



Research article

Recreation economics to inform migratory species conservation: Case study of the northern pintail

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ABSTRACT

Quantification of the economic value provided by migratory species can aid in targeting management efforts and funding to locations yielding the greatest benefits to society and species conservation. Here we illustrate a key step in this process by estimating hunting and birding values of the northern pintail (*Anas acuta*) within primary breeding and wintering habitats used during the species' annual migratory cycle in North America. We used published information on user expenditures and net economic values (consumer surplus) for recreational viewing and hunting to determine the economic value of pintail-based recreation in three primary breeding areas and two primary wintering areas. Summed expenditures and consumer surplus for northern pintail viewing were annually valued at \$70M, and annual sport hunting totaled \$31M (2014 USD). Expenditures for viewing (\$42M) were more than twice as high as those for hunting (\$18M). Estimates of consumer surplus, defined as the amount consumers are willing to pay above their current expenditures, were \$15M greater for viewing (\$28M) than for hunting (\$13M). We discovered substantial annual consumer surplus (\$41M) available for pintail conservation from birders and hunters. We also found spatial differences in economic value among the primary regions used by pintails, with viewing generally valued more in breeding regions than in wintering regions and the reverse being true for hunting. The economic value of pintail-based recreation in the Western wintering region (\$26M) exceeded that in any other region by at least a factor of three. Our approach of developing regionally explicit economic values can be extended to other taxonomic groups, and is particularly suitable for migratory game birds because of the availability of large amounts of data. When combined with habitat-linked population models, regionally explicit values could inform development of more effective conservation finance and policy mechanisms to enhance environmental management and societal benefits across the geographically dispersed areas used by migratory species.

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1. Introduction

Many migratory species have experienced local- to continental-scale population declines attributable to numerous anthropogenic

stressors across their ranges (Baum, 2003; Harris et al., 2009; Møller et al., 2008; Robbins et al., 1989). Reductions of migratory populations threaten not only biodiversity but also societal benefits derived from outdoor recreation activities including angling (Lellis-Dibble et al., 2008), wildlife viewing (Edwards et al., 2011; USFWS, 2008), ecotourism (Bagstad and Wiederholt, 2013), and non-use values (Diffendorfer et al., 2014). Because their life cycles often span entire continents, migratory species conservation requires

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coordinated protection and management of widely dispersed habitats in their breeding, migration, and wintering areas. Such broad-scale conservation is an enormous challenge that requires collaboration among diverse stakeholders and governments (Jacobson and Robertson, 2012). Budgets for conserving migratory species are often much less than what is required for conducting management actions where they are needed most (Unger, 2007), and optimal allocation of funds for conserving these species requires detailed demographic information linked to decision models (Martin et al., 2007; Runge et al., 2014; Sheehy et al., 2011). At the same time, stressors impacting migratory species such as climate change, resource development, agriculture, and urbanization have intensified and will continue to do so, compromising managers' abilities to effectively target and fund management activities for conserving these species (Lee and Jetz, 2008; Robinson et al., 2009). Modeling frameworks are emerging that link regional-scale habitat management with continental-scale population dynamics of migratory species (Klaassen et al., 2008; Martin et al., 2007; Mattsson et al., 2012; Robinson et al., 2016). Conservation strategies based on these habitat-linked population models could further benefit from spatially congruent economic information that resonates with the public and policy-makers while offering innovative means for conserving cross-border migratory species (Semmens et al., 2011; Sultanian and van Beukering, 2008).

Ecosystem services – the benefits nature provides to society – are used to integrate ecological and social concerns in decisions about natural resource management (Daily et al., 2009; Maes et al., 2012; Millennium Ecosystem Assessment, 2005). Migratory species are increasingly recognized as providing important recreation (i.e., hunting, fishing, and viewing) services to diverse human beneficiary groups (Diffendorfer et al., 2014; Green and Elmsberg, 2014; Kunz et al., 2011; Semmens et al., 2011). The recreation services and associated economic benefits of a given migratory species are often not distributed uniformly across the species' range. Economic analyses of services provided by species and ecosystems to inform migratory species conservation, however, typically have focused either on a single portion of a species' geographic range (Cleveland et al., 2006; Stoll et al., 2006), or on groups of species (Boyle et al., 1994; Cooper and Loomis, 1991; Edwards et al., 2011). Spatial information gaps regarding the economic costs and benefits of migratory species conservation limit managers' and policymakers' ability to make resource-allocation decisions for habitat management among regions. Filling these gaps will involve quantifying services and economic benefits provided by individual migratory species among the major portions of their ranges (Bagstad and Wiederholt, 2013; Diffendorfer et al., 2014; Semmens et al., 2011).

