

Research



Cite this article: Jepson P, Schepers F, Helmer W. 2018 Governing with nature: a European perspective on putting rewilding principles into practice. *Phil. Trans. R. Soc. B* **373**: 20170434.
<http://dx.doi.org/10.1098/rstb.2017.0434>

Accepted: 11 August 2018

One contribution of 16 to a theme issue 'Trophic rewilding: consequences for ecosystems under global change'.

Subject Areas:
systems biology

Keywords:
rewilding, nature conservation, ecological restoration, network governance, institutional change, nature-based solutions

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Governing with nature: a European perspective on putting rewilding principles into practice

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Academic interest in rewilding is moving from commentary to discussion on future research agendas. The quality of rewilding research design will be enhanced if it is informed by knowledge of the rewilding practice. Here, we describe the conceptual origins and six case study examples of a mode of rewilding that emerged in the Dutch Delta and is being promoted and supported by Rewilding Europe, an umbrella organization established in 2011. The case experiences presented help position this version of rewilding in relation to the US 3C's version and point towards a rewilding action philosophy characterized by pragmatic realism and pioneer projects around which multiactor networks interested in policy innovation and change form. We argue that scaling-up the models of rewilding presented is constrained by institutional cultures and will require innovations in conservation finance and business models. Nonetheless, we suggest that the expanding European Rewilding Network and associated facilities, such as the European Wildlife Bank, represent a valuable asset for natural science research, aimed at exploring the ecological impacts of grazing and the relationship between role of restored herbivore guilds and biotical expansion, and for social science research investigating concepts such as non-human agency and autonomy. Lastly, we ask applied scientists to view rewilding as an uncertain and unfolding conservation approach and to refrain from seeking to specify it as a management approach supporting the delivery of pre-determined targets and/or ideals. This is because such actions may constrain the transformative potential of rewilding practice.

This article is part of the theme issue 'Trophic rewilding: consequences for ecosystems under global change'.

1. Introduction

Academic interest in rewilding is moving from commentary to discussion on future research agendas. The quality of rewilding research design will be enhanced if it is informed by knowledge of rewilding practice in different contexts. The term rewilding was coined in the mid-1990s by a group of US conservation biologists influenced by deep ecology philosophy [1]. They presented rewilding as the scientific argument for a continental wildland strategy focusing on securing and connecting large core areas and releasing functional species such as wolves [2]. This has become known as the 3C's approach (core, corridors and carnivores) and the realization of a North American 3C ecological network is the goal of the American rewilding movement [3]. Subsequently, the term rewilding has been associated with conservation initiatives that explicitly seek to restore missing or dysfunctional ecosystem processes, often through the reintroduction of functional species [4]. A content analysis of 30 organizations practising rewilding revealed three main organizational groupings: those with a focus on (i) ecosystem processes, (ii) baselines and (iii) conserving large spaces [5].

Practical expressions of rewilding are situated and contextual: the conservation approach adopted is the outcome of interactions between the biophysical,

institutional and political characteristics of place and the agendas, worldviews and action philosophies of the practitioner groups involved. For example, the Pleistocene Park project in Siberia is a large-scale science experiment investigating the potential to restore mammoth steppe ecosystems as a means to reduce permafrost melt and release of greenhouse gases [6]; in Mauritius, taxon substitutes for the extinct giant *Cylindraspis* tortoises are being introduced to restore historic vegetation types [7] and, in Argentina, the Iberia rewilding programme is reintroducing multiple species to restore a defaunated ecosystem [8]. Restoration is at the centre of rewilding practice: Prior & Ward [9] argue that rewilding is distinguished from other forms of ecology restoration by its focus on restoring non-human autonomy (of abiotic and biotic actors and process) through the gradual relinquishment of direct human management.

This paper describes and analyses a version of rewilding that emerged in The Netherlands and is gaining prominence in Europe through the actions of Rewilding Europe (est. 2011) and the European Rewilding Network (61 members in 21 countries). Seven goals and principles are coming to guide and characterize this approach: (i) restore ecosystem processes and dynamics (biotic and abiotic), (ii) take inspiration from the past to shape future natures, (iii) move up a scale of rewilding within the constraints of what is possible, (iv) work towards the ideal of passive management, (v) create new natural assets that connect with modern society and economy, (vi) work with restored forces of nature to find solutions to societal problems and (vii) reconnect conservation policy with public conservation sentiment [10].

Through a series of case experiences, we describe the conceptual and practical origins of these principles. Our aim is to provide scientists with a sense of the innovations in conservation organization, policy and practice associated with their emergence, and a sense of the challenges associated with their expression in different contexts. In so doing, we hope to help lay the foundations for an effective rewilding science–policy interface: one that is grounded in practice and that is collaborative, interdisciplinary, visionary, expresses multiple values and is attuned to context (e.g. [11,12]). More specifically, and in the context of this special issue, we specify a model of rewilding that is responding to climate, landscape and socio-economic change and has the restoration of natural processes, including (re)assembly of a large-herbivore, carnivore and scavenger guilds, at its core. By elucidating these dynamics, our aim is to provide scientists with a resource to inform the design of future research to quantify and understand the impacts of rewilding.

2. Approach and methods

We adopted a collaborative/action research approach. While these approaches are more usually associated with educational, health and indigenous studies, they are characterized by a desire to work across cultures (professional as well as ethnic), to write with (as opposed to about) practitioners and generate knowledge that empowers stakeholders (e.g. [13,14]). The need for the research arose from a collaboration between F.S. and P.J. (November 2015–May 2016) that sought to align rewilding with EC policy frames [10]. This collaboration revealed worries within Rewilding Europe concerning academic commentary on rewilding: in particular, a view that some articles lacked

an understanding of rewilding practice beyond a few flagship projects (e.g. the Oostvaardersplassen) and promulgated definitions and concerns that could influence policy and constrain innovations in practice (*sensu* [15]). In response, the authors (see annex 1 for biographies) agreed to co-write accounts of (i) the conceptual origins of Dutch nature development policy, (ii) a suite of rewilding initiatives that illustrate the practical development of this policy and its extension after the founding of Rewilding Europe (figure 1) and (iii) two mechanisms designed to help ‘scale-up’ this approach. This choice of content reflects a desire on the part of the practitioners to systematically reflect on their 25-year history of leading rewilding projects and to contribute accounts that will diversify the range of rewilding projects, mechanisms and associated insight available for academic discussion and research.

The accounts and analysis presented below were generated through a mix of site visits, interviews and document review. On 11–12 April 2017, P.J. visited the Gelderse Port and Kempen-Broek projects in the company of W.H. The focus of the visits was (i) understanding W.H.’s roles in the projects and events that have influenced Rewilding Europe’s action philosophy and (ii) making connections between these themes and P.J.’s research interests in governance innovation and institutional change. Subsequently, the authors co-wrote §3 and drafted accounts of each area. These were sent to the respective project leaders and used by P.J. as the basis of interviews (by Skype and in person) to clarify details and ask critical questions of practice. In the spirit of collaborative research, the analysis and discussion of this content emerged from a series of discussions by phone and in person during the writing and revision process.

3. Conceptual, discursive and policy origins of rewilding in a Dutch context

By 1980, there was little wild nature left in The Netherlands. In response, a new generation of ecologists trained in wildlife and systems ecology [16] formulated revolutionary ideas on an ‘offensive’ (as opposed to defensive) conservation approach that foregrounded the notion of working with natural processes to restore value for nature, society and economy [17,18].

The trigger for this new thinking was the Oostvaardersplassen (hereafter OVP), a polder originally intended as an industrial area but abandoned during the economic downturn following the 1973 oil crisis [19]. Two ecologists working for the Ministry of Agriculture, Nature Management and Fisheries (Ministerie van Landbouw, Natuurbeheer en Visserij, hereafter LNV) contemplated the spontaneous sequence of natural processes on the OVP and the role of geese grazing in ‘steering’ ecological succession and the rich and unique nature that emerged. Inspired, they wrote a policy brief for government decision-makers where they presented the OVP as a ‘unique ecological experiment’ and introduced ‘nature development’ as a feasible option for spatial planning policy [17,20]. Their concept of nature development was formally acknowledged in the 1990 Nature Policy Plan [21], and OVP was designated as a nature reserve in 1991 with nature development as its guiding concept.

