

Decision Making for Wildlife Damage Management

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Introduction

Wildlife damage management is an integral and responsible part of the wildlife management profession (The Wildlife Society 1990). "It is a broad subject, cutting across the entire field of wildlife ecology and management" (Berryman 1972). Specifically, this aspect of wildlife management focuses on reducing conflicts between humans and wildlife that occur when wildlife negatively impact any of a wide variety of agricultural resources, properties, natural resources, and public health and safety.

Unfortunately, wildlife damage management decisions are too often misunderstood by the general public, as well as by some members of the wildlife profession. Many perceive wildlife damage management solely as coyote (*Canis latrans*) control to protect livestock. In fact, it encompasses a broad range of management activities directed not only at wildlife but at affected resources as well. In order that responsible management of wildlife damage may be conducted, it is imperative that the basic tenets of wildlife damage management decision making be understood.

Many state and federal agencies have legislated mandates, special interest, or involvement in wildlife damage management. Private organizations, institutions, pest control firms and individuals are also actively involved in this specialized field. Frequently, the formulation, implementation and success of a control strategy is contingent on highly coordinated and cooperative efforts among many parties. Those responsible for wildlife damage management decisions are routinely challenged with unique and often complex problems. No single method or combination of methods

is applicable to all damage situations (Berryman 1972, Salmon and Lickliter 1983), nor are there simplistic rules of thumb. In fact, truly effective decision making can only be achieved through interdisciplinary consideration of the specific biologic, physical, economic, sociocultural and other environmental circumstances associated with each wildlife damage problem.

In this paper we present a compartmentalized decision model (Figure 1) and discuss the key factors requiring consideration in formulating responsible and effective strategies to address specific wildlife damage problems. Our objective is to increase the awareness of this decision making process among wildlife managers to better enable them to explain the variables and complexities of the process to all of our publics.

Decision Model

Wildlife damage decision models can be useful management tools (Schmidt et al. 1985). They can serve as meaningful communication instruments as well. The fol-

