Factors affecting harvest-reporting rates for white-tailed deer

Howard J. Kilpatrick, Andrew M. LaBonte, and John S. Barclay

Abstract

Harvest data often are used to model deer (Odocoileus sp.) population growth and evaluate harvest strategies. Understanding factors that may influence harvest-reporting rates among methods of data collection is important in assessing the reliability of harvest data. Our objectives were to compare deer harvest-reporting rates over a 3-year period between mail-in archery-kill report cards (AKRC) and hunter surveys (HS) from the same group of bowhunters, assess the effects of harvest incentive programs, and evaluate factors influencing harvest-reporting rates. Estimated deer harvest, based on the HS, was almost 2.5 times greater than estimated harvest from AKRC. Of hunters initially classified as unsuccessful because no AKRC were submitted, 61% reported harvesting a deer on the HS. The HS appeared to better reflect actual deer harvest, and AKRC were more representative of actual harvest when harvest incentives were provided. Hunters classified as “less active” reported harvesting more deer on the HS than on AKRC for only 1 of 3 years, while hunters classified as “more active” reported harvesting more deer on the HS than on AKRC for all 3 years. Harvest incentives such as “earn a buck” or “earn a trip” may increase harvest and harvest-reporting rates. Hunters who spent much time hunting and harvested multiple deer in a season appeared to be more relaxed about reporting harvest on AKRC than hunters who spent less time hunting and harvested fewer deer. We concluded that harvest incentives will increase harvest-reporting rates, especially in areas with high deer populations, and that caution should be used when evaluating effects of harvest incentive programs.

Key words

archery-kill report cards, harvest incentives, harvest reporting rates, Odocoileus virginianus, white-tailed deer

White-tailed deer (Odocoileus virginianus) harvest data are used to model population dynamics, determine bag limits and hunting-season length, and assess the potential of harvest incentive programs to manipulate harvest and reporting rates. Understanding factors that may influence harvest-reporting rates among methods of data collection is important in assessing the reliability of harvest data. Data on harvest estimates are comparable among years and are used as indicators of population trends. A nationwide survey by Rupp et al. (2000) indicated that most state wildlife agencies use mail questionnaire (n = 26), check station (n = 27), telephone (n = 7), report card (n = 9), or some combination of these methods (n = 16) to survey deer hunters. Most states use these survey methods to estimate the total deer harvest and set harvest regulations (Rupp et al. 2000). Hunter bias or harvest-reporting methods may affect reliability of harvest estimates. Prestige bias (Smith 1959) refers to hunters inflating the number of animals harvested or altering the sex and age of animals harvested. Response bias refers to hunters incorrectly reporting their hunting activity either by mistake or by survey design (MacDonald and Dillman 1968). Recall bias refers to hunters failing to correctly recall the results of their hunt (Filion 1980). Nonresponse bias results from failure to get responses from designated individuals, which may bias results from respondents (Filion 1980).
Much information exists on biases that affect harvest-reporting rates by waterfowl hunters (Atwood 1956, Hayne 1964, Sen 1973, Wright 1978). Harvest estimates obtained from waterfowl hunter surveys have produced estimates 11-80% higher than estimates from check stations (Atwood 1956, Hayne 1964, Wright 1978). Little information exists on factors that affect harvest-reporting rates for white-tailed deer. Unsworth et al. (2002) found no difference in mule deer (O. hemionus) harvest estimates in Idaho between check station and telephone survey data, although it was unclear whether the same participants were used to generate both estimates. MacDonald and Dillman (1968) surveyed, over a 3-year period (1960-1962), deer hunters whose performance was known based on data collected at roadblocks and check stations and reported that 9% of unsuccessful hunters reported killing a deer and 4.5% of successful hunters reported killing no deer. Steinert et al. (1994) found no difference in harvest estimates for elk (Cervus elaphus) and mule deer between harvest data collected from a mandatory check station at a park exit and a telephone survey conducted 2-3 months later.

Only McPhillips et al. (1985) compared harvest-reporting rates between mail surveys and mandatory hunter report cards from successful and unsuccessful deer hunters. McPhillips et al. (1985) found that 19% of hunters who submitted no mandatory hunter survey reported killing a deer on the mail survey, which increased the annual harvest by 16%. No studies have evaluated potential factors influencing harvest-reporting rates for deer hunters between mandatory kill report cards and mail surveys. Our objective was to compare deer harvest-reporting rates between mail-in kill report cards and mail surveys from the same group of bowhunters over a 3-year period and evaluate factors influencing harvest-reporting rates. We also discussed effects of incentive programs on potential survey biases.

