



Available Online at EScience Press

Plant Protection

ISSN: 2617-1287 (Online), 2617-1279 (Print)
http://esciencepress.net/journals/PP

Research Article

A Systematics and Comparative Analysis of Life History Traits in Two Cricket Species, *Acheta domesticus* (Linnaeus, 1758) and *Gryllobates supplicans* (Walker, 1859) (Gryllidae: Orthoptera)

Shamshad Ali Talpur, Riffat Sultana

Department of Zoology, University of Sindh, Jamshoro, Sindh, Pakistan.

ARTICLE INFO

Article history

Received: 24th April, 2025

Revised: 26th July, 2025

Accepted: 27th July, 2025

Keywords

Life history traits

Gryllidae

Comparative analysis

Orthoptera

Cricket species

ABSTRACT

The current study presents a comprehensive morphological and ecological comparison of two orthopteran species, *Acheta domesticus* (Linnaeus, 1758) and *Gryllobates supplicans* (Walker, 1859), collected from multiple agroecological zones in Sindh Province, Pakistan. A total of 431 male and 357 female *A. domesticus* and 282 male and 240 female *G. supplicans* were examined. Detailed morphological assessments revealed species-specific distinctions, with *A. domesticus* exhibiting a larger body size and more robust morphological traits compared to *G. supplicans*. Females of both species were consistently larger than males. Particularly, *A. domesticus* developed faster, completing its life cycle in approximately 56.7 days, while *G. supplicans* required around 81 days, suggesting differential life history strategies. Reproductive analysis indicated that *G. supplicans* follows an r-selected strategy, characterized by high fecundity and a 92% hatching rate, while *A. domesticus* exhibits traits consistent with K-selection, including higher larval survival and broader environmental tolerance. Thermal and humidity tolerance studies showed that *A. domesticus* survived across a wider temperature range (15-30°C), whereas *G. supplicans* preferred narrower, more stable tropical conditions (25-35°C; 60-90% RH). Longitudinal monitoring revealed that *G. supplicans* exhibited faster population growth, while *A. domesticus* maintained steady population levels, reinforcing their respective adaptive strategies. These findings emphasize the ecological flexibility of *A. domesticus* and the reproductive efficiency of *G. supplicans*, offering valuable insights into species distribution, pest potential, and environmental adaptability. This comparative study enhances our understanding of orthopteran life history evolution and has implications for integrated pest management in agroecosystems under shifting climatic conditions.

Corresponding Author: Riffat Sultana

Email: riffat.sultana@usindh.edu.pk

© 2025 EScience Press. All rights reserved.

Introduction

The family Gryllidae, commonly referred to as crickets, comprises over 2,028 species and 106 subspecies distributed across a range of ecosystems worldwide, including forests, meadows, and urban environments

(Walker and Masaki, 1989; Cigliano et al., 2025). Crickets are well known not only for their characteristic stridulatory vocalizations but also for their significant ecological roles, such as facilitating decomposition, nutrient cycling, and serving as a key food source for

various insectivores (Alexander, 1962).

Within the Gryllidae family, two species stand out for their broad distribution and ecological adaptability: *Acheta domesticus* (the house cricket) and *Gryllodes supplicans* (the Indian or tropical house cricket). These species are particularly notable for their capacity to thrive in anthropogenic habitats and are frequently used in ethological and experimental entomology research (Loher and Rence, 1978).

Understanding life history traits in Gryllidae is crucial for elucidating how species have evolved under different selective pressures. Key traits include growth rate, reproductive output (Bate, 1971, 1972; Channa et al., 2011, 2013), and other biological parameters that influence survival and reproductive fitness (Stearns, 1992; Sanam et al., 2021). These characteristics are central to determining population dynamics and shaping community structure, as species adopt varying strategies to maximize reproductive success and optimize resource utilization.

This comparative study examines *A. domesticus* and *G. supplicans* across several parameters, including anatomy, life cycle, reproductive strategies, feeding behavior, and ecological adaptation, to identify how and why their life history traits differ. *A. domesticus* is considered a cosmopolitan species due to its broad geographic distribution, particularly in temperate regions, which is largely attributed to its high environmental plasticity (Mulkern, 1967). Males possess a relatively large body size, robust hind limbs adapted for jumping, and distinct chirping used in mate attraction (Walker, 1975). The species has a short developmental period, completing its life cycle from egg to adult in approximately 45-60 days, depending on environmental conditions (Dingle et al., 1990). This rapid development is advantageous in temperate zones, where seasonal fluctuations demand quick maturation and reproduction. Moreover, its omnivorous diet, comprising diverse organic material, enables survival across a wide array of habitats, from natural ecosystems to urban settings (Alexander and Meral, 1967).

In contrast, *G. supplicans* originates from tropical regions and exhibits several morphological and physiological adaptations suited to stable, warm climates. Unlike *A. domesticus*, which has a compact body form with shorter appendages adapted to cooler climates, *G. supplicans* displays an elongated, slender body with longer limbs, features that aid thermoregulation and enhance mobility in high-temperature environments (Loher and Orsak,

1985). Its developmental cycle spans approximately 70-90 days, reflecting the more stable thermal conditions and extended reproductive seasons typical of tropical habitats (Rueda et al., 2007). Furthermore, *G. supplicans* is characterized by high fecundity, producing numerous small eggs, a strategy that supports elevated population densities and enhances colonization potential in competitive and resource-rich environments (Basolo, 2007; Sultana and Wagan 2015; Sultana and Song, 2024). This comparison illustrates how the life history traits of each species align with their native environmental conditions. *A. domesticus* is well adapted to regions with significant seasonal variability, while *G. supplicans* thrives in consistently warm, tropical climates. These adaptive differences contribute to a broader understanding of ecological specialization within the Gryllidae family and provide insight into the evolutionary trajectories of species under varying environmental pressures.

In the context of global climate change, such comparisons are increasingly important, as shifts in temperature and habitat conditions may alter the distribution, behavior, and survival of species like *A. domesticus* and *G. supplicans* (Davidowitz et al., 2004).

