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Research, part of a Special Feature on Ecological Restoration in Northern Regions

Do the Principles of Ecological Restoration Cover EU LIFE Nature Cofunded Projects in Denmark?

Jonas Morsing [1], *Sally Ida Frandsen* [1], *Henrik Vejre* [1] *and Karsten Raulund-Rasmussen* [1]

ABSTRACT. Ecological restoration is becoming a main component in nature management; hence, its definitions and interpretations of the underlying principles are widely discussed. In Denmark, restoration has been implemented for decades, and the LIFE Nature program has contributed to several large-scale projects. Our aim was to indicate tendencies in Danish nature policy by analyzing a representative sample of nature management projects. Using qualitative document analyses of official reports, we investigated how well 13 LIFE Nature cofinanced projects undertaken in Denmark fit with the principles of ecological restoration, as formulated in the nine attributes of the Society for Ecological Restoration's Primer on Ecological Restoration, and based on the five myths of ecological restoration. Objectives of the analyzed projects were divided into three categories: conservation of a single or a group of species; restoration of set-aside areas, mainly on abandoned agricultural land; and habitat management of Natura 2000 areas. Despite this grouping, improvement in living conditions for certain species associated with specific nature types was in focus in all projects. No projects considered or fulfilled all nine attributes. It seems that attributes associated with fundamental requirements for the existence of target species or habitats were more often fulfilled than attributes associated with continuity of the ecosystem as a whole, which indicated a focus on ecosystem structures rather than on processes. We found that the two assumptions of a predictable single endpoint (the myth of the Carbon Copy) and that nature is controllable (the myth of Command and Control) were notably frequent in the Danish projects. Often, the target ecosystem was associated with a semicultural landscape, and management focused on keeping the vegetation low and preventing overgrowth of colonizing trees. The results indicated that nature policy in Denmark and the LIFE Nature program are based on a control paradigm, with the focus on structures rather than on processes. Further, the results revealed that the definition and interpretation of ecological restoration is ambiguous, and according to land use history, there is a need for concepts and approaches to be clearly defined.

Key Words: *benchmark; ecological restoration; human impact; LIFE Nature; Natura 2000; nature policy; semicultural landscapes; SER attributes*

INTRODUCTION

Ecological restoration has become more and more frequent in nature management around the world (e.g., Suding 2011). Though ecological restoration follows the overall guiding principle of reverting ecosystems to some kind of earlier and more desirable state, it covers a wide range of actions at many spatial scales and a wide range of incitements and goals. Ecological restoration has been practiced for decades, but attempts to formalize and define the concept have emerged only gradually in scientific communities. As a milestone in this effort, the Society for Ecological Restoration International (SER) published a primer in 2004 that defines ecological restoration as "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" (SER 2004). Parallel to this condensed definition, the primer presents nine descriptive attributes of ecological restoration, followed by a comprehensive introduction to the concept, for example, a glossary and a discussion of ecological restoration in comparison to related practices. Though the primer has been disputed, e.g., by Davis and Slobodkin (2004) and Winterhalder et al. (2004), it represents a thoroughly prepared approach, and has been used as a tool to evaluate restoration projects (e.g., Ruiz-Jaen and Aide 2005).

The discourse over the subject continued when Hilderbrand et al. (2005) highlighted conventional understanding of ecological restoration as often being "over-application of over-simplified" guiding principles or myths. The authors raised caution regarding a risk of failure when not addressing the complexity of systems or the uncertainty of future changes (Hilderbrand et al. 2005), e.g., by lack of system resilience. The five myths encompass (1) the myth of the Carbon Copy, where a single-state endpoint with predicted species assembly is expected, (2) the myth of the Field of Dreams, where the restoration activities are based on self organization and focus solely on physico-chemical conditions, (3) the myth of Fast-Forwarding, with belief in repeatable successive ecosystem development pathways that can be accelerated, (4) the myth of the Cookbook, where methodologies are not site adapted, and (5) the myth of Command and Control and the Sisyphus Complex, which assume that humans can actively control ecosystems to manage for particular ecosystem states indefinitely into the future. The most recent discussions continue to deal with the incorporation of future changes in restoration projects, e.g., from land use to climatic change and differences inherent to spatial scale in the goal setting of projects (Hobbs 2007, Hobbs and Cramer 2008), which have

[1]Department of Geosciences and Natural Resource Management, University of Copenhagen

led to the proposal of a more open-ended approach in ecological restoration (Hughes et al. 2011).

Numerous restoration projects aimed at improving nature values and environmental standards have been implemented in Denmark within the last three decades (Pedersen 2010): they range from small-scale private projects, such as afforestation (Madsen 2003), to large-scale national projects, such as the remeandering of the Skjern River and recreation of its associated 2200-ha floodplain (Oxboel State Forest District 2005, Pedersen et al. 2007). The LIFE Nature program (EC 2011a) has played an essential role in the financing of many large-scale projects (COWI 2009a), and projects implemented under this program may be considered as a representative sample of nature management projects in Denmark.

