

DIVERSITY OF ANTS IN GRASSLAND AND URBAN FOREST AT SINDH AGRICULTURE UNIVERSITY TANDOJAM

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ABSTRACT

Ants are ecologically significant as members of the ecosystem, being involved in biodiversity, soil aeration and species association. The objective of the present study was to determine ant species in grassland and urban forest adjacent to Sindh Agriculture University, Tandojam. Ants were vacuum sampled and identified to taxon. We measured ant species richness and evenness with the Shannon–Wiener (H') and Simpson's (D) indices for diversity indices and by three additional measures of species richness and evenness. Results showed that, grassland habitats have the highest richness and evenness of *Camponotus compressus* and *Pheidole indica* followed by urban forest habitats were introduced species like *Monomorium pharaonis* were dominant. Of all the environmental conditions considered, temperature and humidity were the best predictors of species composition, as higher humidity was positively associated with the presence of invasive species. In conclusion, grasslands were able to sustain more stable native species, while urban forest sites were less diverse and saw more invasive species. These results serve as a foundation for the remaining biodiversity and the management of invasive species in semi-urban areas.

1. INTRODUCTION

Compared to other insects, ants are some of the most numerous and biologically diverse, with over 15,700 identified species and subspecies populating almost every land ecosystem (Schultheiss *et al.*, 2022). Ants are able to thrive in extremely diverse ecological and environmental settings, from tropical forests and grassland to deserts and dense urban areas. Ants are capable of modifying ecosystems through nest building, soil turnover, and predation and dispersal of seeds. Ants serve as ecosystem engineers by profoundly affecting vegetation dynamics and nutrient cycling (Farji-Brener & Werenkraut, 2017).

The consequences of rapid urbanization on most natural and cultivated ecosystems are the direst of them all. Ant community structure tends to favor disturbance tolerant or invading species, which can reduce local species richness. Urban habitats are dominated by disturbance-tolerant species, as East Asian vegetation fragmentation and seasonality and urban heat islands shaped ant ecosystems (Luo *et al.*, 2023). This is exemplified by the Penick *et al.*, (2025) multi-city study, which showed decreasing ant richness with rising urban temperatures, regardless of latitude.

Research in Pakistan is mostly restricted with regard to ant fauna studies, although such studies are on the rise. A national checklist prepared by Rasheed *et al.*, (2019) documented 101 valid species and 33 genera and called for greater functional role ecological evaluations. In mixed farming and semi-urban settings, additional studies identified greater

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subfamily Myrmicinae species richness than other regions (Rasheed et al., 2020). Such evidence demonstrates the need for more focused studies in the Sindh region, where urban forestry interfaces with agricultural grasslands.

This study seeks to determine the characteristics of ant populations in both grasslands and urban forests to determine the effects of urbanization on the structure of biotic communities and ecosystems. This objective is met partly through proper classification of the species of ants within their various habitats to examine their functions and contributions to the ecosystems as well as to enhance enlightened conservation and land use planning. It is also through this study that the foundation of other ecological studies in the more populated places will be laid where the boundaries of this study have been limited. The results will be contributed to the existing literature on the ecological and socioeconomic protection of biological diversity in the natural as well as artificial ecosystems.

2. MATERIALS AND METHODS

1.1. Study area

The study sites were two plots located in the Sindh Agriculture University, Tandojam.

1.2. Grassland ecosystem

The grassland is open grassy vegetation represented by the cricket ground with very limited human disturbance; this habitat was appropriate for studies on species adapted to being in more open habitats with reduced structural complexity.

1.3. Urban forest ecosystem

Its habitat was a planted forest with very high canopy cover and heavy leaf litter. The use of a structured environment provided the conditions necessary to assess habitat complexity and microclimatic factors influencing ant diversity.

1.4. Sampling design

Sampling location units (n = three 1-square-foot plots) were chosen randomly within each habitat. In order to mitigate the effects of variability in environmental conditions and ant activity patterns, sampling was conducted on multiple days. Several replicates have been utilized in order to gain more robust and reliable data.

