

Revisional notes on the subgenera *Saturnia* (*Perisomena*) and *Saturnia* (*Neoris*) stat. rev. (Lepidoptera: Saturniidae)

Part A: Introduction and subgenus *Perisomena* [s. str.]

Wolfgang A. NÄSSIG, Stefan NAUMANN and Swen LÖFFLER

Dr. Wolfgang A. NÄSSIG¹, Entomologie II, Forschungsinstitut Senckenberg, Senckenberganlage 25, D-60325 Frankfurt am Main, Germany; wolfgang.naessig@senckenberg.de

Dr. Stefan NAUMANN², Hochkirchstrasse 71, D-10829 Berlin, Germany; sn@saturniidae.com

Swen LÖFFLER, Hospitalgasse 7, D-09350 Lichtenstein/Sachsen, Germany; swen.loeffler@t-online.de

Abstract: The subgenus *Saturnia* (*Perisomena*) sensu NÄSSIG (1994) is analysed. A new concept is proposed: *Saturnia* (*Perisomena*) is restricted to one species (*S. (Perisomena) caecigena*), while *Saturnia* (*Neoris*) is re-separated as separate subgenus (stat. rev., status change). *S. (Perisomena)* is revised here; the revision of *S. (Neoris)* will follow soon. A male lectotype is designated for *Perisomena caecigena transcaucasica* O. BANG-HAAS, 1927, deposited in Museum für Naturkunde, Berlin. Status changes: *Saturnia (Perisomena) caecigena transcaucasica* (O. BANG-HAAS, 1927), stat. rev., and *S. (Perisomena) caecigena stroehlei* NÄSSIG, 2002 stat. rev., both re-instated as separate subspecies. — The Italian distribution area of *Saturnia (Perisomena) caecigena* is most likely restricted to the NE part (Friuli-Venezia Giulia region); a single report from the eastern Abruzzi Mts. (Apennin Mts., central Italy) was never confirmed, and a supposed record from Sicily in recent literature is surely incorrect and most likely based on a misinterpretation of an Italian text.

Beitrag zu einer Revision der Untergattungen *Saturnia* (*Perisomena*) und *Saturnia* (*Neoris*) stat. rev. (Lepidoptera: Saturniidae); Teil A: Einleitung und Subgenus *Perisomena* [s. str.]

Zusammenfassung: Das Subgenus *Saturnia* (*Perisomena*) sensu NÄSSIG (1994) wird analysiert. Ein neues Konzept wird vorgeschlagen: *Saturnia* (*Perisomena*) ist beschränkt auf eine einzige Art (*S. (Perisomena) caecigena*), während *Saturnia* (*Neoris*) auf den Status als separates Subgenus (stat. rev., Statusänderung) in neuer revidierter Kombination geführt wird; die Revision von *S. (Neoris)* folgt demnächst im Teil B dieser Arbeit. Ein männlicher Lectotypus wird designiert von *Perisomena caecigena transcaucasica* O. BANG-HAAS, 1927, im Museum für Naturkunde, Berlin. Statusänderungen: *Saturnia (Perisomena) caecigena transcaucasica* (O. BANG-HAAS, 1927), stat. rev., und *S. (Perisomena) caecigena stroehlei* NÄSSIG, 2002 stat. rev., beide revidiert als separate Subspezies. — Die Angaben zur Verbreitung von *Saturnia (Perisomena) caecigena* in Italien sind wohl nur für den Nordosten (Region Friaul-Venezia Giulia) zutreffend; der einzige Nachweis von den östlichen Abruzzen (im Apennin Zentralitaliens) wurde bisher nicht bestätigt, und ein angeblicher Nachweis von Sizilien in rezenter Literatur ist sicher unzutreffend und basiert höchstwahrscheinlich auf einem Übersetzungsfehler oder Mißverständnis aus dem Italienischen.

Introduction and general notes

The genus *Saturnia* and its subgenera

The genus *Saturnia* VON PAULA SCHRANK, 1802 *sensu lato* (*sensu* NÄSSIG 1994 and also *sensu* the present paper) is a genus of the family Saturniidae with Holarctic and Asian distribution. Many amateur lepidopterologists enjoy collecting and rearing the species of the family. Caused by the general interest especially of non-specialists, several only weakly defined genera (and also taxa on species-level) have been described in the Saturniini in the last over 100 years, following a “fashion” especially well-established among butterfly amateurs: “Every species requires a genus of its own” — the more so, when there is a chance to describe a new one under one’s own authorship.

Beginning in the mid-20th century, revisional workers on the Palaearctic and Nearctic Saturniidae (e.g., MICHE-NER 1952: 477, FERGUSON 1972: 176–179, LEMAIRE 1978: 129) successively concluded that it does not make much sense to split the holarctic (and, of course, also worldwide) species of the family into a vast number of small or even monotypic “micro-genera” and that it is much more informative to group them together into larger, surely monophyletic units (= genera). Such larger genera should be formed in a way that also non-specialists could identify them on genus level more or less at first glance. Apparently monophyletic subdivisions identified within these genera should, then, perhaps best be classified as subgenera and, subordinate to these, species-groups and -subgroups or -complexes, to have enough “space” which allows sufficient steps in taxonomy to reflect the supposed phylogenetic hierarchy.

One of these supposedly monophyletic larger units is the genus *Saturnia* (*sensu* NÄSSIG 1994) from the Holarctic and tropical continental Asian regions with presently (26. iv. 2016, based on 625 specimens with over 500 base pairs [= bp] of the COI mtDNA barcode identified) ca. 75 different BIN codes in BOLD (see RATNASINGHAM & HEBERT 2007, 2013), suggesting a similar (or possibly even higher) number of species.

¹ 88th contribution to the knowledge of the Saturniidae. (87th contribution: NAUMANN, S., ROUGERIE, R., & NÄSSIG, W. A. (2016): Additional note on the genus *Archaeoattacus* WATSON [in PACKARD], 1914: Description of a fourth species (Lepidoptera: Saturniidae, Saturniinae, Attacini). — Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. 37 (1): 5–11.)

² Research Associate of Museum für Naturkunde Berlin, Germany.

Perisomena WALKER, 1855 and *Neoris* MOORE, 1862 were erected as separate genera and generally used in that sense for about a century. Already JORDAN (1911: 219) suggested they might be closely related. NÄSSIG (1994) eventually grouped them together in a united subgenus under the older name *Saturnia* (*Perisomena*), especially caused by the seemingly overwhelming large similarities in preimaginal instars (of the larvae in particular) expected to be synapomorphies, but also by general similarity in ♂ genitalia morphology, some details in imaginal morphology other than genitalia, behaviour (e.g., both groups comprise autumn fliers only) and a potentially plausible zoogeographical explanation, and a few further details. Other authors (e.g., PEIGLER 1996) generally followed this arrangement. Later NÄSSIG (2002) coined a “*Neoris*-section” within *Perisomena* as informal group name for the former *Neoris* species.

REGIER et al. (2002), in a paper on the phylogeny of the subfamily Saturniinae, analysed mainly two nuclear genes: *elongation factor-1α* (EF-1α) and *dopa decarboxylase* (DDC) with together ca. 2290 bp of nucleotids, mainly mined from GenBank data. They were the first authors to deliberately re-separate *Perisomena* and *Neoris* again. They were mainly focused on the higher systematics of the entire subfamily and, consequently, had only a quite small species sample of the Eurasian taxa of *Saturnia* s.l.: only one species each of the *boisduvalii*-group of *Rinaca* WALKER, 1855 (under the name *Caligula* MOORE, 1862), of *Perisomena* and of *Neoris* (with apparently one specimen only each), plus further two species of the Nearctic *Agapema* NEUMOEGER & DYAR, 1894 and all three species of *Calosaturnia* SMITH, 1886. As already shown earlier (NÄSSIG & NAUMANN 2010b: 139–140, NAUMANN et al. 2012a: 107–109), the use of the name *Caligula* as a separate subgenus or even genus, e.g. as applied in REGIER et al. (2002) or MIRANDA & PEIGLER (2007), does not make much sense, as *Caligula* as used there is anyway clearly a non-monophyletic assembly.

As already discussed by MIRANDA & PEIGLER (2007: 436), NÄSSIG & NAUMANN (2010b: 139–140) and NAUMANN et al. (2012a: 107–109), the concept of subgenera of the genus *Saturnia*, now well over 20 years old (NÄSSIG 1994), requires some revision based on recent results, especially the discovery of many new species. However, we still believe that, in general, the category of subgenera, clearly allowed and supported by the Code (ICZN 1999), has its significant merits, because it allows one more level for classification in apparently monophyletic, well-structured groups relatively rich in species. We do not agree to take all these subgenera elevated to full generic level, as done by, e.g., MIRANDA & PEIGLER (2007). As an early result of our studies, the new subgenus *Saturnia* (*Cachosaturnia*) was described recently (NAUMANN et al. 2012a) for a small, but distinct group of species.

The present publication (both parts) is part of our ongoing studies of the genus *Saturnia* s.l. and another preparatory work on the palaearctic Saturniidae fauna for the book series “Palaearctic Macrolepidoptera”.

Notes on DNA data

Our ongoing studies of mitochondrial DNA barcodes of the *cytochrome-c oxidase* gene, subunit I (= mtDNA COI gene, see RATNASINGHAM & HEBERT 2007), compiled from many specimens of all subgenera and species-groups of *Saturnia* s.l. (now, in April 2016, consisting of well over 590 specimens barcoded with high sequence lengths above 600 bp identified, shorter ones discarded), resulted in an apparently clear information: the populations and species of *Perisomena* and *Neoris* never grouped together within any of the trees computed from the sequence data, neither by the BOLD website (NJ only) nor with MEGA5/6 software (several methods, with additional bootstrap tests; TAMURA et al. 2011, 2013). The two species-groups always were well-separated and at quite different places within the sometimes rather divergent trees of *Saturnia* s.l., thereby in this aspect clearly confirming the results of REGIER et al. (2002) based on a different, albeit short, mtDNA sequence. Consequently, the observed larval similarities might possibly just as well represent basic plesiomorphies or even just secondary similarities rather than synapomorphies.

Therefore, we decided to separate *Perisomena* and *Neoris* again and re-instate these two as separate and quite obviously each monophyletic subdivisions of the genus *Saturnia*.

- *Neoris* usually keys out rather basally in the *Saturnia* barcode trees: often, but not always, just as the first basal forking of *Saturnia* in the widest sense – sometimes in competition with *Agapema* and/or *Calosaturnia* for that position –, depending on the combination of taxa, the number of data included and the method used for tree computing (compare Fig. 1a: based on a NJ tree from the BOLD website without bootstrap, dated 19. XII. 2012, based on 401 specimens with over 600 bp, subgenera *Eudia* JORDAN, 1911, *Calosaturnia* and *Agapema* excluded; and Fig. 1b: based on 584 specimens, dated 31. VIII. 2015, with over 600 bp, all subgenera included). *Neoris* may, therefore, perhaps be regarded as a very basal (i.e., generally plesiomorphic) member of *Saturnia* s.l.

On the basis of the results cited above, *Neoris* is herewith formally re-instated as a **separate subgenus** of *Saturnia*: *Saturnia* (*Neoris*) stat. rev.

The re-established subgenus *Neoris* will be dealt with in the second part of this present publication, to be published in due course.

- In contrast, the subgenus *Perisomena* s. str. is usually found nesting amidst the subgenus *Rinaca* WALKER (1855a: 1199 [key], 1855b: 1274; see FLETCHER & NYE 1982: 143) (e.g., Fig. 1a). *Perisomena* s. str. links in usually either as sistergroup to the *grotei*-group (sensu NAUMANN & NÄSSIG 2010a), or to the *zuleika*-group (sensu NAUMANN & NÄSSIG 2010b), but sometimes also elsewhere within *Rinaca*.

The position of the subgenus *Perisomena* s. str. within the subgenus *Rinaca* is rather flexible, and it may, always depending mainly on the composition of the sequence data (number and minimum length of sequences, composition of taxa and specimens, etc.) and, to a smaller part, the statistical method applied, sometimes key out at nearly any place in between or just at the root of the different species-groups of *Rinaca* (and, sometimes, even not within *Rinaca* at all). These species-groups within *Rinaca*, however, appear to be generally rather well-defined and apparently monophyletic, as they (with exception of a very few taxa or subgroups, respectively, to be dealt with elsewhere in separate publications) are usually *not* changing in their internal configuration of the species included, and *Perisomena* s. str. usually does not key out *within* one of these other well-defined species-subgroups.

Critical comments on mtDNA analyses

This indicates that the large subgenus *Saturnia* (*Rinaca*) in the sense as defined by NÄSSIG (1994), retained by NAUMANN & NÄSSIG (2010b) and other authors and recently modified by the exclusion of the new subgenus *Cachosaturnia* (NAUMANN et al. 2012a: 107–110), under taxonomic exclusion of a separate and monotypic subgenus *Perisomena* s. str. may possibly represent a paraphyletic, not a monophyletic unit. However, we decided to keep *Rinaca* and *Perisomena* as separate subgenera within *Saturnia* for the time being, based on the following indications and implications:

1. The general use of COI barcode data for phylogenetic reasoning in larger, less closely related groups hierarchically above closely related species-groups is not fully adequate; first, the sequence studied is very short (with only 658 bp), and, second, the COI gene has in general only a low phylogenetic signal at higher levels of the systematic hierarchy, e.g., above the level of [large subgenera or] genera (WILSON 2010).
2. In addition, the mitochondrial COI gene reflects only the *female* DNA heredity, and the females of Saturniidae usually are much weaker fliers than the males and usually tend to show a faster “speed” of mtDNA differentiation into local subpopulations than their conspecific males. The genetic information of the mtDNA usually does not become dispersed so fast.
3. The methods of using different more or less “phylogenetic” tree building statistics based on these barcode sequences (as well as on any other DNA data) are, as a matter of fact, modern variants of “Numerical Taxonomy” in the classical sense of SOKAL & SNEATH (1963) or SNEATH & SOKAL (1973). These methods remain somehow inconclusive and unstable; their results are often strongly influenced just by minor changes in the composition and by the plain numbers of sequence data (i.e., by species and specimen coverage). In fact, only clearly identified synapomorphies allow a really reliable phylogenetic reasoning; statistic

methods are no more than an *approach* based more or less on some sort of the use of the “big data principle” in biology instead of clear apomorphic signals, in plain hope that it works in every case. (No general prejudice against “big data” approaches in biology, because they may often be extremely helpful to begin sorting something out, but, if at all possible, never rely on them *alone* for phylogenetic research!). A major (maybe the main) problem with synapomorphies in living beings, however, in most cases is “underscoring the importance of defining polarity in characters” (MIRANDA & PEIGLER 2007: 439), which may explain at least for some part of the often observed divergence of phylogenetic hypotheses between morphological and purely statistical biochemical studies.

