INITIATING RESEARCH AND CONSERVATION OF TERRESTRIAL MOLLUSCS IN ARMENIA

Reporter: Meri Arzumanyan

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Yerevan State University, Alek Manukyan 1, Yerevan 0025, Armenia

Email: arzumanyan.meri@ysu.am

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CONTENT

Introduction

Molluscs are one of the most fascinating, interesting and diverse animals in the world. In the case of molluscs species diversity, Armenia isn't an exception. Armenia has an extremely rich landscape and biological diversity. The estimated number of species of invertebrate animals is 17200 species (5th National report, 2014). The total number for molluscs is 155 species which has been provided by Akramowski in 1976 (Akramowski, 1976). These animals are using a wide variety of environment for living from wetlands and lowlands, to subalpine and alpines. The 155 species that was described for Armenia are divided between 2 classes: Gastropoda and Bivalvia. Terrestrial molluscs species are consisting the largest number to compare with freshwater ones. In total Akramowski described 121 terrestrial and 44 freshwater: 30 Gastropoda, 14 Bivalvia, species of molluscs. After Akramowski few works were done on Armenian molluscs species distribution and taxonomy. In 2014 was studied terrestrial molluscs diversity in the Caucasus (Walther, et. all, 2014) and described one new species for Armenia *Pupilla kyrostriata* Walther & Hausdorf, 2014.

Unfortunately, the conservation and protection of this group of animals were ignored a very long time. In total 16 molluscs, species are included in Red Book of Armenia from which only 4 are terrestrial and 12 are freshwater species.

Molluscs as one of the most threatened species on the earth need more attention and awareness all around the world. Molluscs comprise about 6% of known fauna diversity, 17% of threatened fauna species worldwide and 42% of recorded modern fauna extinctions worldwide (IUCN Species Survival Commission 2000). In Armenia, this species protection becomes one of our team main objectives. The project main purpose was to study diversity and conservation of terrestrial molluscs in Armenia. The aim of the project was to enhance molluscs conservation by the study of mollusc species included in IUCN Red List and to evaluate the conservation status of endemic species. Based on a field survey of target species we planned to examine distribution ranges, habitat specifications and clarify species identity in order to develop conservation status of these species using IUCN Red List criteria and recommend to update the next publication of Armenian Red Book. Currently, in IUCN Red List, 2 endangered species can be found, the range of which extends in Armenia. Clearly, there is a strong deficiency in our knowledge of distribution and conservation statuses of Armenian molluscs. Therefore, our aim is to initiate the research and conservation of threatened terrestrial molluscs species of Armenia in order to confirm or update their status and to promote their conservation in regional and international level.

Basic goals for the project was:

- Analyze scientific literature and museum collections of the terrestrial molluscs in order to organize existing information and make it widely available;
- Conducting field work to fill the gaps in the knowledge of species distribution and threats facing local populations of molluscs;
- Identify and map threats effecting on molluscs which will help in planning future conservation activities for those molluscs species;
- Organize training courses for a field research team including students recruited from Yerevan State University in order to enhance the interest in these diverse, threatened although the overlooked animal group in Armenia.

During the project following activities were done:

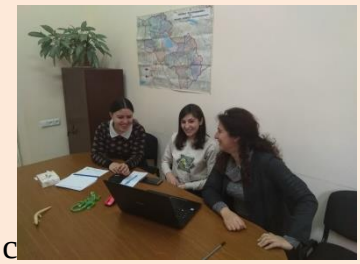
Table 1. The project activities description.

ACTIVITY	**STATUS**
Students training	Successful/finished
Museum collection treatment	Successful/finished
Fieldwork	Successful/finished
Species distribution mapping	Successful/finished
Public awareness activity	Successful/finished
Molluscs species popularization activities at university and schools	Successful/finished

Students Training and Museum Collections Treatment

We organized training courses for students from Yerevan State University who were interested in conservation, especially in molluscs research and conservation. The basic conservation biology principles and importance of molluscs for ecosystem and food chain was explained. Sampling design for a different group of molluscs was shown. During laboratory practice courses students were trained how to collect, identify, measure and observe molluscs. Students were trained to work with animals and with museum collections (image. 1).

