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Notes on the "Apollo" butterflies from Tibetan areas - 1

(Lepidoptera, Papilionidae)
by

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Abstract: A practical method for the subspecific classification of the species that possesses various intergradations is provided. The subspecies of *Parnassius acco* Gray, [1853] inhabiting western Tibet are reviewed, with ssp. *gyanglaputsai* Huang, 1998 revalidated on the character of the fringes on the forewing upper side. *Parnassius labeyriei* Weiss & Michel, 1989 and *P. hide* Koiwaya, 1987 are discussed with *P. labeyriei shihongliangi* **subspec. nov.** and a new material of *P. hide petriki* Kocman, 2003 reported from S Serxu, NW Sichuan. Additional specimens of *P. stoliczkanus florenciae* Tytler, 1926 from Mayang-la, Zhada, SW Tibet are reported and figured. A discussion on the subspecific classification of *P. stoliczkanus* C. & R. Felder, 1865 is made.

Introduction: Starting with this paper, the author prepares to discuss some taxonomic problems in *Parnassius* species from Tibetan plateau on some new materials collected by Chinese collectors. A clarification of the complicated taxonomy of *Parnassius* should be based upon as many as possible specimens from as many as possible localities, thus any collections by the new explorations from exact localities deserve being published to fulfill the final analysis in future. In this series of papers, only the most important works in literature (usually the first taxonomic changes and those with important materials figured) are cited for the taxa discussed, with numerous unimportant works neglected in citation.

Abbreviations

SHNU:	Biological laboratory of Shanghai Normal University, Shanghai, P.R. China.
CHH:	Collection of Hao Huang, Qingdao, Shandong.
CQZY:	Collection of Zhi-Yuan Qi, Shanghai.
CSHL:	Collection of Hong-Liang Shi, Beijing.
TL	Type locality
ZFMK:	Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn

Subspecies concept. Some *Parnassius* species, such as *P. acco* Gray, [1853] and *P. epaphus* Oberthür, 1879, have a strong willing to disperse, with many individuals encountered by the collectors far from the biotopes. Thus the geographical variations are more continuous and less discrete than in other species. The distantly apart populations are markedly different in appearance and well accepted as distinct subspecies, but the intermediate populations are gradually changed in wing-pattern from locality to locality, forming a series of continuous intergradations, making the subspecific classification very controversial between different authors. Although some subspecies concepts are theoretically defined and well accepted (Braby et al., 2012; Remsen, 2010), they do not provide practical method to solve the problem in the species with numerous intergradations.

Remsen (2010) gave a practical standard for subspecies, of which the individuals should be distinguishable from those of other populations by one or more phenotypic traits at the 95% level of diagnosability. Rose & Kawasaki (1999) expressed a similar but vague viewpoint that subspecies should stand on a high percent level of diagnosability and the two subspecies could have "a few" identical individuals. The subspecies concept based on 100% level of diagnosability or low percent level of diagnosability seems to be not widely accepted. However, there is a big problem concerning the limit of the populations for calculating such diagnosability. Assuming an idealized extreme example, a species with five continuously varied populations (A, B, C, D and E) which are well isolated from one another, not immediately connected. It could be possible that A, C and E are distinguishable from one another in more than 95% level of diagnosability, but A and B, as well as B and C, C and D, or D and E, are distinguishable in less than 95% level of diagnosability. The only possible classifications require a preclusion of B and D or a preclusion of A, C and E. If we combine A and B into a taxonomic unit for calculating C's diagnosability from A+B, C will be inseparable from A+B by the lower degree of diagnosability. And then we have to combine A, B and C into a calculating unit. At last all the populations could be inseparable from the unit, but it could be possible that A and E are entirely different at specific level. A more meaningful classification might be to treat A, C and E as subspecies and ignore B and D as transitional forms. B and D could be attached to A, C or E by the level of similarity, but they can not be used to calculate the level of diagnosability for the outside population (**rule of preclusion**). There is no perfect classification in accordance with the nature and we have to ignore some populations in some extreme cases to make a relatively meaningful classification. Another reason to reject the combined populations for calculating the level of diagnosability in subspecies is that we are unable to assign weights to different populations in the calculation. (The combined populations can be calculated for species delimitation as the dividing line is at 100% level of diagnosability, and in such case the assigned weights to the populations do not affect the result). It is noteworthy that to reduce the number of subspecies in a classification for a complicated case does not make such classification more reasonable; a classification with fewer subspecies is often as subjective as that with more subspecies in complicated cases (such as *P. acco* Gray). Actually we cannot find a more reasonable method for a better subspecific classification solely by reducing the number of subspecies. It seems that only the above-mentioned "rule of preclusion" with preclusion of transitional populations is practically useful in complicated cases. Rose & Kawasaki (1999) expressed a similar viewpoint that "it is acceptable to declare a few intermediate populations as subspecies and to allocate the other similar populations to these subspecies", but they did not give a practical method in detail.

For the above-mentioned calculating, each population need to be defined as a combination of all localities which are immediately connected without apparent isolation. A better classification should be based on calculating for individuals from a concentrated range that is consisting of a series of immediately connected localities. And the samples for calculating are at best collected from different years;

by doing this we can practically more or less avoid the mistakes caused by ecological variations. Rose & Kawasaki (1999) emphasized that "breeding experiments carried out under different climatic conditions compared to the place of discovery could resolve" the problem that "whether distinctive characteristics between different populations are genetically fixed or based on an ecological reason".

Further more, we still meet great difficulty in selecting the subspecies under **the law of priority**. In the above-mentioned idealized example, there could be four types of diagnosability or similarity: 1) AB-CD-E (B is closer to A than to C; D is closer to C than to E); 2) A-BC-DE (B is closer to C than to A; D is closer to E than to C); 3) AB-C-DE; 4) A-BCD-E.

In Cases 1 and 2, if we first named A, C and E as subspecies, there will be no problem in accordance with the above-mentioned **rule of preclusion**. But if we first named A and B and thence C, there will be a paradox: B is invalid as B is distinguishable at no more than 95% level of diagnosability from A; C is invalid too as C is distinguishable at no more than 95% level of diagnosability from B. The classification will be different by the naming order. To avoid such instability, another rule (**rule of replacement**) is required in such complicated cases: for a better overall classification, the named population can be replaced by the most similar neighbouring population in calculating the level of diagnosability between subspecies, and by doing this the replacement must be fixed and satisfy more subspecies. In above-mentioned Cases 1 and 3 under such rule, if A and B were named first, B will be invalid (synonymous with A) with the population replaced by A for calculating, the later named C will be valid. In Cases 2 and 4 under such rule, if A and B were named first, B will be valid with the population replaced by C for calculating, the later named C will be invalid (synonymous with B).

Taxonomic accounts

Papilionidae

***Parnassius acco* Gray, [1853]** (fig. 1-20)

Current subspecific classification of *P. acco* Gray. The following authors have published their subspecific classifications of *P. acco* Gray which are controversial: Weiss, 1992; Shinkai, 1997; Inaoka & Sugisawa, 1997; Rose, 2000; Sakai et al., 2002; Kocman, 2009; Rose & Weiss, 2011. The most controversial one is provided by Inaoka & Sugisawa (1997) who retained only six subspecies and sunk most taxa as synonyms. This work was largely followed by Sakai et al. (2002). However, such an elegant classification is actually very subjective as well as those with numerous problematical subspecies, on no methodological basis. The validity of ssp. *vairocana* Shinkai & Weiss, 1992 is particularly problematical as this taxon is restricted to a small range with great individual variations in transition between the *acco* subspecies group and the *przewalskii* subspecies group. It is apparent that Inaoka & Sugisawa (1997) were unable to assign ssp. *vairocana* Shinkai & Weiss to any of the subspecies groups thus they had to keep it as a separate subspecies. However, ssp. *vairocana* Shinkai & Weiss is not distinguishable at 95% level of diagnosability from any of the neighbouring subspecies (ssp. *rosea* Weiss & Michel, 1989 in the south and ssp. *hideyukii* Ohya & Koiwaya, 1990 in the north), being a transitional population.

Even the separations between the subspecies groups are somewhat subjective as more or less transitional populations have to be ignored by such classification. There are several well defined subspecies (ssp. *yvonne* Eisner, 1959, ssp. *pseudobubo* Shinkai, 1998; ssp. *tchernyshevi* Shinkai, 1998) connecting the *acco* subspecies group and the *baileyi* subspecies group; they were arbitrarily attached to the *baileyi* subspecies group.

The purpose of this paper is to clarify the subspecies of *P. acco* Gray in western Tibet on the basis of the above-mentioned method, as a good number of specimens are collected by the author in addition to the specimens figured in literature.

The best classification for subspecies from C Tibet is probably the one provided by Rose & Weiss (2011), which is out of the scope of this paper. It is apparent most populations from C Tibet are at 100% level distinguishable from ssp. *acco* Gray, with a preclusion of the transitional populations on west of Sachia and Lazi. Inaoka & Sugisawa's (1997) classification is unacceptable, ignoring all these geographical variations.

Subspecies in western Tibet and adjacent areas

***Parnassius acco acco* Gray, [1853]** (figs. 1, 5, 11, 12, 14 & 16)

Parnassius acco Gray, [1853]: 76 (TL: Chinese Tartary; clarified as the current Pulan [= Burang or Purang] area, SW Tibet).

Parnassius acco chumurtiensis Bang-Haas, 1928: 59 (TL: Shilang Pass; about 7 km SE of Mayang village, Zhada, SW Tibet); Inaoka & Sugisawa, 1997: 95, synonymy for ssp. *acco* Gray; Sakai et al., 2002: 345, synonymy for ssp. *acco* Gray; Kocman, 2009: 106, synonymy for ssp. *acco* Gray; Rose & Weiss, 2011: 482, synonymy for ssp. *pundjabensis* Bang-Haas.

Parnassius acco pundjabensis Bang-Haas, 1927: 23 (TL: Tum-Tum-Thang, mont. Spiti or.), pl. 4, figs. 3-4; Inaoka & Sugisawa, 1997: 95, synonymy for ssp. *acco* Gray; Sakai et al., 2002: 345, synonymy for ssp. *acco* Gray.

Parnassius acco tagalangi Bang-Haas, 1927: 23 (TL: Taglang La, Ladakh); Inaoka & Sugisawa, 1997: 95, synonymy for ssp. *acco* Gray; Sakai et al., 2002: 345, synonymy for ssp. *acco* Gray.

Parnassius acco transhimalayensis Eisner, 1938: 29 (TL: Demtchok, Trans-Himalaya; clarified as the village of Demchok at India-Chinese border, close to Zhaxigang); Inaoka & Sugisawa, 1997: 95, synonymy for ssp. *acco* Gray; Rose, 2000: 264, synonymy for ssp. *acco* Gray; Sakai et al., 2002: 345, synonymy for ssp. *acco* Gray; Kocman, 2009: 106, synonymy for ssp. *acco* Gray; Rose & Weiss, 2011: 482, synonymy for ssp. *acco* Gray. **Transitional to ssp. *hampsoni* Avinoff.**

TL & topotypes. (fig. 1- a1-a3)

The TL of ssp. *acco* Gray is the same as that of *P. charltonius charltonius* Gray, 1853. The type material was originally labeled from Chinese Tartary, meaning some Tibetan area under the control of the Qing Dynasty. The TL was stated by Talbot (1939) as the country between Nepal and Tibet; it was assumed to be Kumaon area by Bryk (1935) and Weiss (1992). Shinkai (1997) discussed the possibility of the TL at Pulan (= Purang) area. Kocman (2009) supposed the TL to be probably SW of Manasarovar Lake (in Pulan area) near the border between Tibet and Nepal or India, this viewpoint was followed by Rose & Weiss (2011). The author explored the area between the south border of Pulan and the lakes on the north, and collected *P. charltonius charltonius* Gray in three localities and *P. acco acco* Gray in one locality; in the last locality the author observed that both *P. charltonius charltonius* Gray and *P. acco acco* Gray flew on the same slope (*P. acco* Gray on top of the hill whilst *P. charltonius* Gray at about 300 m below the top in small number). It is highly possible that the TL of ssp. *acco* Gray is situated in the current Pulan area because the simultaneously collected *P. charltonius charltonius* Gray is restricted to the Pulan area.

Two ♀ syntypes were figured by Shinkai (1997) and Sugisawa (2001) as color photos. Seven further specimens from Pulan area were figured by Shinkai (1997: pl. 1, fig. 4), Sakai et al. (2002: pl. 57, figs. 2-4) and Kocman (2009: pl. 27, figs. 2-4). Besides, 3 ♂♂ collected by the author from Pulan and six further topotypes in ZFMK have been closely examined in this work.

Notes on *P. a. chumurtiensis* Bang-Haas, 1928 (figs. 1- p1-p8, 5).

The type series of this taxon were figured by Shinkai (1997: pl. 2, figs.7-9) and Kocman (2009: pl. 27, figs. 5-8). The TL was clarified as Shilang (= Shiring) Pass, now called Xi-rang La (ca. 79.04 E, 31.77 N), about 9 km southeast of Mayang village, W Zhada. 34 ♂♂, 19 ♀♀ were collected by the author from Mayang area, all these specimens could be regarded as topotypes as they are collected from the same mountain range as TL, less than 8 km apart from the TL.

