1. Introduction

For more than 100 years, the number of Capercaillies has decreased systematically across Europe, a process which has been coupled with habitat fragmentation/decline, fragmentation of area of occurrence, and extinction of local, isolated populations (STORCH 2007). The Capercaillie is a receding species in Poland and its population density has dropped to a critical level, making it impossible for the population to function properly. At the beginning of the twentieth century there were just some 2,500 Capercaillies living in Poland (DOMANIEWSKI 1933). In the 1970s, numbers started to decline dramatically and ranged between 700 and 1,350 individuals. In the subsequent years, all populations decreased in number and territorial ranges, particularly in the lowlands (GŁOWACIŃSKI & PROFUS 2001). In the late 1990s, the national population was only c. 500-600 birds (KELLER 2001), and recently an estimated 380-500 individuals are living in four isolated populations in the Western Carpathians, the Solska Primeval Forest and Lasy Janowskie Forest, the Augustowska Primeval Forest, and the Bory Dolnośląskie Forest (Fig. 1; ŻUREK & ARMATYS 2011). In the late 1960s, 360 birds inhabited the Bory Dolnośląskie Forest (BUŁA 1969), at the end of 1970s, the population collapsed, and only 200-270 birds were recorded (GŁOWACIŃSKI & PROFUS 2001). In 2000, 11 active breeding refuges of Capercaillies were known in the following Forest Districts: Ruszów, Pieńsk, Węgliniec, Bolesławiec, Świętoszów, and Żagań (KELLER 2001). In 2006, the inventory taken in the Bory Dolnośląskie Forest recorded only 18 Capercaillies (MERTA et al. 2008), whereas in 2009 there were only two accidental observations of a female (J. KOBIELSKI pers. comm.). Genetic studies performed in 2003 showed a statistically significant surplus of


In order to re-establish Capercaillie population in the Bory Dolnośląskie Forest, 78 young Capercaillies (45 cocks and 33 hens) from Polish breeding farms were released between 2009 and 2012 in the Ruszów Forest District. The Capercaillies from Kadzidłowc were reared by a ‘born to be free’ method. They were brought to the place of release together with their mothers. The mother was kept in a permanently closed aviary and remained there until the time of natural dispersion of the young. The adaptation of released birds was carried out in a special area (18 ha) where the Capercaillies were protected from terrestrial predators. More than 60 % of young Capercaillies were fitted with telemetric transmitters. The combined activity range of Capercaillies released in 2009-2011 (n = 33) assessed by the MCP method was 45,360 ha (females: 42,485 ha, males: 16,585 ha), and together with data from observations 91,196 ha. The activity range of Capercaillies from Kadzidłowc amounted to 20,723 ha while for the birds from the Wiśla breeding centre it was twice as large (41,834 ha). The average size of activity ranges calculated for 33 birds released during 2009-2011 was 3,918 ha. 85 % of the birds survived the first four weeks after release, including 93 % of cocks, and 75 % of hens, while the survival of Capercaillies bred using the ‘born to be free’ method was 100 %. In the first year after release, the average survival was 165 days (median 107 days). It was longer for birds reared by the ‘born to be free’ method (average 227 days; median 139 days). In both groups, the cocks survived better (average 225 days; median 186 days) then the females (average 91 days; median 74 days). The main cause of death was predation (76 %). The most important predator was the Northern Goshawk (56 %), in particular for the hens (78 %). Martens (Martes spp.) were the most important predators killing Capercaillie cocks (43 %). The key measures include permanent monitoring and reduction of predation pressure in an area of c. 90,000 ha. Additionally, measures improving the quality of habitat and environmental education campaigns were carried out.

Key words: Capercaillie Tetrao urogallus, captive breeding, ‘born to be free method’, home range, survival, predation, habitat quality improvement.
The most important protection measures undertaken in Poland include (1) the monitoring of the Capercaillie population size and the range of its occurrence; (2) habitat quality monitoring from the viewpoint of habitat requirements by Capercaillies and the active protection of its habitats; (3) reducing the numbers of predatory mammals, particularly Red Fox *Vulpes vulpes* whose numbers in Poland have quadrupled (chiefly as a result of providing vaccine against rabies); (4) reducing the anthropogenic pressure, and (5) providing environmental education for the public (Głowaciński & Profus 2001, Keller 2001, Dziedzic et al. 2004, Zawadzka & Zawadzki 2003, 2006, Merta et al. 2007). The effects of these measures are not sufficient as despite the stemming of local regression, none of the Capercaillie populations in Poland have been successfully rebuild. In recent years, efforts have been made at restitutuion of the species using birds from Polish breeding centres. At present, there are three Capercaillie breeding centres, i.e. the Breeding Centre of Forest Grouse at the Wild Animal Park in Kadzidlowo and the Capercaillie Breeding Centres of the State Forests in the Wisła and Leżajsk Forest Districts (Dziedzic et al. 2008, Krzywiński & Kobus 2009). The objective of this paper is to present preliminary results of the restitution of the Capercaillie population in the Bory Dolnośląskie Forest in SW Poland.