Study area

The study area was the town of Greenwich, Connecticut, a 124-km² township located in Fairfield County in the southwest corner of Connecticut, about 48 km from New York City. Greenwich was bounded on the south by Long Island Sound, on the east by the city of Stamford, and on the north and west by Westchester County, New York. The human population was about 58,000 (1998-1999 census data). Greenwich was primarily residential, with 0.81- and 1.62-ha minimum zoning restrictions. Only 17 parcels totaling 147 ha of farmland remained (Planning and Zoning Commission 1998). Greenwich was 36% forested land, 29% turf-nursery, 23% commercial-residential, 8% field-pasture, and 4% other. Deer densities in the upper two-thirds of town ranged from 31-46.3 deer/km². Only 11% of the town potentially could be open to firearms hunting because of a law that prohibited hunting within 152 m of a house. However, homeowners may sign a written waiver to allow firearms hunting within 152 m. No minimum property size or minimum distance was required to discharge a bow. Using the 2002 deer-hunting season framework, each bowhunter in Greenwich could harvest 2 bucks and unlimited antlerless deer (no cost for additional antlerless deer tags) in any order during a 91-day archery deer-hunting season (15 Sep-31 Dec). Deer hunters were required to have written permission from the landowner.

Methods

Successful archery hunters were required to complete a mail-in archery-kill report card (AKRC) within 24 hours of harvesting a deer. On kill cards hunters were required to report date, time, sex, and location of kill. No report card was required from hunters who harvested no deer.

We used a 9-page survey of bowhunters to assess where hunters lived, how often they hunted, where they hunted, and how many deer they harvested. We mailed hunter surveys (HS) to all bowhunters who reported harvesting >1 deer over a 3-year period (1999-2001) in Greenwich (successful hunters). We also mailed surveys to all Greenwich residents who purchased archery deer permits in 2001 (successful and unsuccessful resident hunters). We cross-referenced both lists of hunters to prevent duplicate mailings. We mailed surveys to bowhunters in January 2002 and mailed follow-up surveys to nonrespondents every 4-5 weeks. After 4 mailings we contacted nonrespondents by phone and requested that surveys be completed and returned.

Number of deer harvested per hunter per year was determined using AKRC and HS. We classified successful hunters who lived in Greenwich or an adjacent town as "local hunters" and those who lived in all other towns as "distant hunters." Based
Results

We censored 4 of 159 surveys because hunters no longer resided at the same address and left no forwarding address or residents purchased a hunting license to support the state wildlife agency but did not hunt. We received completed hunter surveys from 110 of 155 (71%) hunters. Contact with the remaining 45 hunters was unsuccessful. We received 64% of surveys from the first mailing, 22% from the second mailing, and 14% after contact by phone. Nonresponse bias was not assessed due to the small sample size of outstanding questionnaires and the low likelihood of obtaining questionnaire data from the remaining hunters after 3 unsuccessful attempts.

On AKRC hunters reported harvesting 61 ($\bar{X} = 1.49$ deer per hunter, $SE = 0.12$), 63 ($\bar{X} = 1.75$ deer per hunter, $SE = 0.18$), and 107 ($\bar{X} = 1.98$ deer per hunter, $SE = 0.21$) deer in 1999, 2000, and 2001, respectively (Table 1). Mean number of days AKRC were postmarked from the date deer were reported killed was 3 ($n = 43$ AKRC were postmarked, $SE = 0.57$). Thirty-seven percent of hunters returned AKRC within the 24-hour requirement. Mean number of deer killed per hunter on AKRC was similar ($f_{2,128} = 1.877, P = 0.187$) in 1999, 2000, and 2001. Over the 3-year period 2-13% of hunters reported harvesting $\geq 4$ deer in a season and 1 hunter reported harvesting 9 deer.

Using the HS, 84, 89, and 91 respondents hunted in Greenwich in 1999, 2000, and 2001, respectively. On the HS hunters reported harvesting 176 ($\bar{X} = 2.5$ deer per hunter, $SE = 0.22$), 184 ($\bar{X} = 2.6$ deer per hunter, $SE = 0.24$), 198 ($\bar{X} = 3.0$ deer per hunter, $SE = 0.29$) deer in 1999, 2000, and 2001, respectively (Table 1). Mean number of deer killed per hunter on the HS was similar ($f_{2,209} = 0.874, P = 0.419$) in 1999, 2000, and 2001. Over the 3-year period 21-31% of hunters reported harvesting $\geq 4$ deer in a season and 4 hunters reported harvesting $\geq 10$ deer. Hunters reported harvesting more deer on HS than on AKRC in 1999 ($f_{1,02} = -4.14, P \leq 0.001$), 2000 ($f_{1,04} = -2.8, P = 0.006$), and 2001 ($f_{1,14} = -2.7, P = 0.008$).

