Edited by
Nunzia Borrelli, Giulia Mura, Michela Rota

DisSeminAzioni: Telling the Story of Biodiversity

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It is more important than ever to reflect and explore the deep connections between what we eat, the environment around us, and our health. In a world of constant change, consumption of natural resources and attacks on ecosystem services, it is becoming increasingly urgent to reflect on our food model and on the conservation of biodiversity, which fully includes that of agricultural production environments. It is also important to reflect on the crucial role that urban greenery plays in our quality of life. All this is necessary in order to gradually equip ourselves with the tools to understand and raise awareness of how our daily choices, both individual and dictated by political agendas, have a global impact. The integrated approach of the concept of *One Health, which inextricably links human, animal, and environmental health, is a good way to understand the plurality and relevance of these interconnections.*

The project, with the publication of this volume and the related exhibition, clearly shows how our eating habits influence the environment and our health. The concept of short supply chains, the importance of a balanced and sustainable diet and the value of local and seasonal products are not fads, but precise indicators of behaviors that contribute overall to our health and that of the planet. However, it should be remembered that not everything can be traced back to the question "what can we do as consumers": we must remember and highlight the specific political responsibilities that drive us to address the solutions to be adopted as a genuine collective action by society.

The relationship between food and biodiversity is very clear, as food security and ecosystem quality are closely interrelated factors. In fact, biodiversity and its associated ecosystem services act as a driving force and influence overall quality. It

is also clear that when we talk about biodiversity conservation, we are not just talking about exotic locations or natural parks. Nor is it a question of reducing the issue to the protection of particularly striking species or those considered 'flagship' species for conservation efforts. The issue of biodiversity fully concerns all living spaces and, given the high concentration of population in urban contexts, it also concerns green spaces in the city. They are essential to mitigate climate change, improving air quality, and support specific biodiversity. And it is this combination that promotes a recognized and sought-after psychological and physical well-being for citizens. Therefore, we welcome an invitation to rethink our cities as living ecosystems in which we humans are a part, a significant part, but only a part.

Finally, we must consider the entire cycle that this volume and the exhibition present in this work in an exemplary way. Reflecting on food means first and foremost recognizing the connections between the environment and biodiversity, with a line of reasoning that leads us to extend our reflection to economics, society, and history. Food also tells us about culture and tradition, art and literature, and a sense of belonging to places. Undoubtedly, when we think about food, we are led to reflect on our role as consumers, but we must not forget to take into account the role of politics. Politics brings decisions that can favor industrialization of the supply chain or initiate paths toward sustainability. These are decisions that have repercussions throughout the supply chain, including, above all that of conservation or environmental "quality."

If these are the foundations, it is important to recognize that museums have a role to play as active places to build and share knowledge, debate, activism, and combating inaction. This is a new role for museums that are reinterpreting themselves as open spaces for debate and collective growth, rather than simply custodians of heritage. Museums should be understood as true agoras, where a virtuous path linking knowledge and awareness can emerge. Museums as construction sites where ideas for a better future to be translated into action as a social commitment.

Michele Lanzinger
President of ICOM Italy

In a historical phase marked by an unprecedented acceleration of ecological instability, biodiversity is emerging as a systemic issue at the convergence of the main challenges of our time: the balance between human activities and natural cycles, climate change, food security, global health, the resilience of urban ecosystems, and the ethical and political implications of environmental justice.

In this complex scenario, universities, research centers, natural history museums, and eco-museums are asked to rethink their institutional role. Today, these institutions are required to take integrated action, combining research, conservation, cultural mediation, scientific dissemination, territorial planning, and the construction of shared paths based on listening, discussion, and active inclusion of communities.

It is within this framework that the exhibition/volume DisSeminAzioni: Raccontare la Biodiversità (DisSeminations: Telling the Story of Biodiversity) is set, promoted by the Department of Sociology of the University of Milan-Bicocca in collaboration with the National Biodiversity Future Center. The project aims to explore, through a strongly multidisciplinary approach, the many ways in which biodiversity can be known, represented, communicated and experienced. Not just scientific data, but cultural value, relational principle, and shared language. The exhibition and the book take the public on a journey through the themes of museumization, representation, food, active citizenship, and visual and artistic communication, offering concrete tools to stimulate a new ecological awareness.

In this context, the Natural History Museum, which was consulted during the preparatory phase of the project, is an emblematic example of the transformation underway. Its institutional commitment is now based on a vision of biodiversity as a fundamental dimension of life on the planet: evidence of the variety and

interdependence between species, environments, and cultures. This approach has inspired and continues to inspire the development of scientific, educational, and communicative practices capable of integrating different types of knowledge and languages, restoring biodiversity its systemic value, and at the same time, promoting widespread and participatory responsibility for its protection.

Underlying this approach is a unified and integrated conception of the main functions of museums: from research to the conservation and digitization of collections, from the critical interpretation of their scientific, cultural and historical significance to the enhancement of archives and library collections, to environmental education, public communication, and the promotion of civic participation.

Research is the foundation of museums: botanical, mineralogical, paleontological, and zoological collections not only document the biological and geological history of the planet, but also serve as dynamic knowledge resources capable of generating empirical data, constructing interpretative models, and implementing the formulation of predictive scenarios. Through collaboration with universities, research institutions, and centers of excellence, museums actively participate in the production and dissemination of systemic knowledge, which is now indispensable for analyzing ecological dynamics and addressing the causes and consequences of biodiversity loss. However, for this knowledge to have a real impact, it is essential to overcome the historical divide between the specialized production of knowledge and its social appropriation. Museums must assume the role of cultural mediators between the scientific community and society, translating complex content into accessible, engaging, and culturally relevant forms of communication, while maintaining the rigor that guarantees their authority and legitimacy.

Exhibitions such as Viaggio intorno a un albero (Journey around a tree), developed by the Natural History Museum in collaboration with the University of Milan-Bicocca, and Grande come un virus (As big as a virus), created in synergy with the Institute of Biophysics of the National Research Council (CNR-IBF, Milan section), are effective examples of cultural coproduction between scientific and museum institutions. They integrate data, narration, visuals, and participation, creating new communication formats that bring diverse audiences closer to the complexity of science.

In this dynamic of openness and connection, the digitization of museum collections also plays a strategic role: in addition to expanding the possibilities of access and enjoyment for the public, it paves the way for the construction of interoperable information environments capable of connecting, in real time, dispersed and geographically distant heritage, fostering the creation of collaborative networks on a national and international scale, and contributing concretely to the progress of research and cultural innovation.

No less important in this system are the activities carried out in museum storage facilities and laboratories, which are essential spaces for the conservation, cataloguing, preparation, and study of naturalistic materials. When properly enhanced, these environments can be transformed into true operational sites for applied research and, where possible, into spaces for shared learning and interaction between scholars, professionals, and citizens.

This framework is complemented by the promotion of historical archives and documentary collections, which preserve not only the memory of naturalistic disciplines but also the narratives, images, and ideas through which societies have built and transformed their relationship with nature. Their cultural activation allows us to restore historical depth and critical foundation to the discourse on biodiversity, strengthening the ability to combat both ecological illiteracy and the circulation of distorted or pseudoscientific narratives on environmental issues.

This systemic and relational dimension of natural history museums can find full expression in their ability to act as an operational bridge between theory and practice, through multidisciplinary projects rooted in the territories and in close contact with communities. The many types of intervention include thematic exhibitions on ecosystems and sustainable food systems; workshops on composting, urban agriculture, and soil management; urban visual communication campaigns, including augmented reality; immersive experiences and ecological simulations in virtual reality; and citizen science initiatives codesigned with universities and research centers. These activities could be organized within public programs spread throughout the territory, as already experimented by the Natural History Museum in the project Il museo sotto casa (The museum near home), or be included in an annual cultural program, with a particular focus on involving younger generations.

However, in order for these practices to become established and generate lasting value, it is necessary to build an ecosystem of cooperation based on formal agreements between museums, research institutions, universities, public administrations, and local communities. Joint participation in competitive calls for proposals, the establishment of agreements with citizens, the creation of thematic networks to share resources and skills, and the adoption of inclusive communication strategies are fundamental tools for ensuring the continuity, consistency, and effectiveness of actions.

It is in this direction that the role of natural history museums, together with ecomuseums, universities, and research centers, is confirmed as strategic actors in the ecological transition, true permanent laboratories of learning, storytelling, and participation. Biodiversity, in its irreducible complexity, as effectively highlighted by the exhibition/volume "DisSeminAzioni: Raccontare la biodiversità" Biodiversity can no longer be treated exclusively as the domain of disciplinary specialization: it has become shared knowledge, a collective concern, a generative theme for the present. It is on this awareness that museum institutions, in alliance with academia and society, are called to ground their action: becoming relational, dynamic, and cooperative cultural systems, capable of articulating knowledge, experiences, and imagination within a new shared responsibility toward the natural world and its equilibria.

Chiara Fabi
Responsabile Musei Scientifici, Comune di Milano

Facing today's polycrisis is not easy, but there is good news: because crises affect people, their relationships with others and with the planet, they can also become opportunities. They reveal deeper cultural and social issues that we are called to address.

Pope Francis, starting from the recognition that "everything is connected" and that nature is a complex, interdependent system, reminds us that creation is a work of communion and that human beings are called to live in harmony with it. In this light, we are invited to re-establish our relationship with all living beings, based on care rather than domination.

Change depends on us—both as individuals and as communities. We must, and can, change before each crisis reaches a point of no return.

Part of the problem lies in the prevailing model: the "rational economic man"—a figure with a calculator in his head, money in his hand and an ego in place of a heart—ends up alone, exploiting or discarding others on a planet he assumes to be limitless. Too many economic models still rely on this archetype, despite clear evidence of its failure.

In this context, cultural institutions can act as catalysts of meaningful change. Guided by insights from the past, they can promote processes that respond to the needs of the present and future, generating impacts that are rooted locally yet resonate globally. Biodiversity—and its intrinsic relationship with food systems—is a theme these institutions must fully address.

The National Biodiversity Future Center, which this publication introduces, serves as a beacon on this path, bringing together expertise and promoting research to tackle the complex challenges of biodiversity. Here, the contribution of cultural institutions—and ecomuseums in particular—is crucial for translating scientific

knowledge into concrete action, engaging communities and territories in transformative processes.

Italian ecomuseums, inspired by the principles of the recently amended Italian Constitution, can be seen as "constitutional bodies" and "institutions for the future": processes of active citizenship which—through the principle of subsidiarity (Art. 118)—take care of landscape and heritage, protect the environment, biodiversity and ecosystems also in the interest of future generations (Art. 9), contribute to the material and spiritual progress of society (Art. 4) and to the full development of the person (Art. 3, para. 2).

The Parabiago Landscape Ecomuseum is one of many examples. Born from a participatory process and accredited by the Lombardy Region, it shows how a cultural institution can become a catalyst for change. The case of the Olona River—among the most polluted rivers in Europe, long perceived as "invisible" as it flows through Parabiago—illustrates how ecomuseums can redirect attention to living heritage, fostering an emotional and value-based reconnection with the environment and reactivating local, sustainable food supply chains.

Ecological restoration and the return of complex biotic communities to the river at the beginning of the century were not enough: people continued to ignore the Olona and the surrounding agricultural landscape, often viewed as negative elements. Through participatory heritage mapping, citizen science, landscape education, and strategies and action plans co-designed with communities, ecomuseums build knowledge, participation and subsidiary action—prerequisites for the sustainable use of cultural and environmental heritage.

This publication also explores the role of transformative change and Nature-Based Solutions (NBS) in fostering biodiversity. Through fieldwork and community engagement, ecomuseums can significantly contribute to these processes—facilitating the uptake of sustainable practices and implementing ecological restoration measures. The creation or restoration of wetlands, fish restocking, and the habitat-oriented management of irrigation canals are just a few examples of actions ecomuseums can promote with local partners.

In Parabiago, such actions were technically feasible but long ignored by

policymakers and local actors—hence the need for a shift in perspective and strategy facilitated by the ecomuseum.

Biodiversity in urban contexts—and its representation in popular culture and contemporary art—is another theme addressed here, one that finds fertile ground in the work of Italian ecomuseums. Acting as mediators between scientific knowledge and citizens' perceptions, they raise awareness of the importance of urban green spaces, city ecosystems and the role each of us can play in protecting them. Art, in particular, offers new perspectives and languages for representing biodiversity, stimulating reflection and emotional connection.

*The exhibition scheduled for 2025, *Being Part of the River: the Olona Through Us*, created with artist Marisol González-Reforma, Parco dei Mulini and the Parabiago Ecomuseum, is a virtuous example of how art and culture can become instruments of transformation and awareness. Born from an intergenerational participatory process, the works on display are not mere aesthetic objects but traces of encounters, workshops and shared experiences. The *embroidered map*—created with contributions from older residents—depicts the water cycle and local emotions; the cloth book of *new myths and poems of the Olona River*, created by children, testifies to the power of collaborative art in making the invisible visible and nurturing ecological awareness. The installation of the "Piccola Custode" (Little Guardian) filter island, which purifies water and symbolizes collective commitment to the river's regeneration, embodies the idea that even small gestures can generate significant change.*

The relationship between biodiversity and food systems is another central theme. Ecomuseums are well placed to explore and promote this vital connection. Agricultural biodiversity, the conservation of local varieties, and short, sustainable supply chains are crucial to ecosystem health and food security. Working with farmers, producers and local communities, ecomuseums help rediscover and enhance agri-food heritage closely interwoven with the biodiversity of rural landscapes.

In Parabiago, the "Pact for the Care and Enhancement of Agroecosystems along the Olona River and the Villoresi Canal and the Supply of Local Products" shows how biodiversity protection can be integrated with more sustainable and resilient

food systems. Aiming to support multifunctional agroecosystems from ecological, economic and cultural standpoints, the initiative demonstrates how collaboration among institutions, associations, farms and citizens can improve both landscape and local culture.

In conclusion, this publication highlights the strategic role of cultural institutions and ecomuseums in promoting biodiversity and building more sustainable food systems. Through community engagement, education, the valorization of local heritage and innovative, community-based practices, ecomuseums contribute to the rebirth of territories, helping to forge a future in which people and nature can thrive in harmony. The examples of many Italian ecomuseums—and the experiences gathered in this volume—offer valuable insights and replicable models to address our time of polycrisis and to renew the vital bond between humans and the planet, grounded in care.

Raul Dal Santo
Coordinator, Parabiago Landscape Ecomuseum
(Municipality of Parabiago)
Contact point for the Lombardy Ecomuseum Network

Chapter 1

The research project: Towards shared and participatory biodiversity

Nunzia Borrelli, Giulia Mura, Michela Rota

The Context: National Biodiversity Future Center (NBFC) and SPOKE 7

The biodiversity crisis that we have created and are facing in the 21st century is a fact and shows no signs of slowing down. "We are living in an era of unprecedented environmental transformation, in which climate change, habitat alteration, pollution, invasive species, and excessive exploitation all contribute to the decline of species"
(Millennium Ecosystem Assessment 2005, IPBES 2019).

We cannot expect to reverse this trend through scientific research alone, although this is essential for understanding and classifying species and their interrelationships, as well as for understanding the mechanisms of interaction with human activities, and through environmental reporting, which is necessary for changing collective awareness but may go unheeded. What is built through research and reporting must become the heritage of society as a whole through widespread sharing. The causes of the current biodiversity crisis are systemic (deterioration of terrestrial and aquatic forests, invasive species, population growth and urbanization, destruction of soil and aquatic habitats), pollution, indiscriminate exploitation of biological resources, global warming, and extreme weather events) and as such require systemic interventions.

We need paradigm shifts, new ways of living and consuming, new awareness, new limits and regulations, and finally behaviors that follow science-based ecological principles. There can be no "ecological transition" without a social commitment to true integral ecology; that is, without a strong strategic focus on biodiversity both as a value in itself and as a guarantee of our survival (i.e., through the provision of resources and recycling waste), and as a source of ecosystem resilience and a resource for economic recovery.

To work on these issues, Italy has established the National Biodiversity Future Center (NBFC), funded by the MUR (Ministry of University and Research) through European Union funds - NextGenerationEU. This is a coordination structure that involves more than 2,000 people, which combines and enhance research efforts while making knowledge and technologies accessible to the various actors operating in the territory.

Within NBFC there is a specific area, Spoke 7 dedicated to Biodiversity and society: communication, education, and social impact. The main objectives of the spoke include maximizing cross-cutting relationships between different sectors of society and promoting the dissemination of knowledge, including the promotion of new languages and methods of teaching and communicating science and biodiversity.

As part of the activities of Spoke 7, the research group coordinated by Nunzia Borrelli and composed of environmental and regional sociologists, as well as scholars specializing in museums, art, and image, has pursued three closely interrelated lines of research. The first line of research investigates the role of museums and ecomuseums in terms of how they work on biodiversity, and subsequently, it carried out a specific study on how it is possible to analyze and measure the effectiveness of the actions of these institutions. More specifically, building on the outcomes of COP 16 on Biodiversity, certain indicators defined within that framework were revisited.

The second line of research investigated biodiversity as nourishment; that is,

as nourishment for cities (including the issue of urban biodiversity) and as nourishment for people (but also for animals) (including the issue of food production, especially in low-income countries).

A third strand is what we have defined as emotional, which focuses more on art and photography and aims to understand how these important channels of communication convey biodiversity and, above all, the risks associated with its loss.

The results of the various research projects are documented in the publications listed in the attached bibliography, which also includes a list of forthcoming publications and details of the new Biodiversità Cibo e Cultura (Biodiversity, Food and Culture) series being launched by the Ledizioni publishing house, of which this volume is a part.

The journey: From the Symposium to the Exhibition and the Book

The activities carried out by the sociology group within Spoke 7 alternated between field and documentary research and discussions with potential stakeholders interested in these issues.