4. Further because the only comparative study of other genes *within* the genus *Saturnia* s.l. so far available (REGIER et al. 2002), which was aimed on subfamilial level analysis, did not cover sufficient species (and also specimens) for clear results about the *internal* structure of that genus. In fact, REGIER et al. dealt with 5 subgenera and 8 species of *Saturnia* s.l., estimating the entire group for ca. 38 species; we know presently ca. 8–10 subgenera and over 70 species (the most recent BOLD-BIN count is ca. 75, see above). The other papers dealing with molecular data of Saturniidae published recently concentrated only either on entire high-rank groups like Lepidoptera, Ditrysia, the “bombycoid complex” or similar scenarios, or they dealt with small, restricted [intra-]generic groups (but regrettably not with *Saturnia* s.l.) for defining species within these – in any case, they did not cover the genus *Saturnia* s.l. in any more detail.

In the case of *Perisomena* and *Rinaca*, there are different indications about the phylogeny from different data sets, e.g., larval morphology versus mtDNA nucleotide sequences versus different morphological and behavioural hypotheses based on imagines – and we do not see that any of these methods *per se* is more decisive than all the others, except one could define clear synapomorphies in any of them.

In general, when there are such basic discrepancies between the phylogenetic results of different and often competing methods, it seems advisable to wait for studies using additional methods which might help to overcome that problem. For example, the larval similarity of *Perisomena* s. str. and *Neoris* (supported by several other morphological and behavioural aspects of the imagines) still is a strong argument which should not just be totally ignored through a simple statistical “majority decision” on basis of evolutionarily unexplained similarities and differences in nucleotide sequences.

Basically, DNA is just some sort of a mere primitive 4-letter “alphabet”, combined in quite imprecise 3-letter “words” (often with many ambivalent “spelling variants” with identical meaning) and analysed just in terms of numerical statistics, usually without any evolutionary

explanations in terms of synapomorphies (or evolutionary processes) for the observed differences. — These contradictory and competing phylogenetic hypotheses require a lot of further studies to explain the cases in a sufficiently plausible way.

DNA results and growing accumulation of data

Based on earlier downloads of barcode sequences and in the resulting NJ-trees, the subgenera [*Rinaca* + *Perisomena*] in most cases formed some sort of monophyletic group (see Fig. 1a) until ca. 2–3 years ago. At that time, we expected that this observation (i.e., *Perisomena* s. str.

appearing to be included within the subtree of the subgenus *Rinaca* in the sense as revised here, i.e., the combination of the supposedly monophyletic species-groups of *grotei*, *zuleika*, *simla*, *boisduvalii* and *thibeta*, but excluding the subgenus *Cachosaturnia* and the other described subgenera) would also receive regular support in future studies based on other and larger data sets and also receives support by other methods more reliably applicable for larger-scale phylogenetic studies. If that came true, a possible adequate resolving of the case would be to unite these two subgenera (*Rinaca* and *Perisomena*) under one of the two names. Both names were described in the same

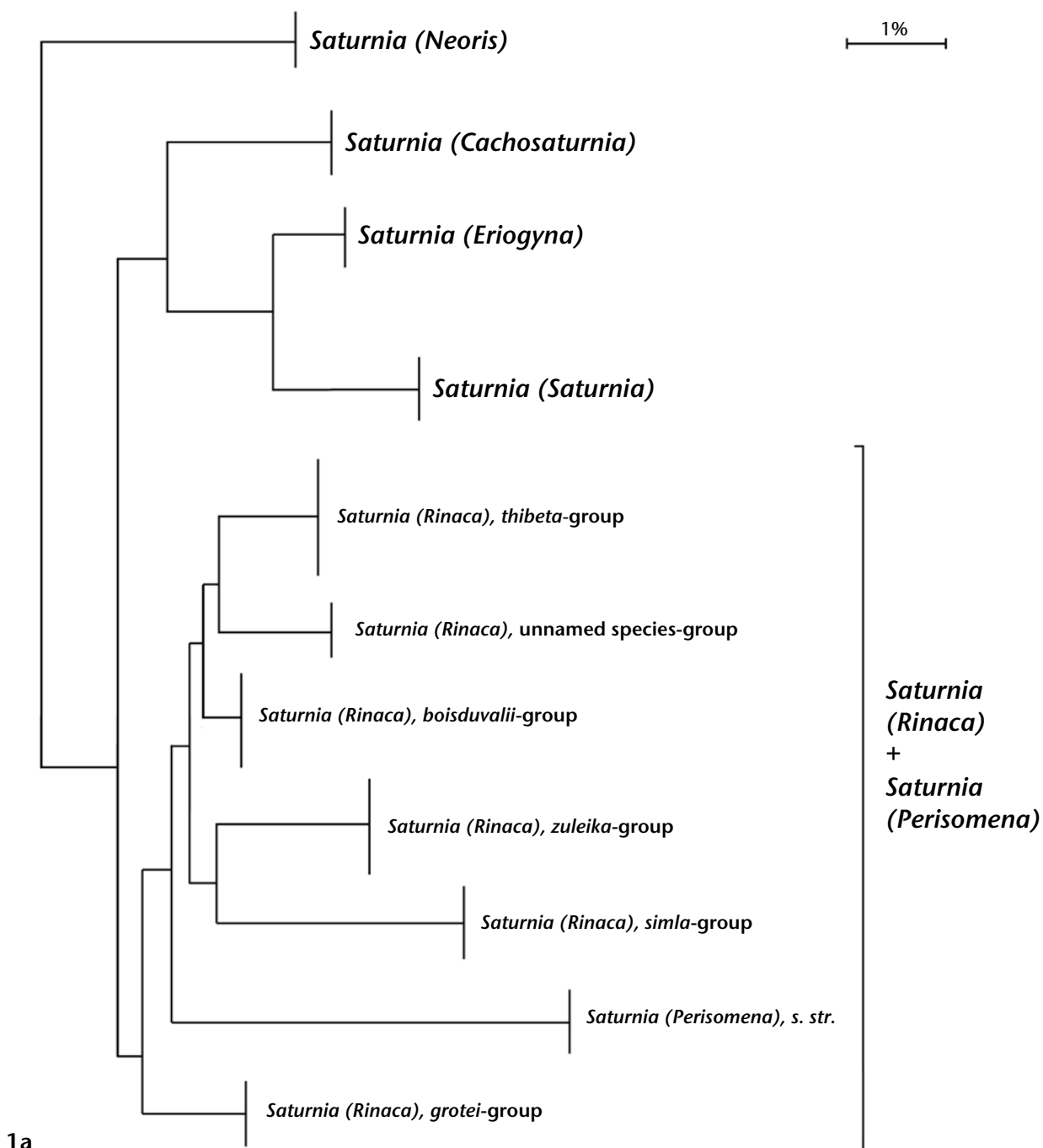
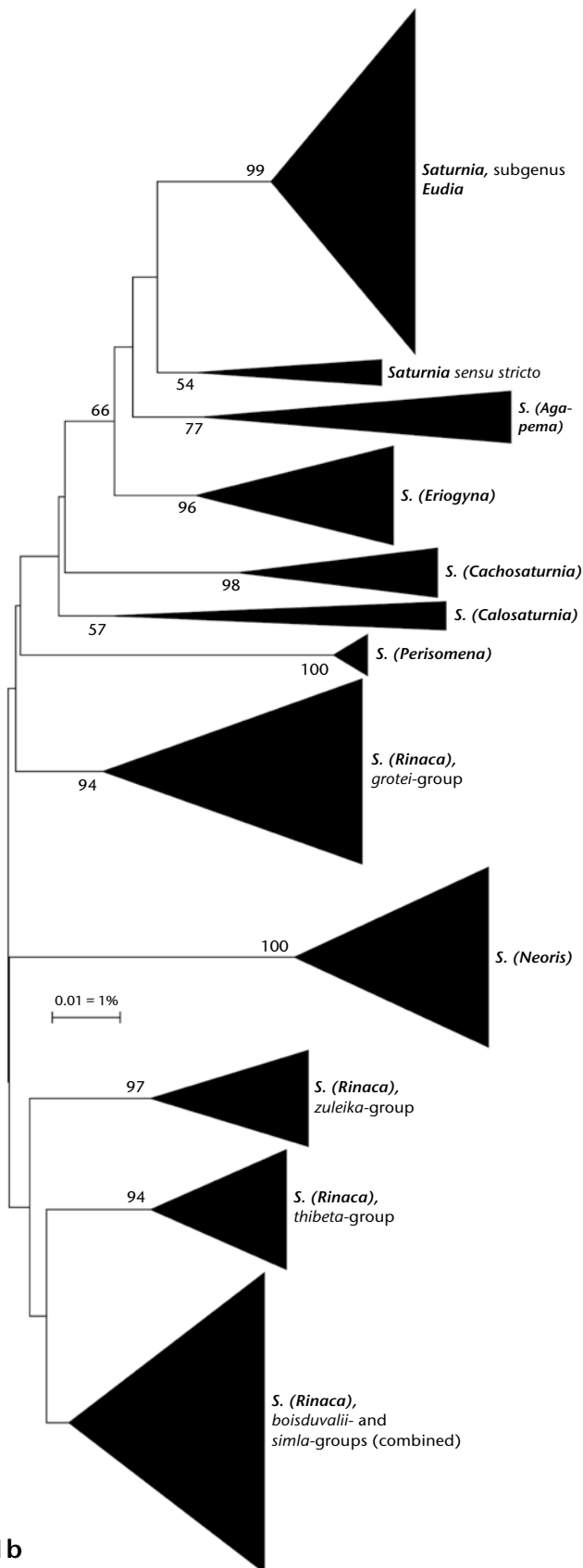


Fig. 1a: Condensed (by hand) mtDNA COI barcode Neighbor Joining tree produced by the BOLD website on 19. xii. 2012, based on 401 specimens (over 600 bp each) of the *Saturnia* subgenera *Saturnia* (*Saturnia*), *S.* (*Eriogyna*), *S.* (*Cachosaturnia*), *S.* (*Rinaca*) (with species-groups identified), *S.* (*Perisomena*), *S.* (*Neoris*). The subgenera *Eudia*, *Calosaturnia* and *Agapema* are not included; their inclusion would most likely change the arrangement significantly (see text for discussion of the placement of *Saturnia* (*Perisomena*) s. str.).



1b

Fig. 1b: Condensed (by MEGA5 software) mtDNA COI barcode NJ tree, based on a download of sequence data from BOLD on 31. VIII. 2015 of 584 specimens (over 600 bp each) of all *Saturnia* subgenera (see text for discussion of the placement of *Saturnia (Perisomena) s. str.*). The % of replicate trees in which the taxa clustered together in the bootstrap test (1000 replicates) are shown (FELSENSTEIN 1985), with all values below 50% discarded. — The structure of these two tree graphs (Figs. 1a & 1b) is also differing from the BOLD NJ tree shown by NAUMANN & NÄSSIG (2010b: 138, fig. 31), because the data base is different (and this data set of 2010 was much smaller than it is now).

publication by WALKER (1855a) on the same page, and both genera were again dealt with in WALKER (1855b), see FLETCHER & NYE (1982). In that case, a decision on the preference for one of the two names in the case that it is really needed must then be made *ad hoc* (“first reviser’s choice” in the sense of the Code, ICZN 1999).

However, with growing datasets during ca. the last two to three years, we observed a new, different tendency: *Perisomena s.str.* more often keyed out as sister-group or in close proximity to the *grotei*-group, and these two both then usually as sister-group to a conglomerate consisting of *S. (Saturnia)*, *S. (Eriogyna)* JORDAN, 1911, *S. (Eudia)*, *S. (Calosaturnia)*, *S. (Agapema)* and *S. (Cachosaturnia)* — or a similar combination (see Fig. 1b). This might indicate that also the *grotei*-group may require another status. Further research and additional data sets are necessary.

Perisomena s. str. seen internally

By contrast, the internal relationships of the subgenus *Perisomena s. str.* are and always remained clear: it is a small “group” of obviously just one species with a few weakly distinct subspecies in the West (S.E. Europe and W. Anatolia), on Cyprus and in the East (Transcaucasus and E. Anatolia region), with a only recently discovered outlying population in N. Israel of which we did not get any mtDNA data so far (see below).

On the other side, *Saturnia (Neoris)* still is a challenge due to its isolated distribution at higher elevations of especially the Central Asian mountain ranges (see Part B of the present publication, in preparation, to be published soon).

Material and methods

Photos of set specimens were taken with a digital camera and a circular daylight fluorescent tube; only some photos especially of museum specimens (either older ones or photos taken by other people) were taken with other equipment and, in part, with analogous cameras, the resulting photographic slides being scanned recently. Morphological studies on imagos followed standard procedures. For the genitalia, the last segments of the abdomen of the moths were cut off and macerated in ca. 2–3% aquatic NaOH or KOH solution at ca. 96–98°C for ca. 1 h to clean the genitalia from scales, fat and tissue. After dissection in water and low-concentrated ethanol, the genitalia were stored in 70% ethanol in vials, because we believe, in accordance with, e.g., ZWICK (2009: 148), that the preservation of the undistorted three-dimensional structure of the genitalia may often be essential for the understanding of their function. However, genitalia photographs were usually taken from flattened, slide-mounted preparations, in spite of possible distortion, as this is generally the only way besides drawing to get a clear photographic picture information. Taking photographs of weakly flattened genitalia swimming freely in ethanol is also a possibility, but often results in reflections making details less clearly visible.

DNA was extracted from the legs of dried specimens mainly in the collections of the authors and from other collections including many museums. DNA analysis was conducted in Ontario, Canada, at the University of Guelph (BOLD 2016). Technical details and references relative to the laboratory protocols see on the CCDB website (CCDB 2016) and also in, e.g., DECAËNS & ROUGERIE (2008) or VAGLIA et al. (2008). Sequences of the specimens analysed (see

Table 1 here and dataset in part B) will (after publication of part B of the present manuscript) also be deposited in GenBank and then also be publically available on the BOLD website (BARCODE OF LIFE 2016). DNA sequence analysis was conducted using MEGA5 software (TAMURA et al. 2011). The so-called “Bold-BIN” (“Barcode Index Number”, an mtDNA-based “Operational Taxonomic Unit” [OTU], see RATNASINGHAM & HEBERT 2013), automatically computed by BOLD, is provided; these numbers were useful especially within Part B (*Neoris*) in helping to recognise separate populations possibly representing distinct species.

In general, the analysis of mtDNA of dried museum specimens of Lepidoptera in Canada in more recent years (since ca. 2013, in contrast to the earlier times of the CCDB) works well only with material less than ca. 20 years old, but strongly depending on the specific conditions with which these specimens were treated after their death. Older specimens often do not deliver any results or only short, fragmented sequences, when using the recent standard protocols. For older specimens, special and much more expensive “forensic methods” must be applied, which is out of our usual standard working frame, as we pay the analyses in Guelph from our private money since mid-2012, while the CCDB requests at least double the price (often much more) for such “forensic” analyses compared to the “quick-and-cheap” standard.