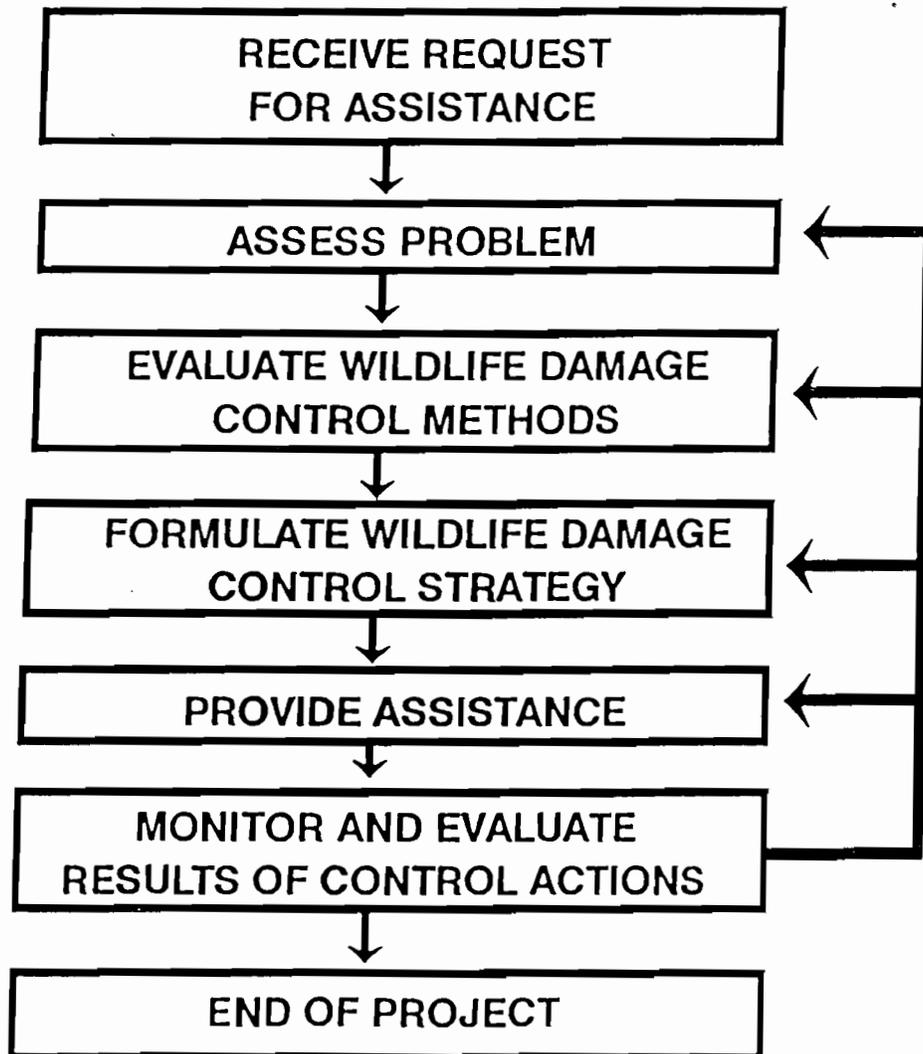


Figure 1. Wildlife damage management decision model.

lowing model is well suited to serve as both a useful management and communication tool; however, it necessarily depicts thought processes as being more linear than they actually are. In our experience, this model includes the major considerations to responsibly address specific wildlife damage management decisions.

The following discussion is represented by compartments in the decision model as shown in Figure 1.

Receive Request For Assistance

Wildlife damage management services are provided in response to requests for assistance. Such requests may encompass a broad range of wildlife conflicts from nuisance wildlife in urban structures to more intricate problems, such as wildlife hazards to public safety, wildlife predation on livestock or protection of endangered species.

Assess Problem

Those engaged in wildlife damage management are subject to limitations on the scope and diversity of their activities. These limits are established by legislative direction, legal mandates, MOUs, cooperative agreements and other constraints. Therefore, a brief initial assessment of each request is necessary for a purview determination. Those requests determined to be within the responsibility and authority of the receiving agency, organization, firm or individual should then be subjected to a more detailed assessment of the damage.

In assessing the damage, immediate attention should be given to confirming that damage was caused by vertebrate animals, the species responsible for damage and the type of damage (e.g., bird hazard at an airport, loss of livestock, flooded crops). This commonly requires an on-site inspection, depending on the type and complexity of the problem. The extent and magnitude of damage is also important in assessing current and potential economic losses in the absence of control. The resource manager or affected party is usually the source of this information. Pertinent aspects of the damage history also are relevant to the assessment. For example, is this a recurring problem, or is it the first episode of this type? What control actions, if any, have been attempted by the resource manager or affected party? What were the results? If no further control action is taken, is damage likely to continue or recur? All of these factors are considered in deciding which management options are potentially applicable to the problem.

Evaluate Wildlife Damage Control Methods

Once the problem assessment is completed, potentially available methods are evaluated for their practicality in reducing damage. Conceptually, this component of the decision model consists of a series of legal, administrative and environmental screens for each potential method (Figure 2). The output from this compartment is a list of methods deemed practical for further consideration in the formulation of the wildlife damage control strategy.

To facilitate a better understanding of the availability of control methods and who generally applies them, methods are organized under three action approaches to managing wildlife damage problems (Table 1). For the purposes of this paper, Table 1 is limited to methods potentially available to prevent or control damage caused by blackbirds (*Icterinae sp.*), beaver (*Castor canadensis*) and coyote.

