EXPERIENCE WITH DEER REFLECTORS

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INTRODUCTION

Minnesota is ranked sixth in the United States for deer/vehicle accidents (1). The most visible, and from a monetary perspective the most significant, transportation induced mortality of wildlife in Minnesota involves motor vehicle collisions with whitetail deer (*Odocoileus virginianus*). Deer/vehicle accidents in recent years are estimated to range from 12,000 to 16,000 year (Figure 1) (2). With the average vehicle damage estimated to be $2000 per accident and the recreational cost of a deer estimated to be $500, the roadkill of whitetail deer in Minnesota is about a $35 million problem each year.

Deer/vehicle accidents are a problem throughout the state particularly in late fall and early spring. The character of the problem varies with the wide diversity of habitat types within the state. Minnesota is home to three major biomes; the northern coniferous forest, the central hardwood forest, and the prairie or "farmland" (Figure 2). The deerkill problem varies in each biome.

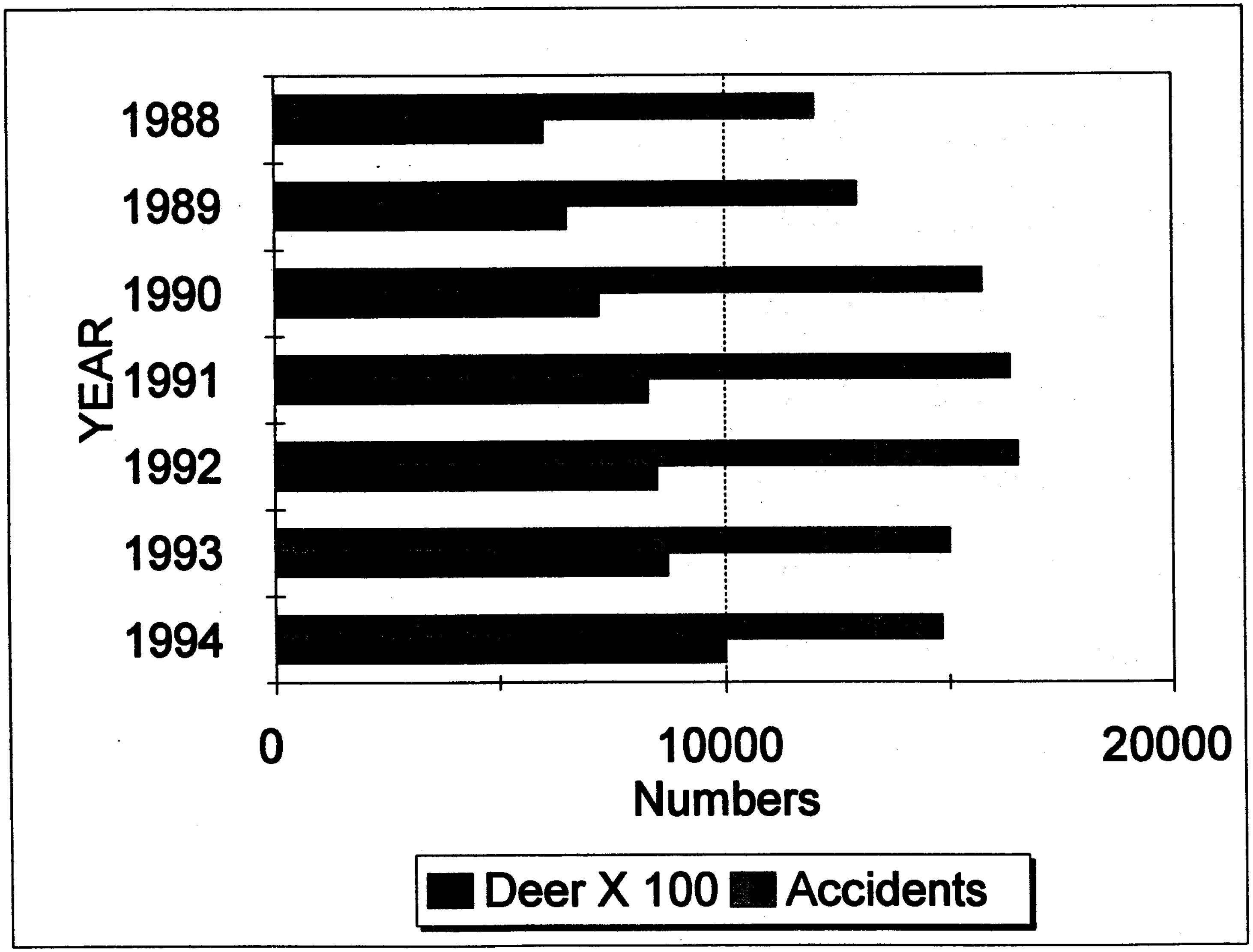
REGIONAL DEERKILL PATTERNS

In the northern coniferous forest forage is relatively scarce, the deer distribution is scattered, and the majority of deer/vehicle accidents occur at dispersed crossing locations along roadways. The exception occurs in winter and late spring when cold and snow force deer into confined areas or "yards". Roads that cut through deer yards experience very high deer/vehicle accident rates. This is attributable to deer movement within the yard . The attraction of the roadside due to available salt, less snow depth, and early green up of vegetation may also be factors in attracting deer.

The central hardwood forest has been heavily cleared for agriculture, resulting in interspersion of woods and farm fields. Deer densities are high, forage is relatively abundant, and deer distribution is skewed to areas of good cover. Deer/vehicle collisions usually occur in fairly discrete areas as deer cross roads while moving between feeding and resting areas.

The prairie has been heavily converted to agriculture. Deer densities in this region are the lowest in the state, since cover is limited. However, forage is very abundant and where wooded cover exists, such as river valleys, local deer concentrations can be extremely high. Roads that cut through this habitat can result in the highest deer/vehicle accident rates in the state.

Figure 1. Minnesota Deer/Vehicle Accidents and Estimated Statewide Deer Population, 1988-1994 (Source: MNDNR).