The type specimens of most taxa in the two subgenera (as far as still existing) are at least over 40 years old (all those described before the 1990ies) or much older (the oldest one nearly 200 years: KUPIDO 1825) and, therefore, not easily accessible for standard DNA analyses. We have not yet attempted to get some useful results from old types due to lack of experience and funding, but it should be tried at some time to analyse at a large scale the DNA of the original types to somehow coordinate and “calibrate” the DNA barcode systematics with the existing (morphology-based) taxonomy. This is not a new idea, but due to the general lack of sufficient funding and the optimising and “stream-lining” of the DNA analysing techniques for systematically broader studies in recent years, the methods in most laboratories went away from the old museum specimens to fresh material. This tendency, away from the expensive and time-consuming “forensic” analysis with lots of parallel trials to find reliable sequence results also for broken DNA of old specimens, towards cheaper “quick machine runs” for big numbers of fresh specimens, but without any efforts of error-checking for degraded, old DNA, is quite contraproductive for calibrating barcode systematics with types.

That such a calibration of barcode systematics with original types can sometimes be very successful, has been shown, for saturniids, e.g., by the BMNH for the lectotype of *Loepa damartisi* JORDAN, 1911 (see NAUMANN et al. 2012b: 88), or, in lasiocampids, by SPEIDEL et al. (2015) for the type of *Lasiocampa decolorata* (KLUG, 1830), collected in 1820; or, in geometrids, by STRUTZENBERGER et al. (2012) for 96 historical specimens in the genus *Eois* (using a combined method to get both, genitalia and DNA, in one extended procedure, see, e.g., KNÖLKE et al. 2005). STRUTZENBERGER et al. (2012) emphasize in their abstract: “We encourage that DNA barcodes obtained from types specimens should be included in all species descriptions and revisions whenever feasible.”

The DNA analyses of type specimens of saturniids older than ca. 20–50 years requires access

- to such types with the permission to extract DNA (and possibly genitalia in the same process, see, e.g., KNÖLKE et al. 2005 or HUNSDÖRFER & KITCHING 2010),
- to a laboratory technically highly experienced for that special purpose (using these special “forensic methods”) and, last, but not least,
- sufficient funding, as this task requires quite some effort.

Instead, we have tried to get more recent material from as close to the type localities as possible for our barcode study, but did

not succeed in all cases – some questions have to remain open presently.

The aim to eventually achieve still should be that of “Integrative Taxonomy” as defined by WILL et al. (2005) and DAYRAT (2005) and reviewed by SCHLICK-STEINER et al. (2010), using different data sets achieved with different methods to form an integrative hypothesis on the phylogeny of the taxa dealt with.

Note (disclaimer): The expressions “[species-]group” and, subordinate to this, “[species-]subgroup” (or “species-complex”) are used in this publication (in both parts, and generally also in other such publications by us) as tentative informal groupings (ranked below a subgenus) of species which are deemed to be closely related to each other and supposedly form a monophyletic unit within the genera. However, these groupings are here not intended to be published for the purpose of zoological nomenclature (ICZN 1999: Art. 8.2, disclaimer), and these collective group names, therefore, do not enter into the genus-group of names in zoology (ICZN 1999: Art. 10.3, 10.4).

Abbreviations and conventions

Collections

BMNH	The Natural History Museum (formerly British Museum (Natural History)), London, U.K.; this abbreviation, well-established for more than a century, is now sometimes replaced by NHMUK.
CABF	Collection Andreas BERGMANN, Forst, Germany.
CCLP	Collection Claude LEMAIRE, now in MNHN, Paris, France.
CdFM	Collection Josef J. DE FREINA, Munich (München), Germany.
CMWM	Collection Museum Thomas WITT, Munich (München), Germany, now part of ZSM, Germany.
CRRP	Research collection Rodolphe ROUGERIE, Paris, France.
CSLL	Collection Swen LÖFFLER, Lichtenstein/Sachsen, Germany.
CSNB	Collection Stefan NAUMANN, Berlin, Germany, part of the Rainer SEEGER Foundation, which will be deposited in the collections of ZMHU.
CWAN	Collection Wolfgang A. NÄSSIG, now in SMFL, Frankfurt am Main, Germany.
LNK	Museum für Naturkunde, Karlsruhe (formerly Landes-sammlungen für Naturkunde Karlsruhe), Germany.
MHNG	Musée d'Histoire naturelle, Genève, Switzerland.
MNHN	Muséum national d'Histoire naturelle, Paris, France.
MMBC	Moravia Museum Brno, Czech Republic.
NHMW	Naturhistorisches Museum Wien, Vienna, Austria.
NHRS	Naturhistoriska Riksmuseet, Stockholm, Sweden.
OUM	Oxford University Museum, Oxford, U.K.
SMFL	Senckenberg-Museum, Frankfurt am Main, Lepidoptera collection, Germany.
SMTD	Senckenberg Museum für Tierkunde, Dresden, Germany.
WMNH	Wroclaw Museum of Natural History, Wroclaw, Poland.
ZMHU	Museum für Naturkunde, Berlin (formerly Zoologisches Museum der Humboldt-Universität), Germany.
ZMUH	Zoologisches Museum der Universität Hamburg, Germany.
ZSM	Zoologische Sammlung des Bayerischen Staates, München (Munich), Germany.

Other abbreviations and conventions

- ‡ Unavailable and/or invalid name (infrasubspecific, misspelling, other errors), following the use in FLETCHER & NYE (1982).

BC [no.]	Barcode [with number].
CCDB	Canadian Centre for DNA Barcoding, Guelph, Ontario, Canada.
Fw.	Forewing.
GP [no.]	Genitalia dissection [with number] (Genitalpräparate-nummer).
HT	Holotype.
Hw.	Hindwing.
Lfw.	Length of the forewing, measured in a straight line from the base of the wing to the most distant point of the apex, without the width of the thorax.
L.t./l.t.	Locus typicus.
LT	Lectotype.
PLT	Paralectotype(s).
PT	Paratype(s).
ST	Syntype(s).
uns.	Underside.
ups.	Upperside.

Results: Barcode analysis

For the present study, the barcode data of 16 specimens of the subgenus *Saturnia* (*Perisomena*) and, as an out-group, a selection of 4 specimens of *S. (Saturnia)* were analysed. The number of (*S.*) *Neoris* specimens condensed in Fig. 2 is 71, but may increase slightly until Part B goes to print. Further specimens which either resulted in less than 600 bp successfully identified or had dubious collecting data etc. were discarded. For details of the specimens studied, see Table 1.

In Fig. 2, we show the results in a tree graph calculated with the Neighbor Joining method (MEGA5) (optimal bootstrap tree inferred from 1000 replicates). The results based on the same sequence data, but computed with other methods offered by MEGA5 software are generally very similar when based on identical data.

The three subgenera used in this present comparison (*Neoris* [compressed, details will be shown in Part B of this publication], *Saturnia* s. str. and *Perisomena*) are well-separated at around 10%. The single species of *Perisomena* is identified with the Bold-BIN AAC6908 (as in iv. 2016).

Within *Perisomena*, the three populations found are quite homogenous each (with respective bootstrap values of 67/71% for the basal forking between ssp. *transcaucasica* and the rest, and 89/91% for the second forking between the other two subspecies), but differ only on average with ca. 0.5% in the sequences between the subspecies. Such small values, in combination with great similarity in morphology, do not offer any reliable interpretation for separate species. However, the respective genetic *homogeneity* of the three populations clearly demonstrates that these entities are at least to some degree real, and we decided, therefore, to interpret these three populations as distinct geographical subspecies. These differences in the barcode data largely correspond with similarly minor differences in external morphology; we did not find any noteworthy differences in genitalia (see Figs. A–D).

The nominotypical population is that of Europe, *S. (P.) caecigena caecigena*. We further found that the populations of *S. (P.) caecigena caecigena* of Europe and the western part of Asia minor do not differ in the barcode sequences (which means that the population described from Kızılcahamam near Ankara as ssp. *parviocellata* is to be treated as a synonym of the nominotypical subspecies), but the populations in East Turkey, Armenia, Azerbaijan and Georgia are different and correspond to the subspecies *S. (P.) c. transcaucasica*.

Populations without barcoded individuals which originate from within the range of clearly identified (= bar-coded) populations were plotted in the colour of the surrounding subspecies. However, there are populations in between these two subspecies from which we did not get any barcode sequences so far, and these are plotted as white dots on the map (Fig. 3). These unknown data regrettably also include the most southern population from N. Israel. We received two specimens for our study but these did not result in any barcode data.

The third population is that from Cyprus, corresponding to the subspecies *S. (P.) c. stroehlei*, isolated on this island.

The greatest homogeneity in barcode sequences is found in the nominotypical subspecies; there are apparently no differences in the sequenced specimens from NE Italy across the Balkan Peninsula to western Turkey. The intrasubspecific variability of the COI-sequences is greatest in subspecies *transcaucasica* (with the bootstrap value between a specimen from Georgia and the other specimens from eastern Turkey and Armenia counting for 56%!). This possibly may indicate that the species originated in this area and later dispersed from there across Asia minor to Europe. However, populations from many areas in SE Europe still have not been sequenced, and there may be, of course, additional variability.

Taxonomy of *Saturnia (Perisomena)* s. str.

Annotated catalogue of the described taxa of *Saturnia (Perisomena)* *sensu stricto*:

Perisomena WALKER, 1855

Perisomena WALKER (1855a: 1199 [key], 1855b: 1276). – Type species by subsequent designation by KIRBY (1892: 775): *Saturnia caecigena* KUPIDO, 1825.

Etymology: According to SPULER (1908: 107), the name might possibly be based on the Latin “PER” [throughout, definitively] and the ancient Greek words ἴσος [isos = equal] and μῆνη [moon]?

Present status: Subgenus of *Saturnia* VON PAULA SCHRANK, 1802 (see NÄSSIG 1994, but here used in revised sense).

History: WALKER (1855a, b) included two unrelated species in his genus *Perisomena*: the African *Saturnia forda* WESTWOOD, 1849 (now *Cirina forda* – this genus *Cirina* was also described by WALKER 1855b: 1382 in the same volume as *Perisomena*, but under “Addenda”) and *Saturnia caecigena*. With KIRBY’s (1892) designation of a type species, *Perisomena* was finally transferred to and fixed in European saturniidology. Later descriptions within *Perisomena* were then always based on individual variants or a “Europe versus

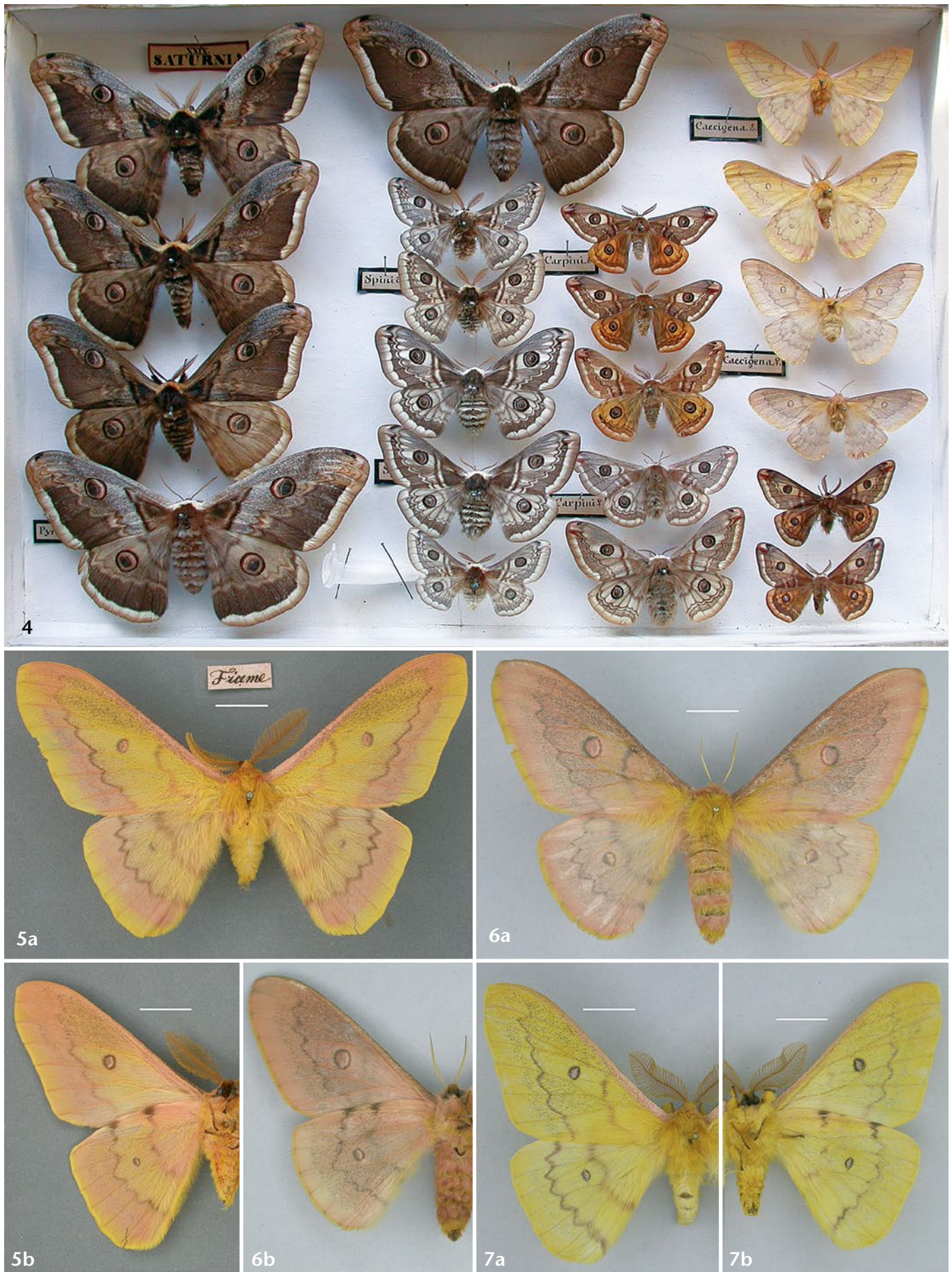
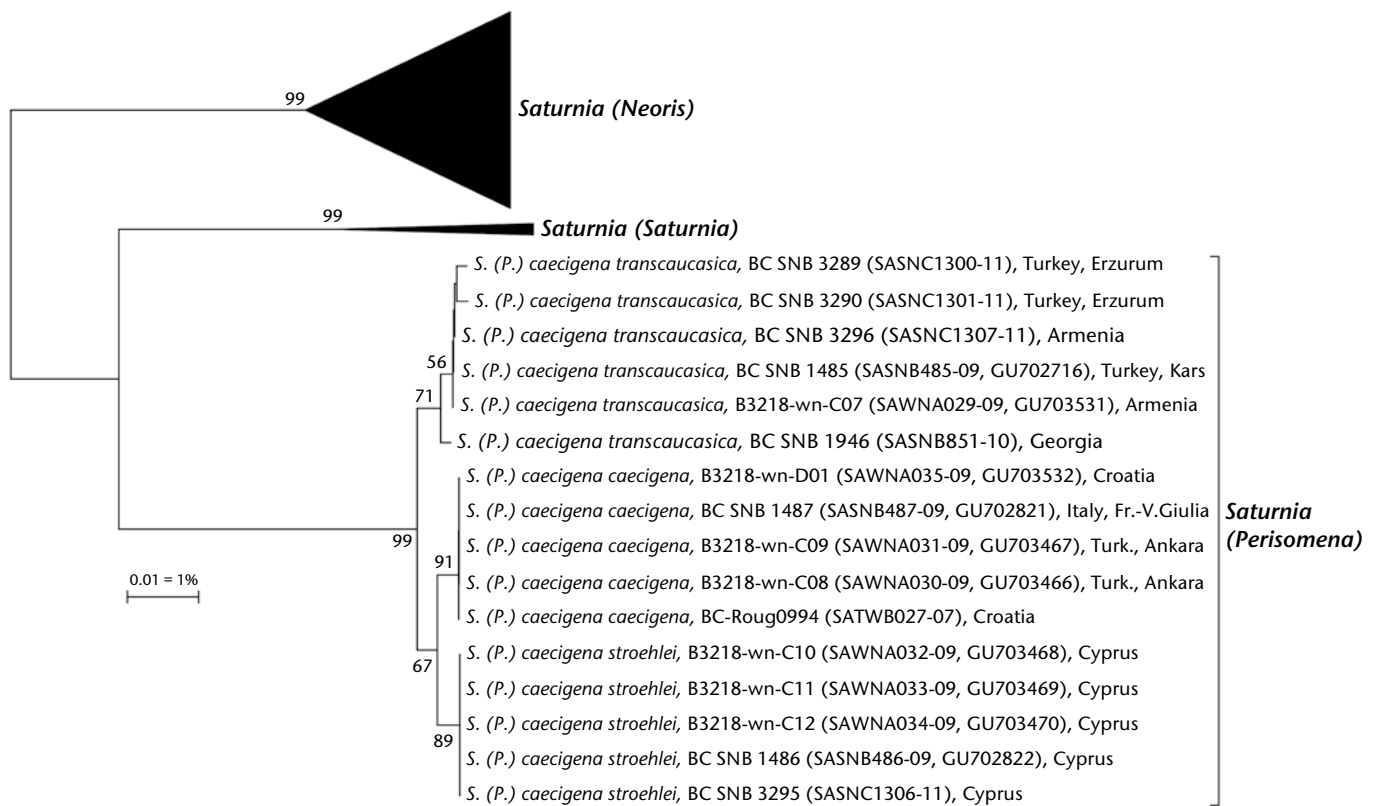