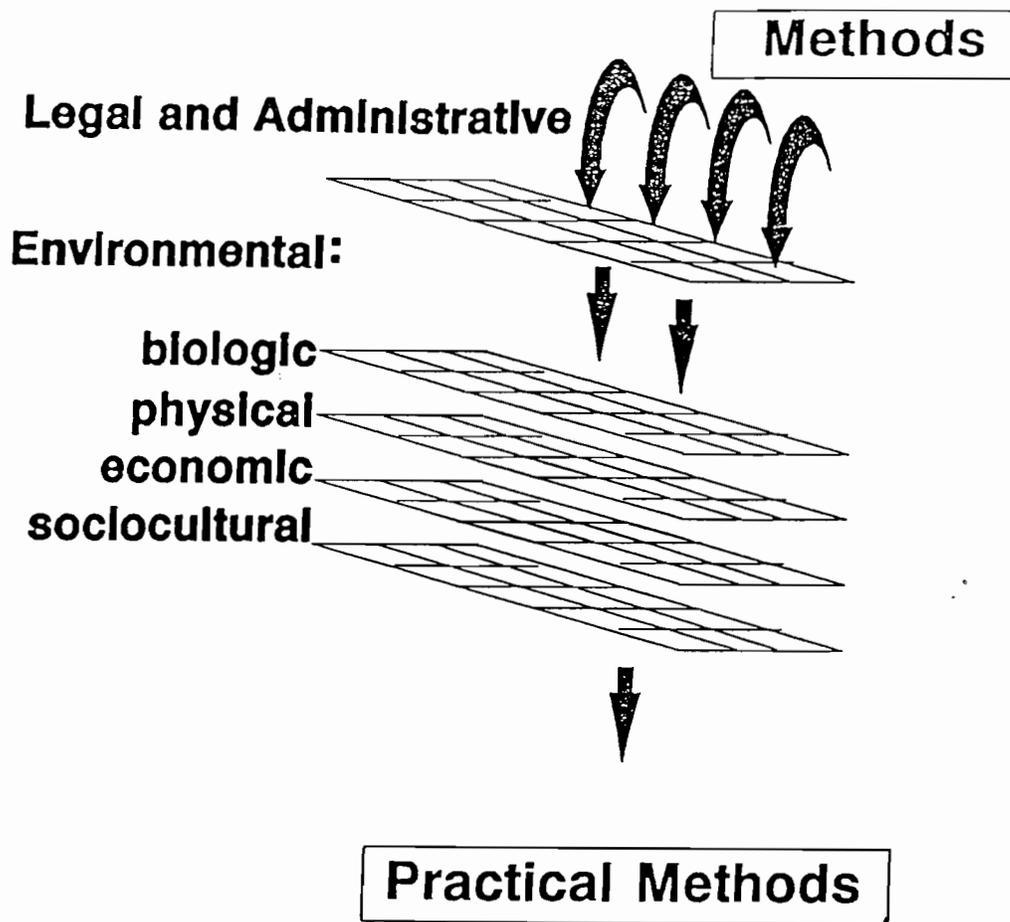


Figure 2. Methods evaluation screens.

One action approach is management of the resource damaged or negatively affected by wildlife. It includes those activities designed to improve or modify ongoing resource management practices, such as husbandry and cultural practices, as well as modification of human behavior. Application of these methods is typically the responsibility of the resource manager or affected party. However, wildlife managers make technical assistance recommendations concerning these methods.

A second action approach is placement of physical barriers to separate the resource that has sustained or is susceptible to damage from specific wildlife species. Fences, nets and wire grids are examples of physical barrier methods. Like resource management methods, these are usually applied by the resource manager or affected party. Wildlife managers often make technical assistance recommendations concerning the installation of physical barriers to reduce wildlife damage. State and federal programs may also loan materials or demonstrate fencing or other physical exclusion methods.

A third approach, management of wildlife, includes habitat management, modification of wildlife behavior and wildlife population management to reduce damage. Habitat management includes activities such as thinning trees from bird roosts or manipulating water level through removal of beaver dams. Habitat management is

Table 1. Wildlife damage methods by action approach.

Control methods	Beaver	Blackbirds	Coyote
RESOURCE MANAGEMENT			
Animal husbandry			
Night penning			x
Shed lambing			x
Time of breeding			x
Move livestock			x
Change class of livestock			x
Herding			x
Guarding animals			x
Removal of dead livestock			x
Crop selection and planting schedules			
Time of harvest		x	x
Time of planting		x	x
Damage resistant varieties		x	
Change crop		x	x
Habitat management architectural design			
Modify human behavior			
Stop wildlife feeding			
Stop wildlife handling			
Alter aircraft flights		x	

PHYSICAL BARRIERS			
Fencing			x
Sheathing (hardware cloth, solid metal, chain link)			
Tree protectors	x		
Entrance barricades			x
Netting		x	
Roost exclusion		x	
Wire grid			
Other			
Close storage containers			

WILDLIFE MANAGEMENT			
Habitat management			
Modify vegetation		x	
Eliminate standing water		x	
Roost thinning/removal		x	
Close garbage dump		x	
Manipulate water level	o		
Dam removal (beaver)	o		
Lure crops/alternate foods			
Food planting—hold birds		x	
Crop sacrificed—to birds		x	
Grain piles—attract birds		x	
Sacrifice goats—protect sheep			x

Table 1. Continued.

