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Short communication

The value of species rarity in biodiversity recreation: A birdwatching example

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ABSTRACT

Wildlife viewing recreation offers conservationists opportunities for education and generating revenue but can also have detrimental ecological impacts. To manage these opportunities and impacts effectively, a better understanding is needed of what people value in wildlife viewing events. We examine the relationship between species rarity and value for wildlife viewing recreation. We undertook visitor counts of birdwatchers attending rare (vagrant) bird sightings and collected home postcodes to assess the distances these individuals travelled to achieve these sightings. We also undertook visitor counts at common bird viewing locations for comparison. We regressed birdwatcher numbers against rarity, site protection status, time the bird had been on site and day of the week when the count took place. We undertook these analyses for rare bird sightings only, using a continuous measure of rarity, and for both rare and common species combined, using a categorical rarity index. Species rarity was the clearest predictor of visitor numbers in both the analyses. When studying rare birds only, we found the functional form of the relationship between rarity and visitor numbers to be inverse and asymptotic. Individuals also travelled further to see rarer species. However, while exceptional numbers of visitors attended exceptionally rare bird sightings, the marginal value of rarity appeared to be relatively low. Despite the opportunity for revenue raising and education provided by rare bird sightings, a comparison of visitor numbers at sightings inside and outside protected areas showed no evidence that managers of protected areas capitalise on these opportunities.

1. Introduction

To broaden and deepen support for conservation in society, we need to understand what aspects of biodiversity people value, to reflect these values in conservation policies and actions, and to enhance them through outreach and education. Such values can include both economic and non-economic representations of anthropogenic preferences regarding biodiversity. Many characteristics of biodiversity can be associated with value. People may value diversity itself (Fuller et al., 2007) or individual species that are particularly rare (Tisdell and Swarna Nantha, 2007; Angulo and Courchamp, 2009) or charismatic (Richardson and Loomis, 2009).

Wildlife viewing recreation offers opportunities for educating people about biodiversity and for generating revenue for conservation. However, the accompanying recreational disturbance can impact species and habitats (Taylor and Knight, 2003; Pearce-Higgins et al., 2007; Reed and Merenlender, 2008; Kangas et al., 2010). To manage these opportunities and impacts effectively, we need to understand better what people value in wildlife viewing events (Reynolds and Braithwaite, 2001). Some authors have suggested that if people value rarity in wildlife viewing recreation and recreation activities have detrimental ecological impacts, then a species may suffer from an "anthropogenic Allee effect" putting it at risk of extinction (Courchamp et al., 2006; Angulo and Courchamp, 2009). In this hypothesis, rarity attracts more visitors to see the species, whose impacts cause further declines in the species abundance, setting up a dangerous feedback loop. However, despite its critical role in this hypothesis, the nature of the relationship between species rarity and the value people attribute to wildlife viewing is not well understood (Angulo and Courchamp, 2009).

Estimating the value of rarity has attracted attention from biologists (Courchamp et al., 2006; Gault et al., 2008; Angulo and Courchamp, 2009) and other disciplines (Koford and Tschoegl, 1998). Many studies on species rarity focus on extractive use values from hunting and trade (Courchamp et al., 2006; Gault et al., 2008) or existence values (Christie et al., 2006; Tisdell and Swarna Nantha, 2007), the values people attribute just to knowing that a particular species or ecosystem exists. The value of rarity that is realised through wildlife viewing recreation has received less attention.

Past studies of the value people attribute to the rarity of species in wildlife viewing have concentrated on species in zoos (Maresova

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and Frynta, 2008; Angulo et al., 2009) and other *ex situ* contexts (Angulo and Courchamp, 2009). This shortcoming is perhaps due to the challenge of associating a particular wildlife viewing event *in situ* with an individual species while still observing sufficient wildlife viewing events for comparable species to make inferences regarding rarity. Studies demonstrating that species rarity has value typically compare only two species or types, one rare and one more common (Christie et al., 2006; Tisdell and Swarna Nantha, 2007; Gault et al., 2008; Angulo and Courchamp, 2009), saying nothing about the functional form of the relationship between rarity and value, or about the marginal change in value that results from a marginal change in rarity.

We undertake a field-based examination of the value of species rarity in wildlife viewing. By observing a range of wildlife viewing events for species of varying rarity, we provide an assessment of the functional form between rarity and value and estimate the marginal value of rarity. To do this, we capitalise on an unusual example of wildlife viewing, specifically vagrant bird sightings, which enables us to examine the value attached to extremely rare events.

