Original Article

First Record of *Rumina Decollata* (Linnaeus, 1758), a Terrestrial Snail, in the Middle Euphrates Region, Iraq

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Abstract

Background: *Rumina decollate* is a terrestrial mollusc known for its wide distribution in the Mediterranean region, the original home of the snail. Although snails are widely distributed in the Middle East, they have not yet been recorded in the Middle Euphrates region of Iraq. This study recorded the first confirmed occurrence of R. decollata in this region, which means expanding the known geographical range of this snail. **Method:** Snail samples were collected from the areas of Al-Hussainiya/Karbala, Kufa/Najaf, and Al-Shanafiya/Diwaniya, and the number of snails was recorded according to the collection site and in three replicates using two methods: direct manual collection and wet traps. The samples were identified morphologically and compared with the approved taxonomic keys, which confirmed their identification at the Natural History Museum at the University of Baghdad. Temperature and humidity standards were also used, and the soil texture was examined in relation to environmental factors. **Results:** It was found that the Kufa/Najaf region was found to be the most widespread region of the Middle Euphrates for this type of snail, while the Husseiniyah/Karbala region was the least widespread. This is because of the higher humidity in Kufa/Najaf than in Husseiniya/Karbala. The F value was 11.46 (representing the difference between groups compared to the variance within each group). The p-value was 0.0089 ($p < 0.05$). This snail species prefers humid areas more than others, in addition to the availability of rice and wheat farms in Kufa, which increases humidity levels more than in the other two regions. **Conclusions:** This new record indicates new environmental effects, especially with regard to the molluscs available in the Middle Euphrates region and agricultural practices in the region, in addition to the impact of this type of snail on climate and soil factors, as well as the availability of food, and most of the results were consistent with previous studies. We recommend conducting further research to evaluate the impact of this species on ecosystems and local plants. This new discovery contributes to our understanding of the distribution and environmental role of R. decollata in this type of habitat.

Keywords: *Rumina Decollata*, Terrestrial Snail, Mediterranean Region, Environmental Effects.

Introduction

Rumina decollata represents one of the most important types of terrestrial mollusc in the family Xanthonychidae.[1] The distinctive shape of its shell and its varied and graduated colours are the two main characteristics of this snail. This snail is characterised by its conical shape, is long, ranging in length from 20 to 30 cm, and has multiple coils (5-7 coils). It is characterised by its irregularly cut shape at the top of the shell, which is what the shell suffers from after it gets older, and for this reason, it is called scaly. Despite this, the snail also has a brown colour gradient and smooth shell.[2,3] This snail is widely distributed in many places around the world, and its original habitat is southern Europe, and it is found in some areas of North Africa. It is widely distributed in different parts of the world, particularly in the Mediterranean region.[4] The publication has also been published in Argentina. and snails have also been recorded in the Americas and many areas of the Middle East. They were aware of biodiversity and ecological relationships. Most research conducted on this type of snail has focused on it, especially in habitats rich in calcium, which is an important element for the formation and structure of the shell.[5] The spread of land snails globally and in the Arab world is the result of environmental adaptation, as indicated by some studies, including a recent study that showed that the diversity of these snails is due to repeated environmental dispersion and maintenance of specific