Control methods	Beaver	Blackbirds	Coyote
Frightening devices			
Electronic distress sounds		o	
Propane exploders		o	x
Pyrotechnics		o	
Lights			x
Water spray devices		o	
Harassment (boats, planes, autos, atvs)		o	x
Other soaring devices			
Strobe—siren			o
Eye-spot balloons		o	
Effigies		x	x
Chemical repellents			
Odor	x		
Tactile, etc.		x	
Frightening agents		o	
Kill or relocation methods			
Leghold traps	o		o
Cage traps	o	o	
Snares			
Neck/body	o		o
Foot/Leg			o
Catch-pole			o
Quick-kill traps	o		
Denning			o
Shooting			
Aerial hunting			o
Calling and shooting			o
Spotlighting and shooting	o		o
Shooting on sight	o	o	o
Hunting dogs/shooting			
Tracking/trailing dogs			o
Decoy dogs			o
Egg and nest destruction			
Remove hatchlings			
Chemical toxicants			
Aluminum phosphide			
Zinc phosphide			
Strychnine			
Sodium cyanide			o
Livestock protection collar			o
Gas cartridges			o
DRC-1339		*	
Starlicide		o	
PA-14		*	

Methods Primarily Used by:

* - Wildlife Damage Specialists

x - Resource Manager or affected party

o - Wildlife Damage Specialist and Resource Manager or affected party

usually implemented by the resource manager or affected party. Modification of wildlife behavior includes the use of frightening devices, repellents or lure crops. Population management includes translocation or lethal removal of wildlife from local populations. Behavior and population management methods may be conducted by either the resource manager or wildlife managers, depending on legal and administrative considerations in each state, county or municipality.

Legal and administrative considerations. Wildlife damage control methods are subject to legal and administrative authorities. For example, a method may be legal in one state and not another. Or, a method may be legal only in portions of a state (e.g., not allowed in areas heavily populated by humans). The status of the target species (state or federally listed as threatened or endangered), or the presence of listed species in the general area where control activities are proposed may preclude the use of a method. Also, wildlife damage control programs may restrict the use of specific methods by policy or agreement with other agencies or parties. The important questions that should be answered for each method during this phase of the assessment include:

1. Is it legal and administratively permissible to use this method on this species within the state where the request for assistance has been received?
2. Is it legal and administratively permissible to use this method to address this specific type of damage?
3. If so, is it legal and administratively permissible to use this method at the specific site for the request for assistance, or are there restrictions because of land class, other land use patterns or the presence of listed species near the damage site?

All of the methods that pass these legal and administrative screens are deemed available for further consideration in the decision process. It should be noted, however, that there are additional legal considerations with regard to who may apply methods. These are considered under the "Formulate Wildlife Damage Control Strategy" compartment.

Environmental considerations. During this phase of the assessment, each legally and administratively available method is evaluated with regard to pertinent aspects of the biologic, physical, sociocultural and economic environments. In effect, the methods evaluation is an environmental cost-effectiveness analysis (Owens and Slate 1991). Consideration is given to the impacts each method would have on each of the four environments and vice versa. A general question to be considered is: what are the positive or negative, short- or long-term, direct, indirect or cumulative environmental effects of implementing or not implementing control action with each method under evaluation on each of the environments? Other important questions that should be considered in making decisions about each method are discussed for each of the four respective environments.

Important questions to be addressed for the biologic environment include:

1. What is the population status of the target species—endangered, threatened, or is it relatively abundant nationally, statewide and locally?
2. Are there any threatened or endangered or other potential nontarget species in the area that could be directly or indirectly impacted either positively or negatively by using this method?

3. Are there any special behavioral traits of the target species, such as daily or seasonal movement patterns, that require consideration relative to method application?
4. Could the use of this method potentially affect species diversity?

