

Filling gap of *Glenosema* Kieffer (Hymenoptera, Bethylidae) in Central Asia, with description of a new species

Первая находка рода *Glenosema* Kieffer (Hymenoptera, Bethylidae) в Центральной Азии с описанием нового вида

C.O. Azevedo*, P. Rosa**, G. Mirzaeva***, A. Akhmedov***
Ц.О. Азеведо*, П. Роза**, Г. Мирзаева***, А. Ахметов***

* Universidade Federal do Espírito Santo, NESB — Núcleo de Excelência em Sistemática de Bethylidae, Vitória ES, Brazil. E-mail: bethylidae@gmail.com

** Федеральный университет Эспириту-Санту, NESB — Центр передового опыта в систематике семейства Bethylidae, Витория Эспириту-Санту Бразилия.

*** Université de Mons, Institut de Recherche en Biosciences, Place du parc 20, 7000 Mons Belgium.

*** Университет Монса, Институт биомедицинских исследований, Парковая площадь 20, 7000 Монс Бельгия.

*** Zoologiya Instituti, Fanlar Akademiyasi, 232B Bogishamol Str., Tashkent 100053 Uzbekistan.

*** Институт зоологии, Академия наук Узбекистана, ул. Богишамол, 232Б, Ташкент 100053 Узбекистан.

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Abstract. A new species of the bethylid wasp genus *Glenosema*, *Glenosema octoleleji* Azevedo, **sp.n.**, is described from the Kyzylkum Desert, Uzbekistan. This represents the first record of the genus from Central Asia and fills a major distributional gap between the Mediterranean, Arabian, and Oriental regions. The new species is described from a male specimen and can be distinguished from its congeners by a unique combination of morphological characters, including extremely reduced propodeal spiracles, a strongly elongate ocellar triangle, a complete metapostnotal median carina, and distinctive genitalia. A reassessment of the diagnostic characters previously proposed for males of *Glenosema* is provided, incorporating morphological variation documented in all currently known species. Several previously overlooked genitalic features, including paired apical filaments of the aedeagus and the enlarged basal ring, are identified as potentially important generic characters. The discovery of *G. octoleleji* extends the known range of *Glenosema* into the Central Asian Palaearctic and supports the interpretation of the genus as an Afro-Eurasian trans-Palaeotropical lineage rather than a predominantly Afro-Mediterranean group. The new record highlights the importance of poorly surveyed regions in revealing the true diversity and distribution of Bethylidae.

Резюме. Описан новый вид ос-бетилид рода *Glenosema*, *G. octoleleji* Azevedo, **sp.n.**, из пустыни Кызылкум (Узбекистан). Это первая находка данного рода в Центральной Азии, заполняющая значительный пробел в его известном распространении между Средиземноморским, Аравийским

и Ориентальным регионами. Новый вид описан по самцу и отличается от других представителей рода уникальным сочетанием морфологических признаков, включая чрезвычайно редуцированные проподеальные дыхальца, сильно удлинённый глазковый треугольник, цельный медиальный киль и характерное строение гениталий. Проведена переоценка диагностических признаков, ранее предложенных для самцов *Glenosema*, с учётом морфологической изменчивости, известной у всех описанных видов рода. Несколько ранее не отмеченных особенностей строения гениталий, включая парные апикальные филаменты эдеагуса и увеличенное базальное кольцо, рассматриваются как потенциально важные диагностические признаки рода. Обнаружение *G. octoleleji* расширяет известный ареал *Glenosema* до Центральноазиатской Палеарктики и поддерживает представление о роде как об афро-евразийской транспалеотропической линии, а не преимущественно афро-средиземноморской группе. Новая находка подчёркивает важность недостаточно изученных регионов для выявления разнообразия и распространения Bethylidae.

Introduction

Glenosema Kieffer, 1905 constitutes the single genus of Glenoseminae, a subfamily recently created under phylogenomic circumscription, which differs from the other bethylid ones by having the mandibles seven-toothed in the females and five in the males, the dorsal

mandibular margin usually denticulate in the females, and the combination of the slender forewing, distal area almost double than basal area, pterostigma dislocated to base, and 2r-rs&Rs vein very long [Santos et al., 2024].