The Danish landscape is highly cultivated, as is typical for lowland northwestern Europe. Some 65% of the land territory is arable land, and the remaining land area comprises strongly cultivated forests, urban areas, and minor patches of permanent grassland and other seminatural areas (EUROSTAT 2011). Relatively untouched natural areas are confined to coastal areas and occur in a few terrestrial ecosystems, such as natural forests. The highly intensive agriculture and forestry have had a significant influence on the biodiversity and authenticity of the landscape (COM 2001, 2006, Strandberg and Krogh 2011).

The ecological frames of northwestern Europe suggest that under natural conditions and no human intervention, forests would be the dominant land cover (Bradshaw and Holmqvist 1999, Hannon et al. 2000), but the openness and exact composition remain disputed (e.g., Svenning 2002, Bradshaw et al. 2003, Nielsen et al. 2012). Pollen analyses indicate that the natural ecosystems have changed (Bradshaw and Holmqvist 1999, Hannon et al. 2000, Overballe-Petersen and Bradshaw 2011), and anthropogenic disturbances have had a decisive influence on land cover and forest composition in at least the last 3000–6000 years (Hannon et al. 2000). Hence, the potential reference for ecological restoration is a landscape deprived of any unambiguous community structure representing a natural state, with a decisively changed species composition and a strongly manipulated hydrology after millennia of human influence. Nonintervened reference systems are essentially lacking. Furthermore, most species and habitats in focus in Danish nature policy are related to seminatural landscapes (Wilhjelm-udvalget 2001).

Young (2000) suggests that conservation is a good way to stop the biodiversity decline in the short term, but that in the long run, ecological restoration will be more suitable. Therefore, we found it relevant to investigate how well the principles of ecological restoration cover the actions undertaken in Denmark. The evaluation of nature management efforts may take many points of departure. A traditional ecological evaluation would analyze the specific outcomes in terms of, e.g., ecological processes, species composition, and spatial structures in the landscape, per se. These approaches are costly and time consuming, and in many cases the outcomes may take decades to register due to the slow recovery or resilience of natural systems (Hughes et al. 2011). Alternative evaluation methods are hence needed to examine the policy behind practiced management. However, the huge variation in nature management approaches and spatial scales makes benchmarking of projects challenging.

The SER primer (SER 2004) and the "myths of restoration ecology" (Hilderbrand et al. 2005) are among the more sound and systematic approaches to formulate and define ecological restoration; hence, they are suitable for *ex post* and *ex ante* evaluation. Such evaluations are relatively rare in the scientific literature (e.g., Ruiz-Jaen and Aide 2005, Suding 2011). Based on this background, we aimed to analyze actions in Danish projects that have been cofinanced by the LIFE Nature foundation in order to reveal tendencies in the policy behind nature management. Our evaluation was based on qualitative analyses of official documents, and whenever possible, the final project reports.

METHODS

Qualitative evaluation of documents implies a number of standard assumptions, which is not usually encountered in quantitative analyses, and hence may appear odd in a natural science context. Considerations regarding the material, the data quality, the scientist as interpreter, and the need for triangulation in methodology are essential. In the following, we address this methodology.

Selection criteria

The aim of the selection criteria was to identify projects that had a significant character of ecological restoration. A large number of restoration projects have been carried out in Denmark in the past three decades. There is, however, little systematic, concise, or consistent use of terms or concepts in these projects; the project reports and evaluations arbitrarily use terms such as nature management, nature restoration, mitigation, and engineering. Hence, it was not simple to identify a sample of projects that represents processes that fulfill the criteria of ecological restoration, i.e., "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed." After screening a number of projects, we decided to limit the sample to LIFE Nature projects (EC 2011a) that were finalized by October 2010 and were fully or partly executed in Denmark. Marine projects and projects with pure surveying or monitoring purposes were not included.

To gain LIFE funding, the project and the beneficiary must fulfill a range of criteria (COM 2010). Technical activity reports, including a descriptive final report, must be submitted

Table 1. List of the 13 included projects, in chronological order.