Image 1. Student training at Yerevan State University Zoology Department: a) M. Arzumanyan and R. Shushanyan; b) Z. Abrahamyan; c) M. Arzumanyan, A. Hovhanyan and M. Arakelyan (from left to right).

a  b  c 

One of the priorities and the most important part of our project was museum collection and existing literature treatment, about the terrestrial snails of Armenia. We have visited Zoology Museum of Institute of Hydrology and Zoology where are preserved data about Armenian molluscs species.

Fieldworks

During the project, we organized field trips to different sites in Armenia in order to collect, preserve and analyze species distribution and local status. Basic fieldwork periods was during early spring to the middle of summer and autumn as the snails are active mainly at these periods due to climate conditions. During fieldwork first stage we have had trips last from April to July (4 months) and during the autumn - from September to the beginning of November (3 months). In each period we will organize several field trips each of 3-4 days long. In general, we have had collected snails from 51 points from 8 different provinces from Armenia (image. 2). Currently, we have collected data about 50 species of terrestrial snails.

Image 2. Fieldwork and sampling points

Sampling design

Study areas were selected according to data existing in literature and museum collections. Multiple sampling methods were applied for material collection during fieldwork. We combined visual searching (for large size animals), quantitative quadrats, and bulk leaf litter/soil samples for small snails (for small ones) to provide ensure effective sampling. We sampled research material and assessed species relative abundance by counting adult, juvenile samples within a 5 × 5 m plot for middle and large size molluscs and take 1 kg soil samples for small snails.

Using combined quantitative/qualitative survey methods allowed us to intensify our sampling and collect as much data as possible from the field.

Image 3. Fieldworks with students and volunteer from YSU: a), b), c), e) Noratus village, A. Hovhanyan, M. Arzumanyan and R. Petrosyan; d) Vayots dzor province, Hors village, V. Arzumanyan; f) taking ecological peculiarities, Noratus; g), h), i) surround territories of Martuni city; j) and k) Pounds near to Stepanavan city; l) Lick village, near to the Argisht river; m) and n) Gndevank monastery.

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The following ecological peculiarities were fixed during the fieldworks: temperature of the air, humidity of the air, elevation, habitat types, etc. For animals and their habitat capturing we used Nikon Digital Camera (D3300, 18-105mm), in the laboratory we used Motic Digital Stereo Microscope.

Results

We have collected data about 49 terrestrial snail species. Among them 3 species listed in Red Book of Armenia: *Vertigo angustior, Orcullela ruderalis, Orculella bulgarica* and 3 species in IUCN Red List: *Vertigo angustior, Vertigo moulinsiana,* and *Helix albesxens.*

***Table 2*. List of species that were recorded during the fieldwork**

1	*Bollingeria pupoides*	26	*Orculella ruderalis*
2	*Carychium minimum*	27	*Oxychilus subeffusus*
3	*Carychium tridentum*	28	*Oxyloma elegans*
4	*Chondrula tridens*	29	*Pomatias rivularis*
5	*Cochlicopa lubrica*	30	*Pupilla bipapulata*
6	*Cochlicopa lubricella*	31	*Pupilla inops*
7	*Elia somchetica*	32	*Pupilla interrupta*
8	*Euconulus fulvus*	33	*Pupilla kyrostriata*
9	*Eumphalia selecta*	34	*Pupilla muscorum*
10	*Fruticocampylaea narzanensis*	35	*Pupilla triplicata*
11	*Geminula isseliana*	36	*Quadriplicata quadriplicata*
12	*Georginapaeus hohenackeri*	37	*Sphyradium doliolum*
13	*Harmozica pisiformis*	38	*Succinea putris*
14	*Harmozica ravergiensis*	39	*Succinella oblonga*
15	*Harmozica selecta*	40	*Truncatellina costulata*
16	*Helix albescens*	41	*Truncatellina cylindrica*
17	*Helix lucorum*	42	*Vallonia costata*
18	*Hesseola pretensis*	43	*Vertigo angustior*
19	*Idyla foveicollis*	44	*Vertigo moulinsiana*
20	*Lauria cylindracea*	45	*Vertigo pusilla*
21	*Ljudmilena sieversi*	46	*Vertigo pygmaea*
22	*Merdigera obscura*	47	*Vertigo substriata sieversi*
23	*Mucronaria duboisi*	48	*Vitrea contortula*
24	*Bollingeria pupoides*	49	*Xeropicta derbentina*
25	*Orculella bulgarica*		

Species marked by RED are included in Red List or we found only once.