In summary, this study highlights the morphological, developmental, reproductive, and ecological distinctions between *A. domesticus* and *G. supplicans*. By examining their life history strategies, the findings enhance our understanding of species adaptation and ecological success within the Gryllidae, and emphasize the significance of life history evolution in shaping insect biodiversity and resilience.

Materials and Methods

Study sites

The life history and reproductive strategies of Gryllidae (crickets) were investigated in Lower Sindh, Pakistan, during 2024. Field surveys were conducted across four districts viz., Badin, Mirpurkhas, Tharparkar, and Umerkot (Figure 1). Specimens were collected from a wide range of habitats, including agricultural fields, deserts, semi-deserts, natural vegetation (trees, shrubs, herbs, and grasses), and anthropogenic environments such as bakeries, residential crevices, and artificially illuminated areas at night. Additional habitats sampled included leaf litter, soil fissures, and vegetable fields. This study integrated original field observations with an extensive literature review to compare the life history traits of *Acheta domesticus* and *Gryllodes supplicans*.

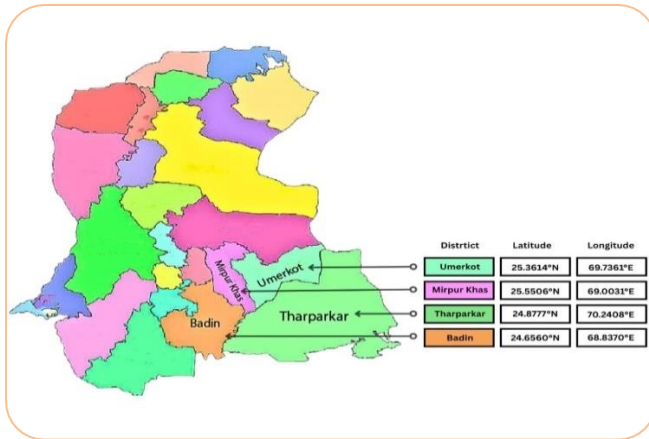


Figure 1. Surveyed locations with geographic coordinates.

Field surveys and specimen collection

Gryllidae specimens were collected from various ecological niches across the four selected districts of Lower Sindh. Sampling sites included agricultural lands, arid and semi-arid zones, vegetation of differing structure (trees, shrubs, herbs, and grasses), and human-modified environments such as bakeries, household crevices, and nocturnally illuminated areas. Additional samples were obtained from soil cracks, leaf litter, and vegetable crops. Collection methods included hand-picking and sweep netting using hand nets (10.0 cm diameter, 40.0 cm length). Collected specimens were transferred into polythene bags and plastic containers and transported to the Entomology and Biocontrol Research Laboratory (EBCRL) for further analysis.

Killing and preservation

Specimens were euthanized using chloroform, following the protocol described by Sultana and Wagan (2015). Dried specimens were preserved in standard entomological boxes. Each specimen was labeled with two tags: one containing locality, date of collection, and collector's name; and the other indicating the suborder and species name. Naphthalene balls were placed in the boxes to prevent damage from predatory insects and ants.

Morphological identification

Specimens were identified under a stereoscopic binocular microscope (Model Z730, China) equipped with 100× × 10× magnification. Identification was based on taxonomic keys provided by Cigliano et al. (2025), accessible at <http://www.orthoptera.org>. Moreover, the identification protocols outlined by Uvarov (1977) and Sultana and Wagan (2015) were consulted for confirmation of Orthoptera species.

Species-specific morphological traits

Morphological analysis was performed by assessing body size, limb length, tegmina structure, and sound-producing organs. Body size was measured from the head to the tip of the abdomen, while limb lengths were recorded to evaluate interspecific differences in mobility and environmental interaction. The tegmina, which play a crucial role in acoustic communication, were examined for their structural characteristics, including thickness and positioning on the body, as these features contribute significantly to species-specific variations in mating calls. To ensure measurement accuracy and reduce human error, all dimensions were recorded using a digital caliper, and morphological traits were documented using a high-definition camera.

Observation of life cycle and developmental monitoring

To compare the life cycle and growth rate of *A. domesticus* and *G. supplicans*, individuals were monitored from the egg stage to adulthood. Eggs were collected from breeding pairs of each species and incubated under controlled environmental conditions. The incubation temperature and humidity were tailored to each species: *A. domesticus* was maintained at 25°C with moderate humidity, while *G. supplicans* was reared at 30°C with high humidity.

Daily observations were conducted to record the timing of hatching and subsequent developmental stages. Both free-ranging and laboratory-reared nymphs were measured for body length and weight to assess developmental progression. The durations of each life stage, including egg incubation, nymphal development, and time to adult maturation, were carefully documented.

Multigenerational assessment

To ensure consistency, developmental traits were evaluated over multiple generations under the same rearing conditions. Data was recorded to detect any generational variations in growth rates and to assess potential evolutionary patterns in development across successive generations.

Reproductive and oviposition behavior

To investigate reproductive strategies, this study analyzed fecundity rates, egg morphology (shape and size), and mating behaviors of *A. domesticus* and *G. supplicans*. Mated pairs of both species were maintained under controlled environmental conditions simulating their natural habitats, *A. domesticus* at 25 °C with moderate humidity, and *G. supplicans* at 30 °C with high humidity. Observations focused on courtship behavior,

acoustic signaling (vocalization), and mating frequency. Fecundity was assessed by counting the number of eggs laid per female within a defined time frame. Egg shape and size were measured using a stereo optical microscope to evaluate species-specific reproductive investment. The findings were compared with existing literature to determine how reproductive traits of each species correspond to their ecological niches.

Environmental adaptations

Both species were exposed to varying temperature and humidity regimes to assess their tolerance thresholds and corresponding behavioral responses. Specifically, *A. domesticus* was evaluated for thermoprotective (thermoprophylactic) adaptations due to its known resilience in temperate environments, whereas *G. supplicans* was assessed for its tolerance to elevated temperatures and high humidity, traits characteristic of tropical climatic zones. Behavioral observations included digging, refuge-seeking, and changes in activity levels, which served as indicators of stress responses to environmental changes. Furthermore, findings from previous studies on metabolic rate modulation and energy metabolism were integrated to provide deeper understanding for the physiological mechanisms underlying environmental adaptation in these species.

