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ORIGINAL ARTICLE

FIRST RECORD OF SNAKEFLY FAMILY INOCELLIIDAE (ORDER, RAPHIDIOPTERA) FROM KURDISTAN REGION, NORTH OF IRAQ

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ABSTRACT

The present study reports the first record of the snakefly, family Inocelliidae (Order Raphidioptera) from the Kurdistan Region of Iraq. A specimen identified as *Parainocellia ressli* (Aspöck & Aspöck, 1965) was collected during field surveys in northern Iraq. This record fills a significant distributional gap between populations in Anatolia (Turkey) and western Iran, thereby extending the known range of Inocelliidae within the Western Palearctic. The finding underscores the role of the Zagros Mountains as a biogeographical corridor linking Euro-Siberian, Pontocaspian-Iranian, and Syro-Mesopotamian faunal elements. Given the relictual nature and poor dispersal ability of snakeflies, this discovery highlights the persistence of temperate forest refugia in northern Iraq and emphasizes the Palearctic affinities of its entomofauna. Further targeted surveys are essential to document the diversity and ecological significance of Raphidioptera in Iraq.

Keywords: Fauna, Inocelliidae, Kurdistan Region , *Parainocellia ressli* , Raphidioptera.

INTRODUCTION

Snakeflies (Raphidioptera) were grouped within the order Neuroptera due to their net-veined wings, elongate prothorax, and other superficial similarities to lacewings and antlions .Historically, the *Raphidioptera* was included within the order "Planipennia" (Handlirsch, 1906; Tillyard, 1916), which encompassed all net-winged insects. However, morphological, biological, and molecular research throughout the latter half of the 20th century led to a comprehensive re-evaluation of holometabolous insect phylogeny. Notably, the studies by Aspöck *et al.* (1991) and Aspöck (2002a, b), in conjunction with cladistic analyses and ribosomal DNA sequencing (Whiting *et al*., 1997; Kristensen, 1999), provided evidence that *Raphidioptera* constitutes a distinct, monophyletic lineage. These findings contributed to the formal recognition of the superorder Neuropterida, which now comprises three separate orders: *Raphidioptera*, *Megaloptera*, and *Neuroptera*. This reclassification is now widely accepted and forms the modern systematic foundation for studies on these groups. Raphidioptera are distinguished from Neuroptera primarily by their elongate

prothorax with high head mobility, long ovipositor in females, mobile decticous pupae, terrestrial predatory larvae with prognathous heads, and homonomous narrow wings with a characteristic pterostigma. These unique morphological and developmental features, absent in Neuroptera and Megaloptera, underpin their recognition as a separate order (Kristensen, 1999; Aspöck, 2002b).

