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Species diversity of terrestrial mollusks in Shemiranat County, Tehran Province with introducing four new species for Iranian fauna

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Abstract

This study was designed to investigate about species diversity of soil mollusks in Shemiranat county. The country was divided into 10 sampling stations and the collected samples were identified morphologically and systematically according to the certified identification keys. Results showed the significant effect of temperature and relative humidity on the abundance of the soil mollusks. There were no samples collected in cold months, but in warm seasons, August had the most numerous samples, and March showed the lowest abundance. In this study, a total of 94 samples belonging to 10 species under 9 genera and 8 families were identified as follows: *Helix lucorum* (Helicidae), *Cernuella neglecta*, *Monacha cantiana* and *M. parumcincta* (Hygromidae), *Succinea putris* (Succineidae), *Chondrula tridens* (Enidae), *Planorbis intermixtus* (Planorbidae), *Deroceras tritulatum* (Agriolimacidae), *Ambigolimax valentianus* (Limacidae) and *Arion fuscus* (Arionidae). *P. intermixtus* was the most abundant species among the collected samples and *S. putris* had the lowest density.

Keywords: Diversity, Mollusca, Shemiranat, Species, Tehran

Introduction

Terrestrial mollusks with about 10 thousand species all around the world, gain incredible importance in different aspects. This great taxon of invertebrates feed on a vast variety of crops and makes an enormous loss on the young plants in spring; so some of the species can be considered the main pests of vegetables and orchard plants (Majidi Shilsar et al., 2021); for example, *Parmacella ibera* Eichwald is one of the most serious pests of the citrus nursery in Mazandaran province (Ahmadi & Javadi, 2012) and *Agriolimax agresteris* L. has been reported on lettuce from many provinces in Iran (Ahmadi et al., 2018). Also, snails can be the intermediate host for many human and animal pathogens and parasites (Shahaway et al., 2008). Soil mollusks are a rich nutrient for the other invertebrates in many ecosystems (Akbari et al., 2017).

Shemiranat county is based on the north part of Tehran Province and consists of two parts of Lavasanat (including Lavasan city, the villages of Grand and Small Lavasan) and Roudbar Ghasran (including Tajrish, Shemshak, Oshan, Fasham, and Meygun areas). This county has six different climates including cold and semi-arid, Mediterranean cold, cold-semi-humid, very humid-mountainous, and ultracold-very humid due to its location in the mountainous region of Tehran as well as the heights of Alborz mountains (Malek Mahmoudi & Piri, 2012). Climatic diversity in the county and different plant species can provide a great habitat environment for terrestrial snails.

Research on the biodiversity of mollusks in Iran has a relatively long history. From the first studies, during the study of soil mollusks in Golestan and Mazndaran provinces, two new species of snails were identified belonging to *Prosobranchia* sp. and 29 species belonging to the order of Pulmonata and finally the new species of *Cochlicella acuta* Muller from Miankaleh in Golestan province (Mansoorian, 1993). In another research on the snails of the orange orchards in Mazandaran province, based on the morphometric characteristics it was found that there are a total of 16 species belonging to 14 genera under nine families; then, *Cochlicella acuta* Muller was reported for the first time in this study (Ahmadi & Javadi, 2012). Beygi (2013) reported 11 species of soil snails by investigating terrestrial mollusks in the central part of Markazi province and the most frequent was assessed for *Cernuella virgata* Da Costa. Through studying terrestrial snails in the west of Isfahan province, six species were identified and *C. virgata* was reported as the most enormous (Fazilinejad & Belgheiszadeh, 2020).

