RECIPE 1: How to organize an advanced blended course on Taxonomy

How to design and deliver an advanced blended training course in taxonomy, aimed at empowering early-career researchers and university students, the next generation of taxonomists. At its core is the Train the Trainers (TTT) model, which turns trainees into Future Local Trainers (FLTs), who then multiply the impact by running their own courses. This cascading approach, supported by the CETAF-DEST infrastructure, ensures that taxonomic expertise remains accessible, sustainable, and embedded in decision-making processes across Europe.

The recipe walks you through what is needed: expert taxonomists, laboratory and field facilities, a Learning Management System (LMS) for asynchronous learning, and tools for online teaching. It then provides a clear, step-by-step process—from budgeting and uploading materials, to selecting trainees, running the course, evaluating it, and issuing certificates. A suggested 10–12 month timeline shows how to plan and implement the course efficiently.

Perfect for anyone aiming to build taxonomic capacity, this recipe gives you a structured, practical roadmap for training that not only teaches taxonomy, but grows a community capable of sustaining and expanding it for years to come.

RECIPE 2: Sounds Right Nature-Music Excursions for Youth Engagement

To learn how to design a powerful youth-focused nature experience that blends music, biodiversity, and sensory exploration to inspire young people to reconnect with nature. By combining the skills of a musician and a biologist, the excursion taps into the global Sounds Right campaign, which frames nature itself as an artist, to spark curiosity, emotional engagement, and species discovery.

The model outlines how to bring a youth group into a natural setting for a sequence of activities that cultivate **Nature Connectedness**: a guided introduction, a silent sensory sit-spot, collaborative reflections, and hands-on species identification using apps like iNaturalist.

The recipe highlights what works best, such as leveraging musicians' social media reach, and what could enhance future excursions, including more resources for media production and broader accessibility. With measurable outcomes like increases in Nature Connectedness and continued app use, this model offers a replicable and impactful way to engage young people in protecting nature through the universal language of sound.

RECIPE 3: How to build a reference collection

This recipe provides a clear and practical guide to building both physical and virtual reference collections. By explaining what reference collections are, why they matter, and how to create them within a coordinated, multi-institutional framework, the recipe shows how fundamental these collections are to Europe's biodiversity knowledge and environmental decision-making.

Drawing on hands-on experience from TETTRIs and its satellite projects, the guide outlines how to define the collection's scope, assess existing materials, develop shared standards, assemble and digitise specimens, and build distributed collections across several institutions. It highlights the dual importance of technical quality and collaboration, showing how shared catalogues and harmonised workflows help institutions combine strengths, reduce duplication, and improve long-term resilience. It also provides insights into bottlenecks such as verification time and digitisation demands.

With its step-by-step structure, lessons learned, and clear indicators for success, this recipe acts as a blueprint for any organisation aiming to strengthen taxonomic capacity. Whether building a museum collection, expanding national biodiversity monitoring, or establishing a distributed virtual archive, it offers the strategic and practical guidance needed to develop high-quality reference collections that support science, policy, and conservation for years to come.

RECIPE 4: How to collaborate to develop image recognition tools for collections

It presents a clear, collaborative roadmap for natural history institutions, museums, universities, biodiversity centres, NGOs, and citizen science groups that want to work together to create image recognition tools for collection objects. While image recognition has already transformed species identification in the field, its development for museum specimens has lagged, mainly due to individual institutions rarely having enough training data to build reliable models. By pooling specimens, images, expertise, and infrastructure, this barrier is removed and strong, scalable tools can be produced at relatively low cost.

The recipe outlines what is needed to get started: clear objectives, a species checklist, a coordinated team, high-quality imaging, standardised metadata, and modelling expertise. A structured workflow then guides users through defining the taxonomic scope, assembling a multi-institution team, standardising digitisation protocols, collecting and checking training images, building the model, and finally deploying and sustaining the tool. Lessons learned emphasise the importance of consistent imaging, robust coordination, and early agreement on standards.

With its practical steps and focus on collaborative data creation, this recipe demonstrates how coordinated action across museums can accelerate the development of image recognition models that support taxonomy, improve identification accuracy, and unlock the scientific value of Europe's vast natural history collections.

RECIPE 5: How to Use the Taxonomic Expertise and Services Marketplace

This recipe explains how to navigate and contribute to the Taxonomic Expertise and Services Marketplace, a European, curated index designed to make taxonomic expertise and digital e-services easier to find, compare, and connect with. The Marketplace provides a trusted, FAIR-aligned entry point for discovering experts, identification tools, and digital resources across Europe. It does not provide taxonomic services directly; instead, it acts as a discovery and connection layer, helping researchers, consultants, policymakers, students, and citizen scientists quickly locate the right expertise or tool for their needs.

The recipe outlines how both Providers (experts and developers) and Users interact with the platform. Providers can register their skills, tools, or services so they become discoverable, citable, and connected with major biodiversity infrastructures. Users can search or filter entries by taxonomic group, service type, or technical capability to find verified, professional-grade expertise—far more targeted than broad web searches. With step-by-step instructions for onboarding, tips for creating high-quality profiles, and insights from the pilot phase, the recipe shows how the Marketplace helps align Europe's supply and demand for taxonomic knowledge. By engaging with this platform, the community strengthens the visibility, usability, and impact of taxonomic science across research, conservation, and environmental decision-making.

RECIPE 6: SpartExplorer

It introduces SpartExplorer, an intuitive web platform that enables integrative taxonomists, phylogeneticists, and molecular ecologists to quickly explore competing species-partition hypotheses from single-locus DNA data. In this platform users can compare alternative species partitions side-by-side, interpret their results using graphical and statistical summaries, and export outputs in multiple formats for analysis.

Designed for speed, simplicity, and interpretability, SpartExplorer helps researchers generate preliminary species hypotheses in minutes, supporting clearer decision-making and more rigorous downstream taxonomic work.

RECIPE 7: CheckMyName

The CheckMyName tool is presented in this recipe, as an easy-to-use online service that helps researchers, taxonomists, data curators, and citizen scientists identify which name-matching service is best suited for checking scientific names in their datasets. There are many online services available with each offering different scopes, formats, and capabilities. It can therefore be difficult choosing the right tool, especially for those unfamiliar with biodiversity informatics.

By following the steps on CheckMyName, users can quickly identify the most appropriate resource and proceed directly to the selected service to validate their names. Free to use and browser-based, CheckMyName streamlines a task that supports cleaner datasets, stronger scientific outputs, and more reliable connections with global taxonomic infrastructures.

RECIPE 8: How to use a Taxonomic Resolution Engine Wikibase

To introduce the Taxonomic Resolution Engine (TRE), which is a custom Wikibase application developed within TETTRIs to help researchers manage the complex, interlinked data essential to digital taxonomy. Built as an open data platform, the TRE enables users to create, edit, and maintain relationships between taxonomic names, type specimens, material citations, authorship information, and other components of taxonomic knowledge. Designed as a secondary data source, it connects back to authoritative repositories while making these relationships transparent, queryable, and machine-readable.

TRE allows researchers to harmonise data from multiple sources, create stable links across datasets, and automate updates through scripts or bots. The recipe explains what expertise is needed and outlines the workflow from setting up an account to importing data, linking concepts, and establishing automated pipelines. By following this recipe, users gain the ability to contribute to a shared, evolving taxonomic knowledge graph, strengthen provenance and linkages among datasets, and support long-term, cross-infrastructure interoperability in European biodiversity science.

RECIPE 9: Cascade Grant Mechanism (Financial Support to Third Parties – FSTP)

It provides a clear, experience-based overview of how to design and implement a Cascade Funding (FSTP) mechanism within an EU-funded project. Drawing on lessons from TETTRIs, it explains how project coordinators, consortium partners, and innovation managers can create an efficient, transparent, and compliant system for distributing small grants to external organisations.

The recipe outlines the essential components of a successful cascade funding cycle: defining objectives and eligibility rules, preparing documentation and platforms, running an open call, evaluating and contracting beneficiaries, supporting them throughout implementation, monitoring progress, processing payments, and closing and reporting the grants. It highlights practical considerations often overlooked, such as the substantial administrative workload, the importance of regular communication with beneficiaries, the need for clear guidance on requirements, and the value of joint meetings to build cohesion and shared purpose. The recipe helps future projects anticipate timelines, resource needs, and common challenges helping to ensure that their own cascade funding schemes can be delivered smoothly, compliantly, and with high impact.

RECIPE 10: Citizen Science initiative for biodiversity monitoring

This recipe builds on the FOOTPRINTS project, a TETTRIs-funded citizen science initiative that successfully engaged the public in winter wildlife monitoring by identifying animals through photos of their footprints in the snow. The approach illustrates how AI-assisted observations, simple tools, and community participation can generate valuable biodiversity data—while fostering learning, inclusion, and engagement.

Designed for citizen science practitioners and anyone interested in launching a biodiversity monitoring project, this recipe outlines how to turn a research idea into a participatory initiative, highlighting the importance of involving both experts (to validate data) and volunteers (to gather it), supported by clear communication, inclusive outreach, and tailored training.

By following the steps, timelines, and learning from the lessons learned, practitioners can design their own effective, engaging citizen science programme. Used as inspiration, this model can help generate meaningful ecological data, support education, and build long-term interest in biodiversity.

RECIPE 11: How to organise a BioBlitz

A clear and practical guide for organising a Bioblitz; a short, intensive biodiversity survey designed to document as many species as possible within a defined place and time. Combining scientific purpose with public participation, a Bioblitz offers a powerful way for researchers, NGOs, educators, and community leaders to generate high-quality local biodiversity data, while inspiring people to explore and appreciate nearby nature. Because it is deeply rooted in observing a specific place, a Bioblitz also helps build long-term stewardship and connection to local ecosystems.

This recipe outlines how to define objectives, choose a suitable site, form partnerships, recruit experts, and plan logistics. It also highlights how to create excitement through outreach, guided walks, species hunts, and educational activities during the event itself.

RECIPE 12: How to organise a Stakeholder Lab

A guide for organising a stakeholder lab; an in-person, interactive workshop designed to build awareness of taxonomy among external sectors and spark new cross-sector collaborations.

Based on the TETTRIs experience, the recipe shows how a successful stakeholder lab begins long before the event itself. Early stakeholder engagement helps organisers understand existing knowledge, expectations, and opportunities. This groundwork feeds into the programme design, which typically includes impulse talks from high-profile speakers, a panel discussion representing both sectors, and carefully crafted conversation starters that make it easier for participants to connect. The format encourages honest exchange, reduces barriers caused by technical language, and highlights compelling real-world examples that show how taxonomy contributes to applied challenges. With strong facilitation, thoughtful preparation, and well-documented results, a stakeholder lab can become a catalyst for new partnerships and a deeper recognition of taxonomy's value beyond the scientific community.

RECIPE 13: How to Produce and Amplify Taxonomy Recognition Day

To learn how institutions can design and amplify Taxonomy Recognition Day, an annual event (23 May) launched within TETTRIs to highlight taxonomy's societal value and celebrate the work of taxonomists. Built on the success of the 2025 pilot campaign, which reached more than 700,000 people, the recipe provides a practical blueprint for museums, universities, biodiversity centres, NGOs, and citizen science groups to run both in-person events and online campaigns.

The model centres on a flexible event format: public talks, open labs, demonstrations, guided tours, classroom activities, exhibitions, or a fully digital awareness campaign. The recipe stresses the importance of assembling a motivated organising team, engaging partners early, and preparing accessible communication materials anchored by a catchy social media hashtag, such as #NameItToSaveIt, which unifies messaging and boosts visibility. The approach encourages organisations to celebrate something and through this celebration. strengthen public and policy recognition of it.

RECIPE 14: Ethics matter – From the field to collection

Rooted in TETTRIs ethical standards, this recipe explains how to protect people, data, and the environment throughout the entire process, from preparation to on-site activities and data handling. It emphasises compliance with ethics rules, GDPR, informed consent, safe sampling protocols, and institutional regulations, ensuring that research is fair, secure, and respectful of all involved.

Ethical fieldwork goes beyond specimen collection: personal data must be collected voluntarily and stored securely; participants must understand risks and give informed consent; and all sampling must follow institutional guidelines and legal permits. This recipe outlines what researchers need, such as consent forms, risk assessments, data-protection procedures, permits, insurance, and provides a clear process for preparing participants, performing safe and compliant fieldwork, and managing data responsibly. By following these steps, teams safeguard both human participants and natural environments, prevent conflicts or safety issues, and ensure their research outputs meet professional ethics standards and open-science expectations.

Inspirational videos



VIDEO 1: Why does the TETTRIs project exist?

In this video, the Technical Coordinator of TETTRIs and Executive Director of the Consortium of European Taxonomic Facilities, (CETAF), Ana Casino gives insight into why TETTRIs exists and why it matters: discussing the global shortage of taxonomists, the experts crucial for identifying species, protecting biodiversity, managing invasive species, and enforcing environmental legislation. By showing how TETTRIs acts as a vital bridge between scientific expertise, policymakers, businesses, universities, and citizens, the video highlights why taxonomy is essential to safeguarding nature and why supporting this work is more important than ever. Watching it will give you a clear, eye-opening understanding of a silent crisis and the community's efforts to solve it.



VIDEO 2: Why is Taxonomy important?

Professor Thomas Pape of the Natural History Museum Denmark, explains in this video how the diversity of species, that taxonomy helps us understand, is the foundation of resilient, healthy ecosystems. It also highlights how knowing and appreciating the species around us enriches our culture, identity, and imagination, revealing just how deeply nature shapes our lives. An inspiration for all types of audiences on how to give the relevance to biodiversity that it deserves.



VIDEO 3: What is needed to educate the next generation of taxonomists?

The Head of Education at the Natural History Museum of Crete-University of Crete, Iasmi Stathi, highlights in this video a critical challenge for taxonomists: too few young scientists are choosing to become taxonomists, leaving the field at risk. She explains why current experts must train the next generation, and why policymakers must be convinced to invest, to enable the fundamental discipline of taxonomy to survive and thrive into the future. This video is a call to new generations to be involved in taxonomy as well as a supportive plea for current taxonomists to transfer their knowledge to new participants in the system.



VIDEO 4: What are the key needs for transforming taxonomy in Europe?

In this video Kate Evans, of the Gothenburg Global Biodiversity Centre, University of Gothenburg, highlights how transforming taxonomy in Europe depends on fostering life-long curiosity and giving people access to museum and university collections, as well as real connections to nature. It showcases how TETTRIs brings together innovation, passionate experts, and rich biodiversity resources to inspire and sustain that curiosity and interest in nature across society.