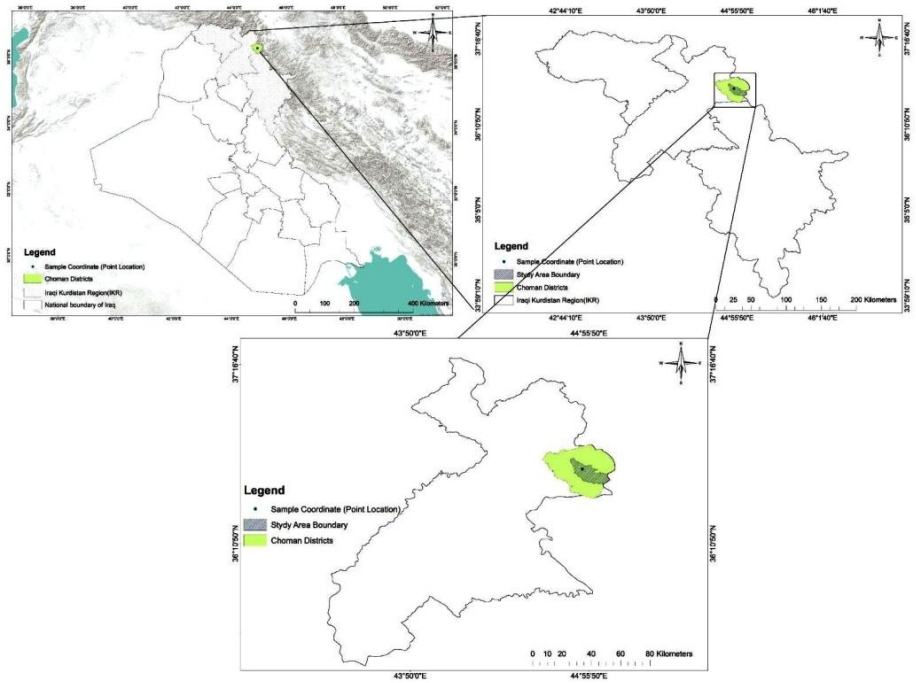
The order Raphidioptera has two extant families: Raphidiidae and Inocelliidae. The highest diversity of snakeflies is centered in the Mediterranean Basin, Anatolia, and adjacent regions of the western Palearctic (Aspöck *et al*., 2001; Canbulat, 2015; Aspöck and Aspöck, 2007, 2023). Snakeflies are effective predators, with all larval stages and Raphidiidae feeding on soft-bodied arthropods, thereby playing an important role in natural pest regulation, larvae of Inocelliidae typically develop beneath tree bark. The family currently comprises 7 extant genera and approximately 44 recognized species, along with one fossil genus (Aspöck *et al*., 1991; Engel 1995; Aspöck *et al.*, 2001). Over recent decades, intensive research across their Palearctic range has also significantly expanded the number of described species (Aspöck, 2002b). The genus *Parainocellia* is distinguished by narrow, elongate forewings**,** and diagnostic male genital morphology (Aspöck *et al*., 1991; Aspöck *et al*., 2012; Shen *et al*., 2022). Inocelliidae are treated in detail in the West-Palearctic catalogue, which provides systematic notes, synonyms, and country-level distributions for all species and subspecies (Aspöck *et al*., 2001). A comprehensive checklist of Turkish Raphidioptera reports that the distribution of the families including 38 species from Raphidiidae and 2 species from Inocelliidae (Canbulat, 2015). Unlike the species diversity documented in Turkey, only four species of Raphidioptera are recorded from Iran, two of which are endemic to the Alborz Mountain forests (Aspöck and Aspöck, 1970; Anderson, 1999). Moreover, no published records confirm the presence of Inocelliidae or *Parainocellia ressli* in Syria, Jordan, Palestine, highlighting a significant distributional gap across the Levant (Aspöck *et al*., 2001; Aspöck *et al*., 2012; Aspöck and Aspöck, 2023). The raphidiopteran fauna of Iraq is very poorly known in comparison to surrounding countries. Most of the available information on the region's fauna comes from older local literature, along with one recently published source, which refers only to the order Neuroptera without mentioning any families within Raphidioptera (Derwesh, 1965; El – Haidari *et al*.,1971; Swailem *et al*., 1974; Stary and Kaddou, 1975; Al-Ali, 1977; Khudhur and Abraham, 2025). Consequently, the two families of the Raphidioptera have remained unreported from the country.

In this study, we present the first confirmed record of *Parainocellia ressli* (Aspöck & Aspöck, 1965) (Family Inocelliidae) for Iraq from the Kurdistan Region. This finding not only expands the known distribution of the species but also fills a significant biogeographical gap in the regional faunal data for Raphidioptera.

MATERIALS AND METHODS

Study area: The specimen was collected in the mountainous region of Sakran village, northern Kurdistan Erbil Province, Choman District (36◦36'28''N, 44◦53'47''E) at an elevation of approximately (1180m) (Map 1). The region is characterized by oak–pine woodlands interspersed with semi-arid steppe.

Sampling and identification: An adult specimen was collected in early May 2021 by visually inspecting tree trunks. The specimen was preserved in 70% ethanol and subsequently examined under a stereomicroscope. Species identification was carried out by sharing photographs online with Professor Horst Aspöck at the Medical University of Vienna, and further confirmation was obtained using the identification keys and morphological illustrations provided in Aspöck *et al.* (1991) and the annotated catalogue by Aspöck *et al*. (2001).



Map (1): Area and sampling points for the newly recorded snakefly *Parainocellia ressli* in the Kurdistan Region of Iraq.

