

Challenges and Opportunities for the Wildlife Damage Management Profession in the Face of Expanding Wildlife Populations: An Extension Perspective

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ABSTRACT: Many wildlife populations are expanding both their range and population densities given effective management practices. This wildlife expansion, combined with concomitant human expansion, has led to increased human-wildlife conflict in many parts of North America. Managing these conflicts has become more difficult given increased regulation on many management tools, leading to a need for new, effective strategies for mitigating these conflict situations, as well as a clearer understanding of how current management practices influence both target and non-target wildlife. A greater and more focused effort on education and outreach is needed to clearly inform all parties about true versus perceived risks associated with controversial management strategies given that the general populace will likely drive most future wildlife damage management regulation. As wildlife scientists, our goal should be to allow society to make management decisions that are based on sound science rather than on limited data sets, or worse yet, conjecture or social dogma. Such a strategy would allow for management programs that are both socially acceptable and effective in minimizing human-wildlife conflict.

Key Words extension, predator, regulation, research, rodent

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Wildlife provide many positive attributes including physical utility, recreational, and ecological values (Conover 2002). However, wildlife often come in conflict with humans as well. This applies both to native (e.g., coyotes [*Canis latrans*], pocket gophers (Geomysidae), voles [*Microtus* spp.]) and non-native species (e.g., rats [*Rattus* spp.], house mice [*Mus musculus*], wild pigs [*Sus scrofa*]), with such conflict often resulting from expanding wildlife populations. Recent expanse of wildlife populations and concomitant human-wildlife conflict has occurred for a variety of reasons including changes in how land is managed, intended and unintended supplementation of wildlife diets, and better regulation of harvest (Timm et al. 2004, Hristienko and McDonald 2007).

Not surprisingly, managing human-wildlife conflict in the face of expanding wildlife populations is difficult and becoming

more complicated. In many situations, we have the tools to remediate these conflicts, but increasing regulation and changing public opinion limits what can be done. The management of burrowing rodents provides a great example, where anticoagulant rodenticides have recently become restricted-use pesticides (Hornbaker and Baldwin 2010), an extended buffer zone has been enacted around buildings where certain burrow fumigants can be used (e.g., aluminum phosphide, Baldwin 2012), and trapping has been banned in some states (e.g. Washington). Similar restrictions have been observed with commensal rodents in California, where second-generation anticoagulants have become restricted-use products, are currently banned in some areas, and may be banned statewide in the future (proposed California Assembly Bill 1687). This has substantial impacts on human health

and safety given potential disease transmittance and structural damage caused by these rodents, not to mention the damage these species cause to the agricultural industry (Pimentel 2007).

There have also been increases in human conflicts with predators in recent years, largely due to both expanding predator and human populations (e.g., black bear [*Ursus americanus*], Hristienko and McDonald 2007; wolf [*Canis lupus*], Treves et al. 2004; coyote, Gompper 2002). During this same timeframe, we have seen increased restrictions on the use of lethal tools for managing predators including complete protection status, restrictions on hunter take, and changes in trapping laws (Manfredo et al. 1997, Wolch et al. 1997, Hristienko and McDonald 2007). This has led to a proliferation of non-lethal management tools that have often proved effective (Miller et al. 2016). However, there is some concern as to the long-term effectiveness of these non-lethal approaches when lethal removal is concurrently eliminated given the need for many of these non-lethal approaches to induce a fear response in the predator (e.g., repellents and frightening devices; Conover 2002). Indeed, there has been a substantial increase in pet and human attacks by coyotes in many residential areas where coyote removal is largely absent (Timm et al. 2004, Baker 2007, Quinn et al. 2016).

Of course increasing regulation is not the only limitation to effective management of human-wildlife conflict, as limited supplies have reduced the use of some management tools (e.g., strychnine shortage; Baldwin et al. 2017), while further technological development for other potential management options is needed to fully realize their utility (e.g., bait box for wild pig management; Campbell et al. 2013). There is also a strong need for more information on species' biology life requisites, as this knowledge can

greatly influence the effectiveness of management programs (Baldwin et al. 2014).

Is research the answer?