VIDEO 5: How can SoilMATs project help us teach taxonomy

In this video, PhD candidate Edoardo Massa of the University of Modena and Reggio Emilia, explains how the TETTRIs satellite project SoilMATs (Soil Meiofauna Advanced Taxonomy school) is training the next generation of experts to understand and teach the hidden biodiversity living beneath our feet. It shows how future trainers and students across Europe are being equipped to study soil micro-arthropods, tiny but essential creatures that most people don't even know exist, yet are crucial for nutrient cycling, healthy crops, and many human-related activities. By highlighting this overlooked world and the effort to build local training capacity, the video offers a fascinating look at why soil biodiversity matters and how teaching taxonomy can help protect it for the future.

VIDEO 6: How can the INC-STEP satellite project help us study pollinators?

With the guidance of Senior Researcher Robert Wilson of the National Museum of Natural Sciences in Spain, this video explains how the TETTRIs satellite project INC-STEP is helping scientists better understand threatened pollinators by building Spain's first national reference collection. Robert explains why identifying pollinators is so challenging, why validated museum reference collections are essential, and how the project brings together experts, students, and citizen scientists to improve monitoring and protect the biodiversity that underpins our food systems and ecosystem services. He therefore highlights how improved taxonomy directly supports conservation, agriculture, and our ecological future.

VIDEO 7: How can citizen scientists help us gather taxonomic data?

In this video, Beatriz Ortega of the European Citizen Science Association (ECSA), explains how anyone, not just scientists, can meaningfully contribute to taxonomic knowledge by getting outdoors, observing nature, and joining local biodiversity projects. It also points viewers to the European Citizen Science Platform, making it easy to find nearby initiatives and start helping gather the data needed to understand and protect Europe's species.

VIDEO 8: How can taxonomy and industry benefit each other? (Part 1)
VIDEO 9: How can taxonomy and industry benefit each other? (Part 2)

These videos show a TETTRIs stakeholder meeting hosted by the Natural History Museum of Vienna which brought industry leaders and taxonomic experts together to understand how deeply business sustainability depends on biodiversity, and therefore on taxonomy. By showing that nearly every supply chain relies on ecosystem services, the workshop illustrated why companies must integrate taxonomic knowledge into their strategies, from combating illegal logging to designing biodiversity-friendly products. It also highlights new models, like Taxonomist-in-Residence programs and corporate biodiversity ambassador training, that help industry invest in long-term ecological resilience. Watching this gives businesses a clear, practical understanding of why supporting taxonomy is not just good for nature, but essential for future-proofing the economy.

Part 1 provides the high-level insights, from EU policy to corporate biodiversity strategies, whilst **Part 2** brings industry and taxonomic experts together to explore concrete solutions, innovations, and collaborations. Watching both gives a complete understanding of why taxonomy matters for Europe's economy, environment, and future, and how industry can, and should, play an active role in that transformation.

VIDEO 10: What is Taxonomy Recognition Day

The Taxonomy Recognition Day is introduced in this video by Michael Magee of the Natural History Museum Denmark, who highlights this Europe-wide celebration dedicated to the science that names and protects life on Earth organised as a collective campaign under the common thread #NameItToSaveIt. Viewers will learn why taxonomy is essential for understanding biodiversity, preventing extinctions, and supporting fields like agriculture, medicine, and conservation, and how over 30 European museums and botanical gardens are uniting to highlight its importance. It also invites everyone, from scientists to nature lovers, to join the #NameItToSaveIt movement by discovering and sharing species around them, making taxonomy visible and giving biodiversity a louder voice.

VIDEO 11: Taxonomy Recognition Day

This video delivers a simple but powerful call to action for Taxonomy Recognition Day on May 23rd, reminding us that every species plays a vital role in Earth's interconnected web of life. It encourages viewers to celebrate biodiversity by sharing a photo of their favourite species, using its scientific name and the hashtag #NameItToSaveIt, highlighting how taxonomy helps us understand and protect the diversity we depend on.

VIDEO 12: How can we support early career taxonomists?

In this video, PhD candidate Edoardo Massa of the University of Modena and Reggio Emilia, explains how the TETTRIs satellite project SoilMATs (Soil Meiofauna Advanced Taxonomy school) is training the next generation of experts to understand and teach the hidden biodiversity living beneath our feet. It shows how future trainers and students across Europe are being equipped to study soil micro-arthropods, tiny but essential creatures that most people don't even know exist, yet are crucial for nutrient cycling, healthy crops, and many human-related activities. By highlighting this overlooked world and the effort to build local training capacity, the video offers a fascinating look at why soil biodiversity matters and how teaching taxonomy can help protect it for the future.

VIDEO 13: What's in a name? The case for biological nomenclature

In this video Senior Researcher, Quentin Groom of the Meise Botanical Gardens explains why biological names, often seen as a dusty, overly technical part of taxonomy, are essential for making biodiversity data usable, shareable, and meaningful. It highlights the need to modernise and standardise nomenclature so that data from researchers, databases, and institutions around the world can seamlessly work together, enabling better science, stronger collaboration, and more accurate understanding of life on Earth.

VIDEO 14: How can digital infrastructure help taxonomy?

The Director of the Center for Biodiversity Informatics and Collection Data Integration in Berlin, Anton Güntsch, explains in this video how modern digital infrastructure is transforming taxonomy, turning tasks that once required time-consuming travel and manual searching into instant, accessible, online workflows. It explains how tools like digital specimen portals, integration services, and shared data standards, that are supported by projects like TETTRIs, allow scientists to combine globally scattered biodiversity resources and build innovative research processes, making taxonomy faster, more connected, and more powerful than ever.

VIDEO 15: How can AI help taxonomy?

In this video Vincent Kalkman of Naturalis Biodiversity Centre showcases how AI is making species identification faster, easier, and more accessible than ever, allowing anyone, not just experts, to identify plants, animals, insects, and even vocal species using simple image or sound recognition. By turning smartphones into powerful biodiversity tools, AI helps people record more species and upload more reliable data, dramatically expanding our ability to monitor nature and understand the world's biodiversity.

VIDEO 16: How do we find taxonomic experts?

In this Video Laura Tilley from CETAF Secretariat explains how TETTRIs is fixing a major challenge in taxonomy, that it is currently extremely hard to find the right experts, since information about taxonomists is scattered across universities, museums, and online sources. The video introduces a new solution, a centralised Taxonomy Marketplace that makes expert profiles easy to search, compare, and visualise, helping stakeholders quickly identify who can meet their taxonomic needs. In addition, this resource helps identify the gaps, where expertise is missing, and where capacity building is needed. It's an insightful look at how better infrastructure can strengthen the entire biodiversity community.

VIDEO 17: How can we increase diversity within the field of taxonomy?

Carole Paleco of the Royal Belgium Institute of Natural Science, explores in this video different practical, meaningful ways to increase diversity within taxonomy, highlighting the gender gap that persists in research and offering concrete steps to close it. She explains why encouraging women to publish, promoting visible female role models, and ensuring balanced, unbiased training environments are essential for creating a more inclusive field, one where future taxonomists of all genders can thrive.

VIDEO 18: How can we get young people engaged with taxonomy?

Again Michael Magee of the Natural History Museum Denmark, identifies in this video creative, exciting, and unconventional ways through which TETTRIs has engaged young people in taxonomy and biodiversity, from youth-led debates and nature events to music collaborations where pop artists make "nature" a co-writer and donate royalties to conservation. It highlights how TETTRIs and partners are reaching both nature-interested youth and those with little prior connection—using festivals, Bioblitzes, art, technology, and immersive outdoor experiences to build stronger nature connectedness and inspire the next generation of citizen scientists and taxonomists.

Following the description of the existing Recipes it is necessary that those accommodate to the needs and expectations of the right audiences and target groups who could best use and apply them. Identified throughout this Blueprint, each Recipe distils concrete methods, tools, and lessons learned into clear, actionable steps that can be readily applied within the workflows of the people and institutions who shape, support, and rely on taxonomic capacity. Every target group—whether working in research, policy, education, collections management, or community engagement and science communication—could then quickly **locate the guidance most relevant to them** and understand how it can be integrated into their regular practices. The aim is not only to offer solutions, but to empower practitioners and stakeholders to adapt, combine, and evolve these Recipes as part of a broader, dynamic system of capacity-building.

3.2 Focus audiences

To ease and enlarge its usability this Blueprint differentiates between two categories of potential audiences, namely, the **target groups**, those that will directly and primarily benefit from this guidance tool in their daily work and practice. Secondly, the **strategic stakeholders** who will take into consideration what can be extracted and value its applicability and contribution to broader frameworks and instances.

Each of those groups have distinct requirements and user practices, for which the Blueprint provides tailored approaches. Therefore it is important to link the existing **Recipes to the right audiences and target groups** who could best use and apply them. Identified throughout this Blueprint, each Recipe distils concrete methods, tools, and lessons learned into **clear, actionable steps** that can be readily applied within the workflows of the people and institutions who shape, support, and rely on taxonomic capacity. By adding the Recipes alongside concise explanations of **their purpose and use,** this section enables every target group —whether working in research, policy, education, collections management, or community engagement and science communication—to quickly locate the guidance most relevant to them and understand how it can be integrated into their regular practices. The aim is not only to offer solutions, but to empower stakeholders to adapt, combine, and evolve these Recipes as part of a broader, dynamic system of capacity-building.



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3.2.1 Target groups

Target groups are primary and direct users of the TETTRIs outcomes, and the Recipes have been designed to enable application and practical use of them. The target groups include:



TAXONOMISTS AND OTHER RESEARCHERS, including students, early-career or experienced researchers, and research leaders, can use the Blueprint as **a hands-on catalogue for building and sharing expertise within your team.**

Exceptional use can be made of **Recipes 1 to 8**. By combining these Recipes, new initiatives can arise and then evolve to transform them into a learning environment that generates both high-quality taxonomic outputs and a new generation of experts.



EDUCATORS AND ACADEMIC INSTITUTIONS, including educational study boards, universities, and research institutions (curriculum designers, trainers), education political bodies.

For those who design or deliver curricula in universities or other higher-education institutions, the Blueprint can be of support in **bringing taxonomy back into teaching in a visible and engaging way.**

Recipes 1 and 2, as well as **Recipes 10 to 13** can be highly valuable for this group. The Blueprint is particularly relevant for academia and training initiatives in which taxonomy has largely disappeared from their programmes and there is a need to re-establish it as a cross-cutting competence linked to ecology, conservation, data science, and policy.



STAFF OF COLLECTIONS AND RESEARCH INFRASTRUCTURES, in addition to researchers, mainly museums, botanical gardens, collections-based institutions and research infrastructures.

For the staff working in a natural history collection, museum, or research infrastructure, the Blueprint helps in **transforming your facilities and platforms into active training hubs**. Special added value may come from **Recipes 3 to 8**, and **Recipes 11 to 14**. By using these Recipes, institutions can more clearly and prominently position themselves as key partners for employers and training environments in preparing the next generation of future taxonomists.



CITIZEN SCIENTISTS, including amateur taxonomists, professionals in the field, NGOs and community partners (such as town councils).

For citizen scientists, amateur taxonomists, NGO, or community partners, the Blueprint provides practical, concrete ways to structure and consolidate their engagement with biodiversity so that it is both **scientifically robust and socially inclusive.**

This group can benefit from using **Recipe 2** and **Recipes 10 to 14**. Together, these Recipes help to understand where activities connect to broader monitoring schemes and policy processes.

3.2.2 Strategic stakeholders

The strategic stakeholders are the **indirect users and key actors who shape policies, funding, governance, and societal context** in which the Recipes are applied. While they may not use the Recipes directly, they will play a critical role in enabling adoption, scaling impact, and ensuring long-term sustainability and **alignment with policy and societal priorities**. These strategic stakeholders include from policy and generally decision makers to journalists and a diversity of actors in the private sector.

Similarly to target groups, stakeholders are a critical audience for the TETTRIs' outcomes. **The Blueprint and its Recipes can be used as strategic levers** by stakeholders who shape the wider enabling environment for taxonomy. While target groups work directly with species, data and collections, stakeholders influence frameworks, funding, mandates and public narratives. For each **stakeholder group** – policy makers and international advisory bodies, nature protection decision makers, funders and industry stakeholders, and journalists and science communicators – the section identifies which Recipes are most relevant to their responsibilities and how these can be incorporated into programmes, regulations, funding schemes, communication strategies and long-term plans. The aim is to make it easy for stakeholders to see **where taxonomy underpins their core missions**, and to adopt ready-to-use formats that strengthen taxonomic capacity and its impact on biodiversity governance, sustainable development and public awareness.

Within the strategic stakeholders, the following categories are identified:



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POLICY MAKERS AND INTERNATIONAL ADVISORY BODIES: national and European policy workers, as well as international advisory platforms such as The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES)

For better designing policies or programmes at national, regional or European level, or contributing to international advisory platforms such as IPBES, **the Blueprint helps you identify the types of instruments needed to make taxonomy an operational part of biodiversity governance.**

Recipes 3 and 4, as well as **Recipes 7 to 10**, and **Recipes 12 and 13** provide this group with a set of ready-to-use tools that can be directly integrated into programme design, legislative work, funding schemes, and strategic planning. By applying the templates and examples provided—from commissioning reference collections to enabling digitisation, ensuring consistent species naming, supporting citizen-science initiatives, or convening Stakeholder Labs—stakeholders can quickly strengthen the taxonomic foundations of biodiversity governance.

NATURE PROTECTION DECISION MAKERS: the leadership of protected landscape areas and national parks, national nature conservation agencies, managers of large conservation projects, and regional nature conservation authorities.



For the staff responsible for managing protected areas, a member of a regional conservation authority, or part of a large conservation project, the **Blueprint acts as a menu of tested field-ready formats for mobilising taxonomic expertise and citizen participation** in your region. Some recipes show you not only what works but how to implement it efficiently, specifically **Recipes 9 to 14**, that provide practical, ready-to-use pathways to strengthen conservation outcomes, accelerate impact, deepen community engagement, and make smarter, data-informed decisions for nature protection.

FUNDERS AND INDUSTRY STAKEHOLDERS: public and private funding bodies, and companies in fields where taxonomy plays a role (for example ecosystem services, bioindication and natural products).



For the representatives of funding bodies or an industry stakeholder, relying on accurate biodiversity information, such as environmental consulting, agriculture, forestry, biotech, or infrastructure development, the **Blueprint helps you identify high-leverage investment opportunities that build durable taxonomic capacity and encourage innovation.** The Recipes below highlight formats that generate measurable returns, reduce operational uncertainty, and strengthen the evidence base for regulatory compliance, sustainability commitments, and R&D initiatives.

The **Recipes 3, 4, 9, 10 and 13** highlight the role of individual projects in generating wider impacts on biodiversity monitoring, decision-making and sustainable use of biological resources.

JOURNALISTS AND SCIENCE COMMUNICATORS, press officers, outreach and media professionals.



