

RESEARCH PAPER

A new species of *Dasygogon* (Diptera: Asilidae) from Azerbaijan with notes on its biologyWojciech T. SZCZEPAŃSKI^{1,2,*}), Roland DOBOSZ^{1,3}) & Ilhama G. KERIMOVA^{4,5})¹) Upper Silesian Museum, Department of Natural History, Pl. Jana III Sobieskiego 2, 41-902 Bytom, Poland²) e-mail: w.szczepanski@muzeum.bytom.pl;³) e-mail: dobosz@muzeum.bytom.pl;⁴) Institute of Zoology, Ministry of Science and Education of Azerbaijan Republic, Baku, Az1004, A. Abbaszadeh str.115, pr.1128, bl 504⁵) Western Caspian University, 31 Istiglaliyyat, Baku 1001, Azerbaijan Republic; e-mail: ilkershah@mail.ru

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Accepted:

9th September 2025

Published online:

10th December 2025

Abstract. *Dasygogon kerimovae* Szczepański & Dobosz sp. nov. (Diptera: Asilidae) is diagnosed and described from Azerbaijan. The species is readily distinguished by the male terminalia and unique combination of characters of females, which exhibit dark coloration resembling that of males, including smoky black wings, black legs and predominantly black setae. Photographic documentation of the habitus and the male and female genital structures is included. Observations concerning habitat preferences, flight activity, and biological interactions are discussed, with particular emphasis on ecological plasticity, mimicry, and trophic relationships.

Key words. Diptera, Asilidae, Sphecidae, *Dasygogon*, Batesian mimicry, new species, post-glacial colonization, prey, robber flies, Shirvan NP, Azerbaijan, Palaearctic Region

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Introduction

The genus *Dasygogon* Meigen, 1803 (Diptera: Asilidae) is widely distributed in the Palaearctic Region, comprising a group of species inhabiting warmer habitats such as steppes and other xerothermic areas, especially in the Mediterranean Basin. Representatives of the genus in the Caucasus region have been poorly documented so far. In the literature, information on *Dasygogon diadema* (Fabricius, 1781), *D. octonotatus* Loew, 1869 and *D. variabilis* Brullé, 1833 can be found; however, notes on the first two species are limited to general distribution data (e.g. RICHTER 1964, 1968; LEHR 1988). Only *D. variabilis* was reported from a specific locality (Tbilisi, Georgia) by MOUCHA & HRADSKÝ (1963).

Given the numerous taxonomic misidentifications recorded in the genus *Dasygogon*, it is necessary to be very cautious when considering the previous data valid (WEINBERG 1986, TOMASOVIC 1999, SZCZEPAŃSKI 2023). Examination of the male genitalia of specimens is mandatory to ensure accurate identification, and according to the current state of research we hypothesize that in the Caucasus region (Armenia, Azerbaijan, Georgia), neither of the aforementioned species is present. For example, *Dasygogon irinellae* Weinberg, 1986, described relatively recently based on

male genitalia from a single specimen collected in Tbilisi (Georgia), casts doubt on the validity of earlier records of *D. variabilis* in the area (WEINBERG 1986).

Based on the literature, no specific data on the genus *Dasygogon* has been reported from Azerbaijan. During the revision of museum collections, only a single female specimen from that country was found. The examined specimen was morphologically unique within the genus. In contrast to all other known species, with the exception of *Dasygogon melanopterus* Loew, 1869, it possessed wings that were almost as dark as those typically observed in males. Additionally, the legs were entirely black, while the setae and macrosetae were predominantly black, further accentuating the resemblance to male-specific characteristics. Therefore, during the field research in Azerbaijan, the focus was also placed on finding a similar specimen, particularly a male, to properly identify the species. The results of this investigation are presented in the following sections of the paper.

Material and methods

The field research was conducted under a permit issued by the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan (3-14/2-1599-D-03-21/2025). The



presented material is deposited in (or comes from) the collections of the Upper Silesian Museum in Bytom, Poland (USMB), the National Museum of the Czech Republic, Praha, Czech Republic (NMPC), and the Institute of Zoology, Ministry of Science and Education of the Azerbaijan Republic (IZMSE).

Specimens were studied using a PROLAB MSZ Stereo Microscope at magnifications 7–90×. To examine the male genitalia, only the tip of abdomen was relaxed in distilled water. Subsequently, the male terminalia were separated from the remaining abdominal structures using pins or forceps without removing the rest of abdomen. The separated terminalia were placed in 10% NaOH at room temperature for approximately 24 hours. To separate the genital structures of females, the entire abdomen was relaxed under the same conditions. Finally, the terminalia were separated from the remaining abdominal structures and after examination placed in microvials containing glycerin for permanent storage, and each vial was attached to the specimen pin.

