

Radio-tracking of Capercaillie (*Tetrao urogallus* L.) in North Belarus

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Abstract

Launching an application of the radiotelemetry method, we endeavour to determine the home range size of Capercaillies and forest structure characteristics in terms of the age and tree species composition; forest site moisture and species composition of the herbal layer preferred by capercaillies in their habitats. We conduct our investigations in the mixed coniferous forest of the northern Belarus. This area is distinguished by apparent abundance of capercaillie. Five radio-marked males of adult capercaillie *Tetrao urogallus* were tracked in the period from April 2010 to November 2011 (in total 206 locations of all males). The first obtained data show that the home range size of the longest radio-tracked male reaches 2,810.93 ha (the number of fixes $n = 141$). The range span, that was considered as a distance between two farthest points including a distance to the lek where male has been captured, is 7,877 m in the period from April 2010 to November 2011. Home ranges and range span of other four males during period from 16th May to 30th November 2011 were as follows: 1,278.6 ha (7,844 m); 206.5 ha (2,633 m); 149.4 ha (2,615 m) and 90.9 ha (1,296 m). During the whole radio tracking period, capercaillies mostly occur in the mature mixed pine and spruce and soft deciduous stands growing in the dry forest sites and in the pine stands in the overmoistured and peatland sites. All males select locations with bilberry cover in the mature forests. The longest radio-tracked male shows the largest dynamics of the home range in September and March while the least was in May – July and December – January. The single case of autumnal singing has been registered. Considering the annual natural cycles through the year, foraging habits and lifecycles of capercaillie, we have distinguished nine stages of lifecycles in the adult males of capercaillie as the ground for the further investigations.

Key words: capercaillie, radiotelemetry, home range, range span, habitat, autumnal singing.

Introduction

Capercaillie is one of the largest and most long-lived Tetraonid (Ekedahl 2005, Graf 2005) and a typical species of the boreal climax forests on a world scale. Capercaillie occurs extensively in Scandinavia, Central Europe and in the most parts of boreal Russia. During the last few decades, capercaillie number has markedly declined in the most of its range. In Europe, this species is listed in the Annex 1 of the EC Birds Directive and Appendix II of the Bern Convention as well as are included into the IUCN Red List of Threatened Species (Status Least Concern, IUCN 2009).

Capercaillie has been an object of thorough studies and publications during the latter part of the last century. In some different regions (most in the Alpine Mountains and Scandinavian countries), investigations have been done to describe his ecology and habitats within its range. Habitat loss and their degradation have been assumed to be the major causes of capercaillie decline (Storch 1994, Никифоров et al. 1996, Ekedahl 2005, Braunisch and Suchant 2007, Ludwig et al 2008, Berchtold et al. 2010, Çerus et al. 2011, Sirkiä et al. 2011, Fernández-Olalla et al. 2012) including a landscape fragmentation, cutting of the mature trees within capercaillie leks and changes in the for-

est structure, besides a human disturbance, pollution, collisions, exploitation and increase in predation impact and other factors.

The characteristic features of capercaillie habitats are the presence of coniferous trees (mainly Scots pine *Pinus sylvestris*), an open structure with moderate canopy cover and rich ground vegetation dominated by bilberry *Vaccinium myrtillus* and other dwarf shrubs. Their primarily habitat is a landscape dominated by old-growth forest, intermixed by bogs and patches of younger successional stages (Virkkala and Rajasärkkä 2006, Storch 2003, 2007a, Miettinen et al. 2008, 2009, 2010). The positive association between old or mature forests and the presence of capercaillie has been widely documented (Долбик 1974), but relatively young forests (30-40- year-old and more) also have been found to be suitable for the species (Storch 2000). However, large areas of clear-cutting reduce the quality of capercaillie habitats (Kurki et al. 2000, Miettinen et al. 2009, 2010, Pavlushchick et al. 2011).

