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The species composition of the terrestrial Gastropods in Tehran Province

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Abstract

Tehran province as a diverse habitat for different animal species, has the potential to support many land molluscs species. However, a little glimpse of the research on malacology shows that Tehran province is probably the least well-studied area for land snails in Iran. Herein, the very first comprehensive study about the land snails collected from Tehran province in addition to the previous scientific document is presented. The data included here are based on the field investigations and the published records by different authors from 2008 to 2023 This checklist is collectively composed of 22 species belonging to 16 genera under nine families from different parts of Tehran province. However, some areas of Tehran province have not been investigated in terms of the diversity of snail species. The outcome of this report shows that more research is needed on the species diversity of terrestrial snails in Tehran province

Keywords: Gastropoda, mollusca, snail, Tehran, terrestrial.

Introduction

Mollusca with around 85000 described species is the second largest phylum of animals on the Earth. The largest class in Mollusca, Gastropoda compromises 83% of the accepted and valid species and has been repeatedly and successfully surveyed and identified worldwide. Although the terrestrial group with an estimated 25000-30000 species attracts great economic interest and ecological importance (Koudenoukpo et al., 2020), the general knowledge about the species composition is incomplete. Despite their ecological importance and economic interest in many ecosystems (Strong et al., 2008), our information about their ecology and distribution patterns in different provinces of Iran is scattered (Wiktor, 2000).

Issel (1865) presented the first list of the Iranian terrestrial snails by visiting several cities such as Tabriz, Urmia, Rasht, Tehran, Isfahan, Yazd, Kerman and Bandar Abbas and reported seven species which were mostly found in the northern part of the country. Then, Forcart (1935) sampled the land snails of the northern part of Iran and reported 30 species. Through another old research on the snails from the northern parts of Iran, 25 different species of terrestrial molluscs were identified for the jungle ecosystem (Eliazian et al., 1979). Then, in a previous study, Mansourian (2004) collected the land snails of both Golestan and Mazandaran provinces and reported 34 species from garden spades, sieving litters and sands and introduced *Cochlicella acuta* to the Iranian fauna. Valipour Norouzi (2014) reported six land snail species from the barks of Gahar Lake, in Lorestan province, four of them medically important. Fazilinejad and Belgheiszadeh (2020) reported six land snails belonging to two families in Isfahan province, collected from Khansar, Chadogan, Faridan and Fereydounshahr. A complete list of Enidae molluscs of Iran with the description of new 17 species has been presented by Bank and Neubert (2016) following a study on the review of the Iranian Pupillidae (Gittenberger & Pieper, 1988).

Snails are considered significant agricultural pests in humid areas worldwide. They feed on the soft plant tissues and can damage various parts of plants. Data collected from West Azarbaijan province indicated that 18 species belonging to 10 families of snails can be mentioned as potential pests of orchards (Ahmadi, 2014). In another study, *Helicella candaharica* (Pulmonata: Hygromiidae) was considered one of the main pests of fields and orchards in Mazandaran province (Alishah et al., 2020). In a similar study about the snail pest to crops, *Succinea putris* L. was reported from the rice seedlings in Mazandaran province (Amooghli Tabari & Ahmadi, 2013). Bagheri and Nasr Esfahani (2011) showed that

Helicella krynickii Krynichkii and *H.candeharica* Pfeiffer, are the main Mollusca pests of the medicinal plants in Isfahan province. In a recent study, Shamsi et al. (2021; 2019) studied the shell and radula morphology of land snails, besides their diversity in Urmia city, North-west of Iran, reported nine species.

Terrestrial snails can be considered as the biotic index of soil pollution, too; as Valizadeh et al. (2020) determined the role of *Xerolenta obvia* Menke as the bio-filter of heavy metals in soils. Tehran province with a diverse eco-climate from east to west has the adequate potential for inhabiting many terrestrial mollusks. Tehran province with an area of 18909 km^2 is located to the north of the central plateau of Iran. Due to its location at a crossroads connecting the Alborz and Central mountain ranges, Tehran province is a great importance for its biological and climatic diversity (Mohammadi Fazel, 2020). In this study, for a better understanding of the Molluscan fauna, the species diversity of terrestrial molluscs from Tehran province is gathered.