Results

Acheta domesticus (Linnaeus, 1758)

Table 1, 3 and Figure 2, 3.

Gryllus (Acheta) domesticus Linnaeus. 1758.

Gryllus domesticus Linnaeus. 1761.

Acheta domestica Fabricius. 1775.

Gryllulus domesticus Uvarov. 1935.

Material examined

Pakistan: Sindh Province: Badin (24°39'20.59"N, 68°50'14.07"E), 72 ♂, 65 ♀, coll. Shamshad and Riffat, 24 August, 2024; Mirpurkhas (25°31'39.3"N, 69°00'50.6"E), 109 ♂, 136 ♀, coll. Riffat and Shamshad, 18 August 2024; Tharparkar (24.8777°N, 70.2408°E), 102 ♂, 87 ♀, coll. Shamshad and Riffat, 31 August. 2024; Umerkot (25.3549°N, 69.7376°E), 83 ♂, 69 ♀, coll. Riffat and Shamshad, 01 September, 2024.

Description

Male

Males were characterized by medium-sized, pubescent, and convex bodies, displaying a distinctive testaceous to bright fulvous coloration. The head bore two testaceous bands of variable length, contrasting with the overall

brown hue. The pronotum featured two prominent, large brown spots. The elytra extended beyond the apex of the abdomen, and the wings surpassed the length of the elytra. The yellowish legs occasionally exhibited brown spots. The femur displayed several longitudinal lines on its dorsal side, while the tibia bore 6-7 spines. The cerci were located at the posterior end.

Female

Females were larger than males and exhibited a lighter brown coloration. The posterior part of the head was slightly protruded, and the eyes appeared bulging, giving a more pronounced outward appearance. The inner margin of the pronotum was inwardly curved. Elytral veins were distinctly slanting. The tibia bore 5-6 spines, and the posterior side of the femur was relatively narrow. The cerci appeared slender when viewed from the front. The ovipositor was elongated, sharply pointed, and regularly structured.

Phenology

The common house cricket, *A. domesticus*, is widely distributed across various field habitats. Its life cycle spans approximately two to three months and lacks a distinct overwintering stage. This species has been observed in diverse agroecosystems and is known to cause damage to several economically important crops, including *Triticum aestivum* (wheat), *Oryza sativa* (rice), *Saccharum officinarum* (sugarcane), and associated vegetation.

Comments

A. domesticus exhibits a cosmopolitan distribution. Its presence has been documented in a wide range of geographic regions, including the Himalayas, Srinagar, and Kashmir, where it has been recorded at altitudes of up to 6,000 feet (Chopard, 1969). In the current study, we report the occurrence of this species in the Sindh region. Previous studies have identified *A. domesticus* and closely related species as significant agricultural pests in both Pakistan and India (Ghouri, 1961; Sultana et al., 2013, 2016, 2021; Talpur, 2020), where they affect multiple crop types and surrounding flora.

Natural history

A. domesticus is considered one of the most widely distributed orthopteran insects. Its native range extends from southern Africa across the Indian Ocean to Southeast Asia, including Malaysia. The species exhibits notable ecological plasticity, enabling it to colonize a wide array of habitats. Populations of *A. domesticus* or closely related species occasionally experience outbreak events, particularly in tropical reserves, where they can

become locally abundant and exhibit extreme polyphagy. During such outbreaks, they consume a broad spectrum of plant material, including *Heliconia* spp., palm fronds, and various dicotyledonous herbs and trees. This feeding behavior highlights their adaptability and their potential to alter plant community structure in tropical and subtropical ecosystems.

Table 1. Morphometric measurements of various body parts of *A. domesticus*.

Body parameters	Male (n=10) Mean $\pm$ SD (mm)	Female (n=10) Mean $\pm$ SD (mm)
Length of head	4.3 $\pm$ 0.25	4.7 $\pm$ 0.62
Length of pronotum	5.0 $\pm$ 0.40	5.3 $\pm$ 0.62
Length of femur	12.1 $\pm$ 1.03	11.7 $\pm$ 0.47
Length of tibia	8.6 $\pm$ 0.70	8.6 $\pm$ 0.57
Length of cerci	8.3 $\pm$ 1.50	8.2 $\pm$ 0.85
Tegmina Thickness (mm)	0.29 $\pm$ 0.01	0.35 $\pm$ 0.05
Total body length	27.1 $\pm$ 1.79	27.6 $\pm$ 2.5



Figure 2. *A. domesticus*: (a) Dorsal view of *A. domesticus*; (b) Close-up of femur and tibia showing sharp spines.

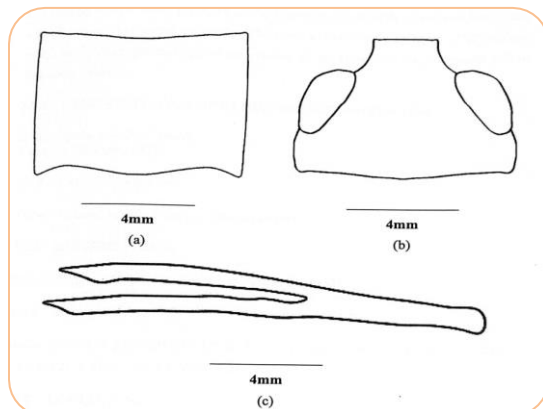


Figure 3. *A. domesticus*: (a) Head, dorsal view (DV); (b) Pronotum, dorsal view (DV); (c) Ovipositor, lateral view (LV). Scale bar = 4 mm.

Grylloides supplicans (Walker, 1859)

Table 2, 3 and Figure 4, 5.

Acheta supplicans Walker, F. 1859.

Gryllus supplicans Walker, F. 1869.

Grylloides sigillatus Chopard. 1967.

