EU NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

Name of organism: *Krynickillus melanocephalus* (svarthuvad snigel)
Author: Ulf Bjelke
Risk Assessment Area: Sweden

Draft: 1.

The slug *Krynickillus melanocephalus* was discovered at ≈ 25 localities (mainly in private gardens) in Sweden*, September - November 2019. A photo from 2015 was also discovered that displayed the species. Thus, it has been present without being detected for some years. We believe the true number of localities in Sweden may be tenfold (25 x 10). *K. melanocephalus* was very abundant at several localities, with individuals occurring almost every square meter. Concern was raised for the potential of *K. melanocephalus* to be a serious garden pest given the abundance and the species being a herbivore.

Originating in Caucasus, the slug has spread to Eastern, Northern and Central Europe in the past decades with populations presently in Belarus, Estonia, Finland, Germany, Latvia, Lithuania, Russia, Sweden and Ukraine.

The main vector is probably the commercial and private trade of garden plants and soil. It is known to be invasive in Latvia and a serious pest in gardens in northern Russia and in Belarus. It has also been observed to displace other species of slugs and snails (however, scientific documentation of this is lacking). In Germany the species has been present in some places for 20 years without being known to cause serious damage.

This risk assessment suggests that *K. melanocephalus* is very likely to be problematic in Sweden from now on.
The following measures should be taken:
Studies on the number of populations in Sweden
Studies on the origin of the Swedish populations using molecular methods
Determine the ways of entry
Studies on the damage of this species
Studies on the diet and life cycle
Studies on competition with other species of slugs and snails
Information campaigns aimed to garden trade and gardeners
Pilot studies on local eradication

*Appendix 2, distribution maps (p21)

Krynickillus melanocephalus, Virsbo, Västmanland County. Photo: Ulf Bjelke

EU CHAPPEAU	
QUESTION	**RESPONSE**
1. In how many EU member states has this species been recorded? List them.	Estonia, Finland, Latvia, Lithuania, and Germany and Sweden
2. In how many EU member states has this species currently established populations? List them.	Estonia, Finland, Latvia, Lithuania, and Germany and Sweden
3. In how many EU member states has this species shown signs of invasiveness? List them.	Latvia (outside EU Belarus, included in their Black List), Russia
4. In which EU Biogeographic areas could this species establish?	Boreal, Continental, Atlantic
5. In how many EU Member States could this species establish in the future [given current climate] (including those where it is already established)? List them.	More than 10
6. In how many EU member states could this species become invasive in the future [given current climate] (where it is not already established)?	More than 10

SECTION A – Organism Information and Screening		
Stage 1. Organism Information	**RESPONSE** **[chose one entry, delete all others]**	**COMMENT**
1. Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	Yes	
2. If not a single taxonomic entity, can it be redefined? (if necessary use the response box to re-define the organism and carry on)		
3. Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	Belarus	Buga, S., & Sinchuk, A. (2016). Alien species of terrestrial invertebrates in black book of invasive animal species in Belarus. In *Sustainable use, protection of animal world and forest management in the context of climate change* (pp. 101-101).
4. If there is an earlier risk assessment is it still entirely valid, or only partly valid?	Belarus	
5. Where is the organism native?	Caucasus	
6. What is the global distribution of the organism (excluding Europe)?	Asian part of Caucasus	
7. What is the distribution of the organism in Europe?	Belarus, Estonia, Finland, Germany, Latvia, Lithuania, Russia, Sweden, Ukraine.	
8. Is the organism known to be invasive (i.e. to threaten organisms, habitats or ecosystems) anywhere in the world?	It is known to be invasive, the effects are not sufficiently understood	Included in the Black List of Belarus, invasiveness preliminary studied in Latvia
9. Describe any known socio-economic benefits of the organism in the risk assessment area.	No benefits	

SECTION B – Detailed assessment

PROBABILITY OF ENTRY

Important instructions:

- Entry is the introduction of an organism into Europe. Not to be confused with spread, the movement of an organism within Europe.
- For organisms which are already present in Europe, only complete the entry section for current active pathways of entry or if relevant potential future pathways. The entry section need not be completed for organisms which have entered in the past and have no current pathways of entry.