Most of the authors agreed to treat ssp. *chumurtiensis* Bang-Haas as synonym of ssp. *acco* Gray except for Rose & Weiss (2011), who synonymized ssp. *chumurtiensis* Bang-Haas with ssp. *pundjabensis* Bang-Haas and regard this subspecies as separable from ssp. *acco* Gray by having a larger size and generally larger markings. It is for sure that most of the type specimens appear to be larger with larger dark markings than the topotypes of ssp. *acco* Gray, but two of the figured type specimens (Kocman, 2009: pl. 27, figs. 5-6) are inseparable from ssp. *acco* Gray. The basis of Rose & Weiss's (2011) viewpoint may come from the lack of material, as only two ♀ specimens of ssp. *chumurtiensis* Bang-Haas from Chumurti were presented in Rose's collection (now in ZFMK). The area around Xi-rang La has been closed for foreign travelers since 1951, and no new material has been collected by any foreign researchers since then. Fortunately the area is still open for Chinese travelers and a good number of specimens have been collected by the author and recently also by four friends of the author. The majority of these new specimens from Mayang area (figs. 1, 5) are as large as the topotypes of ssp. *acco* Gray (fig. 1). More than 60% specimens from Mayang are inseparable from the topotypes of ssp. *acco* Gray. More than 50% specimens from Mayang are inseparable from the specimens of ssp. *transhimalayensis* Eisner from Namru. In conclusion, ssp. *chumurtiensis* Bang-Haas is confirmed to be a synonym of ssp. *acco* Gray.

Notes on *P. a. pundjabensis* Bang-Haas, 1927.

The type series of this taxon were figured by Shinkai (1997: pl. 2, figs.15-18) and Sakai et al. (2002: pl. 57, fig. 17). The TL was originally stated as Tum-Tum-Thang, in mountain range on east of Spiti (ca. 77.93 E, 32.34 N). The Spiti valley is immediately connected with Diya area (including Mayang) of Zhada by deep valleys, with no isolation by glaciers or plains..

Most of the authors agreed to treat ssp. *pundjabensis* Bang-Haas as synonym of ssp. *acco* Gray except for Rose & Weiss (2011), who synonymized ssp. *chumurtiensis* Bang-Haas with ssp. *pundjabensis* Bang-Haas and regard this subspecies as separable from ssp. *acco* Gray by having a larger size and generally larger markings. The materials of this taxon figured in literature are scanty, but most of the figured syntypes are inseparable from ssp. *chumurtiensis* Bang-Haas. There might be possibility that ssp. *pundjabensis* Bang-Haas is constantly larger than the topotypes of other subspecies and stands by the above-mentioned "rule of preclusion" with preclusion of transitional forms. However, one of the type specimens figured by Sakai et al. (2002: pl. 57, fig. 17) is inseparable from ssp. *acco* Gray, indicating that the difference quoted by Rose & Weiss (2011) comes from insufficient sampling. Considering that there is no zoogeographical isolation between the very close TLs of ssp. *pundjabensis* Bang-Haas and ssp. *chumurtiensis* Bang-Haas, these two taxa should be identical in status, being synonyms of ssp. *acco* Gray.

Notes on *P. a. tagalangi* Bang-Haas, 1927 (fig. 11).

As the TL of this taxon is a very famous locality with numerous specimens figured in literature, a conclusion is easily reached that the population inhabiting Taglang La is inseparable from ssp. *acco* Gray in high percentage. 3 ♂♂, 4 ♀♀ in the type series were figured by Shinkai (1997: pl. 2, figs. 19-21, 23-26). Rose & Weiss (2011) stated that this subspecies "shows a lesser sexual dimorphism than" the above-mentioned subspecies. It is for sure that the ♀ specimens of ssp. *tagalangi* Bang-Haas are frequently less marked, but they are still inseparable from those of other subspecies in high percentage, not fulfilling Remsen's (2010) necessary condition for subspecies.

Notes on *P. a. transhimalayensis* Eisner, 1938 (fig. 10- t3-t5).

The type series of this taxon were figured by Weiss (1992: 77, fig. 11), Shinkai (1997: pl. 1, figs. 21-25), Sakai et al. (2002: pl. 57, fig. 20) and Kocman (2009: pl. 27, figs. 9-11). The TL was clarified as Demchok (ca. 79.46 E, 32.70 N) at China-Indian border. Besides the type series, a good number of specimens were collected by various collectors from Namru (= Namuru) (ca. 80.15 E, 31.91 N) in the same valley, not far from Demchok. All these specimens can be used for calculating the diagnosability in the subspecific classification, as they come from the concentrated range (not apparently isolated).

Nearly all of the modern authors agreed to treat ssp. *transhimalayensis* Eisner as synonym of ssp. *acco* Gray. It is for sure that all the above-mentioned specimens are not at 95% level diagnosable from the topotypes of ssp. *acco* Gray by any phenotypic trait. However, a high percent of individuals are markedly paler than the topotypes of ssp. *acco* Gray, ssp. *chumurtiensis* Bang-Haas, ssp. *pundjabensis* Bang-Haas and ssp. *tagalangi* Bang-Haas. This taxon can be regarded as transitional form between ssp. *acco* Gray and ssp. *hampsoni* Avinoff, 1916. It can be attached to ssp. *acco* Gray by closer distribution and more similarity, but can not be calculated for the subspecies identity of ssp. *hampsoni* Avinoff under the above-introduced "rule of preclusion".

Parnassius acco hampsoni Avinoff, [1916]

Parnassius acco hampsoni Avinoff, [1916]: 352 (TL: Karakorum), pl. 5, fig. 4; Inaoka & Sugisawa, 1997: 95, synonymy for ssp. *acco* Gray; Sakai et al., 2002: 345, synonymy for ssp. *acco* Gray.

Parnassius acco punctata Tytler, 1926: pl. 5, fig. 3 (TL: not stated); Bang-Haas, 1927: 22, clarifying TL as Marsimik Pass (ca. 78.57 E, 34.12 N); Weiss, 1992: 73, synonymy for ssp. *hampsoni* Avinoff; Inaoka & Sugisawa, 1997: 95, incorrectly considering this taxon as nomen nudum; Sakai et al., 2002: 35, synonymy for ssp. *acco* Gray; Kocman, 2009: 106, synonymy for ssp. *acco* Gray.

Parnassius acco baltorana Bang-Haas, 1937: 302 (TL: Shigar, Baltora Geb., Baltistan); Weiss, 1992: 73, synonymy for ssp. *hampsoni* Avinoff; Sakai et al., 2002: 345, synonymy for ssp. *acco* Gray.

Parnassius acco yasudae Ohya, 1996: 8-9 (TL: Gyoinmaixoi'ng Kangri, Rutog, NW Tibet), pl. 2, figs. 1-2; Inaoka & Sugisawa, 1997: 95, synonymy for ssp. *acco* Gray; Rose, 2000: 264, synonymy for ssp. *acco* Gray; Sakai et al., 2002: 345, synonymy for ssp. *acco* Gray; Kocman, 2009: 106, synonymy for ssp. *acco* Gray; Rose & Weiss, 2011: 482, synonymy for ssp. *acco* Gray. **Transitional to ssp. *acco* Gray.**

Subspecies identity. The exact TL was not specified and the number of the type series was not mentioned in the original description. Only a black-white photo is known for the type material that might be lost. Weiss (1992) stated that the figured type specimen in original description is "an aberrant specimen with very reduced maculae" but gave no evidence. Shinkai (1997) published a series of specimens kept in RMNH collected from Sasser Pass, Karakorum and Baltistan, all of which could be to the south or southwest of the TL. By such scanty information no stable conclusion can be made at present.

However, Avinoff (1916) possibly described this taxon on a series of specimens as he clearly mentioned the number of specimen when he described *P. loxias raskemensis* Avinoff on a single ♀. He had a good collection of ssp. *acco* Gray from Eastern Ladak and Rupshu for a comparison. It is highly possible that ssp. *hampsoni* Avinoff from the TL is at more than 95% level diagnosable from ssp. *acco* Gray with a preclusion of the transitional forms found in Demchok, Namru and Rutog. The synonymy of ssp. *baltorana* Bang-Haas needs a further research. On the other hand, the synonymy of ssp. *punctata* Tytler is strongly supported by a pair of topotype of ssp. *punctata* Tytler figured by Shinkai (1997: pl. 3, figs. 12-13).

This subspecies is tentatively acceptable under the above-introduced "rule of preclusion" and "rule of replacement". To solve this taxonomic problem, further investigations to Karakorum are inevitable.

Notes on *P. a. yasudae* Ohya. (fig. 10- t1, t2).

Beside the original figures, 4 ♂♂, 3 ♀♀ collected together with the type material by the same collector (W. Kitawaki) were figured by Shinkai (1997: pl. 3, figs. 16-20) and Kocman (2009: pl. 27, figs. 13-14). Further 2 ♂♂ in Rose's collection (now in ZFMK) from the same source were closely examined by the author. Ohya (1996) described this taxon as new on account of a bigger ratio of termen-length to dorsum-length of forewing and a paler overall appearance. However, its diagnosability from either ssp. *acco* Gray or ssp. *hampsoni* Avinoff on wing-shape does not approach 95% level among the known specimens. This subspecies was considered by all the subsequent authors as synonym of ssp. *acco* Gray. It is actually a transitional form between ssp. *acco* Gray and ssp. *hampsoni* Avinoff and seems to be a little closer to ssp. *hampsoni* Avinoff.

Similarly, the unnamed populations from Yanhu and Gejie are transitional from ssp. *hampsoni* Avinoff to ssp. *gyanglaputsai* Huang, and seem to be closer to ssp. *hampsoni* Avinoff.

***Parnassius acco gyanglaputsai* Huang, 1998** (figs. 2, 6, 15, 17)

Parnassius acco gyanglaputsai Huang, 1998: 271-272 (TL: Naogaola Pass, N of Tsochen), pl. 1, figs. 1a-1d, 2a-2b; Kocman, 2009: 106, synonymy for ssp. *acco* Gray; Rose & Weiss, 2011: 482, synonymy for ssp. *acco* Gray.

Parnassius acco sakamotoi Sorimachi, 2010: 83 (TL: Tsochen Pass, no north of Tsochen); Weiss & Rigout, 2016: 573-574, synonymy for ssp. *acco* Gray **syn. nov.**

Subspecies identity. The most stable diagnostic character of this taxon was overlooked or neglected by the subsequent authors (Kocman, 2009; Rose & Weiss, 2011), clearly stated in original description (Huang, 1998), quoted herein: "in the *acco* sub-group, the outer margin of forewing is clearly defined by a line of black scales at the base of ciliae; but in ssp. *gyanglaputsai* such a line is replaced by a whitish line". This character is hardly recognizable from the photos and is easy to overlook.

Such marginal line on forewing upper side is formed by some black scales along the termen, assembled more densely than the black scales in marginal band; the difference found between populations is more constant and striking in the fringes around veins 2-4 on forewing upper side. In ssp. *acco* Gray such black marginal line is generally continuous but is occasionally interrupted between veins with such gaps shorter than black dashes at vein-ends. In ssp. *gyanglaputsai* Huang the assembled black scales are restricted to vein-ends, at most forming black dashes which are shorter than white gaps between vein-ends. The type specimen of ssp. *hampsoni* Avinoff seems to have a clear black margin on forewing upper side, and so do all the specimens of ssp. *hampsoni* Avinoff figured by Shinkai (1997). By this phenotypic trait the type specimens of ssp. *gyanglaputsai* Huang are at 100% level diagnosable from all the known topotypes of ssp. *acco* Gray, ssp. *chumurtiensis* Bang-Haas, ssp. *pundjabensis* Bang-Haas, ssp. *tagalangi* Bang-Haas and ssp. *transhimalayensis* Eisner. With an ignorance of this character, ssp. *gyanglaputsai* Huang could be attached to ssp. *hampsoni* Avinoff instead of ssp. *acco* Gray by having a generally paler and more creamy appearance.

The problem comes from the transitional populations in Rutog and Yanhu areas. One of the topotypes of ssp. *yasudae* Ohya figured by Shinkai (1997: pl. 3, fig. 18) seems to possess a whitish marginal line whilst all other topotypes have a clear black marginal line. A close examination of two further topotypes of ssp. *yasudae* Ohya (fig. 10- t1, t2) confirmed that the majority of ssp. *yasudae* Ohya have a rather continuous black marginal line on forewing upper side. As ssp. *yasudae* Ohya is much closer to ssp. *hampsoni* Avinoff than to ssp. *gyanglaputsai* Huang by this marginal line, the subspecies identity of ssp. *gyanglaputsai* Huang is acceptable under the "rule of preclusion" and "rule of replacement".

A small percent of specimens from Yanhu have a pale marginal line on forewing upper side as ssp. *gyanglaputsai* Huang. But this will not affect the validity of ssp. *gyanglaputsai* Huang as this population has not been named. The Yanhu population is a transitional form and it could be attached to ssp. *hampsoni* Avinoff or ssp. *gyanglaputsai* Huang.

All the type specimens of ssp. *gyanglaputsai* Huang came from the vast northern Tsochen area between Nagaola Pass (85.04 E, 31.16 N) and Xiakangjian Mts. (between 85.03 E, 31.81 N and 85.09 E, 31.36 N); this area is big enough for the definition of a concentrated range in subspecies classification. However, the specimens recorded from southern Tsochen area (close to Saga) in literature (Shinkai, 1997: pl. 4, figs. 3-8) already have a black marginal line on forewing upper side, being a transitional form to ssp. *gloria* Kocman.

In conclusion, ssp. *gyanglaputsai* Huang is tentatively acceptable as a subspecies under the "rule of preclusion". However, more specimens from the TL examined in future may prove that the black-margin-form is over 5% of the entire population, making ssp. *gyanglaputsai* Huang a synonym of ssp. *hampsoni* Avinoff.

***Parnassius acco gloria* Kocman, 1996** (figs. 4, 7, 18)

Parnassius acco gloria Kocman, 1996: 38-40 (TL: Sachia), figs. 7-9; Inaoka & Sugisawa, 1997: 95, synonymy for ssp. *acco* Gray; Rose, 2000: 264, synonymy for ssp. *gemmifer* Fruh.; Sakai et al., 2002: 348, synonymy for ssp. *gemmifer* Fruhstorfer, 1904; Kocman, 2009: 99, reinstating as distinct subspecies.

