Appendix 3.

Summary of professional accomplishments

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1. Name and surname

Jakub Benedykt Gryz

2. Academic experience

June 2003 – MSc, Biology, Warsaw University of Life Sciences, Faculty of Agriculture and Biology, title of MSc thesis: „Ecology of a northern goshawk *Accipiter gentilis* (Linnaeus, 1758) population in Rogów Forest", supervisor: prof. dr. hab. Jacek Goszczyński

January 2010 – PhD, forestry, Warsaw University of Life Sciences, Faculty of Forestry, title of PhD thesis „Environmental determinants of diet composition and reproduction of tawny owl *Strix aluco* Linnaeus, 1758", supervisor, prof. dr. hab. Jacek Goszczyński

3. Work experience

March 2004 – February 2009: PhD student, Doctoral studies – Faculty of Forestry, Warsaw University of Life Sciences

December 20017 – December 2009: assistant, Department of Forest Ecology and Wildlife Management, Forest Research Institute

January 2010 – now: assistant professor, Department of Forest Ecology, Forest Research Institute

4. The academic achievement resulting from Article 16 Paragraph 2 of the Act of 14th March, 2003 about the academic degrees and academic title submitted for habilitation procedure:

a) Title of the academic achievement

The scientific achievement consists of a series of five publications on „**Functioning of populations of raptors in changing environment**". Pooled „impact factor" of these five papers is 3.744, while the total number of points based on journal list ranked by Ministry of Science and Higher Education is 103. Declarations of co-authors contribution to the publications are to be found in Appendix 5.

b) Authors, titles of the publications, year, journal title

1. **Gryz J.,** Krauze-Gryz D. 2018. Density dynamics, diet composition and productivity of sparrowhawk *Accipiter nisus* L. population in central Poland. Forest Research Papers 79(3): 245-251; https://doi10.2478/frp-2018-0024, **13 points**.
My contribution to this paper is about 70% and included: study design and field-work methodology, conceiving the idea of a paper, data collection in the field, result interpretation, and manuscript writing.

2. **Gryz J**., Krauze-Gryz D**.** 2019. Indirect influence of African swine fever outbreak on the Raven (*Corvus corax*) population. Animals 9(2), 41; https://doi.org/10.3390, **IF = 1.654** this journal was not listed on Ministry of Science and Higher Education Lists published in January 2017, estimated number of points as based on IF: **30 points.**
My contribution to this paper is about 70% and included: study design and field-work methodology, conceiving the idea of a paper, data collection in the field, laboratory analysis, statistical analysis, and manuscript writing.

3. **Gryz J.,** Krauze-Gryz D. 2019. Pigeon and poultry breeders, friends or enemies of northern goshawk *Accipiter gentilis*? A long term study of the population in central Poland. Animals, 9(4), https://doi.org/10.3390/ani9040141, **IF = 1.654** this journal was not listed on Ministry of Science and Higher Education Lists published in January 2017, estimated number of points as based on IF: **30 points.**
My contribution to this paper is about 80 % and included: study design and field-work methodology, conceiving the idea of a paper, data collection in the field, laboratory analysis, statistical analysis, and manuscript writing.

4. **Gryz J.,** Krauze-Gryz D. 2019. Common buzzard *Buteo buteo* population in a changing environment, central Poland as a case study. Diversity 11(3), 11; https://doi.org/10.3390/d11030035, this journal was not listed on Ministry of Science and Higher Education Lists published in January 2017, since June 2019 will be indexed in a Web of Science, estimated number of points: **15 points.**
My contribution to this paper is about 75% and included: study design and field-work methodology, conceiving the idea of a paper, data collection in the field, laboratory analysis, statistical analysis, and manuscript writing.

5. **Gryz J**., Chojnacka-Ożga L., Krauze-Gryz D. 2019. Long-term stability of tawny owl (*Strix aluco*) population despite varying environmental conditions – a case study from central Poland. Polish Journal of Ecology, 67: in press, doi10.3161/15052249PJE2019.67.1.006, **IF = 0.436; 15 points.**
My contribution to this paper is about 70% and included: study design and field-work methodology, conceiving the idea of a paper, data collection in the field, laboratory analysis, statistical analysis, and manuscript writing.

c) A discussion of the scientific aims of the papers and the results achieved, together with a discussion of their possible use

Introduction

I conducted studies of five raptor species: sparrowhawk, raven, northern goshawk, common buzzard and tawny owl in the area of Experimental Forest Station of Warsaw University of Life Sciences in Rogów. Most studies were done in the years 2011-2018 and their results were compared to literature and unpublished data from the previous decades. Studies on predators and their prey in this area were initiated by prof. dr. hab. Jacek

Goszczyński more than 40 years ago in 1978. Such long time span but also complexity of the studies in question (i.e. focusing on the whole raptor community) make the study area unique in Polish and European scale. Since the end of the 1970s some significant changes, both global as local, have taken place in the environment inhabited by the studied raptor species. This includes climatic changes, changes in farming and forest management practices but also changes in the attitude toward raptors, which are no longer treated as pests by hunters and society. In present studies, apart from an inventory of focal raptor species, we also analysed a range of environmental factors that could have influenced studie populations. This included: food availability (like field and forest rodents, domestic pigeons, poultry, small game, selected corvid species), meteorogical conditions in winter, oak masting, changes in stand structure, and martens density. Also, availability of nesting places for tawny owl was experimentally increased. With long-trend data on raptor abundance and environmental changes, it was possible to search for drivers of these ongoing population changes.

1. Gryz J., Krauze-Gryz D. 2018. Density dynamics, diet composition and productivity of sparrowhawk *Accipiter nisus* L. population in central Poland. Forest Research Papers 79(3): 245-251.

Our research was the first and detailed one focusing on the population of sparrowhawk in Rogów forest. The first records of the species presence are museum specimens, collected in the Museum of Wood and Forest of WULS in Rogów, dating back to the 1940s and 1950s. In the 1980s this species was seen to be rare in the area, with an abundance of only a few breeding pairs. Nevertheless, no scientific data were collected from this period. Basing on scarce information found in diploma theses, reports and instructions, it can be concluded that between 1945 and the end of the 1960s this species was treated as a serious threat for small game, perceived as pest and intensively persecuted. At the same time its population was negatively affected by toxic pesticides (DDT).

I conducted the first inventory of the species in Rogów forest in 2001-2003, while collecting data for my MSc thesis. Next research was done in 2011-2017, broadened by diet analyses, nesting trees description and population productivity assessment.