Recall bias

We censored 3 of 21 follow-up surveys (FUS) because hunters changed addresses and left no forwarding address. Hunters returned 16 of 18 (89%) FUS. Contact by mail with the remaining 2 hunters was unsuccessful. We compared harvest rates reported on AKRC, HS, and FUS. No difference existed in reported mean harvest between the HS and FUS in 1999 ($f_{2,45} = 9.79, P = 0.632$), 2000 ($f_{2,45} = 11.9, P = 0.73$), and 2001 ($f_{2,45} = 7.2, P = 0.82$) (Table 2). Reported mean harvest was higher on the HS and FUS than on AKRCs in 1999 ($P \leq 0.001$), 2000 ($P \leq 0.001$), and 2001 ($P = 0.002$) (Table 2). Difference in reported harvest between the HS and FUS was $\pm 1$ deer for 6 of 16 bowhunters (37.5%) in 1999 and 10 of 16 bowhunters (63%) in 2000 and 2001. Differences in reported harvest between the HS and FUS was $\geq 1$ deer for all remaining hunters in 1999-2001.

Successful and unsuccessful hunters

Two percent of successful hunters reported killing no deer on the HS (1999-2001). Successful hunters reported harvesting 138 deer ($\bar{X} = 2.6$ deer/ hunter, $SE = 0.26$) in 1999, 146 deer ($\bar{X} = 2.5$ deer/ hunter, $SE = 0.24$) in 2000, and 176 deer ($\bar{X} = 3.1$ deer/ hunter, $SE = 0.33$) in 2001 (Table 1). Mean number of deer killed by successful hunters was higher on the HS than AKRC in 1999 ($t_{77} = -3.514, P = 0.001$), 2000 ($t_{83} = -2.249, P = 0.027$) and 2001 ($t_{95} = -2.475, P = 0.015$) (Table 2).

Of 31 unsuccessful hunters, 19 (61%) reported harvesting $\geq 1$ deer on the HS. Unsuccessful hunters reported killing 38 deer in 1999 ($n = 17$ hunters, $\bar{X} = 2.2$ deer per hunter, $SE = 0.40$) and in 2000 ($n = 13$ hunters, $\bar{X} = 2.9$ deer per hunter, $SE = 0.71$) and 22 deer in 2001 ($n = 11$ hunters, $\bar{X} = 2.0$ deer per hunter, $SE = 0.49$) (Table 1). No difference existed in mean number of deer harvested on HS between successful and unsuccessful hunters in 1999 ($t_{18} = 0.632, P = 0.53$), 2000 ($t_{14} = -0.54, P = 0.60$) and 2001 ($t_{20} = 1.93, P = 0.07$) (Table 2).
Table 1. Archery statistics for deer hunters in Greenwich, Connecticut using archery-kill report cards (AKRC) and hunter surveys (HS) from 1999–2001.

<table>
<thead>
<tr>
<th>Results</th>
<th>1999</th>
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<tbody>
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<tr>
<td>AKRC</td>
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<td>54</td>
</tr>
<tr>
<td>HS</td>
<td>36</td>
<td>71</td>
<td>67</td>
</tr>
<tr>
<td>Reported no. of deer harvested</td>
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<td></td>
</tr>
<tr>
<td>AKRC</td>
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<td>176</td>
<td>107</td>
</tr>
<tr>
<td>HS</td>
<td>63</td>
<td>184</td>
<td>198</td>
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<tr>
<td>Reported no. of deer harvested by hunters classified as successful</td>
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<td>146</td>
<td>176</td>
</tr>
<tr>
<td>Reported no. of deer harvested by hunters classified as unsuccessful</td>
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<td>38</td>
<td>22</td>
</tr>
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<tr>
<td>Local hunters (n = 63)</td>
<td>17</td>
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<tr>
<td>Distant hunters (n = 47)</td>
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<td>28</td>
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<tr>
<td>No of respondents reported killing deer on AKRC and HS</td>
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<tr>
<td>Local hunters (n = 63)</td>
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<td>13</td>
<td>23</td>
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<td>Distant hunters (n = 47)</td>
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<tr>
<td>Difference in reported harvest between AKRC and HS (%)</td>
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<td>More on HS than AKRC</td>
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<td>63</td>
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<td>Distant hunters</td>
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<tr>
<td>More on HS than AKRC</td>
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<tr>
<td>Same on HS than AKRC</td>
<td>47</td>
<td>44</td>
<td>57</td>
</tr>
</tbody>
</table>

Notes:

a. Hunters who submitted an AKRC for deer harvested in Greenwich.

b. Greenwich residents who purchased an archery deer permit in 2001 but submitted no AKRC.

