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Perspective

Fifteen operationally important decisions in the planning of biodiversity offsets

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ABSTRACT

Many development projects, whether they are about construction of factories, mines, roads, railways, new suburbs, shopping malls, or even individual houses, have negative environmental consequences. Biodiversity offsetting is about compensating that damage, typically via habitat restoration, land management, or by establishment of new protected areas. Offsets are the fourth step of the so-called mitigation hierarchy, in which ecological damage is first avoided, minimized second, and third restored locally. Whatever residual damage remains is then offset. Offsetting has been increasingly adopted all around the world, but simultaneously serious concerns are expressed about the validity of the approach. Failure of offsetting can follow from either inappropriate definition of the size and kind of offset, or, from failure in implementation. Here we address planning of offsets, and identify fundamental operational design decisions that define the intended outcome of an offsetting project, and organize these decisions around objectives, offset actions, and the three fundamental ecological axes of ecological reality: space, time and biodiversity. We also describe how the offset ratio of a project (size of offset areas compared to impact area) can be constructed based on several partial multipliers that arise from factors such as degree of compensation required relative to no net loss, partial and delayed nature of restoration or avoided loss gains, time discounting, additionality, leakage, uncertainty, and factors associated with biodiversity measurement and offset implementation. Several of these factors are partially subjective and thus negotiable. The overall purpose of this effort is to allow systematic, well informed and transparent discussion about these critical decisions in any offset project.

1. Introduction

Ecological damage caused by infrastructure projects or other activity can be sometimes compensated by restoring habitats, by establishing new protected areas, or by other methods of conservation management. This process is called biodiversity offsetting (ecological compensation) (e.g., ten Kate et al., 2004; McKenney and Kiesecker, 2010; BBOP, 2012; IUCN, 2016), or offsetting in short. Offsets are the fourth step of the so-called mitigation hierarchy (ten Kate et al., 2004; IUCN, 2016), in which negative ecological impacts are (i) avoided altogether, (ii) minimized by appropriate project design, (iii) reduced by habitat restoration in the impact area, and only then (iv) compensated by offsetting. Conceptually, offsets resemble the "polluter pays" principle.

To set the stage, we recap major terminology of offsets. In-kind means that biodiversity losses are compensated with gains for exactly the same biodiversity (species, habitats, biotopes etc.). In out-of-kind (flexible) offsets gains can be accepted for biodiversity features different from those suffering damage (Bull et al., 2015). No net loss (NNL) is commonly used to describe the goal of offsetting, full compensation for all ecological damage (e.g. Gibbons and Lindenmayer, 2007; Maron et al., 2018). Net Positive Impact (NPI; Gibbons and Lindenmayer, 2007) means that offsets produce an outcome that is ecologically better than NNL. Net Gain (NG) is a similar concept (Bull and Brownlie, 2017), with the difference in flavor that it is primarily used for in-kind offsets whereas NPI is more associated with trading-up situations (Section 2.4.2). In this work, we use NPI/NG for an outcome that is better than NNL, whether in- or out-of-kind. We use impact area and offset area for areas in which ecological losses and gains take place, respectively. There are two major ways of producing offset gains, habitat restoration (Section 2.5.2) and so-called avoided (averted) loss (Section 2.5.3), which typically means protection of an area to avoid ecological losses in

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it – the avoided losses are then counted as offset gains. Different forms of land (habitat) management can produce gains alike those produced by restoration or avoided loss. We use the term multiplier (offset ratio, compensation ratio; Moilanen et al., 2009) to indicate the size of the offset areas compared to the size of impact areas; for example, a multiplier of five means that five area units of land are needed to offset one area unit of loss.

There is widespread and globally expanding interest in offsetting (Boisvert, 2015; Bonneuil, 2015). The purpose of this work is not to exhaustively review concepts, principles, case studies, offsetting activities in various regions or countries, or concerns about offsetting, as these have been extensively discussed in prior literature (e.g. IUCN, 2016 and references therein; Wende et al., 2018). Rather, it is to describe a framework that allows systematic and transparent examination of the main design decisions that significantly impact the meaning of and outcome expected from an offset plan. The following presentation builds on Finnish and English language grey literature reports by the same authors, Moilanen and Kotiaho (2017) and (2018).

2. The fifteen decisions and their impacts

The ecological reality of the World can be expressed in terms of three main dimensions: what biodiversity (features) you have, where (space), and when (time) (Wissel and Wätzold, 2010). Ecological losses and gains can be expressed through these dimensions: what and how much is damaged or lost, where and when? What offsets gains are generated, where and when? Operationally important decisions about offsets can be grouped around objectives, actions and these three major axes of ecology (Fig. 1).