QUESTION	RESPONSE [chose one entry, delete all others]	CONFIDENCE [chose one entry, delete all others]	COMMENT
1.1. How many active pathways are relevant to the potential entry of this organism? (If there are no active pathways or potential future pathways respond N/A and move to the Establishment section)	very many	high	Commercial and private import of plants and soils for gardens. Likely from Baltic states but the origin needs to be confirmed.
1.2. List relevant pathways through which the organism could enter. Where possible give detail about the specific origins and end points of the pathways. For each pathway answer questions 1.3 to 1.10 (copy and paste additional rows at the end of this section as necessary).	[Commercial and private import]		Commercial and private import of plants and soils for gardens. Likely from Baltic states but the origin needs to be confirmed.
Pathway name:	[Most likely transport across the Baltic sea]		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)?	accidental	Very high	

(If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)			
1.4. How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.	likely	high	
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.	very likely	very high	
1.6. How likely is the organism to survive existing management practices during passage along the pathway?	very likely	very high	
1.7. How likely is the organism to enter Europe undetected?	very likely	very high	
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	very likely	very high	
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	very likely	very high	
1.10. Estimate the overall likelihood of entry into Europe based on this pathway?	likely	high	
End of pathway assessment, repeat as necessary.			
1.11. Estimate the overall likelihood of entry into Europe based on all pathways (comment on the key issues that lead to this conclusion).	very likely		

PROBABILITY OF ESTABLISHMENT

Important instructions:

- **For organisms which are already well established in Europe, only complete questions 1.15 and 1.21 then move onto the spread section.** If uncertain, check with the Non-native Species Secretariat.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
1.12. How likely is it that the organism will be able to establish in Europe based on the similarity between climatic conditions in Europe and the organism's current distribution?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.13. How likely is it that the organism will be able to establish in Europe based on the similarity between other abiotic conditions in Europe and the organism's current distribution?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.14. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Europe? Subnote: gardens are not considered protected conditions	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.15. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Europe?	ubiquitous	very high	Most gardens in Northern and Western Europe are likely to be suitable habitat and, in addition, often the surrounding environment
1.16. If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in Europe?	NA very unlikely unlikely moderately likely	low medium high very high	

	likely very likely		
1.17. How likely is it that establishment will occur despite competition from existing species in Europe?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.18. How likely is it that establishment will occur despite predators, parasites or pathogens already present in Europe?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.19. How likely is the organism to establish despite existing management practices in Europe?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.20. How likely are management practices in Europe to facilitate establishment?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.21. How likely is it that biological properties of the organism would allow it to survive eradication campaigns in Europe?	very likely	high	Probably impossible to eradicate other than locally
1.22. How likely are the biological characteristics of the organism to facilitate its establishment?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.23. How likely is the capacity to spread of the organism to facilitate its establishment?	very unlikely unlikely moderately likely likely	low medium high very high	

	very likely		
1.24. How likely is the adaptability of the organism to facilitate its establishment?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.25. How likely is it that the organism could establish despite low genetic diversity in the founder population?	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.26. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Europe? (If possible, specify the instances in the comments box.)	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.27. If the organism does not establish, then how likely is it that transient populations will continue to occur? Subnote: Red-eared Terrapin, a species which cannot re-produce in GB but is established because of continual release, is an example of a transient species.	very unlikely unlikely moderately likely likely very likely	low medium high very high	
1.28. Estimate the overall likelihood of establishment (mention any key issues in the comment box).	very unlikely unlikely moderately likely likely very likely	low medium high very high	

PROBABILITY OF SPREAD IN SWEDEN

Important notes:

- Spread is defined as the expansion of the geographical distribution of a pest within an area.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
2.1. How important is the expected spread of this organism in Sweden by natural means? (Please list and comment on the mechanisms for natural spread.)	minimal minor moderate major massive	low medium high very high	Most likely a slow spread from gardens to surrounding areas.
2.2. How important is the expected spread of this organism in Sweden by human assistance? (Please list and comment on the mechanisms for human-assisted spread.)	minimal minor moderate major massive	low medium high very high	Main vector is most likely transport of plants to and between gardens
2.3. Within Sweden, how difficult would it be to contain the organism?	very easy easy with some difficulty difficult very difficult	low medium high very high	Probably impossible to eradicate other than locally
2.4. Based on the answers to questions on the potential for establishment and spread in Sweden, define the area endangered by the organism.	[Sweden south of Limes Norrlandicus]	very high	Götaland, Svealand, Southern Norrland and urban areas north of that.
2.5. What proportion (%) of the area/habitat suitable for establishment (i.e. those parts of Sweden were the species could establish), if any, has already been colonised by the organism?	0-10 10-33 33-67 67-90 90-100	low medium high very high	Most likely already locally common but not present in the vast majority of suitable area in Sweden
2.6. What proportion (%) of the area/habitat suitable for	0-10	low	Most likely it will continue to spread in the coming

establishment, if any, do you expect to have been invaded by the organism five years from now (including any current presence)?	10-33 33-67 67-90 90-100	medium high very high	years. The attention given to and fear of other invasive slugs will likely be beneficial for campaigns in order to slow the spread of *K. melanocephalus*
2.7. What other timeframe (in years) would be appropriate to estimate any significant further spread of the organism in Sweden? (Please comment on why this timeframe is chosen.)	10 20 40 80 160	low medium high very high	Most likely it will continue to spread in the coming years. The attention given to and fear of other invasive slugs will likely be beneficial for campaigns in order to slow the spread of *K. melanocephalus*
2.8. In this timeframe what proportion (%) of the endangered area/habitat (including any currently occupied areas/habitats) is likely to have been invaded by this organism?	0-10 10-33 33-67 67-90 90-100	low medium high very high	
2.9. Estimate the overall potential for future spread for this organism in Sweden (using the comment box to indicate any key issues).	very slowly slowly moderately rapidly very rapidly	low medium high very high	Gardening is an activity popular among millions of Swedes. Many activities related to gardening pose a risk for further spread; private and commercial import, domestic private and commercial trade. Spread of waste from gardens to natural areas (a very common, but prohibited, practice).

PROBABILITY OF IMPACT

Important instructions:

- When assessing potential future impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.
- Where one type of impact may affect another (e.g. disease may also cause economic impact) the assessor should try to separate the effects (e.g. in this case note the economic impact of disease in the response and comments of the disease question, but do not include them in the economic section).
- Note questions 2.10-2.14 relate to economic impact and 2.15-2.21 to environmental impact. Each set of questions starts with the impact elsewhere in the world, then considers impacts in Europe separating known impacts to date (i.e. past and current impacts) from potential future impacts. Key words are in bold for emphasis.

QUESTION	RESPONSE	CONFIDENCE	COMMENTS
2.10. How great is the economic loss caused by the organism within its existing geographic range, including the cost of any current management?	minimal minor moderate major massive	low medium high very high	Presently not possible to estimate. Likely a garden pest, but damage to private gardens and elsewhere not possible to yet estimate. The greatest likely losses are for private citizens interested in gardening. Management costs not possible to estimate until we can determine the likely number of populations in Sweden.
2.11. How great is the economic cost of the organism currently in Sweden excluding management costs (include any past costs in your response)?	minimal minor moderate major massive	low medium high very high	Presently not possible to estimate. Likely a garden pest, but damage is possible to estimate, not in single gardens and not overall. The likely losses greatest for private citizens interested in gardening.
2.12. How great is the economic cost of the organism likely to be in the future in Sweden excluding management costs?	minimal minor moderate major massive	low medium high very high	Presently not possible to estimate. Likely a garden pest, but damage not possible to estimate, not in single gardens and not overall. Not possible to estimate until we can determine the extent and likely number of populations in Sweden.
2.13. How great are the economic costs associated with managing this organism currently in Sweden (include any past costs in your response)?	minimal minor moderate major massive	low medium high very high	Not known, studies are required. Not possible to estimate until we can determine the likely number of populations in Sweden.

