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Modernization-induced socio-economic changes and their effect over the spatial distribution of recreational hunting and volunteering with animals

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ABSTRACT

Socioeconomic changes characterizing the last 70 years changed human-wildlife relationships and diminished activities such as recreational hunting. However, little research has tested whether the same changes also increased other behaviors, such as volunteering for nongovernmental organizations (NGOs) that focus on protecting animals. We modeled the effects of urbanization, income, and higher education over the incidence of recreational hunters and people who volunteer with animals in Tuscany (Central Italy). Urbanized areas, characterized by more educated residents, have fewer hunters and more people volunteering than rural municipalities. Hunting participation over the last 15 years also declined more in urbanized municipalities than in rural ones. Our findings indicate that the increased number of people volunteering in animal welfare NGOs might be related to a shift in human-wildlife interactions similar to North America. Moreover, our approach may be used to identify hotspots of social conflicts with wildlife.

KEYWORDS

Wildlife value orientations; urbanization; human-wildlife relationships; rural-urban divide; values

Introduction

Over the last few decades, Western countries faced unprecedented growth in their levels of income, education, and urbanization. These socioeconomic changes: (a) triggered a shift toward post-materialist values emphasizing needs such as self-expression, social affiliation, or egalitarianism over subsistence (Inglehart, 2018); (b) created a social context favorable for the diffusion of anthropomorphic thinking (Manfredo et al., 2020b); and (c) changed how domination and egalitarian ideologies were applied to conceptions about wildlife. Mutualistic wildlife value orientations became progressively more common, at least among some social groups, and this in turn is reshaping attitudes toward wildlife and their management (Manfredo et al., 2009, 2020a).

The multilevel model of shifting wildlife value orientations (Manfredo et al., 2009, 2020a) became one of the most popular theoretical frameworks used for understanding spatiotemporal dynamics in human-wildlife relationships in Western countries (e.g., Europe: Teel et al., 2010; North America: Manfredo et al., 2018). Given its potential to tie socioeconomic 2 👄 J. CERRI ET AL.

dynamics with changes in value orientations (e.g., in North America: Manfredo et al., 2017; Slagle et al., 2017), attitudes, and behaviors related to wildlife, this theory offers a powerful analytical framework. However, all studies we can identify that have adopted this model focused entirely on activities such as recreational hunting and angling. Considering their economic relevance, the focus on these activities is understandable (Williams, 2010). Nevertheless, many people also practice non-consumptive forms of wildlife use, including nature photography and wildlife viewing (Cordell et al., 2012), or they engage in activities enhancing animal well-being, such as volunteering for animal protection nongovernmental organizations (NGOs).

Volunteering for NGOs operating in the field of environmental or animal protection has become a particularly important form of human-wildlife interaction. Approximately 5% of all people who volunteer in the United Kingdom (National Council for Voluntary Organizations (NCVO), 2019) and nearly 3% in the United States (US Bureau of Labor Statistics, 2015) volunteer for these NGOs. These organizations operating in the field of animal protection are important stakeholders in conservation (Challender & MacMillan, 2019). In geographical areas where these NGOs have many members, their political influence is sometimes enough to challenge traditional wildlife management, often clashing with opposite groups of interest (e.g., hunters; Barca et al., 2016). The escalation of these conflicts can have detrimental consequences for wildlife and society. Therefore, understanding how socio-economic changes can affect the spatial distribution of members of these NGOs and recreational hunters can be important for identifying potential hotspots of social conflicts about wildlife where agencies could focus their efforts to avoid them.

The multilevel model of shifting wildlife value orientations should be suitable for this scope. The spatial distribution of hunters may be predicted from socioeconomic variables associated with a decrease in traditional wildlife value orientations. For example, Cerri et al. (2018) found that the number of hunters in Italy decreased in urbanized, wealthy, and more educated areas. Given that people who volunteer for animal protection NGOs are likely to hold more mutualistic wildlife value orientations (Manfredo et al., 2009), their spatial distribution should be diametrically opposed to that of recreational hunters. Notably, volunteers for animal protection NGOs should be more abundant in urbanized, wealthy, and more educated areas.