In 2011-2017 on average 20.1 breeding pairs were recorded. Population density was 19.1 pairs/100 km^2 of the whole area and 8.2/10 km^2 of forest area. As compared to 2001-2003, when in the whole area nested 16 pairs of the species, an increase by 26% was recorded. Parallely, lower anthropophobia was detected. Currently, birds nest in the area of Arboretum, or sewage plant that is close to the student campus in Rogów. Sparrowhawks had 1 to 5 juveniles, on average 3.4 per successful breeding pair. Among nesting trees larches (36.9 %) and Scots pines (35.9 %) dominated. Mean tree age was 31 years. Nests were built at 11.7 m height. Birds were the dominant prey, constituting 81.5% of prey items and more than 95% of consumed biomass. Domestic pigeon was the dominant bird prey when total biomass was taken into account. Other numerous prey species were common starling (5.6% of prey items and 9.8% biomass) and hawfinch (6.3% prey items and 7.6% biomass). A common prey were also thrushes constituting for more than 11% of consumed biomass.

A population rebuilt in the area probably took place in the 1990s. Consequently, density recorded in the years 2011-2017 was one of the highest ever recorded in Poland, especially when calculated per forested area. An increase of sparrowhawk in the last decades

was shows in many places in Poland and Europe. Data from The State Environmental Monitoring show that population was stable in the years 2000-2016. Long-term changes of the population abundance, shown for the vicinity of Rogów, as well as their causes are probably analogical to most European populations. Persecution by people and DDT usage led to population drop, when those ceased, population increased in number.

2. **Gryz J**., Krauze-Gryz D**.** 2019. Indirect influence of African swine fever outbreak on the Raven (*Corvus corax*) population. Animals 9(2), 41, https://doi.org/10.3390

The persecution of ravens ceased in the middle of the 20th century, and consequently the abundance of the species started to rise in most European countries. The raven is a food opportunist that can eat plants, prey on animals, and feed on garbage dumps. Numerous authors point to the crucial role of carrion in the species' diet. In Europe, ravens feed mainly on the carrion of animals killed by vehicle collisions, the game remains left by hunters, and the prey of big predators. In the vicinity of water bodies, ravens feed on dead fish, and in farmland they feed on the carrion of livestock.

In the vicinity if Rogów, the carrion of farm animals was thought to be the main food source for ravens. Numerous pig farms disposed of dead animals and animal waste illegally. This changed radically in February 2014, after the first case of African swine fever (ASF) in Poland. The virus is lethal to wild boar and domestic pigs, and its occurrence is a serious economic problem. Therefore, Polish veterinary services introduced actions and procedures to stop the virus from spreading. These measures included intensive controls in farms and educational activities. As a result, the illegal disposal of domestic pig remains became more difficult and carried the threat of severe fines. Moreover, the strict procedures involving the utilization of wild boar killed on the roads and the remains of hunted game were implemented.

The aim of this study was to assess the influence of assumed restricted access to carrion on the raven population. Therefore, we compared certain ecological aspects (i.e., population abundance, breeding parameters, and diet) before and after the implementation of restrictive procedures that are aimed at stopping the spread of ASF to Western Europe. Diet composition data were based on pellet analysis and direct observations of feeding birds.
In the first 'before ASF' period (2011–2014), on average, 12.3 (SD = 1.0) breeding pairs of ravens were recorded in the study area per year. In the second 'ASF outbreak' period (2015–2018), an average of 7.5 pairs (SD = 1.3) were recorded (i.e., the number of pairs dropped by 42%). The recorded densities were 11.7 pairs/100 km^2 for the total area during the first period and 7.1 pairs/100 km^2 for the total area during the second period. The breeding successes in both periods were similar (65% and 61% for the first and second periods, respectively) and the number of juveniles per breeding pair did not differ. However, birds in the second period (2015–2018) had fewer fledglings per successful pair. The time when juveniles left their nests (7 May, on average) did not differ between the two periods. A comparison of the ravens' diet during the two periods on the basis of two methods gave similar results. In both cases, a significant decrease in the share of carrion of domestic pigs and wild boar was recorded. In the years 2011–2014, domestic pigs and wild boar remains were recorded in 36.9% of the raven pellets, and in the second period they were found in 13.7% of the pellets. In the case of

direct observations of birds, feeding on pig and wild boar carrion was recorded 76 times (31.3% of observations) in the first study period, but only 16 times (5.6% observations) in the second period. At the same time, an increase of other food categories was recorded, i.e., carrion of domestic dogs and cats was recorded in 11.2, as opposed to 3.8% of pellets, while remnants of small vertebrates (shrews, rodents, small birds, reptiles, and amphibians) were recorded in 75.4 as opposed to 54.8% of pellets. In the two periods, ravens fed on roe deer and poultry carrion, fed from rubbish dumps, and made use of plant matter.

In the 'before ASF' period (2011–2014) during fieldwork (both concerning this study and other done in the same area), we recorded numerous cases of illegal disposal of domestic pig carrion. The most extreme case was a dump of about 40–60 carcasses in sand pits. In other cases, between one to several carcasses were seen in one place. On the contrary, during the years 2015–2018, such cases were rare, however animal waste might have been covered with soil or garbage, and thus was more difficult to find. Additionally, due to a reduction in the wild boar population and the restrictive utilization of game remains, the availability of wild boar carrion decreased. We may assume that this high rise in the raven abundance in the study area over the years 1978–2014 was possibly due to a high level of anthropogenic food availability (including carrion of farm animals). Population densities for the 'before ASF' period (2011–2014) were among the highest ever recorded, both in Poland and in Europe. Higher densities were shown, mostly in less extensive areas with very abundant food sources (e.g., rubbish dumps), where ravens nested in semi-colonies. In Great Britain, the highest densities (up to 21 pairs/100 km^2) were recorded in areas of intensive sheep production, where birds had access to the carrion of those animals. Similarly, as in our case, limited access to carrion resulted in a decrease in raven abundance in those areas.

Our results confirm that the raven is a food opportunist and that carrion plays an important role in its diet. Nevertheless, it needs to be considered that the real share of carrion in the species' diet could have been even higher than was confirmed by pellet analysis. Probably, in most cases, eaten meat was totally digested, and no remains, such as feathers or fur, were found in pellets. It should also be stressed that, in our case, ravens fed on carrion during the breeding season, which points to its crucial role in the population condition. In other areas, a high share of carrion in the raven diet was recorded only in autumn and winter.

