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Drive-Line Census for Deer Within Fenced Enclosures

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Abstract

Methodology is presented for conducting drive-line counts to obtain absolute numbers of deer within fairly small ($\leq$560 ha) areas. Planning and layout of the drive and the organization of persons who make up the drive-line teams are discussed. Procedures for maintaining proper spacing and alignment of drivers are described. On a drive of a 5.7-km^2 estate enclosed by a 2.5-m-tall deer fence in northwest Pennsylvania, numbers of deer (78) were within one of an estimate derived from a standard deer pellet-group count. The key elements of a successful drive are organization and communication before and during the drive.

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Introduction

Early estimates (1800's) of deer *Odocoileus* sp. numbers in North America were obtained by driving deer past shooters and counting the numbers of deer killed (Leopold 1933). This technique was refined for use by the Civilian Conservation Corps in the Allegheny National Forest in the 1930's (McCain 1939) and was published as a Forest Service technique in 1940 (USDA For. Serv. 1940). As developed, the technique was used to census free-ranging deer on fairly small tracts of land ($\leq$260 ha) by driving deer past counters stationed on boundary lines of areas being censused (Hosely 1956; Overton 1971). A modification (Morse 1943) replaced counters on boundary lines with snow-covered open lanes: deer were driven past these lanes by drivers on line. Counts of tracks on the lanes and deer passing back through the drive line constituted the estimate of deer numbers within the area censused.

The drive census was plagued by a number of problems. It was time consuming and costly. Only small areas could be censused and a large number of personnel was required. Terrain must be fairly level and undissected, and deer must be highly visible, requiring little understory vegetation and/or snow cover (McCain 1939; Ruff 1939; Morse 1943; Trippensee 1948; Hunter and Taylor 1956).

Consequently, it was discontinued as a general method for estimating numbers of free-ranging deer and replaced by other techniques, such as pellet-group counts and aerial surveys (Gill et al. 1983). However, the utility of the drive-census technique for counting deer within enclosures was recognized decades ago (O'Roke and Hamerstrom 1948). It continues to be used in that setting (McCullough 1979) and as a tool to "prove" to disbelievers that there are still large numbers of deer in the woods (Jenkins and Bartlett 1959).

For the past 2 years we have been involved in a project on a private estate near Bradford in McKean County, Pennsylvania, to demonstrate that managing the density of white-tailed deer (*O. virginianus*) can enhance hardwood regeneration. Deer density was being estimated by pellet-group counts. The managers of the estate did not want to manage deer numbers based solely on such counts, so we conducted a drive census on the estate on November 4, 1988.

In our search of the literature for guidelines on conducting deer drives, we found little specific current information, as have others (Davis and Winstead 1980; Riney 1982; Boyd et al. 1986), and had to model our procedure on old and sketchy reports. In this paper we describe the procedure used for conducting a drive census of deer within a deer-proof enclosure, and compare the results of our drive census with a population estimate derived from pellet-group counts.

Study Area and Methods

The drive was conducted on the 5.7-km^2 Glendorn Estate, approximately 8 km southwest of Bradford, PA (Fig. 1). The estate is enclosed by a 2.5-m-tall deer fence constructed of woven-wire livestock fence material and supported on 3-m-tall steel posts driven 0.6 m into the ground. Roughly rectangular, the estate is approximately 2,845 m long and 2,000 m wide. A small valley runs through the middle of the long axis of the estate, and two ridges rise above on either side. Elevation ranges from 487 to 610 m. The estate is moderately dissected and contains three small ponds, the largest of which covers approximately 3.1 ha. A system of paved and graveled roads and trails allows easy access to all areas on the estate.

Approximately 90 percent of the estate is heavily wooded with second-growth northern hardwoods, including red and sugar maples (*Acer rubrum* and *A. saccharum*), black cherry (*Prunus serotina*), American beech (*Fagus grandifolia*), white ash (*Fraxinus americana*), birch (*Betula* spp.), eastern hemlock (*Tsuga canadensis*), and white pine (*Pinus strobis*). There is relatively little understory growth, and visibility within 1.5 m of the ground is excellent.

