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Contributions to the study of butterflies from Xinjiang - 2 the genus *Neolycaena* De Niceville, 1890

(Lepidoptera: Lycaenidae)

by

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Abstract: A review is made on the genus *Neolycaena* de Niceville, 1890 from China. Five species are recorded as new to Chinese fauna: *N. eckweileri* Lukhtanov, 1993, *N. chimaera* Churkin, 2004, *N. enkhnasani* Churkin & Kolesnichenko, 2019, *N. zaisana* Zhdanko, 2013, and *N. rufina* Lukhtanov, 1994. Two new species and two new subspecies are described: *N. iliensis* ***liuyei*** **subspec. nov.**, *N.* ***xingruii*** **spec. nov.**, *N.* ***liyinghuii*** **spec. nov.**, and *N. davidi* ***wenhaoi*** **subspec. nov.**. *Neolycaena sapozhnikovi* Yakovlev, 2012 **syn. nov.** is considered as a new junior synonym of *Neolycaena chimaera* Churkin, 2004. *N. davidi tangutica* (Grum-Grshimailo, 1891) **stat. rev.** is confirmed to be subspecies of *N. davidi* (Oberthür, 1881). *N. (Rhymnaria) markhasiovi* Krupitsky, 2021 is downgraded to a subspecies of *N. kozlovi* Zhdanko, 1994. Most of the Chinese taxa have been examined in both ♂ and ♀ genitalia, with individual variations investigated. The type locality of *N. davidi davidi* (Oberthür, 1881) is clarified as near Fengcheng, Dandong. The larvae and the host plants of *N. davidi davidi* (Oberthür, 1881) and *N. davidi* ***wenhaoi*** **subspec. nov.** are figured or recorded.

Introduction: The genus *Neolycaena* de Nicéville, 1890 was historically reviewed, partly or fully, by Lukhtanov (1993), Zhdanko (1998, 2000), Weidenhoffer et al. (2004), Churkin (2004, 2006) and Weidenhoffer et al. (2016). Further six taxa have been described by various authors (Korb, 2017; Weidenhoffer & Šumpich, 2017; Huang, 2019; Churkin & Kolesnichenko, 2019; Krupitsky, 2021) since the last review (Weidenhoffer et al., 2016). It is noteworthy that *N. turkomana* Korb, 2011 (TL: Turkmenistan, Niya, Badhertz Nature Reserve, Kizilejar Canyon) was overlooked in the last review and the subsequent works; this species was described to be close to *N. tengstroemi* (Erschoff, 1874) and different by having a more protruding apex of valva.

The *Neolycaena* fauna of Xinjiang was poorly known, with only six valid species recorded in literature. R.-X. Huang et al. (2000) recorded *N. tengstroemi* (Erschoff, 1874) and *N. eckweileri* Lukhtanov, 1993 in their book but gave no collecting data, they just reproduced the figures of the foreign specimens in literature for records. The author explored the northern Xinjiang (on north of Tianshan) in 2022 and made a good collection that forms the basis of this report. The *Neolycaena* fauna of southern Xinjiang (on south of Tianshan) has not been investigated till now. The author failed to find any *Neolycaena* butterflies in the mountain ranges and plains around Korla during his two visits to this area (late May and late June, 2022). The vast Korla area seems to be not occupied by any *Neolycaena* species. However, the *Neolycaena* species are hopefully discovered in the Chinese Pamir and the Maidantag Mt. Range in the future.

The author takes the convenience to include the taxa from other Chinese areas in this analysis. Only the recently described *Neolycaena* (*Rhymnaria*) *arcana* Weidenhoffer & Šumpich, 2017 from "Tibet" (no detailed locality) is omitted as no new material has been known.

Abbreviations:

NHML:	The Natural History Museum (London, UK)
BSNU:	Biological laboratory of Shanghai Normal University, Shanghai, P.R. China.
CHH:	Collection of Hao Huang, Qingdao
CLP:	Collection of Peng Li, Xi'an
CMWW:	Collection of Wei-Wei Mao, Shanghai
CSWH:	Collection of Wen-Hao Sun, Zhangqiu
CXR:	Collection of Rui Xing, Urumqi
LF:	Length of forewing
TL:	Type locality
ZISP:	Zoological Institute, Russian Academy of Sciences (St.-Peterburg, Russia)

A checklist of the *Neolycaena* De Niceville taxa from Xinjiang

1. *N. (Neolycaena) sinensis* (Alphéraky, 1881) = *Satyrium yiliensis* R.-X. Huang & Murayama, 1992
2. *N. (Neolycaena) langi* Huang, 2019
3. *N. (Rhymnaria) eckweileri eckweileri* Lukhtanov, 1993 - **new record**
4. *N. (Rhymnaria) chimaera* Churkin, 2004 - **new record**
5. *N. (Rhymnaria) enkhnasani* Churkin & Kolesnichenko, 2019 - **new record**
6. *N. (Rhymnaria) zaisana* Zhdanko, 2013 - **new record**

7a. *N. (Rhymnaria) iliensis iliensis* (Grum-Grshimailo, 1891) - not examined

7b. *N. (Rhymnaria) iliensis liuyei* Huang **subspec. nov.**

8. *N. (Rhymnaria) neosinica* (Lee, 1963)
9. *N. (Rhymnaria) xingruii* Huang **spec. nov.**
10. *N. (Rhymnaria) liyinghuii* Huang **spec. nov.**
11. *N. (Rhymnaria) rhymnus rhymnus* (Eversmann, 1832)
12. *N. (Rhymnaria) rufina* Lukhtanov, 1994 - **new record**
13. *N. (Rhymnaria) kozlovi markhasiovi* Krupitsky, 2021 **stat. nov.**

A checklist of *Neolycaena* De Niceville taxa from other Chinese areas

14a. *N.* (*Rhymnaria*) *davidi davidi* (Oberthür, 1881)
14b. *N.* (*Rhymnaria*) *davidi wenhaoi* **subspec. nov.**
14c. *N.* (*Rhymnaria*) *davidi tangutica* (Grum-Grshimailo, 1891) **stat. rev.**
15. *N.* (*Rhymnaria*) *arcana* Weidenhoffer & Šumpich, 2017 - not examined

Useful characters & individual variations: An examination of a good number of Chinese specimens in both, ♂ and ♀ genitalia (the photos are carefully prepared for the same aspect in all of the specimens examined), proves that most of the genitalic characters are highly variable individually and useless in distinguishing the closely related species. However, more genitalic characters can be found useful in diagnosing the distant species which are strikingly different in wing-pattern. There are more genitalic characters working for separating the species groups. As for the closely related species, a detailed discussion is as follows.
♂ brand is individually variable in size for most Chinese species and generally useless in taxonomy. It is nearly absent and replaced by a few scattered androconia in *N. davidi davidi* (Obth.), *N. davidi wenhaoi* **subspec. nov.** and *N. davidi tangutica* (Gr.-Gr.).
Wing-pattern on upper side was used by Churkin & Kolesnichenko (2019) and Weidenhoffer et al. (2016). However, the wing characters on upper side are individually variable in most Chinese species and generally useless in taxonomy. Wing-pattern on underside is important in taxonomy on a sufficient sampling.
Anal tuft of ♀ abdomen was used by Krupitsky (2021) for the species delimitation between *N. kozlovi markhasiovi* Krupitsky and *N. kozlovi* Zhdanko, 1994. However, it is observed to be individually variable in nearly all Chinese species (figs. 15-16), or even in single populations, thus it has no absolute value in taxonomy. It could be used for subspecific classification based on a sufficient sampling.
Weidenhoffer et al. (2016) stated that the area between the eyes is covered by black hairs with only the central stripe whitish in *N. zaisana* Zhdanko but is completely whitish in *N. balchashensis* Zhdanko, 1998. However, such difference was not confirmed by Churkin & Kolesnichenko (2019). The author examined the eyes (fig. 17), the body and the legs for Chinese species and found no constant difference between species. The following description is applicable to all the Chinese species examined (terminology follows Ehrlich, 1958): vertex is covered by black scales; only a few whitish hairs are present around transfrontal suture between antennifers, mixed with black ones, such whitish hairs can be replaced by greyish hairs in some individuals; paraocular area is covered by whitish hairs and scales; frontoclypeal sclerite is mainly covered by black scales, bordered by lower transversal line of whitish scales (often incomplete) above labrum. No character is found useful in taxonomy.
Churkin (2004) stated that the aedoeagus has no taxonomic value among Mongolian species and he (Churkin, 2006) did not study this organ in his taxonomic notes on Tianshan species. However, length of upper cornutus and appearance of cornutus-apex in dorsal or ventral view are significantly different between some Chinese species (fig. 34). Unfortunately, these characters have not been investigated for most of the known species from outside China, pending a thorough study in future.
Shape of tegumen can be individually variable, flattened laterally or not (Churkin, 2004); such variation is also observed in Chinese species (fig. 46). Size of ♂ genitalia is useful for a few Mongolian species (e. g. *N. musa* Zhdanko & Yakovlev, 2001 and *N. chimaera* Churkin), with only slight individual variations; however it seems not to be constantly different among Chinese species. The falces (figs. 23-24, 32, 44) are dissected from the genitalia for an accurate comparison in this work but no difference is found between the closely related species whilst the difference is only found between the different species groups. Churkin (2004) reveals that the position of the base of the falx (hidden by tegumen in ventral view or not) might be very important for isolation of sympatric species; this character is individually variable in the *N. rhymnus* (Eversmann) group and the *N. davidi* (Obth.) group, and is less individually variable in the *N. tengstroemi* (Erschoff) group. However, this character, as well as the position of the cross-point of falces, has no taxonomic value for the closely related species.
Churkin (2004) stated "the juxta is situated at the inner side of the tegumen, being only faintly sclerotized, and has no taxonomic value". Such "juxta" is actually subscaphium which is generally variable individually (fig. 46) with no taxonomic value in most groups of Lycaenidae. The true juxta is absent in the tribe Eumaeini Doubleday, 1847.
Valvae provide the most important characters for separating the species groups. However, as for the closely related species in China, characters of valvae (e.g. shape in lateral view and ventral view) are generally individually variable and useless in taxonomy (fig. 36).
Churkin (2004, 2006, 2019) is the first who reveals that the size and the position of the non-pigmented zone at apex of the valva in ventral and lateral views are important in taxonomy. Such non-pigmented zone is important in distinguishing some difficult taxa, such as *N. balchashensis* Zhdanko, *N. zaisana* Zhdanko and *N. enkhnasani* Churkin & Kolesnichenko. Unfortunately, these characters have not been investigated for most of the known species, pending a thorough study in future. The following characters of valvae are found to be useful in only two cases for Chinese taxa: distal part of valva is constantly different in length between *N. davidi* (Obth.) and *N. kozlovi* Zhdanko, 1994; outer shoulder of valva (i.e. outer margin between base of distal process and widest point of valvae in ventral view) is constantly different in length between *N. sinensis* (Alphéraky) and *N. langi* Huang.
Churkin (2004) is the first who reveals that the relative length of the apophyses posteriores is important in dividing some species. This character is particularly useful in separating *N. chimaera* Churkin and *N. enkhnasani* Churkin & Kolesnichenko in Xinjiang, but is individually variable in *N. zaisana* (Zhdanko) and other Chinese species (fig. 40). As stated by Churkin (2004), the shape of antrum and ductus bursae is not very specifically different as Zhdanko (1998) believed. The signum is also individually variable and statistically different in various populations. An examination of a good number of specimens from Xinjiang (fig. 40) confirmed that the ♀ genitalia are highly variable individually. The employment of the ♀ genitalia in taxonomy should be base upon a sufficient sampling. Measurement of ♀ genitalia (e.g. length of antrum and ductus bursae) might be useful as stated by Churkin (2004, 2006). Unfortunately, such measurement has not been investigated for most of the known species, pending a thorough study in future (The genitalia figures shown in the last review (Weidenhoffer et al., 2016) seem to be useless in most cases, lacking measurements of structures).
Host plant has been widely used as an important evidence to distinguish species. However, it is possible that in most cases host plant has no absolute value in classification. At least the phylogenetic relationships of species can not be solely determined by foodplants. For example, *N. enkhnasani* Churkin & Kolesnichenko (feeding on *Halimodendron*) should be closer to *N. musa* Zhdanko & Yakovlev (feeding on *Caragana*) than to *N. zaisana* Zhdanko (feeding on *Halimodendron*) by having the broader non-pigmented zone at apex of valva in ventral view of ♂ genitalia and a short apophyses posteriores in ♀ genitalia. *N. halimodendroni* Zhdanko, 2013 is

apparently much closer to *N. baitenovi* Zhdanko, 2012 than to any other species feeding on *Halimodendron* (the morphological difference between these two species is actually not well defined). This viewpoint needs further researches in future. Nevertheless, host plant might be used as an additional character in supporting the species delimitation that is based on morphological differences.

Species delimitation of the closely related Chinese taxa

It is noted that the following useful characters might be applicable to certain species, but not to all species.

1) The discrete wing-character states. If there is constant difference in any of the wing-characters (e.g. appearance of androconia and brand; contrast between markings and ground; size, shape or position of markings; extent or color of basal scaling on underside) based on a large number of specimens in various populations (i.e. character states are discrete, not continuous), the taxa could be different species. Such different taxa in China generally have more or less constant difference in ♂ or ♀ genitalia.

2) The discrete ♂ genitalic character states. Only the following characters are found useful for the closely related Chinese species: size of the non-pigmented zone at apex of valva in ventral view (different between *N. enkhnasani* Churkin & Kolesnichenko and all other taxa); length of upper cornutus; width of apex of upper cornutus; length of distal branches of valvae (different between *N. davidi* (Obth.) and *N. kozlovi* Zhdanko).

3) The discrete ♀ genitalic character states. Only the following characters are found useful: width of caudal part of antrum in lateral view (different between *N. iliensis* (Gr.-Gr.) and its relatives); length of apophyses posteriores (different between *N. chimaera* Churkin and *N. enkhnasani* Churkin & Kolesnichenko).

4) Some close taxa have statistical differences in wing-characters, genitalia (♂ or ♀) and foodplant, they are considered as separate species on account of the combined evidences. Such differentiation is found between *N. enkhnasani* Churkin & Kolesnichenko and *N. musa* Zhdanko & Yakovlev in Mongolia, and is found between *N. neosinica* (Lee) and *N. xingruii* **spec. nov.** in Xinjiang.

List of collecting localities (fig. 49)

To be convenient, the specimens figured in this work are labeled by some simple geographical names in collecting localities, of which the longitude and latitude data are listed herein (mapped in fig. 49).

Barkol: 43.79 N, 93.29 E
Beijing: 40.50 N, 115.81 E
Daxigou: 44.38 N, 80.76 E
Diebu: 34.17 N, 102.87 E
E Wenquan: 44.93 N, 81.12 E
Fukang: 44.36 N, 87.93 E
Gongliu: 43.61 N, 81.83 E
Gultu: 44.41 N, 83.78 E
Horgos: 44.40 N, 80.39 E & 44.35 N, 80.39 E
Jimunai: 47.76 N, 86.11 E
Jimunai: 47.53 N, 85.89 E
Jinghe (or W Jinghe): 44.46 N, 82.25 E
Kalamari: 45.98 N, 89.49 E
Mengkegou: 44.82 N, 80.92 E
N Alataw: 45.56 N, 82.58 E
Ping'an: 36.49 N, 102.10 E
QaganGol: 46.61 N, 90.78 E
Qiongbola: 43.54 N, 80.98 E
Shihezi: 44.19 N, 86.08 E
S Wenquan: 44.95 N, 81.04 E
SW Hoboksar: 46.49 N, 84.98 E
Takshken: 46.15 N, 90.74 E
Takshken: 46.17 N, 90.92 E
Takshken: 46.16 N,, 90.95 E
Tekkes: 43.25 N, 82.29 E
Ulungur: 47.02 N, 86.93 E
Xiahe: 35.21 N, 102.56 E
Xining: 36.48 N, 101.77 E
Xinyuan: 43.58 N, 83.24 E
Yiwu: 43.27 N, 94.39 E
Yiwu: 43.19 N, 94.48 E
Yulin: 37.25 N, 110.35 E

Taxonomic accounts

***Neolycaena* (*Neolycaena*) *sinensis* (Alphéraky, 1881)** (figs. 1-4, 15, 17, 23-31, 52-56)

Lycaena sinensis Alphéraky, 1881: 383 (TL: altitude de 3500... promontoires du Tian-Chian, district de Kouldja; proved in this work to be on N & NW of Tekkes in northern piedmont of the Ketmen Mts. - see fig. 49), Tab. XIV, fig. 7.

Neolycaena sinensis: Lukhtanov & Lukhtanov, 1994: 229, Taf. 41, Fig. 10, Karte 275; Zhdanko, 1998: 642, lectotype (ZISP) designation, 643- fig. 1 for ♂ genitalia, 651- fig. 17 for ♀ genitalia; Zhdanko, 2000: 107, 108- fig. 24-1 for ♂ genitalia from Ketmen Mts., 109- fig. 25-2 for ♀ genitalia from Ketmen Mts., pl. 54, figs. 34-36 for specimens from Dzhungarsky Alatau, Kazakhstan; Tshikolovets, 2003: pl. XXX, fig. 28 for ♂ lectotype; Weidenhoffer et al., 2004: 60, records from Dushanzi and Bayan Gol, figs. for ♂ and ♀ genitalia; Tshikolovets, 2005: pl. XLI, figs. 1-3 for "syntypes" (fig. 1 - lectotype; figs. 2-3 - paralectotypes); Tshikolovets et al., 2016: 129, records for Kazakhstan, pl. XIX, figs. 37-40; Weidenhoffer et al., 2016: 62.

Thecla sinensis: Staudinger & Rebel, 1901: 70, catalogue, range as "Thian. oc."; Seitz, 1909: 268, range wrongly as "Sinin Mts.".

Satyrium yiliensis R.-X. Huang & Murayama, 1992: 11 (TL: originally as Yili, subsequently clarified by its first author as Guozigou, Huocheng - see fig. 49), 10- fig. 31 for holotype ♂. Synonymised by Zhdanko (1998)

Neolycaena yilliensis (sic!): Zhdanko, 1998: 642, synonymy for *Neolycaena sinensis* (Alphéraky).

Neolycaena yiliensis: R.-X. Huang et al., 2000: 61, clarification of TL as "Guozigou, Huocheng", pl. 38, fig. 6; Weidenhoffer et al., 2004: 62, reserve as uncertain species; Weidenhoffer et al., 2016: 64.

Material. 15 ♂♂, 1 ♀ (CHH, CLP), Horgos, 1500m, 6.VI.2019, H. Huang & P. Li leg.; 62 ♂♂, 31 ♀♀ (CHH), Qiongbola, 900 m, 21.V., 30.V. & 30.VI.2022, H. Huang & Y.-H. Li leg.; 34 ♂♂, 8 ♀♀ (CHH), E Wenquan, 1200 m, 31.V.2022, H. Huang leg.; 21 ♂♂, 5 ♀♀ (CHH), S Wenquan, 1400 m, 1.VI.2022, H. Huang leg.; 26 ♂♂, 14 ♀♀ (CHH), Mengkegou, 2000 m, 29.VI.2022, H. Huang leg.; 21 ♂♂, 6 ♀♀ (CHH), W Jinghe, 1000 m, 19.-20.V., 1.VI. & 27.VI.2022, H. Huang leg.; 51 ♂♂, 17 ♀♀ (CHH), Shihezi, 900 m, 14 & 18.V.2022, H. Huang leg.

Individual & geographical variations. At the beginning of this work, a few specimens from all the above-listed localities were dissected for a comparison and some genitalic differences were found between the southern populations (from Horgos and Qiongbola) and the northern populations (from Shihezi, Jinghe, Wenquan and Mengkegou). The northern populations tend to have a narrower valva-base in lateral view and a shorter antrum in dorsal view than the southern populations. However, the differences disappear when more and more specimens are examined (only partly photographed and figured).

Each of the populations seems to have its own peculiar host: the *Caragana* plants from different localities (figs. 53, 55 & 56) are apparently different species though they have not been identified. And there is some statistical difference in external features between the populations: the population from Qiongbola has an average larger size than all other populations; the easternmost population from Shihezi frequently has abnormal forms (fig. 4- n64, n59 & n60). However all these populations are connected by transitional forms in both external features and genitalia, frequently sharing some identical forms. There are no discrete character states to separate any of these populations. Therefore, all these populations are considered as a single species.

Type material. The lectotype and the paralectotypes figured by Tshikolovets (2003, 2005) fall into the individual variations observed in this work. The identical forms of the two paralectotypes are frequently found in most of the Chinese populations reported herein. The lectotype is somewhat peculiar by having the hindwing postdiscal markings remoter from the termen, but such character is occasionally found in the southern populations from Qiongbola (fig. 2- n20) and Horgos (fig. 2- n9).

The lectotype is labeled from Tian-Chian on 14th May, 1879 (in old Russian calendar, not the present Gregorian calendar) and the two paralectotypes are labeled from Tekkes on 19th May, 1879. Grieshuber et al. (2012: 98) clarified Alphéraky's schedule as follows. On 15th May, 1879 Alphéraky visited a village named Sharbugchi, which is located at 43.47 N, 81.93 E. Approximately 12 km to the west of this village there is a river which Alphéraky called Chibar. This is the place which Alphéraky (1881) gave as "Kouldja ... une gorge du Tian-Chian, a 5000". It is assumed that Alphéraky collected in a very nearby locality at a lower altitude the day before. Therefore the TL (visited on 14th May, 1879) must be located at a small area in Ketmen Mts. on north and northwest of Tekkes as located on the map (fig. 49).

Synonym. Zhdanko (1998) simply listed "*Neolycaena yilliensis* (sic!) Murayama, 1992" as a new synonym of *N. sinensis* (Alph.), giving no evidence. He (Zhdanko, 1998) wrongly attributed the authorship of *Neolycaena yiliensis* (R.-X. Huang & Murayama) to Murayama. Weidenhoffer et al. (2004 & 2016) reserved this taxon as uncertain species in their books, and stated: "The type locality is practically identical to that of *N. sinensis* (Alph.). On this basis, but without studying the type material, Lukhtanov (1994) synonymized it with *N. sinensis* (Alph.). On the contrary, from Huang and Murayama's description, it is evident that they compared both taxa and found differences both in wing-pattern and in genitalia structure". However, Lukhtanov has never published such synonymy in his publications.

According to R.-X. Huang (personal communications, September 1993), Murayama is the actual author of the paper who visited R.-X. Huang in summer of 1991 and studied the collection at Xinjiang University, Urumqi. They did not have any specimens of *N. sinensis* (Alph.) except the type series of *N. yiliensis* (R.-X. Huang & Murayama) at their hands. Murayama apparently consulted Seitz's (1909) book for the information of *N. sinensis* (Alph.) as he stated "*S. sinensis* Alphéraky, 1882, from Sining Mts.", a peculiar mistake copied from Seitz's (1909) work. The hand-drawings of the ♂ genitalia made by Murayama are far from the reality of the specimen just as those published by himself in his other papers; the details of the valvae, tegumen and aedoeagus figured do not match any known specimens of the *N. sinensis* (Alph.) group, and the apex of the aedoeagus figured even has no down-curved keel or cornuti. The comparative description of the ♂ genitalia is most likely fabricated, as the valvae figured are not "much longer" than those of any known specimens of *N. sinensis* (Alph.).

The TL of *Neolycaena yiliensis* (R.-X. Huang & Murayama) was clarified by its first author in his book (R.-X. Huang et al., 2000) as "Guozigou, Huocheng" (see fig. 49). R.-X. Huang (personal communications, 1993) told the author (who visited R.-X. Huang at Urumqi in 1993) that Huocheng area is the main collecting locality when he visited the Yili area the years before. This locality falls into the extent of the localities studied in this work. And the holotype of *Neolycaena yiliensis* (R.-X. Huang & Murayama) represents a form with obsolete submarginal markings on hindwing underside, which is occasionally found in most of the populations studied in this work (Horgos, Qiongbola and W Jinghe).

In conclusion, *Neolycaena yiliensis* (R.-X. Huang & Murayama) is a synonym of *N. sinensis* (Alph.).