RESULTS AND DISCUSSION

Family: Inocelliidae Navás, 1913

Navás 1913: Neurópteros del R. Museo Zoológico de Nápoles. Annuario del Regio Museo Zoologico della R. Università di Napoli (N.S.), 4(3): 1–11, type genus: Inocellia Schneider, 1843.

It is a small relict group within the order Raphidioptera, distinguished primarily by the absence of ocelli, an elongated prothorax, and wings with net-like venation bearing a pterostigma without cross-veins. Male terminalia without a hypovalva. Adults and larvae are active predators, with larvae typically developing beneath tree bark.

Genus: *Parainocellia* Aspöck & Aspöck, 1968
Aspöck, H. & Aspöck, U. 1964: Entomologisches Nachrichtenblatt, Wien, no. 15.

Parainocellia characterized by elongate forewings with distinct pterostigma lacking cross-veins, and an elongated prothorax typical of Inocelliidae (Aspöck *et al*., 1991). It is distinguished primarily by male terminalia gonocoxite 9 cup-shaped with a short gonostylus 9, and the segment-10 distal complex forming paired, very slender, subparallel digitiform processes with acute apices; gonarcus slender and evenly arched. Adults are montane, associated with forested habitats of the Palearctic Region (Aspöck *et al.*, 2012; Shen *et al*., 2022).

Species: *Parainocellia ressli* (Aspöck & Aspöck, 1965) (Pl. 1)
Inocellia ressli Aspöck & Aspöck 1965: Z. ArbGem. Österr. Entomol., 21: p. 22.
Synonym: *Inocellia ressli*.

Description: Head prognathous, strongly sclerotized, ocelli absent; Antennae filiform, longer than head and pronotum combined; compound eyes large. Prothorax markedly elongate (snake-neck aspect). Wings hyaline with distinct pterostigma; venation reticulate. Abdomen elongate, cylindrical, slightly flattened dorsoventrally, composed of 10 visible segments, ovipositor elongate, aciculate, projecting beyond abdominal apex (Pl. 1).

Material examined: 1♀, Sakran village, 36◦36’28’’N, 44◦53’47’’E, 1180 m, 12.05.2021. Distribution in Iraq: Erbil Province, Choman District, Range: Turkey (S and E Anatolia), Greece (Samos) (Aspöck *et al*., 2001).

Parainocellia ressli distinguished from other related species by the presence of two prominent dorsolateral bristles at the apex of the male surstylus. Adults possess narrow, elongate forewings with a well-defined pterostigma lacking cross-veins (Aspöck *et al*., 1991; Aspöck *et al*., 2001) (Pl. 1). This species was originally described from Anatolia, Turkey, and later recorded from the Greek island of Samos (Aspöck *et al*., 2001; Aspöck *et al*., 2012). The present finding in the Kurdistan Region of Iraq represents the first confirmed record of the family Inocelliidae in the country and provides a key distributional link between populations in eastern Turkey and western Iran. It highlights the Zagros Mountains as a vital biogeographical corridor and emphasizes the Palearctic affinities of northern Iraq’s entomofauna, particularly in forested and mountainous regions. This record provides significant zoogeographical insights, as the region lies within the Palearctic realm of the Holarctic and represents a transitional zone influenced by three major subregions: (1) the Euro-Siberian, represented by cold-adapted montane fauna in the Zagros; (2) the Irano-Turanian (sometimes referred to as Pontocaspian-Iranian), affecting the uplands and forest-steppe; and (3) the Syro-Mesopotamian, which dominates the semi-arid plains (Sagheb-Talebi *et al*., 2014). Although Iraq as a whole is not part of the Euro-Siberian region, the highlands of the Kurdistan Region, particularly within the Zagros Mountains, exhibit clear Euro-Siberian affinities due to their temperate, forested habitats. This transitional setting supports a distinctive assemblage of Palearctic taxa that integrates Euro-Siberian, Irano-Turanian, and Syro-Mesopotamian elements. Our specimen was collected in May 2021 from an oak forested

mountain near a freshwater stream (Pl. 2) Subsequent surveys in the same locality in later years yielded no further specimens, potentially due to climate change and prolonged drought conditions affecting the region. Snakeflies are relict insects restricted to temperate forested areas and have poor dispersal abilities (Aspöck *et al*., 1991).