In Belarus, capercaillie is still game species despite its number has declined significantly during the last century. The wholesale forest logging in the interwar and post-war periods has caused decrease in the area of premature and mature stands from almost 27% of the total forest area in 1930 up to 10% in the post-war time and more (up to 2-3% in the certain districts) in 1990. During 1960-1970's nationwide drainage programme was launched in Belarus. Large wetland areas were transformed into arable lands and commercial forest stands. Many areas under important food plants of capercaillie (e.g. cranberry and cotton-grass) have disappeared at once. Destruction of capercaillie habitats due to the large-scale clearcutting of old-growth and mature pine forests was the main reason for the population decline 3 times on average (from 1.5 indv/1,000 ha to 0.6 indv/1,000ha) after 1960th (Никифоров et al. 1996, Pavlushchick et al. 2011). As monitoring results have shown, in the last decades, capercaillie number has stabilized partly because of the mass afforestation has been performed. The same authors suppose that post-war reforestation has positively affected capercaillie number as artificially regenerated forests average 40 years in age and more.

Investigation on capercaillie lekking areas were performed in the southern Belarus before two decades. Correlation analysis from the data of this investigation has shown that in the lekking area, the wet pine stands are predominated and the total abundance of capercaillie micro population directly depends on the area under bogs and mature deciduous stands. On the ground of performed winter and summer transect survey, authors indicate that most of the individuals have been found in the *Pinetum sphagnosum*, *P. myrtillo-*

sum and *P. vaccinio-myrtillosum*, and least number in the pine plantations (Никифоров et al. 1996).

In the present study using radio tracking method, we aimed to investigate: 1) the home range size of capercaillie and 2) which forest structure characteristics in terms of the age and tree species composition; moisture of forest sites and herbal species composition are preferred by capercaillies in their habitats in northern Belarus. We hope that results obtained from this study will help to improve the species investigation level over the region and usefulness implementing capercaillie conservation measures.

Material and methods

Study area

We have performed our study on the area situated in the Rasony district of Vitebsk Region, Upstate Belarus (56°00' N, 28°30' E) (Figure 1). The territory belongs to the zone of temperate continental climate. The average annual temperature is +4.9°C, the snow cover depth is 30 cm, the mean precipitation reaches 580mm (430 mm in the warm period), and the radiation balance is 1,500 MJ/m². The average altitude is 130-190 m. Terrain is mostly flat or partly undulating. The dominated forest soils are Turfy Podsoles (52.48%), Fibric Histosols (39.45%) and Podsoles (2.45%). All forests are state-owned in Belarus including 1st group forests (i.e. forests of the environmental protection function). The total forest cover comprises 66.8%. Coniferous species predominate (53%) in forests including the main species pine (39%) and spruce (12%).



Figure 1. Study area in the European Forest Map (Gerashimov et al. 2010)

Deciduous tree species comprise 47% including birch (31%), aspen (9%) and alder (9%). All forests are divided into age groups as young forests (19.7%), middle-aged (47.2%), premature (24.8%) and mature and old-growth forests (9.3%). Pine stands prevail in the *Pinetum pleuroziosum* (42%), *Pinetum ledosum* and *Pinetum caricoso-sphagnosum*, *Vaccinia uliginosi-Pinetum* (8-11%) on the dry (75%) and wet (25%) forest sites (Проект організації і ведення... 2006).

On the investigated area of forests in the Vitebsk region, capercaillie abundance has been considered as the one of the largest in Belarus (1.8 bird/1,000 ha of the forest area) during the mid- and in the second half of the 20th century (Никифоров et al. 1996).

Marking and locating of birds

In spring, birds were captured at the lekking site using fishing nets. We have caught single male #303 on 23rd April 2010 and four males on 20-26th April 2011. Birds were equipped with radio-collar transmitters (model TW-3, necklace – type, 22 g weight) with a battery life of 2.3 years. We have named the points of capturing within the lekking site as the “main“ lekking sites. The transmitters were completely hidden beneath the bird plumage and did not affect bird behaviour notably. We used the Telonics TR-4 portable receiver with a 3-element Yagi antenna for positional tracking. If the occasion arises, we make from one to three locations per month identifying the precise location of the bird. Its position was determined by GPS Garmin device marking UTM coordinates. Periodically, we have tried to locate the birds visually checking their condition. Considering measurements of the bird nib (Moss 1987), four males were attributed to adults and #263 to the age-group of sub-adults.