Related species. Tshikolovets (2003, 2005) put all of the known taxa of the *N. sinensis* (Alph.) group into a single species, *N. sinensis* (Alph.), and stated most of them as synonyms of *N. sinensis pretiosa* (Lang, 1884) or *N. sinensis lunara* Zhdanko, 1998. This opinion was not agreed by Weidenhoffer et al. (2016). In the author's opinion, the ♂ genitalia and especially the ♀ genitalia of *N. sinensis* (Alphéraky) do not vary greatly in a vast area (from Shihezi to Horgos), thus some genitalic differences between *N. sinensis* (Alph.) and its relatives assuredly reflect the species delimitation within the group. However, the independent statuses of *N. medea* Zhdanko, 1998 and *N. lunara* Zhdanko, 1998 need a further research, as their genitalia in both sexes are not significantly different from those of *N. sinensis* (Alph.) observed in this work. It is worth noting that the minute teeth of the ostium bursae are occasionally observed in the specimens of *N. sinensis* (Alph.) (fig. 29- n15) in various degrees.

Neolycaena (*Neolycaena*) *langi* Huang, 2019 (figs. 1-4, 15, 17, 23, 25-26, 28-31, 57)

Neolycaena langi Huang, 2019: 211 (TL: Xinyuan - see fig. 49), figs. 84-86 for holotype & paratypes, fig. 206 for ♂ genitalia, fig. 207 for ♀ genitalia.

Material. 22 ♂♂, 25 ♀♀ (BSNU, CHH, CLP; the entire type series), Xinyuan, 1200-1300 m, 20.VI.2017 & 27.VI.2019, S.-Y. Lang, H. Huang & P. Li leg.

Diagnosis & individual variations. The following characters are proved to be constant in distinguishing *N. langi* Huang from *N. sinensis* (Alph.): all whitish markings on the underside are in much greater contrast with the dark ground color; outer shoulder of valvae in ventral or dorsal view shorter (i.e. base of distal process closer to the widest point of valvae in ventral view); antrum in dorsal or ventral view somewhat fusiform, with lateral sides not parallel to each other.

All the known specimens of *N. langi* Huang are rather uniform in wing characters, with very weak individual variations. Therefore only a few specimens representing the extreme forms are selected to be figured in this work.

Neolycaena (*Rhymnaria*) *eckweileri eckweileri* Lukhtanov, 1993 (figs. 5-6, 15, 39-40)

Neolycaena eckweileri Lukhtanov, 1993: 65 (TL: Kazakhstan, Dshungarian Alatau, Dzhalanashkol), karte 1 for distribution, abb. 10- A & B for ♂ genitalia, Farbtafel II, abb. 8-9 for ♂ holotype; Lukhtanov & Lukhtanov, 1994: 228, Taf. 56, Figs. 3-4; Zhdanko, 1998: 654, fig. 28 for ♀ genitalia; Weidenhoffer et al., 2004: 80, figs. for ♀ genitalia; Weidenhoffer et al., 2016: 93; Tshikolovets et al., 2016: 131, pl. XIX, figs. 34-35 for paratype.

Material. 1 ♀ (CHH), Horgos (44.35 N, 80.39 E), 1040 m, 15.VI.2019, H. Huang leg.
Chinese record. The easternmost locality in Kazakhstan marked by Lukhtanov (1993: 66 - karte 1) on the map is just at Dzhungarian Gate (called Ala-shankou or Alataw in China) at Kazakhstan-Chinese border. It is logical to deduce that the species can be found in China. However, this species was not found by the author from the Chinese area around Dzhungarian Gate. It was unexpectedly found at a military area along Kazakhstan-Chinese border on north of Horgos.

***Neolycaena* (*Rhymnaria*) *chimaera* Churkin, 2004** (figs. 5-6, 15, 18, 32-37, 39-40, 68-71)

Neolycaena chimaera Churkin, 2004: 172 (TL: SW Mongolia, Khovd aimak, Sutai Uul - see fig. 49), figs. 2, 3 & 8 for ♂ and ♀ genitalia, cpl. XI-XII, figs. 17-20 for habitus; Weidenhoffer et al., 2004: 86, figs.; Weidenhoffer et al, 2016: 98.

Neolycaena sapozhnikovi Yakovlev, 2012: 65 (TL: W Mongolia, Hovd aimak, Bulgan-gol basin, Bayan-gol basin, middle stream Ulyastain-Sala river), figs. 13-14 for habitus and genitalia in both sexes; Weidenhoffer et al., 2016: 99, figs. for more paratypes, taxonomic notes. **syn. nov.**

Material. 8 ♂♂, 5 ♀♀ (CHH), Takshken, Qinghe County, Altay Prefecture, Xinjiang, 1195-1237 m, 16.VI.2022, H. Huang leg.; 3 ♀♀ (CHH), QaganGol, Qinghe County, 1444m, 17.VI.2022, H. Huang leg.
Synonym. Yakovlev (2012) compared *Neolycaena sapozhnikovi* Yakovlev, 2012 with *N. chimaera* Churkin, 2004 and figured both species side by side on a color plate. But no external difference can be read to distinguish these two species except for a V-shaped discocellular bar on forewing underside in *N. sapozhnikovi* Yakovlev. Yakovlev (2012) employed the following characters to distinguish his new species from *N. chimaera* Churkin: "a distinct V-shaped white streak on the underside of the forewing, stronger sclerotization of the corpus bursae basally, wider globe-shaped corpus bursae, and the poorly curved phallus". However, the corpus bursae and the shape of phallus do not provide any reliable diagnostic characters in the classification of *Neolycaena* De Niceville, being individually variable in all of the known species. Moreover, Weidenhoffer & al. (2016) figured further two ♂ and one ♀ paratypes of *N. sapozhnikovi* Yakovlev, of which the discocellular bars are just the same as those of *N. chimaera* Churkin, not V-shaped.
The specimens collected from Chinese side of the Mongolian Altai in this work match the original description of *N. chimaera* Churkin in external features and genital characters. Most of them have a non-V-shaped, mostly obsolete discocellular bar on forewing underside as in *N. chimaera* Churkin, but one ♂ (fig. 6- r10) possesses a distinct V-shaped discocellular bar, indicating that the diagnostic character in discocellular bar used by Yakovlev (2012) is individually variable. The TL of *N. sapozhnikovi* Yakovlev falls into the range of *N. chimaera* Churkin because of the discovery of *N. chimaera* Churkin in Chinese side of the Mongolian Altai.
Remarks. It is noteworthy that the population from QaganGol has a markedly larger size than usual. All of these large specimens (figs. 5-6: r1 & r2) have the genitalia (fig. 40- r1 & r2) nearly in the same size as those of the small specimens from Takshken (fig. 40- r4).
The upper cornutus of this species (with dorsal view not figured) is the same as that of *N. zaisana* (Zhdanko) in all details (fig. 34).

***Neolycaena* (*Rhymnaria*) *enkhnasani* Churkin & Kolesnichenko, 2019** (figs. 5-6, 15, 35, 39-40)

Neolycaena enkhnasani Churkin & Kolesnichenko, 2019: 282 (TL: SW Mongolia, Khovd aimak, Dzhungarian Gobi des., Ushig spring - see fig. 49), figs. for habitus and genitalia in both sexes.

Material. 2 ♀♀ (CHH), Kalamari, semi-desert, 950 m, 16.VI.2022, H. Huang leg..
Remarks. Only two worn-out ♀♀ were collected from a locality close to the TL (fig. 50). They match the original description and figures of *Neolycaena enkhnasani* Churkin & Kolesnichenko in all details. However, they have the apophyses posteriores markedly shorter than the combined length of the antrum and ductus bursae. A study of more specimens is necessary in the future.

***Neolycaena* (*Rhymnaria*) *zaisana* (Zhdanko, 2013)** (figs. 5-8, 15, 18-20, 32-37, 39-40, 46, 72-74)

Rhymnaria zaisana Zhdanko, 2013: 28 (TL: E Kazakhstan, 18 km N Zaisan town, Kuanysh (Dairovo) vic. - see fig. 50), color page 2- fig. 2 for holotype ♂, fig. 3 for ♂ genitalia, fig. 8 for ♀ genitalia.

Neolycaena zaisana: Weidenhoffer et al., 2016: 89, part on specimens from Dairovo vill.; Churkin & Kolesnichenko, 2019: 281, taxonomic notes and clarification of known localities, pl. 1, figs. 7-8 for ♂ paratypes, pl. 3, figs. 2, 6 & 9 for ♂ genitalia, pl. 6 for distributional map (modified in this work- see fig. 50).

Neolycaena iliensis zaisana: Tshikolovets et al., 2016: 134, pl. XIX. figs. 38-40.

Material. 22 ♂♂, 10 ♀♀ (CHH), Jimunai, 500 m, 7.VI.2022, H. Huang leg.; 6 ♂♂, 9 ♀♀ (CHH), 60 km SW Hoboksar, 960 m, 3.VI.2022, H. Huang leg.; 2 ♂♂, 7 ♀♀ (CHH), 20 km W of Ulungur lake, roadside of G3014 highway, 718 m, 11.VI.2022, H. Huang leg.
Individual variations. Churkin & Kolesnichenko (2019) were correct in predicting the discovery of this species from the Chinese area around the Black Irtysh River. Mr. R. Xing and Miss Y.-H. Huang (personal communications, June 2022) first collected this species from two localities near the Black Irtysh River and shared their collecting data with the author. The author collected this species from a third locality near the Black Irtysh River (as shown in figs. 49-50), indicating that this species is commonly seen in this area. Moreover, the author collected this species from two farther localities (SW Hoboksar and Ulungur, as shown in figs. 49-50), proving the species to be rather widely distributed in Xinjiang.
This newly collected material from Xinjiang indicates that the species is very variable in both external features and genitalia. After a careful examination of both ♂ and ♀ genitalia, the author failed to divide this material into more species than *N. zaisana* (Zhdanko). All the variations in wing characters and genitalia are continuous (figs. 5-8, 18-19, 33-40).
Field observations (figs. 72-74). This species was observed to be associated with *Halimodendron halodendron* (Pall.) Voss (Fabaceae) by Miss R.-H. Huang at one locality near the Black Irtysh River, but was found to be associated with *Caragana* shrubs in other localities. However, due to the restricted collecting hours, the author failed to find any oviposition of the ♀ adult. The butterflies were found hiding in the *Caragana* shrubs at two biotopes.

***Neolycaena* (*Rhymnaria*) *iliensis* (Grum-Grshimailo, 1891)**

A small series of worn-out specimens were collected by Mr. Y. Liu, one of the best friends of the author, from a semi-desert area of Fukang near Urumqi. This population is remote from the known localities of *N. iliensis* (Gr.-Gr.) in the Ili valley. It could be a separate species from *N. iliensis* (Gr.-Gr.) in a viewpoint of zoogeography. However, the ♂ and ♀ genitalia of *N. iliensis* (Gr.-Gr.) have not been

carefully studied in literature, with some important characters missing. Nevertheless, the absence of any clear postdiscal markings on forewing underside of this new population support a temporary subspecies to be described. This new subspecies from Fukang is very similar to *N. iliensis* (Gr.-Gr.) in ♀ genitalia, of which the antrum in lateral view is very wide [markedly wider than in *N. zaisana* (Zhdanko)].
The author failed to collect any specimens of *N. iliensis* (Gr.-Gr.) from the Ili valley, thus an accurate comparison between the new subspecies and the nominotypical subspecies is not possible now.

***Neolycaena* (*Rhymnaria*) *iliensis iliensis* (Grum-Grshimailo, 1891)**

Lycaena tengstroemi iliensis (Grum-Grshimailo, 1891: 452 (TL: provincia Iliensis, ad Sujdun reperta; lectotype labeled from prov. Suidun Kuldja, Tshimpandzi - see fig. 50).
Thecla tengstroemi iliensis: Staudinger & Rebel (1901), 1901: 70.
Neolycaena iliensis: Lukhtanov, 1993: 64, farbtafel 2, abb. 1 for ♂ syntype; Lukhtanov & Lukhtanov, 1994: 227, part on Yili; Zhdanko, 1998: 652, lectotype designation, 643- fig. 8 for ♂ genitalia, 652- fig. 25 for ♀ genitalia; Zhdanko, 2000: 432, pl. 54, figs. 16-17 for lectotype & paralectotype, fig. 26-5 for ♂ genitalia, fig. 30-2 for ♀ genitalia; Weidenhoffer et al., 2004: 77, figs. for specimens from Dscharkent, ♂ and ♀ genitalia; Weidenhoffer et al., 2016: 88, figs. for ♂ lectotype and ♀ paralectotype; Tshikolovets et al., 2016: 134, pl. XIX, fig. 37 for ♂ from Kazakhstan.
Material. None.

***Neolycaena* (*Rhymnaria*) *iliensis l i u y e i* subspec. nov.** (figs. 7-8, 21, 33-37, 39-40)

Holotype ♂: China, Xinjiang Uygur Autonomous Region, Changji Hui Autonomous Prefecture, Fukang, Beishawo, 700 m, 1.VI.2007, Y. Liu leg., to be deposited in BSNU.
Paratypes: Xinjiang: 2 ♂♂, 1 ♀ (CHH), same data as holotype.
Etymology. This new subspecies is named in honor of Mr. Ye Liu, who collected the entire type series.
Diagnosis. This new subspecies can be distinguished from the nominotypical subspecies from Ili region by the following combination of characters.
1) Postdiscal markings on forewing underside in both sexes are absent or obsolete, not clearly defined as in nominotypical subspecies.
2) ♀ ciliae on both wings upper side are whitish at outer half, those on underside are entirely whitish, not dark or blackish as in nominotypical subspecies.
Remarks. The antrum of this new subspecies in dorsal or ventral view seems to have a larger length-width ratio than that of the nominotypical subspecies figured by Weidenhoffer et al. (2004, 2016). The detailed feature of the non-pigmented zone at apex of valvae and the details of the upper cornutus are unknown for the nominotypical subspecies, thus a comparison in these important characters is not made. The upper cornutus of this new subspecies (with dorsal view not figured) is the same as that of *N. zaisana* (Zhdanko) in all details (fig. 34).

***Neolycaena* (*Rhymnaria*) *neosinica* (Lee, 1963)** (figs. 7-10, 15, 17, 20, 32-36, 38-40, 46, 62-64)

Strymonidia neosinica Lee, 1963: 102 (TL: Shihezi), pl. 1 figs. 9-10 for ♂.
Neolycaena neosinica: Weidenhoffer et al., 2004: 79; Weidenhoffer et al., 2016: 92.
Neolycaena iliensis: Wu & Hsu, 2017: 1199, 1202- figs. 13 for ♀ from Jinghe. Misidentification

Material. 22 ♂♂, 4 ♀♀ (CHH), Shihezi, 640 m, 14 & 18.V.2022, H. Huang leg.; 33 ♂♂, 17 ♀♀ (CHH), W Jinghe, 900 m, 19.-20.V.2022, H. Huang leg.
Identification. Due to the poor original figure and the misleading simple description, this species was supposed by Weidenhoffer et al. (2004, 2016) as close to *N iliensis* (Gr.-Gr.) or even a synonym of the latter. The type specimens of this species were confirmed to be lost in Institute of Zoology, Chinese Academy of Science, Beijing when the author visited this museum in 2002. The photos of the holotype originally published are overexposed to lose all details, with all markings on hindwing underside not defined and with the grey ciliae (mentioned in the Chinese version of the original description) turned into white. It is worth noting that the photo of *Sinocupido lokiangensis* Lee, 1963 in the same paper is overexposed too, with all the distinct black spots invisible at all. Therefore, the underside pattern of *N. neosinica* (Lee) can not be read from the original figure.
The original description is composed of two versions: a detailed Chinese one, and a English one in summary. The English text is just an inaccurate translation of the Chinese text with some words missing or incorrectly translated. In Chinese text, only marginal markings on both wings underside are described to be thin and small, but in English text, it turns into "markings faint and minute" without a definition for marginal markings. The localities are stated as Shihezi and Wusu in Chinese text but simply as "Sinkiang" in English text. It is apparent that the Chinese text instead of the English text should be consulted for further researches.
The newly collected specimens from Shihezi, the TL, confirm that Lee (1963) is correct in considering this species as comparable with *N. tengstroemi* (Erschoff, 1874), not *N iliensis* (Gr.-Gr.). Some of these new specimens exactly match the original description and figures: the apical white suffusion on forewing upper side can be very distinct, in great contrast with the dark ground; hindwing underside is entirely covered by greenish grey scales [rather bluish in *N. iliensis* (Gr.-Gr.)]; marginal markings on both wings underside are thin and small.
As for the possible distribution of *N. iliensis* (Gr.-Gr.) on north of the Borohoro Mts., no population of *N. iliensis* (Gr.-Gr.) has been found from the areas near Shihezi by any Chinese collectors. The only known population of *N. iliensis* (Gr.-Gr.) from the northern areas of the Borohoro Mts. is *N. iliensis* ***liuyei*** **subspec. nov.**, of which the postdiscal markings on forewing underside are obsolete, not so distinct as shown in the original figure of *N. neosinica* (Lee).
Diagnosis. *N. neosinica* (Lee) is highly variable individually in wing characters. The wing-pattern in some specimens is very similar to that of *N. balchaschensis* Zhdanko, 1998, but the non-pigmented zone at apex of valva in lateral view is markedly wider than in *N. balchaschensis* Zhdanko. Some specimens are similar to those of *N. zaisana* Zhdanko, but with basal dusting on hindwing underside in greenish rather than bluish. The ♂ and ♀ genitalia are generally inseparable from those of *N. zaisana* Zhdanko, except for the thinner and sharper apex of the upper cornutus.
Biotope (figs. 62-64). The biotopes are restricted to dry valleys in piedmont belt on north of the Borohoro Mts.. This butterfly was found to be associated with *Caragana* shrubs (Fabaceae) at its biotope. The author failed to find any oviposition of the ♀ adult.

***Neolycaena* (*Rhymnaria*) *x i n g r u i i* spec. nov.** (figs. 7-10, 15, 20, 32-36, 38-40, 46, 65-67)

Holotype ♂: China, Xinjiang Uygur Autonomous Region, Wusu City, Gultu, semi-desert, 500 m, 18.V.2022, H. Huang leg., to be deposited in BSNU.

Paratypes: Xinjiang: 24 ♂♂, 6 ♀♀ (CHH), same data as holotype.

Etymology. This new species is named in honor of Mr. Rui Xing, Urumqi, who first discovered this new species and shared the information with the author.

Diagnosis. This new species is clearly derived from *N. neosinica* (Lee), but can be distinguished from the latter by the following combination of characters.

1) ♀ is frequently smaller.
2) Postdiscal white linear spots on both wings underside in both sexes are wider, in greater contrast with the dark ground, less black-shaded at inner side and frequently more continuous.
3) Combined length of antrum and ductus bursae (fig. 40) is generally no more than 1.55 mm, being smaller than that of *N. neosinica* (Lee) in high percentage. The apophyses posteriores is frequently shorter than that of *N. neosinica* (Lee).

Remarks. This new species is only statistically different from *N. neosinica* (Lee) in a high percentage. Two of the total 25 ♂♂ specimens (r67, r70) are indistinguishable from those of *N. neosinica* (Lee). One of the total 6 ♀♀ specimens (a18) is very similar to that of *N. neosinica* (Lee), but is distinguishable by the smaller ♀ genitalia.

However, this new species is supported by the following evidences in biotope and distribution, in addition to the highly statistical differences in morphology:

1) The biotope of this new species is a semi-desert on a plain associated with *Atraphaxis* shrubs (Polygonaceae) (figs. 66-67), whilst that of *N. neosinica* (Lee) is restricted to the wetter valleys associated with *Caragana* shrubs (Fabaceae). (figs. 62 & 64). The host plant of this new species is unknown, but definitely not *Caragana* shrubs as in *N. neosinica* (Lee).
2) The TL of this new species falls into the range of *N. neosinica* (Lee), being at the center between the two known localities of *N. neosinica* (Lee).

This new species might be just a semi-species under speciation. Nevertheless, the morphological difference between *N. xingruii* **spec. nov.** and *N. neosinica* (Lee) seems to be more evident than that between *N. musa* Zhdanko & Yakovlev and *N. enkhnasani* Churkin & Kolesnichenko.

Field observations (figs. 65-67). The biotope is a xerothermic semi-desert on a plain, associated with *Atraphaxis* shrubs (Polygonaceae) and sparse grassy plants. The *Neolycaena* butterflies were observed sucking nectar, perching on or hiding into the *Atraphaxis* shrubs. The author failed to find any oviposition of the ♀ adult. No *Caragana* shrubs (Fabaceae) was found at the biotope. The host plant might be some small grassy plants of Fabaceae overlooked by the author, but definitely not *Caragana* species. *Cigaritis epargyros* (Eversmann, 1854) [not found at any biotopes of *N. neosinica* (Lee)] was observed to fly together with this new species.

***Neolycaena* (*Rhymnaria*) *l i y i n g h u i i* spec. nov.** (figs. 9-12, 15, 21, 32-37, 39-40, 60-61)

Holotype ♂: China, Xinjiang Uygur Autonomous Region, Ili Kazak Autonomous Prefecture, Gongliu, 730 m, 8.V.2022, H. Huang leg., to be deposited in BSNU.

Paratypes: Xinjiang: 43 ♂♂, 14 ♀♀ (CHH), same locality as holotype, 3. & 8.V.2022, H. Huang leg.; 1 ♂ (CHH), Tekkes, 15.VII.2019, local collector, purchased by H.-Z. Li, ex coll. H.-Z. Li.

Etymology. This new species is named in honor of Mr. Ying-Hui Li, who accompanied the author during his 2022 expedition to Xinjiang.

Diagnosis. This new species could be closely related to *N. neosinica* (Lee) by a viewpoint of zoogeography and by the similarity in ♂ and ♀ genitalia; but this new species has a much more limited greenish grey dusting on hindwing underside. Moreover, the upper cornutus of *N. **liyinghuii*** **spec. nov.** is constantly longer and wider than that of *N. neosinica* (Lee) and *N. **xingruii*** **spec. nov.**.

In external features, this new species is more or less similar to the remotely distributed *N. carbonaria* (Grum-Grshimailo, 1890), *N. submontana* Zhdanko, 1994, *N. saurica* Zhdanko, 1998, *N. tengstroemi* (Erschoff, 1874), *N. iya* Zhdanko, 2000, *N. confusa* Churkin, 2006, *N. baitenovi* Zhdanko, 2012, *N. halimodendroni* Zhdanko, 2013, *N. chuilensis* Zhdanko, 2014 and *N. urru* Zhdanko, 2005. The following statements will help in distinguishing this new species from all these old taxa.

Neolycaena carbonaria (Gr.-Gr. has no extensive greenish grey dusting on hindwing underside. It is restricted to a few localities in the remote Tajikistan and Uzbekistan. A detailed comparison in ♂ and ♀ genitalia is not possible as some important characters have not been investigated for this species.

Neolycaena submontana Zhdanko has a much weaker and narrower greenish dusting on hindwing underside than *N. **liyinghuii*** **spec. nov.**, and has a much wider antrum in lateral view than *N. **liyinghuii*** **spec. nov.**.

Neolycaena saurica Zhdanko has forewing postdiscal markings much closer to apex of forewing than *N. **liyinghuii*** **spec. nov.**, and has a much deeper and larger signum on corpus bursae in ♀ genitalia.

Neolycaena tengstroemi (Erschoff) has no apparent greenish dusting on hindwing underside, and has a row of more distal postdiscal markings on forewing underside than *N. **liyinghuii*** **spec. nov.**.

Neolycaena iya Zhdanko, *N. confusa* Churkin and *N. halimodendroni* Zhdanko all have a weaker greenish dusting on hindwing underside and a row of more distal postdiscal markings on forewing underside than *N. **liyinghuii*** **spec. nov.**.

Neolycaena baitenovi Zhdanko has a much narrower distal end of antrum in ♀ genitalia than *N. **liyinghuii*** **spec. nov.**.

Neolycaena chuilensis Zhdanko has a more continuous postdiscal row of markings on hindwing underside and a markedly narrower conjunction between antrum and ductus bursae than *N. **liyinghuii*** **spec. nov.**.

