

Understanding the Value of Wildlife in Pennsylvania

Melissa M. Kreye, Assistant Professor, Department of Ecosystem Science and Management, Pennsylvania State University

March 21, 2019

Why examine the economic value of wildlife?

The primary threat to wildlife populations in the US is loss of habitat, due to changes in ecosystem management and the conversion of land to other uses. Economic drivers are primarily responsible for these changes. However, emerging research has found the local economy and communities can be made better off by increasing wildlife diversity through forest conservation (Figure 1). This means wildlife management is not just for the sake of helping wildlife, but wildlife management can also help enhance human health and wellbeing.

Sometimes when we think about wildlife, we may consider some of the negative experiences we have had (e.g., racoons in the garbage). We may also think about some positive interactions we have had with wildlife (e.g., song birds in the backyard). However, *individual experiences with wildlife represents only one aspect of the many ways that humans are connected with our non-human allies*. This article examines the ways humans and wildlife are connected, apart from individual experiences, and the economic value of these relationships.

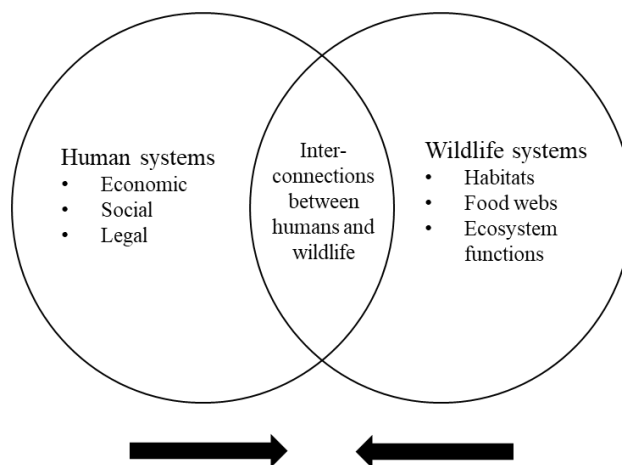


Figure 1. A conceptual model of the inter-connections between humans and wildlife.

Wildlife and Ecosystem Services

Ecosystem Services are the services that nature provides that enhances human health and wellbeing (Daily, 1997). For example, natural areas, such as forests and wetlands provide clean water and beautiful vistas which people value. Wildlife species also provide valuable services to society in much the same way.

The following ecosystem services are often provided by wildlife.

- *Provisioning services* are the products and materials obtained from wildlife that can be used as food or help in the creation of other products and materials (e.g., glue, lubricants, cosmetics).
- *Cultural services* help describe the recreational value of direct experiences with wildlife, and the protection value of wildlife (i.e., the benefits of knowing and caring about wildlife)
- *Ecological-supporting services* relates to the important role that wildlife has in keeping ecosystems healthy.

In this paper, we focus on the value of wildlife ecological-supporting services and wildlife protection value (a cultural service). These types of values do not depend on people's individual experiences with wildlife and help describe the broader value of managing for wildlife.

Ecological-supporting Services

The ecological services provided by wildlife are part of the natural behaviors of wildlife that helps keep ecosystems healthy. Some of the most important ecological services provided by wildlife includes *pest management*, *pollination*, and *seed dispersal*. Without these services natural areas would become degraded and desolate, and cultivated landscapes would struggle to produce.

Because many ecological services underpin ecosystem health and environmental quality, the importance of these services cannot be understated. However, there are ways to meaningfully describe the economic importance of these services. One way is to assess what it would cost to use human technology to do the same job as a wildlife species (i.e., replacement value). Another approach is to estimate how wildlife protect economically valuable resources or help humans avoid economic losses (i.e., damage avoidance).

Pest Management

Many types of wildlife species, including predatory insects, birds, amphibians, reptiles, and small mammals, contribute to pest-management (Holmes et al., 1979; Hocking and Babbitt, 2014; Losey and Vaughan, 2006). In fact, so many animals depend on insects for food it is estimated up to 99% of potential pests are eliminated in natural ecosystems (Naylor and Ehrlich, 1997). The value of pest management services is most evidence when there is a positive impact on nearby agricultural resources (i.e., damage avoidance). A global study found the value of natural pest control in agricultural settings ranges between \$54 billion and \$1 trillion, and includes reductions in both crop losses due to pests and direct/indirect costs of pesticide use (Pimentel et al., 1991).

Forest birds are particularly skilled at managing potentially harmful pests in forest ecosystems. For example, birds in temperate deciduous forests reduce up to 90% of the moths and larvae on forest understory vegetation. The largest reductions tend to coincide with nestling and fledgling periods of the nest cycle (Holmes et al., 1979). The Emerald Ash borer is an invasive beetle that has the potential to wipe out many of the ash trees in the U.S. If left unabated, the potential costs of emerald ash borer treatment, ash tree removal, and replacement is estimated to be \$10.7 billion (Kovacs, 2010). Bark foraging birds (e.g., woodpeckers) contribute to emerald ash borer control by foraging more heavily on trees that are infested with the beetle. In some conditions bark foraging birds could reduce economic costs of the emerald ash borer by over 80% (Flower et al., 2014; Kovacs et al., 2011). Populations of bark-foraging bird species, and their pest control services, can be enhanced by maintaining snags and nesting sites during and after forest pest outbreaks. Unfortunately, North American populations of insectivorous birds are in decline. With fewer birds to provide pest management services, potentially higher numbers of tree damaging insects will likely reduce forest productivity (Marquis and Whelan, 1994).

