

IV. URBAN FAUNA: VERTEBRATES

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Characteristic features of animal populations under urbanization – the case of the Blackbird and of the Striped Field Mouse

Abstract. It is postulated that similarities resulting from ecological shifts in characteristics of the synurban populations – high densities, reduced territories, prolonged breeding season, reduced dispersal pressure, change in dietary composition, reduced migratory behaviour – may be attributed to specific use by both species of the benefits offered by the town environment. Some differences found in the urbanization processes of the Blackbird and Field Mouse – different patterns of distribution of synurban populations, morpho-anatomical peculiarities concerning urban synurban populations, but identical in the rural population; different history of their synurbanization – result mostly from different facts, size and stability between the species compared. Other interesting features observed only in one of the species but not investigated in the other may add to any future list of similarities between the two species and allow for more general statements about the synurbanization process. Up to date there is no conclusive proof of genetically based adaptations to urban environments.

INTRODUCTION

The aim of this paper is to compare some ecological and behavioural features of two vertebrate species, which have undergone a process of synurbanization (or urbanization) during the last 100–150 years. The Blackbird *Turdus merula* and the Striped Field Mouse *Apodemus agrarius* are among the most profoundly studied species of urban vertebrates. This paper is based on data already published (mainly by STANISŁAW (1988), LUNIAK et al. (1990), MIZERA (1983), REISE (1990) and SCHNACK (1991) – for the Blackbird, and by ANDRZEJEWSKI et al. (1978), BARNIAGA-WERBA et al. (1979, 1981), GONCZYŃSKI (1979) and GŁOWIŃCZ (1986) – for the Field Mouse). The term “synurbanization” used in this paper has been introduced by ANDRZEJEWSKI et al. (1978) as an analogy to “synanthropization”, but indicating a close connection between an animal population and a specific urban environment.

The comparison of these two species is made to verify the hypothesis that the effect of urban conditions upon the synurban populations is so strong that it produces convergent changes in behavioral and ecological characteristics of taxonomically