Neolycaena urru Zhdanko has a weaker dusting in bluish rather than greenish on hindwing underside and a row of more distal postdiscal spots on forewing underside than *N. **liyinghuii*** **spec. nov.**.

It is noteworthy that all the above-mentioned old species have not been fully studied in literature, with most of the important genitalic characters overlooked by their authors. The independence of some old taxa are based upon insufficient sampling in genitalia or solely on foodplant. A thorough revision is still wanting.

Remarks. As the species diversity of the *N. tengstroemi* (Erschoff) group is apparently caused by the allopatric speciation. The most closely related species of *N. **liyinghuii*** **spec. nov.** could be the two closely distributed species: *N. neosinica* (Lee) in the north and *N. submontana* Zhdanko in the west. As stated in above discussion, *N. **liyinghuii*** **spec. nov.** is strikingly different from *N. neosinica*

(Lee) by having a much wider and longer upper cornutus, and is different from *N. submontana* Zhdanko by having a much narrower antrum in lateral view. Therefore, the independence of *N. **liyinghuii*** **spec. nov.** can be stably established.

Field observations (figs. 60-61). The biotope is a dry valley in piedmont belt on north of the Ketmen Mts.. The butterflies were found flying or perching on the *Atraphaxis* shrubs (Polygonaceae). No *Caragana* shrubs (Fabaceae) were found at the biotope. The author failed to observe any oviposition of the ♀ adult.

***Neolycaena* (*Rhymnaria*) *rhymnus rhymnus* (Eversmann, 1832)** (figs. 13-14, 16, 21, 46-48, 75)

Lycaena rhymnus Eversmann, 1832: 350 (TL: originally as "montosis Obtschei-Syrt"; clarified as "Russia, Samara Region, Sergievsk" by lectotype designation), Tab.XIX, figs. 1-2.

Neolycaena rhymnus: Zhdanko, 1983: 150, lectotype designation; Lukhtanov, 1993, 62, Farbtafel II, abb. 4 for paralectotype; Lukhtanov & Lukhtanov, 1994: 225, Taf. 43, Fig. 4, Karte 270; Zhdanko, 1998: 644, fig. 15a for ♂ valva, fig. 16 for ♀ genitalia; Zhdanko, 2000: 109, pl. 54, figs. 1-6 for habitus, fig. 26-1 for ♂ genitalia, fig. 27-1 for ♀ genitalia; R.-X. Huang et al., 2000: 61, first record for China from Altai Mts., pl. 38, fig. 7 for ♂ and ♀; Wu & Hsu, 2017: 1200, 1202- figs. 14 for ♂ from Habahe, Xinjiang.

Neolycaena rhymnus rhymnus: Weidenhoffer et al. 2004: 68, figs. for habitus, ♂ and ♀ genitalia; Tshikolovets et al., 2016: 129, pl. XIX, figs. 1-4, 6 & 12 for specimens from Kazakhstan, fig. 5 for lectotype; Weidenhoffer et al., 2016: 70.

Neolycaena rhymnus glaurung Korb, 2003: 47 (TL: Russia, region Nizhnyi Novgorod, Bor, Oktyabrskyi); Weidenhoffer et al., 2016: 70, synonymy for *N. rhymnus* (Eversmann, 1832). Synonymised by Weidenhoffer et al. (2016)

Material. 32 m, 24 f (CHH), Jimunai, 800m, 7.VI.2022, H. Huang leg.

Remarks. The individual variations in anal tuft of ♀ abdomen, ♂ and ♀ genitalia are investigated (figs. 47-48). Apical thorn of valva is weakly developed in all the Chinese specimens examined, not well developed as in the specimens from Kazakhstan (Weidenhoffer et al., 2004 & 2016).

This species was first recorded by R.-X. Huang et al. (2000) from Altai Mts. for Chinese fauna. Mr. J.-Q. Wang (personal communications, 2019) collected a series of specimens from Hemu village (48.58 N, 87.44 E), Kanas. The specimens from Altai Mts. do not differ from those from Jimunai and Habahe (very near Jimunai).

Tshikolovets et al. (2016) treated *N. rhymnus betpakdalensis* Zhdanko, 1998 (retained by Weidenhoffer et al. (2016) as good subspecies) as a synonym of *N. rhymnus rhymnus* (Eversmann).

***Neolycaena* (*Rhymnaria*) *rufina* Lukhtanov, 1994** (figs. 13-14, 16, 21, 46-48, 58-59)

Neolycaena rufina Lukhtanov, 1994: 200 (TL: Kazakhstan, Dshungarian Alatau, Katutau Mts., Koibyn Valley), Farbtafel VIIa, Abb. 1-4 for ♂ and ♀ paratypes; Zhdanko, 1998: 645, fig. 16 for ♀ genitalia; Weidenhoffer et al. 2004: 70, figs. for habitus, ♂ and ♀ genitalia; Weidenhoffer et al., 2016: 72.

Neolycaena rhymnus rufina: Tshikolovets et al., 2016: 130, pl. XIX, figs. 7-11 for specimens from Kazakhstan, fig. 9 for holotype.

Material. 5 ♂♂, 1 ♀ (CHH), N Alataw, 1480 m, 2.VI.2022, H. Huang leg.; 4 ♂♂ (CHH), Daxigou, Huocheng, Yili Prefecture, 1.VI.1998, C.-S. Zhang leg., ex coll. C.-S. Zhang.

Remarks. The independence of this species from *N. rhymnus* (Eversmann) needs a further research, as the ♂ and ♀ genitalia of both taxa seem not to be constantly different. The apical thorn of valva can be absent in *N. rufina* Lukhtanov (fig. 47- ♂ from Daxigou) and poorly developed in *N. rhymnus* (Eversmann). Some specimens of *N. rhymnus* (Eversmann) from Jimunai (fig. 14- a38 & a42) can be more or less dusted by pale scales in postdiscal area on hindwing underside, being hardly separable from some individuals of *N. rufina* Lukhtanov from N Alataw (fig. 14- n93). The whitish marginal linear markings on both wing underside can be individually variable in *N. rhymnus* (Eversmann) (fig. 14- n101).

***Neolycaena* (*Rhymnaria*) *davidi* (Oberthür, 1881)**

Six subspecies were recognized by Churkin (2004) from Mongolia and S Siberia beside the nominotypical subspecies, two of them were split into another species (*N. kozlovi* Zhdanko, 1994) by Krupitsky (2021) who added a further subspecies of *N. davidi* (Obth.) from S Tuva and NW Mongolia. However, an examination of a new material of *N. davidi davidi* (Obth.) reveals that most of the Mongolian subspecies are different from *N. davidi davidi* (Obth.) by having a clear ♂ brand formed by assembled androconia. On the other hand, *N. davidi davidi* (Obth.) is in common with *N. tangutica* (Grum-Grshimailo, 1891) by having only sparse androconia on forewing upper side; these two taxa are connected, both biogeographically and morphologically, by *N. davidi **wenhaoi*** **subspec. nov.** from N Shaanxi.

Churkin (2004) discussed the possibility that the Mongolian subspecies of *N. davidi* (Obth.) could be divided into two species on account of androconia, foodplant and some wing characters. The character of androconia is rather discrete between the two subspecies groups and is possibly important in taxonomy; this needs a further research in future. But the foodplant (the larvae of this group actually have flexible adaptability for foodplants as recorded in literature and observed by Dr. Sun on *N. davidi **wenhaoi*** **subspec. nov.**) and wing characters (highly variable individually) might be useless in specific classification of this group. On the other hand, Krupitsky (2021) revalidated *N. kozlovi* Zhdanko as full species; this viewpoint is supported by the morphology of ♂ genitalia (more specifically, the length of valvae).

Krupitsky (2021) went further to consider the population from Karlik Mts., E Xinjiang as another full species, *N. markhasiovi* Krupitsky, which was regarded by Weidenhoffer et al. (2016) just as a population of *N. davidis namkhaidorji* Churkin, 2004. *N. markhasiovi* Krupitsky is slightly distinguishable from *N. kozlovi namkhaidorji* Churkin by some wing characters and the differently colored anal tuft of ♀ abdomen, but its independence from *N. kozlovi* Zhdanko is not supported by any structural differences in androconia, ♂ and ♀ genitalia, counting the individual variations. Anal tuft of ♀ abdomen is not a good character for specific classification as observed in many species of the subgenus *Rhymnaria* Zhdanko. The color of the anal tuft is individually variable for a large extent even in single populations of many species (fig. 15); it is noteworthy that *N. davidi wenhaoi* **subspec. nov.** is strikingly different from *N. davidi davidi* (Obth.) by having a much paler anal tuft.

In short, two species are tentatively recognized in *N. davidi* (Obth.) group: 1) *N. davidi* (Obth.), characterized by the longer valvae, with *N. davidi dahurica* Churkin, 2004, *N. davidi goliath* Churkin, 2004, *N. davidi irkuta* Zhdanko, 1994, *N. davidi victoriae* Chur-

kin, 2004, *N. davidi tannuola* Krupitsky, 2021, *N. davidi tangutica* (Gr.-Gr.) and *N. davidi* ***wenhaoi*** **subspec. nov.** as subspecies; 2) *N. kozlovi* Zhdanko, 1994, characterized by the shorter valvae, with *N. kozlovi namkhaidorji* Churkin, 2004 and *N. kozlovi markhasiovi* Krupitsky, 2021 **stat. nov.** as subspecies.

***Neolycaena* (*Rhymnaria*) *davidi davidi* (Oberthür, 1881)** (figs. 11-12, 16-17, 22, 41-46, 76-78)

Lycaena tengstroemi var. *davidi* Oberthür, 1881: 13 (TL: "nord-est de la Chine, où M. l'abbé David l'a rencontrée près de la frontière"; deduced to be near Fengcheng in this work), pl. VIII, fig. 1 for ♀ syntype; Churkin, 2004: 155, interpretation of TL (situated between the southern half of Great Khingan and Mandschuria); Churkin in Weidenhoffer et al., 2004: 71, interpretation of TL (area southward from Kharbin in the eastern direction from Khingan Range); Churkin in Weidenhoffer et al., 2016: 73, interpretation of TL (NE Inner Mongolia, area south of the Great Khingan Range).

Thecla tengstroemi var. *davidi*: Leech, 1893: 368; Staudinger & Rebel, 1901: 70, catalogue.

Neolycaena davidi: Lukhtanov, 1993: 64; Zhdanko, 1998: 655, part on reference list; Wu & Hsu, 2017: 1199, part on record from Beijing, 1202 - figs. 12 for ♀ from Beijing.

Satyrium tengstoemi (sic!): Yang et al., 1994: 110-111, fig. 16 for ♀ from Beijing; Z.-C. Wang, 1999: 241, figs. for ♂ from Fengcheng, Dandong.

Neolycaena davidi davidi: Churkin, 2004: 195, notes on type series, cpl. X figs. 17-19 for ♀ holotype (actually syntype).

Material. 2 ♂♂, 1 ♀ (CHH), open grassland near village (fig. 76), Songshan, Yanqing, N Beijing, 500m, 2.VI.2007 & 12.VI.2010, M.-L. Bi leg.

TL. Churkin (2004 & 2016) interpreted the TL as from south of the Great Khingan Range in Inner Mongolia. Churkin (2004) published the photos of the only known syntype (this syntype was considered by Churkin (2004) as holotype as no other type specimens were traceable from NHML) and gave a discussion on the TL. As the TL was originally stated as from the NE Chinese frontier, Churkin (2004) at first discussed the possibility of the TL at the NE Chinese frontier and concluded that the TL is far from the Amur River and the territory of Korea. He tried to infer the TL from his knowledge on E Mongolia and considered the S Great Khingan Range in Inner Mongolia as the TL. However, the ♀ specimen from the area near the supposed TL (150 km NW Arxan), figured by Weidenhoffer et al. (2016) as *N. davidi davidi* (Obth.), does not match the ♀ syntype at all: the ground color of hindwing underside is paler greyish brown, not pure brown as in the syntype; the postdiscal white spots on hindwing underside are not inwardly black-shaded as in the syntype; the discocellular bar is clearly defined on forewing underside and markedly broader on hindwing underside than in the syntype; the inner row of the black submarginal spots are mostly rounded, not triangular as in the syntype.

However, the ♀ specimens (fig. 12- r114; Yang et al., 1994: 111- fig. 16) collected from N Beijing match the syntype nearly in all details. Thus Beijing is probably not far from the real TL. On the other hand, a little-known Chinese book published by Z.-C. Wang (1999) gave a clue that the TL might be at Fengcheng near China-Korean border (see fig. 51). This book is based upon a large collection made by many collectors from NE China, but only one ♂ (wrongly identified as ♀) of *N. davidi davidi* (Obth.) is figured under "*Satyrium tengstoemi* (sic!)" for the entire region, labeled from Fengcheng, Dandong (about 40.45 N, 124.06 E). This ♂ can not be distinguished from the ♂♂ from Beijing except for a more obscure discocellular bar on forewing underside; the unknown ♀ from the same locality could have a more reduced discocellular bar as in the syntype. As Fengcheng is very close to the China-Korean border, it is supposed to be close to the real TL.

Diagnosis. In wing characters, *N. davidi davidi* (Obth.) is characterized by a large size (smaller in *N. davidi dahurica* Churkin, *N. davidi tangutica* (Gr.-Gr.) and *N. davidi* ***wenhaoi*** **subspec. nov.**), a frequently linear white discal spot in space 6 on hindwing underside (always dotted in *N. davidi goliath* Churkin and *N. davidi* ***wenhaoi*** **subspec. nov.**), the broad black shades inside of the white postdiscal spots on hindwing underside (more or less narrower in other subspecies), a wide orange submarginal band on hindwing underside (narrower in *N. davidi tangutica* (Gr.-Gr.), *N. davidi goliath* Churkin and *N. davidi* ***wenhaoi*** **subspec. nov.**), and a double row of large black submarginal spots on hindwing underside (smaller in *N. davidi dahurica* Churkin).

For *N. davidi davidi* (Obth.), the androconia and the ♂ and ♀ genitalia are studied and figured for the first time in this work. Like in *N. davidi tangutica* (Gr.-Gr.), only a few small androconia are sparsely present at apex of cell on forewing upper side of ♂, not assembled into a distinct ♂ brand. The valvae are rather long as in *N. davidi dahurica* Churkin, with a very narrow non-pigmented zone at apex in ventral view. The shape of the non-pigmented zone at apex of valvae is not different from that of the other Chinese subspecies. The aedoeagus, the cornuti and the antrum are not markedly different from those of the other members of the group, only the apophyses posteriores is longer than that of *N. davidi tangutica* (Gr.-Gr.) and *N. kozlovi markhasiovi* Krupitsky. However, such a long apophyses posteriores is also found in *N. davidi* ***wenhaoi*** **subspec. nov.**.

Host plant. Mr. M.-L. Bi (personal communications, May 2023) recorded *Caragana rosea* Turcz. ex Maxim. (fig. 77) as foodplant and found some larvae (fig. 78) feeding on this plant.

***Neolycaena* (*Rhymnaria*) *davidi wenhaoi* subspec. nov.** (figs. 11-12, 16, 22, 41-46, 79-86)

Holotype ♂: China, Shaanxi Province, Yulin City, Qingjian County, Dianzegou Township, slopes of hills (fig. 79), 30.V.2014, W.-H. Sun leg., to be deposited in BSNU.

Paratypes: Shaanxi: 1 ♂, 1 ♀ (CHH), same locality as holotype, 29.V.2014, W.-H. Sun leg.; 1 ♂ (CMWW), same data as holotype; 7 ♂♂, 3 ♀♀ (CSWH), same locality as holotype, V.-VII.2014, W.-H. Sun leg.

Etymology. This new subspecies is named in honor of Dr. Wen-Hao Sun, who collected the entire type series.

Diagnosis. This new subspecies is close to *N. davidi davidi* (Obth.) by having no assembled androconia on forewing upper side of ♂.

It can be distinguished from the nominotypical subspecies by the following combination of characters.

1) Size is constantly smaller.
2) Submarginal orange band on hindwing underside is constantly narrower.
3) White postdiscal spot in space 6 on hindwing underside is frequently dotted, not so linear as in *N. davidi davidi* (Obth.).
4) White postdiscal spots in spaces 4-5 on hindwing underside are frequently (not always) more irregular in shape and closer to submarginal markings.

It can be distinguished from *N. davidi goliath* Churkin by having a constantly smaller size and more separated postdiscal spots in spaces 4-5 on hindwing underside.

It can be distinguished from *N. davidi dahurica* Churkin by having a narrower orange band and two rows of larger black spots on hindwing underside.

It can be distinguished from *N. davidi tangutica* (Gr.-Gr.) by having a browner upper side ground color, a thinner discocellular bar and the more black-shaded whitish postdiscal spots on hindwing underside.
It can be distinguished from other Mongolian subspecies simply by having no clear defined ♂ brand on forewing upper side.
Remarks. This new subspecies forms a transition from *N. davidi davidi* (Obth.) to *N. davidi tangutica* (Gr.-Gr.). For more discussion, see under *Neolycaena* (*Rhymnaria*) *davidi tangutica* (Gr.-Gr.).
Early stages. Dr. W.-H. Sun (personal communications, May 2023) recorded *Caragana korshinskii* Kom. (fig. 80) as foodplant and found some larvae (fig. 84) on this plant. He even used *Robinia pseudoacacia* L. to rear the larvae (fig. 85) successfully into adults. The ♀ lays egg just below the shoot bud on the branch of the foodplant (figs. 81-82). The egg is camouflaged by some hairs fallen from the anal tuft of the ♀ (fig. 83). The larvae are in common with those of *N. davidi davidi* (Obth.) recorded by Mr. M.-L. Bi from Beijing, with changeable ground color depending on foodplants. The pupa is greyish brown dotted by black (fig. 86).

***Neolycaena* (*Rhymnaria*) *davidi tangutica* (Grum-Grshimailo, 1891) stat. rev.** (figs. 11-12, 16, 22, 41-46)

Lycaena tengstroemi var. *tangutica* Grum-Grshimailo, 1891: 452 (TL: Dshachar, near the current Guide, Qinghai).
Neolycaena davidi tangutica: Lukhtanov, 1993: 65, abb. 10- D & E for ♂ genitalia taken from Xining specimen, farbtafel II, abb. 7 for ♂ from Xining; Zhdanko, 1998: 656, lectotype designation.
Neolycaena tangutica: Churkin, 2004: 197-200 & 205, notes on type material and TL, redescription, cpl. XI-XII, figs. 15-16 for paralectotypes, fig. 7-h for ♂ genitalia; Weidenhoffer et al., 2004: 73, figs. for specimens from Xiahe, ♂ and ♀ genitalia; Weidenhoffer et al., 2016: 75; Wu & Hsu, 2017: 1200, 1202- figs. 15 for ♂ from Xining, Qinghai; Krupitsky, 2021: 515, records for foodplants ("*Caragana tangutica* in Qinghai and *C. densa* in Gansu"), figs. for habitus, ♂ and ♀ genitalia.
Neolycaena tengstroemi: Cai, 2011: 263, figs. for ♂♂ from Xiaolongshan, Gansu; Mao, 2015: 189, figs. for ♀ from Diebu, Gansu. Misidentification.
Neolycaena davidi: Wu & Hsu, 2017: 1199, part, 1202- figs. 10-11 for ♂ and ♀ from Yongjing, Gansu.

Material. 2 ♂♂ (CHH), Yinshan, Xining, Qinghai, 29.V.2012 & 10.VI.2012, K. Song leg.; 1 ♂ (CHH), Xining, Qinghai, 9.VI.2021, ex. coll. W.-H. Sun; 1 ♂ (CHH), Ping'an, Qinghai, 2800-3000m, 11.VII.2017, P. Li leg.; 2 ♂♂ (CHH), Xiahe, Gansu, 3200 m, 23.VII.2015, H. Huang leg.; 1 ♂, 1 ♀ (CHH), Diebu, Gansu, 3.VII.2016, H. Huang leg.
Specific status. Churkin (2004) tentatively considered this taxon as independent from *N. davidi* (Obth.) by having "a very long and narrow distal part of valva, M-spots (in spaces 4-5 on hindwing underside) strongly displaced towards the antemarginal pattern and connected with the antemarginal spots". However, Churkin's (2004) temporary conclusion is based upon an insufficient sampling. Some specimens of *N. davidi tangutica* (Gr.-Gr.) have a shorter (fig. 41- r202 & r206) or wider (fig. 41- r201) distal part of valva than in *N. davidi davidi* (Obth.). In a few specimens from Xining and Diebu (fig. 12- r202 & r208), the postdiscal spots in spaces 4-5 on hindwing underside (M-spots, sensu Churkin, 2004) can be widely separated from submarginal markings as in *N. davidi davidi* (Obth.). Churkin in Weidenhoffer et al. (2004, 2016) pointed out another important character that "unh postdiscal spots linear and thick without traces of black shades". However, the black shades of the postdiscal spots can be present in a few specimens of *N. davidi tangutica* (Gr.-Gr.) (fig. 12- r201 & r203). The white postdiscal spots of *N. davidi tangutica* (Gr.-Gr.) are generally wider and more irregular than in *N. davidi davidi* (Obth.), but *N. davidi* ***wenhaoi*** **subspec. nov.** from N Shaanxi is transitional in this character between the former two subspecies.
Neolycaena davidi ***wenhaoi*** **subspec. nov.** is in common with *N. davidi davidi* (Obth.) by having a brown ground color on both wings upper side, a narrow V-shaped discocellular bar on hindwing underside, the frequently well-developed black shades of the postdiscal spots on hindwing underside and a long apophyses posteriores; it is in common with *N. davidi tangutica* (Gr.-Gr.) by having a small size of wings, the wide and irregular postdiscal spots in spaces 4-5 on hindwing underside which are frequently very close to submarginal markings. Considering that all these three taxa have a pure brown ground color on both wings underside without any pale suffusion and have no constant difference in ♂ brand and both ♂ and ♀ genitalia (except for the length of apophyses posteriores), it is at best to unite all of them into a single species.

***Neolycaena* (*Rhymnaria*) *kozlovi markhasiovi* Krupitsky, 2021 stat. nov.** (figs. 11-12, 16-17, 22, 41-46)

Neolycaena davidi namkhaidorji: Weidenhoffer et al., 2016: 74, part on fig. of ♀ from Yiwu.
Neolycaena markhasiovi Krupitsky, 2021: 508 (TL: 53rd km of S303 Road, Barkol Range S slope, Karlik Mts., Xinjiang), figs. for habitus, ♂ brand, ♀ anal tuft, ♂ and ♀ genitalia, 512, record of most probable foodplant ("*Caragana leucophlaea*").

Material. 8 ♂♂, 13 ♀♀ (CHH), W of Yiwu, on plain, 1993 m, 6.VII.2022, H. Huang leg.; 2 ♂♂, 5 ♀♀ (CHH), SW of Yiwu, on pathway to glacier through piedmont, 2200 m, 7.VII.2022, H. Huang leg.; 4 ♂♂, 4 ♀♀ (CHH), N of Barkol, at entrance of the piedmont, 2000 m, 9.VII.2022, H. Huang leg.
Individual variations. Due to the late collecting times, most of the type specimens and the newly collected specimens are worn-out. However, a fresh ♀ (fig. 12- r107) closely resembles that of *N. kozlovi kozlovi* Zhdanko figured by Krupitsky (2021: 505- fig. 2) in having a pale green-brown ground color and the black-shaded postdiscal spots on hindwing underside. The size of the ♂ brand is individually variable just as in other species of *Neolycaena* De Niceville observed in this work: one of the ♂♂ from N Barkol (fig. 22- r101) has a thin brand as in the specimens of *N. kozlovi kozlovi* Zhdanko and *N. kozlovi namkhaidorji* Churkin figured by Krupitsky (2021: 507- figs. 16-17). The ♀ anal tuft is also individually variable for a considerable extent: Specimen r107 (fig. 16) has anal tuft much darker than Specimen r119 (fig. 16). The shape and the length of the valvae are variable as figured: Specimen r103 (fig. 41) has the apex of the valva rounded as in *N. kozlovi namkhaidorji* Churkin. The antrum is considerably variable: that of Specimen r107 is abruptly expanded caudally with a concaved lateral margin; that of Specimen r108 is less expanded caudally with a convex lateral margin, matching that of *N. kozlovi kozlovi* Zhdanko figured by Krupitsky (2021: 511- fig. 36). It is certain that if more specimens of *N. kozlovi kozlovi* Zhdanko are examined, there will be no reliable genitalic difference found between these taxa.