The photographs of the habitus were taken with a Canon EOS 550D digital camera equipped with a Canon EF 100mm f/2.8L Macro IS USM lens. The images were stacked, aligned and combined using Helicon Focus software (www.heliconsoft.com). The photographs of the genital structures were taken with a NIKON SMZ1500 stereoscopic microscope equipped with a Nikon DS-Si1 camera. Line drawings of the male terminalia were produced using Adobe Photoshop software, and present them in their natural position, with the right and left gonocoxites each slightly bent outwards. To make the drawings clearer, setae are not illustrated.

The distribution of species was illustrated using Quantum GIS (QGIS) 3.6.0 ‘Noosa’, and the raster layer was obtained from server.arcgisonline.com website (source: Esri, Maxar, Earthstar Geographics, and the GIS User Community).

The material includes the original label data, with the following abbreviations used throughout the text: LK – Lech Kruszelnicki, RD – Roland Dobosz, WS – Wojciech Szczepański. All specimens were included in the type series and labelled with red, printed labels. The species description is based on a composite of all specimens and not exclusively on the holotype. Body length was measured from the mystax to the apex of the abdomen, and body width at the widest part of the thorax. Terminology follows CUMMING & WOOD (2017) and LONDT & DIKOW (2017). The term ‘pubescence’ refers to the short, fine microtrichia densely covering certain body parts.

Results

Genus *Dasygogon* Meigen, 1803

Dasygogon kerimovae Szczepański & Dobosz sp. nov.

(Figs 1A–D, 2A–C, 3A–C)

Type material examined. HOLOTYPE: ♂, AZERBAIJAN, 39°40′01.0″N 49°20′08.0″E, Şirvan Milli Parkı, meadows, 23.05.2025, -30 m a.s.l., RD and WS, leg. (USMB). PARATYPES: 30 ♂♂ 40 ♀♀, AZERBAIJAN, 39°40′01.0″N 49°20′08.0″E, Şirvan Milli Parkı, meadows, 22.05.2025, -30 m a.s.l., RD and WS, leg. (26 ♂♂ 36 ♀♀ USMB; 3 ♂♂ 3 ♀♀ NMPC;

1 ♂ 1 ♀ IZMSE); 12 ♂♂ 15 ♀♀, AZERBAIJAN, 39°40′01.0″N 49°20′08.0″E, Şirvan Milli Parkı, meadows, 23.05.2025, -30 m a.s.l., RD and WS, leg. (USMB); 5 ♂♂ 10 ♀♀, AZERBAIJAN, 39°39′04.5″N 49°19′55.4″E, Şirvan Milli Parkı, coast, 23.05.2025, -29 m a.s.l., RD and WS, leg. (USMB); 2 ♂♂, AZERBAIJAN, 39°40′02.0″N 49°10′47.0″E, Şirvan Milli Parkı, Estakada, 23.05.2025, -27 m a.s.l., RD and WS, leg. (USMB); 4 ♂♂ 8 ♀♀, AZERBAIJAN, 39°39′04.5″N 49°19′55.4″E, Şirvan Milli Parkı, coast, 24.05.2025, -29 m a.s.l., RD and WS, leg. (USMB); 1 ♂, AZERBAIJAN, 40°05′57.0″N 49°19′07.0″E, Qobustan Milli Parkı; 31.05.2025, 60 m a.s.l., semi-desert habitat, RD and WS, leg. (USMB); 1 ♀, AZERBAIJAN, 40°05′57.0″N 49°19′07.0″E, Qobustan Milli Parkı; 31.05.2025, 60 m a.s.l., semi-desert habitat, LK, leg. (USMB); 1 ♀, AZERBAIJAN, 40°08′57.0″N 49°28′22.0″E, Sanqaçal env., 31.05.2025, -20 m a.s.l.; coast, RD and WS, leg. (USMB); 3 ♂♂ 1 ♀, AZERBAIJAN, 40°25′33.0″N 50°12′48.0″E, Dubandi env., 02.06.2025, 8 m a.s.l., ruderal habitat, RD and WS, leg. (USMB); 1 ♀, USSR, Azerbajdzan, Apseron. Pol., Bil’Gjach, 21.06.1987, A. Halsova, J. Ruzicka lgt. (NMPC).