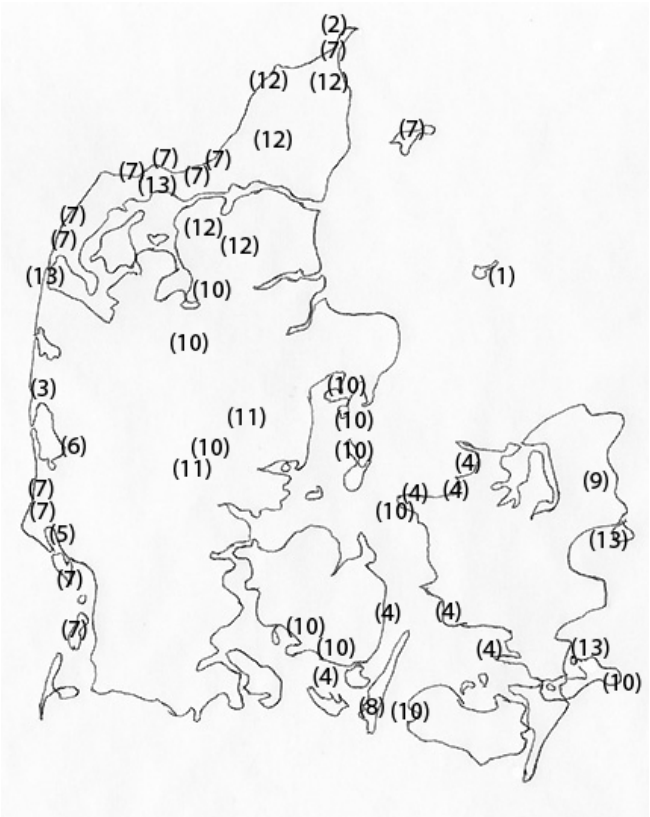
Project name	Short name	Aim	Period	LIFE number	Reference
Re-establishing lichen and coastal heaths in the Anholt desert, Denmark	Anholt	Re-establish lichen heath	1994–1996	LIFE94 NAT/DK/000492	Århus Amt (1997), EC (2011b)
Protection of grey dunes and other habitats on Hulsig Hede/Hulsig Heath	Hulsig Heath	Protect dune heath habitats	1996–2001	LIFE96 NAT/DK/003000	Nordjyllands Amt (2002), EC (2011b)
The restoration of the area of Vest Stadil Fjord	Vest Stadil Fjord	Restore wetlands and lakes to improve conditions for prioritized species	1997–2001	LIFE97 NAT/DK/004199	Ministry of the Environment (1997), Danish Forest and Nature Agency (2001), EC (2011b)
Consolidation of *Bombina bombina* in Denmark	*Bombina bombina*	Conserve the fire-bellied toad (*Bombina bombina*)	1999–2003	LIFE99 NAT/DK/006454	Fyn County (2003)
Wadden Sea estuary, nature, and environment improvement project	Wadden Sea	Restore natural hydrology and change agricultural practices	1999–2002	LIFE99 NAT/DK/006456	Ministry of the Environment and Energy (1999), Danish Forest and Nature Agency (2003)
Restoration of habitats and wildlife of the Skjern River	Skjern River	Improve conditions for wetland fauna, restore self-purification of the river, and improve the recreational value	2000–2004	LIFE00 NAT/DK/007116	Ministry of the Environment and Energy (2000), Oxboel State Forest District (2005)
Restoration of dune habitats along the Danish West Coast	Dune Habitats	Regain a favorable conservation status for the Danish dune habitats	2002–2005	LIFE02 NAT/DK/008584	Ministry of the Environment (2002), Danish Forest and Nature Agency (2005)
Improving status of coastal lagoon Tryggelev Nor, Denmark–IMAGE	Tryggelev Nor	Obtain a favourable conservation status of the coastal lagoon	2002–2006	LIFE2002 NAT/DK/8588	Fyn County (2002, 2006)
Restoration of Lake Fure—a nutrient-rich lake near Copenhagen	Lake Fure	Obtain clear water and improve conditions for flora and fauna	2002–2006	LIFE02NAT/DK/8589	Frederiksborg County (2006)
RODGID—Restoration of Dry Grasslands in Denmark	Dry Grasslands	Achieve a favourable conservation status for three priority dry grasslands habitat types	2004–2008	LIFE04NAT/DK/000020	Ministry of the Environment (2004, 2008)
BALTRIT—Protection of *Triturus cristatus* in Eastern Baltic Region	*Triturus cristatus*	Conserve isolated population and restore metapopulation structure of *Triturus cristatus*	2004–2008	LIFE04 NAT/EE/000070	Ministry of the Environment of the Republic of Estonia (2009)
ASPEA—Action for sustaining the population of *Euphydryas aurinia*	*Euphydryas aurinia*	Bring the isolated population of *Euphydryas aurinia* into favorable conservation status	2005–2008	LIFE05 NAT/DK/000151	Danish Forest and Nature Agency (2009)
Restoration of Meadow Bird Habitats—REMAB	Meadow Birds	Restore and maintain a favorable conservation status for two wading bird species and associated habitat types	2006–2009	LIFE06 NAT/DK/000158	Danish Forest and Nature Agency (2010)

to the Commission within three months of the end of the project (COM 2010). If possible, we based our analyses on final reports, but in a few cases the final report was inaccessible; therefore, the application form and other official descriptive documents were used (Table 1). Due to the lack of descriptive documents, the project *Management of North European Heathland Areas in Relation to the Directive 79/409/EEC* (LIFE92 NAT/DK/013600) was omitted. Another project, *Restoration Forest—Restoration of Large Areas of Natural Forest for the Benefit of Endangered Birds, Plants, and Biotopes* (LIFE95 NAT/DK/00216), had the character more of a government policy than an active restoration project, so was also omitted. Of 22 LIFE Nature-supported projects initiated in Denmark, only 13 projects had fulfilled our criteria by October 2010. The spatial distribution of those projects is shown in Fig. 1.

