

Diversity, Morphological Characterization and Feeding-Guild Structure of Coccinellidae Associated with Cotton Ecosystems in the, Marathwada Region of Maharashtra, India

Ganesh Kishanrao Lahane

Research Scholar, Department of Zoology, Adarsh College, Hingoli

Abstract

Coccinellidae are important components of cotton agroecosystems because many species prey on aphids, whiteflies, jassids and other soft-bodied arthropods, whereas some epilachnine ladybirds are herbivorous. The present study analyzes a field-identification dataset comprising 30 recorded coccinellid specimens from cotton ecosystems in the Marathwada region of Maharashtra, India. Specimens were characterized using field photography, external morphology and diagnostic elytral and pronotal patterns, with comparison against standard identification keys. The supplied dataset records *Coccinella transversalis* (1 specimen; 3.3%), *Harmonia* sp. (10; 33.3%), *Cheilomenes sexmaculata* (4; 13.3%), *Epilachna/Illeis* sp. (10; 33.3%), and five Coccinellidae specimens represented by immature or incompletely resolved stages (16.7%). Adults comprised 25 specimens (83.3%), while eggs, larvae, pupae and a newly emerged adult were also documented. The recorded feeding-guild classification comprised 15 predatory/beneficial specimens, 10 herbivorous/fungivorous specimens and five unidentified or immature specimens. *Harmonia* sp. and *Epilachna/Illeis* sp. were co-dominant in the supplied summary. The observations demonstrate that cotton foliage can support both beneficial predatory coccinellids and phytophagous/fungivorous forms, emphasizing the need for conservation-oriented integrated pest management. The study is primarily a morphological and descriptive inventory; it does not provide replicated seasonal abundance, prey-density, environmental, or experimental efficacy data. The source record contains two internal data inconsistencies in specimen numbering and identification-level totals, which are explicitly reported rather than silently corrected.

Keywords: Coccinellidae; cotton ecosystem; ladybird beetles; morphological identification; biological control; *Epilachna*; *Harmonia*; *Cheilomenes sexmaculata*; Marathwada; Maharashtra

1. Introduction

Cotton is a major commercial crop in India and supports a diverse arthropod community that includes both economically important pests and natural enemies. Among the natural enemies, coccinellid beetles are conspicuous predators in many crop systems. Their ecological importance is associated particularly with predation on aphids, whiteflies, scale insects and other soft-bodied prey. Indian catalogues have documented a broad prey range of predaceous coccinellids and emphasized their potential in biological control.

The ecological significance of coccinellids is especially relevant in cotton because sucking pests such as *Aphis gossypii*, *Amrasca* spp. and *Bemisia tabaci* can occur throughout crop development. Recent cotton studies have shown that Coccinellidae can constitute a substantial component of natural-enemy assemblages, while seasonal monitoring demonstrates that predator abundance may change with pest abundance and crop stage.

The present contribution is based specifically on the supplied field-identification record. Its objective is not to claim a complete fauna of Marathwada, but to organize and analyze the available observations into a scientifically structured account of taxonomic composition, morphological differentiation, life-stage representation and feeding-guild structure.

2. Objectives

- To characterize the coccinellid specimens recorded from cotton foliage using external morphological traits.
- To summarize the taxonomic composition and relative abundance represented in the supplied dataset.
- To document the observed life stages and feeding-guild categories.
- To evaluate implications of the observed predator assemblage for conservation biological control in cotton.
- To identify data limitations and quality-control issues relevant to future field surveys.

3. Materials and Methods

3.1 Source dataset and study context

The analysis used the supplied 36-page document “Entomology- Marathwada reagon.pdf”. The source describes morphological identification and characterization of Coccinellidae associated with cotton ecosystems and includes specimen photographs, diagnostic descriptions, taxonomic assignments and a final summary of 30 specimens. Exact village/site coordinates, sampling dates, number of fields, sampling effort and standardized trapping/collection protocol were not supplied and therefore were not invented.

3.2 Morphological identification

The principal diagnostic characters in the supplied record were thick transverse black bands for *Coccinella transversalis*; irregular elytral blotches with a black-white, mask-like pronotal pattern for *Harmonia* sp.; a zig-zag wavy black band and round spots for *Cheilomenes sexmaculata*; and a maze-like elytral pattern for the *Epilachna/Illeis* group. Immature stages were assigned at family level where species-level diagnosis was not supported.