Concurrently, Dutch nature reserve managers were promoting ‘natural grazing’ as a means to replicate traditional



Map data: GeoBasis-DE/BKG, INEGI, ORION-ME, Google

Figure 1. Locations of three pioneering Dutch rewilding projects and three Rewilding Europe areas.

forms of grazing and the phytological associations they produced. LNV ecologists and OVP managers decided to take this a step further and assemble a guild of large herbivores, comprising Heck cattle, konik horses and red deer (*Cervus elaphus*) to explore the impacts of natural grazing dynamics. The OVP 'experiment' inspired Vera's [22] 'theory of cyclical vegetation turnover' and the proposition that dynamic parkland-like landscapes populated and shaped by herbivore herds were a lost, yet recoverable, European natural archetype. As a result of these practical, theoretical and discursive developments, natural grazing assumed a central role in the practice of nature development.

The nature development discourse influenced two major policy 'pillars' of Dutch delta management, namely (i) rural spatial planning and land consolidation and (ii) water management. Since 1924, the former had focused on reversing the historic fragmentation of farms to develop the agricultural sector through land consolidation and drainage [23]. A delta plan involving engineering solutions had guided the latter since 1953, and by 1980, the disastrous ecological consequences of the plan's programme of dam construction

were apparent to all. As a result, ecologists gained a foothold in the Department of Waterways and Public Works (hereafter V&W) [24]. In response to this ageing policy, the Eo Wijers Foundation launched a competition in 1986 for ideas to improve the spatial quality of riverine landscapes. The winning entry was Plan Ooievaar (Plan Stork) developed by a group of ecologists, water engineers and landscape architects who believed that elements of the OVP philosophy could be applied to Dutch river systems [25]. Their plan involved the spatial segregation of floodplain agriculture and nature to reduce flood risk and create spaces where river dynamics could be restored and nature allowed to recover and develop unaided. Furthermore, it proposed adjustments to floodplain (clay) mining policy to create starting situations for the recovery of the natural process [26]. LNV initially considered the vision too radical and declined to support it.

In 1993, WWF Netherlands lent its support to Plan Stork. They commissioned Strooming Ltd, co-founded by one of the authors of the plan, to develop a more detailed elaboration of clay mining as the 'engine' behind river rewilding and the idea that restoring side channels would help rivers self-clean.

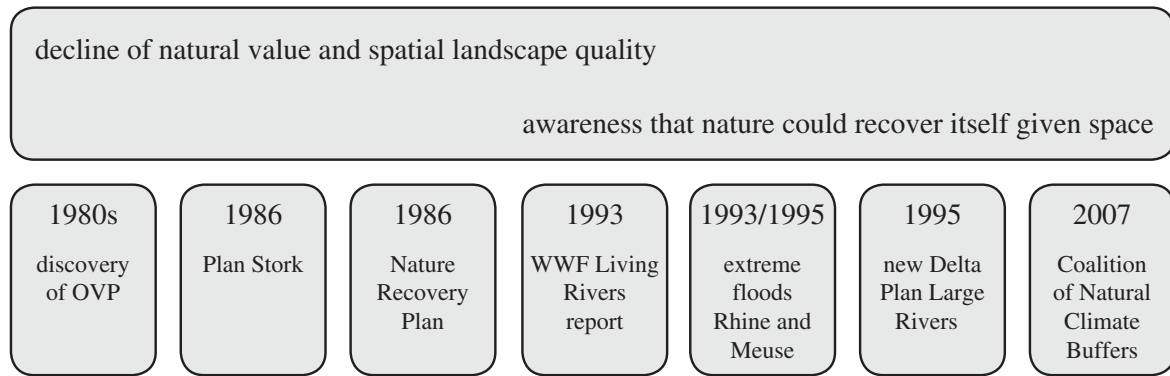


Figure 2. Events influencing the emergence of pioneer rewilding projects in The Netherlands 1980–2015.

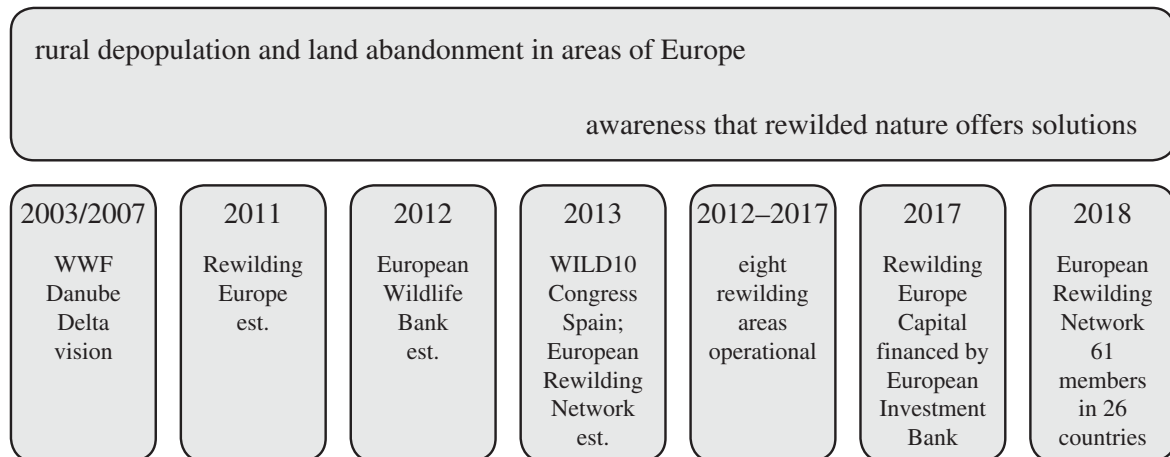


Figure 3. Key events in the history of Rewilding Europe (2008–present).

Publication of their *Living Rivers* [27] report coincided with the costly floods of 1993 and 1995 (the latter requiring evacuation of over 200 000 people). These events generated the political will to trial the *Living Rivers* vision, thereby initiating a paradigm shift in water management. A 'Room for Rivers' philosophy has since been widely adopted by Dutch water authorities [28].

These discursive and practical developments in The Netherlands (figure 2) established three novel concepts in policy: (i) nature itself can be 'a creative power, flexible and resourceful, if given space and time' [19, p. 7], (ii) nature conservation can be linked with modern economy and society, and (iii) such concepts can offer novel and popular solutions to major policy challenges relating to social and environmental change.

4. Case accounts of rewilding initiatives

Two of the authors (W.H. and F.S.) co-initiated and led three projects that pioneered and shaped these new policy concepts. Case accounts of each are presented below. As these policies became mainstream in The Netherlands, W.H. and F.S. joined forces to found Rewilding Europe as a vehicle to facilitate, test and develop the principles in different regions of Europe (figure 3). They invited nominations from groups elsewhere in Europe who were developing similar visions. Over 30 nominations were received and eight areas are currently operational. Case accounts of three of these areas are also presented below and are broadly representative of the

biophysical, cultural and institutional settings where Rewilding Europe is active.

(a) Gelderse Poort

Gelderse Poort (GP) was strategically identified as the main pilot area for Plan Stork because it is located at the top of the delta (east of the city of Nijmegen) and therefore rewilding outcomes would have beneficial downstream impacts. The summer floods of the 1980s had heightened awareness of the economic risk of floodplain farming and in 1986 the Gelderse Milieu Federatie (a regional NGO federation which published the Plan Stork book) partnered with farmers to relaunch a land reallocation plan that LNV had previously refused. LNV approved the new plan and, in 1987, established a seven-person commission to coordinate the process. W.H. was appointed to this commission, thereby embedding Plan Stork principles in negotiations to restructure the landscape.