A faunistic study of terrestrial snails in the Damavand region showed that *C. virgata, Cernuella*

neglecta Draparnaud, *Helicella italia* L., *Monacha messenia* Blanc under Hygromiidae and *Chondrula tridens* Muller under Enidae are distributed in the area (Hamiyati, 2015). Through different studies about soil mollusks in other regions in Iran, 13 species were reported for Gilan province (Qasemi et al., 2022), six species for the Firouzkouh area (Yousefi, 2015), four species for east of Tehran province (Golbaz, 2015), 23 species for Mazandaran province (Akbari et al., 2017) and nine species for Oroumieh area (Shamsi et al., 2019). Due to the enormous changes in ecosystem climates and lack of enough information about the species diversity of the soil snails in Shemiranat county, this study aimed to identify the terrestrial Mollusca in the area and conducted the relationship between species diversion and climatic factors.

Martial and methods

Sampling was conducted through a gradual increase in temperature and relative humidity, April-September 2020. Regarding the plant cover, rivers, and height above the sea, 10 different sampling points were chosen including Shemshak, Meygun, Oshan, Tajrish, Small Lavasan, NiknamDeh, Latian dam, Garmabdareh, Zardband, Sohanak, and Grand Lavasan. In each sampling point, temperature, relative humidity, height above the sea, and geographical coordination were recorded (Table 1, 2).

Table 1. geographical characteristics of the sampling points in Shemiranat county

row	Name of the sampling point	longitude	latitude	Height above the sea (m.)
1	Meygun	35˚ 57′ N	51˚ 29′ E	2131
2	Shemshak	36˚ 02′ N	51˚ 30′ E	2600
3	Small Lavasan	35˚ 49′ N	51˚ 42′ E	1700
4	Latian dam	35˚ 48′ N	51˚ 43′ E	1860
5	Grand Lavasan	35˚ 81′ N	51˚ 57′ E	2071
6	Sohanak	35˚ 32′ N	51˚ 17′ E	1800
7	Zardband	35˚ 49′ N	51˚ 34′ E	1850
8	NiknamDeh	35˚ 22′ N	51˚ 33′ E	1821
9	Tajrish	35˚ 48′ N	52˚ 25′ E	1600
10	Oshan	35˚ 43′ N	51˚ 52′ E	1917

The samples were collected from the surface of the soil, under the soil, plant residues, under the boulders, and rocks or tree trumps on the banks of the river twice a month using a garden shovel and after recording the necessary information including the sampling point, the date, temperature and relative humidity and the geographic location, were transferred to alcohol ethanol 70%. The samples were transferred to the laboratory and identified by a stereo-microscope based on valid identification keys (Daw & Ivison 2013; Samaee & Mansoorian, 2000; Fahy, 2001). Then the relative frequency of the species was calculated to show the difference in sampling month and points.

Table 2. Climatic characteristics of the sampling month in the Shemiranat area

Month	Min. temperature ˚C	Max temperature ˚C	Mean temperature ˚C	Min. relative humidity %	Max relative humidity %	Mean Relative humidity %
April	5.2	15.1	10.1	31	72	51
May	12.6	23.2	17.9	26	59	43
June	16	28.2	22.1	16	28.2	35
July	21.4	33.4	27.4	17	36	27
August	21.6	33.6	27.6	16	32	24
September	18.2	30.2	24.2	16	31	24

Results

In this study, 94 samples including 10 species under 9 genera belonging to 9 families were collected and identified. Zardband sampling point had no mollusk sample but Oshan was the most abundant with 22 samples; then Grand Lavasan with 20 samples, NiknamDeh with 17 samples, Sohanak with 16 samples, and Tajrish with 10 samples were ranked respectively. Three samples were collected from the Latian Dam point and two samples from each Meygun, Shemshak, and Small Lavasan (Fig. 1).

