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Research article

The inclusion of biodiversity in environmental impact assessment: Policy-related progress limited by gaps and semantic confusion

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ABSTRACT

Natural habitat loss and fragmentation, as a result of development projects, are major causes of biodiversity erosion. Environmental impact assessment (EIA) is the most commonly used site-specific planning tool that takes into account the effects of development projects on biodiversity by integrating potential impacts into the mitigation hierarchy of avoidance, reduction, and offset measures. However, the extent to which EIA fully address the identification of impacts and conservation stakes associated with biodiversity loss has been criticized in recent work. In this paper we examine the extent to which biodiversity criteria have been integrated into 42 EIA from 2006 to 2016 for small development projects in the Montpellier Metropolitan territory in southern France. This study system allowed us to question how EIA integrates biodiversity impacts on a scale relevant to land-use planning. We examine how biodiversity inclusion has changed over time in relation to new policy for EIA and how the mitigation hierarchy is implemented in practice and in comparison with national guidelines. We demonstrate that the inclusion of biodiversity features into EIA has increased significantly in relation to policy change. Several weaknesses nevertheless persist, including the continued absence of substitution solution assessment, a correct analysis of cumulative impacts, the evaluation of impacts on common species, the inclusion of an ecological network scale, and the lack of monitoring and evaluation measures. We also show that measures for mitigation hierarchy are primarily associated with the reduction of impacts rather than their avoidance, and avoidance and offset measures are often misleadingly proposed in EIA. There is in fact marked semantic confusion between avoidance, reduction and offset measures that may impair stakeholders' understanding. All in all, reconsideration of stakeholders routine practices associated with a more strategic approach towards impact anticipation and avoidance at a land-use planning scale is now necessary for the mitigation hierarchy to become a clear and practical hierarchy for "no net loss" objectives based on conservation priorities.

1. Introduction

Natural habitat destruction by development projects (e.g. linear infrastructures, urbanisation, commercial centres, quarries, etc.) has continued to cause the loss of genetic and species diversity, the fragmentation of natural habitats and the degradation of ecosystem function (Fahrig, 2003; McKinney, 2008; MEA, 2005). Many countries have thus developed instruments that attempt to ensure a « no net loss » (henceforth NNL) of biodiversity with measures to attenuate and mitigate the loss of biodiversity in the face of land development (Bull et al., 2016; Hassan et al., 2015; Maron et al., 2016). The development of the NNL paradigm, and its application in land-use planning, has however encountered difficulties due to inconsistencies in the way its underlying concepts are framed (Apostolopoulou and Adams, 2015; Bull et al., 2016; Gordon et al., 2015) and how impacts are compared with a baseline to assure NNL (Bull et al., 2014; Maron et al., 2016, 2015). Indeed, in practice, NNL appears to be impossible, there is nearly always some form of

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decline in biodiversity - a sort of generalised net loss impossible to avoid, but never explicitly presented (Aronson and Moreno-Mateos, 2015; Maron et al., 2012; Moreno-Mateos et al., 2015). In relation to these difficulties, many countries have developed two main instruments to apply NNL policy in their land-use planning procedures.

The first of these instruments concerns Environmental Impact Assessment (henceforth EIA) that developed during the 1970's to become a key instrument in site-specific planning for biodiversity (Mandelik et al., 2005) and environmental management (Morgan, 2012). EIA contributes to the assessment and anticipation of development projects and their impacts on environment and to the adoption of pro-active policy to mitigate the impacts of such projects. However, many authors have pointed out recurrent weakness in the identification of impacts and the conservation stakes associated with biodiversity and landscape ecological context (Byron et al., 2000; Drayson et al., 2015; Gontier et al., 2006; Thompson et al., 1997; Treweek and Thompson, 1997). EIA has also been criticised because choices among alternative options for development projects are more often based on socio-economic considerations than on ecological arguments (Bonthoux et al., 2015), the delimitation of the area used to assess impacts is often made on a non-ecological basis (Geneletti, 2006), measurable indicators or quantitative predictions are rarely used (Mandelik et al., 2005; Samarakoon and Rowan, 2008), and the relevance of an impact is unclear (Atkinson et al., 2000; Khera and Kumar, 2010). In addition, the study scope is often poorly defined or too narrow; many studies only assess biodiversity in terms of species' populations with little attention paid to understanding of effects on ecological processes, ecosystem function or genetic variation (Atkinson et al., 2000; Gontier et al., 2006; Khera and Kumar, 2010). Finally, an absence of precise definitions and correct understanding of ecological processes makes the identification of what represents a “significant” impact difficult (Briggs and Hudson, 2013; Geneletti, 2006).