The sexual dimorphism is accentuated and not restricted to the mandibles, the males are usually macropterous and the females may be macropterous, brachypterous or micropterous, so that it is impossible to establish conspecific male-female associations using morphological criteria alone [Azevedo, van Noort 2019].

Currently there are 36 described species around the world, and the main goal of this contribution is to describe the first species from Central Asia collected in the Bukhara desert in Uzbekistan, filling a vast gap in the largest continent of the planet.

Material and methods

The single specimen of *Glenosema* was collected during a field expedition carried out from May 4th to 30th 2026 under the scope of the project "Ecological Characteristics of Aculeate Hymenopteran Insects (Hymenoptera: Aculeata) in Natural and Anthropogenic Habitats of the Bukhara and Navoi Regions". This research work was carried out within the framework of the research program of the Institute of Zoology of the Academy of Sciences of the Republic of Uzbekistan for 2025-2029 "1.2. Creation of a digital information system of the animal world of the Bukhara and Navoi regions", financed from the state budget. The nomenclature for integumental sculpture follows Harris [1979], while general terminology adheres to Lanes et al. [2020], and mesopleural terminology follows Brito et al. [2021]. The following abbreviations for measurements are used in the text: DAO — diameter of anterior ocellus; FPL — frontal projection length (measured at the base in frons to apex); HE — height of eye in dorsal view; LFW — length of forewing (measured after the tegula); LH — length of head in dorsal view; OOL — ocelli-ocular line; POL — posterior ocellar line; WOT — width of ocellar triangle in dorsal view; WF — minimum width of front in dorsal view; WH — maximum width of head including eyes in dorsal view.

Photographies were carried out using a Leica Z16 APO stereomicroscope paired with a Leica Flexacam C3 video camera (Leica Microsystems, Germany). Images were captured using Leica LAS X Life Science software (Leica, Switzerland). Subsequently, the images were merged into a single composite image using the Helicon Focus program (version 6.3.6, Helicon Soft, Dominica), employing the C (Pyramid) method.

We adopted the operational criterion proposed by Cronquist [1978] to delineate the species, considering a species as the smallest group consistently and persistently morphologically distinct from similar ones.

The classification of the biogeographical regions proposed by Holt et al. [2013] was adopted here.

The present work is registered in ZooBank (www.zoobank.org) under urn:lsid:zoobank.org:pub:801C1811-852B-4A07-806F-43B7C85DD552

Results

Among about 100 specimens of Bethyilidae collected during the expedition only one is recognized as *Glenosema* which represents a new species described below.

Glenosema octoleleji Azevedo, sp.n.

Figs 1–5.