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environments over a period of 50 million years. This snail is found in Mediterranean areas, the most important of which are dry habitats that are open and have calcium-rich soil.[6] Also, in the Arab world, the spread and distribution of land snails are generally affected by climatic and environmental conditions such as humidity levels, temperatures, and the availability of nutrients. In addition, it is characterised by a biological control factor against other harmful snails, such as snails. The spread of this snail has been confirmed in the Arab world, especially in Egypt, in a study.[7] The researchers presented a survey of terrestrial molluscs on the northern coast of Egypt. Thirteen species of terrestrial snails from four families were recorded, including the study snails, which were among them. This snail is widespread in countries neighbouring Iraq, such as Türkiye, where it has been found in citrus orchards in Adana, where it has been used to manage harmful snail populations. It has also been used as a pest control agent.[8] The snail R. decollata was used to combat some agricultural pests as well as harmful snails to agriculture, since snails are predators. However, after using it in combination, the results were unexpected, as they not only prey on harmful snails but also on earthworms despite their importance to the soil and some harmless insects, which leads to an imbalance in the soil ecosystems.[9] Many researchers have pointed out the danger of the snail as an agricultural pest for several reasons, starting with the characteristics that this snail carries, such as resistance to the environment, rapid spread, and great reproductive capacity, to its ability to prey and cause an imbalance in the ecosystem, which indicates the multiplicity of its types of nutrition, and the spread of this snail without management and a clear vision of methods of control on all biological, chemical, and mechanical levels may lead to the spread and dominance of this type over others for the aforementioned characteristics. A previous study confirmed the presence of this snail in the Aegean Sea in Türkiye.[10] This snail is also found in the Taif region of the Kingdom of Saudi Arabia, where it has been studied morphologically along with two other types of land snails.[11] This indicates the possibility of the spread of this snail species, especially in areas with a moderate central climate. The environment of the Middle Euphrates in Iraq is attractive due to its many climatic factors and fertile plains. Most of these areas are famous for their orchards and green spaces, and the importance of snails lies not only in their use in managing the populations of some harmful snails but also in representing a secondary host for a number of parasites. They contribute indirectly to the spread of epidemics and diseases, as they are carriers of the worm *Aelurostrongylus abstrusus*, which contributes to the severity of pneumonia in cats.[12,13] Another study talks about giving a clear picture of the spread of the studied snail, which contributes to the spread of parasitic diseases.[14,15] Snails are also considered one of the types of agricultural pests that may cause harm, as they are predatory snails that may eliminate species or generations of snails, as well as their impact and the damage caused by the snail to the leaves and tubers of some crops.[16] Because of the damage caused by this snail and the losses it causes to plants, several studies have been conducted to find out the mechanisms for controlling this type of snail. It is important to note that *R. decollata* is more widespread in cultivated lands and urban cities, and despite its ability to adapt to the environment, *R. decollata* has not been previously recorded in the Middle Euphrates region in Iraq, especially because this region has a semi-arid climate, which provides a new environment suitable for the optimal conditions for the spread of this snail, allowing the discovery of new insights for understanding the biology of this snail. This type of snail can be grown commercially because of its rapid adaptation and laying of large numbers of eggs that are resistant to environmental conditions. This is one of the factors that may contribute to the spread of snails and their adaptation to the natural environment. It was found that this snail contributes to a decrease in the number of brown or chocolate garden snails because of its predation on them. Previous studies have found that it can be eliminated within ten years.[17] Snails have affected the soil either directly or indirectly, such as through the decomposition of organic materials and waste in the soil, thus contributing to the natural nutrient cycle. They also enhance microbial activity and consume organic debris, in addition to compacting the soil if the population density is high. They also aerate the soil, but not to the extent that earthworms reach. These are some of the positive aspects of snails.[18] The study snail is one of the most common land snails causing problems in gardens and farms, as was the case in the California gardens. This snail was introduced in France and is the main reason for its use as food.[19] The snail Rumina decollata acts as an intermediate host for the parasitic worm Toxocara cati, which is a roundworm that causes infections in domestic cats and poses a risk to humans as it contributes to the transmission of visceral toxoplasmosis through the faeces of cats contaminated with these worms. The characteristics or features of this snail, such as biological diversity, rapid adaptability, resistance to drought, and diverse diet, in addition to its great reproductive capacity, have contributed in one way or another to its rapid spread in various habitats.[20] From the Mediterranean to Patagonia: Study *of R. decollata*. The shelled snails are mixed-feeding animals, and the fertile soil is enjoyed by the central region of Iraq, specifically the middle Euphrates, the land of blackness and agriculture, and an extended plain. It is made up of soils rich in organic materials, and the availability of organic materials with the availability of moisture factors contributes to the spread of such types of snails and even slugs.[21] Documenting new records represents a fundamental step in scientific research to enhance understanding in multiple directions, including representing a database to record everything new. This