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Fig. 1: Habitus of *Neolycaena langi* Huang, 2019 and *Neolycaena sinensis* (Alphéraky, 1881) under same scale: upperside (scale bar = 1 cm; LF = length of forewing).

Fig. 2: Habitus of *Neolycaena langi* Huang, 2019 and *Neolycaena sinensis* (Alphéraky, 1881) under same scale: underside (scale bar = 1 cm).

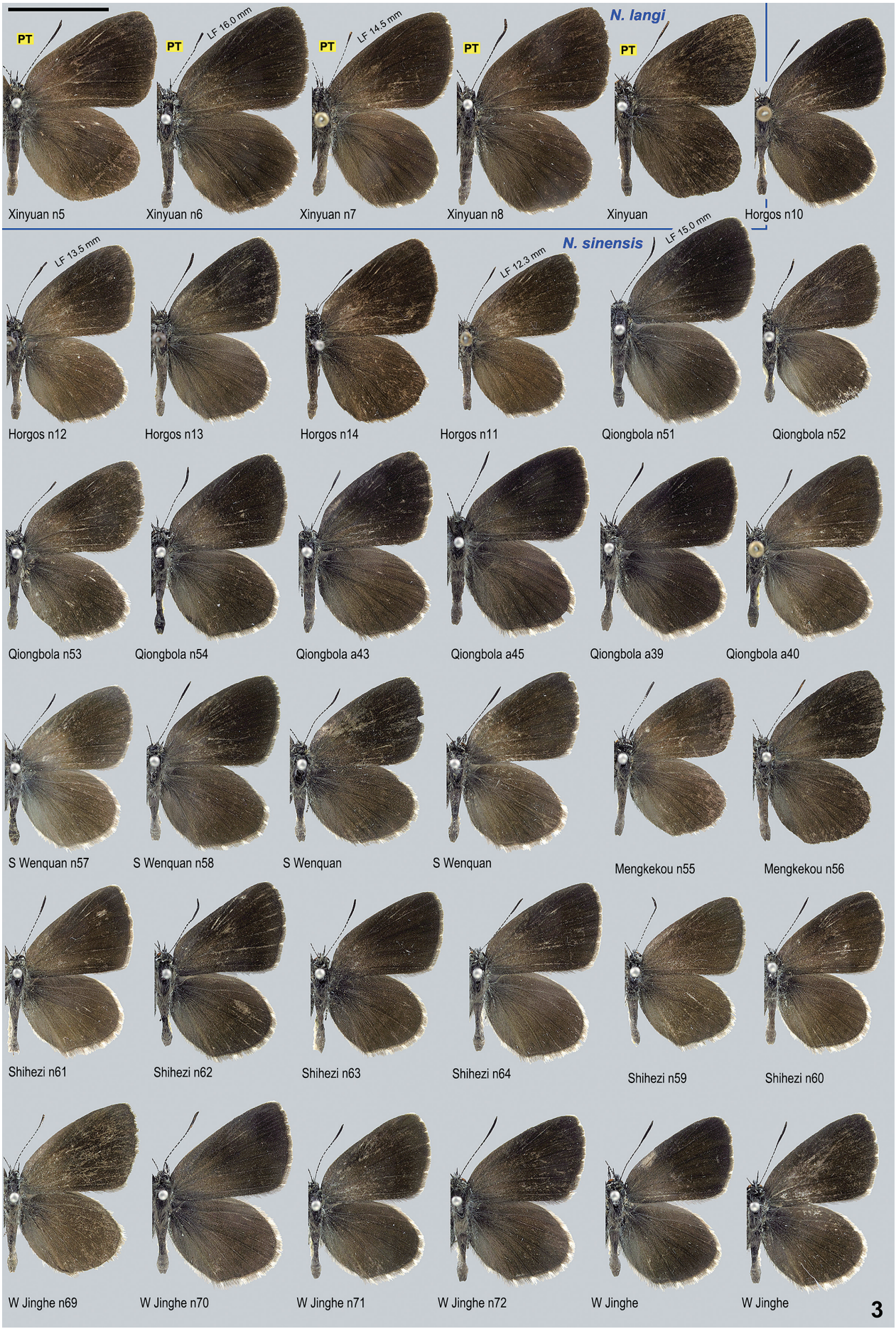


Fig. 3: Habitus of *Neolycaena langi* Huang, 2019 and *Neolycaena sinensis* (Alphéraky, 1881) under same scale: upperside (scale bar = 1 cm; LF = length of forewing).

Fig. 4: Habitus of *Neolycaena langi* Huang, 2019 and *Neolycaena sinensis* (Alphéraky, 1881) under same scale: underside (scale bar = 1 cm).

Fig. 5: Habitus of *Neolycaena eckweileri* Lukhtanov, 1993, *Neolycaena chimaera* Churkin, 2004, *Neolycaena enkhnasani* Churkin & Kolesnichenko, 2019 and *Neolycaena zaisana* (Zhdanko, 2013) under same scale: upperside (scale bar = 1 cm; LF = length of forewing).

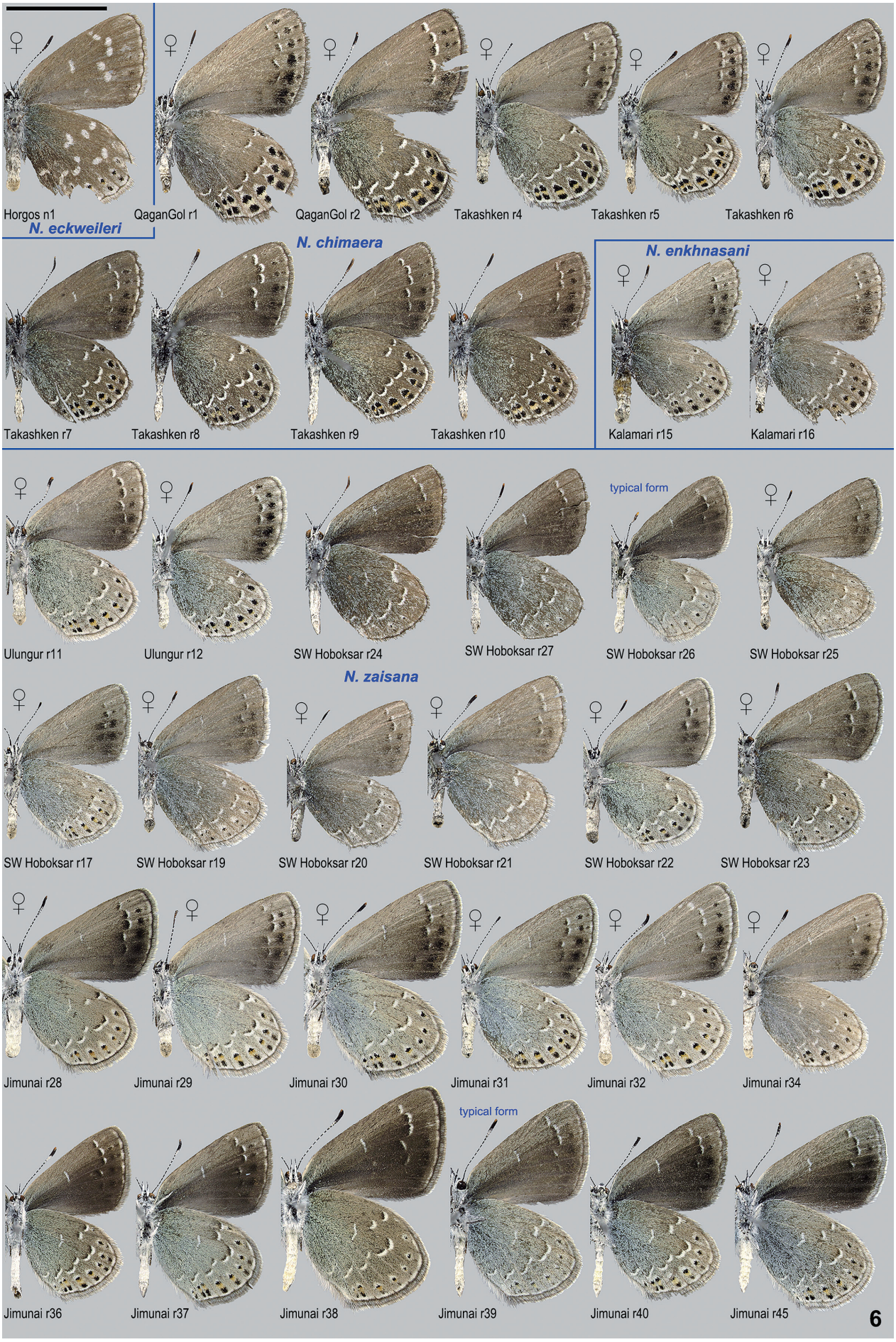


Fig. 6: Habitus of *Neolycaena eckweileri* Lukhtanov, 1993, *N. chimaera* Churkin, 2004, *N. enkhnasani* Churkin & Kolesnichenko, 2019 and *N. zaisana* (Zhdanko, 2013) under same scale: underside (scale bar = 1 cm).

Fig. 7: Habitus of *Neolycaena zaisana* (Zhdanko, 2013), *N. iliensis* ***liuyei*** **subspec. nov.**, *N.* ***xingruii*** **spec. nov.** and *N. neosinica* (Lee, 1963) under same scale: upperside (scale bar = 1 cm; LF = length of forewing).

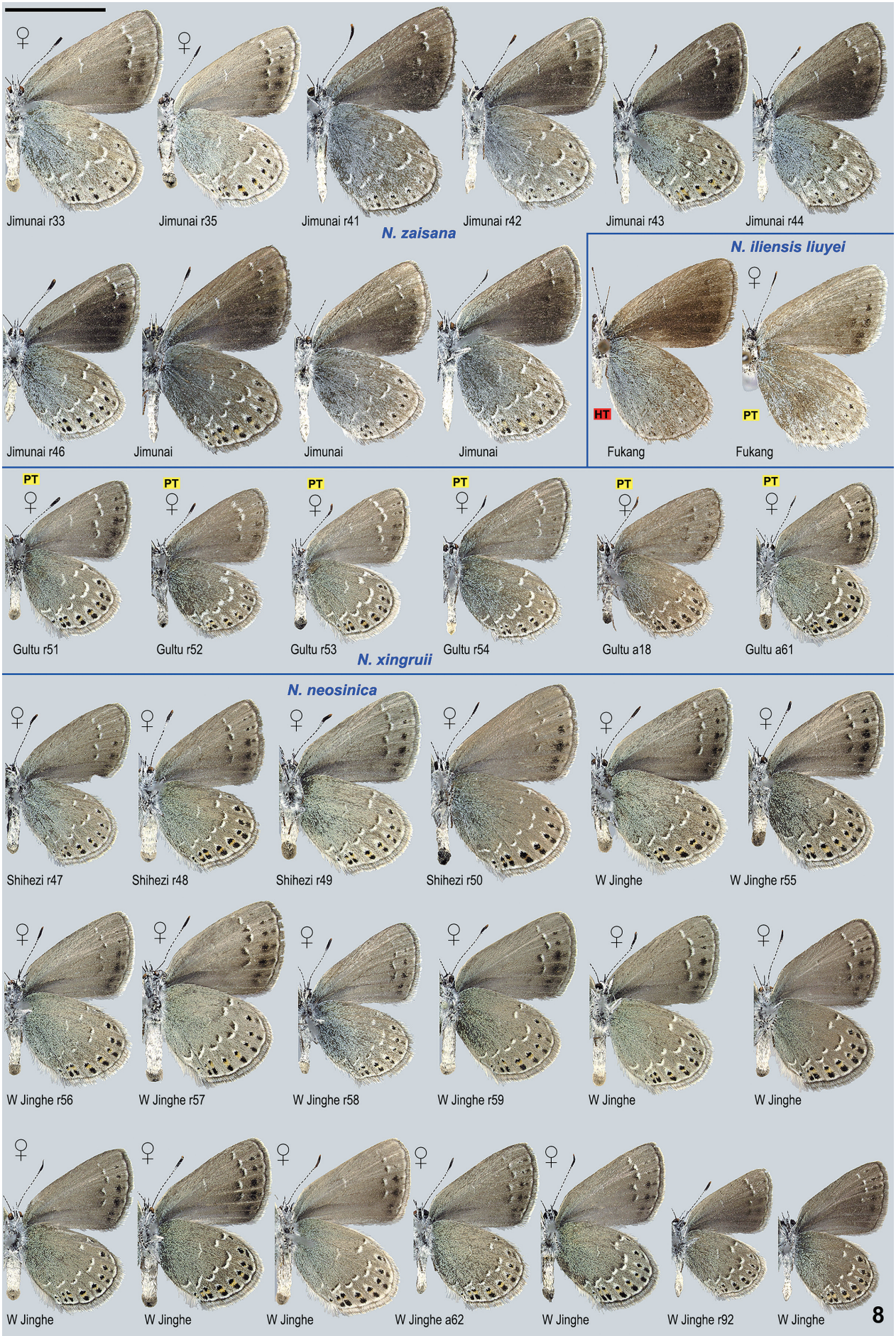


Fig. 8: Habitus of *Neolycaena zaisana* (Zhdanko, 2013), *N. iliensis* ***liuyei*** **subspec. nov.**, *N.* ***xingruii*** **spec. nov.** and *N. neosinica* (Lee, 1963) under same scale: underside (scale bar = 1 cm).

Fig. 9: Habitus of *Neolycaena* ***xingruii*** **spec. nov.**, *N. neosinica* (Lee, 1963) and *N.* ***liyinghuii*** **spec. nov.** under same scale: upperside (scale bar = 1 cm; LF = length of forewing).

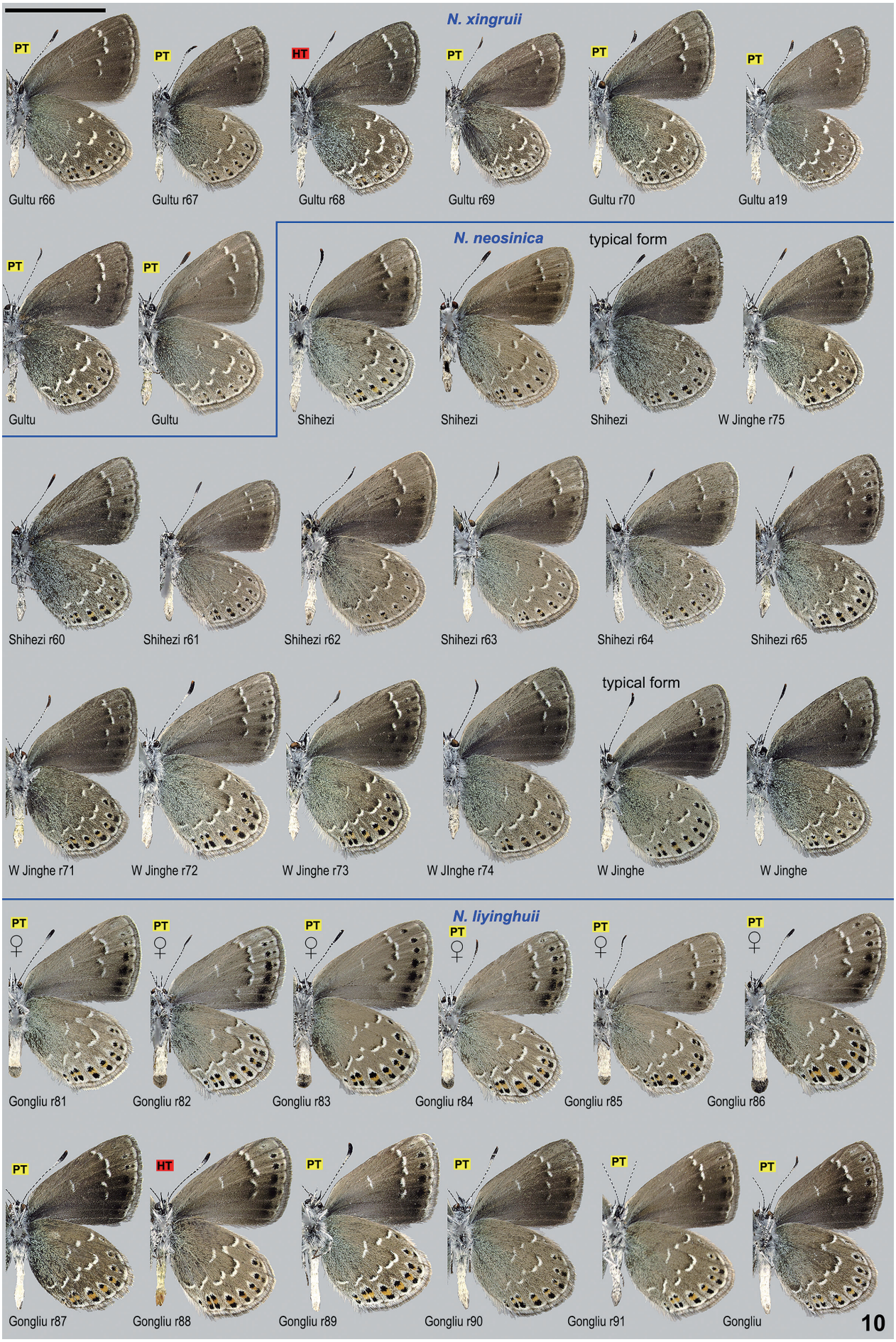


Fig. 10: Habitus of *Neolycaena* ***xingruii*** **spec. nov.**, *N. neosinica* (Lee, 1963) and *N.* ***liyinghuii*** **spec. nov.** under same scale: underside (scale bar = 1 cm).

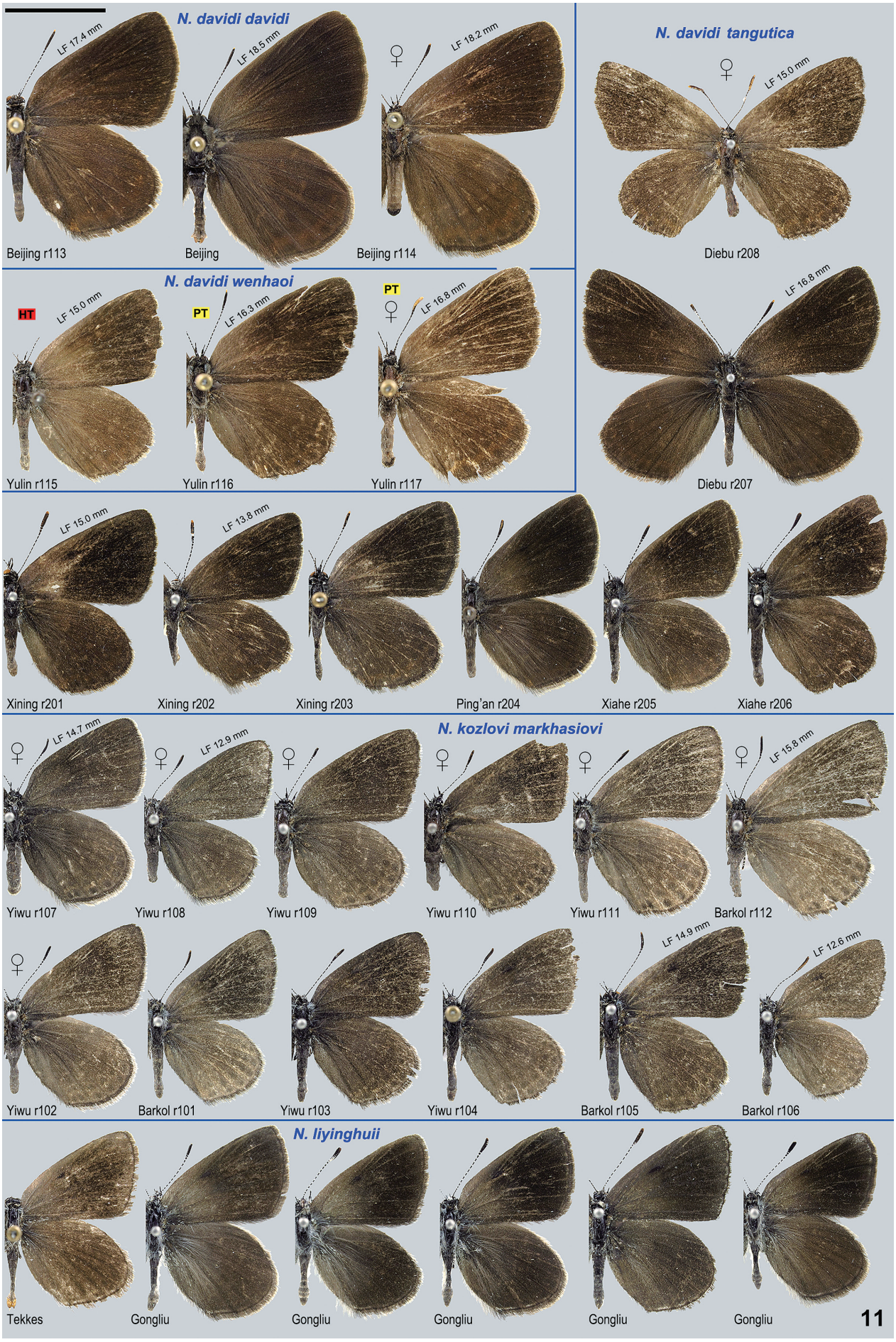


Fig. 11: Habitus of *Neolycaena davidi davidi* (Oberthür, 1881), *N. davidi tangutica* (Grum-Grshimailo, 1891), *N. davidi* ***wenhaoi*** **subspec. nov.**, *N. kozlovi markhasiovi* Krupitsky, 2021 and *N.* ***liyinghuii*** **spec. nov.** under same scale: upperside (scale bar = 1 cm; LF = length of forewing).

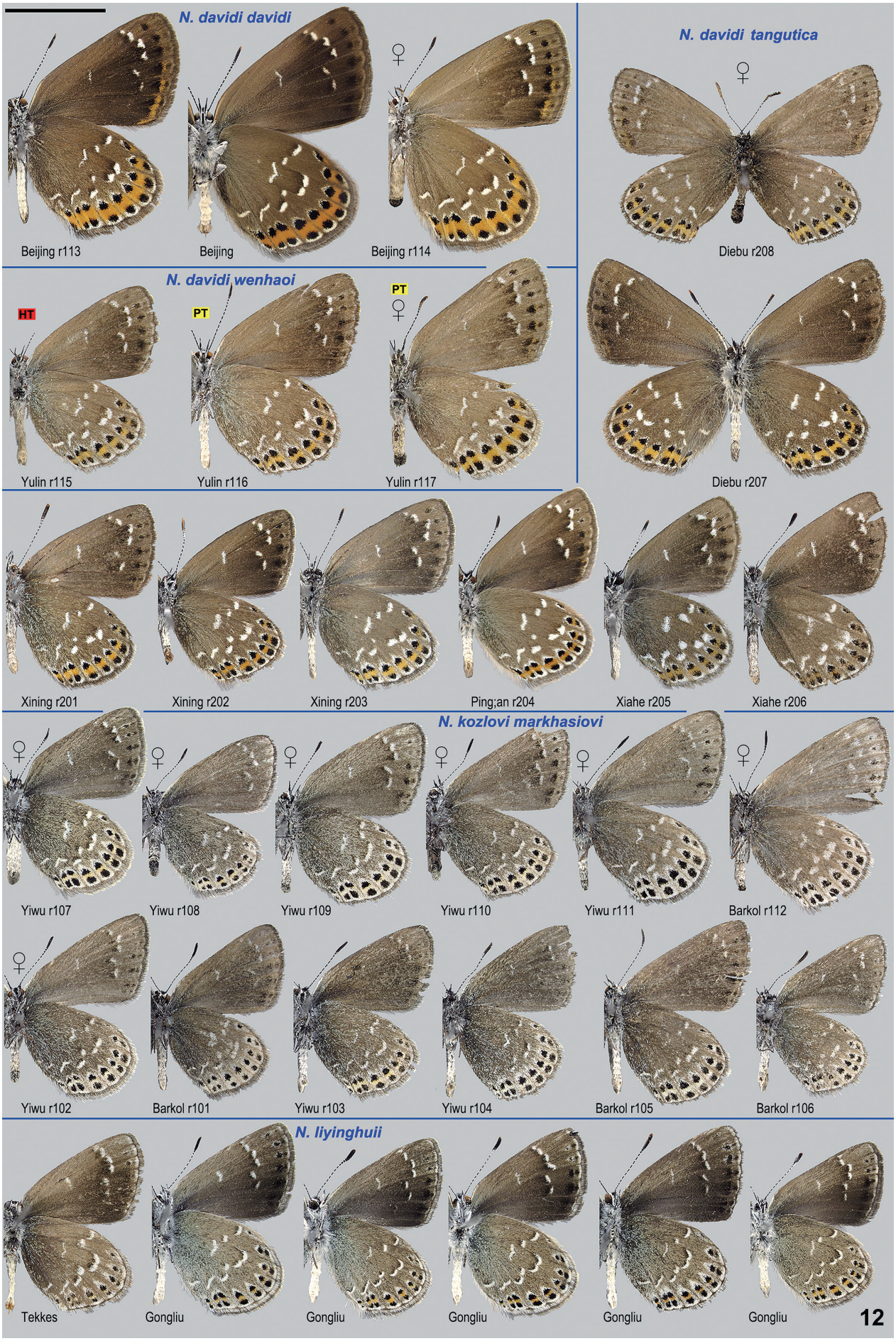


Fig. 12: Habitus of *Neolycaena davidi davidi* (Oberthür, 1881), *N. davidi tangutica* (Grum-Grshimailo, 1891), *N. davidi* ***wenhaoi*** **subspec. nov.**, *N. kozlovi markhasiovi* Krupitsky, 2021 and *N.* ***liyinghuii*** **spec. nov.** under same scale: underside (scale bar = 1 cm).

