ESTIMATING DEER POPULATIONS FROM TRACKS

EDWIN L. TYSON, Florida Game and Fresh Water Fish Commission

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Deer population work in the southeast has been hampered by the notable lack of a reliable census method except on small areas. Most work has been done by the use of indices. Census methods as used in other parts of the country are adaptable to typical southeastern habitat. Recent work with deer track counts, generally considered an index, on Eglin Air Force Base indicate that it may be developed into a census method.

The Eglin Reservation covers 461,117 acres in three counties: Santa Rosa, Okaloosa, and Walton in extreme Western Florida, and lies just north of Santa Rosa Sound and Choctawhatchee Bay. The extreme western end is surrounded by East and Blackwater Bays. The north boundary is the Yellow and Shoal Rivers, Titi Creek, and the old Spanish Trail (U.S. 90). The extreme northeastern corner is enclosed by a small farming community. The east end extends to state highway #83 from DeFuniak Springs south to Freeport (Fig. 1).

Within this area there is evidence of all seven pleistocene terraces recognized in Florida. Most prominent of these is the Sunderland terrace (100 - 170 feet above sea level). The topography of this strip several miles wide is gentle rolling sand, deeply dissected by many steep walled valleys, locally known as spring branches or heads.

No previous study of this extreme West Florida vegetation has been made as far as is known at the present. This lack of attention is perhaps due to the more mystic vegetation types found further south.

About 75% of Eglin Reservation is longleaf pine *(Pinus palustris)* scrub broken only by scattered fluctuating ponds and the deep spring heads. These springs join and form crystal clear creeks that meander through broad flat swamps to the bay.

These swamps, locally known as titi swamps, occupy about 2% of the total area. Most of these have been free from fire for twenty years or more and titi shrub-trees *(Cliftonia monophylla)* up to eight inches d.b.h. are common. Most of these swamps are surrounded by a very narrow band of low pine type dominated by gallberry *(Ilex glabra)* and slash pine *(Pinus Elliottii)*. This, however, is determined by the slope leading into the swamp. If the slope is great the low pine gives way to hammock of oak *(Quercus laurifolia)*, hickory *(Carya* sp.) and magnolia *(Magnolia grandiflora)*. With little slope there is a marshy prairie with the Hypericaceae the only woody plants well represented, and this is banded by low pine.

There is evidence that the once large expanse of virgin longleaf pine fire climax is unable to reproduce itself in competition with more rapid growing trees in the absence of fire. On the sand ridges the scrub oak *(Quercus laevis)* now has a coverage of at least 80%, and the sand pine *(Pinus clausa)* shows evidence of gaining dominance. This, in turn, is replaced by the hammock. In the low pine-wire grass *(Aristida* sp.) flats, slash pine is very rapidly advancing. Adjacent to the

