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Methodology to Estimate Cost Savings Associated with the Use of Trap Monitor Systems by Wildlife Services

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ABSTRACT Legislative changes to regulations surrounding the use of traps and other capture devices have unambiguously impacted the manner in which these devices can be used. In many cases the revisions to trapping legislation have resulted in shortened trap check intervals. This change has increased the costs of using capture devices and decreased the efficiency of Wildlife Services (WS) specialists working in the field. The use of trap monitors may result in cost savings and increased efficiency. Trap monitor systems function as a remote notification system that can identify trap status. These monitor systems can be used as an alternative to visually inspecting the trap, potentially reducing costs. A benefit-cost analysis is an economic method that can be used to evaluate the efficiency of the use of trap monitors by comparing the costs of the trap monitor system to the benefits of reduced specialist time and resources used. This paper describes a method to estimate cost savings associated with the use of trap monitor systems by the WS program and discusses potential scenarios where trap monitors would provide cost savings. This type of analysis aides in legislative decision-making processes through the identification of trapping situations in which the use of trap monitor systems are economical and through quantifying the return per dollar invested in trap monitor systems.

KEY WORDS cost-benefit, economic analysis, Texas, trap monitoring, traps

The USDA Wildlife Services (WS) Operational Program relies on the use of traps and other capture devices to manage human-wildlife conflicts. Recent changes to a number of state laws have eliminated the use of particular traps or have increased the frequency of trap check intervals. Many states have 24-hour trap check laws for all or many types of traps (e.g., CA), and a few have less restrictive laws (e.g., 36-hour trap check in TX). These changes increase the costs of trapping and decrease the efficiency of WS specialists.

A trap monitor system consists of a monitor, receiver and antenna and functions as a notification system when a trap has been triggered. The trap monitor is attached to the trap in such a way that a movement of the trap changes the trap monitor radio signal, thus allowing WS specialists to remotely check the trap by listening to the monitor signal on a receiver instead of visually inspecting the trap. While initially adding costs, trap monitor systems can provide cost savings over time through reducing labor and resource costs by decreasing the number of visual trap checks. The use of remote trap monitor systems can be potentially beneficial in three situations: 1) when traps are located on terrain that is rough, steep, or otherwise difficult to access, 2) when human presence near the trap is undesirable, and 3) to comply with trap check laws (Hayes 1982, Marks 1996).

Previous research related to trap monitors has focused on developing and testing monitoring systems (Hayes 1982, Larkin et al. 2003, Benevides et al. 2008), and identifying trap locations where these systems are appropriate to use (Darrow and Shivik 2008). Although several studies have asserted that monitors could provide cost savings (Larkin et al. 2003, Darrow and Shivik 2008), only one has empirically tested this assertion (Halstead et al. 1995).

The purpose of this economic study was to develop a methodology to identify situations in which a trap monitor system can provide cost savings. This paper describes the use of a benefit-cost analysis (BCA) to measure potential cost savings associated with the use of trap monitor systems in two different trapping situations.

METHODS

To provide a context for the use of BCA to estimate the cost savings associated with trap monitoring systems, two different WS trapping locations in Texas are used as examples: Site 1 is located in West Texas in Hudspeth and Culberson Counties, and Site 2 is located in central Texas in Mills County (Fig. 1).

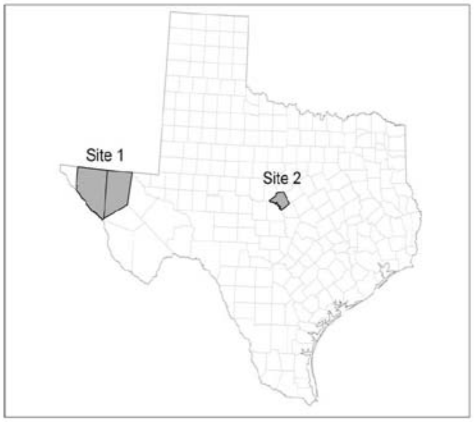

Figure 1. Two different study sites in Texas were used for this study; Site 1 was located in west Texas in Hudspeth and Culberson Counties and Site 2 was located in central Texas in Mills County.

