



Distinguishing India's major swarming pests: A morphometric and taxonomic analysis of *Schistocerca gregaria* and *Locusta migratoria*

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Abstract

Locusts in the family *Acrididae* are primarily phytophagous and mobile, exhibit a range of phase polyphenism, and cause crop damage worldwide; however, shared phenotypes and high intraspecific variation in some species make taxonomy difficult. The comparative investigation is detailed with the taxonomic descriptions and the morphological illustrations provided, showing the complexities of its outer and genitalic features, useful for a visual diagnosis. Through this examination, we identified distinguishing marks. These detailed descriptions identified key diagnostic differences. By correlating in-depth taxonomic visualisations with unique environmental requirements, this framework establishes a reliable foundation for accurate species identification and habitat-specific pest management.

Keywords: *Acrididae*, *Locusta*, *Schistocerca*, taxonomic description, morphological imaging, phase polyphenism, ecology

Introduction

Orthoptera is a large, economically important insect group with great species diversity worldwide. In this group, locusts and grasshoppers, which are members of the suborder Caelifera and the family *Acrididae*, are notable phytophagous pests that do in fact cause great harm to crops (Aziz *et al.*, 2021) ^[1]. Also, it is the locusts that stand out from other grasshoppers in terms of their great voracity, high reproductive rate, and very great mobility over large distances, which put them at a constant threat to global food security and which also cause what we may term large-scale invasions (Aziz *et al.*, 2021) ^[1]. As a result of the very serious economic and agricultural impact of these pests, it is important we have a comprehensive knowledge of their taxonomy, morphological variation, and ecology, which in turn will help us to develop better prediction and integrated pest management strategies.

From a bio-ecological standpoint, locusts live in a great variety of environments, which include deserts and also very dense agricultural areas. Their great increase in population and different swarming behaviours are associated with what we term as phases, which also see changes in their ecology and structure, which at large are brought on by changes in non-living factors like temperature and rainfall (Aziz *et al.*, 2021) ^[1]. As primary consumers, locusts are equipped with highly adapted digestive systems capable of processing massive amounts of plant tissue, making them critical agents in nutrient cycling and energy transfer within their respective trophic webs (Aziz *et al.*, 2021) ^[1]. However, this polyphagous feeding behaviour is exactly what makes the gregarious phase so destructive to diverse crop varieties. Despite their undisputed ecological and economic importance, the systematic taxonomy of locusts remains a complex challenge due to overlapping phenotypic traits and phase polyphenism. A review of the literature shows that Kirby (1914) ^[11] made the foundational contribution to the Acridid fauna of the Indian subcontinent and surrounding regions. Subsequent authoritative frameworks and

taxonomic revisions were provided by Bolivar (1902) and Uvarov (1921, 1927, 1942) ^[27, 28, 29]. The classification was further refined globally by Dirsh (1956, 1961) ^[6, 7], and extended regionally by prominent researchers such as Tandon (1976), Bhowmik (1985), and Usmani and Shafee (1990) ^[3, 22, 26].

The taxonomy of this group inherently relies on meticulous morphological examinations. As demonstrated in various regional faunistic studies, accurate species diagnosis requires the detailed evaluation of external characters—such as the fastigium of the vertex, frontal ridge, pronotal carinae, and the prosternal process—coupled with the structural complexities of male and female genitalia, including the supra-anal plate, subgenital plate, epiphallus, and aedeagus (Kumar & Usmani, 2015; Usmani & Nayeem, 2012) ^[12, 24]. Variations in these precise micro-morphological traits are indispensable for establishing accurate phylogenetic relationships and distinguishing cryptic taxa.

Although many individual species have been treated in isolation during major outbreaks, comprehensive comparative assessments integrating both morphological diagnostics and ecological profiles across multiple locust species remain relatively scarce. To address these existing taxonomic gaps, the present comparative study was undertaken. By critically analysing diagnostic morphological characters and correlating them with the specific ecological dynamics of each species, this investigation aims to resolve ongoing taxonomic ambiguities and establish a reliable, integrated framework for the identification of these formidable insects.

Methodology

Study Area

Sampling of grasshoppers was done in 2021-2022 in the morning and evening of the month of September. We did a survey that used a sweeping net in different districts of the Delhi NCR (National Capital Region) of India. We collected

a sample of the genus *Acrida* from Karnal district of Haryana. The National Capital Region (NCR) is a region that includes the Delhi NCT (National Capital Territory) and also the adjacent districts of the neighbouring states of Haryana, UP and Rajasthan. Collection of.

Collection

There are many techniques of collecting short-horned grasshoppers that taxonomists use. Sweeping nets are a common method, which are of thick cotton material and structured with an aluminium stick. Grasshopper collection was done via hand picking and sweeping nets. Identification.

Identification

Identification was carried out using both morphological and genitalic characteristics. As for the identification, we used a Zeiss Stereo Discover V8 binocular microscope. We dissected males and females to study genitalic characters, which do not really reflect environmental factors. Epiphallus and Aedeagus in males and Spermatheca in females are key tools in taxonomic study. With the help of scissors, we first removed the posterior apical region of the male and female bodies. Once the material was cut off, we put it in 10% potassium hydroxide (KOH) for a while till it became transparent and then studied it under a binocular microscope. Morphometry.

Dissection

Male and female grasshoppers had their body parts, which included total body length, head length, pronotum length and width, wings and hind legs, measured with an electronic Vernier Calliper. A Vernier calliper is a measuring instrument that we use to determine the linear dimensions of grasshopper specimens. Also, this device is used for the comparison of the ratios of the different grasshopper body parts.

Illustrations

The entire specimen and its various parts were photographed with a Nikon S5200.