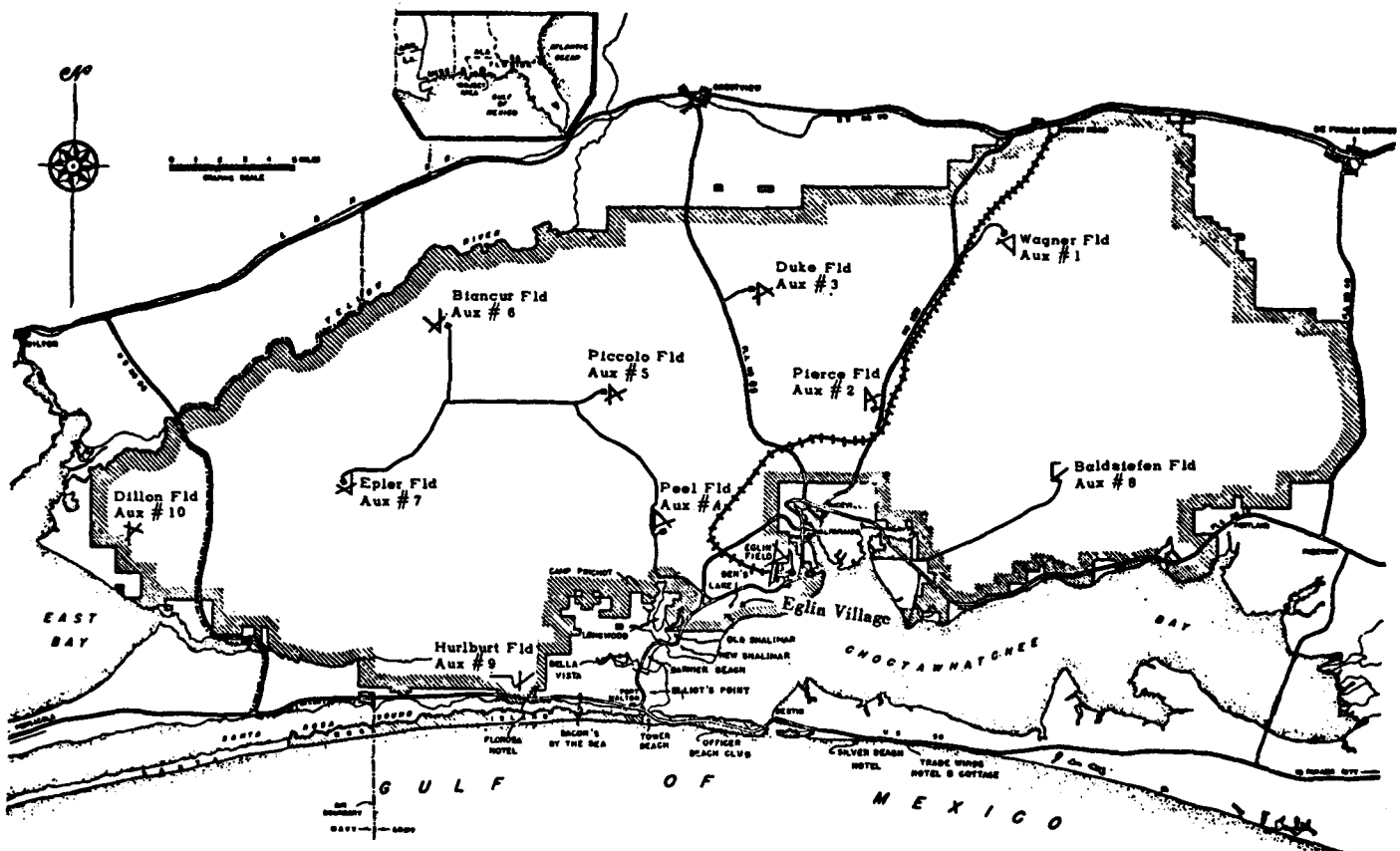

Fig. 1. Map of Eglin Air Force Base, Florida.

farming community in the northeastern corner, where there is some evidence of fertility in the sand, the old field pine *(Pine taeda)* is rapidly becoming common.

It is not in the scope of this paper to discuss succession from a longleaf pine fire climax to a non-fire climax on the same area. It is intended only to point out that after the 40 years of fire protection changes are well under, and that these changes are probably for the long range benefit of turkeys, squirrels, and deer as indicated by the increased frequencies and densities and an increasing number of species of mast and browse producing trees and shrubs.

METHODS

During the summer of 1950 the Florida Game and Fresh Water Fish Commission discussed the possibility of a deer trapping program on Eglin Field with Air Force authorities. These talks brought on considerable criticism and it became desirous to have information on population numbers as well as concentration areas in order to sell the program to the public.

It was decided after studying several census methods that the best possibility was an analysis of a systematic track count. This count was started in July 1950 and has been continued during July and August for three years.

To aid in selecting roads to be counted, the Air Force supplied an aerial photograph scaled one mile to the inch. This gave a very clear view of all roads that were bare enough of grass and shrubs to be of use. After studying the photograph, it was decided to choose roads that practically bisect the reservation from west to east. These roads were chosen on their direction, accessibility, and barrenness of the sand. Consideration was also given to the following:

1. All roads must be easy to get to at any time, even where portions are closed due to military activity.
2. All roads should lie across the boundaries of major vegetation types and drainage systems.
3. An effort should be made to represent in proportion to area all vegetation types, land use practices, and open and closed hunting zones.

In establishing the time of year for beginning a deer track count there were two prime factors to be considered. First, it was essential to choose a time that would give the most accurate returns, and second, a time that would be least expensive and time consuming. After much deliberation over weather charts and deer activity reports, it was decided to begin in July in a low population and work toward the higher population areas. This has proved very successful. As can be seen from Fig. 2, there is an abrupt decrease in individual herd size as fawning begins in July. Thus, tracks are more scattered and easier to count.

