

# **Critique of the 2006 Evaluation of STRIETER-LITES by Investigators Associated with the University of Georgia**

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## **Introduction**

This paper is my response to the article entitled "*Evaluation of Wildlife Warning Reflectors for Altering White-Tailed Deer Behavior Along Roadways*", D' Angelo et al, Wildlife Society Bulletin, Vol. 34, No. 4, 2006. Please note that there is a brief summary of this paper presented on the last page.

## **Problems in the Study**

The University of Georgia (UGA) evaluation of wildlife warning reflectors study, in purporting to be scientific is actually just the opposite – it is unscientific. It is incomplete and its conclusion (that STRIETER-LITES are not effective) is flawed and is misleading the public. In actual usage, the STRIETER-LITE reflector system has been shown to be effective in numerous studies and reports from highway maintenance crews and supervisors.

The UGA study claims that the deer observed were a random sample from the available deer population. However, the study is not clear in exactly how the random sample was selected. If the deer observed were not a random sample from the deer population, the results can not validly be applied to the entire deer population and the results and conclusions would apply only to the deer observed.

Another concern is related to the analysis of the data collected. The investigators have not been open about the specifics of how the data were statistically analyzed. They named some statistical tests (Paired t and Chi-square) but have not explained how these tests were applied to the data. Questions exist as to:

1. whether the assumptions required for proper use of the tests were satisfied,
2. what hypotheses were used for the tests, and
3. what the specific outcomes were.

In the field of statistics there are several statistical tests called "Chi-square." It is not clear which one was used. Without a clear understanding of how the data were statistically analyzed, it is questionable whether the analysis was statistically valid.

Although the Swareflex system was first introduced by John Strieter in 1984 to the Georgia Department of Transportation (GDOT), the only purchases made have been 280 reflectors for use in their 1997-1999 test site and 240 reflectors in the 2006 UGA study.

We believe this 2006 study is the basis for the GDOT indicating refusals to install the STRIETER-LITE deer warning system in areas where concentrated nighttime deer-vehicle collisions occur. Indications of this position seem evident since the findings of the study were presented to the GDOT Districts at a March 15, 2006 meeting in Atlanta. Strieter was not invited to that meeting and was denied a copy of the report.

This is serious business. We fear the consequences of this publication will be detrimental to the safety of Georgia motorists while traveling between dusk and dawn on highways where reports indicate over 50,000 deer-vehicle collisions are occurring yearly.

In essence, the investigators associated with UGA reported that they could not detect any measurable response in deer that were observed grazing near roadways where the warning systems were installed. This, in effect, led to their conclusion that the STRIETER-LITE system is ineffective. That conclusion is in contradiction to published reports of the effectiveness in other locations where the STRIETER-LITES have been installed.

The study is incomplete because it failed to observe the reactions of the most important aspect or function of the reflectors, which is deterring or stopping deer while *running* and attempting to cross the test-site roadways while headlights from traveling vehicles lighted the reflectors. STRIETER-LITE reflectors are not needed nor intended to deter idly grazing deer along the roadways. In this situation, motorists can easily observe the grazing deer and reduce their speeds, thus avoiding collisions. Our reflectors, by design, deter active deer from crossing the road when moving vehicles light up the reflectors.

A serious flaw in the study is that “campus deer”, rather than “deer in the wild”, were used for observation. Observers have indicated that deer in the wild are more alert and react to any movement while running as compared to when they are grazing or when standing still. Therefore, running deer will react to the lighted reflectors. Many observers have witnessed these reactions, and this explains why the reflectors are effective.

Figures 1 and 2 show the proper installation of the reflectors in a rural setting that has wild deer.



**Figure 1**



**Figure 2**

Figures 3 and 4 show the first site on the Berry Campus that was used in the UGA study. Figure 5 shows the second site on the Berry Campus.



**Figure 3**



**Figure 4**



**Figure 5**



**Figure 6**

A former Chief Forester at Berry College (who spent 10 years there) informs us that he is very familiar with deer behavior on the Wildlife Refuge, essentially the Main Campus and the Mountain Campus which are connected by the stretch where the tests took place. As an alum of the University of Georgia, where he received a Bachelor of Science degree in forestry, he states that the campus deer have so much contact with people on campus that they are not nearly as skittish as those in the wild.