An important moment was the Symposium on Biodiversity, Food, and Education on November 25, 2024. The purpose of the meeting was to discuss what museums and other cultural institutions can do to raise public awareness and promote participatory practices on issues of biodiversity conservation and food system sustainability.

The day began with four short presentations discussing experiences in the fields of biodiversity, sustainable food systems, and community participation, followed by three parallel roundtable discussions and a plenary session.

The topics covered by the three round tables concerned the need to support the construction of a bridge between theory and practice. Recent studies

suggest that governance practices in local systems, such as food systems (Manganelli 2022, Halliday 2022) or those aimed at biodiversity conservation (Visseren-Hamakers and Kok, 2022), can benefit from hybridization processes that integrate unconventional actors. We know that, through educational and participatory actions, museums stimulate processes of social, cultural, and environmental change (Hauenschild, 2022). Although museums are not directly involved in food policies, they can contribute to food co-governance practices to the extent that they use learning and capacity-building tools that involve the local community or national and international visitors (Borrelli et al., 2025).

Another topic addressed was the comparison of experiences between institutions. On the national and international scene, various institutions are addressing issues related to the conservation and restoration of biodiversity and the sustainability of food systems. The ways in which they deal with these issues vary greatly, ranging from artistic productions to exhibitions on the theme, such as the Field Museum in Chicago with its Restoring Earth exhibition or the Museum of the City of New York with its Food in New York Bigger Than the Plate exhibition. Increasingly, cultural institutions (museums and ecomuseums) are establishing networks with various local and supralocal entities. Some examples of thematic networks concern the case of the network of Ecomuseums of Taste in the Piedmont Region, or the Food Museums in the Province of Parma. Collaboration in new networks and partnerships with different actors and institutions emerges as fundamental to addressing current challenges. In many cases, these are interinstitutional networks among museums, local authorities, schools, communities, and research and scientific institutions. This synergy is essential both for the conservation and restoration of biodiversity and for raising awareness among a wider audience. Mobilizing institutions and individuals is essential for the success of initiatives. These networks enable the exchange of resources, knowledge, and experiences, promoting the development of sustainable practices. The commitment of

museum associations, including at annual national conferences and in their training and educational programs, is certainly central to the dissemination of good practices among operators in the sector.

Finally, the last issue addressed concerns the assessment of the impact of the actions promoted, which is now the focus of attention not only for researchers but also for politicians and activists. For example, within the framework of the SDGs, both conceptual aspects (such as the choice of indicators and the transition from theoretical definitions to measurable elements) and practical aspects (such as how to raise funds for data collection and who should be responsible for carrying it out) are relevant. In the field, there is a need to identify who has the appropriate training to conduct these assessments or how to provide it. These issues are common to all initiatives aiming to promote change and have an impact both on local communities and on a larger scale. In the development of projects that seek to promote change in a specific natural or social context, for example, impact assessment and measurement are essential for understanding the influence of the activities promoted. However, such impacts are often visible only in the long term, and their measurement may exceed the duration of the project, posing serious challenges to the validation of results.

The discussion that took place at the tables allowed for the integration of the experiences and points of view of both academics and professionals who, with different approaches, work on the issues of biodiversity, food system sustainability, education, and museology.

The discussion highlighted the need to improve knowledge and awareness of these three issues and their interrelationships, challenging old conceptions. The critical issues relating to this macro-objective concern, on the one hand, the ability to reach and activate different populations and stakeholders, promoting networks from the local to the global level; on the other hand, the strategic planning that should characterize this effort, in terms of financial support, governance styles, evaluation methodologies, and so on.

A series of actions and tools has been suggested, based on the needs and objectives highlighted:

- Various types of publication, including:
  - creation of several publications focusing on the relationship between biodiversity, food systems, and education;
  - a summary document aimed at politicians and administrators.
- Exhibitions, including:
  - the creation of a kit for temporary exhibitions (see DisSeminAzioni);
  - The promotion of a master on biodiversity, nutrition, and sustainability;
  - the promotion of various forms of collaboration between artists, museums, and representatives of the food system and rural communities.
- Cooperation, including the establishment of research agreements between universities and the mapping of food systems.

The DisSeminAzioni exhibition is an idea promoted by the Symposium and aims to illustrate the reasons why it is important to disseminate information on biodiversity issues, with the aim of promoting recognition of its intrinsic value. The exhibition is accompanied by this publication, which bears the same title, Disseminazioni: Raccontare la biodiversità (Disseminations: Telling the story of biodiversity), and which opens the series Biodiversità cibo cultura (Biodiversity, Food and Culture) published by Ledizioni, which will also publish other texts, including
"Biodiversity, Food, and Education," by authors Nunzia Borrelli, Karen Brown, Pamela Koch, and Tania Schusler; "Places of Biodiversity: Cities and Landscapes of Contemporary Architecture and Art, Between Nature and Artifice", by Francesca Guerisoli and Andrea Rolando; and "Measuring Sustainability: Strategies and Tools for Research and Design" by Giulia Mura.

Biodiversity as Beauty: The Meaning of the scientific corner and the Digital Exhibition

The exhibition, which this publication explores in depth, essentially aims to sow and spread the idea of biodiversity as beauty and wants to stimulate action. Action that must, however, be guided by common sense and reason (Dante's virtute and conoscenza), but also by feeling and emotion, and therefore by art, which can convey even complex messages in a way that is sometimes much more incisive than scientific texts.

The way the term beauty is used in this work is, we hope, provocative. To quote Renzo Piano, "beauty is never just aesthetic; rather, it is a fragile balance between ethics and poetry, between technique and lightness. It is something that is built with patience, respect, and listening: to the place, the light, the wind, the people," and we would add to nature, which is precisely biodiverse.

The term beauty and the idea that biodiversity is a form of beauty, in this context, go far beyond the aesthetic dimension and have more to do with harmony and balance. The aesthetic beauty of biodiversity, which does exist and manifests itself in the colors of a coral reef, in birdsong, or in the variety of flowers blooming in meadows, is not enough to understand what it is.

Biodiversity, in fact, is not only something to be admired, but also an ethical value. Every living being has the right to exist, regardless of its usefulness to humans. Defending biodiversity means recognizing the deep connection between humans and nature, and taking responsibility for protecting it is an act of justice toward future generations and all forms of life. In an increasingly standardized and attention-seeking world, biodiversity is an irreplaceable source of inspiration, balance, and beauty.

The exhibition disseminates and sows an idea: that of exploring the beauty of biodiversity in all its complexity, intertwining art and photography to stir emotions in visitors. At the same time, it explores how biodiversity is studied in scientific fields such as environmental sociology, with a particular focus on

urban biodiversity, and analyzes the link between biodiversity and food production.

A further objective of the exhibition is to examine the actions taken by certain cultural institutions, particularly museums and eco-museums, to protect and conserve biodiversity.

The exhibition concludes with an explicit call to action, addressed to all those who are sensitive to these issues through the tools offered by participatory science.

In addition to the scientific corner on display in the Department of Sociology, a digital version of the exhibition has been created that can be viewed at the following link: www.biodisseminazioni.it

The result: a brief introduction to the book

The book is organized into eight chapters. This first chapter explains the process that led to the exhibition, the meaning behind it, and the reasons for its organization. At the same time, it briefly presents this publication, illustrating the contents of each chapter.

Chapter 2 examines the role of images in public perception, communication, and the promotion of biodiversity. Starting from the general theme of biodiversity conservation and the link between visualization capabilities and the power to act, it presents the methodological approaches used (between environmental aesthetics and ecocriticism) and the activities carried out by the center. When used well, images can generate awareness and change; however, if not used correctly, they risk obscuring ecological complexity. Visual representation often favors iconic species (such as "charismatic mega fauna"), neglecting less visible levels such as genetic or ecosystem diversity. The chapter highlights how NBFC has studied contemporary visual practices for communication, focusing on coastal and marine environments, and has

created archives and multimedia content to promote an inclusive and critical representation of biodiversity, enhancing it and even transforming the aesthetic strategies of its representation.

Chapter 3 highlights contemporary art's interest in responding to the challenges posed by sustainability, including terrestrial, marine, and aquatic biodiversity. Although not a recent phenomenon, it is increasingly common for various artists internationally to produce works using distinct techniques and approaches that aim to raise awareness of biodiversity or enable people to experience it. Contemporary art responds to the ecological crisis through sensory, slow, and relational approaches. Jakob Kudsk Steensen offers immersive digital experiences, Danh Vo creates spaces for slow and relational regeneration, and Stefano Cozzi highlights the connections between the human body and the environment with a scientific approach. Lars Jan stages human adaptation to sudden floods, recalling the effects of the climate crisis, while Edward Burtynsky visually denounces the environmental impact of mining. Together, these works generate new narrative criticism of the relationship between humans and nature. The aesthetics developed promote empathy, awareness, and connection. Art thus proves to be a powerful tool for communicating biodiversity, stimulating new imagery, and reinforcing new narratives, fostering a critical and sensitive dialogue with our planet.

Chapter 4 analyzes the strategic role of cities in the conservation of urban biodiversity and ecological transition through a three-level methodological framework: quantitative analysis (with the definition of the Re-NATURE Index), study of institutional communication (with the support of an external company), and qualitative research based on interviews. This integrated approach allows us to investigate the intersections between biodiversity, urban governance, civic participation, and climate justice in five Italian cities. The chapter concludes with a reflection on the link between urban biodiversity

and food, highlighting the Slow Food philosophy and Slow Cities as tools to promote sustainable, inclusive, and resilient urban models.

Chapter 5 highlights how biodiversity supports health and food security. NBFC has studied the links between ecosystem degradation and declining nutrient availability, advocating for policies that promote biodiversity conservation alongside sustainable agricultural practices, such as organic and regenerative agriculture. NBFC works in contexts such as Tanzania to promote sustainable agriculture and the recovery of traditional seeds. Community Seed Banks (CSBs) play a key role in seed conservation, access, and dissemination. The experiences presented, in line with FAO principles, strengthen climate resilience, local agricultural culture, and farmers' rights, promoting equity and sustainability, transmitting ancestral knowledge and traditional knowledge, and protecting cultural heritage and continuity between generations.

Chapter 6 addresses the role of museums, ecomuseums, and cultural heritage institutions as actors in the protection and enhancement of biodiversity. From historical collections to participatory practices, these spaces are transformed into places of relationship and sustainable action, committed to building projects capable of systematizing the knowledge collected and catalogued and constructing relationships with communities and the territory. There are numerous significant experiences for biodiversity: from environmental education to *citizen science,* from the digitization of collections, to collaboration with research institutions, from community involvement and participation to the construction of local networks. The project has mapped the Mediterranean eco-museums, assessing their role in environmental governance, sustainable tourism, and food systems. The goal is to develop networks and strategies to integrate biodiversity into the educational and operational practices of museums.

Chapter 7 addresses the issue of assessing and measuring the impact of biodiversity actions, as monitoring the actions implemented and measuring the progress made are essential to achieving concrete results and optimizing investments. It discusses the indicators approved at COP16, which cover ecological, economic, cultural, and social dimensions, providing an integrated framework. The research project assessed how museums and eco-museums can contribute to the application of a set of indicators, including by adapting them to specific missions and practices, and then proposed a set of key indicators in relation to the COP16 targets. Museums and ecomuseums can contribute to participatory monitoring by translating global objectives into local practices. The adaptation of indicators strengthens the role of museums as active players in the preservation and communication of biodiversity. It also emphasizes research activity for the construction of an index that measures the *Webpage Engagement capacity* of institutions as social agents in governance processes for the sustainable transition of biodiversity and food systems.

Chapter 8 represents our call to action. After describing the many links between biodiversity and various aspects of our lives, from art to urbanization, from food systems to museums, this chapter addresses the topic of citizen science, or participatory science. This is a new paradigm that promotes a different view of science in which everyone can play an active role in both collecting data and discussing problems and results. Specifically, a series of concrete examples is offered that allows readers to actively participate in actions dedicated to the study and promotion of biodiversity, for example, in the cities where they live. The aim of this chapter is to open a window onto a relatively recent practice that could prove extremely effective in responding to the crises currently underway.

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Chapter 2

Representing biodiversity: showing and hiding

Chiara Salari

Introduction

The term biodiversity first appeared in the title of a book in 1988[1]. Biodiversity (Wilson and Peter) brings together the results of the National Forum on Biodiversity (Washington, 1986), which, under the auspices of the National Academy of Sciences and the Smithsonian Institution, brought together over 60 biologists, economists, agricultural experts, philosophers, and other professionals to discuss the importance of conserving the variety of living organisms in relation to the threats posed by environmental degradation, species extinction, and potential losses of socio-economic benefits. According to the editor of the volume, biologist Edward Wilson, this growing attention to biological diversity can be attributed to two more or less independent developments: the accumulation of sufficient data on deforestation, biology, and species extinction to think about problems on a global scale and ensure their public dissemination; and the growing awareness of the close link between biodiversity conservation and economic development.

Almost forty years later, economic arguments are among the most commonly used in the cause of biodiversity protection, together with the belief that biodiversity provides "ecosystem services" to human life, such as soil fertility and water quality, as well as cultural and spiritual benefits. These services also include climate regulation, which is increasingly important as the effects of

[1] The term may have appeard for the first time in Dasmann, 1968.

climate change add to the other causes of biodiversity loss[2]: habitat destruction, invasive species, pollution, human population growth and overexploitation of resources. It is still assumed that there is a relationship between the growth of biological knowledge and ethical evolution towards the environment. In an age characterized by the ever-increasing dissemination and circulation of images that allow us to visualize biological diversity – existing, at risk, already lost – the hypothesis is that visual materials create the knowledge and emotional impact necessary for the development of new forms of awareness and action, inviting human communities to discover, value, and protect the environment. How does the link between representation and conservation of biodiversity, between the ability to visualize and the power to act, develop?

Images play a role in shaping cultural, geographical imaginaries and ecological sensibilities, but do not always represent the complexity of ecosystems. They can therefore conceal rather than reveal contemporary environmental and social issues, reproducing the separation between culture and nature. Central to this is the question of the value we place on the natural world in which we have evolved and on ourselves as individuals, and of human behaviour towards the environment that representations express. As the four concluding speakers at the 1986 National Forum on BioDiversity (a poet, a theologian, a philosopher, and a Native American) pointed out, human societies should be considered integral parts of biodiversity, in opposition to a philosophical tradition that keeps humankind separate from an undefined non-human "nature" or a generic category of "animal".

Between environmental aesthetics and ecocriticism: beyond the concept of nature

The most recent developments in environmental aesthetics and ecocriticism challenge anthropocentric approaches to the environment, based on the opposition between the natural and human worlds. The very idea of nature is

[2] These threats are described by the acronym HIPPO: *Habitat destruction*, *invasive species*, *pollution*, *human population growth*, *overharvesting*.

contested in the current geological epoch, the Anthropocene[3], as human impact, which has become a geological force, is literally dissolving the reality of a nature external to human civilisation. Furthermore, the separation between nature and culture, so often taken for granted in the West (Demos, 2015, p. 37), does not have the universality attributed to it. As anthropologist Philippe Descola explained in Beyond Nature and Culture (published in French in 2005), this dualism is not only meaningless to anyone who is not "modern," but also emerged late in the development of Western thought itself, in Europe no more than four centuries ago (Descola, 2021). According to Timothy Morton, in *Ecology without Nature: Rethinking Environmental Aesthetics,* the concept of nature will have to die out in an "ecological state" of human society, as it is paradoxically hindering truly ecological forms of culture, philosophy, politics, and art. The author focusses on the Romantic period and its aesthetics of nature, believing that it still influences the ways in which the ecological imaginary operates. The problem would be the romantic construction of the idea of nature as a separate object (Morton, 2007, p. 125). Morton goes on to explain that nature is not just a term but also something that separates human systems from terrestrial systems. Nature, as such, is a 12,000-year-old human product, both geological (in reference to the development of 'agrilogistics') and discursive (Morton, 2016). In this sense, the conceptualization of the separation between nature and the human sphere would result from a growing real interaction with it, stemming from an increasingly intense exploitation of natural resources (Williams, 1980, p. 83)[4]. While its historical roots can be traced back to the 18th and 19th centuries, environmental aesthetics has developed as a subfield of Western philosophical aesthetics over the past fifty years in response to growing

[3] The term Anthropocene refers to the geological impact of human activities on ecosystems, providing an interdisciplinary meeting point between the natural sciences and the humanities against climate change denial. However, this term conceals important differences in responsibility, because it is not humans as such who pose a threat to the Earth system, but rather certain practices or lifestyles linked to the current capitalist system. Other terms have been proposed that would be more relevant, such as 'capitalocene' (the geological age of capital), or 'plantationocene', which refers to the plantation system as a structural cause of geological transformation (especially in its link to colonialism, slavery or forced labor, and the commodification of nature). See, for example, Moore, 2016; Haraway, 2015; Demos, 2017; and Armiero, 2021.

[4] "the separation is a function of an increasing real interaction".

concern about environmental degradation (Drenthen and Keulartz, 2014; Andermann, Blackmore, and Morell, 2018). Influenced by other disciplines such as landscape architecture, human geography, and ecology, it is increasingly in dialogue with art and media studies. Like ecocriticism, which initially had the mission of studying nature in literature (examining literature from an environmental point of view), it now questions more generally the relationship between cultural imagination and worldview—the meaning given to the environment in cultural productions (Brudin Borg, Wingard, and Bruhn, 2024). At the heart of ecocriticism's concerns is therefore the relationship between humans and the environment, which is investigated through various approaches—such as the "material turn" (Iovino and Oppermann, 2014) or the "blue turn" (Dobrin, 2021)—and disciplinary fields, from art history (Patrizio, 2019; Braddock and Lrmscher, 2009) to film and media studies and geography (dell'Agnese, 2011; Bagnoli and Bozzato, 2023; Latini and Maggioli, 2022). The theoretical perspective of 'Ecocritical Geopolitics,' as presented by Elena dell'Agnese (2021), is particularly interested in environmental discourses expressed in popular culture, focusing on the power that representations can have on our actions and conceptions of the environment:

"What value do we place on 'nature'? What do we think our relationship with the environment should be? And, above all, how did we come to construct the 'catalogue' of taken-for-granted categories with which we make sense of our relationship with non-human animals, plants, wind, and rocks?" (dell'Agnese, 2024, p. 24).