3.3 Data analysis

Abundance and relative frequency were summarized from the final species-diversity table in the supplied document. Percentages were checked against $N = 30$. Descriptive graphs were generated for taxon/group abundance, relative composition, life stages and feeding guilds. No inferential test was applied because the supplied dataset does not contain independent replicated samples, temporal observations or site-level replication.

3.4 Data-quality control

Two inconsistencies were detected. First, the final abundance table reports four *C. sexmaculata* specimens, but the detailed specimen list names insects 4, 5, 19, 20 and 25, i.e. five specimens. Second, the summary states that 15 specimens were identified to species level, although the listed species-level components (*C. transversalis* = 1 and *C. sexmaculata* = 4) sum to only five. The main quantitative analysis therefore retains the final summary table values ($N = 30$) rather than silently changing the supplied dataset. These discrepancies should be resolved against the original field register and photograph register before journal submission.

4. Results

4.1 Taxonomic composition and abundance

Taxon / identification group	N	Life stages represented	Share (%)
<i>Coccinella transversalis</i>	1	Adult	3.3
<i>Harmonia</i> sp.	10	Adult (9), pupa (1)	33.3
<i>Cheilomenes sexmaculata</i>	4	Adult	13.3
<i>Epilachna/Illeis</i> sp.	10	Adult	33.3
<i>Coccinellidae</i> sp. (immature/unidentified)	5	Egg, larva, pupa, newly emerged adult, mature adult	16.7
Total	30	Egg, larva, pupa, adult	100.0

Table 1. Species/group composition and abundance based on the final summary table in the supplied dataset.

The assemblage was numerically dominated by *Harmonia* sp. and *Epilachna/Illeis* sp., each contributing 10 of the 30 specimens (33.3%). *Cheilomenes sexmaculata* contributed 13.3%, while *C. transversalis* contributed 3.3%. The remaining 16.7% consisted of *Coccinellidae* specimens recorded at immature or unresolved identification levels.

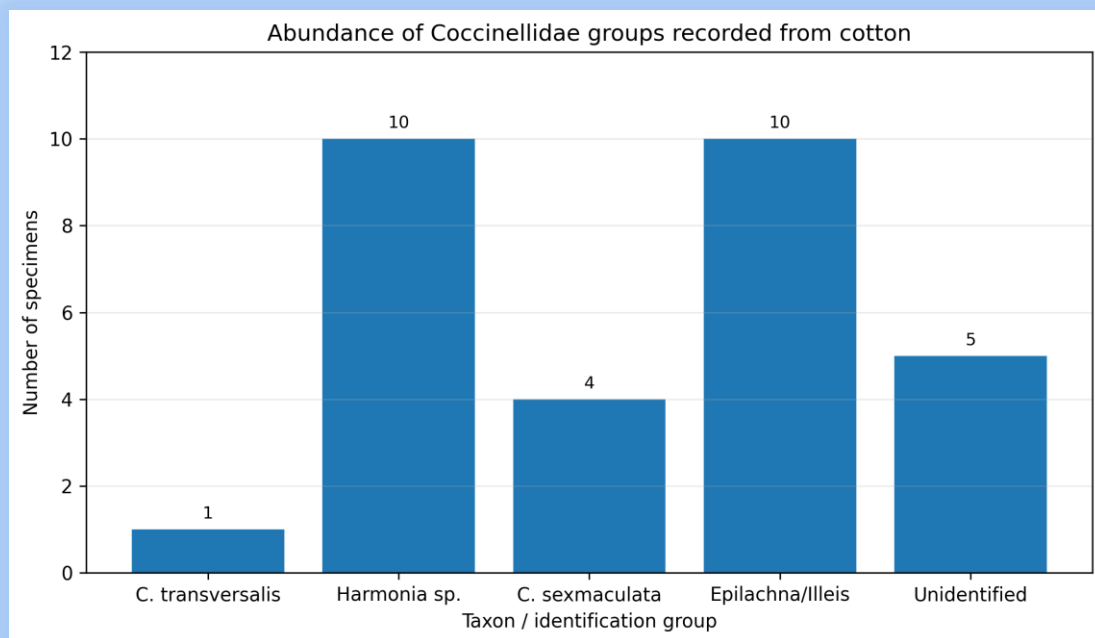


Figure 1. Abundance of coccinellid taxa/identification groups in the supplied dataset (N = 30).

