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Review

Rewilding as a Multifaceted Concept and Emerging Approach: The Romanian Experience

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Abstract: We conduct a review of the multifaceted rewilding concept and rewilding initiatives worldwide, focusing on specific features and outcomes of European rewilding issues and Romanian rewilding projects. In this review of the literature and case studies, we undertake the following: (a) identify the definitions and thorough meanings of the term rewilding worldwide, including its guiding principles aiming at rebuilding the natural ecosystems; (b) map the international and European treaties and policies referring to ecosystems' restoration, biodiversity, environment, sustainability, and rewilding-related issues; (c) explore the benefits and criticisms associated with the rewilding activities, including from a social perspective; (d) structure an overview on the tools used for rewilding assessment; (e) identify the projects and initiatives developed and on-going in Romania on rewilding. Our findings reveal a great diversity of topics addressed within the rewilding umbrella and also a significant growth in this area, despite the numerous challenges faced by experts and locals (e.g., understanding the context of rewilding and identifying the most suitable modalities of operationalizing it) and questions (such as the following: is rewilding a real need? will it bring benefits to nature and people?) that remained to be answered. In Romania, a series of efforts are being undertaken both by the government and NGOs to restore self-sustaining ecosystems and to raise awareness of this topic among different stakeholders.

Keywords: conservation; biodiversity; ecosystems; restoration; sustainability; rewilding

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1. General Layout of the Paper

Rewilding is emerging as a promising restoration strategy in the current context of loss and degradation of ecosystems due to increasingly coercive factors, such as climate change, food security threats, and global increased consumption of natural resources. Despite the large number of publications focusing on the topic of rewilding, which has grown rapidly in recent times, readers are provided with very heterogeneous information, making it sometimes difficult for an interested party to extract a global view on rewilding as a starting point for understanding much deeper related issues. This is more challenging because of the variety of approaches to rewilding and also because of the lack of a universal consensus on its definition and principles. Thus, our paper attempts to present the multiple aspects of rewilding, starting with an overview of definitions encountered worldwide throughout the history of the term "rewilding". In the next step, rewilding is placed in the context of concerns about biodiversity conservation and the sustainable use of its components, bearing in mind that the United Nations General Assembly recently designated the period 2021–2030

as the "decade of ecosystem restoration". Further, rewilding actions are integrated within the European context, with a focus on the main EU biodiversity laws and policies (such as Habitats and Birds Directives, the European Green Deal, and the EU Farm to Fork strategy). Rewilding activities are supported by various European biodiversity protection treaties (e.g., the Carpathian Convention), which are briefly outlined. The concept of rewilding is gaining not only popularity and promotion but also criticism. Thus, without being biased, we have indicated the perceived benefits and risks of rewilding while considering ecosystems, human health and well-being, and economics as the goals and outcomes of rewilding. The challenges and shortcomings of rewilding are also discussed, such as the permanent need for recalibrating human–animal relationships and the need for agricultural subsidies from the EU's Common Agricultural Policy for rewilding progress, respectively. Considering that rewilding is gaining importance across Europe, emerging as an important tool to restore natural processes, its monitoring and assessment are vital. The assessment of rewilding efforts is challenging due to the numerous dimensions that have to be captured in a specific context. The literature is relatively scarce on this topic, but recent technological advances (e.g., satellite imagery, light detection and ranging technology, camera trapping, eDNA meta bar coding of dung, and eDNA of saliva), briefly mentioned here, are increasingly being developed for measuring rewilding outcomes. Largely heterogeneous and to a lesser extent, suitable for rewilding actions, mathematical models have proven to be valuable tools in the field of conservation. A review is made of the frameworks devised and tested in the last 10 years, with an emphasis on their practical benefits, leaving aside their limitations that can be found in the corresponding references.

Finally, we provide an overview of the rewilding projects and initiatives implemented in Romania since 2011, either as a single country or as part of a cross-regional consortium at a trans-regional level. The targeted key species, the actions to enhance rewilding, and also the educational and economic activities associated with rewilding activities are presented in this overview to give the reader a picture of the sustained efforts made at the national level to meet the EU's environmental ambitions. Connecting the science and practice of rewilding and broadening the knowledge about the conservation efforts made in Romania are acknowledged.

However, some questions are not fully addressed in this paper and require further exploration.

2. Rewilding—A Developing Concept

Rewilding, a relatively new conservation practice based on the concept of comprehensive restoration of sustainable biodiversity and ecosystem health, is defined as an approach that considers species (re)introduced into our landscapes [1] and also as an approach to restoration by recognizing ecosystems as dynamic systems [2], in contrast to traditional biodiversity conservation [3]. The concept originated in North America in reference to the (re)introduction of large carnivores (such as wolves) for the restoration and protection of large and connected wilderness areas [2,4], which is a process that allowed for woody encroachment [5] and re-establishment of strong top-down interactions [6]. Rewilding is also a "complementary" conservation approach [7] that works synergistically with tools and measures that protect biodiversity.

A much-debated concept in the field of management of natural areas, rewilding has an ecosystem- and ecology-centric view [8], aiming to reinstate ecological processes' ability to act with little or no human presence and intervention in systems [3,9]. In the last decade, rewilding has increasingly entered the mainstream discourse and nowadays has spread far beyond academia [9]. Seen as a force of landscape change, humans play a central role in rewilding. However, the "people in rewilding" discourse is still fundamentally underdeveloped and incoherent [9]. The role of people, the key beneficiaries of rewilding, within this process has been emphasized in the context of the interactions between calls for "repeopling" (resettlement of landscapes), concerns for official authorization, and drivers of rural economic regeneration [9]. At least in the first stage, human activities, which lead

to certain physical and chemical properties in ecosystems, can be compatible and helpful for rewilding [7]. Animal survival and well-being can potentially be enhanced by both human intervention and non-intervention [10]. Human interventions to save endangered species today are characterized as "bigger, bolder, and costlier than ever" [10].

Considering that it focuses on ensuring ecosystems' health and functionality, rewilding is defined as a narrative and a movement for natural regeneration and as an effective, practical strategy through which ecological solidarity can be applied [11]. Introduced into practice by some European countries (i.e., France) as a new management strategy, ecological solidarity refers to connecting solidarity actions to ecological causes and also to connecting solidarity actions and non-human recipients, such as animal species [11]. More recently, the "rewilding" term was coupled with ecological restoration and regeneration within the ERRR concept—ecological restoration, regeneration, and rewilding—with the consideration that such terms capture actions most clearly driven by ecological goals compared to terms such as "remediation" or "rehabilitation" [12].

When the term "rewilding" was adopted in Europe, some differences in usage were envisaged. Thus, from a philosophical point of view, the difference between Europe and North America consists in creating in areas that have been managed for millennia in Europe and "wildness" that supposes autonomy, spontaneity, self-organization, and absence of human control. The absence of sustained human intervention (passive rewilding) is central to European rewilding programs, which is an approach that is hard to achieve due to rapid environmental change [4]. The focus on large connected areas and the reintroduction of large animals was kept in Europe's rewilding activities, but large carnivores were de-emphasized.

According to Corlett [4], the term "rewilding" has not yet achieved the maturity of an introduction to restoration and conservation. It has been used in various ways with clearly distinct methods. Thus, the term rewilding includes the following: "Pleistocene rewilding", meaning restoring to a pre-human Pleistocene baseline; "trophic rewilding" that has as a key element the species introductions to restore top-down trophic interactions; "passive rewilding" referring to little or no human interference; and "ecological rewilding" that allows natural processes to regain dominance [4]. At the centre of the feasibility of all types of rewilding is the contention between the two kinds of processes—top-down (i.e., predation) and bottom-up (i.e., growth of vegetation and consumption by herbivores) [8].

The term "rewilding" has been used concerning a variety of topics differing over time about varying geographical reference points [13]. Based on the six different uses of the term rewilding in the academic literature by Jørgensen [14], the following rewilding concepts were defined more recently: the "three Cs"—cores, corridors, carnivores; Pleistocene megafauna replacement; island taxon replacement; release of captive-bred animals to the wild; landscape restoration through species reintroduction; productive land abandonment; and restoration of self-sustaining ecosystems [13].

