



Selective mortality of seedlings in response to predation by the slug *Arion vulgaris* (Mollusca: Arionidae)

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Abstract

We investigated the preference of the invasive slug *Arion vulgaris* for seedlings of dicotyledonous herbs. In the field experiment made in Prague (50.086 N 14.297E), seedlings of 25 herb species were exposed to predation by a natural population of slugs. Seeds, spread on the surface of moist potting compost pressed into plastic cups, were allowed to germinate and grow until the cotyledon stage. The cups, each containing the seedlings of one species, were exposed in a 5 × 5 block and replicated five times. After 7 days of exposure, the average mortality of the herb species (percentage of seedlings with devoured hypocotyl and cotyledon leaves) differed significantly and ranged from >95% (*Atriplex sagittata*, *Portulaca oleracea*, *Spergula arvensis*) to <20% (*Cerastium holosteoides*, *Vicia cracca*, *Euphorbia peplus*). The mortality of seedling species was positively related to their size and different between therophytes vs. hemicryptophytes. In the laboratory experiment, seedlings of 11 species were exposed to predation for 9 h, at constant 20 °C and in darkness. The mortality of seedling species also differed significantly and correlated marginally significantly with the mortality in the field experiment. Slugs affected seedling mortality selectively in the period when feeding activity of their population was low. In temperate climate of Central Europe, such period occurs in spring and autumn, at the time when seedlings of most herb species emerge. It is likely that slugs, by selectively feeding on herb species at the seedling stage, can influence the composition of herb populations.

Keywords *Arion vulgaris* · Slug · Herb · Seedling · Predation/field · Laboratory · Plant mass

Introduction

Arion vulgaris Moquin-Tandon, 1855 (= *Arion lusitanicus* auct. non J. Mabille, 1868) is the most important invasive species of terrestrial mollusc in Central Europe. The species originates from SW France (Quinteiro et al. 2005; Zemanova et al. 2016; Zajac et al. 2017) and, since the 1960s, has spread from western to southern, central and northern Europe (Kozłowski 2005). The mollusc was first found in the Czech Republic in 1991 (Juříčková 1995; Dvořák and Horsák 2003) and is now abundant throughout the country at altitudes of <600 m (Horsák et al. 2013). *Arion vulgaris* has become the dominant slug species in ruderal, garden, meadow and field habitats. Its wide distribution can be attributed to its broad polyphagy: it consumes the leaves and flowers of many species of dicotyledonous wild herbs

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(Kozłowski and Kozłowska 2004; Honek and Martinková 2014) and crops (Kozłowski and Jaskulska 2014).

Slugs generally prefer certain adult plant species over others (Getz 1959; Fenner et al. 1999). In *A. vulgaris*, out of 95 species of adult herbs offered for consumption, only 31% were preferred, 48% had low palatability, and 23% were rejected (Kozłowski and Kozłowska 2009). Even more than adult plants, however, *A. vulgaris* prefers to consume seedlings. For example, it preferred the seedlings of dandelion (*Taraxacum officinale*) over adult plants of all species available in the vicinity (Honek et al. 2013). The feeding preferences of slugs have been intensively studied because they are pests of field crops, vegetables and ornamental plants (Hommay 2002; Port and Ester 2002; Kozłowski and Kozłowska 2004). Studies have focused on adult herbs as the slugs mainly devour leaves (Brinner and Frank 1998; Kozłowski and Kozłowska 2009; Moshgani et al. 2017). Their food preferences are influenced by the content of nitrogen (Gebauer 2002), cellulose, which affects the mechanical stiffness of leaves (Pálková and Lepš 2008), and substances that affect the taste and smell of the leaves (Shannon et al. 2016).

Slugs prefer seedlings to adult plants because of the low concentration of repellent substances in their tissues (Albrechtsen et al. 2004; Horrill and Richards 1986; Fritz et al. 2001; Hanley et al. 2011; Shannon et al. 2016; Hanley et al. 2018; Zhang et al. 2024). Consumption of seedlings is also supported by easy access to them from the soil surface on which slugs crawl (Scheidel and Bruelheide 2004), the softness of seedling tissues and the smoothness of the leaf cuticle, which is free of hairs and scales (Scheidel and Bruelheide 1999).

It is likely that the arrival and mass occurrence of *A. vulgaris* in the newly occupied areas of Central Europe has had an impact on the composition of herb communities. Changes in the composition of these communities may occur not only as a result of increased consumption of stems, leaves and flowers of preferred and low consumption of neglected adult plant species. Greater pressure on herbaceous communities may occur due to the predation of seedlings, which always entails the destruction of the entire individual. Therefore, information on preferences for seedlings is important. However, informations available on the variations in preference of slugs for the seedlings of different plant species are few. This is because only a small number of plant species have been tested for palatability to slugs at the seedling stage (Scheidel and Bruelheide 2004, 2005; Hitchmough and Wagner 2011). This applies also to *A. vulgaris*, where differences in preference for adult herb species have been investigated thoroughly (Brinner and Frank 1998; Kozłowski and Kozłowska 2004, 2009) but information about differences in preference for seedlings is lacking.

