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Ecological solidarity as a conceptual tool for rethinking ecological and social interdependence in conservation policy for protected areas and their surrounding landscape

La solidarité écologique : outil conceptuel pour repenser les interdépendances écologiques et sociales pour une politique de conservation de la biodiversité au-delà des périmètres des espaces protégés

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ABSTRACT

Policy for biodiversity conservation must evolve to cope with the increasing human footprint on natural systems. A major issue here is the need for policy for protected areas, which integrates their surrounding landscape and local human populations in the construction of socially grounded measures. To illustrate current conceptual thinking in this direction we present and provide a conceptual basis for a recent initiative in national park policy in France that is based on "ecological solidarity". In the light of other policy ideas and tools that have recently emerged for the co-construction of conservation policy, we argue that this concept provides an imaginative step towards consolidating ecological and social interdependence in biodiversity policy that goes beyond statutory park boundaries.

RÉSUMÉ

La conservation de la biodiversité ne peut se limiter aux seuls périmètres des aires protégées et il est devenu urgent d'adopter une stratégie de conservation qui intègre à la fois les territoires qui entourent les espaces protégés et les populations humaines locales au cœur de cette démarche. Pour illustrer ce double mouvement nous présentons ici une initiative récente dans la politique des Parcs nationaux en France qui est basée sur la notion de solidarité écologique. Ici nous présentons une analyse des bases socio-écologiques de ce concept. À la lumière d'autres initiatives émergentes qui tentent d'associer les populations locales dans la construction des projets de conservation, nous illustrons comment le concept de solidarité écologique ouvre la possibilité d'inscrire les interdépendances écologiques et sociales au cœur d'un projet de territoire.

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1. Introduction

Since their origins in the heart of the American wilderness, National Parks have been established across the World to become a cornerstone in nature conservation policy. Their multiplication has been accompanied by increasing designation of other classes of protected areas with less restrictive protection in diverse ecological, historical and social contexts [1]. In many areas of the World pristine habitats are now few and far between, not only because of intensive land-use changes associated with growing human populations, but also as a result of extensive traditional low-intensity land use that has gradually transformed natural areas into semi-natural habitats. The latter are often associated with high species richness and conservation efforts in such cultural landscapes are thus often focused on continuing traditional agricultural and silvicultural practices or by mimicking such practices [2]. In addition, although protected areas are an indispensable tool for biodiversity conservation, most biodiversity occurs outside their borders and many species they may seek to protect also move beyond their borders; protected areas still only cover around 12% of the terrestrial Earth surface and only 5.8% has strict protection of biodiversity [3]. Hence, based on available scientific knowledge, the conservation of biodiversity in protected areas requires identification of the spatial ecological processes and sociocultural dynamics that link protected areas to their surrounding landscape.

Indeed, the ever-increasing human footprint [4] and the recognition that in most parts of the World, certainly in Europe, natural ecosystems are often closely associated with the history of human societies, the futures of ecosystems and human activities are closely intertwined [5]. This is particularly apparent in the mosaic form of many European and Mediterranean landscapes, which are shaped by the interaction between traditional human activities, the physical environment and its history, and natural vegetation dynamics [6]. This highlights the need for a research and policy perspective that acknowledges humans as components of ecosystems [7], and which integrates both social and ecological mechanisms affecting biodiversity [8]. As these authors suggest, the conservation of biodiversity dynamics and functioning in unprotected and protected areas requires that scientific understanding be confronted with the values and knowledge of the different actors involved. This combination of ecological knowledge and information with the analysis of social mechanisms is now necessary for biodiversity policy to gain in realism and efficiency. In this paper we illustrate conceptual advances in the co-construction of biodiversity policy and the recognition that protected areas form part of larger socioecological systems, and argue for an integrated foundation that manifests clearly the interdependence of social and ecological objectives.