Vertigo angustior and *Vertigo moulinsiana*

Vertigo angustior Jeffreys 1830, Narrow-mouthed Whorl Snail - land snail - IUCN status: NT - include in Armenian Red Book status: CR B1a+B2a (Harutyunova, 2010).

This species is listed as Near Threatened, based on the number of populations which are in decline, which are close to meeting the 30% decline threshold. In Europe, this species is listed as Vulnerable (VU) A2ac+3c at the European level and at the level of the 27 member States of the European Union, based on the estimated loss of individuals in sites, combined with total loss of sub-populations from sites that have been well monitored since the Habitats Directive monitoring began and the lack of habitats in favorable condition as mentioned in recent EU reporting (Moorkens et.all, 2012). In Armenia this species was found only from Lori province, north Armenia and special conservation actions for this species were not done yet.

Vertigo moulinsiana Dupuy1849, Desmoulin's Whorl Snail - land snail - IUCN status: VU - does not include in Armenian Red Book.

The conservation assessment of Vulnerable (VU) A2ac at the European level and at the level of the 27 member States of the European Union is based on the estimated loss of individuals in sites, combined with the total loss of sub-populations from sites that have been well monitored since the Habitats Directive monitoring began. The species is highly conservation dependent and is susceptible to many pressures present in the lowland wetlands where it resides. Thus, the lack of other conservation interest in its habitat and the vulnerable nature of that habitat mean that future prospects suggest further decline is anticipated, especially given the need for active conservation management. The ongoing losses of sites also make the remaining suite of populations more isolated and vulnerable (Killeen et. all, 2011). In Armenia this species was found from 2 sites: Lori province in north and south part of Armenia province Syunik, near to Megri city (image 4).

To understand these 2 species current status in Armenian we have visited several places near to the Stepanavan city and during the fieldworks to the Stepanavan city, we couldn’t find *V. angustior*. Main threats for this species were reviled which are habitat modification, livestock grazing and agriculture activities. During the year these threats were affecting the area in different ways. In spring seasons agriculture activates are

started, around the pounds where species could live. Local people are planting different plants such as potatoes, different sorts of wheat, etc. During summer period water from the pounds are used to irrigate the plantations. During the autumn people are collecting the seeds and after that, they are using the area for livestock grazing. For reproduction, spring and summer seasons are important for the species but the human impact is high on the local area. Living specimens of *V. moulinsiana* also wasn't found in the surrounding areas of Stepanavan city.

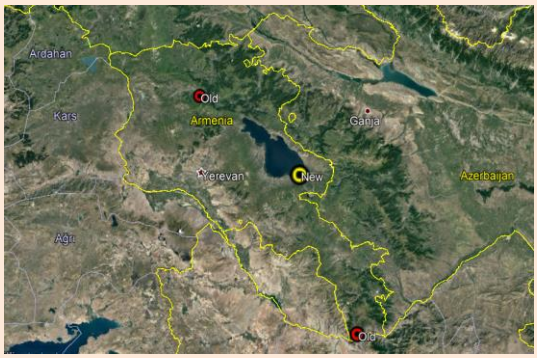
We have had several field trips to the southern part of the country where *V. moulinsiana* was recorded before. Additionally, we have had fieldworks close to the Sevan Lake were habitats are close to the *V. moulinsiana* preferred ones, where we found living individual of this species. This area wasn't recorded for this species before and it's located close to Tsovak village (image. 4). Unfortunately, we couldn't find *V. angustior* there, but this area will become one of the prioritized areas for our future research and conservation for this species. This area also was under the anthropogenic press, it was located close to the main road, and high grazing activity was recorded. Nevertheless, this area is close to the Sevan National Park so the future conservation activities will be easy to organize, then in the surrounding areas of the Stepanavan city where areas, where target species can live are belonging to local people or community, and organizing or creating protected areas, will be problematic.