Material examined

Pakistan, Sindh Province: Badin: 55 ♂, 52 ♀; coll. Riffat and Shamshad, 29 August, 2024, 24°39'20.59"N, 68°50'14.07"E. Mirpurkhas: 88 ♂, 83 ♀; coll. Shamshad and Riffat, 22 August, 2024, 25°31'39.3"N, 69°00'50.6"E. Tharparkar: 92 ♂, 37 ♀; coll. Shamshad and Riffat, 29 August, 2024, 24.8777°N, 70.2408°E. Umerkot: 47 ♂, 68 ♀; coll. Riffat and Shamshad, 05 September, 2024, 25.3549°N, 69.7376°E.

Description

Male

The male exhibited an elongate-oval body shape and was light brown in color. A noticeable protrusion was present on the head. The pronotum, a plate-like structure on the thorax, had a distinct shape useful for identification. The wings were reduced, typically displaying four veins. The femur was strongly developed, indicating powerful legs adapted for jumping or grasping. The tibiae bore pointed spines, a typical characteristic among various orthopteran groups, used for defense or prey capture.

Female

The elytra exhibited regularly arranged veins. The ovipositor was bifurcated at the anterior end, meaning it was split into two parts, a distinguishing feature in certain cricket species. The cerci were slightly elongated.

Phenology

G. supplicans, commonly known as the *fall field cricket*, is a widely distributed species found across various regions of the world. It feeds on a variety of plants, including wheat and rice, although it is generally not regarded as a major agricultural pest due to its limited impact on these crops. This species exhibits both nocturnal and diurnal activity, meaning it can be active during both day and night.

Male *G. supplicans* produce mating calls to attract females and establish territories, an essential component of their reproductive behavior. They often coexist with other cricket species, such as *G. sigillatus*, and are commonly found in grassy areas and open fields. Overall, *G. supplicans* is considered a common and highly adaptable species capable of thriving in a wide range of environments.

Comments

G. supplicans is a species closely related to *G. sigillatus*, sharing many morphological traits. However, distinct differences exist between them. Notably, *G. supplicans* is macropterous (possessing fully developed wings) and exhibits a more elongated body form. This distinction is particularly significant, as female *G. sigillatus* show a marked reduction in elytral (wing cover) size. These morphological variations raise the question of whether a reversion to a fully winged form in *G. sigillatus* is possible, although such a reversion remains hypothetical. To investigate this further, a detailed revision of the genitalia of *G. supplicans* is currently in progress. Upon completion, this analysis is expected to yield more definitive insights into the taxonomic status and distinguishing features of *G. supplicans*.

Natural history

G. supplicans is one of the most cosmopolitan cricket species, with a wide distribution across subtropical and tropical regions worldwide. It thrives in human-

associated environments such as crevices in buildings and rocks, but also adapts to natural habitats like lava fields. This species is notably resilient and opportunistic, often feeding on insect remains, detritus, and other organic matter, which enables it to persist in newly formed or disturbed habitats. Its global distribution is largely attributed to passive, human-mediated dispersal.

Table 2. Morphometric measurements of various body parts of *G. supplicans*.

Body parameters	Male (n=10)	Female (n=10)
	Mean ± SD (mm)	Mean ± SD (mm)
Length of head	2.78 ±0.67	2.11±0.28
Length of pronotum	2.87±1.00	2.42±0.04
Length of femur	10.4±0.65	11.3±1.20
Length of tibia	7.65±0.41	9.2±0.75
Length of cerci	7.75±0.34	8.55±0.35
Tegmina Thickness (mm)	0.21 ± 0.02	0.25 ± 0.03
Total body length	16.2±1.03	17.2±1.03

Table 3. Inter-Specific morphometric comparison of *A. domesticus* and *G. supplicans*.

Body parameters	<i>Acheta domesticus</i> (mm)		<i>Gryllodes supplicans</i> (mm)	
	Male (n=10)	Female (n=10)	Male (n=10)	Female (n=10)
Length of head	4.3±0.25	4.7±0.62	2.78 ±0.67	2.11±0.28
Length of pronotum	5.0±0.40	5.3±0.62	2.87±1.00	2.42±0.04
Length of femur	12.1±1.03	11.7±0.47	10.4±0.65	11.3±1.20
Length of tibia	8.6±0.70	8.6±0.57	7.65±0.41	9.2±0.75
Length of cerci	8.3±1.50	8.2±0.85	7.75±0.34	8.55±0.35
Tegmina Thickness (mm)	0.29 ± 0.01	0.35 ± 0.05	0.21 ± 0.02	0.25 ± 0.03
Total body length	27.1±1.79	27.6±2.5	16.2±1.03	17.2±1.03



Figure 4. *G. supplicans*: (a) Dorsal view; (b) Lateral view.

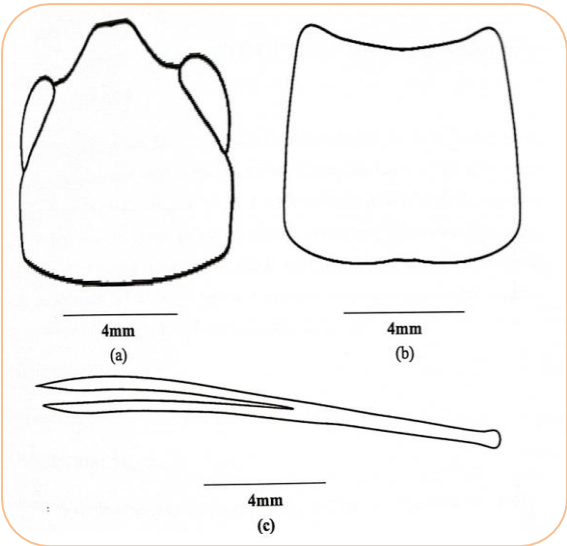


Figure 5. *G. supplicans*: (a) Head, dorsal view; (b) Pronotum, dorsal view; (c) Ovipositor, lateral view. Scale bar = 4 mm.