With the support from WWF Netherlands, the ARK Nature foundation (est. 1989) and its consultancy company Stroming Ltd began activities on a 3 ha plot to be granted by V&W to test rewilding ideas. ARK Nature purchased three konik horses and produced a video projecting a vision of wild horse herds roaming free through the floodplains of The Netherlands, which was screened at the 1991 WWF Netherlands donors meeting. This generated sufficient funds to purchase an additional 17 ha in 1993 and ARK Nature secured agreements with 12 neighbouring

landowners and commenced rewilding management in an area greater than 300 ha.

Concurrently, WWF Netherlands developed an agreement with brick-making companies (signed 1993) to purchase agricultural land made available by the land reallocation process and excavate clay in line with the *Living Rivers* philosophy. Between 1993 and 2008, over 100 ha yr⁻¹ was converted from agricultural to 'natural' river landscapes. As clay excavation progressed ARK Nature removed fences, introduced herds of free-roaming horses and Galloway cattle, and facilitated the reintroduction of well-known species such as beaver *Castor fiber*, otter *Lutra lutra* and sturgeon *Acipenser sturio*. In addition, they promoted public access to restored areas, established a Wilderness Café (in 2001) and ran field programmes involving more than 25 000 schoolchildren.

Over a period of 30 years, the GP has developed from small pilot sites to a coherent rewilding area of ca 5000 ha where river and grazing dynamics are driving the ecology of the floodplains. Notably, the dynamic interaction between restored river channels and dune formation has created 5 km long water gradients where filtering through sands has produced diverse aquatic systems (including mesotrophic systems previously associated with springs) and a remarkable comeback of typical river species [29]. This rewilded natural asset is generating multiple forms of value captured in different domains of society. The municipality has benefited from reduced flood defence and insurance costs and increased tax income from rising house prices [30]. Citizens capture identity, health and life quality value from the range of recreational practices the area supports (e.g. beach sunbathing, picnicking and wildlife photography) and a 10-fold increase in tourist numbers (now over 1 million per year) supports a thriving tertiary economy (rural hotels and restaurant) and investment in new ferries. Over 200 new jobs have been created at a loss of 30 agricultural jobs [31].

During this period, ARK Nature and the river management authorities learnt to deal with uncertainty and practice adaptive management. For instance, the development of river forest and sand dunes hampered the flow of the river presenting two management options: cut the forest or widen the restored river channels. The partnership opted for the latter, which has resulted in a landscape of higher scenic value. In 2009, following completion of the land allocation process, title to the floodplain rewilding area was transferred to the State Forest Service (Staatsbosbeheer) who now manages the area following rewilding principles.

(b) Border Meuse (Grensmaas), The Netherlands/ Belgium

The Border Meuse project is the largest river restoration project in The Netherlands. It covers 45 km of river Meuse between Maastricht and Maaseik on the Netherland–Belgium border. By 1980, this was the only river system in The Netherlands without river traffic and the prospect of an agreement between the Provincial Government of Limburg (hereafter PoL) and the Dutch national government to deep mine 35 million tons of gravel mobilized local and national conservation actors. In 1989, the local natural history society (Natuurhistorisch Genootschap) and BirdLife Netherlands (Vogelbescherming) commissioned Strooming Ltd to develop an alternative plan applying Plan Stork principles.

WWF mounted a communication campaign to promote the *Future of Gravel River* (FoGR) plan (which proposed transforming the deep and narrow Grensmaas into a wider, free-flowing gravel river through shallow gravel excavation), and ARK Nature obtained the grazing rights on more than 200 ha of riverside lands where they introduced natural grazing.

LNV as the responsible ministry initially considered the gravel-mining component too controversial and declined to support the plan. However, the rewilding actions chimed with growing societal pressure to halt deep pit mining and, in 1991, the PoL responded by creating a special project organization, involving the three responsible authorities (PoL, LNV and V&W) to further detail the alternative FoGR plan and commence preparatory planning [32]. The 1993 and 1995 floods tipped political support in favour of the Border Meuse project, which became part of the *Delta Plan for Large Rivers*—a major initiative of the Dutch government. A technical design group was established (led by F.S.) to model and detail the engineering (hydrological, morphological and ecological) and assess the technical and financial feasibility of the FoGR plan. Trans-border approval from Dutch and Belgian authorities was secured in 2001 and the project commenced in 2005 (Belgium) and 2008 (The Netherlands). It will be completed by 2024 and is expected to result in 2000 ha of dynamic river landscape grazed by large herbivores. This will be managed using rewilding principles by a partnership of Dutch and Belgian private and state conservation agencies as part of the Nature Park Meuse Valley. The Dutch component is being delivered by a special purpose vehicle called Consortium Grensmaas (www.grensmaas.nl) made up of the gravel extraction sector, civil engineering contractors and the private conservation organization Natuurmonumenten. The estimated €550 million implementation costs are mostly being financed by sand and gravel extraction.

The extraction design (which has increased from 35 to 52 million tons) is creating a braided gravel river, which has already reduced flood risk to adjacent river villages and towns. Ecological monitoring studies [33] show spectacular responses of riverine flora and fauna and recolonization (partly through reintroductions) of beaver and otter. In addition, the north–south flowing Grensmaas has become an important ecological corridor linking the upstream French and Belgian sections of the river Meuse with its lower reaches in The Netherlands. Initial local opposition to the project dissipated as the identity, recreation and flood alleviation value generated became evident.

(c) Kempen-Broek, The Netherlands

Kempen-Broek is also located in PoL on the Belgian border in the southeast of The Netherlands. During World War II, the last of a large (15 000 ha) marsh system was drained to increase food production; the area drained has remained in agricultural production since.

In response to Al Gore's 'Inconvenient Truth' lecture tour [34], the Dutch government set up a fund to finance climate adaptation pilot projects and Dutch NGOs formed a 'Coalition of Natural Climate Buffers' to support nature-based innovation and learning. ARK Nature together with local partners secured a €500 000 grant from the fund to purchase agricultural lands and reconnect marshland remnants

to create a greater than 1000 ha wetland system that would act as a water buffer and reduce the risk of flooding in the downstream cities of Eindhoven and Den Bosch (see <http://www.klimaatbuffers.nl/>).

Drawing on their land reallocation experiences at GP (§4a), ARK Nature invested in building friendly relations with the local farmers. They found that 60% of farmers wished to stop farming and this knowledge together with time spent explaining their vision enabled them to become effective at closing lands deals. This impressed PoL staff who, as a result, helped ARK Nature secure a second tranche of funding by offering to match a new grant with €3 million. The growing trust between the two parties prompted ARK Nature to offer to purchase land on the Province's behalf at the market price plus 16%. This was substantially below the cost of the Province buying and consolidating land (which could add 105% to the market price of land): the PoL responded with an offer to delegate the Kempen-Broek regional development budget of greater than €26 million to ARK Nature, provided they form a consortium with a land agent and green development company to spread the risk and responsibility.

The consortium was established in 2001 at the height of the Eurozone crisis and the green development company went bankrupt. Fortunately, ARK Nature had foreseen this possibility and structured the consortium so it had no associated liability. The two remaining partners established a 'land bank' with an acquisition strategy focusing on older farmers. The land agent organized a land reallocation process to consolidate 'marshy' and 'good' agricultural land into viable ecological and agricultural 'units', respectively. The first reallocation involved 30 different landowners and 240 land parcels totalling 250 ha in area. As land consolidation progressed, ARK Nature attracted an additional €4–5 million from government agencies and industries with the obligation to offset their biodiversity impacts. In 2016, the 12th land allocation completed the purchase of 650 ha (460 ha for nature/wetlands and 190 ha for agriculture) and the creation of coherent marshland system of almost 2000 ha.