Important questions to be addressed for the physical environment include:

1. What effect would local weather or climatic patterns have on the use of this method?
2. What effect would soil, water, air, elevation or other physical habitat features have on the use of this method?
3. What health and safety risks would this method pose to the applicator and the public?
4. What health and safety risks would be posed to the public by not conducting control using this method?

Important questions to be addressed for the economic environment include:

1. Would the use of this method in this situation be likely to reduce damage?
2. Does the magnitude of damage warrant the cost of applying this method?

Evaluating methods in the sociocultural environment frequently presents the greatest challenge because of differences in human attitudes toward wildlife species (Kellert 1976, Decker and Goff 1987), wildlife damage management methods (Stubby et al. 1979, Arthur 1981) and the resources damaged by wildlife (Connolly 1982). In spite of the difficulties associated with evaluating methods in the sociocultural environment, societal values are important in decision making and they deserve similar consideration in methods evaluation as the other environmental factors. Some important sociocultural issues to consider in evaluating wildlife damage control methods include:

1. What are the perceptions regarding the humaneness of the methods?
2. How acceptable would the risks of this method to nontarget animals be to the resource manager or affected party and the general public?
3. How acceptable is the effect of each method on the target animals—no effect, frighten, exclude, modify habitat, translocate or kill—to the resource manager or affected party and the general public?

The methods evaluation should result in one or more practical methods available for further consideration in formulating a control strategy. However, as a function of this evaluation it is possible to determine that there are no practical methods available. This results in no action being recommended or taken.

Additionally, it should be noted that monetary compensation for wildlife damage is sometimes legislatively mandated. Compensation, however, does not address the damage problem and is not considered as a method in the three action approaches in Table 1.

Formulate Wildlife Damage Control Strategy

At this decision step, those control methods determined to be practical from the previous evaluation are formulated into a control strategy based on considerations of available expertise, legal constraints on methods users, costs and relative effectiveness of methods. In determining the sequence or combination of methods to be applied and who will apply them, preference should be given to practical nonlethal methods.

Available expertise. As previously discussed, resource management and physical barrier methods are usually applied by the resource manager or affected party. Some wildlife management methods also may be applied by the resource manager or affected party; however, effective application of many of these methods often requires personnel with special expertise in wildlife damage management.

The availability of expertise to address each specific request may influence the balance of direct, hands-on management provided by the resource manager or affected party and wildlife damage specialists. Relatively simple damage problems may be adequately addressed through technical assistance. However, effective solutions to many damage problems require an integration of those methods used by the resource manager with direct control services provided by wildlife damage specialists.

Legal constraints on method users. Screening was previously performed (see "Legal and administrative considerations") to determine which methods were legally and administratively permissible for the problem. Here it is necessary to consider any additional legal constraints that define who may apply each method. For example, restricted use pesticides cannot be used by persons who are not certified applicators. Also, EPA label restrictions on specific pesticides may limit their use to specific groups. The avicide DRC 1339, for example, can be used only by USDA personnel trained in bird damage control or persons under their direct supervision.

Costs. Cost-effectiveness is an obvious goal in wildlife damage management. However, the costs of implementing wildlife damage management should not be considered independently from the damage problem, probable environmental impacts and other strategy considerations.

The costs of methods and their application should be weighed against the severity of damage. Even in cases involving serious damage, lack of funds may constrain the resource manager or affected party from hiring special expertise adequate to solve the problem.

Off-site or indirect benefits have to be considered as well. For example, the costs associated with the suppression of an offending coyote population at one location may be relatively high. But when costs are considered in the context of avoided or continuing loss of sheep in neighboring areas, the costs of implementing the control strategy may be low.

Overriding social concerns often preclude the use of the most cost-effective methods. The use of pyrotechnic frightening devices in and around developed areas to reduce damage caused by birds may not be recommended or used because of noise, aesthetic or other social concerns. Safe and effective lethal methods may not be used in a variety of circumstances primarily because of social considerations.

Short-term versus long-term costs and benefits of wildlife damage management strategies also are important. Methods such as the propane cannon have substantially higher initial costs in comparison to pyrotechnics, yet may be less expensive when labor is factored into the strategy budget. Compared to pyrotechnics, propane cannons may be as socially acceptable and efficacious in reducing wildlife damage for some damage problems.

