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Iconic manakins and despicable grackles: Comparing cultural ecosystem services and disservices across stakeholders in Costa Rica

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ABSTRACT

Despite the great cultural and economic benefits associated with birdwatching and other bird-related cultural ecosystem services (CES), little is known about the bird-related CES and disservices perceived by people, and how they differ across stakeholders and species. The goal of this study was to explore CES and disservices across three stakeholder groups in Northwestern Costa Rica. We conducted surveys (n = 404 total) in which we presented farmers (n = 140), urbanites (n = 149), and birdwatchers (n = 115) with illustrations and songs of bird species and collected participants' ratings on items designed to measure multiple CES and disservices. We found bird-related CES and disservices were perceived as six different categories: identity, bequest, education, birdwatching, acoustic aesthetic, and disservices. The three stakeholder groups expressed varying preferences across services, disservices, and species. Specifically, birdwatchers ranked species higher in terms of their education scores and lower in disservices scores compared to the other two groups, whereas farmers scored species higher on identity scores compared to the other two groups. Farmers and urbanites had remarkably similar perceptions towards birds in general, but differed from birdwatchers. Our approach represents a novel method for assessing CES and disservices associated with species that can be adapted and modified for different taxa and multiple geographical contexts.

1. Introduction

Considering local communities' knowledge and perceptions of biodiversity in conservation decisions is critical for the long-term protection of biodiversity (Berkes, 2004). Increasingly, the conservation and wildlife management communities are calling for more integrated approaches that incorporate peoples' diverse values of nature, including how they perceive and value other species (Pascual et al., 2017). Such values vary across different groups of people, as they are shaped by cultural and socio-demographic contexts (Peterson et al., 2010).

Cultural ecosystem services (CES) defined as "ecosystem's contributions to the non-material benefits, such as capabilities and experiences, that arise from human-ecosystem relationships" (Chan et al., 2012) are one of many theoretical frameworks used to characterize relationships between humans and ecosystems, and between humans and non-human animals (Echeverri et al., 2018). CES are for the most part operationalized as positive interactions between people and ecosystems, such as the aesthetic benefits that people derive from landscapes (Gould et al., 2014). However, people's interactions with ecosystems and species can also be negative—often termed as "disservices". Based on Chan et al. (2012), we define cultural ecosystem disservices as "the perceived material and non-material harms that people derive from human-ecosystem relationships". Disservices can be perceived as material harms when ecosystems or species pose threats to people's livelihoods, safety, or health (e.g., species that affect agricultural crops and in turn affect farmer's livelihoods). Disservices can be perceived as non-material harms when they affect people's mental well-being, identities, or induce aesthetic issues (e.g., species perceived as annoying, loud, or obnoxious due to their behavior or appearance).

Though CES are likely to motivate people's connections with nature (Chan et al., 2012), disservices might reinforce people's aversion to or fear of nature (Lyytimäki et al., 2008). Little is known about how particular species contribute to CES and disservices, and how this varies across stakeholders with different relationships to the non-human world (Milcu et al., 2013). Empirical work characterizing CES has focused mostly on landscapes and their associated services (e.g., place values) (Gould et al., 2014; Klain et al., 2014). Fewer studies have analyzed the CES and disservices provided by and constructed with

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species or specific taxonomic groups (Milcu et al., 2013). As such, we currently lack indicators that measure cultural services and disservices associated with species (Hernández-Morcillo et al., 2013).

Instead, research has focused on understanding the biophysical services that species provide to people (e.g., pest control, pollination) by identifying key species that act as ecosystem-service and disservice providers (Karp et al., 2013; Peisley et al., 2017; Whelan et al., 2008; Zhang et al., 2007). Despite the great cultural and economic benefits associated with CES provided by species, such as wildlife viewing and aesthetic benefits, very little is known about the kinds of CES perceived by people. Aesthetic beauty is a commonly cited CES and is often related to biodiversity (Graves et al., 2017). However, the contribution of species to other CES categories such as benefits for identity, sense of place, or education remain largely unexplored. Moreover, while many people discuss the positive aspects of species, fewer studies evaluate the species that are viewed as a nuisance or as pests (Lyytimäki et al., 2008).

Birds are globally distributed, fill various ecological roles, and provide many ecosystem services to people (Sekercioglu, 2006; Whelan et al., 2008). For example, birds provide game meat for food (Fernandes-Ferreira et al., 2011), regulate pest populations (Karp et al., 2013), act as scavengers in agricultural landscapes (Peisley et al., 2017), and disperse seeds (Pigot et al., 2016). They can also be problematic and cause disservices, as they are responsible for billions of dollars in crop damages (Pimentel et al., 2005). They may also act as vectors of food-borne pathogens (Callaway et al., 2014). Culturally, they drive bird-watching tourism industries (e.g., Puhakka et al., 2011; U.S. Fish and Widlife Service, 2009). In the United States alone, estimates suggest that 46 million birdwatchers spend $32 billion each year, which contributes US$85 billion in economic output annually (Pullis La Rouche, 2006). Birds are also portrayed as benign or evil characters in folk tales (Enríquez Rocha and Rangel Salazar, 2015), human languages, proverbs, and ceremonial activities (Ibarra et al., 2013). Thus, birds are appropriate study organisms for characterizing CES and disservices associated with species.

The few studies that have evaluated bird-related CES and disservices either examined single groups of people (e.g., Veríssimo et al., 2009), single services (e.g., Cox et al., 2018), or single species (e.g., Cortés-Avizanda et al., 2018). A study that compares CES and disservices across different groups of people is long overdue for informing current and future bird conservation planning, such as setting aside areas for preserving culturally important birds or characterizing public opinion concerning pest birds to inform wildlife control. Moreover, similar studies are scarce in the growing body of literature attempting to characterize the plurality of perspectives on how people relate to the natural world. Thus, our main research question was: How do bird-related CES and disservices vary across bird species and stakeholder groups? Akin to biophysical services, we predicted that bird-related CES and disservices are perceived as separate categories (e.g., birdwatching vs. bequest), but that these categories would not be independent (i.e., that CES categories would be correlated, and negatively correlated with disservices). We also predicted that CES and disservices exhibit different rankings, such that different stakeholders perceive and value birds for different reasons. Specifically, we predicted that birdwatchers (i.e., ornithologists, recreational birders) would value birds for their educational and aesthetic services because they interact with birds through science, education, and recreation. We also predicted farmers would perceive more disservices than services from the birds, as some birds may feed on their crop. Lastly, we predicted that urbanites would mostly perceive identity services, as birds are often symbols of national identity.

