STUDIES ON THE EUROPEAN HARE. XXIII.

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# Belt Assessment as a Reliable Method of Determining the Numbers of Hares

[With 2 Figs. & 2 Tables]

The reliability of the results obtained by »belt assessment« was checked by comparing them with the results of an absolute quantitative method, consisting in catching hares in areas surrounded by nets. Almost identical results were obtained in three different ways. When belt assessment is used the numbers of hares are over-estimated by 20%. It is suggested in addition that results should be reduced by further 10%, *i. e.* by the coefficient reducing the total area of the shoot.

## I. INTRODUCTION

The methods described in literature of assessing the numbers of hares are as a rule insufficiently accurate and burdened by fairly considerable error, particularly when it is a case of drawing conclusions on the basis of these methods as to the numbers of hares in large areas. Their practical usefulness is in consequence limited. The investigations presented were aimed at checking the accuracy of one of them, namely the method known as belt assessment, which merits particular attention on account of the possibility of its general application in hunting practice.

## II. BELT ASSESSMENT

Belt assessment as a field quantitative method was used in Poland for the first time in 1957. Jezierski & Pielowski (1958) recommended its wide use. It was later described in detail by Pielowski (1962, 1966b). To put it shortly, it consists in a line of several beaters (not less than 1 person every 15 m) moving along a selected belt in the area, of defined breadth and length and starting up from their forms. All the hares hiding in this belt are counted and recorded by the person carrying out the assessment. The route of assessment is so chosen that it runs through all the variants of habitat occurring within the area of a given range, regardless of whether they are suitable or not very sui-

table for hares. If the assessment belt is sufficiently long (at least 15 km) and not less than 100 m in width and covers at least from 5 to 10% of the total area of the range, then it can be assumed that the result obtained by assessment fairly accurately represents the quantitative relations of the hare population in a given hunting range.

As shown by studies made up to the present, belt assessment gives a result adequate to the actual state only during the months from December to March inclusive. In earlier or later months the crops growing in fields (even when not high) cause fairly considerable under-estimation of the number of hares in relation to the actual state (P i e- l o w s k i, 1966a; 1968). Assessment should be carried out under favourable weather conditions, *i. e.* on days without snow or rain and without strong winds. Days on which the ground is covered by a deep layer of snow are very unsuitable.

The density of hares can be calculated per 1 or 100 ha for the belt itself. By multiplying the mean result obtained per 1 ha of assessment belt by the number of hectares of the area of the whole range it is possible to arrive at the total number of hares in this area. It is, however, important here to determine beforehand the real useful area of the hunting district, as only that can form the multiplier of the result of assessment. There are probably no field ranges in which part of the total area does not include areas useless for shooting purposes, such as hamlets or villages, roads, built-up areas of various kinds *etc.* In addition, as far as the hare is concerned, there are also such unused areas as bodies of water of all kinds, closely fenced areas *etc.* By deducting all these areas from the total area concerned the true used area is obtained. Despite the fact that the eliminated unused area varies in size in different localities it can be assumed that on an average it does not exceed 10% of the land area of the range.

Having carried out the necessary determinations, the formula for assessment of the numbers of hares in a range on the basis of the results obtained by belt assessment is as follows: the number of hares per 100 ha assessed area — $N_t$ is calculated by dividing the total quantitative result of assessment — $A$, by the number of hectares of assessment belt — $T$, as follows:

$$\text{(1)} \qquad N_t = \frac{A \cdot 100}{T}$$

If we wish to calculate the number of hares ($N$) occurring over the whole used area of the range ($P_1$), and accepting that it forms 90% of the area of the whole range ($P$), that is $P_1 = \frac{P \cdot 90}{100}$, the result of assess-

ment $N_t$ must be multiplied by the used area of the range. The following formula is then obtained:

$$(2) \qquad N = \frac{A \cdot P \cdot 90}{T}$$

Estimation of the numbers of hares by the belt assessment method should be carried out twice yearly: once immediately before the shooting season starts, and the second time before the reproduction period, that is, in February or March. The first result makes it possible correctly to regulate the number of hares to be removed in a given year, and the second result permits of ascertaining the initial state of the hare population before the reproduction period. This information, and the data collected during utilization of the population, can be used to draw up an annual balance of natural increase (number of young per adult individual) and loss (removal and natural mortality), which should form the basis for a rational productive and lasting utilization of the head of hare. Attempts at drawing up an annual balance of this kind for the hare population for a given shoot have been made by A n d r z e-j e w s k i & J e z i e r s k i (1966) and P i e l o w s k i (1968).

