

## Significance of Genitalic Structures in the Classification of Pyrgomorphidae (Orthoptera: Acridoidea) in Fezzan Region of Libya

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### Abstract

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The present study is based on two genera of the family Pyrgomorphidae. Keys to subfamilies, genera and species belonging to this family in Fezzan region are provided based on conventional as well as genitalic characters. The significance of genitalic structures in the classification is also shown. Developed or indistinct condition of fastigial areolae; presence or absence of external apical spine of hind tibia; elongate or quadrate condition of mesosternal lobes; wide or narrow, long or short condition of lateral plates of epiphallus; presence, absence or indistinct condition of Jannone's organs on female subgenital plate; elongate or short condition of apical diverticulum of spermatheca are used for separating subfamilies. Sulcated or flattened condition of frontal ridge; filiform or ensiform condition of antennae; distinct or indistinct condition of fastigial foveolae; ratio of length of metazona and prozona of pronotum; presence or absence of median or lateral carinae, number of transverse sulci crossing dorsum of pronotum; length of inner hind tibial spurs in relation to external spurs and basal-tarsal segment; broad or narrow condition of bridge of epiphallus; shape of posterior margin of female subgenital plate; toothed, tuberculate or smooth condition of ovipositor valves; length of lateral apodeme in relation to the dorsal valves are suggested as useful generic characters. The specific characters body colour, sculpture, presence or absence and number of tubercles on pronotum, shape of egg-guide of female subgenital plate, shape of ovipositor valves and their apical tips, shape of male supra-anal plate and cerci, size of anterior and posterior lobes of lophi, shape of apical valves of aedeagus were used.

**Key words:** Genitalia, Classification, Pyrgomorphidae, Acridoidea, Fezzan region, Libya.

### Introduction

The name of Pyrgomorphiden was proposed by Brunner Von Wattenwyl (2) based on the genus *Pyrgomorpha* Serville (20). The family-group names: Poekiloceridae and Phymateidae proposed by Burmeister (3) have priority over Pyrgomorphiden. However, these were rejected and replaced by Pyrgomorphidae which has been accepted by all the recent workers in this field. The recent workers, namely, Clamente *et al.* (4), Gracia and Presa (8), Harz (9), Kevan *et al.* (11, 12, 14, 15, 16), Llorente (17), Mason (18) and Willemse (26) recognized Pyrgomorphidae as distinct family of Acridoidea. Dirsh (7) recognized Pyrgomorphidae as a family of Pamphagoidea under his newly erected order Acridomorpha. This was followed by Willemse and Kruseman (27) and Herrera & Schnidrig (10). The present authors uphold recent workers in treating Pyrgomorphidae as distinct family of the superfamily Acridoidea.

The system of classifying Acridoids by earlier workers was mainly based on easily recognizable externally visible characters, namely shape, size, colouration, texture, number of antennal segments etc. The recent trend in Acridoid systematics is mainly based on genitalic characters especially of phallic complex. This has resulted in a profound change in the systematic concept of this group. The genitalic structures particularly epiphallus, aedeagus and spermatheca are less affected than the external characters by environmental conditions. A comparative study of these characters may therefore help to trace the interrelationship of the groups more clearly than the external characters.

A review of literature shows that in recent years the taxonomic significance of different structures of male and female genitalia in the classification of Acridoidea have been shown by various authors. Kevan *et al.* (12, 13, 14, 15, 16) illustrated female subgenital-plate and recepticulum seminis in various genera of Pyrgomorphidae. A comparative study of female genitalia in some Indian species of Pyrgomorphidae and the taxonomic significance of ovipositor in some Indian species of Acridoidea was reported

by Usmani and Shafee (23, 24). Dirsh (5) made taxonomic studies on phallic complex in Acridoidea and made a comparative study of epiphallus in various families and subfamilies of Acridoidea. He erected many new families and subfamilies on the basis of epiphalli. Extensive studies on phallic complex on all known genera of Pyrgomorphidae in order to establish the relationship existing between them was published by Kevan *et al.* (11, 12, 13, 14, 15, 16). Ajaili & Usmani (1) have shown the taxonomic significance of epiphallus in some Libyan species of Acridoidea. The taxonomic significance of a number of morphological traits in the classification of Acridoidea has been reported (5, 6, 25), and their use in differentiating Libyan species was published more recently (21, 22).

This study aims to present a classification of Pyrgomorphidae of Fezzan along with keys to subfamilies, genera, and species based on certain morphological aspects of male and female reproductive organs which together with other conventional characters have made the identification of genera and species more precise and convenient.