Material and methods

Study region

Samples reported in this study have been collected from different locations of Tehran province, at the central Alborz Mountains, situated on the southern border of the mountains and divided into five sections as follows: Shemiranat, Dmavanad, Firouzkouh, Tehran city (west-south) and Tehran city (east). Shemiranat is located in the north of Tehran province. This area bordered Mazandaran province from the north, Tehran city from the south, Damavand area from the east and Alborz province from the west. Due to its location in the mountainous region, the area has a semi-humid and humid climate with cold and long winters. Damavand County with an area of about 188 thousand hectares is located in the northeast of Tehran province. In terms of climate divisions, it has a cold semi-steppe climate in the middle part and a mountainous climate in the highlands. As a result, it has a cold semi-arid climate and even in summer, it is 5 degrees cooler than other parts of the province.

Firouzkouh is located in the northeast of Tehran province and from the north is limited to Mazandaran province, Semnan province in the south and Damavand city in the west. The region has a semi-humid and cold climate with relatively long winters in mountainous conditions. Tehran city is located on the southern slopes of the central Alborz mountain range and on the north-western edge of the central desert of Iran. In the area of Tehran city, the temperate Mediterranean climate covers the northern, north-western and north-eastern areas, and the cold green dry area covers the southern regions. Data gathered for Tehran city belong

to the east, south and southern parts of the city. The geographic characteristics of the sampling points are presented in Table 1.

Varamin area composed of Varamin city, Gharchak, Pishva, and Pakdasht counties has an area of approximately 3000 square kilometres and is located in the southeast of the Alborz mountain range and includes finite sets of hills. Due to the annual average rainfall at 171.3 mm, the area is dry and has desert ecosystems which despite the low amount of precipitation and lack of underground and surface water and saline or alkaline poor soil, has a relatively rich flora.

Table 1. Geographical characteristics of the sampling points through Tehran Province

Area	Sampling point	Longitude (N)	Latitude (E)	Height above the sea (m.)
Damavand	Roudehen	35º44'	51º55'	5051
	Abali	35º45'	51º57'	2265
	Kilan	35º22'	52º09'	11264
	Absard	33º37'	52º09'	13450
	Damavand	35º45'	52º20'	2000
	Garmabsard	35º28'	52º21'	1873
	Kahnak	52º35'	35º43'	1800
Shemiranat	Meygoun	35º57'	51º29'	2131
	Shemshak	36º02'	51º30'	2600
	Lavasan Kouchak	35º49'	51º62'	1700
	Latian dam	35º48'	51º63'	1860
	Lavasan Bozorg	35º81'	51º78'	2071
	Sohanak	35º32'	51º17'	1800
	Zardband	35º49'	51º34'	1850
	Niknam deh	35º81'	51º72'	1821
	Tajrish	35º48'	52º25'	1600
	Oshan	35º93'	51º52'	1917
Tehran (East-West)	Pardisan	35º58'	51º16'	1425
	Bahmani	35º80'	51º32'	1485
	Saei	35º40'	51º40'	1329
	Azadi	35º01'	51º54'	1198
	Rezvan	35º51'	51º15'	1150
	Razi	35º14'	51º27'	1127
	Abouzar	35º33'	51º27'	1122
	Ghaem	35º19'	51º38'	1127
	Besat	35º47'	51º34'	1109
	Golha	35º44'	51º57'	1219
	Chitgar	35º47'	51º29'	1285
Firouzkouh	Tangeh Vashi	35º22'	52º37'	1976
	Arjmand	35º07'	52º06'	2985
	Veresk	35º27'	52º27'	1965
	Vazna	35º07'	52º24'	2000
	Khomadeh	35º69'	52º16'	1936
	Simindasht	35º17'	52º58'	2036
	Goursefid	35º36'	52º57'	1850
	Bournik	35º09'	52º16'	2039
Tehran (North-South)	Gheytarieh	35º32'	51º52'	1535
	Taleghani	35º13'	51º20'	1424
	Sadaf	35º40'	51º56'	1439
	Helal ahmar	35º59'	51º56'	1124
	Miniature	35º59'	51º42'	1300
	Baharan	35º39'	51º29'	1119
	Sorkheh hesar	35º28'	51º03'	1450
	Laleh	35º12'	51º37'	1113
	Pardis	35º29'	51º34'	1104
	Valiasr	35º08'	51º34'	1062
Pakdasht	Hamamk	35 30	51 47	1170
	Filestan	35 25	51 40	1005
	Jito	35 27	51 40	1017
Varamin	Qouinak	35 23	51 40	981
	Khaledabad	35 16	51 36	935
	Charmashar rout	35 18	51 38	909
Ghareckak	Eshghabad pond	35 24	51 30	915
	Bahram	35 27	51 31	962
	Davoudabad	35 23	51 31	912
Pishva	Pishva river	35 20	51 43	944
	Senardak	35 17	51 43	908
	Jungle Park	35 18	51 43	973