According to the results that we have got from the field trips to the Stepanavan city we can say that the target species were not found there. Currently, we can't define them as an Extinct in the local area because we need to have at least 5 years research in the local area to prove that these species are extinct from there. *V. angustior* was recorded in Armenia only from the surrounding areas of Stepanavan city, while *V. moulinsiana* was recorded in the south part of the country too. We have found *V. moulinsiana* in the central-eastern part of the country and we want to continue our research in that area for *V. angustior* too.

Main threats for this species reproduction and distribution close to the Stepanavan city were habitat modification, livestock grazing and agriculture activities.

Image 4. Distribution maps of a) *V. angustior* and b) *V. moulinsiana.* Red points were recorded in the past; yellow point is a new point for *V. mounlinsiana.*

a) 

b) 

Endemic Terrestrial Snails of Armenia

Orcullela ruderalis and *Orculella bulgarica*

Orcullela ruderalis Akramowski, 1947 is included in Red book of Armenia as Critically Endangered species: CR B1a+B2a (Harutyunova, 2010). It was mentioned by Akramowski (Akramowski, 1976) as endemic of Armenia and was recorded only once from village Ginshik, Egheknadzor province. Currently, we have found one empty shell of this species from Syunik province, but this location needs to be studied properly in future.

Orcullela bulgarica (P.Hesse, 1915) also was recorded in Armenia only once and it's endemic as well and included in Red Book of Armenia as Critically Endangered species: CR B1a+B2a (Harutyunova, 2010). It was recorded from surrounding territories of Sevan Lake, close to the Masrik River. We have found the empty shell of this species in Syunik province as well, but the location needs to be confirmed as well as for *O. ruderalis*.

Armenica disjuncta armenica, Akramowskia akramowski and *Akramowskia valentine*

With the framework of our project, we were also studying distribution and conservation status of some endemic tree snail species of the family of Clausillidae such as *Armenica disjuncta armenica, Akramowskia akramowski, Akramowskia valentini* (image 5). These species were recorded from the central and southern parts of Armenia in the past. During the fieldworks that we conducted, we could not find *A. d. armenica* and *A. valentini* which were recorded in the Vayots Dzor province, close to the village

Gnishik which is also close to the Gnishik protected landscape. *A. valentini* was described from the southern part of the country close to the Kapan city. *A. akramowski* was recorded near to Kapan city as well (Akramowski, 1976). We could find one empty shell of this species from there.

Image 5. 1) *Armenica disjuncta armeniaca*, 2) *Akramowskia valentini*, 3) *Akramowskia akramowski*

1)  2)  3) 

Rare Terrestrial Snails

Several rare or IUCN Red Listed species were recorded during our field trips: IUCN Red Listed species were *Helix albescens* and *Pupilla muscorum*. Some of the species were recorded only once during our fieldworks: *Bollingeria pupoides, Carychium minimum, Elia somchetica, Fruticocampylaea narzanensis, Geminula isseliana, Hesseola pretensis, Idyla foveicollis, Ljudmilena sieversi* and *Oxyloma elegans*.

Helix albescens

Helix albescens Rossmässler, 1839 is recorded in Red List of IUCN as Least Concern (LC) species (Páll-Gergely, 2011). *H. albescens* was recorded from the northern part of the country (Akramowski, 1976). We have found several damaged shells from Tavush region. The density of species was only 4 individuals. Current recorded threats that were recorded in the areas of distribution of species were agriculture press and grazing.

Pupilla muscorum

Pupilla muscorum (Linnaeus, 1758) is also recorded in IUCN Red List as Least Concern (LC) species (Neubert, 2011). This species was recorded on high elevations and mountain areas close to the Sevan Lake (Akramowski, 1976). We have found one shell close to the Sevan Lake, Tsovak village. The area was used for grazing which impacts species distribution and abundance.