Remarks. The subspecies identity of ssp. *gloria* Kocman was based upon the clarification of the TL of ssp. *gemmifer* Fruhstorfer, 1904, which was supposed to be Tibetan area near Sikkim, not the area close to Mt. Everest. It is widely accepted that the populations on west of Sachia are different from those on east of Sachia. However, a calculating for some well known populations in the west (from Lalung La, Nielamu) and in the east (from Karo La) does not fulfill Remsen's (2010) necessary condition for subspecies at 95% level of diagnosability. The ♀ specimens are inseparable at high percent level between the populations from Lalung La (4 ♀♀ examined) and Karo La (8 ♀♀ figured by Shinkai, 1997; 12 ♀♀ examined by the author), and the ♂ specimens are only at 80% level diagnosable between the two populations.

It is for sure that the populations on east of Sachia are all at 100% level diagnosable from ssp. *acco* Gray, ssp. *hampsoni* Avinoff and ssp. *gyanglaputsai* Huang by having a wider black ring for hindwing discal ocellus and a darker hindwing cell. But the populations from Saga and its adjacent areas are transitional to ssp. *acco* Gray and ssp. *gyanglaputsai* Huang. The subspecies identity of ssp. *gemmifer* Fruhstorfer is acceptable by a preclusion of the transitional populations.

However, the subspecies identities of ssp. *gloria* Kocman and ssp. *rosea* Weiss & Michel, 1989 in separation from ssp. *gemmifer* Fruhstorfer are problematical. It is highly possible that the topotypes of both ssp. *gloria* Kocman and ssp. *rosea* Weiss & Michel are at less than 95% level diagnosable from the topotypes of ssp. *gemmifer* Fruhstorfer. However, ssp. *gloria* Kocman could be acceptable under the "rule of replacement": some population on west of Sachia might be at 95% level diagnosable from some population on east of Sachia. The taxon, ssp. *gloria* Kocman is meaningful by representing the slightly brighter populations in the vast range on west of Sachia.

The subspecies identities of ssp. *rosea* Weiss & Michel is out of the scope of this paper: it is a very complicated case with numerous variable populations assembled in a relatively small range around Lhasa. Rose & Weiss (2011) were unable to define this subspecies by any reliable phenotypic traits on high level of diagnosability. To solve this problem, a thorough field work is required to find out the most stable and distinguishable populations.

***Parnassius acco gemmifer* Fruhstorfer, 1904** (figs. 3, 8, 19)

Parnassius acco gemmifer Fruhstorfer, 1904: 25 (TL: S Tibet; supposed to be Tibetan area near Sikkim, not the area around Mt. Everest)

Parnassius mirabilis Bang-Haas, 1927: 24 (TL: Gyantse); Inaoka & Sugisawa, 1997: 95, synonymy for ssp. *acco* Gray; Kocman, 2009: 106, synonymy for ssp. *gemmifer* Fruh.

Remarks. The relationship between this subspecies and ssp. *gloria* Kocman is as discussed above. This taxon is the first name published for the central Tibetan populations with a lot of recently published taxa from Lhasa area attached. The validity of the various taxa described from Central Tibet is out of the scope of this paper.

***Parnassius labeyriei* Weiss & Michel, 1989** (figs. 21-31)

The species status of *Parnassius labeyriei* Weiss & Michel in separation from *P. maharaja* Avinoff, 1916 remains unsolved (Rose & Weiss, 2011; Korb, 2020). A quick identification of subspecies is usually based on data of collecting localities (fig. 21). The following key is useful for a better understanding of the important diagnostic characters of the subspecies for normal specimens.

1. Whitish part of wings appearing more transparent, with scales smaller and more sparsely distributed.........ssp. *kiyotakai*
-. Whitish part of wings appearing less transparent, with scales larger and more densely distributed................2
2. Hindwing costal reddish ocellus usually parallelogram-shaped..3
-. Hindwing costal reddish ocellus usually not parallelogram-shaped..5
3. Dark marginal, postdiscal and antediscal bands on upper side of both wings grayer and in lower contrast with pale ground color. Marginal band on both wings narrower..ssp. *holoydai*
-. Dark marginal, postdiscal and antediscal bands on upper side of both wings blacker and in higher contrast with pale ground color. Marginal band on both wings wider..4
4. Length of forewing average 36-41 mm. Hindwing cell with a larger whitish area and with end of cell frequently unmarked..ssp. *shihongliangi*
-. Length of forewing average 25-30 mm. Hindwing cell with a smaller whitish area and with end of cell always marked by black bar..ssp. *natashae*
5. ♂ upper side pale ground color more whitish and in greater contrast with blacker bands. Hindwing costal and discal ocelli usually broadly red and frequently subequal in size..ssp. *labeyriei*
-. ♂ upper side pale ground color more creamy or yellowish and in lower contrast with dark bands. Hindwing costal and discal ocelli, if both broadly red, usually with costal ocellus much larger than discal ocellus.......................................6
6. Hindwing costal ocellus sharply pointed at inner side..7
-. Hindwing costal ocellus not sharply pointed at inner side..8
7. Forewing postdiscal dark band narrower..ssp. *sakyamuni*
-. Forewing postdiscal dark band wider..ssp. *weii*
8. Hindwing with costal ocellus not markedly larger than discal ocellus. Hindwing costal ocellus small, usually black, at most with very limited reddish scaling..ssp. *nosei*
-. Hindwing with costa ocellus much larger than discal ocellus. Hindwing costal ocellus large, usually with large reddish patch..ssp. *giacomazzoi*

***Parnassius labeyriei labeyriei* Weiss & Michel, 1989** (figs. 25, 30- upper half)

Parnassius labeyriei Weiss & Michel, 1989: 7-13 (TL: Montagnes au nord de Lhassa), fig. 3.

Parnassius labeyriei beranki Kocman, 1999: 48-49 (TL: Drigung Til, E. Lhasa Pref.), pl. 6A, figs. 1-2; Rose, 2001: 129, synonymy for *P. l. labeyriei* Weiss & Michel; Kocman, 2009: 93, synonymy for *P. l. labeyriei* Weiss & Michel.

Parnassius maharaja labeyriei: Ohya, 1993: 115.

Remarks. A good number of specimens were figured in literature (Weiss, 1992; Ohya, 1993; Sakai et al., 2002; Sorimachi, 2005; Kocman, 2009; Rose & Weiss, 2011; Inaoka, 2020). A big series of specimens were collected by Mr. Z.-Y. Qi and Dr. S.-Y. Ge from Largeh-la in 2023, with photos examined by the author and with four specimens exchanged into the author's collection. This subspecies is characterized by a high contrast between blacker markings and whiter ground, the frequently large red ocelli on hindwing that are usually subequal in size, an oval costal ocellus on hindwing with inner margin not sharply pointed, and a frequently marked black spot at base of space 1b of forewing.

***Parnassius labeyriei sakyamuni* Kocman, 1995**

Parnassius labeyriei sakyamuni Kocman, 1995: 65 (TL: North of Yamtso Yumco), pl. 1, fig. 4.

Remarks. Only the unique ♂ holotype is known. It shows a curious resemblance to the distant ssp. *naocoae* Morita, 1997, especially the population from Dongda-la, by having a sharply pointed costal ocellus on hindwing.

***Parnassius labeyriei giacomazzoi* Weiss, 1991** (figs. 26, 30 - lower half)

Parnassius labeyriei giacomazzoi Weiss, 1991: 9 (TL: 50 km north of Tanggula Pass), pl. 2, fig. 4; Sakai et al., 2002: 367, synonymy for *P. maharaja labeyriei* Weiss & Michel.

Parnassius maharaja giacomazzoi: Ohya, 1993: 116.

Remarks. Only a few specimens were figured in literature (Weiss, 1992; Sorimachi, 2005; Kocman, 2009; Rose & Weiss, 2011). A good number of specimens were collected by Mr. Z.-Y. Qi and his friend in 2023, with four specimens (not very fresh) exchanged into the author's collection. The very fresh specimens (photos examined) could have the bright red ocelli as those of ssp. *labeyriei* Weiss & Michel. But the color of the red ocelli can turn rapidly into pink or orange over time. Beside the size of the wings and the shape of the hindwing costal ocellus, one of the most useful diagnostic characters for this subspecies is that the size of the reddish coloring in the costal ocellus is much larger than that of the discal ocellus.

***Parnassius labeyriei kiyotakai* Sugiyama, 1992** (figs. 24, 29 - right top, 31- left bottom)

Parnassius labeyriei kiyotakai Sugiyama, 1992: 3-4 (TL: SE Erla Mts., Qinghai), figs. 3-4.

Parnassius maharaja kiyotakai: Ohya, 1993: 116.

Parnassius labeyriei gilgamesh Sorimachi, 2011: 83 (TL: Tong-Li-Jia Pass, Gansu); Weiss & Rigout, 2016: 573, synonymy for *P. l. kiyotakai* Sugiyama.

Remarks. *P. labeyriei gilgamesh* Sorimachi was described on 4 ♂♂, 9 ♀♀ from Tonglijia Pass, Luqu County, Gansu and was subsequently treated by Weiss & Rigout (2016) as a synonym of *P. l. kiyotakai* Sugiyama. This taxon was described to be different from ssp. *kiyotakai* Sugiyama by having the blacker ground color, the more darker post-discal band of forewing, the wider marginal band of hindwing and the more rounded wing-shape. However, judging from the original figures, the above-mentioned differences cannot be confirmed. There is no difference in size and wing-pattern between ssp. *gilgamesh* Sorimachi and ssp. *kiyotakai* Sugiyama.

***Parnassius labeyriei holoydai* Kocman, 2003**

Parnassius labeyriei holoydai Kocman, 2003: 37-38 (TL: 50 km south of Chiehku, Yushu), pl. 6, figs. 1-2.

Remarks. This subspecies is somewhat similar to ssp. *kiyotakai* Sugiyama, but is different from the latter by having an average smaller size, the thinner marginal band on both wings upper side, the brighter and less transparent appearance of both wings (caused by the denser white scales on the wings). Rose & Weiss (2011) reported and figured an intermediate form between ssp. *holoydai* Kocman and ssp. *kiyotakai* Sugiyama from 100 km NW of Zadoi, Qinghai: this specimen is as bright as ssp. *holoydai* Kocman and as large as ssp. *kiyotakai* Sugiyama.

On the other hand, this subspecies seems to be more similar to ssp. *giacomazzoi* Weiss in size and wing-pattern and to be slightly distinguishable from the latter by having a thinner marginal band on both wings upper side..

***Parnassius labeyriei natashae* Kawasaki & Tarasov, 1998** (figs. 23, 29- right bottom)

Parnassius labeyriei natashae Kawasaki & Tarasov, 1998: 30-33 (TL: Chola Shan Mts., Manigango env., NW Sichuan), pl. 10, figs. 10-11; Sakai et al., 2002: 368, synonymy for *P. maharaja nosei* Watanabe.

Remarks. Only 6 ♂♂ in type series and 1 ♀ in Rose's collection are known, with 3 ♂♂ and 1 ♀ figured in literature (Kawasaki & Tarasov, 1998; Rose, 2001; Rose & Weiss, 2011).

***Parnassius labeyriei nosei* Watanabe, 1990** (figs. 27, 31- right bottom)

Parnassius nosei Watanabe, 1990: 2-6 (TL: Demu La), figs. 3A-3D.

Parnassius labeyriei nosei: Kreuzberg, 1992: 2; Rose, 2001: 130, figs. 9-10.

Parnassius maharaja nosei: Ohya, 1993: 116.

Parnassius labeyriei naocoae Morita, 1997: 2 (TL: Anju La), pl. 4, figs. 9-10; Rose, 2001: 130, figs. 5-6; Sakai et al., 2002: 368, synonymy for *P. maharaja nosei* Watanabe; Kocman, 2009: 93, synonymy for *P. labeyriei nosei* Watanabe.

Remarks. Beside the type materials, only very few specimens have been known for the following taxa from the TLs, listed below.

1) Taxon *naocoae* Morita: 1 ♀ (Ohya, 1993); 1 ♂, 1 ♀ (Rose, 2001); 2 ♂♂, 2 ♀♀ (Sakai et al., 2002); 1 ♂ (Rose & Weiss, 2011).
2) Taxon *nosei* Watanabe: 1 ♂, 1 ♀ (Ohya, 1993); 1 ♂, 1 ♀ (Rose, 2001); 3 ♂♂, 1 ♀ (Sakai et al., 2002); 2 ♂♂, 1 ♀ (Kocman, 2009); 1 ♂, 1 ♀ (Rose & Weiss, 2011); 1 ♀ (this work).
3) Taxon *weii* Mikami: 1 ♂, 1 ♀ (Rose, 2001); 1 ♂, 1 ♀ (Sakai et al., 2002); 1 ♂, 1 ♀ (Sorimachi, 2005); 3 m, 1 f (Kocman, 2009); 1 ♀ (Rose & Weiss, 2011); 5 ♂♂, 1 ♀ (this work).

Rose (2001) regarded ssp. *weii* Mikami as synonym of ssp. *naocoae* Morita, based on the similarity between the ♂ specimens of these taxa in his collection (Rose, 2001: figs. 5 & 7). It is a coincidence that the ♂ of ssp. *weii* Mikami in Rose's collection is an abnormal specimen showing a curious resemblance to ssp. *naocoae* Morita; except this, such ♂ specimen of ssp. *weii* Mikami has never been found in literature and the author's collection (10 ♂♂ in total). Nearly all the remaining ♂ specimens of ssp. *weii* Mikami in literature (including this work) have a sharply pointed inner margin of costal ocellus on hindwing, being easily distinguishable from all the known ♂ specimens of ssp. *naocoae* Morita. All the known ♀ specimens of ssp. *weii* Mikami are separable from those of ssp. *naocoae* Morita by having a sharply pointed inner margin of costal ocellus on hindwing or the more developed dark bands and markings on both wings.