Based on the idea that representations are capable of influencing our territorial actions through the connection between power and knowledge, eco-critical geopolitics seems to share with visual culture studies an interpretation of images not only as cultural practices but also as instruments of power. W. J. T. Mitchell considers landscape as a means of political representation, which has effects on the environment and our relationship with it (2002, p. 262)[5], while Nicholas Mirzoeff starts from the power of images to hide rather than

[5] The aim of the collection of essays *Landscape and Power* is not only to ask what landscape is or means, but also what it "does" to us and to the environment.

reveal environmental issues (2014, pp. 220-222), showing how the representation of air pollution in some modern paintings reveals the environmental destruction caused by human activities and, at the same time, anaesthetizes the effects of its representation on our perception (by aestheticizing the effects of industrial pollution, which are thus naturalized). If some representations tend to obscure environmental issues, according to T. J. Demos contemporary art and visual practices can also play a role in 'decolonizing' our conception of nature (2016). A growing number of artistic projects contribute, in fact, to questioning and reinventing our imagery of so-called natural landscapes.

The activities carried out by NBFC

As part of NBFC's activities, research was carried out on the role of images in communicating biodiversity in a series of contemporary visual practices. Particular attention was paid to the study of the aesthetics of seascapes, questioning the function of photography in the construction or deconstruction of stereotypes linked to coastal areas and islands (between artistic traditions and tourist imagery), and in the representation of issues related to biodiversity. Unlike photographic initiatives that can be problematic because they tend to perpetuate anthropocentric illusions, by representing marine environments primarily as resources to be contemplated (as sublime or picturesque landscapes), exploited (for food production and tourism), or viewed exclusively from the perspective of their vulnerability, the artistic projects chosen as case studies[6] seek to express the environmental, social, and economic inequalities exacerbated by climate change and its consequences on marine biodiversity.

In-depth analyses and viewing paths on biodiversity in Italy have also been created for the online multimedia atlas "Greenatlas. An Environmental Atlas of Italian Landscapes" (https://greenatlas.cloud/). While consulting the film

[6] These include *Else, All Will Be Still* (2013-15) by Ravi Agarwal; *After the Storm* (2016) by Amy Balkin; *The Shape of Water Vanishes in Water* (2018) by Marina Caneve; and *Invisible – Paysages productifs* (2018-2020) by Nicolas Floc'h.

archives of the Istituto Luce offered a historical perspective on visual communication of the environment from the 1920s to the 1970s (when the term biodiversity was not yet in use, but rather pollution and nature as a tourist resource were discussed), research in the RAI archives focused on a selection of television programs from the last twenty years, such as GEO, Linea Verde, Linea Blu, and Wild Italy. With regard to photographic collections and the representation of protected natural areas, the photographic archive of the Italian Geographical Society and the collection of the geographical-environmental photography competition "Obiettivo Terra" were consulted[7]. The aim was to investigate changes in the perception of nature and in the communication, enhancement, or promotion of biodiversity. After an initial phase of exploring materials at the national level, the focus shifted to coastal areas, particularly the Tuscan Maremma and the Po Delta. These two geographical regions, which are often considered "wild lands" despite land reclamation and agrarian reforms, where fishing is practiced and sustainable tourism is promoted, were chosen because they are rich in biodiversity and protected areas.

Biodiversity conservation as a cultural and social issue

This research has also allowed for theoretical reflection on the concept of biodiversity and its representations as cultural productions determined by specific historical and social contexts. The perspectives of cultural and visual studies invite us to interpret the current concern for the loss of biodiversity within the narrative of the "death of nature" in the contemporary era under the impact of modernization: the idea that unspoiled or wild nature, as understood since the Romantic era, has disappeared. As a result, endangered animal species (and to a lesser extent, plants, corals, and fungi) derive part of their value from their rarity and from the broader crisis in our relationship with nature, which the risk of their extinction indicates. Hence the focus on

[7] Promoted by the UniVerde Foundation and the Italian Geographical Society, the competition is now in its 16th edition. With over 17,000 photographs, it is the largest national photographic archive of Italy's protected areas.

'charismatic megafauna', the concentration on the aesthetic beauty of endangered species, forgetting that the concept of biodiversity (according to the UN Convention on Biological Diversity) implies two other levels: not only species diversity but also genetic and ecosystem diversity:

"Biological diversity" means the variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems ("International Convention on Biological Diversity," Art. 2, 1992).

In Imagining Extinction, a book dedicated to the "cultural meanings of endangered species," Ursula K. Heise presents a logic of substitution whereby "charismatic megafauna" species stand for "all animal and plant species," which, in turn, stand for ecosystems and biodiversity; this, in turn, becomes a measure of the value we place on nature. Narratives and representations of endangered species generally reflect the identity concerns of communities and the changes they have undergone through modernization and colonization processes (Heise, 2016). Biodiversity conservation is therefore primarily a social and cultural issue and only secondarily a scientific one (Heise, 2024). The assessment of biodiversity and efforts to protect it are deeply cultural initiatives rooted in historical traditions and value frameworks that indicate which species are valued and conserved, and which are ignored, allowed to become extinct, or actively exterminated, often based on a view of a country's fauna and flora as national heritage.

The concept of "multispecies justice"[8] could prove to be a useful tool for reflecting on biodiversity and conservation actions: it brings to the fore issues of justice for both humans and non-humans, emphasizing that justice itself must be imagined at the intersection of different cultural perspectives that may diverge in their conception of what is just.

Multispecies justice must therefore address two central problems: conflicts between the interests of disadvantaged human communities and non-human

[8] For the concept of "multispecies justice," see also Haraway, 2016, and the recent issue of *Cultural Politics* entitled *Multispecies Justice*, 2023.

species, and conflicts between the interests of different non-human species (e.g., species considered "native" and those considered "invasive"). In *Slow Violence and the Environmentalism of the Poor,* Rob Nixon talks about "anti-human conservation practices," contrasting "the environmentalism of the poor"—care for the environment that stems from a community's dependence on local ecosystems for subsistence, health, and work—with the aesthetic appreciation of nature linked to leisure experiences (Nixon, 2011, p. 18). As is well known, the creation of American national parks has often been synonymous with the expulsion of Native Americans in favour of tourism development. Even today, although biodiversity conservation initiatives are important for preserving certain habitats, they can conflict with the activities of local communities, making it difficult to strike a balance between human needs and environmental protection.

Connections with other projects

"Creatures with surprising shapes, unique characteristics, and exceptional behaviours—flat-headed frogs with piercing cries, horned snakes, four-eyed fish, highly poisonous newts, long-nosed monkeys, and moustachioed walruses—appear throughout these pages in a series of images of exceptional expressive power, becoming true testimonials to biodiversity" (Sartore, 2021).).

This description of Joel Sartore's photographic series, published in National Geographic under the title "Photo Ark Wonders", is emblematic of a sort of "virtual" conservation effort based on the aesthetic value and emotional impact of images that highlight the beauty and strangeness of animal and plant species that are at risk, endangered, or already extinct. Artists have long been creating visual inventories to express the biodiversity crisis, starting with John J. Audubon's controversial series, Birds of America (1827-1838), moving on to more recent examples such as the volumes A Gap in Nature: Discovering the World's Extinct Animals (2001), in which Tim Flannery and Peter Schouten reproduce extinct species through hyperrealistic paintings; Remains of a Rainbow: Rare Plants and Animals of Hawaii (2001; 2003) by Susan

Middleton and David Liittschwager, which depicts endangered plant and animal species through photography; Extinct Birds by Errol Fuller (1987; 2001), which collects illustrations and photographs of extinct bird species by a wide range of artists and from different historical periods; Isabella Kirkland's Taxa series (2006), to the use of websites[9].

The rapid pace of species loss over the past two decades has spurred the creation of global visual archives and multimedia databases on biodiversity, which take a more scientific and documentary approach than the artistic representations collected in books, catalogs, and magazines. For example, ARKive.org has created a visual inventory of more than 16,000 endangered species in the belief that "you can't save what you can't see." With the goal of using the power of images to inspire the global community to discover, value, and protect the natural world, it targets a general audience of educators, schools, communities, and environmental conservation organizations. Now under the auspices of the non-profit organization Wildscreen (https://wildscreen.org/), the new version of this archive has been created for young people, educators, photographers, and filmmakers, and also offers free educational resources in the form of downloadable lessons. Another biodiversity database, "The Encyclopedia of Life" (https://www.eol.org/), aims to provide "global access to knowledge about life on Earth" through open access providers of biodiversity knowledge around the world, including museums and libraries, universities and research centers, scientists, students, and citizen science communities. In addition to providing biological and ecological information, red lists classify species according to their risk of extinction. For example, the "IUCN Red List" (https://www.iucnredlist.org/), established in 1964, is a critical indicator of the health of global biodiversity, a tool to inform and catalyze action for biodiversity conservation.

Global digital databases on biodiversity can be understood as the result of the convergence of two trends: an encyclopedic and centripetal impulse that dates back to the Enlightenment and aims to inventory the entire known world,

[9] See, for example, Maya Lin's website "What Is Missing?" (https://www.whatismissing.org/).

and the hypertextual and centrifugal architecture of the Internet, which composes a representation of this world through the constant data movement [10], presenting itself as freely accessible to anyone. The question is how greater accessibility, not only to the use but also to the production (or participation in the creation) of visual content, can lead to greater knowledge and appreciation of biodiversity, and thus to a transformation of our perception of nature. While these archives and databases seek to express the global dimension of biodiversity loss through panoramic views of the current sixth mass extinction, there is an increasing number of photography competitions and citizen science projects inviting citizens and visitors to natural parks to submit their images, participate in the communication and visual memory of local biodiversity, and reproduce or transform the aesthetic strategies of its representation.

[10] The database has been considered by media theorists as an emerging cultural genre, a new way of structuring our experience of ourselves and the world, the "symbolic form" of the information age. See Manovich, 2001. The "perspective as symbolic form" of the Renaissance was theorised in Panofsky, 1991 (1924).

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Chapter 3

Representing biodiversity: aesthetic convergences

Ginevra Addis

Introduction

In recent years, since 2015, the biodiversity crisis has emerged as one of the most serious global threats to the planet's balance. According to the *Global Assessment Report on Biodiversity and Ecosystem Services* published by IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) in 2019, approximately one million animal and plant species are at risk of extinction over the next few decades due to human activities, including deforestation, intensive agriculture, pollution, and climate change.

Within the framework of the 2030 Agenda for Sustainable Development, the visual arts have progressively taken on a key role in raising public awareness of these issues through exhibitions, site-specific installations, immersive experiences using artificial intelligence and augmented reality, and participatory experiences organized by local cultural institutions such as ecomuseums. We have seen how international artists, through the medium of contemporary art, have begun to engage with concepts such as biodiversity, ecological interconnection and the Anthropocene, opening up new spaces for imagination and reflection.

This chapter analyzes five distinct artistic approaches that relate aesthetics and biodiversity, illustrating how contemporary visual arts can represent, interpret, or problematize the ongoing ecological crisis. The works analyzed

are: *Berl-Berl* by Jakob Kudsk Steensen, *Station Haven* by Danh Vo, two photographs from the series *When I Left Home* by Stefano Cozzi, *Holoscenes* by Lars Jan, and *Gold Tailings* by Edward Burtynsky. These projects offer not only alternative aesthetic visions but also strategies for emotional, cognitive, and political engagement, capable of reformulating our relationship with the living; that is, all forms of life, human and non-human beings make up terrestrial and marine ecosystems. The works analyzed contribute to questioning the absolute centrality of human beings, proposing relational models based on empathy, interdependence, and coexistence. Through sensory, performative, photographic, and installation languages, these artistic practices allow us to perceive biodiversity not only as a set of biological data, but as a complex web of relationships on which we too depend deeply, leading humans to feel at one with the ecosystem.

The activities carried out by NBFC

Jakob Kudsk Steensen: immersion in digital ecology

Berl-Berl is a living simulation and virtual performance stage, created in collaboration between artist Jakob Kudsk Steensen, the Museum für Naturkunde in Berlin, curator Emma Enderby, who specializes in contemporary and environmental art practices, and the LAS Art Foundation, a Berlin-based institution dedicated to promoting interdisciplinary projects between art, science, and technology. The installation was first exhibited in the summer of 2021 at Halle am Berghain, an exhibition space located in Berlin, and will also be presented at the ARoS Museum of Art in 2022, a contemporary art museum in Aarhus, Denmark. Created using the Unreal Engine graphics engine—a platform used for the development of three-dimensional digital environments originally designed for video games—the work combines macro-photogrammetry photographs, field recordings,

scientific data, and hybrid soundscapes, creating an immersive landscape inspired by the marshes of the Berlin-Brandenburg region. These ecosystems, native to the urban area, were extensively reclaimed in the 18th century, leading to the alteration of the hydrogeological balance and the loss of habitats essential for biodiversity. These factors have accelerated the processes of reducing carbon absorption capacity and increasing vulnerability to extreme weather events, thus contributing significantly to the contemporary climate crisis.

Berl-Berl presents itself as a changing organism, a virtual landscape that makes the deep history of the territory tangible, from the ice ages to the present. The soundscape was created by Matt McCorkle, an American sound designer known for his collaborations in the environmental and immersive fields, and Arca, a renowned Venezuelan musician and performer who works with electronics to explore themes related to identity and transformation, blending the sounds of local amphibians and environmental vibrations to create an immersive and sensory experience. The work thus becomes an emotional and cognitive portal that connects the audience to a forgotten ecosystem, revealing otherwise inaccessible perspectives and inviting them to reconsider the relationship between humans and nature.

Figure 1. Jakob Kudsk Steensen, Berl-Berl, 2021. Live simulation (styles). Commissioned by LAS Art Foundation. Courtesy of the artist.

Figure 2. Jakob Kudsk Steensen, Berl-Berl, 2021. Live simulation (styles). Commissioned by LAS Art Foundation. Courtesy of the artist.

Danh Vo: the ecology of care and slowness.

With Station Haven, Danh Vo presents an ever-evolving landscape installation, launched in 2021 next to the Niva railway station in Denmark as part of the *Danh Vo Presents* commission promoted by The Nivaagaard Collection. The project, designed to evolve over more than a decade, transforms a small piece of wasteland into a fertile garden, in dialogue with the local community and the spontaneous biological balance of the place. Vo, born in Vietnam in 1975 and a refugee in Denmark after his family fled by sea during his childhood, bases his practice on objects, gestures, and relationships marked by time and migration. His artistic approach intertwines personal memories and collective history, creating environments and situations in which organic change is an integral part of the work. Station Haven is created in collaboration with Carsten Rahbek, biologist and professor of biodiversity at the University of Copenhagen, chef and agri-food activist Christian Puglisi, and the director of the Danish non-profit organization ART 2030, Luise Faurschou. Together, these actors explore

themes such as sustainable agriculture, biological time, the interdependence of species, and the very definition of value and beauty in the context of the ecological crisis. The work acts as an ecological refuge, a laboratory of regeneration in which the public observes the growth of plants throughout the seasons, coming into contact with the time of nature, which rarely coincides with that of humans. The aesthetics of proximity, which underlie this project, imply a form of slow and situated attention, a sensitive and everyday relationship with the inhabited space. It contrasts with the spectacular and detached aesthetics of works often linked to the theme of the Anthropocene, proposing a poetics of care, coexistence, and participatory observation. The garden, rather than an aesthetic object, becomes a relational and political subject: a space for thinking about and practicing biodiversity through communal living.

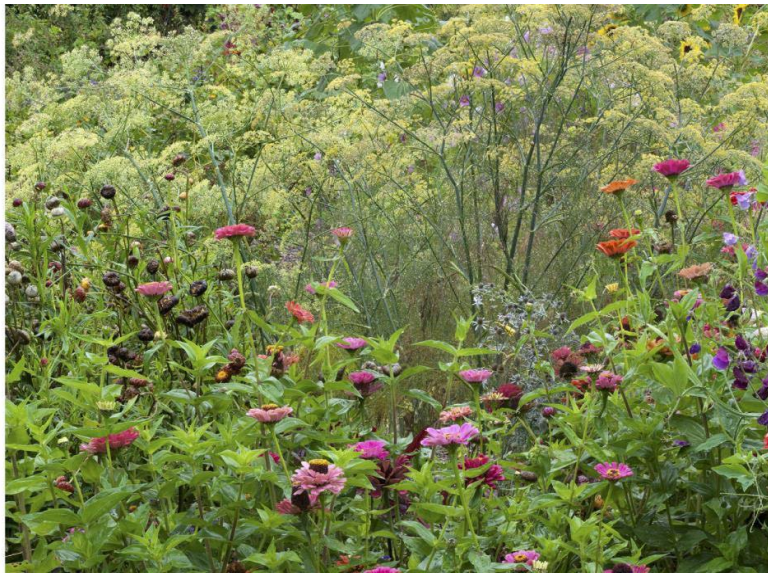

Figure 3. Danh Vo, Güldenhof 2028-2025. Photo credit: Nick Ash

Figure 4. Danh Vo, Güldenhof 2018-2025. Photo credit: Nick Ash

Stefano Cozzi: the non-separation between the body and the environment

In the photographic series When I Left Home (2025), Stefano Cozzi explores the concept of the non-separation between human beings and the environment, conducting a poetic and visual investigation into the experience of moving away, detachment, and the formation of new connections. The series consists of twenty-two photographic e-lambda prints, the result of shots taken while traveling, in which the artist activates an intimate and perceptive

reflection on the links between memory, observation, and belonging. The selected images are inspired by sensations and memories from childhood and early adolescence, transforming the act of leaving home is a process of opening up to the world and renegotiating one's place in the ecosphere. Through a montage of color photographs, with long night exposures, infrared and false-color shots, Cozzi constructs a visual narrative in which the human body becomes an extension of the landscape and nature emerges as a place of belonging. The photographic device is never neutral but becomes an instrument of investigation and revelation: nude images, portraits, details of works of art, and fragments of nature alternate in a rhythm that combines continuity and discontinuity, evoking the silent interactions between skin, light, and environment. The diptych that closes the series, depicting two women inside the kitchen of a restaurant overlooking the street, introduces a powerful metaphor: the fogged glass that separates the observer from the scene transforms the environment into a relational ecosystem, whose visible and invisible connections refer to what lies outside the image. In this way, the gaze becomes an ethical act and a foreshadowing of the possibility of shared existence, capable of inhabiting the experience of others.