Designing the Drive Line

The drive line was divided into 10 sectors, parallel to the long axis of the estate. Each sector was approximately 200 m wide. The drive was conducted from the west fence to the east fence (Fig. 1). A critical factor in obtaining as complete a count as possible was ensuring that persons on the drive line were sufficiently close to one another that they could see each other and any deer passing between them (Hosely 1956; McCullough 1979). On the basis of trial and error in the field, we determined this distance to be about 22 m, requiring nine drivers per sector. Hosely (1936) recommended 40 m between drivers and Trippensee (1948) recommended 15 to 30 m.

Communications among persons on the drive line are critical to maintaining the integrity of the line (McCain 1939; Hosely 1956). A sector leader was assigned to each sector (Hosely 1956; McCullough 1979) to control movements of drivers within the sector. Sector leaders maintained radio contact with the drive leader via hand-held radios and communicated the need for the drive line to stop while their sectors negotiated obstacles. Communication between the drive leader and all persons on the drive line was achieved with a hand-held air horn. One long blast on the horn signaled "stop" to all drivers, three short blasts signaled "start".

Another critical factor is keeping the drive line straight (McCullough 1979). To ensure that the drive line was

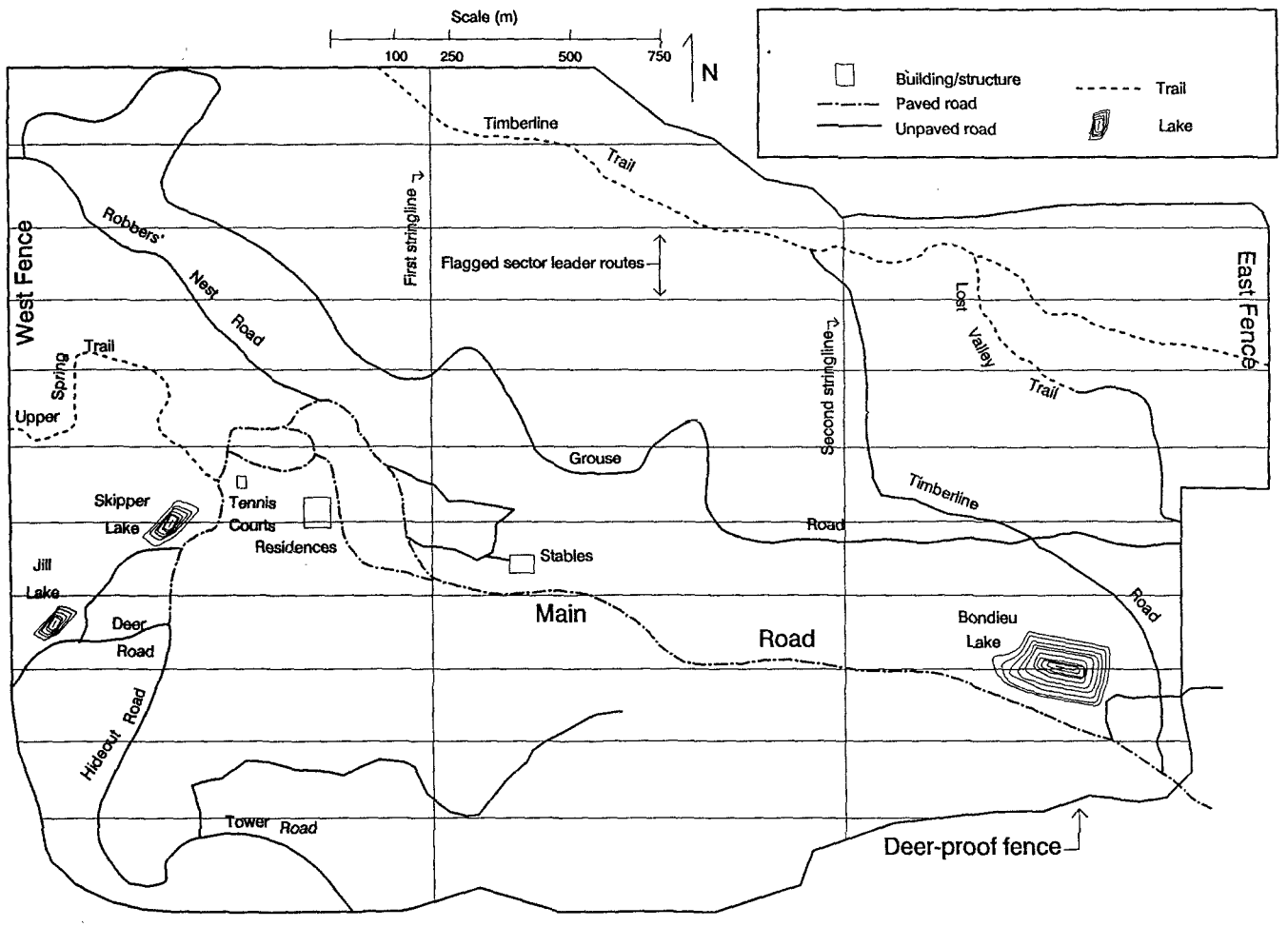

Figure 1.—Map of Glendorn Estate, detailing location of flagged transect routes, string lines, starting and stopping lines, and roads and trails.

properly aligned and with sufficient spacing between adjacent drivers, the starting point for the drive was the west fenceline. Blue 7.5-by-12.5-cm cards were stapled to the fenceline and labeled to mark sector boundaries. Pink cards denoted starting locations of drivers in each sector. Sector numbers were printed on the blue cards, and numbers for individual drivers were printed on the pink cards.

To counter the tendency of the drive line to wander, we placed two lines of string perpendicular to the drive line across the entire width of the estate at approximately one-third and two-thirds of the distance between start and finish (Fig. 1). Hosely (1936) and McCullough (1979) used paint spots on trees to mark places for drive lines to realign. All drivers were instructed to stop at each string line and to wait for a signal (three blasts on the air horn) before they resumed the drive. This procedure ensured that the drive line was realigned a minimum of two times.

Obstacles (ponds, windfalls, or steep terrain) can slow the progress of a portion of the drive line, resulting in large gaps between drivers through which deer can slip undetected (McCullough 1979). To minimize this problem, sector leaders reported obstacles to the drive leader, who then halted the entire drive line by sounding the air horn. The drive was restarted when the sector leader reported that his drivers had cleared the obstacle.