More than ever, scientists and scientific institutions play a role by reporting research relevant to the need for future policy development and the responsibility to do so in a value neutral language that clearly identifies the implications of their research for policy [9,10]. In this paper we introduce a new policy initiative in national park policy in France based on the concept of "ecological solidarity". In defining this concept we illustrate how it provides a conceptual basis to address the issue of conservation in localities beyond the boundaries of strict protection areas. Our objective is to illustrate how this concept integrates, in a complementary manner to other emerging initiatives, issues relating to both the ecological connectivity and coherence of protected areas and their surrounding landscape and the need to convince local decision makers to adopt socially-grounded and ecologically responsible policy for biodiversity conservation which goes beyond statutory park boundaries. Since the policy-making process (especially in industrialized nations) has come to expect rather simple but precise scientific recommendations, which should not overemphasise their reliability nor hide their uncertainty [9], we focus on presenting in a clear and simple fashion the diverse issues involved. The common underlying issue is the recognition of the interdependence of social and ecological objectives.

2. Ecological solidarity in National Park policy

National Parks "*à la française*" were instituted by law in 1960 with a central zone to provide strict regulatory protection of the flora, fauna and landscape and a peripheral zone to "buffer" external developments. Forty years on, it was reported that because the peripheral zone provided poor control on development and that local populations and decision makers had a sentiment of being dispossessed of their livelihood and territory, a reform of park governance and organisation was necessary [11].

This reform came in 2006 with a new law (n° 2006-436 published the 14 April 2006). Here, National Parks were redefined with one or more "core" protection areas and an adjacent "optimal adhesion area" covering several to many local districts. The law states that the adhesion of local districts in the optimal adhesion area to the national park should be based on either their "geographic continuity or ecological solidarity" with the core. In this way, even if a local district is spatially separated from the core, it can participate in the National Park by ecological solidarity with the conservation objectives in the core. In addition, right from the start, local participation is instigated: it is the local authorities in the optimal adhesion area, which decide whether or not to adhere to the National Park. This opens the way to a direct and immediate implication of local populations, alleviating problems associated with absence of relevant interests at the start of a decision-making processes. Once the local authorities adhere, they form the "adhesion area" and sign a charter (a 15-year contract) with the National Park authority in which the goals of ecological solidarity are defined. A form of partnership between state regulation and local district adhesion thus underlies the definition of the National Park and its territorial project.

Already present in civil law, the term solidarity appears for the first time in an environmental law. The term ecological solidarity became part of the law during its deliberation among the different political authorities but was not defined. Ecological solidarity is also a novel concept. A web of science search procedure (16th October

2009) revealed that although 21 papers contained an abstract with the two words, in only one paper, concerning social reactions to an oil spill [12], was the term "ecological solidarity" used. Nowhere in the literature on biodiversity conservation have we seen this term.

From ecology based on interactions to solidarity based on links between individuals united around a common goal and conscious of their common interests and their moral obligation and responsibility to help others, we define ecological solidarity as the reciprocal interdependence of living organisms amongst each other and with spatial and temporal variation in their physical environment. It has two main elements, one factual associated with the dynamics of ecological processes and biodiversity in space and time, the other; normative, based on recognition that human beings are an integral part of ecosystem function [13].

3. Integrating regional ecological process into protected area policy

3.1. Towards ecological connectivity in park policy

Protected area designation has traditionally relied on the designation of politically defined boundaries. Ecology and conservation biology are not however based on the maintenance of equilibrium states in a precise area: natural systems are dynamic, require variability for long-term functioning and evolution, and operate across multiple scales of space, time and biological organization. Indeed, ever since Janzen [14] argued how "no park is an island"; the driving roles of regional processes in community composition [15] and spatial and temporal population dynamics [16] have been increasingly recognized. Biodiversity conservation requires that protected areas are seen as being part of larger ecological systems which encompass regional ecological processes [17–19]. Parks occur within larger watersheds, animals move and migrate beyond park boundaries, and new populations can develop outside these boundaries, hence the need to maintain ecological connectivity. Climate change will likely exacerbate these phenomena [20]. Likewise, development and other human activities in the surrounding landscape can greatly affect conservation objectives inside a protected area [21].