2. Methods

2.1. Study region

This research took place in Northwestern Costa Rica (encompassing the Guanacaste and Puntarenas provinces). The region is rich in biodiversity, hosting ~250 bird species and two Important Bird Areas (Devenish et al., 2009). The region encompasses a multitude of habitats, which include tropical dry forests, tropical rainforests, natural savannahs, cattle pastures, melon/rice crop rotations, sugar cane pastures, and fruit crops (Karp et al., 2018). Costa Rica is especially appropriate for studying bird-related CES because conservation discourses and economies have predominated in the country's recent history, eliciting widespread awareness of biodiversity among Costa Ricans (Vivanco, 2006). Moreover, Costa Rica is one of the top destinations for international birdwatchers in Latin America (Yonz Martinez, 2014). People were surveyed in urban towns, farmland, and protected areas (e.g., Parque Nacional Barra Honda, Parque Nacional Palo Verde, Parque Nacional Diriá) across the region.

2.2. Data collection

In June-July 2016, we collected pilot data from 50 in-person surveys to identify key stakeholders in the region and to tailor the survey instrument to the local context. Moreover, a colleague conducted 20 semi-structured interviews with farmers for another study. The interview protocol had two open-ended questions about the birds that they saw in their surroundings, and the species that they found interesting, appealing, and problematic (Chapman, 2017). Results from the pilot data indicated that 8 species were most often discussed (both positively and negatively). Based on these pilot data, we developed a survey to evaluate the perceived CES and disservices associated with birds by different stakeholders.

We received support from local organizations (e.g., Nicoyagua foundation) to conduct this work. Surveys were administered in-person and online to 404 people during November and December 2017. We surveyed farmers (n = 140), urbanites (n = 149), and international and local birdwatchers and birdwatching guides (n = 115). Participants were selected and sampled differently for each group. For farmers, we established partnerships with the Ministry of Agriculture and Cattle Ranching (MAG) in Nicoya and Hojancha. We attended their meetings and cattle ranching fairs. At the local meetings, we invited farmers to participate in the study and explained that there was no compensation and that participation in the study was voluntary. Additionally, we visited small-scale and large-scale farms (e.g., 100 m^2 vs. 6000 ha) to recruit more farmers. We sampled farmers who reared livestock and/or grew a variety of crops (e.g., sugar cane, rice, corn, oranges, mangoes). Even though women were less likely to be farmers in the region, we tried to sample as many women farmers as possible to minimize any bias in the data due to gender, however, only 22% of the farmers surveyed were women (Table 1).

To recruit urbanites, we visited public spaces in urban areas across the peninsula (e.g., Liberia, Nicoya, Hojancha, Cañas, Sámara, Tambor), including central town parks, senior homes, universities, schools and local fairs. We approached people randomly and invited them to participate voluntarily in the study. We targeted people with a wide range of ages, different education levels, and 50% women, to gain a representative sample of the population (Table 1). Lastly, our criteria to select birdwatchers was to identify anyone who had gone birdwatching in Northwestern Costa Rica. We advertised the survey in Neotropical and European birdwatching forums and listservs (e.g., NEOORN- Neotropical Ornithology discussion list), in Facebook pages of Costa Rican birdwatching sites, and through the online bulletin of the Costa Rican ornithological association. We also attended two Christmas bird counts in Monteverde and Volcán Arenal (December 2017) and conducted in-person surveys during the meetings prior to the counts. Even though birdwatching is an activity that is mostly dominated by males over the age of 45 in North America and Europe (> 75%) (Vas, 2017), we were able to cover a more demographically diverse sample (Table 1).

Surveys were available in Spanish and English and were administered by the first author and six local field assistants. On average, each

Table 1
Characterization of participants according to demographic information and attitudes and behavior towards birds.

Characteristics	Birdwatchers (n = 115)	Farmers (n = 140)	Urbanites (n = 149)
Age in years	39.34 (15.19)	49.79 (17.47)	34.93 (16.92)
Gender			
Male	67%	76%	49%
Female	33%	22%	51%
Prefer not to answer		2%	
Education level			
Primary school	3%	49%	22%
High school	15%	23%	27%
Technical or vocational school	8%	4%	3%
Bachelor's degree	41%	16%	35%
Specialization	8%	1%	1%
Master's degree	14%	2%	4%
Doctoral degree	9%		
Other	3%	4%	7%
Attitudes and behaviors towards birds			
Gone birdwatching in the past 2 years	96%	37%	45%
Species that can identify	48.36 (15.04)	23.18 (2.65)	19.93 (2.43)

Standard deviation is shown in parentheses.

survey took one hour to complete. All survey responses for farmers and urbanites were recorded in person, but birdwatchers' responses were recorded both online and in-person. Online responses (n = 75) were mostly composed of international birdwatchers who had been birdwatching in Northwestern Costa Rica in the past but were not present at the time of sampling. All data were recorded on Qualtrics (a software for designing surveys).

2.3. Survey design

The survey had six sections. First, participants viewed a page with an introduction to the research, and the consent form. Then, they self-identified as either a birdwatcher, birdwatching guide, farmer, or urbanite; and answered questions tailored to each group. For instance, if they were birdwatchers or birdwatching guides, they were asked where they had been birdwatching. If they were farmers, they were asked what type of farm they owned or operated. Next, participants answered three open-ended questions about which birds they enjoyed watching or hearing, which birds they would like to protect for future generations, and which birds they perceived as annoying or harmful. Then, participants ranked 12 or 13 species by answering 5-point Likert scale items (see below), and they answered three attitudinal questions about personal interest and self-reported behavior towards birds (e.g., birdwatching in the past, or reading books about birds). Lastly, they answered demographic questions (e.g., gender, education).