It is important that drivers be spaced properly during the drive (Hosely 1956). Drivers were instructed to attempt to maintain a distance of 20 to 22 m between themselves and adjacent drivers. Sector leaders wore blaze yellow caps to increase their visibility, and drivers were instructed to attempt to stay abreast of the sector leader. A flagged route was established for each sector leader the day before the drive by placing surveyor's flagging on trees and bushes at intervals of 10 to 20 m along parallel compass lines extending from the west to east fences.

Three counters walked parallel to, and slightly ahead of, the drive line and outside the fence on each side. These

counters were used to count any deer observed exiting the estate by leaping over, climbing under, or bursting through the side fences. Twenty counters were spaced along the east fenceline (finish line) to count any deer forced by the drive line to jump over, climb under, or burst through the end fence. Several counters on the east fenceline were equipped with hand-held radios, and were instructed to contact the drive leader to slow the drive line if the deer were running into the fence or in other ways injuring themselves, or were escaping.

Timing of the drive was important to ensure optimal conditions for observing deer. We scheduled the drive a month after the time of leaf drop when there often is light snow cover.

Communications

Success of a drive requires that all drivers understand exactly what they are to do (McCain 1939; Hosely 1956; O'Roke and Hamerstrom 1948). Two months before the drive, candidate drivers were solicited by mail, forming an initial pool of drivers. This pool was pared to approximately 120 persons who were organized into sector teams according to their home location and/or affiliation (several sportsman clubs participated in the drive). A sector leader was chosen from each sector team. Each driver was mailed an informational brochure that provided details on the drive, expectations of drivers, appropriate clothing, and the name and telephone number of sector members and the sector leader. Drivers in respective sectors were encouraged to contact each other and car pool to the estate.

Drivers for each sector were assigned a meeting point on the estate. Once assembled, all sectors met together for a briefing just before the drive. Assembling drivers by sectors allowed easy verification that all were present.

Conducting the Drive

Participants were briefed at the meeting location, then trucked by sectors to the west fenceline where drivers located their assigned starting positions. Sector leaders called to the drive leader when all of the drivers in their sections were in position. The drive began when all sectors had reported.