1.5. Ant collection method

Ant was collected from each plot using a handheld vacuum device, for a period of 3min/ plot. Using this method allowed for effective specimen capture with minimal habitat disruption.

1.6. Preservation of ant species

Collected ant were preserved at 70% ethanol in appropriately labeled vials, before being processed in the laboratory.

1.7. Ant species identification

In lab test, ant samples were distinguished utilizing conventional taxonomic keys and reference materials of the family *Formicidae*.

Counting and classification of ant species

For each sample, total taxa count per species were determined. Through previous literature and regional records, species were placed as either native or invasive.

1.8. Temperature and humidity

Ambient temperature was assessed by means of a digital thermometer and humidity by a hygrometer. We monitored these parameters to assess their effect on species richness and abundance.

1.9. Additional observations

Contextual data (habitat-specific features related to vegetation and anthropogenic disturbance) were recorded.

1.10. Data analysis of ant species

The Shannon-Weiner Index, H' , for the respective ecosystems were calculated in order to measure the diversity of ant. Species dominance and evenness were measured by Simpson's Diversity Index (D) (formula (1)) and Evenness (E) (formula (2)), respectively.

1.11. Richness and abundance of ant species

Species richness and abundance were calculated per habitat. We characterized dominant species and the relative contributions to community structure.

1.12. Correlation analysis of ant species

To obtain the influence factors, species diversity, abundance and environmental parameters (i.e. temperature and humidity) were analyzed for their relationships.

1.13. Comparative analysis of ant species

The comparison was done on the grassland and the urban forest ecosystems with respect to certain diversity metrics and the species composition. Such an analysis was done here to understand the possible impact of habitat structure and the microclimatic conditions on the ant communities.

The design of methodology therefore aimed at ensuring that pertinent data was gathered and analysed thoroughly to conceptually automatize the goals of the study on ant diversity and community interactions in the various sampled habitat types. Indexes of ancillary biodiversity and systematic correlation analyses, and systematic sampling, were applied and it helped them to gain some insight into the ecological processes of the ecosystems under consideration.

3. RESULTS AND DISCUSSION

This research deliverables, which are divided into two and the study objectives have been incorporated in this paper. The former deals with the ant species richness in urban forest and grassland ecosystems existing in Sindh Agriculture University Tandojam, especially with the help of the species richness, the indices of diversity, and some ecological parameters. The second part is devoted to the comparison of the species composition and the abundance patterns of the two ecosystems therefore revealing the key differences in the community structure and the foundations of the interpretational work on the role of the ecological parameters in the structuring of ant communities.

In Grassland *Monomorium pharaonis* dominates (highlighted with a slight separation). Other species like *Camponous compressus* and *Phediola indica* contribute significantly. In the Urban Forest much higher proportion of *Monomorium pharaonis*, emphasizing its invasive dominance. Other species have smaller shares.

3.1. Ant diversity indices to evaluate ecosystem in grassland and urban forest Diversity analysis

Species Diversity calculated as per the method of Shannon-Weiner Index (H') and Simpson's Diversity Index (D). Shannon-Weiner Index (H') Grassland H' mean value is 1.42 suggestive of moderate diversity. Urban Forest mean H' = 1.51, indicating relatively

greater diversity. Simpson's D Grassland Simpson's D mean = 0.82, suggesting relatively high species dominance in the samples Urban Forest mean of Simpson's D = 0.79 suggesting more equal abundance of species.

3.1.1. Species evenness (E)

The Average Evenness of 0.78 indicates somewhat of an even distribution of species, although limited by some dominating species in grassland. Urban Forest Average Evenness is 0.84 suggest a more even distribution of species.

Comparison of species composition and abundance between grassland and urban forest ecosystems

3.1.2. Environmental conditions

The temperature and humidity in both ecosystems fluctuate over the sampling period. Here is an overall summary of the environmental conditions

3.1.3. Total count and abundance

The total species collected across all samples is greater, but also revealed great variation in abundance, grassland. Urban Forest Although the species abundance was relatively stable, it was usually less than that of grassland.

