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PERC Graduate Fellowship Research Proposal

**Motivation**

As sustainability goals evolve and influential policy decisions are made, it is essential that economists aim to provide high quality, verifiable estimates of the nonmarket benefits from these decisions, typically measured as willingness to pay (WTP). One such method for nonmarket valuation is the contingent valuation method (CVM), which uses survey instruments to effectively ask whether individuals are willing to pay a certain amount of money for a hypothetical amenity. CVM is frequently used to measure the values of goods or policies that do not yet exist (e.g., climate change measures, water quality programs, and wildlife management policies). Although CVM has become widely accepted, there remain some concerns about its reliability. A primary concern—given CVM does not actually require respondents to interact with the good—is whether an individual’s stated WTP would equal their “true” WTP if it were revealed through the market. Despite these concerns, it is necessary to use CVM because revealed prices are not always available for the good being valued. Thus, improving the reliability of CVM results is a pressing matter if we expect them to guide policy decisions.

There has been a growing body of research on best practices for CVM. A common recommendation involves scope testing to verify CVM results (Arrow et al., 1993; Johnston et al. 2017). The goal of scope testing is to examine whether WTP for an amenity varies with the change in quality or quantity of the good being provided.

Our primary contribution is toward improving the understanding of CVM validity testing in the specific context of rationed goods, i.e., a good whose quantity is fixed and is divided among individuals. Access to outdoor recreational activities is often rationed to conserve natural resources. For example, quotas on angling and hunting limit total harvest of fish and wildlife, and “bag limits” cap the harvest per person so that species can be harvested without populations declining. I focus on the specific example of permits for sandhill crane hunting in Indiana. Harvest of sandhill cranes is currently illegal in Indiana, but the Indiana Department of Natural Resources (IDNR) is considering establishing a hunting season. The IDNR would set a quota that limits the total harvest for the season and a bag limit which limits harvest per individual.

A scope test should show that WTP increases with expected harvest. However, hunters buy a permit, and hence the *chance* to harvest sandhill cranes, rather than purchasing sandhill cranes directly. Further, the expected harvest depends on the permit attributes. Credibly testing for scope effects therefore requires demonstrating a systematic relationship between changes in these attributes and changes in WTP for the permit. Yet testing for these relationships is not straightforward. As the quota increases, each hunter can expect a greater harvest all else equal. But this may induce more hunters to purchase a license, increasing competition for limited harvests. Likewise, increasing the bag limit may decrease the likelihood that an individual fills their own bag limit before other hunters’ harvests trigger the quota. This may induce fewer hunters to purchase a license, reducing competition and offsetting the effect of increasing the bag limit. Hence, changing bag limits and quotas may have countervailing impacts on expected harvest, and thus on WTP, which could make respondents appear insensitive to scope (Lancaster et al., 2024). This makes it challenging to know whether to use bag limit or harvest quota as the relevant parameter in our scope test.

I design a theoretical model that decomposes the effects of changing bag limit and harvest quota on WTP. I show that there are countervailing impacts of changing the permit on expected harvest that can mask scope effects: (i) a “direct effect” from changes in the bag limit or quota and (ii) a “congestion effect” from changes in the number of hunters caused by changes in the bag limit or quota. I find that congestion effects may attenuate WTP if the quota is binding, which could make respondents appear insensitive to changes in the permit. I also find that changing the bag limit has a more significant effect on surplus values than the quota, suggesting that it is a more appropriate parameter for scope testing. I design a survey to estimate WTP for hunting sandhill crane in Indiana to test for scope effects. I will have the data from the surveys by the time I begin the fellowship, so my next steps consist of the analysis and writing up of my results.

Our secondary contribution is estimating WTP for sandhill crane hunting in Indiana. Legalizing hunting may generate economic value in the state. Prior research has highlighted the value of sandhill cranes from birdwatching (Huber & Sexton, 2019; Stoll et al., 2006) and conservation (Boyle et al.,1994). Understanding the value of recreational hunting is important because sustainable management of fish and wildlife relies on money generated from permit sales. Twenty-nine percent of funding of the Indiana Division of Fish & Wildlife (DFW) comes from license sales, making angling and hunting permit sales significant source of funding of conservation efforts in Indiana (IDNR). To our knowledge, no prior research estimates use value for this species.

**Approach**

I use a Maximum Likelihood Estimation (MLE) procedure to estimate the joint probability that our model predicts the sandhill crane permit purchase decisions that we observe in our survey data. The utility a hunter gets from the harvest of a sandhill crane depends on the characteristics of the permit, which include bag limit, *b*, harvest quota, *Q*, the number of licensed hunters pursuing cranes, *N*, the permit price, *l*, and other unobservable attributes. Permits are assigned via a random lottery, so the probability a respondent receives a permit is p=Q/N. Let the utility of a hunter who does not purchase a permit be

1. ,

where *W* is a vector of hunter attributes, *y* is income, and *ϵ*0 is a mean-zero i.i.d. shock with a logistic distribution. A respondent who attempts to purchase a license receives expected utility,

1. ,

where *Z* is a vector of personal characteristics that only affect expected harvest. A hunter will attempt to purchase a permit if the utility from having it exceeds that of not having it. The probability this occurs is

where and .