Site 1 is characteristic of the Trans Pecos mountain ecoregion. Cooperating properties at Site 1 tended to be large (> 32,000 acres) and have limited access on both improved ranch roads and unimproved roads, with adjacent properties generally accessible through connecting gates. The typical trap line configuration at Site 1 was an “out-and-back” configuration in which traps were located at the end of an unimproved road accessible by 4-wheel drive vehicle or in a draw requiring the specialist to hike to check the trap (Fig. 2).

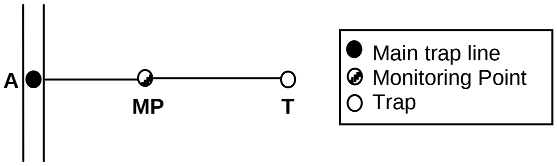

Figure 2. For an out-and-back trap line configuration, the trap and monitor is placed down a 4-wheel drive road or rocky draw. The monitoring point (MP) is the location where the trap monitor signal is first received. Depending on the signal, the specialist may or may not travel the entire distance between MP and the trap (T).

Site 2 was representative of the Lampasas Cut Plain ecoregion. Properties tend to be smaller (< 500 acres) on Site 2 with access from county roads and adjacent properties are rarely accessible through connecting gates. The common trap line at Site 2 is an “array” trap line configuration in which traps fan out from a central location requiring the specialist to check the traps in a circular pattern (Fig. 3).

Without the use of a trap monitor, each trap check would consist of a WS specialist traveling from point A on the main trap line to visually inspect the trap (T) or traps (T_1 through T_4) at each required trap check interval (Figs. 2–3). With the use of a trap monitor, each trap check consists of the WS specialist traveling from point A to the monitoring point (MP) to receive a signal identifying the status of the trap each required trap check interval. Based on the signal, the specialist may or may not travel the remaining distance to the trap (T). The potential savings through using trap monitors is the reduced travel associated with the roundtrip MP-T-MP (Fig. 2) or MP-T_1-T_2-T_3-T_4-MP (Fig. 3) measured in terms of time and resources saved.

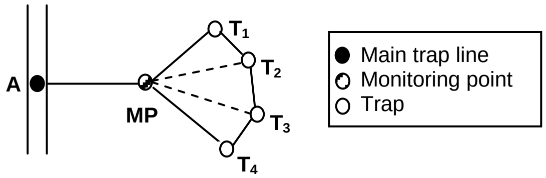

Figure 3. For an array trap line configuration, traps and monitors are dispersed around a field in a fan pattern. The monitoring point (MP) is the location where the trap monitor signal is first received. Depending on the signal, the specialist may or may not travel the entire circular distance between MP and the traps (T), but may instead only visit the trap(s) which are triggered.

Economic Analysis

Benefit-cost analysis is a common method used by economists to determine the efficiency of government wildlife damage management programs as well as management tools and techniques (Shwiff et al. 2008). In a BCA, the benefits associated with management programs and the use of specific equipment is compared to the costs. To compare the benefits and costs of using a trap monitor system, each must be quantified in monetary terms. In this study, the benefits of a trap monitor system were identified as the difference in labor costs and resources (i.e., travel costs) used when the WS specialist remotely checked the trap(s) compared to visually checking the trap(s) for each trap line configuration.

When performing a BCA, the benefits and costs can be compared using different time periods of analysis. The benefits and costs of trap monitor use can be compared for the life of the equipment, on an annual basis, or for the length of time trap monitors are used at a particular study site. For purpose of describing the use of BCA in this study, we compared the benefits and costs for the time period the trap monitors were used at the study site. This would allow for an independent BCA to be completed at each study site and trap configuration, while accounting for the varied terrain, trap line configuration, vegetation, and land use.

Benefits. The total benefit of trap monitor use was the cost savings that resulted from fewer trips between the monitoring point and the trap(s) during the study period. The estimated total benefit (*TB*) was divided into four parts: the cost savings associated with a reduction in distance travel by a WS specialist, the cost savings associated with reduced staff time checking traps, the number of required trap checks, and the probability of the trap being triggered. The roundtrip distance was measured in miles between MP and T (x_b) multiplied by the rate used for reimbursement for different modes of travel (m). The time was measured as the number of hours required for roundtrip travel between MP and T (h_b) multiplied by the WS specialist's wage rate (w). The number of required trap checks during the study period were α and the probability of the trap being triggered was ρ. The calculation of total benefit can be written as;

$$TB_i = \alpha(1 - \rho)[(x_b m)+(h_b w)], \qquad (1)$$

where i represents the trap line configuration (e.g., out-and-back = 1 and array = 2).