With all of these potential challenges, there is a need to identify effective solutions. Certainly, research could address many of these issues. For example, continued research is needed to better understand the potential impacts that anticoagulant rodenticides have on non-target species. How prevalent is exposure, and does exposure relate to impact? Current data on exposure often comes from biased sources (e.g., dead or injured individuals; Ruiz-Suárez et al. 2014, Huang et al. 2016), thereby rendering interpretation difficult. Likewise, it is unclear how wildlife become exposed to anticoagulant rodenticides, obviously making it difficult, if not impossible, to identify effective strategies to mitigate these risks without implementing an outright ban on their use. We also continue to lack an understanding of how non-lethal exposure to anticoagulants impacts non-target species, and at what threshold these impacts are exhibited (Rattner et al. 2014, Webster et al. 2015). Simply stating that all exposure to such toxicants is harmful clearly overstates their impact on wildlife populations. Furthermore, we have little conformational evidence that anticoagulants have a substantive impact on non-target predators at the population level following legal applications (Silberhorn et al. 2006; but see Gabriel et al. 2012 for example of negative impact to fisher populations from extensive illegal applications of anticoagulant rodenticides).

Effective rodent management would also benefit from greater exploration into alternative management strategies. The development of new toxicants could provide effective results while minimizing non-target risk (e.g., cholecalciferol + anticoagulants and sodium nitrite; Witmer et al. 2013,

Baldwin et al. 2016, 2017). Alternatively, the refinement of automatic and self-resetting trapping devices has shown substantial utility in managing rodent pests in New Zealand and may be expanded globally (Carter et al. 2016). There is also increasing interest in the use of natural predators to manage rodent populations. Although results have not always been positive, some potential may exist for natural predation to provide relief in some situations (e.g., Kan et al. 2014, Labuschagne et al. 2016). Further exploration may parse out where, and to what extent, those benefits could be realized.

Of course rodents are not the only wildlife species for which additional information is needed. We also need additional strategies to effectively manage predator impacts in both rangeland and residential/urban areas. In particular, there is a dearth of knowledge on population status of many predatory species throughout the U.S. A better understanding of population size and distribution of predators throughout the landscape, as well as how these change over time, would allow us to better plan management actions (Mitchell et al. 2004). This information would also provide insight into whether increases or decreases in conflict events were due to changes in population status and distribution of these predators or because of some other factor.

Predators certainly have an impact on livestock operations, both through direct and indirect losses. Recent research has shown that indirect losses are more extreme (Rashford et al. 2010, Steele et al. 2013), yet there has been relatively little research into the financial burden borne by ranchers faced with this challenge. Such information is needed to provide a foundation for supplementing rancher incomes if they are expected to remain viable while coexisting with increasing predator abundance (Young et al. 2015). There also is a substantial need for research-driven cost estimates of both

lethal and non-lethal management strategies to better balance these costs with expected gains in ranching incomes from their use (Miller et al. 2016).

Research into effective predator management strategies continues to be conducted, but this research needs to be implemented over a broad range of ecological conditions; not all sites are the same, and efficacy will vary depending on the local environment (Parks and Messmer 2016, Van Eeden et al. 2017). Likewise, there has been little investigation into the long-term efficacy of non-lethal management programs that are conducted in the absence of lethal removal. Such longitudinal studies are needed, as some individual predators will become more aggressive over time if unexposed to some general level of persecution (Timm et al. 2004, Blackwell et al. 2016).

A need for expanded education and outreach efforts

Although there is a lot that we do not yet know about managing human-wildlife conflicts, we do have a good knowledge base to draw from for many conflict situations. Wildlife scientists need to do a better job educating the public on the need to manage wildlife, as well as the need for many tools to mitigate potential conflicts. For example, it is well known that an integrated pest management (IPM) approach is the most effective strategy for managing rodent pests (Engeman and Witmer 2000, Baldwin et al. 2014). However, an IPM approach relies on the availability of many tools to effectively and economically manage rodent conflicts. Eliminating safe and effective tools reduces the effectiveness of IPM programs, and forces reliance on fewer and fewer options. This ultimately can lead to a reduction in effectiveness of those remaining tools (e.g., resistance development to rodenticides, Myllymäki 1995, Salmon and Lawrence

2006) and perhaps illegal use of non-registered management strategies (Hornbaker and Baldwin 2010).

Likewise, stronger education efforts are needed to allow the public to differentiate between perception and what current research supports. For example, there is currently a strong push by some groups to eliminate the use of many lethal tools for rodent management; use of natural predation, particularly raptors, is often advocated instead (e.g., *Raptors are the Solution*: <http://www.raptorsarethesolution.org/>).