HISTORY

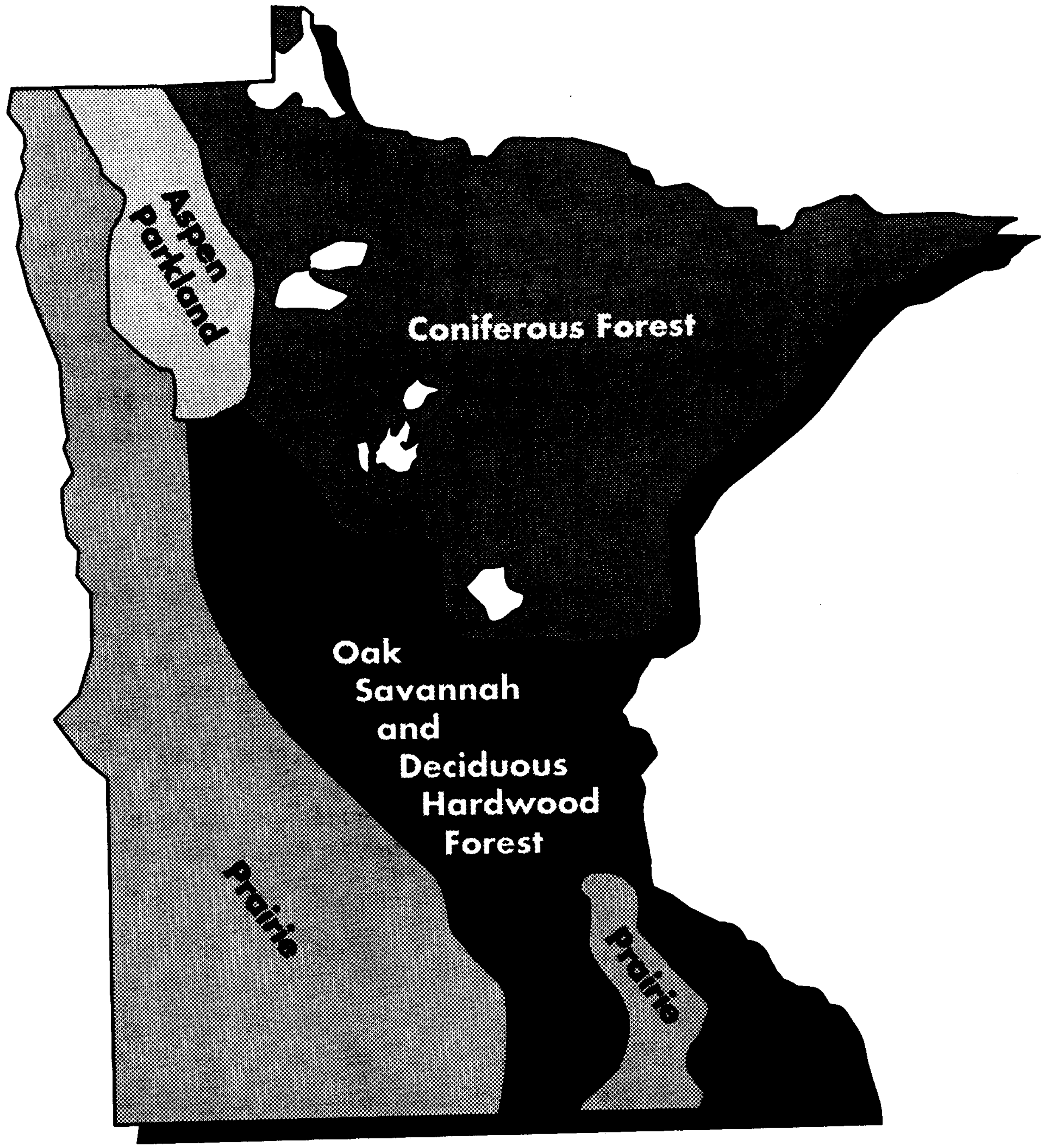
Several methods have been utilized in the past to try to reduce deer/vehicle accidents. Standard highway signs have been used to warn motorists of a deer crossing area. Since deer crossing signs are common and deer are rarely seen, these signs are routinely ignored by most motorists. In the mid 1950's, mirrors were placed on posts alongside a road through a northern deer yard but the experiment did not reduce the accident rate. In the 1970's fences were installed at two interstate highway locations to prevent deer from entering the roadside. One section significantly reduced accidents, while the other did not. Properly installed and maintained deer fences will reduce deer/vehicle accidents but the fences will not work at many of our problem areas (2).

In 1980 the Minnesota Department of Transportation (Mn/DOT) installed the Swareflex brand, red reflector along a one mile stretch of I-94 in central Minnesota. Another brand of white reflector was installed in a one mile stretch of TH 169 in the Minnesota River valley in southern Minnesota. The red reflector reduced deer/vehicle accidents rates over 80% while the white reflector was unsuccessful. Subsequently, the Federal Highway Administration allowed federal safety dollars to be used for deer reflector installation projects and Mn/DOT decided to program reflector installations as safety improvement projects. Locations with high deer/vehicle accidents were identified through a variety of sources including Department of Public Safety accident records, Department of Natural Resources (DNR) conservation officer reports, and interviews with highway maintenance superintendents. Minnesota has since installed reflectors at 38 locations throughout the state totaling 56 miles.

RESULTS

Deer/vehicle accident data for 16 reflector installations are presented in Tables 1-4. Four sites in each of the three major biomes, plus 4 sites from suburban metropolitan central hardwoods habitat were analyzed. Robust parametric statistical analysis of this accident data is not possible due to limited nature of available data. Pre-installation data for all of these sites were collected and amalgamated from a variety of sources, prior to 1988. These sources included Department of Public Safety accident records, DNR conservation officer reports, and Mn/DOT maintenance records. Much of these data were anecdotal. In 1988 a state law was changed and responsibility for the disposal of dead deer along highways, and therefore record keeping, was transferred from the DNR to the road authority. Since 1988 there has been a consistent source of deer/vehicle accident data, although the deerkill is likely under reported by this method.

