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The presence of the genus *Pyrausta* Schrank, 1802 (Lepidoptera, Crambidae, Pyraustinae) on the Arabian Peninsula – faunistic and taxonomic notes with description of a new species

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Abstract
The species of the genus *Pyrausta* Schrank, 1802 reported till date from the Arabian Peninsula are listed and reviewed. Till date, two described species have been known from the Arabian Peninsula – *Pyrausta arabica* Butler, 1884 and *Pyrausta phoenicealis* (Hübner, 1818). The external diagnostic character states, the global distributions and the local distributions of these species on the Arabian Peninsula are commented on. On the basis of material collected by the author in Dhofar, the south-western province of the Sultanate of Oman, a third species of the genus is added to the entomofauna of the Arabian Peninsula, which differs significantly in external character states from congeners with related wing patterns. These differences result in the description of a species new to science, *Pyrausta postmediofusalis* sp.nov. The closest related congeners are *Pyrausta mahensis* Fletcher, 1910, *Pyrausta fulvilinealis*, Hampson, 1913, *Pyrausta amboinalis* Pagenstecher, 1884, *Pyrausta phragmatidalis* Hampson, 1908 and *Pyrausta subflavalis* Warren, 1892. The new species is differentiated from these comparative species in the combination of the following external character states: forewing and hindwing grounds concolorous, width, shape and connectedness of the antemedial, postmedial and subterminal lines in the forewing and absence of lines in the hindwing. In internal character states the new species is unique in the projected basal costa of the valva, the sclerotizations in the basal and postbasal uncus, in the shape of the juxta and in the shape of the cornutus.

Keywords: Pyraloidea, taxonomy, morphology, fauna, distribution, Oman

Introduction
The genus *Pyrausta* Schrank, 1802, the type genus of the subfamily Pyraustinae (Lepidoptera, Crambidae), comprises at present 341 described species and is thus the most diverse genus in the subfamily (Mally *et al*., 2019; Nuss *et al*., 2022) [1, 2]. The genus has a world-wide distribution.
The genus is strongly heterogeneous in the wing pattern, which varies from unicolorous patterns bare from maculation to patterns with line markings with or without presence of cellular spots. The ground scaling spans a spectrum comprising white, red, yellow, darkish brown and black (Slamka, 2013; Maes, 2009) [3, 4]. In the genitalia, however, the genus is subject to little variation. All the species of the genus show uniform characters in the shape of the uncus and in the inner structure of the valva. Characters for specific differentiation in the male genitalia are the shape of the apex of the valva, the shape of the juxta and the number and shape of cornuti (Maes, 2009; Kim *et al*., 2002) [4, 5]. Species identification is thus based primarily on external differential character states in the wing pattern.
A world-wide revision of the genus has not been done till date. Partial revisions have been done by Slamka (2013) [3] on the Palearctic zone, by Maes (2009, 2014) [4, 6, 7] on the Afrotropical zone, by Kim *et al*. (2002) [5] on the Oriental zone and by Munroe (1976, 1995) [8, 9] on the Neotropical zone. Most recent descriptions of new species from the Middle East (Palearctic zone) are given in Kemal, Koçak (2018) [10] and in Kemal *et al*. (2020) [11].
On the Arabian Peninsula, three zoogeographic zones intersect, namely the Palearctic, the Oriental and the Afrotropical zones, whereby the Afrotropical zone is predominant in the southern part of the Arabian Peninsula (Oman, Yemen, SW-Saudi-Arabia). For the genus *Pyrausta* Schrank, 1802, a total of 36 species have been reported so far from the Afrotropical zone.

Only two of the Afrotropical species have type localities in zoogeographic zones different from the Afrotropical zone, namely in the Oriental and the Palearctic zones. 23% of the Afrotropical species have distribution patterns endemic to the Malagasy and Mascarene Islands (De Prins, De Prins, 2022) [12]. From the Arabian Peninsula a total of two species has been reported till date. In the present paper, the differential character states and the distribution of the two known species are reviewed. A third species is added based on material collected in Dhofar, the south-western province of the Sultanate of Oman. This species significantly differs in wing pattern from related congeners. These differences result in the description of a species new to science, *Pyrausta postmediofusalis* sp.nov.