gives us a general idea of the ecological development of a specific area, which caused the emergence of biological diversity and the introduction of new species. In turn, this enhances scientific documentation to prepare fertile ground for accurate and reliable scientific studies and research. The new record and its recording contribute to determining the type of environmental protection, as studies of this new record represent sound decisions, such as the decision to form natural reserves, for example, and not limited to, and finally provide information on the biological and environmental analysis of such records and knowledge of human impacts and activities on animals on the one hand and on their environment on the other. This record represents one of the many tools that document the credibility of research and enhance it.[22] This study seeks to record the first exposure of R. decollata in the Middle Euphrates and evaluate the environmental variables and implications of its introduction. The results offer a deeper understanding of species distribution and aid in future scientific studies on the environmental impacts of such molluscs. This is especially relevant for Iraq, which has different environmental areas and landscapes, from mountainous to desert, and all those bordering the Shatt al-Arab. This ecological diversity provides a positive environment for new animal species, particularly snails.

Literature Review

Gastropod and bivalve species have been analysed in Iraq, and new species records, ecological consequences, and interactions with environmental components have recently attracted increased attention. Numerous previous works have already reported unknown species, assessed their distribution, and examined their ecological function in ecosystems. This section highlights the significance of freshwater and terrestrial molluscs in Iraqi biodiversity. The first record of the exotic land snail Rumina decollata (Linnaeus, 1758) in Iraq was investigated.[23] Manual sampling methods were applied in five localities and frequent soil assessment of chemical and physical factors affecting snail distribution. The results showed that R. decollata built a population in Iraq at various degrees of density over the studied locations. The possible effect of this exotic species on local mollusc communities and the overall ecological context was discussed and further justified the need for frequent monitoring of its ecological importance.

In another investigation, Al-Maliky *et al.*[24] described the role of benthic invertebrates in hydrological processes and water quality and seasonal distribution patterns of snails and population density. They used the quadrate method (25 cm x 25 cm) to collect samples and compared the population density of M. turbuculata with that of M. preaemorsa. They also reported significant differences in levels of dissolved oxygen (DO) and temperature between stations, which point to the impact of environmental factors on the population of the gastropods. Such data provide insights on the preference of habitat of the species, particularly on slow-moving permanent water bodies.

The first record of Eobania vermiculata[25] reported from Karbala, Iraq Eobania vermiculata (O. F. Muller, 1774) They collected specimens from Imam Hussain gardens and nurseries and categorised specimens on the basis of the phenotypic features. The present study reported the presence of E. vermiculata in the parks and gardens of the city, indicating its adaptability and potential dispersal. Morphological features collected on identification testified to the introduction of the species to the region and were photographed and examined. The results indicate the need for systematic surveys to document mollusc biodiversity.

A study by Aureglia *et al.*[26] investigated Rumina paivae Lowe, 1861, in southeast France. The research aimed to clarify the taxonomic differences within the Rumina genus (which comprises dry-land-adapted snails). Morphological and anatomical comparisons between R. paivae and R. decollata were made in Marseille for the first time. Statistical comparison of shell size and egg measurements also added to data on species identification. This research highlights the significance of taxonomic accuracy on the distribution of species and potential ecological influence, particularly on invasive species.

Naser *et al.*[27] provided the initial documentation of Dosinia prostrata (Linnaeus, 1758) on the Iraqi coast. It was done in 2020 and 2021 and positioned this genus on the list of the latest in Iraq's mollusc faunistic records. The finding highlighted the dynamic nature of marine biodiversity in the country's coastal regions and the need for additional monitoring of species distribution patterns and interaction with the environment.

Another freshwater snail study was conducted in the Greater Zab River, Kurdistan Region.[28] Distribution of freshwater gastropods was morphologically defined and examined in this study. Four study areas yielded 4,754 snails, and distribution differences were statistically compared. Important differences in species presence were observed across sites, reflecting local environmental conditions. The findings improve the knowledge of freshwater molluscs in Iraq and call for protecting aquatic biodiversity.