Migratory waterfowl in North America (henceforth, waterfowl) offer an excellent example for linking biological and economic information to inform conservation funding allocation among disparate regions. Their great societal appeal garners economic benefits, but maintaining their populations and international-scale migrations requires engagement of geographically and politically diverse entities, including across national boundaries (Cooperation, 2015; North American Waterfowl Management Plan Committee, 2012). In North America, multiple entities allocate funding for waterfowl conservation (The Trust for Public Land, 2010; US Department of the Interior, 2017; USFWS, 2012). These efforts could benefit from economic assessments of waterfowl-related recreation that help inform strategic disbursement of funds for habitat acquisition and management.

Regular economic assessments of migratory bird hunting and viewing are conducted throughout much of the US and Canada (e.g., USFWS, 2008). Hunters collectively spend significant sums of money each year pursuing migratory game birds (Arnett and Southwick, 2015). For example, hunters in the US spent \$1.81

billion in 2011 pursuing migratory game birds (USFWS, 2011), of which \$1.36 billion was spent hunting waterfowl (Carver, 2015). Waterfowl viewing generates even more economic activity compared to waterfowl hunting. During 2011 participants in the US spent \$41 billion viewing all birds, with nearly one third of birders viewing waterfowl away from home (Carver, 2013). Semi-decadal surveys of wildlife-related recreation provide information on the number of participants, time spent conducting various activities, and expenditures on migratory bird-focused recreation. These surveys do not provide estimates for individual species, which constrains economic analyses focused on individual species or guilds. There are, however, data sources from which species-specific proportions of waterfowl viewing or hunting can be derived for particular regions (Dickinson et al., 2010; Gendron and Smith, 2016; USFWS, 2008; Wood et al., 2011).

Our study assesses regional differences in the economics of recreation associated with an individual migratory species among the primary portions of its range and across its annual cycle. The northern pintail (*Anas acuta*, henceforth pintail) in North America is an excellent subject for such an economic analysis. Pintails are a priority species for conservation by the U.S. Fish and Wildlife Service (USFWS) along with its federal, state, and nongovernmental partners (Guyn et al., 2003; USFWS, 2015), and this dabbling duck species has been particularly important to hunters and birders in the western U.S. (Miller and Duncan, 1999; Wesley and Leitch, 1987). Their North American range includes three primary breeding areas (Alaska, portions of the Yukon Territory and the Northwest Territories in Canada, and the Prairie Pothole ecoregion of the U.S. and Canada) and two primary wintering areas (the west coast of the U.S., and the panhandle of Texas and Gulf Coast areas of Texas and Louisiana) (Mattsson et al., 2012) (Fig. 1). Our objective for this illustrative case study is to quantify the economics of recreation associated with pintails (henceforth, pintail-based recreation) in their primary breeding and wintering areas of North America. We distinguish two main forms of recreation: sport harvest by hunters and viewing by birders. Within each type of recreation, we also distinguish two economic measures that provide a management and policy-relevant economic assessment: expenditures and consumer surplus. Expenditures are monies spent by recreationists on travel, lodging, supplies, and equipment. Consumer surplus, on the other hand, is money recreationists would be willing to spend above and beyond their expenditures, for example if lodging costs were to increase. Here we refer to the sum of annual expenditures and consumer surplus as the combined economic value associated with pintail recreation. To our knowledge, this represents the first economic assessment of recreation services provided by a single migratory species across multiple breeding and wintering regions at a continental scale.

2. Methods

2.1. General approach

We estimated the economic values associated with viewing and sport harvest of pintails within major breeding and wintering areas across the U.S. and Canada. To derive these estimates we used published information on birding and hunting activities, expenditures, consumer surplus for each focal geography (Table 1). Consumer surplus is the additional amount of money that a birder or hunter would be willing to spend for the recreation opportunity beyond what they already pay. We use expenditures and consumer surplus as complementary economic metrics that together more fully characterize the economic benefits provided by pintails (Loomis et al., 2008). In this context the consumer surplus is the dollar amount available, above and beyond existing expenditures,

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