Species-specific morphological traits

Morphometric measurements revealed that *A. domesticus* exhibited larger body dimensions than *G. supplicans* across all parameters. In both species, females were generally larger than males. *A. domesticus* males and females had greater head length (4.3 mm and 4.7 mm), pronotum length (5.0 mm and 5.3 mm), and total body length (27.1 mm and 27.6 mm), compared to *G. supplicans*. Similar trends were observed for femur and tibia lengths, cerci, and tegmina thickness (Table 3). The observed differences between *A. domesticus* and *G. supplicans* suggest that these variations may result from differences in environmental conditions and reproductive system adaptations.

Comparative developmental timelines

The life cycle analysis revealed significant differences in the developmental timelines of the two species. *A. domesticus* exhibited a relatively rapid development, reaching adulthood in approximately 56.7 days, while *G. supplicans* required around 81 days to attain maturity (Table 4). These developmental durations were consistent across generations.

The shorter growth period of *A. domesticus* suggests an evolutionary adaptation to environments with more variable climatic conditions, where rapid life cycle completion may confer a selective advantage. In contrast, the extended developmental period of *G. supplicans* aligns with the species' adaptation to more stable tropical environments.

Table 4. Comparative developmental duration of two cricket species over three generations.

Generation	Development Time (Days)	
	<i>A. domesticus</i>	<i>G. supplicans</i>
1	55 ± 4.0	80 ± 6.7
2	57 ± 3.2	82 ± 5.3
3	58 ± 4.2	81 ± 7.2
Average	56.7 ± 3.5	81 ± 6.5

Reproductive output and egg viability

G. supplicans exhibited a high hatching rate (92%) and greater egg production, characteristic of an r-selected reproductive strategy commonly associated with stable environments. In contrast, *A. domesticus* showed a higher larval survival rate (78%), likely attributable to its larger egg size and greater tolerance to environmental fluctuations. These traits are consistent with a K-selected reproductive strategy, which prioritizes offspring quality and survival over sheer reproductive output (Table 5).

Table 5. Fecundity and Egg Viability in in two cricket species.

Characteristic	<i>A. domesticus</i>	<i>G. supplicans</i>
Average Eggs Laid per Female	125 ± 15	315± 35
Hatching Rate (%)	85 ± 5.3	92 ± 4.6
Egg Size (mm)	2.3 ± 0.1	1.5 ± 0.1
Average Incubation Time (Days)	10 ± 1.5	12 ± 2.5
Larval Survival Rate (%)	78 ± 6.5	64 ± 5.5

Environmental tolerance range analysis

A. domesticus exhibited broader environmental tolerance, surviving across a temperature range of 15-30 °C, in contrast to *G. supplicans*, which thrived within a narrower thermal window of 25-35 °C. This wider thermal adaptability confers *A. domesticus* a competitive advantage in diverse ecosystems globally. In contrast, *G. supplicans* demonstrated a preference for high relative humidity (60-90%) and thermally stable conditions, reflecting its ecological specialization for tropical environments (Table 6).

Table 6. Temperature and humidity tolerance of cricket species.

Environmental Condition	Tolerance	
	<i>A. domesticus</i>	<i>G. supplicans</i>
Temperature (°C)	15-30	25-35
Humidity (%)	40-70	60-90
Optimal Light Hours	8-12	10-16
Activity Level at Peak Temp.	Moderate	High

Longitudinal comparison of population density

Population dynamics over a 12-week period (Table 7) revealed a higher population growth rate in *G. supplicans*, consistent with an r-selected life history strategy that favors rapid reproduction in resource-abundant and fluctuating environments. Conversely, *A. domesticus* showed slower but sustained population growth, indicative of a K-selected strategy aligned with temperate ecosystems, where environmental constraints such as food scarcity can periodically limit population expansion.

Table 7. Temporal changes in population density of two cricket species.

Time (Weeks)	Population Density (per 10 m ²)	
	<i>A. domesticus</i>	<i>G. supplicans</i>
Week 1	10 ± 1	12 ± 1
Week 4	40 ± 3	52 ± 4
Week 8	70 ± 5	88 ± 6
Week 12	110 ± 8	150 ± 7

Comparative analysis of reproductive adaptations and life history strategies

A. domesticus demonstrated a K-selected reproductive strategy with a longer developmental timeline, fewer eggs per day, and higher larval survival (78%) compared to *G. supplicans*, which exhibited an r-selected strategy marked by higher egg production (3,125 eggs/female), greater hatching rate (92%), and faster population increase. Despite laying fewer egg pods, *A. domesticus* had larger egg sizes and higher molting success. In contrast, *G. supplicans* developed more rapidly between molts and showed a higher population density over 12

weeks, suggesting better reproductive output under favorable tropical conditions (Table 8).

Geographic distribution across Sindh, Pakistan

Both species were widely distributed across Badin, Mirpurkhas, Tharparkar, and Umerkot. *A. domesticus* was slightly more abundant overall (n = 723), with a nearly equal male-to-female ratio. *G. supplicans* (n = 522) was predominant in Mirpurkhas and Tharparkar, with a higher male proportion (54.02%) (Table 9). These results highlight the broad ecological adaptability of *A. domesticus* and the regional dominance of *G. supplicans* in certain localities.

Table 8. Comparative analysis of reproductive adaptations and life history strategies in two cricket species.

Parameter	<i>A. domesticus</i>	<i>G. supplicans</i>
Reproductive strategy	K-selected	R-selected
Mating Frequency times per week	3-5	4-6
Average Incubation Time (Days)	10 ± 1.5	12 ± 2.5
Nymph stage duration	56 days (± 5 days)	82 days (± 5 days)
Adult stage duration	57 days (± 3 days)	81 days (± 6 days)
Total number of eggs produced per female throughout the lifespan	2,195 (± 23)	3,125 (± 37)
Average number of eggs laid per day	125 (± 15)	315 (± 35)
Oviposition Rate/ egg pods per female	12 ± 3	10 ± 2
Egg Pod Weight (grams)	1.8 ± 0.3	2.1 ± 0.1
Number of Eggs per Pod	75 ± 7	85 ± 9
Egg Size (mm)	2.3 ± 0.1	1.5 ± 0.1
Hatching Rate (%)	85 ± 5.3	92 ± 4.6
Larval Survival Rate (%)	78 ± 6.5	64 ± 5.5
Number of Molts	8	7
Time Between Molts (days)	7 ± 1.3	8 ± 1.7
Molting Success (%)	95 (60-70% humidity)	92 (60-70% humidity)
Population Density (per 10 m ²) for 12 weeks	110 ± 8	150 ± 7

Table 9. Geographic distribution of species across various localities in Sindh, Pakistan.

