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ECOLOGICAL STUDIES ON BROWN BEAR (*URSUS ARCTOS*) IN BELARUS: DISTRIBUTION, POPULATION TRENDS AND DIETARY STRUCTURE

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Abstract. The goal of the study was to get knowledge about the current distribution and population trends of brown bear (*Ursus arctos*) in Belarus. Another aim was to analyse the dietary composition of the species on a seasonal basis. The main methods used were track survey and scat investigation. The study suggests that in Belarus brown bears occur mostly in northern and central-eastern districts. One of the population trends was increase in predator numbers in north-eastern and central-eastern districts, whereas another population trend was a gradual decline in brown bears in north-western districts. The total number of brown bears in Belarus was approximately between 140 and 180 (plausibly 160) individuals in 2002–2003. A markedly lower number of brown bears was recorded in 2005 and the data obtained suggest a decreased number of up to 80–100 individuals during the last years. According to the data on the dietary composition of brown bear in northern Belarus, the species may be characterised as a generalist and rather a plant consumer than an active predator. Insects and carrion also play an important role in the feeding of brown bear.
Key words: brown bear, *Ursus arctos*, population density, diet, Belarus

INTRODUCTION

In Belarus, brown bear (*Ursus arctos*) has been included in the list of endangered species for many years (Darapheev *et al.* 1981). Nevertheless, ecological data on this vulnerable predatory species are still poor in Belarus. Several publications have shed some light on the distribution and food habits of brown bear mainly in the single woodland, where the Berezinski Biosphere Reserve is located (Kozlo 1974; Lavov 1987, 1993). So, ecological results concerning brown bear are evidently insufficient and further studies on the species' ecology in Belarus are needed.

MATERIAL AND METHODS

The distribution of brown bears in Belarus was investigated in 2002–2005. In 2002–2003, detailed questionnaires were spread among all local hunter organisations, forestry and nature protection offices and after being filled in they were received back from the districts where the presence of the species was recorded before, as well as from the majority of other districts. Also, the distribution of brown bear was investigated during six special expeditions to three extended woodlands located in northern Belarus: (1) Gorodok and Vitebsk districts, Vitebsk region; (2) Shumilino and Polotsk districts, Vitebsk region; (3) Rossony and Verhnedvinsk districts, Vitebsk region. The same three woodlands were similarly inspected in July to October 2002–2003 and 2005. During the woodland inspection, we searched for tracks of brown bears in order to estimate the relative abundance index as the number of the species' trails found per 10 km of walking. These expeditions added to our knowledge about the distribution of brown bears in Belarus and about temporal changes in their numbers. Also, each year from 1995 to 2004, an area of 600 km^2 in the Lovat River head in the Gorodok district of the Vitebsk region was inspected to find brown bear tracks. Particularly in April and May and from August to October, all places likely to be attractive to brown bears and/or betray their tracks were inspected. Such places were as follows: forest and other roads, fire stripes, sand and mud deposits at stream banks, peat bogs, oat fields, cranberry bogs etc. Track survey usually covered the entire study area and followed the established route net with a distance of about 0.8–2 km between the neighbouring routes. During the route inspection, the width and length of complete fore and hind footprints, including the width and length of interdigital pads in

both footprints, were measured. Track measurement results revealed that the difference between the width and length of complete fore and hind footprints of the same individual varied up to 2 cm, whereas that of the width and length of interdigital pads in both footprints varied up to 1 cm. The recorded differences in brown bear track dimensions that are higher than the above-mentioned ones were accepted as presence of different individual tracks. During the gradual survey of the study area, track information was mapped and the presence of different individuals (presumably both residential and nomadic) was revealed. The number of different individuals the tracks of which were registered in the study area of 600 km^2 was accepted as an index of the species abundance to use that in finding population trends.