Preservation

Grasshoppers were preserved by two methods

- a. **Wet Preservation:** After collecting the samples from the fields were kept in 70% ethyl alcohol within an airtight vial at room temperature. This method helps in keeping the samples safe and moist for further research work. The vials were also labelled with the date of collection, collection site and host plants.
- b. **Dry preservation:** The samples were dried on a stretching board after stretching them on it. These were kept for 24 hours to eliminate all their water content and placed in a wooden cabinet box with naphthalene balls, and also used camphor and phenol powder to prevent the grasshoppers from decomposing.

Results

Genus *Schistocerca* Stal, 1873

Acridium Schistocerca Stal, 1873. Revue critique des Orthopteres decrits par Linne, De Geer et Thunberg. 1: 64. Type species: *Libellula americanus* Drury, 1770 (=Schistocerca americana). Illustrations of Natural History,

wherein are exhibited upwards of 240 figures of Exotic Insects. 1: 128.

Schistocerca Stal; Bey-Bienko & Mistshenko, 1951 [2]. Locusts and Grasshoppers of the U.S.S.R. and Adjacent Countries 1:243 [258].

Schistocerca Stal; Harz, 1975 [10]. Ser. Entomol. 11:397.

Schistocerca Stal; Usmani, 2008 [23]. Zootaxa 1946:19.

Diagnosis

Male: Body large sized with greenish and yellowish color; stout body; integument granulose; head rounded obtusely; antenna filiform type, as long as head and pronotum together; frons barely oblique; fastigium of vertex short and angular without median carinula, well developed lateral carinulae; no fastigial foveolae; frontal ridge narrow and weakly sulcate; prosternal tubercle present, cylindrical with obtuse apex, not anteroposteriorly compressed; dorsum of pronotum tectiform, longer than width, barely constricted in prozona, weak median carina and no lateral carinulae; all the three transverse sulci seen at dorsal side and crossed median carina by all the transverse sulci; metazona longer than prozona, posterior margin obtuse rounded; mesosternal lobes usually rounded, mesosternal interspace open; tegmina and wings fully developed; no dark band present on wings, no intercalary vein present in median area of forewing, the radial area of tegmina without a series of regular, parallel transverse, more or less perpendicular stridulatory veinlets; tympanum present; hind femur slender; hind tibia without stridulatory pegs, inner pairs of spurs subequal and barely more longer than external one, external apical spines absent; large sized arolium.

Male Genitalia: Epiphallus usually bridge-shaped, undivided medially; ancorae absent and lophi present; basal and apical valves of Aedeagus connected by flexure, gonopore process present.

Female Genitalia: Ovipositor without spines, valves comparatively moderate, dorsal valve as long as or barely longer than lateral apodeme; Spermatheca usually with long, tubular apical and pre-apical diverticulum.

Only one species from this region represents the genus *Schistocerca*.

Schistocerca gregaria gregaria (Forsk., 1775)

(Figs. 1 A & B, Figs. 2 A-K, Figs. 3 A-J)

Gryllus gregarious Forskal, 1775. Descriptiones Animalium Avium, Amphibiorum, Piscium, Insectorum, Vermium; quae in Itinere Orientali observati Petrus Forskal. Prof. Haun. Post mortem Acutoris edit Carsten Nieburhr. 81.

Schistocerca gregaria (Forsk.); Dirsh, 1953. Anti-Locust Bull. 16:1–34

Schistocerca gregaria (Forsk.); Usmani, 2008 [23]. Zootaxa 1946:19

Schistocerca gregaria gregaria (Forsk.); Nayeem and Usmani, 2012 [24]. Munis Entomology & Zoology. 7(1): 400.

Schistocerca gregaria (Forsk.); Sultana et. al., 2021. Jour. Orth. Res. 30(2):145

Material examined

India: Delhi NCR: Haryana: Bhagbat: Khekra: 1♂, 16. X.2022, Preeti, hand picking and sweep net; Uttar Pradesh:

Ghaziabad: Masuri: 1 ♂, 03.XI.2022, Preeti, hand picking and sweep net;

Diagnostic features

Male: Large sized with green to brown colour; body robust and roughly cylindrical; Integument punctuate dotted; head rounded in profile, shorter than pronotum; filiform antennae with 28 segments, as long as combined lengths of head and pronotum together, longer than frons oblique, antennal sockets narrow in length; eyes oval in shape, brownish color, maximum diameter of eye longer than the interocular distance; no fastigial foveolae; fastigium of vertex trapezoidal, barely concave with no carinulae, wider than long, obtusely rounded apex; vertex with no carinula, length of vertex longer than width of occiput of the head, length of vertex shorter than length of frons; barely oblique frons; frontal ridge narrow, flat and smooth with lateral carina reaching up to the clypeus, margins almost parallel; prosternal process large conical with subacute apex, laterally compressed, sharp hair; pronotum tectiform, prozona longer than metazona, weak median carina equally raised in prozona and metazona, lateral carinae absent, all the three transverse sulci seen on the dorsum of pronotum and crossed by median carina, median carina not excised at posterior transverse sulcus, posteroventral angle truncated, anterior margin slight wazy, posterior margin rounded; mesosternal lobes strongly rectangular with sharp edges, mesosternal interspace open, narrower, longer than wide, margins somewhat converging below; tegmina fully developed, exceeding the apex of hind femur and abdomen, with obtusely rounded apex, no strap, without intercalary vein in medial area, radial area of tegmen without series of regular

transverse stridulatory veinlets, without any expanded tegminal area, cubital area narrower than the medial area, with hyaline; hind wing fractionally shorter than the tegmina with hyaline apex, speculum and dark strap absent on hind wing; hind femur slender and stout, both the upper and lower carina serrated, reaching to the tip of abdomen, upper apical lobe longer than lower, lower apical lobe not spined, inner margin of inner side without a row of stridulatory pegs, inner side of hind femur without any band; hind tibia cylindrical, not expanded at apical portion, shorter than the hind femora, sparse and dark coloured spines, spines 9 outer and 11 inner, external apical spine present; arolium large with sharp rounded apex.