Data collection

To determine the home range size we have used the RANGESV software for data processing. In order to assess a habitat selection and spacing of capercaillies, we have defined a home range as the total area attended by an individual calculating as 100% convex-polygons.

For the analysis of forest structure, we registered habitat parameters within a radius of 50 metres from all points of the location assessing forest sites visually as dry or wet, determining species composition of forest layers including forest canopy as coniferous (pine and/or spruce) or deciduous (aspen and/or birch), understory, undergrowth and dwarf shrubs. We have divided stands by their species composition grouping them into pure and mixed pine and spruce stands, coniferous and soft-deciduous stands. In the soft deciduous stands, aspen and birch are dominant spe-

cies. The ecotones were described finding birds in the space between two different communities as a cutting area and forest stand or forest and a bog or fen. All forests are divided into four age-groups based on species maturity age i.e. for pine ≥101, spruce ≥71, birch ≥61 and aspen ≥41 years: 1) forests younger than 10-year-old and recently felled areas considered as a clear-cut area, 2) forests from 11-year-old to the half of their technical maturity age considered as young-growth forests, 3) forests from half of the technical maturity to their technical maturity age considered as middle-aged, and 4) older forests as mature forests (Deltuvas 2008). The stand layers were identified by the main species. The ground layer was determined depending on the bird presence on the ground.

Results

During the period from April 2010 to November 2011, we have recorded 206 locations of all five males in the total (Table 1). The male #303 was located in April 2010 – March 2011 (120 locations) and until November 2011. The male #286 has lost its transmitter in August 2011.

Table 1. Number of locations of radio-tagged birds

Month	Study years						In TOTAL
	2010		2011				
	#303	#303	#336	#217	#263	#286	
April	12	5	2	3	1	2	25
May-July	8	8	5	7	11	9	48
August	9	3	2	3	2	3	22
September	37	0	2	1	3	-	43
October-November	23	6	2	3	3	-	37
December- March	31	-	-	-	-	-	31
In Total	120	22	13	17	20	14	206

Investigation of the home range size and bird movement

In the one-year-period from 10th May 2010 to 15th May 2011, the total home range size of male #303 was 2,810.93 ha (100% minimum convex polygon, the total number of fixes n=141). In the period from April 2010 to November 2011 the range span as a distance between two farthest fixes was 7,877 m. During all seasons of the period 2010-2011, the home range dynamics of this male was considerable.

We assume that the male moving activity and distances depend on the character of bird living periods and feeding conditions including the vegetation of feeding plants (Figure 2). The largest home range size was in September. In this time the individual has changed its plumage. It was mostly observed in the

tops of aspen crowns like in March during bird moving between two other detected lekking sites. In April, capercaillie comes back to the lekking site where the bird was captured in 2010. The least home range size was determined in mid-May - June directly following the breeding time when birds change their plumage and move entirely along the ground. Considering these features, we distinguish the nine stages of life cycle in the adult male as follows:

1st period between 16th May and 31st July. Capercaillie leaves the lekking site and retreats to the mixed forest stands with aspen in the upper layer; it starts **changing out the feathers**, feeds on bilberry and uses smaller home range;

2nd period – from 01st August to 31st August. The bird finishes replacing its primary feathers, feeds on the ripe berries of bilberry and cowberry; the daily activity and home range **is increasing**;

3rd period – from 01st September to 30th September. Capercaillie **feeds on the aspen leaves** after bilberry berries have finished; the daily activity and home range size are largest of all year;

4th period – from 01st October to 31st October. Capercaillie **feeds on pine needles** after aspen leaves have fallen; the home-range size decreases; display of the **autumnal singing (autumnal mating time)**;

5th period – from 01st November to 30th November. „**Primary-snowy period**“. In the absence of snow cov-

er, capercaillie still has possibility to feed on the ground; the home-range size decreases much more.

6-7th periods – from 01st December to 28th February. **Feeding on pine needles**; minimum movement and home range.