To investigate the dietary structure of brown bears in northern Belarus, 732 scats were collected mainly in the Gorodok, Rossony and Polotsk districts in northern Belarus. To identify mammalian prey consumed by brown bears, hair from washed scats was checked microscopically (Debrot *et al.* 1982; Teerink 1991). The relative amounts of various food items in the brown bear diet were given as percentage of occurrence in the total number of analysed scats (% OC) and percentage of biomass consumed (% BC) by brown bears. To obtain % BC, we followed the approach recommended by Jędrzejewska and Jędrzejewski (1998) based on coefficients of digestibility, i.e. the ratio of fresh weight of a given food item to dry weight of its remains in scats washed. The coefficients of digestibility (called as correction factors as well) for brown bear were taken from the study by Hewitt and Robbins (1996): 0.16–0.35 for different kinds of vegetation; 0.51–1.84 for various berry species; 0.35–1.40 for different kinds of roots; 0.91–1.25 for insects; 1.54–12.5 for various mammalian species; and 40.8 for fish. The obtained dietary data were divided into five seasonal periods as follows: (1) mid March–mid April; (2) mid April–June; (3) July; (4) August–September; (5) October–November. According to information in relation to feeding conditions, these periods seem to have a distinctive food supply which presumably affects the dietary structure.

Results

Distribution and population trends

The distribution of brown bears in Belarus in 2002–2003 is given in Figure 1. Data suggest that this large predatory species occurs mostly in northern and central-eastern districts of Belarus. Several trends in the distribution of brown bear were seemingly present. The first one was some increase in species numbers in north-eastern and central-eastern districts (Gorodok, Vitebsk, Liozno, Chashniki and Shumilino) since 2001 (Fig. 2). Another discovery was that many migratory brown bears had moved rather far away from the current border of the continuous range of the species (Fig. 1). The second trend was a gradual decline in the number

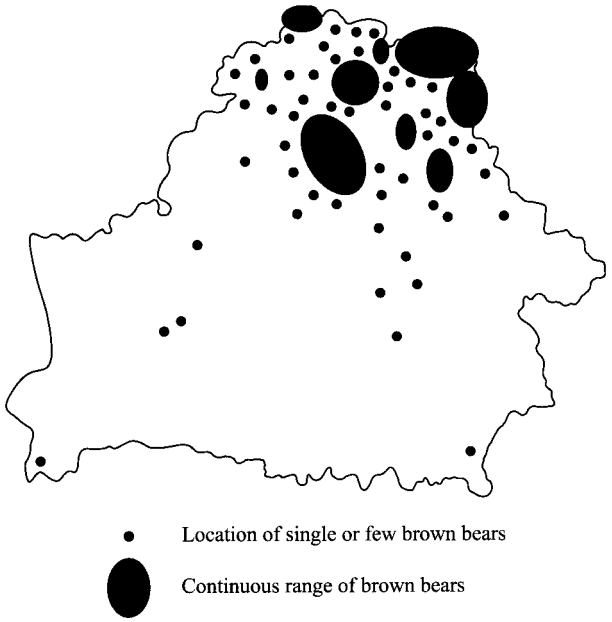

Figure 1. The distribution of brown bear in Belarus according to data obtained in 2002.

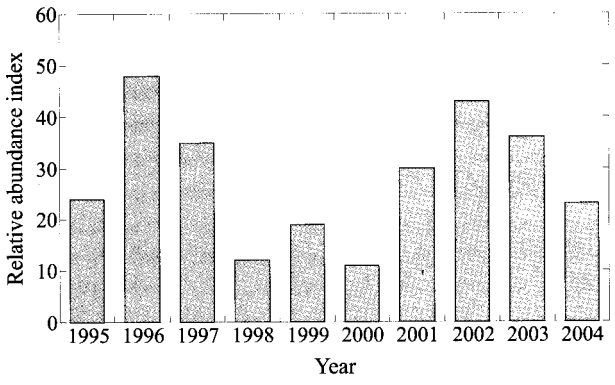

Figure 2. Between-year dynamics of brown bear density in the woodland at the Lovat upper reaches, Gorodok district, Vitebsk region, NE Belarus in August–October 1995–2004.

of brown bears in north-western districts. The above inferences were based on: (1) comparison of personal information about the current distribution of brown bear with previously published data (Lavov 1987, 1993); (2) the local hunters' reports in the questionnaire and (3) the results of the individual monitoring of brown bear distribution, with more detailed data obtained from the Gorodok district (Fig. 2).