In general, the analysed research indicates an increasing interest in the proof and environmental research of molluscs in Iraq. The identification of different species of R. decollata, E. vermiculata, and D. prostrata signifies the need for continuous biodiversity monitoring. In addition, ecological assessments of native species, including M. turboulata and M. preaemorsa, offer crucial information concerning environmental interactions and habitat preference. Although molluscs are crucial bioindicators of ecosystem health, additional analysis is necessary to examine their distribution dynamics and reactions to environmental changes inside Iraq's aquatic and terrestrial habitats. Enhanced monitoring and conservation initiatives are essential to handle the consequences of invasive species and environmental shifts in indigenous molluscs.

Materials and Methods

Figure 1: A map Showing Rumina *Decollata* Collection Areas.

Study Location and Target Area

As shown in Figure (1), a map showing the locations of the spread of R. decollata snails in the Middle Euphrates region (Al-Husseiniyah/Karbala, Kufa/Najaf, and Al-Shinafiyah/Diwaniyah) is shown in Figure 1, and the selection of these locations was based on the presence and availability of environmental factors suitable for the spread of this snail. The study included the selection of areas that were agricultural, humid, and fertile lands and provided biological diversity. These areas were identified based on the previous environment suitable for their spread as well as the surveys that were completed to determine and evaluate the extent of snail abundance and spread.

Table 1: Showing the Latitude and Longitude of the *Rumina Decollata* Sampling Areas.

Governorates	Area Name	Longitude	Latitude
Karbala	Al Husayniya	44.185630°	32.672259°
Najaf	Kufa	44.370774°	32.047529°
Diwaniyah	Al-Shinafiyah	44.648961°	31.582676°

Sample Collection Period and Study Time

The collection operations were carried out during the period from February 2024 to May of the same year per square meter, and this period is the most suitable for the rest of the months of the year, as it represents the peak of the activity and spread of snails. The collection operations were repeated monthly to ensure obtaining numbers that keep pace with the climatic and seasonal changes of the snail, since the reproductive season of the snail is short.

Sample Collection

To ensure sufficient coverage of the largest study area, two methods were used to collect samples of R. *decollata* snails.

- Manual collection

They were collected manually by searching directly between plants and under the accumulated leaves of plants in the designated collection areas as well as under trees, considering the use of special gloves to collect samples to prevent damage to snails. The best time for collection was when the humidity was high (i.e., early morning or after rain).

- Using wet or damp traps

Pieces of cardboard or wet wood were placed to raise the humidity under it to attract snails. After approximately 24 h, they were lifted, and the snails were collected manually. The soil type was examined, and the temperature and humidity factors were measured at the three sites as influential environmental parameters according to the method.

Transport and Preservation of Samples

The snail samples were collected and placed in special glass containers with holes in the lid for ventilation and to preserve the snails alive, and a little of their environment soil was placed with some tree leaves to feed them. All the following notes were recorded on each container and according to the collection sites, including the collection date, collection area, environmental standards, and collection method. Taking the standard dimensions of the shell: The standard dimensions of the shell were recorded, including the length of the snail and its shell, the length and width of the shell opening, as well as the number of growth rings for each length of the shell, which is an indicator of the age of the snail. Some of the samples were preserved in a 10% formalin solution.

The diagnosis of the models and samples was confirmed using the taxonomic keys available in the approved references. A sample was also taken from the Museum of Natural History at the University of Baghdad, which is one of the most important research centres concerned with solid scientific classification in Iraq.[29,30]

Statistical analysis: One-way ANOVA was performed to test differences between groups, and differences were considered significant at a probability level of $P < 0.05$.[31]

Results

Figure (2) shows the shape of the adult snail and its appearance from its dorsal surface, showing the shell (the hard part), the visceral mass (the wet part), and the different shell lengths, in addition to representing the different ages and number of growth rings. It was found that snail lengths differed. The highest length collected was 31 mm, and the number of growth rings was about 6 rings, and the lowest length was 24 mm, and it has 5 of the growth rings.