### 2. Study area

The Ruszów Forest district is situated in the western part of the Lower Silesia Forest, a continuous lowland (140-180 m a.s.l.) forest area covering 2,500 km². The average annual temperature is 8.3°C, the average annual precipitation is 550 mm, and there are only approximately 40 days with snow cover (Kondracki 2002). The area of administrative jurisdiction of the Ruszów Forest District covers 18,900 ha of which 17,800 ha (96%) are forests. This area is sparsely populated (c. 2,500 inhabitants within the jurisdiction of the forest district) with low-intensity agriculture (Bena 2005).

The principal forest tree species is the Scots Pine *Pinus sylvestris*, occupying 93% of the forest area (Kobiełski et al. 2007). Among forest habitat types, fresh coniferous forests of the Leucobryo-Pinetum association predominate, where apart from the Scots Pine, birch (*Betula* spp.), and the Common Oak *Quercus robur* occur, whereas in the forest ground vegetation, Bilberries *Vaccinium myrtillus*, Mountain Cranberries *Vaccinium vitis-idaea*, Common Hairgrass *Deschampsia flexuosa* and Heather *Calluna vulgaris* commonly occur. On sandy areas with higher groundwater levels, the moist pine forest (*Molinio-Pinetum association*) occurs, where Purple Moor-Grass *Molinia caerulea* and Bilberry predominate in the forest ground vegetation. In the more moist areas, bog coniferous forests (*Vaccino-Pinetum association*) with wild Rosemary *Ledum palustre*, Bog Bilberry *Vaccinium uliginosum* and Swamp Cranberry *Oxyccoccus palustris* occur. The alder swamp forests and riparian forests occur only in the river valleys of the Lusatian Neisse, Czerna Mala, and Czerna Wielka rivers (Bena 2005). In conclusion, it can be said that in the habitat structure of the forest the coniferous forest habitats predominate as they cover approx. 94% of the area, of which moist habitats (moist mixed coniferous forest, moist coniferous forest) occupy c. 48% of the area (Kobiełski et al. 2007). The potential predators of Capercaillies in the study area include Red Foxes, Pine Martens *Martes martes*, Raccoon Dogs *Nyctereutes procyonoides*, Raccoons *Procyon lotor* and Northern Goshawks *Accipiter gentilis*.
In 2010–2011, within two historical Capercaillie refuges in the Ruszów Forest District (Głuszec refuge and Dzików refuge) with a combined area of c. 1,800 hectares, a detailed analysis of the habitat quality was performed with the use of the Habitat Suitability Index (HSI, Storch 2002), and some measures aimed at its improvement were suggested. Both in annual and winter time perspectives, these two refuges obtained fair assessments whereas in summer the habitat within the Głuszec refuge was assessed as good (HSI = 0.76), and in the Dzików refuge as fair (HSI = 0.60). The factors primarily bringing down the HSI were the canopy closure in the stand, and the proportions of undergrowth and ground vegetation. Implementing the proposed measures will result in obtaining habitats in both refuges which could be assessed as ‘good’ (HSI range: 0.64-0.80) (Kaszuba 2012).

3. Methods

In 2009–2012, within the Ruszów Forest District 78 young Capercaillies (45 cocks and 33 hens) from the Breeding Centre of Forest Grouse in Kadziółowo (31 birds of the Belarus–Janów, Belarus–Augustów, and Belarus–Augustów–Janów lines), and from the Capercaillie Breeding Centre of the State Forests in the Wisła Forest District (47 birds of the Belarus line) were released. From each bird, samples of feathers were collected for genetic studies, as well as material for veterinary studies (faeces from disposable transportation containers, and smears from the cloaca, beak, and trachea). Each Capercaillie received a ring with an individual number. All birds from the same hatching had rings of the same colour.