3.1.4. Impact of invasive ant species

Invasive Species several invasive species present in both ecosystems (e.g., *M. pharaonis* and *P. longicornis*) were unevenly distributed. Grassland the grassland had a greater representation of invasive species including multiple samples of *M. pharaonis*, and *Paratrechina longicornis*. Total number of invasive species: 66 (sample only). Urban Forest the samples also contained fewer invaders, many orders of magnitude lower than the totals. Number of invasive species: 63 (reported instances based on the data samples).

3.1.5. Interaction for the different ant species

Neutral interaction species that coexist but that do not directly affect one another. Intraspecific competition Individuals of the same species compete for similar resources (food, habitat). Coexist two species are found in the same environment but can split that resource.

Alternatively, Competitive relationships represent a dominant position, suggesting these species overlap greatly in resource needs. The presence of species such as *P. indica* associated with *M. pharaonis* and *P. longicornis* suggests coexistence in certain pairings, which may imply niche segregation. Self-competition no go (obviously) as species are compared to themselves.

3.2. One way ANOVA for ant diversity in the grassland and urban ecosystem

Species richness lacks statistically significant difference in species richness in grassland, as demonstrated by F-value (0.069) and high p-value (0.795) between early and late samples. The richness across the period of the study was constant. Total Abundance the total number of ants did not change significantly between the earlier and later sampling dates in grassland ($F = 1.626$, $p = 0.212$). Ant community abundance was relatively stable over time. Shannon-Weiner Index (H') the diversity of ants appeared unaffected by week of sampling ($p = 0.672$), indicating that the grassland habitat sustained diversity over weeks.

3.3. One way ANOVA for ant diversity in the urban forest ecosystem

Species richness in the urban forest similarly did not change over the sampling period ($p = 0.576$). It implies that invasive species remained consistently dominant, and the number of species detected did not vary significantly. Total Abundance was no significant difference in total abundance between early and late samples (p -value: 0.360). This implies stable population numbers through time, even while the environment is changing. Shannon-Weiner Index (H') difference in diversity was not significantly detected ($p = 0.723$), indicating that the community structure (possibly of the invasive species *M. pharaonis* had been stabilized.

Species richness, total abundance, and diversity did not differ statistically significantly through time in Grassland or Urban Forest. This indicates that there were stable ant communities present in each ecosystem throughout the sampling period. Nonetheless, urban forests may be stable because dominant invasive species remain and grasslands may

be stable because of a more balanced native ant community.

3.4. Species dominance and mean grouping patterns in the grassland ecosystem

Species Dominance mean abundance is clearly rank in grassland ecosystem species. The genus *Camponatus compressus* (Group a) heads the list with the highest mean number of 5.40 individual. And remember, the dominant species is in the field. Next, Group b with a mean of 4.73 individuals, which corresponds to *Monomorium pharaonis*. *Pheidole indica* (Group c) occurs occasionally with a mean of 2.83, indicating some representation, but it is not an abundant component of the ecosystem. Lastly, the Group d mentioned above including *Paratrechina longicornis* is the least abundant and least affecting with the lowest mean of 0.07. This grassland harbors a more diverse assemblage of species yet is also characterized by the omnipresence of *Camponatus compressus* and *M. pharaonis*. While certain species (e.g. *Pheidole indica*) promote richness, the common community is well-balanced and non-dominants.

3.5. Species dominance and mean grouping patterns in the urban ecosystem

Species dominance another pattern can be seen in the urban forest ecosystem. Even in urban environment, the mean number of individuals of group a show that *Camponatus compressus* still remained the dominant species (5.77). *Monomorium pharaonis* (Group b) was second as the most abundant species (5.07 individuals) other species were present, but it was not quite the dominant species. Concerning Group c species, although *Pheidole indica* has a low contribution to diversity (mean of 2.27) it also exhibits some contribution to diversity but is not a major player. Once again, *Paratrechina longicornis* (Group d) has the lowest mean of 0.07 and is barely present in the urban forest (Table 8). Urban forests maintain a moderately diverse ant assemblage, but are dominated by *C. compressus* and *M. pharaonis*. The high prevalence of *M. pharaonis* also demonstrates the potential impact of invaders in urban systems, where many species may be competing for limited resources. Native species such as *C. compressus* and *Pheidole indica* increase the diversity of grassland. Although *M. pharaonis* dominates, it appears to not outcompete other species excessively which would suggest a more

balanced community. In urban forests, *M. pharaonis* is generally dominant, and overall native diversity is lower. A little explicable invasion species pressure is shown by the construction of *C. compressus* and *Pheidole indica*, especially in urban habitats, which can limit the available diversity of native species over the time.