Plate 1: *Saturnia* (*Perisomena*) *caecigena*, Imagines. **Figs. 4–7:** ssp. *caecigena*. — **Fig. 4:** Photo of original KUPIDO drawer ex MMBC, deposited in the castle of Budišov, containing in the upper right edge 4 STs (2 ♂♂, 2 ♀♀) of *Saturnia caecigena* KUPIDO (photo V. KUBÁN). — **Figs. 5a, b:** Topotypic historic ♂ specimen from “Fiume” (now Rijeka) in ZMHU; 5a = ups., b = uns. **Figs. 6a, b:** Recent ♀, NW Italy, Friuli-Venezia Giulia, Gorizia, BC SNB 1487, in CSNB; 6a = ups., b = uns. **Figs. 7a, b:** Recent ♂, yellow form, Greece, Kirki, in CSNB; 7a = ups., b = uns. — Specimens (except in Fig. 4) approx. in natural size; scale bars = 1 cm. — All photos S.N., if not indicated otherwise.

Table 1: Data of the specimens of *Saturnia* (*Perisomena*) (and 4 specimens of *Saturnia* (*Saturnia*) as outgroup) used for the mtDNA barcode analyses; the details for the specimens of *Saturnia* (*Neoris*) will follow in Part B. Specimens arranged from top to bottom in the order of the NJ-tree graph (Fig. 2). — Additional abbreviations: HT = holotype; PT = paratype; SL = Sequence Length (data from BOLD); GBAC (= GenBank Access Code) not yet available for all specimens, to follow later. BIN = Barcode Index Number; an automatically assigned identifier for genetic clusters within BOLD, see RATNASINGHAM & HEBERT (2013).

Sample ID	Process ID	GBAC	Species/BOLD BIN-Code	Deposit.	SL	Sex	Origin
BC SNB 2233	SASNC149-11	—	<i>Sat. (Sat.) atlantica</i> /AAR3973	CSNB	658[0n]bp	♂	Tunisia
BC SNB 2234	SASNC150-11	—	<i>Sat. (Sat.) atlantica</i> /AAR3973	CSNB	658[0n]bp	♀	Tunisia
BC SNB 986	SASNA986-09	—	<i>Sat. (Sat.) pyri</i> /AAB8247	CSNB	658[0n]bp	♀	Iran, Markazi
BC SNB 990	SASNA990-09	—	<i>Sat. (Sat.) pyri</i> /AAB8247	CSNB	658[0n]bp	♀	Hungary
BC SNB 3289	SASNC1300-11	—	<i>Sat. (Per.) caecig. transcaucasica</i> /AAC6908	CSNB	658[0n]bp	♂	Turkey, Erzurum
BC SNB 3290	SASNC1301-11	—	<i>Sat. (Per.) caecig. transcaucasica</i> /AAC6908	CSNB	658[0n]bp	♂	Turkey, Erzurum
BC SNB 3296	SASNC1307-11	—	<i>Sat. (Per.) caecig. transcaucasica</i> /AAC6908	CSNB	658[0n]bp	♂	Armenia
BC SNB 1485	SASNB485-09	GU702716	<i>Sat. (Per.) caecig. transcaucasica</i> /AAC6908	CSNB	658[0n]bp	♂	Turkey, Kars
B3218-wn-C07	SAWNA029-09	GU703531	<i>Sat. (Per.) caecig. transcaucasica</i> /AAC6908	CWAN	658[0n]bp	♂	Armenia
BC SNB 1946	SASNB851-10	—	<i>Sat. (Per.) caecig. transcaucasica</i> /AAC6908	CSNB	658[0n]bp	♀	Georgia
B3218-wn-D01	SAWNA035-09	GU703532	<i>Sat. (Per.) caecigena caecigena</i> /AAC6908	CWAN	658[0n]bp	♂	Croatia
BC SNB 1487	SASNB487-09	GU702821	<i>Sat. (Per.) caecigena caecigena</i> /AAC6908	CSNB	658[0n]bp	♀	Italy, Friuli-Venezia Giulia
B3218-wn-C09	SAWNA031-09	GU703467	<i>Sat. (Per.) caecigena caecigena</i> /AAC6908	CWAN	658[0n]bp	♀	Turkey, Ankara (Kızılcahamam)
B3218-wn-C08	SAWNA030-09	GU703466	<i>Sat. (Per.) caecigena caecigena</i> /AAC6908	CWAN	658[0n]bp	♂	Turkey, Ankara (Kızılcahamam)
BC-Roug0994	SATWB027-07	—	<i>Sat. (Per.) caecigena caecigena</i> /AAC6908	CRRP	658[0n]bp	♀	Croatia
B3218-wn-C10	SAWNA032-09	GU703468	<i>Sat. (Per.) caecigena stroehlei</i> /AAC6908	CWAN	658[0n]bp	♂	Cyprus
B3218-wn-C11	SAWNA033-09	GU703469	<i>Sat. (Per.) caecigena stroehlei</i> /AAC6908	CWAN	658[0n]bp	♀	Cyprus
B3218-wn-C12	SAWNA034-09	GU703470	<i>Sat. (Per.) caecigena stroehlei</i> /AAC6908	CWAN	658[0n]bp	♂	Cyprus
BC SNB 1486	SASNB486-09	GU702822	<i>Sat. (Per.) caecigena stroehlei</i> /AAC6908	CSNB	658[0n]bp	♂	Cyprus
BC SNB 3295	SASNC1306-11	—	<i>Sat. (Per.) caecigena stroehlei</i> /AAC6908	CSNB	658[0n]bp	♂	Cyprus



2

Fig. 2: Evolutionary relationships of taxa, inferred by MEGA5 (TAMURA et al. 2011) using the Neighbor-Joining method (SAITOU & NEI 1987). The optimal tree with the sum of branch length = 0.41967058 is shown; the data set is part of the full set displayed in Fig. 1b (as of 31. VIII. 2015), with representing only the subgenera *Saturnia* (*Neoris*), *S. (Saturnia)* and *S. (Perisomena)*. The specimen details for *S. (Saturnia)* and *S. (Perisomena)* see in Tab. 1. *S. (Neoris)* and *S. (Saturnia)* are condensed by MEGA5; details within *Neoris* will be shown in Part B of this publication. The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1000 replicates) are shown next to the branches (FELSENSTEIN 1985); evolutionary distances were computed using the Maximum Composite Likelihood method (TAMURA et al. 2004). The rate variation among sites was modelled with a gamma distribution (shape parameter = 3).

out of Europe” comparison. — In 1879, MABILLE described a Madagascan saturniid as belonging into *Perisomena*: *P. cincta* MABILLE, 1879(317). This taxon is now correctly listed in the genus *Maltagorea* BOUYER, 1993.

Generic synonymy:

= *Typhloteta* RAMBUR, 1866(377, first footnote). — Type species by monotypy (or possibly by original designation, depending on the interpretation of RAMBUR’s very short wording): *Saturnia caecigena* KUPIDO, 1825. — Objective synonym of *Perisomena* WALKER, 1855 with identical type species (FLETCHER & NYE 1982: 122). — Etymology unknown.

The subgenus *Saturnia* (*Perisomena*) s. str. comprises 4 valid taxa on the species level and 3 infrasubspecific and unavailable names, listed here in chronological order of their publication date:

1. *caecigena* KUPIDO, 1825

IV. *Saturnia caecigena* [sic] KUPIDO (1825: 5, plate).

Type material: STs ♂♂ and ♀♀, total number of specimens and deposition not stated. Present location: unknown, see below. — In 2006, U. BROSCHE contacted the Department of Entomology of the Natural History Museum of the National Museum in Brno, Czech Republic (Moravian Museum, MMBC), because the KUPIDO collection is said to be there (HORN et al. 1990, WIKIPEDIA 2013). The entomology curator V. KUBÁN (in litt.) then found the KUPIDO collection and therein a drawer containing European Saturniidae including 4 STs (2 ♂♂ and 2 ♀♀) of *Saturnia caecigena* (see Fig. 4 for that drawer). It was intended to receive separate photos of these 4 ST specimens to designate a lectotype here in the present publication, or perhaps even get some part of the 4 specimens in loan to Germany. However, the KUPIDO collection is stored about 50 km outside Brno in the castle of Budišov. Somehow the specimens were misplaced on the way to Brno or in Brno itself in the museum, and the present location of the pinning box containing these 4 KUPIDO STs of *Saturnia caecigena* extracted from the KUPIDO drawer is unknown. Repeated search for the pinning box was not successful so far (KUBÁN, in litt. 2013). So regrettably we are not able to show detailed photos of the STs and to designate a LT here and now. — A historic topotypic specimen in the STAUDINGER collection in ZMHU from “Fiume” (Fig. 5) cannot be associated with KUPIDO’s collection and description and, therefore, is also not available for a LT designation. — However, as the identity of this species never was in doubt (the population of the type locality is clearly identified!), this is not a serious problem and does not at all require any action presently.

Locus typicus: “in der Gegend von Fiume” = near Fiume [= Rijeka, today in NW Croatia; formerly in Italy].

Etymology: Named for the “blind” eyespots on the wings (CAECIGENUS [Latin]: born blind; SPULER 1908: 107).

Selected citations in literature:

Saturnia caecigena [sic]: KUPIDO (1825: 5, plate).

Saturnia Caecigena [sic]: LEDERER, G. (1855: 183). HOFMANN (1894: 64, pl. 28, fig. 1 ♂).

Perisomena caecigena: WALKER (1855a: 1199, 1855b: 1276). KIRBY (1892: 775). SONTNAX (1904: 1, pl. XVII, figs. 3, 4 ♂, ♀). ABFAIGNER (1907: 43, pl. 30, fig. 1 ♂). SPULER (1908: 107). HAFNER (1910: 119–120). SCHULTZ (1910: 64). JORDAN (1911: 220, pl. 32b ♂, ♀). NIEPALT in NIEPALT (ed., 1914: 19). SCHAWERDA (1914: 350). BANG-HAAS (1927: 78). BOUVIER & RIEL (1931: 48). AUE (1933: 86). SCHÜSSLER (1933: 251). SCHÜSSLER (1935: 692). BOUVIER (1936: 200, 202). FORSTER & WOHLFAHRT (1960: 132). FRIEDEL (1968: 13). ROU-

GEOT (1971: 112, figs. 157, 158 ♂, ♀, 159 genitalia, 160, 161 antennae). NÄSSIG (1981: 23, figs. 21, 22 ♂, ♀). FLETCHER & NYE (1982: 122). ROUGEOT & VIETTE (1983: 147, pl. 13, figs. 2a, b, c, ♂♂, ♀). BERTACCINI et al. (1994: 153, pl. 11, figs. 1, 2). NÄSSIG (1994: 259, 264). RAINIERI et al. (1995: 5). D’ABRERA (1998: 30, 31, fig. ♂, ♀). FISCHER & LEWANDOWSKI (2003). FAJČÍK (2003: 133). PARENZAN & PORCELLI (2006: 79). MIRANDA & PEIGLER (2007: 434 ff., fig. 2 ♂). LEVENTE (2010: 98, pl. 2, fig. 8 ♂). LAMPE (2010: 361, pl. 318, preimaginal instars, ♂, ♀). HUEMER (2013: 150). HABERER (2014: 171).

Perisomena Caecigena [sic]: STAUDINGER & REBEL (1901: 126).

Perisomena caecigena [sic]: COCKERELL in PACKARD (1914: 153, pl. XXX, figs. 8, 9, pl. XXXVIII, fig. 2, pl. C, fig. 2a, b ♂ ♀).

Perisomena caecigena caecigena: LEDERER, J. (1951: 131–136). DE FREINA & WITT (1987: 397, pl. 37, figs. 1–3). DE FREINA (1994: 337).

