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Revision of the *Idaea inquinata* (SCOPOLI, 1763) species-group s. str. from the Middle East (Lepidoptera, Geometridae, Sterrhinae)

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Abstract

The *Idaea inquinata* (SCOPOLI, 1763) species-group s. str. with four, closely related species in the Middle East is revised. All type specimens of this group have been examined. The status of *adherbariata* STAUDINGER, 1898 as subspecies of *I. inquinata* is confirmed. The taxon *banghaasi* PROUT, 1934 is downgraded from species rank to subspecies of *I. inquinata* (**stat. n.**). Morphological diagnoses are given for the four species *I. inquinata*, *I. holliata* (HOMBERG, 1909), *I. affinitata* (BANG-HAAS, 1907), and *I. saida* (WILTSHIRE, 1968). Lectotypes are designated for the taxa *subherbariata* STAUDINGER, 1897 (with replacement name *adherbariata*), *fimbriata* BANG-HAAS, 1907 (with replacement name *banghaasi*), *holliata* HOMBERG, 1909, and *affinitata* BANG-HAAS, 1907. *I. saida* is new for the fauna of Israel.

Introduction

The *Idaea inquinata* (SCOPOLI, 1763) species-group s. str. consists of some closely related taxa in the Middle East, which differ from the rest of the ‘*inquinata* species group’ by the presence of fringe dots rather than terminal dots, the presence of a pencil at the ♂ hindtibia and the granulated vesica in ♂ genitalia (HAUSMANN, 2004).

All these taxa are very similar to each other, and could hardly be identified correctly on the basis of published information and illustrations, until now (HAUSMANN 1991: 125; HAUSMANN 2004: 129, 131f.). The aim of this paper is to provide information on the type specimens, in order to improve our understanding of this problematic group and to stabilise the usage of the names. Fortunately I have at disposition a lot of additional material from various countries of the Levant, which allows analysis of morphology and geographical variation.

Interestingly enough, all the three ‘sister species’ of the plurivoltine *I. inquinata* seem to reveal as univoltine species with typical, comparatively sharp main flight periods.

Abbreviations:

BMNH	The British Museum (Natural History), London, United Kingdom
MNHN	Musée National d'Histoire Naturelle, Paris, France
MNHU	Museum für Naturkunde, Humboldt-Universität zu Berlin, Germany
NHMW	Naturhistorisches Museum, Wien, Austria
ZSM	Zoologische Staatssammlung München, Germany

Idaea inquinata (SCOPOLI, 1763)

Phalaena inquinata SCOPOLI, 1763: Ent. Carniolica: 230, Fig. 576 (north-western Slovenja: Carniolia). Syntype(s) lost.

‡ *Acidalia subherbariata* STAUDINGER, 1897: Dt. ent. Z. Iris 10 (1): pl. 4, Fig. 31 (Israel: ‘Jordan valley’, probably near Jerico). Lectotype ♂ (MNHU, examined: ‘Jordan [valley], [18]96, Paul[us]’, gen.prp. Hausm.

23549) herewith designated. Paralectotypes 4 ♂ 2 ♀ from type locality and 'Jerusalem'. Junior primary homonym nec RÖSSLER, 1877 (identity: *Idaea subsaturata*).

Acidalia herbariata var. ? *adherbariata* STAUDINGER, 1898: Dt. ent. Z. Iris 10 (2): 306 (Israel: 'Jordan valley', probably near Jerico). No separate types. Replacement name for *subherbariata*. Valid at subspecific rank (HAUSMANN 2004; in SCOBLE 1999 at species rank).

‡ *Acidalia fimbriata* BANG-HAAS, 1907: Dt. ent. Z. Iris 20: 81, pl. 3, Fig. 19 (Lebanon: Beirut). Lectotype ♀ ('Beirut', labelled as 'Orig'; in MNHU no further type specimens), herewith designated, no paralectotypes traced. Junior secondary homonym of *Geometra fimbriata* DENIS & SCHIFFERMÜLLER, 1775 (identity: *Idaea biselata*).

Sterrha banghaasi PROUT, 1934: Lepid. Cat. 63: 383. No separate types. Replacement name for *fimbriata*. Herewith downgraded to subspecific rank, **stat. n.** (in SCOBLE 1999 as separate species). Further synonymy see Hausmann 2004.