A unifying definition and 10 guiding principles for rewilding were developed by Carver et al. [15]. According to the authors, rewilding is "the process of rebuilding, following major human disturbance, a natural ecosystem by restoring natural processes and the complete or near complete food web at all trophic levels as a self-sustaining and resilient ecosystem with biota that would have been present had the disturbance not occurred". The ten basic principles designed by the International Union for the Conservation of Nature Commission on Ecosystem Management (IUCN CEM) [16], in consultation with the global rewilding community, state that rewilding is on a continuum level of scaling, connectivity, and human influence [15]. Thus, rewilding utilizes wildlife to (1) restore trophic interactions, (2) employ landscape-scale planning, (3) focus on the recovery of ecological processes, (4) recognize that ecosystems are dynamic and constantly changing, and (5) anticipate the effects of climate change. It (6) requires local engagement and support, (7) is informed by science, traditional ecological knowledge and other local knowledge, (8) is adaptive and dependent on monitoring and feedback, (9) recognizes the intrinsic value of all species and ecosystems, and (10) requires a paradigm shift in the coexistence of humans and nature from ecological baselines to fully functioning trophic ecosystems.

Created in 1948, the IUCN is the world's largest and most diverse environmental network and also the only environmental organization affiliated with the UN General Assembly. The Conservation Translocation Specialist Group (CTSG) of the IUCN Species Survival Commission (SSC) developed the IUCN SSC Guidelines for Reintroductions and Other Conservation Translocations [17], whose application extends to rewilding efforts that attempt to restore larger ecosystems. The foundation and activity of this specialist group led to radical and courageous practices of reintroductions, which were much needed to revolutionize traditional conservation [10].

3. Rewilding within the Global and European Framework

3.1. International Policies and Strategies for Rewilding

The United Nations General Assembly adopted a set of 17 sustainable development goals (SDGs) to eradicate poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda [18]. The rewilding concept and activities are in line with SDG 15, life on land, and SDG 17, partnerships for the goals of the 2030 agenda.

Recently, the United Nations General Assembly designated 2021–2030 as the "decade of ecosystem restoration" [19]. The UN Decade on Ecosystem Restoration aims to prevent, stop, and reverse the degradation of ecosystems and is a suitable context in which the rewilding topics can be brought, by policy-makers and decision-makers, to the forefront of discussions on how to reach post-2020 biodiversity goals [2]. Rewilding activities are among the relevant initiatives and policies for the UN Decade on Ecosystem Restoration [7]. The progress through the UN Decade of Restoration is associated with the challenge of ensuring restoration funding mechanisms [20], both for scaling up restoration efforts and coping with changing restoration approaches.

Two international treaties of the United Nations provide the legal and policy instruments for action on key issues, such as those related to the environment and development: the Convention on Biological Diversity [21] and the Convention on the Conservation of Migratory Species of Wild Animals [22]. Those conventions created platforms and forums where all the interested parties share ideas and discuss strategies.

The Convention on Biological Diversity (CBD) is an important international treaty that explicitly links biological diversity to ecosystems. CBD targets the conservation of biological diversity and the sustainable use of its components. Rewilding can be identified as an in situ conservation measure [7]. Adopted in December 2022, the Kunming-Montreal Global Biodiversity Framework [23] outlines goals for 2050 to be achieved to protect and restore nature [12]. Several action-oriented quantitative targets need to be reached by 2030. The targets from one to eight aim to reduce threats to biodiversity. Target 4 (Halt Species Extinction, Protect Genetic Diversity, and Manage Human-Wildlife Conflicts) addresses three components, including management actions for threatened species, management actions to maintain and restore genetic diversity, and actions to manage human-wildlife interactions.

The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention; CMS) [22] is an environmental treaty of the United Nations recognizing that wild animals are an irreplaceable part of the Earth's natural system. Starting from the need for their conservation for the good of mankind, it focuses on migration, which is considered an ecological process for rewilding.

3.2. Rewilding in European Context

In Europe, the idea of rewilding is novel [24]. It first emerged in 2010 in response to biodiversity decline as a result of significant levels of farmland abandonment. Driven by a mix of social, economic, and physical reasons, this major land transformation experienced by the European continent for the next decades can be seen as an opportunity for rewilding afforested areas [7]. The rewilding emphasis is put on the creation of a network of core areas for conservation. Also, grazing by large herbivores that leads to channelling forms of ecological restoration is of high interest in rewilding.

The biodiversity and climate crises can be jointly addressed by integrating restoration and rewilding approaches, capitalizing on their strength and targeting different socio-ecological contexts [25]. The multifaceted field of restoration ecology is reflected by various and broad definitions of restoration [12], as they were given by the Society of Ecological Restoration, the UN Decade on Ecosystem Restoration, and the IUCN. If restoration is recognized in mainstream conservation and policy, rewilding is viewed as an alternative way to achieve the large-scale recovery of nature [25]. In the opinion of Shackelford and McDougall [12], rewilding is a branch of restoration-related practice that has experienced a surge in the last few decades. Beyond their definition, the successful integration of the restoration and rewilding agendas requires both scientific congruence and policy support and coordination [25].

Rewilding does not have a legal status per se [7], but the EU and regional legal sources sustain the related initiatives and actions. The support of public authorities of the strategies in favour of the wilderness in Europe is labelled rather as poor, as these strategies are being developed mainly by NGOs [26]. European rewilding is led at present by the non-governmental organization, Rewilding Europe [27]. Wondering how European policy has responded to the increasing number of rewilding projects and their needs for sustainability, Root-Bernstein et al. [28] stated that Rewilding Europe and Rewilding Britain filled this gap by legitimating rewilding as a means of conducting conservation in the 21st century and also by creating policy change to facilitate rewilding.

Rewilding can be considered a land policy in Europe [29]. It can bring back the high-diversity features and support restoration and/or rewilding activities. The agriculture and land-use policy and the biodiversity policy are the two policy areas particularly relevant to rewilding [30]. The Habitats Directive and Birds Directive underpin the current EU biodiversity policy.

The Habitats and Birds Directives form the cornerstones of the EU biodiversity policy, having the ambition to conserve Europe's natural heritage [31]. The Habitats Directive [32] ensures a great part of nature conservation at the EU level, including that of plants and animals. The Directive acknowledged the link between species and habitats by introducing the Sites of Community Importance (SCIs) that can be designed as Special Areas of Conservation (SACs) once approved by the state members. Rewilding is a compatible measure for the management of a SAC [7].

The Birds Directive [33] exhibits an encompassing and ecological approach that is used for the protection of birds, taking into consideration breeding and migration. Rewilding could fit under the requisite measure for the maintenance of the species population [7]. Rewilding can also be considered in agreement with the goals of preservation, maintenance, and reestablishment of sufficient diversity and areas of habitats for all species, as mentioned in Art. 3 (1).

Maintaining or restoring the favourable conservation status of the habitats of sites of community importance represents the objective of Natura 2000, which is "the largest coordinated network of protected areas in the world" [34]. This network focuses on the most valuable and threatened species and habitats listed under both the Habitats Directive and the Birds Directive to ensure their long-term survival.

The Habitats Directive and the Birds Directive, the backbone of the EU biodiversity laws and policies [7], have not been completely applied or implemented enough till the present, and the status of European nature has not significantly improved as it was forecasted. For this reason, the EU Biodiversity Strategy for 2030 has been set forward, as an ''ambitious and long-term plan to protect nature and reverse the degradation of ecosystems" [35]. This EU Strategy offers opportunities to boost the rewilding approach [7]. Rewilding could be applied as an area-based conservation measure (OECM), with the possibility of other effective OECMs being foreseen by the Strategy.

Developed as a result of concerns related to existential threats to Europe and the world, namely climate change and environmental degradation, the European Green Deal is a set of policy initiatives of the European Commission [36]. Within the framework of the

European Green Deal, in May 2020, the EU Farm to Fork Strategy was launched to focus on the sustainability of the food chain and to offer safe, nutritious, and high-quality food to people [37]. In the context of the EU Green Deal and EU Farm to Fork strategy, rewilding may contribute to EU targets for ecosystem services, biodiversity, climate adaptation, and landscape management [38]. Bringing rewilding to the agenda of conservation policies could lead the way to a new transition of biodiversity conservation in Europe [39].