Saturnia (*Perisomena*) *caecigena*: NÄSSIG (2002: 43–48, figs. 8–11 ♂♂, ♀♀).

Typhloteta caecigena: RAMBUR (1866: 377); FLETCHER & NYE (1982: 122).

2. *†unicolor* (SCHULTZ, 1910)

Perisomena caecigena KUP. ab. ♂ (nov.) *†unicolor* SCHULTZ (1910: 65), not illustrated. Unavailable name (infrasubspecific, individual aberration, “forma”).

There is no type material or type locality for infrasubspecific forms. SCHULTZ just described 1 ♂ individual in uniform yellow colour without providing locality data and specimen’s deposition. However, there are 2 ♂♂ without locality labels under this name in ZMUH (examined, S.N.) to which SCHULTZ could have referred.

Etymology: Named for the “unicolorous” yellow appearance — which in fact is a quite common form of ♂♂ of the species in some areas (e.g., see Fig. 7 for a specimen from Greece), perhaps in part depending on environmental factors such as prevalent ambient temperature or humidity during larval or pupal development.

Selected citations in literature:

Perisomena caecigena ab. *†unicolor*: SCHULTZ (1910: 65). BOLLOW (1932: 131). NÄSSIG (1981: 25).

Perisomena caecigena f. *†unicolor*: SCHÜSSLER (1933: 253). ROUGEOT (1971: 115). ROUGEOT & VIETTE (1983: 148). DE FREINA & WITT (1987: 397).

Perisomena caecigena unicolor: BOUVIER (1936: 202, cited in synonymy). NÄSSIG (1994: 259, 264, cited in synonymy).

3. *†wiskotti* (NIEPALT, 1914)

Perisomena caecigena KUPIDO f. *†Wiskotti* NIEPALT n. f. — NIEPALT in NIEPALT (ed., 1914: 19; pl. XII, fig. 13). Unavailable name (infrasubspecific, individual aberration, “forma”).

There is no type material or type locality for infrasubspecific forms. NIEPALT described “2 ♀♀” from Smyrna [= İzmir, western Anatolia, Asia minor] with intensified dark scaling of the ante- and postmedian lines on pink ground colour. Deposition of specimens: “coll. WISKOTT, Kgl. Zool. Institut, Breslau”. — In early 2013, one of the authors (S.N., following a hint by A. SCHINTLMEISTER) found the collection of WISKOTT in Wrocław (formerly Breslau) in the present-day Museum of Wrocław. There are several Lepidoptera collections and quite some material deposited, including further original specimens of infrasubspecific names and also some “real” types, especially from the work of WISKOTT, NIEPALT, STRAND and others. There is also a ♀ with labels “*Perisomena caecigena* ab. *wiskotti* NIEP. ♀” [handwritten, NIEPALT], „Collection NIEPALT; coll. WISKOTT” [green]; „Smyrna [18]79”. It has a Lfw. of 39 mm (see Fig. 9). A second ♀ as cited in the publication was not found there, but a ♂ ex “Smyrna; coll. WISKOTT” [green] with Lfw. of 38 mm (see Fig. 10).

Etymology: Named after the collector WISKOTT.

Selected citations in literature:

Perisomena caecigena f. *†wiskotti*: NIEPALT (1914: 19, pl. XII, fig. 13). SCHÜSSLER (1933: 253).

Perisomena caecigena ab. *†wiskotti*: BOLLOW (1932: 131). NÄSSIG (1981: 25).

Perisomena caecigena f. *†wiskotti*: ROUGEOT (1971: 115). ROUGEOT & VIETTE (1983: 148). DE FREINA & WITT (1987: 397).

Perisomena caecigena wiskotti STRAND [sic]: BOUVIER (1936: 202, cited in synonymy).

Perisomena caecigena wiskotti: NÄSSIG (1994: 259, 264, cited in synonymy).

4. *†derosata* (SCHAWERDA, 1914)

Perisomena caecigena KUP. ab. nova *†derosata* SCHAW[ERDA] (1914: 350), not illustrated. Unavailable name (infrasubspecific, individual aberration, “forma”).

There is no type material or type locality for infrasubspecific forms. SCHAWERDA described 2 ♂♂ from Mostar [Bosnia and Hercegovina] without the pink colour, all yellow (i.e., this was in fact a “redescription” of the same individual variant as f. *†unicolor*, see above). The two ♂ specimens on which the invalid form name is based are deposited in NHMW (examined, S.N.).

Etymology: “Lacking pink color”.

Selected citations in literature:

Perisomena caecigena ab. *†derosata*: SCHAWERDA (1914: 350). BOLLOW (1932: 131). ROUGEOT (1971: 115, cited in synonymy of *P. caecigena* f. *unicolor*). NÄSSIG (1981: 25).

Perisomena caecigena f. *†derosata*: SCHÜSSLER (1933: 253).

Perisomena caecigena derosata: BOUVIER (1936: 202, cited in synonymy). NÄSSIG (1994: 259, 264, cited in synonymy).

5. *transcaucasica* (O. BANG-HAAS, 1927)

Perisomena caecigena transcaucasica O. B.-HAAS, subsp. nov. — O. BANG-HAAS (1927: 78), not illustrated.

Type material: sex and number of specimens not stated by O. BANG-HAAS (more than one specimen per sex, i.e., ST series), deposition not indicated. We found 1 ♂ and 1 ♀ from “Elisabethpol” in coll. BANG-HAAS in ZMHU, of which only the ♂ is properly labelled as “type”. (This is typical both for the colls. BANG-HAAS and STAUDINGER, now held in ZMHU: Quite often only the first specimen of a type series in a box was labelled, whereas the others just bear a coloured or white label without writing.) To stabilise nomenclature in a type series from different localities, we **herewith designate** this ♂ with the typical BANG-HAAS label as **lectotype** of *Perisomena caecigena transcaucasica* (Fig. 13a, b). The second specimen in ZMHU (the ♀, Fig. 14) from “Elisabethpol” and any further specimens originating from there or from Tbilisi (the second locality of the type series) and identifiable as ST specimen will automatically be PLTs. D’ABRERA (1998: 30) mentioned 2 potential ST ex Elisabethpol in the collections of BMNH, and we in the meanwhile found there 4 ♂ and 3 ♀ ST with data: “Elisabethpol, Kaukasus; Co-Type Collection BANG-HAAS”; these automatically become paralectotypes.

Locus typicus: “Transkaukasus: Elisabethpol, Tiflis”, i.e., two different localities in two different present-day nations: [Azerbaijan (Aserbaidshan): Ganja (Gäncä, Russian: Гянджа/Gjandscha)] and [Georgia: Tbilisi]. By designation of the lectotype above, the former Elisabethpol, now Ganja in Azerbaijan, becomes the correct type locality for this subspecies.

Etymology: Named for the area of origin: Transcaucasia.

Selected citations in literature:

Perisomena caecigena transcaucasica: BANG-HAAS (1927: 78). BOLLOW (1932: 131). SCHÜSSLER (1933: 253). BOUVIER (1936: 202, cited in synonymy]. ROUGEOT (1971: 115). NÄSSIG (1981: 25). ROUGEOT & VIETTE (1983: 147). DE FREINA & WITT (1987: 397). DE FREINA (1994: 337).

Perisomena caecigena f. *transcaucasica*: D’ABRERA (1998: 30, 31, figs. ♂, ♀).

Saturnia (*Perisomena*) *caecigena transcaucasica*: NÄSSIG (1994: 259, 264, cited in synonymy). NÄSSIG (2002: 43–44, cited in synonymy).

6. *parviocellata* (FRIEDEL, 1968)

Perisomena caecigena ssp. n. *parviocellata* FRIEDEL (1968: 18–19), not illustrated.

Type material: HT ♂ (by original designation; Fig. 8); 21 ♂♂, 2 ♀♀ PTs. Deposition “in my collection”, except for 1 ♂ in Museum Vindobonensis (= NHMW) from Akschehir [= Aksehir], 1.–10. x. 1931, leg. WAGNER, and 5 ♂♂ in coll. PINKER. During museum visits we located the ♂ HT, 2 ♀♀ PTs (one labelled as “allotype”), and 12 ♂♂ PTs in CMWM, now in ZSM, and 2 further ♂♂ PTs in NHMW (examined, S.N.). The 7 lacking ♂ PTs could not yet be located. The HT bears the following label text: “Holotypus *Perisomena caecigena* ssp. *parviocellata* FRIEDEL 1969” [red cardboard]; “Asia min., Kizilcahamam, 7. x.–9. x. 1968, FRIEDEL leg.”; “coll. Th. WITT, München/Weiden”, and has a Lfw. of 35 mm. The PTs were in part collected at slightly differing dates.

Locus typicus: “Kizilcahamam” [= Kızılcahamam, near Ankara, Turkey, Asia minor].

Etymology: Named for the small wing ocelli.

Notes: The main differential characters used by FRIEDEL to separate his new “subspecies” from the European specimens were the smaller size of the specimens and the wing ocelli [which obviously are correlated characters!]; additional slight differences were found in ground colour. These characters can also be found in SE European populations, especially when developing under dry and hot conditions. It is not surprising that already DE FREINA & WITT (1987) handled this as synonym of *caecigena*.

A pair of specimens in CCLP in MNHN shows the labels “*Perisomena caecigena* ssp. *pauvipunctata*” and “e.o. 17. [♂, Fig. 11]/18. [♀] ix. 1971, E Anatolien”. Such a taxon *†pauvipunctata* evidently was never described, and we have no knowledge about the background of these (obviously reared) specimens (perhaps only an unintentional misspelling of *parviocellata* FRIEDEL, 1968?). [The use of this unpublished name here must not be understood as a description or a synonymisation or any other nomenclatural act; this label name remains permanently invalid and unpublished (Disclaimer in the sense of the ICZN 1999)].

Selected citations in literature:

Perisomena caecigena parviocellata: FRIEDEL (1968: 18–19). ROUGEOT (1971: 115). NÄSSIG (1981: 25). DE FREINA & WITT (1987: 397, cited in synonymy). DE FREINA (1994: 317, 337, cited in error as syn. nov. of *P. caecigena transcaucasica*). NÄSSIG (1994: 259, 264, cited in synonymy). NÄSSIG (2002: 43–44, synonymy).

Perisomena caecigena f. *parviocellata*: D’ABRERA (1998: 30, 31, fig. ♂, ♀).

7. *stroehlei* NÄSSIG, 2002

Saturnia (*Perisomena*) *caecigena stroehlei* ssp. n. NÄSSIG (2002: 45, figs. 1–3, 12).

Type material: ♂ HT by original designation; in SMFL (examined) (SMFL type catalogue no. no. 4208); PTs in SMFL, CSLL & CSNB.

Locus typicus: “Zypern, Pafos Forest, W. Pedoulas, Mylikouri, 600–800 m, e.l./e.p.”.

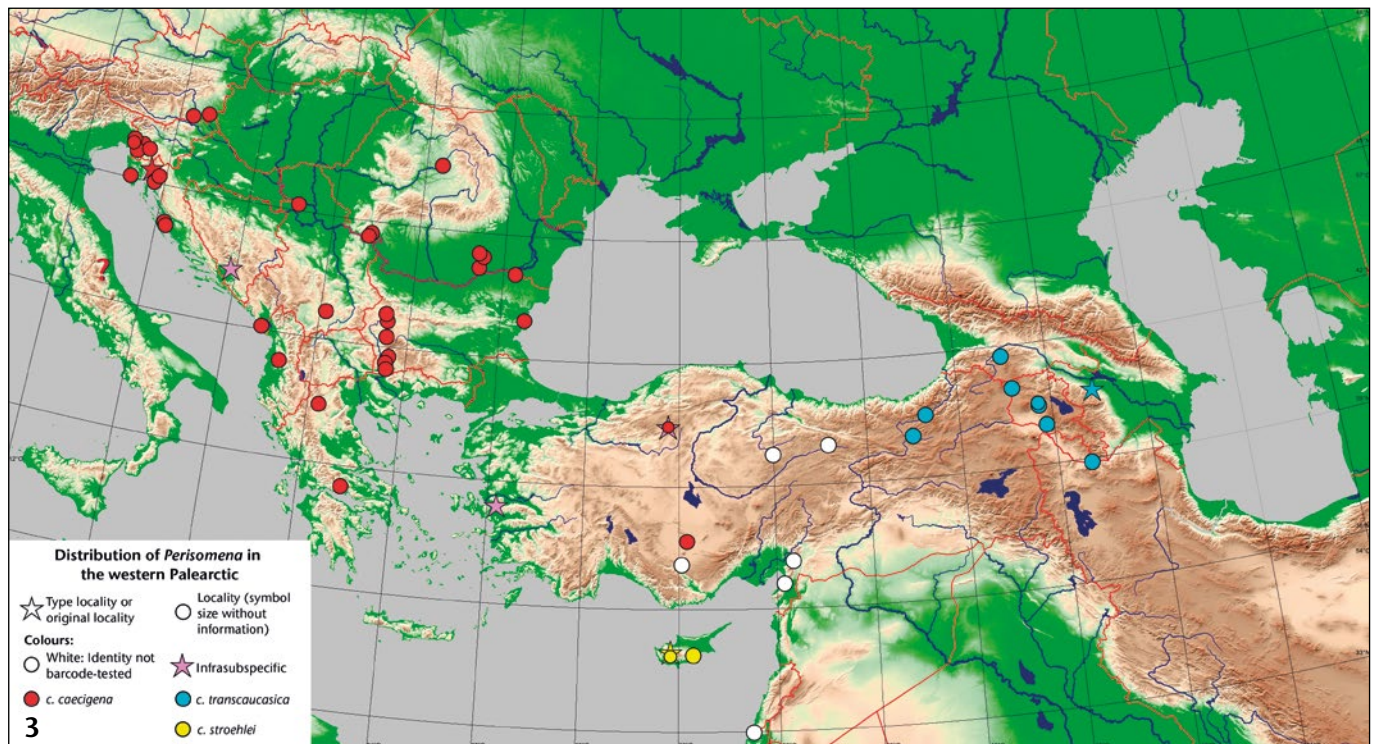


Fig. 3 (map): Distribution of the subspecies of *Saturnia* (*Perisomena*) *caecigena* in the western Palearctic. One dot may represent more than one locality in close proximity; we have not located every label data on the map and have concentrated on localities and areas from where we had barcode-tested data. The size of the dots varies only for graphical reasons to allow better visibility of symbols in close proximity and does not indicate other information. — The red “?” in central eastern Italy indicates the Vomano valley in Teramo province, from where a doubtful record was published (see discussion). — Symbols and colour legend: **asterisk** = type or original locality; **circle** = other localities; **red** = *S. (P.) caecigena caecigena*; **blue** = *S. (P.) caecigena transcaucasica*; **yellow** = *S. (P.) caecigena stroehlei*; **purple** = original localities of infrasubspecific forms; **white** = identity of populations “in between” the subspecies *transcaucasica* and *caecigena* s.str. which have not successfully shown barcode data so far. — Map created with Map Creator 2.0 Personal Edition, © 2003–2007 primap software, modified and localities added.