Infrared images, normally used for vegetation mapping or thermal studies, are reactivated as perceptual and philosophical tools, capable of making the invisible visible, highlighting energy flows and the echo of the relationships between body and environment. The poetics of "non-separation" takes shape in Cozzi as aesthetics and critical practice: the ecological crisis is not seen as an external event but as a condition that permeates and shapes us, implying a radical rethinking of the nature/culture dualism. This approach is also found in the video Stranded. Stories from a Time of Stillness, where the artist documents the global consequences of the eruption of the Eyjafjallajokull volcano in 2010. The work weaves together distant stories—flower growers in Kenya, workers in New Zealand, travelers stranded in Europe—to show how natural events reveal the systemic fragility of our interconnectedness. With a style close to Werner Herzog's poetic documentary, Cozzi interrupts the narrative linearity to introduce visual

suspensions that function as critical pauses. In his works, ethics and aesthetics are never disjointed: visual experimentation, social commitment, and philosophical reflection intertwine in a continuous process of observation and imagination. For Cozzi, photography, like video, becomes a language of resistance and a means of constructing future visions capable of restoring meaning to a fragmented present. His is a gaze that inhabits uncertainty and makes art a space of possibility, where the invisible, the vulnerable, and the eco-systemic find form and voice.

Figure 5. Stefano Cozzi, When I left home, 2025. Courtesy of the artist.

Figure 6. Stefano Cozzi, When I left home, 2025. Courtesy of the artist.

Lars Jan: performing climate collapse

Holoscenes (2014–2025) is a complex project of performance installations conceived by American artist Lars Jan with the Los Angeles-based art collective Early Morning Opera. At the center of the work is a large transparent sculpture, resembling a totemic aquarium towering more than four meters tall, located in an urban space and visible from all angles. Inside, performers carry out everyday tasks—washing windows, selling fruit, playing the guitar, wearing traditional

dress, and watering with a hose—while the tank fills and empties with water in less than a minute, thanks to a hydraulic system that moves up to 15 tons. The performance continues even during the flooding, producing an alienating and disturbing effect: water, a vital and destructive element, invades the scene and transforms the ordinary into something surreal. The work has been presented in several international cities—, including New York, Toronto, and London—also involving organizations active in climate change education. Jan constructs a veritable theatre of the Anthropocene: normality collapses under the pressure of extreme events, but human behaviour remains unchanged, as if nothing were happening. The message is powerful and direct: climate change is no longer a future risk but a present reality that is manifesting itself with increasing intensity. The artist invites the audience to question the relationship between habit and catastrophe, between perception and denial. The aesthetics of Holoscenes are performative, immersive, and provocative: they generate empathy but also unease, making the invisible visible through the body in action. In this installation, the artist questions our ability to face the climate emergency not only with awareness but also with a new ethic of attention, capable of overcoming indifference and recognizing the crisis as an integral part of our present.

Figure 7. Holoscenes - Miami 2015 - installation view - photo by Lars Jan

Figure 8. Holoscenes - Quebec City 2022 - installation view - photo by Lars Jan

Edward Burtynsky: landscapes of the Anthropocene

For over forty years, Canadian photographer Edward Burtynsky has devoted his visual research to the impact of human activity on Earth. In Landscapes of Extraction, the artist documents the deep wounds left by the extractive industry: quarries, salt flats, rare earth mines, and tailings ponds. His aerial images—taken from helicopters or drones—show transfigured landscapes in which artificial geometries and unnatural colors reveal the radical transformation of the environment by humans. Burtynsky defines his work as a form of "visual archaeology of the present," a mapping of the Anthropocene that combines aesthetics and denunciation. The recent exhibition Extraction/Abstraction (February 2024) at the Saatchi Gallery in London highlighted the evolution of his visual language through technological changes in photography, revealing the consistency of his critical gaze on human

encroachment on the natural landscape and its systemic consequences. Among his most significant works is Gold Tailings #1, Doornkop Gold Mine, Johannesburg, South Africa (2018), in which Burtynsky photographs the waste from gold processing in one of the most symbolically complexes contexts on the planet: post-apartheid South Africa. The image shows a land surface engraved with flows and layers of toxic materials, the result of chemical separation processes for precious metals. The colors—ranging from ferrous red to sulphur yellow—intertwine in compositions reminiscent of pictorial abstraction, but they tell a story of a reality marked by environmental violence. The photographer transforms what remains of the extraction into an ambivalent image: one of extraordinary formal beauty and, at the same time, disturbing toxicity. The work not only denounces environmental damage but also evokes the economic and colonial history linked to the exploitation of African resources. Gold Tailings thus becomes a double portrait: of the wounded environment and of a global system that continues to reproduce dynamics of inequality and devastation. In his work, Burtynsky also explores the theme of secondary extraction, documenting the recycling of electronic waste in urban centers in Canada and China. However, these practices remain marginal compared to the scale of primary extraction that still dominates our material economy. With an aesthetic of silent denunciation, Burtynsky prompts the viewer to confront the ambiguous beauty of human impact: his images captivate the gaze and then question it, suspended between the sublime and ruin, between abstraction and testimony. Gold Tailings #1 is not just a photograph of industrial waste, but an act of memory and criticism that makes visible what the market tends to hide: the material and symbolic traces of the global ecological crisis.

Conclusions

Despite the diversity of media, contexts, and approaches, the works analyzed in this chapter share a common tension: the desire to overcome anthropocentrism and build new ways of relating to the living world. In each project—from Jakob Kudsk Steensen's digital ecology to Danh Vo's regenerative slowness, from Stefano Cozzi's perceptive sensitivity to Lars Jan's performative provocation, and to Edward Burtynsky's critical cartography of the Anthropocene—biodiversity is not treated as a simple object of representation, but as a process, an experience, and a living presence to be explored and questioned.

These artistic practices transform the visual into a relational device: they produce forms of sensitive knowledge, open up alternative imaginaries, and stimulate new models of ecological awareness. In them, biological diversity is intertwined with a diversity of perspectives, techniques, and temporalities: the immersive gaze, everyday gestures, slowness, and poetic documentation. Contemporary art thus becomes a laboratory for environmental experimentation, in which alliances between aesthetic languages, scientific practices, and civic responsibility are activated. In the context of the climate crisis and the erosion of ecosystems, these works demonstrate how the visual arts assume a transformative role, contributing not only to raising awareness but also to forming new ways of observing, listening to, and interpreting the world. Representing biodiversity today, therefore, means breaking down the divisions between nature and culture, between observation and participation, and between art and science. It means recognizing that every image, sound, or gesture can become a generative act: not only denunciation but also care, memory, and proposal. In this sense, exhibitions, installations, and artistic experiences become true cognitive, affective, and perceptual ecosystems—spaces in which to think, feel, and act for a more sustainable future, where aesthetics become ethics and sensitivity becomes an active form of coexistence.

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Chapter 4

Feeding on biodiversity: Life in contemporary cities

Monica Bernardi, Nunzia Borrelli, Piergiorgio Oliveti, Alessandra Terenzi

Introduction

The United Nations Convention on Biological Diversity defines biodiversity as the variety and variability of all living organisms that interact with each other and with the environment within complex ecosystems. In urban areas, this concept translates into urban biodiversity, i.e., the set of animal and plant species that populate cities and interact in different urban spaces. It includes not only planned green areas—such as parks, gardens, and tree-lined avenues—but also spontaneous habitats that develop in residual spaces, abandoned areas, flower beds, and infrastructure. This approach highlights how essential it is to preserve and enhance biological diversity in cities, both for human well-being and to strengthen the ecological resilience of urban environments. In this sense, urban biodiversity is a structural element of urban ecosystems, contributing directly to the quality of life and the ability of communities to address environmental challenges.

Thanks to its ecological wealth, Italy is considered one of the most important biodiversity hotspots in Europe (MASE, Ministry of the Environment and Energy Security). However, this heritage is increasingly compromised by a global process of environmental degradation that is causing the irreversible loss of habitats, species, and natural systems, with serious repercussions on the planet's balance.

In this context, cities play a central role. On the one hand, they are among the areas most affected by climate change—such as droughts, heat waves, floods, intense storms, and landslides (IPCC, 2022)—and, on the other hand, they are responsible for a significant part of biodiversity loss at the local and global levels. This is due to high land consumption, a marked ecological footprint (UN-Habitat, 2016), CO_2 emissions, and the increasing artificialization of urban ecosystems. At the same time, cities are also places where solutions are concentrated. The 21st century has been called "the century of cities" (Barber, 2013) precisely because of their growing role as spaces for experimenting with new models of urban governance capable of responding to ecological and social challenges (Rosenzweig et al., 2018).

Today, cities can no longer be considered passive recipients of global crises: they have become key players in the ecological transition. They can take on the role that was once reserved for governments, promoting transformative policies, anticipating change, and translating climate goals into concrete actions. This requires moving beyond the theoretical level to implement measures that include reducing the carbon footprint, promoting resilient communities, protecting and enriching urban biodiversity, adopting renewable energy, and implementing innovative strategies for sustainable resource management.

Numerous scientific studies show that urban biodiversity produces multiple benefits: ecological, social, and cultural. These include urban climate regulation, stormwater management, air purification, and positive impacts on citizens' mental and physical health (Aronson et al., 2014; McKinney, 2008). Furthermore, the presence of biodiversity in cities strengthens the bond between people and nature, contributing to greater environmental awareness and a sense of collective responsibility (Dearborn & Kark, 2010). Aronson and McKinney highlight how biodiversity is a pillar of urban sustainability and resilience.

In light of this evidence, it is clear that cities of the future will need to invest heavily in the conservation and enhancement of urban ecosystems. This requires a rethinking of urban policies, integrating strategies geared towards sustainability and resilience. It is necessary to promote green infrastructure and ecologically active spaces, limit land consumption, protect remaining natural habitats, and equip ourselves with governance tools capable of managing the social, ecological, and economic dynamics that characterize urban contexts in an integrated manner.

Such an integrated approach is essential to make cities not only more sustainable but also more livable and able to face the challenges posed by climate change and biodiversity loss. Local administrations must therefore equip themselves with the appropriate skills and tools to manage biodiversity effectively, promoting concrete actions in the territory, actively involving citizens, and communicating transparently about the value of interventions. Citizen participation is not an accessory element, but an essential component for the success of environmental policies.

The activities carried out by NBFC

The real challenge lies in translating global commitments into measurable local actions, transforming cities from sources of environmental pressure into catalysts for ecological regeneration. To this end, it is essential to have effective tools for assessing, monitoring, and comparing urban biodiversity. Such tools can provide a useful framework for both local governance and the analysis of the effectiveness of urban policies, guiding future choices towards concrete and tangible ecological transformation.

In this regard, a methodological research framework (Bernardi, Borrelli, Terenzi, 2024) has been developed, structured on three distinct but interconnected interscalar levels: quantitative research, communication analysis, and qualitative research. These three areas of investigation are

complementary and consistent with each other, helping to outline an integrated and multidimensional view of urban reality.

The model was applied in practice to five Italian cities—Genoa (Fig. 1), Naples (Fig. 2), Palermo, Florence, and Milan—selected for their complementary characteristics with regard to urban biodiversity in the Mediterranean context. Genoa, Naples, and Palermo are large port and coastal cities, emblematic of areas where urban biodiversity intertwines with marine and coastal ecosystems, highlighting the challenges of urban resilience and natural resource management. Florence and Milan, on the other hand, are inland cities with different ecological and social dynamics, whose inclusion allows for the analysis of urban biodiversity even in metropolitan contexts far from the coast. This choice has made it possible to construct a heterogeneous but coherent sample, capable of representing the main Italian urban configurations from a Mediterranean perspective, highlighting territorial, ecological, and cultural diversity.

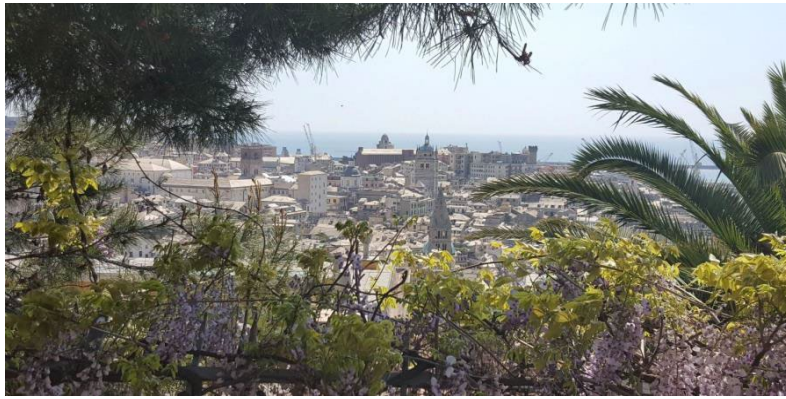


Figure 1. Urban view of Genoa: an example of integration between urban structure and Mediterranean biodiversity, where the morphology of the territory and the presence of coastal and hilly ecosystems shape the interaction between nature and the city (Source: Canva).

Figure 2. Panorama of Naples: the city develops between volcanic, coastal, and anthropized environments, highlighting how Mediterranean biodiversity persists and adapts in the context of a historic metropolis (Source: Canva).

The quantitative component is based on the construction of an innovative index, the Re-NATURE Index (Resilience, Sustainability, Virtuousness & Responsiveness Biodiversity Index). This tool was designed to measure the challenges related to urban biodiversity through a systemic and operational approach, structured around four fundamental dimensions: resilience (ability to adapt to chronic stress), virtuosity (ability to respond to social pressures), reactivity (ability to cope with acute shocks), and sustainability (quality and duration of the strategies adopted). This is a conscious methodological choice aimed at placing cities within a broad and interconnected territorial framework.

Thanks to a multi-level analysis, the Re-NATURE Index allows for the identification of the strengths and weaknesses of metropolitan cities, offering useful tools for guiding targeted urban policies and concrete interventions. The index is developed through five **Thematic Analysis Clusters,** each of which represents a key dimension of the relationship between cities, nature, and society (Fig. 3):

1. People Engagement

This cluster assesses the degree of active citizen participation, recognizing the essential role of communities in building sustainable and resilient cities. Urban biodiversity cannot be separated from people's participation. Involving citizens means raising environmental awareness, promoting sustainable behavior, and strengthening the sense of belonging. The cluster explores topics such as environmental education, social cohesion, collaborative initiatives, inclusiveness, and active citizenship. Citizen involvement is therefore considered a crucial factor in enhancing the bond between people and nature and making cities more livable and inclusive.

2. Economic Prosperity

It investigates the connections between biodiversity and equitable economic development, emphasizing how the quality of the urban environment is closely linked to collective well-being. A sustainable city must create accessible economic opportunities, promoting environmental innovation and social cohesion. This cluster focusses on the integration of economic development, sustainability, and inclusion, promoting the use of innovative technologies and green infrastructure that can generate a prosperous urban economy capable of ensuring equity. The focus is on models that combine growth and environmental protection, helping to improve the quality of life in urban areas.

3. Urban Biodiversity Governance

It focuses on the capacity of urban institutions to manage biodiversity and natural resources effectively and strategically. Environmental governance is the context in which rules, instruments, policies, and actions are defined to protect and enhance natural and social capital. This cluster examines the level of integration of urban policies with environmental challenges, promoting a participatory and transparent approach. It analyzes the soundness of institutions, the consistency of action plans, the capacity for cross-sector coordination, and the activation of inclusive land management tools.

4. Climate Justice

It reflects on fairness in the distribution of environmental risks and benefits, emphasizing how climate change tends to accentuate social and territorial inequalities. Ensuring climate justice means ensuring that biodiversity protection policies are inclusive and do not contribute to increasing disparities. This cluster assesses the ability of urban communities to adapt equitably to climate impacts, promoting safety and resilience through policies that focus on the redistribution of benefits (such as access to green spaces) and the mitigation of environmental costs (such as exposure to risk). The goal is to build fairer cities that are capable of integrating sustainability and social rights.

