Population Ecology of *Achatina fulica* Using Quadrat Analysis Across Different Localities

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Abstract

The present study evaluates the population structure and spatial distribution of *Achatina fulica* across ten different localities over three consecutive years (2023–24, 2024–25, and 2025–26) using the quadrat sampling technique. Key ecological parameters such as frequency, density, and abundance were calculated to assess distribution patterns. The results revealed that the species exhibited high frequency (60–100%) in most study areas, indicating wide distribution. Maximum density and abundance were recorded in Khedgaon, Kasbe Sukhene, and Matori, suggesting favorable ecological conditions. Temporal variations showed a peak population in 2024–25 followed by slight stabilization in 2025–26. The study confirms that *Achatina fulica* is a highly adaptable species capable of maintaining stable populations across varying environmental conditions.

Keywords :- *Achatina fulica*, Quadrat method, Frequency, Density, Abundance, Population dynamics, Spatial distribution

Introduction

Population ecology is essential for understanding species distribution, abundance, and their interaction with environmental factors. *Achatina fulica*, commonly known as the giant African snail, is an invasive terrestrial mollusc species recognized for its high adaptability to diverse environmental conditions and its ability to establish stable populations in varied habitats (Raut & Barker, 2002; Subba Rao, 2003). The quadrat sampling method is a standard ecological technique used to estimate key parameters such as frequency, density, and abundance, which help in assessing spatial distribution and ecological dominance of species (Odum, 1971; Krebs, 1999). The present study aims to analyze the population dynamics of *Achatina fulica* across ten different locations over a period of three years using quadrat analysis.According to Magurran

(2004), the measurement of biological diversity provides valuable insights into species richness, distribution patterns, and ecological balance.According to Nyameasem et al. (2018), the population dynamics of *Achatina fulica* are strongly influenced by environmental factors such as temperature, humidity, and availability of food resources, which affect its growth, survival, and reproductive success. According to Subba Rao (2003), molluscan diversity in India reflects a wide range of ecological adaptations, with many species showing strong tolerance to varying environmental factors. According to Barnes, Calow, and Olive (2001), invertebrates exhibit diverse ecological adaptations that enable them to survive under varying environmental conditions, making them important indicators in ecological studies.

The quadrat sampling method is a standard ecological tool used to estimate population parameters such as frequency, density, and abundance, which provide insights into species distribution and dominance within a habitat. According to Krebs (1999), ecological methodology provides systematic approaches for measuring population characteristics such as frequency, density, and abundance, which are crucial for understanding spatial distribution and population dynamics.

Materials and Methods :-

Study Area

The study was conducted in ten locations: Kasbe Sukhene, Sonjam, Lokhandwadi, Varkheda, Dhadegaon, Matori, Trambak, Igatpuri, Khedgaon, and Lakhmapur.

Sampling Method

The study was conducted using the quadrat sampling method, a standard technique in ecological investigations. At each study site, a total of 10 quadrats (Z = 10) were laid systematically, and the number of individuals of *Achatina fulica* present within each quadrat was carefully counted. This method enabled accurate estimation of population parameters such as frequency, density, and abundance across different locations.

Ecological Parameters

Ecological parameters were calculated to assess the population structure of *Achatina fulica* Frequency (%) was determined using the formula (Y/Z) × 100, where Y represents the number of quadrats in which the species occurred and Z is the total number of quadrats studied. Density was calculated as the total number of individuals divided by the total number of quadrats (Z), indicating the average number of individuals per quadrat. Abundance was computed as the total number of individuals divided by the number of quadrats in which the species was present (Y), reflecting the concentration of individuals in occupied quadrats.

In ecological studies, parameters such as frequency, density, and abundance are essential for understanding the distribution pattern, population structure, and ecological behaviour of a species like *Achatina fulica*. These parameters provide quantitative measures that help in assessing how a species is distributed within a habitat and how it responds to environmental conditions.Together, these ecological parameters provide a comprehensive understanding of the population dynamics, distribution pattern, and ecological adaptability of *Achatina fulica* across different study sites.

Sr. No	Name of Species	Name of place	2023-24 year			2024-25year			2025-26year		
			frequency	density	abundance	frequency	density	Abundance	frequency	density	abundance
1	*Achatina fulica*	Kasbe Sukhene	90	9.2	10.2	100	9.3	9.3	90	9.6	8.7
2		Sonjam	80	5.3	6.6	60	4.6	7.6	80	9.3	7.5
3		Lokhandwadi	80	5.9	7.3	80	6.7	8.3	80	8.1	7.1
4		Varkheda	80	5.5	6.8	80	4.1	5.1	90	5.5	5.0
5		Dhadegao	80	6.5	8.1	90	7.1	7.8	100	6.2	6.2
6		Matori	70	7.5	10.7	90	7.7	8.5	90	7.5	6.8
7		Trambak	90	5.2	5.7	90	6.6	7.3	100	6.7	6.7
8		Iagtpuri	80	7.0	8.7	80	7.0	8.7	90	7.0	6.3
9		Khedgaon	100	6.7	7.4	100	10.9	10.9	100	8.3	8.3
10		Lakhmapur	60	4.4	7.3	60	9.7	16.16	70	7.3	7.3

Observation table year 2023-2026

Results and Discussion

The results of the present study revealed that the frequency of *Achatina fulica* ranged between 60% and 100% across all study sites, indicating a wide distribution of the species. The highest frequency was

recorded in Khedgaon (100%), suggesting uniform occurrence in all quadrats, whereas the lowest frequency (60%) was observed in Sonjam and Lakhmapur, indicating comparatively restricted distribution. Density values showed spatial and temporal variation, with the highest density recorded in Kasbe Sukhene (9.2) during 2023–24, and in Khedgaon during both 2024–25 (10.9) and 2025–26 (8.3). Similarly, abundance values varied across locations, with the highest abundance observed in Matori (10.7) in 2023–24, Lakhmapur (16.16) in 2024–25, and Kasbe Sukhene (9.6) in 2025–26. These variations indicate that the species tends to form aggregated populations in favorable habitats where environmental conditions support higher survival and reproduction.According to Magurran (2004), patterns of species distribution and abundance are key indicators of biological diversity and ecological stability.As stated by Sharma (2013), population density and distribution patterns are often uneven due to habitat heterogeneity and environmental stress factors.As explained by Begon et al. (2006), population dynamics are not static but fluctuate in response to environmental changes and ecological interactions

The trend analysis clearly shows that the population of *Achatina fulica* reached its peak during 2024–25, followed by a slight stabilization or decline in 2025–26. This pattern may be attributed to fluctuations in environmental factors such as moisture availability, temperature, and food resources, which are critical for molluscan growth and activity. The predominance of Frequency Classes D and E across most sites indicates that the species is well-established and widely distributed in the study region. Overall, the findings suggest that *Achatina fulica* possesses high ecological adaptability, enabling it to maintain stable populations under varying environmental conditions, although local habitat factors continue to influence its density and abundance.

Conclusion

The present study concludes that *Achatina fulica* exhibits wide distribution and strong ecological adaptability across all study sites, as indicated by high frequency, density, and abundance values. The species showed peak population levels during 2024–25, followed by slight stabilization in 2025–26, suggesting the influence of environmental factors on population dynamics. Most locations fell under higher frequency classes (D and E), confirming that the species is well established and dominant in the study area.

The use of quadrat sampling proved effective in assessing population parameters, and overall findings indicate that *Achatina fulica* can successfully survive and maintain stable populations even under varying and relatively low temperature conditions.

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