8th period – from 01st March to 05th April. **Pre-lekking period**. The male move between of few existing leks at large distance; display of the periodic wing scratching in the snow leaving imprints of wing feathers.

9th period – from 06th April to 15th May. Capercaillie comes back into the main lekking site; **mating**; the bird moves short distance from the lekking site.

All radio-tagged males left the lekking-place shortly after mating period in the beginning of May. In the period from 16th May to 30th November 2011, home ranges of all five males were largely exclusive. Home ranges of only two males were least overlapped at different distances from the main lekking-sites (Figure 3). Males #303 and #336 were the most distant from the main lekking site where birds were captured, as 7,877 m and 7,844 m, respectively. The most part of home range of male #336 was beyond the large homogeneous sphagnum-dominated bog with rare pines on the territory of neighbouring Russia.

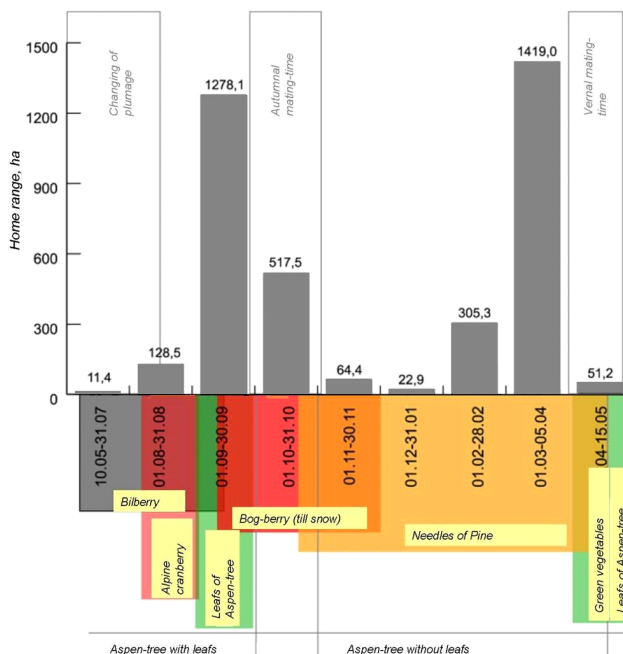


Figure 2. Seasonal dynamics of the capercaillie (male #303) home-range size depending on the living period and foraging character of the bird

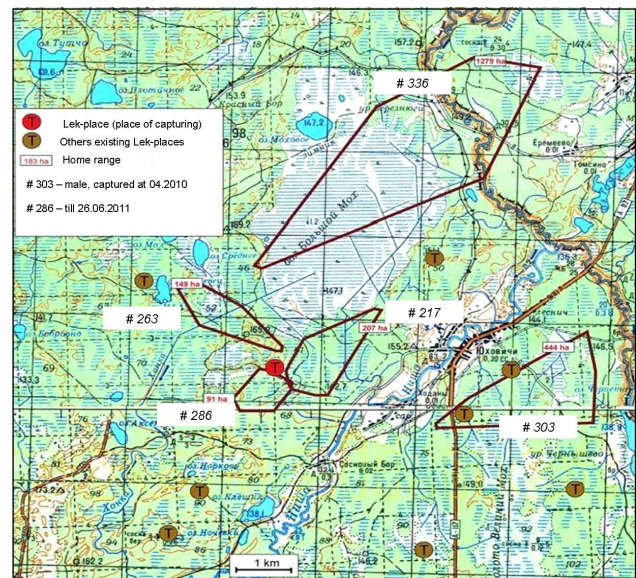


Figure 3. Home range of the five radio-tagged capercaillie males in the period from 16th May to 30th November

Investigation of habitat use

In the period from 16th May to 30th November (the I-V stages, 233 fixes in the total), all males were most located in the dry forest sites of the mature mixed stands of pine and spruce and of spruce with soft-leaved deciduous species. Capercaillies preferred the latter stands because of feeding on aspen leaves in

the upper layer of crown. Birds sparsely occurred in the mature spruce stands without aspen and in the middle-aged mixed stands of spruce with soft-leaved deciduous species (Figure 4).

