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WILDLIFE DAMAGE TO AGRICULTURE IN NEBRASKA: A PRELIMINARY
COST ASSESSMENT^{1/}

by R. J. Johnson^{2/} and R. M. Timm^{2/3/}

ABSTRACT

We estimate the annual financial losses resulting from wildlife damage to major crops and livestock in Nebraska. For each wildlife species, the damage problem is presented along with a description of how the estimate was made. Field crop estimates include losses from Plains pocket gophers (Geomys bursarius), commensal rodents (Rattus norvegicus and Mus musculus), field rodents in grain fields (e.g. Peromyscus maniculatus, Dipodomys ordi, Spermophilus tridecemlineatus), house sparrows (Passer domesticus), blackbirds (e.g. Agelaius phoeniceus and Quiscalus quiscula), lagomorphs (Sylvilagus floridanus, Lepus californicus, and L. townsendii), deer (Odocoileus virginianus and O. hemionus), voles (Microtus spp.), and beaver (Castor canadensis). Livestock estimates include losses from commensal rodents, coyotes (Canis latrans), European starlings (Sturnus vulgaris), black-tailed prairie dogs (Cynomys ludovicianus), and house sparrows. Estimated values of the crop and livestock resources damaged total

approximately \$37 million annually. Further study is needed to refine such estimates, as well as to assess the positive benefits of various wild vertebrates.

INTRODUCTION

Determining costs associated with wildlife damage is a difficult but important aspect of wildlife management. Damage-cost information is used in evaluating the need for programs both statewide and in specific problem situations. Moreover, quantifying economic impacts of damage may help convey the magnitude of damage problems to those not directly affected.

In this paper, we estimate the financial losses resulting from wildlife damage to major crops and livestock in Nebraska. The wildlife species of principal importance are accompanied by a brief description of the damage and an approximate distribution of damage in the state. Estimates of the annual economic value of agricultural resources lost are presented along with a description of how the estimate was made. Thus, estimates can be easily changed as new data become available.

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METHODS

Estimates were based on damage assessment data, as cited, where such

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data were available. However, there are few studies that quantify economic impacts of wildlife damage in Nebraska. Where data were not available, we consulted with appropriate persons with knowledge or experience related to the damage situation. Using these discussions with others and our personal experiences, we then estimated damage levels at what we believe to be conservative amounts. Most such estimates include consideration of damage observed in a number of situations and years. Usually, an estimated mean damage level was then extrapolated to the total resource susceptible to the damage. In some cases, where extrapolation to the total resource seemed inappropriate, the estimate was based on species biology, discussions, and field experiences. An example is livestock feed consumption by Norway rats, a situation where not all feed on farms is available to rats, and estimating available feed would be impractical; the result was a more conservative estimate.

Nebraska agricultural statistics cited such as crop acreages, yields, commodity values, amounts of stored grain, and livestock numbers, unless otherwise indicated, were taken from Rowe (1985).

RESULTS

Damage to Major Field Crops

Pocket gophers -- Pocket gophers feed on roots and other plant parts, while also covering some plants with their soil mounds which provide sites for invading weeds. These actions not only reduce forage yields but also damage harvesting machinery and slow haying operations. In addition to damaging alfalfa fields, hay meadows, and rangelands, they may damage or kill newly-planted trees and shrubs. Pocket gophers are found statewide.

We estimate that pocket gophers inhabit 4% of the 1.4 million acres of alfalfa in Nebraska, normally producing 3.4 tons/ac, causing a 35%

reduction in yield in these areas (Luce et al. 1981). Alfalfa is valued at \$45/ton, and we estimate the cost of machinery damage and slowing of harvest to be equal to the value of lost yield. We estimate that gophers inhabit 2% of the 1.9 million acres of other tame and wild hay, causing a 30% reduction in yield where present (Hegarty 1984). Normal production is 1.05 tons/ac, valued at \$40/ton. We believe that about 8% of Nebraska's 24 million acres of rangeland are populated by pocket gophers, causing a 40% reduction in forage yield where present (Foster and Stubbendieck 1980). Forage is valued at \$5 per acre (conservative figure; value is higher in Nebraska sandhills and in eastern Nebraska) (J. Stubbendieck, pers. comm.). Pocket gophers destroy an estimated 2% of the 6,000 acres of newly-planted trees and shrubs annually, valued at \$200/ac (Nebraska Forest Service and Soil Conservation Service, pers. comm.). An equal amount of economic loss is estimated to occur to established plantings. Estimated total annual loss is \$10.4 million (Table 1).

