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Perspective essay

# Ecological and economic conditions and associated institutional challenges for conservation banking in dynamic landscapes

Astrid J.A. van Teeffelen[a,b,*], Paul Opdam[b,c], Frank Wätzold[d], Florian Hartig[e,f], Karin Johst[e], Martin Drechsler[e], Claire C. Vos[c], Silvia Wissel[g,h], Fabien Quétier[i]

[a] VU University Amsterdam, Institute for Environmental Studies, Amsterdam, The Netherlands
[b] Wageningen University, Land Use Planning Group, Wageningen, The Netherlands
[c] Alterra, Wageningen UR, Wageningen, The Netherlands
[d] Brandenburg University of Technology Cottbus-Senftenberg, Chair of Environmental Economics, Cottbus, Germany
[e] Helmholtz Centre for Environmental Research UFZ, Department of Ecological Modelling, Leipzig, Germany
[f] University of Freiburg, Department of Biometry and Environmental System Analysis, Freiburg, Germany
[g] Helmholtz Centre for Environmental Research UFZ, Department of Economics, Leipzig, Germany
[h] University of Amsterdam, Institute for Biodiversity and Ecosystem Dynamics, Amsterdam, The Netherlands
[i] Biotope, Mèze, France

## HIGHLIGHTS

- We combine ecological, economic and institutional perspectives to evaluate conservation banking.
- Substantial trade-offs between ecological and economic criteria can exist.
- Adequate regulatory capacity for designing and enforcing trading rules is a prerequisite.
- The application of conservation banking is best limited to common and fast-regenerating ecosystem types.
- We outline when conservation banking could be a complementary instrument to improve ecological network effectiveness.

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## ABSTRACT

Protected areas are a cornerstone of current biodiversity policy. The continued loss of biodiversity, however, as well as the limited scope to extend protected area networks necessitates a conservation perspective that encompasses both protected areas and the wider landscape. This calls for policy instruments that can govern land use dynamics, simultaneously meeting demands for conservation (i.e. no net loss of biodiversity) and economic development. Conservation banking could be such an instrument, but only when certain criteria are met. Building on the theory of ecological networks, we combine ecological, economic and institutional perspectives on conservation banking to identify when and where conservation banking could be feasible. Economic prerequisites include sufficient market activity to match demand and supply. Adequate regulatory capacity is needed to design and enforce trading rules. From an ecological perspective, habitat turnover is least detrimental in large and well-connected networks. For many ecosystem types, those prerequisites will be rarely met in practice: sufficient market activity implies sufficient habitat turnover, but most ecological networks are not robust enough to buffer frequent habitat turnover. Therefore, banking is best limited to common and fast-regenerating ecosystem types (e.g. certain coastal systems, wetlands, nutrient-rich grasslands). Furthermore, conservation banking could be applied to a subset of the network only, i.e. the wider landscape, as a complementary instrument to protected area policy. With appropriate trading rules and institutional arrangements, the loss and gain of habitat could be governed to improve the spatial cohesion and size of ecological networks and the capacity of landscapes to support biodiversity.



* Corresponding author at: Institute for Environmental Studies, VU University Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands. Tel.: +31 20 59 82526; fax: +31 20 59 89553.
*E-mail addresses:* astrid.van.teeffelen@vu.nl (A.J.A. van Teeffelen), paul.opdam@wur.nl (P. Opdam), waetzold@Tu-Cottbus.De (F. Wätzold), florian.hartig@biom.uni-freiburg.de (F. Hartig), karin.Johst@Ufz.De (K. Johst), martin.Drechsler@Ufz.De (M. Drechsler), claire.Vos@Wur.Nl (C.C. Vos), S.Wissel@uva.nl (S. Wissel), fquetier@biotope.fr (F. Quétier).

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## 1. Introduction

Protected areas are a cornerstone of conservation efforts worldwide. However, it is widely acknowledged that protected area need to be complemented by additional conservation measures in the wider landscape if the aim is to halt biodiversity loss (e.g. Bengtsson et al., 2003; Daily, 2001; Fischer, Lindenmayer, & Manning, 2006; Grashof-Bokdam et al., 2009; Hanski, 2011). A complementary approach is necessary as: (1) Much of biodiversity occurs outside protected areas (e.g. Cox & Underwood, 2011; Wright, Lake, & Dolman, 2012); (2) Pressures such as pollution and harvesting are not necessarily halted by protection (e.g. Barber, Cochrane, Souza, & Veríssimo, 2012; Liu et al., 2001); (3) Protected areas are often too small and spatially isolated to ensure persistence (Cabeza & Moilanen, 2001); (4) Climate change exacerbates population and community dynamics, also inside protected areas (e.g. Araújo, Alagador, Cabeza, Nogués-Bravo, & Thuiller, 2011; Devictor et al., 2012) and (5) Protected areas are also subject to downgrading, downsizing, and degazettement (Mascia & Pailler, 2011), mostly for access to land and sea and the use of natural resources. As a result, protected area policies alone are not expected to halt biodiversity loss.