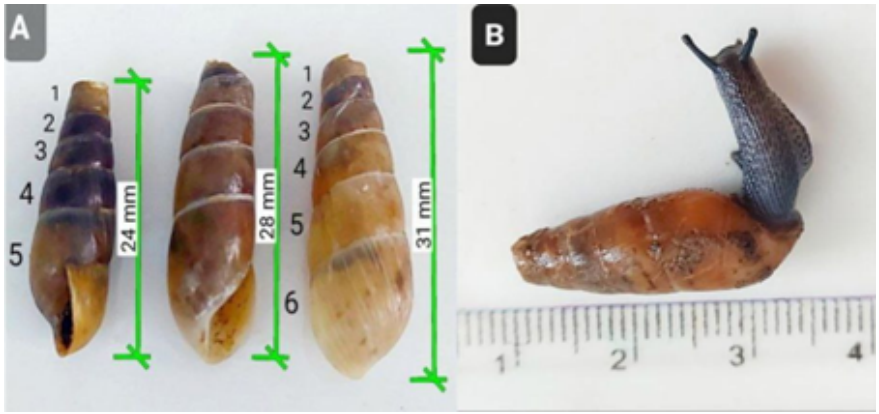

Figure 2: A- *Rumina Decollata* Shell Lengths and Number of Growth Rings, B - shape of *Rumina Decollata*.

Figure (3) shows the standard dimensions of the R. decollata shell opening (length and width). We note that the length of the shell opening was (8.4) mm in the largest adult snails, and the width of the shell opening was (5.1) mm for the same shell. It is also noted that there is a simple right lip, while the left lip is almost non-existent, which is one of the characteristics of the shell of this type of snail.

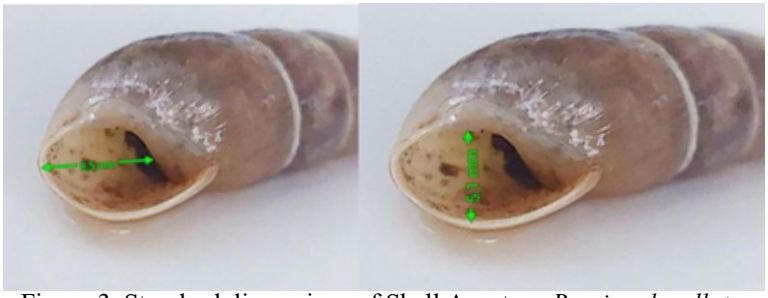

Figure 3: Standard dimensions of Shell Aperture *Rumina decollate*.

Table 2 showing the results of examining soil samples from the three selected sites with the factors of temperature and humidity were as follows:

Table 2: Soil and Climate Information.

Governorate	Soil Type	Humidity (%)	Temperature (°C)
Najaf	The soil varies from clayey silt in shoulder areas, silty clay in basins, to sandy loam in plateau areas.	84.56	13.7
Diwaniya	Loamy silt soil in riverbank areas.	81.21	12.9
Karbala	Sandy loam soil in plateau areas.	80.32	11

Figure (4): The results of collecting snail samples showed the presence of R. decollata in the indicated collection areas, with three replicates for each site, and a clear difference in the population density of the study snails. According to the map, it was found that the Kufa area in Najaf (N1, N2, N3) and its farms were higher in density and spread than the rest of the collection areas, as their number reached (4293) snails. As for the farms of the Husseiniyah area in Karbala (K1, K2, K3), they had a lower density and spread of snails, as their number reached (1293) snails, while their number in Al-Shinafiya/ Diwaniyah (D1, D2, D3) reached (2634) snails.