2.14. How great are the economic costs associated with managing this organism likely to be in the future in Sweden?	minimal minor moderate major massive	low medium high very high	Not known, studies needed. Not possible to estimate until we can determine the likely number of populations in Sweden.
2.15. How important is environmental harm caused by the organism within its existing geographic range excluding Sweden?	minimal minor moderate major massive	low medium high very high	Not known, studies needed
2.16. How important is the impact of the organism on biodiversity (e.g. decline in native species, changes in native species communities, hybridisation) currently in Sweden (include any past impact in your response)?	minimal minor moderate major massive	low medium high very high	Not known, studies requireds. Highly invasive in Latvia and Belarus, but effects are unclear. Not likely to hybridize with native species. It may locally outcompete native slugs and snails.
2.17. How important is the impact of the organism on biodiversity likely to be in the future in Sweden?	minimal minor moderate major massive	low medium high very high	Not known, studies required. May affect native slugs and snails. Such indications come from observations in Belarus and Russia. See appendix.
2.18. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism currently in Sweden (include any past impact in your response)?	minimal minor moderate major massive	low medium high very high	Not known, studies needed. Information from Russia on massive population numbers among decaying leaves of alder. Thus it may affect decomposition and the decomposer community. Studies on this needed.
2.19. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism likely to be in Sweden in the future?	minimal minor moderate major massive	low medium high very high	Not known, studies needed. Information from Russia on massive population numbers among decaying leaves of alder. Thus it may affect decomposition and the decomposer community. Studies on this needed.
2.20. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism currently in Sweden?	minimal minor moderate	low medium high	Not known, studies needed. It has been found outside urban areas in Sweden.

	major massive	very high	
2.21. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism likely to be in the future in Sweden?	minimal minor moderate major massive	low medium high very high	Not known, studies needed
2.22. How important is it that genetic traits of the organism could be carried to other species, modifying their genetic nature and making their economic, environmental or social effects more serious?	minimal minor moderate major massive	low medium high very high	Not known, studies needed. Not likely to hybridize with native species
2.23. How important is social, human health or other harm (not directly included in economic and environmental categories) caused by the organism within its existing geographic range?	minimal minor moderate major massive	low medium high very high	Not known, studies needed
2.24. How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	minimal minor moderate major massive	low medium high very high	Not known, studies needed
2.25. How important might other impacts not already covered by previous questions be resulting from introduction of the organism? (specify in the comment box)	NA minimal minor moderate major massive	low medium high very high	
2.26. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Sweden?	minimal minor moderate major massive	low medium high very high	Not known, studies needed
2.27. Indicate any parts of Sweden where economic, environmental and social impacts are particularly likely to	[insert text + attach map if	low medium	Urban and suburban areas of Götaland, Svealand, S. Norrland