Commensal rodents -- Norway rats (*R. norvegicus*) and house mice (*M. musculus*) consume and contaminate stored grains. Contamination may cause substantial reduction in value. Additionally, rodents damage packaging materials such as sacks used in packaging seed grains. Commensal rodents are found statewide. They tend to be found in close association with structures, so the damage they cause tends to be most prevalent in areas of high densities of farm buildings, grain storage, etc.

We estimate that commensal rodents cause the loss of 0.25% of Nebraska's 1.5 billion bushels of stored grain, valued at \$2.25/bu. The estimated total annual loss is \$8.4 million.

House sparrows -- House sparrows damage and consume ripening small

Table 1. Top vertebrate pests of major field crops in Nebraska.

Species	Estimated annual loss (Thousand dollars) <u>a/</u>
Pocket gophers	10,400
Commensal rodents	8,400
House sparrows	2,000
Blackbirds	1,950
Field rodents (grain fields)	1,900
Rabbits and hares	780
Deer	608
<u>Microtus</u> spp.	439
Beaver	400

a/ A description of the damage and the basis for each estimate are included in the text.

grain, particularly sorghum planted near farm buildings. They also consume and contaminate stored grain. House sparrows occur throughout Nebraska but the northwestern one-quarter, primarily the sandhills area, is predominantly rangeland and has generally lower damage to major crops.

The damage estimate for small grains (\$314,000) is based on 0.1% loss on Nebraska's 1.9 million sorghum-for-grain acreage, yields of 75 bu/acre, and sorghum value of \$2.20/bu. For stored grains (\$1.69 million), the estimate is based on 0.05% loss from Nebraska's 1.5 billion bushels of stored grain, valued at \$2.25/bu. Estimated total annual loss is \$2 million.

Blackbirds -- Blackbirds (primarily red-winged blackbirds, A. phoeniceus; and common grackles, Q. quiscula) open ends of corn husks and consume ripening corn in milk and dough stages of development. They may

also damage ripening small grains such as sorghum and wheat. Various blackbirds occur throughout Nebraska. Damage to ripening grain, particularly corn, has been reported in certain counties in the eastern, southeastern, and northwestern areas of the state.

Blackbird damage to ripening corn is generally a minor problem in Nebraska, but each year a number of fields receive moderate damage. The estimate is based on field surveys that reported an 868,000-bu loss in Nebraska in 1981 (Besser and Brady 1986) and on corn value of \$2.25/bu. Losses may increase if sunflowers become an important crop. Estimated total annual loss is \$1.95 million.

Field rodents -- Several species of rodents dig and consume newly-planted corn seeds and kernels attached to seedlings (Johnson 1986). Damage has been estimated from Nebraska field data to range from 0.75% to 4% stand loss in no-tillage cornfields and from 0.25% to 2% stand

loss in other conservation-tillage corn (Holm 1984, Johnson 1986). A range was presented in these estimates because damage was variable among fields and years. Damage levels are sometimes higher: stand loss from rodent damage was 24.2% in one south-central Nebraska cornfield (Nuckolls County) in 1983 (Holm and Johnson, unpublished data). These rodents occur generally throughout Nebraska but southern counties have generally higher damage to newly planted corn.

In this paper, the loss estimate was made using the low end of the damage range: 0.75% stand loss on 188,000 acres of no-tillage and 0.25% stand loss on 3.6 million acres of other conservation-tillage corn, yields of 80 bu/acre, and corn value \$2.25/bu (CTIC 1985, Rowe 1985, Johnson 1986). This estimate does not consider possible compensation in corn production from undamaged plants nor possible replanting costs. Estimated total annual loss is \$1.9 million.

Lagomorphs -- Cottontail rabbits (*S. floridanus*) and hares (*Lepus* spp.) feed on newly-planted and young trees and shrubs; mature plantings are sometimes damaged during seasons of food stress. Lagomorphs also feed on crops (e.g. soybeans, alfalfa) and may reduce forage yield on rangelands. Cottontail rabbits are statewide in distribution. Jackrabbits (hares) are more prevalent in the western 3/4 of the state than elsewhere.