In one of the longest active display ground of Capercaillies in the Ruszów Forest District, an acclimatization plot (c. 18 ha) was established at the border of a 3 ha clear cutting area surrounded by pine forests of the IVth, Vth, and VIth age classes, with low amount of pine undergrowth, growing on moist mixed coniferous and moist coniferous forest habitats. Bilberries and Cranberries predominate in the ground layer (with coverage of c. 80%). In order to protect them from terrestrial predators, the entire adaptation plot was surrounded by fladry lines, and its central part (c. 4 ha) by three rows of electric fence and by a line of fladry. Additionally, acoustic repellents were applied (automatic change of acoustic signal and audio frequency) as well as ultrasound repellents. Barriers were installed on all access roads to the plot, as well as ‘no entry’ and warning notice boards. In order to minimize the risk of an epizootic associated with the prolonged presence of birds in the same place, the location of the adaptation plot against predation pressure was carried out (starting first with fladry lines and later the electric fence) and the aviaries were surrounded with three electric fences and fladry lines within a 20 m radius. Additional supplemental feeding continued to be offered inside the aviaries in form of dried and frozen fruits of Rowan, Bilberry, and Cranberry. At the beginning of winter, after the period of natural dispersion of young Capercaillies, the hens (mothers) were brought back to the breeding centre in Kadziółowo. The Capercaillies from the breeding centre in the Wisła Forest District, having been brought to the adaptation plot, were placed in aviaries, and after a dozen or so days of acclimatization to local conditions released into the wild (Merta et al. 2011a).

In 2009–2012, 47 young Capercaillies were fitted with telemetric transmitters with activity and mortality sensors (if a bird did not move for 12 hours, a mortality signal was activated). In 2009, these collars (Biotrack Ltd.) were placed on the bird’s neck, weighing 22 g each. In 2010-2012 ‘back-pack’ transmitters were used (Sirtrack Ltd., Biotrack Ltd.), weighing 33 g each. With 1-3 day intervals, all individuals were located using either the triangulation method or direct observation. The size of the activity range was calculated for birds released during 2009-2011 (n = 33) as 100% minimum convex polygons (MCP). In 2009-2011, apart from these actions, each individual with a telemetric transmitter was observed from the time it woke up to the time it fell asleep on a roosting tree (147 bird-days, data still being analysed). Survival was calculated for birds released during 2009-2011 (n = 27) as an arithmetic mean of the days survived by all birds within the first year after release, and the median survival duration was also given. The calculations did not include the six birds which lost their transmitters nor those with which contact was lost (most probably resulting from either a very long-range migration or a transmitter malfunction).

The maps for direct observations of Capercaillies and the signs of their presence were distributed among employees of the Ruszów Forest District and neighbouring forest districts, as well as among members of hunting clubs. So far, over 250 accidental sightings of birds have been recorded (including information from Germany supported by photographs). The data obtained from telemetric and traditional monitoring activities provide information on the daily and seasonal activity of Capercaillies, their activity ranges, migration distances, habitat preferences as well as the scope and reasons of mortality among the released birds. As the useful life of the batteries of telemetric transmitters lasts some for several days. After that the birds were able to enter or leave the aviary at any time. During the first three months, the Capercaillies were regularly given supplementary fodder but the frequency and provision and amounts of fodder were systematically decreased. The fodder included leaves of Raspberry _Rubus_ spp. and Dandelion _Taraxacum officinale_, Bilberry and Cranberry fruits, Heather, Rowan _Sorbus aucuparia_ and Cranberry fruits, and later in the season frozen and dried fruits of Bilberry, Chokeberry _Aronia arbutifolia_, Cranberry and Rowan. Photographic cameras, triggered by movement sensors, were set up both inside and outside the aviaries so that photographic records allowed finding if and when the birds appeared in the aviary. After some three months from the date of the release, the wire was removed from the ceiling parts of the aviaries where young birds were kept (thus the Capercaillies could fly directly into the aviary). In November, the gradual dismantling of devices protecting the acclimatization plot against predation pressure was carried out (starting first with fladry lines and later the electric fence) and the signs of their presence were distributed among employees of the Ruszów Forest District, as well as among members of hunting clubs. So far, over 250 accidental sightings of birds have been recorded (including information from Germany supported by photographs). The data obtained from telemetric and traditional monitoring activities provide information on the daily and seasonal activity of Capercaillies, their activity ranges, migration distances, habitat preferences as well as the scope and reasons of mortality among the released birds. As the useful life of the batteries of telemetric transmitters lasts some.
3.5 years, it will be possible to obtain information about the birds entering reproduction and the hatching success of the released birds. The results of the monitoring will give the possibility to assess the effectiveness of the programme and allow necessary corrections in the subsequent years of restitution as well as introducing suitable corrections of the directions of protection measures associated with the improvements in habitat quality for Capercaillies. 