occur (provide as much detail as possible).	possible]	high very high	

RISK SUMMARIES			
	RESPONSE	**CONFIDENCE**	**COMMENT**
Summarise Entry	Present	low medium high very high	Without changes in trade patterns or before information campaigns the risk of further import of the snail is very likely.
Summarise Establishment	Present	low medium high very high	The climate and environment clearly is suitable in Sweden.
Summarise Spread	very slowly slowly moderately rapidly very rapidly	low medium high very high	This species will most likely spread further through domestic commercial and private trade and with dumping of garden material in nature.
Summarise Impact	minimal minor moderate major massive	low medium high very high	Hard to presently discern, studies needed. Most likely damage to gardens and possibly displacement of other species of slugs and snails. Studies needed.
Conclusion of the risk assessment	low moderate high	low medium high very high	High likelihood of being a garden pest and possibility of affecting native species of slugs and snails. The severity is difficult to assess before further studies in 2020.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
3.1. What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?	[Warmer and wetter climate will benefit this species]	low medium high very high	A warmer, more humid, or wetter climate will benefit this species.
3.2. What is the likely timeframe for such changes?	5, 10, 20, 50, 100 years	low medium high very high	
3.3. What aspects of the risk assessment are most likely to change as a result of climate change?	[A drier climate instead of a wetter one will likely reduce the risk]		A drier climate instead of a wetter one will likely reduce the risk.
ADDITIONAL QUESTIONS - RESEARCH			
4.1. If there is any research that would significantly strengthen confidence in the risk assessment please summarise this here.	[Yes]		Studies on the number of populations in Sweden Studies on the ways of entry Studies on the origin of the Swedish populations, by molecular methods. Studies on the damages of this species Studies on the food and life cycle Studies on competition with other species of slugs and snails In addition information campaigns aimed to garden trade and gardeners would be important It needs to be examined whether the species is hermaphroditic: if so a single individual could found a local population.

REFERENCES:

Borleis, F. (2018). Entdeckung von *Krynickillus melanocephalus* (Kaleniczenko 1851) in Sachsen. – Mitteilungen der deutschen malakozoologischen Gesellscahft **98**: 61-62.

Bößneck U. & Feldemann, A. (2003). Zur Ausbreitung von Neozoa im Stadtgebiet von Erfurt am Beispiel der Landschnecken *Cernuella neglecta* (Draparnaud, 1805), *Monacha cartusiana* (O. F. Müller, 1774) and *Krynickillus melanocephalus* Kaleniczenko, 1851 (Mollusca: Gastropoda). – Veröffentlichungen Naturkundemuseum Erfurt **22**: 115-125.

Buga, S., & Sinchuk, A. (2016). Alien species of terrestrial invertebrates in black book of invasive animal species in Belarus. In Sustainable use, protection of animal world and forest management in the context of climate change (pp. 101-101).

Dreijers E., Stalažs A., Pilāte, D. & Jakubāne, I. (2017): The first notes on damage in horticulture made by *Krynickillus melanocephalus* Kaleniczenko, 1851 (Gastropoda: Agriolimacidae). – Zinātnaski parktiskā konference „LĪDZVAROTA LAUKSAIMNECĪBA" 23.02.2017., LLU, Jelgava, Latvija: 154-157. [På Lettiska].

Korol, E. N. & Korniushin, A. V. (2002). Introduced Population of *Krynickillus melanocephalus* (Mollusca, Gastropoda, Stylommatophora) Recorded in Kyiv and Preliminary Results of its Helminthological Investigation. – Vestnik zoologii **36** (6): 57-59. [På Ryska].

Meng S., Bößneck U. 1999. *Krynickillus melanocephalus* Kaleniczenko 1851 in Deutschland eingeschleppt (Gastropoda: Stylommatophora: Agriolimacidae). – Malakologische Abhandlungen, Staatliches Museum für Tierkunde Dresden **19**: 303-309.

Ostrovsky, A. (2017). New records of synanthropic species of slugs *Limacus flavus* (Linnaeus 1758) and *Krynickillus melanocephalus* Kaleniczenko, 1851 (Mollusca, Gastropoda, Stylommatophora) in Belarus. – Ruthenica 27 (4): 155-158. [På Ryska].

Stalažs A., Dreijers E., Ivinskis, P., Rimšaite, J. & Džiugelis, M. (2018). Records of *Krynickillus melanocephalus* Kaleniczenko, 1851 (Gastropoda: Agriolimacidae) in Lithuania. – Bulletion of the Lithuanian Entomological Society **1** (29): 124-128.