We had 22 mutually exclusive versions of the survey to record sentiments about the entire avian community (n = 199 species detected in the region; Karp et al., 2018). Fifteen of the 22 survey versions presented 13 illustrations and sound recordings of species that were shown in random order, while 7 survey versions presented 12 species (Table S1). From the 199 species, 8 were focal species that appeared more frequently in species sets such that 4 species appeared in the first 11 survey versions, and the other 4 species in the remaining 11 versions (Table S1). These 8 focal species were discussed most often (both in positive and negative terms) by farmers and urbanites in pilot interviews (Table 2). Specifically, pilot data indicated that urbanites and farmers perceived the national bird (Clay-colored Thrush, *Turdus grayi*), the Long-tailed Manakin (*Chiroxiphia linearis*), the Rufous-naped Wren (*Campylorhynchus rufinucha*), and the Keel-billed Toucan (*Ramphastos sulfuratus*) as iconic in the region. Farmers, however, had negative sentiments about the Great-tailed Grackle (*Quiscalus mexicanus*), the White-throated Magpie-Jay (*Calocitta formosa*), and the Orange-chinned Parakeet (*Brotogeris jugularis*), as they were perceived to consume crops. The Groove-billed Ani (*Crotophaga sulcirostris*) was commonly discussed in pilot data. It was viewed positively by farmers for feeding on pest insects and negatively by urbanites for its unpleasant appearance. Thus, we chose these 8 species to become focal species for evaluating how different CES and disservices varied across species and stakeholder groups. We collected ratings on the other 191 species to elicit perceived CES and disservices towards local avifauna in general and for validating the survey tool across all species.

Each species was represented with a visual illustration of a male individual (Garrigues and Dean, 2014) and an auditory clip of their song/call (xeno-canto.org; Table S2). For each species, participants were asked how much they liked each species, how frequently they saw the species in a given month, and whether they knew what species it was. If participants knew what the species was, then they were asked the name of the species and their subjective agreement on 12 different 5-point Likert scale items (Table 3) that ranged from strongly disagree (1) to strongly agree (5). Likert scale items were designed to measure different CES and disservices that birds provide to people building on the categories from Gould et al., (2014), and Belaire et al., (2015). Items were tested and refined after collecting pilot data to ensure that the language in the items was simple enough for a wide range of people to understand.

In the pilot survey, we found that when participants were not familiar with a species, they only wanted to rate bequest items. Therefore, if participants did not know what the species was, then they were only presented with two items measuring bequest on a 5-point Likert scale (Table 3). See supplementary material for a copy of the survey.

2.4. Data analysis

First, we examined whether there was a difference between the patterns in responses of the Likert scale items between local and international birdwatchers, between birdwatchers and birdwatching guides, and between online and in-person responses. We found no significant differences between any of these comparisons after conducting one-way ANOVAs (p's > 0.05), suggesting that birdwatchers could be considered one stakeholder group in subsequent analyses.

Table 2
Focal species with their scientific, English, Spanish and local names.

Order	Family	Scientific Name	English common name	Spanish common name	Local name
Passeriformes	Pipridae	*Chiroxiphia linearis*	Long-tailed Manakin	Saltarín de cola larga	El Toledo
Passeriformes	Turdidae	*Turdus grayi*	Clay-colored Thrush	Mirla	El Yigüirro
Piciformes	Ramphastidae	*Ramphastos sulfuratus*	Keel-billed Toucan	Tucán	El Tucán Pico Iris
Passeriformes	Troglodytidae	*Campylorhynchus rufinucha*	Rufous-naped Wren	Cucarachero de nuca roja	La Chocholpía o El Chicopiojo
Psittaciformes	Psittacidae	*Brotogeris jugularis*	Orange-chinned Parakeet	Perico	El perico
Passeriformes	Corvidae	*Calocitta formosa*	White-throated Magpie-Jay	Urraca	La Urraca
Cuculiformes	Cuculidae	*Crotophaga sulcirostris*	Groove-billed Ani	Garrapatero asurcado	El Tijo o El Tinco
Passeriformes	Icteridae	*Quiscalus mexicanus*	Great-tailed Grackle	Zanate mexicano o clarinero	El Zanate

Table 3
Factor analysis results indicating six different constructs that represent various cultural ecosystem services and disservices. Likert scale items are presented with their factor loadings and Cronbach's alphas.

Construct	Survey item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Disservices (Cronbach's alpha = 0.77)	This bird causes problems to other species that are important for me*	0.56	0.00	0.03	0.04	0.00	0.07
	This bird causes problems to the crops or the farms by for example eating the crop*	0.79	0.01	0.00	−0.10	−0.01	0.03
	I find this bird annoying because it is too noisy	0.58	0.00	0.02	0.12	0.16	−0.07
	I dislike this bird because their droppings make a mess or they build nests in inconvenient places	0.54	0.05	0.03	0.21	−0.07	−0.04
Education (Cronbach's alpha = 0.83)	I like learning about or studying this bird, where it lives and what it does	0.00	0.80	0.02	0.03	−0.02	0.01
	I like teaching others about this bird and its habitat	−0.01	0.88	−0.01	−0.02	0.02	0.00
Bequest (Cronbach's alpha = 0.84)	This bird should be protected for future generations	−0.01	0.00	1.01	−0.02	0.01	−0.01
	It would be sad if this bird would no longer exist	0.06	0.06	0.57	0.18	−0.01	0.07
Birdwatching (Cronbach's alpha = 0.84)	This bird is beautiful and I enjoy watching it	−0.02	−0.01	0.02	0.84	0.03	0.02
	I am excited to find this bird	0.08	0.12	0.03	0.66	0.04	0.06
Acoustic aesthetic (NA)	This bird has a beautiful song	0.00	0.01	0.01	0.01	0.99	0.01
Identity (Cronbach's alpha = 0.68)	This bird is like my neighbor and makes me feel at home	−0.02	0.00	−0.08	0.01	0.07	0.63
	This bird helps make this place what it is	0.03	0.04	0.12	0.06	−0.04	0.59
NA	This bird is good for the farms, by for example eating rodent pests	0.19	0.02	0.03	−0.12	0.10	0.01
SS loadings		1.79	1.58	1.55	1.54	1.08	0.93
Inertia explained (%)		13%	11%	11%	11%	8%	7%
Inertia accumulated (%)		13%	24%	35%	46%	54%	61%

* These items were reverse coded.

Therefore, we pooled data from all these groups and called them "birdwatchers".

We pooled data from all species (including non-focal species) and performed an exploratory factor analysis with all complete observations on the 14 different Likert-scale items designed to measure various CES categories (n = 3382 data points). To examine the number of factors, we used the "fa.parallel" function instituted in the "psych" package (Revelle, 2017) in the statistical software R version 3.4.1 (R Development Core Team, 2008). Then, we conducted a factor analysis with "oblimin" rotation and maximum likelihood instituted in the "GPA rotation" package also in R. Factor analysis operates on the notion that measurable and observable variables can be reduced to fewer latent variables that share a common variance and are unobservable, which is known as reducing dimensionality (Bartholomew et al., 2011).

