

**NOTES ON THE SUBGENUS *PENICILLONAROSA* Strand, 1916
(LEPIDOPTERA, LIMACODIDAE)**

ALEXEY V. SOLOVYEV

Ulyanovsk State Pedagogical University

TRAN THIEU DU

Institute of Ecology and Biological Resource

Penicillonarosa Strand, 1916 is a small subgenus of the genus *Narosa* Walker, 1855 ranging in Indo-Malaya region. It was erected by monotypy for the species *Narosa* (*Penicillonarosa*) *penicillata* Strand, 1916 and considered earlier that this subgenus is monotypical and includes only *nigrisigna* with the following synonyms: *penicillata* Strand, 1916, *formosana* Matsumura, 1931, *ochracea* Hering, 1931 (Solovyev & Witt, 2009), but two different forms can be recognized, the yellow one (*ochracea*) and the grey one (*nigrisigna*, = *penicillata*, = *formosana*). The systematic status of both forms was not evident, usually they were considered as two species, viz. *ochracea* and *nigrisigna* (Wu, Fang, 2009), but large sympatric area of both forms, almost identical phenological periods, similar wing pattern, male and female genitalia cause establishing of synonymy of all associated specific names. The present paper devotes to revelation of the status of the mentioned forms.

I. MATERIAL AND METHODS

The materials from the following collections are the basis for this study (with abbreviations given in the text): Museum Witt, Munich, Germany (MWM); collection of Alexey V. Solovyev, Ulyanovsk, Russia (CAS); Natural History Museum, London (United Kingdom) (BMNH); Deutsches entomologisches Institut im Zalf, Müncheberg, Germany (DEI); Hokkaido University, Sapporo, Japan (EIHU); Zoologisches Museum der Humboldt Universität zu Berlin, Germany (ZMHB). The data on distribution of the taxa in China see Wu & Fang (2009).

The material for DNA analysis was collected during our joint expeditions to Vietnam in 2008. The sequences were received from the Biodiversity Institute of Ontario in the network of the general project BOLD: Barcode of Life Data System (project LIMBC-DNA Barcoding Limacodidae moths). The sequences of 16 specimens were used in this paper including 10 specimens of the subgenus *Penicillonarosa* and 6 specimens of the “*Narosa*”-group: *Flavinarosa alius* Solovyev et Witt, 2009, *F. glaesa* Solovyev et Witt, 2009, *Narosa* (?) *erminea* Hampson, 1895, *Quasinarosa fulgens* (Leech, 1888), *Tennya propolia* (Hampson, 1900) and *Caelestomorpha albiceris* Solovyev et Witt, 2009. The collection and BOLD numbers of specimens are given on the Fig. 4. The barcode marker was cytochrome oxidase subunit 1 (COI) with length 658 b.p. The sequences were aligned using BOLD. The obtained sequences include 128 parsimony informative and 181 variable sites.

The molecular phylogeny analysis was carried out using Mega 4 (<http://www.mega-software.net>) based on Neighbor-Joining (NJ) with the following settings: Gaps/Missing Data-Complete Deletion; Model-Nucleotide: Maximum Composite Likelihood; Substitutions of Include: d: Transitions + Transversions; Pattern among Lineages: Same (Homogenous); Rates among sites: Uniform rates) (Saitou, Nei, 1987; Tamura et al., 2007). The bootstrap values supporting nodes were obtained with 10000 replications. The topology at the branch is considered “correct” if the bootstrap value for a node is 95% or higher (Nei, Kumar, 2000; Hovenkamp, 2005; Müller, 2005).

II. RESULTS AND DISCUSSION

Both taxa of *Penicillonarosa*, of yellow and grey ground colours, are characterized with very similar forewing pattern. Their wing pattern is speckled, with darker, usually not well defined transverse fasciae and characteristic dark fasciae running approximately from 3/4 costa to the vein M3 towards the tornus (Fig. 1). The grey-coloured taxon usually has poorly defined wing pattern excepting well recognizable dark fascia running from 3/4 of costa. The ground colour of the body and the wings are grey or yellow. The male antennae are filiform. The wing venation is typical for other “Narosa”-group species and genera (Solovyev & Witt, 2009). The vein R1 in the forewing is strongly curved proximally; the medial stem is not dichotomically divided; the vein R5 is branched from R3+R4.

