Original Article

Diversity of terrestrial gastropods in Diyala governorate, Iraq

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Abstract

The current was conducted to identify the diversity of terrestrial gastropods in five sites in Diyala Governorate. Eight unite had been identified during October 2021 to May 2022.(Eobania vermiculata ، Monacha obstructa، Polygyra cereolus، Cochlicella Barbara ، Xeropicta Spp ، Theba pisana ، Trochulus hispidus ، Rumina decollate ، Deroceras spp. , population density and soil properties (temperature, pH, electrical conductivity, moisture, organic matter, calcium, soil texture) had been studied. the results of the study also showed a spatial and temporal variation in the distribution of gastropods, where M. obstructa was recorded as the dominant species in all sites, while Deroceras spp, recorded as a rare species. the results of the Shanon-Weiner Diversity Index ranged between (0-1.093)bit. Ind -1, the Species richness index ranged between (0 -0.832), as Al- Khalis district site recorded as the richest in species among the five sites, and the Evenness index ranged (0 - 0.788) as the Khanaqin distract site was more evenness than other sites .

Keywords: Terrestrial gastropods , land snail, slug , ecological factor, iraq.

Introduction

Biodiversity and the many ecosystem functions and services it supports are subject to large and rapid changes worldwide, as changes in species distribution and abundance affect all aspects of biodiversity (Jets, et al., 2019). Invertebrates represent the biggest extent of land and freshwater biodiversity, and they assume a significant part in biological ecosystem functioning (Ovando et al., 2019). So far, gastropods stand out enough to be noticed with respect to the effect of current environmental change on their distribution contrasted with different species (Nicolai and Ansart, 2017)

The phylum Mollusca, to which land snails and slugs have a place, is the biggest phylum after arthropods, as far as the quantity of species that contain more than one depicted animal groups. A larg part of mollusks in numerous tropical locales of the world is as yet unclear.

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land snails are a significant wellspring of calcium for different creatures, and it likewise go about as a mark of natural circumstances, and are extremely delicate to climatic and ecological change.(Sen et al., 2012), Mollusca (mollusks) constitute a diverse taxonomic group of animals containing an estimated 70,000 to 76,000 described species, including About 25,000 wild species all over the world, and they inhabit almost all ecosystems, including gastropods, which is a major component of terrestrial ecosystems and plays a pivotal role in the functioning of the ecosystem (Ovando et al., 2019), and gastropods is one of the The most diverse group of terrestrial animals, ordinarily utilized as model organic entities in environment biogeography and conservation biology, and is among the most jeopardized creatures on Earth, having proactively experienced broad man-made extinctions. (Proios et al., 2021)