Large numbers of feral hogs are to be found all over the area, and it was necessary for rains to wet the sand in order to distinguish between deer and hog tracks. Afternoon thunder showers are common during summer, and the tracks were counted early the following morning. Thus, only about twelve hours' activity show in the counts. Often limited distribution of rain allowed only a few miles to be counted.

The afternoon rains were often very hard and usually the low places along the roads were filled with water. Deer activity increased considerably in these areas. It is possible that here the tracks were not counted correctly. Then again, this may have been a factor in deer distributing themselves more evenly over the area and

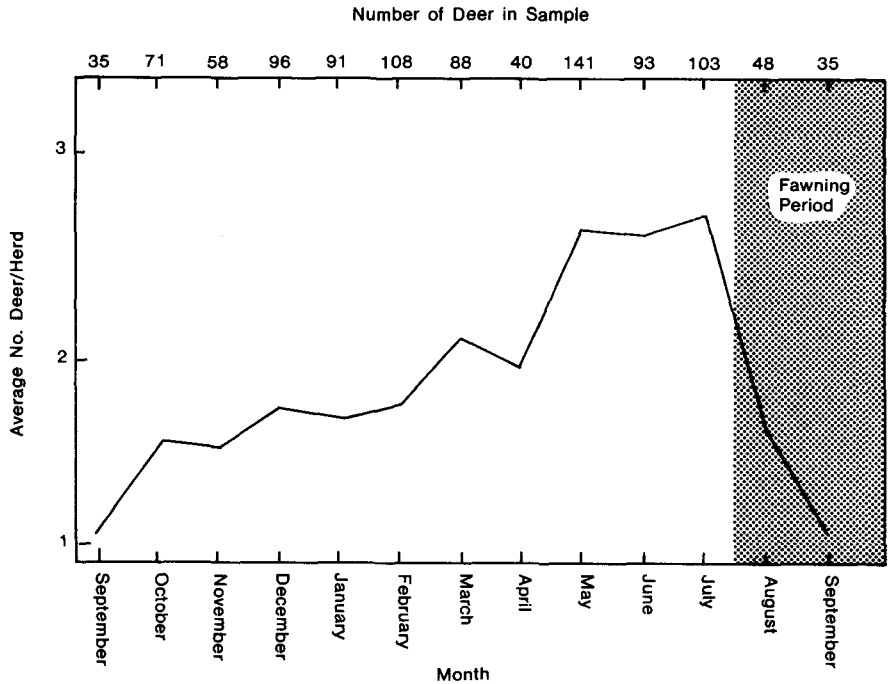

Fig. 2. Average herd size for deer based on two years sight records.

away from the permanent water holes. It is doubtful if ever this answer will be forthcoming.

The counting of tracks was done from a jeep pick-up going as slow as was desirable. Often it was necessary to stop and back up to make positive identification, especially when grass and weeds were in the roads. All tracks were recorded as to the direction the deer was traveling. Table 1 gives a tabulation of three years count.

DISCUSSION

In analyzing the tracks, it was necessary to know two basic things. First, what is the extent of a deer's wanderings during one night? Second, where does the deer begin and finish his nightly activity? Answers to these questions are difficult to find due to the many factors involved such as:

1. Weather conditions.
2. Availability of food.
3. Population density.
4. Season of year.
5. Availability of water.
6. Difficulty of study.

Table 1. Tabulation of deer tracks for three years at Eglin Airforce Base, Florida.