The male genitalia of both taxa are weakly modified (Fig. 2). The uncus is slender, bears an apical spur. The gnathos is slender. The valvae are elongated, without saccular processes. The juxta is flattened. The saccus is semicircle, wide. The aedeagus is longer than 1.5 of the valva length, slightly curved. The vesica bears a row of claw-shaped, basally disc-shaped cornuti; the size of cornuti is gradually decreased in a row caudally in everted vesica. The number of cornuti is not constant, from 4 to 12, but it slightly depends on the ground colour of the specimens. The grey specimens usually have 4–8 cornuti in vesica and the yellow ones 6–12 (Fig. 3).

The female genitalia have ovoid ovipositor lobes and slender anterior and posterior apophyses. The ductus bursae is long, spiral. The corpus bursae is rounded, bears a large ovoid field of stellate signa. The strong differences between both, grey and yellow taxa, in female genitalia are not found.

The grey and yellow taxa are similar distributed through Indo-Malaya and known sympatrically in some locations, but the yellow taxon is more widely distributed and never found in Taiwan and in the several provinces of China. The grey taxon does not known from eastern India, several provinces in China, Thailand, southern Vietnam, Sumatra and Malaysia. The sympatric area of both taxa includes northern Vietnam, eastern and southern China.

The phenological periods of both taxa are almost the same and the flight periods fall on April - August, late September - mid October, but the yellow specimens were also collected in mid November (in Thailand), and mid December (in southern Vietnam).

The reconstruction of phylogeny between both taxa based on the DNA analysis is shown on Fig. 4. All specimens of *Penicillonarosa* form a monophyletic clade with 99% bootstrap values, but it is divided on two clusters of yellow and grey taxa supported by high values of bootstrap (99% and 96% correspondingly). The specimens collected in the same date and exact locality, depending from the ground colour, belong to different clusters (the specimens collected in the same locality and almost in the same date are marked by asterixes).

Thus, taking into account the differences in the ground colour of the body and the wings of *Penicillonarosa* specimens, the numbers of cornuti in the vesica of the aedeagus depending on the ground colour, their distributions, and molecular analysis where the specimens of both taxa form their own clusters, the mentioned yellow and grey taxa corresponding to 2 species: *nigrisigna* and *ochracea*, which are resynonymized here. Their annotated check list is given below.

Narosa (Penicillonarosa) nigrisigna Wileman, 1911

Narosa nigrisigna Wileman, 1911, *Entomologist* **44**: 204. Type locality: “Kanshirei (1000 ft.)” [Taiwan]. Lectotype: ♀ (BMNH), designated in Solovyev & Witt, 2009.

Narosa (Penicillanarosa) penicillata Strand, 1916, *Arch. Naturg.*, A. 3: 141. Type locality: “Kosempo” [Taiwan]. Holotype: ♂ (DEI), designated in Solovyev & Witt, 2009.

Heterogenea formosana Matsumura, 1927, *J. Coll. Agric. Hokkaido imp. Univ.* 19: 90. Type locality: “Baibara (Horisha)” [Taiwan]. Lectotype: ♂ (EIHU), designated in Solovyev & Witt, 2009.

Diagnosis. The moths are grey externally. The number of cornuti is from 4 to 8 (Fig. 3, white columns with black hatching).

Distribution (Fig. 6). Taiwan, China (Yunnan, Sichuan, Gansu, Beijing, Guangxi, Hunan, Jiangxi, Shaanxi, Shandong, Hebei, Liaoning), Vietnam (Nghe An, Ninh Binh, Vinh Phuc).

Biology. The flight period falls on April - mid August, late September - mid October. The moths were collected at the altitudes of 56–2400 m.