Diagnosis. The species can be readily identified, primarily by the habitus of females (Figs 1C, D, 2B), which appear to possess a unique combination of characters within the genus. Females exhibit darker coloration, making them resemble males: wings are similarly smoky black, legs are consistently black, and the colour of mystax and setae on coxae and trochanters, although variable, is often black, as in males. In contrast, females of *D. melanopterus*, which also exhibit similarly dark wings, are nearly twice as large and possess intensely red legs. Males, in turn, are distinguished by the absence of white pubescence along the sides of tergites (Figs 1A, B) and by the shape of phallus (Fig. 2B). One of the main diagnostic characters appears to be the shape and degree of inclination of lateral lobes. In many species, the lateral lobes are positioned parallel or nearly parallel to the phallic sheath (e.g., *Dasygogon diadema*, *D. irinelae*, *D. octonotatus*), or are bent ventrally to varying degrees (e.g., *Dasygogon diabolicus* Szczepański, 2023; *D. melanopterus*). In contrast, the lateral lobes in *D. kerimovae* sp. nov. are distinctly inclined dorsally, forming an almost right angle between the lateral lobes and the median lobe. In this respect, the species resembles *Dasygogon magisi* Tomasovic, 1999. However, this species, in addition to the differences in the shape of the lateral lobes, which are almost straight, also has them slightly inclined laterally.

Description. Measurements. Body length 13.6–20.0 mm (holotype 17.5 mm, Fig. 1A–B), body width 3.2–4.6 mm (holotype 4.0 mm). **Head. Male.** Black, facial gibbosity moderately pronounced, mostly in basal part, mystax consists of several rows of long, black setae basally, ranging almost up to length of proboscis, and of few or several shorter downward-pointing setae in dorsal part, face with silver pubescence, eyes large, inner side almost parallel, slightly undulating, distance between eyes c. equal eye width, ocellar and postocular macrosetae black, occiput mostly directly behind eyes with slight silver pubescence, ocellar tubercle with 3 brown ocelli, antennae black, with slight silvery pubescence, scape and pedicel with black setae of various length, scape 2× longer than wide, pedicel 1.5× longer than scape, postpedicel c. 1.5× longer than both scape and pedicel combined, with group of 3–4 short, fine setae dorsally, sensillum in apical pit, maxillary palpi large, two-segmented, black, with long black setae, proboscis oval, slightly flattened laterally, with black long