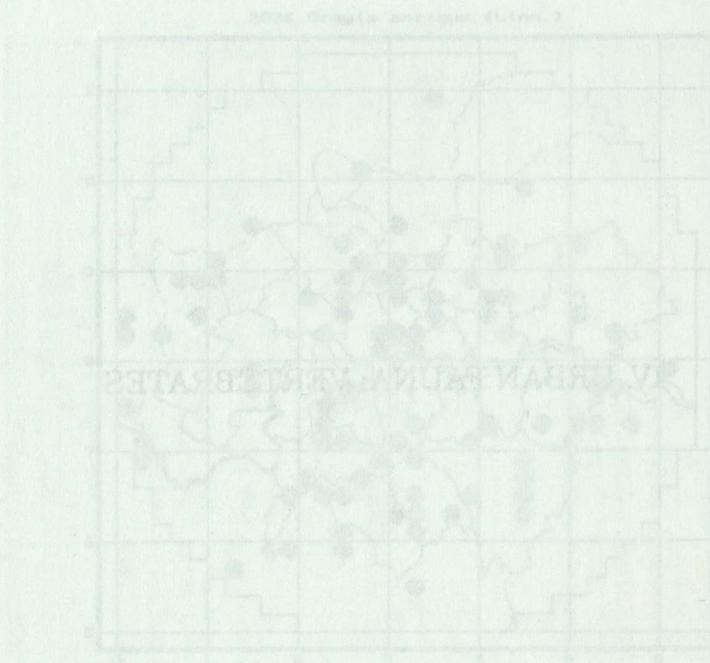


Fig. 13

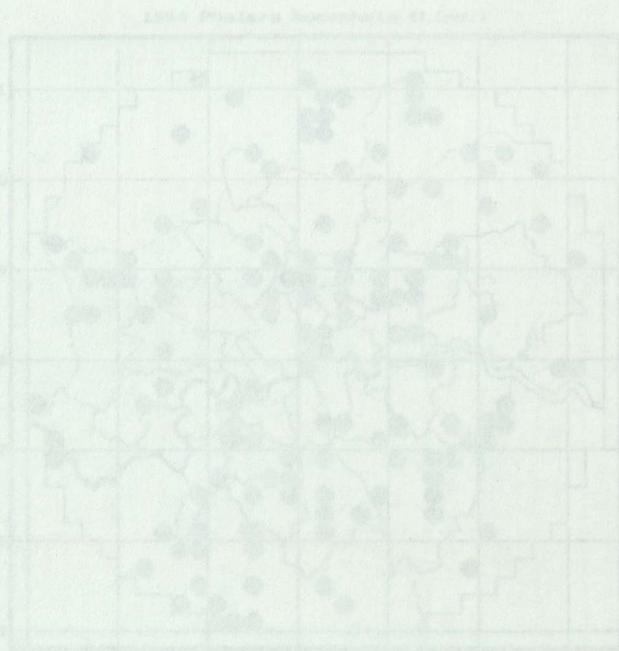


Fig. 14

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Joanna GLIWICZ, Jacek GOSZCZYŃSKI, Maciej LUNIAK

Characteristic features of animal populations under synurbization – the case of the Blackbird and of the Striped Field Mouse

Abstract. It is postulated that similarities resulting from analogical shifts in characteristics of the synurbic populations – high densities, reduced territories, prolonged breeding season, reduced predator pressure, change in dietary composition, reduced migratory behaviour – may be attributed to similar use by both species of the benefits offered by the town environment. Some differences found in the synurbization processes of the Blackbird and Field Mouse – different pattern of distribution of synurbic populations; morpho-anatomical peculiarities occurring in urban mouse population, but absent in the bird population; different history of their synurbization – result mostly from different body size and mobility between the species compared. Other interesting features observed only in one of the species but not investigated in the other may add to any future list of similarities between the two species and allow for more general statements about the synurbization process. Up to now there is no conclusive proof of genetically based adaptations to urban environments.

INTRODUCTION

The aim of this paper is to compare some ecological and behavioural features of two vertebrate species, which have undergone a process of synurbization (= urbanization) during the last 100–150 years. The Blackbird *Turdus merula* and the Striped Field Mouse *Apodemus agrarius* are among the most profoundly studied species of urban vertebrates. This paper is based on data already published (mostly by STEPHAN (1985), LUNIAK et al. (1990), MIZERA (1989), REISE (1990) and SCHNACK (1991) – for the Blackbird, and by ANDRZEJEWSKI et al. (1978), BABIŃSKA-WERKA et al. (1979, 1981), GOSZCZYŃSKI (1979) and GLIWICZ (1980) – for the Field Mouse. The term “synurbization” used in this paper has been introduced by ANDRZEJEWSKI et al. (1978) as an analogy to “synanthropization”, but indicating a close connection between an animal population and a specific urban environment.

The comparison of these two species is made to verify the hypothesis that the effect of urban conditions upon the synurbic populations is so strong that it produces convergent changes in behavioral and ecological characteristics of taxonomically

distant species. If this hypothesis is supported by this and future studies, it will allow prediction of the changes in characteristics of other vertebrate species undergoing the process of synurbization, or even to predict the chances of different species becoming city dwellers on the basis of their capacity for such changes.

THE SPECIES COMPARED AND THE HISTORY OF THEIR SYNURBIZATION

The Blackbird is primarily a forest species, though often nesting on forest edges and in small patches of woodland. It is a common bird in Europe. During the breeding season (spring and early in summer) it feeds on insects, later it becomes mainly frugivorous. Blackbird nests are usually located in trees and shrubs. The species is strictly territorial during the breeding season, and solitary or living in unstable groups outside this period. Synurbization processes in the Blackbird populations have been observed since the middle of the 19th century, first in western Europe and later in central and then eastern Europe. In some cases the Blackbird was artificially introduced into towns situated outside the natural range of occurrence of synurban populations. At the present moment, it is one of the most common bird species in towns.