Document analyses

The documents included in the analyses comprised mainly project applications and final reports for projects in which

Fig. 1. Sites included in the analyses. Projects are identified by numbers, following the same chronology used in Table 1. (1) Anholt, one site; (2) Hulsig Heath, one site; (3) Vest Stadil Fjord, one site; (4) *Bombina bombina*, seven sites; (5) Wadden Sea, one site; (6) Skjern River, one site; (7) Dune Habitats, 12 sites; (8) Tryggelev Nor, one site; (9) Lake Fure, one site; (10) Dry Grasslands, 11 sites; (11) *Triturus cristatus*, two sites; (12) *Euphydryas aurinia*, five sites; (13) Meadow Birds, four sites. Sites outside Denmark in the Triturus cristatus project are not included.



some kind of nature management activity that fit the general definition of ecological restoration took place. That is, the exact term "ecological restoration" or its Danish equivalent was not necessarily explicitly mentioned in the project description or final report. The reports are official documents that are used as communication tools between local authorities and the EU LIFE authorities. The reports have institutional authorship, that is, though a specific author may be identified, he or she acts on behalf of a public institution. But even authors of official documents may be reflective and conscious of reputation. According to Dahler-Larsen (2005), the author may attempt to fix a certain definition of reality given certain circumstances. The documents aim at one major goal: to fulfill criteria and obligations set by the funding authority. Therefore, the documents are not meant to fulfill any other criteria, which we kept in mind when evaluating them by using the SER criteria as a benchmark.

The documents were analyzed to judge whether and how well the principles of ecological restoration covered the actions conducted as part of the projects. The methodology used is what Canter and Alison (2003) refer to as unobtrusive: there is no contact with the author, no impact on the creation of the document, and no reactivity (i.e., no impact on the study object). The reports were analyzed using a standardized interpretation guide (Appendix 1). Concepts and terms were interpreted using the terminology presented in the SER primer (SER 2004).

First, we analyzed the fulfillment of the nine attributes from the SER primer (SER 2004) by reviewing the official project descriptions. For each project, we questioned primarily whether the intentions of the attributes were taken into consideration (C) or not (NC).

Second, we evaluated how well the project had fulfilled the given attribute, i.e., whether the project did or had what was required by the attribute, no matter the answer to the first question. This was done by searching for relevant descriptions as part of the standardized interpretation guide (Appendix 1). We differentiated whether the attribute was fulfilled (F), partly fulfilled (PF), or not met (NM). In some cases, the official project description did not have sufficient information to clarify the degree of fulfillment (–). This could be either because the project did not consider the attribute or because the reports were written before it was possible to draw any conclusion.

Third, we analyzed the perception behind the projects by comparing tendencies in the official descriptions with the myths of restoration ecology (Hilderbrand et al. 2005). This was based on five questions, one assigned for each myth (Text box 1).

In order to perform a triangulation analysis (Dahler-Larsen 2005), two researchers independently scrutinized the projects before comparing the results with each other. This method should reveal systematic differences in the personal evaluations and allow corrections to be made in the evaluations.

Box 1:

The five questions used to identify the presence of each myth of restoration ecology, based on Hilderbrand et al. (2005), were:

The myth of the Carbon Copy

- Is there a single-state endpoint described as the goal of the project, i.e., defined community assembly, without recognizing the uncertainties related to future changes?

The myth of the Field of Dreams

- Does the project focus solely on physico-chemical conditions, based on a self-organization approach, without addressing the uncertainties related to outcome?

The myth of Fast-Forwarding

- Does the project aim at accelerating ecosystem development pathways without recognizing slow recovering, time-dependent ecological processes?

The myth of the Cookbook

- Is the project based on methods adopted from other projects, without consideration/incorporation of site-specific conditions (idiosyncrasies)?

The myth of Command and Control and the Sisyphus Complex

- Does the project aim at actively controlling ecosystem structure and function to manage for a particular ecosystem state indefinitely into the future, without recognizing uncertainties arising from changes in dominant large-scale drivers?