Figure 6 was taken while cycling on the paved road. The buck that is only 15 feet away clearly shows it was not fearful, looking right at the photographer with no tail up in alarm.

Figure 7 shows that the deer have certainly been conditioned to being around people as they are unconcerned as the former Chief Forester rode his bicycle past them.



**Figure 7**

The majority of Swareflex and STRIETER-LITE installations are in rural areas. For the study to not replicate tests in rural areas is a serious omission, thus indicating an incomplete study.

We believe that a more effective test would be to use appropriate controls, using the reduced deer-vehicle collision (DVC) frequencies as the only true measure of effectiveness. Such tests should be replicates of actual highways in various environmental conditions where wild deer are habituating and crossing to feeding and watering areas.

The UGA study observed few favorable behavioral responses by the grazing deer due to the lighted reflectors from a passing vehicle. Yet, they report that in sixty 4-hour observations of deer-vehicle interactions (240 hours), only 1 deer-vehicle collision occurred during the entire testing period from Nov. 18, 2004 to May 1, 2005. This observation in itself would indicate that *the reflectors were effective* in reducing DVCs even with grazing deer. Later in the article, the comment was made that the campus experienced 12–24 deer-vehicle collisions in a year's time. A person who is well acquainted with the campus states that probably most of those collisions were on US 27 where this main 4-lane highway crosses the Berry College land at several points and are *not* associated with the test sites.

## Results of an Earlier GDOT Study

The conclusions in the UGA study contradict an earlier GDOT research project on a ½ mile 2-year test of the STRIETER-LITE reflectors that was conducted in Henry County, Georgia which showed a *100% reduction in collisions*.

In his 1999 report on this installation, author David Jared, Research and Development Branch, GDOT, concluded, “Based on this data, the deer reflectors appear to have reduced the number of deer–vehicle accidents in the section to zero.”

The GDOT test site is shown in Figures 8 and 9. Figure 9 shows a typical reflector installation at the site.



**Figure 8**



**Figure 9**

Herman Miller, owner of the Miller Store shown in Figure 10, along with neighbors, also monitored the test site and reported a 100% reduction in DVCs. This compared with a yearly average of two DVCs which occurred in the test site from 1993-1996.

Unfortunately for the Georgia motorists, upon the conclusion of the test, the reflectors were removed by the GDOT. Mr. Miller reported that DVCs resumed after the reflectors were removed.



**Figure 10**

## Background and Effectiveness of the STRIETER-LITE Reflector System

D. Swarovski & Co. in Austria manufactures the world's finest faceted Strass crystal. They also produce excellent quality optics and highway reflectors. Since 1973, they have designed and distributed the SWAREFLEX Wildlife Reflector System that has been proven effective in Europe, Great Britain and other countries in reducing nighttime DVCs. In 1978, John Strieter became the exclusive distributor for the SWAREFLEX system in North America. He improved upon the reflector and the installation method and in 1994 received a patent for both the STRIETER-LITE Reflector and the installation method. This installation method is very important to its success in reducing DVCs. In addition, STRIETER-LITE is offered in red, blue-green, amber and white.

The STRIETER-LITE reflectors are mounted on posts along each side of the road, staggered, and are directed across the road. Headlights from passing vehicles strike the reflectors, sending flashes of dim light across the road into the roadsides in both directions. The resulting effects set up apparent moving, unnatural light patterns which deter deer from crossing the roadway in front of a vehicle. To approaching motorists, the existence of the reflectors is generally unnoticed since the reflectors do not reflect light back to the driver, but across the highway.

The STRIETER-LITE Wild Animal Highway Warning Reflector System in actual usage is, and has been, proven effective in reducing deer-vehicle collisions between dusk-to-dawn on North American highways and roads since 1981. Purchases by seven Canadian provinces include Alberta, British Columbia, Manitoba, Northwest Territory, Ontario, Quebec, and Saskatchewan. Purchases by state, city and county DOTs in 28 states include Arkansas, Arizona, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Minnesota, Missouri, Michigan, Nevada, New Jersey, New Mexico, New York, Ohio, Oregon, South Dakota, Texas, Virginia, Washington, Wisconsin, and Wyoming.