		1950				1951				1952							
										1st Count			2nd Count				
Location	Mi	N[a]	S[a]	Total	Tracks/ mi.	N[a]	S[a]	Total	Tracks/ mi.	N[a]	S[a]	Total	N[a]	S[a]	Total	Aver.	Tracks mi.
W. Boundary-Fla. #10	4.9									1	1	2	0	0	0	1.0	1.0
Weaver Tower East	1.5									5	4	9	6	8	14	11.5	11.0
211-252[b]	4.0	2	2	4	1.0					12	14	26	6	9	15	20.5	5.1
252-253	2.5	1	4	5	2.0					8	11	19	8	9	17	18.0	7.2
253-Military Hiway	1.2	2	3	5	4.2	9	7	16	13.3	4	6	10	2	2	14	7.0	5.8
Military Hiway 313	1.0	0	0	0	1.0	10	4	14	14.0	13	9	22	4	7	11	16.5	16.5
313-246	2.2	1	4	5	2.3	7	8	15	6.8	3	0	3	10	12	22	12.5	5.7
246-244	1.0	10	2	12	12.0	0	4	4	4.0	4	10	14	8	7	15	14.5	14.5
244-250	2.5	7	13	20	8.0	10	6	16	6.4	9	4	13	9	8	17	15.0	6.0
250-243	1.5	4	3	7	4.7	7	9	16	10.7	5	7	12	6	9	15	13.5	9.0
243-233	3.0	10	8	18	6.0	17	17	34	11.3	23	21	44	7	7	14	29.0	9.7
233-Fla. #85	2.0	5	7	12	6.0	6	1	7	3.5	11	7	18	5	7	12	15.0	7.5
Sawmill-Field #2	3.7	21	8	29	7.8	18	15	33	9.0	20	14	34					9.2
Fla. #185 Rnge 53	1.7	19	20	39	23.0	1	2	3	1.8	7	7	14	0	0	0	7.0	4.1
On Range 53	1.3	20	21	41	31.5	13	11	24	18.5	14	14	28	2	2	4	16.0	12.3
Range 53-E. Rocky	2.0	46	39	85	47.5	12	13	25	12.5	6	2	8	4	7	11	9.5	4.7
East Rocky-214	2.0	30	32	62	31.0	14	15	29	14.5	19	18	37	9	17	26	31.5	15.8
214-201	3.6	40	45	85	25.6	35	36	71	19.7	78	64	142	15	18	33	87.5	24.3
201-400	5.3	19	19	38	7.2	29	33	62	11.7	29	21	50	27	24	51	50.5	9.5
400-Alaqua Creek	2.5	0	1	1	1.0	1	1	2	1.0	14	14	28	4	4	8	18.0	7.2
Alaqua-E. Boundary	2.3	0	0	0	1.0	1	3	4	1.7	0	0	0	3	2	5	2.5	1.1
Total	51.7																

[a] Direction of travel.

[b] Numbers refer to road numbers.

However, considerable time has been spent seeking the best answers possible. In the course of three years study, some knowledge has been gained by watching and recording activities of several distinctive deer.

1. A white doe on Range 52.
2. A buck with 5 antler points on the left and a long spike on the right at the ammunition dump.
3. A white sided doe at the intersection of roads 218-214.
4. A club footed doe at Windham Tower.
5. A three footed buck on Titi Creek.
6. A nine point buck that regularly crossed the road at Windham Tower.
7. A tagged buck at the old Parker Place.

Indications are that these deer spend most of their time within one mile daily range, and that they begin and end their nightly activity in the same general locality. Too, tracking deer with a bird dog in the early morning has shown these findings to be reasonably correct. From these studies, two basic assumptions have been made in answer to the above questions.

1. Deer usually return to the same general location to spend the day.
2. Nightly activity of a deer is confined to about one mile daily range of travel.

Analysis has been based on these two assumptions.

On the first of these assumptions, the population within a circle, the diameter of which is "D" (average daily range), will produce two tracks per animal on the circumference. Animals outside the circle will produce an equal number of tracks on this circumference.

$$\therefore X = \frac{t}{4}$$

where X is the total population within the circle and t is the total number of tracks on the circumference.

$$\text{As } t_1 = \frac{t}{\pi D}$$

where t_1 is the number of tracks per mile on the circumference, then (as assumed above)

$$t_1 = \frac{4X}{\pi D}$$

$$\text{and } X = \frac{t_1 \pi D}{4}$$

$$\text{As } X_1 = \frac{X}{\frac{\pi D^2}{4}} \text{ and } X = X_1 \frac{\pi D^2}{4}$$

where X_1 is the population per square mile.

$$\text{Then } X_1 \frac{\pi D^2}{4} = \frac{t_1 \pi D}{4}$$

$$\therefore X_1 = \frac{t_1}{D}$$

That is, the population density, in deer per square mile, is equal to the number of tracks per mile divided by the average daily range expressed in miles.

It is obvious that the main source of error is in the estimation of the average daily range. This characteristic probably varies with a number of factors, such as population density, season, and habitat. Thus, it is thought essential to any application of the track count census that the average daily range be determined simultaneously with the track count. No satisfactory methods have as yet been devised for the determination of this factor, and the estimates as here used are made from general observations. It is believed that the actual average daily range for Eglin Field is somewhat less than one mile, perhaps 0.8, but one mile is used to insure a conservative estimate.

Better methods must be devised for determining average daily range. In the future, emphasis will be placed on marked deer, and the use of slow trail dogs.