When using belt assessment in practice the numbers of hares are usually overestimated. R a j s k a (1968) found, that overestimation is the consequence of committing an error due to subjective enlargement of the breadth of the assessment belt by the person counting hares, particularly when they start up at some distance from the line of beaters. It is a question of the principle of perspective here. The narrower the assessment belt, the greater the error will be. This accounts for the above author's unfavourable opinion of the 50 m assessment belt used by some research workers. The author also considered the relation between density of the hares and the result of assessment, and reached the conclusion that the error in assessment increases with decreasing density. She failed, however, to support this conclusion by documentation.

Despite the foregoing, belt assessment forms a quantitative method which perhaps best meets contemporary requirements *i. e.* a method permitting of drawing conclusions on the basis of its results as to the number of hares in the whole of the shooting range.

### III. CHECKING THE RELIABILITY OF BELT ASSESSMENT

On the experimental shoot of the Research Station of the Polish Hunting Union at Czempin we were able to compare belt assessment with the absolute quantitative method, which we must consider catching and removing hares from areas surrounded by nets to be (A n d r z e-

jewski & Jezierski, 1966). Judging by our experience quantita-
tive censuses made by the above authors by means of this method are
not, however, completely accurate, since several very important mo-
ments have been overlooked in their investigations. For instance they
assume that the number of hares which escape from the catching area
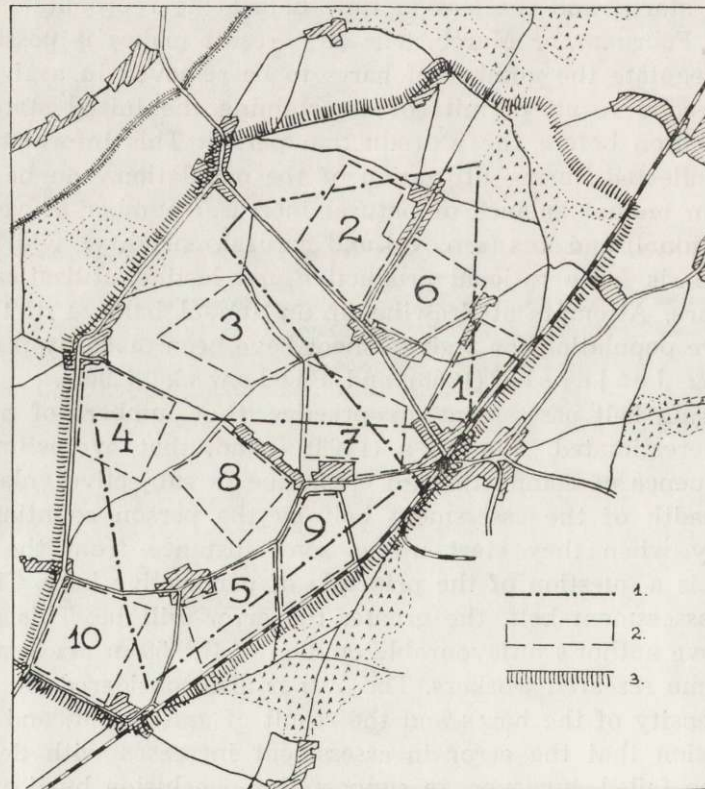(called the beat) during the time the nets are being put up, is equal



Fig. 1. Plan of the distribution of assessment routes and "enclosed squares" in
the study area.
1 — assessment routes; 2 — areas for catching and removing hares (enclosed
squares); 3 — boundary of study area.

to the number of hares which run into the centre of the beat during
this time. Exhaustive observations however permit of stating that as
a rule far more hares escape than enter the enclosing area. In the case
of the 19 carefully checked beats a total of 129 hares escaped before
the area was completely enclosed, while only 47 ran into centre. In
addition the above authors failed completely to take into account the
fact that a certain number of hares always escape through the net,

jump over it, wriggle out of it after being rounded up or take advantage of a moment when a section of the net falls to the ground and ceases to form an obstacle. In the 19 beats I observed the above circumstances enabled as many as 118 hares to escape, out of the 749 animals which were caught. Together with the hares which escaped from the beat before it was completely surrounded by nets, and after deducting those which ran into the centre — this forms 19% of the total numger of hares in the census area. These circumstances were of course taken into consideration in these investigations.