Overall, in our study the carrion of farm animals (disposed of illegally) was the main food source for ravens in the past. Its high availability allowed local population to reach one of the highest densities ever recorded. With the introduction of strict procedures for the utilization of pig and wild boar carcasses to stop the spread of the ASF virus, thus drop in the carrion availability, ravens changed their diet, i.e., they fed on the carrion of dogs and cats or preyed on small vertebrates more often. As a result raven population abundance decreased rapidly. Overall, our study points to a crucial role of the availability of the carrion of big farm animals (i.e., domestic pig) in maintaining the high density of breeding raven populations in a human-transformed habitat such as field and forest mosaic.

3. **Gryz J.,** Krauze-Gryz D. 2019. Pigeon and poultry breeders, friends or enemies of northern goshawk *Accipiter gentilis*? A long term study of the population in central Poland. Animals, 9(4), 141, doi;10.3390/ani9040141

The goshawk abundance in Europe fluctuated throughout the first half of the 20th century due to the persecution of raptors by hunters and forest management practices finally crashing in the 1950s and 1960s due to the usage of highly toxic pesticides (DDT) in agriculture. Since the 1970s, the European population of goshawks started to rise moderately, yet this trend was not consistent for all countries. For example, in the UK, the goshawk went extinct in the 1980s. It was reintroduced, and its population grew in number; a systematic growth in the forest cover was conducive to this process of population restoration. On the contrary, in Finland and Sweden, a decrease in goshawk abundance was recorded in the years 1980–2010. A population decrease was also noted in Poland in the last decade. Similarly, in the USA, the population trend was equivocal, and many authors pointed to the potentially negative influence of forest management practices on goshawk populations, both in Europe and in North America.

This central Poland study area is where the goshawk population has been studied long term for almost 40 years and where a population drop followed the record density found in the 1980s. In our current study (2011–2018), we continued the long-term monitoring of the goshawk population in central Poland. We compared data obtained in the current study with analogical data obtained in the previous study periods. Therefore, we were able to analyse crucial environmental factors (i.e., the main and complementary prey availability and changes in the forest structure) that may have influenced the population density of the goshawk, its breeding parameters, and its diet composition.

The current population densities (2011–2018) of goshawk were 0.76 pairs/10 km^2 of total area and 3.3 pairs/10 km^2 of forested area. The number of breeding pairs decreased when compared with the two previous study periods. This means that, in comparison to the first study period (1982–1992), the population has decreased by almost 50%. Such a decrease in the number of breeding pairs was recorded in all forest complexes. In the years 2011–2018, goshawks produced on average 1.6 fledglings per breeding pair (SD = 1.07) and 2.1 (SD = 0.69) per successful pair. The breeding success was 76% (SD = 7.2). Compared to previous study periods, these parameters seemed to be similar or decrease. In the current study period (2011–2018), goshawks preyed mainly on domestic pigeons and poultry, which accounted for 24.1% of their total prey items (N = 1065) and 49.2% of the biomass consumed (211,664 g in total). From among wild birds, wood pigeons and Eurasian jays were most important. Mammals accounted for 11.5% of their prey items and 3.7% of their biomass, including small prey and, in some cases, carrion. Amphibians, reptiles, and insects were found in very few pellets. As compared to the previous study periods, a decrease in the share of domestic pigeons (from 38% of all prey items in 1982–1992 to 22.8% now) was recorded. The same was evident in the case of poultry, which, in the first period, constituted over 10% of all biomass, while recently, it was just 3.3%. The share of small game (brown hare, European rabbit, pheasant, and grey partridge) in the current study was the lowest from all three study periods. On the contrary, the share of Eurasian jay and wood pigeon increased. We were not able to obtain data regarding the pigeon and poultry availability from the previous decades. However, the number of farms that had domestic pigeons and poultry available for goshawks decreased even within the last study period between 2011 and 2018. The number of farms with domestic pigeons dropped by 34% (from 64 in 2011 to 42 in 2018), and those with

poultry dropped by 33% (from 182 to 122 farms). The interviewed farmers confirmed that small-scale pigeon and poultry production has been limited in the last 30 years.
A far as other food sources are concerned, the small game density was very low in 2011–2018 and dropped notably as compared to the 1980s. Brown hares and grey partridges became very rare, while European rabbits went extinct in the area.

Overall, our study showed that anthropogenic food (poultry and domestic pigeons) plays a key role for the goshawk population in the transformed habitats of the field and forest mosaic, even though the hunting birds were persecuted by local farmers. The birds built their nests in small forest complexes, but much of their prey was caught in open spaces in the vicinity of farmsteads. Consequently, what has led to the observed population decrease is the current limited anthropogenic food base, as a result of political and socioeconomic changes that have affected polish farmland. As medium-sized mammals and birds (i.e., small game and most corvid species) are not abundant (or absent, like forest grouses), they could not replace the staple food of anthropogenic origin when it was removed. This study showed the complex way in which socioeconomic changes in agriculture influence the raptor population, both positively (with fewer cases of persecution since the small scale production of poultry and pigeons is no longer important and widespread) and negatively (by influencing the food base directly; in this case, by limiting anthropogenic food source availability; and indirectly, by changes in farming practices that have led to a decrease in small-game prey availability). Even though farmers have now stopped persecuting goshawks, this has not counterbalanced the anthropogenic food base loss.

4. **Gryz J.,** Krauze-Gryz D. 2019. Common buzzard *Buteo buteo* population in a changing environment, central Poland as a case study. Diversity 11(3), 11; https://doi.org/10.3390/d11030035

Common buzzard is the most abundant bird of prey in Poland and in Europe. In most countries, its abundance decreased between the second half of the 20th century and the 1970s. The main reasons for this were deforestation, persecution, and usage of organochloride pesticides in the 1950s and 1960s. In most cases, those factors have been eliminated, which allowed the population to grow in the last few decades. Also, in Poland, cases of a dynamic population growth were recorded. Our study was done in Central Poland, in the field and forest mosaic, where long-term studies of common buzzard began in 1982. At present, (2011–2018) we have continued the long-term monitoring of this species. We compared data obtained in the current study with analogical data obtained in the previous study periods. Therefore, we were able to analyse crucial environmental factors (i.e., prey availability, changes in the forest structure and abundance of a competitive raptor species, i.e., northern goshawk) that may have influenced the population density of the common buzzard, its breeding parameters, and diet composition.