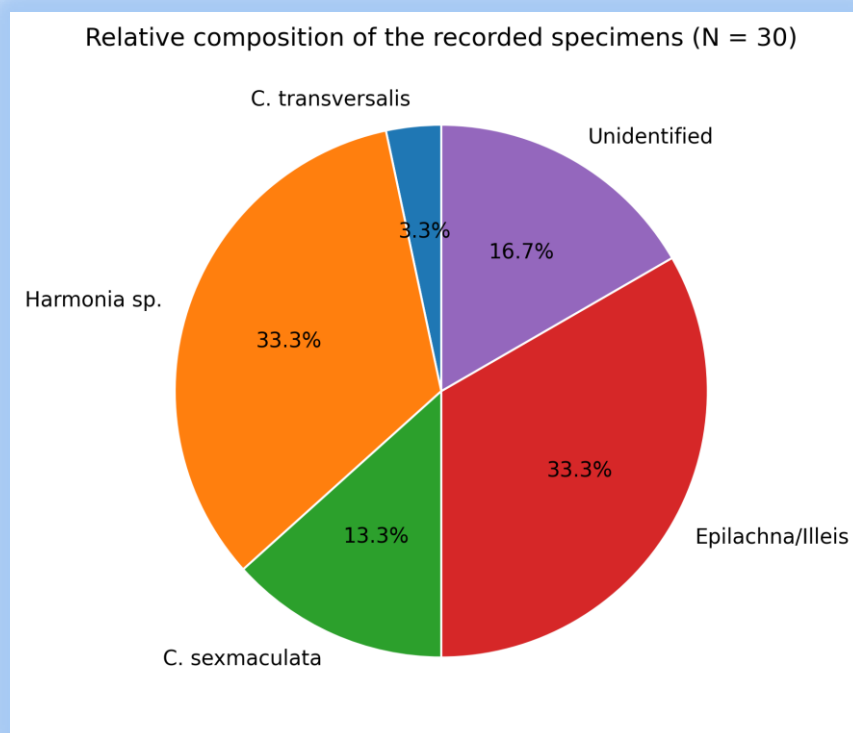


Figure 2. Relative composition of the recorded coccinellid sample.

4.2 Morphological differentiation

Taxon/group	Diagnostic elytral character	General colour	Body form/size	Functional note
Coccinella transversalis	Transverse black bands	Bright orange-red	Dome-shaped; 5–7 mm	Aphid predator
Harmonia sp.	Irregular black blotches; variable pattern	Cream/yellow/tan	Elongated oval; about 5–6 mm	Predatory; associated with aphids/whiteflies
Cheilomenes sexmaculata	Zig-zag wavy band + round spots	Tan/orange-yellow	Compact convex; 4–6 mm	Predatory; aphids/jassids/whiteflies
Epilachna/Illeis sp.	Maze-like/network black pattern	Orange	Dome-shaped; size variable	Herbivorous/fungivorous group in source

Table 2. Principal morphological characters used for field-level differentiation.

The diagnostic value of elytral patterning was particularly strong in the supplied record. The transverse banding of *C. transversalis*, irregular blotching of *Harmonia*, and zig-zag pattern of *C. sexmaculata* provide readily visible field characters. Photographic identification should nevertheless be treated cautiously for polymorphic taxa and for groups such as *Harmonia* and

Epilachna/Illeis where species-level separation may require additional characters and specialist confirmation.

4.3 Photographic documentation

Representative specimen photographs contained in the supplied field-identification document are reproduced below as source documentation.