Habitus and external morphology (Figs. 1, 2, 5 - 8): for nominate subspecies see HAUSMANN (2004: 129 - 132, Figs. 56a - f; gen. fig. 56 male and female). Wingspan of *I. i. adherbariata* and *I. i. banghaasi*: ♂ ♀ 14 - 17 mm, exceptionally up to 20 mm. Wings glossy sand coloured. Dark suffusion on wings usually absent or scarce. Antemedial and postmedial lines brown, diffuse. Terminal area with brown spots, slightly diffuse, but in strong contrast to the light ground colour. Postmedial line often at more basal position than in the other species. Cell spots fine. In Arava valley transverse lines darker and comparatively sharp, spots in terminal area dark grey brown, confluent. Frons dark brown, palpi sand coloured, often with darker tip. Vertex and collar sand coloured. Proboscis developed. Antennae of ♂ ciliate - setose, cilia comparatively long in populations from Rhodos, Cyprus, Israel and Jordan (*I. i. banghaasi* and *I. i. adherbariata*): 0.75 - 1.15 times width of flagellum, in two examined ♂♂ from Arava valley particularly long, 1.05 and 1.36 times width of flagellum (see Tab. 1). Hindtibia of ♂ slender, with weak pencil. Tarsus as in nominate subspecies 0.3 - 0.5 times length of tibia (see Tab. 1), in one ♂ examined from Tunisia 0.25 times only.

Male genitalia (Figs. 14, 15): Uncus slender. Valva slightly curved at ½, with one dorsal and one ventral spinule at tip. Aedeagus short, with two short, narrow and straight cornuti, one with base curved at an angle of 180°. Populations from Mt. Hermon with longer cornuti, one of them slightly curved (approaching shape of *I. holliaata*), base of cornuti not curved. Populations of Arava valley with one cornutus truncate at half length. As correctly outlined in WILTSHIRE (1968), the male genitalia figured in STERNECK (1940) under the name '*banghaasi*' are misidentified and refer to *Idaea holliaata*.

Female genitalia (Figs. 20 - 23, Tab. 2): Antrum strongly sclerotized, widely dilated with lateral endings tapering, cup-shaped. Ductus bursae short and comparatively narrow. Appendix bursae closely attached to corpus bursae at posterior end. Corpus bursae with posterior spinose crest comparatively short and broad. In the populations from western Israel to the Lebanon (*I. i. banghaasi*), antrum less dilated and more rounded, approaching shape of *I. holliaata*.

Differential diagnosis: This species can be distinguished from the others by (1) the paler, sand coloured, and slightly shiny ground colour, (2) fine cell spots, (3) absence of polychroism, i.e. no forms with black brown basal area of wings, (4) more basal position of the postmedial line on the forewing, (5) longer ♂ antennal cilia (Tab. 1), (6) shorter cornuti in ♂ genitalia, one of them with strongly curved basal sclerite, and (7) the width of the female antrum >1.9 times width of ductus bursae (Tab. 2). *I. affinitata* and *I. holliaata* are smaller than *I. inquinata*, on average. Antennal cilia in nominate subspecies of *I. inquinata* 0.5 - 0.65 times width of flagellum only.

Distribution: *I. i. adherbariata* with wide distribution in the Levant: western Syria, Lebanon, all regions of Israel, northern and western Jordan, northern Egypt and eastern Libya (Cyrenaica).

Distribution of nominate subspecies: West-Palaeartic. Widely distributed in Europe (see map in HAUSMANN 2004), in the east to Crimea and western European Russia. Recorded from all larger Mediterranean islands including Malta and Rhodos. Outside Europe from Morocco to Tunisia, from Turkey and Cyprus across Caucasus, Transcaucasus and northern Iran to central Asian mountains (HAUSMANN 2004).

Replaced by *I. i. banghaasi* in the northern Levant, i.e. from north-western Syria and Lebanon to western Israel. Replaced by *I. i. adherbariata* in the southern Levant, i.e. from south-westernmost Syria, north-western Jordan, Dead Sea region, and Arava valley to northern Egypt, and eastern Libya (Cyrenaica).

Phenology: The species is bi- or plurivoltine in most parts of the distribution (compare HAUSMANN 2004: 131). *I. i. adherbariata* bi- or plurivoltine from mid-March to mid-October (n = 38), but no data from July to September, to date. Scarce data of *I. i. banghaasi* ranging from mid-March to late June (n = 8).

Remarks: Antrum in female genitalia of *I. i. banghaasi*, and the male genitalia of populations from Mt. Hermon approaching shape of *I. holliata*, though the males of these populations have long antennal cilia, similar to *I. i. adherbariata*. Habitus is intermediate, sometimes, i.e. with some dark suffusion, but without polychroistic, basally dark coloured forms. This mosaic feature pattern raises the question whether hybridisation of *I. i. banghaasi* with *I. holliata* occurred in evolution, possibly.

Idaea holliata (HOMBERG, 1909)

Acidalia holliata HOMBERG, 1909: Bull. Soc. ent. Fr. 1909 (13): 229 (NW. Syria: Maydan Ikbis ('Akbès')). Lectotype ♂ (ZSM/HERBULOT, Akbès, gen.prp. G 14403, examined), herewith designated. Paralectotypes ♂♀ from type locality in MNHN.