On the other hand, the three specimens of ssp. *naocoae* Morita figured by Sakai et al. (2002: pl. 67, figs. 1, 2, 5) are inseparable from the common specimens of ssp. *nosei* Watanabe (Sakai et al., 2002: pl. 67, figs. 7-9), and one ♀ of ssp. *nosei* Watanabe figured by Rose & Weiss (2011: 476, fig. 15) is inseparable from the common ♀♀ of ssp. *naocoae* Morita.

It is apparent that ssp. *naocoae* Morita is distinguishable from ssp. *nosei* Watanabe at a level of diagnosability lower than 95%. However, ssp. *weii* Mikami is distinguishable from ssp. *nosei* Watanabe at almost 100% level of diagnosability. Because ssp. *naocoae* Morita has more individuals in common with ssp. *nosei* Watanabe than with ssp. *weii* Mikami, it should be attached to ssp. *nosei* Watanabe as a synonym. Ssp. *weii* Mikami should be treated as a bona subspecies under the rule of preclusion. It is noteworthy that Kocman (2009) drew to the same conclusion.

***Parnassius labeyriei weii* Mikami, 1998** (figs. 28, 31- upper part)

Parnassius labeyriei weii Mikami, 1998: 65, 81-82 (TL: Dongda La), pl. 13, figs. 7-13; Rose, 2001: 130, synonymy for *P. l. naocoae* Morita, figs. 7-8; Sakai et al., 2002: 368, synonymy for *P. maharaja nosei* Watanabe; Kocman, 2009: 93, reinstating subspecies status.

Remarks. This subspecies is at 100% level distinguishable from ssp. *nosei* Watanabe. Even if more specimens of this subspecies are found to be indistinguishable from ssp. *naocoae* Morita in future, it deserves being retained under the rule of preclusion unless someone proves that ssp. *naocoae* Morita is closer to ssp. *weii* Mikami than to ssp. *nosei* Watanabe.

***Parnassius labeyriei shihongliangi* subspec. nov.** (figs. 22, 29- left half)

Holotype ♂ (figs. 22- central top, 29- left top): China, Sichuan, Ganzi Pref., Serxu County, on road between Serxu and Luoxu, Molashan Pass, 5000m, 5.VII.2023, H. Huang leg., will be deposited in BSNU.

Paratype: 1 ♂, 2 ♀♀ (CHH), same locality as holotype, but 5-6.VII.2023; 1 m, 1 f (CSHL), same locality as holotype, but 29.VII.2017, H.-L. Shi leg.

Etymology. This new subspecies is named after Dr. Hong-Liang Shi, who first discovered this amazing butterfly.

Diagnosis. This new subspecies is distributed between the ranges of ssp. *kiyotakai* Sugiyama, ssp. *holoydai* Kocman and ssp. *natashae* Kawasaki & Tarasov, however, it does not show an intermediate appearance between the latter three subspecies.

It is more similar to ssp. *natashae* Kawa. & Tara. than to other subspecies in having: 1) the dark markings and the pale ground in great contrast; and 2) the costal ocellus of hindwing parallelogram-shaped. However the new subspecies can be easily distinguished from ssp. *natashae* Kawa. & Tara. by a strikingly larger size in both sexes (length of forewing 36.2-41.4 mm in six specimens against 25-30 mm in seven specimens of ssp. *natashae* Kawa. & Tara.), a seldom black-dusted cell-end of hindwing and a much larger pale patch in hindwing cell.

It can be easily distinguished from ssp. *kiyotakai* Sugiyama by having the more contrasted dark markings and pale ground on both sides of both wings, the constantly larger hindwing ocelli, and the better developed sub-tornal black ocellus on hindwing upper side.

It can be easily distinguished from ssp. *holoydai* Kocman by having the constantly larger size, the blacker antediscal, postdiscal and marginal bands on upper side of both wings, the frequently more developed postdiscal markings of hindwing, and the constantly wider marginal band on both sides of both wings.

Remarks. The difference in size is usually not a good character to divide subspecies, as most of the known populations of many *Parnassius* species are individually variable in size. However, the difference in size observed in this case is very discrete, based upon specimens from two different years for both populations. Such difference might be genetically fixed. A further study on more specimens of both subspecies is necessary in future.

Range. Hitherto only known from the Molashan pass between Serxu and Luoxu, NW Sichuan.

***Parnassius hide* Koiwaya, 1987** (figs. 32-38)

A study of the new material collected by Chinese collectors resulted in some opinions on the following three subspecies.

***Parnassius hide meveli* Weiss & Michel, 1989** (figs. 36-37)

Parnassius priamus (?) *meveli* Weiss & Michel, 1989: 14 (TL: montagnes au Nord de Lhassa - Largeh La = Nagen La), fig. 6.

Parnassius hide meveli: Weiss, 1992: 90.

Parnassius patricius meveli: Kreuzberg, 1992: 7.

Remarks. This subspecies was considered as different from ssp. *hide* Koiwaya by the following points: "smaller than *hide*, with the maculae more developed and the ocelli larger" (Weiss, 1992); bands wider and ♂ posterior ocellus more frequently pink coloured than in ssp. *hide* Koiwaya (Kocman, 2009); slightly smaller than "*hide"* with better delineated markings and red ocelli (Rose & Weiss, 2011). However, a small number of specimens collected from Tanggu-la, identified widely in literature as ssp. *hide* Koiwaya, are hardly distinguishable from the topotypes of ssp. *meveli* Weiss & Michel from Largeh-la. Again, we meet with the problem caused by transitional populations. Actually the population of Tanggu-la should be attached to ssp. *meveli* Weiss & Michel instead of ssp. *hide* Koiway by having whitish part of wings less transparent, being a transitional population.

***Parnassius hide poshulalinus* Nose, 1990** (figs. 32, 34)

Parnassius hide poshulalinus Nose, 1990: 7-9 (TL: Demu La), figs. 2A-B.

Parnassius hide hengduanshanus Nose, 1990: 10 (TL: Dongda La - on the National Road g318), figs. 2C-D; Kreuzberg, 1992: 7, synonymy for ssp. *poshulalinus* Nose; Sakai et al., 2002: 295, synonymy for ssp. *poshulalinus* Nose; Kocman, 2009: 121, synonymy for ssp. *poshulalinus* Nose; Rose & Weiss, 2011: 448, synonymy for ssp. *poshulalinus* Nose.

Parnassius hide qamdensis Nose, 1990: 10-11 (TL: 38 km NE of Qamdo - Kaqi La on the old National Road from Sichuan to Xizang), figs. 2E-F; Kreuzberg, 1992: 7, synonymy for ssp. *poshulalinus* Nose; Rose, 2001: 134, synonymy for ssp. *hengduanshanus* Nose; Sakai et al., 2002: 295, synonymy for ssp. *poshulalinus* Nose; Kocman, 2009: 121, synonymy for ssp. *poshulalinus* Nose; Rose & Weiss, 2011: 448, synonymy for ssp. *poshulalinus* Nose.

Parnassius patricius poshulalinus: Kreuzberg, 1992: 7.

Remarks. 23 ♂♂, 1 ♀ were collected by the author from the TL, showing considerable variations in wing-pattern and size. All the extreme ♂ forms are selected and figured in this work.

Parnassius hide petriki **Kocman, 2003 stat. rev.** (figs. 33, 35)

Parnassius hide petriki Kocman, 2003: 38-39 (TL: 50 km S. of Chiehku, Yushu, Qinghai), p. 6, figs.5-6; Rose & Weiss, 2011: 449, synonymy for ssp. *poshulalinus* Nose.

Remarks. Rose & Weiss (2011) treated ssp. *petriki* Kocman as a synonym of ssp. *poshulalinus* Nose and figured 2 ♂♂ from 60 km south of Serxu, Sichuan as belonging to this taxon. It is for sure that some type specimens of ssp. *petriki* Kocman approach ssp. *poshulalinus* Nose in appearance. However, more specimens collected from S Serxu, Sichuan (newly collected 4 ♂♂, 1 ♀ from S Serxu examined) are constantly distinguishable from ssp. *poshulalinus* Nose (newly collected 23 ♂♂, 1 ♀ from Dongda-la examined) by having a thinner dark postdiscal band and a more conjoined pale submarginal band on the forewing. The Yushu population of ssp. *petriki* Kocman forms a transition from the Serxu population to ssp. *poshulalinus* Nose. Therefore, by the discovery of the well defined Serxu population, ssp. *petriki* Kocman merits being retained for the populations from a large area around Yushu and Serxu. These combined populations are distinguishable from those of ssp. *poshulalinus* Nose in high percentage.

Ssp. *petriki* Kocman is acceptable under the "rule of replacement": the population from Serxu, Sichuan is almost at 100% level diagnosable from ssp. *poshulalinus* Nose.

Parnassius stoliczkanus florenciae **Tytler, 1926** (fig. 39)

Parnassius stoliczkanus florenciae Tytler, 1926: 251 (TL: near Phup, Hundes, North of Tehri Garhwal), pl. 4, fig. 9 for unique ♂ holotype.

Parnassius stoliczkanus spitiensis Bang-Haas, 1927: 33 (TL: N of Sutley river, NW of Pu = Poo, Tum Tum Thang Mt., Spiti), pl. 4, figs. 17 - ♂ syntype, 18 - ♀ syntype; Weiss, 1992: 128, synonymy for ssp. *florenciae* Tytler; Kocman, 2009: 122, pl. 37, fig. 2 - ♀ syntype, fig. 1 - ♂ from Shilang Pass (Xirang la, in current Mayang area, Zhada, SW Tibet), first record for current China; Ge et al., 2021: 442-445, recent record for China, figs. 1-4 - ♂ & ♀ from Myangla, Zhada, SW Tibet.

Parnassius stoliczkanus harutai Omoto & Kawasaki, 1998: 150 (TL: Tata, Mahakali, W Nepal), fig. 1 - ♂ holotype, fig. 2 - ♀ paratype, fig. 18 - ♂ genitalia; Sakai et al., 2002: 306, synonymy for ssp. *florenciae* Tytler.

Material. 4 ♂♂ (CHH), Mayangla (31.89 N, 78.98 E), W Zhada, SW Tibet, 5200-5300 m, 18-21.VII.2020, H. Huang leg.; 1 ♀ (CSHL), Mayangla, 5250 m, 18.VII.2019, H.-L. Shi leg.; 1 ♂, 1 ♀ (CHH), Mayangla, 5200-5300 m, 19.VII.2023, Z.-Y. Qi leg.; 13 ♂♂, 8 ♀♀ (CQZY; only photos), Mayangla, 18-20.VII.2013, Z.-Y. Qi leg.

Remarks. Sakai et al. (2002) retained only three bona subspecies of *Parnassius stoliczkanus* C. & R. Felder, 1865: ssp. *stoliczkanus* C. & R. Felder, ssp. *florenciae* Tytler, 1926 and ssp. *zanskarica* Bang-Haas, 1935. Rose & Weiss (2011) followed this classification, but synonymized different taxa with ssp. *stoliczkanus* C. & R. Felder and ssp. *florenciae* Tytler. The taxa, *gracilis* Bryk & Eisner, 1932 and *parangensis* Eisner, 1939 were attached to ssp. *florenciae* Tytler by Sakai et al. (2002), and to ssp. *stoliczkanus* C. & R. Felder by Rose & Weiss (2011), being transitional populations. There is no argument that ssp. *zanskarica* Bang-Haas is well characterized by the better-marked hindwing anal reddish marking, the wider pale band between antediscal and postdiscal dark bands on forewing and the frequently wider discal ocellus of hindwing. The main taxonomic problem is concentrated in ssp. *stoliczkanus* C. & R. Felder, ssp. *florenciae* Tytler and their synonyms.

An investigation using the method introduced at the beginning of this paper draws to the same conclusion as that by Sakai et al. (2002) and Rose & Weiss (2011). Ssp. *stoliczkanus* C. & R. Felder is characterized by the small discal and submarginal ocelli on hindwing. The secondly published ssp. *florenciae* Tytler, 1926 is slightly different from ssp. *stoliczkanus* C. & R. Felder by having the larger hindwing submarginal ocelli with conspicuous pale pupils; no further specimens were reported from the TL since its publication. Bang-Haas (1927) reported and figured a pair of specimens from Muhling (?= Muling; not TL) which are however different from the holotype of ssp. *florenciae* Tytler by having the small hindwing submarginal ocelli with no conspicuous pupils; this population is apparently transitional from ssp. *florenciae* Tytler to ssp. *stoliczkanus* C. & R. Felder. The thirdly published ssp. *spitiensis* Bang-Haas, 1927 seems to be well distinguishable from ssp. *stoliczkanus* C. & R. Felder by having larger reddish discal ocellus and larger submarginal ocelli on hindwing, judged from the very few specimens figured in literature (Bang-Haas, 1927; Kocman, 2009). The lately published ssp. *gracilis* Bryk & Eisner, 1932 and ssp. *parangensis* Eisner, 1939 blunt the difference between the earlier subspecies, being transitional populations with considerable individual variations as revealed by Sakai et al. (2002) and Kocman (2009) who figured 11 variable specimens of ssp. *parangensis* Eisner from Parang-la and Baralacha-la. By ignoring the transitional taxa, only ssp. *spitiensis* Bang-Haas is acceptable by a high percent level of diagnosability from ssp. *stoliczkanus* C. & R. Felder under the "rule of preclusion". The validity of ssp. *florenciae* Tytler seems to be short in evidence as only the holotype is known. However, judging from the distribution of all these taxa (fig. 40), ssp. *florenciae* Tytler is acceptable under the "rule of replacement", as a close population from Mayangla (fig. 39) is at high percent level distinguishable from ssp. *stoliczkanus* C. & R. Felder, with 28 specimens examined, of which some individuals fit in with the type specimens of ssp. *florenciae* Tytler and ssp. *spitiensis* Bang-Haas respectively. By such treatment, both ssp. *spitiensis* Bang-Haas and ssp. *harutai* Omoto & Kawasaki are synonyms of ssp. *florenciae* Tytler.