Localities	Species			
	<i>A. domesticus</i> (n = 723)		<i>G. supplicans</i> (n = 522)	
	Male	Female	Male	Female
Badin (n = 244)	72	65	55	52
Mirpurkhas (n = 416)	109	136	88	83
Tharparkar (n = 318)	102	87	92	37
Umerkot (n = 267)	83	69	47	68
Total (n = 1245)	366	357	282	240
Percentage	50.62	49.38	54.02	45.98

Discussion

Numerous researchers from various regions have conducted significant studies on key taxa within Orthoptera and Coleoptera. For instance, the family *Schizodactylidae* has been investigated by Sultana (2019), Barkat et al. (2024), and Maleeha and Sultana (2025a, b).

Cigliano et al. (2025) provided a comprehensive overview of *Gryllidae* Laicharting, 1781, through the Orthoptera Species File. Katydidids from the arid zones of Bahawalpur were studied by Irfan et al. (2025), while Jakhrani et al. (2025) and Memon et al. (2024) examined the systematic and ecological statuses of *Hemicaridinae*

and *Pyrgomorphidae*, respectively. Studies involving DNA barcoding and the effects of climate change on Orthoptera were conducted by Ashfaq et al. (2022), Munir et al. (2022), and Nawab et al. (2021, 2022). More recently, Kumari et al. (2025) updated the Orthopteran diversity of the Nara Desert. Waseem et al. (2024, 2025) explored the Coleopteran fauna of the Cholistan desert and described a new species within the subgenus *Afromorgus* (Trogidae: Scarabaeoidea). Talpur (2020), Bhangar et al. (2024) and Chandio and Sultana (2024) documented the diversity of field crickets (*Gryllidae*) in Mirpurkhas, Sindh, while Talpur and Sultana (2025) examined the life history traits of *A. domesticus* under both natural and laboratory conditions.

Despite these efforts, comparative studies between *Gryllidae* species remain limited, which formed the rationale for the present study. The comparative analysis of *A. domesticus* and *G. supplicans* (Tables 8 and 9) provides key insights into how life history traits are shaped by environmental pressures and functional adaptations. This discussion interprets the findings through the lenses of physiology, morphology, reproduction, and behavior, relating them to prior work on *Gryllidae*.

Marked interspecific differences were observed in structural adaptations, developmental timing, reproductive strategies, feeding habits, environmental tolerance, and acoustic signaling. Morphologically, *A. domesticus* tends to be larger and possesses longer antennae, which may enhance sensory capabilities and adaptability to variable temperate environments. Walker (1975) hypothesized that increased body mass and advanced sensory structures confer survival advantages in temperate zones, where resources are seasonally constrained. Conversely, *G. supplicans* displays elongated hind limbs, which facilitate mobility through dense tropical vegetation, an adaptation typical of crickets in humid ecosystems (Loher and Orsak, 1985).

Tegminal morphology also differs: *A. domesticus* features thicker tegmina adapted for robust acoustic signaling whereas *G. supplicans* has slender tegmina, suited to more stable and less acoustically competitive environments. Developmentally, *A. domesticus* reaches maturity in approximately 56 days, a trait advantageous in temperate environments where rapid development increases survival under fluctuating conditions. This observation aligns with Masaki (1978), who reported shorter life cycles in temperate species. In contrast, *G.*

supplicans matures in roughly 81 days, a longer cycle associated with stable tropical conditions, supporting Roff's (2002) life history theory, which suggests that stable environments favor prolonged development and greater biomass accumulation.

The reproductive strategies of the two species further reflect environmental adaptation. *A. domesticus* follows a K-selected strategy, producing fewer but larger eggs (Bate, 1971, 1972) with a relatively high survival rate (78%). This corresponds with Stearns (1992), who characterized K-strategists as investing more parental resources in fewer offspring. *G. supplicans*, on the other hand, represents an r-selected strategy, producing numerous smaller eggs with a hatching rate of 92%, which facilitates rapid population expansion in resource-rich environments. These patterns are consistent with Hedrick (1986) and Basolo (2007), who noted adaptive reproductive strategies among tropical *Gryllidae*.

Feeding behavior also indicates ecological specialization. *A. domesticus* is an opportunistic omnivore (Shamshad, 2020), consuming both plant material and decaying organic matter, enabling it to thrive in temperate and anthropogenically influenced habitats (Alexander and Meral, 1967). In contrast, *G. supplicans* primarily feed on decaying organic matter, functioning as a decomposer within tropical ecosystems, as also observed by Uvarov (1977) in other tropical *Gryllidae*.

Environmental tolerance further distinguishes the two species. *A. domesticus* thrives in a broader temperature range (15-30°C) and moderate humidity levels, demonstrating significant ecological plasticity (Davidowitz et al., 2004). *G. supplicans* prefers consistently high temperatures (25-35°C) and high humidity (60-90%), reflecting its adaptation to stable tropical environments (Loher and Rence, 1978). Although this limits its geographical distribution, it maximizes reproductive success and ecological fitness within its niche.

Acoustic behavior also varies significantly. *A. domesticus* produces frequent, high-pitched mating calls to rapidly attract mates, a strategy well-suited to environments with variable photoperiods and population densities (Alexander, 1962). In contrast, *G. supplicans* emits longer, less frequent calls that align with the consistent light cycles and stable ecosystems of the tropics (Montealegre and Mason, 2005; Hedwig, 2016).