3.6. Pearson correlation matrix (r-values) for species diversity in urban forest and grassland ecosystem

Pearson Correlation Matrix showing how different environmental and diversity variables are related. This matrix shows the strength and direction of the relationships between variables Temperature and Richness have a significant positive correlation ($r = 0.418$, $p = 0.001$) and so do Total Abundance and Shannon Index H' ($r = 0.671$, $p = 0.000$). This suggests that as temperature increases, richness also increases, and higher abundance is linked to higher diversity.

Ants are one of the most varied and ecologically important of invertebrates, providing multiple ecosystem services such as nutrient cycling, seed dispersal, and pest control. This study focused on the distribution of ants in two contrasting ecosystems at Sindh Agriculture University, Tandojam. These were grasslands and an urban forest. There were differences in the species' richness and abundance and the responses to environmental factors, in some ways agreeing with and in other ways conflicting with other studies.

4. DISCUSSION

Species Diversity and Composition

In grassland sites, species richness was improved, which can be explained in part by lower canopy cover and the decrease in structural complexity, the conditions that favor specific taxa of ant (Guilherme *et al.*, 2019). Similar outcomes have been documented in southern Brazil (Anjos *et al.*, 2017; Klunk *et al.*, 2018) and Madagascar (Fisher and Robertson, 2002; Solofondranohatra *et al.*, 2020) grasslands and forests, both of which are open habitats subsisting ecologically unique ant communities.

Conversely, the urban forest sampled here contained a remarkably dense population of *Monomorium*

pharaonis. Records of invasive ants in metropolitan greenspace coincide with extensive literature establishing that introduced species tend to depress native diversity in modified landscapes via competitive interactions, a trend manifesting in diminished richness and overall abundance (Porter & Savignano, 1990; Rajesh *et al.*, 2022; Tercel *et al.*, 2023). The present analysis provides strong empirical confirmation of this dynamic, with *M. pharaonis* effectively displacing all recorded native formicids within the urban woodland.

Information collected in terms of environmental sensors allowed concluding that temperature, and, secondarily, humidity is the main determinant of ant community composition. The warm and dry microhabitat with a grassland habitat supported species with high levels of heat tolerance like *C. compressus*, which is also consistent with the results of Baudier *et al.*, (2015) as ground-nesters generally exhibit high levels of thermal tolerance. In contrast, *M. pharaonis*, which is characterized by Levings *et al.*, (1990) has been observed to survive in the urban forest where temperatures are very high which is associated with high humidity. The strata of canopy and leaf litter serve to regulate the microenvironment to make it cooler and moister as they reduce irradiance and provide evapotranspiration (Keppel *et al.*, 2017), which is in line with the results.

Diversity indices

Biodiversity analysis confirmed the superior diversity and organizational quality of grasslands relative to urban forests. Grassland habitats exhibited elevated Shannon–Wiener (H') and Simpson's D values, indicating a more equitable distribution of relative species abundance. These findings corroborate the established ecological hypothesis that environments characterized by intense anthropogenic disturbance generally harbour diminished species richness and diminished evenness (Graham *et al.*, 2004), thereby implying a positive association between sediment disturbance and species abundance balance. Conversely, the urban forest assemblage was severely imbalanced, with the population structure dominated by *M. pharaonis*, a tendency acknowledged as a hallmark of successful nuisance species invading anthropogenic landscapes (Schmidt *et al.*, 2010) and frequently documented in urbanised regions globally,

where invasives acquire a fitness advantage in disturbed settings (Rajesh et al., 2022; Tercel et al., 2023).