RESULTS

Based on the aims of each project, we classified them into three main categories (Table 2): (1) projects aimed at conservation of a single species or a group of species, (2) projects aimed at restoration of set-aside areas, mainly on abandoned agricultural land, and (3) projects aimed at habitat management of Natura 2000 areas. The number of projects grouped into each of the three categories was equally abundant, and we did not investigate intercategorical differences.

No project considered or fulfilled all nine attributes (Table 2). Most projects (10 of the 13) used reference sites for defining diversity and community structure goals (attribute 1). An example of reference information was the use of historical records. Eleven of the 13 projects fulfilled the reference criteria (attribute 1), for instance, revealed by a botanical survey based on the Raunkiær method. Four of the 13 projects considered whether nonindigenous species were present (attribute 2). All projects that considered the presence of nonindigenous species also fulfilled this attribute, at least partly. In the Vest Stadil Fjord project, which aimed to restore former lagoon wetlands on land reclaimed for farming, a botanical survey showed the presence of the nonindigenous and strongly invasive *Rosa rugosa*, but presumably no actions were taken to combat this species. Three of the 13 projects considered the presence of functional groups (attribute 3), whereas four of the 13 seemed to fulfill this attribute, at least to some degree. An example is the project Tryggelev Nor, where higher biodiversity of aquatic plants and animals, as well as improved food web structures constituted the complied goals. However, for several of the projects, this attribute was difficult to evaluate.

All analyzed projects considered restoring an appropriate physical environment (attribute 4). Only the project Lake Fure did not fulfill this attribute. It aimed to improve ecological conditions of the lake as a whole, as well as for waterfowl and elodeid plants, but a high internal phosphorus load was not sufficiently lowered by the end of the project. Eight of the 13 projects considered restoring normal functioning ecosystems (attribute 5), and six succeeded in fulfilling this attribute. An example of fulfillment is the river restoration in Skjern River, where sedimentation and turf buildup processes became restored.

Almost all the projects considered the landscape dimension (attribute 6), and all projects seemed to fulfill it. The projects Meadow Birds, Vest Stadil Fjord, Skjern River, and Wadden Sea were all wetland restoration projects with a shared focus on wetland birds. They were adjacent to one another and were located on the important route for migrating birds, known as the West Palearctic Flyway, and were an example of integration into a larger ecological matrix. The presence of external threats was considered in 10 of the 13 projects, and was evaluated to be eliminated in four projects (attribute 7). A prevalent problem in most project areas was nitrogen deposition due mainly to high stocking densities of domestic animals and widespread use of sludge in the surrounding areas.

Resilience of the restored ecosystem was considered in six of the 13 projects (attribute 8). Since resilience is a time-dependent phenomenon, it was difficult to evaluate the fulfillment of this attribute. In the two large projects that were aimed at restoring natural dune heaths, i.e., Dune Habitats and Hulsig Heath, large surveys of the ability of the natural vegetation to re-establish showed good recovery, and both projects were assessed as having fulfilled the attribute to some degree. Eight of the 13 projects considered the self-sustainability and future development of the restored ecosystems (attribute 9). Five of the 13 projects did not meet the intention of the attribute, either because the idea of ecosystem development contradicted the aims, e.g., in the project Dry Grassland, aimed at increasing the area of grassland habitats that was formerly overgrown, or in the project Lake Fure, where the restored lake ecosystem was not yet self-sustaining but was dependent on an artificial oxygen supply. In the projects Hulsig Heath and Anholt, natural vegetative development was allowed, and the projects were evaluated as having partly fulfilled the attribute. Similarly, the allowed dynamic stream development in Skjern River was partly fulfillment.

Two of the myths described by Hilderbrand et al. (2005) were remarkably common among the 13 projects (Table 3). The myth of the Carbon Copy was recognized in 12 projects, and

Table 2. Evaluation of 13 Danish LIFE Nature co-funded projects using the nine attributes by SER (2004) that characterize well-restored ecosystems. C and NC refer to consideration or not, respectively, of the attributes in the project goal, whereas degree of fulfilment of the attributes is categorized as not met (NM), partly fulfilled (PF), or fulfilled (F); (−) indicates where evaluation was not possible. The 13 projects are categorized into three main groups: conservation of a single species or a group of species, restoration of set-aside areas, and habitat management.