Materials and Methods

Sampling

The specimens of the material presented in this paper were collected in a research expedition to Dhofar in November 2021. Monitoring on the Pyraloidea fauna of Dhofar has been done in a total of seven expeditions from 2016 – 2021. One specimen of the sample was captured in the day by means of an entomological hand net. The other specimens were captured by night by means of two light traps. The traps were equipped with lamps each consisting of four UV-power-LEDs spanning a wave length spectrum of 365 nm – 385 nm. The traps were set up in the field at a distance of 100 m from each other. The trapping technique applied is described in Brehm (2017) [13].

Macro-Preparation and Dissection

The adults were photographed with a SONY HX400V after relaxation and subsequent preparation. For examining the genitalia and tympanal organs, dissection, preparation and slide-mounting techniques were applied on the specimens on the basis of the protocol described in Robinson (1976) [14]. The preparation of the tympanal organs and of the genitalia was done under a Motic stereomicroscope (SMZ-171). The slides were photographed with a ToupCam c-mount camera (ToupTek Inc., Zhejiang, China) under a resolution of 18 megapixels. The images were optimized by means of the imaging software Adobe Photoshop PS, Version 21.0.2.

Morphological Analyses

Analysis of wing pattern characters and morphological structures in the specimens of the sample was done on the images. Structural ratios in external characters, genitalia and tympanal organs were calculated on the images by means of the imaging software ToupView, Version 1.0 (ToupTek Inc., Zhejiang, China).

The specimens of the sample were compared with the types of the Afrotropical, Oriental and Palearctic species of the genus as listed in Nuss *et al*. (2021) [2], Slamka (2013) [3] and in De Prins and De Prins (2021) [12] on the basis of type images and original descriptions.

Terminology and Abbreviations

The denotations of the veins follow Shaffer, Munroe (2007) [15]. The descriptions of wing pattern characters, genitalia and tympanal organs follow the terminology in Maes (1995) [16]. Abbreviations: ZSM = Zoological State Collection Munich, Germany.

Results and Discussion

Pyrausta Schrank, 1802

Diagnosis: Small to medium sized moths, strongly varying in coloration and wing maculation. Wingspan interspecifically varying form 12 mm to 30 mm. Antenna filiform ciliate, with the ciliae varying in length. Abdomen slender, exceeding the anal angle of the hindwing. Legs slender, mid-femur thickened in the male, outer tibial spur shorter than the inner one. Forewing subtriangular, R5 not basally approximated to the R3+4 stem. M2, M3 and CuA1 variably spaced around the posterior angle of the cell. Hindwing rounded, M1 and Rs anastomosed. Cell concave distally, with the posterior angle prolonged. M2, M3 and CuA1 variably spaced at the posterior angle of the cell (Kim *et al*., 2002) [5]. Uncus triangular-shaped or simply rounded, with the apex chaetose. Valva simple, with a lobe-shaped, chaetose sella. Transtilla projected medially, concave at the edges. Juxta strongly sclerotized. Cornuti present, varying in shape and size (Maes, 2009; Kim *et al*., 2002) [4, 5].

Pyrausta arabica Butler, 1884

Diagnosis: Wingspan 15 mm. Labial palpus, frons and vertex white. Legs white. Forewing and hindwing ground deep purplish-brown to black. Forewing subterminal line cream-coloured, widened and incurved near the costa. Termen with black, conical interneural spots. Fringe metallic leaden grey (Butler, 1884) [17].

Distribution: Endemic. The records known till date are restricted to the Arabian Peninsula. The type locality is near Aden in Yemen. Further records are known from Northern Oman (Pelham-Clinton, 1977) [18].

Pyrausta phoenicealis (Hübner, 1818)

Diagnosis: Wingspan 14 mm – 16 mm. Vertex with a line of white scales bordering the eye (Asselberg, 2009) [17]. Forewing ground golden-yellowish. Forewing antemedial and postmedial lines present, reddish, strongly incurved medially. Hindwing ground yellowish-grey, with a black postmedial line. Distal uncus narrowed with the apex pointed. Juxta subquadrangular-shaped. Valva rounded obliquely towards the costa. Sella subtriangular-shaped, spatulate. Saccus v-shaped, apically pointed, basally strongly broadened. Vesical surface of the phallus apodeme with several thorn-shaped cornuti differing in size (Kim *et al*., 2002) [5].