As soon as a hydrologically coherent group of land parcels was acquired (i.e. rewetting would not affect neighbouring farms), drainage systems and fences were removed and natural grazing introduced with free-ranging herds of horses (Exmoor breed) and cattle (Tauros breed). Some old fen systems were restored by digging out the substrate. These actions created a landscape mosaic that now hosts the richest butterfly and dragonfly populations of the Benelux. Many other species have returned, including common crane *Grus grus*, tree frog *Hyla arborea*, beaver, wild boar *Sus scrofa* and red deer.

ARK Nature engaged local communities in these developments by organizing events to celebrate each project milestone, recognizing local culture in names on new access gates and publishing a book on the area's oral history. In addition, ARK Nature responded to people's fear of Tauros cattle by replacing them with more docile breeds in areas used for recreation.

As with GP (§4a), citizens are capturing new identity and a recreational value from the rewilded areas. Restaurant enterprises are benefiting, real estate values are increasing and 10 farm businesses have been improved. In addition, this rewilding initiative has increased water storage in the area by 150 000 m³ yr⁻¹ leading reductions in downstream

flood management and insurance costs (see <http://www.klimaatbuffers.nl/>). Furthermore, by outsourcing land reallocation competencies and risk to ARK Nature, the PoL doubled the benefit achieved with taxpayers' money at four times the speed! In 2017, ARK Nature, as a temporary landowner, transferred the lands to the final managers, which are established conservation organizations on both sides of the border.

(d) Danube Delta, Ukraine and Romania

Situated along the Western Black Sea coast, the Danube Delta is Europe's largest and most intact river delta, comprising over 600 000 ha of reed, marsh, lake, woodland and dune systems. Nonetheless, the delta's hydrological and ecological functions were severely damaged during the Soviet era (ca 1950–1990) by engineering operations. These included dyking and the construction of sluices and canals to create agricultural polders, enable industrial scale reed harvesting and connect the river to lakes to create reservoirs for irrigation, drinking water and fish farming [35]. The delta's growing human population resulted in an increase in the intensity of hunting, fishing and trapping causing the expiration of functional species such as beaver, red deer and wolf, and the collapse of populations of the delta's four sturgeon species.

In response to the political changes in Romania (1989) and Ukraine (1991), international agencies came together to plan efforts to restore the natural functioning and values of the delta system. This resulted in the establishment of a transboundary Biosphere Reserve (Romania 1993, 442 000 ha; Ukraine 1998, 122 000 ha). An important linked initiative was the design of a 'Lower Green Danube' restoration project. This was led by WWF Germany's Institute for Floodplain Ecology and the Danube Delta Institute in Romania and took inspiration from a large-scale restoration project on the upper Rhine. The project was implemented by the Biosphere Reserve management authority and the WWF Danube-Carpathians programme with technical support from the Dutch V&W. Dykes surrounding the Babina and Cernovca islands were opened (1994 and 1996, respectively) which restored the flood regime in agriculture polders leading to a good recovery of the diversity of aquatic plants, zooplankton and native fish populations. This initiative stalled when the Romanian State devolved property rights to Tulcea County Council who then issued concessions for polders and fish farms to local interests (2002–2008; constrained further restoration in the Romanian part of the delta [35]).

Starting in 1999, WWF Netherlands developed a vision for the Ukrainian part of the delta under the 'Partners for Wetlands' Programme (led by F.S.). The vision was developed in conjunction with Ukrainian stakeholders and scientific institutions which visited the GP (§4a) and Border Meuse projects. The vision [36] incorporated the nature development principles and ethos of the 'Living Rivers' initiative (§4a–c): a subsequent iteration [37] covered the whole delta. In 2003, Ukrainian authorities approved a proposal for the WWF Danube-Carpathians Programme (DCP) to pilot this vision on Ermakov (2300 ha) and Dolin and Daller (100 ha) islands. Dykes were removed and natural grazing with horses and primitive cattle breeds was introduced. However, this initiative also stalled when, in 2006, the WWF-DCP reoriented its resources to influence policy affecting the wider Danube system.

In 2011, WWF Romania nominated the Danube Delta to be a Rewilding Europe focal area and the organizations signed a collaboration agreement. To support this initiative, local conservation professionals together with Rewilding Europe founded two local NGOs: Rewilding Ukraine (a countrywide initiative est. 2017) and Rewilding Danube Delta (Romania, est. 2018). These new NGOs are initiating pilot projects to implement the earlier visions. At the time of writing (July 2018), a coalition involving Rewilding Ukraine, Rewilding Danube Delta and the Danube Biosphere Reserve coordinated by Rewilding Europe are in the process of securing a major grant to restore 40 000 ha of wetlands in the delta and surrounding steppe areas. In the delta, the activities will focus on dyke removal and re-flooding of polders to reconnect the river with lakes and restore ecosystem processes and productivity. Specifically, the restoration of fish spawning conditions is expected to restore the delta food chain and local economies based on fish. It is hoped that this new, transboundary cooperation involving rewilding groups, local authorities and the Biosphere Reserve will reinvigorate key natural processes leading to wildlife comeback creating new economic opportunities associated with nature-based tourism.

(e) Côa Valley, Portugal

The Côa Valley rewilding initiative, located in northeastern Portugal near the border with Spain, is a response to land abandonment and climate change. This remote area of spectacular gorges, oak forests, olive groves and rocky heath has many rock engravings of horses, aurochs, Iberian ibex and other animals dating from 20 000 to 22 000 BP. By the 1960s, the valley was badly overgrazed by sheep and goats. For a variety of reasons, families and young people began leaving the valley for the cities and abroad in search of a better life. With the reduction of shepherding, open lands are transitioning to bush and woodland, and this increased biomass combined with hotter, dryer summers has increased the incidence, scale and intensity of wild fires with risk to human life and negative ecological impacts.

In 2000, a community of naturalists, biologists and archaeologists formed the Associação Transumancia e Natureza (hereafter ATN). The founders used their resources and networks to purchase parcels of land and create Faia Brava (est. 2010), Portugal's first private reserve. ATN initially focused on protecting cliff-breeding birds of prey and adopted a conservation management approach that 'reenacted' traditional pastoral practices. In 2003 and 2005, Faia Brava was badly damaged by fires started by a shepherd with whom ATN were collaborating. This prompted ATN to reassess its approach: it adopted a vision of ecosystem restoration based on the recovery of ecological processes and reduction of direct human management. They replaced sheep with semi-wild horses (see [38] for more details).

In 2011, ATN nominated the Côa Valley to become one of Rewilding Europe's focal areas. The partnership commenced with an activity to co-produce an artistic impression of a future landscape vision. This depicts an Iberian lynx *Lynx pardinus* overseeing mixed herds of horses, red deer *C. elaphus* and aurochs *Bos primigenius*, with vultures soaring over a group of Iberian ibex *Capra pyrenaica*. This artwork is widely used in ATN communications and although the decentring of humans (depicted in a distant wildlife hide and safari

camp) unsettles some villagers, visitors and conservationists, it promotes transparency concerning ATN's intentions.

In 2013, ATN joined the European Wildlife Bank (EWB) (see below) and received herds of Tauros and Garanno horses (a local breed), and funds for fencing in return for incorporating its own herds into the EWB. The growing herbivore herds have reduced the risks of wild fire and created habitats favoured by the prey species of iconic species such as Iberian lynx, Spanish imperial eagle *Aquila adalberti* and Bonelli's eagle *Aquila fasciata*. The new availability of larger carcasses is benefiting vulture populations and supports the future comeback of the Iberian wolf *Canis lupus signatus*.

The restoration of these wildlife assets and ecological dynamics is supporting the emergence of the nature-based economy as an alternative to the unsustainable pastoral economy. Rewilding Europe has provided business and investment support (via Rewilding Europe Capital (REC), see below) to start safari camps, wildlife hides, bush dinners and guiding enterprises linked to Faia Brava reserves. ATN receives fees from this nature-based tourism package and has secured grants and private funding to increase the reserve area to greater than 2000 ha.