Initial procedures of zoning around statutory protection areas that developed in the 1970s such as M.A.B reserves with their core, buffer and transition zones or the central and peripheral zones of National Parks in France were initial responses to these issues. A major advance came with the convention on biological diversity in Rio in 1992 whose article 8 recommended biodiversity policy for areas adjacent to protected areas in order to facilitate and reinforce their conservation objectives. Movements towards functional zoning of M.A.B. reserves [22] and European policy for large scale ecological connectivity [23] illustrate recent advances in international policy for preserving spatial ecological processes that have developed since the convention on biological diversity.

3.2. Founding ecological solidarity

To bring ecological connectivity firmly to ground in conservation policy it is necessary to identify the ecological processes which create interactions between protected areas and their surrounding landscape [24–26]. We argue here that this objective is different from designating corridors through an otherwise inhospitable matrix to link patches of favourable habitat to one another. Although such corridor designation on maps often dictates spatial conservation programs, it provides a rather simplistic appreciation of the complexity of regional ecological processes [27]. Biodiversity is highly variable in space and time, organisms vary dramatically in dispersal capacities and processes acting across protected area boundaries may be more critical for species conservation than movements along corridors [28]. Indeed, since parks are not islands, the most significant issues for biodiversity conservation in protected areas may lie around and on their boundaries and not in hypothetical corridors linking one protected area to another. Hence, other issues related to the conservation of:

- landscape elements that are associated with functional aspects of local ecosystems;
- species that occur in small patch ecosystems but in many small areas across a region;
- species whose dispersal requirements and day to day movements necessitate the conservation of large tracts of land all require integration for a complete vision of the biodiversity issues related to protection across park boundaries to be founded.

Our purpose here is not to provide an exhaustive review of the abundant literature on these topics but to illustrate the diversity of spatial ecological processes, which provide a functional ecological foundation to ecological solidarity in the territory of a National Park. To do so we propose six schematic representations of ecological coherence and connectivity (Fig. 1). Each of these is based on specific ecological principles, which can be reframed in terms of a specific conservation objective (Table 1) [29]. The first three concern the spatial organization of biodiversity and the different components of ecological systems. They include:

- major landscape entities and watersheds;
- the minimum dynamic area of continuous habitat necessary to assure home range or population viability;
- the spatial complementarities of different sites for local scale species and small patch ecosystems.

To this we add a classification that builds on previous work [24] to identify the range of ecological processes and biological levels of movement and dispersal, with:

- individual movements on a regular basis either daily for foraging and breeding or seasonal migration;
- regional processes of population extinction and colonization;
- species' distribution changes in relation to long term environmental (climate) changes.