Genitalia: Supra-anal plate elongated and broad with smooth triangular apical portion, no prominent tubercle present; cercus strongly compressed at tip with rounded apex, longer than supra-anal plate; Sub-genital plate short and sub-conical, barely wider than long, broad at base, obtuse apex; medially undivided Epiphallus with medium bridge; no ancorae; lophi present; short anterior projection with acute apex; short posterior projection short blunt apex; Aedeagus flexured, apical valve curved with rounded apex, narrower and slightly shorter than broad basal valve.

Female: Not found

Distribution: India: assam, bihar, delhi nct, gujarat, haryana, jammu & kashmir, madhya pradesh, maharashtra, punjab, rajasthan, sikkim and uttar pradesh.

Globe: Mediterranean Region, Nepal, Pakistan, Sri Lanka, South Europe, South & Central America and Western Asia.

Schistocerca gregaria gregaria

Body parameters (mm)	♂ (n=3)		♀ (n=3)	
	Mean ±SD	Min-Max	Mean ±SD	Min-Max
Length of body	38.23 ± 0.99	37.24-39.10	43.38 ± 1.02	42.36-44.24
Length of pronotum	7.83 ± 0.78	7.05- 8.52	12.26 ± 0.44	11.82-12.86
Length of Antenna	14.25 ± 0.62	13.67-14.92	19.6 ± 0.48	19.12-20.24
Length of tegmen	34.76 ± 0.46	34.21-35.03	38.84 ± 0.61	38.23-39.32
Length of hind femur	21.41 ± 0.59	20.82-22.21	27.06 ± 0.72	26.34-27.83
The ratio of the length of tegmen to the length of pronotum	4.43		3.16	
The ratio of the length of tegmen to the length of hind femur	1.62		1.43	

Ecology

In the Indian subcontinent, the primary player in the eco-dynamics of the genus *Schistocerca* Stål, 1873, is the Desert Locust (*Schistocerca gregaria*), which can be seen in the arid and semi-arid areas of the West of India, including the Thar Desert in Rajasthan and Gujarat (Rao, 1960; Gaur *et al.*, 2026) [8, 20]. This genus' ecology is very much a part of the regional monsoon cycle, which the species had to very precisely time their reproductive efforts too in order to lay their eggs in bare, moist sandy soils. At the same time, the emerging hoppers depend entirely on the subsequent flush of ephemeral desert vegetation for survival and development (Mitra *et al.*, 2024) [17]. A feature of *Schistocerca*'s ecology is its density-dependent phase polyphenism; that takes place in favourable climatic events which include unseasonal cyclonic rain that in turn causes heavy vegetation growth that solitary populations increase in number, come together and transform into the very mobile, gregarious phase

(Uvarov, 1966; Pener Simpson, 2009) [18, 30]. By means of present weather systems, these swarms move from western spring breeding areas into the Indo-Pakistan summer breeding zones (Mitra *et al.*, 2024) [17]. In this gregarious state, they become ravenous, polyphagous mega consumers which, with their great mass and non-selective feeding action, change local vegetation dynamics; what were once localised desert species become large-scale ecological players that greatly affect natural food chains and also vast agricultural systems across the Indian plains (Gaur *et al.*, 2026) [8].

Genus *Locusta* Linnaeus, 1758

Gryllus (*Locusta*) Linnaeus, 1758. *Systema Naturae per Regna tria naturae* (10th ed.). 1: 431.

Type species: *Gryllus migratorius* Linnaeus, 1758 (= *Locusta migratoria migratoria*). *Systema Naturae per Regna tria naturae* (10th ed.). 1: 431.

Locusta Linnaeus; Kirby, 1890. Sci. Proc. R. Dublin Soc. 6:590

Locusta Linnaeus; Bey-Bienko & Mistshenko, 1951 ^[2]. Locusts and Grasshoppers of the U.S.S.R. and Adjacent Countries 2:573 [216].

Locusta Linnaeus; Usmani, 2008 ^[23]. Zootaxa 1946:30

Diagnosis

Male: Body medium to large size with greenish and yellowish color; head sharp rounded; antenna filiform type, as long as longer the length of head and pronotum together; no fastigial foveolae; fastigium of vertex angular and barely concave with median carinula, with obtuse lateral carinulae; frons vertical; frontal flat; prosternal tubercle absent; Dorsum of pronotum tectiform without prominent X-marked pattern, longer than width, median carina well developed and strongly equally raised in prozona and metazona, with weak lateral carinae, barely excised at posterior transverse sulcus, prozona shorter than metazona slightly, posterior margin of pronotum obtuse angulate; mesosternal lobes usually rounded, mesosternal interspace open and as long as wide; tegmina and wings fully developed, dark band present on wings, intercalary vein present in median area, the median/radial area of tegmina usually without a series of regular, parallel transverse stridulatory veinlets; tympanum present; hind femur slender; hind tibia without stridulatory pegs, inner pairs of spurs subequal and longer than external spur, no external apical spines; small sized arolium.

Male Genitalia: Supra-anal plate angular and broad; cercus conical and straight with obtuse apex; subgenital plate conical with subacute apex; Epiphallus with undivided narrow bridge; ancorae large and curved, lophi large and bilobate; basal and apical valves of aedeagus connected by flexure, apical valve narrow, upcurved and much longer than basal valve.