ATN's vision to reintroduce Iberian ibex has so far been thwarted by the refusal of the Portuguese government conservation agency to issue permits. However, together with Rewilding Europe and other partners, they are working to create a Greater Côa Valley corridor. This involves a mix of buying and leasing land and developing management partnerships with landowners to create additional reserves that will function as 'stepping stones' connecting the Douro Valley in the north with the Malcata mountains in the south.

(f) Velebit Mountains, Croatia

In 2015, Rewilding Europe facilitated the establishment of a Croatian NGO called Rewilding Velebit to act as the local entity to develop a pioneer wildlife management model with the potential to achieve rewilding at a scale within the current hunting policies and regimes of the Croatian government. Most land in Croatia is owned by the state, which generates revenue from concession (use) licences. Purchasing these concession 'layers' is a way to deliver rewilding, i.e. rights to manage wildlife (hunting) and grazing dynamics (grazing). The nation is divided into 11 000 hunting concessions: licences to operate a concession (normally 10 years) are auctioned by the Department of Hunting within the Ministry of Agriculture. They are normally acquired by hunting associations, clubs, companies or private-landowners (there are 90 000 licenced hunters in Croatia).

In 2014, Rewilding Europe bought a 60% stake in a company holding three concessions totalling 17 000 ha within the Velebit Natural Park located in coastal, central Croatia. This was financed with a loan from the REC facility (below). Velebit is a 145 km long 50 km wide karst mountain range recognized for its scenic beauty, botanical diversity and wildlife: the area retains populations of brown bear (*Ursus arctos*), wolf (*Canis lupus*), Balkan chamois (*Rupicapra rupicapra*) and Eurasian lynx (*Lynx lynx*). The human population in the area is in decline and with this grazing by sheep and cattle herders.

The hunting management plans acquired were based on traditional principles and the hunting quotas were unsustainable. Rewilding Velebit revised the company's business

models and concession hunting plans (which expire in 2019 and 2021) in accordance with rewilding principles and within the constraints of hunting law. Specifically, Rewilding Velebit designed a zoning system involving a 10 000 ha no-take (breeding) zone surrounded by a regulated hunting zone and an outer zone where local residents are given rights to hunt wild boar in return for fees and volunteer workdays. This design limits disturbance from hunting and complies with concession law (which requires retention of some hunting) while creating the conditions for wildlife to recover natural densities, behaviours and interspecific interactions. In addition, a 10-year hunting moratorium was instituted for red deer and chamois that had been reduced to low numbers and the former have been restocked to accelerate rewilding.

To develop non-consumptive income sources to finance the concessions fees, the company is building wildlife photography hides. A specialist company has been engaged to design, manage and market these hides and maximize the chances of iconic species such as brown bear, Eurasian lynx, wild cat and red deer appearing in front of them.

This effort to develop and demonstrate a hunting concession business model that integrates rewilding with ecosystem recovery and wildlife tourism is facing a number of challenges. These include the different business attitude of hunting interests, weak governance in the region and the heavy time investment needed to build and maintain the support of competent authorities. Nonetheless, the latter has led to new interpretations of hunting law and new understandings of how to involve the hunting sector in rewilding initiatives.

5. Rewilding facilities

Rewilding Europe has developed three facilities to support these initiatives and the wider European Rewilding Network: the European Safari Company (an online booking platform), the EWB and REC. The latter two facilities are of particular relevance to this special issue.

Scaling-up the restoration of natural grazing dynamics is constrained by the limited supply of herds of wild horses and bovines. The EWB is a response to these constraints and the fact that many rewilding initiatives lack the funds to buy animals. The EWB enters into 5-year custodianship contracts with recipient landowners or area managers. On maturity of the 5-year contract, half of the herd must be 'paid back' to grow the EWB's 'wildlife capital.' Usually, the size of a herd triples during this contract period. Furthermore, the contracts are structured to enable the EWB to maintain control over the development and quality of ecologically functional breeds of bovines and horses, without doing the daily management.

Since 2011, the EWB herd has grown from less than 300 animals to greater than 800: a compound growth rate of 20–25% [39]. The EWB breed 'portfolio' includes several primitive horse breeds, the European bison, water buffalo and the Tauros. The latter is a functional analogue of the extinct auroch being developed by the Taurus Foundation in partnership with Rewilding Europe and in conjunction with Wageningen University.

Importantly, the creation and scaling of a conservation asset class (rewilded herbivores) is enabling Rewilding Europe to negotiate veterinary regulations suited to this new type of livestock. The Netherlands now recognizes a

category of 'kept wild' herds and allows calves to be tagged and registered within a year rather than within 3 days of birth. Rewilding Europe is pushing for free-roaming horses and Tauros inhabiting larger natural areas to be afforded 'kept wild' status in law. This would dissolve the requirement to remove carcasses, thereby restoring the decomposition/scavenger dynamics and guilds within trophic rewilding, also called the 'Circle of Life' (see [40]).

The creation of new natural assets that promote innovation, enterprise and investment in and around natural areas is a key Rewilding Europe principle. In 2013, Rewilding Europe together with Conservation Capital (a UK-based company developing new conservation business and investment mechanisms) established REC to act as a small business incubator. During the first phase of REC (capitalized with a €50 000 grant from the Dutch Postcode Lottery), loans were made to 17 rewilding-related enterprises involved in wildlife breeding, regional products and wildlife tourism. These investments generated 22 new jobs and a turnover of greater than €1 million [39].

In 2017, REC leveraged this success to secure a €6 million loan facility from the Natural Capital Financing Facility (NCF) of the European Investment Bank (EIB). With this new capital, REC is negotiating larger investment loans with rewilding enterprises. These include the acquisition of hunting concessions (e.g. \$4f) and investment in innovative business models that aim to deliver rewilding outcomes in other economic sectors such as forestry, water management and energy.

6. Discussion

While rewilding may be a relatively new concept in the academic literature, the material presented above shows that practical expressions of rewilding concepts commenced 30 years ago in The Netherlands, albeit under the label of nature development. From this practice and other influences, a distinct action philosophy emerged. This is being applied and tested in other regions by Rewilding Europe in partnership with local organizations. The three Dutch case accounts illustrate the role of innovative pioneer projects and multiactor networks in initiating and embedding institutional change. The case accounts of the three Rewilding Europe projects offer insight on the factors that might enable or constrain this rewilding action approach in different contexts. A characteristic aspect of the body of rewilding practice described is the restoration of herbivore guilds and grazing dynamics. Consideration of these aspects enables us to position this European version of rewilding in relation to the US 3C's version.

(a) A rewilding action philosophy

The practical engagements with the three Dutch rewilding projects together with insight gained from professional engagements with the development of conservancy and private conservation models in Europe and Southern and East Africa crystalized into an action philosophy for Rewilding Europe. From an organizational perspective, it is characterized by the ethos of (i) 'If you have a vision, begin it' (recalling Goethe's famous quote), (ii) use imagery as a universal language to inspire and engage others and build shared visions, (iii) as an organization keep small, practical and responsive and establish 'sister' and 'spin of' enterprises to

reduce managerial 'drag' and to fill new enterprise roles, (iv) adopt a positive and entrepreneurial approach and find solutions in seemingly opposing interest (e.g. extractive mining and river restoration, hunting and wildlife comeback), (v) identify and develop relations with professionals in key institutions who are interested in change and innovation, (vi) build trust-based partnerships with organizations of different types and sizes (NGO, commercial and government, national and local), and (vii) look for innovative forms of finance (e.g. brick and gravel companies (§4a), regional development funds and offset finance (§4c)). From an ecological restoration perspective this action philosophy aims to: (viii) restore abiotic dynamics in the landscape (river braiding, siltation and filtration) and trophic interactions (§4a,b), (ix) bring back lost species guilds including introducing a blend of de-domesticated (wilded) and iconic native species (§4a–c), (x) create new natural assets that respond to societal change and challenges and (xi) embrace uncertainty and allow nature to take its course, but intervene when competing interest needs to be managed (e.g. navigation versus dune formation, §4a). Contra to Jørgensen [41], we take the 're' prefix to mean again not back, where the future natures that emerge will have connections to the past but be new, dynamic and unfolding.