The current population density (2011-2018) of the common buzzard was 3.5 pairs/10 km^2 of total area and 14.3 pairs/10 km^2 of forested area. Between 36 to 39 (on average 37.2, SD = 1.04) breeding pairs were recorded each year. The number of breeding pairs increased when compared with the two previous study periods (i.e. by more than 100% when compared to 1982-1992). The abundance of the common buzzard was negatively correlated with the

abundance of goshawk recorded in this area. In the current study period (2011–2018), common buzzards preyed mainly on mammals, which accounted for 72.6% prey items but for 38.6% of total biomass consumed. The percentage share of the main groups of prey changed in the subsequent study years, i.e. the share of rodents in a diet was correlated with their availability in a given year. Compared to the previous study periods, a decrease in the share of voles *Microtus* spp. (from 44% of all prey items in 1982–1992 to 18% now) was recorded. At the same time, the share of mice *Apodemus* spp. increased. *Apodemus* species also dominated among live-trapped small rodents. By contrast, voles *Microus* spp. were not frequently trapped in the field, while they were absent from the forest. In the current study period, breeding success was between 53 to 87% (on average 74%), the lowest in 2011 when rodent abundance was very low, yet no correlation between breeding success and rodent availability was found. However, the number of produced fledglings per breeding pair (min 0.7., max 1.8, average 1.3, SD = 1.0) and the number of fledglings per successful pair (min 1.4, max 2.2, average 1.8, SD = 0.7) depended on small rodent availability

The current density of the common buzzard in our study area was high when compared to other European studies. It was stable in the first study period (1982–1992), and probably at least until 1978. Then, the population started to grow (in the beginning of the 1990s), and this has continued until today. One of the reasons that might have allowed for the population growth was the decrease in the northern goshawk number. Up to 1989, the abundance of the two species was similar, but since 1989, buzzards have always been in larger numbers, and this disproportion was higher every breeding season. The abundance of goshawk dropped to 6–7 pairs, while that of the common buzzard peaked at 37–39 pairs in the last few years. Goshawks can prey on juvenile and adult buzzards. Indeed, in our study area in 2001–2002, buzzard (mostly juveniles) constituted almost 1% of goshawks' prey items. The two species may also compete for food, as the current share of birds in a total consumed biomass by common buzzards was 60%, with more than 18% being domestic pigeons and poultry, the staple food of goshawks in this area. The presence of goshawks is known to be the factor that affects nest place choice by buzzards and negatively influence their breeding parameters. Our results showed important changes in the diet composition of the common buzzard in the last 30 years, which were the result of changes in rodent availability, mainly a decrease in the abundance of voles of *Microtus* genus, and dampening of their population cycles. We showed that common buzzards reacted to changes in rodent availability by switching to other food categories.

To sum up, the common buzzard is a species that inhabits various landscapes, from continuous forests to relatively open landscapes, like agrocenoses or moorlands. The field and forest mosaic of our study area is somewhere in the middle of this continuum, with highly available nest sites (mature trees) and open arable lands, with abundant small rodents, as a hunting place. At the same time, this is the type of landscape that undergoes a variety of changes, i.e., changes in farming practices affect prey availability, forest management affects nest site availability, and the socioeconomic situation may result in lower or higher persecution of birds by farmers. In our case, both positive (lower persecution, higher availability of nesting trees) and negative (lower abundance of voles as preferred rodent prey) changes took place. Common buzzards adapted well to these changes and, despite being forced to switch to an alternative prey, their population grew significantly. The last factor

which probably allowed this population growth might have been the drop in the northern goshawk number, a raptor species that may affect the common buzzard negatively.

5. **Gryz J**., Chojnacka-Ożga L., Krauze-Gryz D. 2019. Long-term stability of tawny owl (*Strix aluco*) population despite varying environmental conditions – a case study from central Poland. Polish Journal of Ecology, in press doi10.3161/15052249PJE2019.67.1.006

The tawny owl is the most abundant owl species in Poland and in Europe. In the wild, this species breeds in both large tree-holes and the stumps of dead trees, as well as – occasionally – in the abandoned nests of birds of prey but willingly uses nesting places of anthropogenic origin (i.e. nest boxes) when available. A factor that may exert a transient negative impact on abundance in this species is harsh winter weather. Equally, climatic warming can also have an indirectly negative effect due to limiting numbers of voles. Many studies demonstrate an influence of fluctuations in numbers of rodents on populations of tawny owls. When fledglings are concerned, medium-sized carnivores can be the main source of the mortality.

Here we aimed to assess the influence of selected environmental factors on the population dynamics of the tawny owl over fifteen-year period. Numbers of pairs (territories) were established by the standard playback survey technique supplemented by searches for nest sites. The selected environmental factors studied in parallel were the acorn production, density changes in field and forest rodents, meteorological conditions in winter and density of martens.

At the start of the study period 20 nest boxes designed for tawny owls were placed out in the study area. This number was enlarged by additional 27 nest boxes placed in 2012. The number of owls in the area remained stable – in the range of 26−29 pairs, despite changes in nesting sites availability. The population of the tawny owl was stable over the whole study period, yet, it fluctuated year-to-year with changing environmental conditions, i.e. the number of tawny owl pairs correlated negatively with persistence of snow cover. In turn, availability of rodent prey in forest (following changes in acorn crop) correlated positively with the numbers of pairs of tawny owls the following year. Also the record year for forest rodents was associated with greater numbers of both eggs laid and young reared. Thus, in years in which rodents were moderately abundant and for which productivity was assessed, an average of 3.5 eggs were laid by each female (n = 11, SD = 1.37), while in 2006 (when rodent numbers peaked), the comparable figure was 4.5 (n = 6, SD = 1.05). Numbers of young birds leaving the nest in years in which forest rodents were moderately abundant was 2.9 (n = 15, SD = 1.03), as opposed to 4.1 (n = 8, SD = 1.1) in the 2006 breeding season. Though the two study periods did not differ significantly in terms of mean numbers of eggs laid, a significant difference was noted for numbers of young raised. Densities of martens was low (0.29 ind./km^2) and remained relatively stable throughout the study period, and there were no reported cases of these carnivores killing tawny owls, despite the former taking shelter in the owl-boxes.

In essence, our work demonstrated stability over 15-year period of numbers of tawny owls irrespective of changes in nesting site availability and changes in environmental conditions, which points to high plasticity of the species and stays in contrast to other raptor

species in our study area, for whom important changes in long-term abundance trends were recorded.