One of the key activities in the programme of restitution of the Capercaillie population in the Ruszów Forest District is permanent monitoring (winter tracking on transects, inventorying burrows) and – since 2008 – the reduction of predatory mammals (Foxes, Raccoon Dogs, Martens, Raccoons) by traditional hunts, hunts using trained hunting dogs capable of going into burrows as well as catching the predators in live-traps. Since 2009, financial rewards have been introduced for the documented hunting of these mammals, and since February 2013 the reduction of mammalian predators has been extended over an area of c. 90,000 ha. Additionally, for many years, the Ruszów Forest District has carried out a number of measures aimed at improving the quality of habitat considered from the viewpoint of habitat requirements of Capercaillies. The most important among such measures include: (1) increasing the moisture levels in the area by constructing small water retention facilities; (2) adapting the forest stand structure to the requirements of Capercaillies i.e. reducing canopy closure, removing excessive amounts of undergrowth and ground vegetation, avoidance of planting new trees in the gaps made in forest stands by natural phenomena (e.g. hurricane-type winds); and (3) improving hiding and feeding conditions of Capercaillies by e.g. seeding or planting spruces (which is particularly important for hens building nests) and by rejuvenating old, poorly productive bilberry patches by selective cutting. Other protection measures which should be mentioned include the removal of neophytes, particularly a strongly expansive species of hardhack (Spiraea tomentosa), replacing dangerous road surfaces by local all-in aggregate, as well as by providing gravel at some sites (the necessary source of gastrolithes); making wire-netting around plantations visible by sticking branches into it as well as reducing anthropogenic pressure. Also implemented is a broadly-designed environmental education campaign (educational path „Following Capercaillie tracks“, printing educational folders, classes with children and young people) aimed at increasing environmental awareness among the local population and tourists, as well as developing social acceptance for the implemented programme leading to the restitution of the Capercaillie population in the Bory Dolnośląskie Forest.

4. Results

During the first three weeks after release, the birds reared by the ‘born to be free’ method were observed within 150-200 m from the aviary. Over time they started to migrate over increasing distances. The strong social contact of young birds to their mothers was also observed. In the initial stage of the project the adult Capercaillie hens often called the young with a specific sound, the latter responded with long wailing signals. Towards the evening, the young Capercaillies appeared near the aviary where the mother was kept and from there they flew out to the nocturnal roosting trees, and again flew in from these trees near the aviaries. This kind of behaviour was observed until late October when the natural dispersion of young birds occurred. The Capercaillies from the Wisła breeding centre showed much greater timidity and kept at a greater distance from people. Most of them flew out of the adaptation plot immediately after release, therefore we have only scarce information about the behaviour of this group of birds in the initial period after their release. The telemetric data indicate considerable daily movements (even as much as 10 km in a straight line) particularly in the first two months after release. In 2009-2011, the average size of the activity range of Capercaillies bred using the ‘born to be free’ method in the first ten days after release was 6.9 ha while in the group of birds from the breeding centre in Wisła it amounted to as much as 811.9 ha. In this period, the respective average daily movement in straight lines, in the compared groups of birds released in 2010 were 0.19 km and 1.29 km (Merta et al. 2011b). Up to now the maximum distance covered from the point of release was 43 km in a straight line (a cock from Breeding Centre of the State Forests in the Wisła Forest District). On the basis of telemetric measurements and direct observations, it was found that after several weeks of long-distance autumn migrations, young Capercaillies returned to the vicinity of the adaptation plot, but this kind of behaviour was displayed much more often by the birds from Kadzidłowo. The activity range of all Capercaillies fitted with transmitters assessed by the MCP method using telemetric measurements was 45,360 ha (females: 42,485 ha, males: 16,585 ha), and after taking into account the data from observation records MCP was 91,196 ha, in the area covering, apart from the Ruszów Forest district, portions of the following forest districts: Bolesławiec, Pieńś, Świętoszów, Węgliniec, Wymiarki, and Zagań. The combined activity range of Capercaillies from Kadzidłowo amounted to 20,723 ha while for the birds from the Wisła breeding centre it was twice as large (41,834 ha). The sizes of activity ranges calculated for 33 birds released during 2009-2011 were highly variable. The average range was 3,918 ha. Among birds from both breeding centres, hens were more liable to disperse. The average activity ranges in Capercaillie cocks and hens obtained from the Wisła breeding centre were larger than in comparable groups of birds bred with the ‘born to be free’ method and amounted to 3,454 ha vs. 2,490 ha for cocks, and 6,170 ha vs. 4,575 for hens. The maximum range of activity among hens was 27,337 ha and among cocks 8,970 ha (birds from the Wisła breeding centre), whereas minimum values were 127 ha and 19 ha (birds from Kadzidłowo breeding centre), respectively. In 30 % of the birds the average size of the activity range was less than 1,000 ha. During winter time, Capercaillies were significantly less mobile. Some of the birds stayed near the release site, regularly feeding on diet offered there (dried and
frozen fruits of Rowan, Bilberry and Cranberry). The next period of intensive migration coincided with the spring months, particularly March and April.