Table 1 summarizes why these questions/topics impact offset design. We note effects on several different factors of interest to parties involved in offsetting. (i) Options for offsetting. How many alternatives will there be for implementing the offsets? (ii) Feasibility. How easily, if at all, can offsets be implemented? (iii) Credibility. How credible is the compensation plan in delivering NNL or better? (iv) Multipliers. How would decisions influence multipliers and hence implementation costs? (v) Costs. Costs accumulate from design and administrative expenses, land purchase (or rent) and implementation of habitat restoration or other conservation actions. (vi) Complexity of design and implementation is increased by stricter requirements and size of the project. (vii) Local satisfaction. How satisfactory are the offsets likely to appear from the perspective of locals, who suffer losses of ecosystem services and biodiversity in their neighborhood? Table 2 summarizes expected effects, with major ones discussed in the following sections. Note that depending on their objectives with respect to the proposed offsetting effort, different stakeholders (developer, regulator, local inhabitant, etc.) might hold varying opinions about whether some type of effect is “good” or “bad”.

Having set the stage, Sections 2.1–2.5 examine each of the fifteen factors in increased detail.

2.1. Objectives

2.1.1. Degree of adherence to the mitigation hierarchy

The degree to which the mitigation hierarchy is followed is a partially heuristic decision, because there probably are no clear rules for how much effort a business or other developer must spend on impact avoidance and local minimization before embarking on offsetting. Who says how much avoidance is possible? Who defines how far minimization can and has to be taken? From the perspective of the developer, this is primarily a question of costs and secondarily about credibility. It is quite plausible, that minimization and impact avoidance can come out as more expensive than offsets, in which case there may be a tendency to skip avoidance and to go direct to offsets (Quétier et al., 2014; Spash, 2015; Schoukens and Cliquet, 2016).

How far avoidance and minimization are taken will influence both options for local restoration (step 3 of the hierarchy) and options for offsetting. Stricter adherence to the hierarchy will reduce environmental damage done, which leads to lesser requirements for offsetting, which implies increased feasibility and credibility and reduced costs for the offsetting phase (but higher costs in avoidance).

Decision to be made: how far is the developer required to take impact avoidance and minimization before embarking on offsetting?

2.1.2. Definition of NNL

One might expect the meaning of NNL - a basic concept - to be clear, but it is not. First, gains are counted in relation to a reference scenario, which can be generated and used in various ways (Maron et al., 2018; Section 2.5.4). Second, there is a question of levels of certainty required. Assume for the sake of illustration that an area has 7423 individuals of a given species (not that you'd ever be able to know the exact number). When aiming at NNL compensation, the expectation

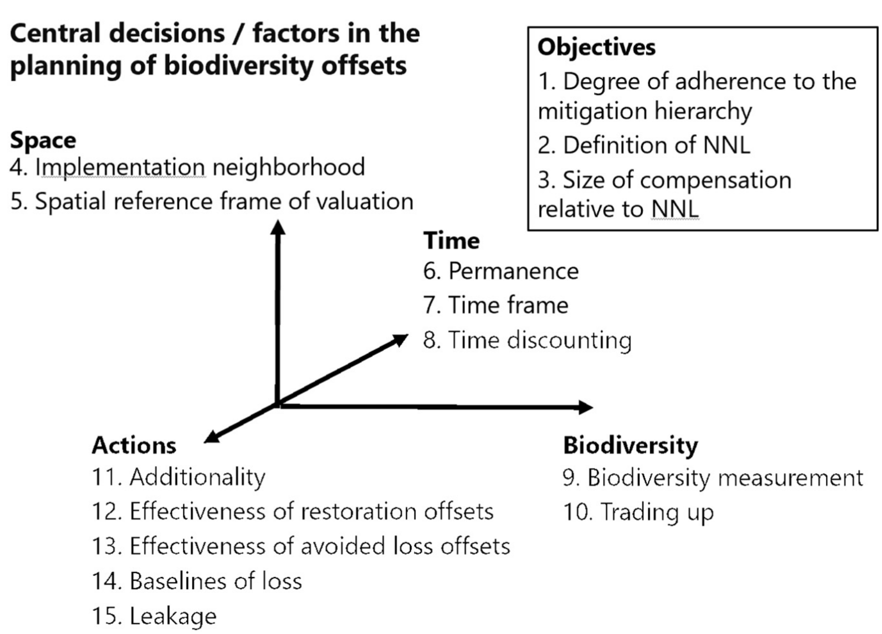

Fig. 1. Important decisions/factors of biodiversity offsetting grouped around objectives, offset actions and the three major axes of ecological reality.