### Material and methods

Adult grasshoppers of both sexes were collected from the fields of Fezzan, Libya during 1994-1995. For the study of genitalia, the apical parts of male and female bodies were cut off and boiled in 10% KOH solution till the material became transparent. These were later washed thoroughly in water for complete removal of KOH, and dissected with the help of fine needles under a stereoscopic microscope in order to take out the genitalic structures. Then normal process of dehydration was followed and clearing was done in clove oil. The subgenital plate, spermatheca, aedeagus, supra-anal plate and cerci were mounted in Canada balsam on cavity slides under a 22 mm square cover glass while the epiphallus and ovipositor were mounted in Canada balsam on another slide and oriented to the required position without cover glass. Drawings were done with the help of a lucida Camera.

## Results and Discussion

### 1. Family Pyrgomorphidae Brunner

Pyrgomorphidae Brunner, 1874: 225.

Type genus: *Pyrgomorpha* Serville, 1838

#### Diagnosis

Size small to large; body of variable form, form short and sturdy, cylindrical, fusiform to narrow cylindrical; head acutely conical or elongated conical; fastigium of vertex of variable shape; fastigial furrow present; fastigial foveolae absent; fastigial areolae mostly present; antennae filiform or ensiform; dorsum of pronotum of various shapes; prosternal process present; mesosternal interspace of variable form, open or closed; tympanum normally present; tegmina and wings fully developed, shortened or absent; lower basal lobe of hind femur usually longer than upper one; Brunner's organs normally present; external apical spine of hind tibia present or absent; no stridulatory mechanism known; aedeagus (Figs. 1G, 2H, 3C) paired, undivided with basal and apical valves usually contiguous, joined only by membrane of endophallic sac, apical valve upcurved with acute apices, basal valve robust, widened laterally with rounded end, flexure and gonopore process absent; spermatophore sac sclerotized in dorsal position; epiphallus (Figs. 1F, 2F, 3B) bridge-shaped, robust and strongly sclerotized with dorso-lateral appendages, ancorae completely absent, lophi hook-like, strongly sclerotized, lateral plates with strong posterior projections, oval sclerites absent; spermatheca (Figs. 1C, 2D, 3F) of variable forms mostly with a single diverticulum, sometimes with small or large pre-apical diverticulum; posterior edge of the female subgenital plate never fused with the floor of the genital chamber; Jannone's organs present,

indistinct or absent, egg-guide well developed; ovipositor valves short, robust and curved at apices.

The family Pyrgomorphidae is represented by two subfamilies from Fezzan. A key for their separation is given.

### 2. Key to subfamilies of Pyrgomorphidae Brunner, based on specimens collected in Fezzan

Body never very large, fusiform to elongate fusiform; pronotum smooth, finely rugose or finely granulose; tegmina and hind wings variable in degree of development; mesosternal interspace mostly open, usually quadrate; external apical spine of hind tibia absent; Jannone's organs on female subgenital plate distinct, posterior margin distinctly serrated (Figs. 1B, 2B); mesial tooth on ventral valve of ovipositor present (Figs. 1D, 2C); bridge of epiphallus broad, lateral plates short and broad, posterior projections small and angular (Figs. 1F, 2 F) .....