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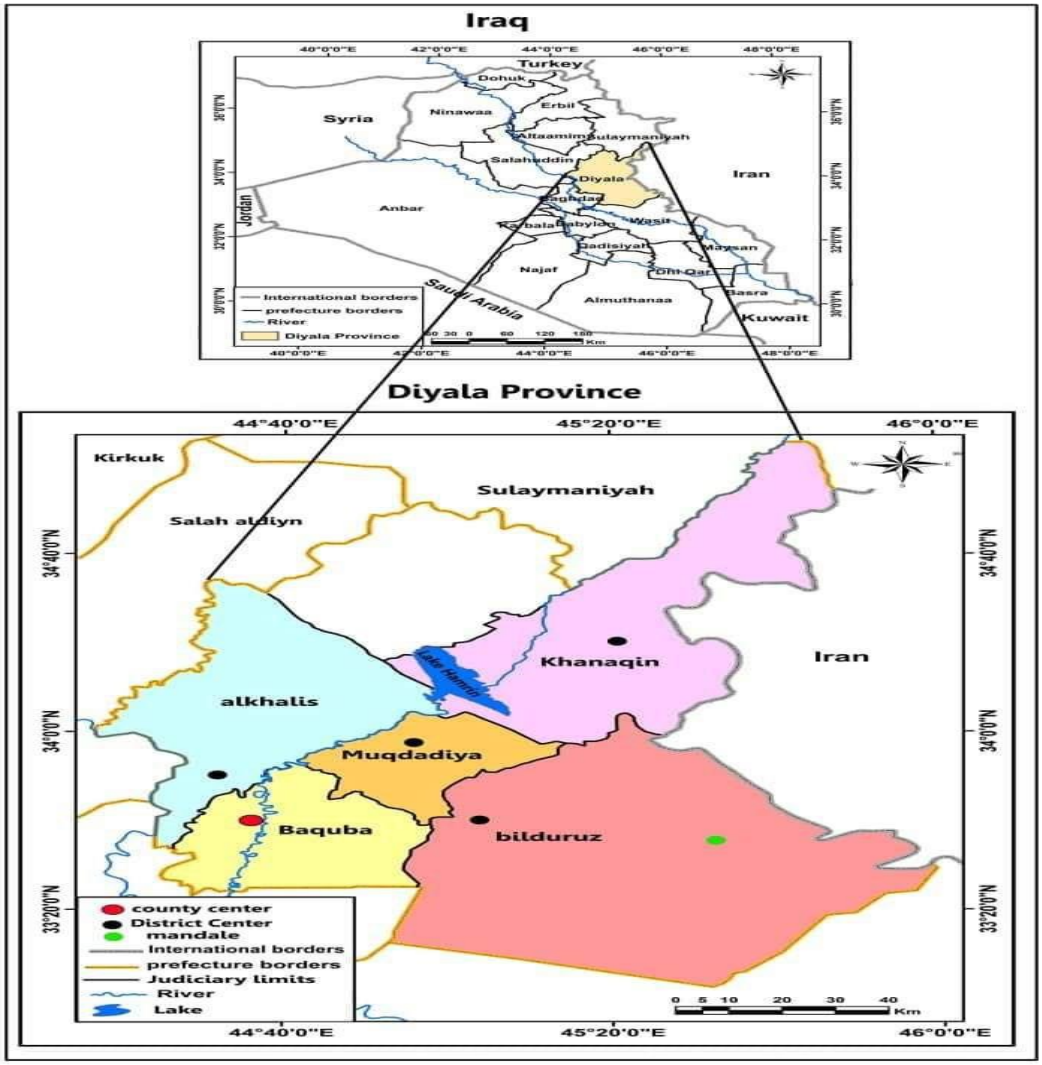
The distribution and activity of the gastropods are closely related to temperature, drought, humidity (pearce and Orstan, 2006), pH, and calcium content (Sen et al., 2012) , In addition, to amount of penetrating light, the processing of nutrients, the percentage of dissolved oxygen, temperature and salinity (Al-Saadi, 2008), they are sensitive to climatic conditions (Nicolai and Ansart, 2017), and it has been proven by(Wehner et al., 2021) that changes in abiotic factors such as soil pH, moisture content, soil calcium content, depth of leaf litter, soil surface structure or vegetation type alter gastropod communities.

Material and Methods:

The samples monthly were collected from the five study sites between October 2021 and May 2022 and with three replicates for each site, Samples were collected manually from among the plants, under the leaves of the accumulated plants, or from above the small plants within one square meter (Hlaváč and Peltanová, 2010), The samples were kept in plastic bottles, containing 70% ethyl alcohol, (Hossain and Baki, 2014), As for soil samples, they were collected at a depth of (5-15) cm, according to (Labaune and Magnin, 2001), ecological factor were measured monthly in all study sites, as temperature, pH, electrical conductivity, Soil moisture, soil organic matter, calcium content, and soil texture



Map (1) Study sites from Iraq

Results and Discussion

Measurements of ecological factors in the study sites:

The results of the study showed that the values of soil temperature ranged between (7.9 - 37.1) °C , as the highest value of the temperature was recorded in the month of May and the lowest recorded in January 2022, and the values of pH of the soil ranged between (7.0 - 8.7) The length of the study period, meaning that it ranges from neutral to alkaline. The highest value was recorded in October and the lowest

value was in December 2021. As for salinity, its lowest value was recorded in October 2021, reaching 0.1 ms / cm, and the highest percentage in April 2022, when it reached 8.73 ms/cm. Moisture values ranged between (1.4 - 20.64)% and the lowest value was in October 2021, while the highest value was recorded in March 2022, and the percentage of organic matter in the soil during the study period ranged between 1.6% in March and 8.2% in February 2022, and the highest value of soil calcium content was recorded in February 2022, reaching 12.2mg.kg-1, and the lowest value in December 2021, reaching 5.2 mg.kg-1.

It was found that the soil in which the studied species live is a mixture of clay, sand and silt, but it differs in the proportions of its components.

In the current study, 9 taxonomic unite were diagnosed (Eobania vermiculata, Monacha obstructa, Polygyra cereolus, Cochlicella Barbara, Xeropicta spp, Theba pisana, Trochulus hispidus, Rumina decollate, Deroceras spp).

The results showed a weak negative correlation between the density of monthly species, temperature and humidity (Table 1) due to the high temperatures and low relative humidity, which have a significant impact on the activities and distribution of gastropods, which may cause a complete cessation of the gastropod activity, and the reason for this is also To the soil tissue, most of the soil components for these sites are sandy, and this leads to easy filtration of water through it, which leads to reducing the moisture content in it, but in the case of low temperatures, it will increase its activity and carry out vital activities, and this is consistent with the study of (Attia, 2004) and (Abed, 2015), as climate change causes fluctuations in temperature and this affects the Directly on the life cycle of terrestrial ventricles, their ability to reproduce, and their population dynamics (Dhiman et al., 2020).

The results also showed a weak positive correlation between PH and the density rate of the species, and this is due to the high PH resulting from the use of organic fertilizers, so it was noticeable that the density of snails increased in areas with intensive cultivation (León et al., 2022) and the decrease in PH negatively affects the presence of Terrestrial snails because this affects the leaching of calcium and damages the shell, which causes the death of individuals (Dhiman et al., 2020), This was confirmed by (Martin and Sommer, 2004), who showed that the population density of snails decreased significantly in different parts of European forests due to acid deposits in that area, as snails are very sensitive to changes in PH values, And he showed that the pH and calcium content are important in determining the properties of the soil, as they affect the density of snails in the region, explaining that the pH can compensate for the processed calcium, and he explained that the number and types of snails increase by increasing the pH of the soil in different areas of forests and different fields.

The results also indicated a weak negative relationship with electrical conductivity and this is due to the changes that occur in the vegetation cover that have a strong relationship in changes in soil salinity, due to high temperatures, low rainfall, weak irrigation system (wells) and misuse of land that leads To increase the concentration of salts in the upper layer of that soil, our current study agrees with (Heiba et al., 2018), Despite the effect of salinity on land snails, it can be used as a means of controlling snails, such as the giant African snail Achatina fulica, which is considered a serious pest that causes agricultural economic losses (Mathai, 2014).

While the results showed a positive correlation with organic matter, this is due to the fact that it is an important factor for the presence and spread of gastropods because it is a food source for them, because they contain nutrients necessary for their growth, especially calcium to build their shell, and it was noted through the current study that snails prefer soil containing large quantities Large amounts of organic matter (such as animal waste and plant residues) Represented by the fallen plant leaves and other plant parts such as wood residues and others, as well as the bodies of dead organisms, as the organic materials present in the soil provide the fundamental supplements for plant growth as well as the ability of the soil to retain moisture, and can likewise decidedly influence the overflow of gastropods, and this is reliable with what Referred to by (Zaidi et al., 2021) .