Fig. 13: Habitus of *Neolycaena rhymnus rhymnus* (Eversmann, 1832) and *N. rufina* Lukhtanov, 1994: upperside (scale bar = 1 cm; LF = length of forewing)
Fig. 14: Habitus of *N. rhymnus rhymnus* (Eversmann, 1832) and *N. rufina* Lukhtanov, 1994: underside

Fig. 15: Anal tuft of ♀ abdomen in ventroposterior and lateral views. Scale bar = 1 mm.

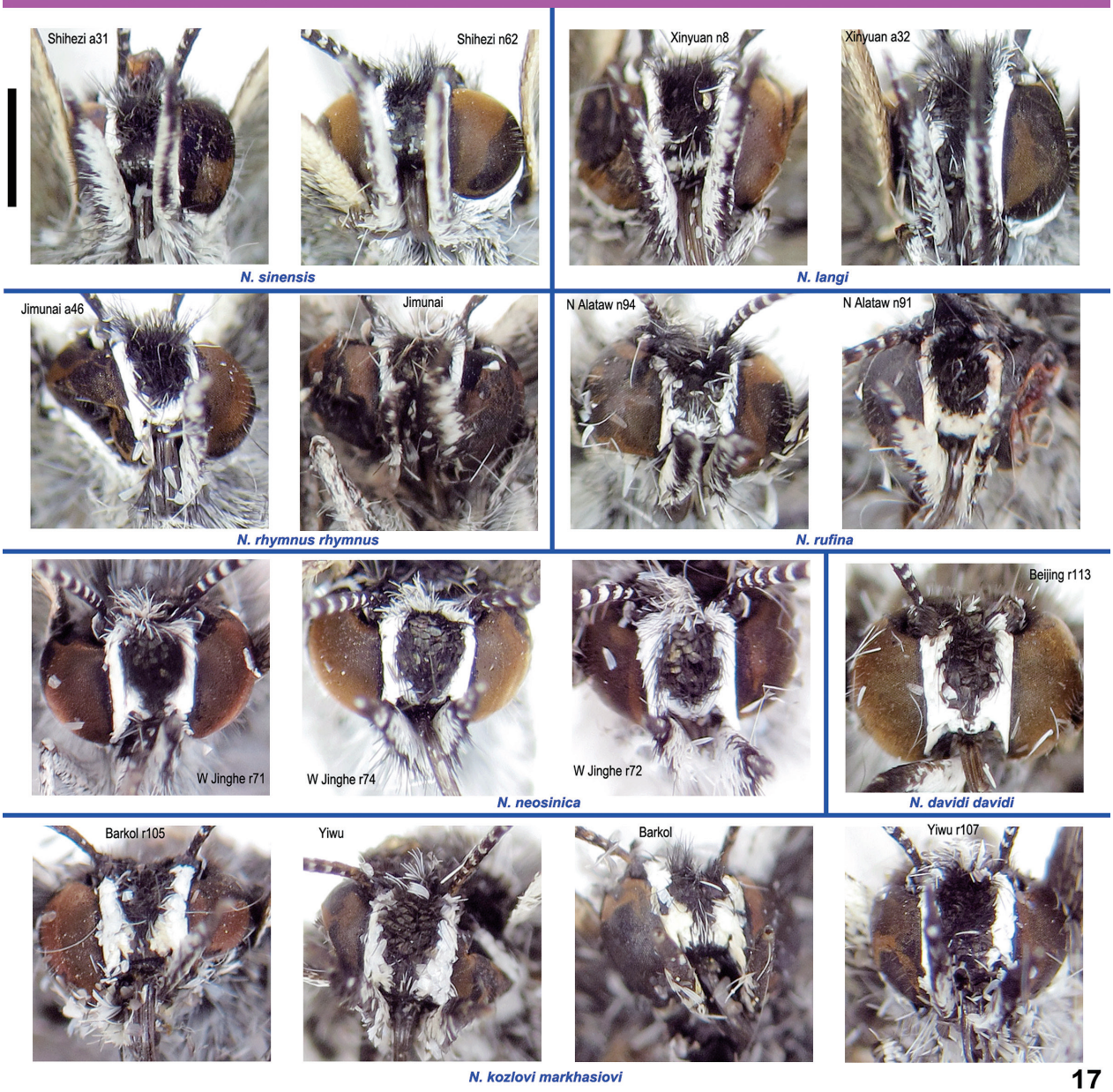


Fig. 16: Anal tuft of ♀ abdomen in ventroposterior and lateral views. Scale bar = 1 mm.
Fig. 17: Heads in anterior or ventroanterior view. Scale bar = 1mm.

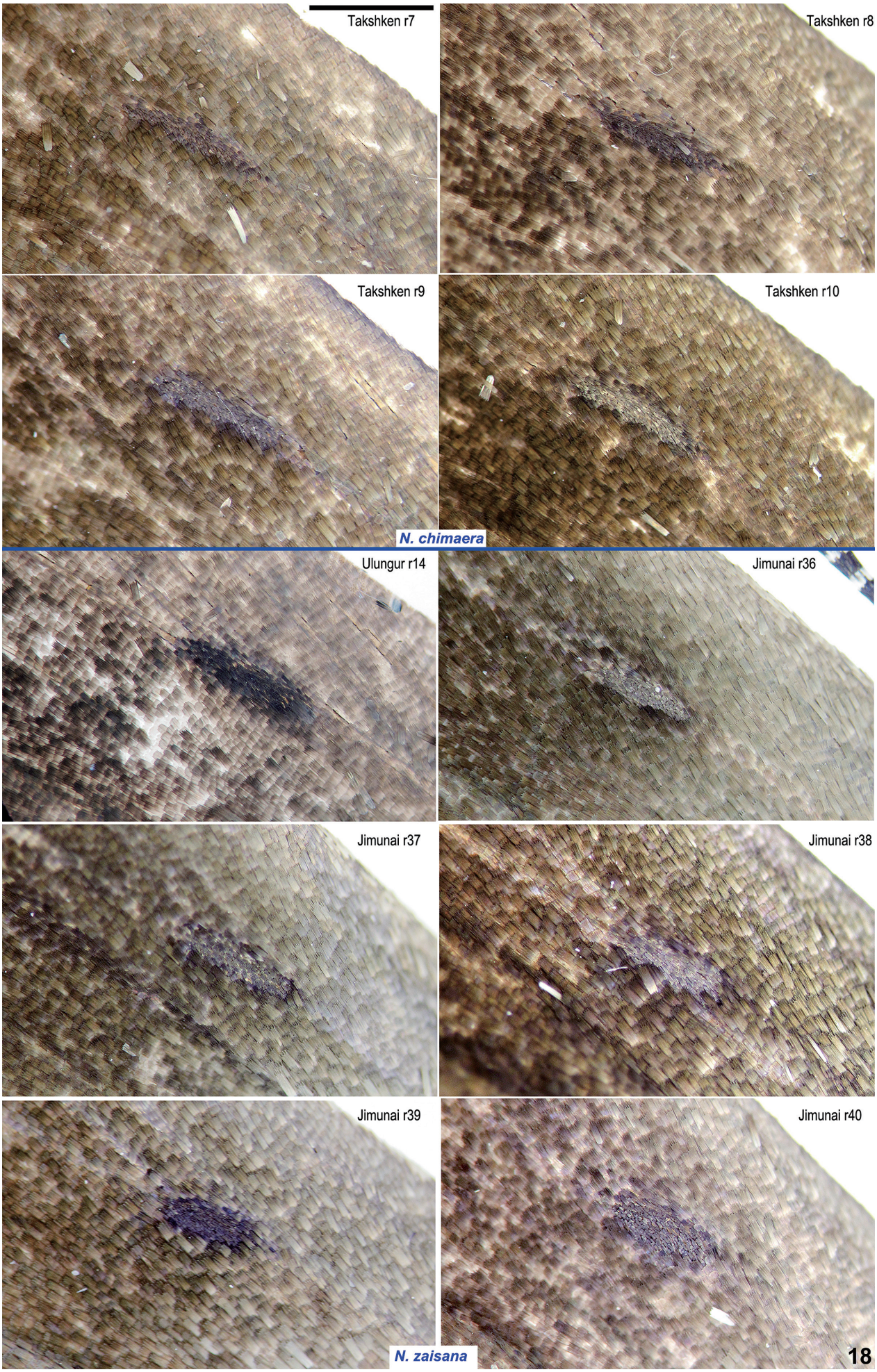


Fig. 18: ♂ brands of *Neolycaena chimaera* Churkin, 2004 and *N. zaisana* (Zhdanko, 2013). Scale bar = 1 mm.

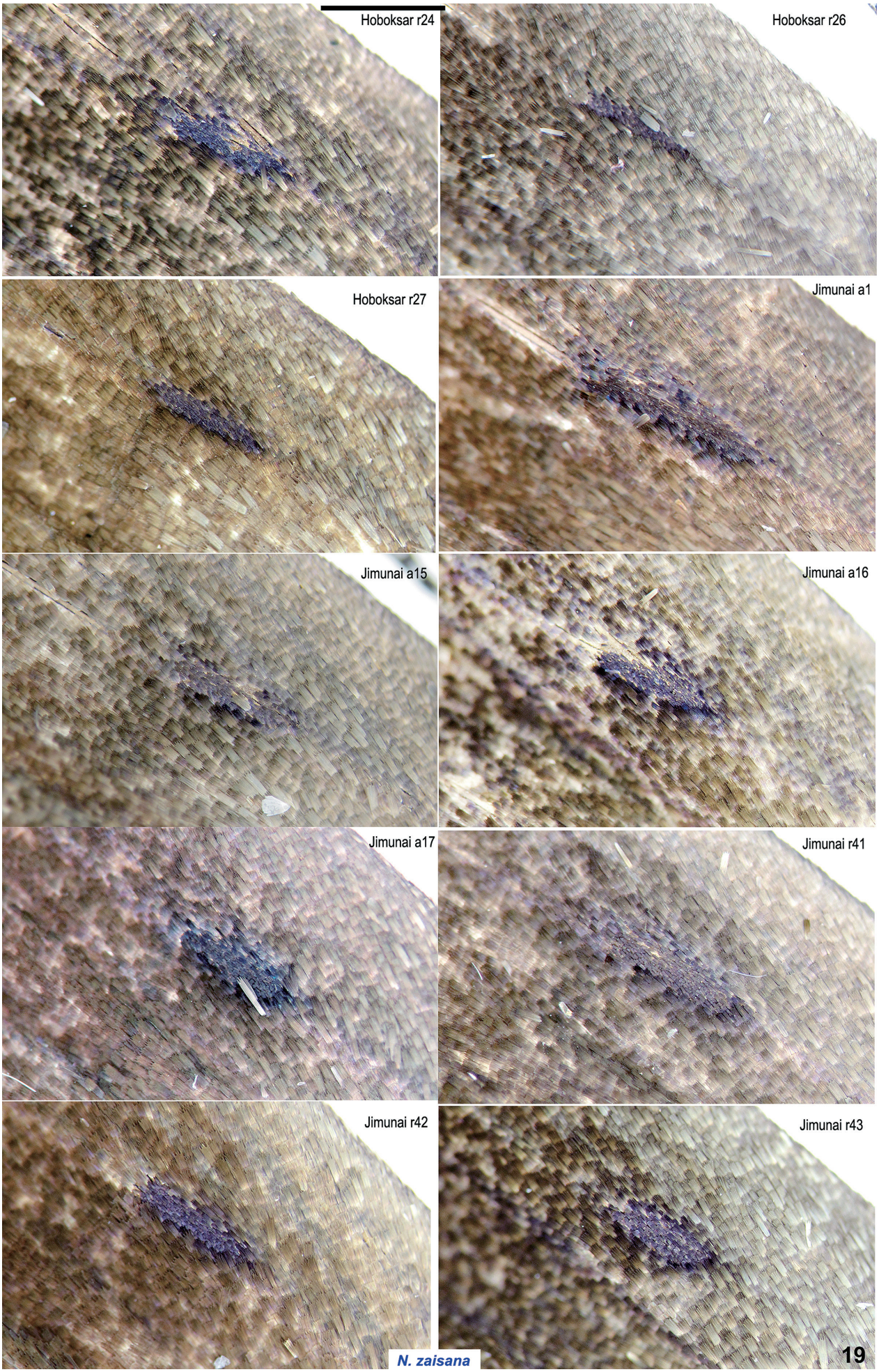


Fig. 19: ♂ brands of *Neolycaena zaisana* (Zhdanko, 2013). Scale bar = 1 mm.

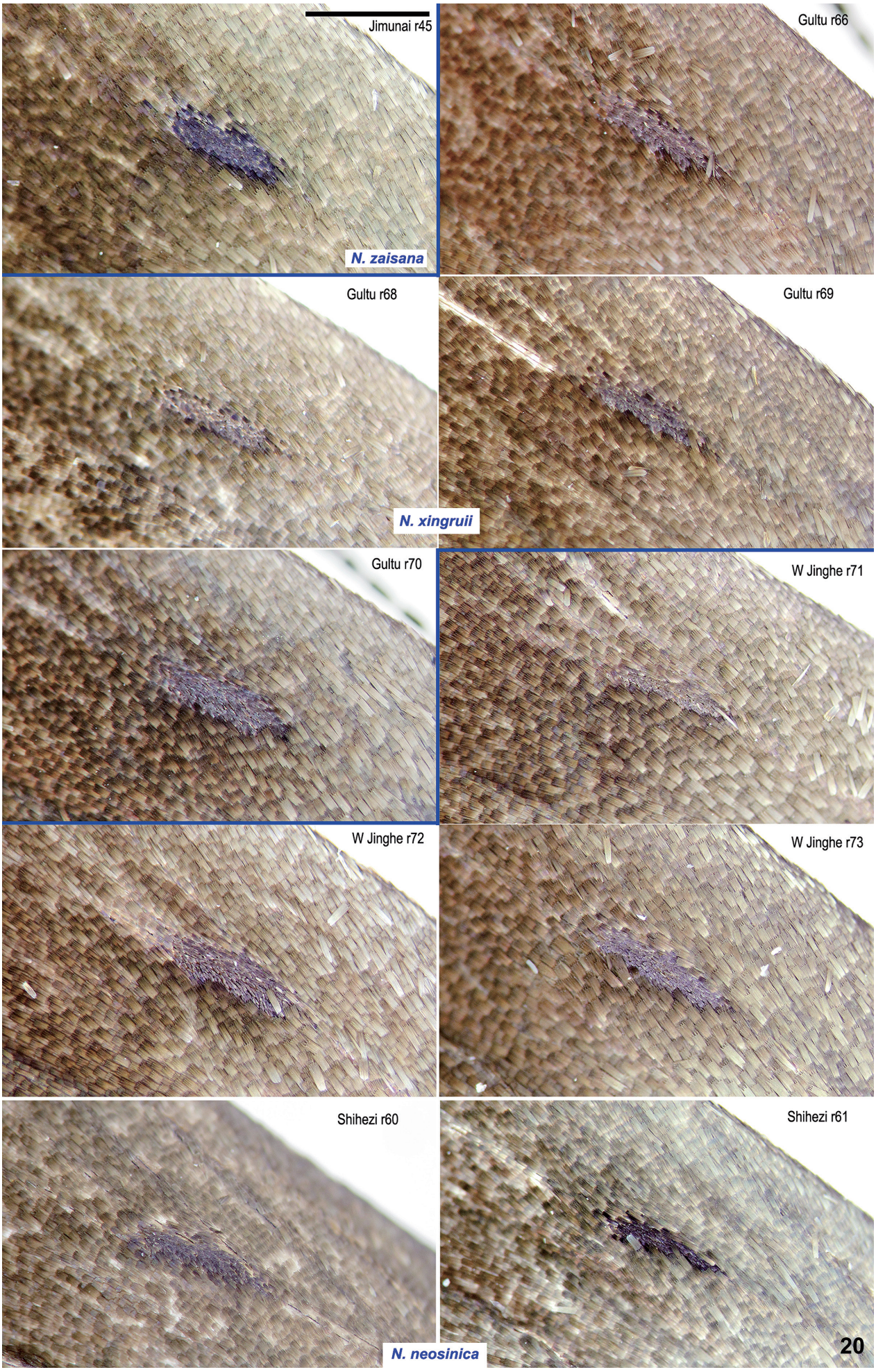


Fig. 20: ♂ brands of *Neolycaena zaisana* (Zhdanko, 2013), *N.* ***xingruii*** **spec. nov.** and *N. neosinica* (Lee, 1963). Scale bar = 1 mm.

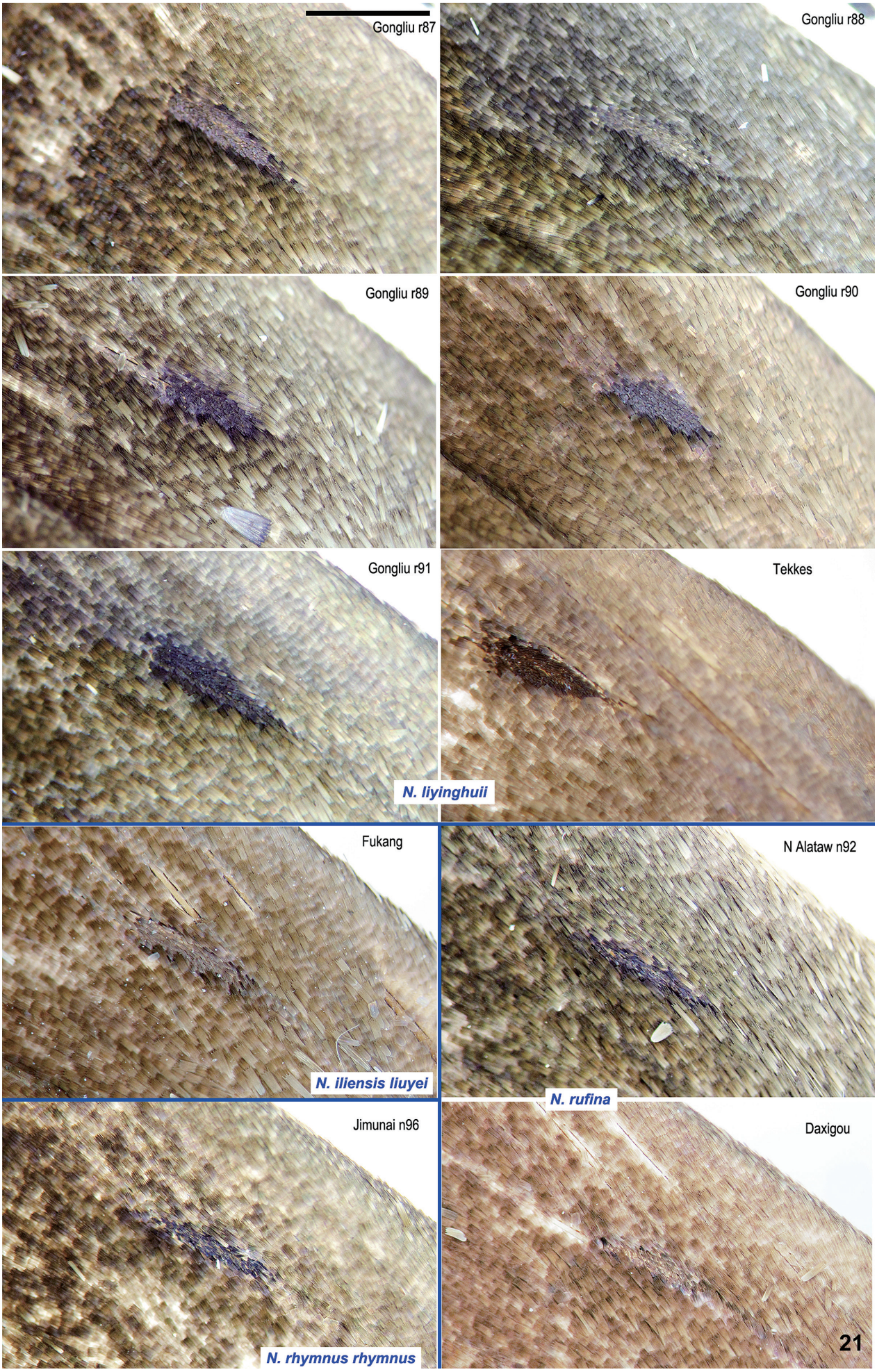


Fig. 21: ♂ brands of *N. liyinghuii* HUANG **spec. nov.**, *N. iliensis* ***liuyei*** **subspec. nov.**, *N. rhymnus rhymnus* (EVERSMANN, 1832) and *N. rufina* LUKHTANOV, 1994. Scale bar = 1 mm.