According to the rough estimates based on the local hunters' reports, hunting wardens, forest guards and others, the total number of brown bears throughout Belarus in 2002–2003 was approximately between 140 and 180 individuals, probably about 160 individuals. Nevertheless, during the track survey in three extended woodlands in northern Belarus in 2005, markedly fewer brown bear signs were revealed compared to a similar survey conducted in the same woodlands and during the same seasons in 2002–2003 (3.6 versus 6.2 trails per 10 km on average; $t = 10.1$, $p = 0.001$). Consequently, this suggests a significant decline in the total number of brown bears in Belarus, plausibly up to 80–100 individuals during the past years.

Seasonal changes in the diet

The results on the dietary composition of brown bears and its seasonal changes are summarised in Table 1 and Figure 3. In northern Belarus, under the conditions of transitional coniferous-deciduous (mostly small-leaved) woodlands, brown bears basically consumed the following food categories: leaves and whole shoots of trees, bushes and grass, underground storage parts of grass – 27.1–96.6% OC, on average seasonally 54.6% OC and 7.0–54.2 (21.6%) BC; berries and other fruits – 4.7–77.9% (50.1%) OC and 1.4–31.8 (16.2%) BC; oat and other cereal seeds – 0–75.0 (22.5%) OC and 0–35.6 (10.2%) BC; beetles and other invertebrates – 22.8–86.7 (45.8%) OC and 2.1–20.5 (11.6%) BC; preyed mammals and mammalian carrion – 6.3–82.4 (30.2%) OC and 9.0–77.8 (33.0%) BC. Concerning the mentioned food categories, the following details were revealed. Amongst plant vegetative parts, leaves and whole shoots were basically eaten by brown bears from May to mid August, and underground storage parts of grass were dug out and consumed in early spring and autumn. From May to July, brown bears

Table 1. Seasonal changes in the proportions (%) of different food items in the brown bear diet estimated as a frequency of occurrence of their indigestible remains in scats (all analysed scats were taken to be 100% in the dietary calculations, n = 732), northern Belarus, 1985–2004.

Food item	Mid March–mid April	Mid April–June	July	August–September	October–November
Beetles (imago)	7.1	16.5	85.0	73.7	33.7
Other invertebrates	20.0	49.6	28.3	17.4	20.2
Fish	4.3	0.4	0.9	-	-
Birds	-	0.8	1.8	-	1.1
Bird eggs	-	1.3	-	-	-
Small rodents	15.7	2.1	2.7	4.0	13.5
Beaver	12.9	1.3	-	0.9	2.3
Raccoon dog	2.9	-	0.9	0.5	15.1
Brown bear	-	0.8	-	-	-
Wild boar	54.2	2.5	1.8	0.5	13.5
Elk	21.4	0.8	-	0.9	7.9
Cow	2.9	1.3	0.9	1.4	3.4
Horse	2.9	-	-	0.5	-
Roe deer	2.9	0.4	-	-	-
Leaves and shoots of trees, bushes and grass; underground storage parts of grass	27.1	96.6	81.4	30.4	37.1
Berries	45.7	4.7	76.1	45.5	59.6
Apples, plums and pears	-	-	1.8	20.1	9.0
Oat and other cereal seeds	-	-	18.6	75.0	19.1
Other hard digestible matter	28.5	2.1	1.8	0.9	12.3
Number of scats analysed	70	236	113	224	89