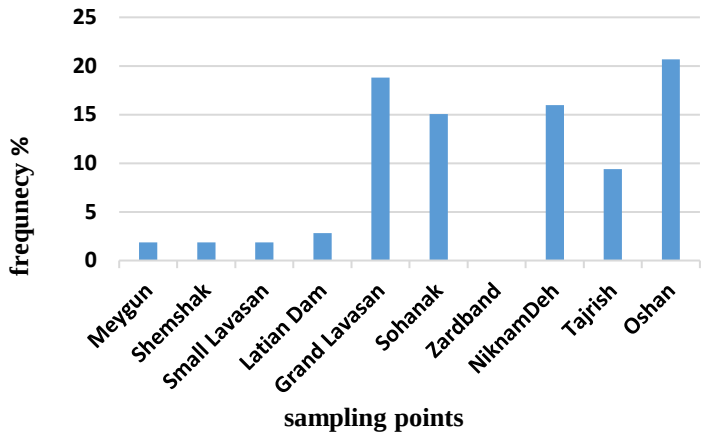

Figure 1. Rational frequency (%) of the collected species from sampling points

Samples collected belonged to the following species:

Helix lucorum, Linnaeus, 1758 (Helicidae)

Shell round and almost convex, Aperture reversed and reddish-brown inside, strangely thick and protrusion completely visible; shell with 4.5 to 5.5 convex whorls, the last whorl deeper and descending near the diaphragm. Shell size is 35-42 mm long and 21-36 mm wide, quite big. This species mostly feeds on rotten and decomposing leaves on roadsides, in forests, on a tree trunk, or under trees. Four samples were taken at Sohanak which constituted 3.76 % of all samples.

Cernuella neglecta, Draparnaud, 1805 (Hygromidae)

White shell with brown stripes, often with a slightly raised edge and some narrow stripes below, 5-6 slightly convex whorls with shallow slits, aperture thin with a pink inside edge; navel slightly wide, diameter of shell 1.4-1.6 mm. 12 samples collected from Grand Lavasan and Sohanak which constituted 11.28 % of all samples.

Monacha cantiana, Montagu, 1803 (Hygromidae)

Known as the land snail with lungs to breathe, medium size, right turn, brown shell with 5-6 whorls, the shell with the navel. Five samples of this species were collected from Grand Lavasan which constituted 4.7 % of all samples.

Monacha parumcincta, Menke, 1828 (Hygromidae)

Light brown shell with white brands, hard and slightly striped with 6 whorls, the last whorl has a border from the beginning; aperture with raised white edge and often red inner margin, navel usually covered by marginal columns. 16 samples of this species were collected from Grand

Lavasan (6 samples), Sohanak (4 samples), Latian Dam (3 samples), and NiknamDeh (3 samples) which constituted 15.04% of all samples.

Succinea putris, Linnaeus, 1758 (Succineidae)

Think aperture with visible prominence, 3-4 convex whorls, the last deeper and descending near the diaphragm. Skin is amber yellow, visible soft parts of the body are reddish-yellow in color. The habitat of the species is mostly humid areas. Just one sample from NiknamDeh was collected.

Chondrula tridens, Muller,1774 (Enidae)

Brownish yellow shell with fine grooves, opening with a sharp white border in the parietal part, the inner edge of the shell hard and visible. 7-8 straight whorls, strong lower radula and weak upper radula. Five samples from Oshan were collected, constituting 4.7 % of all samples.

Planorbis intermixtus, Mousson, 1874 (Planorbidae)
Known as *P. persicus, the* shell is completely flat, left turn, air-breathing, head, and legs are very tiny, long string tentacles. 21 samples from Sohanak (3 samples), Tjrish (3 samples), and Oshan (15 samples) were collected, constituting 19.74 % of all samples.

Ambigolimax valentianus, Férussac, 1822 (Limacidae)

Formerly known as *Lehmannia valentiana*, air breathing is distributed in some Asian and European countries and islands, the habitat is humid, shady and vegetated areas in gardens, greenhouses, and urban green spaces. Yellow to brown and grey. Nine samples were collected from Shemshak and NiknamDeh, which constituted 8.46 % of all samples.

Deroceras reticulatum, Müller, 1774 (Agriolimacidae)

A short knot on the back of the body as other species of *Decoderas* spp., creamy to brown in color, habitat in farms, roadsides, gardens, jungles, and pastures, nocturnal and polyphagous. 16 samples were collected from Shemshak, Small Lavasan, Sohanak, NiknamDeh, Tajrish, and Oshan, constituting 15.04 % of all samples.