Sysoev, A. & Schileyko, A. 2009. Land Snails and Slugs of Russia and Adjacent Countries. – Sofia/Moscow (Pensoft). 312pp. +142 colour plates. [*Krynickillus melanocephalus* på sidorna. 145-146].

https://artfakta.se/artbestamning/taxon/krynickillus-melanocephalus-6045530

Appendix 1. Information from communication with experts in other countries. In no country we have a full picture. Below is best knowledge at the moment. Main informants are the researchers in the published papers above.

Belarus (listed in the Black data book of Belarus) *K. melanocephalus* has been present for some years and is considered a dangerous pest, consuming a variety of vegetables and other plants. It rapidly disperses and populations are very numerous. It occurs in both natural and anthropogenic habitats. It is considered very aggressive and is replacing other mollusk species. However, effects on other mollusks are observed rather than investigated and further studies are needed.
Germany The species has been present in some places for 20 years without being known to cause serious damage. The 2018 drought seems to have affected the populations which were considerably smaller in 2019. It is suggested that the climate in Germany is not optimal for this species.
Latvia The species is considered highly invasive and is rapidly dispersing. However, for now, it is not considered a serious garden pest and minor or no damage in gardens have been observed. Instead, it is feeding on decaying fruit, algae and fungi. This stems from an observational study of a population in Dobele 2017-2019. Besides gardens, it is rapidly spreading in natural habitats. It also seems to be dominant over native slug and snail species. Further studies are needed, and are also planned, in order to understand the full effects in Latvia.
Russia (mainly in the area near Moscow, far from the origin of the species (Caucasus). The natural range of *K. melanocephalus* covers almost the entire Caucasus, floodplain and bayrachnye forests of Stavropol and mountain Crimea. Known from Turkey and Northern Iran. As part of its natural habitat, it lives in forest and subalpine zones. From the banks of rivers it extends into the underlying arid zones. It lives among decaying leaves, under stones, in old stumps. In 2011-2012, large populations of *K. melanocephalus* were registered Tver near Moscow, its

immediate environs and in the Bitsevsky Park of Moscow. In the dry season they hide in the natural cavities of the soil and amongst rotting wood which retains moisture after rains for an extended period. During rains and nights when dew falls, it moves out to the grass, tree trunks, and bushes. Slugs are active until the frost. It continues to feed even at a temperature of + 1 ° C. The length of adult slugs crawling on a wet surface is 50-52 mm and mass - 1.33 g. The nutrition of *K. melanocephalus* is diverse. It eats fallen decaying foliage and various green plants.
In the gardens, *K. melanocephalus* harms zucchini, cabbage, strawberries, lettuce, and pumpkin.

K. melanocephalus populates not only anthropogenic biotopes: parks, cemeteries, gardens, vegetable gardens, areas of secondary deciduous forests, raw floodplain and upland meadows, but also has become successfully naturalized in natural gray alder forests along the valleys of small rivers and streams.

The population density *of K. melanocephalus* is directly dependent on the thickness of the rotting leaf litter layer and moisture content. So, in a natural gray alder forest in the floodplain of a river near Tver, where the thickness of the litter is 3-5 cm, the density of slugs was 12 ind./m2. Whereas near the valley of the same river in a drier man-made deciduous forest with a similar litter 3-5 cm thick - 4 ind./m2, and at the bottom of raw ditches near the nearest cemetery where the thickness of the litter is 8-12 cm - the density in some places exceeded 100 ind./m2.

Slugs live until frost. In the Tver gardens *K. melanocephalus* appeared several years ago and the abundance *of K. mlanocephalus* is growing rapidly.

K. melanocephalus seems to crowd out other slug species. This is only observed and quantitative species analysis needs to be carried out.

Appendix 2. Distribution maps.
Left: Sweden. All localities were discovered September - November 2019. Some dots contain several sub-localities. Confirmed data from Artportalen (The Swedish Species Information System), but information on three localities were received from Ted von Proschwitz at the Gothenburg Museum of Natural History. Right: Global map from GBIF. Some known localities/countries are missing in the GBIF map.