Total benefit increases as x_b, m, h_b, w, or α increases, but decreases when ρ increases. As the probability of the trap being triggered approaches 100%, the savings associated with the use of trap monitors approaches zero. The equation was calculated on a per trap basis and aggregated across all traps in the same configuration.

Costs. The total cost of trap monitor use was the costs resulting from monitor system acquisition and use. The estimated total cost

(TC) of trap monitor use for the study period included four components: the cost if MP is off route, the cost associated with a specialist physically attaching the monitor to each trap, the number of required trap checks, and the cost of the trap system. The cost if MP was off the main trap line but not on the way to the trap was measured as the roundtrip miles between the main trap line and MP ($x_c m$) plus the WS specialist time ($h_c w$). The cost of additional time needed to initially attach the monitor to the trap was calculated as hours (h_t) multiplied by w. The number of required trap checks was α and the amortized cost of the trap monitor system was c. The calculation of total cost can be written as;

$$TC_i = \alpha[(x_c m+(h_c w)] + (h_t w) + c, \qquad (2)$$

where i represents the trap line configuration (e.g., out-and-back = 1 and array = 2). Total cost increases as x_c, m, h_c, w, α or c increases. The equation was calculated on a per trap basis and aggregated across all traps in the same configuration.

Benefit-cost ratios can then be estimated by comparing the value of the total benefit to the total cost of monitors used during the study time period. If the ratio of benefit to cost is greater than 1, then the use of trap monitors in the modeled scenario is economically efficient. This analysis can be used to estimate the dollar amount of WS expenditures saved for every dollar expended on trap monitors.

DISCUSSION

The use of traps and capture devices can be controversial and garners a great deal of public attention, which may result in changing legislation requiring increasingly stringent standards for using traps. More stringent regulation can come in the form of a greater frequency of trap check intervals which can reduce individual WS specialist efficiency and increase the costs associated with wildlife damage management programs. In certain situations, the use of trap monitors has the potential to save time and money thereby increasing trapping efficiency.

This study described a method to estimate the cost savings associated with trap monitor systems. This economic methodology allows the examination of potential scenarios that would provide the greatest cost savings. It became evident that scenarios in which the required trap check interval (α) is high (i.e., every 4 hours), this increases the potential savings associated with the trap monitor (equation 1). Additionally, if the values for wages (w), time T (h_b), or distance (x_b) are large, which could be associated with particularly rough terrain surrounding the trap location, then greater savings will be garnered. Conversely, if the probability of the trap being triggered (ρ) approximates 100%, it would negate any efficiency gains from trap monitor system use. Similarly, if visitation to the trap location for reasons such as frequent trap maintenance including lure replacement and removal of trapped animal is high, the cost savings will be eroded.

Other factors exist that may influence the potential cost savings gained from trap monitor use. The nature of the conflict (preventative work vs. stopping loss or coyotes [*Canis latrans*] vs. cougars [*Puma concolor*], the severity of the conflict (losing livestock on a nightly basis vs. every other week), or the expected duration of the project (48 hours vs. 2 months) would impact the cost savings estimates. Additionally, combinations of wildlife damage management tools (e.g., traps, snares, and M-44s) are often used to address conflicts. Snares and M-44s are checked on a regular basis and if this equipment is in close proximity to traps or if the specialist has to “drive by” the trap to check this equipment-cost savings from monitor use would be reduced. Furthermore, trap monitors may increase trapping efficiency when human presence near the trap is undesirable, therefore increasing the benefit gained from monitor use. Although these other factors may influence cost savings, this economic methodology cannot evaluate these factors.

Quantification of these factors is the first step in identifying the cost savings associated with the use of trap monitors and ultimately determining the situations in which these monitors will provide efficiency gains and overall programmatic savings. While other factors, such as specificity and humaneness are involved in the decision-making process regarding the use of any capture device use, economic analysis provides can also aid in the decision-making process.

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