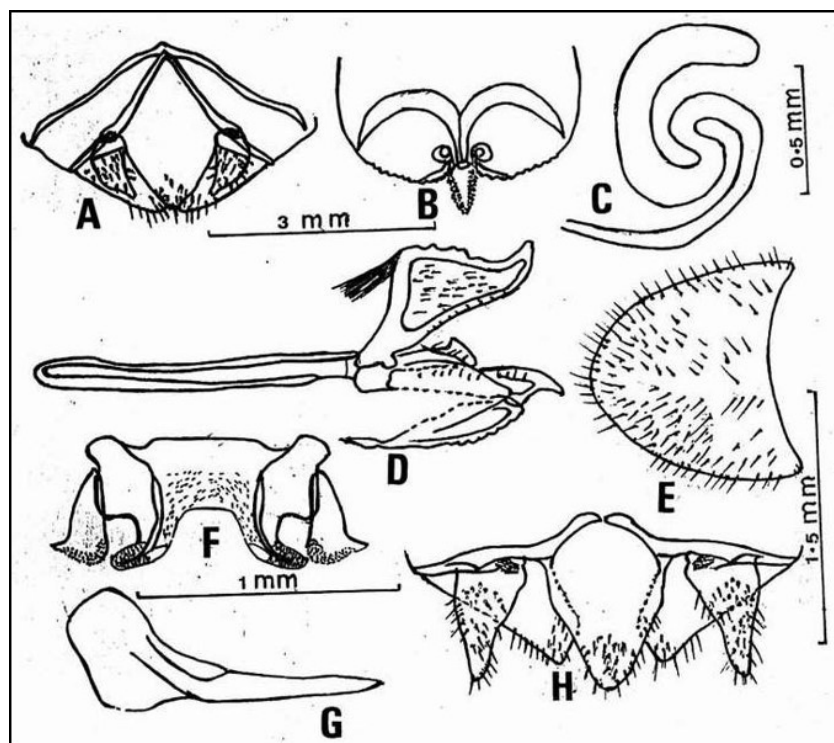
..... PYRGOMORPHINAE BRUNNER, 1874

1. *Pyrgomorpha* Serville, 1838

Body large and robust, subfusiform; pronotum rugosely punctate, never armed with spines or tubercles; tegmina and hind wings always well developed, usually surpassing the abdomen; mesosternal interspace open, elongate, rarely quadrate; external apical spine of hind tibia present, Jannone's organs on female subgenital plate indistinct, posterior margin faintly serrated (Fig. 3D); mesial tooth on ventral valve of ovipositor absent (Fig. 3E); bridge of epiphallus narrow, lateral plates long and narrow, posterior projection indistinct (Fig. 3B) .....

..... POEKILO CERINAE BURMEISTER, 1840

2. *Poeciloceris* Serville, 1831



**Figure 1.** A-H. *Pyrgomorpha cognata* Krauss. A= Supra-anal plate and Cerci, ♀; B= Subgenital plate, ♀; C= Spermatheca, ♀; D= Ovipositor, ♀; E= Subgenital plate, ♂; F= Epiphallus, ♂; G= Aedeagus, ♂; H= Supra-anal plate and Cerci, ♂.