Some 85% of the birds (n = 27) survived the first four weeks after release, a critical period in the restitution programme, with survival rates of 93% in males (n = 15) and 75% in females (n = 12). Within this period, the survivability of Capercaillies bred using the ‘born to be free’ method was 100% while in the birds from the Wisła breeding centre it was 67%. In the first year after release, the average survival time of the Capercaillies released in 2009-2012 with telemetric transmitters (n = 27) was 165 days (median survival duration: 107 days) and the Capercaillies bred using the ‘born to be free’ method (n = 15) had a longer survival time of 227 days (median survival duration: 139 days).

In both groups, the cocks (n = 15) survived better (225 days in the first year after release, median survival duration: 186 days) then the hens (n = 12; 91 days in the first year after release, median survival duration: 74 days). Major differences in the survival duration were noticed in the subsequent years of the programme, e.g. birds released in the year 2010 (n = 9) survived on average 230 days, whereas the average in those released in 2011 (n = 15) was 120 days.

Before the end of August 2012 21 dead birds with transmitters were found. In two cases the examination of place and remains did not allow the unambiguous identification of the cause of death. Main cause of death was predation (76%, 16 birds), the remaining reasons included diseases or random incidents. The most important predator killing Capercaillie was the Northern Goshawk (56%, nine birds), with its prey constituting as many as 78% (seven birds) of hens. Martens were the most important predators killing Capercaillies cocks (43%, three birds).

A number of observations confirm the creation of social groups among the released Capercaillies, usually consisting of birds of the same sex, including individuals coming from different breeding centres and of different ages. In spring 2011, a typical display behaviour was noticed in a cock bred in Kadzidłowo, released in 2009, and in autumn 2011, two cocks released in 2010 participated in supplementary courtship in the immediate vicinity of the release site (within the adaptation plot). In spring 2012 in two display grounds in c. 2.5 km distance from each other, six cocks (four from Kadzidłowo breeding centre, and two from Wisła) took part.

5. Discussion

During the last few decades, populations of Capercaillie have declined throughout their range. Although the species is not considered to be globally threatened, many local populations in Central and Western Europe have become extinct and the remaining small and isolated populations are threatened with extinction (STORCH 2007). To restock or re-establish local populations of Capercaillie, the release of birds reared in captivity has become a common conservation method (KLAUS & BERGMANN 1994, KLAUS 1998, SEILER et al. 2000, SIANO & KLAUS 2013). Although the technique of rearing forest grouse in aviaries has been developed in detail (ASCHENBRENNER 1982, 1985, DZIEDZIC et al. 2008, KRZYWIŃSKI & KOBUS 2009), the release itself still poses a major problem (STARLING 1991, STORCH 2007).

In the 1980s and 1990s, hundreds of captive-reared Capercaillies were released in Central Europe each year. However, the survival of such captive-reared birds after release is poor – the majority of them died in the first weeks after release (KLAUS & BERGMANN 1994, SEILER et al. 2000; SIANO et al. 2006). These results coincide with those obtained for the Grey Partridge Perdix perdix (PANEK 1998, PUTAALA & HISSA 1995) and for the Common Pheasant Phasianus colchicus (MAJEWSKA et al. 1979). The primary cause of mortality among the released birds was the activity of predators, on the one hand resulting from the insufficient formation of anti-predator behaviour patterns in birds reared in captivity (STARLING 1991, HAKANSSON 2007) and on the other hand from the increase in numbers of mamalian predators, particularly foxes (KLAUS & BERGMANN 1994, STORCH 2007). According to SCHERZINGER (1982), the sufficient formation of anti-predator behaviour patterns in Capercaillies reared in captivity depends on whether the chick is reared by its mother or not, as it is the mother which teaches its young the proper reaction to predators. SOKOS et al. (2008) recommend that even released Galliformes require anti-predator training.