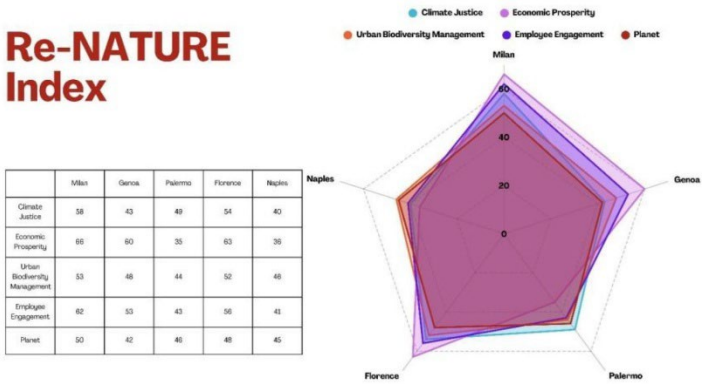
5. Planet

It examines the impact of cities on global ecosystems and the relationship between urban well-being and the health of the planet. The cluster is based on a systemic vision aimed at promoting responsible resource use practices, strengthening the resilience of urban ecosystems, and reducing emissions through active biodiversity protection. The focus is on monitoring environmental quality, land management, promoting green infrastructure, and climate adaptation strategies. In this way, the cluster highlights how urban biodiversity can contribute to climate change mitigation, generating benefits at both the local and global levels.

The Re-NATURE Index is therefore not only a measurement tool but also an operational device capable of guiding urban strategies from an integrated perspective. Its division into thematic clusters allows the complexity of urban sustainability to be addressed through an intersectoral and multidimensional approach, capable of bringing together environmental, social, economic, and institutional aspects.

Through this index, cities can develop data-driven policies, assess their environmental performance, and identify areas for improvement. The

systemic and multi-level approach offered by Re-NATURE encourages the development of strategic planning tools that can be adapted to local contexts without losing sight of global sustainability goals. It also promotes the development of an urban culture focused on resilience, justice, and inclusivity, which are essential elements for addressing future challenges. Equipping cities with the right tools to measure, assess, and monitor urban biodiversity means offering public decision-makers and local actors concrete support for implementing effective policies. It also means making communities more aware and involved in the ecological transition, transforming cities from factors of environmental pressure to true catalysts of regeneration.



	Milan	Genoa	Palermo	Florence	Naples
Climate Justice	58	43	49	54	40
Economic Prosperity	66	60	35	63	36
Urban Biodiversity Management	53	48	44	52	46
Employee Engagement	62	53	43	56	41
Planet	50	42	46	48	45

Figure 3. The figure shows the performance of the five cities analyzed in each of the Thematic Clusters, based on the results obtained through the application of the Re-NATURE Index.

The second level of the survey analysed communication and narratives on urban biodiversity as part of the Mapping the Urban Biodiversity DISCOURSE project, with the support of Words, a company specialising in public communication and narrative strategies. The aim was to understand how biodiversity is communicated and perceived in urban contexts, with a focus on institutional communication by municipalities (Fig. 4). The languages, tools, and strategies used to raise awareness among citizens were examined, assessing the consistency between messages and actions and their impact on public participation. The survey highlighted the central role of communication as a lever for urban transformation, capable of guiding behavior, generating a sense of belonging, and making visible the connections between nature, health, and quality of life.

Figure 4. The figure shows how much biodiversity is discussed in Milan, Genoa, Naples, Florence, and Palermo, through the temporal trend of the number of clips (media and social content mentioning the topic) and the relative audience engagement. The peaks highlight moments of greatest attention, often linked to public events, campaigns, or local news.

The third strand, of a qualitative nature, explored the ways in which biodiversity is integrated into urban policies, with a particular focus **on governance, institutional communication, and civic participation.** Through interviews with various actors (experts, administrators, technicians, stakeholders, and policymakers), obstacles, enabling factors, and operational strategies aimed at promoting the protection and enhancement of biodiversity in urban areas emerged.

Common critical issues include the fragmentation of responsibilities between offices and institutional levels; the difficulty of ensuring continuity of action in the absence of structural funds; the lack of indicators and tools for monitoring urban biodiversity; and, in terms of communication, biodiversity is often perceived as a technical or marginal issue, with a general weakness in the ability to engage citizens and raise awareness of the ecological and social importance of the issue.

Alongside these critical issues, however, there are also promising experiences: local practices of urban renaturation and co-design; citizen science initiatives and school involvement; and initial attempts to build cross-sectoral task forces to address biodiversity in a transversal manner. In many cities, participation in European projects and international networks has also provided an opportunity to experiment with innovative approaches, although the challenge of embedding these experiences in ordinary urban governance processes remains.

The integration of the three levels of investigation—quantitative, communicative, and qualitative research—has made it possible to address urban biodiversity in a multidimensional and coherent way, overcoming the fragmentation typical of sectoral approaches. The methodological framework is an innovative model of integrated analysis, capable of combining scientific rigour, operability, and adherence to real contexts.

The Re-NATURE Index provided an objective basis for evaluating urban

performance; discourse analysis interpreted meanings and perceptions related to biodiversity; while qualitative research explored decision-making dynamics and governance practices.

Overall, these tools offer an operational view of cities as spaces where biodiversity is a lever for sustainability, equity, and social innovation. This approach provides concrete support for urban policies, guiding planning towards more participatory, inclusive, and resilient solutions.

Connections with other projects

However, alongside the necessary measurement and management of biodiversity, it is equally essential to activate production and governance processes that favor sustainable development models, both from an economic and social point of view. A symbolic area in this sense is food biodiversity, which is now deeply threatened by global market dynamics. Suffice it to say that 60% of the world's food supply is based on just three cereals—, wheat, rice, and corn—, which are grown in hybrid form by a small number of multinationals, with dramatic consequences for the thousands of local varieties once widespread in Asia, Africa, and Latin America.

This process has serious repercussions not only on natural biodiversity but also on local economies and traditional knowledge. Shepherds, farmers, and fishermen, who for generations have adopted production practices in harmony with ecosystems, find themselves progressively excluded from an agri-food system dominated by profit and competition. The consequences of this imbalance are also evident in urban areas, where the construction and governance of **sustainable and accessible food systems** are becoming determining factors for quality of life and social cohesion.

In response to these critical issues, significant initiatives have emerged, such as the Cittaslow network (1999), founded by a group of Italian municipalities inspired by Slow Food (1989). These initiatives promote an alternative model

of local development based on quality, slowness, the protection of biodiversity, and the enhancement of local characteristics. Applied to the urban environment, the slow movement philosophy emphasizes the value of care, active participation, and sustainability as a pillar of collective well-being and liveability in cities.

In recent years, many urban administrations have taken a leading role **in building sustainable food systems,** positioning themselves as laboratories for social and environmental innovation. Through local and international networks, administrators, policymakers, activists, and producers have jointly designed initiatives aimed at preserving biodiversity, recovering knowledge related to local products, and promoting native breeds and traditional plant varieties. In this scenario, **food governance** is a key tool for promoting social inclusion, strengthening urban resilience, and guaranteeing collective rights.

The link between **urban biodiversity, sustainable food systems, and community participation** therefore takes on strategic value in addressing the major challenges posed by the climate and environmental crisis. Cities, from simple places of production and consumption, are evolving into global actors of change, capable of guiding the ecological transition through integrated, collaborative, and systemic approaches.

Only by equipping cities with the right tools—such as the Re-NATURE Index, local governance networks, and models inspired by the slow philosophy—will it be possible to imagine and build livable, equitable, and sustainable urban centers capable of preserving and regenerating biodiversity as a common good.

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Chapter 5

Feeding on Biodiversity: Agriculture, Food, and Seeds

Nunzia Borrelli, Giuseppe de Santis, Laura Lancellotti, Giulia Mura, Laura Prosperi

Introduction

For many years now, research has demonstrated the connection between industrial, intensive, monoculture-based food production and biodiversity loss. In turn, biodiversity loss affects the nutritional quality of food and, consequently, human health (Horrigan, Lawrence, and Walker, 2002).

Biodiversity is the foundation for resilient ecosystems, which are essential for sustainable food production. Preserving biodiversity requires a concerted effort to protect habitats, reduce human impacts, and promote practices that favor its recovery. This involves not only conserving iconic species but also safeguarding the genetic diversity of flora and fauna, ensuring the resilience of ecosystems in the face of environmental disturbances (Mace et al., 2012).

Developing food production systems that draw on cultural traditions can have repercussions for both food and environmental security; by conserving native seeds, promoting organic farming methods, and valuing traditional knowledge, communities can not only preserve biodiversity but also ensure food security for future generations.

In other words, biodiversity is the basis of our food. Each seed contains a history of climates, cultures, and adaptations and guarantees variety on our

tables. Preserving seed diversity means protecting the future of agriculture, making it more resilient to climate change and disease (Westengen, Dalle, and Mulesa, 2023). Moreover, seeds are not alone in this balance: insects such as bees, bumblebees, and butterflies also play a fundamental role. It is they, through pollination, that enable the formation of fruit and the reproduction of many cultivated plants. Protecting these small allies means safeguarding the food chain, sustainable agriculture, and the safety of our food.

Intensive agriculture, pesticide use, and habitat loss are threatening both traditional seeds and pollinating insects (Kovacs-Hostyanszki et al., 2017). Defending biodiversity means choosing local foods, supporting organic farming, and promoting ancient varieties: in this way, we can build a healthy, fair, and sustainable food system.

The issue of conservation and promotion of native species and biodiversity linked to food production is very broad and highly complex. Both the media and academia are actively seeking strategies to increase visibility and public discussion on these issues.

These issues can be promoted in different ways, for example, through sustainable and responsible tourism projects or by identifying actors who are not necessarily part of the governance of the food system, such as museums and ecomuseums, which may work to reduce the gap between theory and practice. That is, i.e. they can promote greater dissemination of scientific knowledge on the subject and more solid implementation of new behavioral patterns.

The center has worked on these two fronts, conducting research that has made it possible to understand how tourism can become a tool that promotes the conservation and protection of biodiversity, while also exploring the role of actors (museums and ecomuseums) that do not strictly belong to the governance of biodiversity and the food system in defining practices capable of promoting greater dissemination of scientific knowledge and new ways of acting.

Activities developed by NBFC

NBFC, in particular the group of environmental sociologists, has studied in depth the relationship between biodiversity, food systems, tourism, and cultural institutions, investigating a series of practices that experiment with strategies for intervention and change in different contexts.

The analysis of case studies that bring together biodiversity conservation, food production, and tourism, (e.g., the Ark of Taste project by Slow Food, the practice of Zero-Budget Natural Farming promoted in India, and the Potato Park in the Cuzco area of Peru), have made it possible to explore the interconnection between these different elements in the context of sustainability (Borrelli, Mura, and Agovino, 2024).).

From community-led conservation initiatives to innovative agroecological practices, the research highlighted the need for and importance of holistic, community-led approaches to promoting biodiversity, sustainable food production, and responsible tourism, while also pointing out existing limitations and critical issues.

Traditional agricultural practices, rooted in agroecology, can revitalize local economies and ecosystems. By promoting native crops and agroforestry, it is possible not only to strengthen biodiversity but also to support food sovereignty. However, although such projects have succeeded in creating niche markets for high-quality organic products, doubts remain about their impact. It is important to reflect on how localized efforts can be integrated into broader food systems so that sustainability becomes a shared goal accessible to all. The relationship with tourism also poses risks: tourism can commercialize indigenous practices, turning them into spectacles for visitors. It is essential for these communities to find a balance between cultural integrity and the economic benefits of tourism.

In these experiences, food production sits at the intersection of biodiversity conservation and cultural traditions. Tourism plays a complex role in these

initiatives, with the potential to either support or undermine conservation efforts. Sustainable tourism, characterized by community involvement, cultural preservation, and environmental protection, can create economic incentives for conservation. Visitors are attracted not only by natural beauty but also by the unique cultural and agricultural heritage of these regions, fostering a virtuous circle in which tourism supports biodiversity conservation. However, it is necessary to consider the risks of poorly regulated tourism to avoid environmental degradation, cultural commodification, and social inequalities.

These considerations form the basis of the work carried out in Tanzania, at Lake Manyara Basin, where NBFC, in collaboration with the Nelson Mandela African Institution of Science and Technology (NM-AIST) in Arusha, is promoting a feasibility study for the implementation of a community empowerment initiative.

The Lake Manyara Basin (LMB) is an important biodiversity hotspot that contributes significantly to the local economy through tourism, agriculture, and livestock farming. The basin provides critical habitat for wildlife and birds, with an exceptional bird population. It is also home to resident and migratory wildlife species such as lions, elephants, buffalo, hippos, giraffes, wildebeests, zebras, impalas, bushbucks, leopards, and baboons. The abundance of wildlife and biodiversity in the basin supports the tourism industry and tourism-related development activities, including hotels, tented camps, and shopping centers. Despite its important economic and ecological significance, the area is subject to increasing socioeconomic pressures that pose a serious threat to its ecosystems and the services they provide. This affects biodiversity conservation, agricultural production, grazing, and the overall livelihoods of populations (Ngana et al., 2003; Wynants et al., 2018; de Bisthoven et al., 2020). The project, therefore, aims to combine academic research findings and indigenous knowledge to understand and design appropriate communication and training materials to promote behavioral change and widespread awareness of sustainable biodiversity protection. The

project focused on identifying the best approaches to promote engagement and inclusion, i.e., to broaden the audience of citizens interested in biodiversity as much as possible, including all categories of stakeholders, age groups, and genders; changing the behavior of residents in the lake area, i.e., raising community awareness that agricultural practices, waste management, energy, and water have an impact on biodiversity and the ecosystem and, consequently, on livelihoods; instilling environmentally friendly behaviors and practices in stakeholders in agriculture and tourism, encouraging them to use natural capital sustainably, manage biodiversity, and respect it. One of the potential outcomes of the intervention in Tanzania is the creation of an ecomuseum that would give continuity to the process initiated by the project.

As mentioned in the previous paragraph, the role of museums and ecomuseums in the co-governance processes of agri-food systems represents a further area of reflection and research carried out by the research group. In this context, co-governance can be described as a collaborative, voluntary, and public policy process that engages people constructively across the boundaries of public agencies, levels of government, and/or the public, private, and civic spheres in order to achieve a public goal that could not otherwise be achieved. In studies of the governance of food systems, it has been observed that the involvement of non-state actors (such as farmers, private companies, civil society and community groups, academics, the media, etc.) in food policies is a hallmark of the shift from top-down governance to governance that favors the construction of networks of actors who should act collaboratively (Stoker, 2000 in Halliday, 2022). Recent studies are analyzing the role that hybrid governance can play in promoting the sustainability of food systems, identifying a range of potential actors and possible outcomes (Glin, Osterveer and Mol, 2015, Gaitan-Cremaschi et al, 2018, Manganelli, Van den Broeck and Moulaert, 2020; Andrew et al, 2022).

Museums and ecomuseums are playing an active role in promoting sustainable food systems and raising awareness of sustainability and climate change issues.

In particular, ecomuseums promote local gastronomic traditions and sustainable agricultural practices, actively involving communities in educational and participatory activities.

For example, since 2015, the Italian Ecomuseum Network, Slow Food, and the Acque del Gemonese Ecomuseum have promoted the "Eco Slow Road" network, which aims to promote ecomuseums with a rich agri-food heritage and to enhance little-known geographical areas, supporting the preservation of traditional culture as a resource for developing a model of sustainable tourism. At the individual level, there are numerous ecomuseums in Italy (such as the Ecomuseo delle Dolomiti Friulane, Lis Aganis, or The Lagorai Ecomuseum in Trentino-Alto Adige), as well as in other European countries (such as the Écomusée du Pays de la Cerise in France, the Valdorba Ecomuseum - "Vivencias de Antafio" in Spain, or the Ecomuseu do Corvo in Portugal), using traditional crops as key factors for interpreting the territory and strengthening the bond between the local community and its tangible and intangible heritage. From the cultivation of ancient apple varieties at the Lis Aganis ecomuseum to cheese production in mountain dairies promoted by the Lagorai ecomuseum, as well as the production of French kirsch and traditional Spanish and Portuguese agricultural practices. All these initiatives are based on a deep knowledge of the territory and its traditions in order to promote change that has a positive impact not only on food production but on the system as a whole.

Another particularly significant example that was the subject of our analysis of food system governance and biodiversity concerned the city of New York, where museums are already working extensively to promote healthy and sustainable food. For example, in 2022, the Museum of the City of New York held an exhibition entitled Food in New York: Bigger Than the Plate. Equally interesting are the initiatives carried out by the Brooklyn Botanic Garden and the New York Botanical Garden. The latter, in collaboration with the Edible Academy, frequently offers small exhibitions and educational tours that help

visitors understand the production processes related to particular foods (especially fruits and vegetables), promoting the acceptance of healthy foods that are not always popular with children and young people. Equally significant are the initiatives promoted by the New York Aquarium, which highlight the importance of marine biodiversity. During the COVID-19 pandemic, however, some institutions, including the Brooklyn Museum and the Queens Museum, took action to offer food pantries and support the most affected communities, showing how cultural venues can also play a direct role in promoting food security. Finally, other practices include those promoted by the Museum of Food and Drink (MOFAD) and the Tenement Museum, which have organized exhibitions and public meetings to explore food as an expression of cultural identity, politics, and social justice. The exhibitions address issues such as unequal access to food, the sustainability of food supply chains, and the role of home cooking in passing on traditions and knowledge (Borrelli et al. 2024).

Connections with other projects

Sustainable tourism projects, as well as those promoted by cultural institutions such as museums and ecomuseums, can become a driving force for the adoption of good practices directly involved in food production and the protection of ancient seeds.

Among these practices, we would like to highlight the experience of Community Seed Banks (CSBs) and those proposed by FAO relating to the implementation of the International Treaty on Plant Genetic Resources (ITPGRFA), particularly concerning farmers' rights.

Starting in the 15th century, on the initiative of the Franciscan order, seed banks with a charitable mission called "monti frumentari" spread throughout Italy. The monti frumentari provided loans of wheat, barley, and other cereals to poor farmers. The farmers borrowed the seeds in the fall, returning the same amount after the harvest, with seeds coming from community work

obligations. These community-managed practices were effective in mitigating the effects of climate crises and the unpredictability of agricultural seasons. However, these institutions faced the risk of insolvency during poor harvests. Dissolved by laws passed in 1865 and definitively closed in 1922, they were replaced by agricultural credit banks, shifting from community assistance to monetary lending. The contemporary 'grandchildren' of these institutions, known as Community Seed Banks (CSBs), emerged in the last thirty years in the 'global south' and have also spread to Europe in the last 15 years.