The aim of our study was to determine the preferences of *A. vulgaris* slugs for herb seedlings. We investigated seedlings of 25 herb species, which is more than in any earlier study. This allowed us to determine the extent of differences in mortality of individual species caused by predation of *A. vulgaris*. Such broad range of species also allowed us to attempt at establishing a relationship between the size of seedling and intensity of their consumption. Finally, we contemplate the effects of seedling predation on changes in composition of herb communities.

Materials and methods

Field experiment

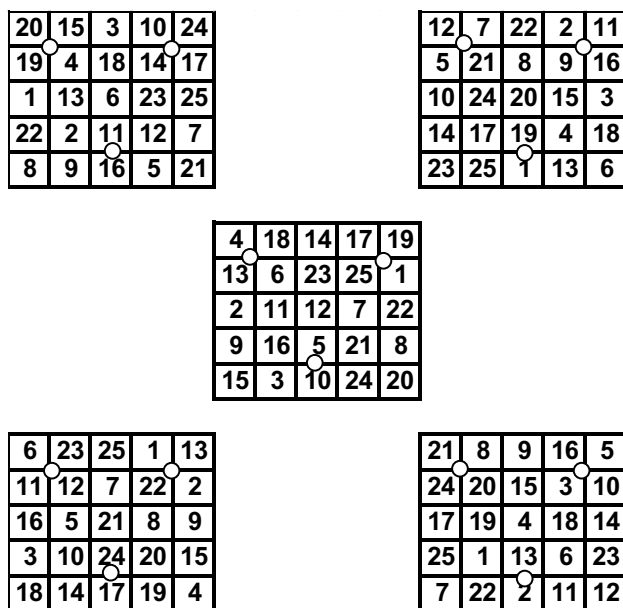
The main experiment was conducted under field conditions, where the selection and consumption of seedlings could be influenced by several factors, particularly an abundance of local population of *A. vulgaris*.

Seedling presentation. For the experiment, seeds of 25 wild herb species (Table 1) were selected from the collection that was available at the workplace. On 11 July 2007, the seeds were sown in plastic cups (8 cm in diameter, 5 cm deep) that were filled to 1 cm with moist potting compost (GreenVital Aussaaterde). In each cup, ~100 seeds of one herb species were placed on the compost surface. The potting compost was then moistened with tap water to full soil capacity, and the cups were placed under laboratory conditions at an oscillating temperature of 24 ± 2 °C and a naturally long day photoperiod. The numbers of seedlings that established in particular cups differed because the percentage of germination of seeds of a particular weed species differed. On 16 July at 19:00–21:00 Central European Time (CET), the emerged seedlings were counted, and the cups were exposed in the experimental area.

Experimental design. The experimental area (situated at 50.086 N 14.297E at 340 m asl altitude) was a grass stand in an old pear orchard consisting of *Poa pratensis* L., *Dactylis glomerata* L. and *Arrhenatherum elatius* (L.) J. et C. Presl with admixture of dicot plants (*Aegopodium podagraria* L., *Geranium pratense* L., *Geum urbanum* L., *Plantago lanceolata* L., *Potentilla reptans* L., *Taraxacum officinale* Weber ex Wigg. and *Trifolium hybridum* L.). At the time of the experiment, the grass stand was approximately 8 cm tall. *Arion vulgaris* was the main seedling predator at the experimental location. Other potential slug seedling predators (*Limax maximus* Linnaeus, *Arion hortensis* Férussac, and *Deroceras* sp.) very rarely occurring at the location (Honěk and Martinková 2025), were not observed at the time of the experiment. Besides *A. vulgaris*, the only important seedling predator in the experimental area may become