Habitus and external morphology (Figs. 3, 9, 10): Wingspan ♂♀ usually 10.5 - 15 mm, lectotype and reared specimens from south-western Syria 16 mm. Wings sand coloured, more or less suffused with dark grey brown scales. In 1/3 to 1/2 of the populations the dark suffusion is very strong and dense in the basal area and the basal half of medial area of both wings (polychroism). Antemedial and postmedial lines dark grey brown, usually fine and sharp. Terminal area sometimes with inconspicuous shadows, but often concolorous with ground colour. Cell spots usually distinct. Frons dark brown, palpi brown, vertex and collar sand coloured. Proboscis well developed. Antennae of ♂ ciliate-setose, cilia very short: 0.58 - 0.71 times width of flagellum (see Tab. 1). Hindtibia of ♂ slender, with pencil. Tarsus 0.33 - 0.48 times length of tibia (see Tab. 1).

Male genitalia (Figs. 16, 17): Uncus slender. Valva slightly curved at 1/2, with one dorsal and one ventral spinule at tip. Aedeagus short, with two stout, curved cornuti, arising from broad sclerites.

Female genitalia (Figs. 24, 25, Tab. 2): Antrum narrow, laterally rounded. Ductus bursae broad. Appendix bursae closely attached to corpus bursae. Corpus bursae with posterior spinose crest long and narrow.

Differential diagnosis: Differential features from *I. inquinata*, see above. *I. affinitata* without constant differences from *I. holliata* in habitus and external morphology, but on average larger, flying later and distributed on the central mountain ridge of Israel and Lebanon only. Shape of cornuti in ♂ genitalia, and shape of appendix bursae in ♀ genitalia, however, allow clear distinction between *I. affinitata* and *I. holliata*. *I. sarda* on average larger, with homogenous dark suffusion all over the wings and considerable differences in ♂ ♀ genitalia (Figs. 14 - 27).

Distribution: North-western Syria (locus typicus), with populations in Jordan and Israel, here common in the Dead Sea region and the lower Jordan valley, but, rarely, also in the adjacent mountains, such as Bet Lehem or Amman. Some records from south-western Syria (near Dar'a) and in north-eastern Jordan (80 km east Amman) suggest a wider distribution in western Syria, where scarce information on the fauna is available, to date.

Phenology: Univoltine, earlier than the following species: In Israel from late March to mid-May (n = 85). In Jordan some records from June and July (HAUSMANN 1991).

Remarks: There is almost no sympatric occurrence with *I. affinitata*, and flight period is quite different. These facts, and similar patterns in habitus (polychroism) and structure (e.g. short male antennal ciliation) characterize *I. holliata* and *I. affinitata* as parapatric species pair.



