



## DISPERSAL OF TERRESTRIAL GASTROPODS BY BIRDS DURING THE NESTING PERIOD

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**ABSTRACT:** We observed a blackcap *Sylvia atricapilla* L. (Sylviidae) which carried terrestrial gastropods *Fruticicola fruticum* (O. F. Müller) (Bradybaenidae) and *Zonitoides nitidus* (O. F. Müller) (Zonitidae) in a deciduous forest. Similarly, a blackbird *Turdus merula* L. (Turdidae) was observed carrying a slug, *Arion subfuscus* s. l. (Arionidae), in a dry pine forest. *Z. nitidus* was transported over a distance of at least 48 m, while *A. subfuscus*, no less than 25 m. The possibility of terrestrial gastropod dispersal by birds during the chick-feeding period is discussed.

**KEY WORDS:** terrestrial Gastropoda, *Fruticicola fruticum*, *Zonitoides nitidus*, *Arion subfuscus*, dispersal, birds, *Sylvia atricapilla*, *Turdus merula*

### INTRODUCTION

Home ranges of land gastropods vary widely in size, as their radius ranges from several decimetres for small-sized species to several dozen metres for the big ones (E. V. SHIKOV, unpublished). Many land gastropod species are stenoecious, and this considerably limits their dispersal abilities. Not only wide roads but even narrow forest paths may turn out to be impenetrable barriers for snails. Therefore, passive dispersal is of special importance for them – they can be carried by wind, water, mammals, birds, and people (REES 1965, DUNDEE et al. 1967, VAGVOLGYI 1975, 1978, SHIKOV 1977, 1981, FISHER et al. 1996, KIRCHNER et al. 1997, DÖRGE et al. 1999, HORNUNG

et al. 2003, KAWAKAMI et al. 2008, BEINLICH & PLACHTER 2010, MACIOROWSKI et al. 2012).

Land snails can be accidentally or deliberately transported by birds. Birds of numerous species bring snails to their chicks as food (AKRAMOVSKIY 1970, KISS et al. 1978, KORNUSHIN et al. 1984, BEREZANTSEVA 1997, BELSKIY et al. 1998, ALLEN 2004, ZEMOGLYADCHUK 2004, ROSIN et al. 2011). However, data on the distances over which the snails are carried by birds are scarce (KIRCHNER et al. 1975, VAGVOLGYI 1975, 1978). Here we provide more information on the distances over which terrestrial gastropods can be dispersed by birds.

### MATERIAL AND METHODS

Bird nests built in habitats with poor mollusc fauna were chosen for this research. A. A. VINOGRADOV did long-term observations of birds feeding their chicks there. Birds bringing land snails for their chicks were registered. E. V. SHIKOV studied the malacofauna of the habitats surrounding the nests. The chick-feeding observations included pho-

tos and video recordings with an automated candid camera. The malacological part of the study was carried out using traditional methods (LIKHAREV & RAMMELMEIER 1953); the nomenclature follows SHILEYKO (2004) and SYSOEV & SHILEYKO (2005). Weight of individuals living in wet conditions was determined with a scale. The plant associations were

classified according to NEVSKIY (1960) and RYSIN & SAVELYEVA (2008).

Feeding chicks with snails was observed primarily in a blackcap (*Sylvia atricapilla* L.) nest located in the western part of the Beriozovaya Rotscha Park in the city of Tver, Russia. The park was planted in the early 20th century, replacing cultivated fields and meadows. At first it was composed of birch trees only. Later, the park did not get proper maintenance, and now its western part resembles a natural deciduous forest. The park is situated on a plain, and the microrelief is not prominent. The soil is clayey. The trees include *Betula pendula* Ehrhart, *Populus tremula* L., *Alnus incana* Moench, *Fraxinus excelsior* L., the shrubs – *Rhamnus frangula* Miller, *Corylus avellana* L., *Sambucus*

*nigra* L. and *Sorbus aucuparia* L. The herb layer is scanty and composed of *Aegopodium podagraria* L., *Geum rivale* L., *Lysimachia nummularia* L., *Urtica dioica* L., and other herbs. The litter consists of leaves and twigs, and is 2–5 cm thick. The observations of the blackcap nest were conducted in daylight on 20–25 June 2010. Photographs of the birds near the nest were taken daily from 11:00 to 14:00.