Drivers were instructed to count only deer that passed between themselves and the driver to their immediate right (Hosely 1956; McCullough 1979). Drivers recorded deer that either passed back through the line or passed forward from behind the line. Deer recorded passing in both directions were totaled separately. At the end of the drive, the count of deer was obtained by subtracting the sum of those passing forward from the sum of those passing back through the line.

The estate narrowed from 2,000 to about 1,600 m two-thirds of the way between west and east fencelines. Rather than shorten the distance between themselves and adjacent drivers, those drivers forced into the north and south fencelines at the constriction point simply walked along the fenceline until they reached the east fenceline.

As each sector completed the drive, sector leaders collected data forms from drivers and led them back to the meeting point where they waited for a final debriefing. The drive leader collected all data forms from sector leaders at the meeting point, quickly tabulated results, and reported them to drive participants.

Deer Numbers from Drive vs. Pellet-Group Counts

Pellet groups were counted along eight transect lines (3 m wide) that traversed the width of the estate. Earlier work (J. Jordan and N. Tilghman, USDA Forest Service, Warren, PA, pers. comun.) suggested that deer in northwestern Pennsylvania defecate an average of 13.5 times daily. An estimate of the number of deer on the estate was obtained using this value in a standard procedure for counting pellet groups (Overton 1971). Estate managers had requested the drive so that they could calculate how many deer to harvest to achieve a deer density compatible with successful regeneration of hardwoods, i.e., about 6.5 deer/km^2 (Behrend et al. 1970; Tilghman 1989). Managers harvested 38 deer from the estate in the months following the drive. The number of deer counted in the drive, minus deer harvested, was compared to an estimate of deer derived from a pellet-group count conducted the following April.

Results

Seventy-eight deer were counted by 116 drivers and counters. Deer passed through the line of drivers singly and in groups. Some drivers counted only a single deer, others counted as many as 5 to 10, and many drivers never saw a deer during the 2½ hour drive. Light rain/hail fell during the first half hour of the drive, and there was no snow cover.

As the drive line approached within 300 m of the east fenceline, observers on the fence reported that several groups of deer were dashing back and forth in front of the fence and that one deer had broken its neck leaping into the fence. The drive line was stopped, then allowed to proceed at about half the original speed. This tactic was effective as the remaining deer bolted back through the drive line in two large groups of 10 to 15.

The pellet-group technique provided an estimate of 39 deer present on the estate in April, which was in close agreement with the number presumably remaining after harvest (78 deer counted – 38 deer removed = 40 deer).

Recommendations

The technique for censusing deer within fenced enclosures seems to produce reliable estimates of deer numbers so long as environmental conditions allow optimal viewing. Had there been a thick understory or heavy rain or snowstorms,

it is likely that drivers would have missed counting some deer. Lack of snow cover did not reduce visibility, but visibility would have been enhanced by more of a contrast between darker deer and a light background.

We believe that our emphasis on communicating and organizing before and during the drive contributed materially to its success and lack of problems. The flagged sector-leader routes and string lines helped maintain a straight drive line, which, in turn, reduced the possibility of deer running unnoticed between drivers.

This technique requires an investment in time and money for the planning sessions and mailings. A large number of able and committed volunteer drivers is an absolute requirement. Enclosures with regular boundary lines formed of deer-proof fencing ensure that deer remain within the census area. There is undoubtedly an upper limit to the size of enclosure that can be driven in a single day. Our results suggest that a distance of 5,000 m can be driven in one day. The width of the area driven would be determined by the number of drivers available. Placing string lines at intervals of roughly 1,000 m perpendicular to the direction of the drive line should allow the drive line to be realigned as needed.

The close agreement between estimates of deer density derived by pellet-group counts and the drive census suggests that either can be used to estimate deer density within fenced enclosures. But because pellet-group counts require so much less time, manpower, and expense, one might question the use of the drive count. Also, conditions favorable for conducting drive censuses and pellet-group counts are similar (minimal understory vegetation and open, gentle terrain). The drive census probably should be reserved for locales where there are no reliable pellet-group defecation rates, where local conditions are not conducive to easily observing pellet groups (extremely dense, low ground cover), or where an actual count of deer is desired.

The technique described here is not applicable everywhere there is a deer enclosure, but for situations similar to ours, with good visibility in the understory and fairly level terrrain, it does provide managers with a reliable estimate of deer numbers.

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