3.3. European Rewilding Projects

"Explore our rewilding landscapes" is the online invitation addressed by Rewilding Europe [40] with a view to encourage rewilding initiatives by demonstrating the benefits of rewilding implemented at a landscape scale for both nature and people. To sustain this, ten selected large pioneering landscapes in Europe are presented [41] as follows: (1) the Iberian Highlands (Spain); (2) the Rhodope Mountains (Bulgaria); (3) the Greater Côa Valley (Portugal); (4) the Southern Carpathians (Romania); (5) the Central Apennines (Italy); (6) the Swedish Lapland (Sweden); (7) the Velebit Mountains (Croatia); (8) the Danube Delta (Ukraine, Romania, and Moldova); (9) the Oder Delta (Germany, Poland); and (10) the Affric Highlands (Scotland).

The abovementioned information presents a wide range of rewilding efforts made in various areas differing by location, size, ecological restoration needs, or relevance for landscape management. Besides these initiatives, others labelled as "rewilding" are briefly acknowledged below, without pretending to have an exhaustive list. Thus, in the Alladale Wilderness Reserve (Scotland),a core area of native Caledonian pine forest was restored [42], and the Devon Beaver project (England) aimed to reintroduce beavers (*Castor fiber*) to create a diverse wetland environment and reduce the peak discharge and pollutant load of downstream water [43], while in the Oostvaardersplassen Nature Reserve (Netherlands), a "partly self-regulating" population of cattle, horses and red deer replaced extinct megaherbivores to install a Pleistocene community [44].

More recently, the GrazeLIFE project (Grazing for wildfire prevention, ecosystem service provision, nature conservation, and landscape management–LIFE18 PRE/NL/000002) [45] coordinated by Stichting Rewilding Europe, Netherlands and cofounded by the EU, aims to identify the grazing models with the most beneficial impacts, and the case studies are being conducted in the following areas: Greater Côa Valley (Portugal), Galicia (Spain), Velebit (Croatia), Rhodope Mountains (Bulgaria), Danube Delta (Romania/Ukraine), Oder Delta (Germany/Poland), Lowland Rivers Rhine and Meuse–Netherlands/Belgium, and Lithuania.

Finally, but not in the end, the wildE (Climate-smart rewilding)should be mentioned, which is a Horizon 2020 project that will take place between 2023 and 2026. Through a holistic approach, considering the rewilding potential to contribute significantly to the EU goals, the project "will develop climate-smart rewilding as a nature-based solution to the twin threats of climate change and biodiversity loss" [46].

4. Treaties for European Biodiversity Protection and Sustaining Rewilding Activities

Policies, administration, and national borders are not respected by animals, habitats, and environmental features. Consequently, some agreements are in force to better monitor the rewilding-related issues in Europe, as follows:

- the Carpathian Convention, entered into force on 4 January 2006 as "a sub-regional treaty to foster the sustainable development and the protection of the Carpathian region" [47];
- the Bern Convention on the Conservation of European Wildlife and Natural Habitats entered into force on 1 June 1982 and was "signed by the European Union and 50 countries that are committed to protecting wildlife, both species and their habitats"; it encourages education and research on biodiversity and harmonizes conservation laws [48];
- the Alpine Convention entered into force on 6 March 1995 as—"an international treaty between the Alpine Countries (Austria, France, Germany, Italy, Liechtenstein, Monaco,

Slovenia, and Switzerland) as well as the EU, for the sustainable development and protection of the Alps" [49].

The Carpathian Convention was adopted and signed by seven parties (Romania, Czech Republic, Hungary, Poland, Serbia, Slovak Republic, and Ukraine) "to cooperate for the protection and sustainable development of the Carpathians and for improving the quality of life, local economies and communities, and conservation of natural values and cultural heritage" (Art. 2(1)).

Due to the high presence of bears, wolves, and lynxes, the Carpathians is a kingdom of carnivores, which supports viable populations of the greatest mammals. The Carpathian Convention targets high-level protection and takes into consideration the surrounding areas of habitats (through continuity and connectivity). This fits with the rewilding approach of going beyond the conservation of a given natural habitat.

As a result of the concerted efforts, both in legislation and practices related to species conservation, Eastern Europe is starting to become the ecological heartland of Europe [24].

5. Benefits, Risks, and Gaps of Rewilding

5.1. Rewilding between Benefits and Criticism

Rewilding has been both promoted and criticized in recent years [2]. The created benefits for both ecosystems (i.e., flexibility to react to environmental change and enhancing biodiversity) and societies (i.e., the opportunities to reconnect with nature and contributions of ecosystems to human well-being) are emphasized by proponents. By creating and protecting microhabitats, rewilding could diminish the undesirable effects of climate extremes on biodiversity [1] and help to reduce pollution, especially in urban areas [11].

It has been stated that rewilding reduces the spread of infectious diseases (i.e., zoonosis) from pathogens, contributes to the containment of disease transmission (i.e., Lyme disease), and prevents disease (with scavengers, such as vultures, playing an important role). Ecosystem decline has led to more pathogenic diseases, such as those caused by leishmaniosis, malaria, dengue, or viruses [11,50]. Another link between rewilding and health refers to health not only in biological terms but also in a multidimensional way [11]. The rewilding actions create positive stories, and wilderness conceptions are largely concerned with issues of feeling [26].

Highlighting the importance of herbivory as a key factor in rewilding, Gordon et al. [8] pointed out that it is possible to gain economic returns (ecotourism, sale of livestock products) from rewilding lite, making these systems more acceptable to landowners. The engagement of farmers in practices closer to their traditions can be a benefit for society.

Rewilding in urban areas leads to greater diversity by introducing native flora and fauna into urban infrastructures and brings benefits to humans. Thus, it can reverse the degradation of the natural world, reconnect people with nature, and alleviate the stresses of expanding urbanization [51].

However, if the science of rewilding is discussed, it is criticized for being theory-led rather than evidence-based [52]. More than that, the extent to which rewilding can deliver benefits remains uncertain [3]. The lack of a consistent conceptualization of rewilding, the insufficient knowledge about rewilding potential outcomes, and the mistaken opinion that rewilding actions are planned without taking into consideration their societal acceptability and benefits are underlined by critics. The perception that rewilding excludes people from landscapes is also pointed out by rewilding' critics. Rewilding may conflict with local cultural traditions and agriculture [53,54]. As a direct result of rewilding programs across Europe, the risk to food and nutrition security was highlighted at a small farms level. New forms of governance in rural spaces are engendered through rewilding [55].

5.2. Rewilding Challenges and Shortcomings

Rewilding progress is threatened by various factors, the weighting of which may vary across sites. Thus, regulations and policies that dictate land management and agricultural subsidies from the EU's Common Agricultural Policy (CAP) were identified as factors that

stopped or reversed rewilding progress in some areas of Europe [56]. Competing desires for the use of land found within a diverse ownership matrix can also undermine the scaling of rewilding actions. Locally, reversing abandonment land trajectories to agriculture [57] and regulations, such as supplementary feeding to support hunting practices [58], have negative implications for rewilding progress in certain areas. Environmental limitations (i.e., climate, gradient, and water flows) can slow down the construction of cultural landscapes [5]. Also, trophic rewilding could not reach its objective of creating self-regulating ecosystems by using megafauna restoration. Here, one uncertainty was the inability of the recovered wildlife alone to reverse the alternative states caused by defaunation [6]. The high human density (i.e., in Western Europe countries) offering only a little room for wilderness can be seen as a challenge for rewilding actions [26]. Thus, populations of native herbivores or predators may not be acceptable close to areas of high human density or agricultural land [8].

Policy and advocacy are complementary to rewilding measures taken at local scales to allow rewilding to scale up across entire landscapes [56], while the aims of rewilding can be achieved through careful site-specific interpretations [15]. To operationalize the rewilding concept for an ecologically degraded landscape, stakeholders' full engagement and consensus are vital [59]. Focusing on large herbivore assemblage, du Toit [59] recommends five steps for operationalizing active rewilding: estimation of total potential biomass density, allocation of biomass to functional types, prioritizing ecosystem services and requisite functional traits, prioritizing native species, and taking into account surrogates and re-engagement of stakeholders. Developing typologies of functional types of animals within bioregions of trait space would help operationalize the rewilding concept on a global scale [59]. Implementing comprehensive long-term plans to manage herbivore populations will maximize biodiversity gains, mitigating welfare concerns and reputational risks [52].