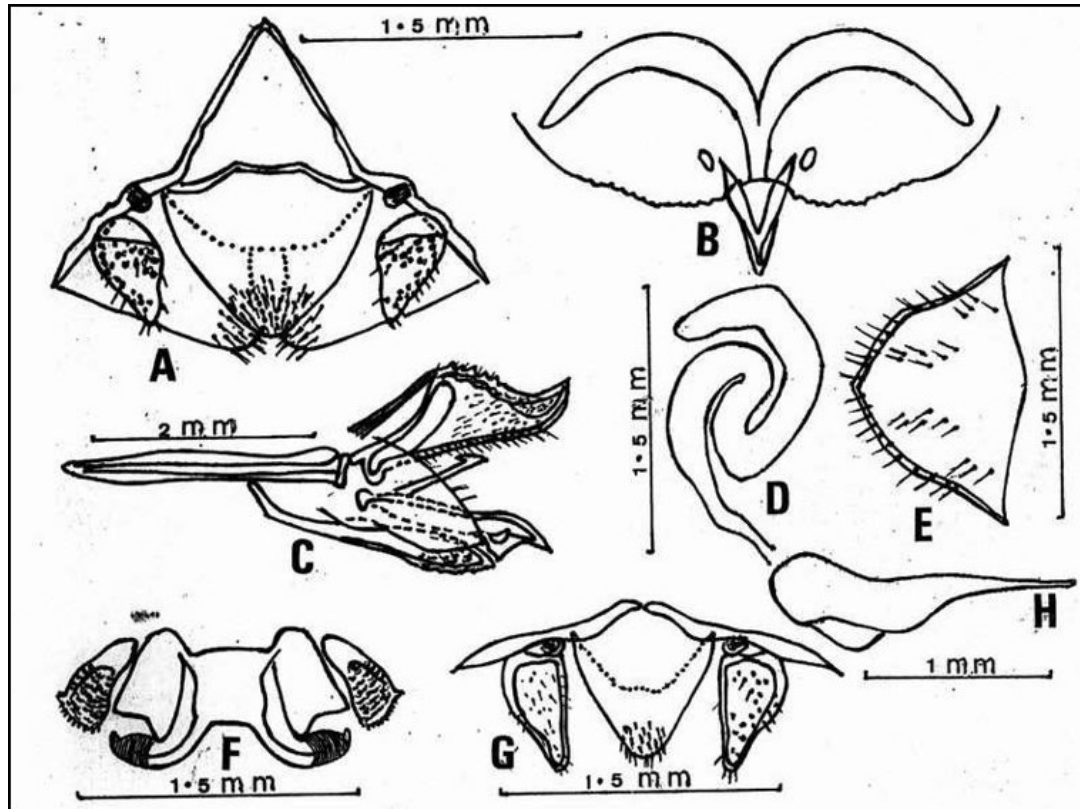


Figure 2. A-H. *Pyrgomorpha conica* (Olivier). A= Supra-anal plate and Cerci, ♀; B= Subgenital plate, ♀; C= Ovipositor, ♀; D= Spermatheca, ♀; E= Subgenital plate, ♂; F= Epiphallus, ♂; G= Supra-anal plate and Cerci, ♂; H= Aedeagus, ♂.

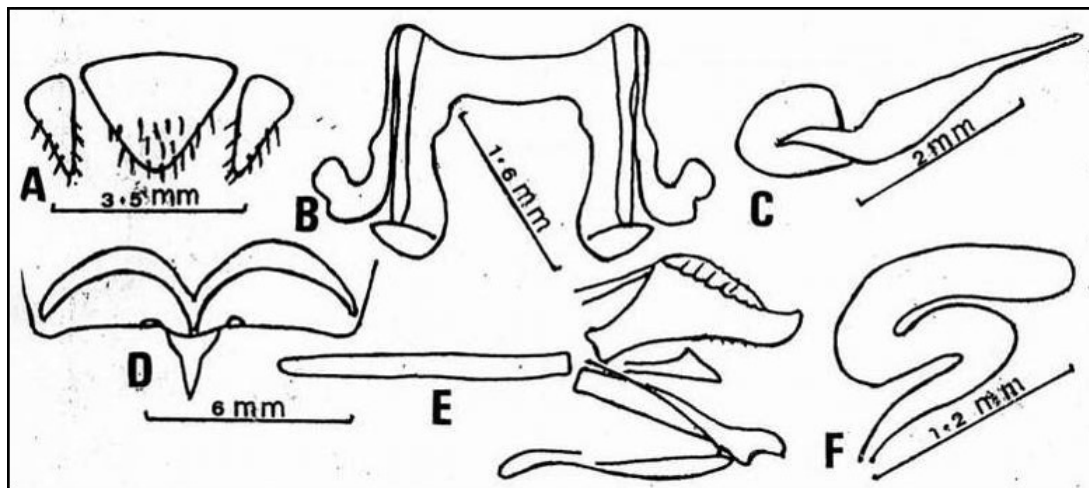


Figure 3. A-F. *Poekilocerus bufonius hieroglyphicus* (Klug) A= Supra-anal plate and Cerci, ♂; B= Epiphallus, ♂; C= Aedeagus, ♂; D= Subgenital plate, ♀; E= Ovipositor, ♀; F= Spermatheca, ♀.

### 3. Genus *Pyrgomorpha* Serville, 1838

The genus is represented by two species from Fezzan.

#### Key to species of the genus *Pyrgomorpha* serville recorded from Fezzan

Antennae subfiliform; posterior lobe of pronotum without lateral carinae; lateral pronotal lobe with an acute-angle, tooth-shaped, well discernable process on anterior corner of postero-inferior truncate corner, anterior section of lateral lobe of pronotum twice as wide as posterior section

(Steinmann (20); Fig. 3B); arolium shorter (Harz ( 9); Figs. 740, 741); egg-guide short, antero-lateral arms not much developed, apex obtuse-angular (Fig. 1B); valves of ovipositor distinctly shorter than lateral apodeme, dorsal valve with apical tip curved and blunt, external edge serrated, ventral valve with apical tip subacute (Fig.1D); apical valve of aedeagus of uniform width, much longer than basal valve (Fig. 1G); apex of male cercus obtusely-conical (Fig. 1H).  
..... *P. cognata* Krauss, 1877

Antennae distinctly ensiform; posterior lobe of pronotum with lateral carinae; lateral pronotal lobe without an acute-angled, tooth-shaped process on anterior corner of postero-inferior truncate corner, instead, a minute, obtuse-angled protuberance on rounded, anterior portion of corner, anterior section of lateral lobe of pronotum only one and a half times as wide as posterior section (Steinmann (20); Fig. 3D); arolium longer (Harz (9); Figs. 736, 737, 738); egg-guide with outer-lateral arms well developed, apex obtuse-conical (Fig. 2B); valves of ovipositor slightly shorter than lateral apodeme, dorsal valve with apical tip short and subacute, external edge tuberculate, ventral valve with apical tip pointed (Fig. 2C); apical valve of aedeagus narrowing apically with pointed apex, slightly longer than basal valve (Fig. 2H); apex of male cercus obtusely-rounded (Fig. 2G). ..... *P. conica* (Olivier,1791)