A journalist or science communicator can directly benefit from the **Blueprint that provides a rich collection of real-world stories that demonstrate why taxonomy matters today**, not as an academic discipline, but as a living engine behind conservation, policy, climate resilience, and community engagement. These Recipes offer compelling angles, human-centred narratives, and concrete examples that can help translate complex biodiversity work into stories that resonate with the public.

The **Recipes 2, 5 and 7,** as well as **Recipes 10 to 13** provide language standards, visuals, and concrete narratives to help frame taxonomy not only as a technical discipline, but as a key driver of biodiversity, human survival, ecosystem recovery and environmental policy.

3.3 User scenarios

A key role of the Blueprint is for it to function as a practical, transferable tool that enables diverse users to **learn from the successes, challenges and tested approaches** developed through the TETTRIs project. By translating project outcomes into clear pathways and actionable Recipes users can replicate similar **training, tools**, and innovations and/or leverage on those findings to develop more specificity-driven elements for biodiversity conservation. and thus support the sustainability of taxonomic skills and expertise in Europe.



FOR TAXONOMISTS AND RESEARCHERS, the Blueprint serves as a resource for strengthening scientific practice, enhancing methodological coherence, and fostering innovation across disciplines. It provides access to validated training modules, and interoperable tools that support both traditional and emerging taxonomic methods, from morphology-based identification to genomic, digital, and automated approaches.



For **EDUCATORS AND ACADEMIC INSTITUTIONS**, the Blueprint provides guidance on lifelong learning routes, skill-building opportunities, and competency frameworks that can help shape career development. It supports educators in identifying where and how they can create relevant experience, and in helping their students understand how their skills fit within a modern, interoperable taxonomic system.



For **POLICYMAKERS AND FUNDERS**, the Blueprint illustrates where targeted investments can have the greatest long-term impact. It highlights system-level gaps, strategic leverage points, and scalable models that can be incorporated into national and European biodiversity policies, infrastructure programs, and capacity-building strategies.



For **COLLECTIONS AND RESEARCH INFRASTRUCTURES**, it demonstrates how taxonomic expertise can support broader organisational missions. They can draw from the Blueprint to design sustainability plans, embed taxonomic functions within interdisciplinary teams, and align their work with FAIR, biodiversity data standards.



Finally, for **CROSS-SECTOR ACTORS SUCH AS CITIZEN SCIENTISTS, NGOs, AND ENVIRONMENTAL AGENCIES**, the Blueprint shows how taxonomic knowledge can be shared, transferred, and operationalised in community-driven or applied conservation initiatives. It points to ways that collaborative models from the TETTRIs Cookbook can be adapted to foster new partnerships and expand participation in taxonomic work and conservation.

> **Across all these use cases, the Blueprint supports the long-term sustainability of taxonomic skills** and expertise by offering adaptable, evidence-based guidance. It empowers users not only to replicate tested training and tools but also to refine and extend them, creating more context-specific, innovation-driven solutions for biodiversity conservation across Europe.

SECTION

2 The three strategic areas of taxonomy capacity building



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4. BUILDING TAXONOMIC CAPACITY THROUGH KNOWLEDGE CREATION

PATHWAY 1: KNOWLEDGE CREATION

BUILDING TAXONOMIC SKILLS AROUND NEW TOOLS, DATA AND METHODS

VISION FOR 2030

Taxonomic knowledge is a strategic resource for implementing the EU Biodiversity Strategy 2030.

Learning opportunities exist along Pathway 1 from initial interest to advanced expertise.

People in biodiversity hotspots are able to use taxonomic tools and apply data in their own context.

Institutions acknowledge taxonomy as a viable and attractive long-term career path for the next generation of scientists.

WHAT TETTRIs BUILT

Training pathways & workshop series that combine lectures, hands-on identification and data skills.

Field-based learning modules in biodiversity hotspots that link survey work with data standards and quality assurance.

Learning components around innovative tools & methods (e.g. imaging, molecular approaches, digital platforms) so that users can adopt them in practice.

Accessible learning materials & micro-learning resources that help non-specialists understand taxonomic concepts and workflows.

WHO IS INVOLVED

- **Students & early-career taxonomists**
- **Collections' staff and technicians**
- **Professionals in biodiversity hotspots**, such as conservation practitioners, protected-areas' staff and NGO experts
- **Citizen scientists and naturalists** whose observations and collections expand the evidence base of professionals.
- **Trainers and mentors** in museums, research institutes and universities who act as multipliers.

HOW LEARNING AND CAPACITY BUILDING HAPPENS

- **Training and workshop sessions** – expert-led, blended formats from introductory to advanced levels.
- **E-learning and digital resources** – modular online units, videos and micro-learning materials.
- **Mentorship and networking** – supervised research, peer groups and career-oriented mentoring.
- **Field and laboratory training** – surveys, specimen work and data workflows with clear standards.
- **Citizen-science engagement** – Bioblitzes, Taxonomy Recognition Day and community monitoring projects.

IMPACT: WHAT CHANGED BY 2026

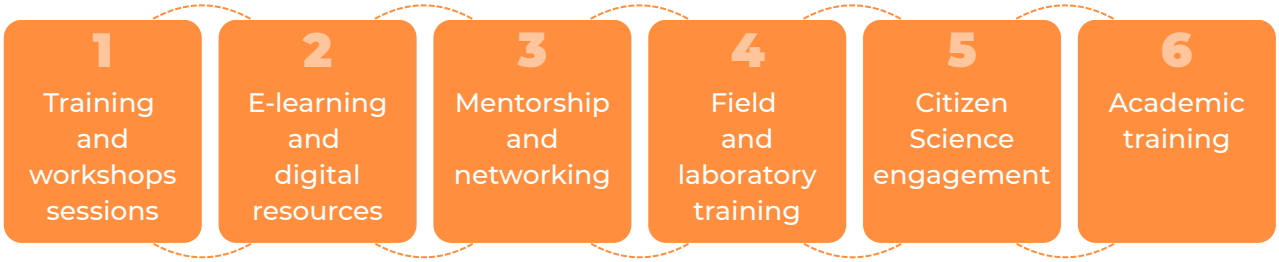
- **Piloted & refined training pathways** in biodiversity hotspots, with evidence of increased skills and confidence among participants.
- **Enabled uptake of new tools & methods** by learners and institutions beyond original project partners.
- **Created a visible network of trainers and mentors** connecting collections, universities and field-based organisations.
- **Increased visibility of taxonomic learning opportunities**, for potential students, amateurs and professionals
- **Provided recipes and materials** to replicate and adapt the training models and similar projects.

KEY RECIPES:

Recipe 1: How to organise an advanced blended course on Taxonomy,
Recipe 2: Sounds Right Nature-Music Excursions for Youth Engagement,
Recipe 3: How to build a reference collection, Recipe 4: How to collaborate to develop image recognition tools for collections.

Capacity building relies on programmes and initiatives that look to increase the competences of professionals and provide them with the skills needed to be operational, efficient and tool-up on the use of the technological advances in the field. The necessary creation of knowledge to articulate that capacity building goal for taxonomists identifies first who is the **targeted audience**, namely who should be involved in that capacity building process, to then present **concrete achievements from TETTRIs** and finally, propose a set of **recommendations** to continue and strengthen capacity building into the future.

During TETTRIs a variety of formulas and activities have been developed and put into practice for the training of taxonomists, targeting many user groups and **focusing on several biodiversity aspects**. Taxonomic capacity is built through focused training anchored on a combination of different learning formats, digital resources, mentoring relationships, field-based practice, citizen-science engagement and academic programmes:



For each of those outcomes, we acknowledge the **lessons learnt from TETTRIs** and provide the **Recipes and the inspirational Videos** that will facilitate, operate and efficiently use the results of TETTRIs by the different user groups. Practical and successful experiences through the **satellite projects** have helped to consolidate the courses, actions and initiatives undertaken in TETTRIs for developing well-grounded training and capacity building programmes.

WHO IS TARGETED

- **Students & early-career taxonomists**
- **Collections' staff and technicians**
- **Professionals in biodiversity hotspots**, such as conservation practitioners, protected areas' staff and NGO experts.
- **Citizen scientists and naturalists** whose observations and collections expand the evidence base of professionals
- **Trainers and mentors** in museums, research institutes and universities who act as multipliers

TETTRIs achievements in building taxonomic capacity

4.1 Training and workshops sessions

LESSONS LEARNED IN TETTRIS:

Expert-led courses and workshops on taxonomy and systematics **created a well sustained, robust and dynamic corpus of taxonomic resources** for training and capacity building. The training materials, documentation and methodological designs developed through TETTRIs offer tested formats and learning pathways that institutions across Europe can easily adopt and adapt to their own needs.

SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

These models offer hands-on and thematic guidance, tailored to different learner profiles and career stages. Satellite projects **L.U.C.E. and SoilMATS** have used such frameworks to design and validate courses for students and future local trainers in real contexts. Moreover, tailored and targeted workshops were part of all satellite projects, e.g., TEOSS.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 1: How to organise an advanced blended course on Taxonomy
Recipe 2: Sounds Right Nature-Music Excursions for Youth Engagement

Video 3: What is needed to educate the next generation of taxonomists?
Video 5: How can SoilMATS project help us teach taxonomy

4.2 E-learning and digital resources

LESSONS LEARNED IN TETTRIS:

Digital tools developed in TETTRIs demonstrate the viability of virtual taxonomic education. The project introduced a user-friendly **web-based platform facilitating integrative approach in species delimitation**, complete with video tutorials that guide learners through modern analytical methods. It also created digital access pathways to **reference collections**, enabling trainees to explore species-level data remotely and build identification skills without needing to visit physical institutions. In addition, TETTRIS established a Europe-wide **digital training knowledge** base and a network of skilled trainers, forming the backbone of a long-term, distributed learning infrastructure for taxonomy. Together with the TETTRIS e-learning platform and virtual collections, these tools illustrate how learners can access datasets, workflows, and curated training materials from anywhere, expanding the reach and sustainability of taxonomic capacity building across Europe.

SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

Satellite projects not only validated the use of many of the digital resources but also extended the taxonomic digital learning space. **INC-STEP**, **ARCADE** and **Balkan PolliS** developed digital indexes, virtual collections and online mapping tools for pollinators, which can be used as remote training resources and case studies for students and trainees. SoilMATs and **L.U.C.E**. design blended learning programmes that combine online materials with field and laboratory components, feeding tested course structures and content into the TETTRIs e-learning infrastructure. **FOOTPRINTS-CITSCI** adds a citizen-science data collection platform and AI-supported feedback, creating live datasets and visualisations that can be reused as learning dashboards in online modules. **TEOSS** extended this digital learning space by combining an AI-based sound recognition model for European grasshoppers with workshops and online training materials, enabling both professionals and naturalists to learn sound-based identification and contribute recordings to open repositories.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 1: How to organize an advanced blended course on Taxonomy

Recipe 4: How to collaborate to develop image recognition tools for collections

Recipe 6: SpartExplorer – Explore species partitioning on a single-locus dataset in just a few click

Recipe 7: CheckMyName - find the right online matching tool for checking the scientific names of organisms

Recipe 8: How to use a Taxonomic Resolution Engine Wikibase,

Video 6: How can the INC-STEP satellite project help us study pollinators?

Video 7: How can citizen scientists help us gather taxonomic data?



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4.3 Mentorship and networking

LESSONS LEARNED IN TETTRIS:

Experience from TETTRIs shows that mentoring and networking are powerful forms of capacity building. Throughout the project, partners worked together in **cross-work package workshops**, joint training events and shared development of tools and collections.

Early-career taxonomists, trainers and collection staff built new professional relationships, learnt from colleagues in other countries and **discovered complementary expertise** they had not anticipated at the start of the project. This has led to a growing community of trust that now provides a basis for future joint projects and shared supervision of students and early-career researchers.

TETTRIs put in place several foundational structures to support early-career researchers and thus strengthen long-term capacity in taxonomy. The project created a Europe-wide digital training knowledge base together with a coordinated network of skilled trainers, ensuring that learners could access guidance, expertise, and high-quality learning materials throughout their career journey. It also established clearer **career pathways and new professional opportunities**, helping emerging taxonomists navigate entry points into the field and connect with institutions across the continent. In parallel, TETTRIs developed **comprehensive ethics guidelines** and engaged an external ethics advisor to review practices and support ongoing reflection. These ethics and gender-mainstreaming discussions were embedded into knowledge-sharing activities across the project, **serving as a model for responsible professional development and mentoring within the taxonomic community.**

SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

Mentoring was also built into the design of the satellite projects. Every satellite project had to be linked to at least one task in the core TETTRIs project and was assigned a scientific contact person - consultant from within the consortium. This ensured **regular consultation on methods, standards, tools and outputs,** and created structured mentoring relationships between core partners and external teams. As a result, satellite projects not only implemented their own activities, but also learnt how to align their **work with European infrastructures, quality requirements** and collaborative practices. The satellite scheme thus functioned as a mentoring mechanism by design, not as an add-on.

Twelve satellite projects further extended the network beyond the core TETTRIs consortium by connecting local trainers, citizen-science leaders and tool developers in different countries. Together, these activities demonstrate that **investing in shared spaces, time and formats** for networking is essential for developing and retaining taxonomic capacity in Europe. Each satellite project acted as a 'networking laboratory', demonstrating how multi-partner collaboration naturally fosters mentoring, knowledge exchange and the formation of new professional relationships.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 1: How to organise an advanced blended course on Taxonomy

Recipe 2: Sounds Right Nature-Music Excursions for Youth Engagement

Recipe 10: Citizen Science initiative for biodiversity monitoring, based on the Footprints project,

Recipe 11: How to organise a Bioblitz

Recipe 12: How to organise a Stakeholder Lab

Recipe 13: How to Produce and Amplify Taxonomy Recognition Day

Video 8: How can taxonomy and industry benefit each other? (Part 1)

Video 9: How can taxonomy and industry benefit each other? (Part 2)

4.4 Field and laboratory training

LESSONS LEARNED IN TETTRIS:

Satellite projects demonstrated that **well-curated, digitised, and accessible reference collections** are central to biodiversity conservation and monitoring. Success depends on **sustained expert involvement, strong collaboration, capacity building, and innovative use of digital tools.**

INC-STEP and ARCADE both highlighted that building and improving biological reference collections is foundational for species identification, monitoring, and conservation. It was found that many specimens lacked accurate or up-to-date identifications, requiring extensive expert effort to curate and verify records. In addition, reference collections needed not just digitisation but **standardisation and gap analysis** to be genuinely useful across research and conservation, stressing the importance of planning for resources and workflow design early. **ARCADE** found uneven representation of sexes in collections and missing species, signaling areas for future sampling work. Whilst **INC-STEP's species list** updates highlighted how taxonomic revisions and changing scientific names affect even well-studied groups. Gap analysis is itself a source of strategic knowledge that helps focus limited resources where they are most needed.