Birdwatching is the fastest growing segment of the ecotourism market with the potential to generate significant conservation income (Şekercioğlu, 2002). For example, Hvenegaard et al. (1989) estimate the local income generated by birding visitors to Point Pellee, a small national park in Canada, to be $3.2 million, and Şekercioğlu (2002) estimates the annual income from five birding sites in the USA at US$2.4 million to US$40 million. A subset of birdwatchers, known as "twitchers" in the UK and "listers" in the USA, travel long distances and expend significant resources to see rare birds. The definition of rarity here is an unusual one, in that the most valued sightings are often vagrant birds that have strayed from traditional migratory routes and are observed outside their customary geographic range, where they may be relatively abundant.

We examine how the rarity of birds affects the number of birdwatchers that come to view them, using the number of birdwatchers as a simple measure of value. We discuss other measures of value (travel-cost) later.

2. Materials and methods

2.1. Dataset 1 – rare birds only

We collected data from 45 rare bird sightings on 29 sites across the UK over three birdwatching "seasons" – autumn 2007, spring 2008 and autumn 2008. We obtained notifications of sightings from specialised paging services for birdwatchers. We recorded the maximum number of people viewing a bird, day of the week, location and species. We also noted the number of days that had elapsed since the focal individual was first observed and whether the sighting occurred on a protected area. We calculated the average number of sightings of the species in the UK per year since recording for the species began (taken from annual reports published in British Birds up to 2006) as a continuous measure of rarity.

2.2. Dataset 2 – rare and common birds combined

For comparison with the data on rarities, we collected similar data for more common species at 14 additional sites in Yorkshire and Norfolk. For this second analysis, we combined the data on common species with the data on rare species in these regions, giving a total sample of 63 observations. To analyse the combined dataset, we used a categorical measure of rarity, with 1 representing species having more than 1000 individuals in the UK, 2 those with fewer than 1000 individuals, 3 scarcities, 4 rare birds, and 5 birds considered to be megas – i.e. very rare. The latter three categories were classified following the system used in 2008 by the Birdguides website (http://www.birdguides.com), a website for dedicated birders that holds detailed information on bird species and sightings in Great Britain and runs the pager service used for this study. The categories are established using information from the British Birds journal and the British Birds Rarities Committee (http://www.bbrc.org.uk).

2.3. Distances travelled to rare bird sightings

We collected home postcodes from birdwatchers at two bird sightings: the brown flycatcher (*Muscicapa dauurica*), the second recorded sighting of this species in Britain, and the red-flanked bluetail (*Tarsiger cyanurus*), another "mega" at the time of data collection but one recorded 38 times between 1950 and 2006. These sightings took place at different times at one location (Old Fall Plantation in the Flamborough Outer Headland Local Nature Reserve in Yorkshire).

2.4. Statistical analysis

For Dataset 1 (*rare birds only*), we regressed birdwatcher numbers against our continuous measure of rarity, site protection status (binary categorical), time since the bird was first detected on site (days), and whether visitor numbers were counted on a weekend or weekday (binary categorical). Visitor numbers, the continuous rarity index and time on site were log transformed to base ten to meet assumptions of normality. We included the time the bird had been on site prior to the visitor count in case there had been any fall off in visitor numbers before we arrived. We tested for an effect of the interaction between rarity and protected area status (rarity index $*$ site status) to allow for non-additive effects. Other interaction terms were not included.

For Dataset 2 (*rare and common birds combined*), we regressed birdwatcher numbers against our categorical measure of rarity (1–5 scale), site protection status (binary categorical), the interaction of these two variables, and whether visitor numbers were counted on a weekend or weekday (binary categorical). Including the time the bird had been on site would not have been appropriate for more common species.

For both sets of analyses, we first checked predictor variables for collinearity. We followed standard protocols to implement an information theoretic approach to model selection (Burnham and Anderson, 2002). We constructed all possible models given our predictor variables (19 models for Dataset 1: *rare birds only* and 9 models for Dataset 2: *rare and common birds combined*). We used the Akaike Information Criteria (AIC) to calculate model weights. Model weights estimate the probability that each model is true assuming that the truth lies inside the model set. The smallest number of models whose cumulative weights summed to 0.95 was included in the 95% confidence set of models. We conducted model averaging across this set of models to assess the influence of each predictor variable.

3. Results

3.1. Rare birds only

The number of people viewing rare birds ranged from 2 to 300. Focusing first on our continuous measure of rarity, 10 models were retained in the 95% confidence set (Table S1) and all of these included rarity as one of the predictor variables. The model with the lowest AIC value retained rarity alone and had an r^2 of 0.24.