Sampling

Multiple locations of Tehran province named in Table 1, were selected for the study. In each of these locations, the selection of the sampling sites, a mosaic of soil, grass, individual plants and concrete structures constituted the habitat elements with ample moisture and shade conditions, qualifying as prospective spaces for the presence of the snails. Samples were collected carefully from the underneath stones, at soil level and among the leaf litter and transferred to the laboratory in for further investigations. The collected samples were identified to the species level by use of certified identification keys such as (Forsyth, 1999).

Results

Species composition

The data included here are based on published records and field investigations from 2008–2023 by different authors. The list provides taxonomic notes where needed, as well as distribution ranges of genera and species. The original names of the type species of genera and subgenera are provided. The district name is mentioned for all species from Tehran province and particular locations such as other provinces in Iran wherever data are available. The list includes 22 species under 16 genera and 9 families.

Family: Hygromiidae

***Cernuella virgata* Da Costa 1778**

Synonym: *Cochlea virgate* Da Costa 1778

Globosely-depressed shell, Yellowish-white, sometimes reddish in color with two dark bands on the apical surface along the coiled shell; 3-4 narrow lines on the lower surface; 4.5-5.5 convex whorls; last whorl initially angulated or rounded; aperture rounded with red or white parietal wall of the aperture; umbilicus variable but always open.

Evidence in Tehran province: Damavand area (Hamiyati, 2015), Varamin area (Torabi Diarjan, 2015).

Evidence in Iran: Isfahan prov. (Fazilinejad & Belgheiszadeh, 2020); Mazandaran prov. (Akbari et al., 2017); East Azarbaijan prov. (Zamanehro, 2014); Guilan prov. (Asgari, 2015)

***Cernuella neglecta* Draparnaud 1805**

Synonym: *Helix neglecta* Draparnaud 1805

The white shell with brown stripes, often with a slightly raised border and several narrow stripes underneath; 5-6 slightly convex whorls with shallow slits; pinkish inside edge of the aperture; perforate and slightly wide; shell diameter 1.4-1.6 mm.

Evidence in Tehran province: Shemiranat (Hoseini et al. 2023; Table2), Damavand (Hamiyati, 2015; Table2), Tehran capital city (Abbaszadeh, 2015; Golbaz, 2015; Table2), Varamin area (Torabi Diarjan, 2015).

Evidence in Iran: Isfahan prov. (Fazilinejad & Belgheiszadeh, 2020); Mazandaran prov. (Akbari et al. 2017; Akbari, 2014); Zanjan prov. (Beygi, 2013); Guilan prov. (Asgari, 2015).

***Monacha cantiana* Montagu 1803**

Synonym: *Helix cantiana* Montagu 1803

Kentish snail; globosely depressed and slightly transparent brown shell with white mottles and a pale spiral band around its circumference; 5.5-6 whorls; lunate aperture with a white or brown rib toward insertion; a narrow navel.

Evidence in Tehran province: Tehran capital city (Golbaz, 2015; Abbaszadeh, 2015; Table2) and Shemiranat area (Hoseini et al. 2023; Table2).