Both INC-STEP and ARCADE experiences underscore that digitising specimens and creating accessible databases with **online keys expands usability** beyond traditional museum walls, enabling easier access for researchers, other institutions and citizen scientists.

Satellite projects repeatedly note a shortage of experts and the need to diversify training. **SoilMATs**, focused explicitly on training new taxonomists for soil biodiversity, has shown the value of structured training (blending online and hands-on work) in producing emerging experts. Strengthening taxonomy capacity through **targeted training programmes** is essential to sustain biodiversity research and make reference collections fully operational, usable and accessible.

Regional diversity in expertise, collection holdings, and institutional strengths meant that collaboration was "non-negotiable." Projects like **Balkan PolliS** illustrated this well with their success dependent on coordinating between **nine collections across countries and aligning digitisation efforts** to international standards. Working across national and institutional boundaries is critical to tackling biodiversity challenges that don't respect borders.

Projects experimented with smart work practices to ease expert shortages and logistical barriers: **INC-STEP's** use of high-resolution photography to pre-screen specimens before experts performed on-site identifications, **reduced the experts time to validate** and/or their travel burden, significantly improving productivity and stretching limited expert resources.

Finally, several projects, including INC-STEP and Balkan PolliS highlighted the importance of outreach tools, such as **downloadable ID guides, searchable species maps, and online databases** for empowering non-specialists to catalyse broader conservation impact.



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SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

Practical, place-based field and laboratory training was launched through several pilot actions. A shared roadmap for strengthening and defining reference collections was shaped and tested through satellite projects such as **INC-STEP, ARCADE, and Balkan PolliS**. The first designs for pilot training programmes were refined through hands-on validation in the **L.U.C.E. and SoilMATES** satellite projects. Strategies and workflows for connecting local taxonomies with wider European frameworks were developed and tested in the **TLNS project**. Approaches for integrative species delimitation were further refined through practical application in the **CRYPTERS project**.

Together, these field- and lab-based methods allowed students and early-career professionals to **work directly with biodiversity data and real specimens**. Participants learned how sampling, identification, and curation procedures connect to broader standards and infrastructures, supported throughout by collaboration with natural history institutions participating in TETTRIs.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 1: How to organise an advanced blended course on Taxonomy

Recipe 12: How to organise a Stakeholder Lab

Video 5: How can SoilMATS project help us teach taxonomy

Video 6: How can the INC-STEP satellite project help us study pollinators?

Video 8: How can taxonomy and industry benefit each other? (Part 1)

Video 9: How can taxonomy and industry benefit each other? (Part 2)



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4.5 Citizen science engagement

LESSONS LEARNED IN TETTRIS:

Citizen science engagement has proven to be a strategic way to expand both the reach and impact of TETTRIs, not only by generating additional data but by c**reating spaces for lifelong learning** and mutual learning between professional taxonomists, citizen scientists, students and other stakeholders.

An engaging project website, social media outreach, and the dissemination of accessible educational content (webinars, explainer videos, and training materials), together with platforms such as **EU-Citizen.Science**, were identified as essential for fostering two-way engagement and empowering a diverse and distributed **community of volunteer naturalists**. These tools supported non-professional contributors in gradually building their understanding of biodiversity, taxonomy and data quality.

The annual **Taxonomy Recognition Day** (TRD, 23rd of May), introduced within, and designed to continue beyond, the project, **engages the general public, students, media and policymakers**, across multiple European locations. This event demonstrates that a well-branded (**#NameItToSaveIt**) coordinated campaign combined with locally hosted activities, can significantly raise awareness of taxonomy's role in biodiversity preservation and stimulate community interest in contributing to taxonomic research. Locally hosted **activities, interactive sessions, and public tours of collection**s and/or institutions help demystify scientific processes and strengthen the bridge between professional taxonomists and citizen contributors. When combined with continuous digital communication, **TRD** builds long-term citizen participation and enhances the visibility of taxonomy as a science essential to biodiversity conservation.

The inclusion of hands-on activities in events (e.g., specimen viewing under microscopes, practical demonstrations) and collaborative sessions **foster deeper engagement**. These elements help demystify taxonomy, making abstract scientific work more accessible and relatable to attendees from non-scientific backgrounds, and can spark further interest in participation or support for biodiversity initiatives.

Bioblitz-style activities likewise proved to be effective entry points into sustained citizen participation: they generate high volumes of usable data when **linked to digital infrastructures**, while simultaneously building practical skills in species observation and identification and strengthening collaboration between professional taxonomists, citizen scientists and local stakeholders. Beyond data collection, **Bioblitzes** deliver measurable educational and capacity-building outcomes. Participants gain practical skills in species observation and identification, increasing understanding of the importance of taxonomic expertise and reference collections. The events also **foster collaboration between professional taxonomists, citizen scientists, and local stakeholders**, reinforcing trust and long-term engagement.

Technology-enabled citizen science showed that well-structured programmes can work even under challenging conditions and that digital tools can strengthen both data quality and learning. **Combining guided field activities with modern data infrastructures** delivered robust biodiversity observations and gave participants meaningful experience with species recording and interpretation.

The **Stakeholder Labs** added a complementary dimension by bringing together participants from science, industry, policy, education, culture and civil society to discuss taxonomy's broader relevance. They showed that co-creative spaces help translate scientific concepts into contexts relevant to diverse stakeholders.

The Stakeholder Lab TETTRIs co-hosted with pan-European **competence network Skills4EOSC**, illustrated how collaboration with other **EU projects** can create synergies around topics such as open science skills for biodiversity and support capacity building and cross-sector learning.

Lessons learnt emphasise that language and framing are crucial – for example, some industrial stakeholders first associated "taxonomy" with the "EU Taxonomy for sustainable finance" rather than biological classification. **Clear, context-sensitive communication** is essential is citizen engagement in science participation.

It was also important that all these activities were co-ordinated and gathered in a **comprehensive plan** for communication, dissemination, and exploitation of results, which included approaches for mobilising public involvement in taxonomic data gathering and fostering long-term engagement with biodiversity monitoring.

SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

TETTRIs integrated citizen-science engagement as a core part of its dissemination and public-facing strategy, ensuring that non-experts could meaningfully contribute to **biodiversity knowledge** while learning taxonomic skills. The project demonstrated how external partners, such as local organisations, research groups, and community networks, can, and should, play an **active role in community-based taxonomy** by participating in pilot training activities and co-developing field-based learning experiences. Several satellite projects offered strong examples of good practice, showing how collaborations between professionals and citizen scientists can expand data collection, strengthen local taxonomic capacity, and increase public awareness of biodiversity.

Satellite projects such as **L.U.C.E. and FOOTPRINTS-CITSCI** demonstrated how collaborations between professionals and citizen scientists can expand data collection, strengthen local capacity and increase public awareness. FOOTPRINTS-CITSCI, in particular, combined winter field activities with volunteer **photo submissions and machine learning** to generate high-quality records of mammal presence while at the same time building participants' understanding of ecological processes and digital tools.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 2: Sounds Right Nature-Music Excursions for Youth Engagement
Recipe 10: Citizen Science initiative for biodiversity monitoring: based on the Footprints project
Recipe 11: How to organise a BioBlitz
Recipe 12: How to organise a Stakeholder Lab
Recipe 13: How to Produce and Amplify Taxonomy Recognition Day
Recipe 14: Ethics matter – From the field to collection

Video 7: How can citizen scientists help us gather taxonomic data?
Video 10: What is Taxonomy Recognition Day
Video 11: Taxonomy Recognition Day

4.6 Academic training

LESSONS LEARNED IN TETTRIS:

TETTRIs made important contributions to aligning academic training with real-world taxonomic needs by identifying gaps in existing university curricula and highlighting where educational programmes must evolve to meet current and future demands. The project developed a strong foundation for **future modular academic content**, supporting the creation of flexible learning pathways that can be adapted across institutions. It also initiated the design of a structured graduate-level training programme to **strengthen Europe's pipeline of taxonomic expertise**. As part of its recommendations, TETTRIs encourages universities to integrate modules that are compatible with the European Credit Transfer and Accumulation System (ECTS) and to formally recognise informal and non-formal learning, ensuring that field experience, citizen-science participation, and professional upskilling can be acknowledged within academic frameworks.



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SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

Amongst the satellite projects, **SoilMATS**, stands out as a strong example of how targeted collaboration can significantly advance taxonomic capacity. The project delivered **high-level training at university and early-career researcher levels**, engaging 3rd- and 4th-year bachelor students, graduates, Master's students, PhD candidates, and postdocs (up to five years after PhD). More importantly, SoilMATS created a cohesive learning environment where participants gained **hands-on experience** in soil biodiversity assessment, specimen processing, and taxonomic identification using both classical and modern techniques. This multi-layered training approach strengthened the pipeline of future experts by exposing learners at different stages of their careers to the same high-quality resources, real research data, and expert mentoring.

The satellite project also strengthened connections between universities and research infrastructures demonstrating how satellite projects can act as **incubators for long-term collaboration**. Participants reported increased confidence in taxonomic methods, improved technical skills, and new professional relationships that continued beyond the project.

By combining advanced academic training, field-relevant skills, and community-building, SoilMATS exemplifies how **satellite projects** can deliver tangible, sustainable contributions to Europe's taxonomic workforce.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 1: How to organise an advanced blended course on Taxonomy

Video 5: How can SoilMATS project help us teach taxonomy

5. SUPPORTING TAXONOMIC CAPACITY BUILDING THROUGH SYSTEMS DEVELOPMENT

PATHWAY 2: SYSTEMS DEVELOPMENT

BUILDING INTEROPERABLE ONLINE PLATFORMS FOR LEARNING, REFERENCE AND COLLABORATION

VISION FOR 2030

Collections and platforms are shared learning environments where new tools, methods and standards are continuously tested and adopted.

Taxonomic expertise is visible and reachable through dynamic matchmaking and networking tools.

Data flows seamlessly across local and national infrastructures and into international aggregators.

Procedures and governance ensure that systems remain reliable, open and fit for learning.

WHAT TETTRIs BUILT

Established the basis for a dynamic taxonomic marketplace for taxonomic expertise and services.

Developed a cross-cutting knowledge platform that links taxonomic resources.

A virtual reference collection for target pollinators was established, demonstrating the capacity of digital research infrastructures to support both research and training.

Built upon and feeding into partner research learning infrastructure CETAF- DEST

WHO IS INVOLVED

- **Collection managers and curators.**
- **IT developers and research. infrastructure staff** who design and maintain platforms and services.
- **Taxonomists and data stewards** who define standards, vocabularies and workflows.
- **Researchers and conservation practitioners** who rely on integrated systems for decision-making.
- **Partner networks and infrastructures** that host or connect taxonomic expertise.

HOW LEARNING AND CAPACITY BUILDING HAPPENS

- **Reference backbone for integrative taxonomy:** virtual and reference collections and TRE
- **Integrative taxonomy workflows and AI tools**
- **Taxonomic expertise and services exchange.**

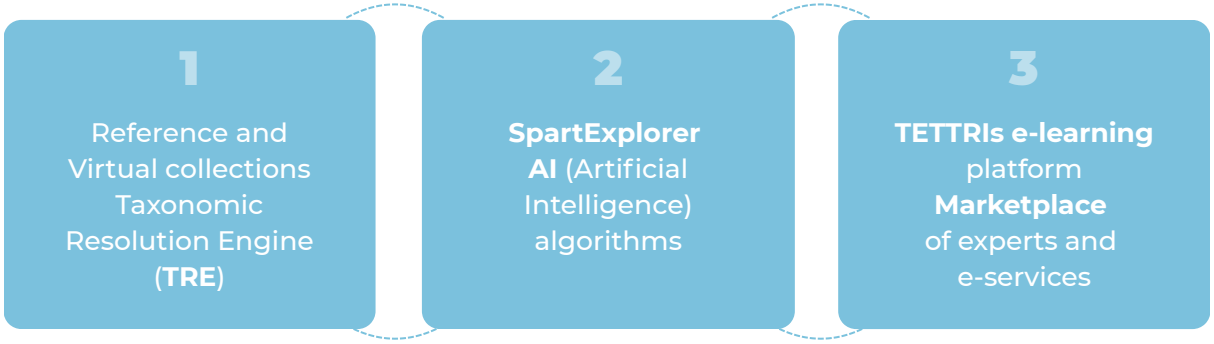
IMPACT: WHAT CHANGED BY 2026

- **Operational taxonomic marketplace and knowledge platform** in active use by multiple users.
- **Enhanced digital access to reference collections,** including demonstrator virtual collections that support both research and training.
- **Shared procedures and harmonised data standards** adopted by several partners.
- **Closer alignment between TETTRIs tools and major biodiversity infrastructures,** ensuring that project outputs live on beyond the project lifetime.
- **Pilot examples of institutions** using these systems as learning environments, where staff, students and external partners learn.

KEY RECIPES:

Recipe 5: How to Use the Taxonomic Expertise and Services Marketplace;
Recipe 6: SpartExplorer – Explore species partitioning on a single-locus dataset in just a few click;
Recipe 8: How to use a Taxonomic Resolution Engine Wikibase;
Recipe 7: CheckMyName - find the right online matching tool for checking the scientific names of organisms. Related recipes:
Recipe 3: How to build a reference collection

In TETTRIs, systems were not limited to individual structures, but were conceived as a tiered taxonomy system built in layers. At the foundation layer of the system are **specimens, data** and taxonomic accuracy in virtual and reference collections, connected through a **shared backbone**. On top of this backbone, there is the layer of **analytical and species-delimitation workflows**, allowing users to delimit species, interpret patterns and generate and share new knowledge. The third layer consists of **taxonomic expertise and services exchange tools**, providing entry points for learners, projects and institutions to use and further develop the systems.



Capacity in taxonomy is strengthened not only by the technical infrastructure itself, but also in the way users are onboarded, work hands-on in these systems, solve problems together and share standards and workflows across institutions. **Curated support resources** help new users navigate Marketplace portals and collection services, while practical configuration and contribution – uploading data, registering services and **annotating specimens** – fosters experiential learning. Technical workshops bring developers, curators and users together to solve integration problems, and shared documentation plus standard operating procedures act as living learning materials that enable peer-to-peer knowledge exchange. **Communities of practice** around platforms and infrastructures allow peers to share tips, templates and solutions, and **cross-institutional** pilots demonstrate how systems can be adapted and reused in different contexts.

WHO IS TARGETED

- **Collection managers and curators**
- **IT developers and research infrastructure staff** who design and maintain platforms and services
- **Taxonomists and data stewards** who define standards, vocabularies and workflows
- **Researchers and conservation practitioners** who rely on strategic systems for decision-making
- **Partner networks and infrastructures** that host or connect taxonomic expertise

TETTRIs achievements in building taxonomic capacity

5.1 Reference backbone facilitating integrative taxonomy

LESSONS LEARNED IN TETTRIS:

Work on virtual and reference collections, together with the **Taxonomic Resolution Engine** (TRE), showed that turning distributed specimens into a usable taxonomic backbone requires much more than digitisation.