Additionally, the captive-reared birds differ from their wild conspecifics in many morphological, physiological and behavioural traits, which may explain their high mortality rate (MAKINEN et al. 1997, LIUKKONEN-ANTILLA et al. 2000, LIJER et al. 2005, SIANO et al. 2011, WIENEMANN et al. 2011). Captive-reared birds are raised in unnatural conditions. They usually have a limited area for flying, their social contacts are frequently disturbed and captive conditions cause long-term stress in birds. Captive Galliformes fed with commercial poultry diets have a shorter gastrointestinal tract and lighter gizzards than wild birds and a different microbial composition of the caecal flora which is specialized to decompose cellulose and lignin. The role of active caeca is very important in the winter, when the Capercaillie feeds almost exclusively on low-digestible needles. As a result of nutritionally deficits, the released birds can suffer from starvation, which makes them more vulnerable to predation (SIANO et al. 2006, 2011, KRZYWIŃSKI et al. 2011). Beyond captive Capercaillies have smaller hearts, lungs and pectoral muscles than wild birds (HISSA et al. 1990, LIUKKONEN-ANTILLA et al. 2000). All this reduces their flying ability which can be of utmost importance in the case of predator
attacks.

In the years 1998–2006 a total of 914 Capercaillies were released in the Czech Republic, in the mountain ranges of Beskydy, Brdy, Cesky Les, Jeseniky, Kralkicky Snežnik, Krkonose and Sumava. Some of the birds were bred in captivity within the Czech Republic (379 individuals) while some were imported from Germany (438 individuals) and Sweden (97 individuals). Among 112 radio-tagged Capercaillies, the average duration of survival varied between 23 and 139 days, depending on the area and season. The main cause of mortality (67-100%) was predation by foxes, martens and Northern Goshawks (Bejcek et al. 2007). In the Black Forest, in 1984–1989 out of 37 young captive-reared Capercaillies (20 cocks and 17 hens) as much as 57% perished during the first two weeks after release, and only two birds survived the first winter (Schroth 1991). Females survived better than cocks during the first 10 weeks after release, but the difference was not significant. The main cause of death was predation (74%), particularly by martens and foxes (57%), and also by Northern Goshawks (17%). Some 15% of birds died in random incidents resulting from panic flights, a typical reaction to attacks by Goshawks. As part of the reintroduction project carried out in the Harz Mountains in 1999–2003, 83 birds reared in captivity and fitted with transmitters were released (Siano et al. 2006). The median survival duration was 13 days, higher for hens (18 days) than for cocks (12 days). As many as 79% of death losses occurred in the first four weeks after release, and the main cause (79%) was predation, especially by foxes (62%) and Northern Goshawks (10%).

The release of wild-caught birds seems to be one of the most effective methods of restoring wild populations. In Kazakhstan, about 60 wild Capercaillies were released in an isolated forest area and 20 years later, the population was estimated at 700 birds (Romanov 1988). Between 1999 and 2003, 145 wild Capercaillies captured in Russia, were translocated to Thuringia. The mean survival time of 33 radio-marked birds was 286 days, the median was 100 days (Unger & Klaus 2008, Rzońca 2011). After a period spend in the near vicinity of the aviary with their mother, over time, the young Capercaillies start to migrate over increasing distances, and returns of the young birds after leaving the place of planned release where the adult Capercaillie hen remains with them until the time of natural dispersion of young birds. In the Wisła breeding centre, young fledgling birds are transferred to adaptation aviaries where they encounter the natural habitat and get used to it. From the beginning, the hatchlings are given natural animal and plant food, supplemented by mixed fodder and small amounts of high-protein foods. Several weeks before release, the food is gradually changed into exclusively natural diet. Additionally, the chicks to be released into the wild have their contacts with humans reduced to the necessary minimum (Dziedzic et al. 2008, Rzońca 2011).

The results of the programme confirm the higher survivability of Capercaillies reared using the ‘born to be free’ method, which most probably results from the presence of the mother at the site of release. Shorter migrations in this group of birds, particularly in the initial period after release, result in reducing energy expenditures associated with intensive movements in an unknown environment and a lower level of exposure to predators. Additionally, mortality of this group of birds may be reduced through the use of equipment protecting the adaptation area against terrestrial predators (Merta et al. unpubl.). After a period spend in the near vicinity of the aviary with their mother, over time, the young Capercaillies start to migrate over increasing distances, and returns of the young birds after leaving the adaptation plot for 1-2 days are often observed. It seems, therefore, that entering natural habitats by young Capercaillies is a gradual, long-lasting process and goes on in a manner similar to that in wild birds. Moreover, the strong social contact with the mother at the site of release most probably facilitates the proper formation of anti-predator and social behaviour, and it may also relieve stress in young birds, connected with the transfer to a new unknown environment. It also seems that the unrestricted freedom of movement since the first hours of life and feeding on natural diet found on their own can prevent the emergence of anatomical
and physiological differences observed in birds reared in captivity.

