Wildlife Detection System Reliability and Effectiveness, US Hwy 95, Boundary County, ID

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Animal detection systems and driver response

Reliable warning signals

Increased driver awareness; large animals may be on or near the road

Lower vehicle speed

Increased driver alertness

Reduced reaction time when confronted with a large animal ahead

Shorter stopping distance

Vehicle may hit animal at lower speed

Vehicle may not hit animal
The System: Area cover
Sloan Security Technologies

Doppler radar
Thermal camera
Cellular antenna
Warning sign
Data processing and storage
The System
Sloan Security Technologies

White line = detection area

Purple line = Area covered by thermal camera

Blue area = Detection area but not covered by thermal camera

Area evaluated: between A and F
Goals and Objectives

Goal: investigate the reliability and effectiveness of the animal detection system installed along US Hwy 95, Boundary County, Idaho.

Objectives:
1. Basic system functioning and research equipment
2. Reliability of the system in detecting large mammals
3. Effectiveness of the system in reducing vehicle speed.
4. Effectiveness of the system in reducing collisions with large wild mammals.
5. Compare with results from similar projects with animal detection systems.
6. Analyze driver and large mammal behavior
Measure System Reliability

Correct detection:
Detection, large mammal is present

False positive:
Detection, large mammal is not present (not visible)

False negative:
No detection, large mammal is present

4 test periods (fall, winter, spring, summer)
Each test period is 10 consecutive days
Compare Detection Log to Images Thermal Camera

Radar alarming message starts:
Within about 1 second the warning signs are activated.

Radar alarming message ends:
Warning signs are active for another 38-41 seconds
Compare Detection Log to Images Thermal Camera

3 randomly selected hours per day (table shows hrs for 1st test period)

<table>
<thead>
<tr>
<th>Day</th>
<th>Hr 1</th>
<th>Hr 2</th>
<th>Hr 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>2</td>
<td>23</td>
<td>19</td>
</tr>
<tr>
<td>Day 2</td>
<td>23</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>Day 3</td>
<td>20</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Day 4</td>
<td>3</td>
<td>21</td>
<td>11</td>
</tr>
<tr>
<td>Day 5</td>
<td>24</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Day 6</td>
<td>23</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Day 7</td>
<td>21</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Day 8</td>
<td>8</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>Day 9</td>
<td>20</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Day 10</td>
<td>7</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Note if hr = 2, this means 2 am – 3 am
Radar Detections
(2x10 days, 3 hrs/day, 60 hrs analyzed)

- Correct detection: 85, 73%
- Possible false positive: 30, 26%
- False negative: 1, 1%

1.92 detections/hr
Duration detection:
Average: 15 s
SD: 9 s
How long does it take to cross?

For an individual

N=41

For the entire group

N=9

[Bar chart and scatter plot depicting time on road for individual and entire group]
Measure System Effectiveness

1. Reduction in vehicle speed in response to activated warning signs?
   4 test periods (after 10 day reliability test periods)
   Warning signs “forced on” for 1 randomly selected hr per day
   Vehicle speeds with activated warning signs
   Select periods when no detections occurred
   Vehicle speeds with warning signs turned off

2. Reduction in large mammal-vehicle crashes and large mammal carcasses?
   BACI design: Before-After-Control-Impact
   Limited time (After)
   Limited Impact (Short zone with detection system)
Speed Radars
Effectiveness: speed reduction
Hwy 191, Yellowstone NP

Main effect lights on/off: P<0.001 (Huijser et al., 2009)
Where are the Warning Signs?
## Warning Time for Drivers

### Seconds warning before animal steps on road
(add 1 second for delay in activation warning signs)

<table>
<thead>
<tr>
<th>Warning signs on entire time when animal is on road?</th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>35.21</td>
<td>36.31</td>
<td>6.32</td>
<td>20</td>
<td>1</td>
<td>119</td>
<td>118</td>
<td>33</td>
</tr>
<tr>
<td>Partial</td>
<td>12.40</td>
<td>27.73</td>
<td>12.40</td>
<td>0</td>
<td>0</td>
<td>62</td>
<td>62</td>
<td>5</td>
</tr>
<tr>
<td>No</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Unknown</td>
<td>135.00</td>
<td>13.71</td>
<td>6.86</td>
<td>137</td>
<td>118</td>
<td>148</td>
<td>30</td>
<td>4</td>
</tr>
</tbody>
</table>

### Percentile

<table>
<thead>
<tr>
<th>Warning signs on entire time when animal is on road</th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9.8</td>
<td>12.5</td>
<td>20</td>
<td>30.5</td>
<td>108</td>
</tr>
</tbody>
</table>
Warning Time for Drivers

<table>
<thead>
<tr>
<th>Warning sign</th>
<th>Distance to detection area (m)</th>
<th>Time to detection area (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>South end</td>
<td>North end</td>
</tr>
<tr>
<td>South</td>
<td>224</td>
<td>338</td>
</tr>
<tr>
<td>North</td>
<td>200</td>
<td>87</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>mi/h</th>
<th>km/h</th>
<th>m/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>South</td>
<td>60</td>
<td>96.5</td>
<td>26.8</td>
</tr>
<tr>
<td>North</td>
<td>60</td>
<td>96.5</td>
<td>26.8</td>
</tr>
</tbody>
</table>
Suggestions Warning Signs

1. Increase number (but no sign saturation)
2. Reduce distance between signs
3. Drivers *should not be able to pass sign without being able to see and interpret next sign*
4. Use LED signs
   - No detection = no message
   - Detection = Warning signs activated
Preliminary Conclusions

73-100% of detections relate to large mammals
Probably few (if any) true false positives

Very few false negatives
1 out of 44 animals was not detected

Warning time sufficient for about 90% of animals
Can be improved through number and placement of signs
Next Steps
Analyze reliability data 3rd test period
Collect reliability 4th test period
Collect effectiveness (speed) data
16 Aug: test for blind spots

Questions:
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