



Tools and Technology

Evaluating Fladry Designs to Improve Utility as a Nonlethal Management Tool to Reduce Livestock Depredation

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ABSTRACT Nonlethal deterrents against carnivores are important components to protecting livestock and conserving carnivore populations. However, the performance of the visual deterrent called fladry, a historical tool used to defend livestock from carnivores, is often hindered by design flaws that eventually reduce its effectiveness. Our purpose was to identify a fladry design that reduces coiling (i.e., wrapping of individual flags tight to the rope from which they hang) and maintains free movement of the deterrent in the wind. We created 6 new designs, replicated designs using 2 materials (nylon and marine vinyl), and compared them with the design most commonly used today—where flags were sewn directly onto the line along which they are strung. We conducted the study during January–February 2014 at the U.S. Department of Agriculture, Wildlife Services, Predator Research Facility in Millville, Utah, USA. Fladry made of marine vinyl and attached via 2 of our 6 designs showed the least amount of coiling, were relatively easy to construct, and did not result in significant additional costs. The 2 designs were shower curtain, where the flags are attached via circular links, and knotted, where a knot is tied in the flag below its point of attachment. We suggest users of nylon fladry modify it to one of these designs and advise new users to consider a heavier (e.g., marine vinyl) material. © 2015 The Wildlife Society.

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Human–carnivore conflict is a major threat to carnivore conservation and ecosystem function (Estes et al. 2011, Ripple et al. 2014). Retaliatory killing of carnivores for livestock depredation is a primary source of human-caused carnivore mortalities (Woodroffe and Ginsberg 1998, Gittleman et al. 2001, Woodroffe et al. 2005) and short-term strategies to alleviate conflict are necessary (Treves et al. 2009).

Nonlethal tools to protect livestock from carnivores mediate conflict and increase tolerance for the presence of wolves (*Canis lupus*) and coyotes (*C. latrans*; Mech 1996, Lance et al. 2010). They can be used independently or in concert with lethal tools. Some nonlethal tools have long histories of use, while others are based on newer technology. For example, the use of livestock guard dogs is a historical nonlethal tool used to reduce livestock depredation by carnivores in Europe, Africa, and North America (Ciucci and Boitani 1998, Hansen and Smith 1999, Gehring et al. 2010, Rust et al. 2013, VerCauteren et al. 2013). Electric fencing and electronic guarding systems that emit sounds, flashing

lights, or electric shocks to frighten predators have recently been shown to reduce livestock depredation by felids in Guatemala (Zarco-González and Monroy-Vilchis 2014) and canids in the United States (Lance et al. 2010).

Another method often integrated with the aforementioned approaches, and one requiring fewer logistics, is a simple visual stimulant called fladry. Fladry, which consist of a strand of flags measuring approximately 50 cm long × 10 cm wide that are sewn onto nylon rope at 35–50 cm intervals, was originally used to hunt wolves in Europe (Okarma 1993). Today, it is primarily used to deter wolves and coyotes from crossing barriers, especially livestock pasture boundaries (Musiani and Visalberghi 2001, Musiani et al. 2003, Mettler and Shivik 2007). When the flags are hung just above the ground, their motion in the wind creates a novel, visual stimulus that frightens canids, and can exclude them from the protected area for 60–75 days (Musiani and Visalberghi 2001, Musiani et al. 2003, Mettler and Shivik 2007, Davidson-Nelson and Gehring 2010). However, in strong winds or thick vegetation, users of fladry in western states have reported it to coil, and create gaps in this optical deterrent. Coiling is when a flag wraps itself tightly around the rope to which it is attached. Once a flag coils, it tends to coil repeatedly, leaving gaps through which wolves, and coyotes may pass. Once fladry is crossed by canids, the fear

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