Collectively, these findings demonstrate how environmental variability or stability drives the

evolutionary divergence of morphological, physiological, reproductive, and behavioral traits among *Gryllidae*. The distinct ecological adaptations of *A. domesticus* and *G. supplicans* exemplify the wide range of life history strategies employed by crickets to ensure survival and reproductive success across diverse habitats.

Conclusion

This comparative study of *A. domesticus* and *G. supplicans* illustrates how life history traits evolve in response to specific environmental demands. *A. domesticus* exhibits characteristics adapted to temperate zones, including faster ontogenetic development, greater physiological plasticity, and omnivorous feeding behavior. These features confer resilience in unstable and anthropogenically influenced environments. Conversely, *G. supplicans* demonstrates traits aligned with tropical stability, such as slower development, high reproductive output, and dietary specialization in decomposing organic matter, an indication of adaptation to moist, resource-rich ecosystems.

The study highlights the importance of ecological specialization in shaping the evolutionary pathways of *Gryllidae*. By revealing how each species has adapted to optimize survival and reproduction within its respective habitat, these findings provide valuable insights into the ecological dynamics and adaptive strategies of field crickets. This contributes to a broader understanding of how environmental factors influence biodiversity and life history evolution across insect taxa.

Acknowledgement

The authors express their sincere gratitude to the farmers for their valuable assistance during the field surveys.

Author's Contributions

RS conceptualized the study, provided guidance, and analyzed the data; SAT collected the samples, compiled the data and wrote the first draft; RS proofread the manuscript; Both the authors approved the final manuscript.

Research Funding

This research was financially supported by the Higher Education Commission (HEC), Islamabad, under Project No. 14787/NRPU/R&D/HEC.

Conflict of Interest

The authors declare no conflict of interest.

Sustainable Development Goals Targeted

SDG 2: Zero Hunger

SDG 12: Responsible Consumption and Production

SDG 15: Life on Land

References

- Alexander, R.D., 1962. Evolutionary change in cricket acoustic communication. *Evolution* 16, 443-467.
- Alexander, R.D., Meral, G.H., 1967. Sound production in crickets and other arthropods. *Annual Review of Entomology* 12, 495-526.
- Ashfaq, M., Khan, A.M., Rasool, A., Akhtar, S., Nazir, N., Ahmed, N., Manzoor, F., Sones, J., Perez, K., Sarwar, G., Khan, A.A., Akhter, M., Saeed, S., Sultana, R., Tahir, H.M., Rafi, M.A., Iftikhar, R., Naseem, M.T., Masood, M., Tufail, M., Kumar, S., Afzal, S., McKeown, J., Samejo, A., Khaliq, I., D'Souza, M.L., Mansoor, S., Hebert, P.D.N., 2022. DNA barcode survey of insect biodiversity in Pakistan. *PeerJ* 10, e13267.
- Barkat, A.I., Shome, A.R., Sultana, R., Rabb, M.F., 2024. First confirmed record of *Schizodactylus monstrosus* (Orthoptera: Schizodactylidae) based on its nymph from Bangladesh. *Journal of Bangladesh Academy of Sciences* 48, 161-163.
- Basolo, A.L., 2007. Reproductive strategies in crickets. *Insect Reproduction and Biology* 4, 58-69.
- Bate, J., 1971. Life history of *Acheta domesticus* (Insecta, Orthoptera, Gryllidae). *Pedobiologia* 11, 159-172.
- Bate, J., 1972. Variation in fecundity of *Acheta domesticus* (Insecta, Orthoptera, Gryllidae) in relation to season and temperature. *Pedobiologia* 12, 1-5.
- Bhanger, N., Sultana, R., Baloch, N., Kumar, S., 2024. Taxonomic insights and geographic distribution of Gryllidae (Gryllinae: Orthoptera) in Sindh, Pakistan. *Journal of Wildlife and Biodiversity* 8, 1-15.
- Chandio, A., Sultana, R., 2024. Comparative study on the Oothecae of three species of Mantodea (Dictyoptera: Insecta). *LGU Journal of Life Sciences* 8, 480-492.
- Channa, S.A., Sultana, R., Wagan, M.S., 2011. Studies on the immature stages and burrow excavating behavior of *Schizodactylus monstrosus* (Drury) (Grylloptera: Gryllodea: Schizodactylidae) from Sindh, Pakistan. *African Journal of Biotechnology* 10, 2328-2333.
- Channa, S.A., Sultana, R., Wagan, M.S., 2013. Morphology and burrowing behaviour of *Schizodactylus minor*