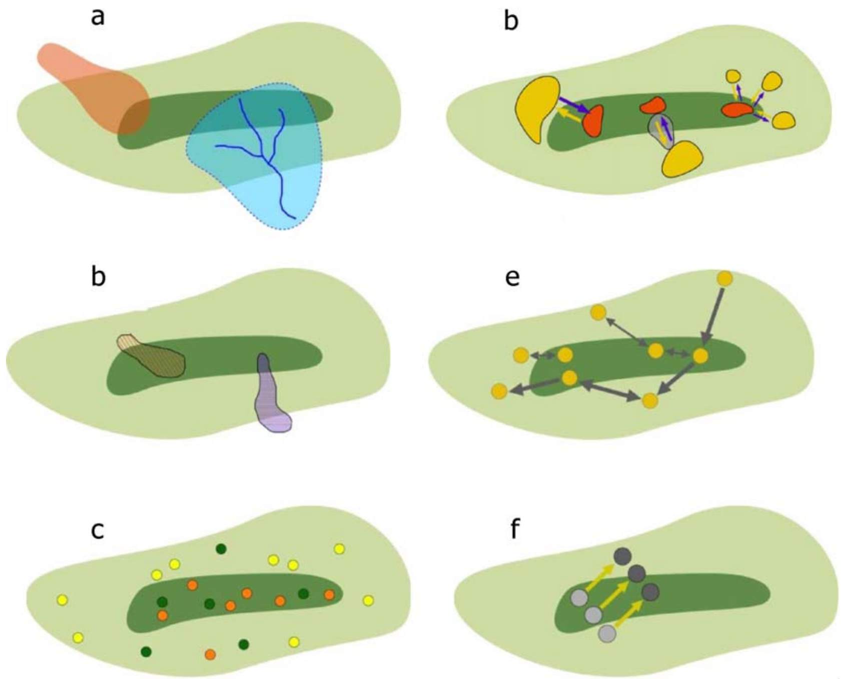

Fig. 1. Schematic representations of how ecological coherence and connectivity can be portrayed in relation to park zoning – our example refers to a core (dark green) and an optimal adhesion area (pale green) of a National Park in France: (a) landscape entities (brown) and watersheds (blue), (b) continuity of minimum dynamic area (hatched surfaces), (c) complementarity – species turnover (in the example here each color could represent the occurrence of a listed species), (d) individual movements for seasonal migration or daily activities (e.g. feeding and nesting sites) which may involve corridors (grey), (e) population colonization and extinction dynamics (arrows are colonization events), and (f) species' distribution change in response to long-term environmental changes (light grey to dark grey).

Table 1
Ecological principles and possible conservation objectives associated with the six representations of ecological coherence and connectivity (see Fig. 1).

Scale and process	Ecological principle	Conservation objectives
(a) Landscape units and watersheds	Landscape units have ecological functions which go beyond the boundaries of protected areas	Maintain the functioning and integrity of landscape units
(b) Minimum dynamic area	Decreasing population size or surface area increase risk of extinction	Conserve continuous habitat for population viability
(c) Complementarity	Spatial variation in species composition for species with limited dispersal	Spatial priorities based on turnover and variation in community composition
(d) Movement of individuals	Species require disjunct or complementary habitats to accomplish daily activities or annual migration	Protect critical habitats for species to move and accomplish their life cycle
(e) Population dynamics	Demographic stability depends on the regional balance of population colonization and extinction	Maintain habitats and connectivity for species to establish new populations
(f) Species' distribution changes	Migration across environmental gradients allows response to long-term environmental changes	Conservation of a mosaic of habitats across ecological transition zones

This schematic classification was tested against a sample of 100 papers (known to two of the authors: JDT and MC), which relate to general conservation interest, different taxonomic groups and propositions relating to the establishment of functional conservation areas. A short-list of studies, which illustrate the six representations, is shown in Table 2; a complete table with the full list of references is available from the first author. Interviews with Park staff in all seven (including the future Calanques) National Parks in continental France also produced a large number of examples for each of the representations [30].

The six different representations of ecological connectivity and coherence can be presented to local stakeholders in a way that ecological processes and their associated conservation targets can be identified and appropriated. In this way they represent a decision-making tool that can be used as arguments for the adhesion of a local authority to the National Park charter based on ecological solidarity,

Table 2
Examples of the six representations (a–f) of ecological coherence and connectivity depicted in Fig. 1.

Representation	(a)	(b)	(c)	(d)	(e)	(f)	References
Landscape entities and watersheds	x						[17,19,33]
Minimum dynamic area		x					[34,35,36]
Complementarity			x				[37,38,39]
Movement of individuals				x			[40,41,42]
Population dynamics					x		[43,44,45]
Species' distribution changes						x	[20,46,47]
Movement of birds and small mammals				x	x		[48]
Movement of mammals		x		x	x		[49]

even if a site or local district is not contiguous with the core. They provide in fact a basis for the establishment of criteria, which can be used to argument the adhesion of a local district to the charter. Here, the contribution of different sites is identified more in terms of the ecological process they support than simply by contributing to geographical continuity (which is only one form of ecological connectivity). Ecological solidarity thus replaces the simplistic distinction between high-priority hotspots of biodiversity and large areas of low-priority ordinary biodiversity. In the latter, human activities give rise to ecological systems that provide the support for the former. That said, not all areas in the surrounding landscape are likely to be of equal importance and it will be necessary to establish priorities for the role of different sites in terms of their ecological solidarity. This can be done with reference to well-developed methods in the systematic conservation planning literature [31,32].