(b) Pioneer projects and institutional change

Our account of the wider impacts of the Dutch rewilding projects is consistent with institutional theory. This posits that institutions are highly path-dependent and resist change until some form of 'critical juncture' creates an imperative for them to try something new [42,43]. Plan Stork (in its various iterations) was initially resisted by governmental institutions until 'critical junctures' (floods, society resistance to deep mining) created a political imperative to pilot the visions.

An important insight from the Dutch cases is the role of 'post-normal' (*sensu* [44]) visions and pioneer projects in catalysing and embedding institutional change. The first pilot projects, even though small initially, made the Plan Stork vision tangible, exciting and meaningful for other conservation groups and public constituencies with political influence at local and national levels. However, it is important to note that ARK Nature's ideas and activities were enabled by professionals with progressive agendas in government agencies and major NGOs, some of which took over the long-term management of sites. ARK Nature acted as a pioneer to test ideas outside their agencies and develop working models that they could use to push for change internally. Indeed, these pioneer rewilding initiatives can be understood as spaces where networks of like-minded professionals in different sectors mobilized and/or leveraged their expertise and organizational capacities to effect change. For example, WWF Netherlands mobilized its campaign and communication expertise to position new visions (*Living Rivers*) and pilot projects within their broader campaign agenda, and multiactor partnerships formed to support the GP (§4a) and Boarder Mesue (§4b) initiatives. This has supported the emergence of more networked and multiscale modes of conservation governance (cf. [45]).

This network approach, involving different society actors, has enhanced the success and resilience of the Dutch projects. Such cross-sectoral participation in novel practice generated shared learning and cross-sectoral trust resulting in openness

to change and the confidence to deal with natural uncertainty (cf. [46]). More significantly, it has contributed to a fundamental change of worldview in Dutch river management institutions and the mainstreaming of nature development/rewilding principles in Dutch policy (there are now hundreds of rewilding sites). These accounts offer a reminder that, when it comes to effecting policy and institutional change, pioneer projects offer an alternative and/or complimentary approach to lobbying.

(c) Scaling-up challenges and opportunities

It is still early days for the three Rewilding Europe areas described and, as mentioned, Rewilding Europe's approach is to develop a vision with others, begin small and stay put. The potential of each project is outlined in the case accounts. Here, we reflect on three challenges that were not so evident in the Dutch context.

The first challenge concerns institutional contexts. As discussed, public opposition to an ageing Dutch water management policy combined with disastrous floods events led to a political and professional interest in experimenting with rewilding as a new approach. In the Danube delta, a 'critical juncture' (collapse of the Soviet Union) led to the creation of new institutions (Biosphere Reserve authorities), but associated restoration initiatives have stalled. This is a quite different dynamic to that experienced in The Netherlands and one where institutional complexity, residual distrust and animosities [47] may constrain the formation of multiactor networks interested in change. In Portugal, the increasing incidence of wild fires may afford a critical juncture for rewilding (grazing reduces the severity), but it is clear that government conservation agencies are more cautious regarding reintroductions than their Dutch counterparts. Furthermore, in both the Côa Valley and Velebit cases, the culture of government institutions constrains the collective learning which was important to the success of the Dutch rewilding initiatives.

A second challenge concerns finance. In the Dutch case, it was possible to mobilize significant new finance from the extractive sector and public funds associated with land reallocation. Innovative sources of finance have yet to be identified in the three Rewilding Europe areas. To pursue rewilding visions in these areas, Rewilding Europe together with the local organizations are applying for grants in a conventional manner. However, important funding facilities such as EU Life express compositionalist conservation logics that require applicants to conduct more traditional species reintroduction projects. Furthermore, grant funding risks creating a situation where local organizations become too donor-driven.

A third challenge relates to the idea that developing wildlife tourism economies will help address processes of rural depopulation and land abandonment. At issue here is: (i) the paucity of entrepreneurs in the regions and with this the difficulty of investing (e.g. via REC) in the development of nature-based enterprises; (ii) the dependency of many regions on EU funds to support traditional land uses which undermines entrepreneurship and innovation; and (iii) the reality that nature-based economies are unlikely to generate revenues that can compete with other land use options (e.g. forestry), at least in the short- to mid-term.

Rewilding Europe is responding to such learning by adding a focus on developing scalable models with a strong business/

financial case that can be adopted by others. This paper illustrates three models: (i) riverine rewilding and aggregate mining (§4a,b); (ii) rewilding catchment management and regional development finance (§4c); and (iii) hunting concession rewilding and wildlife photo-safari enterprise (§4d). Three additional models are currently under development: (iv) estate rewilding and new wildlife safari income streams (Spain, Portugal, UK); (v) converting timber monocultures to grazing mosaics to reduce the risk of wildlife fire (§4f); and (vi) restoring peat mines with rewilding and carbon offset finance (Finland). In short, we have concluded that scaling-up the models of rewilding presented here will require innovations in conservation finance and rural business models.

(d) European rewilding areas and models as research assets

This special issue aims to advance scientific research aimed at studying and evaluating the impacts of rewilding through a framework of global change. In Europe, the increasing number, size and geographical representation of rewilding areas represents a valuable asset for researchers. In this article, we have drawn attention to some of the innovations in governance associated with rewilding areas. We have illustrated how interplays between the specifics of place, action philosophies and sources of finance give rise to emergent ecologies, nature-based solutions and institutional change. Moves to class rewilding as a conservation management approach that requires a ‘clear definition... decision framework... and scientifically robust rational as to how best to implement it’ ([48], p. 9) risk constraining practice and the dynamic interplays that give the approach its transformative potential. In our view, rewilding practice will always be in a process of ‘becoming’ and we ask that scientists resist the desire to specify what it should or should not be.

One feature of this version of rewilding is the restoration of large-herbivore guilds through the introduction of de-domesticated horses and cattle. Trait-based approaches are likely to inform future research on the impacts of trophic rewilding. The EWB represents a potentially valuable asset for such research. This is because managers are systematically recording information on the genetic, phenotypic and behavioural traits of the herds involved in European rewilding projects and possess contextual knowledge on the de-domestication history and management of each herd and their interactions with landscapes. Furthermore, the existence of the EWB and its growing herds is creating the possibility to negotiate a relaxation of regulations governing carcass disposal. These developments offer an opportunity to test and develop a theory that suggests the restoration of biotic, grazing, predator and scavenger gradients and dynamics will produce biotic expansion [49].

For social scientists, these wilded herds are assets for theory development and/or examining concepts relating to, for example, non-human autonomy [38] and public experiments [50]. However, they may also be assets for promoting interdisciplinary research agendas that connect trait-based ecology and social theory. This is because the cultural profile of an animal or species is a form of a relational trait with the potential (agency) to change the identities and behaviours of other actors within a system, human and non-human alike (see [51]). Wilded large herbivores certainly had a role in generating public buy-in for the rewilding visions presented

above. We suggest that this may be because de-domesticated cattle and horses provide an accessible and reassuring connection between tradition and the new worldviews and dynamic processes of change and adaptation that rewilding represents. The (re)appearance in the European landscape of bovines and horses as wild-living social animals with the herd, breeding and roaming behaviours is simultaneously familiar yet novel, inspiring yet unsettling, i.e. intriguing. Their presence blurs the domestic/wild binary that has structured policy and cultural institutions (cf. [52]). This, in turn, unsettles sedimented ideas of what is natural where (e.g. large mammal assemblies are an African not European phenomena) and resets expectations of what is possible and appropriate in conservation policy and management. This cultural dimension of trophic rewilding may represent the crucial link between rewilding as a new conservation approach and rewilding as an approach that helps society respond to global change.