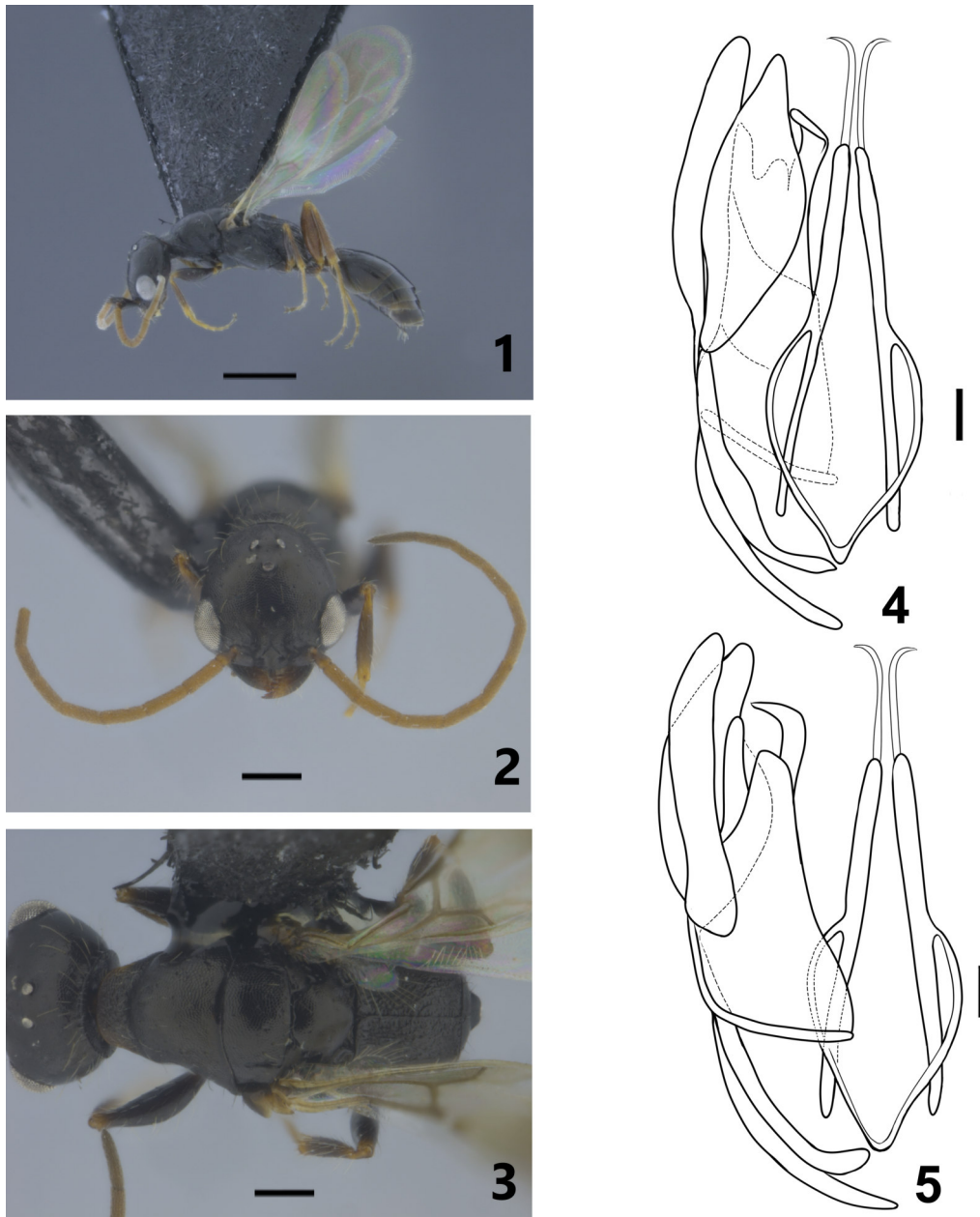
<https://zoobank.org/NomenclaturalActs/9A3827C9-5AE6-479C-B843-B848CE05F001>

Description, holotype male (Fig. 1). Body length 3.1 mm. Forewing length 2.3 mm.

Color (Fig. 1). Head black, antenna castaneous with scape and proximal dorsal surface of pedicel almost black, sensillae dark castaneous, mandible from almost black proximally to dark castaneous distally, palpi dark castaneous with proximal and distal ends lighter; mesosoma black, legs dark castaneous with trochanters and tarsi lighter; metasoma dark castaneous almost black; fore wing subhyaline, progressively darker distad and with hyaline spot distal to Rs&M vein, veins castaneous, except pterostigma darker and base of 2r-rs&Rs almost unpigmented; hind wing hyaline.

Head (Fig. 2). Mandible $0.44 \times LH$, wider distally, teeth sharpened, progressively larger from dorsal to ventral. Clypeus angularly extending posterad, epistomal suture well carinate, median lobe trapezoidal, its surface inclined at about 45° , median area elevated but forming carina, apical margin straight when seen in dorsal view, outcurved and thick and arched in anterior view, lateral lobe well outlined, short. Antennal foramina distant each other about $1.58 \times$ antennal foramen diameter. First four antennomeres in ratio about 3:1:3:3. Antenna very long, 2.6 mm, reaching middle metasoma, pedicel longer than wide, wider submedially, flagellomeres about thrice longer than wide; flagellar pubescence appressed, dense, very short, with some sub-appressed outstanding setae slightly longer than regular pubescence; sensillae elongate, dense, aligned in longitudinal series in each flagellomere. Eye subcircular, bulging, small, placed at medial area of head when seen in lateral view, with few sparse and short setae visible only at high magnification. Frons coriaceous, punctures very small, inconspicuous, shallow, very sparse, distant one to another about 5–7 their diameters; frontal line carinate, but weak and ill-defined. LH $0.96 \times WH$. WF $0.61 \times WH$. WF $1.56 \times HE$. OOL $1.84 \times WOT$. VOL $1.14 \times HE$. Distance of posterior ocellus to vertex crest $1.0 \times DAO$. Distance of anterior ocellus to supra-ocular line $1.67 \times DAO$. Anterior angle of ocellar triangle acute; ocellar triangle clearly longer than wide, POL $1.5 \times DAO$. Vertex outcurved, sides of head posterior to eye converging posterad. Occipital carina complete and conspicuous, visible in dorsal view. Malar space $5 \times$ as long as wide. Hypostomal carina almost evenly arched, somewhat thickening mesad, not angled medially.