Table 1 Characteristics of species included in the study

Species	Family	N seedlings	Series	Volume	L-hist	F-divers	Emergence
<i>Amaranthus retroflexus</i> L.	Amaranthaceae	18–70 (41.6)		27,09621	1	3	iv–viii
<i>Atriplex sagittata</i> Borkh.	Chenopodiaceae	3–6 (4.8)		200,6691	1	3	iii–iv, ix–x
<i>Brassica napus</i> L.	Brassicaceae	32–50 (41.6)		279,6015	1	3	viii–ix
<i>Capsella bursa-pastoris</i> (L.) Med.	Brassicaceae	15–22 (18.8)	1	5,167916	1	4	iv–v, vii–x
<i>Cerastium vulgare</i> Fries	Caryophyllaceae	35–90 (62.0)	1	5,4	2	4	iv–vi
<i>Chenopodium album</i> L.	Chenopodiaceae	35–155 (84.0)		18,06414	1	3	iv–ix
<i>Cichorium intybus</i> L.	Asteraceae	60–100 (70.0)	1	70,09673	2	2	iii–v, vii–x
<i>Daucus carota</i> L.	Apiaceae	12–18 (15.4)		53,70155	2	5	iii–v
<i>Descurainia sophia</i> (L.) Prantl	Brassicaceae	16–29 (23.0)	1	8,227039	1	3	iii–v
<i>Dysphania pumilio</i> R. Br.	Chenopodiaceae	15–35 (22.6)		13,04545	1	2	iv–v
<i>Euphorbia pepus</i> L.	Euphorbiaceae	10–18 (13.8)	2	13,25358	1	3	iv–v
<i>Geranium pusillum</i> Burm. fil.	Geraniaceae	8–22 (12.2)		35,26435	1	4	iii–v
<i>Lamium amplexicaule</i> L.	Lamiaceae	4–13 (8.6)	2	24,34732	1	3	iii–v, viii–ix
<i>Lepidium ruderalis</i> L.	Brassicaceae	9–15 (12.6)		8,933897	1	2	ii–v, vii–ix
<i>Portulaca oleracea</i> L.	Portulacaceae	13–29 (21.6)		20,22399	1	3	iv–vii
<i>Rumex patientia</i> L.	Polygonaceae	40–80 (59.0)		28,05342	2	3	iii–v
<i>Sisymbrium loeselii</i> L.	Brassicaceae	9–17 (11.8)		21,59843	1	2	iii–v, viii–ix
<i>Spergula arvensis</i> L.	Caryophyllaceae	70–150 (100.0)	1	11,23904	1	3	iii–v
<i>Spergularia rubra</i> (L.) J. et C. Presl	Caryophyllaceae	12–16 (14.2)	2	10,83849	2	3	iii–v
<i>Tanacetum corymbosum</i> (L.) Scop.	Asteraceae	18–41 (26.6)		23,090687	2	3	iii–v
<i>Taraxacum officinale</i> Weber ex Wigg.	Asteraceae	30–70 (49.0)	1,2	22,16294	2	3	iii–v, ix–x
<i>Tripleurospermum inodorum</i> (L.) Schultz-Bip.	Asteraceae	50–80 (58.0)	2	7,971785	1	3	iii–v, viii–ix
<i>Veronica persica</i> Poir.	Scrophulariaceae	38–55 (45.4)	2	33,35485	1	3	iii–iv
<i>Vicia cracca</i> L.	Fabaceae	13–17 (14.8)		0,409977	2	2	iv–v
<i>Viola tricolor</i> L.	Violaceae	13–25 (19.2)		4,442405	1	3	iv–v, viii–ix

**Fig. 1** Arrangement of seedlings in the field experiment. Cups with seedlings of plant species were placed in the centre of squares whose dimensions were 30×30 cm (other dimensions in the figure are displayed on the same scale). The numbers indicate the species of seedling (see Table 1). The placement of plasticine baits is marked with circles

the common pill-bug *Armadillidium vulgare* (Latreille)

(Isopoda: Oniscoidea) (Honek et al. 2009), whose seedling predation was prevented so that the cups were buried in the soil to approximately 1 cm below the rim (Honek et al. 2013). This experimental design prevented all ground arthropods from eating the seedlings. Each cup was protected from rain and sunshine using a tray (20 cm in diameter) wrapped in aluminium foil and supported by a wooden rod 8 cm in height. To prevent seedling mortality caused by drought, the cups were moistened daily using a sprinkler. The cups, each containing 10–100 seedlings of a particular herb species, were exposed in blocks. Each block consisted of 5×5 cups, and each cup contained the seedlings of a different herb species. We used a randomised block design. The cups were placed in a randomized order, with each block being different (Fig. 1). The cups were separated from one another by a distance of ~20 cm. The number of germinable seeds and sprouted seedlings varied; thus, the number of seedlings exposed to predation was different for each species. This difference did not affect the results because no significant relationship was found between the number of exposed seedlings and the arcsin transformed percentage of mortality (Linear model, $R^2 < 0.001$, $F_{1,23} = 0.0177$, $P = 0.895$). In each block, three pairs of plasticine baits (manufactured by Jovi S. A., Barcelona, Spain) (Fig. 1) were placed and covered with a wire mesh cage to protect the plasticine from consumption by mice. The baits were used to determine the

feeding activity of slugs, which was detected according to the amount of consumed plasticine (Honek and Martinkova 2007, 2025).