The STRIETER-LITE System has been shown to be effective in numerous studies and reports from highway maintenance crews and supervisors. Site Reports from state and county DOTs are available which show *significant decreases* in DVCs on highways where reflectors have been installed for years:

Menomonie, **Wisconsin** DOT 1995  
Waukon, **Iowa** DOT 2004  
Boulder, **Colorado** DOT 2004  
**New Jersey Turnpike**  
**New Jersey** DOT 2004  
Hunterdon County, **New Jersey** 2004  
Bridgewater, **New Jersey** 2003

We started selling the SWAREFLEX Wildlife Reflector in 1981. Our total sales from 1981 – 1994 were 98,839. Total sales of the STRIETER-LITE Wild Animal Reflectors from 1994 – 2007 were over 122,144. New orders and reorders by State, County and City DOTs are clear indications that these people know how effective the reflectors are. Sales in 2005, 2006 and 2007 were:

**California**  
20 – Apr. 2007  
**Colorado**  
7 – Aug. 2007

Grundy County, **Illinois**  
80 – Sep. 2005  
Calhoun County, **Michigan**  
200 – Jan. 2005

**New Mexico** DOT  
80 – 2005  
**New Jersey Turnpike**  
200 – Apr. 2006

**New Jersey**  
 350 – Jan. and Feb. 2007  
**Nevada DOT**  
 1,000 – Sep. 2006  
 1,000 – Sep. 2007  
**New York Thruway**  
 790 – Oct. 2005  
**New York DOT**  
 140 – Jan. thru Sep. 2005  
 200 – Mar. 2006  
 200 – Jun. 2006  
 580 – Mar. 2007  
 280 – Apr. 2007  
 40 – May 2007  
 980 – Aug. 2007  
 120 – Dec. 2007

**Pepper Pike, Ohio**  
 165 – June 2006  
**Solon, Ohio**  
 400 – Mar. 2006  
**South Dakota DOT**  
 3,000 – Jun. 2007  
 20 – Nov. 2007  
**Sunset Valley, Texas**  
 20 – Jun. 2006  
**Wisconsin**  
 20 – Jun. 2007  
**Wyoming DOT**  
 330 – Feb. 2007  
 425 – Aug. 2007

*Canada:*  
**Alberta MOT**  
 150 – Feb. and Sep. 2005  
 170 – Oct. 2006  
 120 – Apr. 2007  
 820 – Jun. 2007  
 140 – Jul. 2007  
 65 – Oct. 2007  
**British Columbia MOT**  
 700 – Mar. 2005  
 200 – Jun. 2006  
 330 – Oct. 2006  
 400 – Oct. 2006  
**Manitoba MOT**  
 150 – May 2005  
**Saskatchewan MOT**  
 160 – Jun. 2005

Starting in 1985, the installation of our reflectors on state, county and city highways were eligible for 80% federal funding by the Federal Highway Administration. Now they are eligible for *100% federal funding* under the Federal Highway Administration, Highway Safety Improvement Program (HSIP).

Twelve test reports that were *critical* of the effectiveness of our reflectors were published from 1985 to 2003. Each test site was 1 mile or less in length. I have analyzed them and found 90% of them were flawed or not applicable. Sixteen critical reports with no tests were published. These merely referred to some or all of the flawed test reports. Proper installation, accurate monitoring of the collisions and proper maintenance of the reflectors is essential to their effectiveness. The analysis of these reports is available from the Strieter Corporation. A listing of these reports is provided at our Web site ([www.strieter-lite.com](http://www.strieter-lite.com)) under **Flawed Reports**.

We also have available published studies on reductions in DVCs with the reflectors. (Gladfelder 1984, Schafer 1985, Ingebrigtsen and Ludwig 1986, Pafko 1996).

The very first study of five test sites in the US reported an average of 41% reduction in the December 1984 Final Report by Lee Gladfelder, Wildlife Research Biologist, Iowa Conservation Commission, Wildlife Research Station, Boone, Iowa. 600 reflectors were replaced by the manufacturer D. Swarovski & Co. since the reflectors were the first model in production. Certain defects in the housing resulted in reduced reflectivity and caused many reflectors to break from their mountings and fall to the ground.