Female Genitalia: Supra-anal plate broad, angular; cercus short and conical; subgenital plate rounded with setose; Ovipositor, dorsal valve shorter than lateral apodeme; Spermatheca with rudimentary apical and broad sac-like pre-apical diverticulum. Only one species from this region is representative of the genus Locusta.

Locusta migratoria migratoria (Linnaeus, 1758)

(Fig. 4 A & B, Fig. 5 A-K, Figs. 6 A-J)

Gryllus (*Locusta*) *migratorius* (Linnaeus), 1758. Systema Naturae per Regna tria naturae (10th ed.). 1: 432.

Gryllus (*Locusta*) *danicus* (Linnaeus), 1767. Caroli a Linne Systema Naturae 1, pt. 2: 702. Syn. By Uvarov, 1921 ^[27]. Bull. Ent. Res. 12: 162.

Locusta Linnaeus; Bey-Bienko & Mistshenko, 1951 ^[2]. Locusts and Grasshoppers of the U.S.S.R. and Adjacent Countries 2:573 [216]

Locusta migratoria Linnaeus; Usmani, 2008 ^[23]. Zootaxa 1946:30

Locusta migratoria migratoria Linnaeus; Nayeem and Usmani, 2012 ^[24]. Munis Entomology & Zoology. 7(1): 408.

Locusta migratoria migratoria Linnaeus; Kumar & Usmani, 2015 ^[12]. Journal of Entomology and Zoology Studies 2(3):142

Material examined

India: delhi ncr: uttar pradesh: bulandshahr: khurja: 2 ♂, 1 ♀, 01.ix.2021, preeti, sorghum, hand picking and sweep net; hapur: gulaothi: 4♂, 3 ♀, 01.ix.2021, preeti, paddy, hand

picking and sweep net; kurana: 2 ♂, 1 ♀, 01.ix.2021, preeti, hand picking and sweep net; haryana: mahendragarh: nangal sirohi: 1♂, 2 ♀, 12.xi.2022, preeti, barren field with grasses, hand picking and sweep net;

Diagnostic features

Male: Body medium to large sized with green to brownish in colour; body stout; Integument smooth; head rounded, shorter than pronotum; filiform antennae with 28 segments, as long as or barely longer than combined lengths of head and pronotum together, longer than frons oblique, antennal sockets narrow in length; eyes oval in shape, brownish color, maximum diameter of eye longer than the inter-ocular distance; no fastigial foveolae; fastigium of vertex shape slightly angular, sharp concave with lateral carinulae, weak carinulae, wider than long, obtuse or somewhat rounded apex; vertex with weak median carinulae, length of vertex longer than width of occiput of the head, length of vertex shorter than length of frons; vertical frons; frontal ridge not sulcated, broad and flat, with lateral carina barely reaching up to the clypeus, margins almost parallel; prosternal tubercle absent; pronotum tectiform, with prominent median carina, without X-mark on pronotum, median carina almost crest-shaped, equally raised in prozona and metazona, lateral carinae absent, all three transverse sulcus visible on the dorsum of pronotum and only posterior transverse sulcus crossed median carina, prozona shorter than metazona, anterior margin smooth and angular, posterior margin acute-angular, lateral posterior angle smooth and rounded; mesosternal lobes fine rounded, mesosternal interspace as long as wide, margins somewhat parallel with slight diversion; tegmina fully developed, exceeding the apex of hind femur and abdomen, with truncated round apex, with sharp strap, medial area with well-developed and strong serrated intercalary vein, area fuscous beyond middle; hind wing barely shorter than the tegmina without speculum, apex hyaline, disc without strap; hind femoris slender, upper somewhat serrated and smooth lower carina, reaching to the tip of abdomen, upper apical lobe longer than lower, lower apical lobe not spined, inner margin of inner side without a row of stridulatory pegs, inner side of hind femoris with complete band; hind tibia cylindrical, equal to or barely shorter than the hind femoris, barely expanded near apical portion, sparse, small and light coloured spines, 10 outer and 13 inner spines, external apical spine absent; Arolium small size with somewhat rounded apex.

Genitalia: Supra-anal plate broad, angular with triangular apical portion, no prominent tubercle present, obtuse apex; simple cercus not at all compressed apically, with rounded apex, barely longer than supra-anal plate; Sub-genital plate short and conical, barely wider than long, broad base, almost obtuse apex; medially undivided Epiphallus with narrow bridge; simple, short incurved small pointed ancorae; lophi large, bilobate and lobiform; short anterior projection with rounded apex; short posterior projection obtuse apex; Aedeagus flexured, apical valve barely curved with rounded apex, narrower and barely shorter than moderately broad basal valve with obtuse apex.

Female: Same as male but larger in size and different antennal segments.

Genitalia: Supra-anal plate angular, broad without triangular apical portion, acute apex; short and conical cercus with obtuse apex, as long as or shorter than supra-anal plate; Sub-genital plate sharp broad, hairy ventral surface, posterior margin serrated with one small medial projection; Ovipositor valves without serration at edge, dorsal valve flat, concave and longer than lateral apodeme; narrow ventral valve with acute at apex; Spermatheca with

broad, long, thick, sac like pre-apical diverticulum, tapering at apically while short, tubercle like apical diverticulum with rounded apex.

Distribution: India: haryana, himachal pradesh, meghalaya, odisha, rajasthan and uttar pradesh. Globe: afghanistan, bangladesh, china, indo-china, myanmar, nepal, pakistan, sri lanka, taiwan, thailand and vietnam.