Experiment course. The experiment started on 16 July 2007 at 21:00 CET, when the initial number of seedlings was recorded. The number of seedlings was then recorded daily until the experiment was terminated on 23 July 2007, at 10:00 CET, when the seedlings in 25% of the cups had been completely consumed.

As the data came from a block design we used Generalized estimating equations (GEE), which is an extension of GLM for correlated data (Pekár and Brabec 2018), from the *geepack* (Yan and Fine 2004) within R (R Core Team 2023) to analyse the data. GEE with binomial error structure and exchangeable working correlation was used in order to account for the block design. The block was set as an independent cluster. The linear predictor included either the herb species or the herb family.

Laboratory experiment

Laboratory experiment was conducted under standardized temperature, humidity and light conditions.

Seedling presentation. Two series of seedlings, each of which consisted of a set of six species, were exposed to predation by slugs. In order to cover the full range of seedling acceptability, included were preferred species well accepted in the field experiment and nonpreferred species rejected in the field experiment. The first series consisted of the reference species *Taraxacum officinale* Weber ex Wigg., three nonpreferred species, *Capsella bursa-pastoris* (L.) Med., *Descurainia sophia* (L.) Prantl and *Cerastium vulgare* Fries, and two preferred species, *Cichorium intybus* L. and *Spergula arvensis* L. The second series consisted of the same reference species, then three different nonpreferred species, *Spergularia rubra* (L.) J. et C. Presl, *Euphorbia pepus* L. and *Veronica persica* Poiret, and two different preferred species, *Lamium amplexicaule* L. and *Tripleurospermum inodorum* (L.) Schultz-Bip. (Table 1). Preferred and non-preferred species were selected according to the results of the field experiment.

Experiment design. Seeds were sown on 20th July 2007 in plastic boxes with 16 × 11 cm floors and 6.5 cm high side-walls. The boxes were filled to a height of 1 cm with potting compost (GreenVital Aussaaterde) and moistened with tap water to full soil capacity. Using a paper screen, six circular plots with a diameter of 3.5 cm were marked in each box. Each circular plot was sown with one species of seed. Both series of seeds were sown in 15 replicates each (i.e., in 15 boxes). Experimental slugs (individuals weighing ~2 g) were collected in the vicinity of the field experiment site. To standardize hunger, the slugs were kept in moistened, closed

plastic cups at 10 °C, in the dark and without food for 3 days from the time of collection to the start of the experiment.

Experiment course. The experiment began on 25 July 2007 when the sprouted seedlings were counted. One slug was inserted into the centre of each box at 22:00 CET. The boxes were closed with perforated plastic lids and left at 20 °C in the dark until 26 July 2007, when the experiment was finished at 07:00 CET, i.e., nine hours from its start. After the end of the experiment, the remaining seedlings were counted.

Also these data were analysed using GEE-b due to a block design. The exchangeable working correlation was used. The linear predictor included the slug mass and the herb species.

Seedling traits

Plant species nomenclature, taxonomy and data on life form were taken from Kubát et al. (2002), and data characterizing floristic diversity in the habitats where species regularly live were taken from Grime et al. (2007).

Seedling size was characterized by the volume (V) of the above ground part of the seedling. To assess this volume we used published data (Kropáč and Nejedlá 1956; Fisjunov 1984) on hypocotyl length (HI), hypocotyl diameter (Hd), cotyledon leaf length (LI) and cotyledon leaf width (Lw). The volume of seedlings was calculated as the volume of the hypocotyl plus the volume of the cotyledons, where the volume of the hypocotyl was calculated as the volume of a cylinder with the diameter and length of the hypocotyl, the volume of the cotyledons was calculated as the area of an ellipse with the major axis equal to the length of cotyledon leaf, the minor axis equal to the width of cotyledon leaf, and with a thickness of 1 mm. The calculation was made using the formula $V = (HI \cdot Hd / 2 \cdot Hd / 2 \cdot \pi) + (LI / 2 \cdot Lw / 2 \cdot \pi)$. Here we use the volume of the seedling as a proxy for the fresh weight of the seedling (seedling mass).

Similarly, differences in life strategy (Kubát et al. 2002), and floristic diversity of habitats typically inhabited by the species (index Fd taken from Grime et al. 2007) were tested.

In order to test hypotheses about the effect of traits mentioned above on the mortality we used phylogenetic generalised least squares (PGLS) from the *nlme* package (Pinheiro et al. 2023). We downloaded a phylogenetic tree from the *timetree.org* for 24 species of herbs (excluding *A. retroflexus*). As a covariance structure we used Brownian motion model from the *ape* package (Paradis and Schliep 2019) in the PGLS (Pekár and Brabec 2016). The linear predictor included all traits mentioned above. The mortality was angularly transformed.