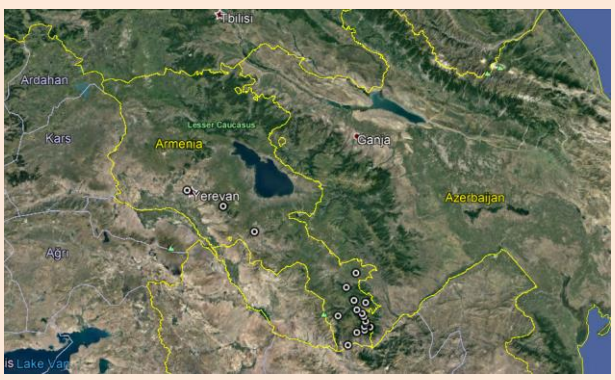
Common Terrestrial Snail

Most of the species for table 2 were recorded in different areas: *Helix lucorum, Georginapaeopsis hohenckeri, Chondrula tridens, Harmozica ravergiensis, Cochlicopa lubricella, Lauria cylindracea,* etc. Status of some of them is currently undefined and we provided information about distribution on some species from the list below:

Helix lucorum

H. lucorum Linnaeus, 1758 is one of the largest terrestrial snails in Armenia. This species was recorded mainly from the southern part of the country included Yerevan where it was introduced. Currently, this species was found in the north also (Akramowski, 1976). This species has interesting phenotypic diversity. Colour of the shell can be different from white to dark brown and even can some shells can have dark coloured lines. This species can live in high elevations up to 2500 m (above sea level) was recorded and prefers different types of habitats (image 6). Basically lives insides farms and has a negative impact on agriculture. Farmers sometimes use pesticides against this species. This species is used as a food as well. These above factors can cause the species distribution and abundance in future which makes us be aware of this species status. Being one of the largest molluscs species it also makes its sensitive to the environment and habitat modification. *H. lucorum* can be a good model to analyze impact of environmental factors and protection effectiveness on mulluscs.

Image 6. a) *H. lucorum* distribution map, b-f) *H. lucorum*, b) Yerevan, c) v. Hors, d) v. Khncoresk, e) c. Goris, f) c. Kapan.

a) 

b) 

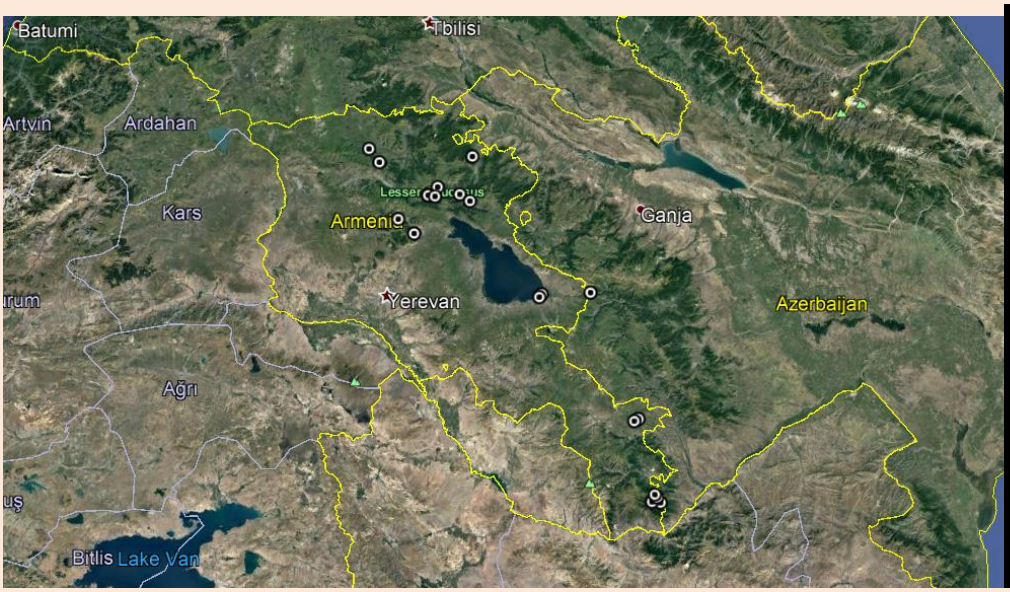
c) 

d) 

Cochlicopa lubricella

This species is one of the largest distributed species in Armenia. *C. lubricella* prefers to lie under forest litter, rocks and the other humid areas. This species is small size: shell length is from 3.8 mm to 5.7 mm (Akramowski, 1976). During the field trips, this species was recorded from about 20 different sites, which were different in elevation; habitat types and also the density of the individuals were different (image 7). The highest density from 25 m^2 was recorded from Kotayk province. The number of individuals per 25 m^2 was about 50 adults.