Distribution: Pantropical (Landry, 2015; De Prins, De Prins, 2022; Kim *et al*., 2002) [5, 12, 20]. On the Arabian Peninsula the species has been reported from Yemen (Walsingham, Hampson, 1896) [21] and from the UAE (Asselberg, 2009) [19].

Remarks: The species is listed under the taxon *P. panopealis* (Walker, 1895) in Asselberg (2009) [19] and in Kim *et al*. (2002) [5]. The latter taxon has been synonymized with *P. phoenicealis* (Maes, 2014) [7].

Pyrausta postmediofusalis sp.nov.

Zoobank ID: urn:lsid:zoobank.org:act:73671C72-42E1-401D-ADE2-A67B1154927C

Material: Holotype: ♂, Oman, Dhofar, Jebel Samhan, Viewpoint, 1400 m, 05-XI-2021, leg. M. Seizmair, coll. ZSM, slide no. 22GP003. Paratypes: 3♂, same collection data as the holotype, slide no. 22GP004, 22GP005, 22GP007, 1♂, Oman, Dhofar, Ayun Anthoum Waterfalls,

06-XI-2021, 22GP061, leg. et coll. M. Seizmair.

External characters (Fig 1 - 3): Wingspan of the holotype: 22.7 mm. Wingspans of the paratypes: 21.0 mm – 24.1 mm. Head: Flagellum darkish-fuscous, ciliae greyish-white, equal in length with the width of the flagellum. Labial palpus porrect, 1.3 times as long as the diameter of the eye, 2.5 times as long as wide, scaling unicolorous, greyish-white in all segments. Maxillary greyish-white at segment 1, darkish-fuscous to blackish in segments 2 and 3, fulvous in segment 4, acuminate, length relative to the length of the labial palpus 45%, width relative to the width of the labial palpus 38%. Proboscis yellowish-ochreous. Frons and vertex greyish-white. Thorax: Ventrally and dorsally darkish-fuscous to blackish interspersed with greyish scales, laterally greyish-white. Legs whitish-grey. Tegula greyish white. Abdomen: Ventrally and dorsally greyish-white, interspersed with darkish-fuscous scales dorsally in segments A3-A6, exceeding the hindwing tornus by 100% of the length of the anal border. Anal tuft yellowish-white.
Forewing: Oblong, 2.3 times as long as wide, apex rounded, termen and inner border slightly concave, tornus acute. R2 basally very closely approximated to the R3+4 stem. Basal spacing R5-R3+4 relative to the basal spacing R5-M1 90%. Basal spacing M2-M3 relative to the basal spacing M3-CuA1 48%. Upper side: Ground greyish-white irrorated with darkish-fuscous scales. Costa yellowish-fuscous, interspersed with darkish-fuscous scales up to the onset of the antemedial line. Discocellular spot present, darkish-fuscous, very small. Antemedial line, postmedial line and subterminal line present, concolorous, darkish-fuscous, broadened, equal in width, width +/- 1.5 mm, strongly interrupted and diffused. Antemedial line and postmedial line straight. Subterminal line oblique and excurved between costa and R5, straight between R5 and M3, slanted basad between M3 and CuA1, where it is fused with the postmedial line. Terminal line interrupted, darkish-fuscous. Fringe yellowish. Underside: ground pale-yellowish, darkish-fuscous irroration absent, line pattern as for upper side. Hindwing: 1.2 times as long as wide, apex and tornus rounded. Distance of the connection point M1- Sc+R1+Rs-stem relative to the maximum length of the hindwing 50%. Terminal space between CuA1 and CuA2 1.3 times as wide as the terminal spaces between M2-M3 and M3-CuA1, which are equal in width. Upper side: ground concolorous with the ground of the forewing. Antemedial, postmedial, subterminal lines absent. Shape and scaling of the terminal line as for the forewing. Fringe concolorous with the fringe of the forewing. Underside: ground and maculation as on upper side, ground irrorated with yellowish-fulvous scales between the costa and Sc+R1.