Evidence in Iran: There is no previous report of other parts of Iran.

***Monacha messenica* Westerlund and Blanc 1879**

Synonym: *Helic (Carthusiana cantiana* var. *messenica* Blanc 1879

Gray shell with a sharp head; apex pointed; with 5-5.5 not very convex whorls; slightly perforate or completely imperforate; aperture with white lip inside; margin sharp; umbilicus narrow and partly covered by the reflected columellar margin.

Evidence in Tehran province: Firouzkouh (Yousefi, 2015; Table2) and Damavand (Hamiyati, 2015), Varamin, Pishva, Gharechak and Pakdashat (Torabi Diarjan, 2015; Table2)

Evidence in Iran: Isfahan province (Fazilinejad & Belgheiszadeh, 2020).

***Monacha parumcincta* Rossmassler 1834**

Synonym: *Helix parumcincta* Rossmassler 1834

Shell hard horny brownish with dull white stripes; lined and slightly striped; striated and slightly corrugated; 6 whorls; last whorl initially angulated; aperture with prominent white lip inside and often a reddish margin; umbilicus with marginal columellas.

Evidence in Tehran province: Firouzkouh (Yousefi 2015; Table2) and Shemiranat (Hoseini et al. 2023; Table2).

Evidence in Iran**:** Khuzistan prov. (Field, 1950)

Family: Helicidae

***Helicella itala* Linnaeus 1758**

Synonym: *Helix itala* Linnaeus 1758

Shell white, yellowish or pale pink; pale to dark brown bands; 5.5-6.5 weakly convex whorls; very depressed above and rounded below; aperture without internal lip; umbilicus very wide and perspectival.

Evidence in Tehran province: Firouzkouh (Yousefi, 2015), Varamin, Gharechak, Pishva (Torabi Diarjan, 2015; Table 2).

Evidence in Iran: Isfahan prov. (Fazilinejad & Belghieszadeh, 2020)

***Xerogyra spadae* Calcara 1845**

Synonym**:** *Candidula spadae* Calcara 1845; *Helix spadae* Calcara 1845.

Shell pale white with narrow light brown stripes; 5-6 convex whorls; two last whorls larger and increasing more rapidly; aperture large, inside white or light yellowish with white lip inside; upper margin strongly bent; columellar margin widened and slightly reflected; umbilicus initially narrow.

Evidence in Tehran province: Firouzkouh (Yousefi, 2015; Table 2).

Evidence in Iran**:** Mazandaran prov. (Akbari et al. 2017).

***Helix lucorum* Linnaeus 1758**

Shell basically white but almost covered with broad and pale black bands with reddish hue; striated; some spiral lines on the upper whorls; 4.5-5 slightly convex whorls; aperture small, inside grey with violet hue; umbilicus usually covered not always completely closed.

Evidence in Tehran province: Jajroud River (Ranjnush et al. 2018; 2016; Table2); Shemiranat area (Hoseini et al. 2023; Table2)

Evidence in Iran: West Azarbaijan prov. (Shamsi et al. 2021; 2019; Ahmadi, 2016; 2014; Neubert & Bank, 2006); Guilan prov. (Goli, 2016).

Family: Bradybaenidae

***Bradybaena similaris* Ferussac 1821**

Synonym: *Helix similaris* Ferussac 1821

Shell Transparent with some white parts on the apex; brown periostracum; 5-6 convex whorls; aperture narrow; perforate and dextral; shell width 1.4-1.6 mm.

Evidence in Tehran province: Tehran capital city (Abbaszadeh, 2015; Golbaz, 2015; Table 2).

Evidence in Iran: There is no previous report of the species from other parts of Iran.

Family: Succineidae

***Succinea putris* Linnaeus 1758**

Synonym**:** *Helix putris* Linnaeus 1758

Shell amber yellowish with 3-4 convex whorls; animal yellow with a reddish hue, getting lighter downwards to the sides, maybe dark grey.