Local versus distant hunters

Mean travel time to hunting sites was less for local hunters (n = 32; $\bar{x}$ = 17.8 minutes, SE = 1.7) than distant hunters (n = 47; $\bar{x}$ = 69.1 minutes, SE = 10.7, $t_{48.2} = 4.75, P \leq 0.001$). Mean days hunted in Greenwich was greater for local hunters ($\bar{x}$ = 43.9 days, SE = 4.4) than distant hunters ($\bar{x}$ = 22.4 days, SE = 2.8, $t_{54.5} = -4.1, P \leq 0.001$). Mean number of deer harvested per local hunter was greater on HS than on AKRC in 1999 ($t_{39.6} = -2.9, P = 0.006$) but similar between HS and AKRC in 2000 ($t_{28.1} = -0.76, P = 0.452$) and 2001 ($t_{46.7} = -1.7, P = 0.092$) (Table 2). Mean number of deer harvested per distant hunter was greater on HS than on AKRC in 1999 ($t_{33.5} = -2.2, P = 0.037$), 2000 ($t_{37.8} = -2.1, P = 0.038$), and 2001 ($t_{39.3} = -2.2, P = 0.035$) (Table 2).

Mean number of deer harvested per hunter on AKRC was similar for local and distant hunters in 1999 ($t_{26.8} = -1.5, P = 0.149$). Mean number of deer harvested per hunter on AKRC was greater for local than distant hunters in 2000 ($t_{18.6} = -2.2, P = 0.043$), and 2001 ($t_{30.8} = -2.4, P = 0.024$). Mean number of deer harvested per hunter on HS was similar between local and distant hunters in 1999 ($t_{51.0} = -1.5, P = 0.138$), 2000 ($t_{50.9} = -0.626, P = 0.534$), and 2001 ($t_{52.3} = -1.8, P = 0.082$) (Table 2).

Hunter effort

Mean days hunted per month was 1.7 (n = 34, SE = 0.2) for less active hunters, 5.1 (n = 34, SE = 0.2) for active hunters, and 11.0 (n = 42, SE = 0.7) for more active hunters. More active hunters reported harvesting more deer than active and less active hunters on the HS in 1999 ($f_{21.07} = 76.4, P \leq 0.001$), 2000 ($f_{21.07} = 25.0, P \leq 0.001$), and 2001 ($f_{21.07} = 14.5, P \leq 0.001$) (Table 2). More active hunters reported harvesting more deer on the HS than on AKRC in 1999 ($t_{68.1} = -7.6, P < 0.001$), 2000 ($t_{67.0} = -5.7, P < 0.001$), and 2001 ($t_{69.7} = -3.3, P = 0.001$) (Table 2). Active hunters reported killing more deer on the HS than on AKRC in 1999 ($t_{33.3} = -2.4, P = 0.02$) and 2000 ($t_{38.6} = 2.3, P = 0.026$) and reported harvesting a similar number of deer in 2001 ($t_{54.7} = 1.4, P = 0.17$) (Table 2). Less active hunters reported harvesting similar numbers of deer on the HS and AKRC in 1999 ($t_{65.6} = -1.6, P = 0.11$) and 2001 ($t_{63.5} = -1.2, P = 0.22$) and more deer on the HS than on AKRC in 2000 ($t_{63.4} = -2.1, P = 0.036$) (Table 2).
Discussion

Method of reporting harvest influenced estimated harvest and hunter success rates. With the AKRC, many hunters failed to submit kill cards for all deer harvested or submitted cards after the 24-hour requirement. Less than half of hunters reported harvesting the same number of deer on HS and on AKRC in 2001. Hunters who tended to be more active and hunted more often were less likely to submit all AKRCs.

Successful hunters reported harvesting twice as many deer on the HS than on AKRC, and more than half of hunters classified as unsuccessful (submitted no AKRC) reported harvesting deer on the HS. Estimated deer harvest, based on the HS, was almost 2.5 times greater than estimated harvest from AKRC.