Summary

Among studied species only in case of goshawk, a strong, long-term decrease of abundance was recorded, which was due to a limited food base of domestic pigeons and poultry. This, in turn, originated in socio-economic changes in farming which took place in the last 30 years. Local farmers resigned from small-scale pigeon and poultry breeding, on the other hand, big hen farms, with thousands of birds, yet unavailable for goshawks, occurred. In this case pigeon and poultry breeders practically allowed to maintain high abundance population in the past, even though they persecuted goshawks at the same time.

An abundance decrease, though not so spectacular as in the case of goshawk, was also recorded in the case of raven. This species also reached very high density, until when food base in a form of carrion of domestic pigs and wild boar, as a result of fight with ASF in Poland, was rapidly limited. Similarly, as in the case of goshawk, anthropogenic food was the factor that allowed to keep high population density up to 2014.

Different population trend was shown in the case of sparrowhawk and common buzzard. Population drop of goshawk was undoubtedly positive for the two species. Common buzzard is the most successful species of all presented here and its population probably started growing in the beginning of 1990s. This trend was correlated with population decrease if goshawk (an antagonistic and dominating species). Population growth of buzzard was possible regardless limitation of the main prey (voles). Buzzard, as opposed to goshawk and raven, could use an alternative prey, i.e. mice.

Tawny owl population was stable during 15 year period. In the beginning of the study, we assumed that availability of natural tree holes in a managed forest can be a factor limiting population of this species. However, no influence of experimental increase of nesting places in a form of nest boxes was seen. Also, other environmental factors, did not have long-term influence on the population.

It should be stressed that forest practices did not influence any of the studied species negatively. Changes in stand structure, resulting in an increase of larch and broad-leaved species seemed to have positive consequences. Nests built on larches are more stable and durable than those built on pines, they are also less vulnerable i.e. during storm or snowfall in April, when females already incubate eggs. Additionally, larch as fast growing species provides base for nests when as young as 40 years old. Having in mind that felling age is similar for Scots pine and larch, stands of the latter seem to be safer place to build nests. Also, in the last years share of stand in older age classes, as well forest cover in general, increased, which was also beneficial for all of the studied species.

5. Summary of remaining scientific activity
5.1. Research

My research activity, besides main academic achievements presented in the point 4, focused on seven research areas:

1. **Ecology of predatory mammals and birds**

I started studies on influence of domestic dogs and cats in 2004. This topic is still poorly recognized in central Europe. At the same time the issue of the role of these two predators in the ecosystem is very controversial and widely discussed, i.e. when legal changes regarding animal welfare and protection and game management are introduced. Unfortunately, such debate often lacks scientific facts.

First of published papers showed spatial and seasonal pattern of activity of cats, and pointed to their potential predatory pressure (Goszczyński et al. 2009). Next paper (Krauze-Gryz et al. 2012a) studied interactions between three opportunistic predators (i.e. dog, cat and red fox) in a field and forest mosaic of central Poland. We focused on spatio-temporal niche segregation and factors influencing their coexistence in field and forest areas. This paper was cited 26 times according to the Web of Science. The results suggest that there are antagonistic interactions between the three predators. Especially dogs, seem to affect other predators. They are dominant predators and, there are numerous cases documented in the literature that they influence other carnivorous mammals by chasing, scent marking or killing. Having in mind high density of free-ranging dogs in field and forest mosaic of central Poland, we may assume that their spatio-temporal activity will affect space use by other studies predators (and probably other medium-sized species). The aim of the next studies realized in 2005-2011 was to assess density and diet composition of free ranging dogs (Krauze-Gryz and Gryz 2014). Density of dogs was high (2.2 to 3.1 ind./km^2). Dogs, especially at night formed groups. It may be assumed that they left villages to hunt or look for carrion, therefore, group forming was beneficial. We also recorded dogs breeding in wild. Dog scats contained mostly grains (assumingly given as food by farmers), but also remains of wild living animals, including game. Also, our observations confirmed that dogs killed roe deer or brown hares by chasing them onto some barriers like fences. These two papers (Krauze-Gryz et al. 2012a, Krauze-Gryz and Gryz 2014) showed that in field and forest mosaic, with absent wolves and lynxes, dogs are numerous and dominant predators.

Next studies focused on the predation of free-ranging domestic cats. The first showed significant differences in the number of prey of cats when various methods, widely used in studies on cat diet (i.e. prey brought home collection vs. analysis of scats/guts), were compared. It showed that the first of the methods, often used by researchers, underrepresented the real number of killed prey. We also showed that this mistake is different in reference to different prey groups (e.g. small prey, the ones that are less palatable) (Krauze-Gryz et al. 2012b). Next work showed seasonal differences between hunting activity of cats in rural and urban areas. We showed that the number of prey killed (small mammals and birds) and brought home was vividly changing seasonally in rural areas. At the same time urban cats, much more frequently that in rural areas, killed birds and the number of such prey items was

much more stable throughout the whole year (Krauze-Gryz et al. 2017). The last of the series of papers aimed at assessment of the number of birds and mammals killed by domestic cats in rural areas of the whole Poland, during the whole year. It is one of few such large-scale assessments in the world (Krauze-Gryz et al. 2019).

In 2011 I started studies on red foxes inhabiting areas of different level of antropogenic transformation: Białowieża Forest, Rogów forests and Warsaw. In the published paper (Gryz and Krauze-Gryz 2017) we characterized long-term abundance trend of the species in the Białowieża Forest. In turn, in Rogów forests we searched for fox dens, assessed number of raised cubs and analysed diet composition and compared different methods of red fox density assessment. On the basis of this data I gave a speech at a conference (XV Konferencja Aktywne Metody Ochrony Przyrody w Zrównoważonym Leśnictwie w Rogowie, 2019) entitled: "Mission impossible? – how to count red foxes." These results are now being prepared for publication. I am also a co-author of a report prepared for Municipal Forests in Warsaw (Werka et al. 2015), on red fox presence in Warsaw. This research is now continued by our research team and data is collected for PhD thesis of Mateusz Jackowiak, MSc, entitled "Biology and ecology of red fox in urbanized areas – Warsaw as a case study", for which I am engaged in field work (snow tracking and den searching).