Arion subfuscus, Müller, 1774 (Arionidae)

Greyish brown to orange in color, round in shape when contracted, vertical stripes on the leg margins, yellow to orange mucus, distributed in any kind of terrestrial habitat. 5 samples collected from Meygun and NiknamDeh, constituted 4.7 % of all samples.

Figure 2 shows the relative frequency of the collected samples in this study which demonstrated that the most abundant species was *P. intermixtus* and the lowest frequency was related to *S. putris.*

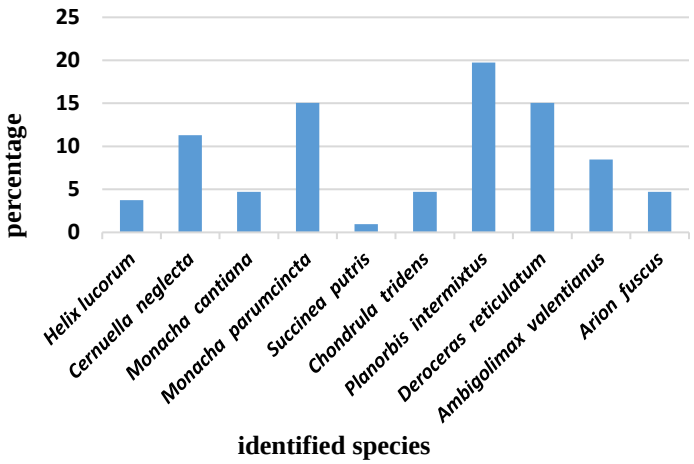

Figure 2- abundance percentage of the collected species

Relative frequency of the collected species through the sampling months showed that 40% of all samples were collected in August and the lowest abundance belonged to September (13.7%). As it can be expected, the species frequency increased gradually from April to July (20%); but the interesting point was that after August, the relative frequencies of species suddenly declined in September (15%).

Discussion

Molluscs are the second largest phylum of Animalia in terms of species diversity and abundance in the world around 60 thousand species have been identified in fresh water and soil, so far. These species are different in terms of morphological diversity and body cover and most of them are identified only based on the shape and characteristics of the shell (Pfleger, 1999).

In many provinces of Iran, various research have been conducted to identify the land snail but the current study is the first independent report about the terrestrial mollusks in Shemiranat County. It this study, 10 species belonging to eight families was identified.

H. lucorum is native to the Eastern Mediterranean and Asia Minor, but it has also been reported in Europe and Israel as well (Mumladze, 2013). The species has been previously reported from Oroumieh city (Shamsi et al., 2019) and the bank of Jajroud river (Ahmadi & Javadi, 2012).

C. neglecta is found in barren lands, gardens as well as roadsides and is mostly seen in the highlands. The species is universally distributed in France, Italy, Belgium, the Netherlands, Switzerland, Germany, Poland, and Uzbekistan (Molet, 2014). In Iran, it has been previously reported from Zanjan province (Beygi, 2013), Isfahan province (Fazilinejad & Belgheiszadeh, 2020), Mazandaran province (Akbari et al., 2017), Damavand County (Hamiyati, 2015),

Firouzkouh area (Yousefi, 2015) and Tehran city (Golbaz, 2015). This is the first report of *C. neglecta* for Shemiranat County, from the Grand Lavasan area and Sohanak point.

M. cantiana known as park snail, is a Mediterranean species with a vast geographical distribution pattern that has been reported from different parts of Asia, Africa, and Europe (Hlavac & Peltanova, 2010). The species has been reported from Tehran city (Golbaz, 2015) and this is its first report from the Shemiranat area. It is assumed that the import of the potted plant to the country has introduced it to Iran. Previously, other species of *Monacha* spp. have been collected from the Kazeroun river (Golchin Manshadi & Pourbagher, 2017) and Isfahan province (Fazilinejad & Belgheiszadeh, 2020).