Reference collections need shared standards, central indexing and **harmonised data structures** so that users can navigate seamlessly across institutions. Experience from satellite projects such as Balkan PolliS, **ARCADE** and **INC-STEP** highlighted the importance of:

- Standardised imaging **protocols** for producing consistent, research-grade specimen images;
- Clear rules for **quality control**, updates, backups and link management; and
- Regular training **tailored to different competency levels**, attracting new learners and ensuring that volunteers contribute reliable data.

Developing virtual collections showed that making distributed digital assets usable requires strong interoperability, central indexing, and harmonised data structures so users can navigate seamlessly across institutions. Experience from the **Balkan PolliS project** highlighted that standardising imaging protocols is crucial for producing consistent, high-quality **specimen images that support reliable comparison**, analysis, and long-term preservation. While intuitive, user-friendly interfaces greatly improve public access and engagement. Both **Balkan PolliS** and **ARCADE** demonstrated that regular training—tailored to different competency levels—plays a vital role in **attracting new learners to taxonomy,** and that workshops and hands-on activities significantly enhance volunteer contributions and foster local expertise networks. Additionally, maintaining clear rules for quality control, updates, backups, and link management ensures smoother workflows and prevents technical and organisational issues over time. Together, these insights emphasise that successful virtual collections rely as much on **community capacity building** and good governance as on technical infrastructure.



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TRE, built on a Wikibase instance (a private or public structured database that uses the same technology of **Wikidata**, allowing organisations, research groups, or projects to store, manage, link and query complex information in a flexible, machine-readable way), adds a linked-data layer that connects taxonomic names with type specimens and other **key concepts across datasets**. Its development revealed challenges around identifier stability, data openness and provenance, underlining the need for close collaboration between data scientists and taxonomic experts.

Together, **virtual collections and TRE** demonstrate that successful reference infrastructures depend as much on community capacity and governance as on technical design, and that a shared backbone is essential for monitoring schemes, red lists and long-term conservation planning.

SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

The TETTRIs satellite projects have made significant contributions to the creation, enrichment, and **modernisation of virtual specimen collections,** demonstrating how distributed infrastructures can function cohesively when built on shared standards, central indexing, and interoperable data structures. By integrating digital assets from multiple institutions, these initiatives have shown that virtual collections can **provide seamless access to otherwise fragmented biodiversity information**. Projects such as Balkan PolliS have exemplified this approach through the standardisation of imaging protocols, producing consistent, high-quality specimen images that support accurate comparison, analysis, and long-term preservation. Their **user-friendly interfaces** further enhance accessibility, enabling researchers, students, and the public to explore species-level information with ease. At the same time, clear rules for data quality, versioning, backups, and link management have ensured that these virtual collections remain **stable, reliable, and sustainable** over time, an essential foundation for any distributed digital ecosystem.



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The satellite projects also demonstrated the critical role of community engagement and capacity building in sustaining virtual collections. **ARCADE's** training programmes attracted new learners to taxonomy by offering courses tailored to diverse skill levels, while **Balkan PolliS** strengthened local expertise through workshops and hands-on activities that boosted volunteer involvement and ensured data quality. Meanwhile, **INC-STEP's** National Pollinator Reference Collection in Spain curated and verified tens of thousands of threatened pollinator specimens, producing a meticulously validated digital resource to support monitoring and conservation. Complementing this, the **iSedge initiative** launched the **Global Cyperaceae Database**—an online platform consolidating taxonomic names, geographic information, and morphological data for sedge species. Together, these efforts highlight the success of the TETTRIs satellite projects in expanding digital biodiversity infrastructures, enriching virtual specimen collections, and building the **human networks** necessary to maintain them into the future.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 3: How to build a reference collection

Recipe 4: How to collaborate to develop image recognition tools for collections

Recipe 8: How to use a Taxonomic Resolution Engine Wikibase

Recipe 10: Citizen Science initiative for biodiversity monitoring: based on the Footprints project

Video 6: How can the INC-STEP satellite project help us study pollinators?

Video 13: What's in a name? The case for biological nomenclature

Video 14: How can digital infrastructure help taxonomy?

- **INC-STEP – National Pollinator Reference Collection (Spain)** curated, verified and validated tens of thousands of threatened pollinator specimens, producing a national reference collection with reliable identifications, references and digitised information to support monitoring, conservation and broader public access.

- **Balkan PolliS – Pollinators of the Balkan Peninsula** established digital species-level indexes and imaging frameworks for hoverflies and bees across several Balkan countries, improving taxonomic coverage and future biodiversity monitoring capacity.

- **ARCADE** modernised and enriched collection holdings and combined this with training programmes tailored to different skill levels, attracting new learners to taxonomy and building local expertise networks.

- **iSedge – Sedges Digital Platform** launched a *Global Cyperaceae Database* that consolidates taxonomic names, geographic and morphological data for sedge species into an accessible, dynamic digital platform for researchers and conservationists worldwide.

These initiatives illustrate how virtual and reference collections, when built on shared standards and **connected through a backbone such as TRE**, can expand access to biodiversity information and provide a solid foundation for evidence-based conservation.

5.2 Species delimitation workflows and AI tools supporting integrative taxonomy

LESSONS LEARNED IN TETTRIS:

SpartExplorer

The TETTRIs project has provided valuable insights into the development of user-friendly, platforms for species delimitation and the sharing of taxonomic expertise. The SpartExplorer web platform demonstrates that usability is a critical factor for adoption, particularly for researchers and taxonomists without extensive programming experience. By offering **step-by-step guidance, interactive visualisations**, and multi-method workflows, the platform allows users to explore complex species delimitation analyses more effectively. Integrating multiple analytical methods and visualisation tools not only improves interpretability but also supports transparent and holistic decision-making. Moreover, planning for **future scalability**, such as expanding methodological support and linking to external data sources, is essential for long-term platform relevance. Providing comprehensive documentation and video tutorials further ensures that the platform is accessible and learnable, highlighting the importance of **supporting users** alongside delivering technical functionality.

SpartExplorer and the **AI-related satellite projects** showed how digital tools can lower entry barriers to complex analyses while at the same time building new skills and practices needed for integrative taxonomy.

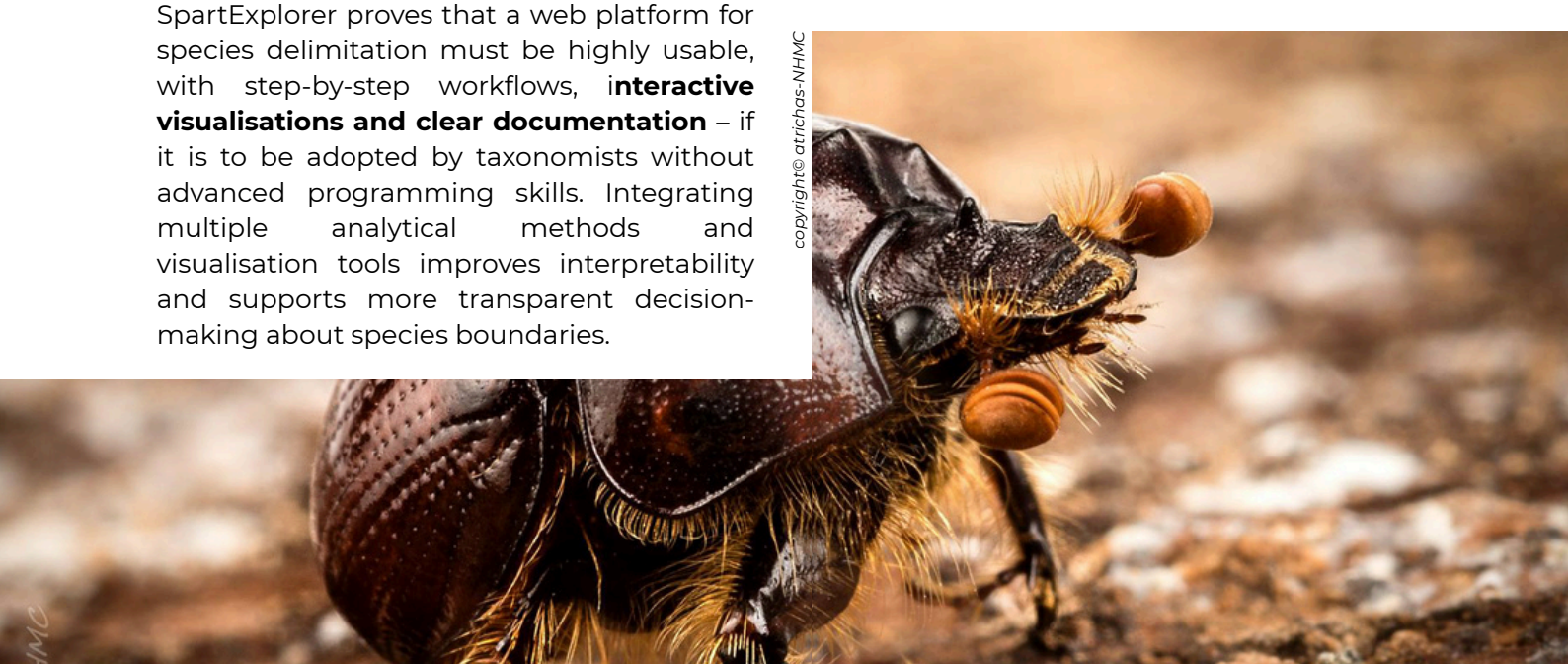
SpartExplorer proves that a web platform for species delimitation must be highly usable, with step-by-step workflows, i**nteractive visualisations and clear documentation** – if it is to be adopted by taxonomists without advanced programming skills. Integrating multiple analytical methods and visualisation tools improves interpretability and supports more transparent decision-making about species boundaries.

AI algorithms

TETTRIs advanced the use of artificial intelligence in taxonomy by supporting automated i**dentification, annotation, and data enrichment**, accelerating research workflows while demonstrating how AI can be responsibly applied in taxonomic practice. Supported **collaborative**, reproducible taxonomic research by providing virtual environments where data, tools, and workflows can be combined, shared, and executed without local technical barriers.

Satellite projects such as **TEOSS, TrAILSID, NEXTRAD and FOOTPRINTS-CITSCI** extended this principle to AI-assisted identification and monitoring. They combined training in data collection (e.g. acoustic recordings, high-quality images, footprints in snow) with the development and evaluation of **machine-learning models**, so that participants contributed both to datasets and to algorithm improvement. These efforts showed that AI in taxonomy works best as a co-created workflow, where experts, students and citizens understand how tools behave, how to check outputs and how to curate data.

Taken together, these tools formed a practical layer built on top of the reference backbone already described: they c**onnect specimens, sequences and observations to decisions** about species delimitation, monitoring and conservation.


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SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS

Several Satellite Projects intensively worked during TETTRIs to validate and test, workflows and protocols to improve species delimitation, but equally to inform and train AI algorithms that could improve the speed and accuracy of the taxonomic work.

The Satellite Project titled **TEOSS – European Orthoptera Sound System-** organised workshops to record and aggregate Orthoptera sound recordings, creating a meta-database of insect acoustic data and laying the foundations for AI-assisted species recognition through sound, while training participants in bioacoustics collection and analysis.

On its hand, the project **L.U.C.E. – Fireflies of Europe-** mentored early-career researchers to fill taxonomic knowledge gaps on fireflies, combining specimen digitisation with integrative data (morphological, molecular, geographic) to revise species boundaries and improve global information access.

Important mention deserves the Satellite Project **TrAILSID – AI for Land Snail Identification-** that developed machine-learning models to accurately identify European land snail species from photographs, dramatically speeding up identification and lowering expertise barriers, while training users in practical AI workflows. It compiled and used high-quality images to train AI, while training users in practical AI workflows.

The Satellite Project **NEXTRAD** advanced taxonomic work on Lotus species (Leguminosae) in the Macaronesian region by combining DNA data, morphology and habitat information, alongside graduate training, to enhance knowledge and data coverage for the group and to help scientists to better understand and thus project plant diversity.

Finally, **FOOTPRINTS-CITSCI** engaged citizens in collecting winter biodiversity data by documenting animal footprints in snow, combining guided field activities with AI-driven species identification and spatial modelling. This not only generated valuable distribution data for elusive wildlife but also strengthened ecological literacy and co-creation. It included bespoke training and created a tool to support future biodiversity monitoring and research.



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TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 4: How to collaborate to develop image recognition tools for collections

Recipe 6: SpartExplorer – Explore species partitioning on a single-locus dataset in just a few clicks

Recipe 10: Citizen Science initiative for biodiversity monitoring: based on the Footprints project

Video 7: How can citizen scientists help us gather taxonomic data?

Video 15: How can AI help taxonomy?

5.3 TETTRIs e-learning platform

LESSONS LEARNED IN TETTRIS:

The TETTRIs e-learning platform in a **Learning Management System** (LMS), which enabled coordinated access to taxonomic services and infrastructures by providing a shared digital environment where on-line aspects of TETTRIs courses were hosted, including the courses by satellite projects. TETTRIs LMS has been a valuable platform for the project to learn from and contribute towards. Its integration in the CETAF-DEST infrastructure after the end of the project will leverage **existing, well-embedded networks** for long-term sustainability beyond the project's lifetime.

Through its inter-connected set of digital resources and infrastructures, TETTRIs has delivered concrete advances in how taxonomic knowledge is discovered, accessed, connected, and reused across Europe. Specifically, the learning material created by TETTRIs partners for the courses "Soil fauna", "Freshwater fauna" and "Pollinators" has been uploaded on the **TETTRIs E-learning platform** to facilitate their implementation and evaluation by the satellite projects SoilMATs and L.U.C.E. The two satellites enriched this learning material on the platform, which was used for the implementation of the online part of their courses.

All this online knowledge will be openly accessed, through self-enrollment in the relevant courses, after the end of the project, **encouraging trainees to develop new expertise** and pursue long-lasting professional careers in taxonomy. This initiative will elevate the field of taxonomy, making it widely recognized also among citizen scientists, governmental bodies, researchers, educators, and the broader scientific community as a fundamental science for understanding, managing, and improving biodiversity preservation.

SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

Two of the satellite projects utilized TETTRIs e-learning platform for their online training. **SoilMATs** successfully delivered high-level training in soil biodiversity with a focus on Nematoda, Tardigrada, and Rotifera. It combined ~60 hours of online theory on TETTRIs e-learning platform with 120 hours of face-to-face workshops across **Czechia, Germany, and Italy**, enabling broad, Europe-wide skill building. The project addressed significant expertise gaps, especially in **hydrophilic meiofauna**, groups often neglected due to a shortage of specialist taxonomists, thus directly expanding taxonomic capacity. A key component of the training program was that it used a "train the trainers" approach and thus ensuring that skills remained in local institutions and knowledge would continue to spread.