Male genitalia (Fig 4-5): Basal and postbasal uncus undifferentiated, broadened, constant in width, ratio length / width 2.15, basal uncus with a bilobed sclerotized structure, with the lobes directed posteriad, postbasal uncus with a triangular-shaped, anteriad-directed sclerite at the transition to the distal uncus. Distal uncus strongly chaetose laterally und dorsally, subtriangular-shaped, with the tip of the apex rounded. Valva oblong, three times as long as wide. Apex obliquely rounded towards the ventral border. Basal costa strongly sclerotized, inflated and projected, with the projection subtriangular-shaped and rounded at the tip. Postbasal ventral border concave. Sella slender, linguiform, flattened, 3.5 times as long as wide. Basal sacculus broadly rounded, lobe-shaped, with an acuminate sclerite ventrally, costal border of the postbasal and distal sacculus sclerotized. Juxta bilobed, with the lobes elongate, three times as long as wide. Saccus rounded, strongly broadened, double as broad as long, with a bilobed sclerotized structure medially. Coremata present, pencil-shaped, strongly sclerotized. Phallus apodeme with an oblong cornutus ranging over the entire length of the phallus, with a bristle of long spicula. Coecum strongly curved.

Female genitalia: The female genitalia are unknown at present.

Tympanal organs (Fig 6): Pons tympani strongly sclerotized at the basis, with a pair of rod-shaped, oblong processes. Fornix tympany broadened, slightly sclerotized. Tergo-sternal sclerite slender, elongate. Rama tympani present, strongly sclerotized, inter-connected. Venula secunda strongly sclerotized, elongate.

Differential diagnosis: The new species is related to *Pyrausta mahensis* Fletcher, 1910, *Pyrausta fulvilinealis*, Hampson, 1913, *Pyrausta amboinalis* Pagenstecher, 1884, *Pyrausta phragmatidalis* Hampson, 1908 and *Pyrausta subflavalis* Warren, 1892 by the following external character states: wingspan > 20 mm, presence of forewing antemedial – postmedial – subterminal lines, presence of a discocellular spot, ground of the hindwing concolorous with the ground of the forewing, ground pale, yellowish-grey to whitish, scaling of the abdomen white.
The new species is differentiated from each of the comparative species by the following character states: Scaling of the labial palpus: unicolorous in the new species (greyish-white) and in *P. subflavalis* (yellowish-white), bicolorous in each of the other comparative species: anteriorly fuscous, white at the base in *P. mahensis*, *P. fulvilinealis*, *P. amboinalis*, anteriorly rufous, white at the base in *P. phragmatidalis*. Scaling of the frons, vertex and the thorax: greyish-white in the new species, in *P. amboinalis* and in *P. phragmatidalis*, white interspersed with fuscous scales in *P. fulvilinealis*, yellowish in *P. subflavalis*, greyish-fuscous in *P. mahensis*. Shape of the forewing antemedial – postmedial – subterminal lines: antemedial and postmedial lines straight and interrupted, subterminal line oblique and excurved between costa and R5, angled at M3 in the new species, antemedial and postmedial lines curved and interrupted, subterminal line oblique, slanted towards the termen between costa and CuA1 in *P. mahensis*, antemedial and postmedial lines curved and interrupted, subterminal line excurved between costa and M1, incurved between at CuA2 in *P. fulvilinealis*, antemedial line straight and interrupted, postmedial line oblique and interrupted, subterminal line interrupted and slanted towards the outer border between costa and M2, straight from M2 to the inner margin in *P. amboinalis*, antemedial and postmedial lines oblique and uninterrupted, subterminal line excurved near the costa and angled inwards at M2 in *P. phragmatidalis*, antemedial line angled, postmedial line straight, subterminal line oblique, slanted towards the outer margin from the costa to M2, angled at M2 in *P. subflavalis*. Width of the forewing antemedial-postmedial-subterminal lines: antemedial, postmedial and subterminal lines equal in width, width equal or less 1.0 mm

in *P. mahensis*, *P. fulvilinealis*, *P. amboinalis*, *P. phragmatidalis*, postmedial and subterminal lines broadened, width +/- 2.0 mm, antemedial line narrowed, width +/- 1.0 mmm in *P. subflavalis*, antemedial, postmedial and anteterminal lines equal in width, width +/- 1.5 mm in the new species. Connectedness of the lines: subterminal line and postmedial line connected in the new species and in *P. subflavalis*, subterminal line connected with the terminal line at CuA1 in *P. mahensis*, lines unconnected in *P. amboinalis*, *P. fulvilinealis* and in *P. phragmatidalis*. Shape and scaling of the forewing terminal line: darkish-fuscous and interrupted in the new species, suffused with a broad darkish-fuscous band in *P. mahensis*, blackish, thin and uninterrupted in *P. amboinalis*, fulvous, thin and uninterrupted in *P. fulvilinealis* and in *P. phragmatidalis*, absent in *P. subflavalis*. Scaling of the costa: yellowish in the new species, in *P. fulvilinealis* and in *P. subflavalis*, darkish-fuscous between the basis and the onset of the postmedial line in *P. amboinalis*, rufous in the basal area in *P. phragmatidalis*. Presence of hindwing postmedial – subterminal lines (1: present, 0: absent): 0-0 in the new species, 1-1 in *P. mahensis*, *P. fulvilinealis*, *P. phragmatidalis*, 0-1 in *P. amboinalis* and in *P. subflavalis*.