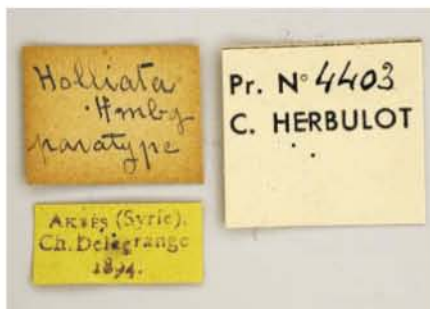
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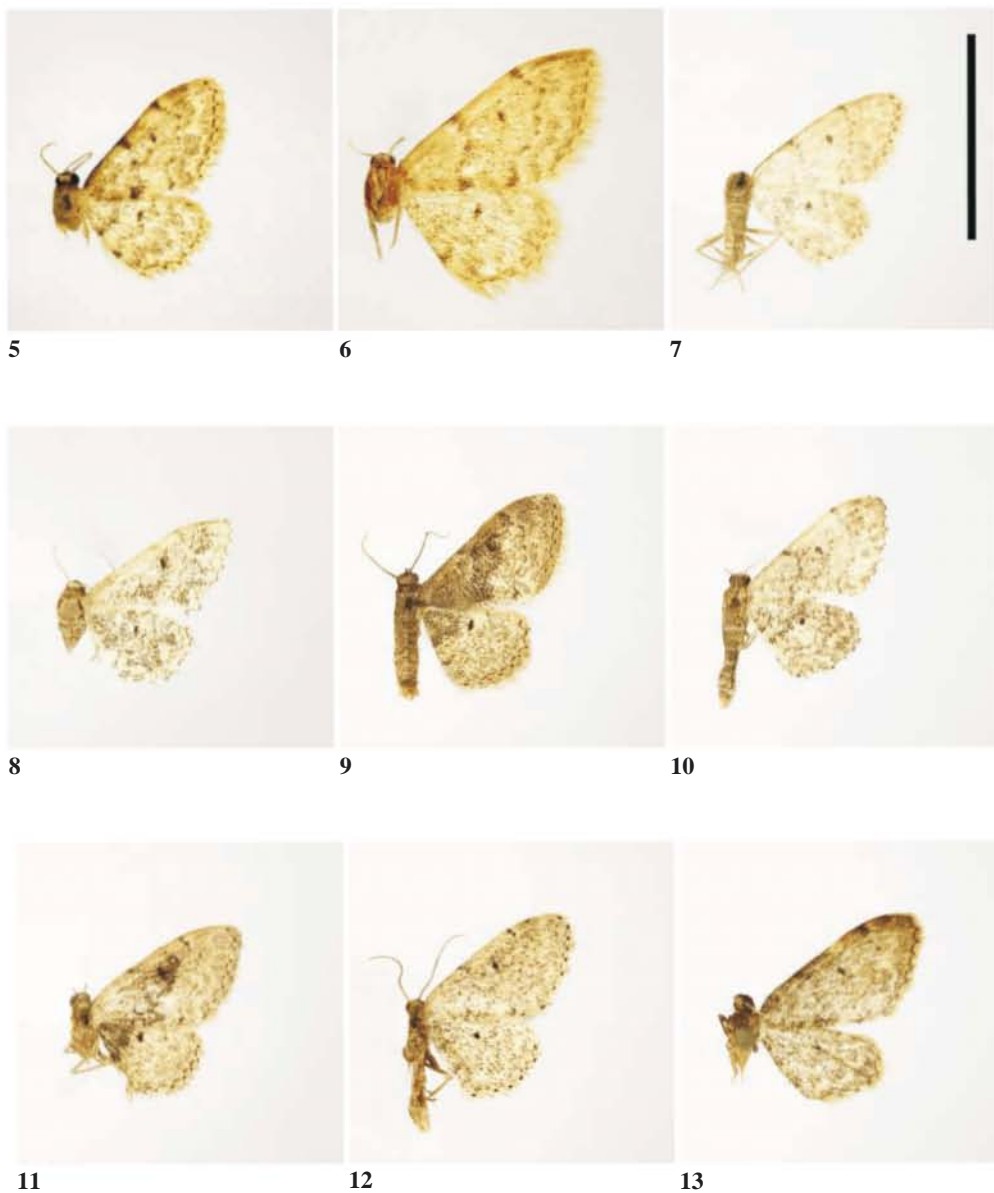
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Figs. 1-4. Type specimens of the *Idaea inquinata* species-group (s. str.): 1, Lectotype ♂ of *Acidalia subherbariata* STAUDINGER, 1897 (and *Acidalia adherbariata* STAUDINGER, 1898), with labels; 2, Lectotype ♀ of *Acidalia fimbriata* BANG-HAAS, 1907 (and *Sterrrha banghaasi* PROUT, 1934), with labels; 3, Lectotype ♂ of *Acidalia holliaata* HOMBERG, 1909, with labels; 4, Lectotype ♂ of *Acidalia affinitata* BANG-HAAS, 1907, with labels.



Figs. 5-13. *Idaea inquinata* species-group (s.str.): **5**, *Idaea inquinata adherbariata* (STAUDINGER, 1898), ♂, south-western Syria; **6**, *Idaea inquinata adherbariata* (STAUDINGER, 1898), ♀, north-western Jordan; **7**, *Idaea inquinata adherbariata* (STAUDINGER, 1898), ♀, central Israel; **8**, *Idaea inquinata adherbariata* (STAUDINGER, 1898), ♂, Arava valley, southern Israel; **9**, *Idaea holliata* (HOMBERG, 1909), ♂, south-western Syria; **10**, *Idaea holliata* (HOMBERG, 1909), ♂, Dead Sea, Israel; **11**, *Idaea affinitata* (BANG-HAAS, 1907), ♂, central Israel; **12**, *Idaea affinitata* (BANG-HAAS, 1907), ♂, central Israel; **13**, *Idaea saida* (WILTSHIRE, 1968), ♂, Tel Dan, northern Israel.

***Idaea affinitata* (BANG-HAAS, 1907)**

Acidalia affinitata BANG-HAAS, 1907: Dt. ent. Z. Iris 20: 82, pl. 3, Fig. 20 (Lebanon). Lectotype ♂ (MNHU, 'Libanon, [18]97, Crem., 3/3', gen.prp. Hausm. 23550, examined), herewith designated. Other paralectotypes, at least 2♂ 3♀ (MNHU, two examined).