Results

Field experiment

Under field conditions, significant differences were found in the consumption of seedlings of individual plant species (GEE-b, $\chi^2_{24}=11.8$, $P<0.0001$, Fig. 2A). The most consumed species (i.e., the species with the highest seedling mortality M) were *Spergula arvensis* L., *Portulaca oleracea* L. and *Atriplex sagittata* Borkh. The least consumed species were *Cerastium vulgare* Fries, *Vicia cracca* L. and *Euphorbia peplus* L.

Similarly, there was a significant difference in mortality among families (GEE-b, $\chi^2_{14}=70.3$, $P<0.0001$, Fig. 2B) with Fabaceae and Euphorbiaceae being consumed least frequently and Chenopodiaceae and Portulacaceae being consumed most frequently.

Among selected traits (Fig. 3A), the floristic diversity (PGLS, $F_{1,20} = 0.45$, $P=0.51$), nor the emergence date (PGLS, $F_{1,20} = 0.2$, $P=0.66$) had significant effect on mortality. But the mortality increased significantly with the volume (PGLS, $F_{1,20} = 11.5$, $P=0.0027$, Fig. 3B) and was significantly affected by the life-history (PGLS, $F_{1,20} = 9.3$, $P=0.006$, Fig. 3C).

Plasticine baits in the field experiment indicated low feeding activity of the slugs. The average consumption was 0.24 ± 0.054 g of plasticine per day.

Laboratory experiment

In the laboratory experiment, the seedlings of individual species were also consumed at significantly different intensities (GEE-b, $\chi^2_{10}=1626$, $P<0.0001$, Fig. 4A). The most consumed species were *Cichorium intybus* L., *Taraxacum officinale* Weber ex Wigg., and *Lamium amplexicaule* L. The seedlings of *Spergularia rubra* (L.) J. et C. Presl and *Euphorbia peplus* L. were not eaten at all. The mass of the seedling failed to have significant effect (GEE-b, $\chi^2_1=1$, $P=0.24$). There was a marginally significant positive correlation between mortality observed in the field and under laboratory conditions of 11 herb species (Pearson correlation, $t_0=2.2$, $P=0.055$, $r=0.59$, Fig. 4B).

Discussion

Earlier it has been found that the preference of the slug *Arion vulgaris* for adult plants varies considerably between different herb species. However, preference for seedlings has only been studied in a small number of herb species. Here we investigated the seedling consumption of 25 dicotyledonous herb species. We established significant interspecific variation in consumption of herb seedlings. Earlier studies indicated that differences in predation rates of herb species are caused by emanating gaseous substances and providing olfactory signals perceived by slugs. In our study, the content of these substances in seedlings could not be examined and the probable chemical causes of the differences in