CSBs represent a dynamic and diverse reality that has emerged in response to the loss of agricultural biodiversity and the need for access to seeds suited to local conditions. These initiatives, which often arise from grassroots efforts, can take different forms, such as networks, seed houses, libraries, or seed archives, reflecting varied approaches and priorities.

For example, there is a certain diversity linked to geographical context: European CSBs show significant regional differences. In southern and western countries (Spain, France, Italy), they are often led by farmers and linked to peasant movements, with a particular focus on local varieties and agroecological practices. In northern and central countries (United Kingdom, Denmark, Austria), private gardeners and environmental organizations have historically played a central role, promoting the conservation of native varieties. Eastern and southeastern European countries (Croatia, Hungary) have more recent CSBs, often with fewer resources and less structured networks. Portugal and Greece combine elements of both models, with a strong emphasis on community and exchange.

Although conservation is a common goal, many CSBs have developed dynamic approaches that integrate participatory selection, genetic improvement, and climate adaptation. Activities such as seed multiplication, training, awareness raising, and database creation are among the most characteristic of these initiatives. Projects such as ARDEAR Auvergne-Rhône-Alpes in France and Consorzio Quarantina in Italy combine the conservation

of cereals and potatoes with participatory selection programs. In Spain, networks such as Red de Semillas promote seed exchange between farmers and consumers, with an emphasis on food sovereignty.

The lack of financial and human resources is the main obstacle, along with restrictive legal frameworks that limit the marketing of uncertified seeds. However, CSBs have strengths such as the enthusiasm of volunteers, organizational flexibility, and the support of national and international networks. The involvement of different actors (farmers, researchers, schools) and the creative use of digital platforms for knowledge sharing is a key strategy. Linking up with global movements for agroecology and farmers' rights also strengthens their political visibility.

CSBs are recognized as key actors in the implementation of the International Treaty on Plant Genetic Resources (ITPGRFA) promoted by the FAO (Food and Agriculture Organization of the United Nations), particularly with regard to farmers' rights.

The Treaty provides the legal basis for the global exchange and conservation of plant genetic resources. Ratified by 154 Contracting Parties, the Treaty includes the Multilateral System of Access and Benefit-sharing (MLS), which has enabled the exchange of over 6.9 million accessions of genetic material between countries, researchers, and farmers. This exchange system supports crop improvement and adaptation to climate change. The benefits generated are reinvested through the Benefit-sharing Fund (BSF), a financial mechanism that supports small-scale farmers, local seed systems, and community conservation efforts.

Since its establishment in 2009, the BSF has supported over 105 projects in nearly 80 countries, benefiting more than one million people, including farmers, researchers, and policymakers. Its activities focus on in situ conservation of crop diversity, the promotion of participatory genetic improvement, and the strengthening of informal seed systems and local value chains. In addition, the BSF promotes knowledge exchange and scientific

collaboration between regions, ensuring that agricultural biodiversity remains a dynamic resource for present and future generations.

CSBs, in particular, play a crucial role in implementing the principles of the Treaty at the local level. More than 200 CSBs have been supported globally through the BSF, providing equitable access to seeds and empowering farmers to conserve and use their own plant genetic resources. In central and eastern India, for example, a BSF-funded initiative in 2019 supported the reintroduction of millet and legume varieties that had been displaced by modern high-yielding varieties. Farmers such as Pudi Soren have used these seeds to diversify their diets and improve family nutrition, demonstrating how conserving traditional varieties can also enrich diets.

In Cotacachi, Ecuador, a project led by indigenous Kichwa women is revitalizing the cultivation of local species such as corn, beans, and potatoes. Supported by the BSF, the initiative has identified over 900 local varieties and distributed seeds to nearly 800 farmers, reaching more than 2,500 people, 80% of whom are women. This project not only strengthens food security and biodiversity, but also preserves traditional knowledge and agricultural practices passed down from generation to generation.

As these examples show, CSBs are much more than just seed banks: they are centers of innovation, resilience, and community empowerment.

By decentralizing seed management, CSBs enable farmers to conserve varieties adapted to local conditions, improve crop resilience, and maintain evolutionary processes through participatory selection. They bridge the gap between formal and informal seed systems, ensuring access to genetic diversity for small farmers, in contrast to commercial seed systems that favor uniformity. For example, Spain's Red de Semillas and France's Réseau Semences Paysannes demonstrate how CSBs promote exchange among farmers, preserve traditional knowledge, and combat genetic erosion. Their emphasis on "dynamic conservation" is in line with Article 6's call for in

situ/on-farm strategies, the promotion of agroecological practices, and climate adaptation. CSBs also address legal barriers (e.g., EU regulations on seed marketing) by creating non-commercial seed networks, thereby operationalizing farmers' rights to save, use, and exchange seeds, a principle enshrined in the treaty.

However, their long-term success depends on stronger political support, adequate funding, and more efficient infrastructure. National and international recognition of their role in conserving agrobiodiversity is essential to ensure their sustainability.

The work of the ITPGRFA and the BSF highlights the urgency of conserving plant genetic resources and supporting the farmers who safeguard them. By investing in community-led solutions, the Treaty enables rural populations to adapt to climate change, improve their livelihoods, and protect the foundations of our food systems. Supporting CSBs is not just about preserving crops from the past; it represents a strategic investment in the future. The seeds saved, shared, and planted today will feed the world of tomorrow, helping to build more diverse and resilient agricultural systems capable of coping with the uncertainties of the future.

Further information: DIVERSIFOOD is a Horizon 2020 project dedicated to assessing and enriching the diversity of cultivated plants withindiversified agroecosystems, with the aim of increasing their performance, resilience, and quality through a multi-stakeholder approach. The project conducted a survey in 2016-2017, compiling a questionnaire that was answered by 85 CSBs. The results showed that 70% of the initiatives managed between 100 and 1,000 members, mainly local and ancient seed varieties. Sixty percent used databases, but only 30% had refrigerated storage facilities. Funding came from membership fees, donations, and public funds, with annual budgets ranging from less than €1,000 to over €100,000. Interaction with farmers, horticulturists, and public institutions was common, while collaboration with the industrial seed sector was rare.

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Chapter 6

Musealizing Biodiversity. From collections to participation

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Introduction – Museums and Ecomuseums for Biodiversity

Knowledge of nature, inspired by the principles of deep ecology[11] (Naess, 1973), with a biocentric perspective, is fundamental to supporting ecological transition. In this context, biodiversity is a central theme, together with the development of culture, skills, and strategies for its protection, restoration, and enhancement.

Museums and ecomuseums are increasingly aware of their potential role as social actors, committed to developing projects that can systematize the knowledge collected and cataloged by building relationships with communities and the local area for a more sustainable future. Scientific and natural history museums, thanks to their collections and specific expertise, and ecomuseums, which are deeply rooted in their local areas, have been pioneers in launching significant initiatives for biodiversity that go beyond the 'mere' creation of exhibitions or exhibition itineraries: from environmental

[11] Deep ecology is based on eight fundamental principles, the first of which is stated here: the well-being and flourishing of human and non-human life on Earth have value in and of themselves (in other words, they have intrinsic or inherent value). These values are independent of the usefulness that the non-human world may have for humans (Devall and Sessions, Deep Ecology, 1985).

education to citizen science, from the digitization of collections to collaboration with research institutions, from the involvement and participation of communities to the creation of local networks. These initiatives are now becoming increasingly widespread, but the integration of biodiversity issues into the wider museum sector is still partial and heterogeneous.

Ecomuseums embody the ingredients for inclusive and sustainable heritage management. Characterized by the triad of "territory, heritage, communities" (De Varine: 2005; Maggi & Falletti: 2002), they are a tool for bringing together different stakeholders in the promotion of the territory. The new definition of museum proposed by ICOM[12] (2022) reinforces the role of institutions towards sustainability, participation, and inclusion. This legitimizes their commitment in areas such as nature conservation, climate impact mitigation, sustainable food, regenerative agriculture, sustainable tourism, combating biodiversity loss, and ecosystem restoration.

In this perspective, museums and ecomuseums can take on a cultural leadership role, which requires a strategic vision that not only interprets socio-environmental changes but also acts as a catalyst for collective, educational, and transformative processes, with participatory planning and operational tools aimed at monitoring and communication, given the availability of economic, human, and technological resources and adequate support to ensure the success of the initiatives. During the symposium "Biodiversity, Food, and Education" (Bicocca, Milan, November 25, 2024), the dialogue between the various experts present highlighted the essential need for participatory governance to ensure effective and shared management of environmental heritage. In this context, there is a growing trend for museums

[12] "A museum is a permanent, non-profit institution serving society that conducts research, collects, preserves, interprets, and exhibits tangible and intangible heritage.Open to the public, accessible, and inclusive, museums promote diversity and sustainability. They operate and communicate ethically and professionally, with the participation of communities, offering diverse experiences for education, enjoyment, reflection, and the sharing of knowledge." ICOM, 2022

and ecomuseums to operate increasingly in networks, developing projects with institutions, local communities, and various stakeholders. Collaborations or partnerships provide access to additional resources, amplify the scope of initiatives—including educational ones—and stimulate the active participation of communities in biodiversity conservation while raising awareness of how biodiversity loss impacts social communities in different ways, with particular attention to the most vulnerable groups.

Museums and ecomuseums are opening up as platforms for dialogue on the broader issues of contemporary challenges, including climate justice, various forms of greenwashing, and the promotion of diversity. This is the case with the Agorà at the MUSE in Trento, places for collective meetings and participated where it is possible to develop ideas, present projects, discuss issues relevant to the community, reflecting on the climate, ecological, and social crisis, and simultaneously imagining, designing, and building alternative futures in collaboration with local associations and organizations. Through the spectrum of activities, the commitment of cultural institutions is aimed at reflecting, raising awareness, promoting, and communicating more conscious and sustainable ways of living, reducing environmental impact[13], and strengthening participatory actions towards the care and innovative management of common goods. With this in mind, local authorities promote "River Contracts"[14] or "Lake Contracts," as seen in the

[13] According to data from the Digital Innovation in Cultural Heritage and Activities Observatory of the School of Management at the Politecnico di Milano, 1.83% of Italian museums have undertaken measures for environmental sustainability, in particular for energy efficiency (implemented by 53% of institutions), reuse and material recycling (49%) and activities to raise staff awareness of virtuous behavior (45%) (ASVIS Cultura, Position Paper, 2024).

[14] The River Contract is an agreement between parties responsible for water management and use, land-use planning, and environmental protection. It is a "voluntary strategic and negotiated planning tool that pursues the protection and proper management of water resources and the enhancement of river areas, together with protection from hydraulic risk, contributing to local development." The River Contract contributes to achieving the objectives of the European Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC) by supporting and promoting policies and initiatives aimed at consolidating resilient river communities, repairing and mitigating, at least in part, the pressures caused by decades of unregulated urbanization.

case of the Ecomuseum of Lake Orta, which itself is a promoter of the initiative. Here, the signatories contribute to the construction and implementation of the Contract through concrete actions included in the Action Plan and executed in the area in collaboration with public and private bodies, associations, and local communities, with the primary objective of improving the overall condition of the water body and the surrounding area. Similarly, in the case of the Parabiago Ecomuseum, which has taken on the role of facilitator of a complex network of actors to better understand the landscape and, through collaboration agreements, has enabled the care, management, and regeneration of certain common goods.

Taking action for biodiversity also means contributing to collective well-being by improving the quality of living spaces through green infrastructure and nature-based solutions (NBS). NBS include measures such as the creation of urban parks, community gardens, water management gardens, green roofs and walls, and ecological corridors for fauna and urban reforestation projects. Green infrastructure and natural solutions improve the resilience of cities, promote local biodiversity, and offer spaces for well-being, socializing, and education for communities. Through educational programs, participatory workshops, and local initiatives, museums and ecomuseums can raise public awareness of the importance of integrating nature into everyday life and encourage citizens to participate in or promote nature-inspired urban and territorial regeneration practices, becoming protagonists of this change. With regard to educational activities, museums, which traditionally operate indoors, have recognized the value of taking visitors outdoors and offering experiences that combine scientific knowledge with direct exploration of the environment. Outdoor education focuses on experiential learning in natural environments, such as parks, forests, and gardens, and goes beyond passive listening, stimulating curiosity and critical thinking through an opportunity for direct connection with nature. One advantage that stands out is greater accessibility to scientific content and inductiveness; in fact, new audiences—

people of all ages and backgrounds—who are unlikely to choose to visit museums, participate and benefit from these experiences.

In relation to the territory, museums and ecomuseums can promote local knowledge and traditional agricultural practices, contributing to the conservation of agri-food biodiversity, as emerges from the survey on "Ecomuseums in the Mediterranean Area and the Promotion of Sustainable Food Systems" (Borrelli et al.), discussed in the following paragraph together with a series of initiatives carried out with the project funded by NBFC.

The activities carried out by NBFC

As previously mentioned, NBFC recognizes the key role of museums in promoting and disseminating biodiversity. Within the scope of Spoke 7 activities, the focus has been mainly on understanding how these institutions are working on biodiversity and issues related to its conservation and promotion in the Mediterranean, as well as elsewhere.

To this end, a census of museums and ecomuseums in the Mediterranean area was conducted (a total of 497 were surveyed). The websites of these institutions were analyzed and a questionnaire was sent to them, which was used to assess the extent to which they are working on the issues of biodiversity and sustainability. In light of the analysis of the websites and the results of the questionnaire (to which 91 responded), it was possible to define an index of the capacity of these cultural institutions to promote biodiversity through web pages (for further information, see chapter 7 of this book). The census and the subsequent survey were very useful in providing a snapshot of the level of activism of these institutions in the Mediterranean, taking into account the diversity that characterizes the territories within it. Specifically, the results revealed an uneven distribution of initiatives, with significant growth potential, particularly in the southern and eastern Mediterranean countries. These institutions showed good potential for promoting sustainable food systems that respect cultural traditions while advancing health and environmental goals.

At the same time, a predominantly qualitative survey was conducted to understand how museums and ecomuseums are addressing the issue of biodiversity with regard to food and food production. Through these explorations, it was possible to investigate a series of recent experiences developed by museums and ecomuseums around the world, highlighting their potential approach. These institutions are, in fact, taking on an increasingly important role in promoting food sustainability, biodiversity conservation, and raising awareness of climate change through educational, participatory, and creative practices. The results of these studies can be explored in the article by Borrelli et al, 2025.

In order to broaden the scope as much as possible, and drawing on previous research, an in-depth study was conducted on the role of museums in promoting sustainability, biodiversity, and food systems in New York City (Borrelli et al., Food Culture Society, 2024).). The latter proved to be a particularly compelling field of observation, as these institutions now have a strong capacity to act in New York City as entities that strive to create a sustainable and healthy food system, one that sees the conservation of biodiversity and respect for, and understanding of, nature as central aspects.

In general, it can be said that, based on the research carried out, it was possible to detect that the cultural institutions observed expressed a growing interest in the issues discussed here. However, alongside a clear need to include issues related to sustainability and biodiversity in their agenda, a different level of maturity in addressing these issues was also noted. Some museums and ecomuseums have made significant progress, making them particularly interesting examples to reflect on, while others have a clear understanding of the problem but are still struggling to focus on it and find the tools to address it. In other cases, institutions have an interest that fails to translate into real action. It would be useful to set up structured training channels with these cultural institutions, which already have strong local roots and solid relationships with local communities, and could therefore become vehicles for communicating the importance and necessity of biodiversity conservation to a wide and varied audience.

Connections with other projects

Existing best practices demonstrate the potential for collaborations with local authorities, schools, universities, citizens, and the private sector, with a view to intergenerational and lifelong learning. Biodiversity is not just a scientific issue but a cultural language to be explored, recounted, and experienced. For this reason, building networks, sharing strategies, and bridging current gaps represent necessary challenges for cultural institutions in relation to communities and territories to address ecological crises and find effective solutions.

Below are some examples of actions and practices developed by museums and ecomuseums.

The Castromediano Museum in Lecce plays a significant role in promoting and protecting biodiversity and is strongly connected to its territory, which has been marked by the destruction of more than 21 million centuries-old olive trees due to the Xylella bacterium. It hosts numerous projects and exhibitions on biodiversity, including the photographic exhibition "Loro. Dalla Fotografia al Progetto di Comunità" (2024) by artist Ulderico Tramacere, which focuses on the theme of the olive tree, and the exhibition entitled "Yeast - Human Biodiversity" (2022), at the crossroads of Apulia's agricultural and landscape biodiversity, food and wine, and human biodiversity, understood as a practice that transforms the products of the earth into geographical identities and anthropological visions. He is also involved in research initiatives for conservation, such as the BEST project, which uses technology to monitor environmental and climatic parameters by installing sensors in rural and coastal areas. He has promoted a network—currently under construction—of museums and institutions for biodiversity at the local level.

UNESCO World Heritage sites are also active in safeguarding and promoting biodiversity, with practices implemented in their parks and gardens, and in the surrounding landscape areas, and in connection with their communities.

For example, the Royal Palace of Caserta (figure 1), as part of its commitments to Agenda 2030, is developing a Green Museum management project involving its communities in shared awareness and responsibility; In fact, the Royal Palace acts as the guardian of a historical and artistic heritage, but also of plant and animal life, which requires complex planning that takes into account all living beings, including insects, birds, fish, and mammals. The Reggia di Venaria (Figure 2) has recently launched a series of initiatives on biodiversity and sustainability in its gardens, such as meetings, themed visits, activities, and workshops for everyone; some are specifically dedicated to schools of all levels, with visits and meetings on the theme of protecting pollinating insects.