The Striped Field Mouse is a species living both in forest and field habitats, often present in field-forest ecotones. Usually cultivated fields are occupied during spring and summer and forest habitats invaded seasonally in autumn by the mice to overwinter there. The species is common in eastern and south-eastern parts of Europe. Its diet differs from other rodents' diets in having a relatively high proportion of animal food in the form of insects and other invertebrates. The first urban populations of this species in Poland were observed over 70 years ago. It is known that the species was absent in central parts of Warsaw 100 years ago (WAŁECKI 1881), but it was present there 40 years later (SUMIŃSKI 1922). Since that time the Striped Field Mouse has become a permanent city dweller, and the most common rodent in urban green areas.

SIMILARITIES IN SYNURBIZATION PROCESSES OF THE TWO SPECIES

The character of changes caused by synurbization of these two species has been assessed by comparing certain characteristics of the urban population with those of non-urban ones. The scope of the comparison has been limited to those features which have been studied in the urban and non-urban populations of both species, and due to different interests and different study methods used by ornithologists and mammalogists, the ranges of parameters estimated for each of the species only partly overlapped.

It has been found that in many respects the changes caused by synurbization were parallel in both species, so the shifts in many ecological and behavioural characteristics were similar (Tab. 1). The changes in demographic characteristics of urban Blackbirds and Field Mice are as follows:

Table 1. Similarities in synurbization processes of the Blackbird and the Striped Field Mouse, expressed as specific features of their urban populations in comparison to non-urban ones.

IN DEMOGRAPHY AND POPULATION DYNAMICS	
•	Higher density and reduced territories
•	Prolonged breeding season
•	Higher survival in winter
•	Reduced losses from predators
IN BEHAVIOUR	
•	Shift in diet composition
•	Nesting in/on man-made constructions
•	Reduced migratory behaviour
•	Reduced fear of man

1. Urban populations of both species live in much higher density than their non-urban populations. In the case of the Blackbird the urban population density is 10–20 times higher: 20–50 pairs per 10 ha in western Europe and western Poland and 6–19 pairs in central Poland, as opposed to 0.5–3 pairs per 10 ha in forests in Poland and east Germany. In the case of Field Mice the population density in towns is 5–10 times higher: 40–80 individuals per ha in some city parks as opposed to less than 10 in rural habitats.

2. In towns the breeding season of both species is longer than outside town in the same geographical region. Urban Blackbirds laid their first eggs 1–4 weeks earlier and their last fledglings leave the nests four weeks later. In the urban Field Mice a prolongation of the breeding season in autumn was observed. In October urban mice were still sexually active, whereas in forests all were by then already inactive for the winter season. There was also some circumstantial evidence of winter reproduction in towns; a very rare event in rural populations of this species.

3. In populations of both species better survival during the winter was observed in towns than outside towns. In the urban Blackbirds generally greater mean longevity (by 1–1.5 year) was observed, and it was attributable mostly to better winter survival, caused by limited migration (see below). In urban Field Mice the assessment of life-span was not made, but their better winter survival was proved by direct estimation of numbers of individuals marked in the autumn and recaptured the following spring (35% in the town as opposed to 23% in the forest).

4. Both urban populations experience lower predator pressure than their non-urban counterparts. Support for this thesis for Blackbirds comes from the observation of albinotic and handicapped individuals present in towns, whereas in forest populations such individuals are immediately removed by predators. Remains of the Field Mouse were much less frequently present in the pellets of raptors and owls in urban areas than in the fields and forest. Taking into account the fact that in rural areas the species is only one of the many components of the rodent community and in towns it is most numerous of the few rodent species, the opposite should be true. The observed

low frequency of the mice in the diet of raptors in towns is due to the greater pressure of raptors on House Sparrows (GOSZCZYŃSKI et al. 1993). The effect of urban domestic animals (cats and dogs) in preying upon the mice has not been studied, but generally mouse mortality due to predation seems to be low in towns.

There were also many similar, important changes to the behaviour of Blackbirds and Field Mice caused by the fact that they become town dwellers.