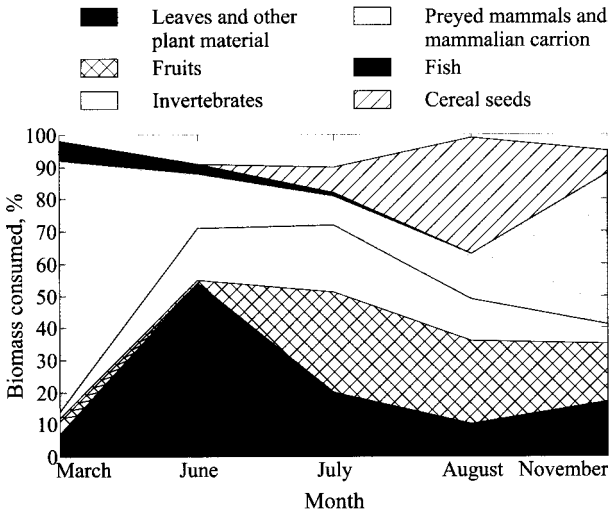

Figure 3. Seasonal changes in the brown bear diet (% biomass consumed) in northern Belarus; n = 732. Scats were collected in 1985–2004.

fed on plant vegetative parts markedly more often than in other seasonal periods. Berries were mostly taken since early July. Firstly, they ate bilberries and raspberries, then in August cowberries and blueberries were more frequently consumed. Ash berries were partly substituted for lattes in September. In October and November, cranberries and ash berries were the main berries available and eaten by brown bears. Cranberries were usually well-preserved until early spring and were frequently favoured by brown bears in this harsh season with poor food supply. In August through October, they quite often fed on apples, plums and pears. An important role in brown bear feeding belonged to oat seeds, while other cereal seeds were taken rarer than oat seeds. Basically cereal seeds were consumed in late July to September. Concerning invertebrates, brown bears ate mostly imago dung beetles, beetle larvae and ant eggs. Beetles were more important food since July, while ant eggs in spring and sometimes since August. Mammals made up a considerable part of the brown bear diet, but they were really an essential food category only in early spring and late autumn. Brown bears used the whole range of mammalian sizes from bank voles to elks. Small rodents were hunted quite often, but this prey constituted a rather small part of the diet (1.6–8.0% BC, on average seasonally 3.5% BC). By spring and late autumn, brown bears preyed beavers and raccoon dogs, which were more available for them to catch than wild ungulates. As to wild ungulates, data suggest that brown bears consumed mainly (89% of known cases) carcasses of individuals that died from other causes. Fairly often those were the wolf kills (about a half). On the other hand, sometimes elks fall dead hardly wounded by brown bears after they escape from them. Three times I came across a dead elk with characteristic bites on its neck in rivers in late autumn. Similar findings were reported by Lavov (1993). With regard to domestic cattle, brown bears mostly ate their carcasses refused by people in their habitats. During this study, I revealed only two cases of brown bears attack on cows. Brown bears also ate fish, birds and their eggs, but it is hard to say how they provided this kind of food for themselves, i.e. hunted or scavenged the carcasses. Sometimes brown bear scats contained a great amount of hard digestible matter, for instance, material of ant hills or spruce branches. It was especially attributable to feeding habits of brown bear in early spring and late autumn under the conditions of poor food supply.

Discussion

The study suggests that brown bears occur mostly in the northern and central-eastern districts of Belarus. In north-eastern and central-eastern districts, some increase in species numbers was observed, while in north-western districts a gradual decline in the number of brown bears was registered. However, during the last few years the decline in brown bears appeared to be more pronounced. Further the main negative factors which seemingly limit the species density and range will be pointed out. First, a low reproduction rate was attributable for the brown bear population in Belarus due to probably either low portion of breeding females or low fertility, or high mortality in cubs especially during the first several months of their life. According to track information gathered from August to September in northern Belarus, the portion of juveniles was only 11% (n = 416). This share of cubs is rather low compared to the other neighbouring regions (Vaisfeld & Chestin 1993). For instance, the portion of juveniles was nearly twice higher (23.5%; G = 5.0, p = 0.04) in a normally reproduced brown bear population in Karelia (Danilov 1988). Having some information on mortality in juveniles, I assume that the main cause of low reproduction rate in brown bears in Belarus is high mortality of newly born cubs, when hunting dogs or hunters scare their mothers from hibernating dens. Brown bear mother that was scared from a hibernating den usually does not return to her newly born cubs (Danilov 1993). Moreover, seemingly killing of cubs by adult males is also common. Three cases of cub killing by adult males were recorded in northern Belarus during the study period. Such interactions have also been reported for other regions (Pazhetnov 1990;