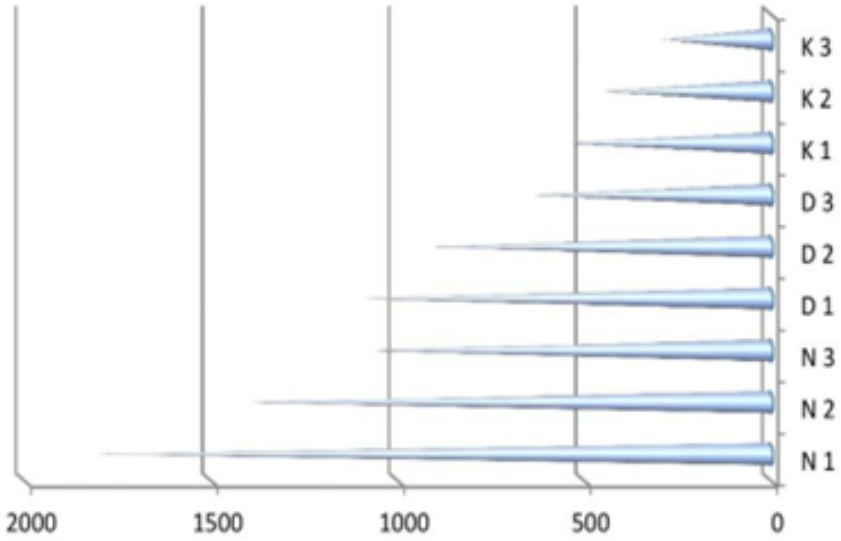

Figure 4: Numbers *Rumina Decollata* According to Collection Region.

Figure (5): through the graph: It shows a comparison between the average numerical values in each group for each governorate using a box plot. We note that the Najaf Governorate has the highest population density of snails for the three selected sites, followed by Diwaniyah and Karbala.

One-way ANOVA variance was also conducted. The results were as follows: F-value: 11.46 (representing the difference between groups compared to the variance within each group).

P-value: 0.0089 (less than 0.05, indicating a significant difference between the groups).

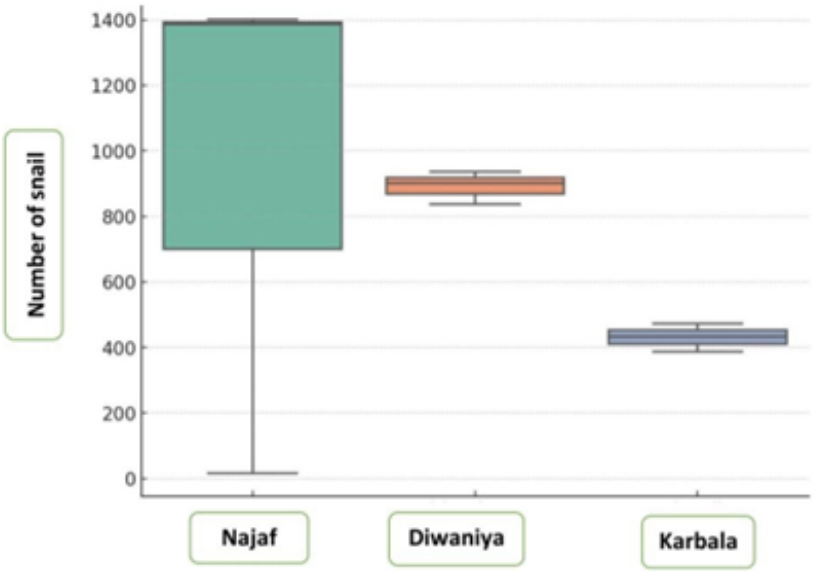

Figure 5: Comparison of *Rumina Decollata* Population Rates in the Three Sites.

Discussion

The first record of the land snail *R. decollata* was documented in the Middle Euphrates region of Iraq. This study represents a qualitative and important addition regarding the geographical spread of such types of molluscs, and we note that there are significant differences in the numbers or population densities among the three sites. Snail spread in the Middle Euphrates region is a clear indicator of the suitability of environmental and climatic factors and conditions for the study of snails, in addition to other contributing factors, such as human interventions and other factors, such as snails. The spread of snails in Kufa was higher because of the availability of suitable food, such as decaying leaves and some agricultural crops that serve as a refuge for them. In addition, the type of soil in Kufa, which is sandy loam, contributes to moisture retention and good drainage of excess water, which can affect the distribution of land snails, whereas Karbala has loamy, sandy soil, which causes water to be lost quickly, which increases the dryness of the soil and thus reduces moisture.[32] There are other reasons that may have played