Etymology: Dedicated to Manfred STRÖHLE, Weiden/Opf., Germany, who rediscovered this taxon on Cyprus. It was first reported from Cyprus by J. LEDERER (1855: 183); for further details see NÄSSIG (2002).

Notes: FISCHER & LEWANDOWSKI (2003: 298) synonymised ssp. *stroehlei* with the nominotypical population, based on their analysis of the colour pattern. However, we prefer to keep this taxon separate at subspecific level due to the genetic homogeneity (see the barcode analysis) and the small, but constant differences to the other likewise very homogeneous populations; see also below. In addition, insular populations of weak fliers (= semi-sessile populations) with small, but constant genetic and external differences to the continental populations are always good candidates for separate subspecies. — Further specimens have been collected later in western Cyprus, while LEDERER’s (1855) material was collected further to the East, always in the hills and mountains of Cyprus.

Selected citations in literature:

Saturnia (*Perisomena*) *caecigena stroehlei*: NÄSSIG (2002: 45–48, figs. 1–7, 12).

J. LEDERER (1855: 183). FISCHER & LEWANDOWSKI (2003: 298).

Revisional notes on *Saturnia* (*Perisomena*)

In our revision, we confirm the existence of only one species in the subgenus. This species is listed on the BOLD website with the BIN code no. (compare RATNASINGHAM & HEBERT 2013) AAC6908 for all three subspecies (as of 26. iv. 2016).

Saturnia (*Perisomena*) *caecigena* KUPIDO, 1825

Saturnia (*Perisomena*) *caecigena* comprises 3 subspecies with small, but apparently well-defined differences both in external morphology and mtDNA COI-barcode. Although our present systematic and phylogenetic interpretation differs from that by NÄSSIG (2002), many of the details compiled there still are valid, and not all have been repeated here.

S. (Perisomena) caecigena caecigena KUPIDO, 1825

- = f. *unicolor* (SCHULTZ, 1910) (infrasubspecific)
- = f. *wiskotti* (NIEPELT, 1914) (infrasubspecific)
- = f. *derosata* (SCHAWERDA, 1914) (infrasubspecific)
- = *parviocellata* (FRIEDEL, 1968), syn.

Diagnosis: In general, there are no apparent differences in genitalia between the three subspecies (Figs. A–D), which might well be expected. Caused by the fact that the majority of specimens in collections have been bred, usually not under natural conditions (with respect to ambient temperature, humidity, diurnal rhythm etc.), a museum collection specimen, consequently, might not always show the natural range of colour and pattern, but exhibit extreme variants; also, often reared specimens are much smaller than those collected in the wild. In the external morphology, there are only tendencies differing between populations and subspecies: the northwestern populations (especially in Italy, Austria, Slovenia, coastal Croatia etc.) usually have large, bicolorous ♂♂ (in vivid yellow and pink, but with quite blurred antemedian zig-zag lines) and pinkish (or sometimes pinkish with some yellow, but generally all colours more greyish mottled than in ♂♂) ♀♀. Uni-

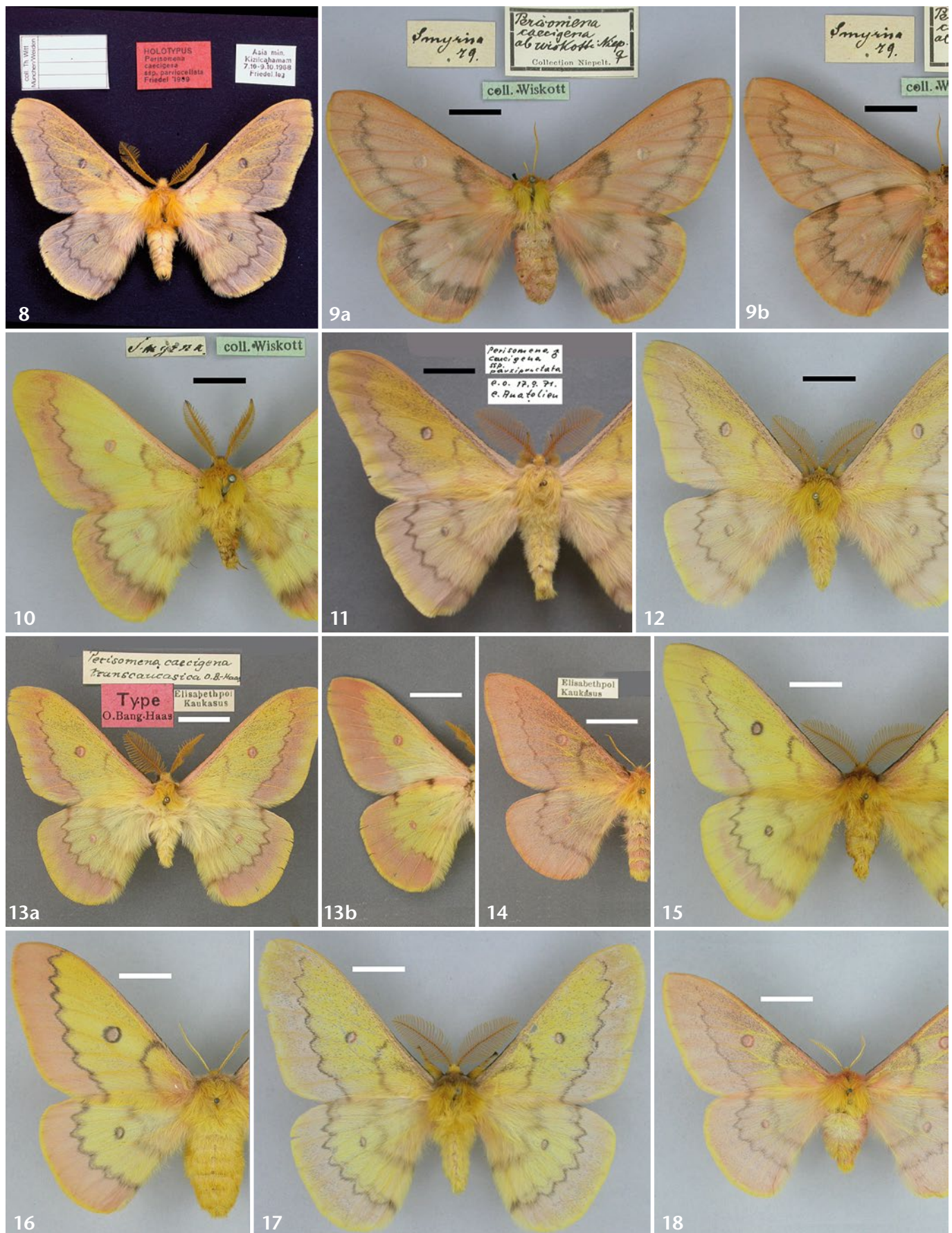
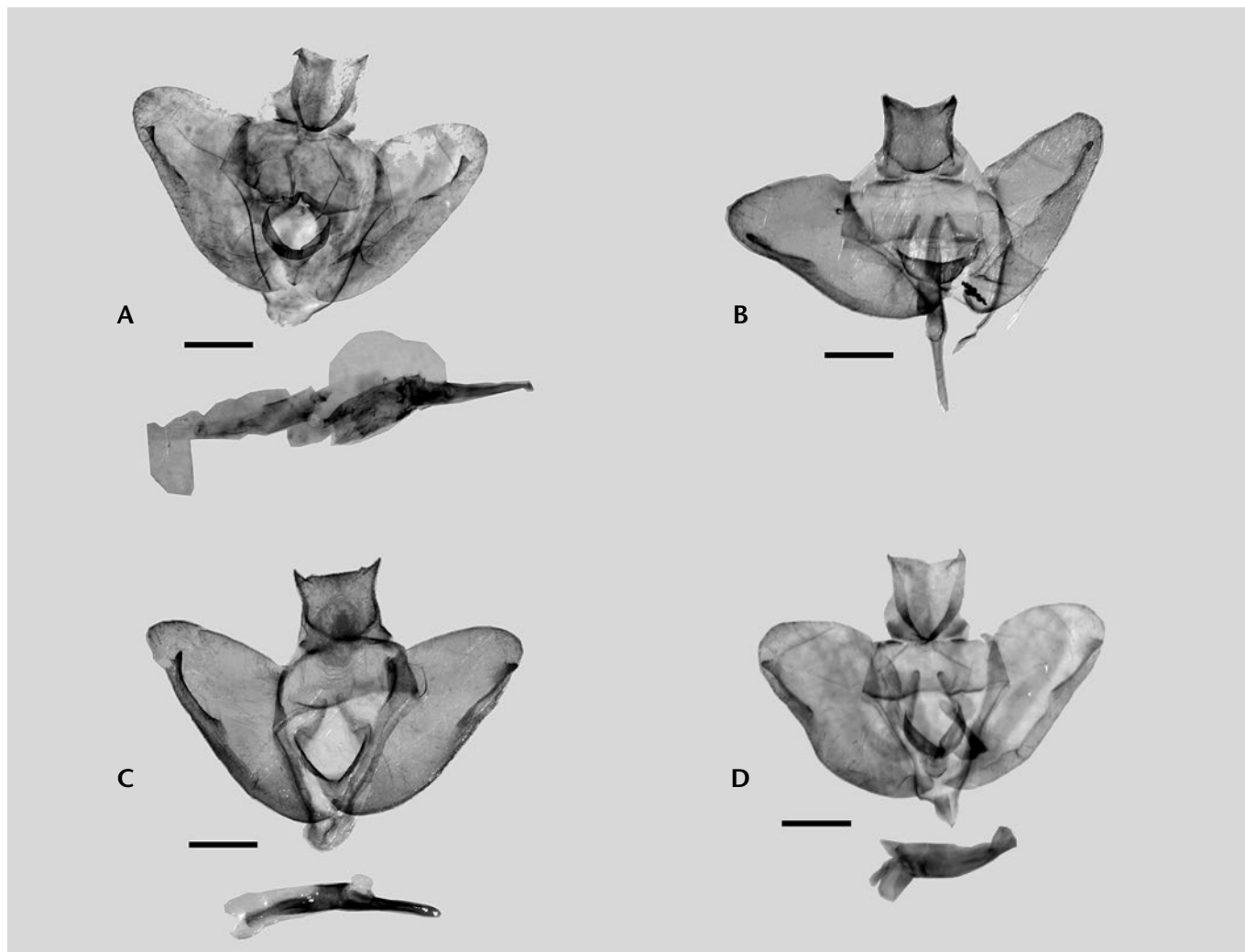


Plate 2: *Saturnia* (*Perisomena*) *caecigena*, Imagines. **Figs. 8–12:** ssp. *caecigena*. **Fig. 8:** Holotype ♂ ups. of *P. caecigena parviocellata* FRIEDEL, 1969 (syn. of nominotypical ssp.), photo without scale, in CMWM. **Figs. 9a, b:** Original ♀ specimen (in WMNH) of forma *†wiskotti*, "Smyrna" = İzmir, western Turkey; **9a** = ups., **b** = uns. **Fig. 10:** ♂ specimen ups. (in WMNH) of forma *†wiskotti*, "Smyrna". **Fig. 11:** ♂ specimen ups. with name label (undescribed) *†pauvipunctata* (in CCLP in MNHN). **Fig. 12:** ♂ specimen ups. from Israel, see discussion in text. — **Figs. 13–18:** ssp. *transcaucasica*. **Figs. 13a, b:** Lectotypus ♂ *transcaucasica* STAUDINGER, ZMHU; **13a** = ups., **b** = uns. **Fig. 14:** PLT ♀ ups. of *transcaucasica*, ZMHU. **Fig. 15:** ♂ ups., Armenia, Kotaiik Distr., BC SNB 3296, CSNB. **Fig. 16:** ♀ ups., Georgia, Bakuriani, BC SNB 1946, CSNB. **Fig. 17:** ♂ ups., Turkey, Erzurum, BC SNB 3289, CSNB. **Fig. 18:** ♀ ups., Azerbaijan, Nachitchevan, BC SNB 1947, CSNB. — Specimens (except in Fig. 8) approx. natural size; scale bars = 1 cm.



Genitalia plate, Figs. A–D: Genitalia of subspecies of *Saturnia* (*Perisomena*) *caecigena*. **Fig. A:** SNB GP 2166/10, *S. (P.) caecigena caecigena*, Montenegro. **Fig. B:** SNB GP 2497/16, *S. (P.) caecigena ?caecigena*, Israel. **Fig. C:** SNB GP 2496/16, *S. (P.) caecigena transcaucasica*, Armenia. **Fig. D:** SNB GP 2167/10, *S. (P.) caecigena stroehlei*, Cyprus. — Scale bar = 1 mm, all approx. to the same scale. Photos S.N.

colourous ♂-forms (in yellow or pink) are more often encountered in the southern part and in western Asia minor, where also smaller forms are more common (however, caution: *most* dwarfs are reared specimens!). These all form a rather heterogeneous external morphology of the nominotypical subspecies, in contrast to the uniformity of the barcode. Evidently the ecological variability depending on external factors of weather (temperature, humidity etc.) and maybe other factors is quite high. DE FREINA & WITT (1987: 397) suggested the following (translated from German): “In coastal biotopes the species tends to show up in luxurious, vivid colours. Specimens from higher elevations are often less scaled and smaller.” This observation would – in the Mediterranean area – suggest a correlation primarily with summer rain/humidity.

Distribution: NE Italy; SE Europe: from S. Austria and Slovenia across most of the Balkan peninsula including Romania to Bulgaria and Greece; western parts of Turkey (Asia minor; Figs. 8–11); also found recently in N Israel (this most southern population has not yet been barcoded successfully). — Exact borderlines of the species in SE Europe are not known, as well as the localisation of the borderline or transition zone to the following subspecies within Asia minor. FORSTER & WOHLFAHRT (1960: 132) list Slovenia (“Krain”) as most northwestern extension; FAJČEK (2003: 133) described the northern limits of the species to run “through NE Italia, Slovenia and Romania”, but DANIEL (1959, 1968), DE FREINA & WITT (1987: 397, 651), HUEMER & TARMANN (1993) and HUEMER (2013: 150) add the southern Steiermark (Styria) in Austria (near Kitzpeak in the Sausal Mts.); in KARSHOLT & RAZOWSKI (1996), the species was still

not listed for Austria. HABELER (2014: 171, fig. 1g) reports the most recent record of *S. (P.) caecigena* for Austria from 2010, found in a nearby, but different locality compared to the older Sausal records. These records from Austria are so far still not considered in FAUNA EUROPAEA (2016). — The further range limits of the species are nowhere clearly depicted; besides remarks without reference or other substantiation in DE FREINA & WITT (1987: 397, 651) we have no positive information whether, and if, where exactly, the species is also distributed north of the Black Sea. According to Konstantin EFETOV (2015, in litt.) and a reference kindly delivered by him (EFETOV & BUDASHKIN 1990), there are no reliable records of the species from Ukraine, the Crimean Peninsula or anywhere else there in the North of the Black Sea (which is in accordance with the distribution shown in FAUNA EUROPAEA 2016).