Evidence in Tehran province: Shemiranat (Hoseini et al. 2023; Table)

Evidence in Iran: Mazanadaran prov. (Amooghli Tabari & Ahmadi, 2013); Guilan prov. (Amooghli Tabari et al. 2016); West Azarbaijan prov. (Shamsi et al. 2019; Ahmadi, 2014).

Family: Zonitidae

***Zonitoides arboreus* Say 1817**

Synonym: *Helix arborea* Say 1817

Shell small, 1 mm diameter; light brown, translucent, faintly and irregularly stated; 4-4.5 convex whorls, sometimes very slightly keeled; dextral umbilicus deep.

Evidence in Tehran province: Tehran capital city (Abbaszadeh, 2015; Golbaz, 2015; Table 2).

Evidence in Iran: There is no previous report of the species in other parts of Iran.

Family: Limacidae

***Limacus maculatus* Kaleniczenko 1851**

Synonym: *Krynickillus mavulatus* Kaleniczenko 1851; *Limax mavulatus* Nunneley 1837

Large snails around 8-13 cm; pale yellow to orange in color; black spots or narrow stripes on the body; antenna greyish blue in color.

Evidence in Tehran province: Tehran capital city (Ahmadi & Jafari, 2017; Abbaszadeh, 2015; Golbaz, 2015; Table 2).

Evidence in Iran: Mazandaran prov. (Ahmadi, 2016); west Azarbaijan prov. (Ahmadi, 2016)

***Lehmannia valentiana* Ferussac 1822**

Synonym: *Limax valentianus* Ferussac 1822; *Ambigolimax valentianus* Ferussac 1821

Yellow in color with a dark band on each side and one near the mid-line; head slightly darker; keel short, mucus colorless; penis appendix rounded or blunt.

Evidence in Tehran province: Shemiranat (Hoseini et al. 2023; Table)

Evidence in Iran: There is no other report for the species in the Iranian fauna.

Family: Agriolimacidae

***Deroceras agreste* Linnaeus 1758**

Synonym: *Agriolimax agrestris* Linnaeus 1758; *Limax agrestris* 1758; *Agriolimax fedschenkoi* Koch ET Heynemann 1874; *Agriolimax transcaucasicus coeciger* Simroth 1901.

Pale brown to tan in color; there are no conspicuous body markings; head and tentacles dark-brown; penis broad with only a single appendix; milky white mucus.

Evidence in Tehran province: Shemiranat (Hoseini et al. 2023; Table); Varamin area (Ahmadi, 2008)

Evidence in Iran: west and east Azarbaijan prov. (Ahmadi, 2016); Mazandaran prov. (Ahmadi, 2008); Guilan prov. (Ahmadi et al. 2021)

Family: Arionidae

***Arion subfuscus* Draparnaud 1805**

Synonym: *Limax subfuscus* Draparnaud 1805

Between orange and brown to dark chocolate, color varies within the population; dark lateral bands in young individuals; dark pigment reaches under the pneumostome from back to front; sole cream or whitish; skin tubercles relatively thick; mucus bright yellow or orange; up to 75 mm long;

Evidence in Tehran province**:** Shemiranat (Hoseini et al. 2023; Table 2).

Evidence in Iran: A close species, *Arion ater* (Ranjnoosh et al. 2016) has been previously reported from Iran.

Family: Enidae

***Chondrula tridens* Muller 1774**

Synonym**:** *Helix tridens* Muller 1774

Yellow-brown shell with fine grooves, a sharp border in the parietal part of the aperture, hard and visible parietal wall of the shell, 7-8 straight whorls on the shell, strong lower molars and weak upper molar.

Evidence in Tehran province: Shemiranat (Hoseini et al. 2023; Table 2); Damavand (Hamiyati, 2015; Bank & Neubert, 2016; Table 2).