Habitus and external morphology (Figs. 4, 11, 12): Wingspan ♂ ♀ 12 - 16 mm, exceptionally 11 mm only. Wings sand coloured, more or less suffused with dark grey brown scales. In 1/3 to 1/2 of the populations the dark suffusion is very strong and dense in the basal area and the basal half of medial area of both wings (polychroism). Antemedial and postmedial lines dark grey brown, fine and sharp, or, often, diffuse and inconspicuous. Terminal area sometimes with inconspicuous shadows, but often concolorous with ground colour. Cell spots usually distinct. Frons and palpi dark brown, vertex and collar sand coloured. Proboscis well developed. Antennae of ♂ ciliate-setose, cilia short: 0.62 - 0.73 times width of flagellum (see Tab. 1). Hindtibia of ♂ slender, with pencil. Tarsus 0.29 - 0.43 times length of tibia (see Tab. 1).

Tab. 1. *Idaea inquinata* (SCOPOLI, 1763) (subsp. *adherbariata* STAUDINGER, 1898; subsp. *banghaasi* PROUT, 1934), *Idaea holliata* (HOMBERG, 1909) and *Idaea affinitata* (BANG-HAAS, 1907): differential characters in male hindlegs and antennae.

	relation length of tarsus / length of tibia	relation length of cilia /width of flagellum
<i>Idaea inquinata</i> Israel: Dead Sea + western plain; n = 10	0.30 - 0.49 m = 0.40 SD = 0.06	0.75 - 1.36 m = 0.99 SD = 0.17
<i>Idaea holliata</i> Dead Sea region + W. Syria; n = 8	0.33 - 0.48 m = 0.41 SD = 0.045	0.58 - 0.71 m = 0.64 SD = 0.04
<i>Idaea affinitata</i> C. Israel + Lebanon; n = 8	0.29 - 0.43 m = 0.38 SD = 0.06	0.62 - 0.73 m = 0.69 SD = 0.05

Male genitalia (Fig. 18): Uncus slender. Valva curved at 1/2, with one dorsal and one ventral spinule at tip. Aedeagus short, with one narrow, straight cornutus and another hook-shaped cornutus, bent at an angle of 90 - 120°.

Female genitalia (Fig. 26, Tab. 2): Antrum dilated with round lateral endings. Ductus bursae short. Appendix bursae divided, one process projecting from corpus bursae at an angle of 50 - 60°. Corpus bursae with posterior spinose crest long and narrow. Anterior spinose patch usually broad, with long spines.

Differential diagnosis: Differential features from *I. inquinata*, see above. *I. holliata* without constant differences from *I. affinitata* in habitus and external morphology, but on average smaller, flying earlier and more eastwards distributed than *I. affinitata*. Shape of cornuti in ♂ genitalia, and shape of appendix bursae in ♀ genitalia, however, allow clear distinction between *I. affinitata* and *I. holliata*. *I. saida* on average larger, with homogenous dark suffusion all over the wings and considerable differences in ♂ ♀ genitalia (Figs. 14 - 27).

Distribution: Lebanon, Israel. In Israel restricted to the central mountain ridge, in the north to Naphtali Mts. and Tel Dan (foothills of Mt. Hermon), in the south to Kiryat Gat, one of the southernmost localities of the temperate climate zone, and with Mediterranean vegetation.

Phenology: Univoltine. In Israel from early May to late June (n = 395), exceptionally emerging from late April, on mountains of the north until mid-July. Later than the preceding species.

Remarks: There is almost no sympatric occurrence with *I. holliata*, and flight period is quite different. These facts, and similar patterns in habitus (polychroism) and structure (e.g. short male antennal ciliation) characterize *I. holliata* and *I. affinitata* as parapatric species pair. Immature stages of *I. affinitata* described in WILTSHIRE (1935).

Idaea saida (WILTSHIRE, 1968)

Sterrha saida WILTSHIRE, 1968: Entomologist 101: 166, pl. 2, Figs. 3,4 text-fig. 4 (Lebanon: Shweir). Holotype ♂ (BMNH, examined); additionally 2♂ paratypes examined in NHMW.

Habitus and external morphology (Fig. 13) : Wingspan ♂ ♀ 14 - 18 mm. Forewing apex rounded. Wings dirty sand coloured with strong dark grey brown suffusion. wing pattern diffuse, ante- and postmedial lines, and terminal shadows darker. Cell spots distinct. Frons and palpi dark brown, vertex and collar sand coloured. Proboscis well developed. Antennae of ♂ ciliate-setose, cilia short: 0.75 - 0.85 times width of flagellum. Hindtibia of ♂ slender, with strong pencil. Tarsus 0.3 - 0.35 times length of tibia.