cies (e.g. Wildlife Radio-telemetry...1998). Nevertheless, the radiotelemetry becomes the usual method in wildlife study and much more studies have highlighted an importance of monitoring, simulation, modelling

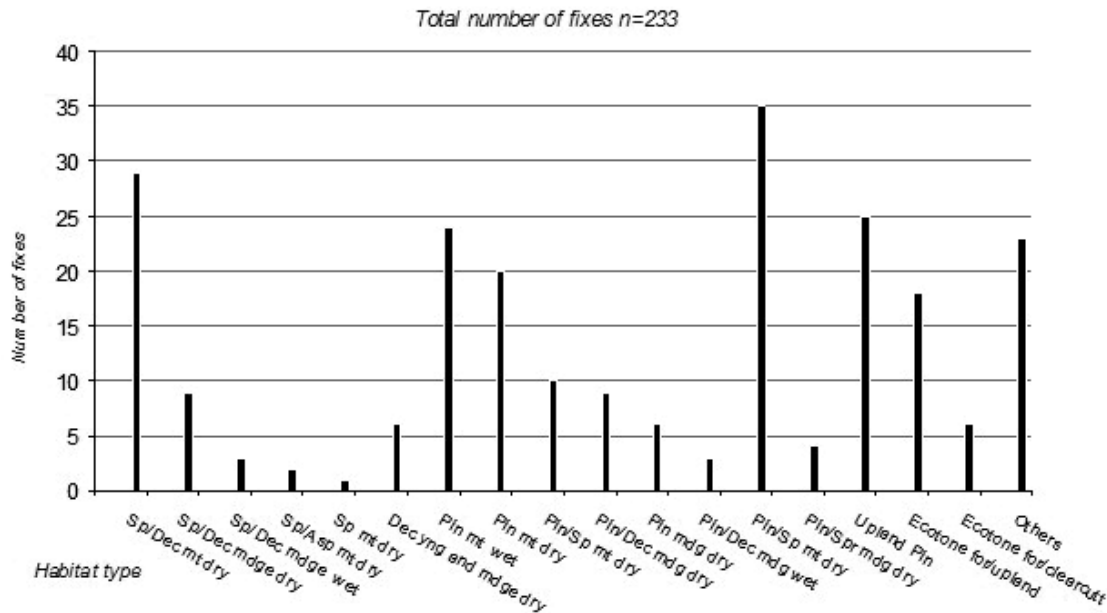


Figure 4. Habitat use by radio-tagged males during the period from 16th May to 30th November. Notation of tree species: Pin- Pine; Sp- Spruce; Bi- Birch; Asp- Aspen; Dec- Deciduous; Notation of forest ('for') age- groups: mt- mature; mdg- middle-aged; yng- young

The most time birds have spent in the tree crown (near 60% of the total number of locations, n=186) selecting pine (50%) and aspen (18%), only in few cases it as spruce and in 28% cases tree species were unidentified.

In the period from 16th May to 30th November all five radio-tagged males preferred patches with rich cover of *Vaccinium myrtillus* within home range. This feature was best represented in the mature forests (Figure 5).

Discussion and conclusions

The aim of this paper is to describe our first results using the radiotelemetry method for radio tracking of endangered bird species as capercaillie. We present this preliminary acquired information seeking to share our experience.

An opposition could indicate that despite its popularity and frequency of use, radiotelemetry is not panacea and could be treated as inappropriate under many circumstances as it is an expensive and time-consuming technique, less data obtained about method effects on the behaviour and survivorship of spe-

and radiotelemetry studying daytime cycles, habitat preferences and survival of capercaillie, their nests and broods (Wege and Larsen 1987, Storch 1994, 1997b, 2002, Finne et al. 2000, Gjerde et al. 2000, Graf et al. 2004, Fernñdez-Olalla et al. 2012, et al). It is obvious today that advances in the field of capercaillie radiotelemetry have made it possible to acquire detailed data on many aspects of bird ecology, including habitat use, home range size, mortality and survivorship, migration timing and routes.