One of the reasons why studies have rarely considered volunteering for animal protection NGOs is the lack of longitudinal data about this phenomenon, which are not as clear as time-series data about recreational hunting or angling. In many countries, estimates about volunteering are produced through surveys every few years due to the cost of data collection. In this research note, we show how: (a) spatial patterns of single-year data about volunteering for animal protection NGOs and recreational hunting can be combined to reflect changes in human relationships with wildlife in line with the multilevel model of shifting wildlife value orientations, and (b) time-series data about recreational hunting can strengthen the validity of spatial patterns observed for single-year data. We tested the following hypotheses based on the multilevel model of shifting wildlife value orientations:

 H_1 : Increased urbanization, average income, and education will show negative relationships with the incidence of recreational hunters in 2011.

H₂: Increased urbanization, average income, and education will show positive relationships with the incidence of volunteers for animal protection NGOs in 2011.

H₃: Hunters, from 2002 to 2017, will experience the highest decline in areas that in 2011 had many of these volunteers and few hunters.

These three hypotheses reflect the two goals of our study. First, H_1 and H_2 aim to test whether the spatial distribution of hunters and volunteers aligns with expectations from theory. Second, H_3 aims to test whether observed spatial patterns are supported by long-term dynamics in recreational hunting.

Methods

Study Area

Our study area was the Tuscany region in Central Italy. Tuscany (22985 km²) is divided into 273 municipalities and hosts the highest number of recreational hunters in Italy even though this number declined by 37% between 2001 and 2017. In this study area, hunting can be practiced by people paying a yearly fee and holding a valid license to hunt on public land and most private properties. Private hunting estates exist, but they cover a minority of the total eligible surface. Game is regarded as a public good and landowners cannot exercise property rights on wildlife. Traditional forms of hunting target mostly small game and migratory bird species, but the massive increase in the populations of wild ungulates over the last 20 years (Regione Toscana, 2016) shifted hunting habits with deer stalking and boar hunting now dominating. Given that wild ungulates damage croplands (by approx. 2.5 mln \notin /year between 2010 and 2016, Regione Toscana, 2016) and professional hunting is illegal in Italy, hunting revenues from licenses help to compensate for crop damage. Recreational hunters also volunteer for control schemes to eradicate wild ungulates from selected areas.

In Tuscany, 130 NGOs focus on animal protection and the defense of animal rights, relying on 2,763 volunteers. Although some animal rights activists operate outside of registered animal protection NGOs and their number is unknown, we believed them to be a tiny minority of the total based on existing literature (Bertuzzi, 2019).

Data Collection and Statistical Analysis

Our study relied on two different types of data: (a) cross-sectional data about recreational hunting and volunteering for animal protection NGOs, and (b) time series data about recreational hunting. Data about the number of people who volunteered for animal protection NGOs in each municipality of the study area were available for 2011 only from the national survey of NGOs (https://www.istat.it/it/censimenti-permanenti/censi menti-precedenti/industria-e-servizi/imprese-2011). Data about the municipal number of hunters were provided by the regional wildlife office for every year between 2002 and 2017. Hunting participation and volunteering for animal protection NGOs (hereafter called "volunteering") were measured as the incidence of recreational hunters or volunteers out of 1000 adult residents in each municipality.

Following Manfredo et al. (2009), we measured modernization by three of its main components (urbanization, income, education). Urbanization was measured as the proportion of the urbanized surface of each municipality and it was calculated by using official values provided by the National Institute for Statistics (https://www.istat.it/it/archivio/156224). Income was measured as the average value of the eligible income for each municipality (IRPEF, the Italian personal income tax, retrieved from the website of the Italian Ministry for Economics and Finance https://www1.finanze.gov.it/finanze3/pagina_dichiarazioni/dichiarazioni.php). Education was measured as the proportion of residents in each municipality possessing a high school diploma or a university degree, and this information was obtained from the 2011 national census (http://daticensimentopopolazione.istat.it/Index.aspx?lang=it).

Statistical Analysis

Statistical analysis was divided into two consecutive steps. First, we used 2011 data about hunting and volunteering to test both H_1 and H_2 , mapping the spatial segregation of hunters and volunteers. Then, we considered time-series data about recreational hunting to test H_3 and see if municipalities with different numbers of hunters and volunteers in 2011 also had different long-term trends in the number of hunters between 2002 and 2017.

