Land Use Policy 49 (2015) 273–286

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

Creating a frame of reference for conservation interventions

J.W. Bull[a,*], N.J. Singh[b], K.B. Suttle[c], E.A. Bykova[d], E.J. Milner-Gulland[a]

[a] Department of Life Sciences, Imperial College London, Silwood Park Campus, Buckhurst Rd., Ascot, Berkshire, SL5 7PY, UK
[b] Department of Wildlife, Fish, and Environmental Studies, Faculty of Forest Sciences, Swedish University of Agricultural Sciences, Umeå, Sweden
[c] Department of Life Sciences and Grantham Institute for Climate Change and the Environment, Imperial College London, UK
[d] Academy of Sciences of the Republic of Uzbekistan, Tashkent, Uzbekistan

ARTICLE INFO

Article history:
Received 27 August 2014
Received in revised form 3 July 2015
Accepted 6 August 2015

Keywords:
Baseline
Biodiversity offset
Counterfactual
Uzbekistan

ABSTRACT

Understanding the context within which conservation interventions take place is critical to effective implementation. The context includes baseline status of conservation targets, and most likely counterfactual given recent trends in those targets i.e. what would have occurred in the absence of intervention. The baseline and counterfactual together provide a 'frame of reference' for judging conservation outcomes. It has recently been demonstrated that, since conservation interventions take place within dynamic systems, and involve either encouraging or discouraging changes in those systems, the reference frame against which interventions are evaluated fundamentally determines how much effort is required to achieve objectives, and whether they are deemed successful. In turn, this makes frames of reference crucial to planning and policy development. Counterfactuals are difficult to estimate, however, and subject to considerable uncertainty. They are consequently not widely specified in practice.

We analyse the historical context, baseline and trends for Uzbekistan's semi-arid Ustyurt plateau, as a case study development of a frame of reference for policymaking. Our framework incorporates physical, social, economic and institutional considerations. We conduct analyses of socio-ecological trends relevant to conservation targets in the region over the last 100 years – particularly the iconic, critically endangered saiga antelope *Saiga tatarica* – based upon primary data sets (e.g. vegetation surveys), secondary data sets obtained from collaborators (e.g. meteorological data), and satellite imagery.

We demonstrate that an informative frame of reference can be developed even in the absence of exhaustive data on land use and landscape ecology. This is because the broader historical context, drivers of change, and interactions between these drivers are so influential upon the necessary design of conservation interventions. The approach taken here – of dividing trends and drivers of change into those that are physical, social, economic and institutional, and considering conservation targets in light of each in turn – provides a manageable structure for building a frame of reference. Additionally, it provides a means for making assumptions about the counterfactual explicit, leaving them open to critical evaluation.

Finally, by developing alternative feasible counterfactuals, testable hypotheses can be outlined and used to improve future iterations of management plans—essentially, an adaptive management approach.

1. Introduction

An understanding of the existing context within which conservation interventions take place is critical to effective conservation. The specification of appropriate baselines, which express the current status of a conservation target, would support more rigorous evaluations of conservation success and failures, and thus, a more scientific approach to developing conservation policies themselves (Ferraro and Pattanayak, 2006; Maron et al., 2013). However, a baseline understanding of the current status of the target is not adequate in itself. There is also a need to project counterfactuals based upon ongoing trends, i.e. expectations for what would have occurred in the absence of the intervention (Gordon et al., 2011a). It is the choice of counterfactual, which can be thought of as a dynamic baseline, that enables measurement of true conservation impact (Ferraro and Pattanayak, 2006). Although a range of possible counterfactual scenarios exist for any given region, all of which are subject to a number of sources of uncertainty (Gordon et al., 2011a),

* Corresponding author.
E-mail addresses: j.bull10@imperial.ac.uk (J.W. Bull), navinder.singh@slu.se (N.J. Singh), b.suttle@imperial.ac.uk (K.B. Suttle), esipov@xnet.uz (E.A. Bykova), e.j.milner-gulland@imperial.ac.uk (E.J. Milner-Gulland).

http://dx.doi.org/10.1016/j.landusepol.2015.08.005
0264-8377/

they allow the calculation of the net outcome of interventions rather than merely reporting observed gains (McDonald-Madden et al., 2009).

Baselines and counterfactuals are particularly pertinent in relation to the development of biodiversity offset policies, as a result of offsets requiring the achievement of 'no net loss' of biodiversity alongside development (Bull et al., 2013a). Few biodiversity offset schemes include the development of both a baseline and a counterfactual as part of a systematic approach to the calculation of true conservation benefit (Quétier and Lavorel 2012; Maron et al., 2013). We refer to the calculation of a baseline and counterfactual by which to calculate net conservation benefit of an intervention as the development of a 'frame of reference' for conservation (Bull et al., 2014). A robust frame of reference should not only consider the ecological status quo, but also incorporate physical, social, economic, and institutional factors (Ferraro and Pattanayak, 2006). Further, it is insufficient to consider factors within these domains in isolation, as interactions and feedbacks between them can be important (Nicholson et al., 2009). These factors, both in isolation and in interaction, drive the trajectory of overall biodiversity value in the ecosystem in question (Bull et al., 2014). Finally, a historical perspective is necessary—not only for evaluating the success of potential offset schemes, but also to prevent shifting baseline syndrome (Pauly, 1995), and to provide the social and economic context to which any conservation intervention should be sensitive (Pooley, 2013).