Relative effectiveness of methods. Subject to other constraints and considerations, as previously discussed, wildlife managers should recommend or use the most ef-

fective method or combination of methods to resolve problems. Method effectiveness must take into account many of the variables previously discussed, such as legal and administrative availability, and practicality from a comprehensive environmental perspective. Effectiveness of a method or combination of methods is also determined by their costs, negative environmental impacts and ability to reduce damage. Ideally, a method or combination of methods should be selected that produces maximum damage resolution with minimal negative environmental impacts (Owens and Slate 1991).

Provide Assistance

Wildlife damage management service may be provided to the public by two basic means: technical assistance and direct control. Technical assistance is the provision of advice, recommendations, information or materials for use in managing wildlife damage problems. Its emphasis is on helping others help themselves. Technical assistance may require substantial effort by wildlife damage specialists in the decision-making process, but the actual control activities are the responsibility of the resource manager or affected party. Direct control is the implementation of control activities by wildlife damage specialists. Direct control may be provided when funding is available and if the control efforts of the resource manager or affected party are ineffective and technical assistance alone is inadequate. Direct control should be employed when actions may affect sensitive species or sensitive areas of the public domain, or involve certain hazardous materials (Berryman 1972).

Monitor and Evaluate Results of Control Actions

If wildlife damage management services have been provided, it is usually necessary to monitor control actions to determine if they are achieving the desired results. Return site visits or telephone contacts to the resource manager or affected party represent the common forms of monitoring activities. Site visits or phone contacts also are required to monitor equipment placed in the field to assess if it is functioning properly, or with capture methods such as traps and snares, to determine if any animals have been captured.

Monitoring control actions is an important step in determining if further assistance is required to address the problem. Monitoring also allows the wildlife damage specialist to know when to discontinue control activities, thus reducing unnecessary environmental impacts and expenditures.

The need for additional assistance is usually identified through routine monitoring and evaluation of control actions. If the recommended strategy is having an effect but damage has not abated, continuation of the strategy may be in order. In our model (Figure 1) this is represented by a feedback to "Provide Assistance." When monitoring reveals that further assistance is needed, additional feedback from problem reassessment, methods reevaluation or control strategy reformulation may be necessary to determine if more assistance is feasible.

End of Project

For many projects that are addressed through technical assistance alone, the project ends with recommendations or advice being provided to those making the request. Some direct control projects such as the removal of a single family of beaver and the associated dams responsible for flooding a road or dispersing blackbirds from an

urban roost have well defined end points. Other projects such as chronic predation on livestock or at aquaculture facilities may require ongoing attention at various times of the year and have no well-defined end point.

Summary

The resolution of human-wildlife conflicts is a dynamic and complex process. Each damage situation has to be addressed in relation to the unique set of environmental circumstances associated with the problem. To effectively address wildlife damage problems, it has been stressed that managers need access to accurate information (Kendrick 1978, Schmidt et al. 1985) and effective management tools and options (Berryman 1972, Salmon and Lickliter 1983), as well as the ability to adapt each management strategy to local environmental conditions (Salmon and Schmidt 1986).

The model presented in this paper emphasizes that decision making should be based on a complex of factors including a comprehensive assessment of the damage and an evaluation of methods in the context of biologic, physical, economic; socio-cultural, and other environmental and legal circumstances. Methods identified as practical are then formulated into a wildlife damage management strategy based on the availability of expertise, legal constraints on methods users, costs and the relative effectiveness of methods. Preference should be given to practical, nonlethal methods when formulating each strategy. However, this must not be misinterpreted as a recommendation that nonlethal methods always be applied as a first response to each damage problem. Commonly, the most appropriate response is the integration of nonlethal and lethal methods, and there will be many instances where the application of lethal methods alone is the responsible approach. In fact, there may be more than one appropriate strategy for each damage problem.

We feel that the process discussed in this paper is generally applicable to decision making across the broad range of wildlife damage problems. It is important that those in the wildlife profession understand and communicate the many variables and complexity associated with wildlife damage management decision making. Wildlife managers should emphasize sound decision making as the key to balancing human interests and wildlife needs.

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