**Description of Genitalia**

***Pyrgomorpha cognata* Krauss, 1877**

**Male Genitalia:** Supra-anal plate elongate, longer than wide, apex elongate, broadly rounded; cercus long, broad basally, narrowing apically, incurved and excurved, twice as long as wide, apex obtusely-conical (Fig. 1H). Subgenital plate (Fig. 1E) wide, semi-elliptical, wider than long, apex obtusely rounded. Epiphallus (Fig. 1F), bridge broad, with dorso-lateral appendages and excurved anterior margin, ancorae absent, lophi relatively short and hook-like, anterior projections prominent, lateral plates short and broad, posterior projections small and angular. Aedeagus (Fig. 1G), valves of penis undivided, without flexure, apical valve long, straight, of uniform width, much longer than basal valve, with pointed apex; basal valve widened laterally.

**Female Genitalia:** Supra-anal plate elongate-angular, much longer than wide, apex obtuse-angular; cercus short, broad basally, abruptly narrowing at apical third, incurved, twice as long as wide, apex obtuse-conical (Fig. 1A). Subgenital plate (Fig. 1B) with posterior margin finely serrated, concave in middle, without setae; Jannone's organ one on each side; egg-guide short, antero-lateral arms not much developed, twice as long as wide, apex obtuse-angular. Spermatheca (Fig. 1C) with a single curved, uniformly broad diverticulum. Ovipositor (Fig. 1D) valves robust, curved and distinctly shorter than lateral apodeme; dorsal valve short, broad, two and a half times as long as wide, apical tip curved and blunt, external edge serrated, dorsal condyle less prominent; ventral valve with slope concave, apical tip subacute, mesial tooth present, basal sclerite moderately broad and serrated basally; mesial valve dilated, apical tip small and slightly blunt.

***Pyrgomorpha conica* (Olivier, 1791)**

**Male Genitalia:** Supra-anal plate slightly longer than wide, apex elongate, broadly rounded; cercus broad basally, abruptly narrowing at apical third, twice as long as wide, apex obtusely-rounded, compressed laterally (Fig. 2G). Subgenital plate (Fig. 2E) wide, flattened, wider than long, apex obtuse-angular. Epiphallus (Fig. 2F), bridge broad with dorso-lateral appendages and projecting anterior margin, ancorae absent, lophi relatively short and hook-like, anterior projections prominent, lateral plates short and broad, posterior projections small and angular. Aedeagus (Fig. 2H) undivided, without flexure, apical valve straight, narrowing

apically with pointed apex, longer than basal valve, basal valve widened laterally.

**Female Genitalia:** Supra-anal plate elongate, much longer than wide, apex short, rounded; cercus broad, slightly less than two times as long as wide, apex obtusely-rounded (Fig. 2A). Subgenital plate (Fig. 2B) with posterior margin finely serrated, concave in middle, without setae; Jannone's organs one on each side; egg-guide with outer-lateral arms well developed, broad basally, elongate-angular, slightly less than two times as long as wide, apex obtuse-conical. Spermatheca (Fig. 2D) with a single curved, coiled, uniformly broad diverticulum. Ovipositor (Fig. 2C) valves robust, curved and slightly shorter than lateral apodeme; dorsal valve short, broad, two and a half times as long as wide, apical tip short and subacute, external edge tuberculate; dorsal condyle less prominent; ventral valve with slope deeply concave, apical tip pointed, mesial tooth present; basal sclerite narrow, tuberculate and serrated basally; mesial valve with apical tip small and pointed.

**4. Genus *Poecilocerus* Serville, 1831**

The genus is represented by a single species from Fezzan.

***Poecilocerus bufonius* (Klug, 1832)**

This species was divided into three subspecies by Popov and Kevan (19). They provided a key for their separation. *Poecilocerus bufonius hieroglyphicus* is the only subspecies represented in Fezzan, Libya.

***Poecilocerus bufonius hieroglyphicus* (Klug, 1832)**

**Male Genitalia:** Supra-anal plate broad, wider than long, apex short, broadly rounded; cercus broad basally, narrowing apically, twice as long as wide, apex obtusely conical (Fig. 3A). Subgenital plate obtusely pointed, upturned apically. Epiphallus (Fig. 3B) bridge narrow, undivided, with dorso-lateral appendages and excurved anterior margin, ancorae absent; lophi relatively short and hook-like; anterior projections prominent; lateral plates long and narrow; posterior projections indistinct. Aedeagus (Fig. 3C) undivided, without flexure; apical valve straight, wide, narrowing apically, much longer than basal valve, apex pointed; basal valve widened laterally.