In the first step, we modeled the effect of urbanization, income, and education over the incidence of recreational hunting and volunteering by means of multivariate random forests analysis (Segal & Xiao, 2011). Multivariate random forests analysis extends the application of random forests to more than one response variable, modeling the effect of covariates over a subset of responses. By doing so, and by not modeling response variables separately, multivariate random forests are able to detect shared patterns of responses to covariates (Ferrier & Guisan, 2006). We calculated variable importance by permuting the values of predictors and evaluated the change in the Mean Squared Error (MSE; Breiman, 2001), and we used partial dependence plots to graphically represent the marginal effect of covariates over the two responses. Then, we extracted the proximity matrix from the random forests model, which represents a measure of similarity among observations. We then performed PAM (Partitioning Around Medoids) cluster analysis to identify groups of municipalities characterized by similar incidences of recreational hunters and volunteers in 2011. We used the silhouette-width method to identify the optimal number of clusters (Kassambara, 2017).

In the second step, we tested whether temporal trends in the incidence of recreational hunters (2002–2017) differed among the clusters of municipalities. We used a linear regression with a normal distribution of the error and a first-order autocorrelation structure with a variable assigning each municipality to a specific cluster and the year as predictors.

Before any statistical analysis, we tested for spatial correlation among municipalities by Moran's I and Moran's correlograms (Plant, 2018). We found no evidence of spatial correlation. However, to account for large-scale spatial trends, we included latitude and longitude of municipal centroids as covariates in the random forests model. Statistical analyses were carried out in R 3.6.3 (R Core Team, 2020). The dataset and software code can be downloaded from https://osf.io/fj238/

Results

Our random forest model explained approximately 63% of the variability in the two response variables. Partial dependency plots revealed that urbanization and education showed a marked negative and nonlinear association with the incidence of recreational hunters. Urbanization and education showed a specular pattern, a positive and nonlinear association with the incidence of volunteers. Finally, income showed a negative and non-linear relationship with the incidence of recreational hunting, as well as a U-shaped association with the incidence of volunteers, which first declined and then increased again in wealthy municipalities (Figure 1). In terms of variable importance, the proportion of urbanized areas was the most important predictor for the incidence of recreational hunting at the municipal scale, whereas average income and education were the most important predictors of volunteering. Overall, these findings supported both H_1 and H_2 .

The PAM cluster analysis revealed the presence of two groups of municipalities (Figure 2). The first cluster, consisting mostly of rural municipalities, showed a higher median incidence of recreational hunters (66.97 hunters every 1000 adult residents) and a lower incidence of volunteers (0.24 volunteers every 1000 adult residents) compared to the second cluster (hunters/1000 residents = 35.38, volunteers/1000 residents = 0.65) that consisted mostly of urbanized municipalities.

Time-series analysis revealed significant differences in the 2002–2017 decline of recreational hunters between the two clusters. The number of hunters declined steadily throughout all the study area. However, the average incidence of recreational hunting was consistently lower at municipalities from the second (i.e., urbanized) cluster, with more volunteers and fewer hunters in 2011 (Table 1). These municipalities also faced a higher overall variation in the incidence of hunters (median $\pm SD = -0.42 \pm 0.09$) compared to those who had more hunters in 2011 (median $\pm SD = -0.29 \pm 0.16$). This finding confirmed our hypothesis stating that differences in the incidence of hunters and volunteers in 2011 were also supported by long-term trends in recreational hunting (H₃).

Discussion

This is one of the first studies where the multilevel model from Manfredo et al. (2009) was adopted to explain two different wildlife-related behaviors (recreational hunting and volunteering for animal protection NGOs). By considering the effects of modernization-induced socioeconomic changes over these different human-wildlife interactions, we could improve our understanding of how society regards wildlife and predict hotspots of social conflicts about wildlife. These are two highly relevant issues in contemporary conservation, characterized by stakeholders with different and conflicting interests (Decker et al., 2016; Decker et al., 2019).

