

NOTES ON THE EARLY STAGES OF *ZETHERA MUSIDES* (LEPIDOPTERA: NYMPHALIDAE: SATYRINAE)

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ABSTRACT.— The juvenile biology of laboratory-reared *Zethera musides* Semper is briefly presented from eggs laid by a confined female in Negros, Philippines. Oviposition was on a bamboo, with *Arundinaria pygmaea* (Poaceae) used as a substitute foodplant. The final-instar caterpillar is illustrated in color, the first time that an immature stage of any *Zethera* has been depicted, as are the nonconsumed exuviae and an unpinned voucher male. The larva and pupa are very similar to *Penthema*, with the same being true for at least one species of *Neorina*. To provide a basic comparison with *Z. musides*, larval and hostplant data gleaned from the available literature (virtually all of it in Chinese or Japanese) and other sources are referenced for *Penthema formosanum* (Rothschild), *Penthema adelma* (Felder), and *Neorina lowii* (Doubleday), with preadult photographs of *P. formosanum* and *N. lowii* included as well.

PAGBUBUOD.— Ang biyolohiya sa kamuraang gulang ng *Zethera musides* Semper na inalagaan sa laboratoryo ay bahagyang ipinakita sa pamamagitan ng iniiitlog ng isang babaeng ispesimen na inobserbahan sa probinsiya ng Negros, Republika ng Pilipinas. Ang pangingitlog ay naganap sa isang kawayan, na kung saan ang inihaliling pagkain ng ispesimen ay *Arundinaria pygmaea* (Poaceae). Ang huling yugto ng uod ay ipinakikita dito nang buong kulay, ang kauna-unahang pagkakataon na maisasalarawan ang *Zethera* sa kamuraang yugto. Isinalarawan din ang hindi makakaing saklob ng uod at isang di-inaspiling lalakeng ispesimen. Ang uod at ang bahay uod ay may malaking pagkakatatulad sa *Penthema*. Ang pagkakaparehong ito ay makikita din sa humigit kumulang isang uri ng *Neorina*. Upang makapagbigay ng batayang paghahalintulad sa *Z. musides*, ang mga datos tungkol sa uod at pagkain na makikita mula sa mga nakalathalang literatura (halos lahat nang ito ay nasa wikang Intsik o Hapon) at iba pang pinagsanggunian ay isinulat para sa *Penthema formosanum* (Rothschild), *Penthema adelma* (Felder), at *Neorina lowii* (Doubleday). Ang mga larawan ng *P. formosanum* at *N. lowii* bago sumapit sa kasapatang edad ay kabilang din.

KEY WORDS: Asia, bamboo, China, Gramineae, hostplants, immatures, Indonesia, Japan, larvae, life history, Malaysia, *Neorina*, Oriental, *Penthema*, Philippines, Poaceae, pupae, Sulawesi, Taiwan.

The satyrid genus *Zethera* Felder is said to include six species that are endemic to the Philippines and Sulawesi (D'Abrera, 1984; Tsukada, 1982; Vane-Wright and Smiles, 1975). The sexes are, for the most part, strongly dimorphic, with all taxa seemingly involved in mimicry (rare for satyrines). Several genera in the Danaeinae appear to be the models for one or two of the male forms and all the female forms (Vane-Wright and Smiles, 1975). Vane-Wright and Smiles (1975) state that nothing is known of the biology of the early stages of these species, an affirmation repeated by Ackery (1988). However, Fukuda (1974) briefly mentions some life history information for *Zethera pimplea* (Erichson), while Igarashi and Fukuda (in prep.) will soon publish an exciting work in which color pictures of the egg, caterpillar, and chrysalis of *Z. pimplea* are shown, and the scrambling bamboo *Dinochloa scandens* (Blume) Kuntze (Poaceae) is reported as a natural foodplant.

In the summer of 1994, I had the opportunity to raise *Zethera musides* Semper from ova, and herewith I present my notes. Unfortunately, travel and other obligations at the time prevented me from making more continuous or comprehensive observations. Nonetheless, it is hoped that this limited account of its juveniles contributes to a better understanding of the taxonomic placement of *Zethera*, a member of an apparent complex whose constituent genera have been lacking in recorded life histories.

On 3 August 1994, I received eight eggs of *Z. musides* that were obtained from a female confined with bamboo at Mambucal, Negros Occidental, (northern) Negros, Philippines. An accompanying note indicated that *Z. musides* was then common on the island of Negros. One ovum hatched on the day of receipt, while the other seven eclosed on 4 August. The eggs were reflective, appearing gold in color with the formed larvae inside and silvery when empty. The chorion were fully consumed by the two hatchlings whose shells were (still?) affixed to the bamboo leaves (the other six ova arrived loose).