Vaisfeld & Chestin 1993). An altered population structure probably leads to more frequent killing of cubs by adult males. In a dense brown bear population, an adult male's home range includes one or several adult female's home ranges and such an adult male usually tolerates the cubs that are present in his home range (Pazhetnov 1990; Danilov 1993). In the case of an altered population structure, an adult male that has newly appeared in an area inhabited by a family group is more likely to respond more aggressively to unfamiliar cubs. Another hypothesis in relation to a rather low portion of juveniles in the brown bear population in northern Belarus is connected with the known result about the low number of cubs on the edge of the range of brown bears, where usually adult and sub-adult males prevail in the population structure (Swenson *et al.* 1998).

Analysis of the brown bear dietary composition in its seasonal changes allows to conclude that in northern Belarus under the conditions of transitional woodlands the species is a generalist and rather a plant consumer than an active predator. Also, insects and carrion play an important role in the feeding of the predator. Such feeding habits are very usual for brown bear within the species range in Eurasia (Chernjavskij & Petrichenko 1984; Pazhetnov 1990; Clevenger *et al.* 1992; Elgmork & Kaasa 1992; Vaisfeld & Chestin 1993 and references therein; Johansen 1997; Dahle *et al.* 1998; Rigg & Gorman 2005). In Belarus, as well as in almost all other regions of Eurasia, where dietary studies on brown bears were conducted, the species acted more often as an active predator in spring and autumn in comparison with its feeding habits in summer. Predation in brown bear feeding habits was more frequently observed in years when the crop of the main plant food was poorer (Chernjavskij & Petrichenko 1984; Ustinov 1993). Analysis of literature (Chernjavskij & Petrichenko 1984; Clevenger *et al.* 1992; Elgmork & Kaasa 1992; Vaisfeld & Chestin 1993 and references therein; Johansen 1997; Dahle *et al.* 1998) suggests that more northern brown bear populations are usually characterised by higher consumption of mammals and more frequent predation. At the same time, the portion of mammals in the brown bear diet may not be realised as a portion of mammalian prey, especially in spring, because brown bears frequently consume carrion as it has been numerically reported for different region of Eurasia (Vaisfeld & Chestin 1993). In Belarus, the snow tracking of brown bears in early spring also demonstrated frequent eating of wild ungulate carrion by the species (Sidorovich *et al.* 2000). This feeding habit of brown bears, i.e. searching for carcasses of wild ungulates that died in winter and eating of their carrion, was four times more common than the predators' attempts to hunt wild ungulates.

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Baltarusijos rudojo lokio (*Ursus arctos*) ekologinė studija: paplitimas, populiacijos kaitos tendencijos, mityba

V. E. Sidorovich

Santrauka

Tyrimų tikslas buvo nustatyti rudojo lokio (*Ursus arctos*) paplitimą ir populiacijos kaitos tendencijas Baltarusijos teritorijoje bei atlikti jo sezoninės mitybos analizę. Pagrindiniai tyrimo metodai buvo žvėrių pėdsakų stebėjimas ir ekskrementų tyrimas. Nustatyta, kad Baltarusijoje rudasis lokys yra paplitęs daugiausia šiauriniuose ir vidurio rytiniuose rajonuose. Šiaurės rytinėje ir vidurio rytinėje dalyse pastebėta populiacijos augimo tendencija, tuo tarpu šiaurės vakariniuose rajonuose rudųjų lokių populiacija palaipsniui mažėja. 2002–2003 m. iš viso Baltarusijoje buvo užregistruota nuo 140 iki 180 (tikėtina apie 160) individų. Ženkliai mažesnis rudųjų lokių skaičius, apie 80–100 individų, buvo užregistruotas 2005 m. Šiaurinėje Baltarusijos dalyje gyvenančio rudojo lokio mitybos analizė parodė, kad jis yra mišrios mitybos gyvūnas ir veikiau žolėdis nei mėsėdis. Vabzdžiai ir maita taip pat sudaro nemažą dalį rudojo lokio mitybos racione.

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