Locusta migratoria migratoria

Body parameters (mm)	♂ (n=3)		♀ (n=3)	
	Mean ±SD	Min-Max	Mean ±SD	Min-Max
Length of body	34.69 ± 1.06	33.63-35.62	46.14 ± 1.02	45.12-47.27
Length of pronotum	8.31 ± 0.39	7.92-8.67	10.62 ± 0.52	10.10-11.19
Length of Antenna	12.40 ± 0.42	11.98-12.87	13.73 ± 0.49	13.24-14.18
Length of tegmen	56.71 ± 1.39	55.32-57.84	56.47 ± 1.26	55.21-57.21
Length of hind femur	21.28 ± 0.53	20.75-21.85	29.35 ± 0.62	28.73-29.92
The ratio of the length of tegmen to the length of pronotum	6.82		5.31	
The ratio of the length of tegmen to the length of hind femur	2.66		1.92	

Ecology

In contrast to the Desert Locust, which has very little tolerance for moisture, the genus *Locusta*, which includes the Migratory Locust (*Locusta migratoria*) that is very prominent in the Indian subcontinent, has very different ecological requirements which are centred around mesic grassland habitats like river basins, coastal plains and marshy agricultural areas (Geng *et al.*, 2022) ^[9]. Extensive taxonomic and faunistic studies across the Indian plains report the widespread presence of these acridid pests, which seek out areas of consistent soil moisture and succulent vegetation, separating their habitat choice from that of true desert-dwelling grasshoppers (Usmani Nayeem, 2012) ^[24]. The breeding ecology of *Locusta* species necessitates moist, relatively low-salinity soils and a continuous abundance of preferred graminaceous vegetation (like reeds and tall grasses), which provide crucial shelter and sustenance for developing nymphs (Geng *et al.*, 2022) ^[9]. Like other true locusts, *Locusta* exhibits a dramatic, density-dependent phase polyphenism; under favourable climatic windows or forced concentration due to land-use changes, solitary individuals undergo rapid behavioural and morphological shifts to form highly cohesive, gregarious swarms (Latchinsky, 2013) ^[13]. Once in the gregarious phase, these insects' transition from selective feeders into fiercely polyphagous mega-consumers whose high mobility and massive biomass allow them to spread rapidly across agricultural landscapes (Le Gall *et al.*, 2019; Usmani & Nayeem, 2012) ^[14, 24]. Although catastrophic plagues of the Migratory Locust in India are historically less frequent than those of its desert-dwelling counterparts, its capacity for rapid multiplication in response to changing hydrological conditions cements its status as a continuous threat to regional grassland ecosystems and agricultural security (Lecoq & Cease, 2022) ^[16].

Discussion

In this study, we combined detailed morphological examinations with environmental data to clear up the confusion around identifying major locust species. This study examines *Locusta migratoria migratoria* and

Schistocerca gregaria gregaria to highlight how their physical differences and habitat needs define them as major agricultural pests. Sorting this out is important because tracking their physical changes and swarming behaviour is key to predicting and managing global outbreaks (Cullen *et al.*, 2017) ^[5].

Taxonomic differentiation of these genera fundamentally comes down to a few specific morphological and reproductive traits. The most obvious physical difference is a peg-like bump under the neck called the prosternal tubercle: *Locusta* doesn't have one at all, but *Schistocerca* has a large, cone-shaped bump there. We also see big differences when looking at the male genitalia under a microscope. Both genera have a solid, undivided epiphallus; however, *Locusta* can be clearly separated from *Schistocerca* by its short, pointed, and inwardly facing ancorae. Recognising these fine structural details remains essential for the accurate taxonomic identification of closely related Indian grasshoppers (Usmani & Nayeem, 2012) ^[24].

Ecologically, these two locusts occupy completely different environments. The Desert Locust (*Schistocerca gregaria gregaria*) lives in dry regions like the Thar Desert. It basically waits for sudden, out-of-season rainfall to wet the sandy soil for egg-laying and for the growth of vegetation for the nymphs to eat (Rajak & Yadav, 2021) ^[19]. The Migratory Locust (*Locusta migratoria migratoria*), on the other hand, prefers much wetter habitats. They live in river basins, coastal plains, and marshy farmlands where the soil stays constantly damp and tall grasses are abundant.

Even with these different preferences, they share one common behaviour: the ability to swarm. Perfect weather or crowded living conditions will cause both species to completely transform. They shift from shy, solitary insects into massive, highly social swarms (Cullen *et al.*, 2017; Le Gall *et al.*, 2019) ^[5, 14]. After gathering in large numbers, they will eat almost any plant and can easily destroy massive areas of farmland (Le Gall *et al.*, 2019) ^[14]. Because they are such a massive threat to our agriculture, we have to look at the whole picture. By combining what they look like under the scope with what triggers them in the wild, we get the solid foundation we need to identify them quickly and manage them effectively based on where they live.



