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Estimating Ungulate Numbers in a Forest by Track Counts

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Dzięciołowski R., 1976: Estimating ungulate numbers in a forest by track counts. Acta teriol., 21, 15: 217—222 [With 3 Tables]

Drives and track counts around driven areas and along transects were tested as techniques for censusing red deer, roe deer, and wild boars. For red deer the regression of drive census upon track counts was statistically significant. The number of tracks on a transect was significantly related to numbers of roe deer and wild boars. Refinements in censusing ungulates by track counts on a transect depend upon future research on the spatial distribution of animals.

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1. INTRODUCTION

Knowledge of animal numbers is a prerequisite to rational game management and several techniques for censusing ungulates are in use. In the northern hemisphere tracking in snow is a frequently used technique (Koivisto, 1962; Julander, Ferguson & Dealy, 1963; Berge, 1969; Ivanov, 1970; Korytin & Vorobyeva, 1970; Priklonski, 1970). In milder climates the tracking of animals along sandy roads or transects with a soft surface has been frequently used (Harlow & Downing, 1967; Harlow & Oliver, 1968; Jenkins & Marchinton, 1969; Talbot, 1970; Daniel & Frels, 1971). The drive census is commonly recognized as the best technique for estimating animal numbers (Jenkins & Marchinton, 1969; Daburon, 1970; Ivanov, 1970; Talbot, 1970), however, its use is usually precluded by high labour requirements. Research by Pucek *et al.* (1975) to develop a ratio between the results of drive census and those of tracking failed to yield reliable results.

The purpose of the present study was to compare a drive census, tracking around subsequently driven aireas, and track counts along a

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transect as techniques for censusing red deer, roe deer, and wild boar in a forest habitat.

2. EXPERIMENTAL PROCEDURES

Data were collected during 1971—1973 at five state forest districts: Józefów, Kobiór, Iława, Augustów, and Płaska. Procedures for tracking animals are described by Pucek *et al.* (1975). Tracks were plotted on sketches to calculate the number of tracks crossing transect lines. The three census methods were analyzed by multiple regression on a digital computer ODRA 1204 at the Polish Academy of Sciences, Warsaw.

3. RESULTS

The results of drives, tracking, and track counts along transects for the three species of ungulates are presented in table 1, and the results of the most important multiple regression analysis are shown in table 2. The coefficient of multiple correlation (K) was 0.529 for 35 samples with red deer, 0.478 for 26 samples with wild boar, and 0.356 for 39 samples with roe deer.

Table 1

Comparison of results of tracking, drives, and track counts along transect for red deer, roe deer and wild boar.

Species	Drives	Tracking	Length of transect, m	No. crossings
Cervus elaphus	70	116	128,270	584
Capreolus capreolus	139	75	146,790	687
Sus scrofa	35	12	103,900	214

The highest standard error of estimate ($S\hat{y} = 4.06$) was in tests with roe deer and the lowest (2.26) in tests with wild boar. As shown in table 2 there was a significant interaction between the census techniques and the various animal species. Tracking (x) provided a significant variable in the equation for red deer, whereas number of tracks (x_3) was significant in equations for roe deer and wild boar.

The regression of y upon x_1, x_2, x_3 and x_4 indicated that the relationship between drive and tracking counts was statistically significant for red deer (Table 3). Therefore, the number of tracks per length of transect may be used as a conversion factor for estimating the number of red deer. A comparison of the multiple correlation coefficient ($R = 0.529$) with the simple correlation coefficient from x_1x ($r = 0.522$) indicates that x_1 was the dominant factor among the three variables.

For roe deer and wild boar the regression of drive results (Y) in relation to track counts (x_3) was statistically significant. Correlation coefficients were lower for roe deer (r_3 = 0.350) and for wild boar (r_3 = 0.389) than for the regression of drive results upon tracking results for red deer (r_1 = 0.522). The variable x_3 was, therefore, of fundamental significance in the regression equation for roe deer and wild boar.

Table 2

Results of multiple regression analysis for tracking, drives, and track counts along transect for red deer, roe deer, and wild boars. Numbers in parentheses stand for standard errors of coefficients above.

No. of samples	Regression equation	Coeff. of multiple correlation $R_{y\,x_1x_2x_3}$	Standard error of estimate S_y
	Red deer		
35	$Y = 0.33 + 0.37x_1 + 0.000036x_2 + 0.018x_3$ (1.54) (0.13) (0.000343) (0.035)	0.529	3.09
	Roe deer		
39	$Y = 2.18 + 0.102x_1 + 0.000022x_2 + 0.085x_3$ (1.93) (0.267) (0.000427) (0.039)	0.356	4.06
	Wild boar		
26	$Y = 0.209 + 0.849x_1 + 0.0000067x_2 + 0.087x_3$ (1.22) (0.573) (0.000267) (0.037)	0.478	2.26

Table 3

Results of the examination of regression of results of drives (Y) separately upon results of tracking (x_1), length of transect (x_2), number of tracks (x_3), and the quotient number of tracks/length of transect (x_4). *SE* — standard error.