1. Similar changes in both species occurred in their feeding behaviour. First of all, both species included new food items of anthropogenic origin in their diet; secondly, they shifted the spectrum of the animal components of their food towards those species of invertebrates which are most abundant in towns (BABIŃSKA-WERKA 1979, LUNIAK et al. 1990). As the result of these changes their food supply in urban areas is more abundant than in non-urban habitats.

2. Both species changed their nesting habits by including a great variety of man-made objects as places for nest and shelter location. Nests of Blackbirds are found on and inside buildings as well as on other artificial objects. Field Mice use cracks in concrete constructions, buildings and tombs as shelters and sites for nests.

3. In urban populations of both species reduced migratory behaviour was observed. Although the term "migration" covers different ecological phenomena in case of birds and small mammals, the observed reduction of migratory behaviour produced the same effect in both species: a more sedentary existence for individuals under the urban conditions. Urban Blackbirds tend to spend the winter in the towns in which they breed. Urban field mice do not change habitats in the autumn, as they do in non-urban areas. Also pre-reproductive dispersal of the young from parental habitats seems to be very limited.

4. In case of both species reduced fear of man has been observed. Blackbirds living in town reduced distance of escape by about 90% (1.5–5 m in towns as opposed to 50–80 m in forests). Mice which are strictly nocturnal in non-urban habitats, became diurnal in town parks despite the constant presence and high levels of activity of human visitors.

DIFFERENCES IN URBAN POPULATIONS OF BLACKBIRDS AND FIELD MICE

Beside the similarities given, the comparison of the Blackbird and the Field Mouse has revealed several differences between ecological and other biological traits characteristic of their urban populations (Tab. 2). Some of these differences have been shown by independent studies of a given feature in each of the populations obtaining different results. Other differences must be treated as unconfirmed, because the characteristic concerned has been studied in depth only in one species, and probably needs more studies in the other.

Among the confirmed differences the following three are the most important:

1. In urban areas there is continuity in the distribution of the bird and discontinuity in the distribution of the mice. Blackbirds inhabiting different green areas within the city move easily from one patch to another, as well as between urban and suburban areas. In contrast to this, the distribution of the urban Field Mice is distinctly insular with little or no successful movement between inhabit patches. Also

contacts between central and peripheral populations of urban mice are negligible due to the barriers created by the urban infrastructure.

Table 2. Differences in synurban populations of the Blackbird and the Striped Field Mouse: + occurrence of the features in the species, - lack of the feature in the species, ? insufficient data to confirm the feature occurrence.

CHARACTERISTICS	BLACKBIRD	MOUSE
A. Confirmed differences		
Continuity in distribution of urban population	+	-
Morpho-anatomical distinctions found in urban populations	-	+
History of synurbization		
B. Unconfirmed differences		
Breeding losses decreasing during the season	+	?
Increased intraspecific aggression	?	?
Increased infestation with parasites	?	+
Inferior blood parameters	?	+

2. In urban Field Mice some morphological, anatomical and physiological features differed significantly from those of non-urban Field Mice. Such differences were not found between urban and non-urban Blackbirds. The differences described between urban and non-urban mice included: higher body mass in towns (2.5–5 g more); different ratio of internal organ mass to body mass for liver, pancreas and kidneys (LIRO 1985); different craniometric characteristics and non-metric skull features (SIKORSKI 1979); and differences in transferrin polymorphism (DOBROWOLSKA, CHABROS 1978).

3. The two compared species differ somewhat in the process by which they become town dwellers. In the case of the Blackbird the first step toward synurbization consists usually of overwintering in the town and then staying there for the breeding season. This is a colonization by invasion of an area which was not inhabited by the species before. The Field Mice can colonize towns in a similar way, by invasion from the outskirts towards the centre. However, they become the city dwellers also in another way. They are able to persist in an area which undergoes transformation from rural into urban, and survive there through all the processes of development and urbanization (GOSZCZYŃSKI, WERKA 1979).

The unconfirmed differences were found in the following characteristics:

1. In the Blackbird it was found (MIZERA 1988, REISE 1990, SCHNACK 1991) that the breeding losses in towns decrease toward the end of the season. In forest populations of the Blackbird such relationship does not occur. Data on reproduction collected for urban mice are too sparse for such detailed analysis.