Image 7. a) *Cochlicopa lubricella* distribution map, b) *C. lubricella*



a)

b)

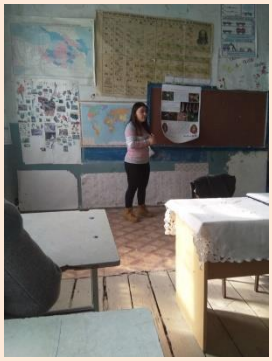
Public awareness activities

One of the important parts of our project was local community including and sharing knowledge of molluscs species among pupils of local villages and cities. We were visiting schools during the project and distribution flyers and posters which were including general information about snails, in detail about Armenian endemic and threatened terrestrial snails. During these visits, we convinced that a lot of people and children in Armenia are not aware of invertebrate animals' extinction. However, species conservation and global conservation problems were introduced to schools very bad, especially in villages. Invertebrate species such as molluscs and others lose a lot of attention for conservation purposes because they are not attractive or their impact on ecological wealth isn't that well shown. During our project, we tried to share and educate people but a lot of works need to be done to solve these problems not only in Armenia but in the global environment too. Our main message to pupils and locals were about protecting not only molluscs species but the natural environment in general.

Image 8. Seminars at schools and university: a, c) in Lichk Basic School, Gegharkunik region; b) Kapan Basic School, Syunik region; d, e, f) Schoolchildren from different schools, visited Yerevan State University.

a) 

b) 

c) 

d) 

e) 

f) 

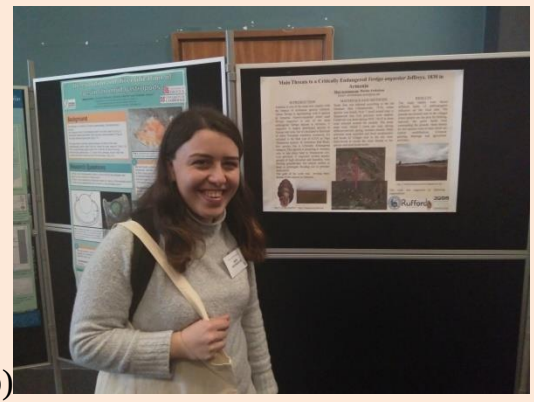
Achieved Outcomes

Conference attended

During 2018 we have attended 3 conferences to share some of our results of the project:

1. Arzumanyan M.V., Arakelyan M.S. **2018**. Main Threats to a Critically Endangered *Vertigo angustior* Jeffreys, 1830 in Armenia. Molluscan 20th Forum, **London**, UK, pg. 6
2. Arzumanyan M. V., Arakelyan M. S. **2018**. The effectiveness of protected area in the example of Dilijan National Park for terrestrial molluscs diversity and richness in Armenia. Rufford Small Grants Conference "Conservation across the Caucasus" **Kazbegi**, Georgia. pg. 10
3. Arzumanyan M.V., Arakelyan M.S. **2018**. Diversity pattern of terrestrial molluscs in Dilijan National Park of Armenia. 2nd International Young Scientists Conference on "Biodiversity and Wildlife Conservation Ecological Issues". **Tsaghkadzor**, Armenia pg. 73-74

Image 9. During the conferences: a) 2nd International Young Scientists Conference on "Biodiversity and Wildlife Conservation Ecological Issues"; b) Molluscan 20th Forum; c) Rufford Small Grants Conference "Conservation across the Caucasus"