We used a factor loading threshold of 0.5 to assign Likert scale items to different factors and calculated Cronbach's alpha for internal consistency. The factor analysis yielded 6 different factors, representing different bird-related service and disservice categories. Only one of the 14 items did not load to any factor, so we excluded that item for posterior analyses (Table 3). With the results from the factor loadings, we then calculated the mean scores for the items in each factor to create 6 constructs and used them as dependent variables in three analyses (Table 3). For the first analysis, we pooled data from all species (n = 199 species) and created linear mixed-effects models to predict the effect of stakeholder group on the 6 dependent variables. For such analyses, we treated both 'species' and 'participant' as random effects. For the second analysis, we only used data from the 8 focal species and regressed each dependent variable against species, stakeholder group, and the interaction between the two using linear mixed-effects models. We also used a random intercept of 'participant'. For all models, we did posterior checks to test for normality and heteroscedasticity assumptions. We then conducted type II ANOVAs to test for the significance of the main effects and used Tukey HSD as post-hoc tests. Lastly, for the third analysis, we conducted pairwise correlations across all CES and disservice categories with data from all species for each stakeholder group separately.

When modelling the effects of species and stakeholder groups on CES and disservice categories (i.e., second analysis), we found that the acoustic aesthetic and bequest constructs did not conform to normality/heteroscedasticity assumptions. Therefore, we used a multinomial regression to evaluate the effects of species and stakeholder groups on the acoustic aesthetic construct. For the multinomial regression, we treated each of the 5 points in the Likert scale as a potential outcome (i.e., response variable), and calculated the probabilities of each stakeholder group ranking each species on any of the five points. In contrast, bequest scores were analyzed as a binary variable because the data were dominated by responses in the "agree" and "strongly agree" categories (i.e., Likert scale scores of 4 and 5). We therefore collapsed responses in the 1–3 Likert categories into a "disagree" class (n = 453), and scores in the categories of 4 and 5 as "agree" (n = 4673). Lumping Likert scale items into a binary variable *a posteriori* is a common practice in statistical analysis when the data are highly skewed and/or concentrated in one or a few of the categories (Gardner and Martin, 2007). With the new binary outcome, we conducted a logistic regression predicting bequest with species, stakeholder group, and the interaction between the two. All analyses were done in R version 3.4.1 (R Development Core Team, 2008). See supplementary material for details from all statistical models and model fits.

We coded the qualitative data from the open-ended questions to identify the most common species mentioned by birdwatchers, farmers, and urbanites when prompted with birdwatching, bequest, and disservices questions. We counted the frequency of mentions for species (e.g., Long-tailed Manakin) or bird groups (e.g., Toucans) by each stakeholder group, and used frequencies as a metric of how salient that bird species/group was for each stakeholder group. The complete data is presented in Tables S9–S11.

3. Results

3.1. Most commonly mentioned species by the three stakeholder groups

From the qualitative analysis, we found that birdwatchers mentioned 156 different species or groups of birds (e.g., raptors) that they enjoyed watching or hearing. Of those, 77 species were mentioned only once. The most mentioned species among birdwatchers were the Long-tailed Manakin (n = 27) and the Jabiru (*Jabiru mycteria*) (n = 26; Table 4). Conversely, farmers mentioned 60 species or groups, 15 of which were mentioned only once. The most mentioned were the Clay-colored Thrush (n = 58) and toucans (n = 39). Finally, urbanites mentioned 70 different species or groups that they enjoyed watching or hearing, 22 of which were mentioned only once. The most-mentioned species were the Clay-colored Thrush (n = 45), toucans (n = 42), and the White-throated Magpie-Jay (n = 42) (Table 4). We also found that all three stakeholders found the Great-tailed Grackle to be most harmful

Table 4
Most frequently mentioned bird species or groups by each stakeholder group in the open-ended questions.

	Bird species or group	Birdwatchers	Farmers	Urbanites
Top birdwatching and acoustic aesthetics service providers	Long-tailed Manakin	**27**	28	15
	Jabiru	**26**	12	7
	Motmots	16	12	18
	Raptors	14	1	2
	Hummingbirds	13	25	32
	White-throated Magpie-Jay	12	25	**42**
	Trogons	10	4	8
	Tanagers	10	0	1
	Clay-colored Thrush	1	**58**	**45**
	Toucans	7	**39**	**42**
	Parakeets	3	31	27
	Scarlett Macaw	7	25	40
	Parrots	4	24	20
	Chachalacas	2	20	3
	Flycatchers with yellow breasts	1	20	26
	Doves	1	16	11
	Orioles	7	11	8
	Blue-gray Tanager	1	10	7
	Woodpeckers	3	5	12
	Rufous-naped Wren	3	8	11
Top bequest service providers	All species	**41**	**62**	**48**
	Jabiru	**26**	9	5
	Toucans	3	**25**	35
	Scarlett Macaw	6	23	**38**
	Clay-colored Thrush	0	20	29
	Parrots	2	15	10
	Parakeet	0	12	8
	Hummingbirds	3	2	13
Top disservice providers	None	**43**	21	17
	Great-tailed Grackle	**41**	**91**	**89**
	Vultures	11	16	**37**
	Parakeets	0	**28**	16
	White-throated Magpie Jay	0	27	16
	Groove-billed Ani	1	14	11
	Woodpeckers	0	12	1

and most annoying (Table 4). Birdwatchers and urbanites found vultures second most harmful/annoying, unlike farmers who found parakeets most harmful/annoying (Table 4).

When participants were prompted with bequest questions (i.e., which species would you like to protect for future generations?), the most mentioned answer across all three groups was "all species" (birdwatchers = 41, farmers = 62, urbanites = 48). Birdwatchers named 59 species or groups when prompted with bequest questions, farmers named 41, and urbanites named 56. The most mentioned species and groups are presented in Table 4.

3.2. Comparing cultural ecosystem services and disservices across species and stakeholders

Results from the factor analysis indicated the presence of six factors among the Likert scale items (Table 3). Those factors were interpreted as different categories that represented various CES and disservices. We analyzed how the mean scores for each of the six CES and disservices categories varied by stakeholders when using data from all 199 species and, in a separate analysis, just the 8 focal species.

3.2.1. Disservices

Birdwatchers perceived fewer disservices than farmers and urbanites across all species (Fig. 1; df = 2, $\chi^2 = 50.56$, $p < 0.0001$). When analyzing only the 8 focal species, results from the linear mixed-effects models showed that disservices varied across species (df = 7, $\chi^2 = 1211.83$, $p < 0.0001$), stakeholders (df = 2, $\chi^2 = 56.96$, $p < 0.0001$), and the interaction between the two (df = 14, $\chi^2 = 112.06$, $p < 0.0001$). Tukey HSD post-hoc tests showed that birdwatchers perceived fewer disservices from four species compared to farmers and urbanites (Rufous-naped Wren, Orange-chinned Parakeet, White-throated Magpie-Jay, and Great-tailed Grackle, $p < 0.05$; Fig. 2). Results from the pairwise comparisons for all post-hoc tests are presented in the supplementary material.