Comparison of the assessment belt method with the capture and removal method was carried out in one of the sections of the experimental area. This section was 3,150 ha in area, and regular belt assessments are made in it along two belts totalling 24 km in length. With a belt 100 m wide assessment thus covered 7.6% of the whole area.

**Table 1.**

Estimate of the numbers of hares in areas of known size arrived at by means of removals using the enclosed squares system.

| | Period over which catching and removal of hares were carried out | Total catching area in ha | Number of hares | | | | | | Density of hares per 100 ha |
| | | | Entered the beat before the area was closed | Escaped | | Caught | Remained in the beat | Total for the catching area | |
| | | | | Before beat was closed | Through the net | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10 beats | 19—25. I. 1966 | 1,227 | 20 | 50 | 43 | 347 | 25 | 445 | 36 |
| 5 beats | 24—26. I. 1967 | 725 | 27 | 34 | 42 | 253 | 20 | 322 | 44 |
| Removal | 7—8. I. 1967 | 630 | — | 45 | 33 | 149 | 55 | 282 | 45 |
| Total | | | 47 | 129 | 118 | 749 | 100 | 1049 | |

In January 1966 I carried out captures of hares from 10 beats distributed evenly as possible over the whole area (Fig. 1). They covered a total area of 1,227 ha, that is, 37% of the used area of the range. In relation to belt assessment the representativeness of the percentage of area was five times as great. The results of captures and exact determination of the number of hares which remained in the area after the captures are illustrated in Table 1.

The following year, i.e. 1967, this experiment was repeated once more (Table 1). I carried out only five beats of a total area of 725 ha, which forms 24% of the used area of the range. In both cases the quantitative result of captures was respectively 20% and 21% smaller than the result of the belt assessment made before the captures (Table 2).

Despite the high degree of agreement of the results obtained in the
two years there remained one objection, that is, whether these two
methods are comparable, since they represent a population investigated
in a slightly different way from the space aspect. Direct comparison
of the two methods for exactly the same area would be the only way

**Table 2.**
Checking the reliability of belt assessment.

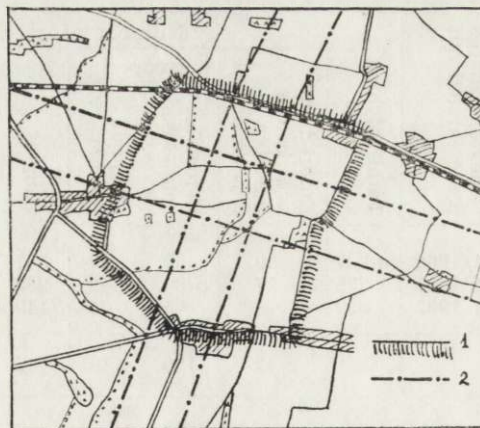| Method of estimation | On the basis of: | | | | | |
|---|---|---|---|---|---|---|
| | 10 enclosed squares | | 5 enclosed squares | | Direct comparison | |
| | Size of area in ha | Density of hares per 100 ha | Size of area in ha | Density of hares per 100 ha | Size of area in ha | Density of hares per 100 ha |
| Captures | 1,230 | 36 | 725 | 44 | 630 | 45 |
| Assessment | 240 | 45 | 240 | 56 | 100 | 57 |
| Difference in % | | 20 | | 21 | | 21 |



Fig. 2. Plan of the location of the experimental study area showing assessment
routes.
1 — boundary of study area; 2 — assessment routes.

of checking this. For this purpose an 630 ha area was marked out,
similar in shape to a square, on the Research Station grounds. The area
was intersected in the shape of a cross by assessment belts of a total
length of 10 km (Fig. 2). Belt assessment was carried out on January
5th and 6th 1967 (Table 1), then captures were made within this area
on January 7th and 8th, carrying out 4 beats, directly adjoining each
other and covering the whole 630 ha of the experimental area. During
the captures all the hares were counted which escaped and those which
entered the area or remained in the beat area after captures (Table 1).

