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Evaluating the environmental factors influences on body mass of wild ungulates obtained in Lublin region

Ocena wpływu czynników środowiskowych na masę tuszy dzikich kopytnych pozyskanych na Lubelszczyźnie

Summary. The study aimed at evaluating the influence of environmental conditions on hunting animals' body mass (red deer *Cervus elaphus*, roe deer *Capreolus capreolus*, and wild boar *Sus scrofa*) obtained from within RDLP in Lublin. The paper includes correlation coefficients between the mean body mass of analyzed specimens and selected environmental factors such as: agricultural production space index, forest coverage, length of forest borders, percentage of main forest habitat types, thickness and time of snow cover presence. The obtained results indicated that the presence of dense forests and high percentage of coniferous forests affected the increased mean body mass of deer. The body mass of wild ungulates depends on environmental circumstances that make animals possible to survive winters in best conditions. A long time of snow cover presence had a negative impact on deer mean body mass in the Lublin region.

Keywords: body mass, environmental factors, wild ungulates

INTRODUCTION

Keeping the wild vertebrates population in its natural habitats at optimum level – from a biocenotic point of view – and possibly high individual condition, are main goals of the specimens breeding. Weather conditions and continuous changes within managed landscapes have stronger influence on individual and population features of hunting than farm animal species [Szukiel 1994]. Environmental conditions the animals live, have direct impact on its health, that reflects the population adjustment to a fodder capacity of a hunting ground. Body mass is one of main factors reflecting the free-living animal's condition [Bobek *et al*. 1984]. Among regulators determining the animal's body mass, there are following: weather conditions, fodder resources, population density, animal's

age, and seasonality [Remmert 1985]. Transformations of natural ecosystems such as agriculture intensification, simplified forest management, and dividing the forest complexes, have considerable effects on individual quality of wild ungulates.

The study aimed at evaluating the influence of environmental factors on body mass of hunting animals obtained in Lublin region.

MATERIAL AND METHODS

The study was carried out on a base of documents and mapping surveys. The documentary data originated from Hunting Breeding Projects supported by Regional Directorate of National Forests in Lublin. Data referred to body mass of three hunting animal species (red deer *Cervus elaphus*, roe deer *Capreolus capreolus*, and wild boar *Sus scrofa*) obtained within particular RDLP inspectorates in Lublin during subsequent management seasons: 1998/99-2004/05. Average bode masses for particular hunting seasons were calculated as a ratio of the total mass of obtained bodies (kg) of each studied species (including sexes and age classes), as well as the amount of hunting obtention (number of animals). Then, mean body mass for particular species for the whole studied period, was calculated.

In order to evaluate the environmental factors influence on mean body mass of studied species, collected information referred to: the soil and agricultural characteristics (general index of agricultural production space quality) on a base of Institute for Cultivation, Fertilization, and Soil Science in Puławy [Witek *et al*. 1993], percentage of main forest habitat types (data of RDLP in Lublin), and forest densities in particular forest inspectorates. Borders of forest complexes within particular inspectorates were measured from topographic maps (1 : 50 000) with a help of electronic opisometer "Plus" (SILVA). Borders of all forests marked on maps with a green color (national and private), the area of which exceeded 1 ha, were measured. All boundaries between fields and forests, as well as between forests and water reservoirs were considered as measured borders.

To evaluate the influence of independent variables (general index of agricultural production quality space (points), percentage of forest habitat types (%), forest coverage (%), length of forest complexes borders (km) in particular inspectorates) on dependent variable (mean body mass), the Pearson's correlation coefficients between analyzed parameters were calculated.

The paper also contains the analysis of the influence of snow cover thickness and presence time on mean body mass of studied species from the whole Regional Directorate of National Forests in Lublin for subsequent hunting seasons. Due to a small set of variables (7 hunting seasons), the dependencies between these parameters were assessed on a base of Spearman's rank correlation coefficients. Meteorological data were achieved from Hydrological-Meteorological Station in Radawiec (http://www.weatheronline.pl).