Figure 2 - Map of Minnesota's Biomes



DISCUSSION

The data from Tables 1, 2, and 3 show a dramatic reduction in the deer/vehicle accident rate after installation of reflectors in the rural Minnesota northern coniferous forest , central hardwoods, and "farmland" habitats. These reductions ranged from 50 to 97 percent, averaging 90% in the four coniferous forest installations, 79% in the four "farmland" installations, and 87% in the four central hardwoods installations. Contrastingly, the four installations in the Twin Cities suburban metropolitan area (central hardwoods) all experienced an increase in the deer/vehicle accident rate after installation of reflectors. Reflectors were generally installed at 66 ft. intervals.

Two sites in rural Minnesota, not shown in Tables 1-3, were apparent failures and the installations have been removed. A one mile segment of TH 169 in the Minnesota River valley had a white reflector installed at intervals of 125 ft. This was a central hardwoods habitat deer movement corridor, characterized by steep slopes and limited roadside visibility. Deer vehicle accidents increased, concurrent with an increase in the regional deer population, and the installation was removed after several years.

TH 61 along the north shore of Lake Superior, a coniferous forest deer yard habitat, is consistently one of the highest deer/vehicle accident sites in the state. Red reflectors were installed along an 11.3 mile segment of TH 61, also in an area of steep slopes, at a density 2-3 times that of Minnesota's other installations. The "North Shore" is a very scenic drive and the public did not like the intrusion of reflector posts at 25 ft. intervals for over 11 miles. Anecdotal evidence indicated that the deer/vehicle accident rate was unchanged. The installation was removed after one year.

Why do reflector installations apparently work in rural Minnesota and fail in suburban areas? The theory for the success of reflector installations is that headlights of approaching vehicles shine into reflectors located parallel to the roadway and the prisms reflect a red glow visible to deer on the roadside. This red glow, perhaps mimicking the eyes of predators, causes deer to remain motionless or escape away from the roadway while vehicles are present. The necessity for headlights means the reflectors will function as intended only during nighttime and other low light conditions. Deer are most active and deer vehicle accidents occur predominantly during night or low light conditions.

Possible explanations for the reduction in deer/vehicle accidents are:

1. Deer populations in the installation area are declining, resulting in a lower deerkill rate. This is not supported by DNR data which indicates a stable or expanding population (Table 1) (1).

2. Deer change their movement patterns over time to avoid crossing roads. If this were true then the overall state deer/vehicle accident rate would be declining dramatically. This has not happened.

3. The reflector installations may modify driver behavior rather than deer behavior. Reflectors are an unusual roadside feature and may increase driver alertness, thereby allowing accidents to be avoided. If true, then accident rates should immediately decline after installation and then gradually increase as drivers become familiar with driving past deer reflectors. The deer/vehicle accident reduction rate trend appears to be stable over time.

4. The reflector installations work as intended.

Possible explanations for the increase in deer/vehicle accidents at reflector installations in suburban metropolitan areas:

1. Deer reflectors do not work. This conclusion is contradicted by the apparent success of reflector installations in rural Minnesota.

2. Pre-installation deer/vehicle accident rates were significantly lower at the metropolitan sites compared to the rural sites, thus normal fluctuations in accident rates may mask long term trends.

3. Highways at these sites have higher and steadily increasing traffic levels. Deer may have few opportunities to cross the road when vehicles are not present. Deer may eventually be compelled to cross the road despite a stimulus not to cross.

4. Development pressure reducing available habitat in a metropolitan area combined with generally higher human activity may increase deer movement rates, thus increasing accident rates.

5. Deer populations in the Twin Cities metropolitan area have increased at a greater rate than the deer population in the rest of the state (1). Higher deer populations equate into higher deer/vehicle accident rates.