It might also be pointed out that the presence of the roads on which the counts were taken seemed to have little effect on activity of the animals. Tracks were found equally abundantly crossing and parallel to the roads.

The total population estimate was based on the number of tracks on the 51.7 miles of track counts, assumed to be an adequate sample. The tracks were plotted, and Fig. 3 shows the results of the counts for three years, as well as the North-South depth of the sample area at each of 52 miles. In preparing the graph, the total tracks found on a stretch of road were divided by the distance in miles. The average North-South depth was found to be 14.13 miles. Thus, a formula was developed to determine total August adult population as follows:

August population = $14.13\ (T_1 + T_2 \ldots t_{52})$

where t represents the number of tracks at each mile taken directly from the graph. The following is the August population for three years.

1950	7616
1951	6627
1952	6655

If the number of tracks for each mile is multiplied by the depth of the area at that particular mile thus:

August population = $d_1\ (t_1) + d_2\ (t_2) \ldots d_{52}\ (t_{52})$

where d_1 is the depth at that mile and t represents the tracks at the same mile, the totals are:

1950	8394
1951	7077
1952	6944

During January of 1952, just before election months, agitation from certain quarters stopped the trapping and restocking program, and demanded a drive census to determine population. The Air Force was to furnish everything; however, the Game and Fresh Water Fish Commission was to supply the technical advice.

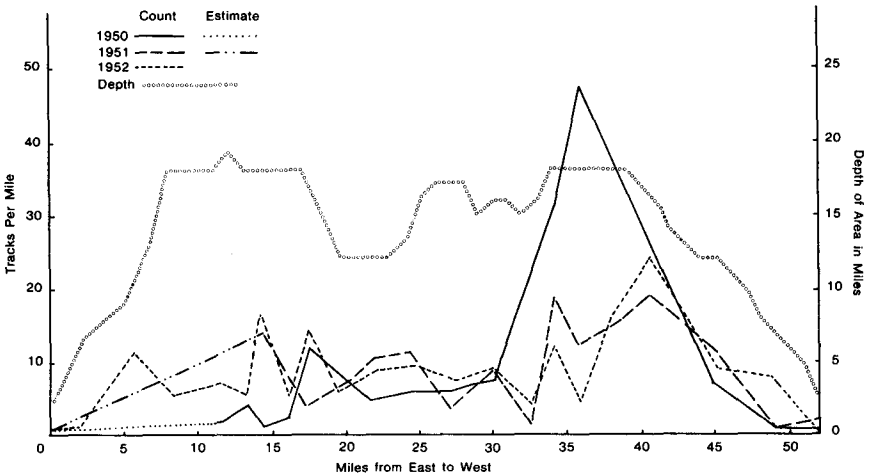

Fig. 3. Tabulation of tracks/mile and area depth.

Thus, a program was worked out with the Air Force through the Forestry Section.

Thirty-four plots, located randomly over the reservation and ranging in size from 160 to 1100 acres, were selected for the drive. Several days before each area was driven, the fire lanes around it were cleared and graded with a road machine. Just prior to each drive the fire lines were dragged with a jeep and light weight drag to blot out all tracks. An average of 34 men, stationed approximately 50 yards apart, made each drive. At a given signal, all men proceeded through the area making considerable noise. After covering the area as thoroughly as possible, two men walked the boundary roads the entire distance and counted all tracks leaving the drive area. In this way a minimum count was obtained.

Approximately 4.6% of the total forested land was covered, and 297 deer left the 20,040 acres or one deer for every 67.47 acres of forest land. This gave a total population of 6354 deer.

There is evidence of considerable error as can be seen from Table 2. It is clear that acres per deer increased rapidly as the number of drives decreased. The habits of deer render it almost impossible to flush them all with men 50 yards apart. Similarly, acres per deer increased as the plot size increased.

Table 2. Tabulation of two factors that may affect the accuracy of a deer drive census.