	Att 1 Reference ecosystem		Att 2 Invasive species		Att 3 Functional groups		Att 4 Physical environment		Att 5 Functions normally		Att 6 Larger matrix		Att 7 External threats		Att 8 Resilient		Att 9 Self-sustaining	
	Consideration	Fulfillment	Consideration	Fulfillment	Consideration	Fulfillment	Consideration	Fulfillment	Consideration	Fulfillment	Consideration	Fulfillment	Consideration	Fulfillment	Consideration	Fulfillment	Consideration	Fulfillment
Species conservation																		
Bombina bombina	NC	−	NC	−	NC	−	C	PF	NC	−	C	PF	C	NM	NC	−	NC	−
Triturus cristatus	C	PF	NC	−	NC	−	C	F	NC	−	C	PF	C	−	NC	−	NC	−
Euphydryas aurinia	NC	−	NC	−	NC	−	C	F	NC	−	C	PF	NC	−	NC	−	NC	−
Meadow birds	NC	PF	NC	−	NC	−	C	F	NC	−	C	F	C	PF	NC	−	NC	−
Restoration of set-aside areas																		
Vest Stadil Fjord	C	PF	NC	NM	C	PF	C	PF	C	PF	C	F	C	NM	NC	−	C	NM
Wadden Sea	C	F	NC	−	NC	−	C	PF	C	PF	C	F	NC	−	C	−	NC	−
Skjern River	C	F	NC	−	NC	PF	C	F	C	PF	C	F	C	NM	NC	−	C	PF
Tryggelev Nor	C	F	NC	−	C	F	C	PF	C	NM	C	F	C	PF	NC	−	C	NM
Habitat management																		
Anholt	C	F	C	PF	NC	−	C	F	NC	F	C	F	C	NM	C	−	C	PF
Hulsig Heath	C	PF	C	PF	NC	−	C	F	C	F	C	F	C	PF	C	F	C	PF
Dune Habitats	C	F	C	PF	NC	−	C	PF	C	PF	C	F	C	NM	C	PF	C	NM
Lake Fure	C	PF	NC	−	C	F	C	NM	C	NM	NC	F	C	F	C	NM	C	NM
Dry Grasslands	C	F	C	F	NC	−	C	F	C	NM	C	F	NC	−	C	−	C	NM

the myth of Command and Control was recognized in 11 of the 13 projects. All projects had predefined target species and/or habitat types, and most did not include acceptance of future changes in species composition or distribution as expressed by the myth of Carbon Copy. To preserve the appearance and species assembly of the restored habitat, most projects included recurring management that expressed the myth of Command and Control. Control of vegetation development, e.g., by controlled grazing and ongoing mechanical removal of colonizing trees, was especially prevalent.

On the contrary, the myth of the Cookbook was not recognized in any of the projects because they all had involved preliminary site studies or used historical reference conditions. Only the *Bombina bombina* project aimed to accelerate ecosystem development, i.e., the myth of Fast-Forwarding, which was articulated in the strong focus on a captive breeding program. The myth of the Field of Dreams was recognized in less than half of the projects (five of the 13), which expressed a sole focus on physico-chemical conditions without addressing that the outcome might hence be uncertain.

DISCUSSION

The main result of our analyses is that no project was found to consider or fulfill all the nine attributes of the SER primer on ecological restoration (SER 2004), and the projects were frequently based on at least two well-defined myths in restoration ecology (Hilderbrand et al. 2005). However, two important questions concerning the data and the methods must be addressed.

The analyses comprised a limited number of the projects that were financially supported by the LIFE Nature program and were carried out in Denmark during the last decades. However, these projects presumably made up a representative sample of projects that fulfilled the selection criteria described in the *Methods: Selection criteria*. Furthermore, there is reason to believe that most large-scale projects in Denmark have received this kind of financial support, and hence were included here. Beneficiaries included the governmental Forest and Nature Agency and municipalities but also private foundations. Some of the projects did not include the term "restoration" in their title, but this was not a selection criterion since this would require that the project managers had made equal semantic decisions during the 18 years covered. On the contrary, the LIFE Nature-supported projects are contributing to the implementation of the Habitats Directive (Council Directive 92/43/EEC), which seeks to not only maintain but also restore natural habitats and species at favorable conservation statuses (EC 2003).

The included reports were intended mainly to document the expenditures as a correspondence between the beneficiary and the contributor. Furthermore, there was no prescribed composition for a final report; hence, the content varied and was not always of traditional scientific standard. The use of a standardized interpretation guide compensated for a possible two-sided source of error: the documents varied because they were written by different authors at different times, and a researcher in qualitative analyses inevitably has preoccupations due to human perception. Both problems were addressed by using the standardized interpretation guide (Appendix 1) and questions (Text box 1), and by conducting cross-checking by two researchers.

This study was built on an interpretation of the SER primer, where ecological restoration involves actions that initiate a process that induces unpredictable development along a trajectory and with no further requirement of external assistance (SER 2004). This interpretation may gain growing support because it appears that restoration ecology cannot turn back the clock (Hobbs and Cramer 2008, Suding 2011), and future challenges, like the spread of nonindigenous species and changing climatic conditions, seem to restrict success when certain ecological states are the goal (Harris et al. 2006, Hobbs and Cramer 2008, Suding 2011). Other interpretations are possible, which reveals an ambiguity in the SER primer (SER 2004) when it comes to the restoration of seminatural areas in millennia-old cultural landscapes, and the incorporation of recurring management that simulates traditional land uses. By using the standardized interpretation guide, all projects were evaluated based on the same interpretation of ecological restoration, i.e., with no regard to the standards at the time of the project initiation. Hence, the results cannot and are not intended to be used to disqualify the projects, but to reveal tendencies in Danish nature policy in comparison with this specific interpretation of ecological restoration.