Distribution of Genus *Schistocerca* and *Locusta* in India

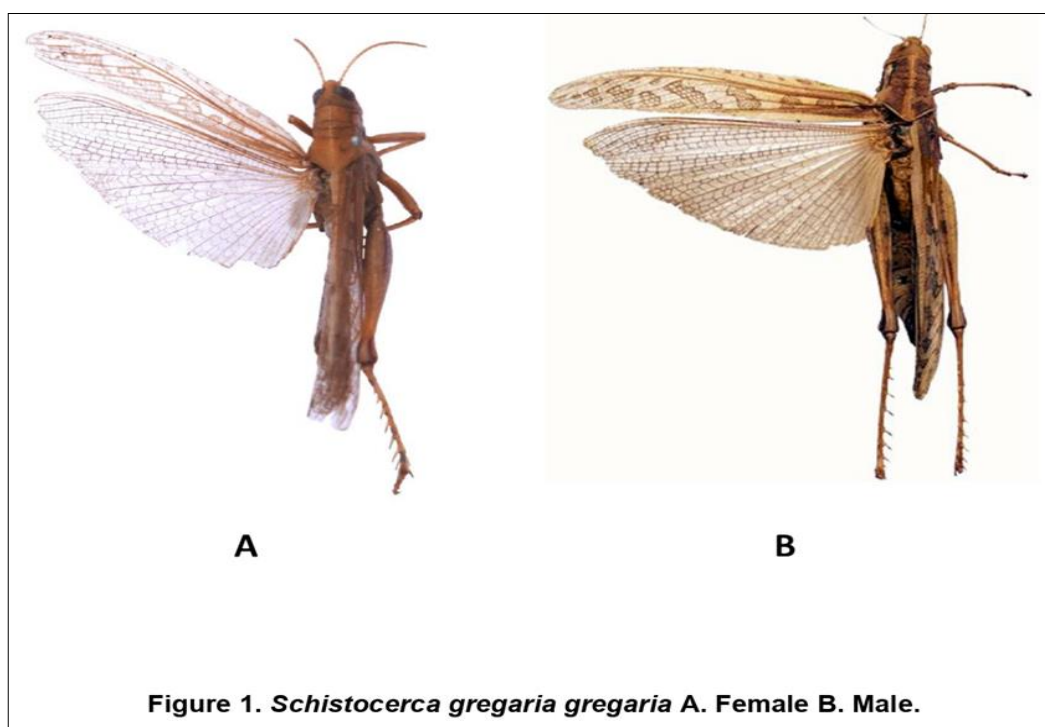
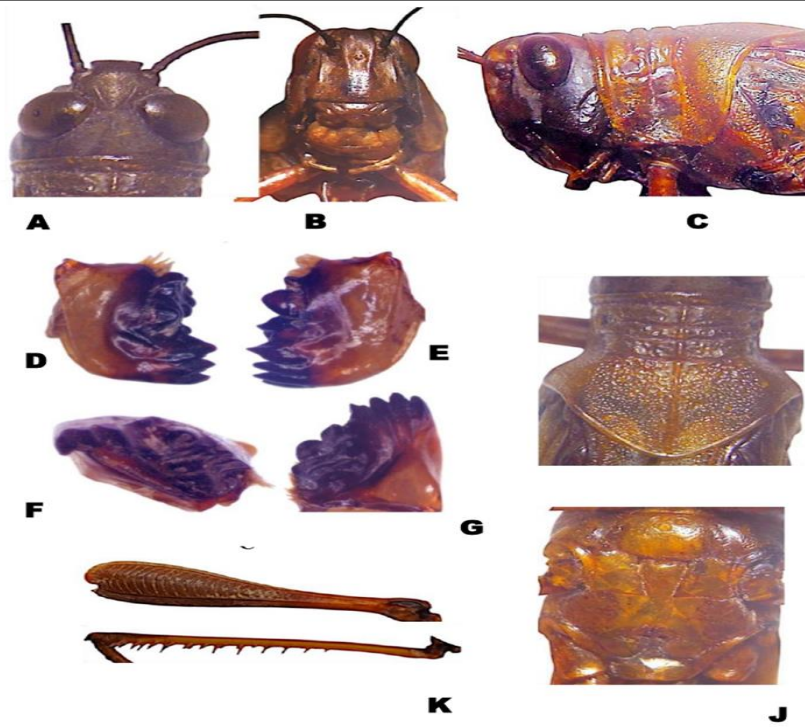
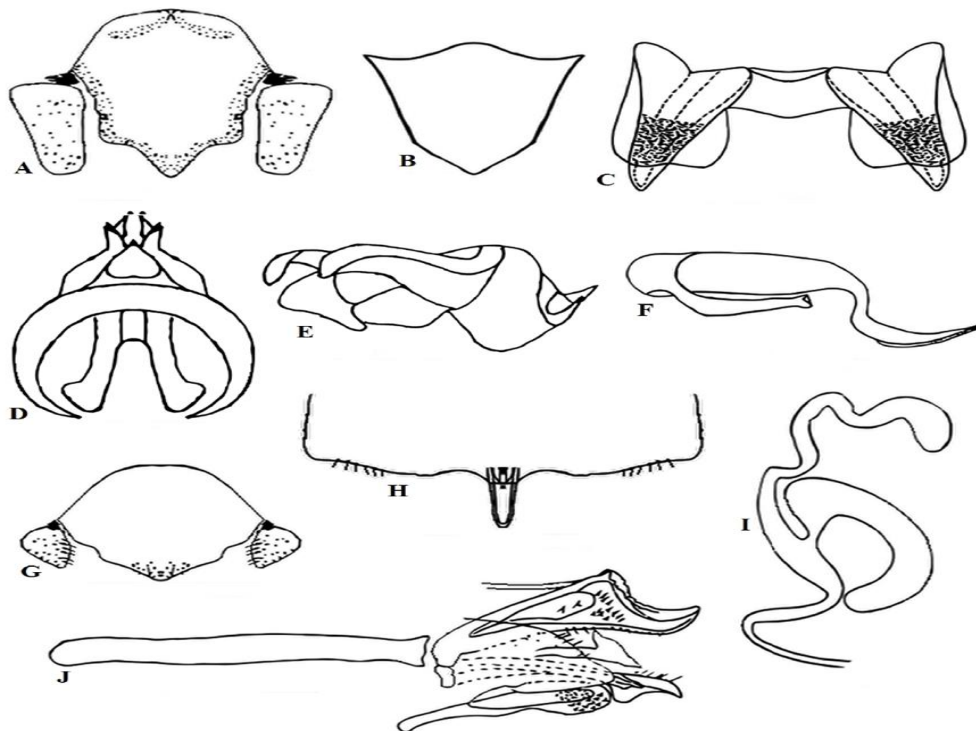