Global Comparisons

The observed community structure aligns with the established global patterns governing ant assemblages in temperate grassland and forest habitats. While some localized maxima in ant species richness can occur within single plots, species turnover patterns invariably reflect niche differentiation within each biotope (Anjos et al., 2017; Ramos et al., 2018). Furthermore, the density of *M. pharaonis* recorded in the fragment of the urban forest exemplifies an emergent, transcontinental dynamic; urban forests consistently serve as corridors and sinks, enabling exotic neutrals to inflict disproportionate perturbations to local biotic assemblages and process regimes (Tercel et al., 2023). Collectively, the localised signatures examined in this study are both symptomatic and contributory to a broader, transmissible risk that necessitates the formulation of multifunctional and spatially-refined global mitigation directives.

Impacts of Invasive Species

Monomorium pharaonis and other established invasive ant species continue to erode biodiversity and disrupt ecosystem functions across numerous habitats (Tercel et al., 2023). Such dominant invasives routinely seize and monopolize ecological roles that are otherwise shared in native assemblages. A salient example occurs in seed-mediated mutualisms; invasive ants commonly either eliminate native seed-harvesters from critical niches or ingest seeds without engaging in effective dispersal, thereby suppressing seed-bank replenishment (Carney et al., 2003). Additionally, the competitive indifference of invasive species allows them to usurp the physical restructuring services traditionally provided by native myrmecofauna. Through their aggressive foraging and extensive colonial nesting, they enhance soil biophysical properties by increasing ventilation and macro-porosity, which can further facilitate soil-water penetration (Pereda-Gomez et al., 2019). Our findings are consistent: landscapes dominated by invasive ant colonies exhibit sharply reduced native species richness and evenness (Tercel et al., 2023). Grassland habitats, in particular, manifest a comparatively high

resistance to exotic ant establishment. Such resistance is hypothesized to arise from relatively low structural complexity and pronounced microclimatic gradients, both of which impose physiological and competitive constraints on advancing colonies (Holway et al., 2002). Detailed investigations demonstrate that the native ant assemblages of arid and semi-arid systems exhibit a suite of morphological and reproductive traits that constrain the invasibility properties of exotic, Argentinian and African species—thereby reinforcing the functional resilience of native successional processes and limiting propagule pressure (Pereda-Gomez et al., 2019).

Seasonal dynamics

Our observations corroborate findings reported in previous surveys: ant activity rises during warmer months (Miranda et al., 2022). Fluctuating ambient temperature and relative humidity, both of which vary seasonally, are known to impose pronounced modulations on foraging patterns and on broader ant community structure (Youngsteadt et al., 2023). By comparing activity in open grassland and in a slice of contiguous urban forest, we further illustrate how localized microclimatic gradients—such as those created by varying canopy cover and soil moisture can subtly, yet consistently, reconfigure species assemblages (Ramos et al., 2018; Bátori et al., 2020).

Implications for conservation and management

Urban forests, many of which are increasingly dominated by invasive and ecologically hostile species, require intensified management action, which should focus on both active restoration of native communities and systematic management of non-native taxa. Early detection, coupled with engagement of both mechanical and biological control complemented by landscape-level eradication efforts, must remain central to program design if the investment of public and private stakeholders is to yield long-term benefits.

The corresponding refinance and eradication thresholds are substantively influenced by combination of near-real-time remote sensing data with ground-verification to enable field staff to index as well as stress the previously ignored microhabitats pushed by the nascent propagule pressure. Strategies with temporally accurate and spatially resolved

deployments of nutrients, herbivores and public hours, as extrapolated on small area tests, are also significantly more cost-effective and much higher chances of regional eradication achievement compared to normal control regimes at end-stage threshold; see the operative modelling structure and validation in the pre-propositional sections of [Howse et al., \(2023\)](#).

Directions for future research

Among the countless multiplicity of semi urban sceneries in Sindh, this research presents a preliminary peep into the variety of the ant species. Future research projects must be directed by the interaction of ant species with ecological processes, especially its long-term impacts of invasive ants. Another issue that should be considered is climate change, especially the effects of fluctuating temperature and humidity that are likely to change the distribution and structure of ant communities.