Following the SER primer (SER 2004) and the adapted interpretation of ecological restoration, we found that no project considered or fulfilled all nine attributes. The project that was best covered by the principles of ecological restoration was Hulsig Heath, where no myths were identified and which lacked only consideration and fulfillment of the presence of all functional groups. In general, we found that some attributes were more often considered and fulfilled than others. They seem to have in common an association with fundamental requirements for the existence of the target species or habitats. An appropriate physical environment (attribute 4) and connectivity with adjacent sites (attribute 6) are examples of such. The use of reference sites (attribute 1) and the elimination of external threats (attribute 7) could also support the favorable conservation status of target species or habitats, and likewise, they were frequently found to be considered in our analysis. Other attributes were associated more with the continuity of the ecosystem as a whole. The two attributes that were most infrequently fulfilled deal with the resilience (attribute 8) and self-sustainability (attribute 9) of the restored systems. Only two of the analyzed projects

Table 3. Evaluation of the 13 analyzed projects by use of the five myths of restoration ecology by Hilderbrand et al. (2005). Presence of the myths is indicated with (+), whereas (–) indicates that the myths have not been recognized.

	Carbon Copy	Field of Dreams	Fast-Forwarding	Cook-book	Command and Control
Species conservation					
Bombina bombina	+	–	+	–	+
Triturus cristatus	+	+	–	–	+
Euphydryas aurinia	+	+	–	–	+
Meadow birds	+	+	–	–	+
Restoration of set-aside areas					
Vest Stadil Fjord	+	–	–	–	+
Wadden Sea	+	–	–	–	+
Skjern River	+	+	–	–	+
Tryggelev Nor	+	+	–	–	+
Habitat management					
Anholt	+	–	–	–	–
Hulsig Heath	–	–	–	–	–
Dune Habitats	+	–	–	–	+
Lake Fure	+	–	–	–	+
Dry Grasslands	+	–	–	–	+

accepted, to some degree, a future development along an open trajectory.

Our findings are parallel to those of Ruiz-Jean and Aide (2005), who found that ecological processes were the least evaluated attribute of restored ecosystems. We tried to explain this trend by using the myths of restoration ecology (Hilderbrand et al. 2005). According to the authors, the presence of myths is not necessarily flawed but rather an expression of a simplification of ecological complexities. Project authorities should therefore be aware of the possible consequences. We found that the two assumptions that there is a predictable single endpoint (the myth of the Carbon Copy) and that nature is controllable (the myth of Command and Control) were notably frequent in the Danish projects. The incorporation of recurring management, like grazing or prescribed heathland burning, was especially prevalent in the analyzed projects. Even though we evaluated this as a possible expression of the Command and Control approach to restoration, it can be argued to be a positive feature as well. In COWI's (2009a) evaluation of the LIFE program in Denmark, this incorporation of future management leads to an assessment that the project has high sustainability. Hobbs and Cramer (2008) discuss this opposing approach in ecological restoration, and argue that even though there is a common assumption that restoration aims to fix problems and then move on, so-called one-off interventions, there is often a need for ongoing management. Basically, such a need depends on the goals behind the individual project, and therefore reflects the perception and the policy behind nature management. In the 13 projects analyzed in this study, most recurring management aimed to maintain ecosystems at a certain state, associated with the desired landscapes similar to those of traditional land uses. In two projects, the recurring management was target driven and aimed at combating non-native invasive species.

According to an evaluation of the whole LIFE Nature program (COWI 2009b), the objective is to contribute to the implementation of the Council Directive 79/409/EEC (Birds Directive) and Council Directive 92/43/EEC (Habitats Directive). Having this in mind, the objectives of the analyzed projects are to improve favorable conservation statuses of Annex birds, habitats, and species. A recent review by Halada et al. (2011) identified habitats of European importance that depend on, or can benefit from, agricultural practices, mainly grazing and mowing. The authors found 63 of such habitat types to be covered by the Birds and Habitats Directives, of which several were the target of the projects analyzed in this study. Hence, the incorporation of grazing and ongoing mechanical removal of trees that are colonizing open habitats in Danish LIFE Nature projects is indeed assisting the overall objectives, and is needed. However, in these analyses, we found that even under this overall objective, it is possible to make nature management projects that are close to the principles of ecological restoration, as in Hulsig Heath. Our analyses reveal a general approach to nature as controllable and with predictable development, described as the myth of Command and Control and the myth of the Carbon Copy. Further, our results reveal that the focus in Danish LIFE Nature

projects has been on structures, i.e., species and appearance, rather than on ecological processes, i.e., resilience and natural dynamics with inherent unpredictable development. This clearly indicates that nature policy in Denmark is based largely on a control paradigm, which, however, is in line with more than 6000 years tradition of agriculture and intensive land use, leading to a high population density and absence of nonmanaged nature.