Figure 1. The greenhouses of the Royal Palace of Caserta. Photo credits: Courtesy of the Royal Palace of Caserta

Figure 2. View of the Royal Palace of Venaria from the gardens. Credits: Consortium of the Royal Residences of the House of Savoy/Photo Micol Sacchi

The MUSE - Science Museum of Trento, in addition to its broad leadership role on sustainability issues, is dedicated to specific actions for biodiversity. This includes both citizen science projects and database management relating to fauna and flora species collected through standardized monitoring and citizen contributions. In line with a green infrastructure approach, the outdoor areas feature vegetable gardens (Figure 3) and a vineyard covering over 800 square meters and more than 300 botanical species from all over the world, accompanying visitors on a journey of agricultural diversity. Accessible and sensory, with a long larch wood walkway that is also wheelchair accessible, they invite visitors to explore the path and the immersive experience of 'Il giardino dei profumi' (The Garden of Scents). The museum's gardens are a refuge for pollinating insects, birds, lizards, and hedgehogs, thanks to the network of dry stone walls, nest boxes, insect hotels, and an educational beehive: an urban ecosystem where workshops and activities for schools and citizens on the importance of these places are offered throughout the year. It recently presented the Food & Sound exhibition on the link between sound,

food choices, and neuroscience, to discover what led scientists to demonstrate that "we also eat with our ears." Also interesting on the theme of conservation biology is the management and curation of databases containing data on fauna and flora species collected both through standardized monitoring, thanks to the contribution of citizens. This includes the coordination and management of naturalistic data sharing through WebGIS platforms, Citizen Science activities aimed at collecting information on biodiversity, and the curation of Fauna Atlases created in collaboration with other provincial authorities.

Figure 3. The biodiversity gardens of MUSE - Museum of Science in Trentino. Photo credits: "MUSE Archive. Photo by Michele Purin

The PAV - Parco Arte Vivente in Turin, an experimental center for contemporary art, has been constantly committed to issues of deep ecology since its inception. Conceived by artist and activist Piero Gilardi as an incubator of collective consciousness, in the preface to "La mia biopolitica" (My Biopolitics) he spoke of the need for an ecological conversion of the general model of development, expressed in the global movement for the common good. The PAV was established in 2008 on a disused industrial site,

covering approximately 23,500 square meters, including classrooms and educational laboratories. The outdoor area (Figure 4) includes gardens, environmental installations created by artists committed to environmental sustainability issues, a vegetable garden, and an urban beekeeping project. Photovoltaic panels are installed on part of the building, while most of it is underground and built under a layer of soil, which turns the garden into a green roof. Contemporary artworks consistent with the center's objectives are installed throughout the site. It is constantly active with a series of practices aimed at wide range of activities, from exhibitions to collective performances and workshops involving the public (figure 5).

Figure 4. PAV, panoramic image, 2023. Courtesy PAV Parco Arte Vivente

Figure 5. PAV, Workshop 60, Extinction? Rebellion!, led by Piero Gilardi, 2019. Courtesy PAV Parco Arte Vivente.

During its annual conference in 2024, the Piedmont Ecomuseum Network presented the theme "Ecomuseums and Biodiversity, the balanced relationship between natural resources and land use," presenting a series of ongoing initiatives by various related ecomuseums and exploring different points of view. In relation to nature and ecosystems, such as the activities carried out by the Cascina Moglioni Ecomuseum. Parco delle Capanne di Marcarolo (AL) with its research on butterflies (Eufedia Aurinia Provincialis) and hay meadows. Or the activities to restore ecosystems and biodiversity in the lake, carried out in collaboration with other research institutions by the Cusius - Lago d'Orta e Mottarone (NO) Ecomuseum. The supply chains of local products are analyzed and action is taken on the biodiversity of the territory in the agricultural environment explored by the Rocche del Roero Ecomuseum, which has, for example, issued good practices for the

management of hazelnut groves, mapped ancient fruits, and provided assistance to companies on biodiversity. They are an integral part of ecotourism networks, cultural participation, and landscape actions. In all cases, the emphasis has been placed on actions undertaken with communities and on the dissemination and exchange of good practices.

The Lis Aganis Ecomuseum of the Friulian Dolomites, located in Friuli-Venezia Giulia, promotes local knowledge and the physical and cultural landscape, encouraging sustainability, participatory planning, and improving the quality of life in rural areas. Its work is based on research and documentation to create activities that respond to the needs of the community, focusing on environmental protection and fostering a sense of belonging to the territory. The Ecomuseum offers cultural itineraries that traverse natural environments, geological landscapes, spontaneous architecture, and local traditions, designed to raise awareness of the history, nature, and material culture of the territory. The experiences are co-designed with teachers, educators, and local groups, creating a mosaic of common goods. In addition, the Natura&Colore working groups have promoted a participatory discussion on the value of local plants, emphasizing the importance of preserving and reinterpreting this knowledge. The Ecomuseum also stands out for its promotion of local products, involving farmers, artisans, and restaurateurs, encouraging the consumption of zero-kilometre products and reducing environmental impact. The PassiParole project, supported by the Friuli-Venezia Giulia Region, promoted explorations of the territory with the community to identify places to be promoted, creating maps and heritage trails. Subsequently, the walks were self-managed by the community. Finally, the Ecomuseum collaborated with the Alberghi Diffusi delle Valli to promote sustainable tourism, involving local accommodation facilities in the promotion of the area.

Figure 6. Children from the school in Vivaro (PN, Friuli Venezia Giulia) in the Lis Aganis Ecomuseum area, during a workshop dedicated to learning about the biodiversity of the area (2021). Photo credits: Lisa Pigozzi

The Parabiago Landscape Ecomuseum (Figure 7), established in 2008 in the Milan metropolitan area, was created in response to the growing difficulty of the local population in recognizing and valuing their living heritage. Part of the Local Agenda 21 process, launched in 2003 with the support of the European Union, the ecomuseum is a strategic tool for territorial and cultural

regeneration. In the first phase, Agenda 21 produced a knowledge framework of the environmental, social, and economic status of the city. Subsequently, thanks to Decree No. 15075 of January 8, 2007, the Lombardy Region financed 80% of the "Parabiago Landscape Ecomuseum" project as part of the European Regional Development Fund for the promotion of Local Agenda 21, with a focus on energy, landscape, tourism, and biodiversity. Through participatory processes, the strengthening of local capacities, and the adoption of the principles of subsidiarity and co-responsibility, the ecomuseum has fostered the creation of a solid network of stakeholders. This network has been activated to map, curate, manage, and regenerate heritage, generating methodological, relational, and social changes even beyond the territorial boundaries of the ecomuseum itself. These transformations have had concrete effects on the urban and peri-urban landscape. The educational activities promoted by the ecomuseum include workshops aimed not only at students but also at parents, grandparents, and the elderly, with lessons, guided tours, and participatory planning.

Figure 7. The territory of the Parabiago Ecomuseum. Photo credits: Adrones for the Parabiago Landscape Ecomuseum

In the field of tourism, the ecomuseum has developed and coordinated initiatives aimed at promoting cultural and nature tourism, also involving the local hotel sector. The main actions include: audio-guided itineraries, both physical and digital, created using participatory approaches; guided themed tours; promotion of local products through agreements with farmers, artisans, and traders, with a particular focus on short supply chains and environmental sustainability. Products with Municipal Designation of Origin (De.CO) and innovative practices that combine local food production with landscape protection and ecosystem services. These activities strengthen the link between the community, environment, and sustainable development, consolidating the ecomuseum as a key player in territorial and heritage governance processes.

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Chapter 7

Musealizing Biodiversity: Towards a System of Shared Indicators

Michela Rota

Introduction - Evaluating the performance of ecomuseums and museums

The issue of monitoring, measuring, and evaluating the impact of museum and ecomuseum activities is crucial for the consolidation and recognition of these institutions in the near future as active players in the social, cultural, and environmental spheres. The growing focus on sustainability, participation, and inclusion requires a review of cultural management and planning practices, steering them toward greater accountability and transparency in favor of the communities they serve.

Social participation is a key theme among the objectives for the creation of inclusive ecosystems, an essential condition for an open, diverse, and multicultural vision of heritage, in line with contemporary sensibilities and the construction of societies open to innovation. Museums and ecomuseums are places where inclusive policies are applied, both in terms of the content of exhibitions and activities involving the public (ICOM Italia, Brescia 2025). Museums and ecomuseums are laboratories of cultural democracy, capable of promoting new models of active citizenship. In order to promote recognition of the significant impact that these institutions have on the societies in which they operate and in the surrounding areas, a gradual paradigm shift is needed

through the practice of structured analysis of the social impact of these activities and the introduction of systematic and continuous evaluation tools.

In this context, the tools must be able to detect not only the immediate outputs of the activities, but performance evaluation cannot be limited to the quantitative measurement of results (number of visitors, tickets sold, number of activities); it must extend to the evaluation of social, cultural, and environmental outcomes are produced gradually and over different time horizons.

At a general level, with regard to museums, it should be noted that the tool for assessing the quality of the activities and services offered has been identified through the 'uniform quality levels' of the National Museum System - SMN (Ministerial Decree 113/2018 - Decree of February 21, 2018, with Annex I - 'Uniform quality levels for museums'), which is associated with a system for verifying the achievement of minimum quality standards and, at the same time, supporting the definition of improvement objectives. The verification of minimum quality levels takes place through a self-assessment phase using a form called LUQV, covering a broad multidisciplinary spectrum of museum activities, divided into three areas: Organization; Collections; Communication

and Relations with the territory. With a view to greater transparency, one of the tools that we hope will be compiled is the Service Quality Charter, which responds to the need to establish principles and rules in the relationship between the entities that provide services and the citizens who use them. It constitutes a real "pact" with users, a communication and information tool that allows them to learn about the services offered, the methods and standards promised, to verify that the commitments made are being respected, and to express their assessments, including through complaints.

These tools are useful as a first step in the organized collection of data and analysis of the current situation, in order to then launch projects aimed at improvement. They are more compilative in their output, but the data can

then be used to build more detailed, transparent, and communicative reports for the various stakeholders, such as those with a social and environmental perspective.

Social reporting practices (or tools) such as social, mission, and sustainability reports are therefore essential for providing a broader and more integrated picture. Mission or social reports, already introduced by several museums in Italy, allow for the transparent documentation and communication of commitments made in relation to their mission and the results achieved, while sustainability reports provide an integrated view of environmental, social, and governance impacts. In some cases, the reports may coincide, particularly when the institution has included sustainability or sustainable development in its mission in light of the SDGs of Agenda 2030, as in the case of MUSE - Science Museum of Trento. The number of organizations that have published a social report is growing, including the Egyptian Museum in Turin and the Royal Palace of Caserta, among others. As for environmental aspects, discussions are underway in the context of museums to move towards more structured and complex reporting, according to standards such as the GRI (Global Reporting Initiative) and also using ESG (environmental, social, governance) principles and criteria, i.e. a series of indicators that allow the social impact of an organization to be assessed and measured on the basis of standardized parameters. These are currently used mainly in corporate museums, while their application in other types of museums or ecomuseums is still critical.

The development of effective evaluation systems also requires the definition of appropriate indicators, both qualitative and quantitative, that can be adapted to the complexity of the activities carried out. In the social sphere, some examples include: the number of projects co-created with the community, the level of physical and cognitive accessibility to museum spaces, the participation of vulnerable groups, the possibility of strengthening the sense of belonging to a community, the increase in knowledge and skills, and

the improvement of individual and collective well-being. On an environmental level, the following can be monitored: the energy efficiency of museum buildings and the use of renewable energy, the use of environmentally friendly materials in exhibitions, and environmental education initiatives aimed at the public. With regard to governance, the transparency of resource management, the presence of participatory bodies (such as community advisory councils), and compliance with ethical criteria in the management of human and financial resources can be assessed.

Furthermore, cultural institutions can strengthen their impact by developing strategic partnerships with public institutions, research bodies, associations, and socially responsible companies. Such collaborations make it possible to expand the resources available for the implementation of innovative projects and to enhance the role of museums as catalysts for sustainable development in their local areas. It is essential, however, that impact assessment and indicator monitoring are not seen as a mere formality but as an opportunity for growth and continuous improvement, conceived as an integrated, multidimensional, and participatory process. Only through the ability to analyze and clearly communicate their impact will these institutions be able to consolidate their role in building open, inclusive, and sustainability-orientated societies. The commitment to monitoring and evaluation practices not only improves the effectiveness of cultural policies but also represents a distinctive element of innovation and competitiveness in the contemporary cultural landscape.

Connections for biodiversity

In order to ensure the effectiveness of biodiversity initiatives, it is also essential to implement monitoring and evaluation systems that measure the impact of cultural and environmental actions promoted by museums and ecomuseums. These tools not only enable accountability to funders and citizens, but also allow for continuous improvement of practices through a transparency- and evidence-based approach.

The communication phase is equally important, as it represents a strategic lever for raising awareness, engaging, and empowering people. We need to move beyond emergency narratives and construct messages that show how biodiversity is an integral part of everyday life and local culture. Museums, as spaces for encounter and reflection, can become powerful media capable of telling stories of coexistence between humans and nature and inspiring practices of care and respect for the environment and ecosystems.

Qualitative and quantitative indicators must be developed in relation to specific objectives, such as the number of participants involved, the quality of the relationships established with the local area, the knowledge acquired by visitors, changes in environmental behavior, and biodiversity conserved or enhanced. Digital technologies can be of great help in this regard through the use of apps for data collection, citizen science platforms, interactive visualization tools, and databases for data storage.

The COP16 on Biodiversity in Rome approved a package of 23 indicators (Targets) to measure progress towards the 23 objectives of the Global Biodiversity Framework, with a document called L-26. Monitoring the actions implemented for biodiversity and measuring the progress made is essential to achieve concrete results and optimize investments. These indicators are essential for assessing the effective implementation of the global framework and for monitoring the progress of nations in achieving the goals; they cover ecological, economic, cultural, and social dimensions, providing an integrated framework. Although developed primarily for large-scale institutional, political, and territorial contexts, these indicators can also be applied in a cultural context.

The activities carried out by NBFC

As part of Spoke 7 of the National Biodiversity Forum Center, an initiative promoted by the Italian Ministry of Research aimed at studying and analyzing

biodiversity, preserve the ecosystems and biodiversity of the Mediterranean area, the Department of Sociology of the University of Milan Bicocca, together with Prof. Nunzia Borrelli's research group, assessed how museums and ecomuseums can contribute to monitoring and evaluation by identifying a set of indicators that can be adapted and flexibly applied to the specific missions and practices of different institutions.

In particular, for ecomuseums, the project investigated the role they play as social agents in governance processes for the sustainable transition of biodiversity and food systems by mapping community ecomuseums in the Mediterranean (Borrelli 2024). An index was then constructed to measure their 'Webpage Engagement Capacity'. (Figure I).

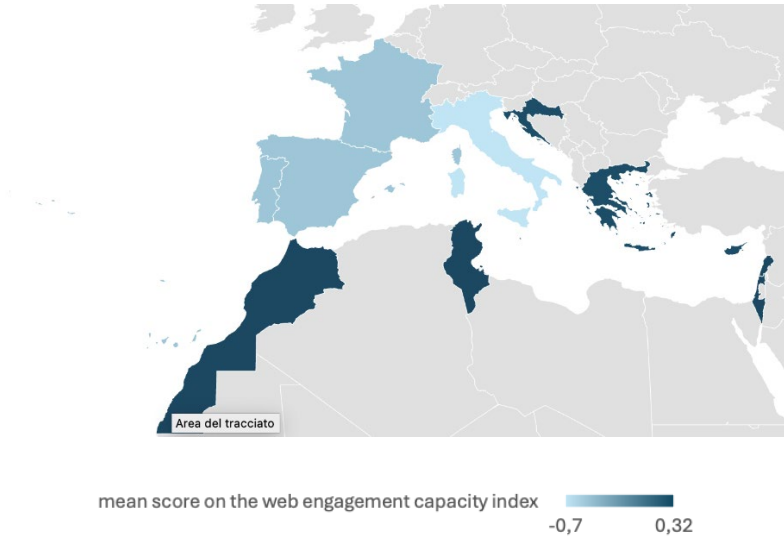

Figure 1. Distribution of Webpage Engagement Index values in Mediterranean ecomuseums

Cultural institutions, including museums and ecomuseums, contribute to collaborative governance processes within the food system. Although they are not directly involved in official food policies, these institutions can still have a significant impact by raising public awareness of food sustainability through exhibitions and educational programs and by supporting the promotion of local networks among stakeholders. Italian ecomuseums, for example, have developed a series of actions, including short supply chain projects, cultural itineraries linking agri-food products to local traditions, and support for local producers.

The first step in the research was to conduct a census of ecomuseums and other cultural institutions that carry out participatory management in the Mediterranean area, active in 2023, to better understand their distribution and involvement in the development of participatory activities, the mobilization of local resources, and the promotion of cultural heritage, including food heritage. A set of 495 institutions was identified, mainly located in Italy but present in 21 countries. Among the sample, 230 had a section of their website dedicated to biodiversity and related topics, 178 institutions worked explicitly on the theme of tourism, and 90 on the theme of food. A positive correlation was observed between the theme of food and biodiversity. In fact, almost all ecomuseums that address the theme of food also work on biodiversity, confirming a particularly attentive approach to the systemic dimension of food and the link between production and consumption and the maintenance of ecosystem balance. In this sense, the vocation of ecomuseums to preserve cultural heritage and promote local development is combined with aspects more closely linked to environmental sustainability.