A distributional map is provided in this work (fig. 40), with all the TLs marked precisely. Only the following three taxa cannot be accurately located. 1) The TL of ssp. *florenciae* Tytler was originally stated as near Phup, Hundes, North of Tehri Garhwal; the author failed to locate Phup and Hundes on the modern map, but the range of Tehri Garhwal can be clearly defined and the TL should be the northern mountain range in high elevations. 2) The TL of ssp. *zanskarica* Bang-Haas was originally stated as Nira, Zanskar Mts.; Nira could be Nerak near the Zaskar valley. 3) The TL of ssp. *davidi* Eisner, 1971 was originally stated as Bura Deosai; Deosai is a large area surrounded by snow mountains so that the author can only mark a large range as TL on the map.

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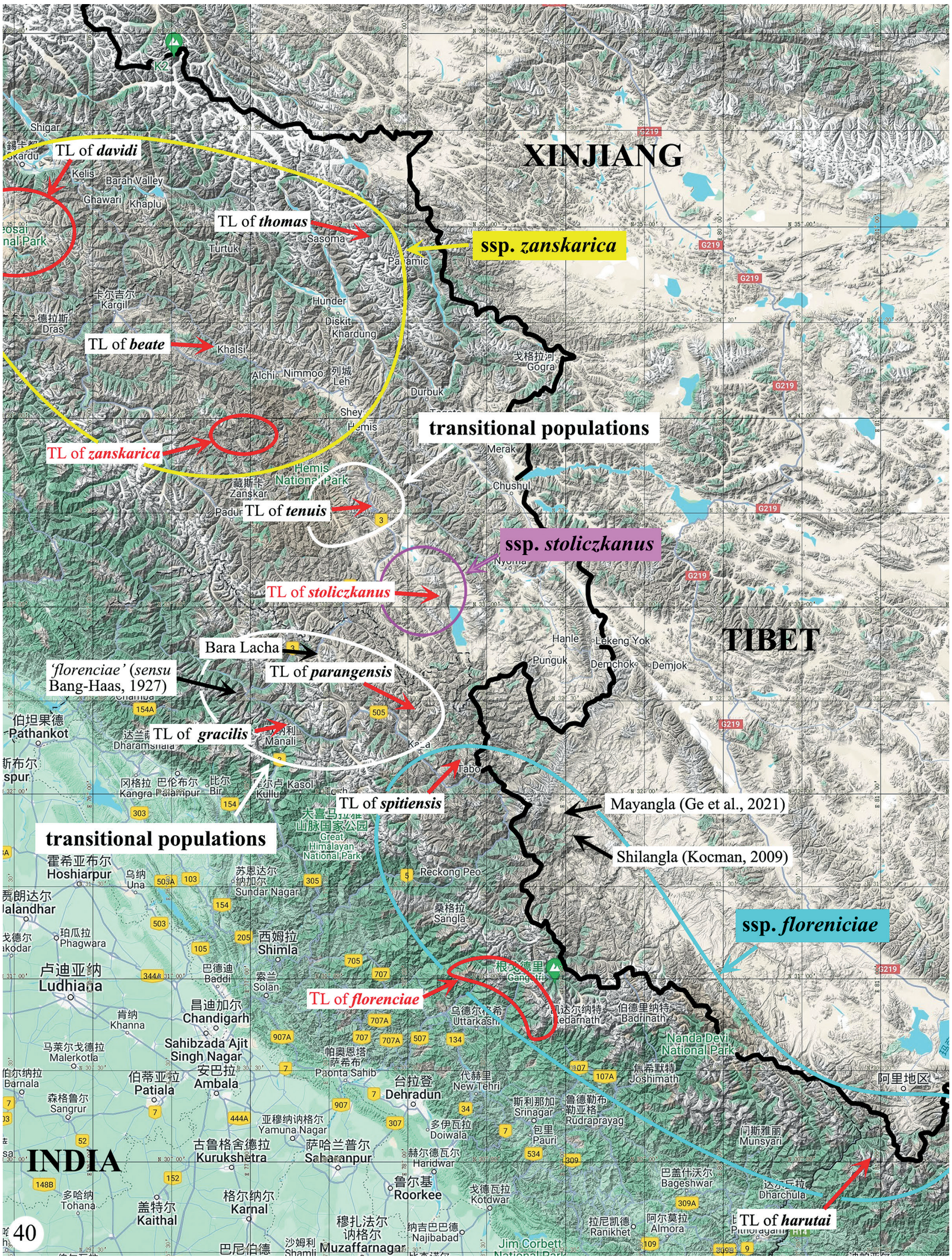
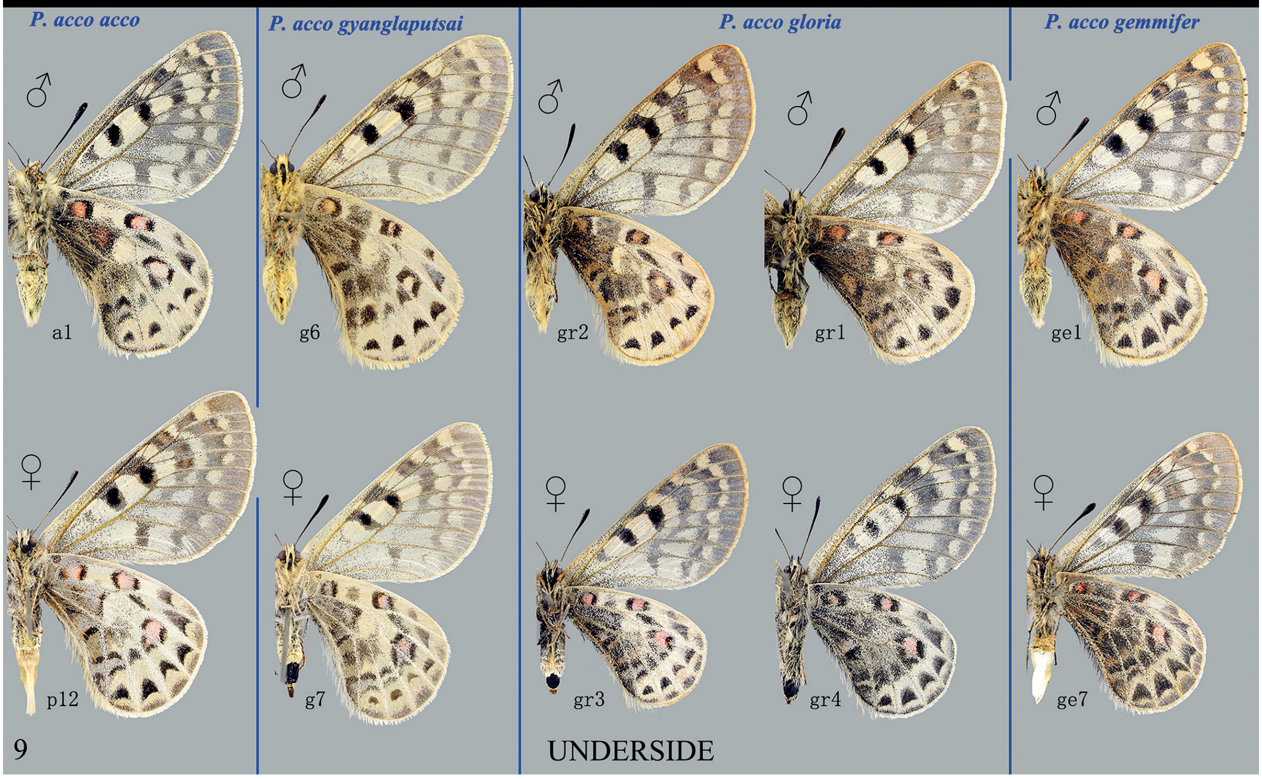
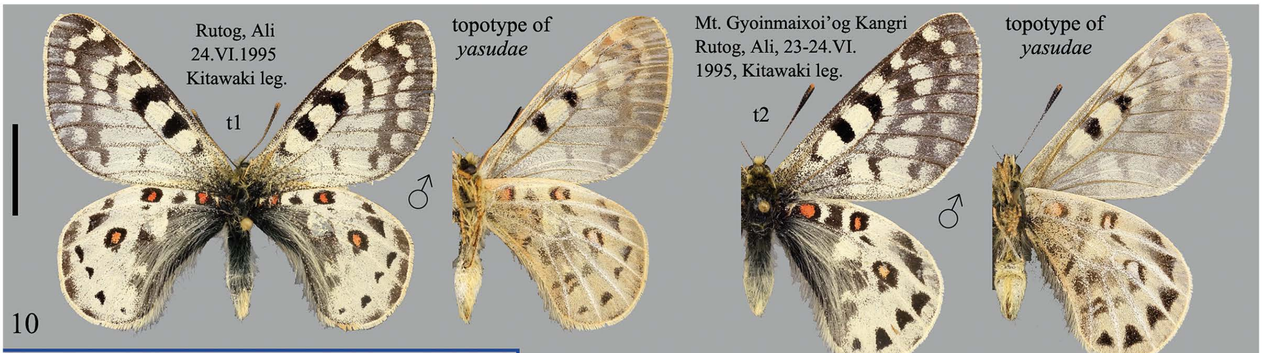


Fig. 40: Distribution of *Parnassius stoliczkanus* C. & R. Felder, 1865.

Figs. 1-4: Habitus of *Parnassius acco* Gray, [1853] ♂♂ under same scale.



Figs. 5-8: Habitus of *Parnassius acco* Gray, [1853] ♀♀ under same scale.
Fig. 9: Habitus of *Parnassius acco* Gray, [1853] ♂♂ and ♀♀ - Underside.



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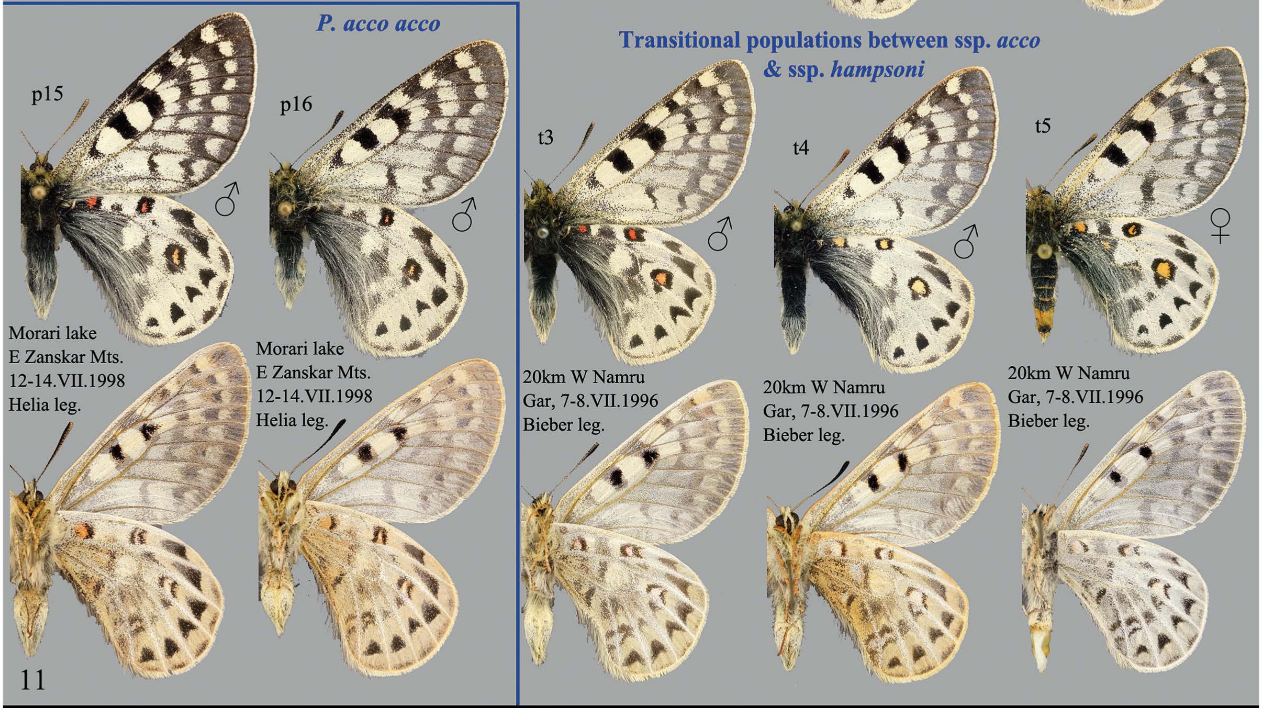
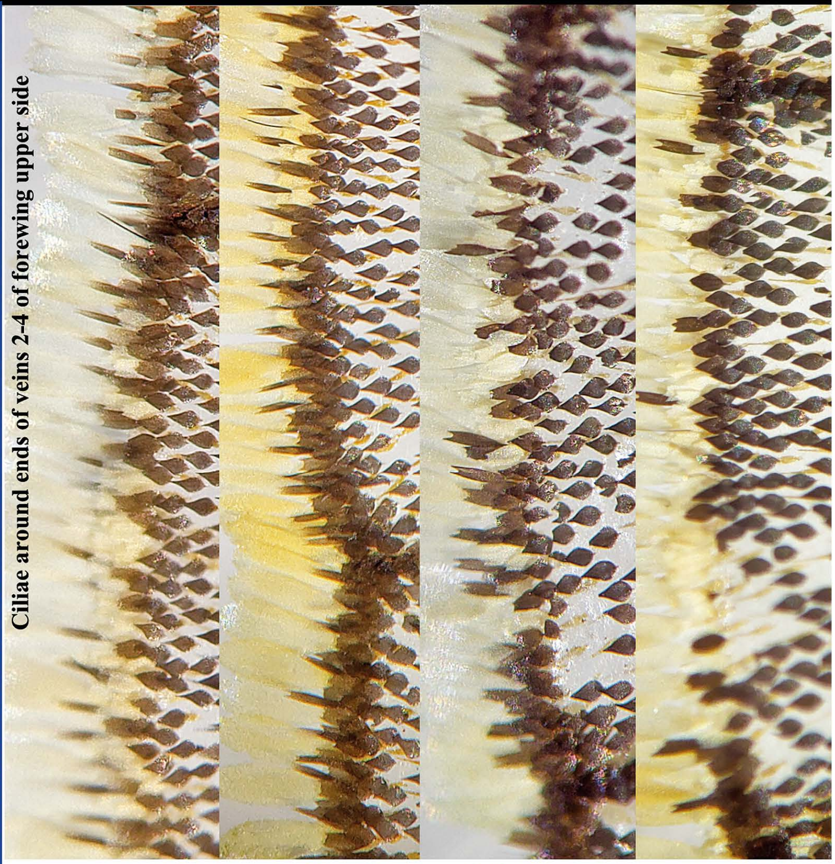