Regression equation	Correlation coefficient *r*	*SE* of estimate Y	*SE* of regression coefficient	Significance of regression
		Red deer		
$Y = 0.677 + 0.399\,x_1$	0.522	3.01	0.114	S
$Y = 0.578 + 0.000388\,x_2$	0.184	3.46	0.00036	NS
$Y = 1.103 + 0.054\,x_3$	0.257	3.41	0.035	NS
$Y = 1.234 + 161.5\,x_4$	0.197	3.46	139.9	NS
		Roe deer		
$Y = 3.39 + 0.089\,x_1$	0.057	4.22	0.259	NS
$Y = 2.72 + 0.000224\,x_2$	0.087	4.21	0.00042	NS
$Y = 2.14 + 0.081\,x_3$	0.350	3.96	0.035	S
$Y = 2.49 + 198.9\,x_4$	0.257	4.09	123.1	NS
		Wild boar		
$Y = 1.10 + 0.537\,x_1$	0.181	2.43	0.598	NS
$Y = 1.41 + 0.000015\,x_2$	−0.011	2.47	0.00029	NS
$Y = 0.73 + 0.075\,x_3$	0.389	2.27	0.036	S
$Y = 0.77 + 250.1\,x_4$	0.321	2.34	150.8	NS

Since the results of drives may depend upon the quotient: number of tracks ($x3$)/length of transect ($x2$), the variable $x4 = x3/x2$ was introduced into the multiple regression. However, its expected relationship with drive results was not significant.

4. DISCUSSION

The expected relationship between the number of tracks on a transect and the number of animals inhabiting a definite habitat has been reported by Harlow & Downing (1967) and by Priklonskii (1970). Tyson (1952) (after Harlow & Downing, 1967) calculated that if the »normal average« daily range of deer was 640 acres (267 ha), then the number of deer crossings on a road 1 mile long should be equal to the deer density per square mile. Because of difficulties in calculating the average, daily range of deer, Tyson tried to determine the relationship between the number of tracks and number of animals leaving the same area during drives.

Downing *et al.* (1965) tested the track count by comparing a known deer population with the number of daily crossings in a 746 acre (311 ha) enclosure. Daily counts were quite variable, and the correlation coefficient (r = 0.20) was extremely weak. Brunett & Lambon (1962) (after Harlow & Downing, 1967) compared the number of crossings made by deer against known populations of 2, 4, and 8 deer in three 160-acres (67 ha) enclosures and concluded that track counts detected differences in population size, but not the magnitude of differences.

Priklonskii (1970), using Formozow's (1932) formula, supplemented later by Pereleshin (1950), described the relationship between animal numbers per area unit and the number of tracks.

The formula reads as follows:

$$Z = 1.57 \frac{s}{d \cdot m}$$

where: Z = number of animals on area unit

s = number of tracks recorded

m = length of route

d = mean length of daily track left by animal

In the USSR various coefficients of *d* are determined for individual animal species and regions. Ivanow (1970) failed to give a coefficient between animal number on 1000 ha and the number of tracks on a 10 km long route. He stated that the possibilities of using coefficients based on the length of daily movements were being studied.

5. CONCLUSIONS

Basic research on the spatial organization of specific animal populations is needed before track counts can be reliably used as a census method for wild ungulates.

Track counts along transect offer promise as a census method for roe deer and wild boar.

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LICZENIE TROPÓW NA TRANZEKCIE JAKO METODA SZACOWANIA LICZEBNOŚCI KOPYTNYCH W LESIE

Streszczenie

Przeprowadzono próbę porównania trzech sposobów inwentaryzacji liczebności jeleni, sarn i dzików, mianowicie: próbnych pędzeń, tropienia wokół przepędzanych powierzchni i liczenia tropów na tranzekcie. Do obliczeń użyto 35 prób dla jelenia szlachetnego, 39 prób dla sarny oraz 26 prób dla dzików. Zależności pomiędzy wynikami trzech sposobów inwentaryzacji zbadano przy pomocy analizy regresji wielokrotnej. Analiza regresji dowiodła, że w przypadku jeleni statystycznie istotna jest wyłącznie regresja wyników pędzeń od wyników tropień (Tabela 2). Oznacza to, że w przypadku tego zwierzęcia metoda tropień rokuje nadzieje na opracowanie przeliczników zbliżających jej wynik do rzeczywistego (Tabela 3). W równaniach regresji wielokrotnej dla sarny i dla dzika istotną zmienną okazała się liczba tropów na tranzekcie. Metoda liczenia tropów na tranzekcie może mieć, zatem, zastosowanie w stosunku do tych zwierząt.

Dotychczasowe próby oparcia inwentaryzacji liczebności zwierząt kopytnych na wynikach liczenia tropów na tranzekcie (Formozov, 1932; Tyson, 1952) utknęły na problemie ustalenia przeciętnego dobowego zasięgu przemieszczania się zwierząt. Problemu tego nie można rozwiązać bez przeprowadzenia podstawowych badań nad organizacją przestrzenną populacji zwierząt określonych gatunków.