Rabbits and hares are estimated to destroy 8% of the 6,000 acres of new trees and shrubs planted in Nebraska annually, valued at \$200/ac (Nebraska Forest Service, pers. comm.). We estimate damage to established plantings to be 4 times that to new plantings, or \$384,000. Further, we estimate crop damage (hay, soybeans, etc.) to be \$200,000/year, and damage to rangelands through reduced yield to be \$100,000/year. Estimated total annual loss is \$780,000.

Deer -- Deer feed on crops (alfalfa, wheat, soybeans, etc.) in fields. They also feed on hay stored in stacks, particularly during seasons of food stress, and their contamination of haystacks with urine and droppings lowers its value as livestock feed. They feed on new and established tree and shrub plantings, and antler-rubbing by bucks damages young and mature trees. Deer populations are generally more dense in the eastern half of Nebraska than they are in the western area of the state.

We estimate that deer destroy 4% of the 6,000 acres of newly-planted trees and shrubs in Nebraska annually, which are valued at \$200/ac (Nebraska Forest Service and SCS, pers. comm.); this totals \$48,000. We estimate damage to established plantings to be \$250,000 annually. We assume that damage to hay, both in the field and in haystacks, totals 0.05% of the state's total production of 6.755 million tons, valued at \$40/ton, or \$135,100 annually. We further estimate damage to miscellaneous crops (soybeans, corn, wheat, etc.) from feeding and trampling to be \$175,000 annually. Total estimated annual loss is \$608,000.

Voles -- *Microtus* spp. clip and consume plant parts, damaging hay meadows and alfalfa fields. During periods of food stress they girdle trees and shrubs, damaging or killing trees in shelterbelts. *Microtus* are statewide in distribution, favoring areas of lush, grassy vegetation such as ditchbanks and roadsides.

We estimate that *Microtus* destroy 2% of the 6,000 acres of newly-planted trees and shrubs in Nebraska, valued at \$200/ac (Nebraska Forest Service and SCS, pers. comm.). Additionally, we estimate that voles damage or destroy \$215,000 worth of established shelterbelt plantings annually. We estimate total *Microtus* damage to other field crops (alfalfa, etc.) to be \$200,000 annually. Estimated total

annual loss is \$439,000.

Beaver -- Beaver dam streams, plug culverts and may otherwise damage water management structures. Their activities flood crop fields, tree plantings, and other lowlands. They harvest trees and crops which they use as a food source and in the construction of their dams and lodges. Beaver are generally more frequently found in the eastern third of Nebraska than they are in the western portion of the state.

The Lower Platte South Natural Resources District estimates beaver damage to water management structures to be approximately \$6700 annually. Beaver harvest data in the area served by this district equals 3.5% of the statewide harvest; therefore, extrapolation of similar beaver damage to the remainder of the state, taking into account the greater number of water management structures in the eastern one-quarter of the state, as well as the distribution of beaver, totals approximately \$100,000 in damage to water management structures. We estimate that beaver damage to forest resources and to crops (through harvest and flooding) to be \$150,000 each. Estimated total annual loss is \$400,000.

Damage to Livestock Production

Commensal rodents -- Norway rats and house mice destroy livestock confinement buildings (principally swine confinement structures) by damaging insulation and causing increased energy loss from environmentally-regulated structures. They burrow under foundations and concrete slabs, causing loss of structural integrity. They also damage machinery and equipment by gnawing, consume and contaminate feed, and transmit diseases between and among herds. Commensal rodents are found statewide. They tend to be found in close association with structures, so the damage they cause tends to be most prevalent in areas of

high densities of farm buildings, grain storage, etc.

Based on a survey conducted by Timm et al. (1983), we estimate that Nebraska pork producers utilize 10,590 insulated buildings for confinement rearing. These structures each receive damage from rats and mice averaging \$600 annually, we believe, for a total of \$6.35 million. Additionally, rodent damage to machinery and equipment (feeders, conveyors, wiring, etc.) is estimated at \$350,000 annually. We estimate damage from rats burrowing under foundations and slabs, plus costs associated with disease transmission by rodents among livestock, to be \$500,000 annually. Livestock feed consumed by rodents is estimated to cost \$750,000. Estimated total annual loss is \$7.95 million (Table 2).