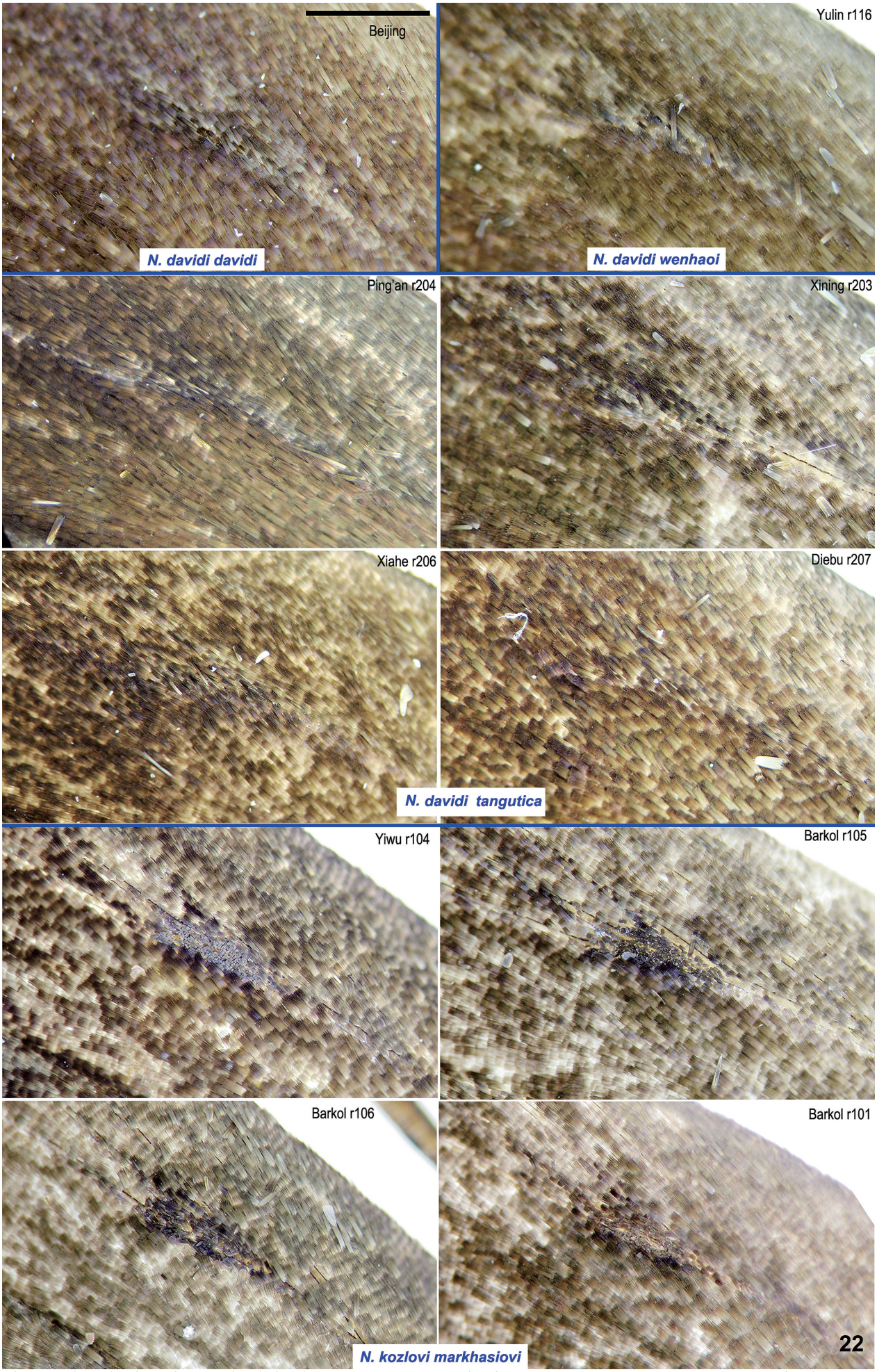


Fig. 22: ♂ brands of *Neolycaena davidi davidi* (Oberthür, 1881), *N. davidi tangutica* (Grum-Grshimailo, 1891), *N. davidi* ***wenhaoi*** **subspec. nov.** and *N. kozlovi markhasiovi* Krupitsky, 2021. Scale bar = 1 mm.

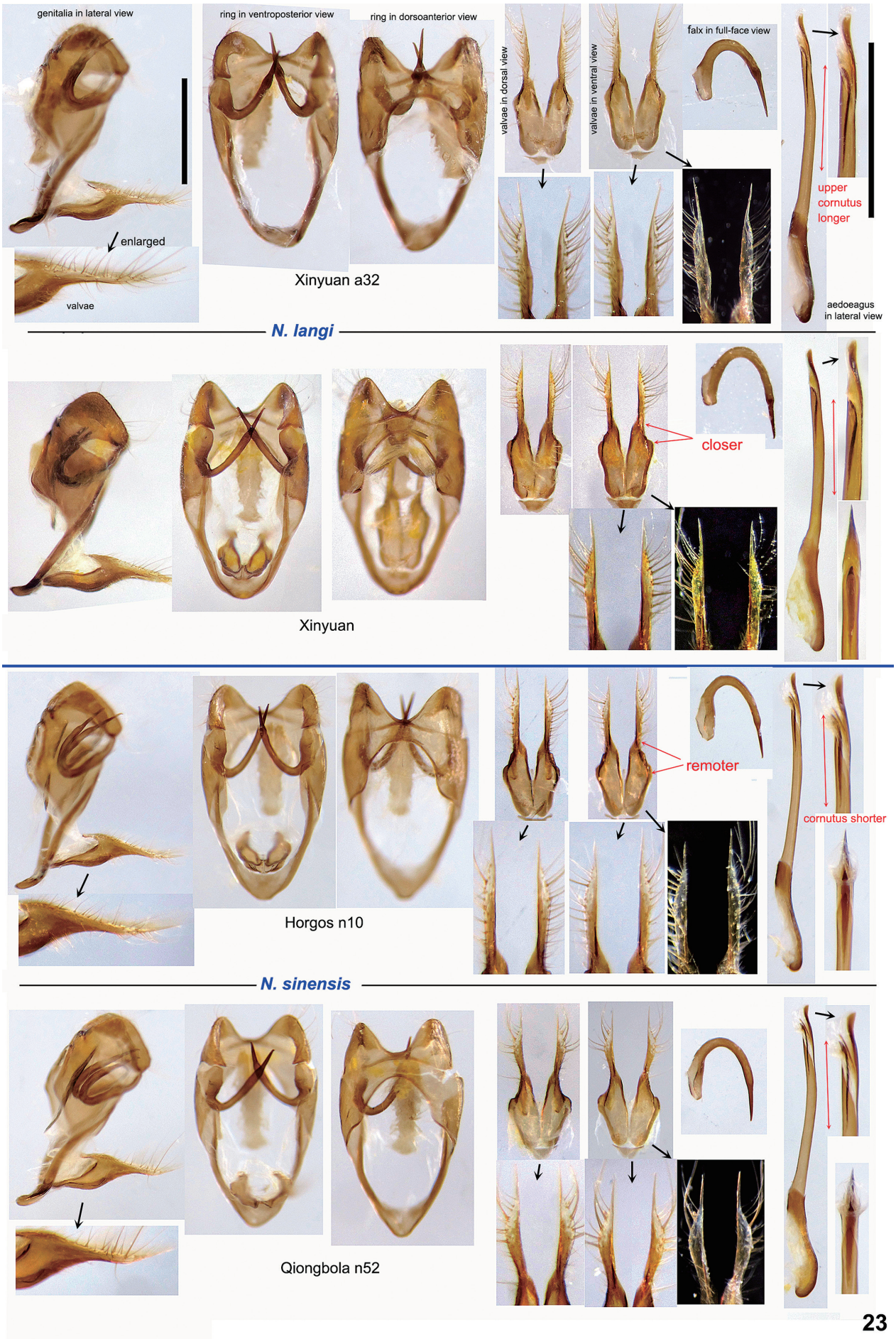


Fig. 23: ♂ genitalia of *Neolycaena langi* Huang, 2019 and *N. sinensis* (Alphéraky, 1881) (scale bar = 1 mm).

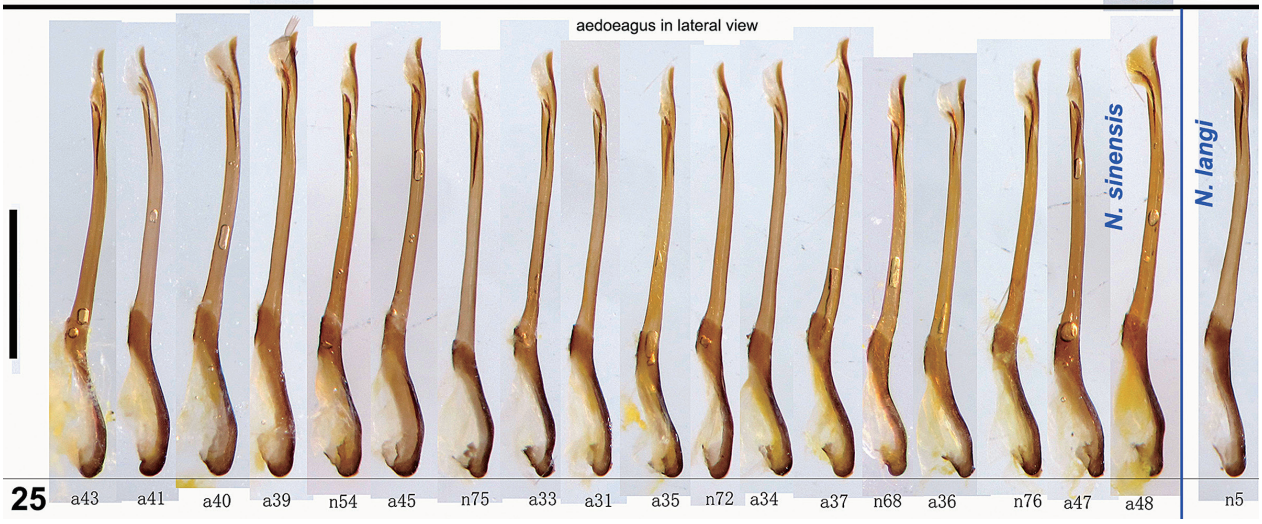


Fig. 24: ♂ genitalia of *Neolycaena sinensis* (Alphéraky, 1881) (scale bar = 1 mm).
Fig. 25: Aedoeagi of *Neolycaena sinensis* (Alphéraky, 1881) and *N. langi* Huang, 2019 (scale bar = 1 mm).

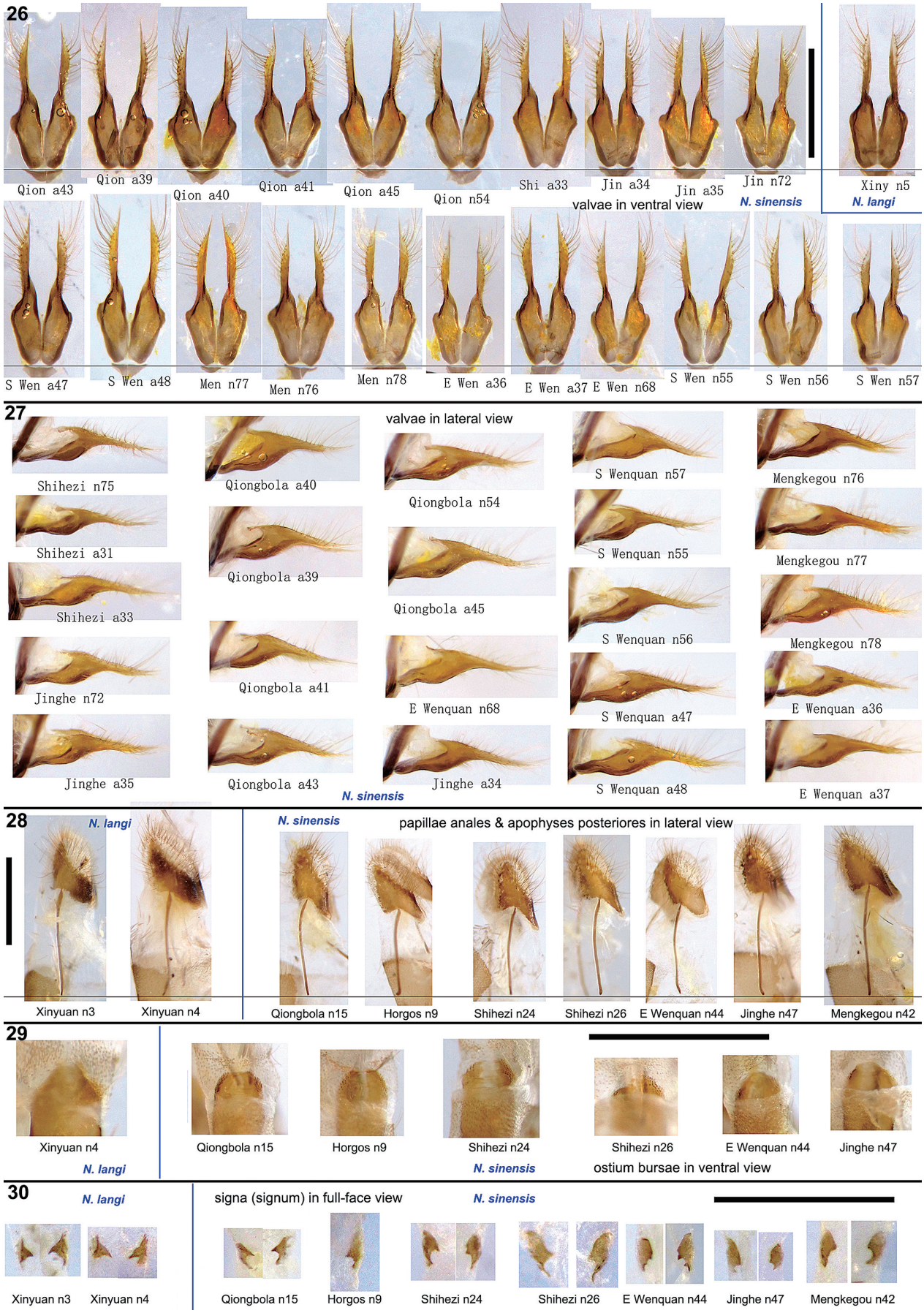


Fig. 26: Valvae in ventral view of *Neolycaena sinensis* (Alphéraky, 1881) and *N. langi* Huang, 2019.
Fig. 27: Valvae in lateral view of *Neolycaena sinensis* (Alphéraky, 1881).
Fig. 28: Papillae anales & apophyses posteriores of *Neolycaena langi* Huang, 2019 and *N. sinensis* (Alphéraky, 1881).
Fig. 29: Ostium bursae of *Neolycaena langi* Huang, 2019 and *N. sinensis* (Alphéraky, 1881).
Fig. 30: Signa of *Neolycaena langi* Huang, 2019 and *N. sinensis* (Alphéraky, 1881).

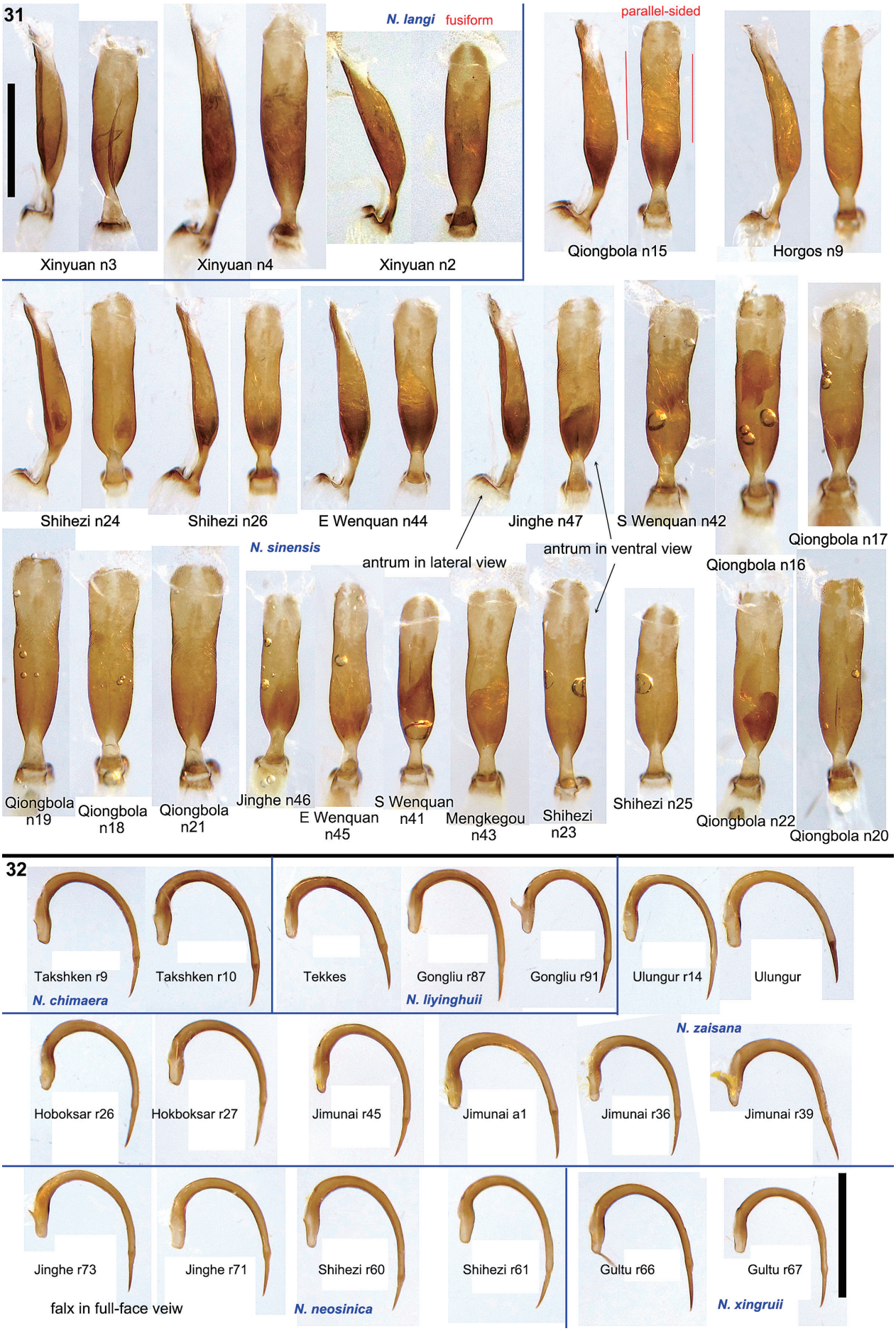


Fig. 31: Antrum & ductus bursae of *Neolycaena langi* Huang, 2019 and *N. sinensis* (Alphéraky, 1881) (scale bar = 1 mm).
Fig. 32: Falces in spread view (scale bar = 1 mm).

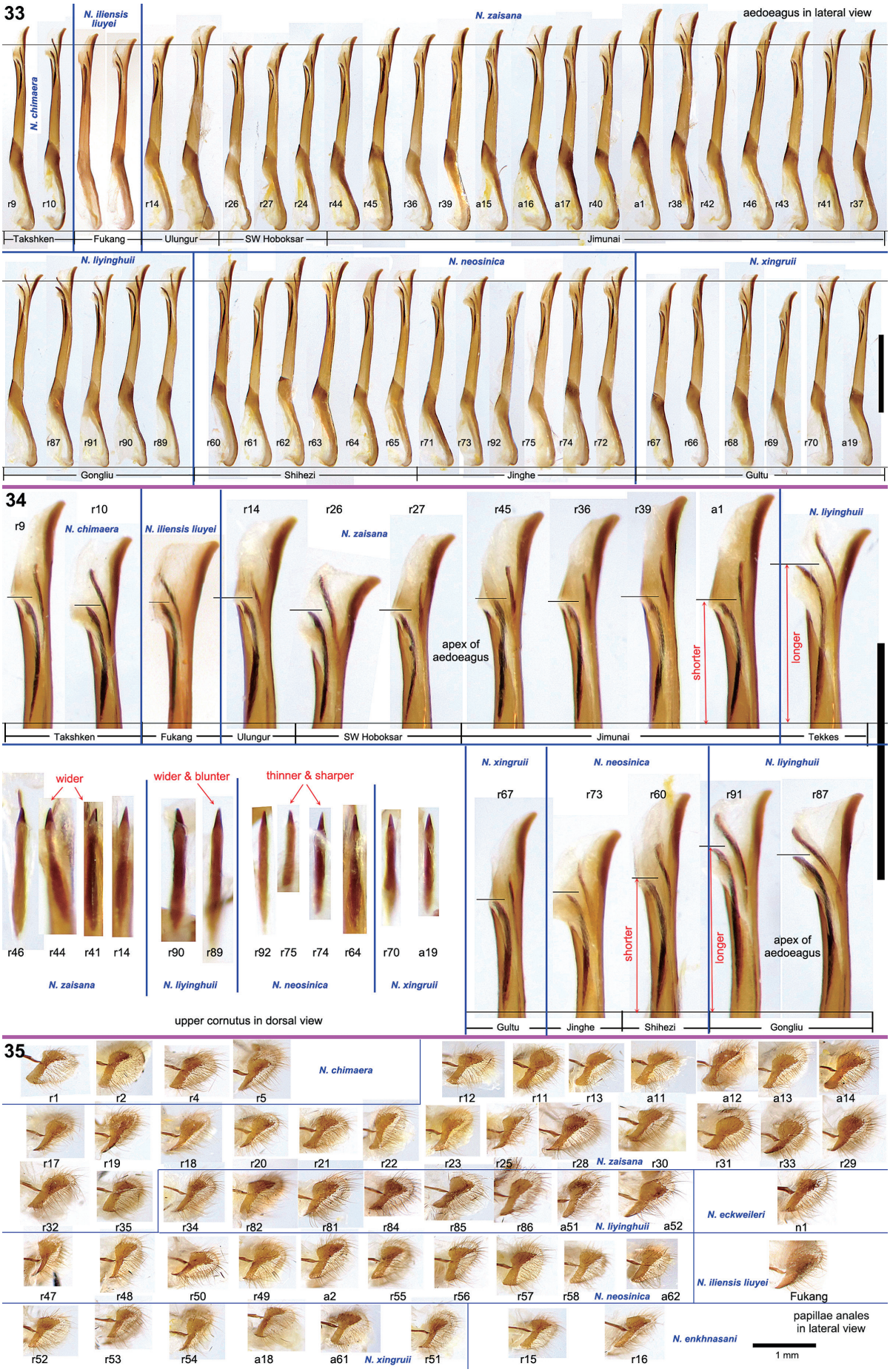


Fig. 33: Aedoeagus in lateral view (scale bar = 1 mm).
Fig. 34: Apex of aedoeagus in lateral view enlarged and upper cornutus in dorsal view (scale bar = 1 mm).
Fig. 35: Papillae anales in lateral view (scale bar = 1 mm).

Fig. 36: Valvae in ventral view, with apex enlarged to show non-pigmented zone (scale bar = 1 mm).

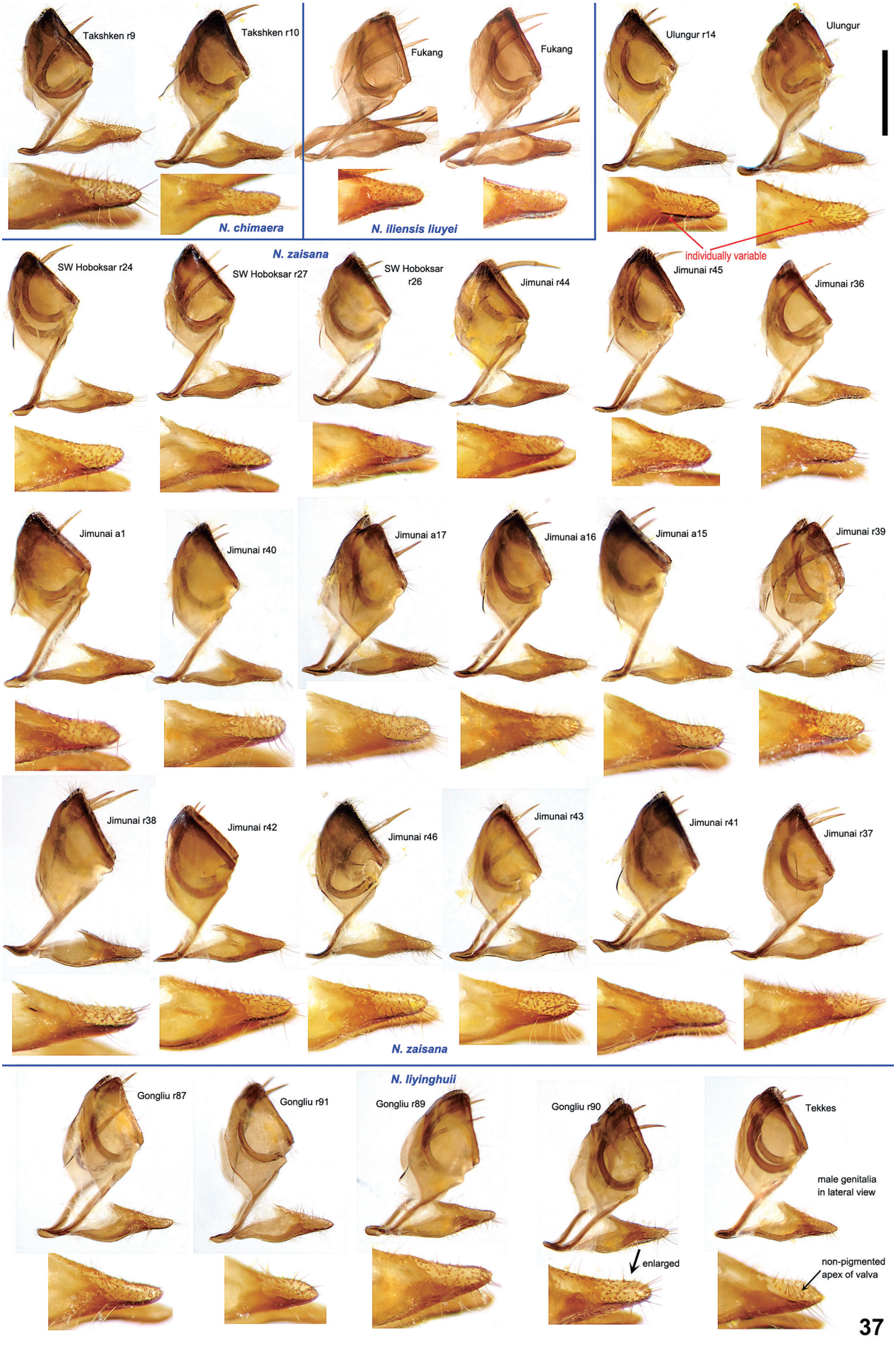


Fig. 37: ♂ genitalia in lateral view with aedoeagus removed, and with apex of valva enlarged to show non-pigmented zone (scale bar = 1 mm).