(e) North American and European rewilding compared

In our view, the differences between the ‘nature development’ version of rewilding described herein and the North American ‘3C’s approach’ are more a matter of worldview than conservation goals. Both focus on the restoration of ecosystem processes and trophic interactions. In Europe, herbivores are emphasized more than carnivores because wild populations of key large herbivores no longer exist and traditional grazing is in decline. At the same time, carnivores are increasing and expanding their range unaided [53]. Improving spatial connectivity is emphasized in both approaches: in the C \hat{o} a Valley and Velebit areas, this involves efforts to link core areas with corridors. However, the literature suggests that in North America, eco-centric worldviews influence the study and practice of conservation biology, restoration ecology and rewilding. These worldviews foreground the intrinsic value of nature, the value of encounters with wilderness (nature as other) and the restoration of past ecosystems by reducing the impacts of modern pressures (e.g. [54]). By contrast, the version of rewilding we promote in Europe expresses worldviews identifiable with utilitarianism and pragmatic realism [55]. We accept that nature, society and economy are intertwined and that the ‘natural’ ecosystems of Europe were transformed and impoverished millennia ago and can therefore only be imagined rather than fully known. Put another way, we are where we are and there is no way back, only forward. In contrast to protectionist worldviews that view nature as vulnerable and in need of protection, this pragmatic realist worldview (see [56]) views nature as a dynamic force that can be restored and embraced to help solve modern socio-economic issues. Rewilding initiatives can start at the centre of modern society as well as places removed from it, and the natures produced will be uncertain and dynamic and never fully autonomous: they will be an emergent property of a new socio-ecological system.

Data accessibility. This article has no additional data.

Competing interests. We declare we have no competing interests.

Funding. We received no funding for this study.

Acknowledgements. We thank O. Hulea, D. Krmpotic, M. Nesterenko, P. Prata and Deli Saavedra for contributing their knowledge and insight on the RE case accounts, and also thank two anonymous reviewers whose comments and advice significantly improved

the quality of this paper. In addition, we thank all the many unnamed people who have participated in the initiatives mentioned and who have contributed through ideas, actions and enthusiasm to the projects, facilities and conservation philosophy we describe. Lastly, we thank Kristjan Young for preparing the map and figures.

Annex 1. Author research positionality

The following short author biographies are intended to promote transparency regarding our positionality in this research.



P. Jepson is a course director of the MPhil/MSc in Biodiversity, Conservation and Management and Senior Research Fellow at Smith School of Enterprise and the Environment. He has been teaching rewilding since 2005, including leading student field trips to The Netherlands.

He started his career working on urban nature restoration and management projects in Manchester and Shrewsbury (UK, 1984–1991) and established and led the BirdLife International Indonesia Programme (1991–1997). He transferred into academia full time in 2006 and has recently written academic and popular articles that frame rewilding as a new, complimentary and hopeful conservation approach. He was appointed to the Rewilding Europe supervisory board in April 2017.



F. Schepers is Managing Director and co-founder of Rewilding Europe. After graduating in forestry, land and water management, he worked for the Dutch government on large river restoration projects (such as the Border Meuse). In 2000, he moved to WWF Netherlands and was responsible for international programmes, with a focus on Southern Africa, Europe and Eurasia until 2014. He has specialized in developing conservation strategies, freshwater and species conservation, ecological networks, protected areas and rewilding approaches.



W. Helmer is a co-founder of Rewilding Europe where he is the head of rewilding and a member of the Rewilding Europe Capital Investment Committee. He also co-founded the consultancy Stroming Ltd, FREE Nature, Rombus Ltd (a filming company) and ARK Nature.

He was a director of the latter organization from 1989 to 2015 during which time he implemented rewilding initiatives in The Netherlands (including GP and Kempen-Broek), Latvia (Letlands) and Bulgaria (New Thracian Gold). He co-authored several change-making visions like 'Living Rivers' and 'Growing with the Sea'. He holds an honorary lectureship with the Forestry and Nature Management Programme at Van Hall Larenstein University of Applied Sciences, The Netherlands.

References

1. Van Maanen E, Convery I. 2016 *Rewilding: the realisation and reality of a new challenge for nature in the twenty-first century*. *Changing perceptions of nature*, pp. 303–319. Woodbridge, UK: Boydell & Brewer.
2. Soulé ME, Terborgh J. 1999 Conserving nature at regional and continental scales—a scientific program for North America. *Bioscience* **49**, 809–817. (doi:10.2307/1313572)
3. Hannibal ME. 2013 *Spine of the continent: the race to save America's last, best wilderness*. New York, NY: Rowman & Littlefield.
4. Sandom C, Donlan CJ, Svenning JC, Hansen D. 2013 Rewilding. In *Key Topics in Conservation Biology 2* (eds DW Macdonald, KJ Willis), pp. 430–451. Chichester, UK: Wiley.
5. Root-Bernstein M, Galetti M, Ladle RJ. 2017 Rewilding South America: ten key questions. *Perspect. Ecol. Conserv.* **15**, 271–281. (doi:10.1016/j.pecon.2017.09.007)
6. Zimov SA. 2005 Pleistocene park: return of the mammoth's ecosystem. *Science* **308**, 796–798. (doi:10.1126/science.1113442)
7. Griffiths CJ, Hansen DM, Jones CG, Zuñel N, Harris S. 2011 Resurrecting extinct interactions with extant substitutes. *Curr. Biol.* **21**, 762–765. (doi:10.1016/j.cub.2011.03.042)
8. Zamboni T, Di Martino S, Jiménez-Pérez I. 2017 A review of a multispecies reintroduction to restore a large ecosystem: the Iberá Rewilding Program (Argentina). *Perspect. Ecol. Conserv.* **15**, 248–256. (doi:10.1016/j.pecon.2017.10.001)
9. Prior J, Ward KJ. 2016 Rethinking rewilding: a response to Jørgensen. *Geoforum* **69**, 132–135. (doi:10.1016/j.geoforum.2015.12.003)
10. Jepson P, Schepers F. 2016 *Making space for Rewilding. Creating an enabling policy environment*. Rewilding Europe Policy Brief. Wageningen, The Netherlands: Rewilding Europe. (doi:10.13140/RG.2.1.1784.1287)
11. Engels A. 2005 The science-policy interface. *Integr. Assess. J.* **5**, 7–26.
12. Young JC *et al.* 2014 Improving the science-policy dialogue to meet the challenges of biodiversity conservation: having conversations rather than talking at one-another. *Biodivers. Conserv.* **23**, 387–404. (doi:10.1007/s10531-013-0607-0)
13. Lieberman A. 1986 Collaborative research: working with, not working on. *Educ. Leadersh.* **43**, 28–32.
14. Bradbury-Huang H. 2010 What is good action research? Why the resurgent interest? *Action Res.* **8**, 93–109. (doi:10.1177/1476750310362435)
15. Gibbs M. 2001 Toward a strategy for undertaking cross-cultural collaborative research. *Soc. Nat. Resour.* **14**, 673–687. (doi:10.1080/08941920120547)
16. Rientjes S. 2002 Making nature conservation modern: an analysis of developments in nature conservation policy in relation to macro-social changes—The Netherlands as a case study. *J. Environ. Policy Plan.* **4**, 1–21. (doi:10.1002/jep.101)
17. Baerselman F, Vera FWM. 1989 *Natuurontwikkeling. Een verkennende studie* [Nature Development: an exploratory study]. Achtergrondreeks Natuurbeleidsplan. Uitgave SFGU's-Gravenhage. [In Dutch.]
18. Van Den Belt H. 2004 Networking nature, or Serengeti behind the dikes. *Hist. Technol.* **20**, 311–333. (doi:10.1080/0734151042000287023)
19. Wigbels V. 2001 *Oostvaardersplassen: new nature below sea level*. Zwolle, The Netherlands: Staatsbosbeheer.
20. Verduijn S, Ploegmakers H, Meijerink S, Leroy P. 2015 Pushing the radical nature development policy concept in the Netherlands: an agency perspective. *Environ. Values* **24**, 55–77. (doi:10.3197/096327114X13947900182076)
21. LNV. 1990 *Nature policy plan. Governmental decision*. The Hague, The Netherlands: Nature Management and Fisheries, Ministry of Agriculture.