Mesosoma (Fig. 3). Mesothorax coriaceous and punctured as frons. Dorsal pronotal area intermediate between subtrapezoidal and bell-shaped; anterior margin not outlined smoothly depressing anterad. Mesonotum divided into anteromesoscutum and mesoscutellar-axillary complex, clearly separated by transscutal fissure. Anteromesoscutum about as long as mesoscutellum, notauli absent, parapsidal signal incomplete anteriorly, straight, parallel and well impressed. Mesoscutum-scutellar suture conspicuous, deep, anterior and posterior margins slightly curved posterad, posterior margin notched medially, scutellar fovea dilated at its lateral end. Metapectal-propodeal disc rugulose, with very few setae on antero-lateral corner, surface flat medially and convex pe-



Figs 1–5. *Glenosema octoleleji* Azevedo, sp.n., holotype, male. 1 — habitus, lateral view; 2 — head, dorsal view; 3 — mesosoma, dorsal view; 4 — genitalia, dorsal view; 5 — genitalia, ventral view. Scale bars: 500 μ m (1); 200 μ m (2, 3); 100 μ m (4, 5).

Рис. 1–5. *Glenosema octoleleji* Azevedo, sp.n., голотип, самец. 1 — общий вид сбоку; 2 — голова сверху; 3 — мезосома сверху; 4 — гениталии самца сверху; 5 — гениталии самца снизу. Масштаб: 500 μ m (1); 200 μ m (2, 3); 100 μ m (4, 5).

ripherally, progressively narrowing posterad, median length $1.15 \times$ median width, metapostnotal median carina complete and conspicuous; metapostnotal-propodeal and paraspicular carinae absent; lateral and posterior transverse carinae complete and strong; spiracle tiny, narrow, elongate, placed at lateral carina. Propodeal declivity coriaceous-areolate, surface subvertical and flat, with some long setae on lateral area, median carina present only dorsally, almost imperceptible. Lateral surface of metapectal-propodeal complex coriaceous-areolate. Mesopleuron with mesepimeron and mesepisternum completely separated by mesopleural suture, imbricate peripherally and coriaceous centrally, mesopleural pit small and deep. Prosternum diamond-shaped, with all

margins incurved, corners very sharpened, much wider than long, surface excavated and flat. Prepectus wide, surface concave and coarse, epicnemium conspicuous. Mesopectus with anterior surface inclined and medio-posterior surface horizontal, mesodiscimen present only medially, slightly wider medially, somewhat deep. Metasternum pentagonal with posterior margins carinate, surface rugulose. Forewing with three closed cells (Costal, Radial and first Cubital), costal vein fully present, 2r-rs&Rs vein not pigmented proximally, 1cubito-anal vein somewhat angled medially. Hind wing with one straight basal hamulus and five curly distal hamuli evenly spaced. Claws progressively narrowing into one single sharpened tooth, smoothly arched.

Metasoma. Weakly coriaceous to coriaceous, tergite II $1.6 \times$ as long as tergite III, with pair of elongate antero-lateral spots with irregular texture contrasting from remain coriaceous surface around. Hypopygium triangular, posterior margin angularly produced. Genitalia (Figs 4–5): harpe double, dorsal one diamond-shaped, ventral one evenly narrow, slightly curved mesad with rounded apex, both arms almost equally long. Cusps bifidous, ventral arm short with apical margin straight, inclined and strongly setose, dorsal arm long apical margin little setose, somewhat, inclined, with dorsal corner rounded and ventral corner sharp. Aedeagus bottle-shaped, base wide with outcurved lateral margins; apex straight, lateral margins barely converging apicad, with long little sclerotized filamentous, which apex curves laterad, surpassing slightly harpe apex height; apodeme slightly narrowing basad, straight, not surpassing genital ring; dorsal half of genital ring much more advanced basad than ventral half. Cupula enlarged and conspicuous, much more developed dorsal than ventrally dorsal, opening subtriangular-subcircular mostly directed ventrad.