Measuring rewilding outcomes and determining the success or failure of rewilding efforts are challenging [52]. Decades or centuries could be needed for the true measurement of rewilding success [52,60]. Indices of recovery progress, recovery completeness, or both are quantified to compare degraded, restored, and intact reference ecosystems to assess the restoration success [61]. Integrated into a suitable framework, numerous relevant variables and indicators must be taken into account to evaluate the ecological outcomes of rewilding projects, and this is information that constitutes the key to long-term engagement and political support for rewilding [62]. To address some of those challenges, recent technological advances are added to short-term measurements, as emphasized at point 7.

From a social perspective, positive or negative attitudes towards conservation action, including rewilding, are investigated to identify factors responsible and mechanisms of emergence. Considering the farming community as one of the key stakeholders in the debate about rewilding, and using thematic analysis of semi-structured interviews, Mikołajczak et al. [63] identified core issues related to farmers' perceptions influenced by mental models, social impacts, and ecological outcomes of rewilding initiatives. The last factor of influence underlines, one more time, from another perspective than the previous ones, the importance of measuring the success of rewilding initiatives. The authors argued that the type of farmers' negative perceptions should be identified to overcome their lack of or decreased support for rewilding. Thus, the negative perceptions can be based either on objectively verifiable causal beliefs or on values. In the first case, a change of rewilding opponents' minds is possible, for example, through the provision of positive experiences, but in the second one, they are unlikely to change easily.

A scoping review conducted by Hart et al. [52] presents 22 studies on data gathered across 15 European countries on the outcomes of rewilding as a management strategy on sites in Europe. As a limiting factor of their study, the authors reported the complexity in quantifying rewilding outcomes due to the variety of ecological and socioeconomic domains. A total of 2 studies from all 22, belonging to Vasile [24] and Segar [56], refer to Romania. Neither of the two studies reported the size of rewilding sites in Romania.

Eventually, generating funds to support and sustain restoration projects was identified by Egoh et al. [64] as one of the biggest challenges facing rewilding activities. Monitoring biodiversity, ecosystem services, and other key variables requires costs, resources, and time that could be prohibitively expensive and challenging to policymakers [65]. Major policy platforms and international funding agencies are requested to sustain the coordination and integration of restoration and rewilding, viewed as complementary and synergistic conservation approaches [25]. In Europe, rewilding funding is supported by rewilding-specific NGOs (i.e., Rewilding Europe and Rewilding Britain) and also by major research funding programs (i.e., Horizon program, Biodiversa+) that included rewilding in their calls to action [20].

5.3. Rewilding Costs Compared to Other Conservation Strategies

The contribution of rewilding to the recovery of more integral ecosystem processes should be also discussed in terms of its associated benefits, risks, and costs. Fernández et al. [66] identified the need for a framework where these criteria are linked to restoration baselines and the operationalization intensity needed to accomplish conservation goals. Related to the economic context in which conservation policies, including rewilding, operate, it has been emphasized that the knowledge referring to the ability of different conservation interventions to deliver conservation benefits for a given cost is almost lacking [30]. More than that, the authors mark the assessment of potential costs and benefits of rewilding as "tricky" because of the expected level of unpredictability in the outcomes. Reaching a new equilibrium in a wide range of ecosystem elements might require many years [67]. Thus, the role of research is considered fundamental both for assessing the costs of rewilding projects and improving the prediction capacity of the spatio-temporal variation in economic costs and associated benefits to support decision-making and adaptive management [30].

Deciding on future nature management schemes in terms of opportunity costs should be stressed from the perspective of the EU 20230 Biodiversity Strategy that aims to reserve 30% of terrestrial land for nature in the EU [68]. Informing policy decision-making should be based on financial records, but a significant lack of evidence on comparing the costs of rewilding with the costs of traditional conservation practices in Europe was reported [52]. Compared with other ecosystem management actions, the economic analysis of rewilding both at the micro and macro levels has not been significantly developed [68]. Considering this gap and emphasizing the lack of comparative assessments of the cost efficiency related to nature management that include rewilding scenarios, Schou et al. [68] performed a private economic CBA (cost-benefit analysis) of three management schemes for nature conservation: two biodiversity scenarios and a business-as-usual scenario involving summer grazing in combination with crop production and forestry in protected nature areas. Considering the aggregate economic rent in each scenario, the authors found that rewilding involving wild large herbivores was more economically attractive than summer grazing and extensive year-round cattle grazing. However, it was pointed out that the size of the areas where the shifting from one system to another is undertaken and the possibility to receive financial subsidies from the EU Common Agricultural Policy (CAP) or through agri-environmental schemes (AES) affect the economic effects of various nature management schemes [68].

Beavers used to inhabit the Iberian Peninsula, and they have been reintroduced in several European locations as a means to restore freshwater ecosystems [69]. Their economic potential was analysed by selecting the actions that beavers might perform, according to the Portuguese Environmental Agency (APA) river restoration guide. Five scenarios were developed, and cost values were calculated for each action. The cost assessment underlined the higher potential of beavers to replicate river restoration actions, possibly saving many thousands and even millions of euros [69]. More than that, bioengineering interventions using beaver (*Castor* fiber) populations provide a boost to biodiversity.

Considering the need to predict and measure the interactions between a reintroduced species and their environment to effectively manage rewilding projects, Sandom et al. [42] evaluated the potential of wild boars (*Sus scrofa* L. 1758) to aid the restoration of the Caledonian pine forest through quantifying their rooting rate at a range of stocking densities. The cost of using wild boars at different stocking densities (cost/ha) takes into account numerous variables such as the number of boar/ha, the number of stocking days, the wild boar purchase price, the costs of butchering a wild boar, feeding a boar/day, transporting the animals, cost to license an enclosure, the staff cost and the sale price of a wild boar, and the number of hectares prepared for the wild boar in the allotted time. The cost-effectiveness assessment demonstrated that it was more cost-effective to stock at higher densities [42].

The empirical evaluation of rewilding is scarce not only in terms of the ecological impact but also the socio-economic. Particularly, the impact of rewilding on ecosystem service delivery has remained under-addressed [70]. The willingness to pay, a concept from ecological economics, measures pro-environmental behavioural intentions. In different restoration scenarios, the willingness to pay is influenced by people's values and attitudes, with the ecocentric ones being identified as the main support for habitat restoration outcomes [71]. Ecosystem service outcomes lead to positive associations between pro-environmental behaviour and egoistic (self-oriented) values [71].

6. Rewilding from a Social Perspective

Rewilding is a narrative and a movement for natural regeneration that seeks to make the planet wilder by ensuring it has healthier and more functional ecosystems [11]. However, wilderness actions might involve actions that are not desired by society [72], although the positive spin-offs of such projects from economic and social points of view are sometimes undeniable [26].

Rewilding can happen spontaneously if humans withdraw from landscapes or by active choices [2]. In the latter case, rewilding projects need to account for social-ecological dynamics. Ecosystems and human societies can be assessed only conjunctively. Thus, all areas that are candidates for rewilding are influenced by people, and any rewilding project can affect local livelihoods and wellbeing. Endangered wildlife and an increasing aversion to keeping captive zoo animals made reintroduction popular starting in the 1960s [10]. On the other hand, the permanent need for recalibrating human–animal relationships is challenging for reintroduction managers who are obliged to walk a fine line between intervention and relinquishment [10]. Both intervention and non-intervention are in a balance between enhancing the survival and well-being of animals and raising serious difficulties respectively, with impacts on flourishing life.

Rewilding discourse does not sit in isolation, being in interaction with discourses on topics such as land reform and climate change [9], and agricultural rewilding has emerged as a form of land use to better respond to societal demands [3]. In the context of countries struggling to find out what to do with abandoned agricultural land, rewilding is a growing movement across Europe [72].

In the rural areas of Europe that are depopulated especially as a result of the moving of the younger generation to urban settlements rewilding lite is growing in importance. It is a compromised form of rewilding aiming to achieve, with some human intervention, the goals of a more natural state of ecosystems that are historically compromised by anthropogenic influences [72,73]. Restoring the functional integrity of ecosystems could be realized by using only well-adapted local breeds of livestock, without the need for analogous non-endemic wild species. This form of rewilding lite is called livestock rewilding, which is a relatively new approach to the rewilding debate that merits public engagement [8,72].

The socioeconomic gain for local communities is central to rewilding success [15,52]. The societal appeal and the economic benefits of rewilding to natives are milestones of its positive extent from a social perspective, and they have also been identified as determinants

of success in some European rewilding areas. A supplementary income can be obtained via the creation of a certification standard for rewilding-associated products, targeting ethical consumers of goods and services with positive environmental externalities [20]. The certification standards for rewilding-based products should highlight an ecosystem's trajectory toward self-sustainability.