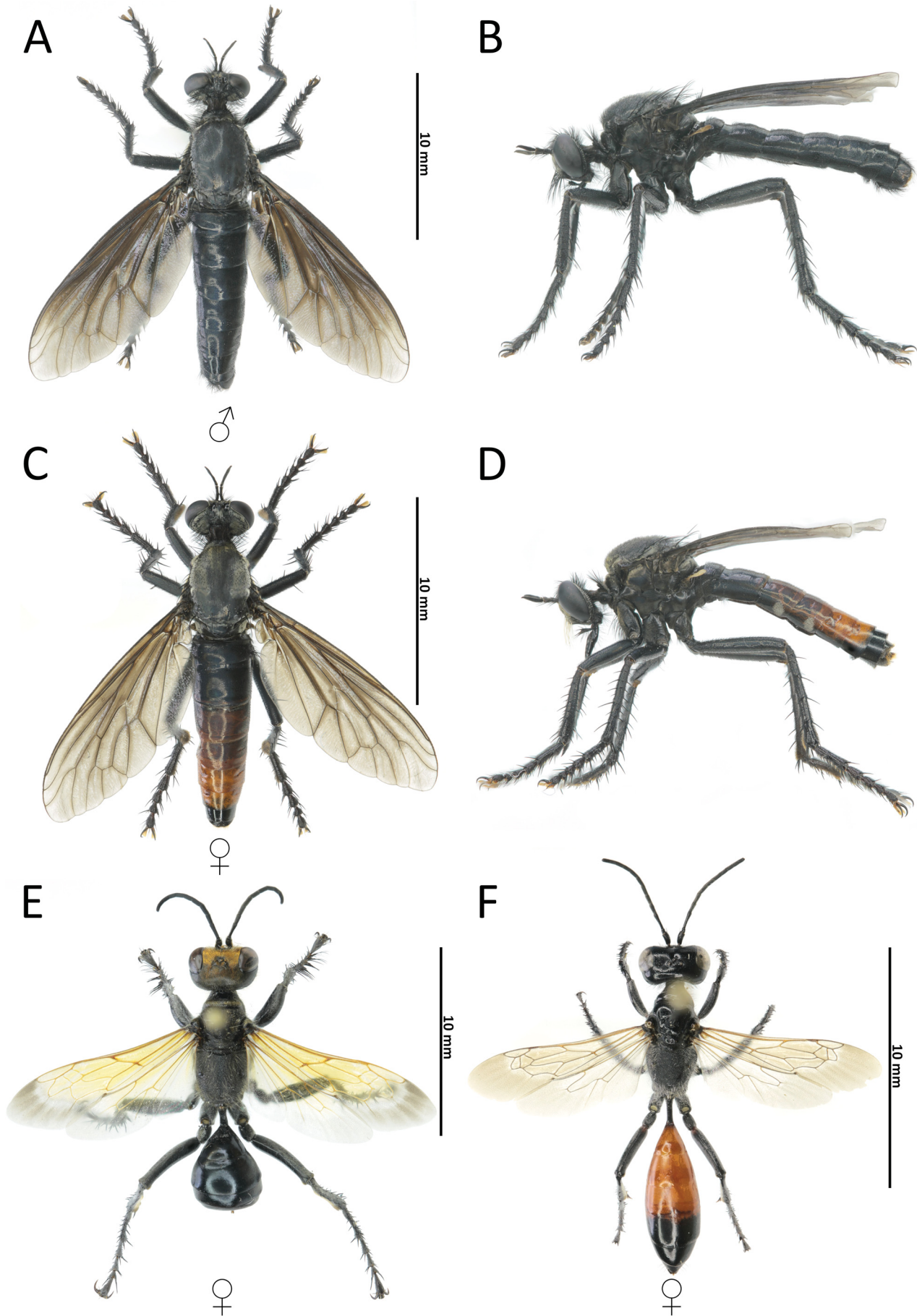


Fig. 1. A–D – habitus of *Dasyopogon kerimovae* Szczepański & Dobosz sp. nov.: A – male holotype, dorsal view; B – male holotype, lateral view; C – female, dorsal view; D – female, lateral view; E – *Prionyx subfuscatus* (Dahlbom, 1845), female, dorsal view. F – *Podalonia fera* (Lepelletier de Saint Fargeau, 1845), female, dorsal view.