2. In dense urban populations of the Blackbird increased intraspecific aggression was observed, e. g. fights between females, which were never encountered in forest populations. Such an increase in aggressiveness among individuals should be also

expected in urban Field Mice; however, the appropriate analysis (e. g. of frequency of wounds on mouse bodies) was not carried out in urban studies.

3. Field Mice in towns are more infested with parasites than non-urban ones. Also the composition of the parasitic fauna in towns is different. Larval stages of parasites, which in adult form live in dogs and cats, were found in urban mice (B. KISIELEWSKA, personal comm.). These parasites were never found in non-urban Field Mice. There is little information about the parasitology of the urban Blackbird, and higher infestation with parasites has never been reported.

4. Haematological studies of the Field Mouse in towns revealed inferior blood parameters of these mice in comparison with non-urban ones. The most distinct differences were found in the numbers of leucocytes, significantly lower in the urban population, and in the oxygen carrying capacity of blood, also lower in towns (REWKIEWICZ-DZIARSKA et al. 1977). This can be an effect of heavy pollution in towns. Analogical studies were not performed for the Blackbird. It seems, however, that the mice as organisms living on ground level and partly fossorial, and eating green parts of plants may be more affected by air and soil pollution than Blackbirds.

CONCLUSIONS

General ecological characteristics of the two species examined, and also a variety of other higher vertebrates undergoing synurbanization, suggest that some species are more pre-conditioned for becoming city dwellers than others. Among important pre-requisites for synurbanization are: lack of strict habitat requirements; wide spectrum of diet, including both plant and animal components; and demographic and behavioural plasticity.

The stated similarities in ecological features achieved by urban populations of the bird and the small mammal stem from similar ways of taking advantage of the generous offer of the town environment. This environment offers:

1. Food supply sufficient for high population densities and lower migration.
2. Nesting sites and shelters sufficient for higher population densities and reduced individual (pair) territory size.
3. Reduced biocenotic control: fewer predators and interspecific competitors, which affects longevity of urban populations.
4. Reduced seasonality, which produces better winter survival, longer breeding seasons and limitation in seasonal migrations.

The differences noted between urban populations of the Blackbird and the Field Mouse may be attributed to differences in body size and mobility of the species: continuity or urban distribution of the bird as opposed to insularity of urban populations of the mouse; different ways of becoming city dwellers. Some differences are due to the different niches of the species (possible cat and dog pressure on mice; composition of parasites; effect of pollution).

There are no conclusive proofs of genetically based population adaptations to urban conditions. All changes in demographic parameters which occurred in urban populations (in comparison with non-urban ones) can be explained by the direct effects of specific urban conditions. All changes in behaviour, which allow these

animals to make good use of the advantages of an urban environment, seem to be within the natural range of phenotypic plasticity. Recent laboratory tests of behavioural components in urban and forest Blackbirds revealed mainly a better learning capability in urban birds (WALASZ 1991).

On the other hand, morphological, anatomical and physiological differences between urban and non-urban mice indicate genetic differences between the populations. However, it is impossible to show that they increase the fitness of individuals under urban conditions. Moreover, it is not certain that they reveal real differences between urban and non-urban populations. The method by which the comparison was made usually included only one urban and one non-urban population, and it is possible that urban populations of the field mice differ randomly from each other due to founder effect (they were usually founded by very small groups of invaders), inbreeding and genetic drift, which are highly probable in "insular" populations.