11

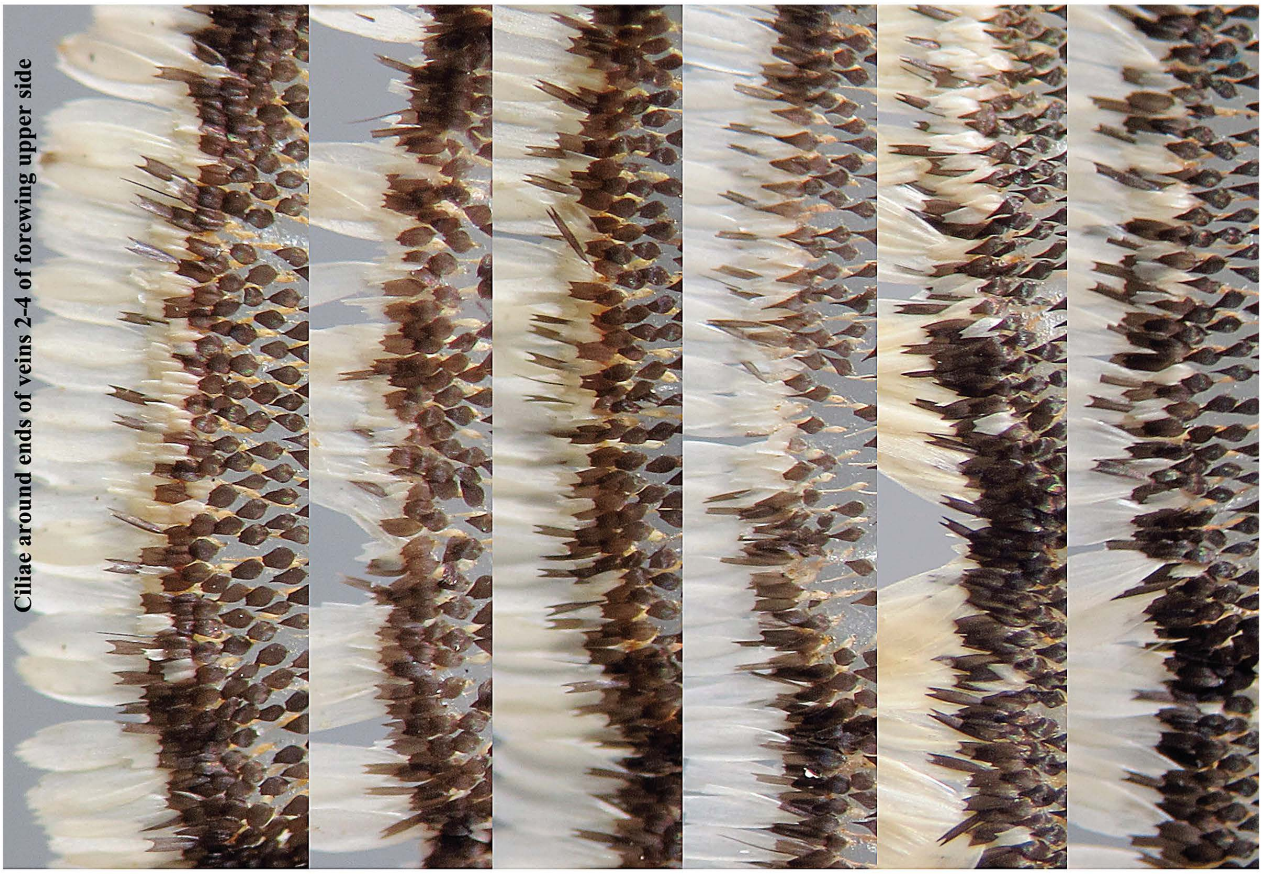
12 p15 ***P. acco acco*** p16



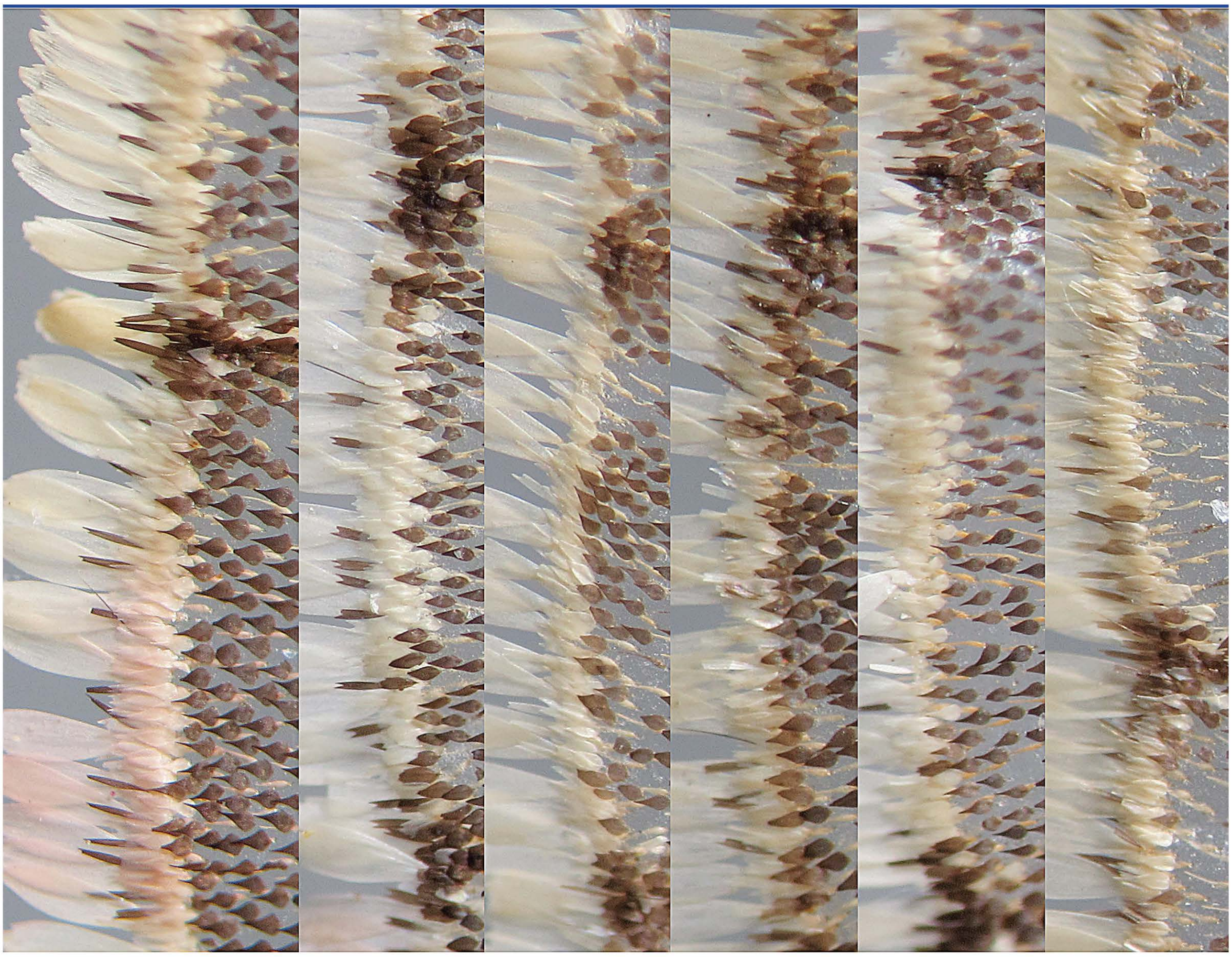
13 t3 t4 **Transitional populations** t2 t1

Figs. 10-11: Habitus of *Parnassius acco* Gray, [1853] ♂♂ and ♀♀ under same scale.

Figs. 12-13: *Parnassius acco* Gray, [1853]: fringes (Ciliae) around veins 2-4 of forewing upper side.



14 ***P. acco acco*** p4 p6 (W Zhada) p7 (W Zhada) a1 (N Pulan) a2 (N Pulan) a3 (N Pulan)

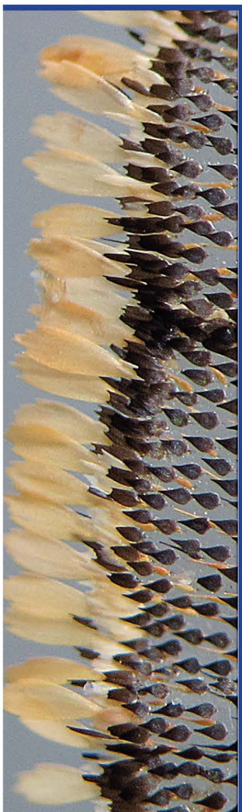


15 ***P. acco gyanglaputsai*** g6 g8 (N Tsochen) g5 (N Tsochen) g4 (N Tsochen) g7 (N Tsochen) g3 (N Tsochen)

Figs. 14-15: *Parnassius acco* Gray, [1853]: fringes (Ciliae) around veins 2-4 of forewing upper side.

16 p9 p11 (Zhada) ***P. acco acco*** p12

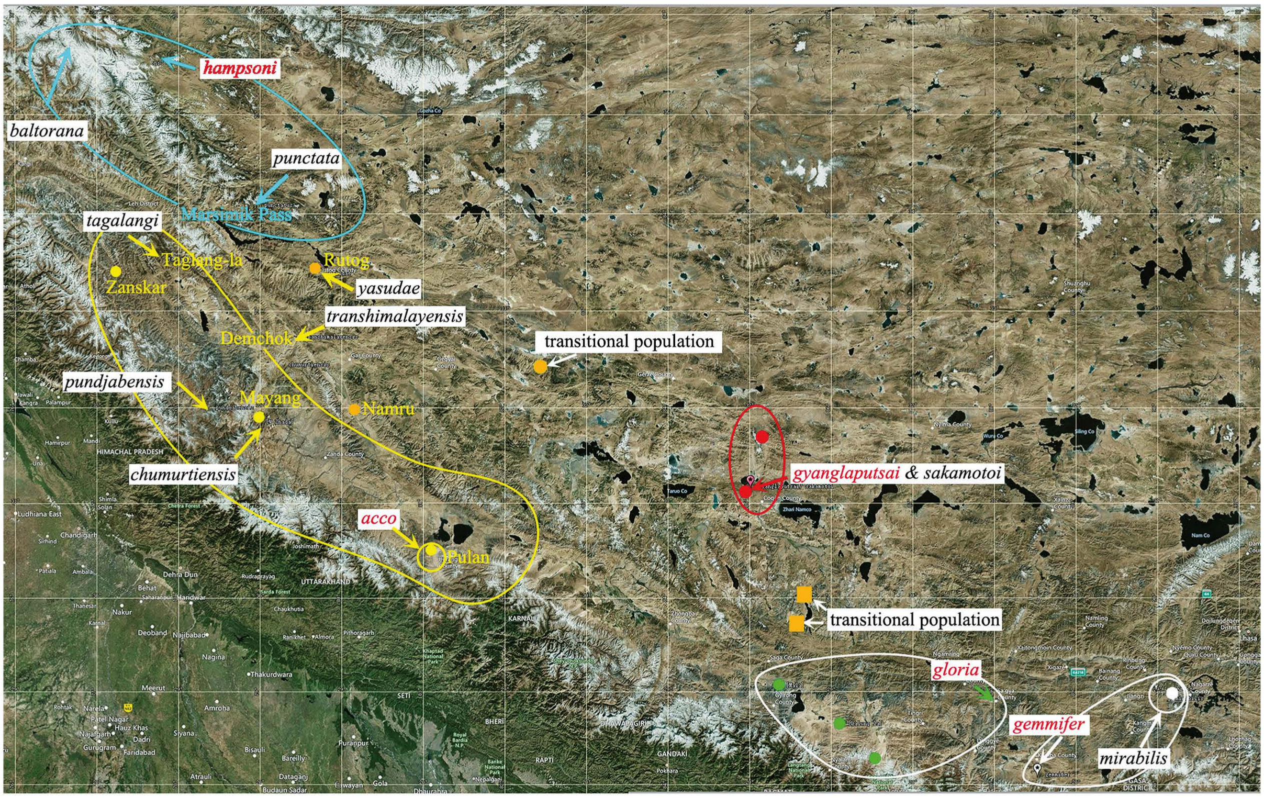
17 g1 ***P. acco gyanglaputsai*** g2 (Tsochen)



18 ***P. acco gloria*** gr3

19 ge1 ge3 (Karola) ***P. acco gemmifer*** ge7 ge9

Figs. 16-19: *Parnassius acco* Gray, [1853]: fringes (Ciliae) around veins 2-4 of forewing upper side.