Material examined. Holotype, Uzbekistan, South Kyzylkum Desert, Bukhara, $40^{\circ}2.369' N$ $64^{\circ}02.896' E$, 198 m, 11–13.v.2026, Mörické, P. Rosa & C.O. Azevedo col. (NESB).

Etymology. This species is named after Arkady Lelej (Vladivostok, Russia) in celebration of his 80th birthday.

Distribution. Uzbekistan (Bukhara Region).

Discussion

ANALYSES OF PREVIOUS MALE DIAGNOSES

Males of *Glenosema* have never been comprehensively diagnosed at the generic level. The only diagnoses available were those of Evans [1978] and Azevedo et al. [2018]. However, the former was based exclusively on *G. crandalli* Evans, 1964, whereas the latter did not consider the highly modified apterous males of *G. occitanicum* Tussac et Tussac, 2005. Furthermore, several Afrotropical species subsequently described by Azevedo, van Noort [2019] expanded the known morphological diversity of the genus and revealed that some previously proposed diagnostic characters require revision.

The present study confirms several characters previously regarded as diagnostic for male *Glenosema*, while also refining their interpretation. The head may progressively widen anterad, as noted by Evans [1978], although several species possess parallel lateral margins, as reported for some Afrotropical species by Azevedo and van Noort [2019]. The mandibles consistently bear five teeth, and the antennae comprise 11 flagellomeres. The median clypeal lobe is invariably short but well defined, whereas the median clypeal carina may be weakly developed or absent in some species. The eyes are small, slightly protruding laterally, and bear sparse, short setae. The ocelli are usually situated well distant from the vertex crest. The occipital carina is complete and visible in dorsal view.

Mesosomal morphology exhibits greater variation than previously recognized. The pronotum is not invariably elongate, and the mesoscutum is not always strongly reduced. The anteromesonotum is divided into a distinct scutum and scutellum in macropterous species, as previously reported by Evans [1978] and Azevedo et

al. [2018], whereas these structures are highly modified in the apterous form. Notauli are absent throughout the genus. Parapsidal signa are present in macropterous species but absent in the apterous *G. occitanicum*. The mesoscuto-scutellar suture is consistently sulcate, and its lateral extremities may expand into distinct foveae.

The metapectal-propodeal disc is bounded posteriorly by a well-defined transverse carina only in macropterous species. Likewise, the metapostnotal median carina and associated metapostnotal-propodeal carinae show substantial variation, ranging from well developed to entirely absent. Tegulae occur only in macropterous forms and are absent in apterous males, contrary to the generalized condition proposed by Azevedo et al. [2018].

Wing venation is relatively stable. The forewings possess two or three basal cells; the R and 1Cu cells are always closed, whereas the C cell may be either open or closed depending on the presence or absence of vein C. The 2r-rs&Rs vein is consistently elongate, although it is not always tubular. The pretarsal claws are weakly dentate.

The hypopygium narrows posterad and terminates in either an acute or curved margin. The harpes are deeply divided into a slender ventral arm and a broader dorsal arm. Contrary to Evans [1978], both arms bear setae, although these are generally sparse. The two arms are usually subequal in length. The cusps are deeply, but not completely, divided into two lobes, both of which bear setae and vary considerably in shape. The aedeagus is simple, bottle-shaped, and undivided.

NEW DIAGNOSTIC GENITALIC CHARACTERS

Although Evans [1978] provided the first diagnosis of male genitalia for *Glenosema*, it was based solely on *G. crandalli* and was necessarily limited in scope. Subsequently, Azevedo and van Noort [2019] described the genitalia of several Afrotropical species but did not reassess generic-level diagnostic characters. The broader taxonomic sampling now available indicates that several genitalic features may be characteristic of the genus, although a comprehensive reassessment of all described species remains necessary before a definitive diagnosis can be established.