Pollination

Pollination is the act of transferring pollen grains between plants of the same species to produce seeds. Pollination is necessary for maintaining species diversity in natural ecosystems as well as productivity on agricultural lands. To ensure success, different plant species have evolved to attract specific types of pollinators. Native pollinators include different species of birds, bats, bees, butterflies, beetles, and other small mammals.

Agriculture is fundamental to Pennsylvania's economy (annual export value of over \$1 billion). Importantly, almost 80% of PA's crops (by type not by quantity produced) are dependent on insect pollination (PDA, 2019). A report by the PA State Beekeepers Association stated that domesticated bees in PA have a value of \$60 million annually (PSBA, 2019). Another nationwide study that found native pollinators provide approximately half of all pollination services (Losey and Vaughan, 2006). This suggests that the value of native pollinators in PA is likely competitive with the value of domesticated bees.

Forests are important habitats for pollinators and forest conservation around agricultural areas can help enhance the pollination services of native pollinators. A study in Brazil found farms that maintained forested areas near their agricultural fields had a 14.6% increase in the production of coffee due to native pollination services (De Marco and Coelho, 2004). Unfortunately, the chemical fertilizers, pesticides, and herbicides used in agricultural settings often harms pollinators. Recent declines in honeybee numbers, due to colony collapse disorder, highlights the need for protecting diverse wildlife species to serve as crop pollinators.

Seed Dispersal and Germination

Seed dispersal and germination are among the most important ecosystem services provided by many types of wildlife. Seeds are often distributed through the eating of fruits and the digestive process. Seeds can be actively transported by wildlife and stored in caches to be consumed in the future. Seeds are also passively transported by attaching to the fur of moving animals.

Nearly 33% of bird species disperse seeds, primarily through fruit consumption, but also through scatter-hoarding of nuts and conifer seed crops. Birds help distribute many types of economically valuable trees, including pines, beech, oak, gum, sassafras, and fruit trees. A study conducted in Sweden found the replacement value of the oak seed dispersal services provided by the Eurasian Jay ranged between \$875 and \$3,916 per acre (depending on the seeding or planting technique; Hougner et al., 2016).

The way seeds are distributed and planted by different wildlife species also contributes to the success of the plant. A study in Brazil found the seeds of a native tropical flowering plant were three times more likely to germinate when distributed by a tree frog rather than a lizard (Fialho, 1990). Thousands of plant species rely on ants to disperse their seeds and many plants use special lures to encourage ants to carry the seeds away (Handel and Beattie, 1990). Many types

of ants have a life-long positive relationship with trees. In northern areas of the US where there are few earth worms, ants help create the topsoil that allow for successful tree seed germination. Ants help mature trees by removing sap feeding pests, and help recycle trees into soil again by breaking the down rotten wood of dead trees (American Forests, 2014).

Forest fragmentation can have a negative effect on native seed distribution services. A recent study found animal-dispersed tree species was 3–40 times lower in forest fragments compared to larger forests, while seedling recruitment among wind-dispersed species was unaffected by fragmentation (Whelan et al., 2008). Seed dispersal by animals is also less common on degraded lands where forests have been removed, because some wildlife are less likely to occur in degraded areas (Duncan and Colin, 2002). Animals can also help distribute the seeds of invasive plants (e.g., blackberries, burning bush) over long distances and into new areas.

Cultural Services

Protection value or “nonuse” value makes up much of the total value people associate with ecosystems and wildlife. Understanding the protection value of wildlife is important for supporting policies and programs that enhance land conservation and habitat management.

There are several ways that people benefit or value the protection of wildlife. *Existence value* describes the satisfaction associated with knowing that a species exists. *Bequest value* relates to the benefit of knowing that your children and grandchildren will live in a world where certain kinds of wildlife exist. *Option value* is associated with the knowledge that wildlife and related ecosystem services will be available in the future, to use or not use.

To understand the economic value associated with protecting wildlife, economists will often collect data describing how much people vote or donate to support wildlife conservation. For example, since 1988 voters in Pennsylvania counties and townships passed a total of 131 rural measures authorizing over \$1.1 billion in tax payer dollars to support farm land and natural areas protection (LandVote, 2018). These types of data help express the importance of rural land conservation for wildlife and other uses. However, voter data offers little understanding of public preferences for specific management alternatives.

To understand tradeoffs among different management options, economists will use surveys methods to ask respondents what they would be willing to pay (WTP) for specific outcomes. For

example, a study conducted in New England found average household willingness to pay for the preservation of the bald eagle to be \$19.28 annually, wild turkey was \$11.86 annually, and Atlantic salmon was \$7.93 annually (Steven et al., 1991). Respondents assigned only 7% of their payments to support recreational uses of these wildlife, indicating much of the value associated with these species was protection value.

Charismatic species such as the Bald Eagle- a symbol of American values about freedom and democracy- tend to have a large protection value for many people. Amphibian and reptile species are often less charismatic (e.g., less attractive or not associated with human thoughts or actions) and therefore tend to have a lower protection value. The protection value of wildlife species can be enhanced by exposing people to wildlife (i.e., having meaningful experiences) and learning about wildlife (i.e., ecological and scientific considerations). Protection values are less often affected by the number of species in a population (assuming that the population can remain healthy), and distance from the wildlife population.

Conclusion

Many types of wildlife have a high ecological and protection value. Looking at individual species, however, offers an incomplete picture of the total value of an ecosystem. Still, to support policies and programs that advance wildlife protection, it is useful to examine the specific ways that wildlife help enhance human health and wellbeing.

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