As in Capercaillie release programmes implemented earlier in Europe, predation was the principal cause of mortality among birds released in the Bory Dolnośląskie forest. The analysis of the importance of this factor should take into account the fact that in natural Capercaillie populations mortality is highest in the first year of life and depends chiefly on pressure from predators, weather conditions, and the availability of food. The highest number of birds die in the first two weeks of life, in autumn the mortality decreases slightly, but increases again in winter (Zawadzka & Zawadzki 2003). According to Wegge & Kastdalen (2007), in Norway 57 % of 115 newly hatched Capercaillie, equipped with small radio transmitters died within first months of life, and 90 % of all observed losses was caused by predation. In Russia, 48 % of males and 59 % of females hatched in spring survive until the beginning of October (Cramp & Simmons 1980). In Scotland, the annual survival rate of hatchlings was 37 % (Moss et al. 2000). According to Lindén (1981) 76 % of young Capercaillies die in the first year of life.

From the mid 1990s, there has been a rapid increase in population numbers of predatory mammals, particularly foxes, which is connected with the action of offering baits with vaccine against rabies, started in 1993 (Smreczak 2007). In the 1980s, the estimated number of foxes in Poland was 50,000, but in 2008 this number has reached c. 204,000, i.e. four times more than before the vaccination campaign (Kamienniarz & Panek 2008). Additionally, since the 1990s the hunting of martens, polecats and badgers has grown seven-fold (Budny et al. 2010) which – considering the little interest in obtaining skins of these species, testifies to the dramatic increase in their numbers. Many studies confirm that whenever there is a major decrease in the numbers of foxes caused by intensified hunting or diseases (e.g. sarcoptic mange Sarcoptes scabiei vulpes) the local populations of Capercaillie increases over 2–3 years (Marcström 1987, Marcström et al. 1988, Keller 2001, Sjoberg et al. 2009). Thus, one of the primary objectives of our project is to reduce the numbers of mammalian predators carried out by variable methods over a large area (c. 80,000 ha). The high numbers of mammalian predators carried out by variable methods over a large area (c. 80,000 ha).

The preliminary results, obtained so far, although based on a relatively small data set, indicate a significant impact of preying by Northern Goshawks, particularly on Capercaillie hens, which is higher than in other programmes of Capercaillie release in Europe. The predation by goshawks is a significant factor in the mortality of forest grouse (Linden & Wikman 1983, Tornberg et al. 2009). The intensity of predatory pressure from goshawks is variable and its impact is strongest when the population densities of prey species are low. In northern Finland, forest grouse are the main prey of Northern Goshawks and in their reproductive seasons can constitute over 40 % of the biomass consumed (Tornberg 2001). Well documented was a strong predation pressure of Northern Goshawks on Capercaillie hens, especially in spring (Tornberg 1997, Widen 1997). In Norway, among known predation losses of Capercaillie chicks Goshawks accounted for a minimum of 25 % (Wegge & Kastdalen 2007), and c. 50 % of the annual mortality of adult Capercaillie hens was caused by Goshawk predation (Wegge et al. 1989). The above mentioned studies confirm the significant impact of predation by Northern Goshawks on the mortality of Capercaillie hens and young individuals which certainly results into a remarkable decrease in reproduction potential and population size of the species. For this reason, in the area of the Ruszów Forest District the program of catching Northern Goshawks in live-traps and translocating them started in 2012. From December 2012 to the end of March 2013, 18 Goshawks (three males and 15 females) were caught in an area of 20,000 ha. Because of the lack of data pertaining to the numbers and distribution of the Goshawk population in the Bory Dolnośląskie Forest, inventoring the nests of this predator is performed over an area of c. 50,000 ha.