Male genitalia (Fig. 19): Uncus slender. Gnathos very broad. Valva curved, usually with three spinules at tip, exceptionally two or up to five. Aedeagus very broad, with one very stout and long cornutus and a conspicuous sclerite beside its base.

Female genitalia (Fig. 27): Antrum posteriorly truncate, almost not narrowing towards the very broad and comparatively long ductus bursae. Corpus bursae with two large spinose patches and one very long spinose crest reaching anterior end of corpus bursae.

Differential diagnosis: This species can be distinguished from the others by (1) the homogenous dark suffusion all over the wings, (2) conspicuous dark cell spots, (3) absence of polychroism, i.e. no forms with black brown basal area of wings, (4) the unique long and stout cornutus in ♂ genitalia, and (5) the extension of spinose patches and the long broad ductus bursae in ♀ genitalia.

Distribution: Lebanon, northernmost Israel. New for the fauna of Israel: Tel Dan (n = 6), Mt. Hermon, 1500 m (n = 1).

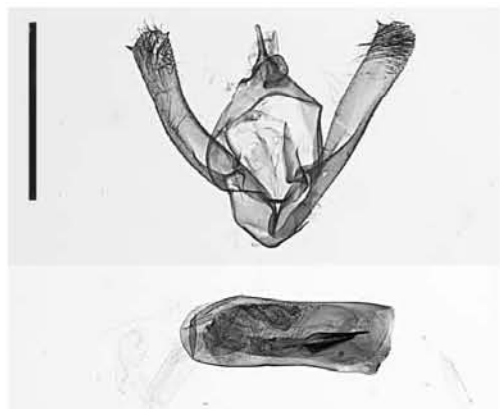
Phenology: Univoltine, in Israel from early June to early July, in the Lebanon reputedly also in May (WILTSHIRE 1968; 1980).

Remarks: Whilst the other three species, *I. inquinata*, *I. holliata* and *I. affinitata* are very closely related to each other, a number of unique characters of *Idaea saida* reveals its more isolated position. Immature stages of *I. saida* described in WILTSHIRE (1936, as '*I. holliata*').

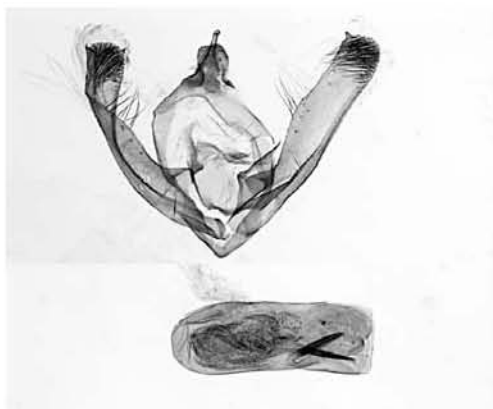
The following simple key allows correct identification of dissected females (see Tab. 2, p. 46):

- (1) appendix bursae projecting from corpus bursae at an angle of 50 - 60 ° *I. affinitata*
- appendix bursae not projecting from corpus bursae (2)

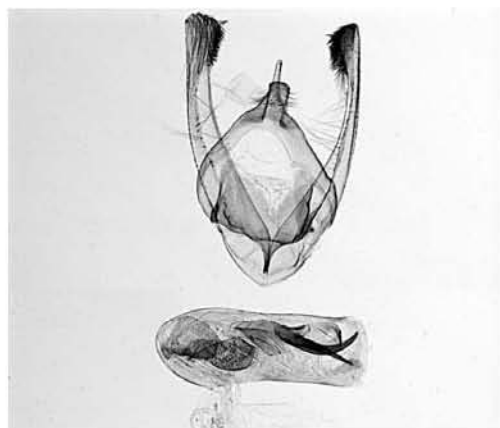
- (2) antrum broad, > 1.9 times width of ductus bursae *I. inquinata*
- antrum narrow and rounded, < 1.9 times width of ductus bursae *I. holliata*