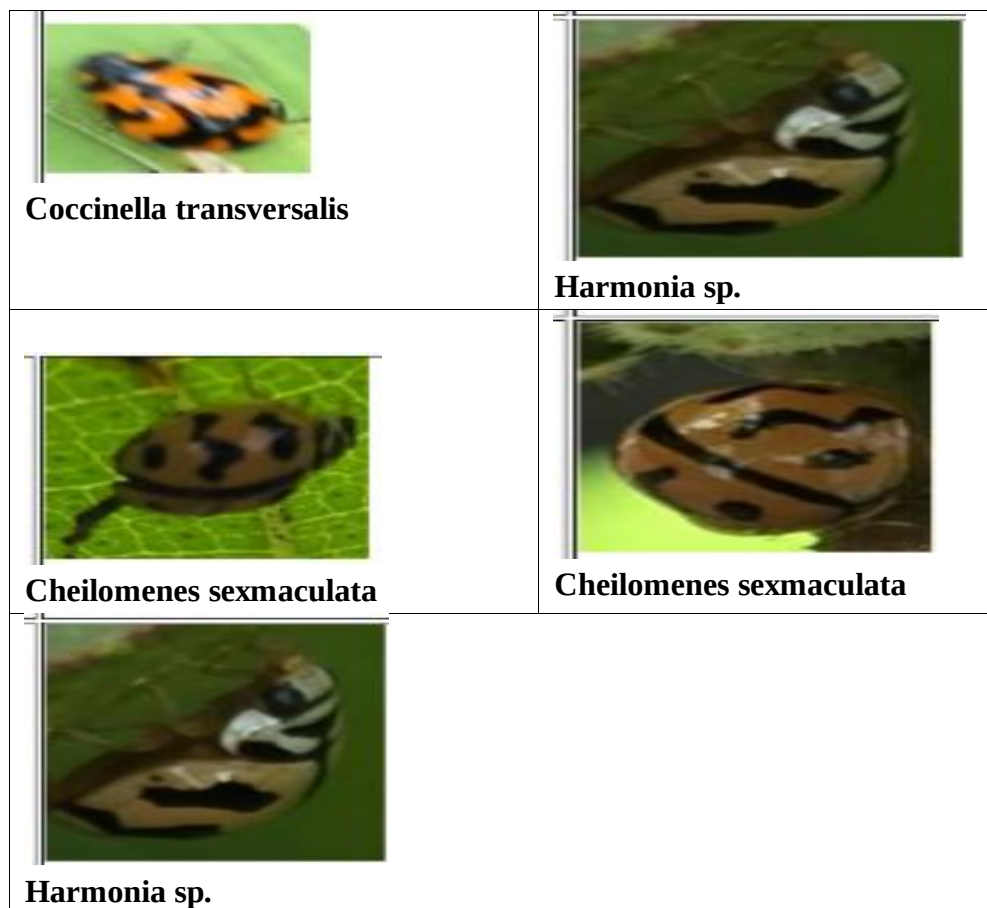


Plate 1. Representative source photographs of Coccinellidae specimens recorded in the supplied document.

4.4 Life-stage representation

Life stage	Number	Share (%)
Adult	25	83.3
Pupa	2	6.7
Larva	1	3.3
Egg	1	3.3
Newly emerged adult	1	3.3

Table 3. Life-stage composition of the recorded sample.

Adults represented the large majority of observations (83.3%), but the simultaneous occurrence of eggs, a larva, pupae and a newly emerged adult demonstrates that multiple developmental stages were present in the observations. This is consistent with active coccinellid development in the sampled cotton environment, although breeding-site continuity cannot be quantified.