The results also showed a weak positive correlation between the total density and the soil content of calcium, because the density of snails depends on the availability of calcium and other elements in the soil, and this affects the distribution pattern and the species richness of land snails because of its relationship to the construction of their shell (Dhiman et al., 2020), And that the numbers rise with the increase in the proportion of calcium in the soil, and this is consistent with the study of (Rady et al., 2019) and (Horsak et al., 2014).

Table (1): Correlation coefficient between different neighborhoods and the studied variables

Variables	Correlation coefficient- r								
	Deroceras spp	Rumina decollate	Trochulus hispidus	Theba pisana	Xreopicta spp	Cochlicella Barbara	Polygyra Cereolus	Monacha Obstructa	Eobania Vermiculata
Temperature	0.02	0.11-	0.04-	0.11	0.01	0.06	0.09-	0.16-	0.04-
PH	0.06-	0.08	0.03-	0.07	0.07	0.03	0.08	0.08	0.02
Humidity	0.02	0.06-	0.08-	0.08-	0.06-	0.08-	0.07-	0.05	0.07-
salinity	0.05	0.02-	0.09	0.02-	0.07-	0.02-	0.07-	0.16-	0.03
Organic matter	0.008	0.09	0.13	0.02-	0.19	0.08	0.13	0.18	0.11
Calcium	0.05-	0.11	0.17	0.17	0.12	0.18	0.18	0.15	0.08

The results of the study showed in Table (2) that the highest abundance was of the type M. obstructa in the sites (Bq, Kh, Mq, MN) and thus it is a prevalent species in those sites, while the type E.vermiculata recorded is rare in the site (Bq, Kh) ,As for P. cereolus, it was recorded as a low abundance species at Bq site and as a rare species in sites (Kh, Mq), and C.barbara was recorded as a rare species at Kh site, while no presence was recorded in the rest of the sites. , As for the type Xreopicta ssp, no occurrence was recorded at Bq site, while rare types were recorded in the rest of the sites, and the type T. pisana was recorded as a rare type in sites (Mq, MN), And species are few in abundance at Kq site, T. hispidus was recorded as a rare species at Kh site, and R.decollate was recorded in all sites as abundant in Kq and as rare species recorded at sites (Bq, Kh, Mq, MN), As for the slug of Deroceras spp., it was recorded as a rare species in site Bq, and no presence was recorded in sites (Kh, Mq, Kq, MN).

Table (2) Relative abundance of gastropods species Ind/m2 for the study sites

Site Species	Bq	Kh	Mq	Kq	MN
E.vermiculata	+	+	-	-	-
M.obstructa	++++	++++	++++	++	++++
P. cereolus	++	+	+	-	-
C.barbara	-	+	-	-	-
Xreopicta	-	+	+	+	+
Theba pisana	-	-	+	++	+
Trochulus hispidus	_	+	_	_	_
R.decollate	+	+	+	+++	+
Deroceras spp	+	_	_	_	_

(+) Less than 10% of rare species, (++) between 10-40% of few species, (+++) between 40-70% of abundant species, (++++) greater than 70% are

considered dominant species, (-) Nothing

The results in Table (3) for Shannon-Winer Index showed a little diversity at sites (Bq, Kh, Mq) but showed diversity in Kq site, while only one species was recorded in MN site, while the results showed in species richness (Species diversity) The Kh site is the richest species among the five sites followed by the site (Mq, Bq, Kq) respectively, while the MN site was recorded as the poorest species ,The results showed the Evenness index of the heterogeneity index at the sites (Bq, Kh, Mq) that it is heterogeneous because the values are less than 0.5 In these sites, while in site Kq characterized by homogeneous species, the index was recorded more than 0.5, while in site MN, no index of homogeneity was recorded.

Table (3) values of diversity indicators (diversity, species richness and Evenness index) of gastropods for the study sites

sites Indecis	Bq	Kh	Mq	Kq	MN
Species diversity	0.57	0.592	0.284	1.093	0
Species richness	0.653	0.832	0.666	0.531	0
Evenness index	0.354	0.33	0.177	0.788	-

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