STUDY AREA

The study included hunting districts within borders of Regional Directorate of National Forests in Lublin that manages the State Treasury grounds of 419 thousand ha

area, including in Lublin region – 326 thousand ha, Podkarpacie region – 82 thousand ha, and Mazovia region – 10 thousand ha. Obtained individuals originated from 6 regions scattered over the whole study area (from south to north): Rudnik Forest Inspectorate, Strzyżewice and Niedrzwica Duża Communes in Świdnik Forest Inspectorate, Kozłowieckie Forests in Lubartów Forest Inspectorate, and Rossosz and Łomazy Communes in Biała Podlaska Forest Inspectorate. Considering the natural-forest regionalization [Trampler 1999], the study area is localized in eastern districts of Mazovia-Podlasie Region and north-eastern districts of Małopolska Region. The RDPL in Lublin forests are characterized by considerable diversity in a view of distribution and size of forest complexes; the forest coverage is 23%. The largest forest complexes are: Solska Forest (including Janowskie Forests), Roztocze Forests, Strzeleckie Forests, Sobiborsko-Włodawskie Forests, and Kozłowieckie Forests. The climate over the studied area is diverse and counted in its northern part (Polesie Lubelskie, Podlasie, Small Mazovia) to moderate-transitional, on south (Kotlina Sandomierska, Roztocze) to near-mountain lowlands and valleys showing diversity depending on an altitude. Annual rainfall sum ranges from 500–600 mm in northern to 700–800 mm in southern regions (Roztocze). Geo-morphologically, the studied area is also greatly diverse: from wide plains on the north (Podlasie) to hills of Lublin Upland and Roztocze on the south, with altitudes above 300 m above sea level. Forests occur mainly in lowland habitats: coniferous, deciduous, and alder forests making up 97% of the total forest area. Remaining 3% are upland habitats: coniferous and deciduous. Forest composition is diverse, as well: coniferous trees dominate occupying 70.4% of the area [Fijałkowski 1993].

RESULTS AND DISCUSSION

Evaluating the influences of agricultural production space quality on wild animals body mass revealed negative and insignificant dependencies between these parameters for all studied species. The highest correlation coefficients were recorded between agricultural production space quality vs. mean body mass of males in the 3rd age class ($r = - 0.44$; i.s.) and young males in the 2nd age class ($r = - 0.37$; i.s.). These dependencies can be explained with the fact that the best soils were always used for agricultural purposes, which is associated with deforestation of the area. Therefore, the negative dependence between mean body mass of species associated with the forest habitat and value of agricultural production space quality should be contributed to the decrease of forests on areas with good soil conditions. Present study proved negative and statistically significant interaction between agricultural production space quality vs. forest coverage in particular forest inspectorates.

Mean body mass of males and females increased along with the increase of forest coverage index in particular forest inspectorates; calculated correlation coefficients amounted to $r = 0.45$ and $r = 0.46$, respectively, which was statistically significant for $p \leq 0.05$. Negative, however insignificant, dependence between the forest area percentage vs. roe deer and wild boar body weights, regardless of the sex and age, was observed during the study (Tab. 1). Presented results indicate that high percentage of the forest area had positive effect on mean body mass of red deer, which was associated with the fact that forest habitat in our country conditions, is a typical biotope for that specimen

[Haber *et al*. 1977, Tomek 2002]. Negative interaction between roe deer and wild boar body masses vs. forest coverage share, are less dependent on typically forest habitats [Genov 1981, Hewison *et al*. 2001].

Table 1. Value of correlation factors between average body mass each species (division on age and sex) and percentage forest cover and forest edge lengths
Tabela 1. Wartości współczynników korelacji pomiędzy średnią masą tuszy poszczególnych gatunków (z rozbiciem na wiek i płeć) a lesistością oraz długością granic kompleksów leśnych w poszczególnych nadleśnictwach

Species Gatunki	Percentage forest cover Lesistość	Forest edge lengths Długość granic leśnych
All red deer Jelenie razem	0.21	-0.16
Stags Byki	0.45*	-0.20
Does Łanie	0.46*	-0.60*
Calfs Cielęta	0.13	-0.34
All roe deer Sarny razem	-0.09	-0.09
Roebuck Kozły	-0.12	-0.11
Goats Kozy	-0.10	-0.10
Fawns Koźlęta	-0.05	-0.09
All wild boar Dziki razem	-0.06	-0.26
Boars < 1year – Warchlaki	-0.11	-0.24
Boars > 1year – Przelatki	-0.02	-0.31
Other Pozostałe dziki	-0.05	-0.44*

* significant at $p \leq 0./05$
* istotne dla $p \leq 0,05$

Statistical processing also revealed negative influence of forest complexes scatter, expressed as the length of forest complexes borders, on mean body mass of all studied species (Tab. 1). The strongest dependence occurred between forest complexes border length and mean body mass of red deer females (-0.60) and adult wild boars (-0.44), which were statistically significant at $p \leq 0.05$. Negative impact of the forest complexes scatter on red deer population was also recorded by Ahlen [1975], according to whom dense forest complexes determine the red deer survival during the hard winter seasons. In present study, mean body mass of roe deer was the worst correlated with the border

length of forest complexes, which indicates lesser influence of the forest complexes scatter on mean body mass of that specimen. It is consistent with observation of other authors [Jepsen and Topping 2004, Czyżowski *et al*. 2009], according to whom roe deer – among all wild ungulates – has the best behavioral features to habitat changes, which makes it well functions in scattered forest complexes.