Evidence in Iran**:** Isfahan province (Fazilinejad & Belgheiszadeh, 2020); Zanjan prov. (Beygi, 2013), Hamedan prov., West Azarbaijan prov., Qazvin prov., East Azarbaijan prov., Khorasan Razavi prov., Guilan prov., Kordestan prov., Ardabil prov., Alborz prov., Fars prov. (Issel, 1865; Bank & Neubert, 2016); Mazandaran prov. (Akbari et al. 2017)

***Chondrula albolimbata* Pfeiffer 1848**

Synonym**:** *Bulimus albolimbatus* Pfeiffer 1848

Very similar to *C. tridens;* White and relatively shiny shell with small grooves, 7-8 straight whorls, strong parietal wall of the shell and visible outside.

Evidence in Tehran province**:** Damavand (Hamiyati, 2015), Varamin, Pishva and Gharechak (Torabi Diarjan, 2015; Table2).

Evidence in Iran: Isfahan province (Fazilinejad & Belgheiszadeh, 2020)

***Pseudonapaeus ignoratus* Bank and Neubert 2016**

A medium sized dextral *Pseaudonapaeus* species with a monochromatic brownish shell and a thickened, hardly reflected, edentate pristome; 6.5-7.9 convex whorls with a moderately deep suture; teleoconch with irregular, fine, oblique striae; shell solid, glossy, brown with a whitish band behind the peristome; aperture rounded.

Evidence in Tehran province: Tehran prov. (no specific area mentioned; Bank & Neubert, 2016; Table2).

Evidence in Iran**:** Qazvin prov., Alborz prov. and Kordestan prov. (Bank & Neubert, 2016).

***Geminula isseliana* Bourguignat 1865**

Synonym**:** *Buliminus isselianus* Bourguignat in Issel 1865; *Jaminia isseliana* Issel 1865

Shell subcylindrical in outline, with an open, slit like umbilicus; 6.6-7.5 slightly convex whorls with a moderately deep suture; teleoconch with irregular, fine, oblique striae; no spiral striae; shell solid and translucent, horny yellow in color.

Evidence in Tehran province: Damavand and Shemiranat (Bank & Neubert 2016; Table2).

Evidence in Iran: Mazandaran prov. (Bank & Neubert, 2016), Iran (Ahmadi, 2016); West Azarbaijan prov. (Ahmadi, 2014) and Guilan prov. (Qasemi et al., 2021).

***Geminula ghilanensis* Issel 1865**

Synonym: *Jaminia (Multidentula) ghilanensis* Issel 1865; *Buliminus ghilanensis* Issel 1865.

Shell egg-shaped in outline with an open slit like umbilicus; 6.8-9.1 convex whorls with a deep suture; shell solid and translucent similar to *G. isseliana*; peristome reflected, thickened by a labial callus.

Evidence in Tehran province: Damavand (Bank & Neubert, 2016; Table 2).

Evidence in Iran: Mazandaran prov., Guilan prov., Qazvin prov. and Ardabil prov. (Bank & Neubert, 2016); Iran (no specific area mentioned; Biggs, 1971)

***Geminula didymodus* Boettger 1880**

Synonym**:** *Bulimus* (*Chondrula*) *didymodus* Boettger 1880; *Buliminus ghilanensis* f. *minor* Boettger 1883.

Shell dextral, subcylindrical to egg-shaped in outline with an open, slit-like umbilicus; 6.1-8 convex whorls with a deep suture; teleoconch with irregular, oblique striae; shell rather solid and somewhat translucent, horny yellow with a whitish band behind the peristome.

Evidence in Tehran province: Damavand (Bank & Neubert, 2016; Table 2).

Evidence in Iran: Mazandaran prov., Guilan prov., Qazvin prov., East Azerbaijan prov., West Azarbaijan prov., Kermanshah prov., Khorasan Razavi prov., Qazin prov., Kordestan prov., Alborz prov. and Hamedan prov. (Bank & Neubert, 2016).

***Buliminus alepensis* Pfieiffer 1841**

Synonym: *Helix alepi* Ferussac 1821.

Shell elongate-ovoid to nearly subcylindrical with an open slit like umbilicus; 6.3-7.1 flat whorls with a moderately deep suture; teleoconch with irregular, fine, oblique striae; shell

rather solid not translucent, glossy; light horny brown in color; aperture broadly rounded below, slightly elongate; peristome thickened and reflexed,

Evidence in Tehran province: Shemiranat area (Bank & Neubert, 2016; Table 2).