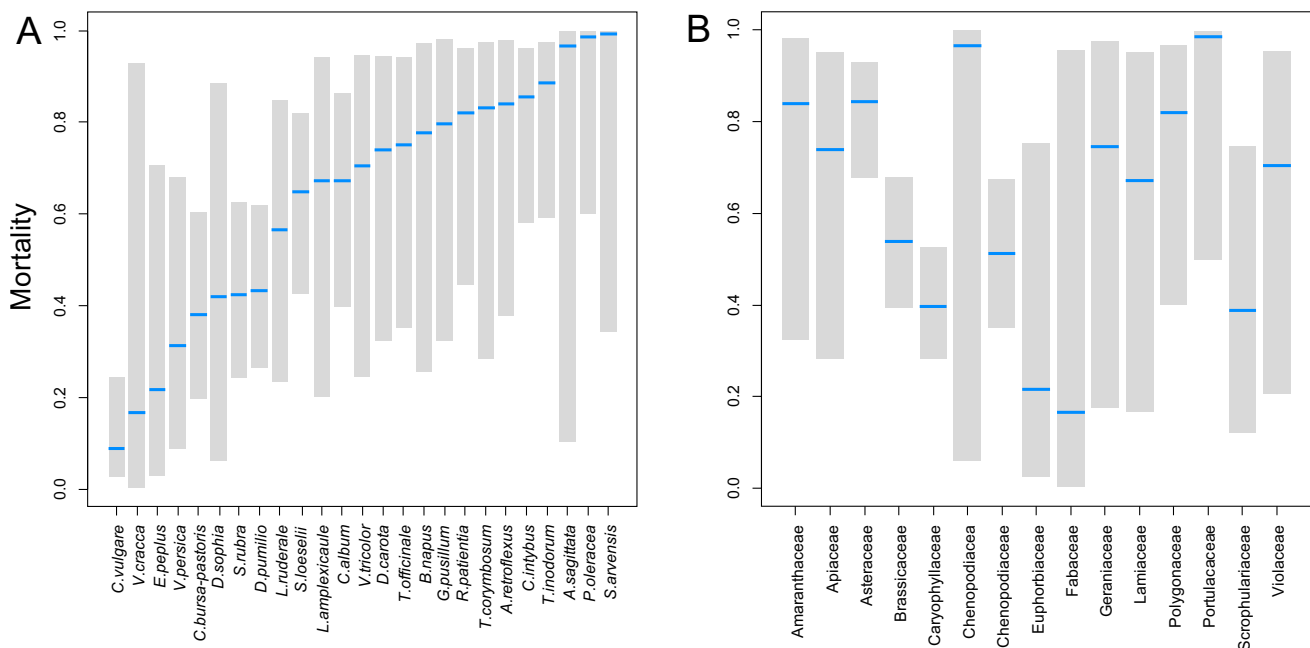


Fig. 2 Comparison of the mortality of seedlings of 25 species (A) belonging to 15 families (B) in the field experiment. Horizontal lines are estimated means, and boxes are 95% confidence intervals

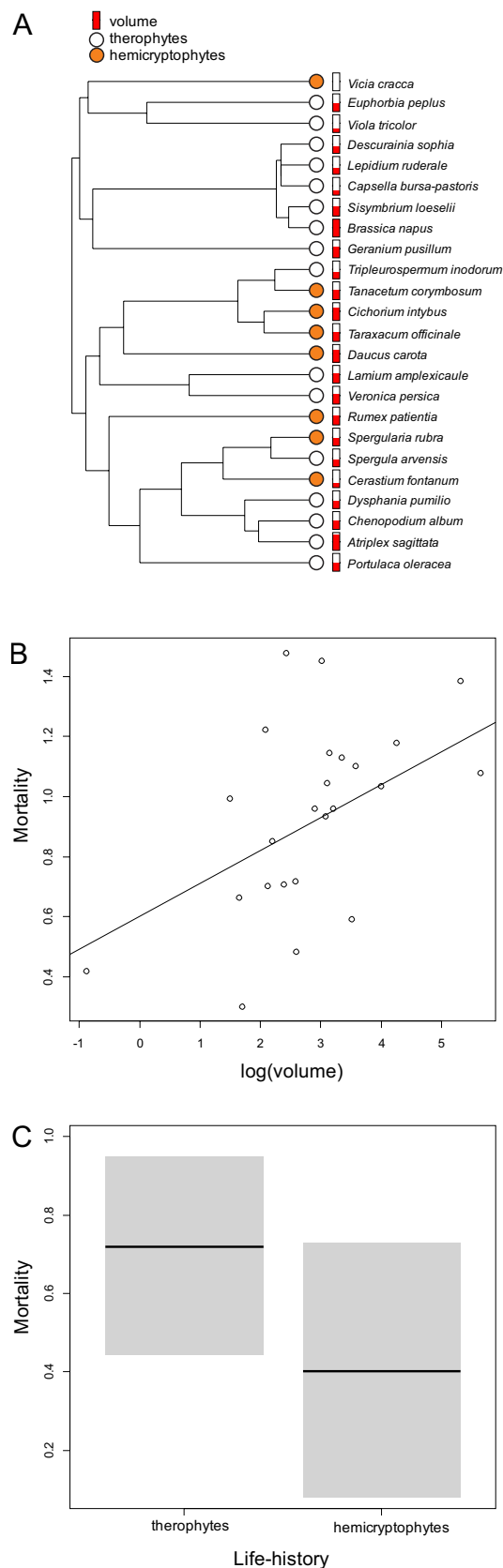


Fig. 3 (A) Phylogenetic relationship among 24 studied herb species with projection of two traits (relative volume and life history) on the tip of branches. (B) Relationship between the seedling mortality (angularly transformed) and seedling logarithm of volume. Estimated line is shown. (C) Comparison of mortality from the field experiment between therophytes and hemicryptophytes. Horizontal lines are estimated means, and boxes are 95% confidence intervals

seedling consumption could not be determined. However, our results showed that seedling selection was also positively related to seedling mass. Slugs preferred plant species with large seedlings mainly because, as we assume, large seedlings provide more food than small seedlings. However, it is not excluded that the mass of seedlings may positively correlate with the increasing content of attractant substances or negatively correlate with the decreasing content of repellent substances in their tissues. Therefore, further research into whether seedling size is the real cause of differences in slug preferences is necessary.