Apart from studies on carnivorous mammals I conducted studies on biology and ecology of tawny owl. They resulted in a series of papers on relation between environment and owl diet (Gryz et al. 2011, Gryz et al. 2012, Gryz and Krauze-Gryz 2016, 2019), changes in its breeding biology in an urbanization gradient (Gryz and Krauze-Gryz 2018), and occurrence of tawny owl in Warsaw (Gryz and Krauze-Gryz 2013). One of the papers referred to plumage colour polymorphism in Kampinos National Park, Warsaw and Rogów Forest District (Gryz and Krauze-Gryz 2013). The works showed high plasticity of tawny owl. Owls nesting in Warsaw started to breed earlier than in rural areas, they preyed on different species (birds rather than mammals) and reacted to changes in prey availability. In Warsaw, drop in sparrow abundance resulted in their lower share in a diet as compared to the 1980s.

Main publications:

1.Goszczyński, Krauze D., **Gryz J**. 2009. Activity and exploration range of house cats (*Felis catus*) in rural areas of central Poland. Folia Zoologica 58: 363-371.

2.Gryz J., Góźdź I., Krauze-Gryz D**.** 2011. Wpływ antropogenicznego przekształcenia krajobrazu na skład pokarmu puszczyka *Strix aluco* L. w Biebrzańskim Parku Narodowym. Parki Narodowe i Rezerwaty Przyrody: 30: 109-118.

3. **Gryz J**., Lesiński G., Kowalski M., Krauze-Gryz D**.** 2012. Skład pokarmu puszczyka *Strix aluco* w Puszczy Białowieskiej. Chrońmy Przyrodę Ojczystą 68: 100-108;

4. Krauze-Gryz D., **Gryz J.,** Goszczyński J., Chylarecki P., Żmihorski M. 2012a. The Good, the Bad and the Ugly: space use and intraguild interactions among three opportunistic predators – cat *Felis catus*, dog *Canis familiaris* and fox *Vulpes vulpes* – under human pressure. Canadian Journal of Zoology 90: 1402-1413.

5. Krauze-Gryz D., **Gryz J.,** Goszczyński J. 2012b. Predation by domestic cats in rural areas of central Poland: an assessment based on two methods. Journal of Zoology 288: 260-266.

6. Gryz J., Krauze-Gryz D. 2013. Plumage colour polymorphism among central Poland's tawny owls Strix aluco Linnaeus, 1758. Zoology and Ecology 23: 58-60.

7. **Gryz J.,** Krauze-Gryz D. 2013. Występowanie puszczyka *Strix aluco* na terenie Warszawy w latach 2005-2010. Ornis Polonica 54: 212-217.
8. Krauze-Gryz D., **Gryz J**. 2014. Free-ranging domestic dogs (*Canis familiaris*) in Central Poland: density, penetration range and diet composition. Polish Journal of Ecology 62: 183-193.
9. **Gryz J.,** Krauze-Gryz D. 2017. Dynamics of red fox *Vulpes vulpes* population in Białowieża Primeval Forest in the years 1981-2016. Sylwan 161(4): 328-333.
10. Werka J., Krauze-Gryz D., **Gryz J.,** Jasińska J., Jobda M., Kowal P., Golke A. 2015. Stan populacji drobnej drapieżnej zwierzyny dziko żyjącej z gromady ssaki bytującej w m.st. Warszawa. Dokumentacja naukowa wykonana na zlecenie Lasów Miejskich – Warszawa, SGGW w Warszawie.
11. Krauze-Gryz D., Żmihorski M., **Gryz J.** 2017. Annual variation in prey composition of domestic cats in rural and urban environment. Urban Ecosystems 20: 945-952.
12. **Gryz J.,** Krauze-Gryz D. 2017. Dynamics of red fox *Vulpes vulpes* population in Białowieża Primeval Forest in the years 1981-2016. Sylwan 161(4): 328-333.
13. **Gryz J.,** Krauze-Gryz D. 2018. Influence of habitat urbanisation on time of breeding and productivity of tawny owl *Strix aluco*. Polish Journal of Ecology 66(2):153-161.
14. **Gryz J.,** Krauze-Gryz D. 2019. Changes in the tawny owl *Strix aluco* diet along an urbanisation gradient. Biologia 74: 279-285.
15. Krauze-Gryz D., **Gryz J**., Żmihorski M. 2019. Cats kill millions of vertebrates in Polish farmland annually. Global Ecology and Conservation 17: e00516, DOI: 10.1016/j.gecco.2018.e00516.

2. Faunistic studies in central and north-eastern Poland

Faunistic studies were conducted mostly parallelly with studies on biology and ecology of tawny owl and other owl species.

Two of published papers show possibilities of pellet analysis as a method of small mammal inventory (Gryz and Krauze 2007, Żmihorski et al. 2011). Based on the method we presented occurrence of small mammals in some of the areas in central Poland: Warsaw (Gryz et al. 2008), Kampinos National Park (Lesiński et al. 2011), Mazovian Landscape Park (Lesiński et al. 2016), or others (Lesiński and Gryz 2008). With the aid of the same method we documented changes in small mammal fauna as related to introduced protection in Bielański Forest reserve (Lesiński and Gryz 2012). In this area, in the past (before the forest was taken under protection), striped field mouse dominated, which the species typical for urban parks and other human-transformed areas. Yellow-necked mouse was rare. Current pellet analysis data were compared with analogical historical data to show changes in small mammal community. We found out that share of striped field mouse dropped, while yellow-necked mouse started to dominate. This fact points to efficiency of conservation management in the reserve, which brought back its more natural character.

I am also a co-author of a few papers documenting fauna in the vicinity of Rogów, one of my main study areas, occurrence of: mammals (Gryz et al. 2011), owls (Gryz et al. 2013), or rare species of birds (Gryz et al. 2016). These papers are based on unpublished data of current and former employees of Experimental Forest Station in Rogów and Warsaw University of Life Sciences, specimens collected in Forest and Wood Museum in Rogów and our data collected during field studies.

I also took part in a project, which aimed at documenting fauna of Pole Mokotowskie Park, obtained results were considered in plans of park revitalisation.