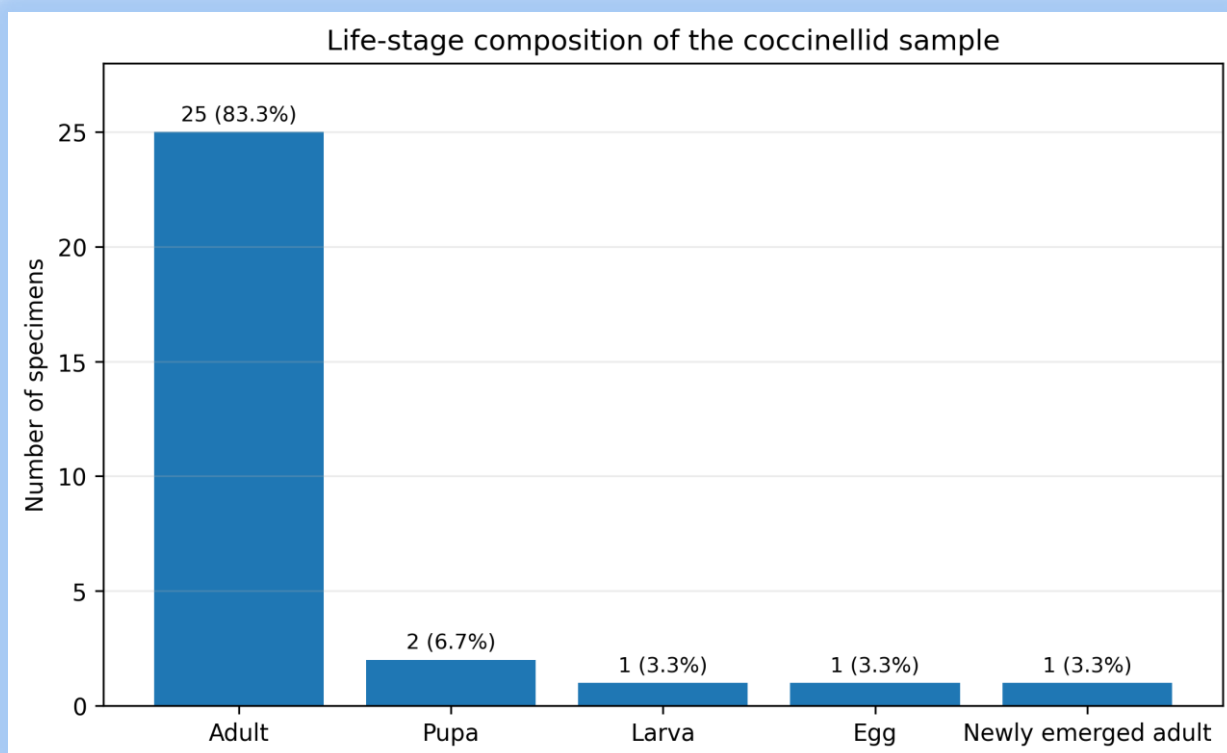


Figure 3. Life-stage composition of the recorded coccinellid specimens.

4.5 Feeding-guild structure

Feeding guild	Number	Share of total (%)	Share among classified specimens (%)
Predatory/beneficial	15	50.0	60.0
Herbivorous/fungivorous	10	33.3	40.0
Unknown/immature	5	16.7	—

Table 4. Feeding-guild classification; the last column excludes the five unknown/immature specimens.

The source classifies 15 specimens as predatory/beneficial, 10 as herbivorous/fungivorous and five as unknown or immature. Predators therefore represented 50.0% of all observations and 60.0% of specimens that could be assigned to a feeding guild; the herbivorous/fungivorous group represented 33.3% of all observations and 40.0% of classified observations.

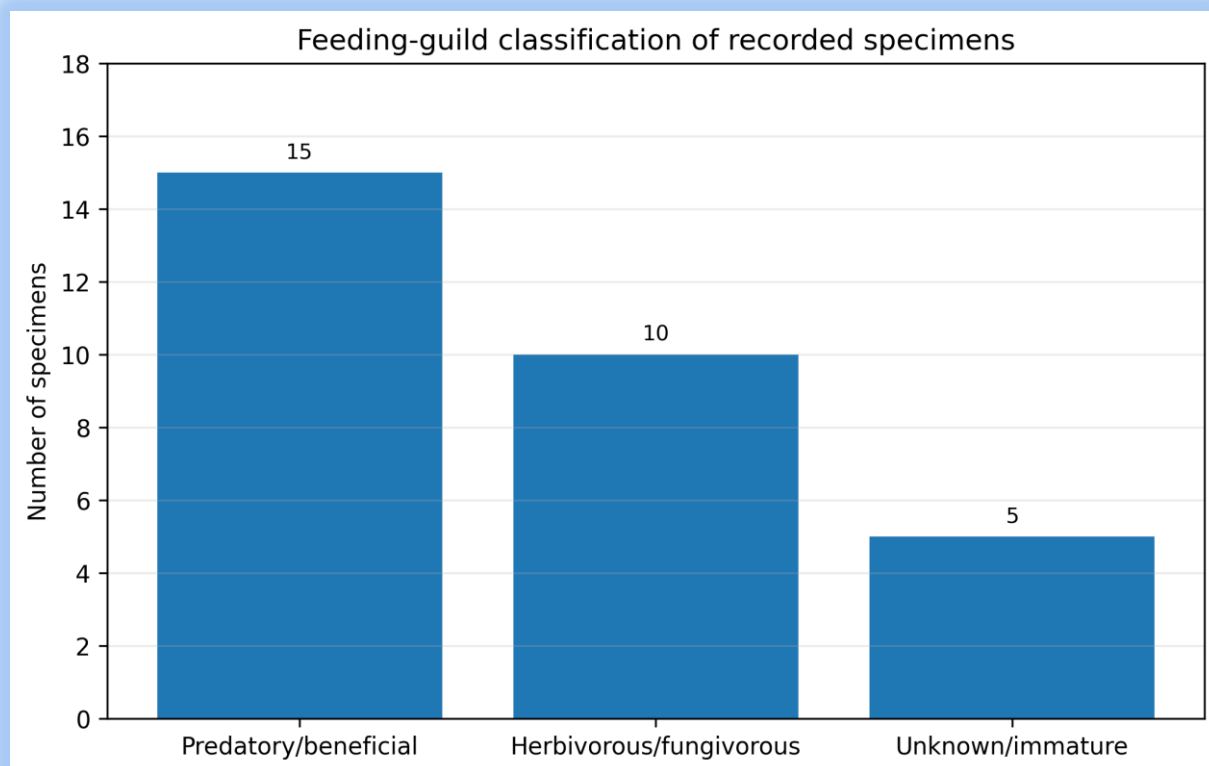


Figure 4. Feeding-guild structure of the supplied sample.