The size of activity range in Capercaillies released in 2009–2011 in the Ruszów Forest district was much higher than noted in other release programmes carried out in Europe. For example, in the Harz Mountains, the maximum activity range was c. 17,200 ha, but most of the birds used an area up to 1,000 ha (Stano et al. 2006). The mean activity range calculated for 16 wild birds translocated from Central Russia to Thuringia was 689 ha (95 % MCP) and was larger in hens (952 ha; range: 412–2,127 ha) than in cocks (326 ha; range: 70–998 ha) (Unger & Klaus 2008). The publications devoted to this topic often described long-distance migrations of young birds, particularly females, leading to the disintegration of family groups (Klaus & Bergmann 1986, Petty 2000). Young Capercaillies can cover great distances during the state of knowing and adapting to the new environment (Romanov 1988, Zawadzka & Zawadzki 2003) and the size of their home ranges depends much on the quality of habitat (Storch 1995). The size of activity range can also be affected by major (several kilometre long) movements of birds in reaction to appearance or attack of raptors as observed during this project. Moreover, the size of these ranges can be affected by the method of gathering data, e.g. the frequency of telemetric locations of birds (Gula & Theuerkauf 2013) as well as by the numbers, sex structure and survival in the studied group of birds.

The analysis of 29 programmes of reinforcement and reintroduction of the Capercaillie, Black Grouse Tetrao tetrix and Hazel Grouse Bonasa bonasia carried
out in 1980-2000 in six European countries showed that projects lasting at least six years in which some 30 birds are released annually have the best chances of success (Seiler et al. 2000), while Schierzinger (2003) suggest to release at least 60 Capercaillies per year. Therefore, in the context of promising preliminary results of the restitution the Capercaillic population in the Ruszów Forest District, its continuation is planned under the umbrella of the project entitled ‘Active protection of lowland populations of the Capercaillic in the Bory Dolnośląskie Forest and Augustowska Primeval Forest’ (LIFE11 NAT/PL/428) financed in 2012-2018 by the European Commission, the National Fund for Environmental Protection and Water Management, and the State Forest, in which the Ruszów Forest District is the principal beneficiary.

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6. Zusammenfassung


Um das Auerhuhn im Waldgebiet Bory Dolnośląskie wieder anzusiedeln, wurden von 2009-2012 78 junge Auerhühner (45 Männchen, 33 Weibchen) aus polnischen Aufzuchtstationen im Waldbezirk Ruszów freigelassen. Dabei erfolgte die Aufzucht von Vögeln aus Kazidlowo nach der „born to be free“-Methode, d.h. die Jungvögel wurden zusammen mit ihren Müttern in das Freisetzungsgebiet gebracht. Dort lebten die Mütter bis zur Zeit der natürlichen Dispersion der Jungen in einer permanent geschlossenen Völker. Die Gewöhnung der freigelaßenen Vögel fand auf einer speziellen Fläche (18 ha) statt, wo sie vor terrestrischen Prädatoren sicher waren. Mehr als 60 % der Vögel wurden mit Telemetriesendern ausgestattet. Der gemeinsame Aktionsraum von 33 ausgewilderten Auerhühner wurde mit Hilfe der MCP-Methode (minimum convex polygones) ermittelt und war insgesamt 45.360 ha (Weibchen: 42.485 ha, Männchen: 16.585 ha) groß, unter Berücksichtigung von Feldbeobachtungen sogar 91.196 ha. Dabei nahm der Aktionsraum von Auerhühnern aus Kazidlowo 20.723 ha ein, bei denen aus der Aufzuchtstation Wisła war er doppelt so groß (41.834 ha). Der Aktionsraum eines Einzelvogels umfasste durchschnittlich 3.918 ha. In den ersten vier Wochen nach der Wilderung betrug die Überlebensrate aller 33 Vögel 85 % (Weibchen: 75 %, Männchen: 93 %), darunter bei Vögeln aus Kazidlowo 100 % („born to be free“-Methode) bzw. bei Vögeln aus Wisła 67 %. Im ersten Lebensjahr lag die mittlere Überlebendauer bei 165 Tagen (Median 107 Tage) und war bei Vögeln der „born to be free“-Methode länger (durchschnittlich 227 Tage, Median 139 Tage). In beiden Gruppen zusammen überlebten Männer länger (durchschnittlich 225 Tage, Median 186 Tage) als Weibchen (durchschnittlich 91 Tage, Median 74 Tage). Der Großteil der Verluste (76 %) war auf Prädation zurückzuführen. Bedeutender Beutegreifer war dabei der Habicht, der 56 % aller Vögel bzw. 78 % aller Weibchen erbeutete. Bei Männchen waren Marder die entscheidenden Prädatoren (43 % der Vögel). Zu den wichtigsten Schutzmaßnahmen gehören daher permanentes Monitoring sowie die Reduktion von Prädatoren auf einer Fläche von 90.000 ha. Zusätzliche Maßnahmen beinhalten eine Verbesserung der Habitatqualität und Kampagnen zur Umwelterziehung.

7. References