Their occurrence in northern Iraq indicates the persistence of suitable habitats in the Zagros Mountains, which serve as a biogeographical corridor linking Anatolia and western Iran (Aspöck *et al*., 2001). This record supports recent analyses identifying the Mediterranean and Anatolian regions as major centers of diversity and dispersal for Palearctic snakeflies (Aspöck and Aspöck, 2023). By filling a critical distributional gap for Inocelliidae in the Middle East, it emphasizes the Kurdistan Region as an important Palearctic refuge situated at the intersection of European and Asian faunal elements. Continued, targeted surveys in this underexplored region are likely to yield additional temperate taxa with Euro-Siberian affinities, thereby improving our understanding of the biodiversity and historical biogeography of the western Palearctic Region.

Plate (1): Adult female of *Parainocellia ressli*. [Scale bar: 5mm].

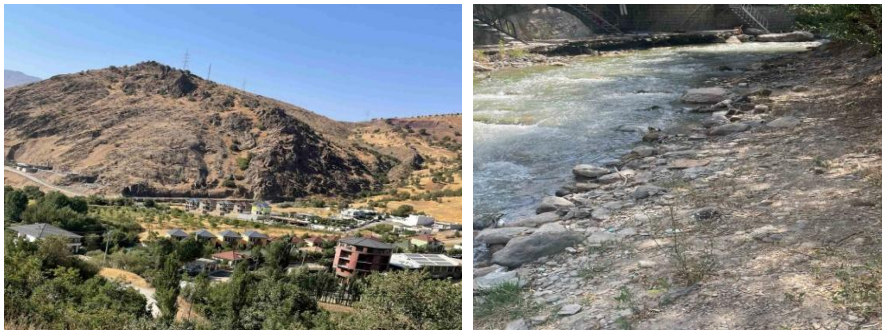


Plate (2): *Parainocellia ressli* collection site, Sakran Village, Choman District, Erbil Province, northern of Kurdistan (36◦36’28’’N, 44◦53’47’’E).

CONCLUSIONS

This study reports the first occurrence of the snakefly family Inocelliidae in Iraq, specifically *Parainocellia ressli* in the Kurdistan region. This record closes a significant

distributional gap between Anatolia and Mesopotamia, underlining the faunal continuity of the region. Further targeted surveys are needed to clarify the diversity and distribution of Raphidioptera in Iraq.

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CONFLICT OF INTEREST STATEMENT

"There are no disclosed conflicts of interest for the author".

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تسجيل اولي لعائلة الذباب الثعباني Inocelliidae (رتبة Raphidioptera) من إقليم كوردستان، شمال العراق

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الخلاصة

وثقت هذه الدراسة أول تسجيل لعائلة Inocelliidae من رتبة Raphidioptera في إقليم كردستان العراق. اذ عثر على نموذج للنوع (Aspöck & Aspöck,1965) *Parainocellia ressli*، خلال المسوحات الحقلية في شمال العراق. يشكّل هذا التسجيل امتداداً توزيعياً مهماً بين تجمعات هذه العائلة في الأناضول (تركيا) وغرب إيران، وبالتالي يوسّع نطاقها المعروف ضمن المنطقة الغربية من الإقليم القطبي الشمالي .وتُبرز هذه النتيجة دور سلسلة جبال زاغروس كممر جغرافي-أحيائي يربط بين العناصر الحيوانية الأوروبية السيبيرية، والبحرية القزوينية-الإيرانية، والسورية-الميزوبوتامية. ونظراً للطبيعة الباقية وضعف قدرة الانتشار لدى هذه الحشره، فإن هذا الاكتشاف يدلّ على استمرارية وجود ملاذات بيئية غابية معتدلة في شمال العراق، ويؤكد الانتماء الحيواني للإقليم إلى المنطقة القطبية الشمالية. وتُعدّ المسوحات الميدانية الإضافية ضرورية لتوثيق تنوع رتبة Raphidioptera والأهمية البيئية لها في العراق.