A blackbird (*Turdus merula* L.) nest was observed 55 km south of Tver, in the vicinity of Feryazkino village in the Tver Region. The nest was located on a pine tree in a *Pinetum hylocomiosum purum* forest. The observations were conducted in daytime, on 7–25 June 2011, and 2–3 video sessions were held daily. Each session lasted 2 hours.

## RESULTS AND DISCUSSION

On 23 June 2010, approximately at noon, A. A. VINOGRADOV took a series of photos of the blackcap at its nest in the deciduous forest. The photos clearly show the bird holding a butterfly larva and two snails in its beak (Figs 1–4). The shells of both snails appear intact. The big snail in the foreground is a young *Fruticicola fruticum* (O. F. Müller, 1774) of the family Bradybaenidae. As can be seen through the slightly translucent shell, the snail's body is retracted. The bird is holding *F. fruticum* by the edge of the shell. The shell has 3.1 whorls, so the snail is a juvenile (adults of the species have shells of 4–5.4 whorls). In wet weather period, the snails with this whorl number weigh from 100 to 130 mg. The smaller dark snail in Figs 1–4 is *Zonitoides nitidus* (O. F. Müller, 1774) of the family Zonitidae. The snail is an adult. The adult weight of the species ranges from 49 to 66 mg.

In order to determine the possible source of the snails, we observed the western part of the Beriozovaya Rotscha Park, where the nest was located. Its malacofauna is characteristic of planted deciduous forests and includes *Cochlicopa lubrica* (O. F. Müller), *Trochulus hispidus* L., *F. fruticum*, *Arion fasciatus* (Nilsson) and *Succinea putris* L. Since *F. fruticum* occurs in the whole western part of the park, the place where the bird found it could not be determined. By contrast, *Zonitoides nitidus* is a hygrophile, and the nearest site where it occurs is 48 m away from the blackcap nest. The site is a wet silted bank of a small stream, inhabited by hygrophiles: *S. putris*, *Deroceras laeve* (O. F. Müller), *Vallonia pulchella* (O. F. Müller), *Z. nitidus*, *Pseudotrachia rubiginosa* (Schmidt), and slugs. Other places inhabited by *Z. nitidus* in the same part of the park are farther away from the nest: 67 and 96 m, respectively. Therefore, it can be assumed that the blackcap transports *Z. nitidus* over distances of not less than 48 m.

A series of photos of the blackbird with a slug was taken on 23 June 2011 at 11 AM in the coniferous for-

est. The photos show the bird holding *Arion subfuscus* (Draparnaud, 1805) s. l. of the family Arionidae in its beak and then feeding it to its chick (Figs 5–7). The uniformly brown colour of the slug dorsum indicates an adult. In that forest, the average adult weight of the species was 1.4 g.

*Pinetum hylocomiosum purum* forests are very dry and not inhabited by *A. subfuscus* (SHIKOV 1981). On the sandy soils there are also various mosses, such as *Pleurozium schreberi* (Brid.) Mitt., *Dicranum schraderi*



Fig. 1. Blackcap *Sylvia atricapilla* L. at its nest, with a butterfly larva, *Fruticicola fruticum* (O. F. Müller) and *Zonitoides nitidus* (O. F. Müller). (Drawn by E. V. SHIKOV from a photo by A. A. VINOGRADOV)



Figs 2–4. Blackcap *Sylvia atricapilla* L. at its nest, with a butterfly larva, *Fruticicola fruticum* (O. F. Müller) and *Zonitoides nitidus* (O. F. Müller). (Photos: A. A. VINOGRADOV)

Wahlenb., *Ceratodon purpureus* (Hedw.) Brid. and many others. The pine tree with the blackbird nest was located on a hill slope. Down along the slope, *Pinetum hylocomiosum purum* was replaced by *Pinetum vaccinosum*, and then by *Pinetum myrtillosum*. *Pinetum*