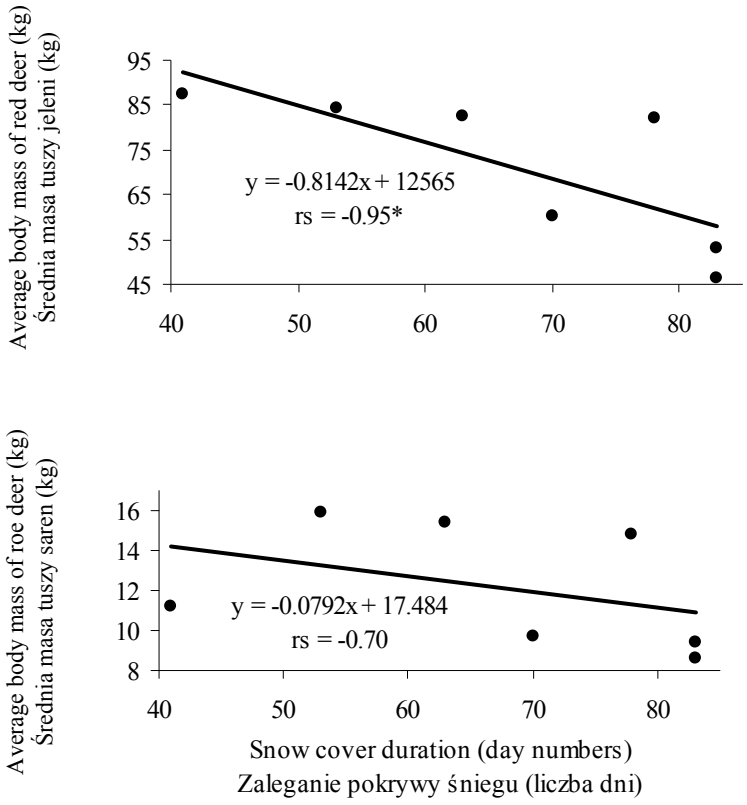

Fig. 1. Relation between average body mass of red deer, roe deer and snow cover duration (* significant at $p \leq 0.05$)
Ryc. 1. Zależność pomiędzy średnią masą tuszy jeleni i saren a długością zalegania pokrywy śnieżnej (* istotne dla $p \leq 0{,}05$)

Analysis of the influence of selected forest habitats revealed positive dependencies between the percentage of coniferous habitats vs. mean body mass of red deer and roe deer. The highest interaction referred to red deer, mainly females, for which correlation coefficient was 0.59, which was statistically significant at $p \leq 0.05$. The coniferous habitats are main mainstay for deer during winter, where both feed and shelter conditions are better than in mixed or deciduous forests that season [Bobek *et al*. 1984, Janiszewski and Szczepański 2001].

Evaluating the selected climate factors on body mass of analyzed species indicated negative dependence between assessed parameters. The Spearman's rank correlation coefficients between mean body mass of red deer and roe deer vs. thickness of a snow cover revealed negative, yet statistically insignificant interaction, which amounted to: -0.29 and -0.13, respectively. Dependence between mean body mass of red deer and roe deer vs. snow cover presence duration was also negative, although it was statistically significant (Fig. 1). The body mass decrease at deer during the thick snow cover presence is accounted for by limited opportunities of a food availability for animals [Mysterud *et al*. 1997, Janiszewski and Szczepański 2004].

In the case of wild boar, no negative influence of the snow cover on their body mass was recorded. Statistical processing even revealed a positive correlations with the duration of snow cover presence (rs = 0.84) and its thickness (rs = 0.18). Such results can be associated with different way of wild boar's feeding as compared to deer. Characteristic way of feeding – rootling – allows wild boar for finding high-energy food beneath the snow cover, when it is unavailable for deer [Howe and Bratton 1976].

CONCLUSIONS

1. Body mass at wild ungulates depends on environmental circumstances that allows for surviving the winter season at the possible best physical condition.

2. Presence of dense forest complexes and high percentage of coniferous habitats make deer easier to find appropriate feeding and shelter conditions during winter, which affects the increase of mean body mass at red deer and roe deer within studied area.

3. Negative dependence between mean body mass of species connected to a forest environments vs. agricultural production space quality coefficient is associated with lower forest cover ratio on areas with great agricultural usefulness.

4. Unfavorable weather conditions during winter, namely long time of snow cover presence had negative influence on mean body mass of deer in Lublin region.