Selected publikacations:

1. **Gryz J.,** Krauze D. 2007. Analiza wypluwek sów jako bezinwazyjna metoda wykrywania rzadkich gatunków ssaków. Studia i Materiały CEPL 16: 431-437.
Lesiński G., **Gryz J**. 2008. Localities of three rare mammal species in central and northeastern Poland. Fragmenta Faunistica 51: 63-69.
2. **Gryz J.,** Krauze D., Goszczyński J. 2008. The small mammals of Warsaw as based on the analysis of tawny owl (*Strix aluco*) pellets. Annales Zoologici Fennici 45: 281-285.
3. **Gryz J.,** Krauze-Gryz D., Lesiński G. 2011. Mammals in the vicinity of Rogów (central Poland). Fragmenta Faunistica 54: 183–197.
4. Żmihorski M., **Gryz J.,** Krauze-Gryz D., Olczyk A., Osojca G. 2011. The tawny owl *Strix aluco* as a material collector in faunistic investigations: the case study of small mammals in NE Poland. Acta Zoologica Lituanica 21: 185-191.
5. Lesiński G., **Gryz J**. 2012. How protecting a suburban forest as a natural reserve effected small mammal communities. Urban Ecosystems 15: 103-110.
6. **Gryz J.,** Krauze-Gryz D., Goszczyński J. 2013. Występowanie sów Strigiformes na terenie Leśnego Zakładu Doświadczalnego SGGW w Rogowie. Sylwan 157: 695-702.
7. Lesiński G., Romanowski J., **Gryz J.,** Olszewski A., Kowalski M., Krauze-Gryz D., Olech B., Pepłowska-Marczak D., Tarłowski A. 2013. Small mammals of Kampinos National Park and its protection zone, as revealed by analyses of the diet of tawny owls *Strix aluco* Linnaeus, 1758(*). Fragmenta Faunistica 56 (1): 65–81.
8. **Gryz J.,** Krauze-Gryz D. 2016. Rzadkie gatunki ptaków gniazdujące na terenie Nadleśnictwa Rogów w latach 1949–2015. Leśne Prace Badawcze 77: 134-140.
9. Lesiński G., Stolarz P., **Gryz J.,** Dąbrowski R., Krauze-Gryz D., Skrzypiec-Nowak P., Świć J. 2016. Small mammals in the diet of owls in the Masovian Landscape Park and in adjacent areas. Fragmenta Faunistica 59: 73-86.

3. Ecology of red squirrel

For a few years I have been involved in studies on red squirrel ecology. The first of published papers is a review on squirrel diet, showing very wide spectrum of food categories used by the species, depending on where it lives (Krauze-Gryz and Gryz 2015). Next paper shows how squirrels use alien species of trees that grow in Arboretum in Rogów. They ate seeds of many tree and bush species, also those that are absent from squirrel natural range, and also migrated to the arboretum area (Krauze-Gryz et al. 2016). Next, we published a paper in an international team, which showed content of heavy metals (mercury) in squirrel hair. It compared samples from Warsaw and two areas in the UK (Lurz et al. 2017).

Since 2012 I have also taken part in studies on red squirrel ecology in Warsaw, conducted in various green areas (parks and forests). We tested different methods to state presence of red squirrels and to estimate their abundance. Results of an experiment on the possibility to use hair-tubes to assess density of squirrels were shown at an international conference (8th International Squirrel Colloquium, 4-8.06.2018) and a publication is being prepared. Next, in Łazienki Park and in Natolin Forest reserve I took part in a radiotelemetry study. Obtained results showed differences between these two squirrel populations inhabiting areas of very different human influence (squirrels in Łazienki Park are supplementary fed and food seems to unlimited, while in Natolin Forest they use only natural food and the area is

closed for public) in relation to spatial organisation, time spent on the ground and in the tress and activity pattern. We found out that only part of park squirrels used food offered by park visitors, while others were alarmed and run away when people approached. This results were presented at 8th International Squirrel Colloquium, 4-8.06.2018 and the paper has just been resubmitted after revisions to Journal of Zoology. I also currently take part in a research financed from NCN Minatura 2 grant, issued to dr. Dagny Krauze-Gryz, which focuses on different feeding strategies of squirrels in Łazienki Park and how they influence squirrel fitness. Since July 2018 I also help with a field work connected to PhD thesis of Agata Kostrzewa, MSc, entitled "Ecology of red squirrel (*Sciurus vulgaris*) in areas of different anthropogenic transformation".

I am also a co-author of a conference speech (VIII Konferencja AMOP, Obce gatunki w lasach, CEPL Rogów), on grey squirrel expansion in Europe (and possibly also in Poland), the main threat for red squirrel these days. We also published a paper on this issue (Krauze-Gryz and Gryz 2012).

Publications:

1. Krauze-Gryz D., **Gryz J.** 2012. Wiewiórka szara w Polsce – science fiction czy realne zagrożenie. Studia i Materiały CEPL 33: 327-334
2. Krauze-Gryz D., **Gryz J.** 2015. A review of the diet of the red squirrel (*Sciurus vulgaris*) in different types of habitats. W: Shuttleworth C.M., Lurtz P.W.W., Hayward M.W. (red.) Red squirrels: ecology, conservation & management in Europe, European Squirrel Initiative, Wielka Brytania, 39-50.
3. Krauze-Gryz D., Mazur K., **Gryz J**. 2016. Zagęszczenie wiewiórki pospolitej na terenie Arboretum w Rogowie i wykorzystanie przez nią obcych gatunków drzew. Leśne Prace Badawcze 77: 32-41
4. Lurz P., Krauze-Gryz D., **Gryz J.,** Meredith A., Schilling A.-K., Thain Ch., Heller E. 2017. Invisible threats to native mammals - mercury levels in three Eurasian red squirrel populations. Hystrix 28(2):280–283

4. Chiropterological studies

I started studies on bats in 2007 when I joined team of dr. Grzegorz Lesiński. On the basis of bat share in tawny owl diet and data on the abundance of bats in wintering sites we showed correlation between the two parameters. This results show that pellet analysis can be used to monitor bat abundance trends (Lesiński et al. 2008). In the next papers, we analysed predation of tawny owl on bats in human-transformed habitats (Lesiński et al. 2009; 2012). We also authored two notes on bats preyed by eagle owl and long-eared owl (Lesiński et al. 2010; 2014). In 2017 and 2018 we did an inventory of bats in the area of Experimental Forest Station in Rogów, with the use of wide spectrum of methods (netting, ultrasound detectors, controls of wintering sites). This results were compared with earlier results and survey in the Museum of Wood and Forest in Rogów, which allowed for complex characteristic of chiropterofauna in this area (Lesiński et al. 2018).