5. Discussion

The observed assemblage illustrates the functional heterogeneity of Coccinellidae in cotton. The occurrence of *Coccinella transversalis*, *Harmonia* sp. and *Cheilomenes sexmaculata* indicates the presence of predatory ladybirds with potential value as natural enemies of sucking pests. This interpretation is consistent with published Indian catalogues documenting broad prey associations of predaceous coccinellids and with experimental literature on aphidophagous ladybirds.

The occurrence of *C. sexmaculata* is particularly relevant because this species is widely recognized as an aphidophagous predator and has been studied as a biological-control agent. Likewise, *C. transversalis* has demonstrated preference for *Aphis gossypii* among several aphid prey in experimental studies. These findings support the functional interpretation of the predatory taxa, but they are not direct measurements of predation efficacy in the Marathwada fields because prey consumption was not quantified.

The co-dominance of *Harmonia* sp. and *Epilachna/Illeis* sp. has contrasting functional implications. *Harmonia* is treated in the supplied record as predatory, whereas the *Epilachna/Illeis* group is presented as herbivorous/fungivorous depending on taxon. This distinction demonstrates why identification beyond family level is important when estimating the contribution of Coccinellidae to biological control.

Recent cotton research has demonstrated that Coccinellidae can form a substantial component of natural-enemy communities and that their occurrence varies with cotton genotype, crop stage, pest abundance and environmental conditions. The present observations are therefore best viewed as a baseline taxonomic record that can be strengthened through replicated seasonal sampling.

6. Implications for Integrated Pest Management

- ❖ Conserve predatory coccinellids by reducing unnecessary broad-spectrum insecticide applications.
- ❖ Scout aphids, jassids and whiteflies together with natural-enemy counts before intervention.
- ❖ Retain compatible refuge vegetation where appropriate to maintain natural-enemy resources.
- ❖ Record predator and prey densities simultaneously to evaluate predator-to-pest relationships.
- ❖ Confirm ambiguous Coccinellidae identifications through specialist taxonomic examination before species-specific biological-control claims.

7. Limitations

- ❖ The dataset is a descriptive specimen record rather than a replicated population survey.
- ❖ Exact sampling coordinates, field number, sampling dates, sampling effort and environmental covariates were not provided.
- ❖ No standardized abundance metric such as individuals per plant, sweep, trap or unit area was supplied.
- ❖ Species-level confirmation was not available for all specimens.
- ❖ The internal inconsistencies in specimen numbering and identification-level totals must be reconciled with the original field records.
- ❖ The study did not experimentally measure predation, prey suppression, yield effects or pesticide interactions.

8. Conclusion

The supplied field record documents an assemblage of coccinellids associated with cotton in the Marathwada region, including predatory *Coccinella transversalis*, *Harmonia* sp. and *Cheilomenes sexmaculata*, together with an *Epilachna/Illeis* group and unresolved immature stages. The final summary table contains 30 specimens, with *Harmonia* sp. and *Epilachna/Illeis* sp. each contributing 33.3% of the sample. Predatory forms account for half of all recorded specimens and 60% of those assigned to a feeding guild. The presence of multiple life stages strengthens the ecological value of the observations, while the coexistence of predatory and phytophagous/fungivorous forms emphasizes the need for accurate identification. The study provides a useful baseline for future replicated surveys, but the dataset should be audited and expanded with coordinates, dates, sampling effort, prey density, weather variables and repeated field observations before stronger ecological or population-level conclusions are drawn.

9. Data Transparency and Reproducibility Statement

All numerical results in this manuscript are derived from the final summary table and supporting specimen descriptions contained in the supplied PDF. The manuscript deliberately reports the two detected inconsistencies rather than silently altering the source. Before journal submission, the author should reconcile the *Cheilomenes* specimen count and identification-level totals against the original field notebook/photograph register and then update tables and figures consistently.

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