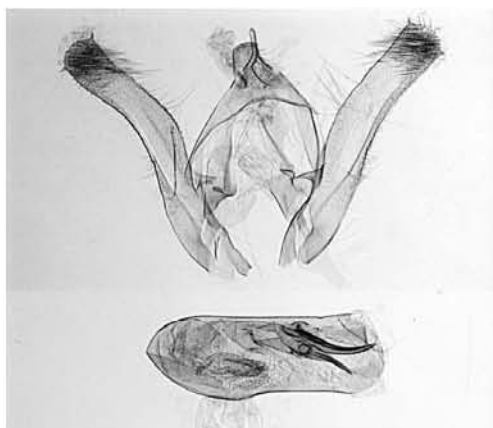
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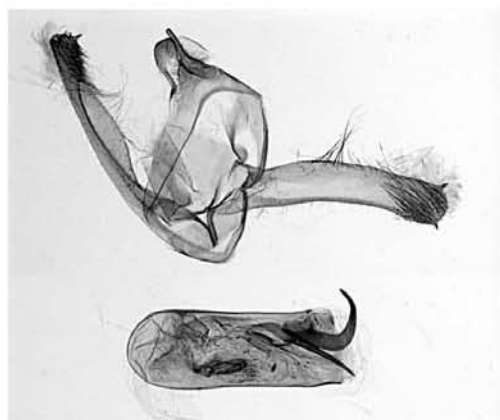
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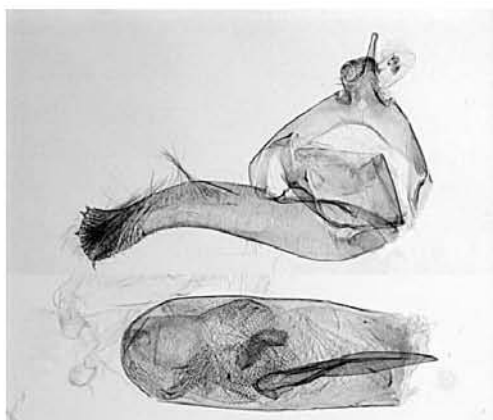
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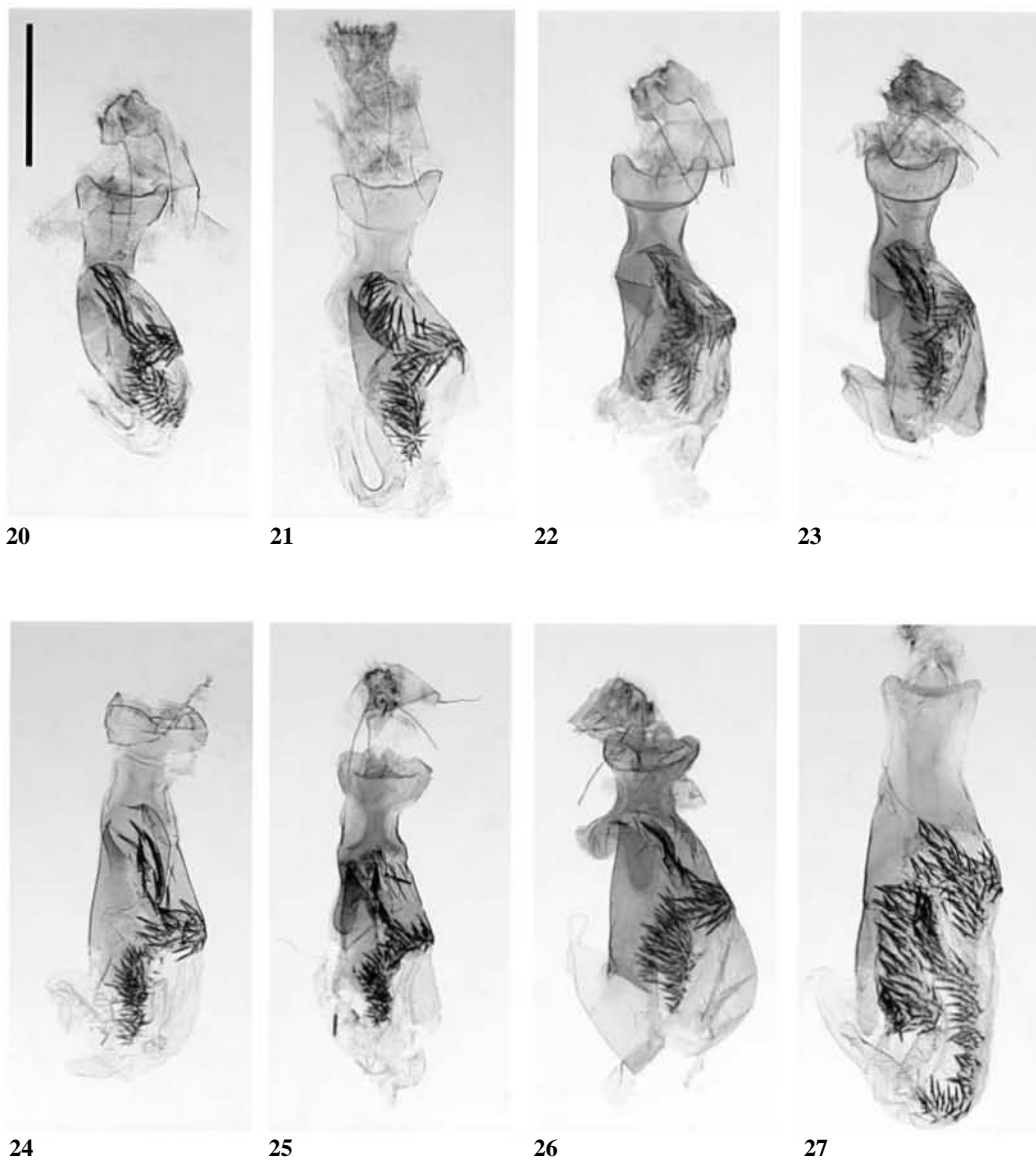