The difference in relation to the result of belt assessment was again 21%. Almost identical results were thus obtained in three different ways.

Accepting for the time being the correction, obtained on the basis of the investigations described, of assessment results by a value of minus 20% as obligatory for different densities of hare populations, the formula (2) set out above for estimating the numbers of hares in a shoot must be further supplemented.

In its final form if will be as follows:

$$(3) \qquad N = \frac{A \cdot P \cdot 90}{T} \cdot \frac{80}{100} = \frac{A \cdot P \cdot 72}{T \cdot 10}$$

## IV. DISCUSSION AND CONCLUSIONS

The high degree of agreement between results, obtained by different methods, of checks on the reliability of belt assessment justifies our accepting, that with the use of this method overestimation of results by approx. 20% does in fact take place in estimates of the numbers of hares. The question raised by R a j s k a (1968) as to whether the error made in estimating numbers will differ depending on the density of hares in a given area, is open to discussion. In principle there are no grounds for such an assumption, of course if we take it that the person making the assessment sets about his task in the most objective way possible. If this condition is satisfied, error should not be increased when density is lower, as the author referred to above suggests. The matter nevertheless requires detailed checking. As shown by the data given in this study (Table 2), differences in density of 9 hares per 100 ha had absolutely no influence on the extent of error.

It would appear that the 28% reduction obtained of results of belt assessment, that is, by a coefficient reducing the total area of the range and taking into consideration the error in assessment, is a sufficiently great guard against the danger of overestimating the numbers of hares in a range. The chief condition for obtaining reliable data will also be correct carrying out assessment in accordance with the requirements of this method, which is very sensitive to such factors as season of the year, weather conditions, number of beaters and width of the assessment belt. It is nevertheless a relatively straightforward method and one technically easy to carry out, and is thus suitable for use in hunting practice to a greater extent than hitherto.

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## OCENA TAKSACJI PASOWEJ JAKO METODY OKREŚLANIA LICZEBNOŚCI ZAJĘCY

Badania miały za cel weryfikację jednej z metod oceny stanu liczebnego zajęcy, tzw. taksacji pasowej. Jako novum przy stosowaniu tej metody postuluje się obniżenie wyników taksacji o 10%, tj. o współczynnik redukujący powierzchnię ogólną łowiska.

Niemniej jednak przy zastosowaniu taksacji pasowej w praktyce dochodzi do przeceniania stanu ilościowego zajęcy na skutek popełnienia błędu wynikającego ze subiektywnego zwiększenia szerokości pasa taksacyjnego przez liczącego zajęca. W celu określenia wielkości tego błędu porównywano taksację z bezwzględną metodą ilościową, jaką są wyłowy zajęcy na powierzchniach otoczonych sieciami.

Na terenie doświadczalnym wielkości 3.150 ha prowadzono regularne taksacje na trasach o łącznej długości 24 km. Taksacja obejmuje 7,6% całego terenu. W roku 1966 przeprowadzono na tym terenie (Fig. 1) wyłowy zajęcy z 10 miotów, które objęły łączną powierzchnię 1.227 ha, czyli 37% powierzchni użytkowej obwodu. W roku 1967 eksperyment ten jeszcze raz powtórzono, stosując jednak tylko pięć miotów o łącznej powierzchni 725 ha. Wyniki wyłowów ilustruje tabela 1. W obu przypadkach ilościowy wynik wyłowu był o 20% lub 21% mniejszy aniżeli wynik przeprowadzonej przed odłowami taksacji pasowej (Tabela 2).

Ponadto skonfrontowano jeszcze obie metody ściśle na tym samym terenie. Na obszarze wielkości 630 ha przeprowadzono taksacje o łącznej długości 10 km (Fig. 2). Następnie przeprowadzono na całym obszarze odłowy zajęcy. Różnica wyniosła znowu 21%. Uzyskano zatem trzema różnymi drogami niemal identyczne rezultaty.

W sumie wyniki taksacji pasowej należy obniżyć o 28%, to jest o współczynnik redukujący powierzchnię ogólną łowiska i uwzględniający błąd taksacji. Ponieważ taksacja pasowa jest metodą stosunkowo nieskomplikowaną i technicznie łatwą do przeprowadzenia, nadaje się ona do stosowania w praktyce łowieckiej szerzej niż dotychczas.