	No. Plots	Total Acres	Total Deer	Acres/Deer
Number of Drivers				
More than 40 men	4	2,280	61	37
From 35 - 39 men	8	4,560	73	62
From 30 - 34 men	18	10,360	143	72
Less than 29 men	4	2,840	20	142
Plot Size				
Less than 600 acres	15	6,500	112	59
More than 600 acres	19	13,480	185	73

During the summer following the drive, tracks were counted around each drive area to determine the possible error. Regardless of the plot size, one mile of road was counted on each side of as many plots as possible. The expected population was determined by dividing the number of deer found on an area into the number of acres. This gave the number of acres per deer. This, in turn, was divided into 640 to give the expected minimum number deer per section. This count gave an increase of 18.9% over the drive or a total of 7556 or 8.6% more than the linear track count based on depth of area at each mile. The following is a tabulation of the 1952 deer population estimate based on the above described methods:

6354 — Drive census in winter
6655 — Track count census using average depth of area
6944 — Track count census using depth at each mile
7556 — Drive area check by tracks

In a study of this nature there are many possible errors as can be surmised. To date we have only one possible check, the kill report, and that within itself is probably very inaccurate. It is based on a questionnaire in the field on the last two days of the hunting season, and the known and estimated illegal kill. The question is, "Have you killed a deer this year?", being careful not to ask what sex, even though there is a buck law. Too, since two deer is the limit no one still hunting will admit he has killed more than one deer, so to find the percentage killing 2 deer it is necessary to ask about the previous year. Possibly some have killed a deer but failed to tag him, thus he is afraid to say so for fear of having his tags checked. It is very unlikely that a checking station system will be worked out in the near future. Plans are to develop a post card survey beginning at the close of the 1952 hunt.

Perhaps from a table beginning with the track count in 1950, and using the fawn crop as determined by sight records and the kill report as discussed above, some light as to the accuracy of the census method may be gained. Table 3 shows population estimates based on the average depth of the reservation. Table 4 is based on area depth at each mile.

Table 3. Deer population estimates.

	1950	1951	1952
January Population		6503	6713
August Population	6682	6551	6605
Apparent Discrepancy		-48	58
Fawn Crop — Percentage	24	30.6	
Fawn Crop — Number	1604	2005	
November Population	8286	8556	
Estimated Kill	1783	1843	
Percentage of November Population	21.5	21.5	

January population is calculated by substracting the estimated kill from the November population. The fawn crop is a function of the sight records from September through March thus:

$$\text{Fawn Crop (\%)} = \frac{\text{Fawns}}{\text{Total Classified Deer}}$$

Table 4. Deer population estimates.

Period	1950	1951	1952
January Population		8625	7400
August Population	8394	7077	6944
Apparent Discrepancy		1548	456
Fawn Crop — Percentage	24	30.6	
Fawn Crop — Number	2014	2166	
November Population	10408	9243	
Estimated Kill	1783	1843	
Percentage of November Population	17.1	19.9	

The number of fawns is calculated from the August population by means of the following formula:

Fawns (No.) = Fawn Percentage (August Population)

The peak of fawning is probably in middle August into September. The November population is the number of fawns plus the August population.

SUMMARY

1. Deer track are easy to count on the large expanses of sand on the Eglin Air Force Base, and it is entirely possible that a reliable census may develop from their analysis.
2. The area is 51.7 miles from west to east with an average North-South depth of 14.13 miles, and 75% of this is longleaf pine scrub.
3. There is considerable evidence (not published) that the longleaf pine fire climax is being replaced by sand pine followed by hardwoods, in the absence of fire.
4. Roads selected for track counts practically bisect the area. These were chosen from Air Force photographs.
5. Track counts have continued on the same roads and by the same methods for 3 years, 1950 - 1952.
6. Analysis of tracks has been based on two assumptions. Namely:
   a) Nightly activity of a deer is confined to about one mile range.
   b) Deer usually return to the same general location to spend the day.
7. Two methods have been used in analyzing results:
   a. By using the average depth of the reservation thus:
      August Population = $14.13\ (t_1 + t_2 \ldots t_{52})$
      where t is the number of tracks per mile taken from the graph.
   b) By using the area depth at each individual mile thus:
      August Population = $d_1(t_1) + d_2(t_2) \ldots d_{52}(t_{52})$
      where t is the number of tracks per mile, and d is the depth of the area at that mile.
8. A drive census was carried out during February 1952, and a check on the drive was done by tracks during the following summer. The drive count showed less deer, and the track check of drive areas indicated more deer than other census methods.

9. The results of the census methods for 1952 are as follows:
   6354 — Drive census in winter
   6655 — Track count census, average depth of area
   6944 — Track count census, depth of each mile
   7556 — Drive area check by tracks
10. Perhaps as a better kill report method is worked out, the inaccuracies inherent in the track count census method can be eliminated.