- (Ander, 1938) (Grylloptera: Schizodactylidae: Orthoptera) of Pakistan. Pakistan Journal of Zoology 45, 1191-1196.
- Chopard, L., 1969. The fauna of India and adjacent countries. Orthoptera, 2 Grylloidea. Zoological Survey of India 2: i-xvii, 421.
- Cigliano, M.M., Braun, H., Eades, D.C., Otte, D., 2025. Gryllidae Laicharting, 1781. Orthoptera Species File. Retrieved on 2025-07-13. <http://orthoptera.speciesfile.org/otus/828880/overview>
- Davidowitz, G., D'Amico, L.J., Nijhout, H.F., 2004. The effects of environmental change on the life history of insects. Biological Reviews 79, 19-37.
- Dingle, H., Evans, K.E., Palmer, J.O., 1990. Responses of *Acheta domesticus* (Orthoptera: Gryllidae) to juvenile hormone analogue in relation to photoperiod, nutrition, and social environment. Canadian Journal of Zoology 68, 2530-2534.
- Ghouri, A.S.K., 1961. Home and distribution of the house cricket *Acheta domesticus* L. Nature 192, 1000.
- Hedwig, B., 2016. Control of cricket stridulation by a command neuron: Efficacy depends on the behavioral state. Journal of Neurophysiology 115, 3245-3252.
- Jakhrani, M.A., Sultana, R., Kumar, S., Baloch, N., 2025. Recent incidence of *Hieroglyphus oryzivorus* (Hemiacridae: Acrididae: Orthoptera) in various districts of upper Sindh. Journal of Wildlife and Biodiversity 9, 220-233.
- Kumari, V., Sultana, R., Bughio, B.A., 2025. Assessing the updated diversity of Orthoptera in Nara Desert. Voyage Journal of Scientific Research and Exploration 2, 103-119.
- Loher, W., Orsak, L.J., 1985. Mating behavior in tropical house cricket, *Gryllobates supplicans*. Journal of Insect Behavior 8, 231-246.
- Loher, W., Rence, B., 1978. Environmental factors and temporal patterning of mating behavior in crickets. Quarterly Review of Biology 53, 379-395.
- Maleeha, J., Sultana, R., 2025a. Observations on the reproductive structures in *Schizodactylus* (Schizodactylidae: Orthoptera). International Journal of Agricultural Innovation and Cutting-Edge Research 3, 7-13.
- Maleeha, J., Sultana, R., 2025b. Occurrence of *Schizodactylus* (Schizodactylidae) in various localities: New distribution records for Pakistan. Voyage Journal of Scientific Research and Exploration 1, 105-116.
- Masaki, S., 1978. Climatic adaptation and the geographic distribution of cricket development. Biological Journal of the Linnean Society 10, 185-211.
- Memon, S.P., Sultana, R., Bughio, B.A., Kumar, S., 2024. Systematic status and ecological account of *Poekilocerus* (Pyrgomorphidae: Orthoptera) of Pakistan. Journal of Zoological Systematics 2, 88-95.
- Montealegre-Z, F., Mason, A.C., 2005. The mechanics of sound production in crickets: *Acheta domesticus* and *Gryllobates supplicans*. Journal of Comparative Physiology A 191, 677-686.
- Mulkern, G.B., 1967. Life history studies of grasshoppers, *Acheta domesticus*. Entomological Research 17, 119-124.
- Munir, A.P., Sultana, R., Kumar, S., 2022. Biodiversity of *Caelifera* (Orthoptera) in Cholistan desert, Punjab, Pakistan. Plant Cell Biotechnology and Molecular Biology 23, 38-44.
- Nawab, M., Sultana, R., Kumar, S., 2021. The study of various body parameters and impact of climate change on potential swarming of *Schistocerca gregaria* forskal (Orthoptera: Acrididae) in Punjab, Pakistan. Plant Cell Biotechnology and Molecular Biology 22, 216-223.
- Nawab, M., Sultana, R., Kumar, S., 2022. Study of biodiversity of Orthoptera from Punjab, Pakistan. Plant Cell Biotechnology and Molecular Biology 23, 92-100.
- Roff, D.A., 2002. Life history evolution. Sunderland, MA: Sinauer Associates.
- Rueda, L.M., Zaim, M., Aranda, C., 2007. Adaptations to tropical environments in *Gryllobates supplicans*. Tropical Insect Ecology 35, 223-234.
- Sanam, S., Sultana, R., Bughio, B.A., Sanam, S., 2021. A review of the Tettigoniidae Krauss, 1902 (Tettigoniidae: Ensifera: Orthoptera) with a new species from Pakistan. Journal of Agricultural Science and Technology A 11, 1-21.
- Shamshad, A.T., 2020. Diversity of field crickets (Gryllidae: Orthoptera) from Mirpurkhas, Sindh. University of Sindh Journal of Animal Sciences 4, 22-27.
- Stearns, S.C., 1992. The evolution of life histories. Oxford: Oxford University Press.
- Sultana, R., 2019. A new genus *Schizocomicus* (Schizodactylidae: Ensifera) from Sindh, Pakistan.

- Pakistan Journal of Zoology 51(5), 1693-1697.
- Sultana, R., Dayo, M.S., Wagan, M.S., Lal, M., 2016. The Thar crickets (Orthoptera: Gryllidae). Sindh University Research Journal (Science Series) 48, 647-650.
- Sultana, R., Song, H., 2024. Annotated catalogue of Pakistani Acrididae (Orthoptera: Caelifera: Acridoidea). Zootaxa 5486, 1-47.
- Sultana, R., Surriya, S., Kumar, S., Sheik, M.R., Saba, F., 2021. A review of Gryllidae (Grylloidea) with the description of one new species and four new distribution records from the Sindh Province, Pakistan. ZooKeys 1078, 1-33.
- Sultana, R., Wagan, M.S., 2015. Grasshoppers and locusts of Pakistan. Higher Education Commission, Pakistan, 1-180.
- Sultana, R., Yawar, S.W., Wagan, M.S., 2013. Orthopteran biodiversity of Thar Desert, Sindh, Pakistan. Pakistan Journal of Zoology 45, 299-304.
- Talpur, S.A., 2020. Diversity of field crickets (Gryllidae: Orthoptera) from Mirpurkhas, Sindh. University of Sindh Journal of Animal Sciences 4, 22-27.
- Talpur, S.A., Sultana, R., 2025. Life history statistics of the common house cricket, *Acheta domesticus* (Gryllidae) under natural and laboratory conditions. Voyage Journal of Scientific Research and Exploration 2, 120-138.
- Uvarov, B.P., 1977. Grasshoppers and locusts: A handbook of general acridology. Volume II: Behaviour, ecology, biogeography, population dynamics. London: Centre for Overseas Pest Research, pp ix-613.
- Walker, T.J., 1975. Sound production and speciation in crickets. Biological Reviews 50, 33-58.
- Walker, T.J., Masaki, S., 1989. Natural history of crickets. Cambridge: Cambridge University Press.
- Waseem, M., Kumar, S., Sultana, R., 2024. A new species of the sub-genus *Afromorgus* (Trogidae: Scarabaeoidea) from Cholistan desert, Pakistan. Pakistan Journal of Zoology 56, 1-7.
- Waseem, M., Kumar, S., Sultana, R., Baboo, I., Manzoor, Z., 2025. Exploration of the Coleoptera fauna in the Cholistan desert, Punjab, Pakistan. Journal of Wildlife and Biodiversity 9, 261-272.