The correlation between consumption of seedlings in the field experiment and in the laboratory experiments was not significant. One of the reasons may be the different situation at the moment of selecting the preferred food. In the field experiment, individual slugs encountered one food source - a cup with one species of seedlings. The other cups were minimum 20 cm apart and separated by a grass stand. The experimental slugs were thus confronted with one species of seedlings and their consumption was determined by their preference for the nearby seedling species. In contrast, in the laboratory experiment, the plots with different seedling species were only 3 cm apart and not separated by a grass stand. The creeping experimental slug was thus confronted with several species of seedlings simultaneously and had to decide which type of seedling it would eat. However, despite this difference the experimental slugs gave approximately the same preference to individual seedling species as in the field experiment.

Slugs contribute to limiting the occurrence of the plant species they prefer, which causes change in the species composition of plant communities (Wilby and Brown 2001; Strauss et al. 2009; Fabian et al. 2012). How do the changes in composition of herb societies contribute to the predation of seedlings?

For predation to be selective and concern only seedlings of palatable herb species while seedlings of unpalatable species would be neglected, it is necessary that the feeding activity of the slug population be rather low, similar to that established in our field experiment. If slug feeding activity were too high, the consumption of seedlings will increase so that slugs would consume seedlings of all herb species, both palatable and unpalatable.

We studied the feeding activity of slugs in 2003–2022, at a location ~20 m away from the location where the field experiment was conducted (Honěk and Martinková 2025).

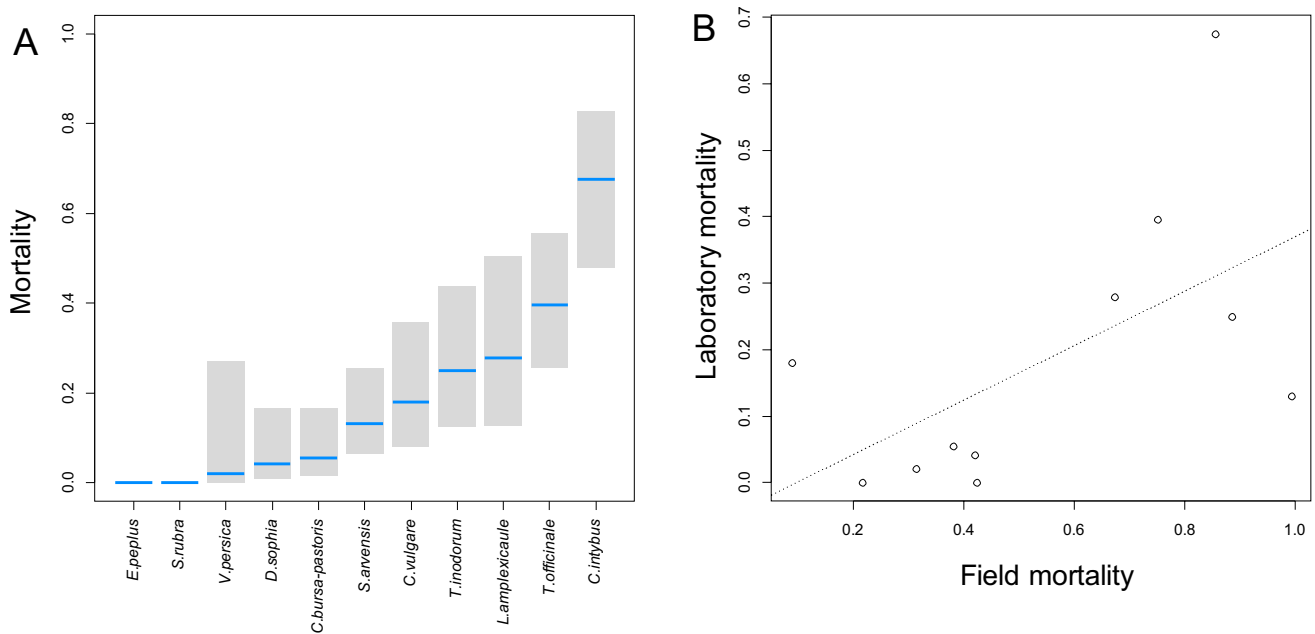


Fig. 4 **A** Comparison of the mortality of seedlings of 11 species in the laboratory experiment (**A**). Horizontal lines are estimated means, and boxes are 95% confidence intervals. **B** Relationship between seedling mortality in the laboratory experiment and in the field experiment