Coyotes -- Coyotes kill and injure livestock including sheep and lambs, goats, calves and cows (while calving), young swine, and poultry. Coyotes are statewide in distribution. Damage to livestock occurs wherever livestock are available. Calf predation is generally greatest in the western half of the state, where calf production is more intensive. Predation on lambs and sheep may occur statewide but has typically been important in the northern Panhandle region, where sheep numbers are highest.

Coyotes are estimated to kill 6.0% of 122,000 lambs and 2.5% of 43,000 adult sheep in Nebraska; average value per head is \$75 (Gee et al. 1977, Rowe 1985). From these estimates, it appears that approximately 6% of all sheep and lamb losses are reported to the Federal Animal Damage Control program (Kelly 1985). We estimate sheep and lamb losses total \$630,000 annually. We assume that the more valuable the animal lost, the more likely the producer will be to report the loss. Thus, we assume that 20% of all calf and cattle losses annually are

Table 2. Top vertebrate pests of livestock production in Nebraska

Species	Estimated annual loss (Thousand dollars) <u>a/</u>
Commensal rodents	7,950
Coyotes	1,580
European starlings	452
Prairie dogs	225
House sparrows	180

a/ A description of the damage and the basis for each estimate are included in the text.

reported to ADC personnel, so calf and cattle losses (valued at \$180/head) total \$482,400. Assuming 2% of all poultry losses (\$4.74/head) are reported, total losses equal \$392,000, and assuming 5% of all swine losses (\$15/head) to coyotes are reported, then total losses are estimated to be \$73,000. Estimated total annual loss is \$1.58 million.

European starlings -- Starlings consume livestock feed and contaminate feed and water with droppings. They can be one way that TGE (transmissible gastroenteritis or baby pig disease) is spread among swine facilities. Roosts inside structures cause unsanitary conditions and droppings may damage stored feed and equipment. Starling damage may occur throughout the state, but relative levels of damage expected are lower in the north central (sandhills) area and higher in the southeastern quarter.

Livestock feed consumption costs are based on birds spending 90 days at facilities in winter x 0.5 (portion of diet from troughs) x 0.0625 lb (starling daily consumption capacity) x number of starlings x cost/lb of feed (Besser et al. 1968). Ninety percent of 10,000 cattle feedlots are estimated to average 100 starlings

each during winter (90 days); with feed costs of \$0.042/lb, the value of cattle feed consumed is \$106,000. Five percent of 14,000 swine facilities are estimated to average 25 starlings each; with feed costs of \$0.065/lb, the value of swine feed consumed is \$3,200. Feed contamination, although generally undesirable, apparently does not reduce livestock weight gains (Glahn and Stone 1984). Impact of starling droppings in water is unknown.

TGE infestations affect approximately 11% (Hog Farm Management, 1980 Market Profile) of an estimated 350,000 sows in Nebraska each year, which indicates 38,500 sows affected. Each infected sow represents a loss of approximately \$50 (Extension Veterinarian, pers. comm.). We attribute 10% of the TGE loss to disease spread caused by starlings. Thus, TGE loss attributed to starlings is estimated to be \$193,000.

An average of 1% each year of 50,000 livestock farms are estimated to have an economically important starling roost (>100 birds) inside a building. Costs associated with bird removal, clean-up, and damage to stored feeds and equipment are estimated to average \$300 per building. Thus, costs of roosts

inside farm structures are estimated to be \$150,000. Estimated total annual loss is \$452,000.

Prairie dogs -- Prairie dogs compete with livestock for forage, and their feeding and digging activities change the plant composition of rangelands. Prairie dogs are limited in distribution to short-grass range, or mid- and tall-grass range that has been grazed or burned. Presumably because of soil type, prairie dogs are not found in the main part of Nebraska's Sandhills, but they occupy the surrounding hardlands. Prairie dogs generally are present in the western two-thirds of Nebraska except for the sandhills area.

Prairie dogs are assumed to reduce forage yields by 50% and to inhabit approximately 90,000 acres of Nebraska rangelands. Forage on rangelands is valued at \$5 per acre (Western Nebraska; J. Stubbendieck, pers. comm.). Thus, the estimated impact is \$225,000.

House sparrows -- House sparrows consume livestock feed and contaminate feed and water with droppings. They may damage blown-on ceiling insulation inside structures, and their droppings may damage stored feed and equipment. House sparrows occur throughout Nebraska but the north central (sandhills) area has generally lower damage to livestock production.