A key reason that counterfactuals are not always developed for conservation interventions is that it is considered difficult to do so, especially where there are inadequate data (TEEB, 2010). Examples do exist of the retrospective evaluation of interventions using a counterfactual, which both emphasize the need for data and show that the use of an appropriate counterfactual change perceived outcomes (Andam et al., 2008), but few examples exist of counterfactuals being developed at the initial intervention design stage. The common outstanding problems with developing counterfactual scenarios for conservation include that it is not done at all, that the assumptions are not made explicit, or that the assumptions made are demonstrably wrong (Maron et al., 2013). In this exploration, we attempt to partially address these obstacles by developing a counterfactual for a case study for which there are very limited data, in which we make our assumptions clear, and in which we compare counterfactuals developed under different assumptions.

The case study used is of biodiversity offsets for the residual ecological impacts of oil and gas extraction on the Ustyurt plateau, in Uzbekistan, which is home to the critically endangered saiga antelope (Fig. 1). The feasibility of a biodiversity offsetting policy covering the Ustyurt to compensate is currently being explored (UNDP, 2010a), and the Ustyurt plateau exemplifies how dynamic an ecological and political system can be, and how difficult data can be to obtain (Bull et al., 2013b). The approach here is to look at the relatively recent past and identify as far as possible the drivers and patterns of change relevant to management and conservation of the Ustyurt ecosystem. This includes compiling historical datasets and identifying key variables that have been monitored through time.

Because biodiversity offsets tend to use either habitat-based (floral) or species-based (faunal) metrics to calculate no net loss (Quétier and Lavorel, 2012), we define conservation targets either as the Ustyurt vegetation (habitat-based metric) or the status of particular species of interest (species-based metric). This study provides insights into the drivers of ecological change for a unique and relatively neglected region, and highlights some of the practical and theoretical challenges that arise when developing frames of reference for conservation interventions.

2. Methods

Information was gathered on trends in primary conservation targets in the Ustyurt, categorized into the habitat and species targets. The two conservation targets selected, vegetation cover and the saiga antelope, were chosen as they are the focus for ongoing biodiversity offset policy development in the Ustyurt region (Bull et al., 2013b). Statistical and spatial analyses were performed upon these data. Subsequently, we explored the drivers of ecological change in the region, and developed a conceptual map of the main interactions between these drivers. We explicitly considered the drivers of change in four domains (physical, social, economic, institutional). Finally, the numerical analyses and assessment of trend interactions were used to develop a frame of reference (a baseline and feasible counterfactual) that could be used to assess the effectiveness of the planned intervention in the region; a biodiversity offset for gas infrastructure. Since socio-ecological systems are complex and multi-faceted, various possible counterfactuals could be projected from existing data and historical trends—so we also developed an alternative counterfactual scenario, in part to make our assumptions explicit. The data were collected and analysed over a period of 27 months (2010–2013), incorporating primary and secondary data sets acquired during three field trips (Gintzburger et al., 2011; Jones et al., 2014), as well as information available online (Table A1). The ecological and technical rationales for the methods used are included in the Supplementary materials, and only the trends in ecological status and drivers of change in status are presented in the main text.

2.1. Habitat target: green vegetation cover

Habitat-based metrics for biodiversity offsetting generally measure area and condition of vegetation (Quétier and Lavorel, 2012). In the Ustyurt, a measurable component of condition important both for rangeland management purposes and for conservation is the amount of green vegetation cover (Opp, 2005; Gintzburger et al., 2011). To gain a landscape scale assessment of trends in green vegetative cover over recent decades, we used remotely sensed datasets, with the Normalized Difference Vegetation Index (NDVI) as the focal metric.

The spring and summer seasons are the time at which vegetation cover is extensive enough to permit use of the NDVI. Bekenov et al. (1998) give seasons in the Ustyurt as: spring (early/mid-March to early June), summer (early/mid-June to early/mid-September), autumn (mid/late September to early November) and winter (November to early/mid-March). These definitions are used throughout. We used spring and summer NDVI from three different satellite data sets to examine vegetation dynamics during the growing season over the period 1982–2012 (Robinson, 2000; Singh et al., 2010a).

For trends in the distribution of vegetation cover, we created a raster layer of the average spring NDVI values for each year, stacked these raster layers, and completed a linear regression analysis pixel by pixel. This allowed calculation of a gradient for the approximate trend in NDVI values for each pixel for the years in question, in turn permitting the creation of a spatial map of NDVI trends across the region. Standard least squares regression was used to calculate the gradient by pixel, with NDVI as the dependent variable and time as the independent variable.

2.2. Species target: saiga antelope

Species-based metrics for biodiversity offsets are designed either to maintain or enhance overall abundance of a species itself, or to manage habitat for that specific species. We explored trends