Also at this long term monitored location slug feeding activity was studied by plasticine consumption. At the time of the field experiment (16 July to 23 July 2007) plasticine consumption at this long-term monitored location was 0.29 ± 0.065 g/day ($n=12$ plasticine baits), which was not significantly different (Mann-Whitney test, $P=0.444$) from plasticine consumption at the site of the field experiment with seedling consumption (0.24 ± 0.046 g/day). This feeding activity was low, which can be demonstrated by comparing it to the fluctuation of plasticine consumption at the long-term monitored location where a ten times as great consumption >3 g/day was recorded in 2005, 2008, 2009, 2010, 2011 and 2014 (Honěk and Martinková 2025). Let us assume that slug feeding activity indicated by consumption of plasticine >0.3 g/day could threaten the survival of most of seedling species. In the abovementioned six “fat years”, plasticine consumption exceeding 0.3 g/day started between 25 May and 16 June and terminated between 23 August and 23 September, lasting 95 days on average (Table 2). During the other years, the period of high feeding activity lasted, on average, only 43 days, and, in three years, plasticine consumption did not exceed 0.3 g/day throughout the entire growing season. Thus, slug feeding activity high enough to cause mortality of all seedling species (both palatable and unpalatable), and in this way capable of precluding selective seedling predation, lasted for a relatively short time around the peak of the growing season. For selective predation of seedlings are favourable spring and autumn periods of the growing season, i.e. periods when seedlings of the investigated species emerge (Table 1) (Fisjunov 1984; Martinková

et al. 2021). It can therefore be concluded that under conditions of Central Europe, seedling predation by the massively occurring slug species *Arion vulgaris* can significantly influence the composition of herbaceous communities.

The mortality of seedlings caused by the feeding activity of slugs could be influenced by other factors, such as seasonal differences in the quantity of food consumed (Honěk and Martinková 2007), intraspecific differences in the usability of seedlings for consumption (Calf et al. 2018) or differences in the quantity of consumed food caused by weather (Mensink and Henry 2011). In this study we established significant differences in the consumption of seedlings of herb species by the slug *A. vulgaris*. Given the total amount of food consumed by *A. vulgaris* varies significantly over the course of the season (Honěk and Martinková 2025), it would be interesting to investigate possible seasonal changes in preference for particular seedling species.

It will also remain to establish whether the differences in consumption of seedling species can have an effect on the composition of herb communities. This requires additional experiments. Convenient methods depend on extent to which the composition of the herb community is affected by seedling emergence. Seedling emergence in dense herb stands is limited because it requires establishment of gaps. When investigating the effect of slug herbivory on these herb communities we may compare seedling mortality in artificial gaps accessible to, or protected from, slugs. We suppose that promising research may be also monitoring of ruderal herb communities that naturally come into being on bare soil surface from the soil seed bank. Here we may

Table 2 Periods in which plasticine consumption at long term monitored location exceeded the critical value of feeding activity 0.3 g/day. Plasticine consumption was measured from 2003–2022 at weekly intervals each year from March to November

	Year	Start date	End date	Duration
Start – the first day of the interval when feeding activity exceeded critical value. End – the last day of the interval when feeding activity exceeded critical value. Duration – length (number of days) of the period in which feeding activity (plasticine consumption) exceeded critical value of 0.3 g/day	2003	29 July	22 August	27
	2004	23 August	30 August	7
	2005	16 June	20 September	96
	2006	29 June	8 September	71
	2007	25 June	19 August	55
	2008	2 June	12 September	102
	2009	15 June	23 August	69
	2010	10 June	23 September	105
	2011	14 June	18 September	96
	2012	–	–	0
	2013	–	–	0
	2014	26 May	6 September	103
	2015	28 May	8 July	41
	2016	23 June	31 July	38
	2017	15 June	9 August	55
	2018	21 June	28 June	7
	2019	–	–	0
	2020	25 June	22 July	27
	2021	8 June	20 September	104
	2022	25 May	06 September	104

compare herb communities which evolved on plots where slug access is prevented and on plots where it is allowed.

Conclusions

Earlier has been established that preferences of *Arion vulgaris* for particular herb species vary considerably. This was established from consumption of adult plants while consumption of seedlings has been studied little. In this study we established consumption of seedlings of 25 species of dicotyledonous herbs which all are in the reach of this slug species. The preference was measured as the percentage of seedlings of a given species eaten during a seven-day field experiment. It varied considerably and ranged from <20% (in *Cerastium holosteoides*, *Vicia cracca*, and *Euphorbia peplus*) to >95% (in *Atriplex sagittata*, *Portulaca oleracea*, and *Spergula arvensis*). The feeding activity of slug population (predation-induced mortality of seedlings) during the experiment was low. If slug feeding activity were higher, seedlings of all species would be destroyed (in experiment location it was in some periods up to 15 times higher). Seedling predation affects herb species selectively when slug feeding activity is low, which is the rule in the spring and autumn periods. Just at this time the selective predation of seedlings by slugs can affect the composition of the herb populations.

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seedlings in response to predation by the slug *Arion vulgaris* (Mollusca: Arionidae).

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Data availability Data available from authors on request.

Declarations

Competing interests The authors have no relevant financial or non-financial interests to disclose.

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