Our study has revealed an importance of the mature forests for capercaillie. Over the whole study period capercaillies prefer dry sites in the mature mixed pine with spruce and spruce with soft deciduous stands, and overmoistured and peatland sites in the pine stands. Capercaillie preference of mature stands was indicated in other publications (Mykrä et al. 2000, Summers et al. 2004, Virkkala and Rajasärkkä 2006, Miettinen et al. 2008) underlining the forest composition and structure (Hjorth 1985, Bollmann et al. 2005, Gustafsson 2008, et al.). Surely, middle-aged forests of 30–40-year-old and more can also be suitable as capercaillie habitats but suitability is not permanent (Miettinen et al. 2010).

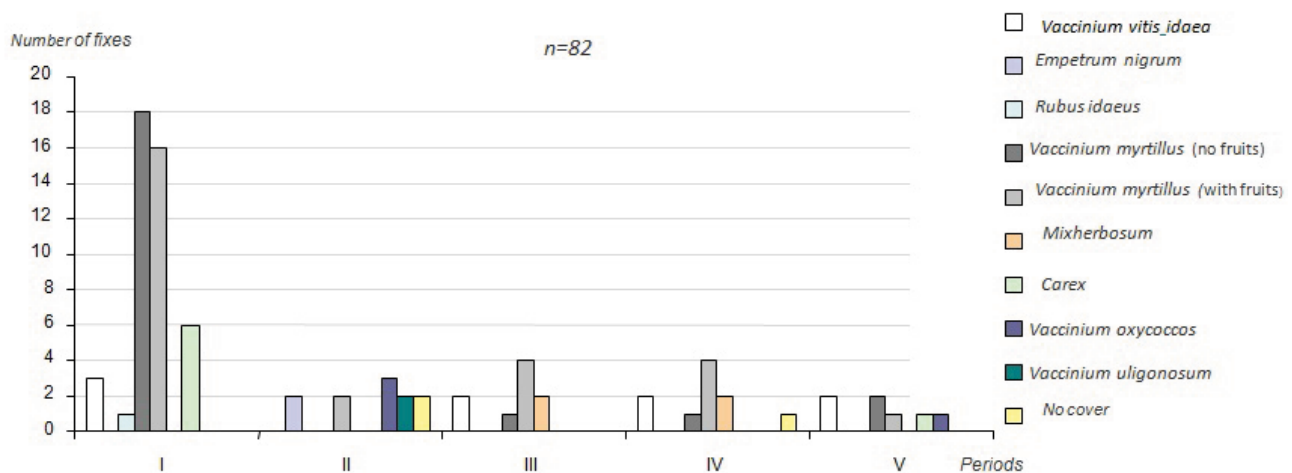


Figure 5. Ground cover by plants species in capercaillie habitats

The data from investigations on capercaillie male movements show that birds change their habitats seasonally from pine-dominated stands in winter and spring to their summer range of mature spruce-dominated forests (Rolstad et al. 1988, Helle et al. 1990, Storch 1995, Beshkarev et al. 1995, Hjeljord et al. 2000). If pine stands are scarce, capercaillie lekking sites could be found in the spruce forests (Hjeljord et al. 2000); however, some works show that lekking site originate from the winter habitat and pine needles are the main food for capercaillie in winter; therefore, birds select pine or mixed pine stands avoiding homogenous spruce stands (Gjerde and Wegge 1989, Hjeljord et al. 2000). In autumn, we indicate capercaillie feeding not only on bilberry berries but also on aspen leaves. This fact explains capercaillie selection of mixed stands with broadleaved species in our study. Some publications also refer to the importance of mixed pine stands for capercaillie as spruce and birch (e.g. Helle et al. 1990, Pulliainen and Tunkkari 1991) or aspen *Populus tremula* (Rolstad 1988). Summers et al. (2004) have noted that broadleaved species might benefit capercaillie providing summer food.