Justification for conservation action is increasingly made based on the concept of ecosystem services (ES), which are "the material and nonmaterial benefits that humans receive from the functioning of intact ecosystems" [71]. This is a concept that furthermore broadens the appeal of ecological restoration and gathers non-traditional supporters. People more concerned about personal gain and benefit from the environment have been identified as ES proponents. Matzek and Wilson [71] found that the disinclination of people to believe that restoration can have significant drawbacks is predicted based on their altruism and desire for preservation.

Rewilding is an emotional subject [74] seeking to highlight the intrinsic value of nature [26] and whose success is linked to public enthusiasm [75] and to the understanding of the context of rewilding projects [15]. Support from the general public and also the involvement of private landowners is considered, in the context of constructing a sustainable, balanced landscape, crucial for the long-term maintenance of benefits [5].

Recovering lost species is an emotionally charged practice. Most people have still "separationist" views (i.e., bison belong to the forest) and agree with wildlife control rather than with non-intervention [10]. Examining the reintroduction of the European bison into the South-Western Carpathians of Romania, Vasile [10] emphasized that the coexistence of most reintroduction projects with local populations is uneasy, contributing to the extinction of these species. An uneasy relationship exists also between reintroduced bison and rangers and hunters [10]. Thus, rethinking the relationship between humans and non-humans can be seen as an opportunity provided by wilderness projects in Europe, whose strong point is also that they awaken the imagination [26]. This trait contributes, if related, to animals' aesthetic charisma, such as when the Taurus cattle was introduced on communal lands in the Romanian Danube Delta [24]. However, it remains unclear whether the locals fully appreciate or understand the reintroduction as part of the long-term rewilding plan and its ecological goals [10,27].

According to Tănăsescu [27], developing an inclusive social approach to rewilding projects will sustain the future of rewilding. More than that, non-ecological thinking should be absorbed within these rewilding projects so that the locals find themselves in a wilder landscape [27]. However, planning rewilding projects should take into account the negative societal narratives—human-wildlife conflict, loss of land productivity, food security, animal welfare concerns, and perceived cultural decoupling [24,52,55]. The identification of a relevant and practical framework for the monitoring and evaluation of rewilding projects in terms of their societal benefits requires, among other things, consistent research on ecosystem processes and service delivery [30].

7. Rewilding Assessment

7.1. A General Overview of Rewilding Assessment

According to Segar et al. [56], rewilding is gaining importance across Europe, emerging as an important tool to restore natural processes as agricultural abandonment trajectories provide opportunities in this sense. The authors underline that a lack of monitoring of rewilding interventions and their interactions contributes to limitations of the rewilding application and its long-term consequences. The ability to capture the socio-economic and ecological responses of rewilding actions is the key challenge in filling this gap.

The successful implementation of ecosystem restoration is based on ecology and a range of other disciplines (i.e., economic analysis, genetic analysis, and engineering). Genetic analysis is useful to evaluate the remaining genetic diversity of populations, to determine the optimal source populations for species introductions, and to monitor issues [12].

Measuring rewilding outcomes is challenging, but recent technological advancements successfully address some challenges [52]. In their scoping review, the authors reviewed some recent technological advances offering opportunities in terms of increasing efficiency in the measurement of rewilding outcomes as follows: satellite imagery, LiDAR (light detection and ranging) technology, acoustic monitoring, camera trapping, biotelemetry, passive sensors, measurement of soil microbiota, eDNA metabarcoding of dung and eDNA of saliva, and specialist taxonomic surveys.

As a spatially explicit understanding of rewilding has been absent so far [76], wildlife tracking and satellite-based remote sensing were incorporated into the monitoring of rewilding projects. The spatial understanding of rewilding progress and potential was provided, with the developed framework being useful in facilitating decision-making for practitioners. Satellite remote sensing is considered promising for the cost-effective monitoring of ecosystem processes, functions, and services [30] and also for assessing the biodiversity outcomes of rewilding projects in terms of land cover mapping and changes in the availability of suitable habitats [62]. The need to incorporate GIS (geographic information systems) in further work was also underlined by Balfour et al. [65] as a modality to allow a more context-sensitive and spatial understanding of agro-ecological farming and conservation land to identify the most suitable management strategies and by Bühne et al. [77] as a modality of evaluation of the benefits and limitations of rewilding on the ecosystem in terms of its composition, structure, and functioning.

New standardized frameworks for measuring rewilding outcomes were developed. Thus, Perino et al. [2] recently proposed a rewilding framework, considering that three components of natural ecosystem dynamics are located at the core of the rewilding actions: trophic complexity, stochastic disturbances, and dispersal. Increasing the self-sustainability of ecosystems is attributed to the restoration of these critical processes and their interactions too. Also, the three ecological processes can promote one another: large vertebrates often act as dispersal agents for plants and can introduce stochastics into a complex ecosystem, e.g., through predation or grazing. Quantifying changes over time across the above-mentioned three central components of rewilding supported a comprehensive assessment of rewilding progress in seven sites across Europe [56].

Applicable at local, national, regional, and global levels, the IUCN Red List of Ecosystems (RLE) Categories and Criteria [78] is a global standard for assessment of the conservation status of ecosystems. It was suggested that RLE assessments could be combined with the three ecological variables identified by Perino et al. [2] to measure the rewilding outcomes in relation to the conservation status of rewilded sites [62].

The standardized frameworks for measuring rewilding outcomes propose models and employ indicators to evaluate the relationship between ecosystem health and the complexity of trophic interactions and natural processes [52]. However, standardizing the assessment of rewilding success should be approached with caution, considering the site-specific outcomes and having in view that rewilding outcomes are inherently self-defining [15,52].

7.2. Monitoring Techniques and Technology in Rewilding Assessment

Measuring and monitoring the progress of rewilding projects requires technical and funding resources but is fundamental for estimating success in restoration initiatives [76].

Besides the existing monitoring methods used in rewilding projects (i.e., expert-led assessments and field-based data collection), other recent additional areas offer opportunities for measurements of specific rewilding outcomes [52], as was mentioned to point 6.1.

The surveys using fixed cameras represent a quantitative technique that can be used in situations where other field methods are likely to fail, such as monitoring highly cryptic species in difficult terrain. The method is non-invasive, relatively low cost, and relatively robust to variations in ground conditions or climate [79]. Wildlife can be monitored without human presence in the habitat, with the cameras being activated by sensors triggered as a result of animals' movements. Successful monitoring is linked to selecting proper locations

for placing camera traps in the field [80]. Positioning camera traps along animal trails maximizes the chances of capturing carnivores [79].

Infrared (IR), black IR, and white flash camera traps are used. The IR cameras have the advantage of emitting a faint red glow less disturbing to animals. On the other hand, their photos can sometimes be blurry. It is recommended to record the GPS coordinates of the camera trap location.

For the first time, camera trap data was combined with ecological niche factor analysis as a new approach to carnivore monitoring by Pettorelli et al. [79]. In this way, spatial distribution and patterns of habitat use of poorly known mammalian carnivore species were assessed. During camera surveys, 23 out of the 35 carnivore species occurring in Tanzania, including the civet, fox, jackal, leopard, lion, hyena, mongoose, and others, were recorded. The authors' analyses underlined strong species-specific habitat-use preferences. However, practical limitations of camera trap-based methods were also emphasized, such as the difficulty of guaranteeing the security of the cameras in unprotected areas and the relatively high costs of cameras.

Tracking the reinforcement process of the Dinaric-SE Alpine lynx population in the frame of the LIFE Lynx project [81] was based on four complementary methodological approaches. Camera trapping is particularly useful for monitoring wild animals, such as the lynx, as it can detect family groups and provide occupancy information, size of their territories, and also lynx density. Non-invasive genetic samples were also collected (i.e., scat samples, urine samples, hair samples, saliva samples, and blood non-invasive). To avoid the contamination of DNA in non-invasive genetic samples, a dedicated laboratory for DNA extraction and PCR (polymerase chain reaction) setup was used. The GPS telemetry, useful for studying lynx behavioural patterns, was applied for monitoring lynx survival, territory establishment, movement patterns, and reproduction. The fourth methodological approach was the examination of all detected lynx mortality. The usefulness of camera trapping was noted as it provided the most informative insight into the demographic status of the lynx population, and the genetic monitoring complemented this picture.