L.U.C.E. 's online course provided **basic knowledge on pollinators** and modern systematics knowledge, ecological background, and insights into global fireflies' diversity, thus ensuring participants had baseline knowledge critical to the face-face field component of the course. This was another project that addressed taxonomic knowledge gaps, focused on rare and **cryptic species**.

Both projects connected trainees, trainers, and institutions across Europe, leveraging the already established TETTRIs e-learning platform and contributing to **filling knowledge gaps** and building capacity in taxonomy.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 1: How to organise an advanced blended course on Taxonomy
Recipe 11: How to organise a Bioblitz

5.4 TETTRIs Marketplace

LESSONS LEARNED IN TETTRIS:

The TETTRIs Marketplace addresses the challenge of fragmentation in taxonomic services by centralising access to expertise, datasets, and analytical tools. It is likely that technical infrastructure alone is sufficient to make this successful; **sustained community engagement**, content curation, and governance mechanisms are going to prove crucial to maintain relevance and usability over time.

Prioritising user-centric design and clear documentation should enhance accessibility and adoption. Clear, accessible documentation on how to use Marketplace will lower barriers to entry and encourage broader adoption across the biodiversity research community.

The development and piloting of the **Taxonomic Expertise and Services Marketplace** demonstrated that discoverability of expertise depends strongly on structured, standardised metadata. Using controlled vocabularies and harmonised fields to describe taxonomic scope, methods, geographic coverage, and service types proved essential for enabling **meaningful search**, filtering, and comparison across profiles and e-services. Without such structure, expertise remains difficult to locate and reuse beyond personal or institutional networks.

TETTRIs also showed that it is critical for the Marketplace to link directly to original e-service webpages and documentation, rather than duplicating content. By acting as an index and discovery layer that points users to authoritative sources, the Marketplace reduces maintenance burden for service providers, avoids inconsistencies, and ensures that the most **up-to-date information** is always available at the source. To further increase trust and reliability, TETTRIs demonstrated the importance of **establishing clear quality-check criteria** for e-services, enabling platform administrators to periodically verify that listed services are operational, up to date, and actively maintained, while responsibility for content and functionality remains with the service providers.

Strong attention to data management and protection was necessary, with regards to: transparent consent mechanisms, clear statements on data ownership, **General Data Protection Regulation** (GDPR) compliant handling of personal information, and well-documented data flows are all necessary to support responsible operation of the platform and to build confidence among contributors and users.

Another key lesson was that the effectiveness of the Marketplace relies on the willingness and responsiveness of experts and service providers. The platform only becomes valuable when profiles and services are sufficiently detailed, kept **up to date**, and **actively maintained** by their owners. Sparse or outdated entries significantly reduce usefulness, and appeal, for users seeking expertise. Consequently, the Marketplace can only fulfil its role if it is well populated and actively curated by the community.

Experience from TETTRIs further highlighted that adoption cannot be instantaneous and requires a stepwise approach. A phased marketing and engagement strategy is essential, beginning with TETTRIs partners to test workflows and resolve early issues, expanding to the **CETAF community** to build critical mass, and only then opening more broadly to external users and providers. This gradual roll-out allows technical and organisational **"teething problems"** to be addressed while ensuring that, by the time wider **audiences engage**, the Marketplace already contains a sufficiently rich and representative body of expertise to be genuinely useful for seekers.



SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

The Marketplace was not officially associated with any satellite projects. Partners of those projects, in which they have developed digital services, have been encouraged to add them to the **e-Services** part of the Marketplace.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 5: How to Use the Taxonomic Expertise and Services Marketplace

Video 8: How can taxonomy and industry benefit each other? (Part 1)

Video 9: How can taxonomy and industry benefit each other? (Part 2)

Video 16: How do we find taxonomic experts?



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6. FOSTERING TAXONOMIC CAPACITY BUILDING THROUGH SUSTAINABLE IMPACT

PATHWAY 3: SUSTAINABLE IMPACT

EMBEDDING TAXONOMY IN SOCIETY, EDUCATION AND LONG-TERM PROFESSIONAL PATHWAYS

VISION FOR 2030

- Citizen scientists participate confidently and critically in taxonomic projects.
- Taxonomy features in school and university curricula, and lifelong learning.
- Institutions offer clear roles and progression routes for people with taxonomic skills.
- Society recognises and celebrates taxonomic contributions to biodiversity and ecosystem management.

WHAT TETTRIs BUILT

- **Citizen science programmes** which support co-creation of taxonomic data and knowledge.
- **Recognition and celebration mechanisms,** such as Taxonomy Recognition Day, including activities that bring taxonomy into schools, communities and policy fora.
- **Targeted communication and social media** that tell compelling taxonomic stories and share project outputs in accessible ways.
- **Career-development analyses to understand better how to** make taxonomic roles visible and attractive, embedding taxonomy in multi-stakeholder ecosystems.
- **Collaborations with educational institutions and professional bodies** to integrate taxonomy.

WHO IS INVOLVED

- **Citizen scientists and naturalist communities** who observe, collect and document biodiversity.
- **Teachers, lecturers, education managers and students** in schools, universities and adult education.
- **Managers and HR officers** who design job roles.
- **Ethics advisors** who assure equal opportunities and safety at work.
- **Policy-makers and stakeholders** who use taxonomic evidence for decisions.
- **Science communicators, museums and outreach teams** who create exhibitions, events and media content.

HOW LEARNING AND CAPACITY BUILDING HAPPENS

- **Cascade Grants for sharing a co-creating knowledge** about biodiversity, target species and regions.
- **Open access publications** - scientific papers and policy briefs for swift dissemination of research results.
- **Awareness and engagement raising events,** that offer direct interaction with and learning from experts (including Taxonomy Recognition Day (TRD) and Bioblitzes).
- **Reflection on values, ethics and equal opportunities**, including gender.
- **Embedment** in EU initiatives (TETTRIX).

IMPACT: WHAT CHANGED BY 2026

- **Demonstrated citizen-science initiatives** where participants co-created validated taxonomic data and had ownership of the results.
- **Established an annual Taxonomy Recognition Day** and events that can be replicated to highlight the importance of taxonomy
- **Clarified and communicated career routes** in taxonomy and related fields, supported feedback from stakeholders.
- **Created recipes and communication templates.**
- **Policy briefs**
- **Open access research papers**

KEY RECIPES:

Recipe 9: Cascade Grant Mechanism (Financial Support to Third Parties – FSTP)
Recipe 10: Citizen Science initiative for biodiversity monitoring: based on the Footprints project,
Recipe 11: How to organise a BioBlitz,
Recipe 12: How to organise a Stakeholder Lab,
Recipe 13: How to Produce and Amplify Taxonomy Recognition Day, Recipe 14: Ethics matter – From the field to collection

Through strategic engagement and outreach activities, TETTRIs built sustainable impact by strengthening the visibility, relevance, and uptake of taxonomy across scientific, policy, and public spheres. **Cascade Grants** supported grassroots innovation and ongoing community-led initiatives, which often connected citizen scientists with regional collections and research institutions, while **Taxonomy Recognition Day** (TRD) highlighted the importance of taxonomic research and its contributors. **Policy briefs** translated technical insights into actionable recommendations for decision-makers, and a programme of awareness-raising events and **active social media** presence broadened understanding of biodiversity challenges and taxonomy's role. Scholarly publications **disseminated results** to global research audiences, and dedicated efforts on ethics and gender awareness helped cultivate inclusive, responsible practices within the taxonomic community.



Learning took place through co-creation activities in which citizens and professionals jointly designed surveys, interpreted results and discussed their implications, complemented by hands-on public events that offered **direct interaction** with, and learning from, experts. Story-based and **visual materials** helped connect taxonomic work to everyday concerns and policy debates, while guided reflection on roles, values and ethics enabled participants to understand how their contributions fit into **broader biodiversity governance**. Continuous engagement pathways allowed people to move from initial interest to long-term involvement and even leadership roles. By documenting learning and disseminating results through **scientific channels**, TETTRIs ensured that innovations and data generated by cascade projects and partners contribute to broader taxonomic and biodiversity knowledge, so that learning is not only generated but embedded, shared and sustained across Europe's taxonomic community.

WHO IS TARGETED

- **Citizen scientists and local communities** who observe, collect and document biodiversity.
- **Teachers, lecturers, education managers and students** in schools, universities and adult education.
- **Managers and HR officers** who design job roles.
- **Ethics advisors** who assure equal opportunities and safety at work.
- **Policymakers and stakeholders** who use taxonomic evidence for decisions.
- **Science communicators, museums and outreach teams** who create exhibitions, events and media content, connecting grassroots activities to validated taxonomic expertise and long-term data stewardship.
- **Taxonomists and researchers** whose work is showcased through Taxonomy Recognition Day, publications, and outreach activities, reinforcing professional visibility and impact
- **Scientists** who publish findings in peer reviewed journals.

TETTRIs achievements to foster sustainable impac

6.1 Cascade grants

The cascade grant system supported 12 satellite projects run by local research groups, NGOs, and citizen-science actors. These mini-grants allowed participants to **test taxonomic tools, training systems, and methodologies in real contexts**, in European biodiversity hotspots turning theory into practice, enabling **knowledge transfer** and skills development at local levels.

LESSONS LEARNED IN TETTRIS:

The **cascade grants** (also known as *Financial Support for Third Parties or satellite projects*) were one of the most impactful components of the TETTRIs project. They enabled practical innovation, capacity-building, community engagement, and the development of new tools and training systems in taxonomy across Europe. TETTRIs learned through its cascade grants that decentralised, hands-on experimentation in real biodiversity hotspots is essential for validating new taxonomic tools and training methods, as the grants enabled 12 diverse projects across Europe to test AI systems, molecular approaches, open-access data infrastructures, and training frameworks in practical contexts. This approach showed that lowering funding barriers allows smaller organisations and citizen-science communities to make meaningful contributions, greatly expanding both innovation and public engagement. The projects demonstrated that applied, field-based work accelerates skill development more effectively than centralised training alone, while open-access systems ensure learning continues beyond the project. Overall, the cascade grants revealed that **inclusive participation, real-world testing, and open data** collectively build a more resilient, skilled, and sustainable taxonomic ecosystem.

SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

Several TETTRIs satellite projects already show strong potential to **sustain lifelong learning in taxonomy and capacity building across borders and fields of expertise.** For example, satellite projects that created open-access collections data infrastructures, such as iSedge, TNLS, INC-STEP, Balkan PolliS, ARCADE are enabling continuous learning by giving researchers, students, and citizen scientists long-term access to shared digital resources that can be reused for training, research, and species identification. Projects developing novel AI and molecular taxonomic tools e.g. TrAILSID, CRYPTERS, L.U.C.E. NEXTRAD and TEOSS are equipping both professionals and learners with cutting-edge methods that modernise taxonomy and ensure skills remain relevant as technology evolves. Meanwhile, satellite projects that tested new training frameworks e.g. SoilMats, are providing validated, scalable models for organisations to adopt in future capacity-building efforts. Finally, those involving citizen scientists in biodiversity monitoring, e.g. FOOTPRINTS-CITSCI, demonstrates how community participation not only expands data collection but also fosters ongoing public engagement and informal learning about species and ecosystems. Together, these successes create a durable ecosystem where learning continues well beyond the project lifetime, supported by open resources, tested tools, and inclusive participation.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 4: How to collaborate to develop image recognition tools for collections
Recipe 9: Cascade Grant Mechanism (Financial Support to Third Parties – FSTP)
Recipe 10: Citizen Science initiative for biodiversity monitoring: based on the Footprints project

Video 6: How can the INC-STEP satellite project help us study pollinators?
Video 7: How can citizen scientists help us gather taxonomic data?

6.2 FAIR data and open access publishing; scientific papers and policy briefs

LESSONS LEARNED IN TETTRIS:

TETTRIs's scientific publications and policy briefs demonstrate that making knowledge available in openly accessible, peer-reviewed outputs is essential for **sustaining European taxonomy**, as it preserves validated methods, reference standards, and case studies for use by future researchers and trainees.

This is exemplified by the growing body of taxonomic studies connected to TETTRIs's satellite projects, including newly documented parasitoid wasp diversity published in the ***Journal of Hymenoptera Research*** (Gasper et al. 2025), new southern European hoverfly records in ***Arxius de Miscel·lània Zoològica*** (Ballester-Torres et al. 2024), and integrative systematic treatments of Eumerus species in the ***European Journal of Entomology*** (Aguado-Aranda et al. 2025) that provide practical identification tools and DNA barcodes for training and species delimitation. Other contributions to the scientific literature, such as faunistic updates in Revista de Museología, molecular and morphological taxonomic insights in ***Insect Systematics and Diversity*** (Ricarte et al. 2024), and conservation-relevant analyses published in ***Conservation Science and Practice*** (Mandeville, C.P. 2025), further illustrate how TETTRIs-linked research generates robust, reusable learning materials. The ***Zootaxa*** article on Italian *Luciola* fireflies, produced by the L.U.C.E. satellite project, adds another rich dataset of DNA-barcoded species-level evidence that strengthens both formal training and advanced research capacities across Europe (Mori et al. 2025)..

SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

The TETTRIs satellite projects demonstrated strong success through a growing body of scientific publications that **significantly advance Europe's taxonomic knowledge base and create durable learning resources**. Balkan PolliS and L.U.C.E have contributed high-quality, peer-reviewed studies across diverse journals, including new taxonomic and biodiversity insights published in the ***Journal of Hymenoptera Research on parasitoid wasps*** (Gasper et al. 2025), newly documented southern European hoverfly records in ***Arxius de Miscel·lània Zoològica*** (Ballester-Torres et al. 2024) by and comprehensive systematic treatments of Eumerus (Diptera: Syrphidae) in the ***European Journal of Entomology*** (Aguado-Aranda et al. 2025) that provide critical tools for species identification. Additional outputs include regional faunistic updates published in ***Revista de Menorca*** (Ricarte et al. 2024), integrative species delimitation work in I***nsect Systematics and Diversity*** (Cortés-Fossati 2025) that advances molecular and morphological taxonomy, and conservation-relevant assessments in Conservation Science and Practice that link taxonomy directly to biodiversity protection strategies. Complementing these is the ***Zootaxa*** publication, which offers DNA-barcode-based insights into Italian firefly taxonomy and expands high-quality reference datasets for ***Europe's biodiversity monitoring infrastructure*** (Mori et al. 2025). Together, these publications illustrate how TETTRIs satellite projects are producing robust, openly accessible taxonomic knowledge that strengthens Europe's long-term capacity for research, education, species identification, and lifelong learning.