In our study, the important criterion for habitat selection was *Vaccinium myrtillus* cover in the mature forests. It is well known fact indicated in many capercaillie investigations (Storch 1993, Selås 2000, Baines et al. 2004, Summers et al. 2004, Alldredge and Griswold 2006, Miettinen et al. 2010) and Baines (2004) underlined that increase in bilberry cover related to capercaillie breeding success. It is obvious that food quality and sufficiency are the key factor influencing survival and existence not only in capercaillie but also other wildlife populations.

Over the one year and seven months (from April 2010 to November 2011 including lekking season and wintering), the largest dynamics in home range size

was in September and March and the least changes are in May – July and December – January. In the mentioned long period the home range size of capercaillie male reaches 2,810.93 hectares and the range span was 7.88 km. Over the shorter period of seven months (from April to November), the home ranges and ranges span were less and fluctuated from 90.9 to 1,278 ha (av 431.35 ha) and 1,296 - 7,844 m (av 3,597 m). Some authors have observed that the distance between the lekking sites could reach 1.0 – 4.2 km (Gustafsson 2008), and each male comes away from the lekking site in the same direction from which it has come back; however, two males never come away or come back in the same direction (Hjorth 1985). Wege and Larsen (1987) noticed that in spring, males do not move away from the lekking site more than 1 km; however, capercaillie home ranges could extend more than 2 km from the lekking site and males use this area all the year round (Hjorth 1985, Wege and Larsen 1987). Wege and Larsen (1987) argued that males hold day territories close to the lekking site but sufficiently distant avoiding intruders. It corresponds with the classic characteristics of the temporal communities as capercaillie leks (Belova 2001).

The nine stages of lifecycle in the adult male of capercaillie would be the ground for further continuous investigations and modelling considering bird annual natural cycle, foraging habits and lifecycle.

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РАДИОТЕЛЕМЕТРИЧЕСКИЕ ИССЛЕДОВАНИЯ ГЛУХАРЯ (*TETRAO UROGALLUS* L.) В СЕВЕРНОЙ БЕЛАРУСИ

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Резюме

Исследование направлено на определение методом радиотелеметрии размера диапазона территории глухаря и характеристики структуры леса, с учетом возрастного и породного состава древостоя, увлажнённости местопроизрастания, которым глухари отдают предпочтение в местах своего обитания. Исследования проведены в смешанных хвойных лесах северной Беларуси. Район выделяется обилием глухаря. Регистрация 5 помеченных радиопередатчиками взрослых самцов глухаря *Tetrao urogallus* была проведена в период с апреля 2010 по ноябрь 2011 года (в общей сложности 206 местоположений всех самцов). Первые полученные данные показали, что размер диапазона территории наиболее длительно отслеживаемого самца достигает 2 810,93 га (количество принимаемых радиосигналов $n = 141$). В период с апреля 2010 по ноябрь 2011 года диапазон, рассматриваемый как расстояние между двумя наиболее удалёнными точками, в том числе расстояние до точки отлова самца, составляет 7 877 м. Диапазон территории и диапазон измерений других четырех самцов в период с 16 мая по 30 ноября 2011 г. соответственно были следующие: 1 278,6 тыс. га (7 844 м); 206,5 га (2 633 м); 149,4 га (2 615 м) и 90,9 га (1 296 м). В течение всего периода радиослеживания, глухарь наиболее часто обнаруживался в зрелых смешанных сосново-еловых и елово-мягколиственных древостоях, растущих в сухих местопроизрастаниях, а в сосняках – на переувлажнённых и торфяных местопроизрастаниях. Все самцы выбирают места в зрелых лесах с черничным покровом. У наиболее долго отслеживаемого самца была самая высокая динамика территории обитания в сентябре и марте, в то время как наименьшая была в мае - июле и декабре - январе. Был зарегистрирован один случай осеннего пения. Учитывая годовые природные циклы, трофические особенности и жизненные циклы глухаря, выделены 9 этапов жизненного цикла взрослых самцов глухарей, что является основой для дальнейших исследований.

Ключевые слова: глухарь, радиотелеметрия, диапазон территории, диапазон измерений, среда обитания, осеннее пение, этапы жизненного цикла