3.2.2. Education

Birdwatchers allocated higher education scores than farmers and urbanites across all species (Fig. 1) (df = 2, $\chi^2 = 53.80$, $p < 0.0001$). Results from the linear mixed-effects models conducted for the 8 focal species showed that education varied across species (df = 7, $\chi^2 = 451.02$, $p < 0.0001$), stakeholders (df = 2, $\chi^2 = 62.14$, $p < 0.0001$), and the interaction between the two (df = 14, $\chi^2 = 71.64$, $p < 0.0001$). Post-hoc tests showed no differences across stakeholder groups ($p > 0.05$) for the Long-tailed Manakin and the Clay-colored Thrush, as all groups displayed strong education attitudes towards these species (Fig. 2). Birdwatchers scored 5 other species significantly higher than farmers and urbanites. We did not find statistically significant differences between farmers and urbanites for any of the 8 focal species ($p > 0.05$) (Fig. 2).

3.2.3. Birdwatching

Birdwatchers and farmers ranked species higher on birdwatching scores than urbanites across all species (df = 2, $\chi^2 = 28.24$, $p < 0.0001$) (Fig. 1). Regarding the 8 focal species, we found that birdwatching varied across species (df = 7, $\chi^2 = 1214.81$, $p < 0.0001$), stakeholders (df = 2, $\chi^2 = 29.26$, $p < 0.0001$), and the interaction between the two (df = 14, $\chi^2 = 111.02$, $p < 0.0001$). Post-hoc tests indicated no significant differences between groups for 3 species (Orange-chinned Parakeet, Long-tailed Manakin, and Keel-billed Toucan; $p > 0.05$), as all groups found them visually appealing (Fig. 2). Birdwatchers perceived 2 species as having higher birdwatching scores compared to farmers and urbanites (Great-tailed Grackle, and White-throated Magpie-Jay; $p < 0.001$), and one species lower than farmers and urbanites (Clay-colored Thrush, $p < 0.001$).

3.2.4. Acoustic aesthetics

Farmers perceived higher acoustic aesthetics than the other two groups across all species (df = 2, $\chi^2 = 18.14$, $p < 0.001$). The multinomial regression conducted for the 8 focal species showed that the acoustic aesthetics varied by species (df = 28, LR $\chi^2 = 469.74$, $p < 0.0001$), stakeholders (df = 8, $\chi^2 = 47.88$, $p < 0.0001$), and the interaction between the two (df = 56, LR $\chi^2 = 82.20$, $p < 0.05$). We did not find significant differences across species and stakeholders for 6 species (Groove-billed Ani, Rufous-naped Wren, Orange-chinned Parakeet, White-throated Magpie-Jay, Keel-billed Toucan and Clay-colored Thrush; $p > 0.05$). Birdwatchers rated the song of the Long-tailed Manakin significantly lower than did the other two groups ($p < 0.001$).

3.2.5. Identity

Farmers ranked species' identity scores higher than birdwatchers and urbanites across all species (df = 2, $\chi^2 = 16.83$, $p < 0.001$) (Fig. 1). We also found that identity scores for the 8 focal species varied across species (df = 7, $\chi^2 = 262.20$, $p < 0.0001$), stakeholders (df = 2, $\chi^2 = 15.32$, $p < 0.001$), and the interaction between the two (df = 14, $\chi^2 = 32.39$, $p < 0.005$). A trend observed from Fig. 2 is that farmers' identity scores across species were higher for all but one

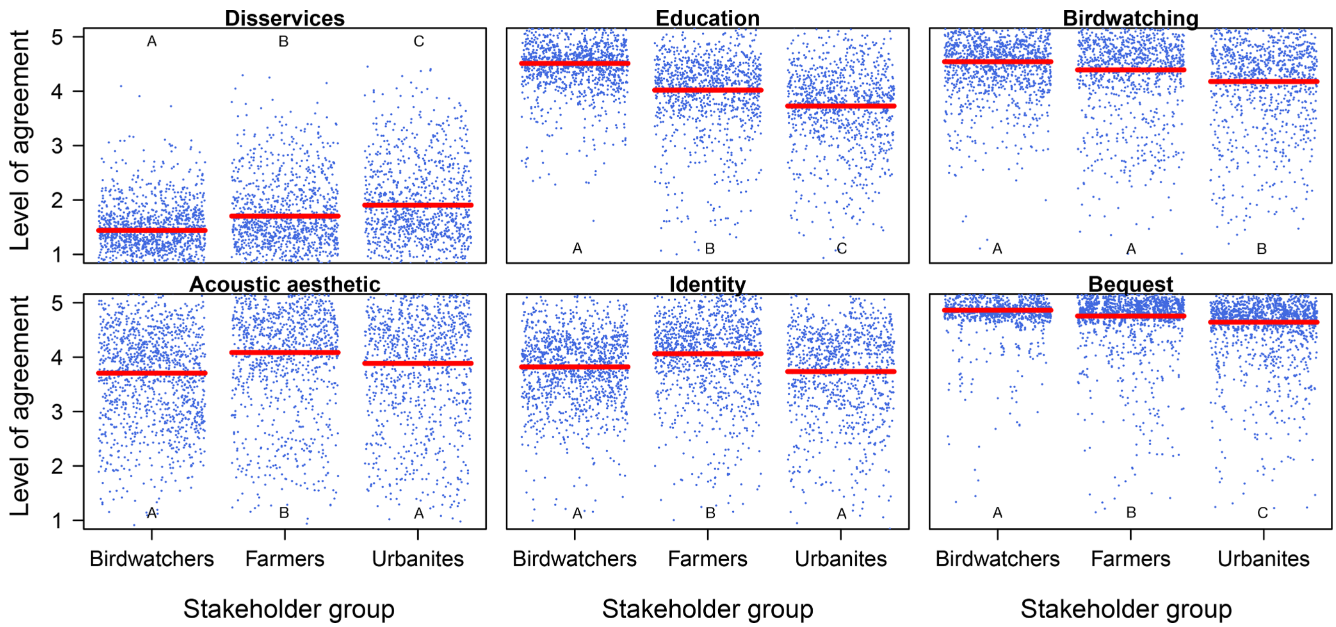

Fig. 1. Relationship between stakeholder groups and their perceived cultural ecosystem service and disservice categories across 199 species. Each dot represents an individuals' ranking for a species for each service or disservice category. Red lines represent the modelled estimate in the linear mixed-effects models for each stakeholder group in each category. Data points are jittered to observe the distribution. Distributions marked with the same letters are not statistically different from one another, while those not sharing any letters are significantly different distributions according to post-hoc tests ($p < 0.05$).