The lack of focus on ecological processes in the analyzed projects in this study is also in line with evaluations of other branches of environment policies. When evaluating the agri-environmental policies of the European Union's Common Agricultural Policy, Primdahl et al. (2003) found that the focus was on performance effects, typically the number of farmers that were adopting a certain management practice, or the area under a particular management practice, rather than outcome effects, e.g., presence of species or reduction of pollution. Likewise, within ecological restoration, specific outcomes may take decades to reach, and policies may be regarded as a failure if the expected outcomes are not accomplished despite the fact that the actors behaved as suggested, e.g., if farmers adopted a certain practice. When the official documents from the LIFE Nature projects focus on performance effects in the same way, it is partly because they are intended to report obligations set by the funding authorities, in this case, the European Union.

A complete evaluation should include analyses of concrete outcomes on the landscape, per se. However, the results of this study reveal tendencies in the nature policy in Denmark and in the European Union LIFE Nature program to focus on structures rather than processes. Due to the time scale of ecosystem development and the unpredictability of the future, it is impossible to evaluate the long-term success of these projects.

According to the SER primer (SER 2004) "restoration initiates ecosystem development along a preferred trajectory, and thereafter allows autogenic processes to guide subsequent development with little or no human interference" and acceptance of unpredictable development, whereas "ecological engineering involves manipulation of natural materials, living organisms and the physical-chemical environment to achieve specific human goals and solve technical problems." Our results indicate that a control paradigm and a goal of predictive end points have been pronounced in Danish nature policy, whereas it is maybe better referred to as ecological engineering or something else (SER 2004). It is our opinion that the interpretation of ecological restoration in the present analyses is neither inappropriate nor impossible in the intensively cultivated northwestern Europe. The 100-year vision of the Wicken Fen in the UK (Hughes et al. 2011) is an example of a restoration project that has adopted the open-ended approach. It follows by the results of this study that the definition and interpretation of ecological restoration is ambiguous, and according to land use history, there is a need for concepts and approaches to be clearly defined.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/issues/responses.php/5847

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Appendix 1. Standardized interpretation guide

General project information

Name of project						
SNS name		LIFE ref nr.				
LIFE name and abbreviation						
Placing / area						
Number of project areas						
Name of areas						
Participating countries						
Main beneficiaries						
Other beneficiaries						
Period of time						
Start and end						
LIFE program						
Purpose / focus						
Species		Habitat		Other		
Description						

Comparison with the attributes of the SER Primer

1. Attribute – References and community structure				
Does the project compare with a reference ecosystem?	Yes		No	
Is the reference ecosystem;	Specific		Imaginary	
What is written about the assemblage of species?				
2. Attribute – Non-indigenous species				
Is the project aiming at a	Cultural landscape		Natural landscape	
Is there an identification of non indigenous species?	Yes		No	
How does the project deal with non indigenous species?				
3. Attribute – Functional groups				
Is there an identification of functional groups?	Yes		No	
How does the project work with functional groups?				
4. Attribute – Physical Environment				
Has special demands of important species been identified?	Yes		No	
How is the physical environment manipulated as part of the project?				

5. Attribute – Functioning ecosystem				
Has ecosystem functions been identified?	Yes		No	
What is written about ecosystem functions?				
Has prospective dysfunctions been identified?	Yes		No	
How does the project deal with prospective dysfunctions?				
6. Attribute – Larger ecological matrix				
Is the project area part of a larger ecological network?	Yes		No	
What is written about ecological connectivity?				
7. Attribute – External threats				
Has external threats and their sources been identified?	Yes		No	
What is done to eliminate external threats?				
8. Attribute – Resilience				
What is written about normal periodic stress events, and the ability of the restored ecosystem to recover from such?				
9. Attribute – Self-sustainability and ecosystem development				
Does the project aim at;	Maintaining a certain type of nature with defined spectrum of species?		Enabling natural processes to develop, with acceptance of changed species composition, appearance etc.?	
Does the project include defined recurring management?	Yes		No	
If so, what does the defined recurring management include?				
Does the project include possibility for adaptive management which is not yet defined?	Yes		No	
Is the recurring and/or adaptive management included in order to;	Maintaining a certain type of nature with defined spectrum of species?		Enabling natural processes to develop, with acceptance of changed species composition, appearance etc.?	