The new species is furthermore related to *P. phoenicealis* and *P. contugualis* Leech & South, 1901 in the broadened antemedial and postmedial lines, to *P. contigualis* in the absence of hindwing lines. From these two species the new species is unmistakably distinguished in the following external character states: wingspan: < 20 mm in each of the two comparative species, > 20 mm in the new species, forewing ground and hindwing ground concolorous in the new species, of different colouration in each of the two comparative species, forewing ground greyish-white in the new species, yellowish to yellowish-fuscous in *P. contigualis*, reddish in *P. phoenicealis*, coloration of the forewing lines darkish-fuscous in the new species, reddish in *P. phoenicealis* and in *P. contigualis*.

The male genitalia of the new species are unique with regard to the known male genitalia of Palearctic, Oriental and Afrotropical congeners as described and figured in Slamka (2013) [3], Maes (2009, 2014a) [4, 6], Kim *et al*. (2002) [5], Kemal, Koçak (2018) [10] and Kemal, Kızıldağ, Koçak (2020) [11] in the projected basal costa (Fig 5A), the sclerites in the basal and postbasal uncus (Fig 5B), the oblong lobes of the juxta (Fig 5C) and the row of spicula in the cornutus (Fig 5D).

The male genitalia of the comparative species *P. mahensis*, *P. fulvilinealis*, *P. amboinalis*, *P. phragmatidalis* and *P. subflavalis* are unknown at present. The male genitalia of *P. phoenicealis* are illustrated in Kim *et al*. (2002) [5].

Bionomics: The major part (3 specimens) of the type material was captured at night by UV-light on a grassy plateau interspersed with rocks and shrubs in the coastal mountain system of Dhofar. Another specimen was captured in the day on terrain densely overgrown with various grasses and interspersed with trees.

Distribution: Only known from the type locality in the coastal mountain system of Dhofar.

Etymology: The epitheton refers to one of the external character states, the fusion of the subterminal line with the postmedial line.

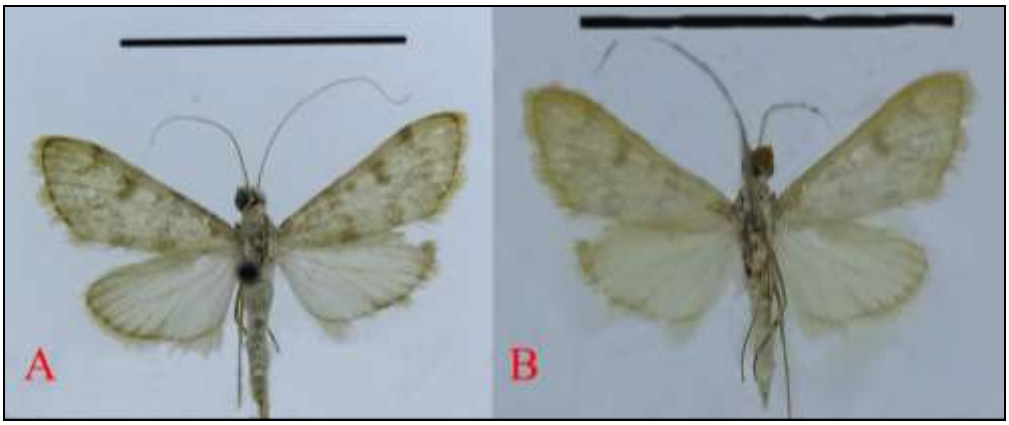

Fig 1: *Pytausta postmediofusalis* sp.nov. – male adult holotype, Oman, Dhofar, Jebel Samhan, Viewpoint, 1400 m, 05-XI-2021, leg. M. Seizmair, coll. ZSM. A: upper side. B: underside. Scale bar = 20mm.