22. Vera FWM. 2000 *Grazing ecology and forest history*. Wallingford, UK: CABI publishing.
23. van den Brink A, Molema M. 2008 The origins of Dutch rural planning: a study of the early history of land consolidation in the Netherlands. *Plann. Perspect.* **23**, 427–453. (doi:10.1080/02665430802319005)
24. Wesseling AJ, Bijker WE, De Vriend HJ, Krol MS. 2007 Dutch dealings with the delta. *Nat. Cult.* **2**, 188–209. (doi:10.3167/nc.2007.020206)
25. de Bruin D, Hamhuis D, van Nieuwenhuijze L, Overmars W, Sijmons D, Vera F. 1987. *Ooievaar, de toekomst van het rivierengebied [Plan Stork: the future of a river area]*. Arnhem, The Netherlands: Stichting Gelderse Milieufederatie. ISBN 90-72010-01-9. [In Dutch.]
26. Buijse AD, Coops H, Staras M, Jans L, Van Geest G, Griff R, Ibelings BW, Oosterberg W, Roozen FC. 2002 Restoration strategies for river floodplains along large lowland rivers in Europe. *Freshw. Biol.* **47**, 889–907. (doi:10.1046/j.1365-2427.2002.00915.x)
27. WWF. 1993 *Living rivers, Netherlands*. ISBN 90-74595-03-0.
28. Peters B, Willems D. 2015 Smart rivers: flood protection based on the DNA of rivers. http://www.smartrivers.nl/wp-content/uploads/Smart-Rivers-international_def-25-2.pdf (accessed 5 March 2018).
29. Bekhuis J, Kurstjens G (eds). 2008 *Beschermde habitats in het Natura 2000-gebied Gelderse Poort: situatie 2007 [Protected habitats in the Natura 2000 area Gelderse Poort: situation 2007]*. Flora en Faunawerkgroep Gelderse Poort. [In Dutch.]
30. Luttik J, de Boer T, Goossen M, Groot Bruinderink G. 2006 *Nature development and the regional economy in the Gelderse Poort*. Wageningen, The Netherlands: Alterra. [In Dutch.]
31. Laar Svd, Lycklama T. 2012 *[Opening up pays off! The effect of nature and opening up on the leisure economy along large rivers]*. The Netherlands: Office for Space and Leisure. [In Dutch.]
32. Helmer W, Overmars W, Litjens G. 1991 *Toekomst voor een Grindrivier [Future for a gravel river]*. Study for the Province of Limburg, The Netherlands. [In Dutch.]
33. Peters B, Kurstjens G. 2008 *Maas in Beeld. Succesfactoren voor een natuurlijke rivier*. Projectgroep Maas in Beeld. Berg en Dal, The Netherlands: Bureau Drift/Kurstjens ecologisch adviesbureau. [In Dutch.]
34. Gore A. 2006 *An inconvenient truth: the planetary emergency of global warming and what we can do about it*. New York, NY: Rodale.
35. Schneider E. 2014 The Danube Delta: lessons learned from nature restoration projects. In *The bio-politics of the Danube Delta: nature, history, policies* (eds C Iordachi, K Van Assche), pp. 87–114. Lexington, MA: Lexington Books.
36. WWF. 2003 *A vision for the Danube Delta, Ukraine*. Zeist, The Netherlands: WWF.
37. WWF. 2007 *Danube Delta: a natural gateway to Europe*. Zeist, The Netherlands: WWF.
38. DeSilve C, Bartolini N. 2018 Where horses run free? Autonomy, temporality and rewilding in the C o Valley, Portugal. *Trans. Inst. Br. Geogr.* (doi:10.1111/tran.12251)
39. Rewilding Europe. 2017 *2016 Annual review: a rewilding retrospective*. Wageningen, The Netherlands: Rewilding Europe.
40. Rewilding Europe. 2017 *Introducing the circle of life. A new way to support Europe's scavengers*. Wageningen, The Netherlands: Rewilding Europe.
41. J rgensen D. 2015 Rethinking rewilding. *Geoforum* **65**, 482–488. (doi:10.1016/j.geoforum.2014.11.016)
42. Hall PA, Taylor RC. 1996 Political science and the three new institutionalisms. *Polit. Stud.* **44**, 936–957. (doi:10.1111/j.1467-9248.1996.tb00343.x)
43. Crouch C, Farrell H. 2004 Breaking the path of institutional development? Alternatives to the new determinism. *Ration. Soc.* **16**, 5–43. (doi:10.1177/1043463104039874)
44. Funtowicz S, Ravetz J. 2003 Post-normal science. In *Online encyclopedia of ecological economics* (ed. International Society for Ecological Economics). See <http://www.ecoeco.org/publica/encyc.htm>.
45. Jones C, Hesterly WS, Borgatti SP. 1997 A general theory of network governance: exchange conditions and social mechanisms. *Acad. Manage. Rev.* **22**, 911–945. (doi:10.5465/amr.1997.9711022109)
46. Pahl-Wostl C, Holtz G, Kastens B, Knieper C. 2010 Analyzing complex water governance regimes: the management and transition framework. *Environ. Sci. Policy* **13**, 571–581. (doi:10.1016/j.envsci.2010.08.006)
47. Goriup P, Goriup N. 2014 Evolution of polices and institutions for conservation of the Ukrainian Danube Delta. In *The bio-politics of the Danube Delta: nature, history, policies* (eds C Iordachi, K Van Assche). Lanham, MD: Lexington Books.
48. Pettorelli N *et al.* 2017 Making rewilding fit for policy. *J. Appl. Ecol.* **55**, 1114–1125. doi:10.1111/1365-2664.13082
49. Brunbjerg AK, Bruun HH, Moeslund JE, Sadler JP, Svenning JC, Ejrn s R. 2017 Ecospace: a unified framework for understanding variation in terrestrial biodiversity. *Basic Appl. Ecol.* **18**, 86–94. (doi:10.1016/j.baae.2016.09.002)
50. Lorimer J, Driessen C. 2014 Wild experiments at the Oostvaardersplassen: rethinking environmentalism in the Anthropocene. *Trans. Inst. Br. Geogr.* **39**: 169–181. (doi:10.1111/tran.12030)
51. Jepson P, Barua M, Buckingham K. 2011 What is a conservation actor? *Conserv. Soc.* **9**, 229–235. (doi:10.4103/0972-4923.86993)
52. Rutherford S. 2007 Green governmentality: insights and opportunities in the study of nature's rule. *Prog. Hum. Geogr.* **31**, 291–307. (doi:10.1177/0309132507077080)
53. Chapron G *et al.* 2014 Recovery of large carnivores in Europe's modern human-dominated landscapes. *Science* **346**, 1517–1519. (doi:10.1126/science.1257553)
54. Jordan WR, Lubick GM. 2011 *Making nature whole: a history of ecological restoration*. Washington, DC: Island Press.
55. Jepson P. 2018 Recoverable Earth: a twenty-first century environmental narrative. *Ambio* (doi:10.1007/s13280-018-1065-4)
56. El-Hani CN, Pihlstr m S. 2002 Emergence theories and pragmatic realism. *Essays Philos.* **3**, 3.
57. Jordan WR, Lubick GM. 2011 *Making nature whole: a history of ecological restoration*. Washington, DC: Island Press.