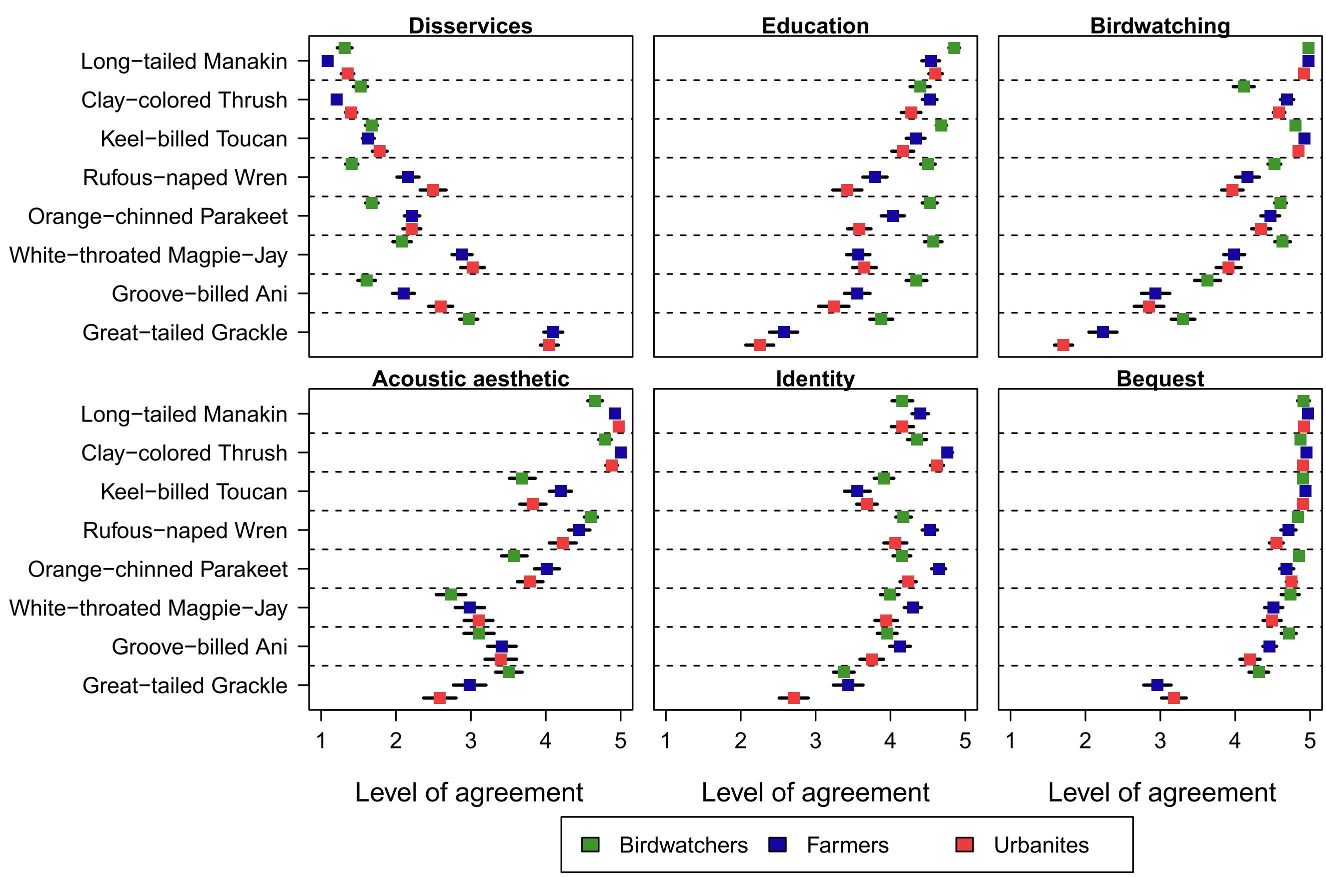

Fig. 2. Scores for six ecosystem service and disservice categories across eight focal species and stakeholder groups. Each square represents the mean value of the level of agreement for birdwatchers (green), farmers (blue), and urbanites (red). The level of agreement was assessed on a five-point Likert scale: 1-strongly disagree, 2-somewhat disagree, 3-neither agree nor disagree, 4-somewhat agree, 5-strongly agree. We present the mean scores for each species with 95% confidence intervals (black lines).

species (Keel-billed Toucan). For example, farmers scored Orange-chinned Parakeet and Clay-colored Thrush significantly higher in terms of their identity scores compared to both birdwatchers and urbanites ($p < 0.005$). Additionally, urbanites scored the Great-tailed Grackle lower than the other two groups ($p < 0.05$). Post-hoc tests found no significant differences across stakeholders for four species (Groove-billed Ani, Long-tailed Manakin, White-throated Magpie-Jay, and Keel-billed Toucan; $p > 0.05$).

3.2.6. Bequest

All stakeholder groups assigned high scores on bequest across all species (Fig. 1): the means for all 3 groups were higher than 4.5, indicating a high level of agreement on bequest items. Nonetheless, we found that birdwatchers had higher bequest scores compared to the other two groups (df = 2, $\chi^2 = 19.38$, $p < 0.0001$). After analyzing bequest as a binary variable for the 8 focal species (> = 3.5 was coded as agree, and < = 3.5 was coded as disagree), we found that bequest scores varied with species (df = 7, LR $\chi^2 = 260.27$, $p < 0.0001$), stakeholders (df = 2, LR $\chi^2 = 32.28$, $p < 0.0001$), but not the interaction between the two (df = 14, LR $\chi^2 = 17.99$, $p = 0.207$). Post-hoc tests showed that the Great-tailed Grackle was the only species for which bequest scores differed by stakeholders, as birdwatchers ranked its bequest scores higher than farmers and urbanites ($p < 0.00001$; Table S8). The other seven species did not show statistically significant differences across their bequest scores when comparing different stakeholder groups ($p > 0.05$; Table S8).