Unsuccessful hunters who reported harvesting no deer on the AKRC accounted for 18% of the mean deer harvest reported on the HS over a 3-year period. Similar to Steinert et al. (1994) and MacDonald and Dilmann (1968), a small percentage of successful hunters (2-4%) reported harvesting no deer. Unlike Steinert et al. (1994) and MacDonald and Dilmann (1968), a large percentage of unsuccessful hunters (61%) reported harvesting deer on the HS. The apparently low reporting rates on AKRC may be attributed to a combination of factors such as higher deer densities, longer hunting seasons, liberal bag limits, and potentially deer shot and not recovered but reported as a kill on the HS. Because of these factors, hunters may not mail in kill report cards and may believe that if their deer was tagged they fulfilled their legal requirements.

Wright (1978) found that harvests reported in post-season survey data for waterfowl hunters were more than twice that observed at check stations. Wright (1978) and Steinert et al. (1994) attributed some differences in reported waterfowl and big-game harvest due to sharing the harvest among party members (party hunting). Because archery hunting tends to be an individual effort rather than a group effort, we assume that party hunting had little or no effect on reporting rates of archery deer hunters.

Mean number of deer harvested per hunter on AKRC increased 50% for local and only 7% for distant hunters over the 3-year period. Mean number of deer harvested per hunter on HS increased 21% for local and 18% for distant hunters over the same 3-year period. In 2001 a "harvest incentive" program was initiated by a local sportsman's group to

<table>
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<th>Year</th>
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<th>HS</th>
<th>FUS</th>
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<th>FUS</th>
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</table>

Table 2. Comparison of deer harvested by Greenwich bowhunters based on archery-kill report cards (AKRC), hunter surveys (HS), and follow-up surveys (FUS) in 1999, 2000, and 2001.

a Includes only hunters who returned hunter surveys.
increase the antlerless deer harvest. The incentive program involved renting a walk-in cooler and offering a free white-tailed deer hunt in Illinois to the hunter who reported harvesting and donating the greatest number of antlerless deer to the Hunters For the Hungry program. This incentive program resulted in a 75% increase in harvest, based on the AKRC. However, harvest based on the HS continued to exhibit a relatively stable increase of 5-7% annually. Incentive programs such as prize drawings or access to additional permits appeared to increase reporting rates in other states (Rupp et al. 2000). The perceived increase in deer harvest on AKRC appears to be related more to the incentive program increasing hunter reporting rates rather than a big increase in deer harvest. When the incentive program was initiated in 2001, mean number of deer harvested by successful hunters was highest, while mean number of deer harvested by unsuccessful hunters was lowest over the 3-year period. Hunters who submitted no AKRC in the past or hunters who did not submit AKRC were more compliant in 2001. The higher increase in reporting rates by local hunters likely was attributed to the incentive programs being sponsored by a local sportsman’s group, with few distant hunters aware of the program. With no HS data, we likely would have incorrectly concluded that the incentive program resulted in increased harvest.

Consistency in reporting harvest between the HS and the FUS and consistency in reporting among years on the HS suggest that the HS more closely reflected true harvest than AKRC. Although hunters were less likely to recall how many deer they harvested 3 years ago (1999), hunter recall improved when recalling harvest data for the current hunting season (2001) or the previous hunting season (2000). Our results suggest that harvest data collected from hunter surveys >1 year after harvest may reduce hunter ability to recall information.

In urban–suburban areas where deer are abundant and hunting seasons are liberal, reported deer harvest may be conservative. States that use harvest data to model populations and develop management strategies should evaluate harvest reporting methods especially as new reporting methods become available, such as on-line and tele-check systems. Harvest incentives such as “earn a buck” or “earn a trip” may increase harvest and harvest-reporting rates.

Harvest-reporting rates appeared to be more affected by amount of time spent hunting and number of deer harvested than by distance hunters traveled to hunting sites. Hunters who spend much time hunting and harvesting multiple deer in a season appeared to be less likely to report harvest on AKRC than hunters who spend less time hunting and harvesting fewer deer.

If the reported harvest from the HS was adjusted for nonrespondents and extrapolated to the population of hunters in Greenwich (Kilpatrick et al. 2004) a correction factor of 6.8 would be needed to estimate the archery deer harvest in the absence of a harvest incentive program (1999 and 2000) and a factor of 3.9 (2001) would be needed to estimate the archery deer harvest if a harvest incentive program was provided. To maximize hunter ability to take advantage of harvest incentive programs, it is important that information about harvest incentive programs is widely disseminated. Method of collecting harvest data should be evaluated to assess the potential effectiveness of different harvest strategies or to evaluate the effectiveness of hunter incentive programs.

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Literature cited


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