Policy briefs

The Policy Briefs jointly address **major topics that have been tackled**, developed and produced under TETTRIs. Together, compiled in a unified package, constitute a comprehensive set of guiding lines that produces actionable recommendations across disciplines and targets:

- **The power of reference collections in biodiversity monitoring** (DOI 10.5281/zenodo.14252852)
- **The Case for Biological Nomenclature in Europe** (DOI 10.5281/zenodo.13991810)
- **Unlocking Biodiversity: European Campaigns for Taxonomic Annotation** (DOI 10.5281/zenodo.19486148)
- **Disclosing Taxonomic Capacity: Scaling a European Marketplace for Expertise and Innovation** (DOI 10.5281/zenodo.19486168)
- **Aligning European taxonomic capacity with biodiversity policy needs** (DOI 10.5281/zenodo.19486179)
- **Strengthening Taxonomic Capacity through Education and Training in Europe** (DOI 10.5281/zenodo.19486192)
- **Scaling Biodiversity Assessment Through Integrating Innovative Molecular Tools and Workflows in Taxonomy** (DOI 10.5281/zenodo.19486197)
- **Taxonomy for Transformation: A Blueprint for Bridging Science, Capacity, and Biodiversity Action** (DOI 10.5281/zenodo.19486204)
- **Reconnecting Europe with Nature through Taxonomy and Citizen Science** (DOI 10.5281/zenodo.19486213)
- **Scaling Impact through Cascade Funding: Policy Recommendations for Future EU Programmes** (DOI 10.5281/zenodo.19538470)
- **Bridging the Gender Gap in research by Enhancing the role of Female Taxonomists** (DOI 10.5281/zenodo.19538512)

Whilst the project's policy briefs on reference collections and biological nomenclature highlight that well-maintained, standardised taxonomic resources are foundational for consistent training and long-term skills development across institutions (Willemse et al. 2024, Quentin & Casino 2024). Together, these publications **exemplify how TETTRIs embeds open-access knowledge systems into broader educational and governance structures**, ensuring that taxonomic learning is continually reinforced across disciplines and generations.



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6.3 Awareness and engagement raising events, including Taxonomy Recognition Day (TRD)

LESSONS LEARNED IN TETTRIS:

TETTRIs's awareness-raising activities showed that public engagement is essential for strengthening taxonomic literacy, expanding community participation, and supporting long-term capacity building across Europe. Experiences from partners demonstrated that **citizen science provides one of the most effective entry points for public learning**: events such as the Citizen Science Fair in Trento, which attracted a large, diverse audience (scientists, policymakers, and business representatives), and offered direct interaction with taxonomists, hands-on demonstrations, and insights into biodiversity monitoring. Similarly, Bioblitzes organised by partners confirmed that short, intensive biodiversity surveys are highly effective in sparking curiosity, motivating nature recording, and sustaining participants' engagement well beyond the event. Research further shows that **Bioblitzes significantly increase biological-recording activity** for months afterwards, reinforcing their value as recurring engagement tools (Meeus et al. 2021, Adriaens, et al. 2021; Tiago et al. 2024). In addition, the Sound Right Nature-Music excursion for youth, offered an opportunity for a hard-to-reach sector of the public to reconnect with nature and understand that nature is not remote from them, but vital to their everyday life, including hobbies!

Panel discussions at events also revealed that taxonomy gains greater relevance when linked to societal challenges, such as environmental assessment, climate adaptation, or policy implementation. Here, the stakeholder labs proved effective in engaging unconventional sectors such as business, industry, and policy. This format stimulated collaboration and innovative concepts, such as the Taxonomists4Future initiative or Taxonomist in Residence program. TETTRIs also learned that **large-scale, coordinated campaigns can dramatically amplify visibility**: Taxonomy Recognition Day (TRD), supported by a pan-European #NameItToSaveIt campaign reached hundreds of thousands of people across Europe and beyond. The campaign's strong storytelling, framing taxonomy as the act that "gives every species a story" proved highly effective in making scientific concepts relatable and emotionally meaningful, strengthening public understanding of why naming and classification matter.

Overall, TETTRIs learned that awareness and engagement events are not supplementary activities but **core mechanisms for sustaining lifelong learning in taxonomy**. When hands-on participation, clear narratives, cross-sector dialogue, and high-quality communication tools are combined, they deepen public interest, strengthen partnerships between professionals and citizens, and make the importance of biodiversity and the role of taxonomy in understanding and protecting it, visible and accessible to a wide range of stakeholders.


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SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

The satellite projects successfully engaged the public by integrating citizen science as a core methodology, involving people directly in real taxonomic research and biodiversity monitoring (I**NC-STEP, Balkan PolliS, FOOTPRINTS-CITSCI, TEOSS, TrAILSID**), built open tools and data platforms (**INC-STEP, Balkan PolliS, ARCADE, TNLS, iSedge, TEOSS)** that invite participation, hosted training events (TEOSS) demonstrations, and fieldwork accessible to non-experts and fostered strong partnerships between experts, institutions, and community groups.

Through **workshops, field campaigns**, data-collection challenges, community meetings, and co-development activities, the satellite projects strengthened networks between professional taxonomists and the public, expanding the TETTRIs network from 17 to 36 institutions.

These strategies collectively ensured that the satellite projects did not only produce scientific outcomes, but also **increased public awareness**, expanded participation in taxonomy, and supported long-term community-driven biodiversity knowledge across Europe.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 2: Sounds Right Nature-Music Excursions for Youth Engagement

Recipe 11: How to organise a BioBlitz

Recipe 13: How to Produce and Amplify Taxonomy Recognition Day

Video 10: What is Taxonomy Recognition Day

Video 11: Taxonomy Recognition Day

Video 18: How can we get young people engaged with taxonomy?



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6.4 Ethics and gender awareness

TETTRIs embedded ethics, inclusivity, and reflective practice throughout its training and capacity-building activities, ensuring that emerging and established taxonomists develop not only scientific expertise but also the ethical awareness required for responsible research and collaboration. The project created comprehensive ethical guidelines and engaged an independent Ethics Advisor, whose ongoing input helped shape discussions on **integrity, equity, and responsible conduct across all project teams**. These efforts, together with regular cross-project discussions on ethics and gender mainstreaming, fed directly into mutual-learning formats that encouraged participants to examine issues such as inclusivity, power dynamics, and gender equity within scientific environments. As a result, ethics formed a core component of the project's professional development approach, strengthening the foundation for a fair, transparent, and socially responsible taxonomic community.

LESSONS LEARNED IN TETTRIS:

TETTRIs demonstrated that **ethical reflection and gender awareness are not peripheral considerations**, but essential components of sustainable capacity building in taxonomy. Taxonomic capacity building benefits greatly when women and other under-represented groups are intentionally included in training programmes, research activities, and community-building efforts. Creating gender-balanced training cohorts enhance diversity of perspectives, strengthens learning outcomes, and helps counter longstanding gender inequities in taxonomy and specimen collection. By appointing an independent Ethics Advisor and embedding ethical principles across partners, TETTRIs showed that **transparent, well-structured ethical governance** enhances the quality and credibility of taxonomic research and learning environments. Ethical discussions supported **responsible data practices, fair team dynamics, and open decision-making**, all of which are essential for a healthy lifelong learning ecosystem. TETTRIs integrated gender considerations into the development of training formats, the composition of trainer networks, and the creation of career pathways. This taught the consortium that gender-aware programme design can **prevent the reproduction of biases, widen participation in taxonomic careers, and promote a more balanced workforce** over time. For example, efforts to encourage women's participation in the satellite projects strengthened their ability to engage with taxonomic researchers at an early stage.

A key lesson was that gender bias can be embedded, often invisibly, within systems that map expertise, manage collections, or evaluate training networks. TETTRIs therefore recognised the importance of **integrating methods to detect and correct gender imbalance in expert directories** and taxonomic service marketplaces. It was also found by **ARCADE** that even within collections, there are historical biases, with collections often having an over representation of male specimens, thus even non-human aspects of taxonomy need to be taken into consideration within the taxonomic landscape for gender awareness.

TETTRIs's capacity-building activities, the workshops, stakeholder labs and training programmes showed that explicitly addressing **inclusivity, power dynamics, and gender norms** fosters safer, more welcoming spaces where learners feel respected (Palid et al. 2023). These conditions are essential for sustained engagement in taxonomy.

The project committed to reporting gender-related data in publications and dissemination activities, even when no gender differences were found. This approach taught TETTRIs that t**ransparency about gender representation** helps reduce publication bias and improves the evidence base available for understanding gender dynamics in taxonomy. By aligning with **EU directives on gender equality** and by adopting **Responsible Research and Innovation** (RRI) principles, TETTRIs highlighted that capacity building is not only about technical skills but about embedding values that shape **long-term professional behaviour**. This strengthens the societal mandate of taxonomy and supports the development of future leaders who practise equitable and responsible science.

TETTRIs learned that **ethical conduct and gender equality are foundational pillars** of lifelong learning in taxonomy. When these principles are intentionally built into training systems, community events, data infrastructures, and governance structures, they create more inclusive learning environments, strengthen research quality, and ensure that Europe's future taxonomic workforce reflects and serves society.



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SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

TETTRIs explicitly required that its satellite project "encourage the application by and inclusion of women," recognising them as an opportunity to reach women and include them in taxonomy. They were also required to work within TETTRIs's ethical framework, overseen by an independent **Ethics Advisor**, ensuring responsible research on specimens, data, and community interactions. As a result, satellite consortia such as INC-STEP, Balkan PolliS, ARCADE, and iSedge involved diverse teams from **natural history museums, universities, and citizen-science groups**, reflecting TETTRIs's push for gender-balanced collaboration structures. Additionally, SoilMATs and TEOSS included early-career researchers into their projects, a vital aspect of gender-equal progression pathways in **STEM**. When it came to collections and the ethical handling of biodiversity data, **NEXTRAD** worked on sensitive island flora and **CRYPTERS** worked with threatened endemic spiders and worked within the boundaries of ethically handling their samples. Some of the projects worked in biodiverse rich but socio-economically vulnerable areas, such as **Balkan PolliS** and **iSedge** where ensuring collaboration with local authorities and communities in a respectful way was vital for the longevity and impact of the project. All projects, where possible, have transparent and open-access outputs which aligns with the **core principle of responsible research** for public benefits.

Several Satellite Pprojects actively engaged citizen scientists (e.g., FOOTPRINTS-CITSCI, Balkan PolliS, INC-STEP) and aligned with TETTRIs's gender commitments, ensuring that participation was **open and accessible to diverse public groups**, including **women**, **youth**, and **non-professionals**, working alongside established scientific communities. INC-STEP, ARCADE in their reference collections, Balkan PolliS in their indexing system and TNLS in their **name-mapping workflow** had practices within their tools to eliminate systematic inequities and widen access to taxonomic data, checking for any bias in gender when it comes to expert attribution and authorship.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

Recipe 14: Ethics matter – From the field to collection

Video 17: How can we increase diversity within the field of taxonomy?



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6.5 Embedment in EU initiatives - TETTRIX

LESSONS LEARNED IN TETTRIS:

TETTRIs has shown that building taxonomic capacity in Europe requires more than isolated training actions or tools. The project demonstrated the need for a coherent European system that brings together FAIR data, reference collections, digital tools, training frameworks and funding mechanisms, and that explicitly **connects taxonomy to biodiversity policy and conservation strategies.** Cascade grants to satellite projects, the development of shared platforms and the creation of new training formats all pointed in the same direction: national efforts are not enough without a common European backbone and a long-term programme for skills and careers, harmonised systems and mechanisms to translate knowledge into replicable action.

The upcoming Horizon Europe project TETTRIX takes these lessons forward by designing an open European system for integrative taxonomy that provides up-to-date, reliable species information for **science, nature conservation and society**. Building on TETTRIs results, TETTRIX is structured around four main components:

1. **Integration** – creating central hubs for FAIR data, expertise and services, and linking taxonomy with genomics;
2. **Transformation** – turning fragmented databases and resources into a connected digital base for European taxonomy, including interfaces to the private sector;
3. **Skills development** – strengthening teaching, training and career pathways for taxonomists in Europe and aligning them with policy and conservation needs;
4. **Validation in practice** – launching a cascade funding scheme to pilot tools, methods and collaborations with organisations and experts.

In this way, the Blueprint and its Recipes provide a tested catalogue of **formats and approaches that can be scaled**, embedded and further developed within TETTRIX, ensuring that the impact of TETTRIs on capacity building continues beyond the project lifetime.

SUCCESS STORIES IN TETTRIS THROUGH SATELLITE PROJECTS:

Satellite projects in TETTRIs provide proof-of-concept models that TETTRIX can take to the next scale.

The **close cooperation with experts** from the TETTRIs core coordination and implementation teams assured excellent and coherent results.

Reference-collection satellite projects (such as INC-STEP, Balkan PolliS, ARCADE and iSedge) showed how **national and regional efforts can be structured into digital and physical frameworks** that feed a European backbone. Training-focused satellites (for example SoilMATs and L.U.C.E.) demonstrated that blended courses, supported by **shared e-learning platforms**, can rapidly expand expertise in poorly covered taxonomic groups.

Other Satellites Projects piloted innovative tools and engagement formats – AI-assisted identification workflows, citizen-science monitoring schemes, stakeholder labs and recognition events – that **link taxonomy to policy, education and local communities**. These experiences collectively validate the cascade-funding approach and offer a portfolio of tested formats that TETTRIX can upscale, adapt and embed into its four components.

TETTRIS OPERATIONAL RESULTS (RECIPES & VIDEOS):

The following recipes offer concrete building blocks and use cases that are directly relevant for TETTRIX implementation:

Recipe 1: How to organise an advanced blended course on Taxonomy – offers tested formats for skills development that can be reused and expanded within the TETTRIX training and careers work.

Recipe 3: How to build a reference collection

Recipe 5: How to use the Taxonomic Expertise and Services Marketplace – provides a model for organising and exposing expertise and services, feeding into TETTRIX hubs for taxonomic support.

Recipe 8: How to use a Taxonomic Resolution Engine Wikibase

Recipe 9: Cascade Grant Mechanism (Financial Support to Third Parties – FSTP

Video 1: Why does the TETTRIs project exist?

Video 5: How can SoilMATS project help us teach taxonomy

Video 6: How can the INC-STEP satellite project help us study pollinators?



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SECTION

3 A cookbook for practice

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The TETTRIs Cookbook, together with its collection of simple, ready-to-use **recipes**, serves as a comprehensive and practical guide designed to support a wide range of users in applying and replicating what have been the TETTRIs key findings. By translating complex and time-intense developments into **accessible**, step-by-step guidance, the Cookbook enables all different interested parties to effectively adapt TETTRIs methodologies to their own specific needs and contexts.

