Exploring systematic differences in the value to birders of species biodiversity: A RUM study of site choice by eBird participants

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The western Meadowlark = state bird for **Oregon**,

Montana, Kansas, Nebraska, North Dakota, and Wyoming.

[Photo credit: bird.audubon.org]

- "Listers: bird-watching = extreme sport" [1]
  - "Comedy 'The Big Year' (2011): fanatical birders who keep lists of every bird they see."
    → *Species maximizers*
- "PORTLAND, Ore. - It may be getting a little more quiet in back yards.... The meadowlark — the state bird — has nearly vanished as grassland habitat gives way to housing and parking lots." [2]
- Research Question: What is the non-market (use) value of birds to bird watchers (eBird citizen scientists)?

1. "Listers turn bird-watching into an extreme sport" Kathyrn True. Seattle Times- Dec 7 2011

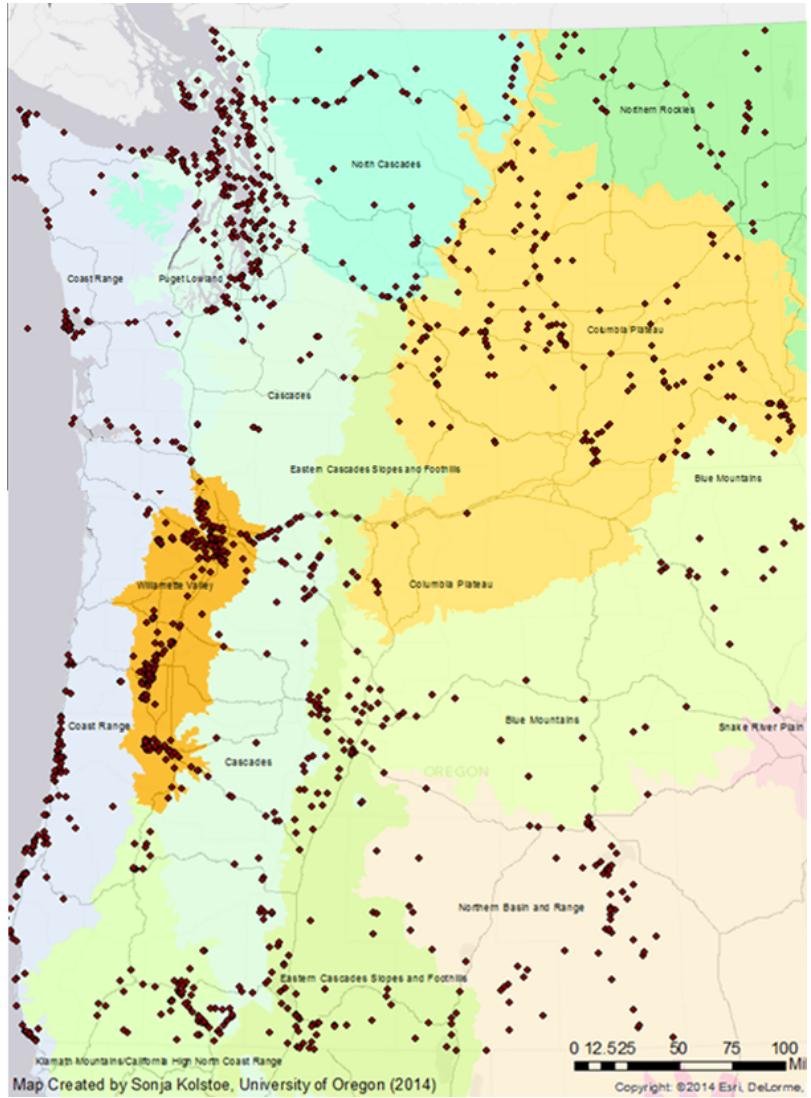
2. "Common yard birds disappearing in Oregon" The Associated Press. June 16, 2007

Recreation Demand Models

- Past Applications of Recreation Demand Model
  - Recreational fishing - Pendleton and Mendelsohn, 1998;

    Parsons et al., 2000; Murdock, 2006; Timmins and Murdock, 2007
  - Hiking - Englin et al., 2006
  - Kayaking - Hynes et al., 2008
  - Birdwatching, migratory shore birds - Myers et al., 2010
- Past studies have never specifically calculated Net Social Benefits from bird watching for such a wide variety of birds or for multiple seasons.