The results of the images from the cameras installed on the main routes used by wolves (*Canis lupus*) in the Southern Carpathians were correlated with the data provided by genetic markers [82]. Based on the frequency with which the individuals were observed on the cameras installed by researchers in the forest, the abundance and density of the population were estimated alongside parameters essential for protecting this species and for implementing a strategy for their coexistence with local communities.

Remote sensing can supply spatial data on ecosystems and habitats and is extensively used for conservation monitoring [76]. Satellite data proved to be useful in land cover mapping, land cover change monitoring, detection of changes in the availability of suitable habitats, and monitoring the level of human-induced disturbances in and around rewilding sites [62,76].

Satellite remote sensing was recently emphasized as a tool well suited to monitor and evaluate the progress of rewilding projects, due to its utility in providing information on the state of and pressures on biodiversity at different spatial scales. More than that, this technique sustains the cost-effective monitoring of ecosystem processes and functions [62]. Despite these advantages, some gaps are currently identified. Thus, few practical guidelines and recommendations are at practitioners' disposal to evaluate the benefits and limitations of using satellite remote sensing technology for rewilding project assessments. Also, the satellite data are reported as underused, including in addressing the knowledge of rewilding science [62]. The use of satellite data in rewilding projects remains limited due to some barriers such as the questionable necessity to monitor rewilding projects, capacity issues (i.e., data access and limited training opportunities), and trust issues in terms of the approach and results [62].

LiDAR technology is a remote sensing method providing three-dimensional (3D) point cloud information. LiDAR sensors mounted on an unmanned aircraft system (UAS/drone) were used to investigate the structural changes (e.g., biomass) in *Cytisusscoparius* and finally

to evaluate management activities aiming to prevent shrub encroachment [83]. The study area was located within the National Park Mols Bjerge (Denmark), where the grazers *Galloway cattle* and *Exmoor ponies* were introduced as part of a rewilding experiment. The animals that fed on shrubs or the damage they caused by trampling constituted one of the identified reasons for biomass decline in wintertime.

Substantially decreasing human influence and pressure across the Eurasian steppes of Kazakhstan and a related large-scale passive rewilding in these areas were established by Baumann et al. [84] using satellite imagery and historical maps. By processing Landsat scenes and examining high-resolution satellite imagery, the authors combined information into a human influence index (HI). Key components of rewilding are captured by the authors' aggregate HI, offering a basis for conservation and land-use planning.

Biotelemetry (biologging) uses miniaturized animal-attached tags for recording and/or relaying data [85]. Different types of sensors are included in this term, such as those aimed at recording fast-tracking GPS positions, neuro-loggers, body temperature, heart rate, and so on. Advances in this technology contribute overwhelmingly to how environmental, physiological, and behavioural data are remotely acquired [86] in any study involving free-ranging animals. However, the degree of biotelemetry implementation in studies ranges from the use of data loggers to acoustic-, radio-, and satellite transmitters [87]. If data loggers must be retrieved to access stored data, transmitters send their information to either land-based receivers or to a satellite circling the Earth.

Unprecedented possibilities over the coming decade on remotely gathering information on animals across their entire lifespans are expected as a result of the advances in the functional longevity of tracking devices [86] and the ability of tracking technologies to provide high-quality data to ecologists [88].

To address some of the challenges faced in tracking terrestrial mammals, Hart et al. [86] tested a new solar-powered biotelemetry device originally designed for vultures for use on large terrestrial mammals. A high and consistent fix acquisition success rate of 99.7% sustained the successful demonstration in terms of precision and performance of this device, whose technical details and capacity were shared. Best capitalizing on rapid technological advances can be sustained through sharing data on the performance of new biotelemetry devices by wildlife researchers [86].

Species translocation is a popular approach in rewilding, whose success or failure needs evaluation. Biotelemetry is becoming an ever more accessible and powerful means to evaluate the efficacy of conservation translocation programs, playing a significant role in pre-release and post-release monitoring studies [88]. A deep review of published case studies, made by Lee et al. [88], explored the extent to which biotelemetry was used in avian translocations. The case studies covered 54 species across 29 families, including *Accipitridae*, *Cacatuidae*, *Cathartidae*, *Falconidae*, *Gruidae*, *Leiothrichidae*, *Otididae*, and so on. It emphasized the extensive use of biotelemetry in these translocation projects, with radio-based telemetry being mostly favoured probably because of the lower unit costs of tags and the limited availability of suitable satellite devices.

7.3. Mathematical Models for Monitoring and Assessment of Rewilding: Case Studies

Local environmental and socio-economic contexts influence wilderness metrics, whose importance differs regionally [89]. Monitoring and evaluation of rewilding projects, which are considered more challenging than that of other management interventions, require clarity on targets (such as the functioning of ecosystems and delivery of services) as well as the availability of monitoring methods for assessing outcomes across various spatial and temporal scales [30]. The main challenges arise from the fact that rewilding success is partially assessed by changes in processes and flows and also from the need for assessing the extent of the societal benefits of rewilding initiatives.

The different components and sub-components integrated into the rewilding score can be described using mathematical functions whose precise shape needs further research [61].

Particularization of this shape could be realized by working with stakeholders to capture the expert assessment of rewilding progress in a certain context.

Predicting ecosystem responses to reintroduction is difficult. Considering the important role of mathematical modelling in its realization, Baker et al. [67] devised an ensemble ecosystem modelling (EEM) method used for describing the range of plausible consequences of wolf (*Canis lupus*) and dingo (*Canis dingo*) reintroductions. The method was applied to interaction networks for wolves in Yellowstone National Park and for dingoes in a national park in Australia. Aiming to develop a prediction that captures both the ecosystem dynamics and the uncertainty, the EEM approach of the authors was built on Bayesian computation, qualitative modelling, and ensemble methods in systems biology. To model species abundances through time, a system of generalized Lotka–Volterra equations was used. For each network, the trajectories from its initial equilibrium (before the predator reintroduction) to the new equilibrium (post-reintroduction, with the predator present) were calculated. The EEM procedure was simulated using the MATLAB and R code developed by the authors. EEM models can be used in risk assessments for interventions being modelled, can help with prioritizing monitoring efforts, and also can provide assistance in decisions around reintroductions labelled as "hard" [67].

Identifying a lack of an approach that combines the intensity of humans forcing natural processes and changes in the integrity of ecosystems in ecological terms to monitor restoration progress and success, Torres et al. [61] devised a bi-dimensional framework that incorporates a set of pressure and state variables associated with the above-mentioned two dimensions. Related to direct human inputs and outputs, the variables proposed were artificial feeding of wildlife, population reinforcement, agricultural production, forestry production, grasslands production, mining, harvesting of terrestrial wildlife, harvesting of aquatic wildlife, carrion removal, and deadwood removal. Disturbance regimes, natural avalanche and/or rock slide regimes, natural fire regimes, natural hydrological regimes, natural pest regimes and mortality events, landscape connectivity and composition, terrestrial landscape fragmentation, aquatic landscapes fragmentation, spontaneous vegetation dynamics, harmful invasive species, trophic processes, and terrestrial large-bodied fauna were proposed as pressure and state variables, for which scores were also assigned to measure rewilding progress and the associated restoration actions. The framework was successfully tested by applying the assessment to three restoration projects with very different characteristics. Additionally, the study was spotlighted as the first attempt at developing and implementing a generalized practical rewilding monitoring framework, and the authors pointed out its practical implications, which are filling the gap in the identification of a set of restoration actions and their associated results [61].

Sandom et al. [42] stated that despite the use of native ecosystem engineers for ecosystem restoration, their interaction with novel environments can take place in unexpected ways, so their effects should be determined in the target system. Quantifying the rooting activity as a prerequisite for the reintroduction of an extirpated wild boar (*Sus scrofa* L. 1758) with the aim of re-establishing ecosystem function was made for the first time by Sandom et al. [42]. The average weekly per capita rooting rate was calculated by dividing the total rooted area by the number of weeks stocked and number of boars stocked. The study demonstrated that the wild boar's rooting rate, useful in estimating the rate of vegetation disturbance, is proportional to stocking density, providing no multiplicative benefits to small-scale restoration projects.