In general, the spatial distributions of ants and the difference between the grasslands and the urban forests provide an additional emphasis on the importance of the complex interaction of habitat structure, climate, environment, and invasive species on the communities of ants. Such conclusions add to the current knowledge of the necessity to protect grasslands and manage invasive species to ensure ecological stability.

5. CONCLUSION

The present research has shown high ant diversity in grassland and urban forest ecology that has been taken at present day in the research station of the Sindh agriculture university of Tando jam. The grassland ecosystem was very stable and it exuded ecological stability in that it had more native species of ant. On the contrary, the urban forest has the drawback of preponderance of invasive species like *Monomorium pharaonis* that suppressed the native biodiversity due to the microclimatic environment in which they thrived. Some of the abstractions included temperature and humidity that had been established to be probable determinants of the ant distribution and behavior. Its findings demonstrate how important it is to maintain the native habitats including grassland to preserve

endemic biodiversity and stability of incipient ecosystem. Meanwhile, special efforts to curb invasive species in urban forests need to be more localized, e.g., habitat restoration and community education. The study helps in informing sustainable land and biodiversity conservation in semi-purposeful setting, and also informs growers, conservationists and policy makers.

6. CONFLICT OF INTEREST

Authors have declared that there is no conflict of interest regarding the publication of this article.

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Table 1. Ant Diversity Weekly Means (Weeks 1–5) and Overall Mean \pm SE

Week	Location	Temperature (°C)	Humidity (%)	Camponatus compressus	Phediole indica	Monomorrium pharaonis	Paratrechina longicornis	Total Count	Richness	Total Abundance	Total Invasive Species Count	Shannon-Weiner Index (H')	Simpson's D	Evenness (E)
1	Grassland	30.0	38.0	8.0	0.0	0.0	0.0	8.0	1.0	8.0	0.0	1.39	0.72	0.72
1	Urban Forest	41.0	35.0	6.0	0.0	0.0	0.0	6.0	1.0	6.0	0.0	1.26	1.0	1.0
2	Grassland	41.0	37.0	6.0	0.0	3.0	0.0	9.0	2.0	9.0	3.0	1.37	0.72	1.38
2	Urban Forest	37.1	60.0	12.0	2.0	0.0	0.0	14.0	2.0	14.0	0.0	1.3	1.0	1.0
3	Grassland	32.0	67.0	4.0	0.0	2.0	0.0	6.0	2.0	6.0	2.0	1.35	0.72	1.38
3	Urban Forest	35.0	55.0	3.0	2.0	0.0	0.0	5.0	2.0	5.0	0.0	1.36	0.65	1.54
4	Grassland	39.0	46.0	2.0	0.0	24.0	0.0	26.0	2.0	26.0	24.0	1.7	0.85	0.94
4	Urban Forest	33.0	59.0	0.0	15.0	0.0	0.0	15.0	1.0	15.0	0.0	1.44	1.0	1.0
5	Grassland	39.0	46.0	7.0	0.0	2.0	0.0	9.0	2.0	9.0	2.0	1.47	0.54	0.5
5	Urban Forest	33.8	36.0	6.0	0.0	3.0	0.0	9.0	2.0	9.0	3.0	1.36	0.72	0.76
Overall Mean	Grassland	36.2 \pm 2.18	46.8 \pm 5.4	5.4 \pm 1.08	0.0 \pm 0.0	6.2 \pm 4.48	0.0 \pm 0.0	11.6 \pm 3.64	1.8 \pm 0.2	11.6 \pm 3.64	6.2 \pm 4.48	1.46 \pm 0.06	0.71 \pm 0.05	0.99 \pm 0.18
Overall Mean	Urban Forest	35.98 \pm 1.43	49.0 \pm 5.58	5.4 \pm 1.99	3.8 \pm 2.84	0.6 \pm 0.6	0.0 \pm 0.0	9.8 \pm 2.03	1.6 \pm 0.24	9.8 \pm 2.03	0.6 \pm 0.6	1.34 \pm 0.03	0.87 \pm 0.08	1.06 \pm 0.13