- eBird is a citizen science project by the Cornell Laboratory of Ornithology
  - Funded by numerous NSF grants
  - Mostly focuses on visualization methods
- Destinations are eBird "hotspots"
- Time frame for most-complete trip data is 2010-2012



Data: eBird, GIS layers and the ACS

- Self-reported information: gender, age-bracket, education level, occupation (from eBird)
- Logged visit history (from eBird)
- Account for neighborhood level information: household income and poverty-level at the neighborhood level as a proxy for socioeconomic status(from ACS, 2007-2011 5-year estimates)
- Travel costs: (distance traveled from home to site) * (standard mileage rate from the AAA for the corresponding year)
- Site attributes: expected # bird species (eBird & BirdLife Int'l), ecoregion (EPA), urban area (2010 Census) & location designation (PAD: USGS & CBI)

Random Utility Model (RUM) for site choice

$$
\begin{aligned}
U_{jt}^{i} &= V_{jt}^{i} + \epsilon_{jt}^{i} \\
&= \alpha(Y^{i} - TC_{j}^{i}) + \beta_0 X_{jt}^{i} + \epsilon_{jt}^{i} \\
&= \alpha(Y^{i} - TC_{j}^{i}) + [\beta_0 + \beta_1 Z^{i}] X_{jt}^{i} + \epsilon_{jt}^{i}
\end{aligned}
\tag{1}
$$

U_{jt}^{i} is associated with bird watching trip to site j at choice occasion t for individual i

V_{jt}^{i} is the systematic component; ϵ_{jt}^{i} is the stochastic component

$Y^{i} - TC_{j}^{i}$ is income net of full travel cost to site

X_{jt}^{i} is variable (or vector) of bird biodiversity

Z^{i} observable birder characteristics

α marginal utility of net income; β marginal utility of site attributes

Select Summary Statistics

Users: 201; Total # choice occasions: 1,240

Choice occasions in estimating sample per user: mean 20.73, median 19

Sizes of 100-mile choice sets: range[1, 801]; mean: 381.91; median 345

Total alternatives across all choice sets: 442,469

Sample is mostly male, from higher income neighborhoods, more educated & live in an urban area

Variable	Mean	Std. Dev.	Min	Max
Travel cost (with op cost of time = 1/3 county avg. wage)	81.20	38.35	2.24	184.17
- Distance to site (one-way miles)	55.70	26.88	1.06	100
- Op cost of time at 1/3 wage	15.66	7.97	0.58	71.83
- Vehicle cost using AAA per-mile fee	65.32	31.58	1.26	119.2
Expected # species at a site	77.84	19.47	2	247
Avidity measure (total # trips taken last year)	44.95	59.43	0	272
# trips taken to *this site* last year	0.016	0.13	0	4
Wilderness Area or National Park?	0.070		0	1
State Park or National Forest?	0.21		0	1
Urban area? (per 2010 Census)	0.347		0	1
Congestion - fraction of visits to site, of all visits same month last year	$4.65\text{x}10^{-04}$	$2.83\text{x}10^{-03}$	0	0.113

Select Estimates

Total Alternatives = 442,469	(clogit)	(mixlogit)	(clogit)	(mixlogit)
Travel Cost (OpCost $\frac{1}{3}$ wage)	-0.0295***	-0.0295***	-0.0292***	-0.0299***
#Species·1(UrbanArea)	0.0287**	0.0268**		
#Water birds·1(UrbanArea)			0.123***	0.119***
#Raptors ·1(UrbanArea)			-0.136***	-0.107**
#Perching birds·1(UrbanArea)			-0.00720	-0.0180
#Game birds·1(UrbanArea)			0.0978+	0.110+
# Species·1(female)	0.0132*	0.0159**	0.0156**	0.0158*
# Species·1(Grad. Deg.)	-0.0164***	-0.0224***	-0.0130**	-0.0179**
# Species·1(Variety/Habit)	-0.0277***	-0.0271***	-0.0277***	-0.0269***
1(National Parks, etc.)	1.147***	1.117***	1.129***	1.123***
1(National Forests, etc.)	0.513***	0.500***	0.544***	0.525***
1(Urban Area)	-2.843***	-2.688***	-1.526*	-1.654*
Popularity	234.8***	229.1***	230.2***	223.7***
Popularity, squared	-4842.9***	-4716.8***	-4631.2***	-4476.2***
Month & Year FE? Control for time trend?	Yes	Yes	Yes	Yes

NOTES: Preliminary results *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, + $p < 0.15$

Welfare Estimates

Benchmark: Mean species, 2012, June, rural, not managed, Puget Lowlands

Mixed logit, # species †, by # species present:	$TWTP	$MWTP/species
5 species (minimum)	24.98***	0.73
64 species (10th %ile)	68.06**	
74 species (25th %ile)	75.43**	same
78 species (50th %ile)	78.38*	(linear
81 species (75th %ile)	80.60*	model)
84 species (90th %ile)	82.81*	
98 species (maximum)	93.17*	
eBird observables, female	120.38***	1.27**
National Parks, etc.	115.83***	
National Forests, etc.	94.94**	
Urban	58.37	1.65**
Rural 0 past trips to site	78.13*	0.73
One past trip to site	23.77	

Discussion of Results, eBird members:

- Exhibit variety-seeking behavior
- If female, have a higher MWTP per species
- Exhibit seasonal variation in MWTP for species and types
- Exhibit significant evidence of heterogeneity of preferences across bird species/types based on parameter variance/covariance matrix in mixed logit

Future Work

- Sensitivity analysis
- Forecast welfare changes associated with recreational birding when bird populations shift geographically due to climate change
- Survey eBirders to verify/update address information
- Conduct a stated preference survey

Thank you
Questions? Comments?

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Picture by David Anderson, 2014