REFERENCES

- ANDRZEJEWSKI R., BABIŃSKA-WERKA J., GLIWICZ J., GOSZCZYŃSKI J. 1978. Synurbization processes in an urban population of *Apodemus agrarius*. I. Characteristics of populations in urbanization gradient. *Acta theriol.*, **23**: 341–358.
- BABIŃSKA-WERKA J. 1981. Food of the Striped Field Mouse in different type of urban green areas. *Ibidem*, **26**: 285–99.
- BABIŃSKA-WERKA J., GARBARCZYK H. 1981. Animal components of the diet of the Striped Field Mouse under urban conditions. *Ibidem*, **26**: 301–318.
- BABIŃSKA-WERKA J., GLIWICZ J., GOSZCZYŃSKI J. 1979. Synurbization processes in an urban population of *Apodemus agrarius*. II. Habitats of the Striped Field Mouse in town. *Ibidem*, **26**: 405–415.
- BABIŃSKA-WERKA J., GLIWICZ J., GOSZCZYŃSKI J. 1981. Demographic processes in an urban population of the Striped Field Mouse. *Ibidem*, **26**: 275–283.
- DOBROWOLSKA A., CHABROS E. 1978. Serum proteins of *Apodemus agrarius* (PALLAS 1771) from different urban environments. *Bull. Acad. Pol. Sci.*, **28**: 505–510.
- GLIWICZ J. 1980. Ecological aspects of synurbization of the Striped Field Mouse *Apodemus agrarius* (PALL.). *Wiad. ekol.*, **26**: 117–124.
- GOSZCZYŃSKI J. 1979. Density estimation for an urban population of the Field Mouse. *Acta theriol.*, **24**: 417–419.
- GOSZCZYŃSKI J., JABŁOŃSKI P., LESIŃSKI G., ROMANOWSKI J. 1993. Variation in diet of Tawny Owl *Strix aluco* along an urbanization gradient. *Acta orn.*, **27**:
- GOSZCZYŃSKI J., WERKA J. 1979. Influence of development and technical structure on fauna migrations. *Człowiek i Środ.*, **3**: 55–64.
- LIRO A. 1985. Variation in weights of body and internal organs of the Field Mouse in a gradient of urban habitats. *Acta theriol.*, **30**: 359–377.
- LUNIAK M., MUSLOW R., WALASZ K. 1990. Urbanization of the European Blackbird – expansion and adaptations of urban population. In: M. LUNIAK (ed.). *Urban ecological studies in central and eastern Europe*. Wrocław, pp. 187–199.
- MIZERA T. 1978. An ecological study on the synanthropic avifauna of the Solacz District in Poznań in 1975–1984. *Acta zool. cracov.*, **31**: 3–64.
- REISE H. 1990. Untersuchungen zur Ökologie und Biologie der Amsel (*Turdus merula*) in Stadtzentrum von Leipzig. *Zool. Abh. Staatl. Mus. Tierkunde Dresden*, **45**: 155–178.
- REWKIEWICZ-DZIARSKA A., WIELOPOLSKA A., GIL J. 1977. Hematological indices of *Apodemus agrarius* (PALLAS 1771) from different urban environments. *Bull. Acad. Pol. Sci.*, **25**: 261–268.
- SCHNACK S. 1991. The breeding biology and nestling diet of the Blackbird *Turdus merula* L. and the Song Thrush *Turdus philomelos* C. L. Brehm in Vienna and in an adjacent wood. *Acta orn.*, **26**: 85–106.
- SIKORSKI D. M. 1982. Craniometric variation of *Apodemus agrarius* (PALLAS 1771) in urban green areas. *Acta theriol.*, **27**: 71–82.
- STEPHAN B. 1985. *Die Amsel Turdus merula*. Wittenberg Lutherstadt, 231 pp.

- SUMIŃSKI S. 1922. Fauna Warszawy. *Ziemia*, **7**: 328–335.
- WALASZ K. 1990. Experimental investigations on the behavioural differences between urban and forest blackbirds. *Acta zool. cracov.*, **33**: 235–271.
- WALECKI A. 1881. Fauna zwierząt ssących Warszawy i jej stosunek do fauny całego kraju. *Pam. fizjogr.*, **1**: 268–291.

Joanna Gliwicz and Jacek Goszczyński
Agricultural University of Warsaw
Dept of Wildlife Management
ul. Rakowiecka 26/30, 02-528 Warsaw
POLAND

Maciej Luniak
Museum and Institute of Zoology PAS
ul. Wilcza 64, 00-679 Warsaw
POLAND