Ninety percent of 10,000 cattle feedlots are estimated to average 25 house sparrows each, with sparrows receiving 25% of their diet (total diet: 10 lb/year) from feed in troughs; feed value of \$0.042/lb indicates loss of \$23,625. Fifty percent of 14,000 swine facilities are estimated to average 15 sparrows each, with sparrows receiving 10% of their diet from troughs; feed value of \$0.065/lb indicates loss of \$6,825. An average of 1% each year of 50,000 livestock farms are estimated to have

economically-important damage to insulation or to stored grains and equipment inside a building. Costs associated with insulation replacement, clean-up, and damage to stored feeds and equipment are estimated to average \$300 per building. Thus, costs of damage inside farm buildings is estimated to be \$150,000. Estimated total annual loss is \$180,000.

DISCUSSION

Estimates made for individual wildlife species indicate that losses from wildlife damage to crops in Nebraska total approximately \$27 million, and to livestock production, \$10 million. Thus, the estimated total loss to these agricultural resources in Nebraska is \$37 million. Although sufficient data to reliably estimate economic losses are virtually unavailable, we believe that estimates presented here represent reasonable first approximations.

Damage to newly-planted trees and shrubs attributed to pocket gophers (2%), rabbits and hares (8%), deer (4%), and voles (2%), totals 16%, which initially seemed to us too high. However, the estimate for each species was based on considerable discussions with Nebraska Forest Service personnel (D. Adams, R. Lodes, and T. Wardle, pers. comm.) who often observe such damage in the field. Subsequent discussion to reconsider and rethink these estimates arrived at the same 16% total, so we conclude that the values are reasonable approximations until further data are available.

Estimates made in this paper are of actual losses only and do not include indirect costs of damage (e.g. replanting costs or equipment down time) nor expenditures for control practices. Additionally, these estimates deal only with damage to agriculture. Non-agricultural damage such as human health concerns; urban lawn, landscape, or garden problems; and damage to homes or other non-agricultural structures is not included. Information examined

indicates that damage caused by certain vertebrate species may be considerably higher than estimated here.

In considering damage caused by wildlife, it is important to acknowledge the many positive values and attributes of most vertebrate species. For example, deer, rabbits, and beaver are valued as game animals, providing sport hunting and trapping to Nebraska residents and non-residents. Landowners are usually tolerant of some damage from these species as long as the damage is not excessive, and they may undertake habitat improvements to benefit certain wildlife. Further, many Nebraskans place a high value on various kinds of wildlife, and many enjoy non-consumptive wildlife uses such as observing wildlife in their habitats. A 1985 national survey (U.S. Fish and Wildlife Service 1987) indicated that 78% of adults in the United States (141 million people age 16 and over) participated in wildlife-associated recreation, spending \$55 billion on wildlife-related activities; specific state data were not yet available. Such recreational expenditures cannot be compared directly to damage losses because such a comparison would often involve different people, locations, and wildlife species, as well as other variables. However, they do provide an economic indication of the strong positive values often associated with desirable wildlife experiences.

Attitudes about wildlife in relation to damage vary depending in part on individual perceptions and experiences with damage situations. In general, Nebraskans have a positive attitude about most native species except when these species cause damage that is viewed as economically or otherwise intolerable. Non-native "pest" species such as Norway rats, house mice, European starlings, and house sparrows are often disliked, because they are

widely recognized to cause damage but have few recognized beneficial attributes.

When wildlife become too numerous, or when their behavior causes direct conflict with the production of agricultural products, prevention or control may be needed. Normally, initiation of control procedures is recommended when the cost of damage occurring, or which can be expected to occur, exceeds the cost of control plus the positive values of the animals to be controlled (if lethal measures are needed). Control strategies that are developed and implemented should take into account the social and aesthetic considerations involving wildlife as well as the economics of the situation.

Damage assessment is complex and may involve variables associated with agricultural production, attitudes and tolerance levels of people experiencing damage, as well as wildlife behavior and population variables. Although complex, understanding economic impacts of damage is an important and integral part of prevention and control efforts. We encourage others to consider making similar assessments of wildlife damage in their respective states and to develop data or offer suggestions that might improve such damage cost assessment.

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