***Narosa (Penicillanarosa) ochracea* Hering, 1931, stat. rev.**

Narosa ochracea Hering, 1931, in Seitz, *Gross-Schmett. Erde* 10: 675, Taf. 86 b, syn. N. Type locality: “Kwang-tung, Mahn-tsi-schan” [China, Guangdong]. Lectotype: ♂ (ZMHB), designated in Solovyev & Witt, 2009.

Diagnosis. The moths are yellow. The number of cornuti is from 6 to 12 (Fig. 3, black columns)

Distribution (Fig. 6). China (Yunnan, Sichuan, Guangxi, Hunan, Guangdong, Hainan, Fujian, Jiangxi, Zhejiang, Shanghai, Shandong, Tianjin, Hubei), India, Thailand (Chiang Mai, Nan, Phayao, Nakhon Ratchasima), Vietnam (Nghe An, Ninh Binh, Vinh Phuc, Dong Nai). The species also was recorded from Peninsular Malaysia and Sumatra (Holloway, 1990)

Biology. The moths were collected in mid April - August, late September - mid October, mid November and mid December at the altitudes of 56–1800 m. The recorded food plant is a peach, *Prunus persica* L. (Rosaceae) (Hering, 1931).

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Legends to plates

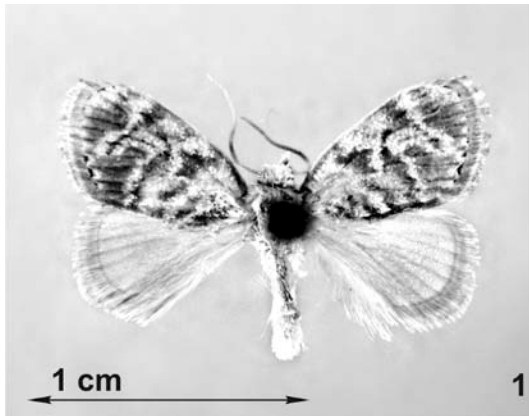


Figure 1: External view of Narosa (Penicillonarosa) sp. (Vietnam, Bao Loc, Rung Cat Tien, in MWM)

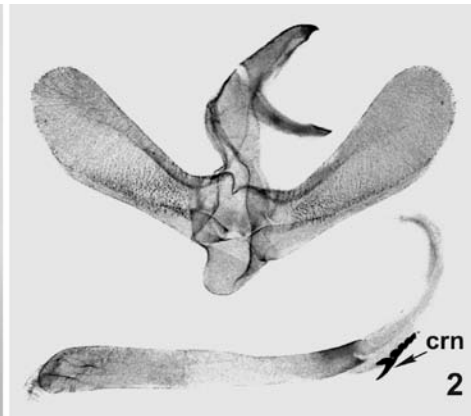


Figure 2: Male genitalia of Narosa (Penicillonarosa) nigrisigna (Vietnam, Me Linh, in CAS, slide 0070). Abbreviation: crn - cornuti in vesica of aedeagus

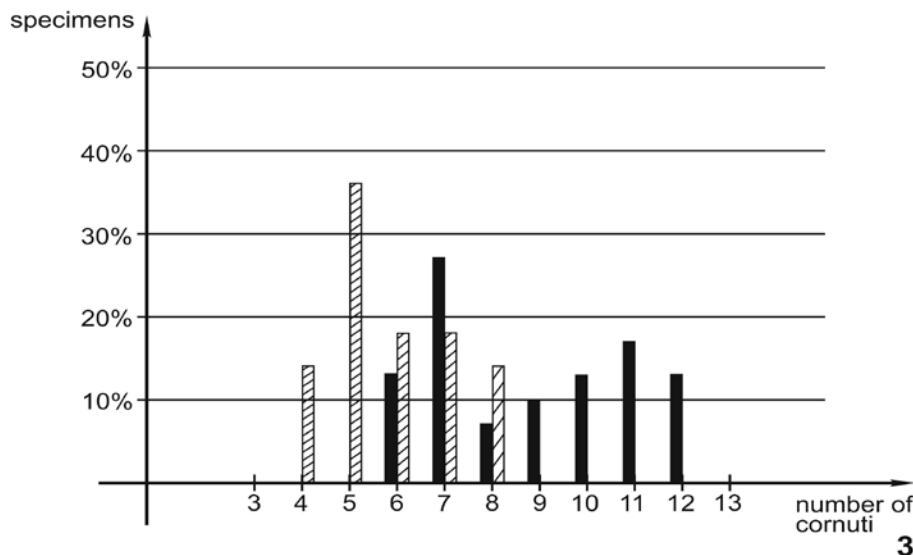


Figure 3: Diagram of a number of cornuti of Narosa (Penicillonarosa) spp., black columns correspond to ochracea (30 specimens examined); white columns with black hatching - nigrisigna (22 specimens examined).