Fig 2: *Pytausta postmediofusalis* sp.nov. – head profile, holotype. A: lateral view. B: dorsal view.

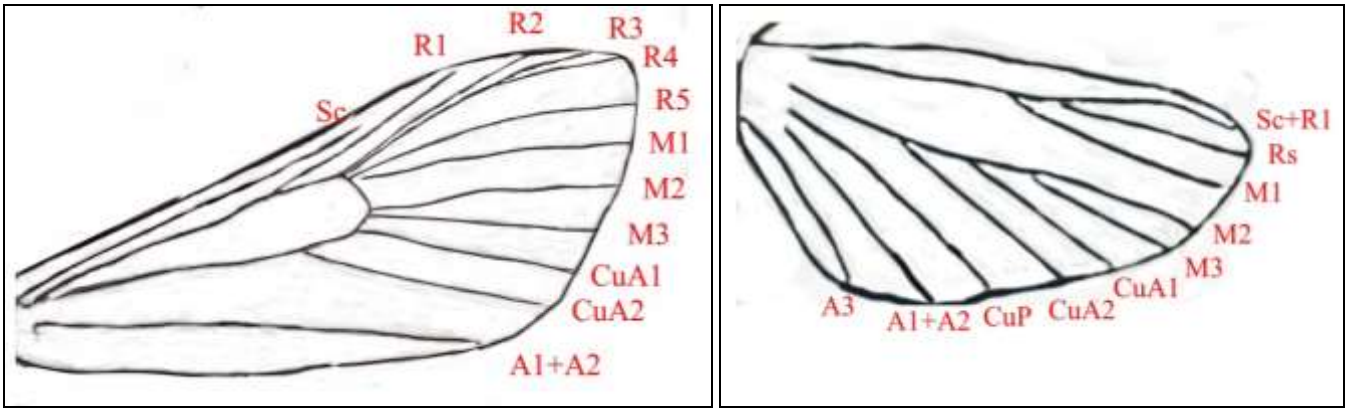

Fig 3: *Pytausta postmediofusalis* sp.nov. – Forewing and hindwing venation

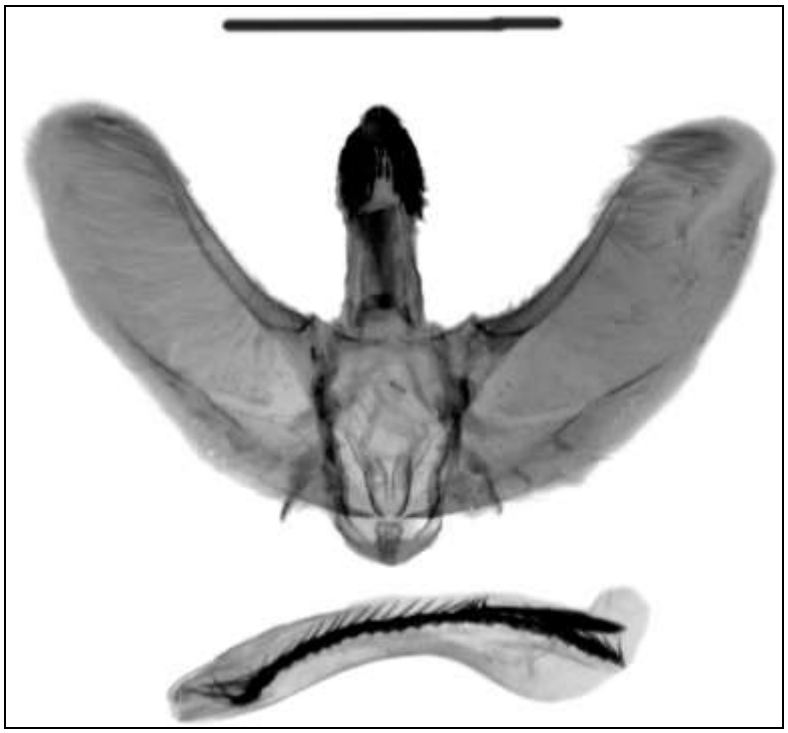

Fig 4: *Pytausta postmediofusalis* sp.nov. – Paratype, slide no. 22GP004, male genitalia. Scale bar = 2 mm