Ceauşu et al. [89] developed a framework to assess the opportunities and challenges for rewilding in Europe in areas projected to be abandoned by 2040, which were identified with the help of the Dyna-CLUE model and confirmed as areas close to Natura 20,000 sites. Considering the wilderness as an area of minimum human influence measured by four metrics, the authors mapped human accessibility based on transport infrastructure, artificial night lights, the deviation from potential natural vegetation, and the proportion of harvested primary productivity. Wilderness mapping can support a tailored management of restoring the aspects of wilderness in different regions with different priorities [89].

Land management strategies deliver societal value through different modalities, including delivering ecosystem services, which is considered useful for the comparison of rewilding with alternative land uses [70]. Linear regression models were used to assess the rewilding intervention on three ecosystem services, namely provisioning (timber), regulating (pollination), and cultural (aesthetics), in the Scottish Highlands. It was demonstrated that rewilding applied to moorland habitats led to significant increases in timber option values, having an impact on pollination and promoting aesthetic quality [70].

8. Rewilding as an Educational and Stakeholder Initiative

Academic debate about rewilding has occurred, to date, among ecologists and to a lesser extent, social scientists [15]. Rewilding is context-specific [15], so bringing the debate into the arena of other categories of science specialists is compulsory to acquire knowledge referring to the impact of rewilding on societies and ecosystems.

By using a multi-scalar approach focused on Western Europe, Locquet and Simon [26] analysed a wider range of approaches to the wilderness to understand the strategies deployed in Europe. The communication strategy contributed to increasing the attractiveness of the projects (i.e., in terms of ecotourism and guaranteeing a certain ecological quality) and legitimized the stakeholders' actions from environmental and social points of view.

The WWF's mission is to achieve a long-term impact on nature conservation [90]. Among the methods used, an important place is occupied by environmental education, which is one of the organization's strategic priorities. Adhering to the objectives of the UNESCO Decade dedicated to Education for Sustainable Development, a Department for Education was founded by WWF Romania in 2011. Numerous different educational resources related to the environment, including protecting wild nature, can be found on the WWF website, including in the Romanian language [91].

The CONNECT project is a three-year project funded under the EU Horizon 2020 Program within the Science with and for Society [92]. The main pillars of this project are open schooling, science-action, and participatory science. By applying the CARE-KNOW-DO model, CONNECT supports schools in implementing science action on future-oriented scenarios related to the environment in the frame of the rewilding module. Participatory science with the community (i.e., families, experts in science, universities, research institutes) is encouraged. Valahia University of Targoviste, Romania, is one of the ten partners from the consortium. Real-life examples of implemented rewilding activities suggest that education has an overwhelming contribution in raising awareness of the importance of rewilding initiatives. Last but not least, education represents one of the pillars of rewilding projects during their implementation.

9. Rewilding: The Romanian Experience

Eastern Europe is starting to be conceived of as a rewilding frontier [24], which has been created both from within and without. Romania has over 6 million hectares of forests, of which a significant area is still virgin. Here, bears, wolves, and lynxes still live freely, and more than 3700 species of plants are present, many of which are found only in this part of Europe [93]. Rewilding Europe is committed to a rewilding plan at the continental scale. A total of two of the 10 different sites involved in this plan are in Romania, with one in the southwestern Carpathians and one in the Danube Delta [24].

The interest in wilderness actions at the level of a wider public (i.e., local landowners, managers, decision-makers, and the general public) can be increased by proposing a different form of environmental governance [26], including communication and awareness-raising work. Rewilding has become a topic of interest for Romanian research institutes, non-governmental organizations (NGOs), academia, governmental agencies, and local communities too. Rewilding activities involve stakeholders taking into account policies (i.e., Natura 2000) and/or societal and cultural issues of the ecosystems targeted by projects implemented in the last 15 years (Table 1).

Table 1. Rewilding/reintroduction/conservation projects and initiatives in Romania.

Project, Implementation Period, Funding	Description in Brief	Key Species	Actions to Enhance Rewilding	Source
Building a resilient ecological network of conserved areas across Europe for nature and people, 2022–2026, Horizon Europe	Supporting the development of the Trans-European Nature Network (TEN-N) of conserved areas in the European Union	Eurasian lynx (*Lynx lynx*), gray wolf (*Canis lupus*) and brown bear (*Ursus arctos*)	Protecting and restoring multifunctional corridors; reviewing and disseminating conservation funding mechanisms	[94]
Creation of a wilderness area in the Southern Carpathians, Romania, 2019–2024,LIFE programme	Activities divided into five pillars:forest conservation, ecological reconstruction, fauna conservation, local communities, and green business (based on nature)	European Bison (*Bison bonasus*), beaver (*Castor fiber*)	Purchasing natural forests affected by non-compliant cutting down for full protection and ecological reconstruction; creating a model of human-wild animal coexistence; creating wildlife-watching programs	[95]
Urgent actions for the recovery of European bison populations in Romania, 2016–2021, LIFE Programme	Establishing a wild bison population that is demographically and genetically viable	Bison (*Bison bonasus*)	Reintroducing 100 individuals in the Southern Carpathians (2000 sites in the Țarcu Mountains and Poiana Ruscă Natura) Establishing two stable and interconnected bison sub-populations (Bison Hillock area and Bison Glade area)	[96]
Bison hillock wilderness innovation lab insustainable rural development, 2016–2018, WWF-Danube Carpathian Programme Romania	Bison reintroductions in real-time in the Southern Carpathians (Armeniș, Caraș Severin County) through multimedia installations	Bison (*Bison bonasus*)	Transforming Armeniș in a hub for applied ecology; developing a complex protocol to observe the impact of bison on the ecosystem of the area, as the core of the monitoring activities; creating a better infrastructure for rewilding	[97]
Implementation of active measures for the conservation of biodiversity based on the Natura 2000 Site Management Plan, 2020–2023, European Regional Development Fund	Improving the conservation status of species and habitats of conservation interest by implementing the management plan of Natura 2000 Sites ROSPA0093 Padurea Bogata and ROSCI0137 Padurea Bogăţii	Brown bear (*Ursus arctos*)	Maintaining/restoring, through forestry works, an optimal structure and a favorable state of conservation of forest habitats of conservation interest	[98]
Regional platforms on people and large carnivores, 2018–2021, European Commission, DG Environment	Addressing conflicts on large carnivores: establishing a platform in Harghita county focusing on the impact of bears on human activities	Brown bear (*Ursus arctos*)	Monitoring bear tracks; studying to asses the effects of artificial feeding and tourism activities on bears in Harghita county	[99]
Implementation of the National Action Plan for the conservation of the brown bear population in Romania, 2018–2023, European Regional Development Fund	Long-term maintenance of the favorable conservation status of the brown bear population in Romania	Brown bear (*Ursus arctos*)	Determining the size of the population and establishing the number of individuals through genetic studies; mitigation of human-bear conflicts; establishing a complex for breeding, care, rehabilitation, and protection of the brown bear species	[100]
Creation of a wilderness reserve in the Southern Carpathian Mountains, Romania, 2019–2023, Endangered Landscapes Programme	Create a world-class wilderness reserve in the Southern Carpathians; developing social sensitivity to conservation issues; finding solutions to problems on the local communities' agenda	Bears (*Ursus arctos*), wolves (*Canis lupus*), lynx (*Lynx lynx*), bison (*Bison bonasus*), beavers (*Castor fiber*)	Conservation and restoration; human-wildlife conflict resolution programme; bison and beaver reintroduction; conservation enterprise programme	[101]
Restoring and managing ecological corridors in mountains as the green infrastructure in the Danube basin, 2018–2021, Danube Transnational Programme	Maintain and improve the ecological connectivity between Natura 2000 sites and protected areas of transnational relevance in the Carpathian ecoregion, including in Romania	Large carnivores	Identifying the ecological corridors; management to overcome the conflict between infrastructure development and wildlife conservation	[102]