*vaccinosum* was also a dry forest with *Vaccinium vitis idaea* L. and *Melampyrum pratense* L. apart from the mosses. No gastropods were found there. *Pinetum myrtillosum* was moderately moist. Its shrub layer consisted of *Vaccinium myrtillus* L. There were many herb

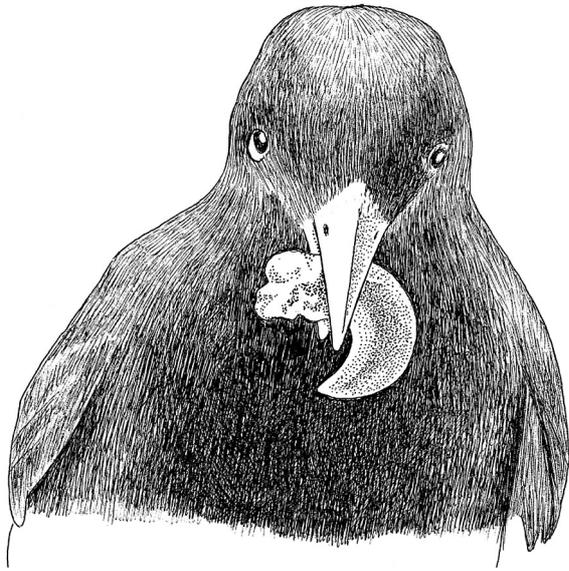


Fig. 5. Blackbird *Turdus merula* L. at its nest, with *Arion subfuscus* (Drap.) s. l. (Drawn by E.V. SHIKOV from a photo by A. A. VINOGRADOV)

species, such as *Lusula pilosa* Willd., *Calamagrostis arundinacea* Roth., *C. lanceolata* Roth., *Viola canina* L., *Pirola rotundifolia* L. and others. It was the only place where *A. subfuscus* and some other gastropod species *Vitrina pellucida pellucida* (O. F. Müller, 1774), *Perpolita hammonis* (Strøm, 1765) and *Euconulus fulvus* (O. F. Müller, 1774) were recorded. Therefore, the bird had carried the slug over a distance of at least 27 m.

Feeding their chicks, adult birds sometimes lose some of the food they transport to the nest. Birds can accidentally drop their prey on their way to the nest as well as at the nest itself. Besides, the chicks regurgitate some hard-covered invertebrates (BELSKIY et al. 1998, GRAVELAND 1996; A. A. VINOGRADOV, unpublished).

We have observed many bird species feeding their chicks. Initially the bird puts the food it has brought into the chick's open beak but the chick does not always swallow it at once. If it does not close its beak for a long time, the parent will take part of the food away from the chick's open beak and put it into the beaks of the other chicks. Doing this, the parent bird sometimes accidentally drops some parts of the food onto the nest edges and beyond it. The snails that fall onto



Figs 6–7. Blackbird *Turdus merula* L. at its nest, with *Arion subfuscus* (Drap.) s. l. (Photos: A. A. VINOGRADOV)



the ground may find suitable conditions there. In such cases, birds accidentally aid the spread of gastropods. For terrestrial gastropods this is of considerable significance, considering their very limited capability of active dispersal resulting from slow movement and often strict ecological requirements regarding moisture, litter quality, food, shelters, etc. For example, in natural habitats, *Z. nitidus* usually moves 1–2 m a year (E. V. SHIKOV, unpublished).

Gastropods can be carried considerably farther than we have succeeded to prove. According to our data, the blackcap usually forages for food for its chicks within 30 to 50 m from the nest but sometimes, when searching for food, it can cover a distance of more than 100 m. Besides, we have recorded blackbirds bringing to their nest larvae of aquatic beetles (Dytiscidae, *Macrodytes* sp.) from a pond about 300 m away.

The role of birds in slug dispersal requires further studies. Fig. 5 shows the anterior part of *A. subfuscus*, badly deformed and possibly pecked. We have not recorded any live slugs to be carried by birds but simple pressing of a slug with a bird's beak usually does not cause death.

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