Evidence in Iran: West Azarbaijan prov., East Azarbaijan prov., Kermanshah prov., Ilam prov., Khuzestan province, Fars prov. (Bank & Neubert, 2016).

Table 2. The collected soil mollusc species and their abundance through Tehran

	Family	Species	Tehran (east-west)	Tehran (north-south)	Shemiranat	Firouzkouh	Damavand	Varamin
Stylommatophora	Hygromiidae	*Cernuella virgate*					+	+
		Cernuella neglecta	+	+	+	+	+	+
		Monacha cantiana	+	+	+			
		Monacha messenica				+	+	+
		Monacha parumcincta			+	+		
	Helicidae	*Helix lucorum*			+			
		Candidula spadae				+		
		Helicella itala				+	+	+
	Bradybaenidae	*Bradybaena similaris*	+	+				
	Succineidae	*Succinea putris*			+			
	Zonitidae	*Zonitoides arboreus*	+	+				
	Limacidae	*Limacus maculatus*	+					
		Lehmannia valentiana			+			
	Agriolimacidae	*Deroceras agreste*			+			
	Arionidae	*Arion fuscus*			+			
Pulmonata	Enidae	*Chondrula tridens*			+		+	
		Chondrula albolimbata					+	+
		Pseudonapaeus ignoratus						
		Geminula ghilanensis					+	
		Geminula isseliana			+		+	
		Geminula didymodus					+	
		Buliminus alepensis			+			

Discussion

Tehran province with its vast diverse ecosystems in the urban area, vegetable fields, parks, green spaces and rural pastures would present variety of different habitats for the terrestrial molluscs. This large group of invertebrates has been previously reported from many parts of the Iranian plateau; however, malacological research in Tehran province seemed so dispersed and inadequate. Terrestrial nails can affect human life as important agricultural pests; therefore, due to its scattered agricultural areas, Tehran province can be a useful habitat for the establishment of these species. In addition to the present study, through reviewing the scientific documents related to land snail from Tehran province for 15 years during 2008-2023, 22 different species belonging to nine families have been reported. Some species like *Bradybaena similaris*, *Lehmannia valentiana* and *Zonitoides arboreus* have not been reported from any

other part of Iran; but some species like *Geminula didymodus, Chondrula tridens, Helix lucorum* and *Succinea putris* showed a vast habitat distribution in several parts of Iran. It seems these species are more adaptive to many climatic conditions. Ahmadi (2016) reported 37 land snails from 39 agricultural stations in different parts of Iran, Tehran snail fauna including *L. maculatus, H. lucorum, J. isseliana, S. putris* and *D. agreste* was on the list, too. As snails are highly sensitive animals towards any change in their habitat, environmental variables can influence the distribution and diversity of terrestrial snails. Factors such as temperature, moisture and rainfall, soil pH, type of vegetation, thickness, canopy height and cover can affect terrestrial snails' diversity and abundance (Dhiman et al., 2020). Regarding the species distribution pattern in Tehran province, Damavand (nine species) and Shemiranat (eleven species) areas supported more species than Tehran capital city, due to their moderate temperature and higher moisture. On the other hand, tourism and developmental activities such as the construction of buildings, roads, etc. would result in habitat loss for many species including snails (Pippard, 2012); it may be the main cause of the lower establishment of snails in urban areas.

Environmental changes can reduce the population or eliminate some species; therefore, it seems necessary to check the changes in population density and biodiversity of species periodically. Through the study of Bank and Neubert (2016), some land snail species, such as *G. didymodus, G. ghilanensis, G. isseliana* and *B. alpensis,* was collected from Tehran province, but their frequency was not mentioned by the author. It shows the importance of consistent monitoring projects to find the species diversity through any geographical area; although, there are more areas that should be studied to get a better understanding of the snail diversity and distribution pattern in Tehran province. The outcome of this study shows that more research is needed on the species diversity of terrestrial snails in Tehran province. However, some areas of Tehran province have not been investigated in terms of the diversity of snail species.

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