One previously overlooked feature is the presence of a pair of weakly sclerotized apical filaments arising from the aedeagus. In most species these filaments are curved laterad, whereas in a few species they remain straight. Because these structures are transparent, delicate, and apparently susceptible to breakage or degradation during clearing procedures such as diaphanization, their occurrence may have been underestimated in previous studies. Consequently, they should be carefully examined in future taxonomic investigations.

The ventral arm of the harpe is consistently and smoothly curved, with the apex directed slightly mesad. Its apical portion may be expanded or remain uniformly narrow among species. In addition, the basal ring is remarkably large and resembles the condition observed in some Epyrinae, such as *Anisepyrus* [see Evans, 1964: fig. 5], although the degree of dorsal expansion varies among species.

UNIQUE MORPHOLOGICAL CONDITIONS IN *GLENOSEMA OCTOLELEJI*

Glenosema octoleleji exhibits two remarkable morphological features not observed in any other known species of the genus: the extreme reduction of the propodeal spiracles and the strongly elongate ocellar triangle.

Reduction of spiracular openings is commonly regarded as an adaptation associated with water conservation in insects inhabiting arid environments, where smaller and more deeply recessed spiracles may reduce respiratory water loss [Cloudsley-Thompson, 1975]. In *Glenosema*, propodeal spiracles are generally circular to elliptical, whereas in *G. octoleleji* they are so strongly reduced that they are difficult to discern. Because the species occurs in the arid environments of the Bukhara Desert, this condition may represent an adaptation to xeric conditions, although this hypothesis requires physiological confirmation.

The elongate ocellar triangle represents a second distinctive feature. Ocelli contribute to flight stabilization and orientation by detecting changes in ambient illumination and horizon position [Krapp, 2009]. In *G. octoleleji*, the distance between the posterior ocelli is markedly reduced relative to other congeners, producing a notably elongate ocellar triangle. Whether this configuration affects visual performance or flight stabilization remains unknown, but it represents a potentially informative morphological specialization worthy of future investigation. A possible hypothesis is that this species requires less information on flight stabilization in comparison to the other species of this genus.

COMPARATIVE DIFFERENTIAL REMARKS

Among known species, *Glenosema octoleleji* sp.n. most closely resembles *G. caprae* Masi, 1932, *G. numidianum* (Kieffer, 1906), *G. occitanicum*, *G. paulae* Barbosa, Kawada et Azevedo, 2017 and *G. satae* Barbosa, Kawada et Azevedo, 2017, but can be readily distinguished from each of them by a combination of external and genitalic characters.

Compared with *G. caprae*, *G. octoleleji* possesses a pentagonal head, laterally protruding eyes, a conspicuous scutellar pit, a complete metapostnotal median carina, a proximally depigmented 2r-rs&Rs vein, and an acute posterior hypopygeal margin. In contrast, *G. caprae* exhibits a subquadrate head, eyes aligned with the head surface, a small scutellar pit, an incomplete metapostnotal median carina, a fully pigmented 2r-rs&Rs vein, and an evenly rounded hypopygeal margin. The genitalia are generally similar, although *G. caprae* has a more basally narrowed aedeagus and a substantially broader ventral cuspidal lobe.

Glenosema numidianum differs in having parallel-sided head margins, a sulcate frontal line, flagellomeres approximately 2.5× as long as wide, a dorsal pronotal area nearly twice the length of the anteromesoscutum, a narrow mesoscutum-scutellar sulcus, and both metapostnotal median and metapostnotal-propodeal carinae present. In *G. octoleleji*, the head narrows posteriorly,

the frontal line is carinate, the flagellomeres are approximately 3× as long as wide, the pronotal area is only slightly longer than the anteromesoscutum, the mesoscutum-scutellar sulcus is conspicuous, and only the metapostnotal median carina is present.

The apterous *G. occitanicum* is readily distinguished by its extremely elongate antennae, minute ocelli, absence of parapsidal signa, and entirely ecarinate metapectal-propodeal complex. In contrast, *G. octoleleji* is fully winged, has shorter flagellomeres, normally developed ocelli, distinct parapsidal signa, and a strongly carinate metapectal-propodeal complex. Although the genitalia are generally similar, *G. occitanicum* possesses a broader aedeagal base and an unconstricted ventral cuspidal lobe.