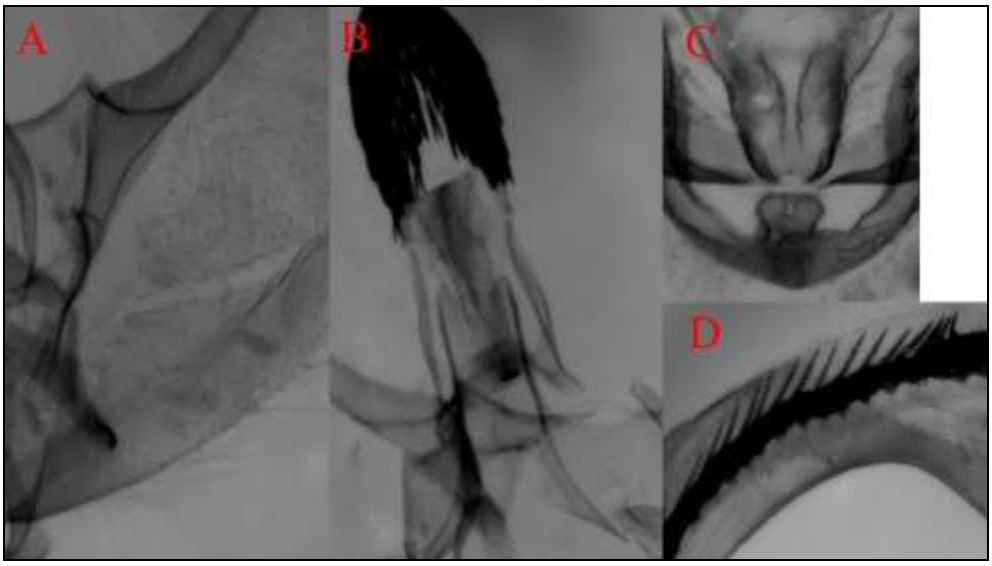

Fig 5: *Pytausta postmediofusalis* sp.nov. – Paratype, slide no. 22GP004, close-ups, male genitalia. A: Right transtilla, right valva – postbasal costa, sella. B: Uncus. C: Juxta, saccus. D: Cornutus, spicula.

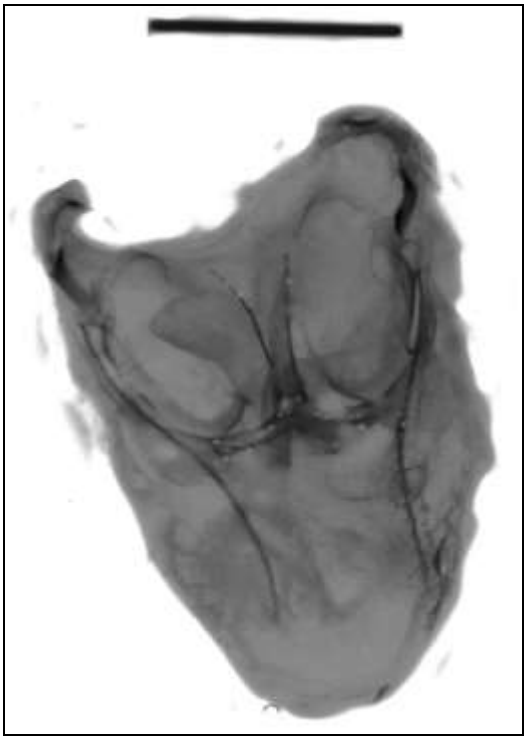

Fig 6: *Pytausta postmediofusalis* sp.nov. – Holotype, slide no. 22GP003, tympanal organs. Scale bar = 1 mm.

3. Conclusion

The species of the genus *Pyrausta* Schrank, 1802 on the Arabian Peninsula were reviewed. From the Arabian Peninsula a total of two species has been reported till date – *P. arabica* and *P. phoenicealis*. A third species *Pyrausta postmediofusalis* sp.nov. Was described as new for science. The new species differs significantly from related congeners in the fore- and hindwing line patterns, with the width, shape and connectedness of the forewing lines and the absence of hindwing lines being the main external differential character states. Furthermore, the new species is unique with regard to known male genitalia of Afrotropical, Oriental and Palearctic species in the projected basal costa of the valva, in the shape of the juxta and in the spiculose cornutus.

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