20 Distribution of *P. acco* in W Tibet (square marks = populations in literature; round marks = populations examined in this work; arrows directed to type localities; red names = valid subspecies names; black names = synonyms)

21 Distribution of *P. labeyriei* in C & E Tibet, Sichuan, Qinghai and Gansu (square marks = populations in literature; round marks = populations examined in this work; arrows directed to type localities; red names = valid subspecies names; black names = synonyms)

Figs. 22-28: Habitus of *Parnassius labeyriei* Weiss & Michel, 1989 ♂♂ and ♀♀ under same scale.

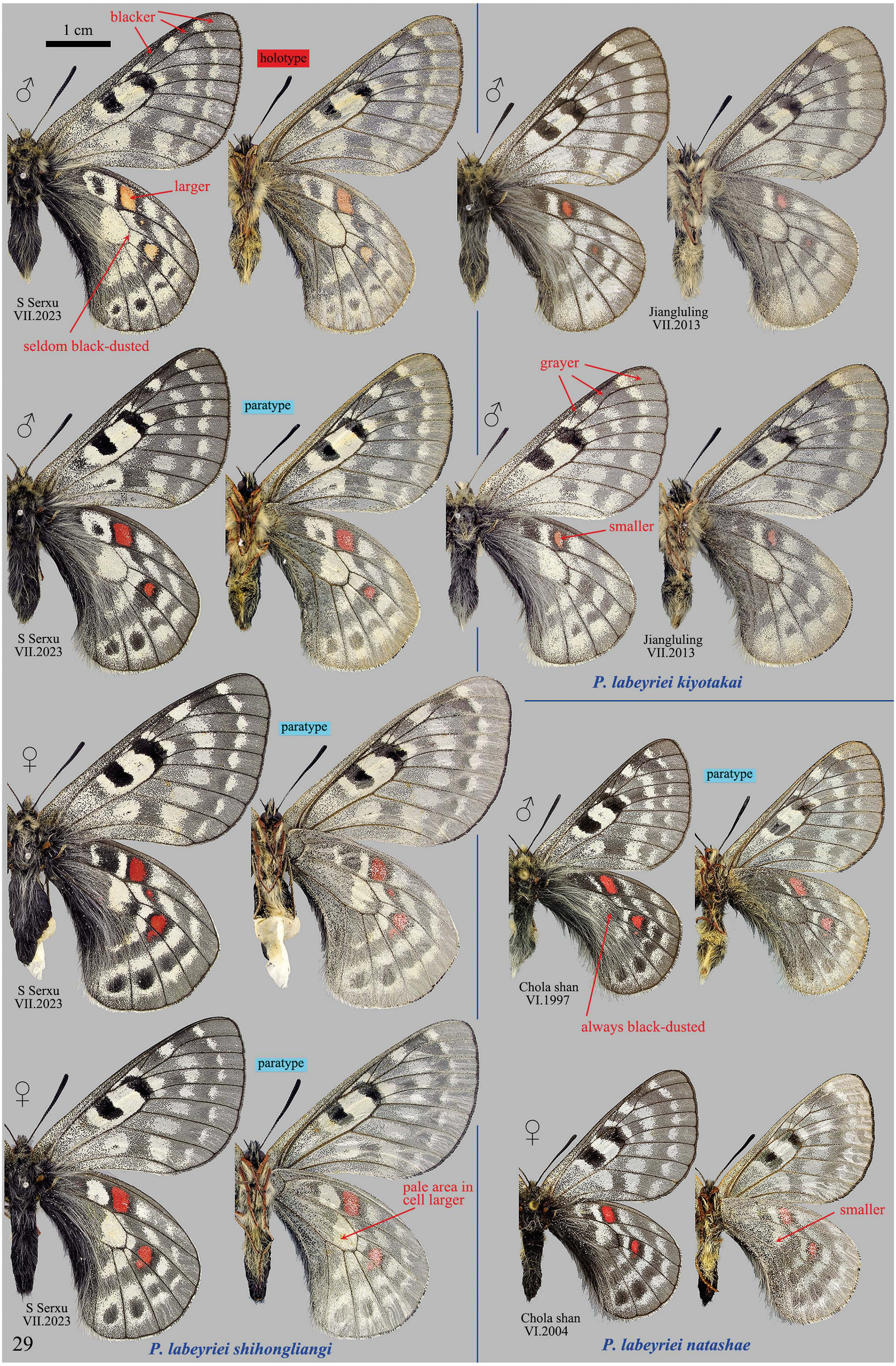


Fig. 29: Habitus of *Parnassius labeyriei* Weiss & Michel, 1989 - Upper side and underside.

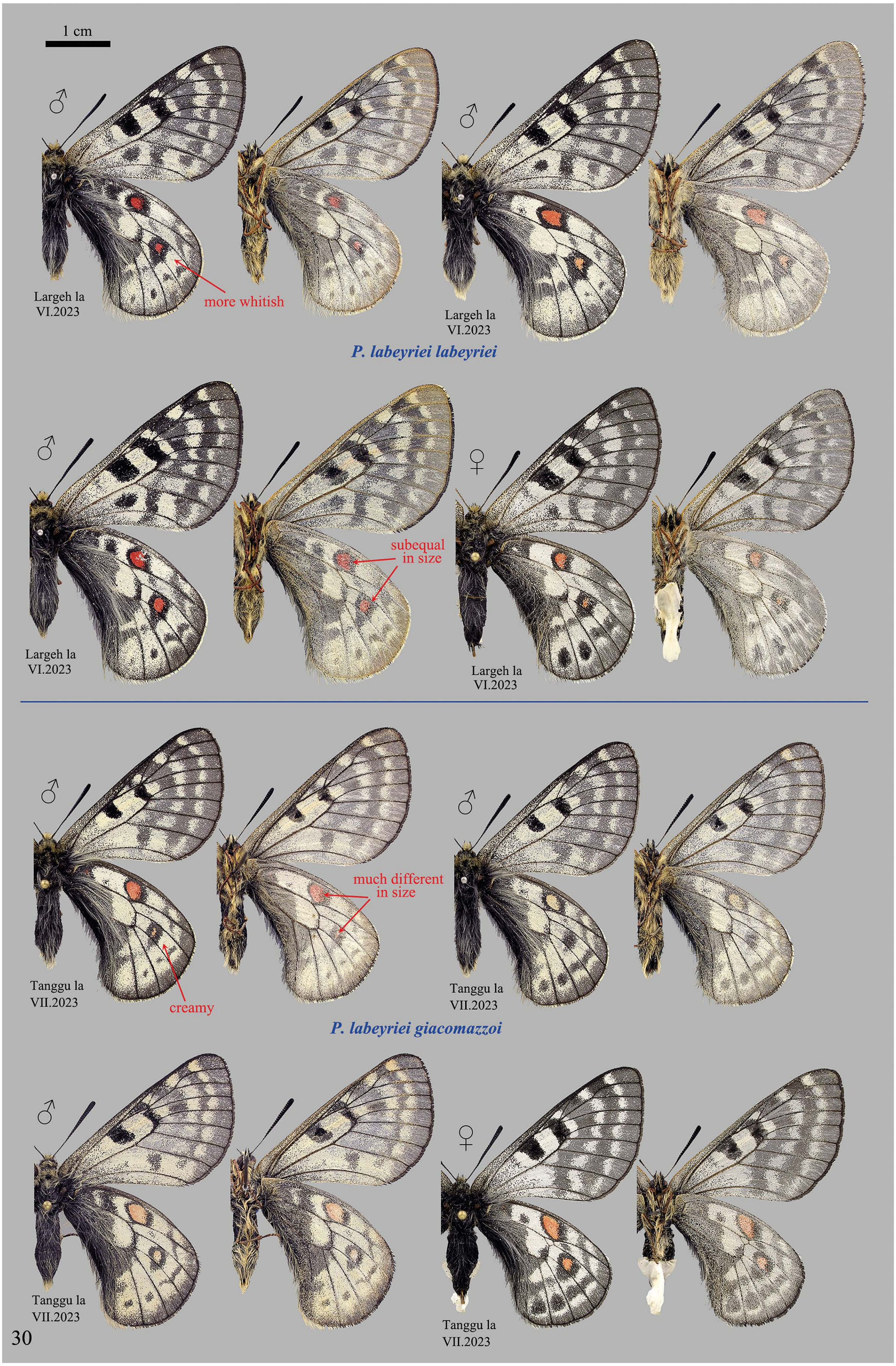


Fig. 30: Habitus of *Parnassius labeyriei* Weiss & Michel, 1989 - Upper side and underside.