EIA provides basic information for the identification of NNL objectives within the context of a second major policy instrument, the so-called mitigation hierarchy. This hierarchy provides a policy framework to identify the process by which environmental impacts from development can be “avoided”, unavoidable impacts “reduced”, and residual impacts “offset” (Maron et al., 2016). This mitigation hierarchy has also become a subject of concern in terms of its environmental efficiency, social implications and ethical basis (Gobert, 2015; Gordon et al., 2015; Levrel et al., 2015; Lucas, 2009; Maron et al., 2016; Moreno-Mateos et al., 2015). Despite high scientific tractability, it begets only moderate implementation tractability, and clear-cut rules on how to classify certain impacts within the mitigation hierarchy barely exist (Martin, 2015; Bull et al., 2016; Maron et al., 2016). In addition, the common reliance on offsetting to achieve NNL has received serious criticism due to the fact that offsets are rarely adequate, complete offsetting may be illusory due to the complexity of ecological processes (Gardner et al., 2013; Moreno-Mateos et al., 2015) and weak institutional organisation of the mitigation hierarchy impairs attempts to achieve NNL (Jacob et al., 2015; Lucas, 2009). Problems associated with identifying ecological equivalence and the absence of a systematic regional approach further undermine the efficiency of the mitigation hierarchy (Habib et al., 2013; Kujala et al., 2015).

The objective of this study is to examine how biodiversity is integrated into EIA and defined and treated in the mitigation hierarchy. We examine this issue in relation to recent changes in French policy aimed at improving the EIA procedure and the implementation of the mitigation hierarchy. In this context, our study addresses four main questions. First, how are impacts on biodiversity taken into account in a large sample of EIAs, all elaborated within a single territory? Second, is there a significant effect of new policy that proposes to make a more detailed analysis of biodiversity features and their inclusion in EIA? Third, how are cumulative impacts taken into account in the study area? Finally, how well do measures proposed in the EIA for the different elements in the mitigation hierarchy fit French national guidelines and definitions of the mitigation hierarchy?

2. Methods

2.1. Case study

To undertake this study we analysed 42 EIAs associated with projects in a single territory, that of the Montpellier Metropolitan Territory (31 municipalities) and nine adjoining municipalities in southern France (Fig. 1). This form of territorial grouping allows the different local municipalities to mutualise their objectives and obligations (waste treatment, sanitation, economic development …) and to develop coherent urban land-use planning strategies. The territory contains a patchwork of semi-natural Mediterranean-type habitats rich in biodiversity, various agricultural areas and is one of the fastest developing metropolitan territories in France.

The 42 EIAs we studied represent a large number of small-scale projects each of which has impacts primarily on common species and habitats and, to a lesser extent on protected habitats and species. The EIAs for the 42 projects were elaborated between 2006 and 2016. Two major infrastructure projects that had EIA documents elaborated during this time period were not used in the initial analyses because their impact concerned several municipalities and different types of ecosystem. Hence, the amount of money and time invested in the EIA production was way above that of all the other 42 projects. The two infrastructure projects are thus not comparable with the 42 small-scale projects. We thus only used the information in these two EIAs in the analysis of cumulative impacts on biodiversity (see below). Thirty-nine of the development projects are small-scale development zones or housing projects, there is one photovoltaic solar power plant project and two short sections of local road construction. The EIA of each project was obtained from the archives of the State environmental agency in the study region (*DREAL*), the authority in charge of examining EIAs. They represent all the available EIAs that have caused irreversible impacts on terrestrial natural habitats in the study region.

2.2. A data base to examine biodiversity inclusion in EIA

We conducted a systematic examination of the extent to which biodiversity is included in each of the 42 EIAs. To do so we analysed six criteria, or questions, that reflect the organisation of the different chapters of an EIA (Table 1). The first criterion concerns a “baseline” description of the impacted zone in terms of species and habitats present, ecological networks, ecological equilibria and ecological interactions. The second involves how “data” are collected and their pertinence. The third concerns a description of the “impacts” which may be positive or negative, direct or indirect, temporary or permanent and can be cumulative with those in other development projects. The fourth requires an assessment of alternative (“substitution”) solutions and a test of the compatibility with existing planning documents. The fifth involves descriptions of the necessary “measures” that are proposed for implementation within the mitigation hierarchy. The sixth criterion relates to propositions for “monitoring and evaluation”. To provide quantitative and qualitative response data in relation to these questions, 32 indicators concerning how biodiversity is included in an EIA were developed (Table 1). These indicators were developed in order to encompass what the French policy reform and the national doctrine require in terms of biodiversity inclusion in EIAs.