Although there may be some situations in which raptors might be able to help manage rodents (R. Baldwin, unpublished data), this concept has yet to be conclusively proven. In fact, many scientists have considered this approach impractical given the extreme reproductive capacity of most rodent species (Marsh 1998, Moore et al. 1998). At a minimum, use of natural predation by itself will not likely be successful in all situations for managing rodent pests, and as such, other tools will still be needed. This point must be clearly articulated to ensure continued availability of alternative management strategies. That said, a stronger effort is needed to educate the public on proper application of management strategies. In particular, individuals using lethal tools need to be better informed on how to use them safely, what species they are legal for, and when they can be effectively used. When used appropriately, lethal tools are generally believed safe to non-target species (e.g., trapping, Witmer et al. 1999; first-generation anticoagulant rodenticides, Silberhorn et al. 2006). It is when they are used improperly that non-target impacts occur (e.g., Gabriel et al. 2012).

A similar opportunity exists for better education surrounding human-predator conflicts. Although efforts to educate the general public on the dangers of feeding wildlife are prevalent in many areas of North

America, it still occurs fairly regularly, either intentionally or unintentionally. Access by coyotes to anthropogenic food sources is believed to be one factor in the increase in the number of human and pet attacks in the southwestern U.S. (Timm et al. 2004, Baker 2007, Carrillo et al. 2007, Quinn et al. 2016). Many in the public do not know that such risks are real and continue to provide wildlife with access to foods. Likewise, there is a general sense among many urban and residential citizens that predation of livestock has little impact on ranchers or rancher livelihoods (Young et al. 2015). Such an impression is clearly inaccurate (e.g., Steele et al. 2013), but it highlights the need for more extensive and efficient outreach efforts to educate a greater segment of the general public on the impacts that predators can have on human populations in the absence of effective management.

We also need to focus outreach efforts on providing better information on what strategies are available and effective at mitigating human-predator conflicts. These outreach efforts need to take into account the differing levels of effectiveness for management strategies across geographical areas given that not all strategies work in every situation (Miller et al. 2016, Parks and Messmer 2016, Van Eeden et al. 2017). Effective management may include lethal removal in some situations where it is legal and warranted (e.g., Bradley et al. 2015, Van Eeden et al. 2017). That said, it is important to stress that predator management is a two-way street. Predators are a valuable part of our natural ecosystem and are here to stay. However, land managers need access to a suite of effective strategies to efficiently manage human-predator conflicts (Young et al. 2015, Blackwell et al. 2016). Hopefully understanding this duality will provide the middle ground needed to better manage predators in the future.

CONCLUSIONS

Human-wildlife conflict has always been present, but in many ways, managing these conflict situations is becoming more difficult, largely driven by personal beliefs and general perceptions by all relevant parties. The big question is, what do individuals in the wildlife damage management profession do to advance effective management in the face of this spirited discussion? Should wildlife damage management professionals simply adhere to the overriding public perception on a given issue, or do they fight the sociopolitical battle if they believe that public perception is out of line with what research indicates is the best strategy? Perhaps the best strategy is to let science speak. Rather than actively engaging in public discourse about what is right or wrong, ethical or unethical, etc., the general public can be provided with the information they need to better understand the issues at hand, thereby making more informed decisions on what management actions are appropriate. This approach would allow scientists and managers to avoid advocacy for any political stance, thereby maintaining credibility throughout the process.

One major limitation of this approach is making sure scientists and managers provide credible information to the general public in a manner that they will consume. This can be done in a variety of different ways, but in today's current environment, that often involves the use of social media. Many advocacy groups consistently provide information to their audience through social media outlets. Sometimes this information is accurate, but sometimes it is not. Wildlife damage management professionals would likely reach a greater audience by more frequently using social media opportunities, potentially countering misinformation received from other outlets. It is important to remember that regulation is often driven by the concerns of political entities, special

interest groups, and the general public irrespective of whether or not those concerns are real or perceived (Conover 2002, Mallonee 2011). Hopefully, through targeted research and outreach efforts, these respective audiences will be able to make better informed decisions. This research may or may not result in findings that support the continued use of a particular management practice, but that is the point of the research. In the end, what really matters is that society makes management decisions that are based on sound science rather than on limited data sets, or worse yet, conjecture or social dogma. Such a strategy would allow for management programs that are both socially acceptable and effective in minimizing human-wildlife conflict. This seems to be the most appropriate path to take.

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