In 2011, municipalities in Tuscany that were more urbanized and characterized by a higher level of education had fewer recreational hunters and more volunteers. Notably, we observed a clear segregation between two groups of municipalities. The first group consisted of urbanized municipalities with educated residents and this group had half the incidence of hunters and three times more volunteers than the other group of primarily rural municipalities. This segregation observed in the 2011 data was supported by long-term differences in hunting participation where rural municipalities faced



Figure 1. Partial dependency plots from the multivariate random forests algorithm. Effect of the proportion of urbanized surface (first row), the proportion of residents with a higher level of education (second row), and the median income per year (third row) over the incidence of recreational hunters (left column) and animal welfare volunteering (right column). Incidence is expressed as the number of hunters or volunteers per 1000 residents.

a smaller decline in hunting participation between 2002 and 2017 compared to more urbanized municipalities. These spatial differences in the distribution of volunteers and hunters in 2011, their relationships with the socioeconomic variables, and their



Figure 2. Distribution of the two clusters of municipalities in the study area: cluster 1 (dark) and cluster 2 (white).

Table 1. Output of the linear regression model (with 1st order temporal autocorrelation structure): time-specific effects and difference between the two clusters of municipalities in time.

Variable	Estimate	SE	t-value	<i>p</i> -value
Intercept	2963.05	89.4	33.13	<.01
Year	-1.44	0.04	-32.37	<.01
Cluster (Municipalities from cluster 2 vs municipalities from cluster 1)	-369.15	116.6	-3.17	<.01
Epsilon (residuals)	0.86	0.01	111.91	<.01
Year*cluster	0.17	0.06	2.89	<.01
Adjuster R ² :.87		Multiple R ² :.87		
F-statistics: 7093		<i>p</i> <.01		

association with long-term hunting trends all seem to suggest that a shift in wildlife value orientations might have occurred in the study area over the last few decades, similar to what has occurred in the United States (Manfredo et al., 2020a). We believe that future studies should test for the occurrence of this shift in detail by carrying out surveys measuring wildlife value orientations and testing for their moderating effects over attitudes toward wildlife and wildlife-related behaviors.

It is important to point out that the part of our hypotheses about the associations among income, hunting, and volunteering were not entirely supported by our analyses, as the incidence of volunteers initially declined with municipal income and then increased again. This pattern could have depended on the small size of our administrative units, as well as rural abandonment (Sallustio et al., 2018), which affects mostly younger residents who were more likely to volunteer for animal protection NGOs. We strongly encourage future cross-sectional studies to replicate our approach over wider geographical units (e.g., provinces) for which

more complex metrics of economic development are available (Calcagnini & Perugini, 2019) and should suffer less from the two biases mentioned above due to their larger spatial scale.

Apart from their theoretical relevance, our findings also raise concerns about changes in how society perceives wildlife in this study area and in the practical difficulties that will affect wildlife management in the near future. Wildlife will be managed in an increasingly fragmented context where municipalities are becoming progressively separated in their hunting participation rate and in the number of people who volunteer for animal protection NGOs. This divide will probably affect wildlife management with social conflicts that will constrain wildlife management policies and promote tensions between stakeholders and agencies. To date, limited research has suggested that these problems could arise in Italy and we believe our study is an important alarm for the potential clash of wildlife value orientations and its consequences. We believe that the emergence and escalation of these conflicts could be mitigated by disseminating information about wildlife management to diverse social groups, contrary to existing communication initiatives that mostly target hunters and farmers. Wildlife technicians should also be trained on human dimensions of wildlife. These two actions would come at a minor cost for agencies and can help to mitigate these problems.

Finally, our study also emphasizes the importance of moving beyond recreational angling or hunting in human dimensions studies. Although these are two major outdoor activities with important implications for conservation, volunteering for animal protection NGOs is becoming an important wildlife-related behavior in contemporary society that deserves more empirical attention. Understanding the spatial distribution of such volunteer behaviors with respect to that of hunters or anglers could reveal areas where social conflicts about wildlife are likely to emerge and would enable agencies to design more tailored, inclusive, and acceptable policies for wildlife management.

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Declaration Of Interest

No potential conflict of interest was reported by the authors.

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