3.2.7. Correlations across cultural ecosystem services

Pairwise correlations across cultural ecosystem services and disservice categories indicated that for all three stakeholders, disservices were negatively correlated with the other five CES categories. Meanwhile identity, education, bequest, birdwatching and acoustic aesthetics were positively correlated with one another. Farmers and urbanites exhibit strong correlations (Pearson's $r > 0.5$) between birdwatching and education, acoustic aesthetics, and bequest (Fig. 3). Additionally, they exhibit strong negative correlations (Pearson's $r < -0.5$) between disservices and birdwatching and bequest (Fig. 3). These correlations suggest that for farmers and urbanites, when birds are perceived as beautiful, they are also perceived as having a beautiful song, worthy of conserving, and worthy of studying (or vice versa). Though the correlation trends were similar for birdwatchers, the strength of the relationships were weaker (Fig. 3).

4. Discussion

4.1. Differences and similarities across stakeholders in relation to the local context

We identified differences between the species that were perceived as CES providers vs. those that were disservice providers. We found that the birds that people enjoyed watching were not the only ones that they wanted to protect for future generations (Table 4). Our results echo those of Cox et al. (2018) who showed that in urban areas of southern England, people perceived 2.5 times as many bird species to be positive for people's well-being relative to those whose behaviors caused conflict. We found similar results in our study where birds were generally viewed positively, but the birds that people found harmful to the crops or infrastructure were also the ones that they perceived as annoying or noisy. The species perceived as most harmful or annoying by far was the Great-tailed Grackle. It was viewed as a pest in agricultural landscapes by farmers, as a nuisance in urban areas by urbanites, and as an invasive species in ecosystems by some birdwatchers.

With increased urbanization and habitat conversion, people are becoming less likely to have direct contact with wildlife in their everyday lives. This phenomenon has been termed the "extinction of experience" (Soga and Gaston, 2016). The three stakeholder groups in this study interact with wildlife in different ways. For instance, birdwatchers are highly connected to wild birds, as their identities are constructed with them (DeMello, 2012). Farmers, on one level, are using the land for productive purposes, but also have frequent contact with wildlife. Urbanites are often less exposed to wildlife, because their interactions are limited to urban parks and gardens (Soga et al., 2016). Given the variation in human-nature relationships across these groups, we expected them to have different perceptions of birds. Instead, we found that, for the most part, farmers and urbanites had very similar perceptions regarding all species and all services. Only the Groove-billed Ani was perceived as more harmful for urbanites than for farmers (Fig. 2), mostly because farmers identified it as a species that gleans parasitic insects off of cattle, while urbanites often confused it with the Great-tailed Grackle (viewed as a pest locally, Dinat et al., 2019). We believe the similarity between the perceptions of farmers and urbanites regarding birds speaks directly to the Costa Rican context and the deep connection between many Costa Ricans and the natural environment (Vivanco, 2006).

Birds are an important component of Costa Rican lifestyles. For instance, over 150,000 parrots are kept as pets in Costa Rican households (Drews, 2001). Also, birds are frequently mentioned in local Indigenous stories and folk tales. For example, in local stories, Barn Owls

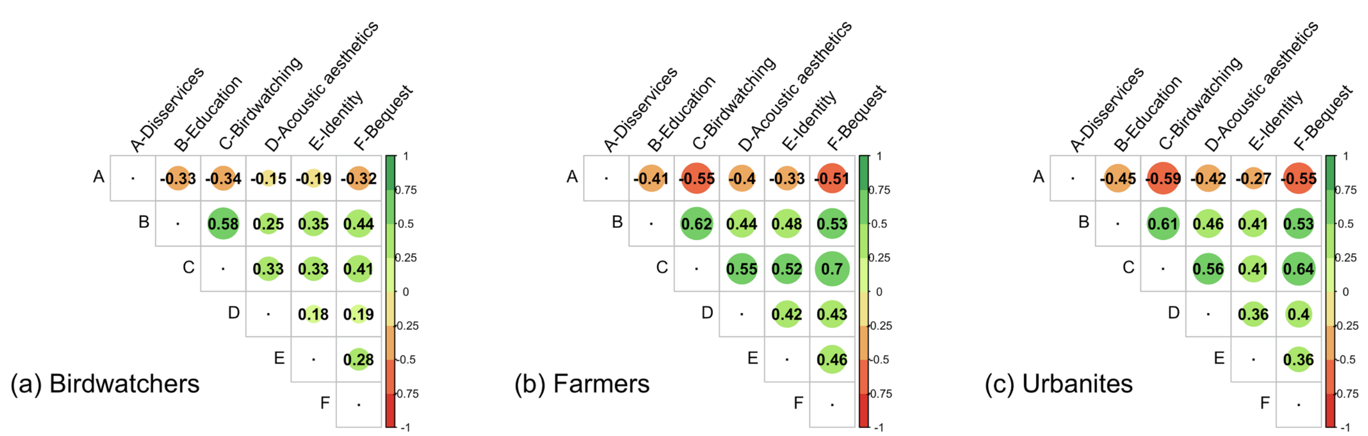

Fig. 3. Pairwise correlations across cultural ecosystem service and disservice categories for each stakeholder group. The size of the circles represents the magnitude of the pairwise correlation, where bigger circles correspond to higher correlations. The numbers refer to the correlation coefficients (Pearson's r); warmer colors (yellow, orange, red) indicate negative correlations, and cooler colors (greens) indicate positive correlations.

(*Tyto alba*) are believed to announce deaths in neighborhoods (Enríquez Rocha and Rangel Salazar, 2015). Similarly, the Clay-colored Thrush (*Turdus grayi)* and the Laughing Falcon (*Herpetotheres cachinnans*) are believed to announce when the rains are coming (Sault, 2010). Birds are also present in Costa Rican folklore; they are often depicted in murals, local art, and are an important part of how Costa Ricans advertise their country to foreigners. The strong connection between people and birds in this context might explain the species egalitarianism elicited across people when prompted with bequest questions (i.e., the species that people wanted to protect for future generations) (Schmidtz, 1998).

The strong correlations between disservices and the five CES categories (Fig. 3) suggest that the categories are not wholly independent. One possible explanation for this finding is the affect heuristic (Finucane et al., 2000), which suggests that people are influenced by a general positive or negative disposition (i.e., affect) when judging risks (i.e., disservices) and benefits (i.e., beneficial CES, such as birdwatching). This interpretation is supported by the additional finding that general likeability (i.e., positive affect) of the birds was positively correlated with education, birdwatching, acoustic aesthetics, identity, and bequest, but was negatively correlated with disservices (Table S12). Importantly, the strength of these correlations was weaker for birdwatchers than for farmers or urbanites (Fig. 3). We believe this finding can be explained by the fact that birdwatchers are more knowledgeable (i.e., experts) about bird species and therefore rely less on the affect heuristic to inform their perceptions towards species, unlike farmers and urbanites who inform their perceptions through affective measures (Markowitz et al., 2013).