The association of the population of Israel with the nominotypical subspecies is surely only tentative at present, as we did not yet receive a barcode result (probably due to age and/or softening process before setting). Morphologically, it fits quite well to the nominotypical population (compare Fig. 12), better than to *transcaucasica* or *stroehlei*. This confirmed existence of the species in northernmost Israel suggests at least a former (possibly still recent?) presence in the Anti-Lebanon (including Mt. Hermon) and Lebanon mountain chains in Lebanon and in western Syria, also further northward; however, due to political unrest and civil war in this area, a research aimed for the species appears to be impossible there presently.

Note: There is an old specimen with locality data “Spanien” (= “Spain”) in BMNH. There is no hint of the collector, and the specimen appears to be a reared one, but as *S. (P.) caecigena* does definitively not live in W Europe, this is for sure an erroneous label. This specimen fits well within the variability range of SE European specimens. — Similarly mislabelled specimens with “Spain” or “France” or similar western European localities have occasionally also been seen in other collections.

Material examined or extracted from literature:

Austria: DANIEL (1959: 107–107, Steiermark, Sausal hills, “zwischen den Orten Fresing und Kitzeck ... zwischen 200 und 600 m” [“between the villages Fresing and Kitzeck at 200–600 m elevation”], 1 ♂, 15. IX. 1959 [at light]. DANIEL (1968: 121–122 resp. 37–38 [pagination of separatum only?]), citing the former data and remnants of a ♀ found during daytime close by on 6. X. 1960. HUEMER & TARMANN (1993: 96): Steiermark [no locality]. HUEMER (2013: 150): Steiermark [Styria, no locality]. HABELER (2014): Steiermark, “Zinsberg bei Fehring (350 m, 46°54,4' N, 16°1,0' E) am 20. IX. 2010”. This last record opens the possibility that the population is not a short-termed adventive one (as supposed by DANIEL 1959, 1968), but a permanently established one, although with a low population density. For a basically non-migratory species (like most saturniids!) this would anyway be the more likely interpretation.

Italy: Julian-Venetian part of the Region Friuli-Venezia Giulia, at several localities from Gorizia to Trieste (A. ZILLI, pers. comm., see below under discussion of the distribution area in Italy). 1 ♂, Trieste, 3.–5. X. 1996, leg. FISCHER (CSLL). 1 ♂, Gorizia, e.p. 8. X. 2004, BC SNB 1487 (CSNB). See Fig. 6.

Hungary: Orsova (JORDAN 1911: 220).

Slovenia: 2 ♂♂, 1 ♀, Wippach (sodni okraj [= juridical district] Vipava, Krain), [18]88 (ZMHU). 1 ♂, Korita Na Krasu, 380 m, 10. X. 1996, leg. Jure FABRIZIO (CSLL). 1 ♂, Kranj env. (figured by MIRANDA & PEIGLER 2007: fig. 2). A series of reared specimens from Kras and Kranj (CWAN).

Croatia: ST series, Fiume [Rijeka] (MMBC), presently not located (see above). 1 ♂, Fiume [Rijeka] (ZMHU, Figs. 4, 5). 4 ♂♂, Dalmatien, Zadar, 18. X. 1988, leg. H. MODL. 1 ♂, Dalmatien, Zadar, 17. IX. 1965, leg. CZIPKA. 2 ♀♀, Dalmatien, Zadar, 6.–9. X. 1965, leg. M. FORST. 6 ♂♂, Insel Krk, Punat, 150 m, 22. X. 2001, leg. C. ZEHEHNER. 2 ♂♂, 1 ♀, Zadar, 15. X. 1997, leg. R. FIEBIG. 3 ♂♂, 3 ♀♀, Dalmatien, Sukosan, 1964. 3 ♂♂, 4 ♀♀, Dalmatien, Zara, 1965. 9 ♂♂, 3 ♀♀, Insek Krk (Ost), 9 km W Bask, 5 km NE Punat, 300 m, 10. X. 2007, leg. A. STEIDEL. 2 ♂♂, Dalmacija, 35 km E/SE Rijeka, 13 km NE Crikvenica, 4 km N Bribir, 16. X. 2007, 420 m, leg. A. STEIDEL. 1 ♂, Dalmatien, ix. 1910 (all in CSLL). Several specimens, Dalmatia, Zara. 1 ♂, Litoriae austr., Opcina-Prosecco. Karsthänge, 4. X. 1915, leg. M. STAUDER (all in BMNH). 1 ♂, Zadar, e.l. 10. X. 1965, leg. SCHVERING. 1 ♂, 1 ♀, Zadar, e.l. X. 1978, leg. CZIPKA. 1 ♂, 1 ♀, Zadar, e.o. 6. & 11. X. 1987, leg. DITTRICH. 1 ♂, Dalmatien [without further data], e.l. 20. IX. 1927, leg. L. EBERHART (all in CSNB). Zara and Zaton, near Dubrovnik (both cited by G. LEDERER 1951: 133). Many reared specimens from different localities in western Croatia (Dalmatia: Vodice, Krk, Zadar etc.) (all in CWAN). Karlovac (coll. P. FÖHST in SMFL).

Bosnia i Herzegovina: Herzegovina, between Trebinje and Lastva, and between Caplina and Domanovice; Sarajevo (all cited by G. LEDERER 1951: 133).

Serbia: Fruška Gora (cited in ABAFI-AIGNER 1907: 43).

[Serbia,] Kosovo: 3 ♂♂, Sribita, Priština, 700 m, 25. IX. 1982, leg. P. JAKSIĆ. 3 more ♂♂, same location, 7. X. 1983 (all CSLL).

Montenegro: 1 ♂, 1 ♀, Stari Bar, e.o. 15. IX. (♂), 1. X. 1988 (♀), leg. D. LEGLER, GP 2166/10 SNB (CSNB).

Albania: 1 ♂, Albanien, ix. 1936 (CSLL). Several specimens, Tirana, e.o. 1. IX. 1936 (MHNG). Tomoritz (cited by G. LEDERER 1951: 133).

Greece: 3 ♂♂, 1 ♀, Makedonia, 12 km S Kastoria bei Vogatsikon, 500–700 m, 8.–10. X. 2001, leg. A. BECHER (CSLL). 1 ♂, Amfissa, Parnassos, 1000 m, 21. X. 2008, leg. HACZ (CSLL). 1 ♂, Kirki, 24. X. 2012, leg. I. JUHÁSZ & G. FABIÁN (CSNB, Fig. 7). Macedonia, Strymon valley, Verkini, 50–300 m, leg. W. SCHACHT (NÄSSIG 1981: 25, in CWAN). 9 ♂♂, [Makedonia], 22 km S Kastoria, Vogatsikon, [at light], 6.–10. X. 2001, leg. A. SCHMIDT (CWAN).

Romania: Orsova, Bukarest (cited by G. LEDERER 1951: 133). Comana, 4. X. 1915. Cernica, 1953, 1954. București, 3. X. 1934. Orșova. Balta Bugeac. Cazanele Dunării, Băile Herculane. Comana, 15. IX. 1949 (all cited in LEVENTE 2010: 98). Tirgo Mures [= Târgu Mureș], Nares (coll. P. FÖHST in SMFL).

Bulgaria: 8 ♂♂, Pirin region, S. Kresnan, Kobanya, 7. X. 2009, leg. G. FABIÁN & I. JUHÁSZ. 6 ♂♂, Pirin region, Kalimanci, 8. X. 2009, leg. G. FABIÁN & I. JUHÁSZ. 1 ♂, SW Bulgaria, Slavjanka, Harsovo, 15. X. 2006, leg. HACZ. 1 ♂, SW Bulgaria, Harsovo, 500 m, 24. X. 2008, leg. HACZ (all CSLL). 1 ♂, Kresna, 7. X. 2009, leg. I. JUHÁSZ & G. FABIÁN (CSNB). 1 ♂, “Bulgaria”, without further data (BMNH).

Turkey: Ankara Prov.: type specimens of *P. c. parviocellata*, Asia min., Kızılcahamam, 7.–9. X. 1968 and other October dates, leg. FRIEDEL (CMWM in ZSM, NHMW, see list of types above; Fig. 8). Several ♂♂, ♀♀, Kızılcahamam, leg. KOÇAK (LNK). 1 ♂, Kızılcahamam, 1. X. 1971, leg. BILEK. Çamlıdere, 32°25' N, 40°26' E, 8. X. 1988, leg. FABIÁN, HERCZIG et al. (DE FREINA 1994: 337, cited in error as *P. caecigena transcaucasica*) (all MHNG). 8 ♂♂, 6 ♀♀, Ankara Prov., Kurdbogazi, 1000 m, 19. X. 1979, leg. A. KOÇAK (LNK). — Akşehir Prov.: (NHMW, see types list). — Prov. Konya: 1 ♂, 1 ♀, Konya, 30 km SW Beysenir, [reared], leg. D. KAHLHEBER, CWAN. — Adana Prov.: 1 ♂, 2 ♀♀, Taurus, (ZMHU). 2 ♂♂, 2 ♀♀, Nurdağı Geçidi, Hasanbeyli, e.l. XI. 1994, leg. V. BIZA & Z. KOŠTAL (all CSNB). — Yozgat Prov.: 1 ♂, Yozgat Prov., 5 km SW Pazarcık, 39°46' N, 35°59' E, 1500 m, 21. XI. 2000, B. BALÁZC & G. FABIÁN (all CSNB). — Edirne Prov.: Keşan, 80 m, leg. NIPPE (DE FREINA 1994: 337). — İzmir Prov.: 10 km NW İzmir, 280 m, leg. NIPPE (DE FREINA 1994: 337, cited in error as *P. caecigena transcaucasica*). — Antalya Prov.: Termessos env., 800 m, XI. 1982, leg. DITTRICH (DE FREINA 1994: 337, cited in error as *P. caecigena transcaucasica*). — Tokat/Sivas provinces: Several specimens, [Sivas prov.], Zara, 1932 (MHNG). Çamlıbel Geçidi, 1600 m, 10. X. 1989, leg. CSORBA & G. RONKAY (DE FREINA 1994: 337, cited in error as *P. caecigena transcaucasica*).

Syria[?]: ♂ ♀, “bred from cocoons from Syria” (COCKERELL in PACKARD 1914: pl. C, figs. 2a, b). (In the early 20th century “Syria” was a large province of the Ottoman Empire, ranging from around Halab [today: Aleppo] in the north to somewhere south of the Dead Sea, so this locality is uncertain and can be almost anywhere in this area where deciduous or oak bushland or forests exist[ed].)

Israel: 2 ♂♂, Upper Galilee, Mt. Meron, northern slopes, 620 m, early IX. 1987 (ex CMWM in ZSM), leg. G. C. MÜLLER, GP 2497/16 SNB, barcode SNB 5215 & 5216 [without result] (CSNB). — These Israelian specimens are quite similar to SE Turkish specimens from the Taurus Mts. in CMWM and ZMHU (see above; Fig. 12). As we did not get barcode data from these specimens and in lack of genitalia differences within the species *S. (P.) caecigena*, they are only tentatively included into the subspecies *caecigena* (see white dot in map).

S. (Perisomena) caecigena transcaucasica (O. BANG-HAAS, 1927), stat. rev.

Diagnosis: This subspecies is externally usually characterised (for specimens collected in the wild) by large size and most often bright yellowish ground colour (of ♂♂), while ♀♀ sometimes show a colouration like Croatian ♂♂ with a median area in bright, clear yellow, while the outer area is pink; others are nearly entirely pinkish. Both sexes are often quite vivid in colouration, and they tend to show a very clearly marked postmedian (and to some degree also the antemedian) black line, not as blurred and fuzzy as usually in the nominotypical subspecies (in this aspect similar to ssp. *stroehlei*).

— Similar ♂ specimens, but usually smaller, might also sometimes be found in Greece etc. There are no unequivocal external characters to identify every specimen of any of the subspecies!

Distribution: Transcaucasus: Azerbaijan, Georgia, Armenia, northeastern Turkey.

Material examined or extracted from literature:

Azerbaijan: type specimens (LT, PLT; Figs. 13–14) of *P. c. transcaucasica* from Elisabethpol [Ganja] (ZMHU, see above). 1 gyn-ander, Caucas. mer., “Armenfeld near Elisabethpol” [Ganja], leg. HABERHAUER. 1 ♂, 3 ♀♀, “Armenfeld”, coll. LED. [= J. LEDERER] (all ZMHU). 1 ♀, Azerbaijan [Autonom. Rep. Nachitchevan], Ordubad [38.896097° N, 45.957139° E, N of border to Iran and Kiamaky Wildlife Refuge], e.o. 5. x. 1986, BC SNB 1947 (CSNB), Fig. 18.

Georgia: type specimens of *P. c. transcaucasica* from Tbilisi (not recently located in ZMHU). 1 ♀, Bakuriani, e.o. [without further data], BC SNB 1946 (CSNB), Fig. 16.

Armenia: 1 ♂, “Amasia” ([sic], 40°56'46" N, 43°47'3" E) (ZMHU). 2 ♂♂, 1 ♀, Kotaikski distr., Atzavan vill., 700 m, 14.–20. x. 2000, leg. P. KAZARJAN. 1 ♂, 3 ♀♀, Agveran, 2000 m, x. 2006, leg. V. AMBARTZUMJAN (all CSL). 1 ♂, Kotaikski distr., Atzavan vill., 700 m, 14. x. 2000, leg. P. KAZARJAN, GP 2496/16 SNB, BC SNB 3296 (CSNB), Fig. 15.

Turkey (Asia minor): Prov. Erzurum: 2 ♂♂, 8 km NW Kop Pass, 2000 m, 1. x. 2005, leg. B. BENEDEK & T. CSOVARI (CSLL). 5 ♂♂, 1 ♀, 8 km NW Kop-Pass, 40°2' N, 40°28' E, 2000 m, 1. x. 2005, leg. B. BENEDEK & T. CSOVARI. 2 ♂♂, N Izpir, 11. x. 2001, leg. R. TRUSCH, BC SNB 3289 (Fig. 17), 3290 (all CSNB). Erzurum Prov., 5–15 km NW Hınıs, 1650–1750 m, 16.–17. x. 1985, leg. DE FREINA. Erzurum Prov., Soğanlı Dağları, Ovit-Pass, 10 km NW Ispir, 1450–1500 m, 18.–19. x. 1985, leg. DE FREINA (all cited in DE FREINA 1994: 337). — **Prov. Kars:** 1 ♂, valley of Aras river, 13 km SW Karakurt, 1450 m, 2. x. 2005, leg. B. BENEDEK & T. CSOVARI, BC SNB 1485 (CSNB). — **Prov. Bingöl/Muş:** Buğlan-Pass, 1600 m, 12. x. 1985, leg. DE FREINA (cited in DE FREINA 1994: 337). — **Prov. Ağrı:** Karasu-Aras-Dağları, 7 km E Aydıntepe, 1400 m, 12.–13. x. 1989, leg. CSORBA & G. RONKAY (cited in DE FREINA 1994: 337).