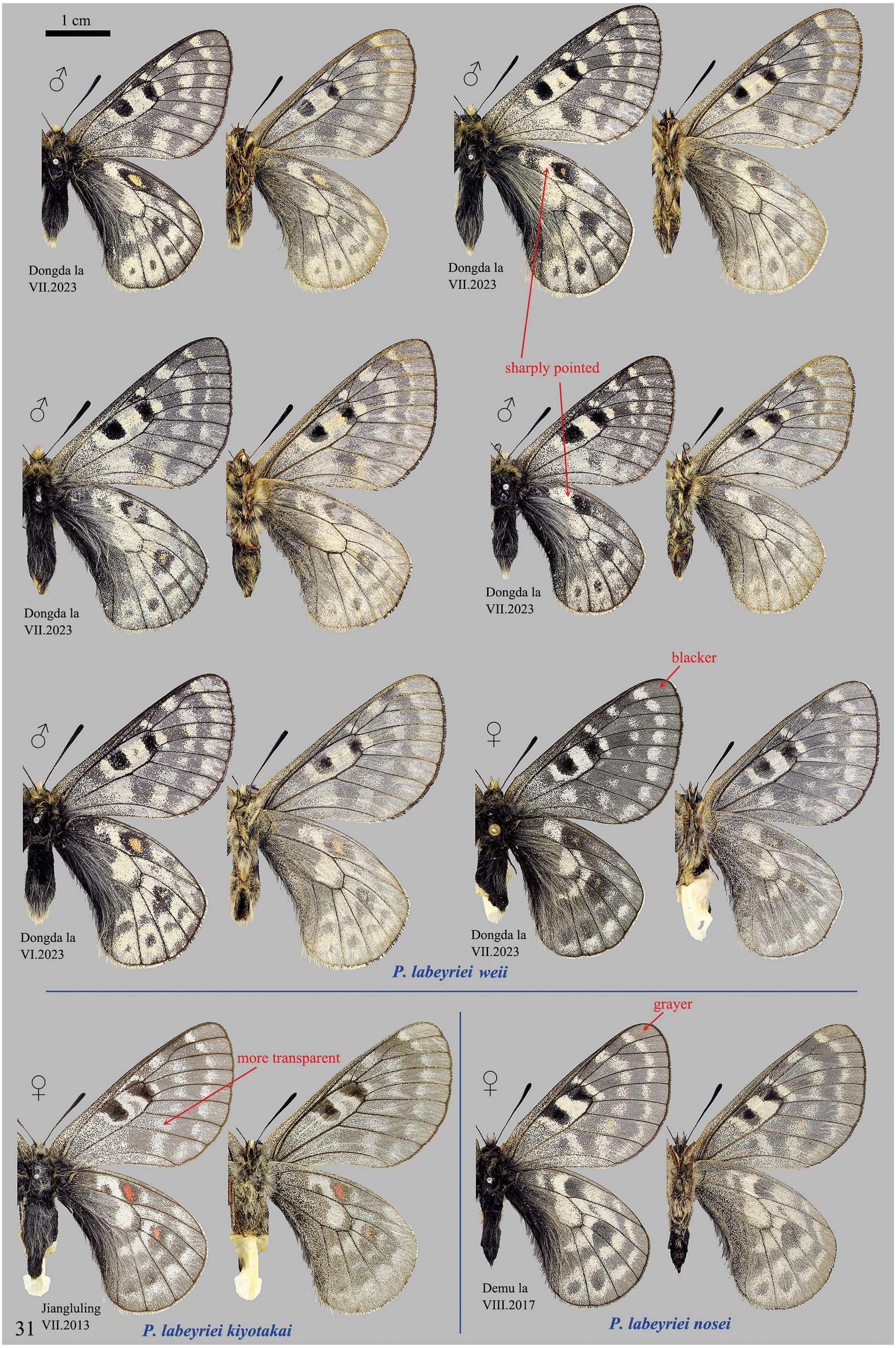
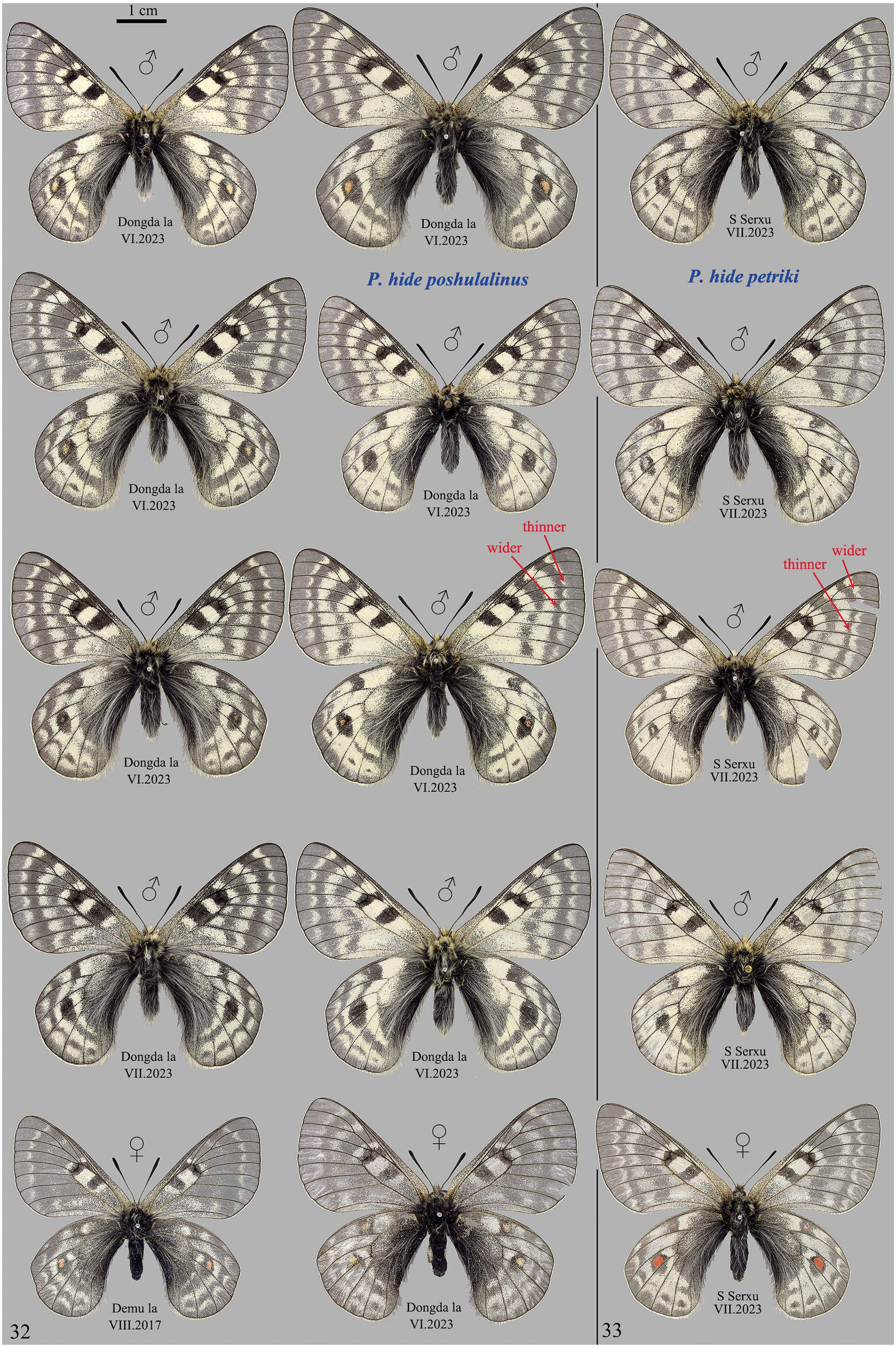
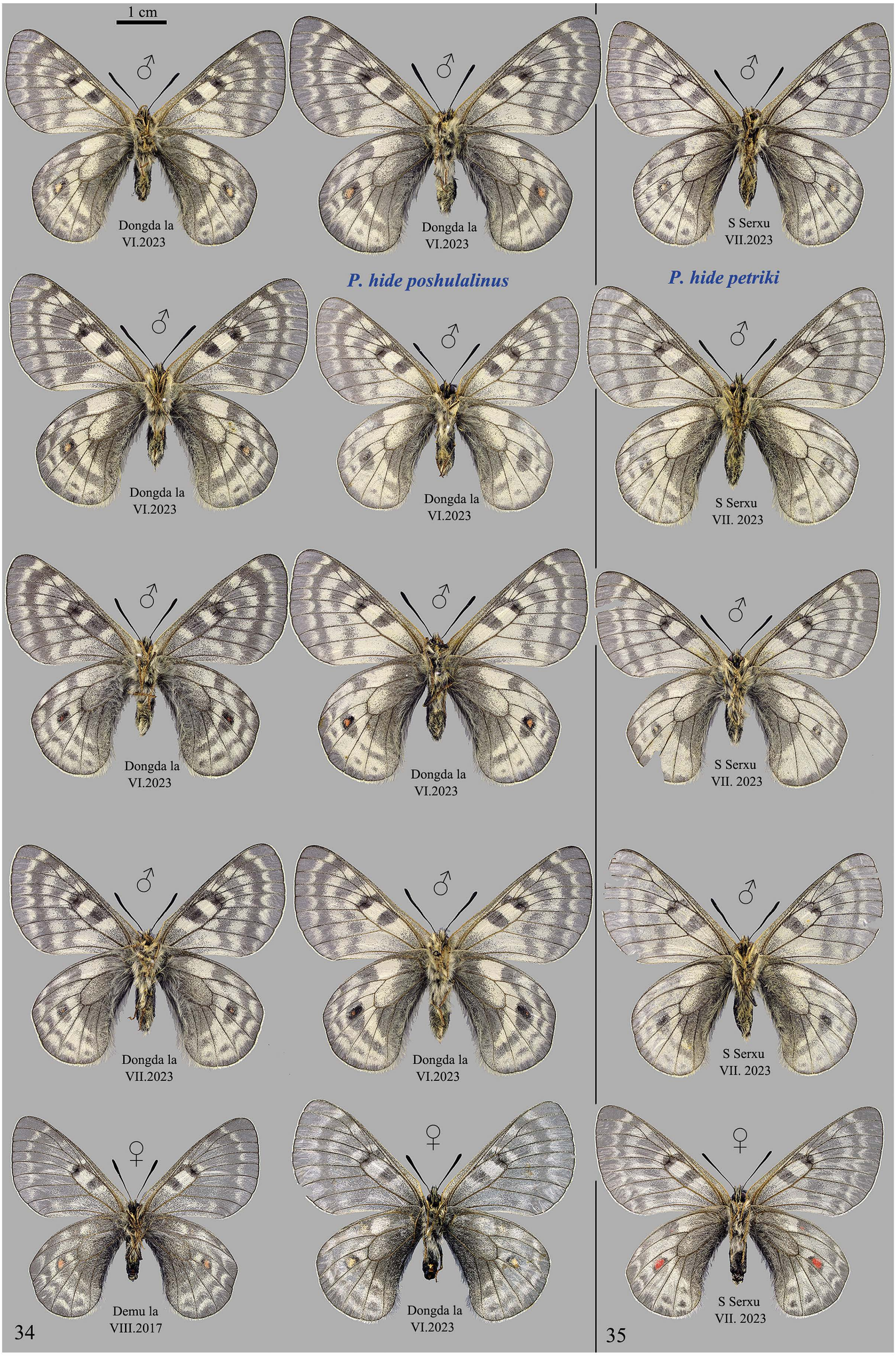


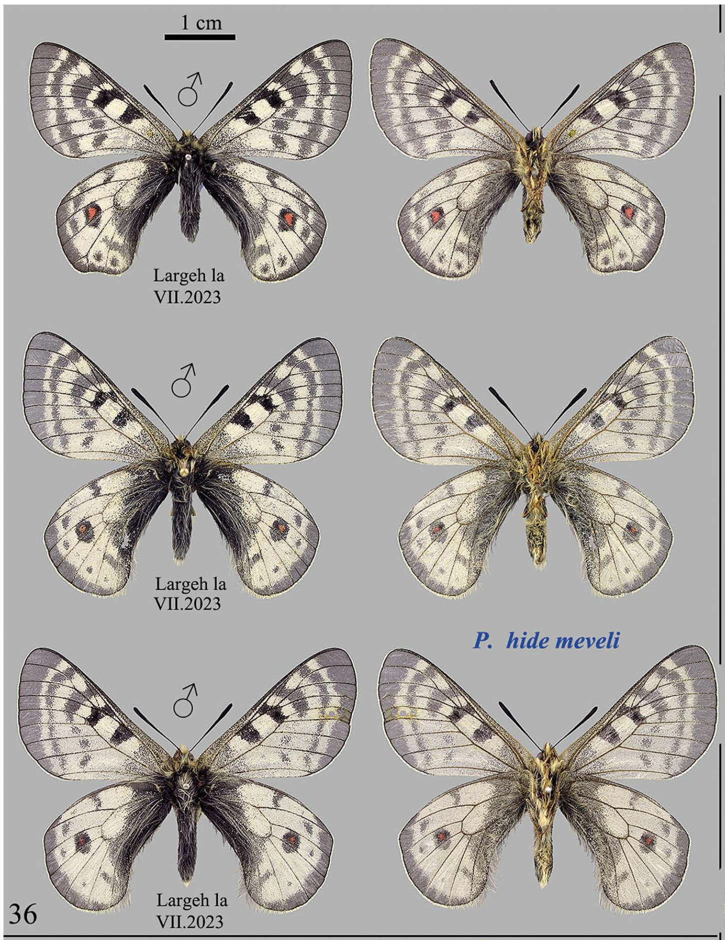
Fig. 31: Habitus of *Parnassius labeyriei* Weiss & Michel, 1989 - Upper side and underside.



Figs. 32-33: Habitus of *Parnassius hide* Koiwaya, 1987 under same scale - Upper side.



Figs. 34-35: Habitus of *Parnassius hide* Koiwaya, 1987 under same scale - Underside.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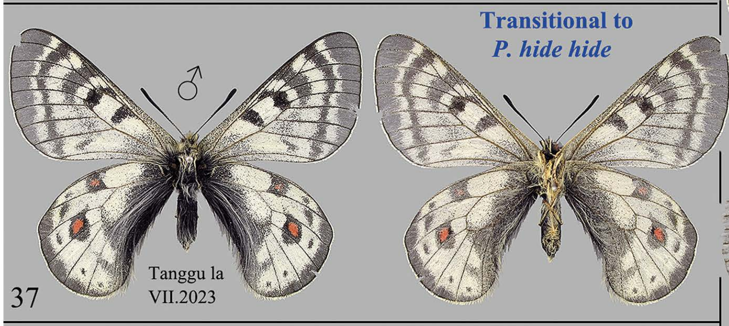
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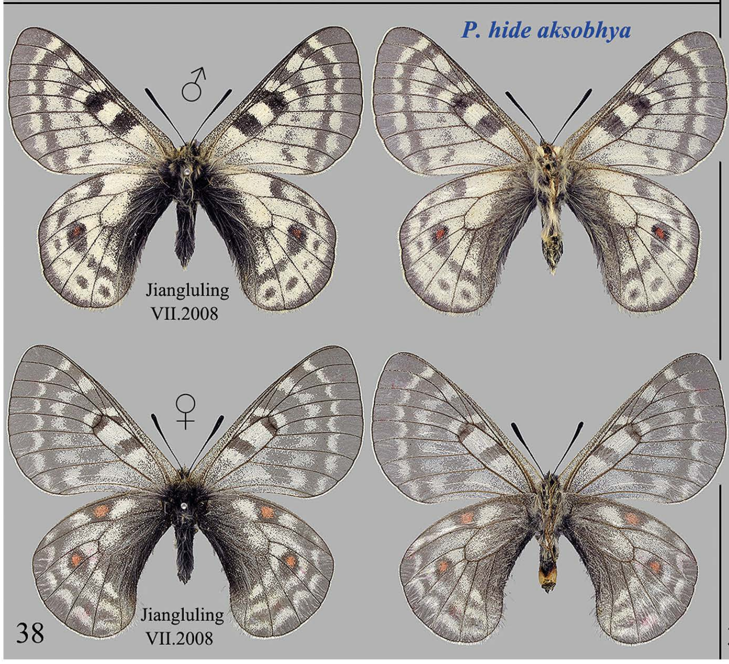
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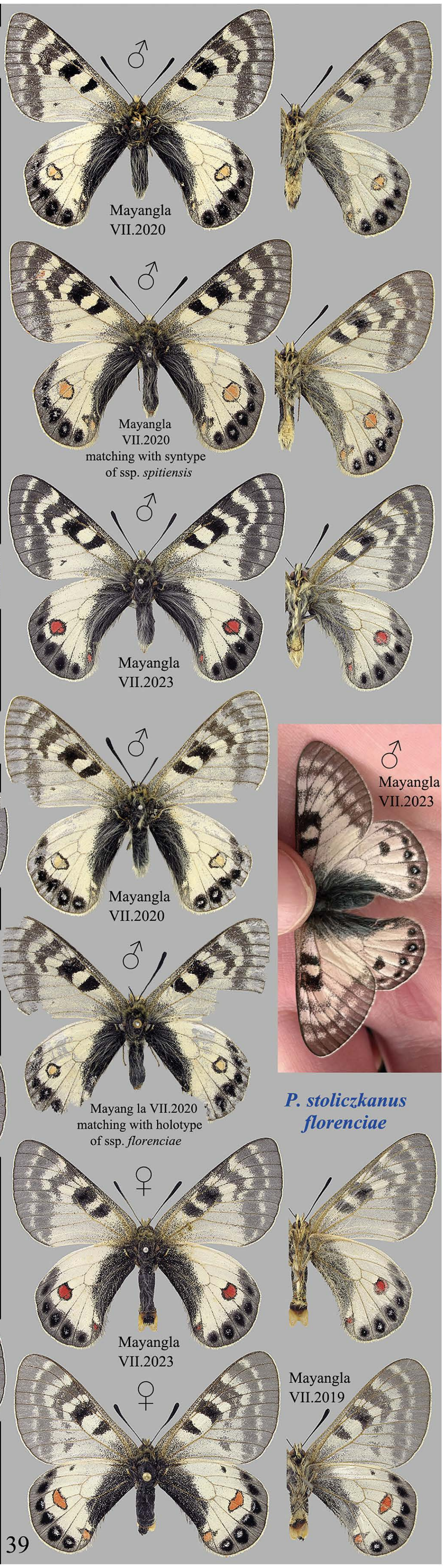
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Figs. 36-38: Habitus of *Parnassius hide* Koiwaya, 1987 under same scale - Upper side and underside.
Fig. 39: Habitus of *Parnassius stoliczkanus florenciae* Tytler, 1926 - Upper side and underside.

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