M. parumcincta is mainly found on soil or under rocks and has been reported in Italy, Greece and Turkey (Welter-Schults, 2012). It has been reported from Khuzestan province and this is the first report of the species for Tehran province fauna.

S. putris often live in very humid areas on the plants near rivers and swamps and has been collected from different countries in Europe (IUCN, 2013). In Iran, it was reported from West Azarbaijan province (Imani et al., 2020; Shamsi et al., 2019; Ahmadi, 2014).

C. tridens as a terrestrial species lives in meadows and sunny dry slopes and feeds on decomposing plants. The species has been reported in many Asian and European countries and easily adapted to heights (Komarova et al., 2015). In Iran, previously it has been reported from Zanjan province (Beygi, 2013), Isfahan province (Fazilinejad & Belgheiszadeh, 2020), Mazandaran province (Akbari et al., 2017), and Damavand area (Hamiyati, 2015). The species collected from Oshan point in the current study.

*P. intermixtus, as a known aquatic species has,*have been reported in Turkey, India, and Iran; the species has a widespread area in Iran such as Fars province (Abbaspour et al., 2019), Khuzestan province (Massoud & Hedayeli, 1979; Mansoorian, 2001), Lorestan province (Massoud & Hedayeli, 1979) and Mazandaran province (Ahmadi & Arbabi, 2004). This is the first report of the species for Tehran province, and it is assumed that this aquatic species was transferred from rivers to their banks by grazing sheep or human use of river water has helped to transfer these aquatic species to un-aquatic areas. Although freshwater snails prefer to live in shallow water, they are usually found along the margins of water bodies; in addition, when small ponds or very shallow rivers dry up, these mollusks can often survive by burrowing into underlying sediments (Vaughn, 2009); these facts could explain the occurrence of *P. intermixtus* on or at the bottom of the soil.

The three-band garden slug, *A. valentianus*, has been reported in Britain, Ireland, Czech Republic, and China (Wiktor et al., 2000), and Colombia (Hausdorf, 2002). This is the first report of the species for the Iranian fauna. As the species is known to be invasive to crops, especially in greenhouses (Ekin & Sesen, 2018), great attention to its new distribution in Iran is needed. *D. reticulatum* is native to Europe but recently has been reported in North and South America and Asian Countries (Crowley & Pain, 1977). Similar species, *D. agreste* was reported as a serious pest of lettuce from Mazandaran province (Ahmadi & Gholamzadeh Chitgar, 2022). This is the first report of the species for the Iranian fauna which was collected from several sampling point such as Shemshak, Small Lavasan, Sohanak, NiknamDeh, Tajrish, and Oshan in Shemiranat county.

Another serious agriculture pest, *A. subfuscus* inhabits in jungles under tree barks, gardens, meadows, and hills; and has been reported in Europe, America, and Asia (Pinceel et al., 2004). This is the first report of this species for the Iranian fauna, in Meygun and NiknamDeh points.

As it was seen, Oshan was the most abundant sampling point, biodiversity and population abundance of invertebrates are affected by several factors such as environmental pollution, food availability, predator presence, proximity to urban areas, and climatic changes. According to the results, Shemiranat county, Zardband, Shemshak, Meygun, and Small Lavasan with the lowest mollusks abundance could be considered unsuitable habitats for these invertebrates; their proximity to urban areas and excessive use of pesticides on crops would be the main causes of high pollution in these points. Comparison of the mollusk's abundance through sampling months showed that in August, their relative frequency was the highest; as it is known mollusks prefer humid areas with the moderate temperature that is in contrast with the observation of this study; so first, this can be explained by the fact that through the warmest month of the year, land snails burrow into the soil or hide under the litter to escape from the heat which makes them more visible to collect. On the other hand, sampling error is very common in invertebrates collections (Cameron & Pokryszko, 2005). Finding the suitable locations of species is the main arm of a sampling project which would lead to missing some species. So secondly, it can be assumed that the high abundance of the collected species would be due to sampling error.

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