an important role in increasing the speed of the spread of this snail in Kufa/Najaf at a higher rate than in Karbala and Diwaniyah, perhaps because the relative humidity in Kufa is higher than in the other two regions, given that Najaf in general is famous for its amber rice farms, and these farms need to be flooded with large quantities of water that work to increase the humidity of the atmosphere in Kufa in particular and Najaf in general, while Karbala is an area where the humidity is lower compared to the other two regions; the area of the governorate is smaller than the other two regions. There was no previous record in the study area for the snail *R. decollata*; this record and documentation represent the beginning of many studies that investigated the real factors and causes contributing to the spread of this type of snail. It is possible that climatic conditions, such as temperature and humidity, have a major impact on the spread of snails, as they need a humid environment to survive, grow, and reproduce. The snail R. decollata can quickly adapt to and can withstand some conditions more than others, such as humidity levels and drought. Human activity also affects the spread and number of snails. For example, Karbala is a small city with few green areas, while Kufa has large areas and large farms, which led to its spread in Kufa more than in the rest of the selected areas. Human activity affects the spread and geographical distribution of snails. What distinguishes these snails is that they are predators of other snails that are smaller than them, which has negative effects on the original local species and may lead to an imbalance in the ecosystem of the Middle Euphrates region. Therefore, it is necessary to monitor the spread of this species and its environmental effects in the short and long term. In comparison to the records of previous research, this type of snail is an invasive species. Therefore, all should come together and devise means of preventing the increase of this type of snail before our eyes to preserve biodiversity and ecosystems.[33]

The differences in shell shape also reflect the degree of environmental adaptation. Shell thickness, for example, could represent predation pressure, while size and shape could be linked to environmental conditions, e.g., soil moisture.[34] Fossil shells provide a tremendous amount of information about the past environment. Evolutionary changes have taken place on this day. By analysing the phenotypic appearance of the shell over time, scientists can infer evolutionary trends, breed diversity, and adaptation to environmental and climatic changes.[35] The study of snail shell measurements, known as clammetry, plays a crucial role in the study of molluscs and in the wider life sciences and shells, as it provides a wealth of information about snail taxonomy, ecology, and evolution. Shell measurements such as height, width, and opening size are essential tools for distinguishing between species. They help to classify snails into taxonomic groups based on phenotypic differences and similarities.[36] This type of snail belongs to the order *R. decollata*, which is an order spread by its different types in Iraq. The most important factor that distinguishes individuals of this order from others is that they enjoy biological diversity and diverse ecosystems. Most of them also live in fertile, flat soil, and most of them enjoy a percentage of salts and organic materials that contribute to building their shells with distinctive shapes and a gradation of their colo**urs).** Perhaps one of the most important factors that helped spread this type of snail is the presence of snails belonging to the same order to which this snail belongs, such as *Helix pomatia*, *Cornu aspersum, and Monacha spp. Cochlicella acuta*. This confirms the documentation of this type, as the environmental and climate factors are suitable for it and its spread, in addition to what this snail enjoys in characteristics that are considered distinctive, such as the diversity of food, adaptation, and reproductive ability.

Conclusion

This study provides a deep understanding of the environmental factors that directly affect the spread and density of the scaly snail *R. dicolata* in the Middle Euphrates region in Iraq, and that moist soil, moderate temperatures, and availability of nutrition play a fundamental role in the distribution of the study snail. The local environment also has the same effect on the reproduction and spread of this type of snail, which was confirmed by most previous studies that confirmed the presence of this snail under climatic conditions identical to the study snail area. However, we noticed that there was a difference in the distribution of the spread of this snail, which requires further research to determine the reasons and factors that lead to such a difference in the population density of the snail in question, despite the fact that the climatic conditions are similar, for example, the snail's interactions with environmental factors or predatory relationships with other animals. This recording indicates the biodiversity of the Middle Euphrates region and that the region may contain other undiscovered or undocumented species. The recording of R. dicolata has led to further research on the ecological role of this snail and its interactions with other species within its ecosystem, as this snail has a limited distribution in Iraq, which requires work to protect its original habitat from climate change factors or habitat destruction.

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