Compared with *G. paulae*, *G. octoleleji* has a more strongly posteriorly convergent head, more protruding eyes, anteriorly incomplete parapsidal signa, absence of paraspiracular carinae, a complete metapostnotal median carina, and a proximally depigmented 2r-rs&Rs vein. The genitalia of both species are similar, but the ventral harpal arm is more strongly expanded in *G. paulae*.

Finally, *G. satae* differs by its evenly convex vertex crest, larger eyes and ocelli, strongly developed convergent parapsidal signa, a metapectal-propodeal disc approximately as long as wide, and a fully pigmented 2r-rs&Rs vein. In *G. octoleleji*, the head is more strongly narrowed posteriorly, the eyes are more protruding, the parapsidal signa are incomplete anteriorly and nearly parallel, the metapectal-propodeal disc is distinctly longer than wide, and the 2r-rs&Rs vein is proximally unpigmented. The genitalia are very similar, although the ventral cuspidal lobe is markedly constricted basally in *G. octoleleji*.

BIOGEOGRAPHICAL SIGNIFICANCE OF THE UZBEK RECORD

The genus currently comprises 36 species distributed across eight biogeographical regions following the classification of Holt et al. [2013], as follows: 14 in the Afrotropical region [Azevedo, van Noort 2019], eight in the Mediterranean region [Kieffer, 1906, 1911; Masi, 1932; Tussac, Tussac, 2005], five in the Oriental region [Krombein, 1996; Terayama, 1996], four in the Arabian region [Barbosa et al., 2017], two in the Malagasy region [Lanes, Azevedo, 2008], one in the Australian region [Dodd, 1924], one in the Nearctic [Evans, 1964], and now one Central Asia.

The discovery of *G. octoleleji* in Uzbekistan substantially alters the current understanding of the geographical distribution of *Glenosema*. Rather than representing a predominantly Afro-Mediterranean lineage with isolated peripheral occurrences, the genus now appears to have a broad Afro-Eurasian distribution extending from the Mediterranean Basin through Central Asia, Arabia, tropical Africa, Southeast Asia, Madagascar, and Australia. This range encompasses much of the warm-temperate, subtropical, and tropical regions of the East Hemisphere. In the Palearctic region, the distribution of *Glenosema*

is partly congruent with the Centralasiatic-Mediterranean and Mediterraneo-Sindian chorotypes defined by Vigna Taglianti et al. [1999].

The occurrence of *Glenosema* in Central Asia is particularly informative, as this region forms a biogeographical link between the Mediterranean Basin, the Middle East, and South Asia. The Uzbek record suggests that apparent gaps in the known distribution may largely reflect insufficient sampling rather than true absence. A similar pattern is observed in several xerophilous and steppe-associated insect lineages that expanded across Eurasia during phases of increasing aridity in the Miocene and Pliocene [Miao et al., 2011; Barbolini et al., 2020].

Overall, this record weakens the hypothesis of *Glenosema* as a strictly Afro-Mediterranean lineage and instead supports a broader Afro-Eurasian biogeographical history. Although this interpretation remains tentative pending phylogenetic evidence, the distributional data are consistent with historical faunal connections across Mediterranean, Arabian, Central Asian, and African regions.

Current evidence further suggests that *Glenosema* is best interpreted as an Afro-Eurasian trans-Palaetropical lineage rather than as a predominantly Mediterranean or Afrotropical genus. Two principal centers of diversification can be recognized: the Mediterranean–Western Palaearctic region and the Afrotropical region. Secondary radiations appear to have occurred in the Oriental region, whereas Madagascar, Australia, and North America each harbor isolated representatives.

Finally, the known distribution of the genus remains strongly influenced by historical sampling effort. Most species have been described from the Mediterranean region [Kieffer, 1906, 1911; Masi, 1932; Tussac, Tussac 2005] and the Afrotropical region [Azevedo, van Noort 2019], whereas large areas of Central Asia, Arabia, and tropical Asia remain poorly surveyed. The discovery of *G. octoleleji* demonstrates that species richness increases substantially when previously unexplored regions are investigated and suggests that the true diversity and distribution of *Glenosema* remain considerably underestimated.

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