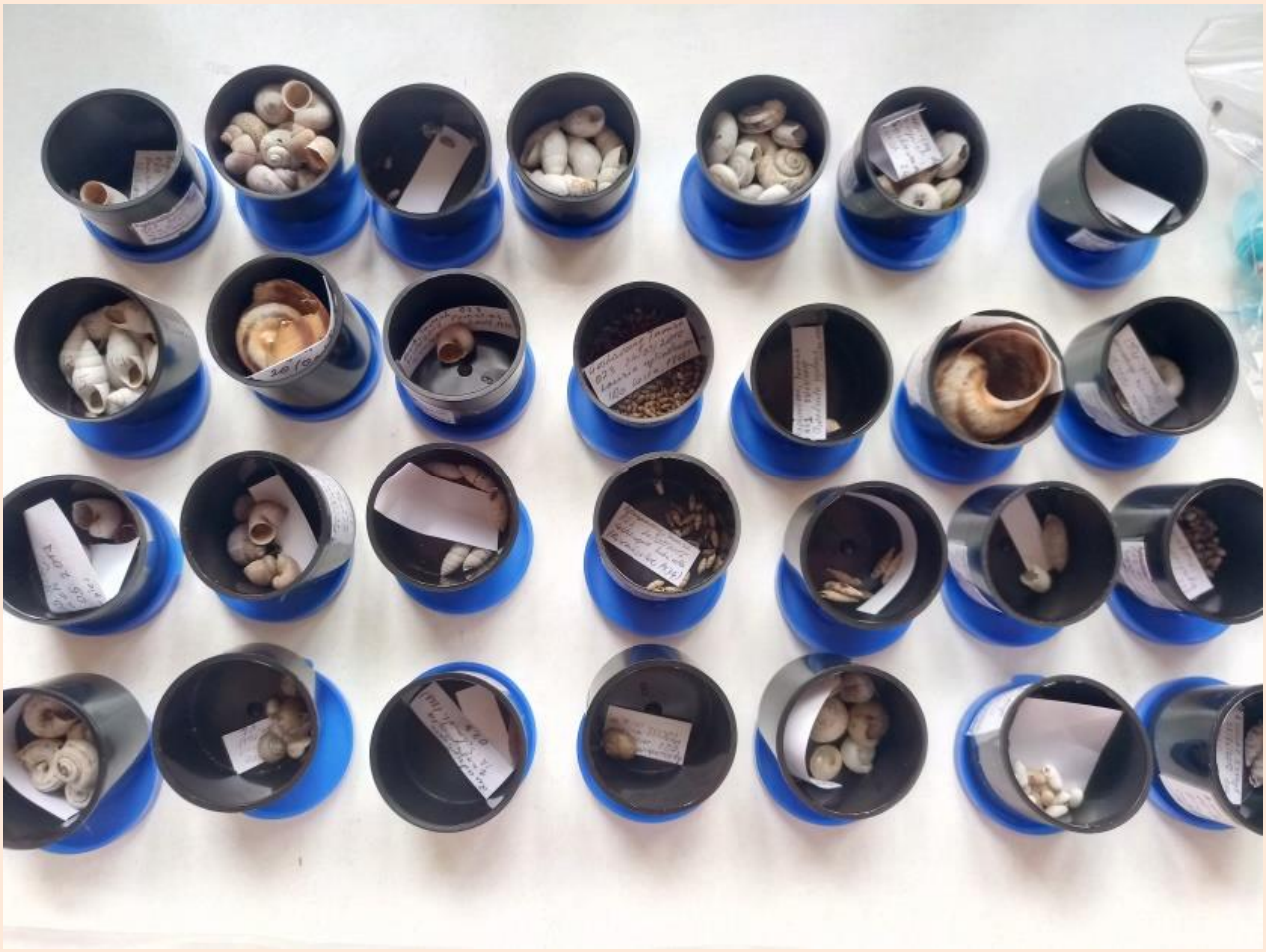
a)   b) 

c) 

Museum collection creation

Within the framework of this project, we have collected empty shells of some snails which became part of the current Zoology museum collection at the Zoology Department at YSU. Currently, we have about 300 samples all over Armenia. This is a good base to analyze the current distribution and abundance of species. This collection samples currently are used during lectures to illustrate Armenian terrestrial snails' diversity and variation among shells (image 10). The museum samples will be useful for educational and research purposes.

Image 10. Museum samples.



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