Finally, a "Webpage Engagement Capacity" index was constructed to assess the effectiveness of institutions in using their webpages to communicate with and engage their users. The results showed the existence of two quite distinct groups of museums, characterized by extremely effective use on the

one hand, and very poor and poorly communicative use on the other. Specifically, those institutions that explicitly included topics related to food and biodiversity also tended to have more engaging and communicative websites. At the territorial level, this index highlighted the high quality of the experiences developed in the eastern and southern Mediterranean countries, where the few ecomuseums identified seem to be engaged in extremely effective communication. This suggests the opportunity to strengthen collaborations with these entities, which are already active in the area, to increase the level of involvement and interaction between museums, cultural institutions, and other local actors, and to enable the activation of effective but still underutilized resources.

Proposal for a set of biodiversity indicators

Previous research has highlighted a close relationship between biodiversity activities and food systems for cultural institutions in the Mediterranean, particularly ecomuseums, but not exclusively. It was also decided to take a step forward by proposing a series of key indicators to assess the commitment of museums and ecomuseums to biodiversity, particularly in terms of community involvement. These indicators are also linked to the COP16 targets.

Museums, as cultural and scientific centers, not only document biodiversity, but also become actors that actively contribute to the protection, enhancement, restoration, and communication of biodiversity through various lines of action.

Adapting the COP indicators to the museum context makes it possible to enhance the concrete actions of museums and measure their impact over time, contributing to the participatory monitoring of global objectives. This approach promotes a systemic and integrated vision in which biodiversity is not only a scientific issue but also a shared responsibility.

When choosing the themes around which to build the indicators, reference is

made to the areas of the National Museum System (SMN), described above, and in particular to that relating to "communication and relations with the territory" and its sub-themes: educational activities; involvement and participation of the public and community; relations with the territory; communication. This choice responds to the need to use tools and language shared among operators, who are thus able to identify information and projects in progress or to identify new ones in favor of biodiversity and environmental sustainability.

Below are some indicators related to the macro area of Communication and Relations with the Territory, and its sub-areas of the National Museum System and the COP16 Targets.

1. Sub-area Educational activities:

1.a Presence of educational initiatives on biodiversity. Number of events, workshops, or temporary exhibitions dedicated to local biodiversity in the last year and number of participants.

Training on biodiversity. Number of courses, workshops, or training sessions on ecological issues and biodiversity.

These indicators are linked to the COP16 targets: TARGET 21: Ensure That Knowledge is Available and Accessible to Guide Biodiversity Action; TARGET 22: Ensure Participation in Decision-Making and Access to Justice and Information Related to Biodiversity for all; TARGET 23: Ensure Gender Equality and a Gender-Responsive Approach for Biodiversity Action.

2. Sub-area: Involvement and participation of the public and communities

2.a Active community involvement. Number and quality of collaborations with schools, associations, and citizens on biodiversity projects.

2.b Citizen science activities. Projects open to the public involving the

collection of biodiversity data (e.g., monitoring birds, insects, and plants) and number of participants.

These indicators are linked to the COP16 targets: TARGET 14: Integrate Biodiversity in Decision-Making at Every Level; TARGET 11: Restore, Maintain and Enhance Nature's Contributions to People

3. Sub-area: Relations with the territory, stakeholders, and networks

3.a Partnerships. Active collaborations with local entities (e.g., park authorities, universities, environmental NGOs, or local farmers) to promote biodiversity.

3.b Mapping local biodiversity. Number of research or data collection projects—including participatory ones.

3.c Management of outdoor and green spaces. Use of criteria for the sustainability of outdoor spaces. (Maintenance of gardens, educational vegetable gardens, or green spaces with native species and pollinators, rainwater collection and reuse, installation of bug hotels and artificial nests, etc.)

3.d Use of sustainable museum practices. Number of ecological practices in the daily management of the museum (e.g., use of recycled materials, energy saving, eco-friendly furnishings, calculation of the ecological footprint).

These indicators are linked to the COP16 targets: TARGET 1: Plan and Manage all Areas To Reduce Biodiversity Loss; TARGET 2: Restore 30% of all Degraded Ecosystems; TARGET 3: Conserve 30% of Land, Waters and Seas; TARGET 7: Reduce Pollution to Levels That Are Not Harmful to Biodiversity; TARGET 8: Minimize the Impacts of Climate Change on Biodiversity and Build Resilience; TARGET 10: Enhance Biodiversity and Sustainability in Agriculture, Aquaculture, Fisheries, and Forestry; TARGET 12: Enhance Green Spaces and Urban Planning for Human Well-Being and Biodiversity; TARGET 16: Enable Sustainable Consumption Choices To

Reduce Waste and Overconsumption; TARGET 20: Strengthen Capacity-Building, Technology Transfer, and Scientific and Technical Cooperation for Biodiversity

3.e Sub-area Communication. Number of communication initiatives on the theme of biodiversity (exhibitions, events, publications, digital content).

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Chapter 8

Taking action for biodiversity: participatory science projects

Giulia Mura, Michela Tudini

Introduction

Since its foundation, the National Biodiversity Future Centre has identified citizens as key partners in the project, involving them not only in data collection but also in the implementation of conservation and proactive monitoring practices. Thanks to this approach, the center has been able to count on an "exponential" number of researchers active in the field.

Citizen science, or participatory science, is a tool that is gaining increasing attention for its ability to involve passionate and knowledgeable people in planning, conservation, monitoring, and analysis activities, which are fundamental to achieving Europe's sustainable goals.

Citizen Science Italia (CSI) defines *citizen science* as 'the involvement of volunteers and scientists in collaborative research activities to generate new knowledge based on scientific evidence' (www.citizenscience.it).

This approach works on two dimensions of the relationship between citizens and science: 1) science should be sensitive to citizens' concerns and needs; 2) citizens themselves could produce reliable scientific knowledge (Cavalier and Kennedy, 2016).

The European Citizen Science Association has defined a decalogue of *citizen science* (ECSA, 2015) which has been adopted over the years by various

associations, such as CSI, and which establishes that:

1. *Citizen science* projects actively involve citizens in scientific activities that generate new knowledge or understanding.
2. *Citizen science* projects produce original scientific results.
3. Both professional scientists and the citizens involved benefit from participating in *citizen science* projects.
4. People involved in citizen science projects can, if they wish, participate in multiple stages of the scientific process.
5. People involved in *citizen science* projects receive feedback.
6. *Citizen science is considered a research methodology, like any other, with limitations and margins of error that must be considered and monitored.*
7. Data and metadata from citizen science projects are made publicly available, and, where possible, the results are published in an open access format.
8. The contribution of people involved in *citizen science* projects *is* officially recognized in project results and publications.
9. *Citizen science* programs are evaluated for their scientific results, data quality, participant experience, and the extent of their social and policy impact.
10. *Citizen science* project leaders take into account legal and ethical issues related to copyright, intellectual property, data sharing agreements, confidentiality, attribution, and the environmental impact of each activity.

Data collection during a *citizen science* project can be carried out directly by volunteers, for example by sending images or observations via an app, or under the supervision of professional scientists. In any case, participation has a number of educational and social benefits, as it represents an opportunity for both formal and informal learning and helps to increase people's sense of belonging to the natural environment around them. The collection of data

and information allows citizens to participate democratically in decisions that affect them, raising awareness of environmental issues and providing useful data to support the development of appropriate policies (Sforzi, 2024).

From the first scientists to participatory science

The first experiences of modern participatory science developed in ornithology, involving enthusiasts in large-scale campaigns to observe bird migration cycles. The North American Bird Phenology Program is the result of an information gathering campaign that began in 1882, and it was one of the first scholarly attempts to define the term *"citizen science"* coined by the ornithologist Rick Bonney, creator of a platform for collecting bird observations (Bonney et al. 2009).

Projects quickly multiplied in all areas of science, representing a valuable tool for monitoring biodiversity while also finding applications in astronomy, medicine, computer science, and the social sciences.

However, the roots of participatory science can be traced back much further in time. Modern science began in the 1600s. Before the professionalization of science in the late 19th century, almost all research in North America and Europe was conducted by "amateur" scientists, i.e., people who were not paid as scientists. Many of these volunteers were recognized experts in their field and conducted research that was indistinguishable from, and sometimes superior to, that carried out by most professional scientists of the time (Vetter 2011).

The progressive professionalization of science, which has characterized the last two centuries, has changed the role of volunteers and amateurs. With the advent of automation towards the end of the 20th century, scientists turned to machines and demanded less from volunteers, whose roles began to change. In the field of ecology and conservation studies, volunteers were mainly involved in two types of activities (Miller-Rushing et al, 2020): data collection

projects of such proportions that they would have been impossible without the widespread involvement of volunteers in the field, and projects of local interest or relevance that were unable to obtain 'official' support (such as investigating the cause of a specific local problem, a source of pollution, an epidemic, etc.).

At the beginning of the new millennium, interest grew in issues such as free access to information, open data, open source software, and the sharing of methodologies, in a push to reopen science to a wide range of people. Berti Suman and Alblas (2023) identified a further turning point for modern participatory science around 2010, thanks to the rapid development of geoinformation technologies and, in particular, the spread of location devices and 'Web 2.0'. Advances in geoinformation and surveying technologies have led to the evolution of all types of *citizen science,* but they can be considered particularly useful in facilitating reactive forms of participatory science, as they allow citizens to engage in scientific research completely independently of governments and traditional scientists. Anyone with a mobile device can act as a 'sensitive citizen' and report environmental information, demonstrating the revolutionary and democratizing potential of this paradigm.

The activities carried out by NBFC

A census of citizen science projects active within the centre has identified 23 initiatives, some already underway and others in the planning stages, dedicated to exploring biodiversity in all its forms. The initiatives differ in terms of

- subject of study: the projects include censuses of animal and plant species, as well as the detection of pollution levels in different environments.
- natural environments, but also the recruitment of patients for clinical studies and raising awareness among the urban population about the

importance of biodiversity

- the type of volunteers involved: projects may be aimed simply at anyone interested in participating or at more specific populations, such as students, divers, sailors, or people with specific medical conditions
- type of commitment required: ranging from simply collecting observations to developing more complex actions, such as collecting samples or carrying out small-scale experiments.

In the course of this working group's activities, we have explored the links between biodiversity and food systems, the connections with increasing levels of urbanization, the role that museums and ecomuseums can play in promoting it, and the impact of different forms of representation of natural environments.

The following is a selection of examples of *citizen science* projects that address these issues through the promotion of concrete actions open to the collaboration of all interested parties:

CLIC! Chiocciole Lumache in Città

https://www.inaturalist.org/projects/clic-chiocciole-1umache-in-citta

The CLIC! Snails and Slugs in the City project is the first nationwide monitoring project of terrestrial molluscs in urban environments, promoted by the Accademia dei Fisiocritici Natural History Museum in 2020 and hosted on the iNaturalist.org web platform/app. Our cities are habitats rich in surprises and many different species, but urban biodiversity is still a relatively unexplored field: molluscs such as snails and slugs are excellent indicators of environmental quality, especially in urban areas, as they play a crucial role in food chains, soil formation, and nutrient recycling. The aim of monitoring is also to understand the effects of climate change and the mechanisms that cause the arrival of species foreign to our fauna.

URBIO

http://urbio.unimi.iti

Urban expansion, which began with human settlement, has led some animal species to become deeply attached to human settlements and activities, especially in the case of certain species of birds and mammals. This ecological process has led to the establishment of unique urban biological communities, making cities a true habitat that is now essential for the conservation of synanthropic species populations. The UrBio project has several ways to participate, allowing citizens, both experts and non-experts, to collaborate by entering data on the distribution of animal species, with or without photos, on the ornitho.it platform.

SBC Siena BiodiverCity

https://www.inaturalist.org/projects/siena-biodivercity-la-biodiversita-urbana-a-siena

Siena BiodiverCity is a project dedicated to the dissemination, education, and scientific research of Siena's urban biodiversity through a citizen science approach. The activities promoted included, among others, the organization of educational meetings on urban biodiversity, the production of "seed bombs" and bee houses to be distributed throughout the city, and the collection of information on biodiversity in the Siena area.

The FAO's commitment and the INCREASE project

The Food and Agriculture Organization of the United Nations (FAO) has been working for nearly a century to combat hunger, ensure food security and nutrition, and promote sustainable development, with a focus on agriculture, fisheries, and forests in more than 130 countries.

Citizen science is an important tool for achieving these goals. For this reason, FAO has been actively engaged in this area for several years, promoting projects aimed at involving different target groups: farmers, students, local communities, and the general public. Citizen science can therefore help identify innovative solutions and raise awareness of the challenges facing food systems, not only among those working in the sector but also among young people, consumers, policymakers, and citizens more broadly.

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), in line with the mandate given by its Governing Body, has developed an online system called Toolbox. This tool has been designed to support all those working in the various fields related to the use of plant genetic resources for food and agriculture (PGRFA). The Toolbox is therefore a digital database that collects and makes accessible almost 2,000 resources, divided between technical tools and policy guidelines, all aimed at promoting the sustainable use of PGRFA. Among the many resources available, the *Farmer Citizen Science for Climate Adaptation* project stands out in particular. The project has launched an initiative aimed at involving farmers in a large-scale campaign to select cultivated seed varieties. The approach is called "tricot." In evaluating tricot varieties, each farmer receives a package containing three different varieties. Farmers are asked to note which of the three is the best and which is the worst based on a list of characteristics that they develop together with researchers. Scientists then link the data generated by farmers via their geographical coordinates to agro-meteorological and soil data.

In 2022, at the side event of the United Nations Food Systems Summit (UNFSS), the One Million Voices initiative of the Transformative Partnership Platform on Agroecology (TPP) was launched, supported by the Swiss Agency for Development and Cooperation (SDC). Through a citizen science campaign that followed the principles of participation, inclusion, and overall social equity, the initiative aimed to bring together smallholder

farmers, agricultural workers, and food consumers to empower them to identify and develop solutions that support agroecological transitions, while generating knowledge and data on agroecology.

Since 2020, the INCREASE (Intelligent Collections of Food Legumes Genetic Resources for European Agrofood Systems) project has set itself the goal of improving the management and use of genetic resources of food legumes—in particular, chickpeas, beans, lentils, and lupins—recognized as strategic for environmental sustainability, food security, and human health. The initiative is part of the new European Protein Plan, which promotes innovation in the agri-food sector.

The project is structured around four main areas:

- innovative data management and definition of standards for interoperability;
- development of new tools for the conservation and efficient use of germplasm;
- application of advanced technologies for genotyping and phenotyping supported by artificial intelligence and
- a solid network of international cooperation for the integration of genetic resources at a global level.

One of the key elements of INCREASE is the *citizen science* experiment, a Europe-wide initiative that involves citizens in the participatory conservation, evaluation, and multiplication of traditional bean varieties. Through the INCREASE CSA app, participants receive seeds to grow in domestic spaces—such as vegetable gardens, gardens, or balconies—documenting the development of the plants with photographs and agronomic evaluations. The data collected contributes to varietal characterization and the identification of traits of interest, thus strengthening the scientific basis for the enhancement of agrobiodiversity.

From 2022, the experiment will include a seed exchange function between citizens in accordance with the rules established in the International Treaty on Plant Genetic Resources for Food and Agriculture. This mechanism allows all participants to share materials with new users, promoting the responsible circulation of genetic resources and strengthening the link between scientific research and civil society.

FAO-ITPGRFA will contribute to data management by facilitating germplasm exchange with Standard Material Transfer Agreements (SMTAs) within INCREASE and the assignment of digital identifiers to germplasm objects.

FAO will also collaborate on a digitized process based on smart contracts to assist SMTAs, which end users will manage via a mobile application.

The SMTA is a private contract with standard terms and conditions that ensure compliance with the relevant provisions of the International Treaty by individual suppliers and recipients of plant genetic material. The proposed smart contract-based system will assist users in compiling, generating, and digitally signing SMTAs in the six official languages of the International Treaty, as well as in reporting SMTAs concluded in accordance with the instructions provided by the Governing Body of the International Treaty. The proposed application combines the functions of SMTA generation, reporting, and digital agreements, and the user can decide to use the generation and reporting tools separately.

FAO will provide assistance with the ethical requirements of the project as they relate to Access and Benefit-sharing (ABS) regulations applicable under the ITPGRFA multilateral system. Project partners will transfer crop germplasm for research and breeding under SMTAs, subject to any other applicable ABS requirements.

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Biodiversità, Cibo e Cultura

Pubblicazioni:
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2. Monica Bernardi, Pablo Gómez-Iniesta, Nunzia Borrelli, *Bringing Nature Back to Cities. Governing, Communicating and Living with Urban Biodiversity in the Mediterranean*
3. Nunzia Borrelli, Giulia Mura, Michela Rota (edited by), *DisSeminAzioni: Telling the Story of Biodiversity*

National Biodiversity Future Center / 3

DisSeminAzioni: Telling the Story of Biodiversity explores biodiversity as a shared cultural, social, and political concern at the heart of today's ecological crisis. Moving beyond a purely scientific perspective, the volume investigates how biodiversity is represented, communicated, experienced, and activated through museums, art, food systems, urban environments, and participatory practices.

Emerging from an interdisciplinary research project connected to the National Biodiversity Future Center, the book brings together scholars from sociology, museum studies, visual studies, and environmental research to examine biodiversity as both an ethical value and a driver of collective action. From contemporary art and visual communication to urban biodiversity, sustainable food systems, and citizen science, the chapters reveal how cultural institutions can act as laboratories of awareness, engagement, and transformation.

Through case studies, theoretical reflections, and applied methodologies—including impact assessment and shared indicators—*DisSeminAzioni* offers concrete tools for rethinking the relationship between humans and the living world. Addressed to researchers, cultural professionals, educators, and decision-makers, this volume invites readers to recognize biodiversity not as a distant or abstract issue, but as a living, relational process that concerns everyday choices, public spaces, and the future of our societies.

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