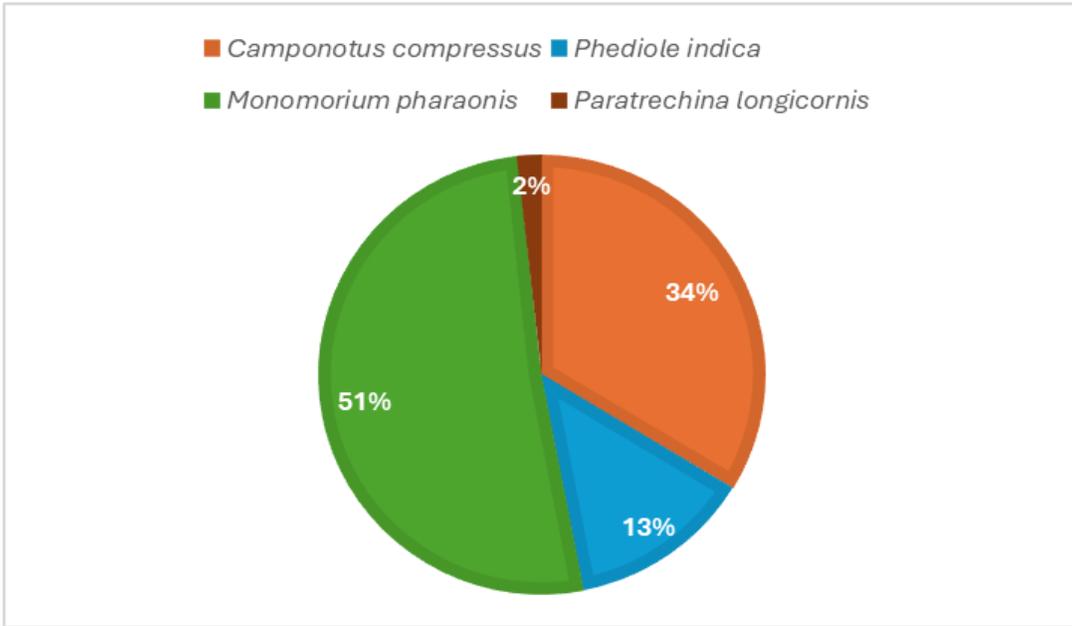


Figure 1. Ant species composition in grassland

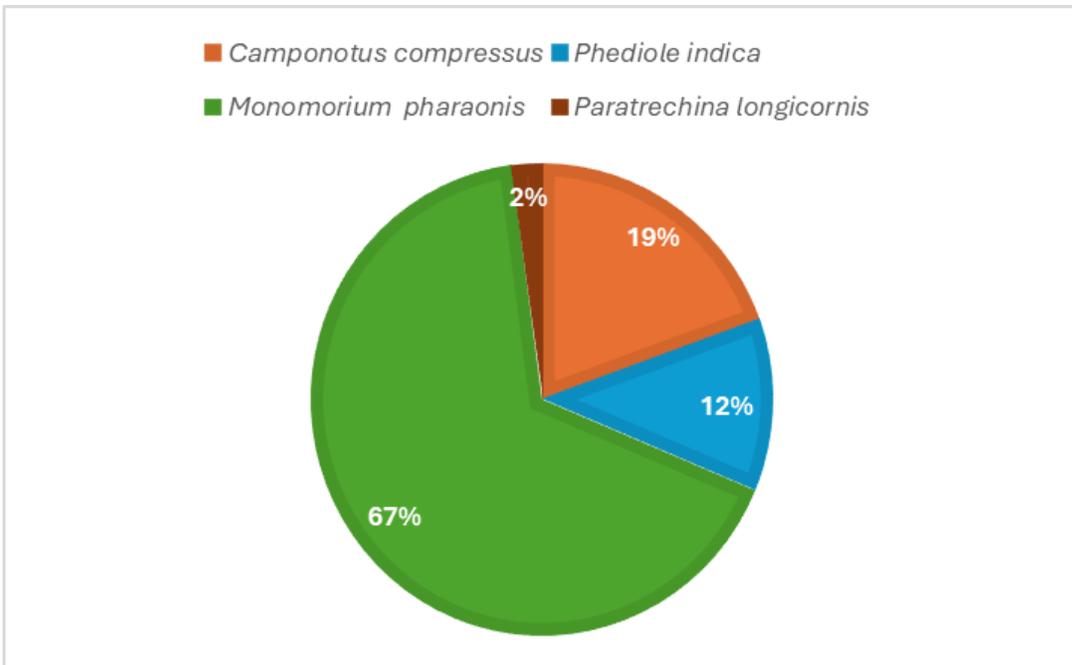


Figure 2. Ant species composition in urban forest

Table 2. Diversity indices for ant communities in grassland and urban forest

Metric	Grassland	Urban forest
Shannon-Weiner Index (H')	1.42	1.51
Simpson's D	0.82	0.79
Evenness (E)	0.78	0.84

Table 3. Comparison key results of grassland and urban forest

Metric	Grassland	Urban forest
Avg. Temperature (°C)	36.2	35.2
Avg. Humidity (%)	45.8	48.3
Total Invasive Species Count	66	63

Table 4. Interaction for the different ant species

Species	<i>Camponotus compressus</i>	<i>Pheidole indica</i>	<i>Monomorium pharaonic</i>	<i>Paratrechina longicornis</i>
<i>Camponotus compressus</i>	No Interaction / Coexist	Competitive	Competitive	Competitive
<i>Pheidole indica</i>	Competitive	No Interaction	Coexist	Coexist
<i>Monomorium pharaonic</i>	Competitive	Coexist	No Interaction	Competitive
<i>Paratrechina longicornis</i>	Competitive	Coexist	Competitive	No Interaction

Table 5. One-way ANOVA for ant diversity in the grassland ecosystem

Metric	F-value	p-value
Richness	0.069	0.795
Total Abundance	1.626	0.212
Shannon-Weiner Index (H')	0.183	0.672

Table 6. One way ANOVA for ant diversity in the urban forest ecosystem

Metric	F-value	p-value
Richness	0.321	0.576