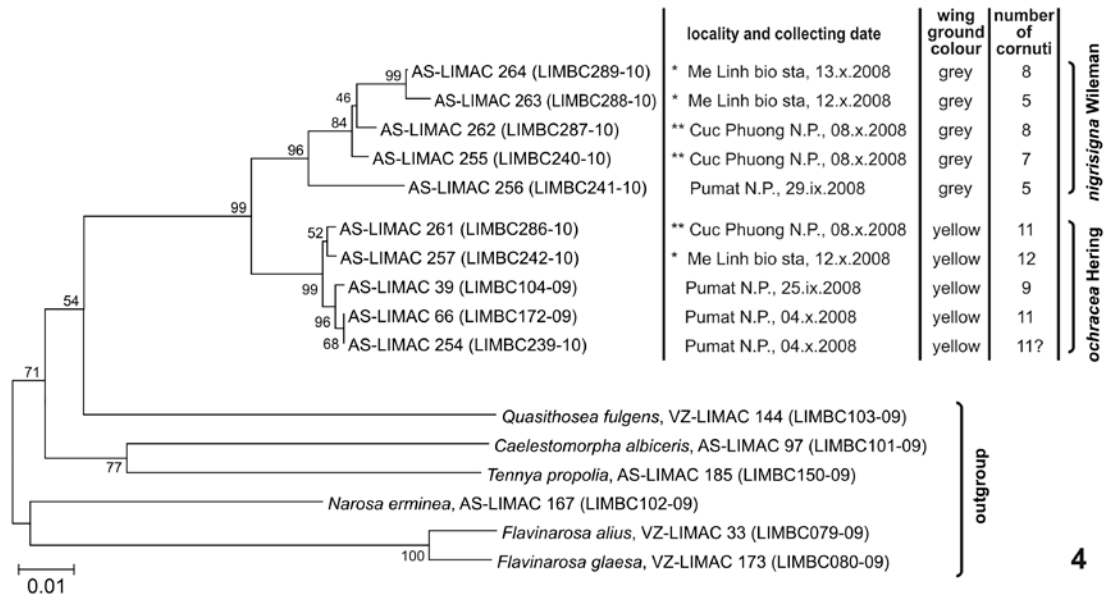
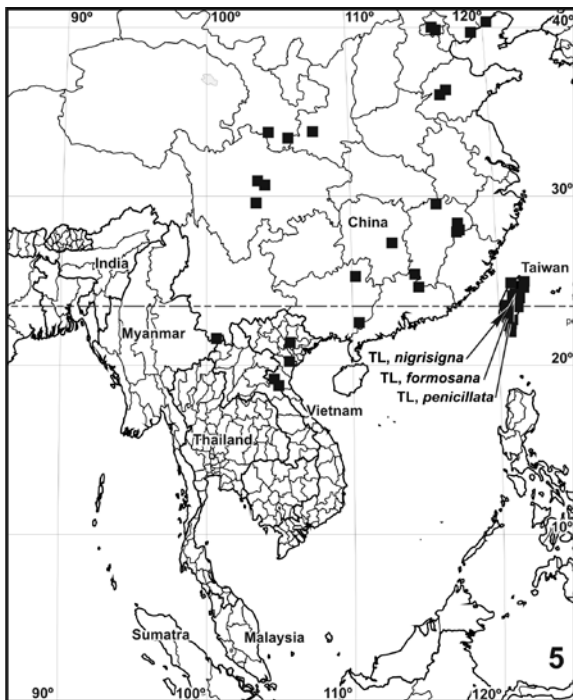
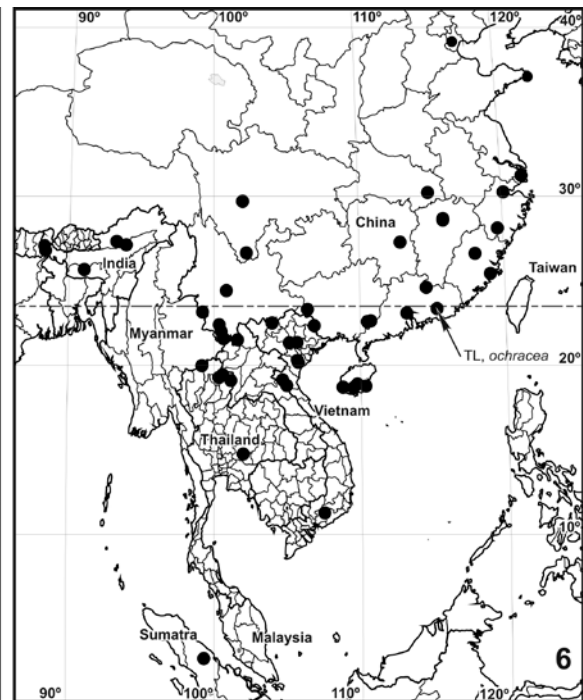