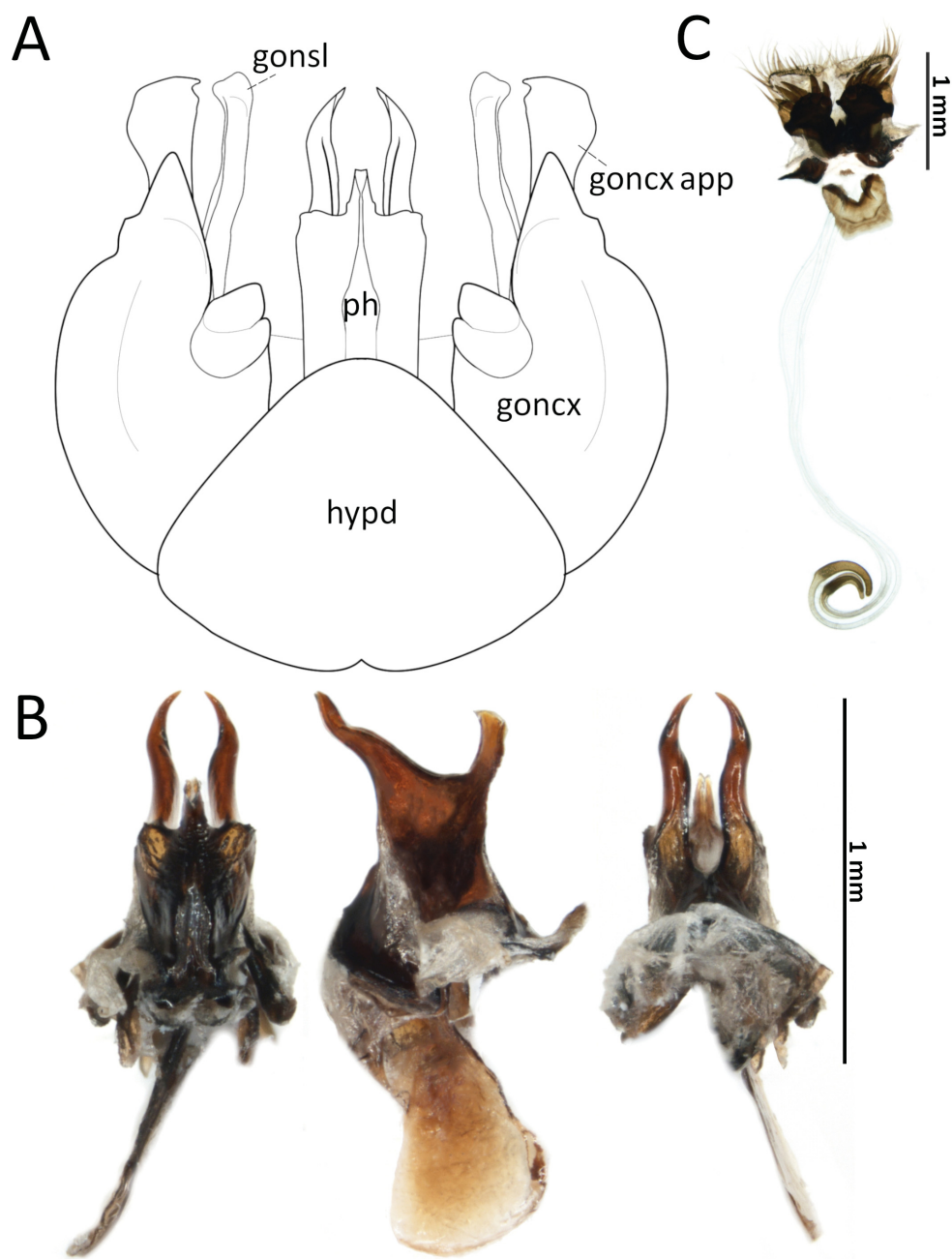


Fig. 2. Male and female terminalia of *Dasyopogon kerimovae* Szczepański & Dobosz sp. nov.: A – male terminalia, ventral view (ph – phallus, goncx – gonocoxite, gonsl – gonostylus, goncx app – gonocoxite appendage, hypd – hypandrium), B – phallus, ventral, lateral and dorsal views, C – female terminalia (acanthophorites, genital fork, spermathecal ducts and spermathecae).

setae ventrally at base and some short, fine, yellowish setae on anterior part. *Female*. As male, but with the following differences: setae coloration variable, mystax usually consists of silvery-white setae, quite often with admixture of black setae, rarely all setae black, ocellar and postocular macrosetae black or mostly black, rarely mostly silver-white, sometimes scape with share of silver-white setae.

Thorax. *Male*. Black, postpronotal lobes and sides of scutum covered with weak, silvery pubescence, setae on scutum numerous, short, black, number of longer macrosetae variable, usually in following ranges: 3–6 notopleural, 3–5 supra-alar, 2–3 postalar, 4–6 apical scutellar, dorsocentral setae weak, katatergite with several, moderately-long

setae, anatergite bare, with silver pubescence mostly laterally, pleura bare, with weak silver-brown pubescence, only anepisternum with tuft of short fine setae in dorsal posterior corner. *Female*. As male, with pubescence more distinct and more yellowish.

Wings. *Male*. Smoky black, darkened along veins, more transparent at apex, veins black, venation typical for genus. *Female*. As male, though slightly paler.

Legs. *Male*. Typical for genus, black, with black setae and macrosetae. *Female*. As male, setae coloration of coxa and trochanters usually black, however in some specimens could be silver-white.

Abdomen. *Male*. Cylindrical, tapering, c. 2.5× longer

than thorax, shiny black with slight bluish reflex, without sliver pubescence, setae on tergites and sternites black, setae on dorsal part of tergites sparse and fine, laterally a little denser and longer, especially on first three segments, first tergite laterally with group of not so prominent, rather short macrosetae, sternites with sparse and short setae. *Female*. Similar to male, black with red spot on tergites, spot range variable, predominantly on tergites 3–6, setae coloration black, only ovipositor predominantly with yellow setae, pubescence in lateral posterior part of tergites present, on tergite 1 yellowish, similar like on thorax, on tergites 2–5 pubescence whitish, on tergites 2 and 5 usually barely noticeable or even absent, on tergites 3–4 prominent.

Male terminalia. Terminalia rotated, epandrium, hypandrium, gonocoxite, gonocoxite appendage and gonostylus typical for genus, as in Fig. 2A, median lobe of phallus rather short, tapering, lateral lobes elongate and slender, slightly twisted, each with smooth, continuous curvature along their length, gradually tapering from broader base to narrowly pointed apex, lateral projections between median and lateral lobes indistinct, in lateral view, lobes distinctly bent dorsally, ejaculatory apodeme moderately long (Fig. 2B).

Female genitalia. Tergite 8 laterally shows two poorly chitinized areas, hypogynium membranous apically, membranous part roughly in shape of oval, each acanthophorite with group of six spines, apex of spines rounded, genital fork U-shaped, spermathecal ducts ca. 8× longer than genital fork, three, slightly curved spermathecae (Fig. 2C). **Etymology.** The species is named in honor of Ilhama Kerimova, an esteemed specialist in lacewings (Neuroptera). Her substantial contributions to the development and execution of our research plans, along with her pivotal role in initiating a scientific cooperation agreement between our institutions, are gratefully acknowledged.