6. Lack of reflector maintenance may reduce or eliminate any effectiveness in reducing deer/vehicle accident rates. The use of salt for winter roadway deicing is significantly higher in metropolitan areas compared to rural roadways. Spray from wet, heavily traveled roads could coat the reflector rendering it ineffective in reflecting headlights onto the roadside.

CONCLUSIONS

The Minnesota experience with deer reflectors shows a mixed result in reducing deer/vehicle accident rates. The installation of deer reflectors at discrete locations along rural roadways in Minnesota with high deer/vehicle accident rates was generally successful in reducing those accident rates. Steep slopes and deer yard habitat may have been factors reducing the effectiveness of deer reflectors in rural Minnesota. Installation of deer reflectors on suburban metropolitan roadways in Minnesota was unsuccessful in reducing deer vehicle accident rates. High traffic, increasing deer populations, and the inability to effectively maintain the reflectors may have been factors in the lack of success in the metropolitan area.

Future research efforts will include the collection of better pre and post installation kill data to garner a statistically testable data set. Possible future studies may also include controlled effectiveness studies such as how deer behave and respond to the presence of reflectors.

LITERATURE CITED

1. Minnesota Department of Natural Resources: Unpublished data. 1996.

2. J. Ludwig and T. Bremicker. Evaluation of 2.4-m Fences and One-Way Gates for Reducing Deer-Vehicle Collisions in Minnesota. TRB, Transportation Research Record 913, 1983, pp. 19-22.

TABLE 1 - DEER KILL AT REFLECTOR LOCATIONS: CONIFEROUS FORESTS

LOCATION	# OF MILES	ESTIMATED ANNUAL PRE-INSTALLATION DEER KILL	POST INSTALLATION DEER KILL (ANNUAL MEAN FROM 1988 - 1994)	PERCENT (%) CHANGE
TH 32	1	24	4	-83%
TH 71	0.7	31	2	-93%
TH 71	0.6	37	2	-94%
TH 64	2.3	11	1	-90%
TOTALS	4.6	103	9	AVG = -90%

Table 2 - DEERKILL AT REFLECTOR LOCATIONS: PRAIRIE ("FARMLAND")

LOCATION	# OF MILES	ESTIMATED ANNUAL PRE-INSTALLATION DEER KILL	POST INSTALLATION DEER KILL (ANNUAL MEAN FROM 1988 - 1994)	PERCENT (%) CHANGE
TH 75	1	24	2	-83%
TH 23	1	40	20	-50%
TH 67	0.75	30	3	-90%
TH 75	1.1	120	10	-92%
TOTALS	3.85	214	35	AVG = -79%

TABLE 3 - DEERKILL AT REFLECTOR LOCATIONS: CENTRAL HARDWOODS

LOCATION	# OF MILES	ESTIMATED PRE-INSTALLATION DEER KILL	POST INSTALLATION DEER KILL (ANNUAL MEAN FROM 1988 - 1994)	PERCENT (%) CHANGE
TH 371	2.39	15	4	-73%
TH 64	0.25	16	1	-94%
TH 169	0.4	29	1	-97%
I - 94	1	38	6	-84%
TOTALS	3.82	98	12	AVG = 87%

TABLE 4 - DEERKILL AT REFLECTOR LOCATIONS: METRO CENTRAL HARDWOODS

LOCATION	# OF MILES	MEAN ANNUAL PRE-INSTALLATION DEER KILL	MEAN ANNUAL POST INSTALLATION DEER KILL	PERCENT (%) CHANGE
TH 96	1.13	3.29 (1980-87)	6.28 (1988-94)	+90%
TH 36	0.94	3.36 (1980-91)	7.33 (1992-94)	+100%
TH 5	1.0	2.36 (1980-91)	5.33 (1992-94)	+100%
TH 61	1.01	2.83 (1980-86)	4.44	+57%
TOTALS	4.08			AVG = -87%