By virtue of its presence in the 2006 law, ecological solidarity provides national parks with a legal foundation to facilitate cooperation between sites within the strictly protected core and surrounding parts of the adhesion area, which have functional links to the core. At the same time, ecological solidarity provides a conceptual framework for the multiple functions of protected areas and a step towards revitalising the ecosystem services that contribute to the environmental, economic and social well being of local communities. This leads to the second integral component of ecological solidarity – it involves socially grounded and responsible action.

4. Recognizing a role for human communities and engaging their responsible action: towards ecological solidarity

Since natural ecosystems are often closely associated with the history of human societies, the futures of ecosystems and human activities are closely intertwined. Contemporary conservation policy must thus encompass a broad range of management objectives and approaches in diverse social and ecological contexts. Here, the need for socially grounded policy for biodiversity conservation has stimulated the emergence and application of a range of conceptual approaches. Based on its reliance on a collective and personal acknowledgement of the multiplicity of social and ecological interdependences that are essential to integrate within conservation policy and practice, ecological solidarity can be seen as a complementary development of these different initiatives.

First, community based conservation (CBC) includes a range of activities that vary across social and ecological contexts, its unifying theme being conservation by, for and with the local community [50,51]. CBC is generally implemented on public land and aims to empower local people in the management process. However, the loss of natural habitat outside protected areas for economic reasons associated with land-use decisions by private landholders has lead to interest in its application on private land [52,53].

Second, defined as the responsibility for environmental quality shared by people whose actions affect the environment, environmental stewardship has also become a promising conceptual and pragmatic tool to implicate local people in conservation policy. A feature of this concept is that it brings to the fore the notion of responsibility which affects the choices of individuals, companies, and government organizations and is the basis for active engagement [54]. This duality of taking responsibility for choices and active engagement has been examined in the context of biodiversity protection, revealing a strong motivation and value-driven desire to steward the land for conservation and the desire of stewards to see their conservation role recognised by public authorities and conservation groups [55,56].

Whilst further research regarding motivational factors for sustained stewardship, as well as testing conceptual models of how these factors combine remains a priority, there is often a need for incentives that overcome the constraints faced by local communities whose wish to enhance conservation is contradicted by financial reckoning. The continuity of traditional human activities (marginal agriculture, extensive grazing, etc.) or adapted management practices where such activities cease often require financial measures that support local rural subsistence economies and/or render restrictions associated with conservation socially acceptable [57–59]. There has thus been a push towards the provision of ecological and environmental services and the development of markets for such services [60]. In many situations the economic value of services is not transferred to those whose activities (or inaction) allow their provision. Conservation payments have thus been promoted and used to provide financial incentives to reward those individuals and populations responsible for the provision of such ecological services [53,61].

Financial incentives are not the only motivation for stewardship. An effective and low cost treatment for conservation on private land can be adopted by recognizing stewards as valued managers of the landscape, while also paying personnel for knowledge and information on agriculture, ecology, and conservation to assist the stewards where necessary. Indeed, in some cases, landowners do not simply desire financial rewards for their conservation efforts, but more a recognition of their stewardship role and greater personal contact with conservation authorities [62]. Even in contexts with strong social contrasts, incorporating the requirements of a surrounding community can create a large group of people capable of contributing to conservation efforts and motivated to do so [63].

