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Analysis

The Non-market Value of Birding Sites and the Marginal Value of Additional Species: Biodiversity in a Random Utility Model of Site Choice by eBird Members

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ABSTRACT

The eBird database is the product of a huge citizen science project at the Cornell University Laboratory of Ornithology. Members report their birding excursions both their destinations and the numbers and types of birds they observe on each trip. Based on home address information, we calculate travel costs for each birder for trips to alternative birding hotspots. We focus on the Pacific Northwest U.S. (Washington and Oregon states). Many birders are "listers" who seek to maximize the cumulative number of species they have been able to see, and each hotspot is characterized by the number of bird species expected to be present. In a random utility model of destination site choice, we allow for seasonal as well as random heterogeneity in the marginal utility per bird species. For this population of birders, marginal WTP for an additional bird species is highest in June when birds are in their mating-season plumage (at more than $3 per species per trip). Total WTP for a birding outing also depends on other site attributes (including ecological management regime, the possible presence of endangered bird species, urban/rural location, ecological region and relative congestion/popularity). Evidence of variety-seeking can also be discerned in birders' destination choices.

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1. Introduction

From the notion of the "canary in the coal mine", to the influential book *Silent Spring* by Carson (1962), birds have long been appreciated as an early indicator of changes in environmental quality. Experts continue to be concerned about the rates of decline for many bird species.[1] Human interest in biodiversity among wild birds remains pervasive, with bird-watching ("birding") continuing to be a popular recreational pursuit. According to the 2011 National Survey of Fishing, Hunting and Wildlife Associated Recreation (NSFHWAR) approximately 46.7 million people in the U.S. reported that they actively engaged in bird watching in the United States in 2011. This is roughly 15 percent of the US population, for people aged 16 and older. Certainly, many other individuals who do not report active participation in bird-watching are likely to derive non-zero utility from "passive" bird sightings even if these sightings are incidental to some other activity in which they are engaged.[2]

Many birders are "listers" who keep track of all the different species of birds they have seen. Some prestige is attached to having a large number of species on one's life list, and some birders aspire to have a "Big Year".[3] The non-market economic value of species richness to birders, however, remains an open question. Early research considered the value of waterfowl to hunters (e.g. Brown and Hammack (1973)), and the regional economic impacts of wildlife-watching activities have also been documented by the NSFHWAR survey since 1991. For benefit-cost analysis of policies that affect avian biodiversity, however, it would help to know something about the *net social benefits* associated with bird-watching and how these will be affected by changes in the biodiversity of bird species. Our research responds to this need by utilizing birders' diary data from the Cornell University eBird project, supplemented with data from BirdLife International.

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[1] BirdLife International is one organization that monitors the numbers and ranges of bird species (see http://www.birdlife.org/datazone/sowb/spotthreatbirds).

[2] "Non-use" values (e.g. option, existence, and bequest values) for bird populations can likewise be expected to be non-zero.

[3] Noah Stryker, followed by Audubon, tallied 6042 species in his world-wide Big Year in 2015.

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Not much non-market valuation research has been attempted with the data from eBird. The eBird project has been criticized by Lamb (2013) for assigning a universal value of $30 per wild bird, as determined by measures of economic impact as opposed to welfare analysis. We use eBird data to help construct measures of the "expected number of bird species" at different birding destinations, based on the number of species reported in the same month of the previous year. We then use this expected species richness measure as the key biodiversity attribute associated with each birding "hotspot" reported to eBird. Hotspots in eBird are publicly accessible locations that people visit regularly for birding and are suggested to eBird by eBird members. These sites undergo a review by eBird prior to being added to the list. Measuring biodiversity using species richness allows us to estimate the marginal value per trip, to this group of bird watchers, of an additional expected bird species at birding destinations, while controlling for an assortment of other site attributes.

The literature on ecotourism (and more specifically on "avitourism") is informative about the preferences of bird watchers who take granderscale trips to visit premium birding destinations outside their local region. Ecotourism has brought to the forefront the value of biodiversity and the importance of conservation e orts because of the economic impact of tourist dollars, i.e. as addressed by Naidoo et al. (2011). Studies in ecotourism and biological conservation point out that ecotourists, in general, tend be interested primarily in distinctive and charismatic species, such as the large mammalian predators of the African Savannah, as described in Di Minin et al. (2013a), Di Minin et al. (2013b), or Grünewald et al. (2016). This literature also explores the issue of how to broaden the interests of ecotourists to include a wider array of species, as in Di Minin et al. (2013b).