In January 1985 at the Transportation Research Board meetings, William P. Carr, A.I.A., Washington State Department of Transportation, Olympia, Washington reported a 90% reduction on DVCs over a test period from 1981 to 1984.

Subsequent field tests and over 60 site reports by persons in charge indicated 50-100% effectiveness of the system. For example, one of the oldest successful sites currently in existence is located in Alamakee County, Iowa. Since January 1987 the average reduction over 15 years was 96.2% from a recorded 50 DVCs per year for 3 years prior to installation. A second site reports a 96.2% average over 11 years. A statistical analysis of before and after data collected from 53 sites as reported by supervisors in charge concluded the reflectors reduced DVCs by 78-90%. This report is available from the Strieter Corporation.

## Background: Contacts with GDOT, First GDOT Test, UGA Study

The Georgia Department of Transportation has continually resisted the use of STRIETER-LITE reflectors to reduce deer-vehicle collisions (DVCs) on the Georgia highways.

1. In 1984 the SWAREFLEX system was introduced to the GDOT in Atlanta.
2. After considerable urging by traffic safety advocates, GDOT finally installed a ½ mile test site in Henry County in March, 1997. For the next two years, this test showed that the reflectors were 100% effective !
3. From 1999 to 2004, GDOT explored areas where excessive DVCs were recorded to install 8 new test sites. Having difficulty in determining high kill areas (although statistics were available), they decided to turn the study over to “Consultants”.
4. A contract with funding obtained by GDOT was executed with three or four Ph.Ds from the University of Georgia (UGA) in Athens and Berry College in Rome, Georgia, to study:
  - a. The effectiveness of the STRIETER-LITE reflector system to reduce DVCs.
  - b. Whistles to deter DVCs,
  - c. Solid fencing to deter DVCs.The evaluation of STRIETER-LITE was given the first priority.
5. Strieter was invited by Bob Warren, Ph.D., UGA, to meet with them in Athens and later at Berry College to approve their method of testing the STRIETER-LITE reflectors.
6. Warren et al. proposed the use of night-time surveillance with a forward-looking infrared camera with equipment to record the interactions of deer with vehicles at the two sites selected where the reflectors were installed using red, amber, blue-green and white lenses.
7. Strieter expressed the real need that if they could record the reactions of deer with moving vehicles while attempting to cross the road, running towards the lighted reflectors and showing how they respond by running away from the site or just freezing while the vehicles moved through -- they would be able to once and for all prove the effectiveness of the STRIETER-LITE reflectors.
8. When Bob Warren was asked if their intention was to disprove the effectiveness, his response was: “No – we want to know why they are effective”.
9. They explained how they were going to use a high tech forward-looking infrared camera that was so effective that it could discern the presence of an object as small as a field mouse on the trunk of a distant tree after dark to record the reactions of the deer.
10. Having been assured this was the intent of their research, Strieter waited until summer 2005 to inquire of the progress. He specifically asked if they were able to capture the interaction of deer running towards the reflector sites as vehicles moved through. Strieter was told that they were not allowed to discuss or disclose any of the findings of their testing. Strieter’s concern was to be of help, not to influence the results.
11. Gino D’Angelo, the graduate student at the UGA working towards a Ph.D., was sent to the August 29 – September 2, 2005 ICOET Convention, San Diego, and two wildlife conferences in Madison, Wisconsin in August and September 2005 to present his poster explaining the research project. However, he was not allowed to disclose any findings.
12. It seems incomprehensible that despite their inability to record the interactions of deer running towards or attempting to cross the roadways with lighted reflectors in front of moving vehicles, they were content to accept the lack of reactions of deer idly standing or grazing along the roadsides. Based on this incomplete testing, they concluded that the wildlife reflectors were ineffective in changing deer behavior such that DVCs might be prevented.