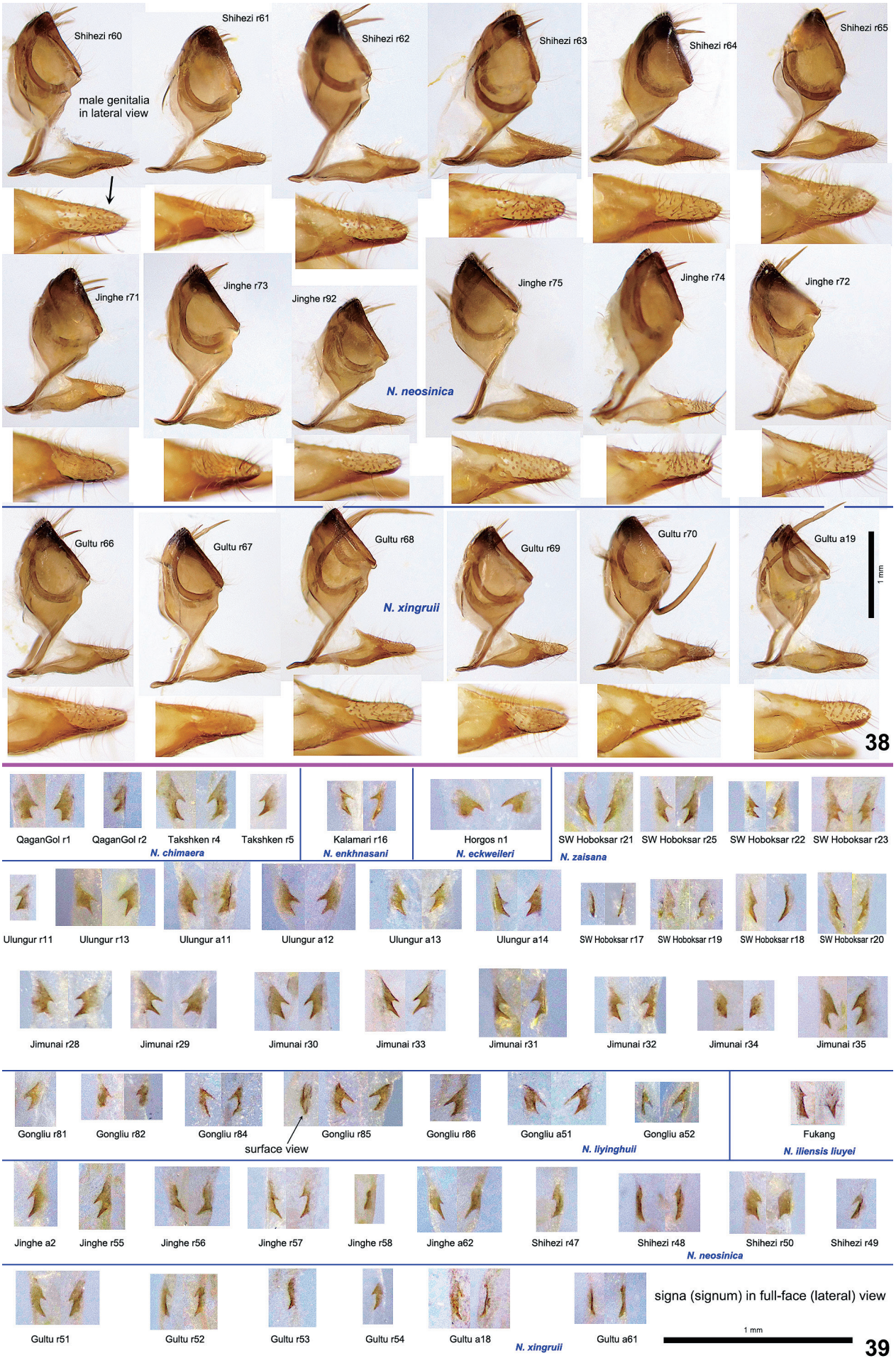


Fig. 38: ♂ genitalia in lateral view with aedoeagus removed, and with apex of valva enlarged to show non-pigmented zone (scale bar = 1 mm).
Fig. 39: Signa in full-face view (scale bar = 1 mm).

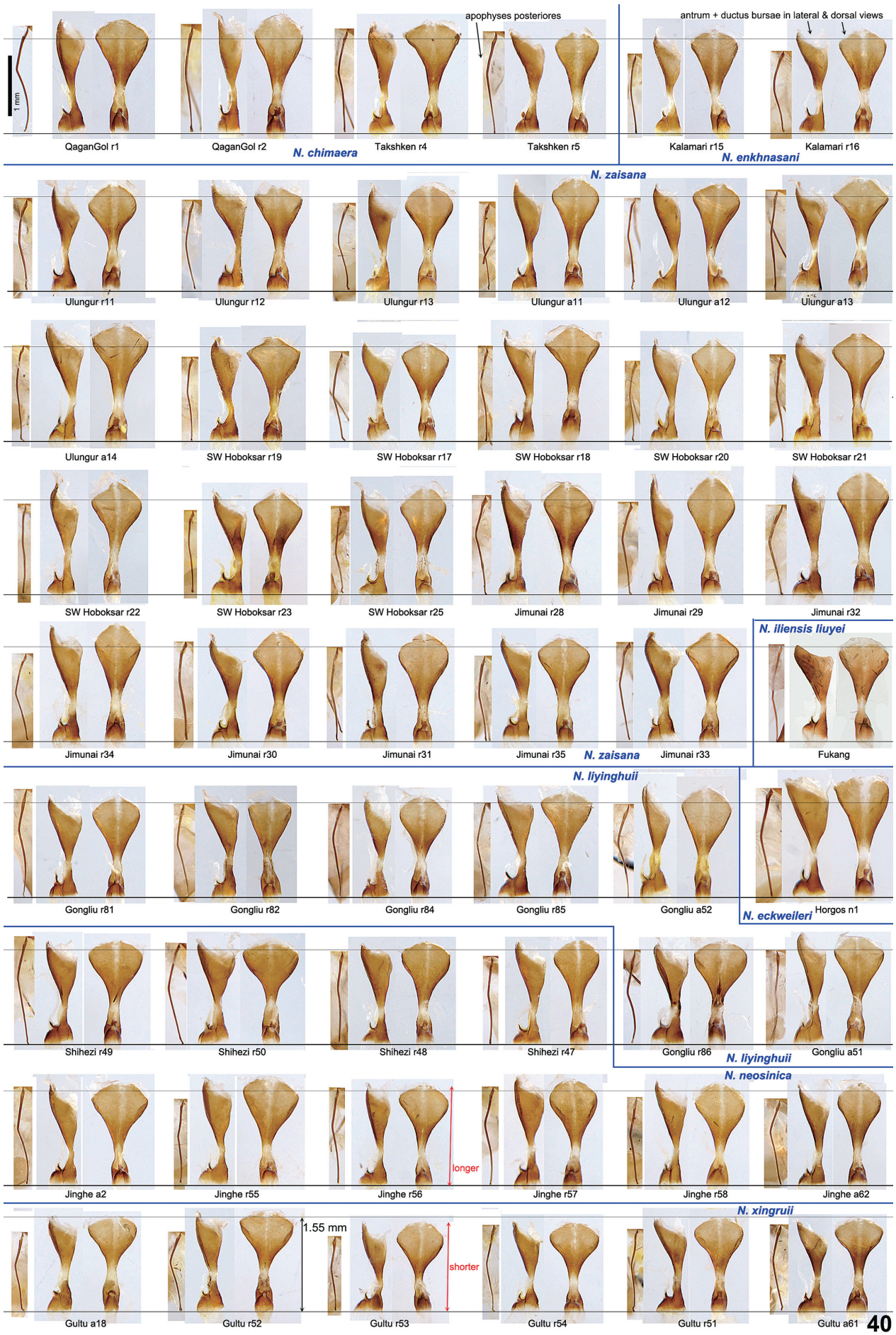


Fig. 40: Apophyses posteriores in lateral view and antrum plus ductus bursae in lateral and dorsal views (scale bar = 1 mm; distance between reference-lines = 1.55 mm).

Fig. 41: Valvae in ventral view, with apex enlarged to show non-pigmented zone (scale bar = 1 mm).
Fig. 42: Aedoeagus in lateral view with enlarged upper cornutus in dorsal view (scale bar = 1 mm).

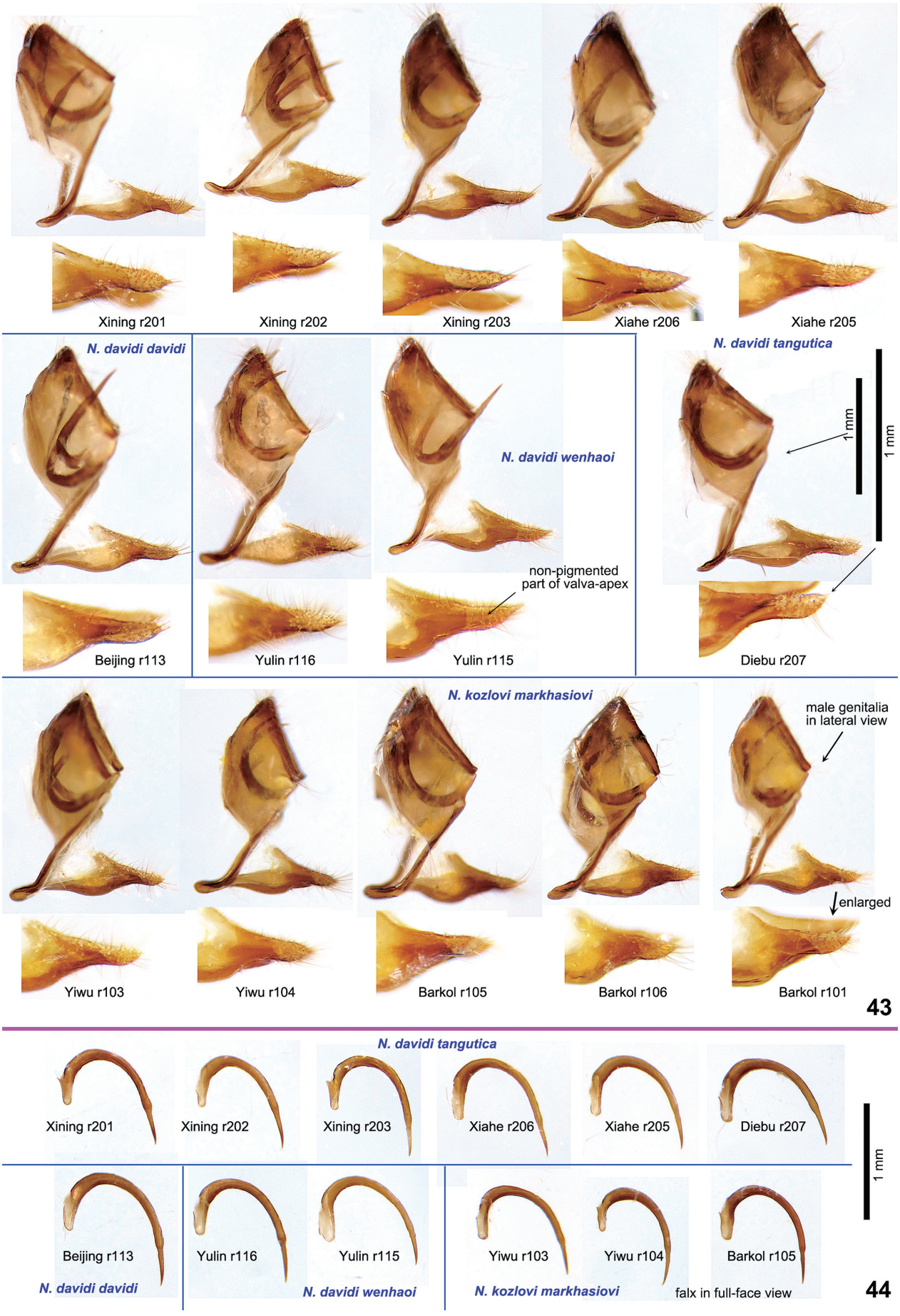


Fig. 43: ♂ genitalia in lateral view with aedoeagus removed, and with apex of valva enlarged to show non-pigmented zone (scale bar = 1 mm).
Fig. 44: Falces in spread view (scale bar = 1 mm)

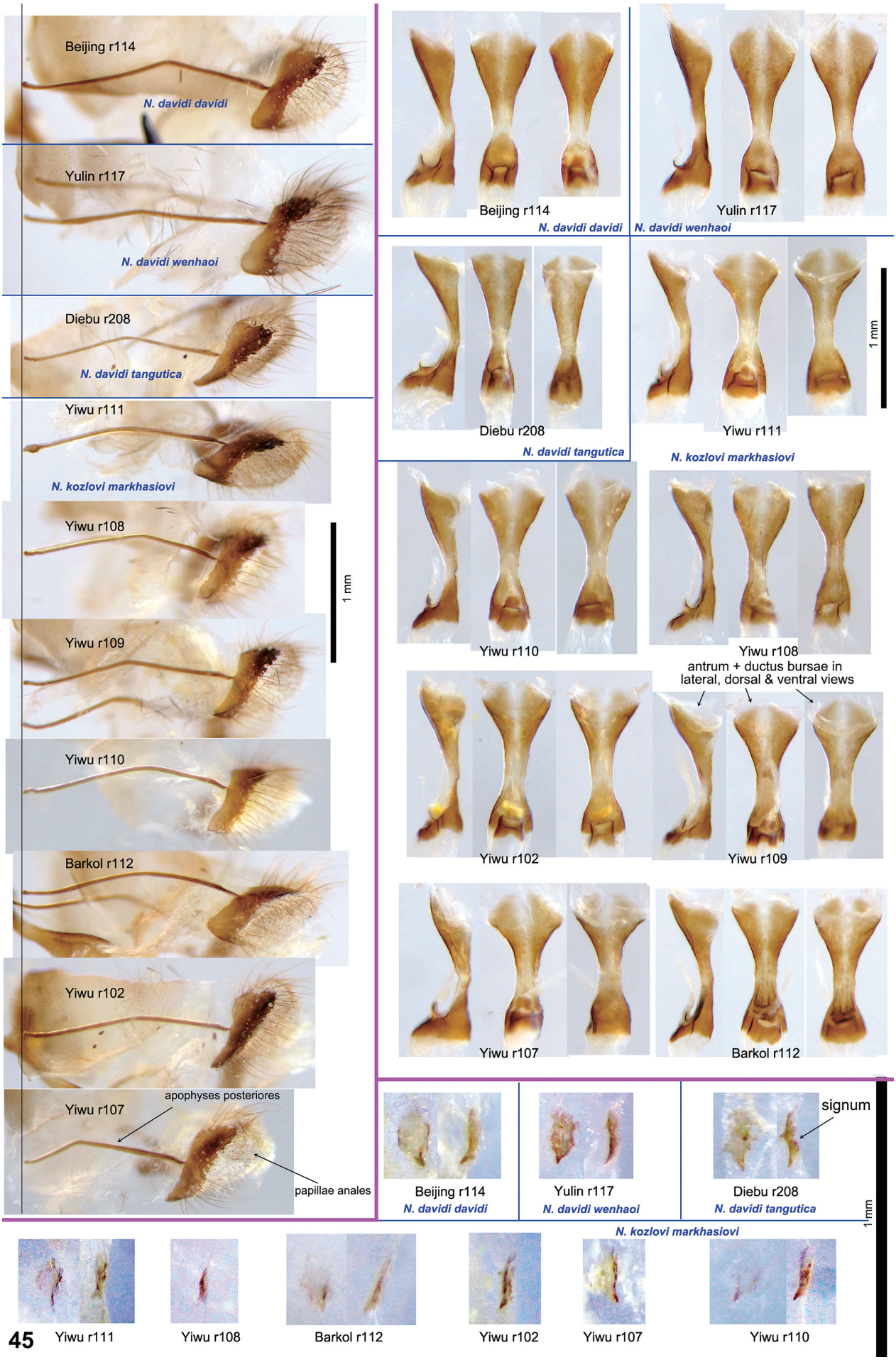


Fig. 45: ♀ genitalia of *Neolycaena davidi* (Oberthür, 1881) group (scale bar = 1 mm).

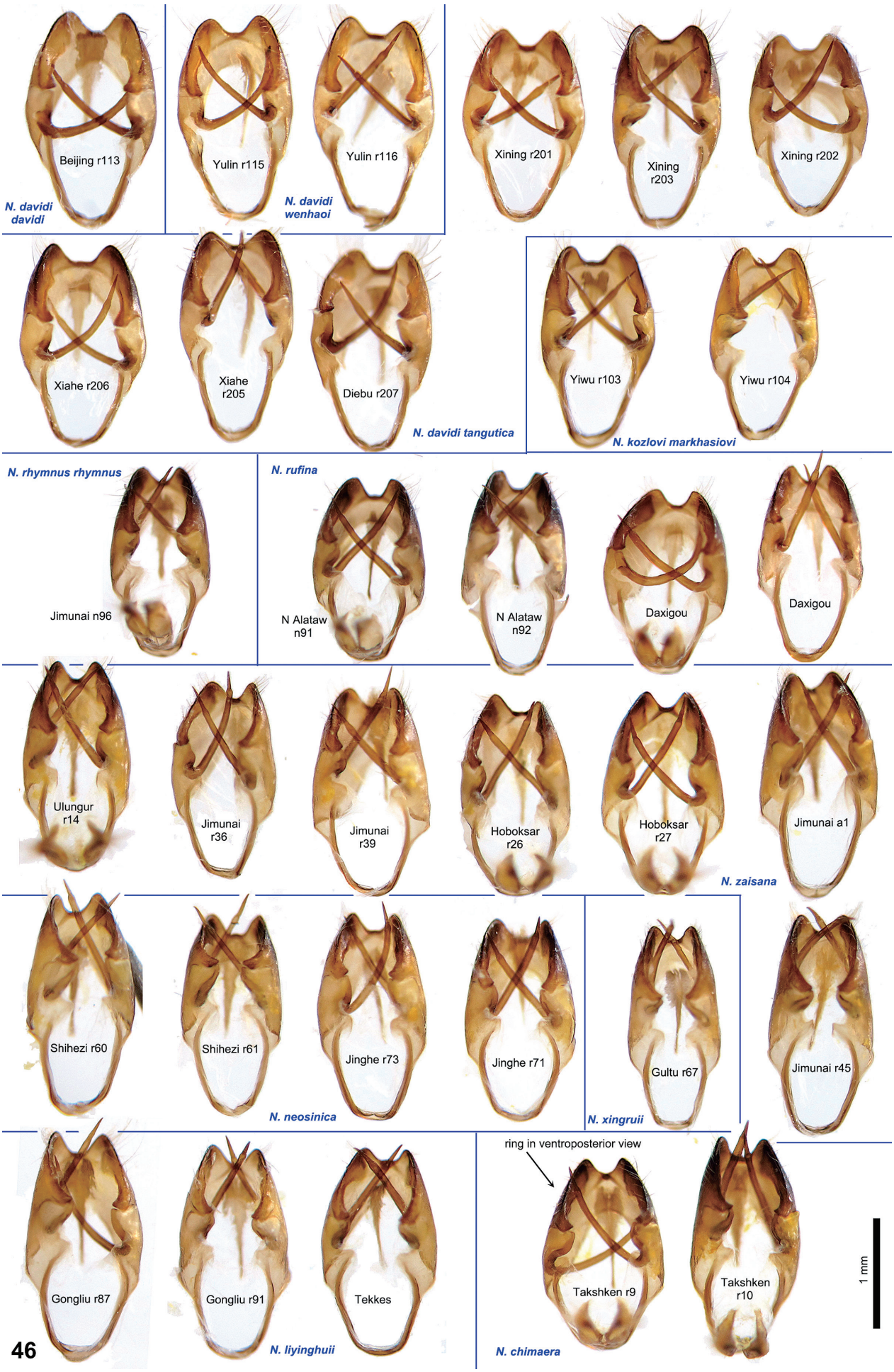


Fig. 46: Ring in ventral view to show falces (scale bar = 1 mm).

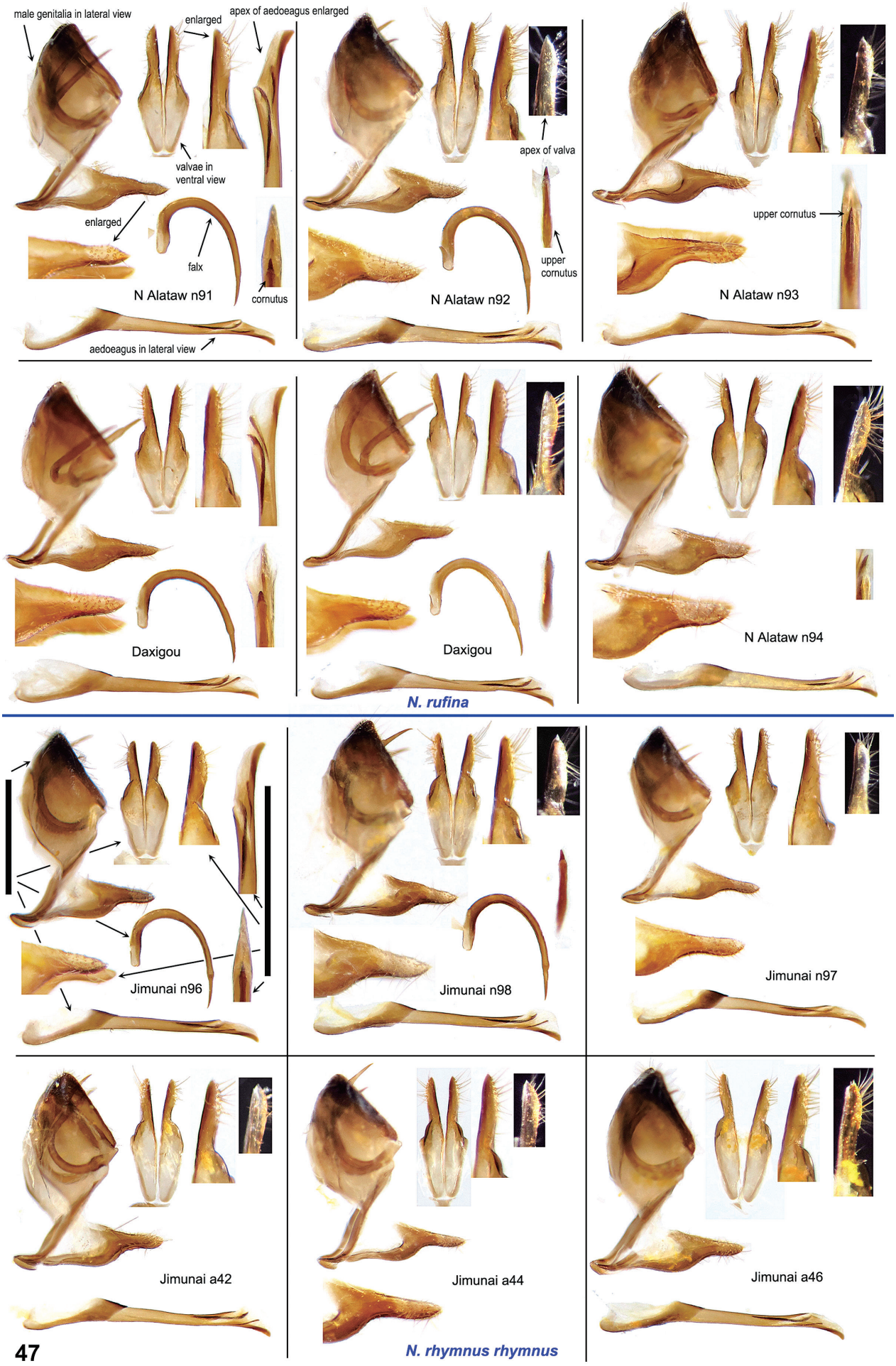


Fig. 47: ♂ genitalia of *N. rhymnus rhymnus* (Eversmann, 1832) and *N. rufina* Lukhtanov, 1994 (scale bar = 1 mm).