The role of the wider landscape in conservation is also acknowledged at international policy levels. For example, the Convention on Biological Diversity's global biodiversity targets for 2020 (http://www.cbd.int/sp/targets/) include target 11, which explicitly states that protected areas networks need to be "(. . .) integrated into the wider landscapes and seascapes." At the level of the European Union, the reformed Common Agricultural Policy requires farms with at least 15 ha of arable land to maintain "ecological focus areas" of at least 5% of the arable area per farm (Council Regulation (EC) 1307/2013 [2013] OJ L 347/608, Pe'er et al., 2014). Furthermore, in line with target 2 of the EU Biodiversity Strategy, the European Commission aims to adopt, by 2015, an initiative on 'no net loss of ecosystems and their services', that goes beyond existing provisions that focus on protected areas (Natura 2000) and species (Tucker et al., 2014).

To establish an approach that is able to integrate conservation in multifunctional landscapes as a complement to protected areas can be challenging. The challenge lies in identifying policy instruments that are able to govern land use changes resulting from economic development in a manner that results in no net loss of biodiversity (compared to the current state of biodiversity in the landscape), while engaging land owners in conservation (Opdam et al., 2013). Conservation banking is one candidate for such an instrument. Conservation banking creates "a market where the credits from actions with beneficial biodiversity outcomes can be purchased to offset the debit from environmental damage. Credits can be produced in advance of, and without ex-ante links to, the debits they compensate for, and stored over time; and they may include both habitats and species" (EFTEC & IEEP, 2010, p. 4; see also Carroll, Fox, & Bayon, 2008). Credits can be generated by landowners through restoration of habitat, and these credits can be bought by developers to compensate for impacts on biodiversity, or by individuals or organisations that wish to increase the conservation value of the land, i.e. credits are bought but no negative impacts are made, thus aiming for net biodiversity gains.

The emergence of a market to trade credits differentiates conservation banking from project-specific offsets (bespoke or one-off offsets) where compensation activities are carried out on a case-by-case basis (OECD, 2013; see Bull, Suttle, Gordon, Singh & Milner-Gulland, 2013 and McKenney & Kiesecker, 2010 for reviews on biodiversity offsets). Note that in the context of 'no net loss', credits can only be generated by restoration activities, and not by protection of existing habitat (i.e. 'compensated net loss'; Bull et al., 2013; see also Bekessy et al., 2010). Trading rules and metrics to assess the value of "losses" and "gains" are intended to ensure that the ecological value of the restored habitat is at least equivalent to the impacted habitat in terms of type ("like-for-like or better", BBOP, 2012) as well as the spatial and temporal context in the landscape (Salzman & Ruhl, 2000). Quantification of ecological equivalence is not straightforward, in particular when a offset site's future value (i.e. after a certain regeneration time) needs to be estimated prior to restoration (see e.g. Moilanen, Van Teeffelen, Ben-Haim, & Ferrier, 2009; Quétier & Lavorel, 2011). In principle though, it has been suggested that conservation banking can be implemented in a way that allows adapting the spatial and temporal characteristics of ecological networks while maintaining ecological value (Dalang & Hersperger, 2012; Drechsler & Hartig, 2011; Drechsler & Wätzold, 2009; Hartig & Drechsler, 2009; Parkhurst & Shogren, 2007). As such, conservation banking has been considered a promising ingredient in the conservation policy mix (OECD, 2013; Ring, Drechsler, Van Teeffelen, Irawan, & Venter, 2011; TEEB, 2010).

Whether a conservation banking scheme can be considered successful from an ecological perspective (i.e. it ensures no net loss of biodiversity at the landscape scale) as well as from an economic perspective (i.e. it facilitates economic development), depends on a number of conditions. Here, we explore the ecological and economic prerequisites for successful conservation banking to identify when these may, or may not, overlap. Given the notion that conservation requires a wider landscape perspective, we take a multifunctional landscape with an intrinsic level of land use change as the baseline. We first examine the conditions under which spatially changing ecological networks can maintain biodiversity, and ask to what extent conservation banking could ensure such conditions. Next, we identify economic prerequisites for successful conservation banking, and reflect on the institutional challenges involved in successfully setting up and running conservation banks. Taking ecological, economic and institutional perspectives together, we specify limitations of conservation banking. We also highlight conditions under which conservation banking could be a suitable complement to the conservation policy mix.

## 2. Ecological prerequisites for successful conservation banking

In this section we examine conservation banking under the assumption that species live in wider regions where some habitat patches (or 'sites') may be situated within protected areas, while others are situated outside protected areas and may be subject to land use dynamics. All sites are viewed as constituting an ecological network that determines the persistence of species (Opdam, Steingröver, & Van Rooij, 2006). We point out what the challenges and opportunities for achieving no net loss of biodiversity in dynamic landscapes are, and we translate these into design criteria for conservation banking.

In multifunctional landscapes where development pressure is high, habitat is often lost due to development, for example infrastructural developments or urban expansion. An effective conservation policy would ensure that such impacts are offset by the restoration of habitat elsewhere in a manner that no net loss of biodiversity is ensured. To achieve no net loss of biodiversity, the spatio-temporal dynamics of the landscape have to be kept within limits that allow species to track suitable habitat over time (Johst, Hartig, & Drechsler, 2012; Van Teeffelen, Vos, & Opdam, 2012). In dynamic landscapes, this is more challenging than in static landscapes, because the loss of habitat may cause a local population to go extinct, which may affect the persistence of the species in the wider region. Furthermore, species need to locate and colonise newly created suitable habitat patches. Hence, dynamic networks