Figure 4: Dendrogram obtaining after molecular analysis; bootstrap values are given left to the nodes; the localities of specimens, ground colour of their wings and number of cornuti in aedeagus vesica are given in columns; the identical localities are marked by the same number of asterixes



Figures 5: Distribution maps of *Narosa nigrisigna* (*Penicillonarosa*)



Figures 6: Distribution maps of *Narosa ochracea* (*Penicillonarosa*)
Abbreviation: TL – type locality

**VỀ PHÂN GIỐNG *PENICILLONAROSA* Strand, 1916
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ALEXEY V. SOLOVYEV, TRẦN THIẾU DƯ

TÓM TẮT

Bài viết này đề cập tới vị trí phân loại học của phân giống *Penicillonarosa* Strand, 1916. Đây là một phân giống nhỏ thuộc giống *Narosa* Walker, 1855 có phân bố ở vùng Indo-Malaya với loài chuẩn là *Narosa (Penicillonarosa) penicillata* Strand, 1916. Hiện nay, trong phân giống này đã phát hiện hai dạng hình khác nhau là dạng hình màu xám và dạng hình màu vàng. Vì có sự rất giống nhau về các đặc điểm hình thái ngoài và cả các đặc điểm về phân bố cũng như các đặc điểm vật hậu học của hai dạng hình này đã dẫn đến các quan điểm khác nhau trong việc công nhận chúng là các loài độc lập. Wu và Fang (2009) cho rằng phân giống này gồm hai loài tương ứng với hai dạng hình là màu vàng (*ochracea*) và màu xám (*nigrisigna* = *penicillata* = *formosana*). Tuy nhiên, Solovyev và Witt (2009) lại cho rằng nó chỉ gồm một loài duy nhất với hai dạng hình khác nhau. Dựa trên kết quả nghiên cứu kỹ các đặc điểm màu sắc, hệ thống gân cánh, cấu trúc bộ phận sinh dục của cả con đực và con cái, cùng sự phân tích về đặc điểm phân bố, cũng như các đặc điểm vật hậu học và đặc biệt dựa trên kết quả phân tích DNA của các vật mẫu nghiên cứu thu được ở Việt Nam, đã có kết luận về sự tồn tại hai loài độc lập trong phân giống *Penicillonarosa* đã được tái lập đối với hai loài tương ứng với hai dạng hình là loài *N.(P.) nigrisigna* Wileman, 1911 (có màu xám) và *N. (P.) ochracea* Hering, 1931 (có màu vàng). Công trình có sự hỗ trợ kinh phí của Chương trình hợp tác nghiên cứu song phương giữa Viện Khoa học và Công nghệ Việt Nam với Quỹ Nghiên cứu cơ bản Nga (2011-2012).