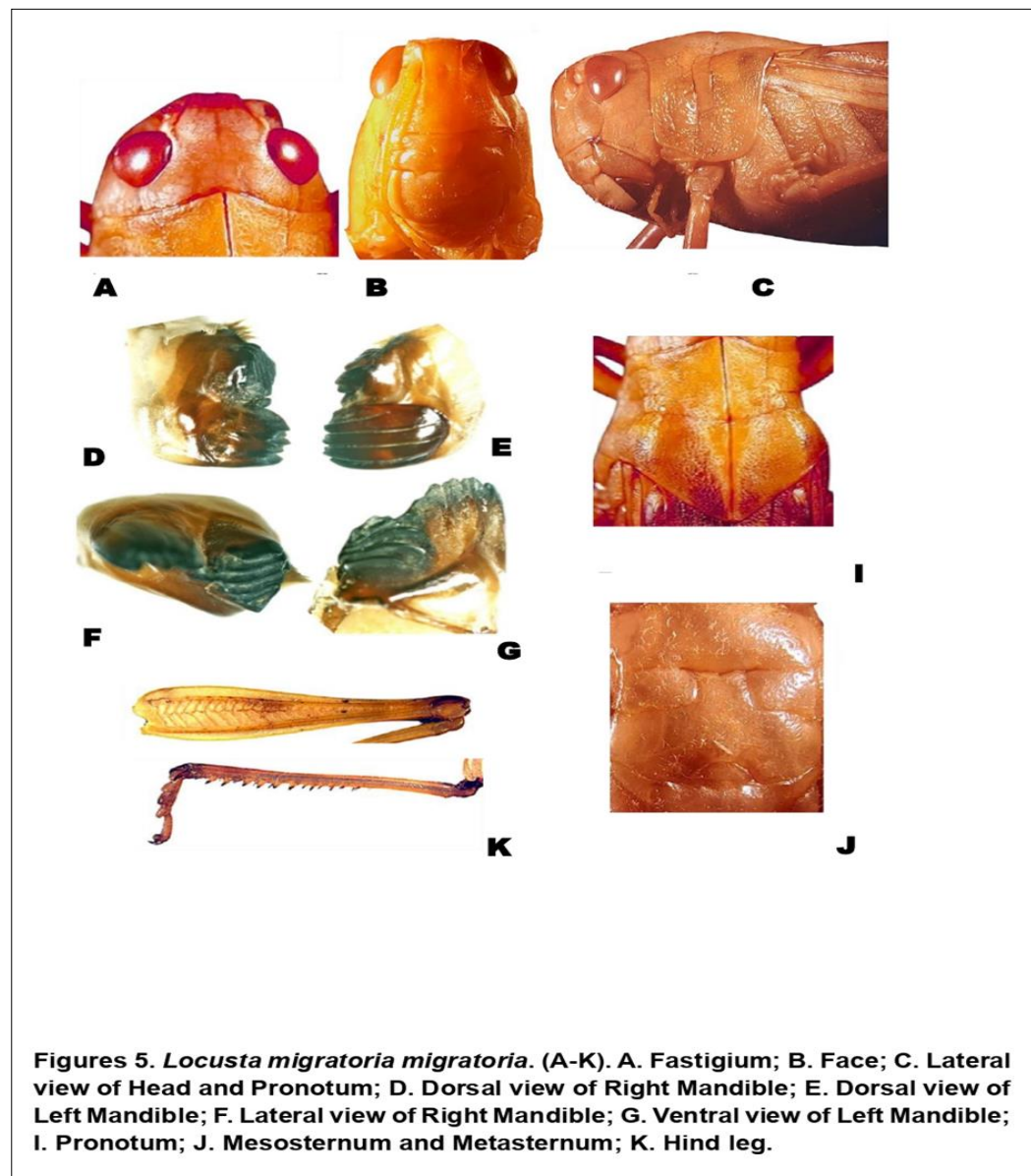
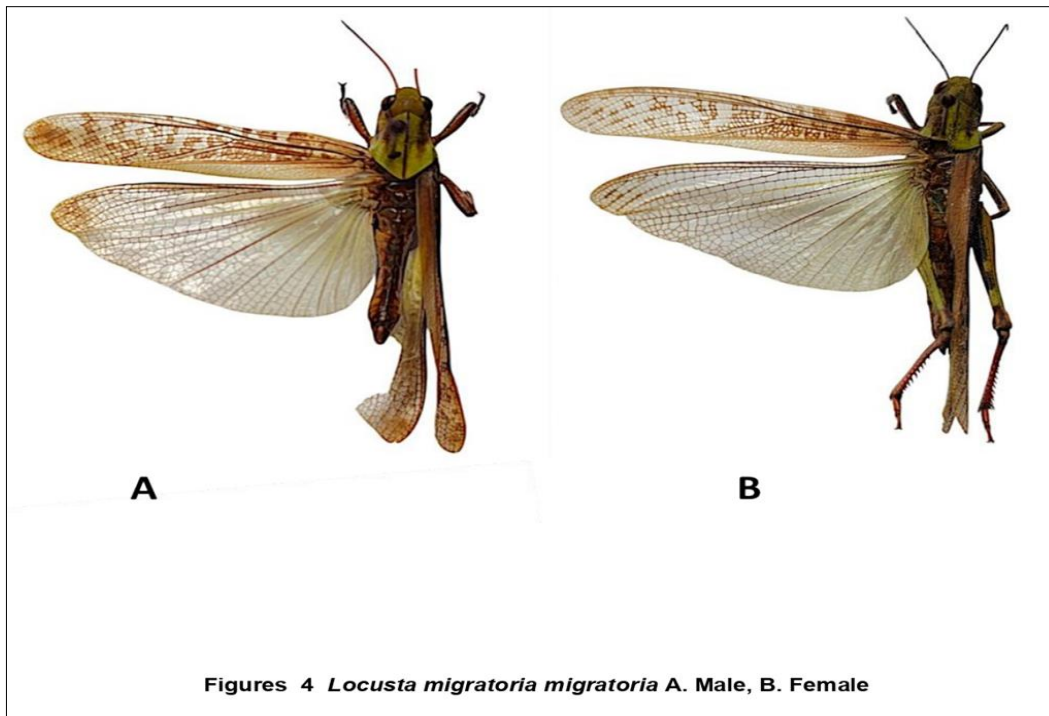
Figure 1. *Schistocerca gregaria gregaria* A. Female B. Male.