I denote the number of registered hunters as . The number of registered hunters multiplied by the probability of purchasing a permit gives us the number of licensed hunters pursuing cranes, . Manipulating equations implies that . I substitute this into (3) and integrate over the joint distribution of *W* and *Z* to get,

where a hat (^) denotes an estimate.

With observable values of *l*, *q*, , and *b*, I follow the contraction mapping approach in Timmins and Murdock (2007) to solve for the equilibrium in equation (3’) for any given change to *b*, *Q*, and *l*. This allows me to estimate WTP under different bag limits and harvest quotas. The WTP for a license satisfies . Totally differentiating WTP with respect to the bag limit and quota yields,

I find that ∂p⁄∂b is equivalent to , where can be interpreted as the elasticity of the demand with respect to the bag limit. Assuming that a greater bag limit is more appealing to hunters, . Thus, , which implies that greater responsiveness to changes in the bag limit should drive smaller changes in WTP. I also find that ∂p⁄∂Q is equivalent to , where is the elasticity of demand with respect to the quota. If is near one, then changing the quota will have a small effect on WTP. If , then I expect and, hence, there should be significant scope effects. Finally, if , then , increasing the quota significantly increases the attenuating effect of participation, swamping the increase in the success probability from raising *Q*.

**Application**

I estimate WTP for a sandhill crane permit using survey data collected from a sample of waterfowl hunters in Indiana. The survey will be administered in February 2025 to a sample of 3,274 Indiana residents who hunted geese during the 2023-2024 season. The questionnaire is divided into four sections. The first section gathers information about respondents' experience with hunting waterfowl and other migratory game birds in Indiana. The second section provides information about sandhill cranes and presents two hypothetical permits, from which we elicit their willingness to pay. Section 3 collects data on their expenditures related to waterfowl hunting, and Section 4 asks for demographic information.

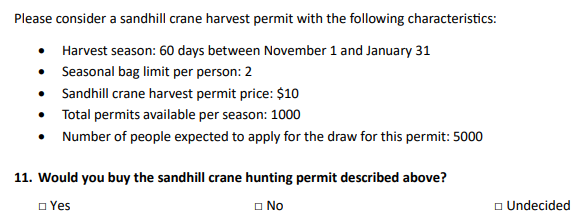
An example of the contingent valuation questions is shown in Figures 1. Before presenting the permit, I ask respondents to imagine that sandhill crane hunting is legal in Indiana and provide some details about how the permit would work. I then present a permit and ask them to consider its characteristics, responding as if it were a real permit. Afterward, I ask whether they would purchase the permit and, if not, ask about the reasons for their decision. Figure 1 demonstrates an example of the permit, though respondents may be shown different permit attributes, as I vary them as part of my identification strategy. Next, respondents are shown a second permit with different attributes, and again asked whether they would purchase it and, if they answer ‘No,’ to explain why.

Figure 1

**References**

Arrow K., Solow R., Portney, P.R. (1993). Report of the NOAA panel on contingent valuation. Fed Reg 58(10):4601–4614

Boyle, K.J., Johnson, R., McCollum, D.W., Desvousges, W.H., Dunford, R., Hudson, S., (1994). An investigation of part-whole biases in contingent valuation studies. Journal of Environmental Economics and Management 27, 64–83.

Dillman DA (2007) Mail and Internet Surveys: The Tailored Design Method. Wiley: Hoboken, N.J.

Huber, C., & Sexton, N. (2019). Value of migratory bird recreation at the Bosque del Apache National Wildlife Refuge in New Mexico. *Western Agricultural Economics Association*, *17*(2).

Indiana Department of Natural Resources (n.d.). Division of Fish & Wildlife Funding. https://www.in.gov/dnr/fish-and-wildlife/about-us/funding-and-license-sales/

Johnston, R. J., Boyle, K. J., Adamowicz, W. (Vic), Bennett, J., Brouwer, R., Cameron, T. A., Hanemann, W. M., Hanley, N., Ryan, M., Scarpa, R., Tourangeau, R., & Vossler, C. A. (2017). Contemporary guidance for stated preference studies. *Journal of the Association of Environmental and Resource Economists*, *4*(2), 319–405. https://doi.org/10.1086/691697

Lancaster, N. A., Reeling, C. J., Lee, J. G., Melstrom, R. T., Caudell, J. N., & Albers, G. (2024). Willingness-to-pay for rationed goods: Bobcat Harvest permits in Indiana. *Journal of Agricultural and Applied Economics*, 1–16. https://doi.org/10.1017/aae.2024.1

Stoll, J. R., Ditton, R. B., & Eubanks, T. L. (2006). Platte River Birding and the spring migration: Humans, value, and unique ecological resources. *Human Dimensions of Wildlife*, *11*(4), 241–254. https://doi.org/10.1080/10871200600802939