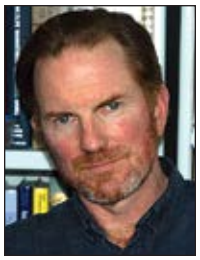
A WICKED ISSUE



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The issue of lead versus non-lead ammunition has been a divisive factor within the hunting and wildlife conservation community for decades. Consider this statement:

> ***"The accounts of the destruction of ducks, geese, and swans by lead-poisoning which are printed on another page bring to public attention a new element of danger to our wildfowl, and one for which a remedy will be hard to find."***

This was written by George Bird Grinnell, co-founder of the Boone and Crockett Club in 1894 (*Forest and Stream vol. XLIL No. 6*). It took 100 years for a remedy to be developed, and that remedy was mandated by the courts making it illegal to use lead shot for waterfowl hunting.

Fast forward to today, and the issue in the forefront is the use of lead versus non-lead bullets for big game hunting. Concerns have been voiced over toxicosis and deaths of California condors, bald and golden eagles, and other raptors. The source of lead is in gut piles or unrecovered carcasses.

The issue has been co-opted by anti-hunting groups intent to find legal means to pursue their agenda to end all hunting. For the ammunition industry, the development and manufacturing of non-lead alternatives requires significant retooling and investment, and the fact is that most bullets (73.4 percent) are used for non-hunting purposes such as target shooting. However, non-lead ammo for hunting is available in many calibers and gauges, and certain manufacturers have been very proactive in the development and promotion of these products.

Regardless, elimination of lead in ammunition is considered by the industry to be one of the greatest threats to their survival. Advocacy of lead elimination by anti-hunting groups has put the hunting community, and many wildlife conservationists, in a defensive mode, reluctant to advocate for something anti-hunters are championing. This has become what is known as a "wicked problem." A wicked problem is a social or cultural problem that is difficult or impossible to solve for as many as four reasons: incomplete or contradictory knowledge, the number of people and opinions involved, the large economic burden, and the interconnected nature of these problems with other problems.

Incomplete knowledge on this issue is presented in the form of "population-level impacts." Arguments are made that there is no evidence that bald eagle populations, for example, are declining due to lead poisoning (the court decision banning lead shot for waterfowl hunting was not based on population impacts). This assumes that it is okay if individual eagles die from lead ingested from gut piles and unrecovered carcasses, as long as it doesn't cause declines at the population level. Since eagle populations are on the increase, why does it matter?

I would like to share some insights from my colleague, Dr. Gary White, professor emeritus at Colorado State University, current president of The Wildlife Society, and avid hunter. Recognized as one of the foremost wildlife population scientists in the history of the wildlife profession, Gary explains it this way:

"For one approach to statistically test for population level effects, we would consider an estimate of the trend line for a series of estimates. Each of these estimates will have an associated standard error, i.e., the values are estimates only known within some level of precision. The null hypothesis of this test is that there is no trend, either upward or downward, to this series of population estimates. Consider the two scenarios that can happen when we conduct this statistical test.

First, we reject the null hypothesis and conclude that there is a statistically important trend. If we conclude this trend is upward, we might want to conclude that lead from hunting is not affecting the population. But the trend might have been even greater if lead could have been removed from hunting. Thus, we cannot conclude from a positive trend that lead is not having an impact. Alternatively, suppose we conclude that there is a statistically important downward trend. One interpretation might be that lead is causing this population to decline, but an equally viable interpretation is that other sources of mortality or decreased reproduction are causing the downward trend.

Second, we fail to reject the null hypothesis. What can we conclude—absolutely nothing. We have learned nothing. Most notably, we cannot conclude that the population is not changing—either upward or downward. When a null hypothesis is not rejected, the null hypothesis is not proven to be correct; rather, the null is not "accepted." There may be a trend in the population, but we lack sufficient data to reject the null. This is known as a Type II statistical error when there is a trend, because our data lack the power to determine if there is a trend in the population.

I submit that the most likely outcome of any test for a trend to assess population level effects will be that the hypothesis is not rejected. Population estimates on most species are fairly imprecise, i.e., large standard errors. In addition, populations fluctuate based on annual conditions, i.e., hard winters, droughts, etc. To detect population trends given imprecise estimates and temporal variability requires a nearly impossible effort (meaning way more money than we are willing to spend).