Habitat, flight activity, and biology. The species was observed in arid habitats such as various ephemeral-wormwood semi-deserts (Figs 3D–F), and even in ruderal sites within urban areas. Nevertheless, the species was found to be significantly more abundant in meadow-type vegetation enriched with wormwood, particularly in depressed areas of Shirvan National Park (Fig. 3D). During field research, hundreds of individuals were observed at this site, with a slight predominance of females; the male-to-female ratio was approximately 3 : 4. The visible predominance of females over males, which usually emerge earlier, suggests that the peak of flight activity most likely takes place in the second half of May or around the turn of May and June. Individuals were typically observed flying low above the ground, either between plants or over more open areas devoid of vegetation. It appears that males were more frequently recorded in overgrown areas, whereas females were more often observed in open patches.

In such saline environments, insects often encounter limited suitable microhabitats and strong interspecific competition for trophic resources. However, other representatives of the family Asilidae were also observed occurring sympatrically as potential competitors in predation, including *Dysmachus dasyproctus* Loew, 1871, *Machimus*

annulipes (Brullé, 1833), and *Scylaticus* sp. Regarding *Dasygogon kerimovae* sp. nov., various invertebrates were recorded as prey, including representatives of Hymenoptera as ants, ichneumon wasps (e.g. *Amblyteles* sp.) (Fig. 3B) or paper wasps (e.g. *Polistes mongolicus* du Buysson, 1911), as well as Coleoptera (e.g. *Sitona* sp.). In this ecosystem, *Dasygogon kerimovae* sp. nov. does not appear to be the top insect predator, since it was frequently recorded as prey of the larger *Machimus annulipes* (Fig. 3C).

Field observations have revealed notable behavior in *Dasygogon*. At times, individuals exhibited a marked alteration in their flight dynamics, adopting a flight pattern strikingly similar to that observed in certain representatives of the Sphecidae (Hymenoptera). Specifically, individuals flew slowly and close to the ground, changing direction. A particularly distinctive feature was the posture adopted during flight: the legs hung limply, enhancing the overall resemblance to Sphecidae.

Distribution. The species' known distribution is predominantly concentrated along the coastal areas of the Caspian Sea in Azerbaijan (Fig. 4). However, its actual range is likely more expansive, potentially extending into the central lowlands of the country, where comparable habitat conditions exist.

Discussion

The Caspian Sea has a long history of fluctuations in water level. It is currently approximately 29 meters below sea level and continues to decline at a rate of about 7 centimeters per year (WANG et al. 2018). Due to these significant changes, the known localities of *Dasygogon kerimovae* sp. nov. appear to have been secondarily colonized, as most of the currently inhabited area was likely submerged around 15,000–20,000 years ago during the Last Glacial Maximum (e.g., ERGUN 2021, LEROY et al. 2020). The areas exposed by the retreating sea have since developed a rich diversity of plant communities. On the Caspian coast alone, more than ninety plant associations have been identified (HUSEYNOVA 2021), while the Shirvan region hosts nearly twenty (GASIMZADE 2020). It is likely that *Dasygogon kerimovae* sp. nov. colonized these regions relatively recently, having descended from populations inhabiting higher elevations. The occurrence of the species across various sites characterized by distinct vegetation profiles may reflect a high ecological plasticity and effective dispersal capabilities within sandy substrate environments. Nonetheless, the full extent of its distribution remains poorly understood and requires further investigation.

Similar adaptive capabilities were documented in *Dasygogon diadema*, which is thought to have begun inhabiting suitable sandy habitats that arose as a result of post-glacial changes in Central Europe (e.g., GELLER-GRIMM 1998, SZCZEPAŃSKI 2023). This suggests that the genus *Dasygogon* has an evolutionary predisposition to rapidly exploit new ecological niches. The capacity to adapt quickly to changing environmental conditions and disperse across heterogeneous landscapes likely played a key role in its expansion. This raises intriguing questions about the phylogeographic history of the genus and the potential for