Ecological solidarity is based on the notion that individuals become united around a common goal and are conscious of their common interests and shared responsibility. The use of ecological solidarity in biodiversity policy could thus represent a further step forward towards identifying the multiplicity of social and ecological interdependences that influence biodiversity dynamics and the construction of a conceptual framework for a collective exploration of the plurality of values associated with the natural World. Indeed, as policy develops to face the biodiversity crisis of the 21st century, engaging the full range of values associated with our dependence on Nature for the provisioning of direct and indirect services has become a key issue. Humans benefit from and depend upon natural systems via the ecological services these systems provide, a perspective that is now receiving much attention in order to identify priorities in conservation practice [5,53,64]. Ecological solidarity can thus ensure the protection of the ecological and human dimensions of landscape functioning, where a multitude of (mostly undervalued) services are provided. It also goes beyond a straightforward benefits driven approach towards a form of "go-between", or pragmatic compromise, in the sway between the Leopoldian land ethics [65] and weak anthropocentric ethics [66] that characterise efforts to value nature and which underlie different approaches to ecosystem management [67,68].

In the context of ecological solidarity, human beings are part of a natural contract with the rest of the living world [69]. Human societies can contribute to the preservation of biodiversity where no monetary value can be identified, or even when a conflict with economic objectives and human interest is identified. With ecological solidarity, human societies can be seen to be responsible for their actions and the consequences of their actions [70]. Based on responsible action, ecological solidarity provides a grounding to make decisions concerning nature conservation based on the full range of values of biodiversity, and not a simple monetary value [71].

In recognising their ecological solidarity, human societies are not just part of natural systems whose dynamics they greatly influence, but can also evaluate the impact of their activities and examine their contribution to ecosystem integrity by adapted and responsible forms of management or non-intervention. Improving a national park's knowledge of its role in the conservation of regional ecological processes, its interaction with different stakeholders and integrating this information into ongoing communication and partnership can put a National Park authority in a better position to attain its conservation aims [68]. A national park, which addresses only the national interest in a state regulated protection zone, will incur major problems (see above) unless local populations integrate conservation objectives. This social acceptability has long been recognised as a critical element in conservation policy [57]. What ecological solidarity provides is a conceptual basis which goes beyond acceptability to provide a step towards more integrated co-construction of conservation policy which reconciles conservation objectives with human activities and social issues by engaging the responsibility of local authorities. The concept thus provides a means to beyond social acceptability (which reflects a top down approach to setting goals) towards raising public awareness and appropriation of conservation objectives (a mix of top down and bottom up goal setting). Ecological solidarity thus affirms the need for a collective and personal awareness based on our duties and responsibilities [70]. As such it introduces a new model of society in which material needs are reduced to the profit of immaterial economy. Beyond its heuristic interests, dealing with ecological solidarity means reconnecting ecological processes, management practices, local knowledge, cultural issues and public policies [13]; it thus implies building bridges and mediation between different world viewpoints, all of which can contribute to ecological solidarity. A key issue underlying ecological solidarity is thus the reciprocal interdependence of ecological interactions – including human activities – and the social and institutional dimensions associated with a willingness to preserve and respect nature.

5. Conclusion

Ecological solidarity provides a novel conceptual framework to integrate landscapes surrounding statutory protection areas into functional conservation areas and to recognize the interdependence of ecological and social dynamics. By leaving the choice to adhere or not in the hands of the local community, we illustrate how the State engages local authorities in the responsibility for conservation objectives of national interest. This voluntary commitment is based on a shared understanding of ecological and social processes. Recognition of ecological solidarity thus does not involve uniform responsibilities, but shared responsibilities differentiated by the power and resources of the State, local authorities and local communities. It will now be necessary to identify the management and regulatory tools, which allow local communities to fully ensure their ecological solidarity with conservation objectives.

Ecological solidarity represents a means to enhance the value of protected areas to society, and a communication tool and framework for structuring policy and management around the relationships of humans with natural systems. This has become a key issue; Johns [72] has recently argued how conservation professionals could engage in creating nature-compatible societies by offering people the incentive of reconnecting with other people and with the natural world. As he stresses (p. 643) "conservation is as much a political endeavor as a scientific one", in which science and conservation values "become policy through organizing and action." In this respect, ecological solidarity is more than a simple doctrine; its scientific basis provides an impelling invitation to act.

Disclosure of Interest

The authors declare that they have no conflicts of interest concerning this article.

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