S. (*Perisomena*) *caecigena stroehlei* Nässig, 2002, stat. rev.

Diagnosis: Usually slightly smaller than, but on average somehow similar to ssp. *transcaucasica*, with in most cases sharply defined postmedian (sometimes also antemedian) lines. The wing eye-spots usually have a conspicuous bright, nearly whitish centre. The variability of the ground colour of the wings is, obviously, higher than in *transcaucasica*, with a lot of brown colour tones in both sexes (possibly caused by extreme hot and dry conditions for the pupae?). In CWAN in SMFL are two ♂♂ collected in the wild; one is entirely vivid pink, the other is a mixture of light pinkish brown in the postmedian and darker yellowish brown in the median field. Although some of the characters listed by NÄSSIG (2002, compare also there) as defining this subspecies did not hold when more material became available (FISCHER & LEWANDOWSKI 2003), this insular population is just as well-defined both in morphology and COI-barcode as the other two populations of the species and surely deserves the same status (here: as subspecies). Especially the barcode is quite homogenous for the different subspecies and justifies these subdivisions.

Distribution: Cyprus. — J. LEDERER (1855: 183) reported caterpillars which had been found by F. ZACH on the Stavro Vunos Mt. (PITTAWAY 2014 calls this locality the Stavrovouni Monastery) ca. 17 km W of Lanarka at the eastern end of the Troodos mountain range. All more recent collecting localities have been at the western end of the Troodos range, in the Paphos forest in the areas of Mylikouri and Agios Nikolaos. ZACH found his caterpillars on *Populus*, while recent collecting of larvae was on *Quercus* bushes and a few other plants — this is very plausible, as *Perisomena* caterpillars are rather polyphagous on wooden submediterranean bushes and young trees.

Material examined or extracted from literature:

All Cyprus: type specimens (HT, PTs; Figs. 19–20) of *P. c. stroehlei*, [Paphos District], Pafos Forest, W. Pedoulas, Mylikouri, 600–800 m, e.l./ e.p. 20. ix.–10. xi. 1978, leg. & cult. M. STRÖHLE (CWAN in SMFL, CSLL, CSNB). 2 ♀♀, coll. LED. [J. LEDERER] (ZMHU). 1 ♂, Lemesos Distr., 8 km SE Ag[ios] Nikolaos, LF 26. xi. 2005, leg. E. GÖRGNER (coll. no. 845) (CWAN in SMFL), Fig. 22. 5 ♂♂, Mylikouri, gravel road to Agios Nikolaos, 750 m, 5. xi. 2002, leg. H. FISCHER; same data, 7. xi. 2002, leg. H. FISCHER (all CSL). 1 ♂, Mylikouri, same data as before, leg. H. FISCHER, GP 2167/10 SNB, BC SNB 3295 (CSNB). 1 ♂, Mylikouri, Schotterstraße nach Agios Nikolaos, 730 m, 31. x. 2002, leg. H. FISCHER, B3218-wn-C10, CWAN in SMFL (Fig. 21).

General discussion

Saturnia (*Perisomena*) *caecigena* appears to be an isolated SE-Ponto-Caucasian (or perhaps Pontomediterranean) species without any obvious close relationships to other *Saturnia* species. Further research is necessary to find out the true relations.

It really was a “nice phylogeny” before the DNA (CO-I, EF-1α and DDC) was used in the group, as imaginal and preimaginal morphology, distribution, ecology, behaviour and other aspects quite clearly and without obvious contradictions favoured a close relationship with *Neoris*. Preimaginals of both subgenera will be shown together in the second part of this publication for direct comparison. This makes clear why formerly a close relationship of both was proposed by e.g. JORDAN (1911), NÄSSIG (1994) or PEIGLER (1996), and only recent molecular work (e.g. REGIER et al. 2002; our barcode results in this paper) resulted in a more distant standing of *Neoris* within the genus *Saturnia*.

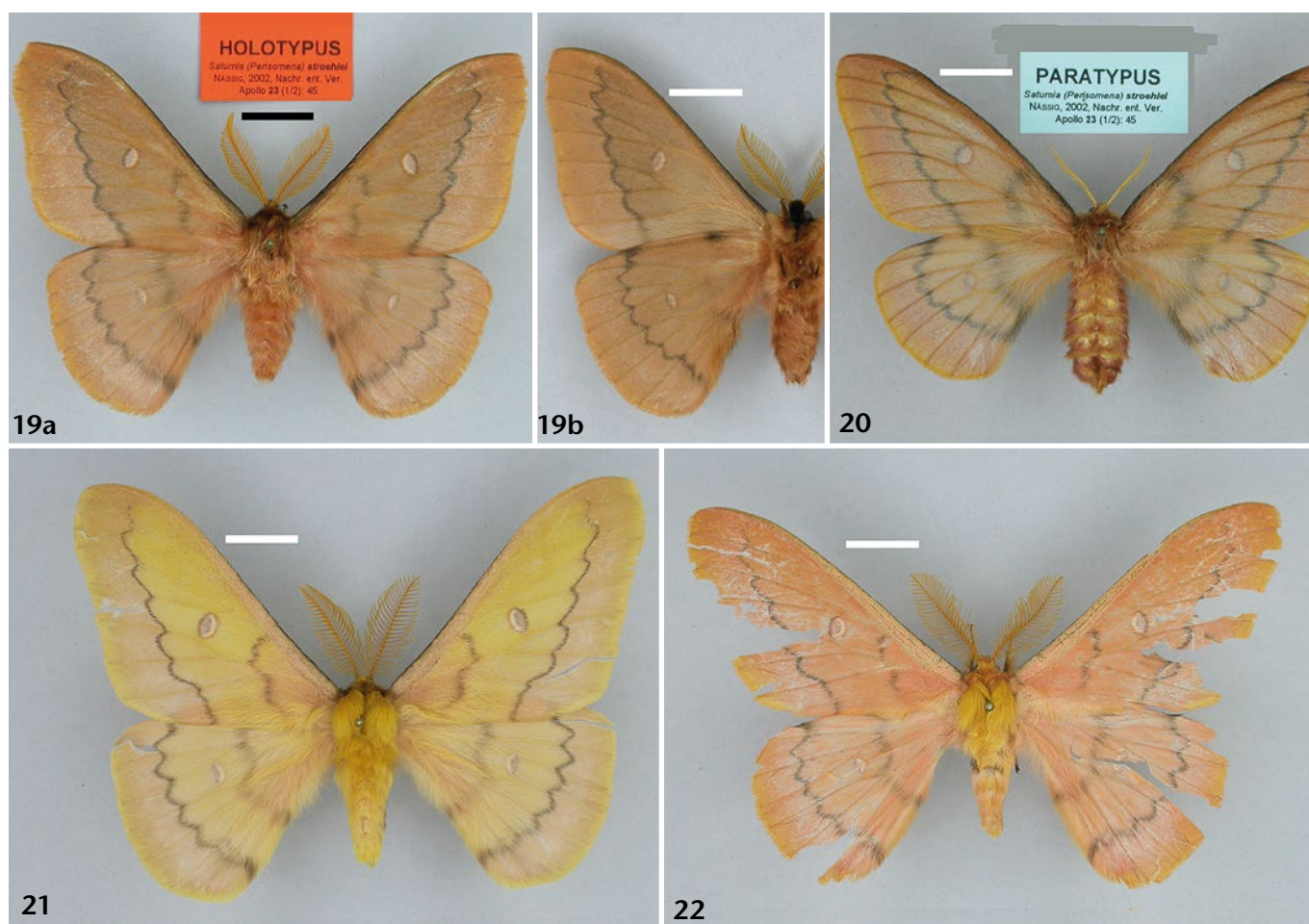
Notes on the postulated distribution area in Italy

In some of the recent literature (e.g., LERAUT 2006: 31), the distribution area of *S. (P.) caecigena* in Italy can be found subdivided into three regions as follows:

- The northeastern part of Italy, close to the border to Slovenia (Region Friuli-Venezia Giulia, according to some authors even more to the West).
- The central Italian Apennine mountains (Abruzzi Mts.) in Teramo on the Adriatic side of the Apennines, especially the Vomano valley.
- “Sicily” (unspecified).

These three areas can be characterized as follows:

1. The northeastern area (as far as dealing with the **Friulian-Julian Venetian region** only) is directly connected via Slovenia to the main SE European distribution area of the species, and we absolutely agree that this record is correct; Alberto ZILLI (pers. comm.) personally collected the species in the Julian Venetian part at several localities from Gorizia to Trieste. This is also the only area which is listed by RAINERI et al. (1995: 5) in the “official” Italian species checklist without a question mark, and also the more recent checklist of PARENZAN & PORCELLI (2006: 79) confirms this area. [The oldest citation for Venetia-Giulia



Color plate 3: *Saturnia (Perisomena) caecigena*, Imagines. **Figs. 19–22:** ssp. *stroehlei*, all from Cyprus. **Figs. 19a, b:** Holotype ♂ of ssp. *stroehlei*; **19a** = ups., **b** = uns. **Fig. 20:** PT ♀ ups. **Fig. 21:** ♂ ups., Mylikouri, leg. H. FISCHER, B3218-wn-C10, in CWAN. **Fig. 22:** ♂ ups., Mylikouri, leg. E. GÖRGNER, in CWAN.

appears to be MINÀ-PALUMBO (1883/1884), according to PARENZAN & PORCELLI (2006); but we have not found this publication so far.] PARENZAN & PORCELLI also state clearly that they, in accordance with PROVERA (1992), do not see the region Veneto adjoining to the West of Friuli-Venezia Giulia as part of the natural range of *S. (P.) caecigena* (“La citazione per il Veneto” [= MARIANI (1941)] “è dubbia” – “the citation for Veneto is doubtful”).

Apparently, the two other areas are at least doubtful or plainly incorrect (A. ZILLI, Uberto NARDELLI, pers. comm.), which is also supported by the view of PARENZAN & PORCELLI (2006):

2. The Apennine area record (Abruzzi) is obviously based on a report of larvae said to be found by “F. DANNEHL” (i.e., probably Franz DANNEHL, 1870–1946/47[?], see HORN et al. 1990) in 1908, quoted by TURATI (1909: 82); this is apparently also the source cited by PARENZAN & PORCELLI (2006) for the Abruzzi record. TURATI, in reality, only wrote that he knew from DANNEHL (i.e., from personal correspondence?) that the latter had recorded larvae of *S. caecigena* in the vicinity of Montorio al Vomano (Teramo province, on the Adriatic coast side) in the Abruzzi Mts. (Alberto ZILLI, pers. comm. 12. IX. 2011). More or less this same record (probably all based on the same source of TURATI, but usually without citing

him) was also listed by MARIANI (1941: 29 – he listed with codes “Abruzzo, Dalmazia, Veneto”; Abruzzi is doubtful, Dalmatia is correct, but not Italian today, and Veneto is in the West of the Friuli-Venezia Giulia region and may be over the fringes of the range, but at least is close to recently reconfirmed localities), ROUGEOT (1971: 115), PROLA et al. (1978: 176) and BERTACCINI et al. (1994: 152), the latter three publications always more or less expressing doubt about the Abruzzi record. According to A. ZILLI (pers. comm.), *S. caecigena* could, just as a matter of ecology, well occur somewhere down the mountains of the Adriatic coastline in Italy; after all, the Vomano valley still is a large oakwood. However, he wrote on: “But did anybody collect it? The answer is no ... Light collecting and light traps along the adriatic coast in the Abruzzi and in the proper season never gave any specimen.” – Accordingly, we presently suppose that the record from Montorio al Vomano is incorrect, although there is a small chance that there might once have been a population; either autochthonous or possibly from some imported material established for a short period?

From zoogeographical point of view, such a record in the eastern Abruzzi Mts. appears to be unlikely, but not impossible. At times of lower sea level during the glaciation periods the then largely dry upper Adria might possibly have been no serious barrier to cross for this

Pontian species in spite of its only rather weak flying abilities. We believe that RAINERI et al. (1995: 5) were correct to quote this locality with a question mark, and we will in future publications not positively list the Abruzzi Mts. for the species, but just quote the potential, while unproven possibility. In the map (Fig. 3), we have indicated this with a question mark.

3. The Sicilian record was obviously first published by DE FREINA & WITT (1987: 397) and then uncritically copied by some subsequent authors. It was not confirmed in the Italian checklist by RAINERI et al. (1995: 5); the only subsequent citations we found in recent literature were those by BERTACCINI et al. (1994: 152, with some clear doubt), NÄSSIG (2002: 43, already marked as a very dubious record) and LERAUT (2006: 31 — only in text, without inclusion in map and without citation of any source, but, however, also without expressing any clear doubt). Also PARENZAN & PORCELLI (2006) do not accept this Sicily record.

BERTACCINI et al. (1994), PARENZAN & PORCELLI (2006) as well as A. ZILLI and U. NARDELLI (pers. comm.) think that

this record for Sicily is based [either on a mislabelled specimen or] on a misunderstanding of the publication by TURATI (1909) in Italian language: This paper dealt at some large proportion of its text with faunistic information from Sicily, but, however, not at all in the paragraph on *Perisomena caecigena*; this is only dealing with the DANNEHL larvae from the Abruzzi Mts. (and thus not from Sicily!). We have asked Josef J. DE FREINA about this question (in litt. and pers. comm., 2011): he could not reconstruct the source for their information, and he consequently agreed that Sicily is an erroneous record.

Accordingly, the Sicily record for *S. caecigena* is definitively an error; there has never been a confirmed report. [We shall see in future how long this incorrect record will be repeated in secondary literature and especially on web sites; errors once being printed or shown in the web regrettably tend to persist forever in spite of any later corrections ...]

Acknowledgements and references

See in Part B: *Neoris*.

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Nachrichten des Entomologischen Vereins Apollo](#)

Jahr/Year: 2016

Band/Volume: [37](#)

Autor(en)/Author(s): Nässig Wolfgang A., Naumann Stefan, Löffler Swen

Artikel/Article: [Revisional notes on the subgenera Saturnia \(Perisomena\) and Saturnia \(Neoris\) stat. rev. \(Lepidoptera: Saturniidae\) Part A: Introduction and subgenus Perisomena \[s. str.\] 47-64](#)