What must be done when the null is not rejected is to then compute the power of the test for various effect sizes and sample sizes. How large would the trend have to be before we could have rejected the null with the current sample

Want to read more? The article *Lead Hunting Ammunition; Factors to Consider if You Will Make the Switch,* by Justin Spring, can be found in the Spring 2020 issue of *Fair Chase* and on Boone-Crockett.org.

size/effort? How large would the sample size have to be before the estimated trend we observed would be considered statistically significant? Can we ever detect changes in the population rate of change given the observed temporal variation? The population ecology literature provides numerous papers on these techniques.

My conclusion is that wildlife biologists should never suggest that lead from hunting is not affecting a population because trends in a population were not observed. We seldom have such powerful data to make that inference.

A second approach to study population level effects is more mechanistic. As an example, a recent paper on nestling golden eagles correlated physiological and growth responses to their lead levels, with the lead in question identified isotopically as coming from ammunition *(Herring, G., C. A. Eagles-Smith, J. A. Buck, A. E. Shiel, C. R. Vennum, C. Emery, B. Johnson, D. Leal, J. A. Heath, B. M. Dudek, C. R. Preston, and B. Woodbridge. 2020. The lead (Pb) lining of agriculture-related subsidies: enhanced Golden Eagle growth rates tempered by Pb exposure. Ecosphere 11:e03006.)*. What this paper did not do was demonstrate that lead levels resulted in changes in survival or reproductive rates. To go this next step requires a long-term study of marked individuals to demonstrate that fitness was related to these nestling lead levels, either through decreased survival or decreased reproduction, or both. Certainly, our knowledge of lead toxicity would suggest there might well be impacts but obtaining hard numbers on changes in survival or reproduction is demanding. As with monitoring populations discussed above, such a study requires a nearly impossible effort (meaning way more money than we are willing to spend). If such a study is available, a population model can then estimate the rate of change in the population as a function of lead levels.

In summary, failure to detect a change in a population, or failure to relate physiological and growth responses to survival and reproduction, does not qualify as no population level effect. We do not want to hang our hats on this deceptive peg of no population level effect."

I'll repeat Gary's concluding words: "We do not want to hang our hats on this deceptive peg of no population level effect."

Copper solid mushroomed bullet on left; fragmented lead bullet on right.

Further aspects of incomplete knowledge pertain to performance and efficacy of non-lead ammunition. In a current study I'm involved in that assesses impacts to society associated with use of alternative ammunition for hunting whitetail deer on national wildlife refuges, some hunters claim "the copper solid is not mushrooming," or "you're not getting that transfer of energy." Further, "your chance of maiming the animal is greater." These statements were made by hunters opposed to alternative ammunition, and who have had no direct experience. The highest chosen influence that would cause these hunters to switch to non-lead was knowing the performance would be similar to lead in accuracy and killing efficiency.

Another element of a wicked problem is the number of people and opinions involved. This issue squarely fits that criterion. Quite often polarizing issues involving strong opposing views and lack of trust are eventually settled in the courts. Do we want this to be the end game on the lead versus non-lead issue? I certainly do not.

I would like to see the conversation led by professional wildlife managers and scientists, in concert with the industry, to position key stakeholders to engage in intelligent discourse. In other words, I would like to see leadership from within our community to reclaim the issue and prevent further hijacking from those with a political agenda who are opposed to hunting. Our research on national wildlife refuge deer hunters demonstrates that "trialability"—actual field demonstrations of ammunition performance—is the best way to cultivate an informed hunter community. There are over 500 national wildlife refuges, considerably more state wildlife management areas, and thousands of rod and gun clubs with shooting ranges in this country that could hold these field demonstrations. Opportunities are there.

Personally, I have converted to non-lead ammunition for big game hunting. I have done this not because as a scientist I have pored over data and made inferences from them, but because I believe it is the right thing to do. I believe that being an ethical hunter involves not only respect for the animal you hunt, but for all wildlife and the environment. Also, I do not want to be feeding my family and friends food that has traces of lead in it. This is my personal choice. How long, we may ask, will this be a matter of personal choice? If we in the conservation community do nothing and let others control the agenda, the courts may ultimately determine our choices. However, if we put political baggage aside and focus on developing valid reliable information to provide to the hunting community on what options are out there, how they perform compared to lead, and why the future of hunting depends on hunters taking the high ground, we can ensure that voluntary choices will remain. ■