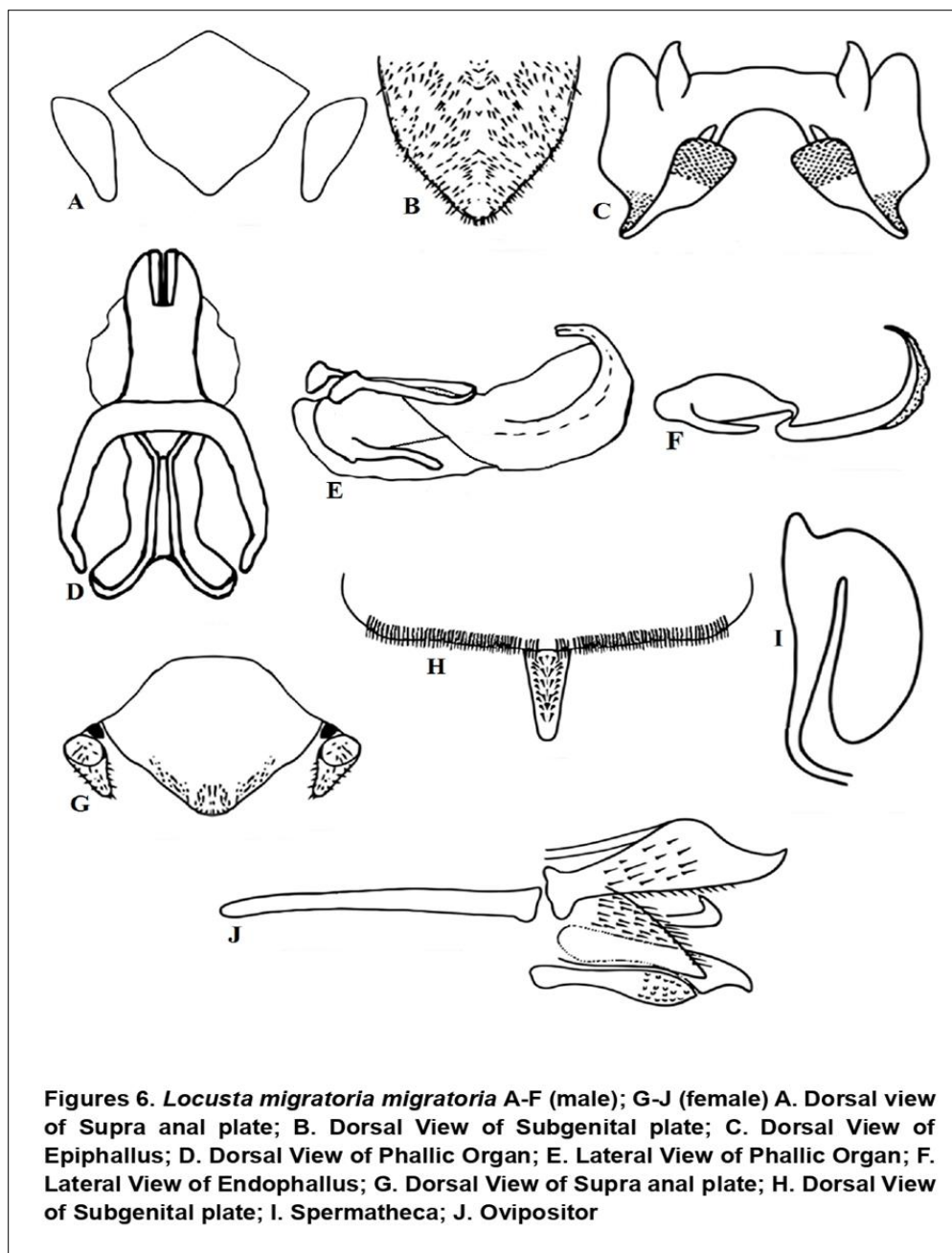


Figures 2. *Schistocerca gregaria gregaria*. (A-K). A. Fastigium; B. Face; C. Lateral view of Head and Pronotum; D. Dorsal view of Right Mandible; E. Dorsal view of Left Mandible; F. Lateral view of Right Mandible; G. Lateral view of Left Mandible; I. Pronotum; J. Mesosternum and Metasternum; K. Hind leg.



Figures 3. *Schistocerca gregaria gregaria* A-F (male); G-J (female) A. Dorsal view of Supra anal plate; B. Dorsal View of Subgenital plate; C. Dorsal View of Epiphallus; D. Dorsal View of Phallic Organ; E. Lateral View of Phallic Organ; F. Lateral View of Endophallus; G. Dorsal View of Supra anal plate; H. Dorsal View of Subgenital plate; I. Spermatheca; J. Ovipositor





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