Publications:

1. Lesiński G., **Gryz J**., Kowalski M. 2008. Does the diet of an opportunistic raptor, the tawny owl *Strix aluco*, reflect long – term changes in bat abundance? A test in central Poland. Folia Zoologica 57: 258-263.
2. Lesiński G., **Gryz J**. 2009. Bat predation by tawny owls *Strix aluco* in differently human-transformed habitats. Italian Journal of Zoology 76: 415-421.

3. Lesiński G., Kusiak J., **Gryz J**. 2009. Nietoperz ofiarą krogulca *Accipiter nisus*. Nietoperze 9: 86-87.
4. Lesiński G., **Gryz J.,** Krauze D. 2010. Borowce wielkie *Nyctalus noctula* w diecie puchaczy *Bubo bubo* z Borów Tucholskich i Pienin. Nietoperze 11: 52-55;
5. Lesiński G. Kasprzyk K., **Gryz J**. 2012. Bats taken by the tawny owl (*Strix aluco*) in relation to its roosting site. North-Western Journal of Zoology 8: 247-251.
6. Lesiński G., **Gryz J.,** Krauze-Gryz D. 2014. Borowiec wielki *Nyctalus noctula* jako ofiara uszatki *Asio otus*. Nietoperze 13: 39-40;
7. Lesiński G., **Gryz J.,** Rachwald A., Krauze-Gryz D. 2018. Bat assemblages in fragmented forest complexes near Rogów (central Poland). Forest Research Papers 79(3) :253-260.

5. Game management

I have been engaged in studies on game management since I started my work in Department of Forest Ecology and Wildlife Management of Forest Research Institute in 2007. I took part in a research grant on abundance dynamics of moose and in an international project financed from Norway Grants (Gryz 2010). At the same time I joined an international team which conducted research on cervids in a vast burned area located in Rudy Raciborskie Forest District. The study was based on VHF telemetry at first and then GPS/GSM. The aim of the study was to assess how this burned area was used by cervid species (red deer, fallow deer) in the context of damages to young forest plantation. GPS/GSM data are now being prepared for publication.

Since 2011 I have been also engaged in game management studies in the Białowieża Forest, where I have supervised and analysed drive census results (Borkowski et al. 2011, Gryz et al. 2016). In this studies I also analysed data collected with the aid of round-year observation forms, I monitored population with trail cameras and snow tracking. Important point was also introduction of alternative methods of ungulate inventory like pellet group counts or distance sampling method. On the basis of collected data I published so far two papers (Gryz and Krauze-Gryz 2017; 2018) and presented them at Polish and international conferences. Collected data are also made available to local forest districts and used in practice when annual and long-term hunting plans are prepared.

Publications:

Gryz J. 2010. Game abundance and hunting bag in Polish forests (numerical data, regional variation, changes in the last decade, available sources with the commentary) In: Polish forest- its condition and processes: 34-45. Forest Research Institute, Sękocin Stary.
http://www.polforex.wne.uw.edu.pl/docs/report_polish_fforest_v2.pdf
2. Borkowski J., Chećko E., **Gryz J.** 2011. Monitoring i ocena zmian liczebności ssaków łownych w Puszczy Białowieskiej w latach 2008-2011. Dokumentacja naukowa. Instytut Badawczy Leśnictwa, Sękocin Stary.
3. **Gryz J.,** Gutowski J., Bystrowski C., Rachwald A., Sućko K. 2016. Dynamika wybranych gatunków zoocenozy na podstawie długoletnich obserwacji prowadzonych w Puszczy Białowieskiej. Dokumentacja naukowa. Instytut Badawczy Leśnictwa, Sękocin Stary.
5. **Gryz J**., Krauze-Gryz D. 2018. Struktura płci i przyrost populacji jelenia *Cervus elaphus* w Puszczy Białowieskiej – porównanie dwóch metod oceny. Sylwan 162 (11): 965-968.

6. An influence of roads on animals

The problem of habitat fragmentation by roads is very current and important. The first studies I conducted during my doctoral studies, when I monitored vertebrate mortality on a local road cross-cutting Biebrza Valley (Gryz and Krauze 2008). These studies showed very high mortality of small vertebrates, on a road with relatively low traffic intensity. The highest number of road kills were detected close to the river. This paper was cited 25 times so far (Web of Science, without self-citations). In the next years I monitored mortality of bats on 72 road (Lesiński et al. 2009) and utilization of an overpass at S7 expressway (Krauze-Gryz and Gryz 2016).

Publications:

1. **Gryz J.,** Krauze D. 2008. Road mortality of vertebrates on the road cross-cutting Biebrza river valley (NE Poland). European Journal of Wildlife Research 54: 709-714.
2. Lesiński G., **Gryz J.,** Krauze D. 2009. Nietoperze ginące na drodze w okolicy Rogowa (województwo łódzkie). Nietoperze 10: 70-72.
3. Krauze-Gryz D., **Gryz J.** 2016. Evaluation of a new wildlife overpass on S7 expressway (central Poland). Annals of Warsaw University of Life Sciences – SGGW 94: 224-230.

7. Entomological studies

In 2011 together with dr. Tomasz Jaworski, we started studies on occurrence of moths from the Tineidae family and other invertebrates in owl pellets and nests of whole-nesting birds. So far two papers were published (Jaworski et al. 2011; 2012), which showed preliminary results. We recorded new localities of *Monopis fenestratella*, which in Poland had been recorded only once before. Since 2015 we have realized a scientific topic "Insects inhabiting pellets and nests of forest birds". The aim is to show relation between substrate (pellets and nests of various bird species) and invertebrate fauna which inhabits them. Additional factors taken into account were forest habitat type and tree species composition of stands where pellets were collected. The study is done mainly in the area of Augustów Forest (coniferous forests), Krotoszyńskie Oakwoods (oak forests) and in Włoszczowa Forest District (alder forest). In the aforementioned areas 60 nest boxes for tawny owls were hung, from which material is collected every year.

Publications:

1. Jaworski T., **Gryz J.,** Buszko J. 2011. *Monopis fenestratella* (Heyden, 1863) (Lepidoptera, Tineidae) – new records from Poland, with notes on species biology. Fragmenta Faunistica 54: 149-151.
2. Jaworski T., **Gryz J.,** Krauze D. 2012. Skrzynki lęgowe puszczyków (*Strix aluco* L.) jako środowisko występowania niektórych gatunków motyli (Lepidoptera). Wiadomości Entomologiczne 31: 17-22

Warsaw, 26-04-2019

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