REFERENCES

Ahlen J., 1975. Winter habitats of moose and deer in relation to land use in Scandinavia. Viltrvy, 9, 3, 45–192.

Bobek B., Morow K., Perzanowski K., 1984. Ekologiczne podstawy łowiectwa. PWRiL Warszawa, 1–315.

Czyżowski P., Karpiński M., Drozd L., Rachfałowski R., Goleman M., 2009. Wpływ długości granicy leśnej na zagęszczenie dzikich kopytnych. [W:] Zagrożenia biotopów leśnych, red. K. Sporek, Wyd. UO, Opole 2009, 99–111.

Fijałkowski D., 1993. Środowisko przyrodnicze Lubelszczyzny. Lasy Lubelszczyzny. LTN, Lublin, 1–252.

Genov P., 1981. Significance of natural biocenoses and agrocenoses as the source of food for wild boar. Ekologia Pol. 29, 117–136.

Haber A., Pasławski T., Zaborowski S., 1977. Gospodarstwo łowieckie. PWN, wyd. II, Warszawa, 1–374.

Hewison A.J.M., Vincent J.P., Joachim J., Angibault J.M., Cargnelutti B., Cibien C., 2001. The effect of woodland fragmentation and human activity on roe deer distribution in agricultural landscapes. Can. J. Zool**.** 79 (4), 679–689.

Howe T.D., Bratton S.P., 1976. Winter rooting activity of the European wild boar in the Great Smoky Mountains National Park. Castanea 41, 256–264.

Janiszewski P., Szczepański W., 2001. Analysis of autumn-winter diet of stags, hinds and calves of reed deer (*Cervus elaphus* L.) based on rumen content. Fol. Forest. Pol., Ser. A, Forestry, 43, 69–83.

Janiszewski P., Szczepański W., 2004. Charakterystyka masy tusz byków, łań i cieląt jelenia szlachetnego (*Cervus elaphus* L.) pozyskanych w okresie jesienno-zimowym. Sylwan, 12, 33–38.

Jepsen J.U., Topping C.J., 2004. Modelling roe deer (*Capreolus capreolus*) in a gradient of forest fragmentation: behavioural plasticity and choice of cover. Can. J. Zool**.** 82(9), 1528–1541.

Mysterud A., Bjørnsen B.H., Østbye E., 1997. Effects of snow depth on food and habitat selection by roe deer *Capreolus capreolus* along an altitudinal gradient in south-central Norway. Wild. Biol. 3, 1, 27–33.

Remmert H., 1985. Ekologia. PWRiL Warszawa, 1–404.

Szukiel E., 1994. Różnice w hodowli zwierząt gospodarskich i zwierząt dzikich na wolności. Sylwan 3, 71–76.

Tomek A., 2002. Właściwości i struktura populacji jelenia (*Cervus elaphus* L.) w lasach krynickich (Karpaty). Zesz. Nauk. AR w Krakowie, ser. Rozprawy, 278, 1–100.

Trampler T., Kliczkowska A., Dmyterko E., Sierpińska A., 1990. Regionalizacja przyrodniczo-leśna na podstawach ekologiczno-fizjograficznych. PWRiL Warszawa, 1–157.

Witek T., Górski t., Kern H., Żukowski B., Budzyńska K., Filipiak K., Fiuk M., Strzelec J., 1993, Waloryzacja rolniczej przestrzeni produkcyjnej Polski wg gmin. IUNG Puławy, Supl., 1–248.

Streszczenie. Celem pracy była ocena wpływu warunków środowiskowych na masę tuszy zwierząt łownych (jeleń europejski *Cervus elaphus*, sarna *Capreolus capreolus* i dzik *Sus scrofa*) pozyskanych na terenie RDLP w Lublinie. W pracy wykorzystano wyliczenia współczynników korelacji pomiędzy średnią masą tuszy analizowanych gatunków a wybranymi czynnikami środowiskowymi (wskaźnik rolniczej przestrzeni produkcyjnej, lesistość, długość granic kompleksów leśnych, udział głównych typów siedliskowych lasu, wysokość oraz długość zalegania pokrywy śnieżnej). Wyniki badań wskazują, że obecność zwartych kompleksów leśnych oraz duży udział siedlisk borowych wpływają na wzrost średniej masy tuszy jeleniowatych. Masa tuszy dzikich kopytnych jest uzależniona od warunków środowiskowych, które pozwalają zwierzynie przetrwać okres zimowy w jak najlepszej kondycji. Długi okres zalegania pokrywy śnieżnej wpływał ujemnie na średnią masę tuszy jeleniowatych na Lubelszczyźnie.

Słowa kluczowe: masa tuszy, czynniki środowiskowe, dzikie kopytne