13. Strieter was informed that the test results would not be released until after GDOT made a presentation to the various highway departments on March 15, 2006 in Atlanta. A copy of the study that was submitted to the Wildlife Society Bulletin in November 2005 was released to Strieter on April 3, 2006. We are baffled by the secrecy and lack of transparency throughout this entire project.
14. Release of the observation data collected during the study was requested by Strieter but was refused until the projected September publication of the manuscript. However, when Bob Warren later offered to have the data copied and sent to Strieter, he explained the cost would be about \$800.00.
15. When Bob Warren actually sent the data, he advised Strieter that the University considers it intellectual property and none of it may be distributed or shown to anyone without first receiving written approval from the University. The cost would be \$1,350.00.
16. Strieter advised Warren that he would not open the package or pay for it unless he received written permission from the University that he could distribute the data to his advisors, counselors, and any interested persons. When no reply from Warren or the University had been received by November 20, 2006, Strieter returned the package. No payment has been made by Strieter.

## Conclusion

The STRIETER-LITE system has been shown to be effective by numerous tests and actual usage. As a result, we continue to have many new orders and re-orders. We believe implications from the UGA report with its erroneous conclusions will cause great harm and delay to the progress of providing motorists' nighttime safety from deer-vehicle collisions which they could have with the STRIETER-LITE reflector system.

## Footnote: Red Reflectors are Effective

As reported in the UGA Office of Public Affairs News Release, April 26, 2005, "If deer can't detect wavelengths in the red portion of the color spectrum, it makes little sense to develop deer deterrents based on the color red," said (Karl V.) Miller. ([www.uga.edu/news](http://www.uga.edu/news)) Miller's remarks were evidently targeting the outcome of the reported UGA, Berry College study that was getting underway. It is interesting to note that Karl V. Miller, PhD was one of the investigators in the UGA study.

For the record, Swareflex wildlife reflectors were using the red color ever since 1973 and are to this day. STRIETER-LITE reflectors have been red in color since 1994. Both systems have been very effective in reducing DVCs.

As shown at our Web site ([www.strieter-lite.com](http://www.strieter-lite.com), click on **Animals' View** and scroll down), *all* types of colored reflectors (red, cyan, amber and white) are seen by deer because all of them *look* blue-green. That is, even red reflectors transmit a certain amount of blue-green light. Field tests using the four types of colored reflectors have indicated that deer readily respond to the shorter wavelengths with blue-green reflectors showing the highest results.

## Summary

The University of Georgia (UGA) study fails to establish that STRIETER-LITES are not effective in preventing deer-vehicle collisions (DVCs). No evidence is reported that supports their conclusion. A close look at the methodology of the study reveals a number of flawed assumptions and protocols that render its conclusions highly suspect and not supported by the data proffered.

The most glaring flaw of the UGA study is the allegation that observers could not detect any measurable motion away from the road by deer that were grazing near roadways where the warning systems were installed. They use this observation of lack of movement to support their conclusion that the STRIETER-LITE system is ineffective. However, the STRIETER-LITE system does not claim that it will induce movement of deer away from the road when they are engaged in random motion, such as grazing, when vehicles approach. The STRIETER-LITE system is designed to keep deer from bolting across the road as vehicles approach with their headlights on. No data were collected or published that measured that effect. In short, their data collection, even if accurate, lends no support to their purported conclusion.

There are other serious methodological flaws in the study:

1. No protocol is stated for selecting which deer were to be observed as vehicles, with headlights activated, approached. There were usually several deer in the area along the roadway of the approaching vehicles. The motion of only one of them was measured. No criteria for selection were given, an omission which invites bias on the part of the observer; even if the motion of the animal measured had relevance to the efficacy of the STRIETER-LITE system.
2. D'Angelo et al have not been open about the specifics of how the data were statistically analyzed. They named some statistical tests (Paired t and Chi-square) but have not explained how these tests were applied to the data. Questions exist as to:
  - a. whether the assumptions required for proper use of the tests were satisfied,
  - b. what hypotheses were used for the tests,
  - c. what the specific outcomes were, and
  - d. which "Chi Square" statistical test was used, since there are several.
3. The validity of conducting the study using a deer population habituated to human contact is also questionable. Most deer-vehicle collisions occur when the deer involved are customarily unfamiliar with man-made devices.

As this study did not test the efficacy of the STRIETER LITE system, due to its methodological flaws and unscientific grounding, it serves no purpose and has no value. The study, based on flawed results, merely denigrates the product and wrongfully discourages its use by those who would benefit from it.