In some ecotourism contexts, it is something distinctive about the destination that draws ecotourists. For example, Naidoo and Adamowicz (2005) find that bird species richness and wildlife viewing are significant predictors of which rainforest reserves tourists choose to visit in southern Uganda. For Finland, Siikamäki et al. (2015) find that national parks with the highest biodiversity values attract more visitors than those with lower levels of biodiversity. In other cases, Booth et al. (2011) determine that the rare appearance of some species, such as a "vagrant" bird species, will temporarily increase the number of bird watchers travelling to a particular destination.

Compared to the research to be described in this paper, the closest recent valuation studies of birds employ either the travel cost methodology or stated preference methods. Some recent single-site travel cost models include (1) Edwards et al. (2011), who estimate the economic value of viewing migratory shorebirds, and (2) Gürlük and Rehber (2008) who estimate the economic value of bird watching at a single park. Stated preference studies sometimes focus on the value of a specific type of bird, often an iconic, endangered or threatened species, for example Yao et al. (2014), Myers et al. (2010), Loomis and Ekstrand (1997), Edwards et al. (2011), and Stoll et al. (2006). Other stated preference studies also focus on the value of birds at one particular site, such as Naidoo and Adamowicz (2005), Hvenegaard et al. (1989) or Cooper and Loomis (1991).[4]

Revealed-preference methods (based on observed travel costs to different birding destinations and formal modeling of preferences) are desirable because they reflect actual birder behavior and permit us to infer measures of consumer surplus. We develop a random-utility recreational site-choice model, using the Cornell eBird hotspot data set for the states of Oregon and Washington in the northwest U.S. We demonstrate the feasibility of using citizen science data to estimate the value of bird biodiversity to these citizen scientists. We derive fitted values for trips to specific types of birding sites based on observed birder choices, differences in expected bird species richness across sites, as well as other (potentially correlated) differences in site attributes. Utility-preserving trade-offs between money and site attributes can then reveal the implied total willingness to pay (TWTP) for birding trips to particular types of sites, as well as marginal willingness to pay (MWTP) for incremental numbers of bird species.

2. Data

The eBird dataset contains information contributed by birdwatchers who are project members. The early data starting in 2002 were rather sparse, but the number of members has expanded greatly since 2009. Worldwide membership in early 2016 exceeded 307,000. The available information includes the trip entries of individual bird watchers, so that it is possible to connect the trip origin (the member's enrollment-date home address from their member profile) and the geocoded destination for each trip. For this paper, we focus on just those eBirders who live in northwestern U.S. states of Washington and Oregon. To make these trip data useful for valuing avian biodiversity, each birding destination must be separately characterized by its various attributes.

2.1. Consideration Sets

There are a total of 2,340 eligible "birding hotspot" destinations in our two-state area (see Appendix note 1). Hotspots are included as potential destinations if they are listed as a hotspot on the eBird website. We use a one-hour one-way travel time to define the consideration set for each birder, and conduct sensitivity analyses with respect to this somewhat arbitrary maximum travel time.

2.2. Expected Numbers of Species

Each eBird trip record includes information about which bird species, and how many of each, are observed during each outing. To fill the gaps in the eBird data, we integrate a second external data set, this one from BirdLife International, via Ridgely et al. (2011), into our calculation of ex ante expected sightings. The BirdLife dataset provides geographic references for bird ranges, their presence (likelihood of being seen), origin (e.g., native or introduced) and seasonality (e.g., resident, breeding, nonbreeding or passage). The BirdLife data are particularly important when no eBird visits were recorded in the same month of the previous year at a particular hot-spot destination. Although no eBird member may have visited a particular site in a particular month, this does not mean that zero species of birds (a.) were present at the site last year or (b.) could be expected to be seen at that site this year. Our RUM models require a conformable set of attributes for all sites that comprise an individual's potential choice set, even when no eBird member visited that site in the same month of the previous year.

2.3. Travel Costs

Distances and travel times for our study are calculated for the "best route".[5] We do not model reported bird sightings that involve a travel distance of less than one mile, so utility from backyard birds or other very local bird populations does not enter into our analysis. Thus we have no revealed-preference measures of WTP for backyard birds, even though such sightings undoubtedly contribute substantially to the aggregate net social welfare associated with avian biodiversity.

The opportunity cost of time is always an important consideration in the construction of the travel cost variable for a site-choice model. The

[4] Loomis (2005) reports on use values from outdoor recreation in National Forests and other public lands, and summarizes results from the literature for 30 different recreation activities. He reports average estimates of consumer surplus values per person per day for different types of activities. For birding, the estimates are based on the results of four studies, and suggest that average consumer surplus is about $29.60 (in 2004 dollars), with a range of $5.80 to $78.46.

[5] The best route is suggested by MapQuest, when using the Stata MQtime.ado utility by Voorheis (2015).

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