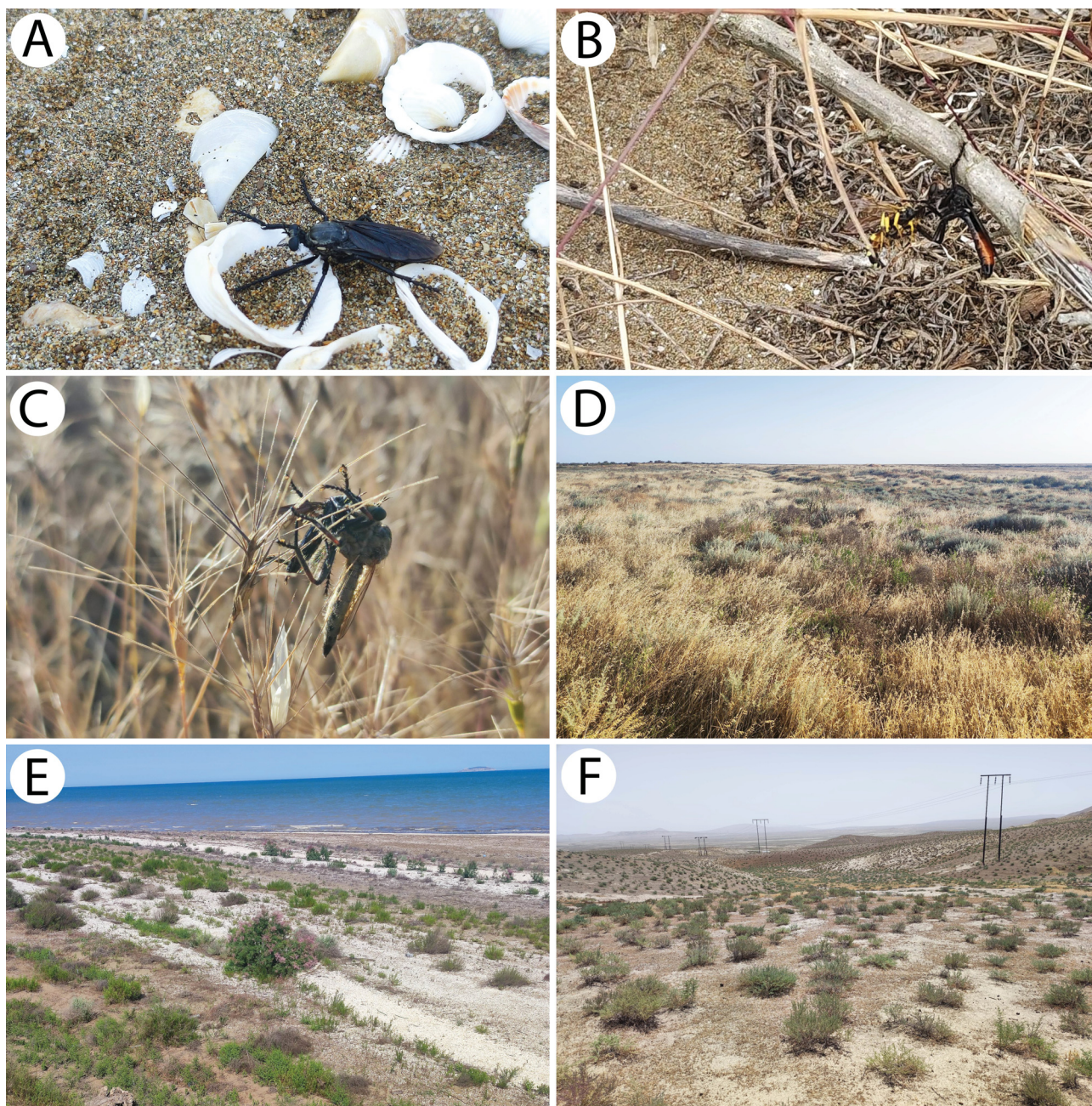


Fig. 3. Field photos of *Dasyopogon kerimovae* Szczepański & Dobosz sp. nov. in nature and its typical habitats. A – male on the sandy shore of the Caspian Sea in Shirvan National Park; B – female with prey *Amblyteles* sp. in Shirvan National Park; C – female of *Machimus annulipes* (Brullé, 1833) with prey *Dasyopogon kerimovae* in Shirvan National Park; D – ephemeral grass habitat in Shirvan National Park; E – ephemeral-wormwood semidesert habitat on the coast of the Caspian Sea in Shirvan National Park; F – semi-desert in Gobustan National Park.

cryptic diversity driven by historical climate fluctuations.

Among the various adaptive strategies developed by Asilidae, mimicry stands out as a particularly effective mechanism for enhancing survival and ecological success (e.g. McCRAVY 2008). Numerous examples of mimicry, particularly involving Hymenoptera, were so far documented in the literature (LAVIGNE 2006). HULL (1962) cited several genera as notable cases, including *Laphria* Meigen, 1803, *Hyperechia* Schiner, 1866, *Dasyllis* Loew, 1851, *Diogmites* Loew, 1866, and *Blepharepium* Rondani, 1848.