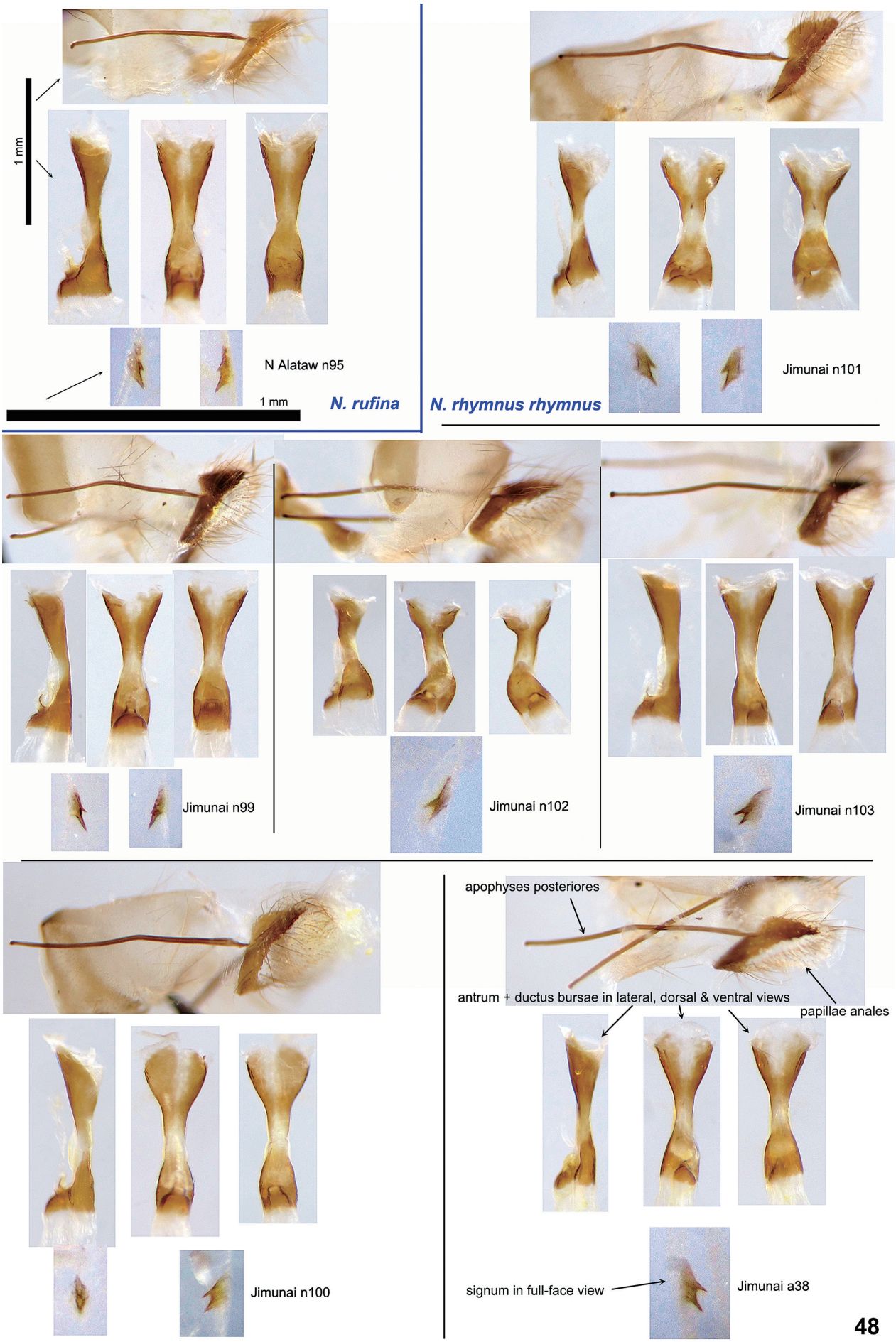
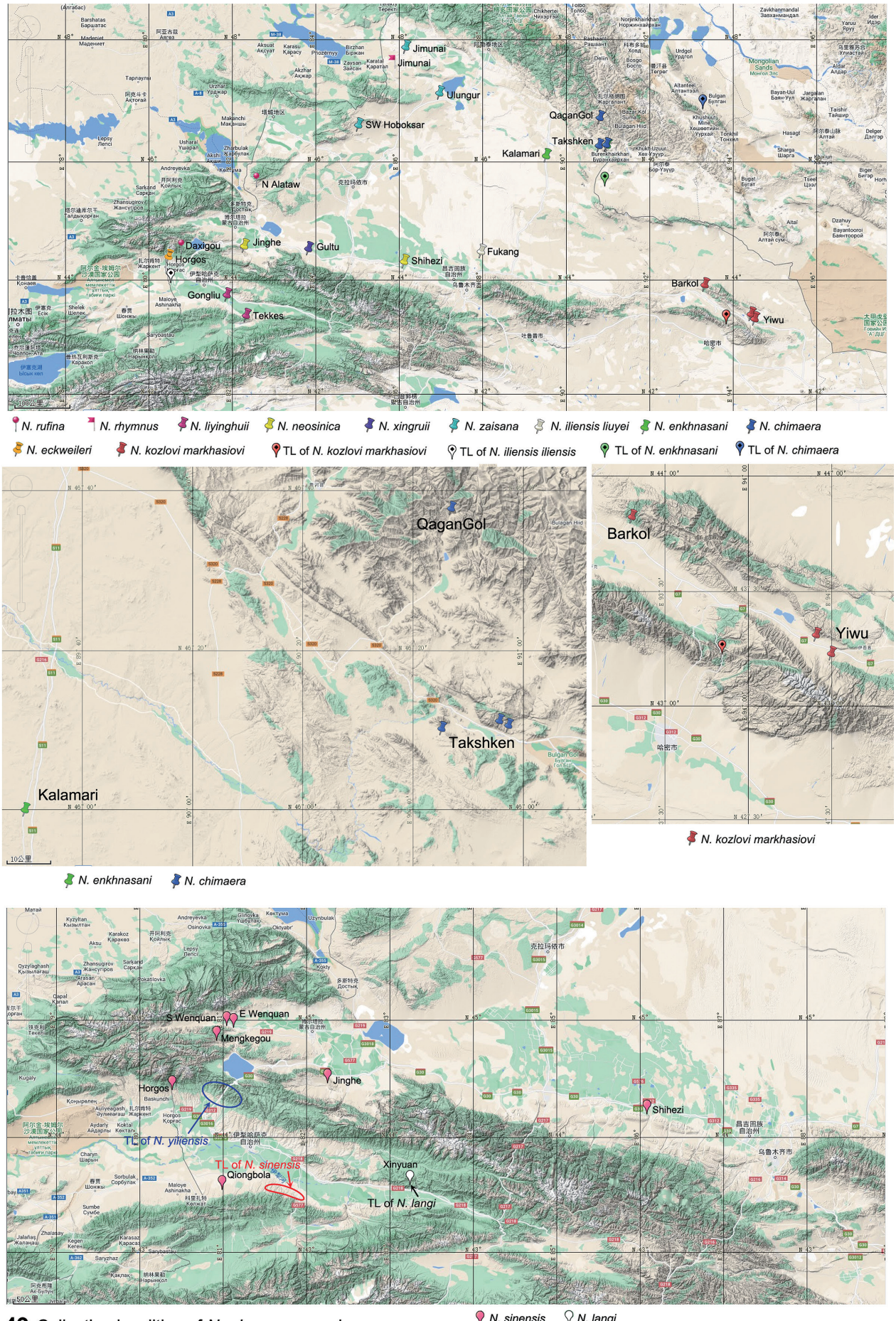
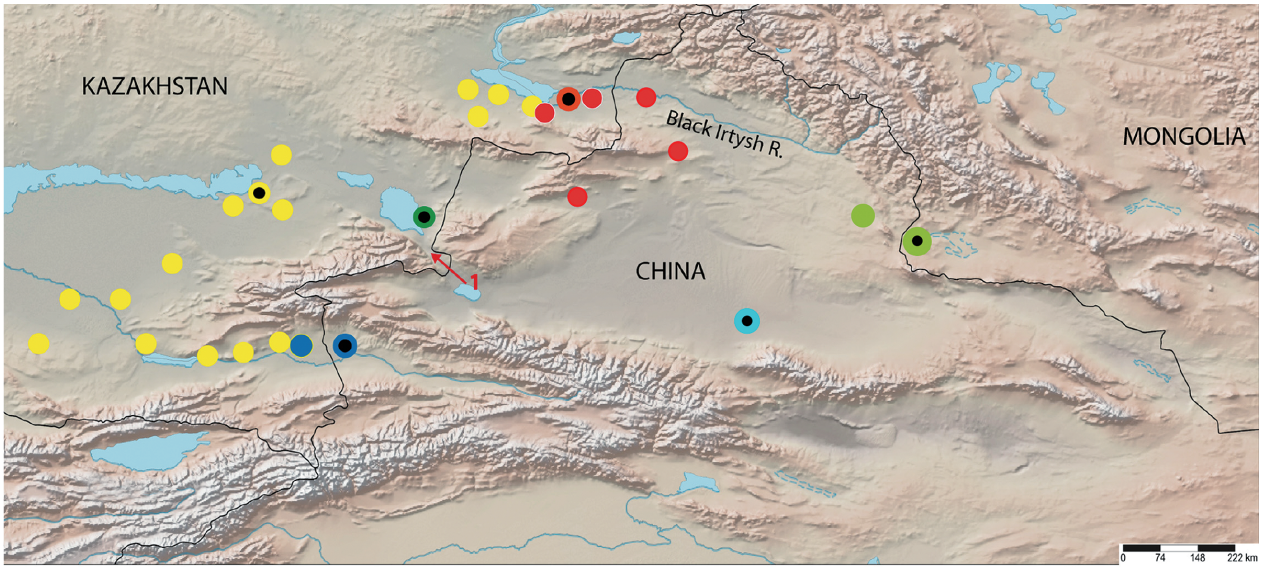


Fig. 48: ♀ genitalia of *N. rhymnus rhymnus* (Eversmann, 1832) and *N. rufina* Lukhtanov, 1994 (scale bar = 1 mm).

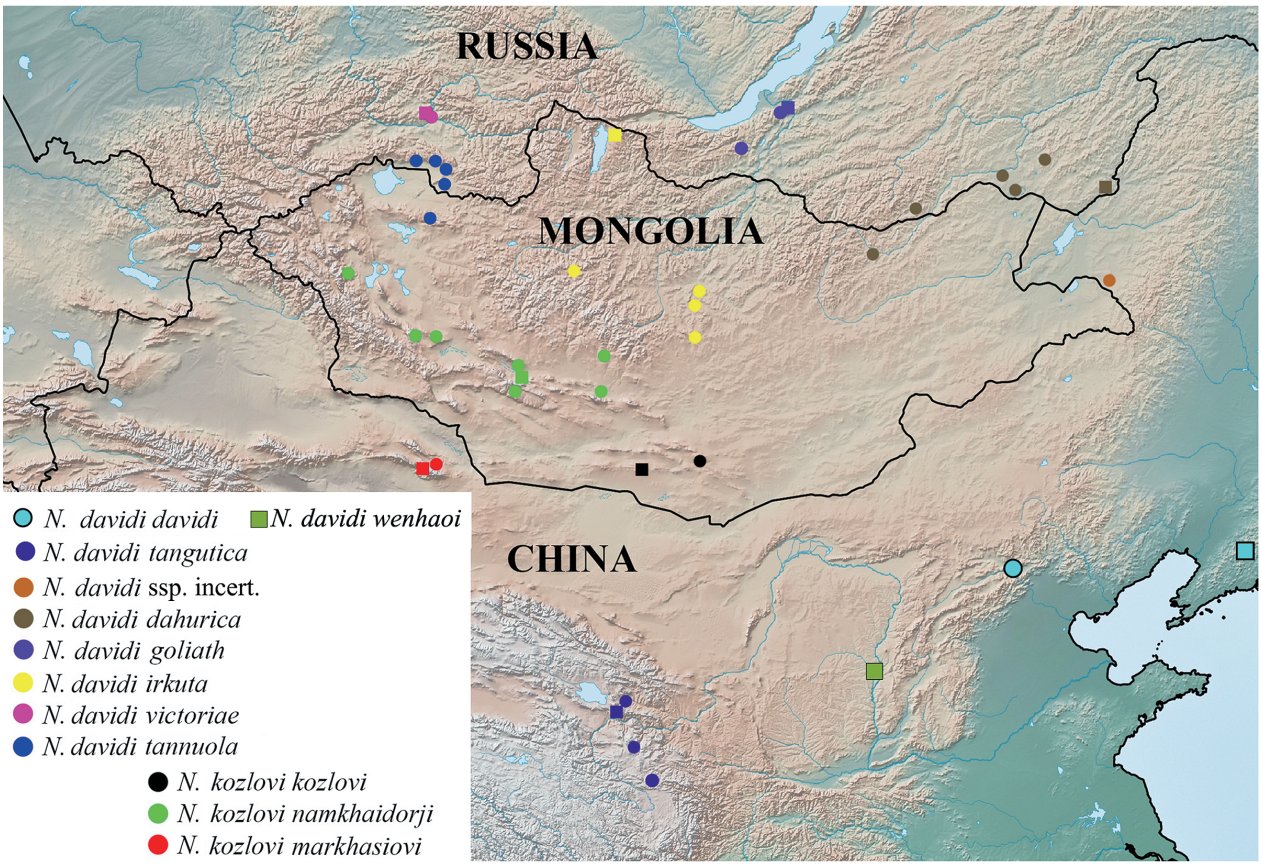


49 Collecting localities of *Neolycaena* species

Fig. 49: Collecting localities in this work.



50 Distribution of *Neolycaena (Rhymnaria)* species living on *Halimodendron halodendron* (modified from Churkin & Kolesnichenko, 2019)

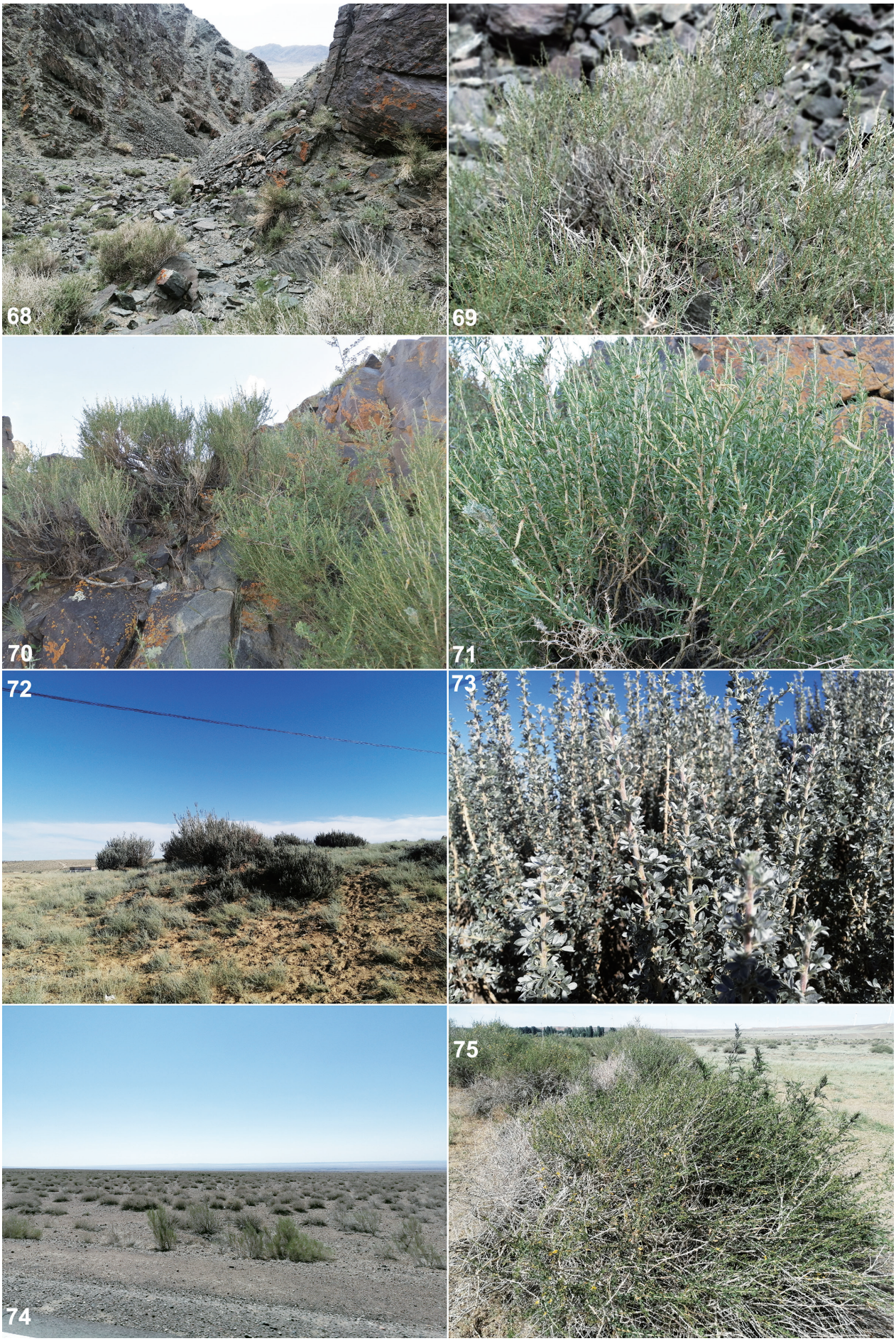


51 Distribution of *Neolycaena (Rhymnaria) davidi* (Oberthür, 1881) species group (modified from Krupitsky, 2021)

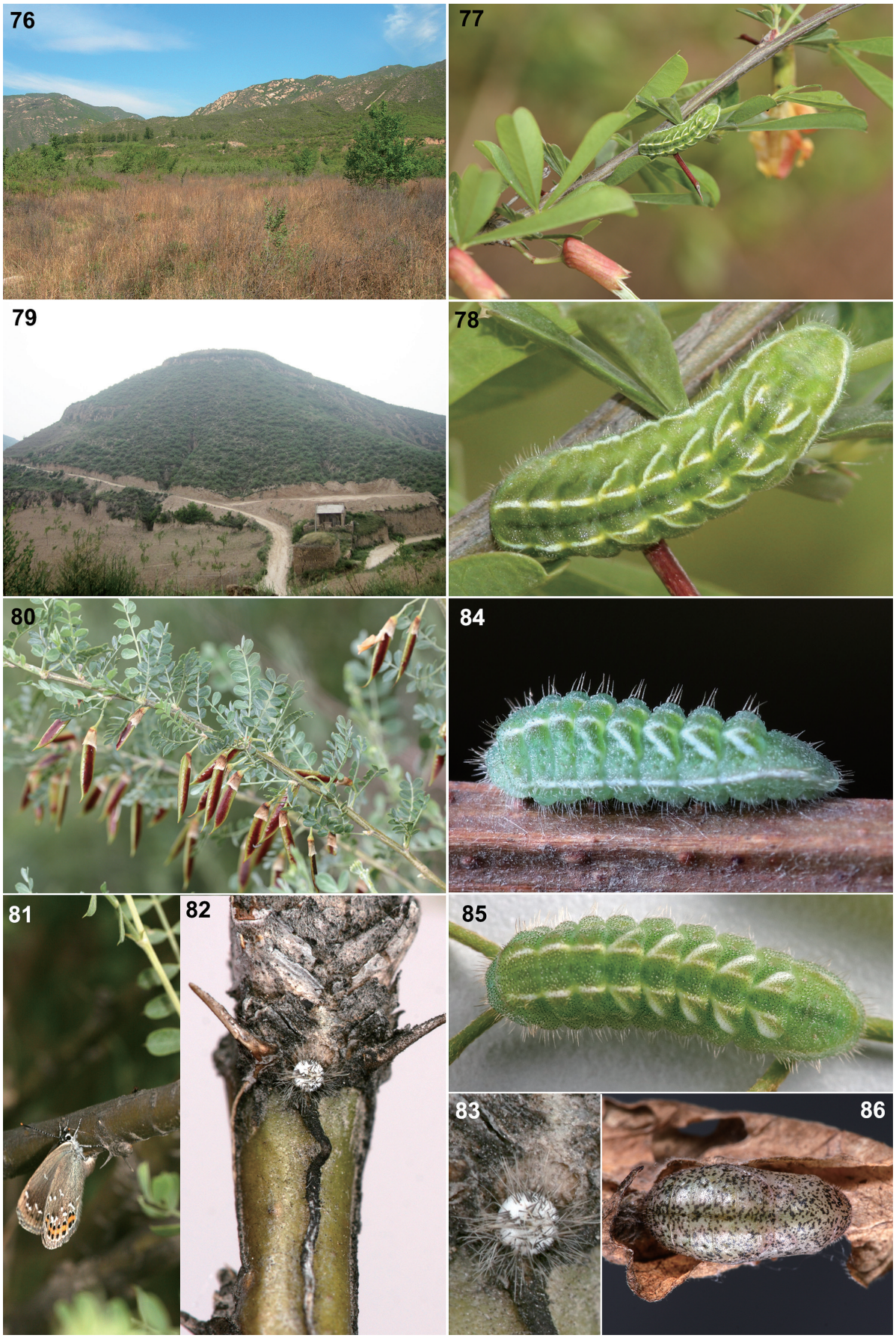
Fig. 50: Distribution of *Neolycaena* species living on *Halimodendron halodendron* (Pall.) Voss .
Fig. 51: Distribution of *Neolycaena davidi* (Oberthür, 1881) group.

Figs. 52-59: Biotopes: 52-56 for *Neolycaena sinensis* (Alphéraky, 1881); 57 for *N. langi* Huang, 2019; 58-59 for *N. rufina* Lukhtanov, 1994; 52 & 53 - Qiongbola; 54 & 55 - Mengkegou; 56 - E Wenquan; 57 - Xinyuan; 58 & 59 - N Alataw.

Figs. 60-67: Biotopes: 60-61 for *Neolycaena* ***liyinghuii*** **spec. nov.**; 62-64 for *N. neosinica* (Lee, 1963); 65-67 for *N.* ***xingruii*** **spec. nov.** ; 60 & 61 - Gongliu; 62 & 63 - W Jinghe; 64 - Shihezi; 65, 66 & 67 - Gultu.



Figs. 68-75: Biotopes: (68-71) for *Neolycaena chimaera* Churkin, 2004; (72-74) for *N. zaisana* (Zhdanko, 2013); (75) for *N. rhymnus rhymnus* (Eversmann, 1832); 68 & 69 - Takshken; 70 & 71 - QaganGol; 72 & 73 - Jimunai; 74 - SW Hoboksar; 75 - Jimunai.



Figs. 76-78: Field observations on *Neolycaena davidi davidi* (Oberthür, 1881) at Songshan, Beijing (photo courtesy from Ming-Lei Bi): 76 - biotope; 77 - host plant; 78 - larva.

Figs. 79-86: Field observations and early stages of *Neolycaena davidi* ***wenhaoi*** **subspec. nov.** at Yulin, N Shaanxi (photo courtesy from Wen-Hao Sun): 79 - biotope; 80 - host plant; 81 - ♀ adult laying egg; 82 - position of egg on foodplant; 83 - egg; 84 - larva feeding on natural host; 85 - larva feeding on alternative host; 86 - pupa.