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Commentary

Commentary on economic valuations of biodiversity

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ABSTRACT

Our planet's biodiversity is in steep decline. Assigning economic values to the impacts of this decline can be very useful in overcoming economic-based objections to sustainable policies at all levels of government. However, economic valuations that are not based on sound scientific analysis threaten to undermine the credibility of ecological valuations in general and could also lead policy makers to misallocate the limited resources available for conservation efforts. Researchers at Cornell University have introduced a valuation into several peer-reviewed journals that asserts that each individual bird in the United States has an average economic value of $30, and they use this valuation to estimate the economic impact of various causes of bird mortality. The $30 valuation is explained with a single sentence that lacks any discernible scientific analysis and can at best be considered a symbolic valuation. While this valuation garnered widespread media attention, it creates a dangerous precedent and could ultimately do more harm than good to native bird populations. As such, further discussion of the role of symbolic valuations in the scientific literature is warranted.

The United Nations' third Global Biodiversity Outlook (Anon., 2010a) report paints a stark picture for the future of our planet's critical ecosystems. Not only does the report warn that "the diversity of living things on the planet continues to be eroded as a result of human activities" but also that "the pressures driving the loss of biodiversity show few signs of easing, and in some cases are escalating." One of the obstacles standing in the way of more environmentally friendly government policies, especially in tough economic times, is the perception that such policies are "job killing," "anti-business," or otherwise bad for the economy. As the UN report notes, helping policy makers at all levels of government to better understand the economic benefit of biodiversity can be critical to overcoming such objections.

Potential problems arise, however, when scientists are tempted to publish inflated economic valuations that are not grounded in sound science or supported by relevant data, but are rather more symbolic in nature. While such symbolic valuations may provide short term media value by generating provocative headlines, they threaten to undermine the credibility of more legitimate valuations over the long term and to create a perception among decision makers and the general public that valuations of biodiversity do not reflect real economic impact. The consequences of that erosion in credibility and public trust could be devastating as governments deal with such important global issues as climate change, overfishing, and deforestation. Symbolic valuations could also lead policy makers to allocate limited conservation resources in ways that do not provide the greatest economic or ecological return on investment.

A good example of this type of unscientific economic valuation first appeared in a 1992 issue of Bioscience (Pimentel et al., 1992) and was repeated in a 2005 issue of this journal (Pimentel et al., 2005), as well as in many other peer-reviewed journals in between (Pimentel, 2002; Pimentel et al., 1998, 2000). In each publication, Pimentel and various co-authors conclude that each individual bird in the U.S. has an average economic value of $30. In each instance, that conclusion rests on three statistics reporting per bird expenditures for observing, shooting, and rearing individual birds. This $30 valuation was not published as its own study, but is rather just one estimate included in several larger studies relating to the environmental impact of pesticides and invasive species. In the 2005 Ecological Economics publication, the entire justification of the $30 valuation is condensed into a single sentence:

> This cost per bird is based on the literature that reports that a bird watcher spends $0.40 per bird observed, a hunter spends $216 per bird shot, and specialists spend $800 per bird reared for release; in addition, note that EPA fines polluters $10 per fish killed, including small, immature fish (Pimentel and Greiner, 1997).

In several publications of this estimate, including the 2005 Ecological Economics publication, the authors multiplied their $30 valuation by an estimate of the number of birds killed by feral and free-roaming

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domestic cats to conclude that "the total damage to U.S. bird population is approximately $17 billion/year." Because the impact of feral cats on native wildlife and disputes over how best to reduce their number have become highly contentious issues, this estimate gained widespread attention in 2010 when it was repeated in a University of Nebraska Extension School literature review on the topic (Hildreth et al., 2010). The $17 billion estimate has been cited in an American Bird Conservancy press release (Anon., 2010b), an Audubon Magazine article (Anon., 2010c), The Wildlife Professional's Spring 2011 issue devoted to feral cats (Dauphine, 2011), a recent peer-reviewed study in Conservation Biology (Lohr et al., 2013) and hundreds of conservation web sites and mainstream news outlets.

The merit of the $30 valuation and other economic estimates that depend on it can be evaluated on two levels: 1) does the valuation adhere to basic scientific and economic principles and 2) if it does not, ought such shortcomings to be overlooked in the interest of a greater ecological good, such as increased media coverage of important topics like pesticide use and invasive species? The arguments against the scientific validity of the valuation are as follows:

1) *Multiplication error.* The authors estimate that feral cats kill 240 million birds per year, and that the value of each bird is $30. They then conclude that "Therefore, the total damage to U.S. bird population is approximately $17 billion/year." However, 240 million multiplied by 30 is 7.2 billion, not 17 billion. Since earlier versions of this estimate, which included both feral cats and free-roaming pet cats, did come to $17 billion, the error is almost certainly the result of excluding free-roaming pet cats from the updated estimate but leaving the old result intact. The error is relevant to this discussion only in that a discrepancy of this magnitude (almost $10 billion, more than a 58% difference) is more likely to go unnoticed in a purely symbolic estimate, designed to make a provocative point with some large number, than in a scientific estimate that seeks to measure real economic impact with some degree of accuracy and precision.
2) *No explanation of underlying math.* The authors do not explain how they calculate their $30 valuation based on the underlying statistics of $0.40, $216 and $800 for seeing, shooting or rearing a bird respectively. Even if we were to create some sort of weighted average on their behalf, we would have to assume unrealistically high proportions of wild birds being either harvested by hunters or reared in captivity in order to arrive at the $30 result. Such a weighted average would require a much more detailed analysis to support the authors' conclusions. For instance, only a small number of wild bird species can be legally hunted under the Migratory Bird Treaty Act, and the vast majority of wild birds are not reared in captivity.
3) *Misapplication of data.* Simply dividing one number by another number does not infer a correlation between the two numbers. For instance, dividing total National Football League revenues by the total number of players on NFL rosters creates an average (revenue per active player), but one that has no economic relevance. There is no reason to believe that simply increasing team roster sizes would yield increased revenues for the league.
   Likewise, simply averaging all bird-related revenue over every bird observation or every shooting or rearing of a bird does not provide us with meaningful economic information. Revenue related to bird watching activities is driven heavily by a desire to see "target" species for a particular area, as well as the overall experience of visiting that area. For instance, the desire to see even a single Colima Warbler or Lucifer Hummingbird is a significant incentive for bird watchers to visit Big Bend National Park in Texas (Anon.; Anon.). Overall numbers of more common birds are far less impactful (exceptions might include spring migration at High Island, Texas or Sandhill Crane migration along the Platte River in Nebraska).
   In fact, while ecologically undesirable, extirpation of certain species from certain locales could actually increase bird related economic activity by creating the need for travel where none previously existed. For instance, numerous bird watchers travel every year to Aransas National Wildlife Refuge in Texas to view federally endangered Whooping Cranes (Anon.). This economic activity would be unnecessary if Whooping Cranes still occupied their larger historical range (Anon.) and could be viewed in much of the United States without travel.
4) *Inaccurate factual claims.* The authors assert that "EPA fines polluters $10 per fish killed, including small, immature fish." Beyond the questionable relevance and application of that figure (see points 6 and 8), this statement is not supported by the source provided. The Pimentel and Greiner study (Pimentel and Greiner, 1997) references a 1991 Associated Press article (Anon., 1991), which in turn references a single incident that was handled at the state level with limited federal oversight. That article suggests only that the polluter "**could be** fined **up to** $10 per dead fish" (bold added) and other articles written after the fine was actually levied (Anon., 2001) indicate that the fine for that incident was closer to $3 per fish and that Coors was only required to make a donation of less than $2 per fish for a similar incident in 2001. In his 1992 paper, Pimentel included the conditional phrases "might be" and "up to" but dropped them in later estimates in favor of the more absolute but less accurate "the EPA fines" language (see also point 10).
5) *Principle of supply and demand ignored.* Even if one believes that individual birds could be monetized as units of product, suggesting that economic benefit is directly proportional to inventory of product is inconsistent with the fundamental economic principle of supply and demand. A widget maker cannot simply double its revenue by doubling its output of widgets. Likewise, there is no reason to believe that simply increasing the number of birds by a certain percentage would also increase the disposable income that bird watchers, hunters, and breeders spend on their respective avocations by that percentage, or even at all. Just as importantly, the authors do not incorporate basic principles of population dynamics into their analysis, ignoring the important relationship between bird mortality and bird reproduction. Unlike most products, birds can replenish themselves without additional manufacturing costs. Since reproductive success is related to the carrying capacity of available habitat and other factors, the economic impact of the mortality of a single bird would, at a minimum, depend on whether that mortality event resulted in a net loss to the overall population.
6) *Equating fines with economic value.* Fines tend to be punitive in nature and are typically much larger than the actual economic impact resulting from the offending action. For instance, a metered parking space may cost only 25 cents for 15 min, but a meter that has expired by only a few minutes could easily incur a fine in the neighborhood of $50. In his 2002 book, Biological Invasions, Pimentel uses the terms "EPA fines" and "EPA values" interchangeably, but those terms have different economic meanings.
7) *No margin of error provided.* Because of its reliance on self-reported survey data, the valuation in question would necessarily have a considerable margin of error, yet none is provided. Bird watchers know that even counting a single flock of shorebirds accurately can be a formidable challenge, let alone every bird seen by every birdwatcher across the entire country over an entire year. Adding self-reported expense data into the equation would add to the margin of error. Not including a margin of error further reflects a symbolic approach to the valuation.
8) *Questionable comparison of birds and fish.* Using the value of one thing to help determine the value of another is a common and useful practice, but only if there is some logical connection between the two things. Real estate agents compare homes based on size, number of bedrooms and bathrooms and other attributes. Professional athletes often have their salaries arbitrated based on their performance metrics (e.g. batting average or earned run average)