In his foundational studies, LEHR (1958, 1962) brought attention to the pronounced morphological resemblance between *Dasyopogon octonotatus* Loew, 1869 and repre-

sentatives of the family Sphecidae, particularly the genus *Sphex* Linnaeus, 1758. He stated that *Sphex* species may act as mimicry models for *Dasyopogon*. Notably, in addition to morphological comparisons, Lehr proposed a hypothesis for sexual dimorphism in coloration observed in both genera. He suggested that these differences are likely driven by behavioral distinctions and the utilization of different microclimatic zones: males are generally more active and mobile, engaging in extensive patrolling or mate-searching behaviors across a broader spatial range, whereas females tend to remain near the ground, often waiting for prey.

In the genus *Dasyopogon*, females spend considerable time in sandy habitats while searching for optimal sites for



Fig. 4. Distribution of *Dasyopogon kerimovae* Szczepański & Dobosz sp. nov. in Azerbaijan.

offspring development, as the larvae develop in the soil. This ecological behavior necessitates effective camouflage, making yellow, brown or orange coloration patterns on body parts (e.g., legs, abdominal spots) advantageous for predator avoidance. However, cause-and-effect relationships in insect evolution are complex and often difficult to interpret. The evolution of insect body appearance is likely driven by multiple factors, some elusive and influenced by stochastic processes, resulting in a wide diversity of visual forms. These forms may vary significantly not only between species within the same genus but also among individuals of the same species. For example, in many species of *Sphex*, abdominal coloration may be variable or uniform across both sexes. Similarly, in *Dasyopogon*, certain populations (species) exhibit predominantly black abdominal coloration in females (pers. observ.).

In the context of *Dasyopogon* mimicry, in Shirvan National Park, the sympatric presence of two sphecid wasp species was observed – *Prionyx subfuscatus* (Dahlbom, 1845) (Fig. 1E) and *Podalonia fera* (Lepeletier de Saint Fargeau, 1845) (Fig. 1F). As these species occupy the same ecological niche as *Dasyopogon kerimovae* sp. nov., it can be hypothesized that mimicry through resembling these sphecids may have been an important evolutionary factor that accelerated the development of the currently observed habitus in both sexes of this robber fly. Both wasps share a similar body size and coloration with *Dasyopogon kerimovae* sp. nov., which may confer a selective advantage to

the latter through Batesian mimicry, providing additional protection from visually oriented predators. Notably, this robber fly is relatively small compared to other members of the genus. Several factors may have contributed to this reduced body mass, including the potential scarcity of food resources for larvae in saline soil. Alternatively, this trait may represent an adaptation to the local Sphecidae fauna, as larger species such as *Sphex* have not been recorded in the area.

However, the behavioral resemblance observed during flight may not necessarily represent only a mimicry adaptation but indicate development of similar energetically efficient flight strategy adapted for prey detection and hunting in low vegetation zones. This raises the possibility that certain traits interpreted as mimicry may have evolved primarily for functional, rather than deceptive purposes. Further doubts regarding the mimicry hypothesis arise when considering wing coloration in females of *Dasyopogon kerimovae* sp. nov. Unlike most congeners, which typically exhibit brownish wing coloration similar to that of Sphecidae, females of the discussed species possess distinctly smoky black wings. This divergence brings into question what ecological or evolutionary pressures might drive such differentiation. If darker wings in females confer advantages unrelated to mimicry – such as improved thermoregulation, camouflage in shaded habitats, or signaling during mating – this would imply that mimicry may not be the key evolutionary driver of morphological

diversification within the genus.

Taken together, these observations underscore the complexity of evolutionary aspects within the genus *Dasygogon*. Several elements, including the extent and function of mimicry, sexual dimorphism, and habitat preferences, still remain insufficiently understood. The observed morphological and behavioral traits raise important questions about the evolutionary pressures shaping this species and its congeners. To fully elucidate these patterns, further research is required, particularly experimental studies on predator perception, analyses of phenotypic variation, and broader ecological surveys across the species' range.

Acknowledgements

First of all, we would like to express our sincere thanks to the authorities of Western Caspian University, which made its field base available to us during our stay in Shirvan NP. We thank Jacek Hilszczański (Forest Research Institute, Poland) for identifying Ichneumonidae, and Waldemar Żyła (USMB, Poland) for identifying wasps (Eumenidae, Sphecidae). We would also like to thank our friends and fellow expedition participants, Łukasz Matuszewski and Lech Kruszelnicki, who helped us during the preparations and implementation of scientific research in Azerbaijan.

Funding

The research was supported by the National Science Centre, Poland, under the MINIATURA 7 Project [2023/07/X/NZ8/01584] granted to W. T. Szczepański.

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