4.2. Methodological insights

Despite recent advances in developing methods for the socio-cultural valuation of CES (e.g. Gould et al., 2014; Martín-López et al., 2007; Plieninger et al., 2013), assessment of CES and disservices provided by species remains underdeveloped (Milcu et al., 2013). An important contribution of our paper is therefore the methodological advancement for measuring and eliciting CES and disservices associated with species. Our study built on the method developed by Belaire et al., (2015) by adding survey items that elicit other CES (e.g., bequest, education), and by allowing people to discuss individual species instead of commenting on birds as a whole group. With our method, we identified species that act as CES and disservice providers. Identifying ecosystem service and disservice providers is important for managing ecosystem services (Kremen, 2005) and for making conservation decisions that require assessing competing trade-offs between species or taxa (Karp et al., 2015). For example, in Costa Rica, the tourism and agriculture industries are at odds. Conservation programs targeting iconic species for birdwatchers such as raptors (Ramírez-Alán, 2014), might induce human-wildlife conflicts with farmers and urbanites who reported negative perceptions of raptors in this study. Thus, navigating competing interests between tourism and agriculture in the region might benefit from incorporating stakeholder perceptions of wildlife via the methods we have described here.

The fact that CES are perceived differently by different people has been of central concern in decision-making for conservation planning and wildlife management (Teel and Manfredo, 2010). Many conservation initiatives begin with stakeholders discussing realistic scenarios for the conservation of species' habitats and how such scenarios might affect their own livelihoods or practices (Rosa et al., 2017). This process identifies salient ecosystem services and often involves stakeholders recognizing the socio-cultural values of species (Goodness et al., 2016). Our method is well-suited to identify the diverse CES and disservices that people derive from and construct with species. It provides a more systematic and nuanced assessment of the CES perceived by different stakeholder groups. For example, we have shown that species can rank differently on disservices and other CES categories (Fig. 2). Such rankings enable a systematic evaluation of trade-offs associated with different species and could be easily adapted to existing conservation efforts for birds. For example, in a different part of Costa Rica, a newly established program for the Golden-winged Warbler (*Vermivora chrysoptera*) is a payment for ecosystem services scheme to conserve the warbler's habitat (Costa Rican Bird Observatories, 2019). Current educational programs with farmers and local communities to raise awareness of the species are ongoing, but future programs would be strengthened by considering the range of CES and disservices that various stakeholders perceive at the outset of the process.

Interestingly, most people (not only birdwatchers) were able to identify birds by their songs (more so than the images), perhaps because they perceived them to be important elements of their daily soundscapes. Our method may thus be useful for researchers and practitioners attempting to capture people's relationships with non-human animals. We received positive feedback from participants regarding the enjoyment they derived from completing an interactive survey that showed both pictures and songs of birds. Many participants stated that this was a novel tool, different from traditional paper-based surveys. However, we also received negative feedback about the length of the survey from participants who knew most species (and so had to score all or most species). Thus, we recommend future applications of the method to reduce the number of species presented so that the survey takes at most half an hour to complete.

4.3. Caveats and future research directions

Our study is motivated by the call to advance methodologies to capture stakeholders' perceptions of human-nature relationships while embracing value pluralism (Pascual et al., 2017). We approached human-bird relationships with a post-positivist epistemology rooted in Western science, and we reflect on some challenges and point to future research directions. First, we used the CES framework to operationalize human-bird relationships, but we recognize that many other theoretical frameworks exist (Echeverri et al., 2018). Our method could be complemented with an ethno-ornithological analysis that draws from Indigenous epistemologies to analyze individual species and their associated myths, folklore, proverbs, and knowledge. Second, our method has only been tested and applied in a Costa Rican context. Hence, future research could apply this survey in other geographical contexts to test the generalizability of peoples' perceptions of species across their distribution range, given the importance of local contexts in shaping people's perceptions of nature (Peterson et al., 2010). Lastly, we developed this method for birds. Adapting our method for other species might require some discussion on other benefits those species provide to people. For example, in our pilot data we found that the birds in this community were not important food sources for local communities. However, if this method were applied to other species (e.g., mammals, fish)—or birds elsewhere—then considering other benefits, such as species as sources of ceremonial or food-related activities, might be relevant.

4.4. Recommendations for local environmental management and conservation

Our results have implications for environmental education and conservation campaigns conducted in Northwestern Costa Rica. By far the most iconic species for all three stakeholders was the Long-tailed Manakin. It received the highest rankings on birdwatching, acoustic aesthetics, bequest and education, and the lowest rankings on disservices (Fig. 2). This said, current conservation and environmental awareness campaigns in Costa Rica tend to highlight the Jabiru as a focal species, and it is also the logo of the protected areas network and the Guanacaste Conservation Area (SINAC-ACG). However, we did not find that Jabirus were prominent in peoples' minds when doing our pilot surveys and interviews, in fact not everyone could recognize this species. Also, Jabirus were mentioned more often by birdwatchers (Table 4). Based on the findings of this study, we suggest that the Long-tailed Manakin would be a more appropriate species to highlight in education and conservation campaigns as it is liked by all stakeholders, has cultural significance, a high degree of familiarity, and widely appreciated charisma. Birdwatchers, farmers, and urbanites all commented positively on this species' courtship dances, color, and song. Given that the Long-tailed Manakin is associated with wet forests, and species associated with wetter, more forested sites are more vulnerable to land-use and climate change (Karp et al., 2018), it might be a good candidate for raising awareness on ecological issues, such as the expected future droughts for the region (Hund et al., 2018).

5. conclusions

International conservation policy efforts, such as the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES), are increasingly calling for plural valuation of ecosystems that take into account the socio-cultural dimensions of biodiversity (Pascual et al., 2017). Our study adds empirical evidence to this call in the context of Neotropical avian conservation. We also showed that CES and disservice providers are different for birdwatchers, farmers, and urbanites in Northwestern Costa Rica. In contrast to our expectations, we showed that for this particular context farmers and urbanites had very similar perceptions towards birds, but they differed from those of birdwatchers. We echo scholars and practitioners that stress the importance of characterizing the human dimensions of biodiversity for finding support to ongoing conservation and wildlife management efforts.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ecolind.2019.105454.

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