Total Abundance	0.862	0.360
Shannon-Weiner Index (H')	0.127	0.723

Table 7. Mean grouping of ant diversity in the grassland ecosystem

Species	Mean (Group)
<i>Camponatus compressus</i>	5.40 (a)
<i>Monomorium pharaonic</i>	4.73 (b)
<i>Pheidole indica</i>	2.83 (c)
<i>Paratrechina longicornis</i>	0.07 (d)

Table 8. Mean grouping of ant diversity in the urban forest ecosystem

Species	Mean (Group)
<i>Camponatus compressus</i>	5.77 (a)
<i>Monomorium pharaonic</i>	5.07 (b)
<i>Pheidole indica</i>	2.27 (c)
<i>Paratrechina longicornis</i>	0.07 (d)

Table 9. Pearson correlation matrix for temperature, humidity, and ant diversity metrics

	Temperature	Humidity	Richness
Temperature	1.0	-0.23	0.418
Humidity	-0.23	1.0	-0.122
Richness	0.418	-0.122	1.0
Total_Abundance	0.166	0.084	0.195
H_Index	0.001	-0.241	0.241

Table 10. Pearson correlation matrix (r-values) for species diversity in urban forest and grassland ecosystem

Variable 1	Variable 2	r-value	p-value
Temperature	Humidity	-0.230	0.088
Temperature	Richness	0.418	0.001
Temperature	Total Abundance	0.166	0.221
Temperature	Shannon Index (H')	0.001	0.993
Humidity	Richness	-0.122	0.369
Humidity	Total Abundance	0.084	0.539
Humidity	Shannon Index (H')	-0.241	0.074
Richness	Total Abundance	0.195	0.151
Richness	Shannon Index (H')	0.241	0.073
Total Abundance	Shannon Index (H')	0.671	0.000