**Female Genitalia:** Subgenital plate (Fig. 3D) with posterior margin faintly serrated, slightly concave in middle; without setae and Jannone's organs; egg-guide broad basally, abruptly narrowing at basal half, slightly less than twice as long as wide. Spermatheca (Fig. 3F) with single curved, somewhat S-shaped diverticulum. Ovipositor (Fig. 3E) valves broad, robust and curved, shorter than lateral apodeme; dorsal valve broad, external edge serrated and tuberculated, dorsal condyle less prominent, apical tip short and pointed; ventral valve with slope deeply concave and small angular, external, lateral projection; mesial tooth absent; basal sclerite narrow, not serrated basally, apical tip short and blunt; mesial valve dilated apically with short and blunt apex.

Kevan *et al.* (14: Fig. 48b) have shown short and apically blunt morphology of the apical valves of the aedeagus. The specimen collected from Murzuk, Fezzan, shows the apical valves long and tapering apically (Fig. 3C).

## المخلص

العجيلي، عبد القادر على ومحمد كامل عثمانى. 2003. أهمية التركيبات الجنسية في تصنيف فصيلة Pyrgomorphidae (Orthoptera: Acridoidea) من منطقة فزان ليبيا. مجلة وقاية النبات العربية. 21: 63-68.

اعتمدت هذه الدراسة على جنسين من فصيلة Pyrgomorphidae، وتم تقديم نبذة مختصرة للفصيلة/العائلة ومفاتيح للفصيلات/العائلات والأجناس والأنواع التابعة لهذه الفصيلة من منطقة فزان، وقد بنيت هذه الدراسة على شكل وتركيب الأجزاء التناسلية، وقد أظهرت أهمية التركيبات الجنسية في تصنيف فصيلة بيرجومورفيدي. حالة الفجوة الأمامية منطوية أو غير متميزة، ووجود أو غياب شوكة القمة الخارجية للقصب الخلفية، وفصوص القص الوسطى مربعة أو مستطيلة الشكل، حالة الصفائح الجانبية للمنطقة العليا من عضو التناسل الذكرى متسعة أو ضيقة، وطويلة أو قصيرة، وحالة عضو جانبي موجود أو غير متميز على الصفيحة تحت الشرجية الأنثوية، وحالة قمة ردوب الكيس المنوي طويلة أو قصيرة، لقد استخدمت للتمييز بين تحت الفصائل، الخدود الأمامية محززة أو مسطحة الشكل، وقرون الإستشعار سيفية أو خيطية الشكل، وحالة النقرة الأمامية مميزة أو غير مميزة، ونسبة طول البروزونا والميتازونا من الظهر الأمامي، ووجود أو غياب سهيم القص الوسطى أو الجانبية، وعدد من الأخاديد العرضية التي تستعرض الظهر الأمامي، وطول الشوكة الداخلية للقصب الخلفية وعلاقتها بالشوكة الخارجية والقطعة القاعدية للرسغ، وحالة القنطرة مستعرضة أو ضيقة على عضو التناسل الذكرى، وشكل الحافة الخلفية للصفيحة تحت الشرجية للأنثى، حالة صمامات آلة وضع البيض مسننة أو مدرنة أو ملساء وعلاقة طول الأبوديم الجانبي بالصمامات الظهرية، قد استخدمت كمميزات للجنس. لون الجلد والنحت، ووجود أو غياب وعدد الدرنات على الظهر الأمامي، وشكل دليل وضع البيض للصفيحة تحت الشرجية الأنثوية، وشكل صمامات آلة وضع البيض ورؤوس قمتها، شكل الصفيحة فوق الشرجية والقرون الشرجية للذكر، حجم الفصوص الأمامية والخلفية للنتوء الخلفي، وشكل قمة صمامات القضيب، قد استخدمت كمميزات للنوع.

كلمات مفتاحية: الجهاز التناسلي، التصنيف، بيرجومورفا، اكريدوايديا، منطقة فزان، ليبيا.

عنوان المراسلة: عبد القادر على العجيلي، قسم العلوم العام، كلية العلوم الهندسية والتقنية، جامعة سبها، ص. ب. 68، براك الشاطي، ليبيا.

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