Table 1. *Cont.*

Project, Implementation Period, Funding	Description in Brief	Key Species	Actions to Enhance Rewilding	Source
Improving humancoexistence-withlargecarnivoresin Europethroughcommunicatio-nand transboundarycooperation, 2017–2022, LIFE Programme	Improving transboundary cooperation and population management of large carnivores in Europe	Large carnivores	Conducted a regional stakeholder analysis to improve understanding of the local context, cross-country events (e.g., grazing livestock farmers) indifferent project regions, a stakeholder analysis on socio-economic impacts	[103]
Ensuring a favorable conservation status to save the European mink population from extinction in Romania, 2017–2020, European Regional Development Fund	Implementation of some measures from the Management Plan of the Danube Delta Biosphere Reserve to improve the conservation status of the European mink (*Mustela lutreola*) in the Danube Delta	European mink (*Mustela lutreola*)	Creating habitats for the European mink; the ecological revitalization of the artificial islands on the Sf. Gheorghe; knowing the health status of the European mink in the Danube Delta Biosphere Reserve	[104]
Sustainable conservation of Danube sturgeons by preventing and reducing poaching and illegal trade in sturgeon products, 2016–2020, LIFE programme	Reducing the threat to the endangered sturgeon in the Lower Danube area and the northwest Black Sea as a result of illegal fishing and trade	Sturgeon (*Acipensergueldenstaedtii*)	Workshops to facilitate the development of relationships and exchange of experience between national agencies responsible for the implementation of regulations on fisheries, aquaculture, and sturgeon trade; increasing the number of checks and seizures; prohibiting illegal fishing and trade in wild sturgeon	[105]
The development of sets of management measures, at the national level, for the species *Castor fiber, Lutra lutra* and *Mustela lutreola*, 2012–2014, Sectoral Operational Program Environment	Elaboration of management measures for protecting and preserving biodiversity and natural heritage	Beaver (*Castor fiber*), Otter (*Lutra lutra*), European mink (*Mustela lutreola*)	Implementation of technical solutions to reduce damages and conflicts and train the factors involved in the management of *Castor fiber*, *Lutra lutra*, *Mustela lutreola* species	[106]
Integrated management of biological and landscape diversity for sustainable region development and ecological connectivity in the Carpathians, 2011–2013, South East Europe–Transnational Cooperation Programme	Implementing the main provisions of the Carpathian Convention Biodiversity Protocol at the level of 16 partners from all the Carpathian countries	Bison (*Bison bonasus*), Wolf (*Canis lupus*), Lynx (*Lynx lynx*), Brown bear (*Ursus arctos*), Golden jackal (*Canis aureus*), Red deer (*Cervus elaphus*), Roe deer (*Capreolus capreolus*), Chamois (*Rupicapra rupicapra*)	Measures for forests; measures for meadows of natural value; measures for wetlands; measures for large carnivores and herbivores; multi-sectoral conditionality and policies	[107]
Monitoring the state of conservation of species and habitats in Romania based on Article 17 of the Habitats Directive 2011–2015, Sectoral Operational Program Environment	Protection of biodiversity and natural heritage, and the improvement of the quality of the natural environment through adequate monitoring of the state of conservation of species and habitats of community interest in Romania	Species of mammals that taxonomically belong to the orders *Rodentia, Carnivora* and *Artiodactyla*	Elaboration/review of plans, strategies, and management measures of protected natural areas and other related activities; activities regarding the improvement and maintenance of the favorable conservation status of habitats and species in protected natural areas	[108]

The targeted key species of rewilding projects are large carnivores but also other species (i.e., sturgeon, otter) depending on the area of interest. The bison was targeted by numerous rewilding projects and initiatives. Perceived by locals as a big and furry "wild cow", with a gentle and domestic appearance, its charisma supports successful rewilding projects in the Carpathian Mountains of Eastern Europe [24]. Nevertheless, the bison is perceived as a vulnerable, hungry animal seeking to survive [24], so it raises a bio-threat narrative, underlying the tension between uncertainty and security when rewilding activities are designed.

The projects and initiatives related to rewilding are developed generally in partnership, either at the national or European level. The funds needed for projects' implementation are

provided fully or partially by the European Union through different programs, such as the Large Infrastructure Operational Program and Life and Horizon.

People are engaged in different ways through volunteering, stakeholder coordination, educational programs, and local businesses with traditional/cultural features. Practitioners and scientists from universities and research institutes, government bodies and non-governmental organizations, specialists (i.e., in spatial planning, biodiversity conservation), think tanks, local hunters, and representatives of civil society are acknowledged. In the frame of these projects and initiatives, lifelong learning concepts are applied, but they also emphasize the need for raising awareness about the wealth of Romanian nature, the importance of the protected area, and the role of fauna and flora within the trophic chain.

A model of coexistence of people with wild animals based on prevention–intervention–compensation and assistance to farmers related to damage compensation paperwork was sustained through implementing some of the projects below.

Some projects/initiatives are focused on silviculture and forestry operations, the application of ecological forestry, and the promotion of high-quality timber. Transforming some areas in living laboratories for the conservation of rare species should be emphasized.

In economic terms, numerous projects are proposed as outputs including green businesses operating in local communities, encouragement of eco-tourism, development of innovative products and services for tourists as well as an economy based on conservation through entrepreneurial training for locals, creating of working places, and credible certification systems. If the educational features of the projects are discussed, education activities, multidisciplinary learning experiences, information campaigns, conservation activities addressed to a wider public, and local and regional events were/are frequently associated with the projects' objectives.

The lessons learned from these projects are extremely diverse in terms of topics, targets, and funding sources and show that such activities must continue to be a priority, integrating knowledge and innovation to increase the strength of ecosystems by restoring natural processes with positive impacts on human livelihood.

Rewilding might be used to encourage and sustain such conservation in Romania and subsequently lead to optimized biodiversity outcomes of targeted landscapes. The information synthesized below in depth aims to emphasize the continuous and systematic efforts made by numerous stakeholders, with environmental and economic benefits and also social value, to ensure the sustainable function of restored systems. Far from being exhaustive, the depicted projects and initiatives as a result of the literature overview demonstrate available evidence on actions made to enhance rewilding. The key results are expected through their implementation. The geographical bias and different context approaches limit the generalization of the results. However, establishing platforms and suitable frameworks for exchange between identified stakeholders, promoting cooperation between practitioners, researchers, and higher-level policymakers, and in practical terms, maintaining and improving the ecological connectivity in the Carpathian ecoregion [109] can be acknowledged. Addressing both tangible and intangible human realities, major ways of thinking about wild animals' reintroduction and rewilding in the Carpathians were identified [24].

Involving numerous areas of research, rewilding in Romania is on the map in terms of the concerns and efforts made globally with a view to integrate within the "decade of ecosystem restoration". Interdisciplinary studies and research are still needed for contextual assessment of rewilding to deeply address the cascading effects of rewilding at the biological and societal level, the feasibility of the modern methods of monitoring and assessment of rewilding, and the modalities to provide key ecosystem services alongside cost-benefit analyses based on specific assessments. Furthermore, trans disciplinarity should be explicitly encouraged by the EU funding programmes [110].

Ensuring initiatives and projects' sustainability is crucial for the long-term conservation of ecosystem functions and services and for building a better future where nature and people thrive.

10. Conclusions

Biodiversity is declining worldwide faster than at any time in human history. Starting from its initial emphasis on protecting large connected areas for carnivore conservation, rewilding is nowadays part of a diversity of concepts and specific actions assisting the restoration of self-sustaining, resilient ecosystems. Although it is yet an approach in its early stages, rewilding envisages, as an umbrella solution, different topics and practices depending on the context and the conservation target identified. The benefits of rewilding are at least restoring natural processes, reaching the environmental goals of this century, completing food webs, and boosting conservation in Europe. By implementing rewilding activities, the UN sustainable development goals for life on land and partnerships for the goals are accomplished. In Europe, rewilding actions are focused on reaching the EU's environmental ambitions, the EU Biodiversity Strategy for 2030, and the EU Green Deal, which are the most recent ones.

A series of efforts have been displayed at the European, national, and regional levels in the last decade to raise awareness of the importance of rewilding initiatives and activities for people and the planet. Rewilding could contribute greatly to preventing biodiversity loss, regulating ecosystem services and economic development especially in rural areas and increasing the tourism potential of rural areas and people's long-term education and enjoyment. However, coordinated actions should be thought of and implemented, with general approaches and solutions being avoided. Although it is not an easy task, studies and specific strategies for rewilding for each specific area should be made by involving various stakeholders, keeping in view that rewilding is a multifaceted concept. The conditions and context for its former assessment and implementation remain challenging for scientific research and decision-makers.

Our paper aimed to broaden the research perspective towards a holistic understanding of the rewilding concept, which is not yet clearly understood and scientifically substantiated, to provide more reliable knowledge for the potential implementation of rewilding activities, both in education and practice.

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