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Figs 14-19. Male genitalia of the *Idaea inquinata* species-group (s.str.), scale bar = 1 mm; **14**, *Idaea inquinata adherbariata* (STAUDINGER, 1898), lectotype, Dead Sea, Israel; **15**, *Idaea inquinata banghaasi* (PROUT, 1934), Carmel, north-western Israel; **16**, *Idaea holliata* (HOMBERG, 1909), lectotype, north-western Syria; **17**, *Idaea holliata* (HOMBERG, 1909), Dead Sea, Israel; **18**, *Idaea affinitata* (BANG-HAAS, 1907), lectotype, Lebanon; **19**, *Idaea saida* (WILTSHIRE, 1968), northern Israel, right valva removed.



Figs 20-27. Female genitalia of the *Idaea inquinata* species-group (s.str.), scale bar = 1 mm; **20**, *Idaea inquinata adherbariata* (STAUDINGER, 1898), western Egypt; **21**, *Idaea inquinata adherbariata* (STAUDINGER, 1898), north-western Jordan; **22**, *Idaea inquinata banghaasi* (PROUT, 1934), lectotype of *fimbriata* BANG-HAAS, 1907, Lebanon; **23**, *Idaea inquinata banghaasi* (PROUT, 1934), Carmel, north-western Israel; **24**, *Idaea holliata* (HOMBERG, 1909), Dead Sea, Israel; **25**, *Idaea holliata* (HOMBERG, 1909), eastern Jordan; **26**, *Idaea affinitata* (BANG-HAAS, 1907), central Israel; **27**, *Idaea saida* (WILTSHIRE, 1968), northern Israel.

Tab. 2. *Idaea inquinata adherbariata* (STAUDINGER, 1898), *Idaea holliaata* (HOMBERG, 1909) and *Idaea affinitata* (BANG-HAAS, 1907): differential characters in female genitalia; posterior patch of spines is measured from its posterior end to lateral margin including the star shaped lateral patch.

	width of antrum (mm)	width of ductus bursae (mm)	relation width of antrum / width of ductus	length posterior patch of spines (mm)	angle corpus bursae / appendix bursae
<i>Idaea inquinata adherbariata</i> Dead Sea + Arava region; n=7	0.61-0.84 m=0.69 SD=0.072	0.26-0.37 m=0.32 SD=0.037	1.91-2.56 m=2.14 SD=0.24	0.69-0.81 m=0.74 SD=0.040	0-30°
<i>Idaea holliaata</i> Dead Sea region; n=8	0.50-0.68 m=0.58 SD=0.052	0.35-0.40 m=0.38 SD=0.021	1.35-1.88 m=1.54 SD=0.15	0.78-0.89 m=0.84 SD=0.055	0-30°
<i>Idaea affinitata</i> C. and N. Israel; n=8	0.55-0.72 m=0.62 SD=0.058	0.32-0.39 m=0.36 SD=0.024	1.46-1.96 m=1.72 SD=0.16	0.72-0.86 m=0.84 SD=0.049	40-60°

Acknowledgements

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Zusammenfassung

Der vorliegende Artikel beinhaltet die Revision der *Idaea inquinata* (SCOPOLI, 1763) Artengruppe s. str., mit vier Arten im Nahen Osten. Alle Typenexemplare dieser Gruppe konnten kontrolliert werden. Der Status von *adherbariata* STAUDINGER, 1898 als Unterart von *I. inquinata* wird bestätigt. Der Artstatus von *banghaasi* PROUT, 1934 kann nicht aufrechterhalten werden, das Taxon wird auf Unterart von *I. inquinata* (**stat. n.**) herabgestuft. Die Morphologie der vier Arten *I. inquinata*, *I. holliaata* (HOMBERG, 1909), *I. affinitata* (BANG-HAAS, 1907), und *I. saida* (WILTSHIRE, 1968) wird beschrieben und analysiert. Lectotypendesignierung erfolgte für die Taxa *subherbariata* STAUDINGER, 1897 (mit dem Ersatznamen *adherbariata*), *fimbriata* BANG-HAAS, 1907 (mit dem Ersatznamen *banghaasi*), *holliaata* HOMBERG, 1909, und *affinitata* BANG-HAAS, 1907. *I. saida* ist neu für die Fauna Israels.

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