Beyond facilitating replication, the Cookbook plays a **crucial role in amplifying the project's overall impact**, extending its reach well beyond the original partnership. It encourages the transfer of knowledge, promotes best practices, and supports the scaling of successful approaches in new geographical, institutional, and sectoral settings.

Moreover, the Cookbook provides a valuable **foundation for new actors entering the field**, allowing them to build upon the extensive experience accumulated throughout the TETTRIs project timeframe. It consolidates lessons learned, proven strategies, and practical insights derived from hands-on implementation, testing and validation provided by the Satellite Projects.

By combining usability, adaptability, and evidence-based guidance, the TETTRIs Cookbook becomes a **key resource** for fostering innovation, collaboration, and long-term sustainability, ultimately contributing to strengthen capacity building in taxonomy far beyond TETTRIs.



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Appendix 1

ACRONYMS

AI	Artificial Intelligence
CETAF	Consortium of European Taxonomic Facilities
CIB	Community Implementation Board
DEST	Distributed European School of Taxonomy
ECSA	European Citizen Science Association
ECTS	European Credit Transfer and Accumulation System
EU	European Union
FAIR	Findability, Accessibility, Interoperability, and Reusable
GDPR	General Data Protection Regulation
IPBES	The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services
NGO	Non-Government Organisation
SME	Small and Medium Enterprises
SDG	Sustainable Development Goal
TETTRIs	Transforming European Taxonomy through Training, Research and Innovation
TETTRIX	TETTRIX: TETTRIs next level for the taxonomy of tomorrow
TRE	Taxonomic Resolution Engine

SHORT NAMES OF SATELLITE PROJECTS

ARCADE	Aligning Reference Collections with taxonomic Development Efforts for pollinator conservation in Portugal
Balkan PolliS	Balkan Pollinator Digital Survey
CRYPTERS	Untangling cryptic diversity of endemic endangered spiders in the Mercantour-Alpi Marittime Natural Park
FOOTPRINTS-CITSCI	Feedback Loop: Taxonomic ID from Photo Recognition, Integrated Species distribution modelling, and Citizen Science
INC-STEP	Instigating a National Reference Collection for Spain's Threatened Pollinators
iSedge	Making biodiversity knowledge available: an integrative, appealing and dynamic digital dashboard for sedges (Plantae, Cyperaceae)
L.U.C.E.	Lighting up the Understudied but charismatic fireflies of Europe: mentoring early-career researchers to improve access to knowledge on fireflies of the Italian Peninsula Hotspot using TETTRIs' name matching and linking workflows
NEXTRAD	Implementing cost-effective genomic tools for high resolution species delimitation in recent plant island radiations in Macaronesia
SoilMATs	Soil Meiofauna Advanced Taxonomy school
TEOSS	Training for the European Orthoptera Sound System
TNLS	Taxonomic Name Linking Services
TrAILSID	Training Artificial intelligence models for land snail identification

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Appendix 2

FROM THE TETTRIS AIMS AND OBJECTIVES TO THE PRACTICAL STRUCTURE OF THE BLUEPRINT

TETTRIs had the ambitious aim to produce a **transformative change in the role played by taxonomy** in tackling biodiversity challenges by boosting taxonomic capacities and transferring critical scientific knowledge to societal actors. The project achieved this through gathering and transferring taxonomic knowledge, innovations and expertise from across Europe to support the reversal of biodiversity decline and to address its main drivers.

TETTRIs triggered change through:

1. The consolidation and reinforcement of **taxonomic research capacity**.
2. **Transferring knowledge** from the scientific community to targeted audiences.
3. Taking an **innovative and coordinated approach** to implementing technology and systems in taxonomic research.



Figure 2: Aims of TETTRIs

To reach its aims, the TETTRIs project defined **six overarching objectives**, ranging from **indexing expertise** and **integrating resources** to **facilitating training** and supporting taxonomic careers. Many project deliverables describe these objectives mainly in terms of systems, infrastructures and policy instruments.

The Blueprint builds on the work of TETTRis and transforms it into a practical framework for taxonomic capacity building (Tab 1).

TETTRIs project logic	How the project logic is translated into practical guidance in the Blueprint
Project aims	Re-framed by a **practical framework** for strengthening taxonomic capacity in three strategic areas - Knowledge creation, Development of Systems, and Sustainable Impact - in real institutional, educational and policy contexts.
Six objectives	**Viewed from the perspective of people and skills** (Figure 3). It focuses on what each objective means for learners, trainers, experts, institutions and decision-makers, and on how the results of TETTRIs can be further exploited, replicated and effectively used to build and sustain taxonomic capacity.
Project outputs	**Selected key outputs** **- translated into practical tool:** for every key TETTRIs result, the Blueprint highlights the lessons learnt throughout the project, the applicable Recipes and examples in the field (via the satellite projects) when designing, reinforcing and strengthening training, collaboration and career opportunities, and contributing to capacity building in taxonomy. **- organised** into three strategic areas - Knowledge creation, Development of Systems, and Sustainable Impact.
Validation of outputs through Satellite Projects	**Validated** through proof-of-concept pilots, the outputs were consolidated into adaptable models for target groups, stakeholders and future initiatives, and are **captured in the Blueprint as recipes, lessons learned and success stories** in three strategic areas - Knowledge creation, Development of Systems, and Sustainable Impact .
Project outcomes	**Distilled into the Blueprint practical framework with three strategic areas** for taxonomic capacity building - **Knowledge creation, Systems, and Sustainable impact** - and **synthesised into main recommendations.**
Sustainability and exploitation	**Enabled** through the **Blueprint** and the **Cookbook** with reusable recipes, and expressed through recommendations and their **expected impact, actions ahead and proposed way forward.**

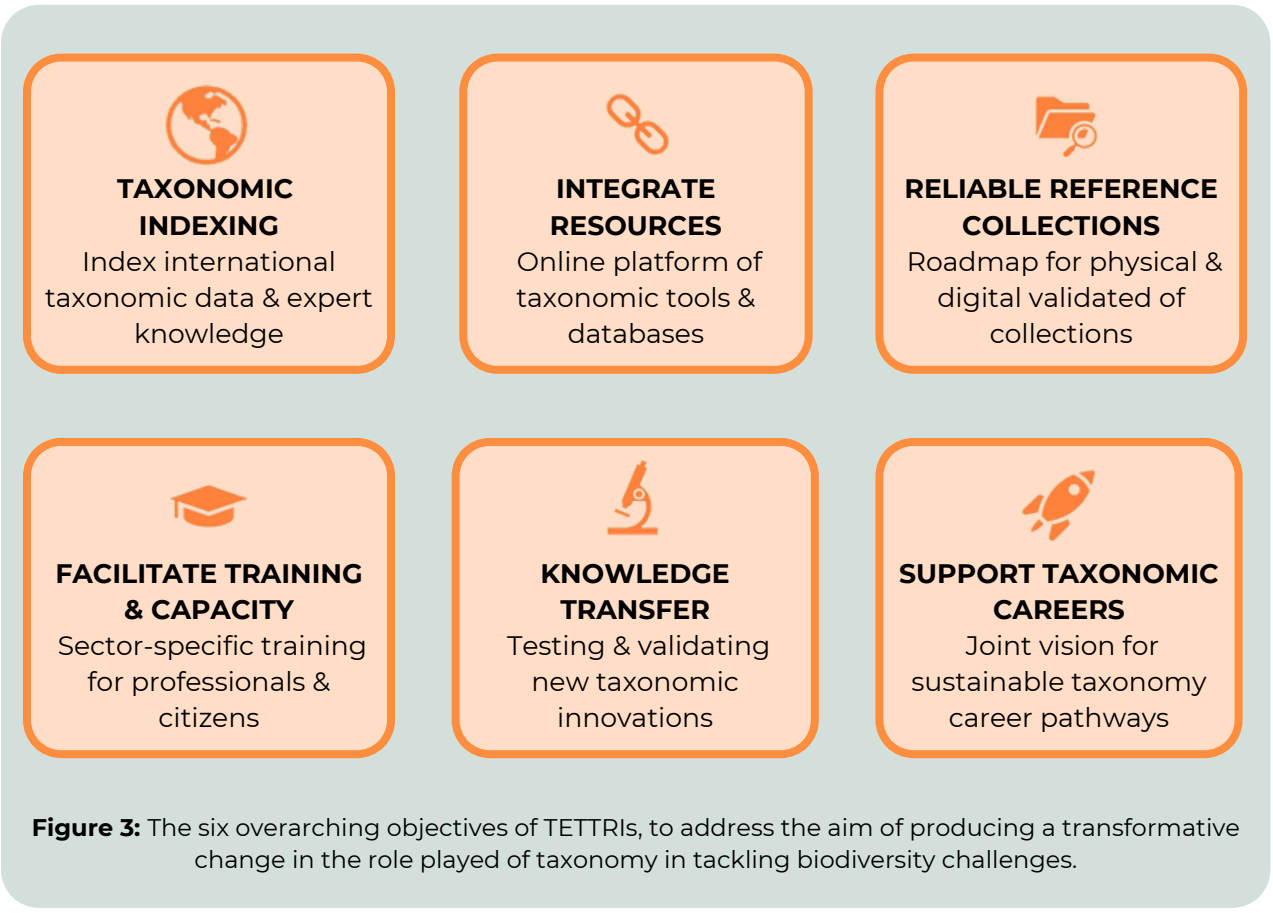


Figure 3: The six overarching objectives of TETTRIs, to address the aim of producing a transformative change in the role played of taxonomy in tackling biodiversity challenges.

SIX ACTION OBJECTIVES BEHIND THE BLUEPRINT

This Blueprint builds on six objectives of work developed in TETTRIs. Together, they form the basis for strengthening taxonomic capacity in Europe:

Objective 1 – INDEX e-Services and expertise

To gather, combine, and harmonise scattered resources, TETTRIs has developed the Expertise and e-Services Marketplace that will allow **taxonomic skills and services** visible and easier to allocate for individuals, institutions and projects. By providing a unified entry-point, the Marketplace of experts and tools will serve a multitude of taxonomic purposes and actors, lowering barriers to access and use.

Objective 2 – INTEGRATE resources and tools

To avoid isolation and facilitate integration of existing and newly developed resources, TETTRIs has focused on linking tools, **databases and platforms** so that users can move more easily between systems when they learn, collaborate and carry out everyday taxonomic work, across disciplines and sectors. E.g. Spart explorer.

Objective 3 – PROVIDE reliable reference collections

Biodiversity monitoring requires the consolidations of references, from factsheets to keys, libraries and reference collections that are instrumental to facilitate **species identification in the ground and escalate** (both geographically and for the different taxa groups) monitoring efforts. TETTRIs has enlarged and documented both physical and digital reference collections as trusted anchors for taxonomists, students and practitioners who rely on them for training, quality control and long-term data curation. Practitioners in the field will use them as a fundamental resource for identification and monitoring.

Objective 4 – FACILITATE training and capacity buildinge

To overcome the current shortage of taxonomic capacity and revert the trend to strengthen the availability of taxonomic experts in the future, TETTRIs has created a variety of **structured learning opportunities for different groups** – professionals, students, educators and citizens – and turning project outputs into training pathways that increase taxonomic competence and consolidate taxonomic capacity over time.

Objective 5 – FOSTER knowledge transfer mechanisms

Fostering the transfer and assimilation of knowledge from science to both, policy and social spheres, has been critical for TETTRIs that has developed and **piloted innovative taxonomic tools and methods to raise awareness** about the critical role played by taxonomy as fundamental science for biodiversity. To further ensure the permeability of scientific outputs across societal layers, TETTRIs has created ways for these innovations to be tested, shared and adopted by different user groups.

Objective 6 – SUPPORT taxonomic careers

To attract and engage with future generations of taxonomists, TETTRIs developed approaches that help taxonomists see and follow viable **career pathways**, build the skills needed at different stages and receive recognition and support across academic and non-academic sectors.

The Blueprint **is anchored in the main outcomes objectives of TETTRIs and distills them into three strategic areas for building capacity** to address taxonomic capacity.

It brings together recipes to enable conceptual models to be turned into action, case studies developed by the TETTRIs satellite projects (the on-the-ground projects funded via the TETTRIs Cascade Grants Mechanism) and **strategic recommendations for policymakers.**

These satellite projects **demonstrated and validated how to adapt** TETTRIs outcomes can be adapted to specific needs detected across the diverse users, ranging from nature conservationists and citizen scientists to researchers in multiple disciplines, journalists and the general public, institutions, companies, academia, and policy makers.

Beyond organising TETTRIs results By delivering clear and featured components of what the overarching system may entail, namely into **strategic areas** and practical the **recipes** and the **three strategic areas**, the Blueprint establishes a roadmap for sustainability and policy integration to secure taxonomic capacity over time, while also fostering partnerships across academic, governmental, and private sectors through an integrative, multidisciplinary approach.

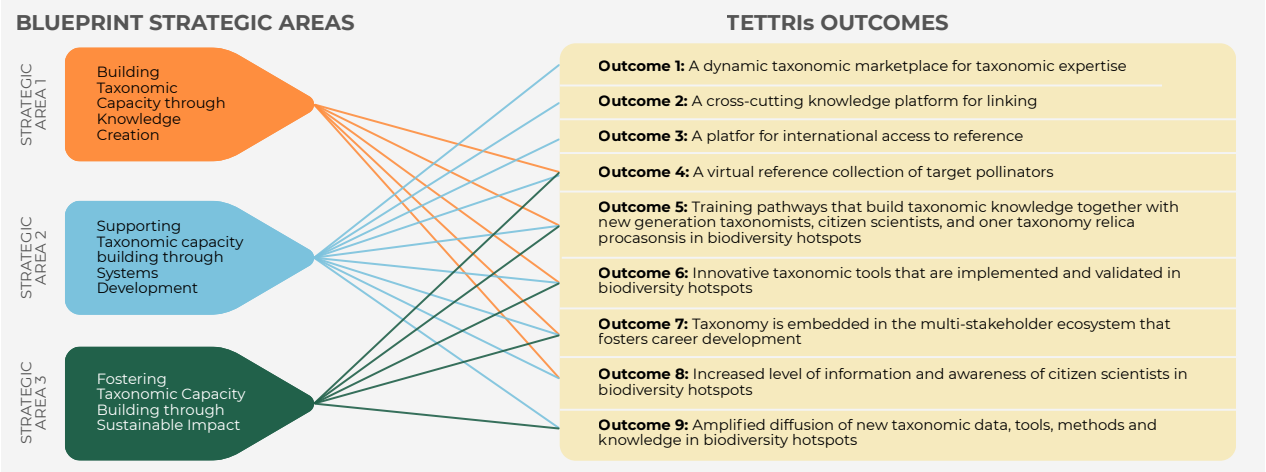


Figure 4: Flow chart showing the three pathways of TETTRIs to deliver a broad suite of outcomes that underpin this Blueprint for taxonomic capacity building

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