Rearing of *Z. musides* was done indoors in a room under ambient, unconfined conditions. The bamboo provided the caterpillars was a growing *Arundinaria pygmaea* (Miquel) Mitford (Poaceae), which was purchased from a local nursery. It was set on a table, among other potted plants, next to a west-facing window where the afternoon sun was filtered by a sheer curtain. The larvae and pupae, as well as the foliage surrounding them, were thoroughly misted with water twice daily.

Except for the first few days of their lives, the *Z. musides* caterpillars were given *A. pygmaea*, which is native to Japan and grows to a height of only about 30cm. Four of them made it through their first molt, but two of these died soon thereafter. The remaining two larvae fed to maturity with no apparent problem, having five stadia lasting, in order, an average of 10, 7.5, 8.5, 11,



PLATE A. *Zethera musides*: 1. Lateral view of a resting mature larva, photographed on *Arundinaria pygmaea* two days into its last (fifth) instar. 2. Dorsal aspect of the same caterpillar at the same time. 3. Ventral surface of one of the reared adult males (forewing length = 36mm). 4. Shed larval head capsules and an empty pupal shell as attached to its formed strip of *Arundinaria pygmaea* (see text).



PLATE B. *Penthema formosanum* and *Neorina lowii*: 5. Dorsal view of a resting *P. formosanum* final-instar caterpillar, photographed on *Arundinaria pygmaea*, the hostplant that it was raised on, 18 days before pupation (ex confined female collected June 1995 in Mucha, Taipei, Taiwan). 6. Fully mature larva of *N. lowii*, photographed at the Penang Butterfly Farm, Penang, Malaysia (courtesy of Hoe Chuah). 7. Chrysalis of *P. formosanum*, lateral aspect, photographed 10 days before its eclosion (foodplant and collection data are the same as for the larval figure). 8. *N. lowii* pupa, photographed at the Penang Butterfly Farm, Penang, Malaysia (courtesy of B. T. Chin).

and 20 days (Fig. 4). Shed skins were obviously eaten, this act being witnessed with one caterpillar that was entering its second instar. The resultant feeding damage to *A. pygmaea*, which was a large swath eaten out of the middle of a leaf that typically left a slender strip of unconsumed blade along one margin, resembles what is made by larvae of the *Penthema formosanum* (Rothschild) (Nymphalidae: Satyrinae) (Chang, 1973; Fukuda, 1975).

In appearance, mature *Z. musides* caterpillars (Fig. 1-2) are quite similar to those of *P. formosanum* (Fig. 5) as well as *Penthema* ("*Paraplesia*") *adelma* (Felder) (Li and Zhu, 1992), the obvious differences being *Z. musides*' two short pale green lines on the back, reddish brown coloration, and flared ends to the caudal projection. Last-instar (fifth) *P. formosanum* and the *P. adelma* of probable like age have no such lines on their light brown dorsum and a pair of entirely adjoining tails. However, it seems likely that the configuration of these posterior projections is subject to some individual variation. Neither of the two *Z. musides* larvae were observed to raise steeply the front part of their bodies off the plant, as is depicted for *P. formosanum* (Fukuda, 1975; Lee and Chang, 1988) and *P. adelma* (Li and Zhu, 1992).

Additionally, I requested and received slides of immature *Neorina lowii* (Doubleday) (Nymphalidae: Satyrinae) that were taken at the Penang Butterfly Farm, Malaysia, and as is the case with the above two Chinese *Penthema* species, the mature caterpillar of *N. lowii* (Fig. 6) strongly resembles that of *Z. musides*. A new pictorial book on tropical rain-forest insects (Unno, 1994) has a small photograph of a younger *N. lowii* larva, identified in katakana only and without accompanying text.

The literature records *Bambusa multiplex* (Loureiro) Raeuschel, *Bambusa oldhamii* Munro, *Phyllostachys makinoi* Hayata, three bambusoid grasses, and *Zizania latifolia* (Grisebach) Stapf, a cultivated vegetable known as "wild rice," all Poaceae, as hostplants for *P. formosanum* in Taiwan. Li and Zhu (1992) show a caterpillar of *P. adelma* clearly on bamboo, and in fact the caption talks about its similarity to a brown and yellow, dried bamboo leaf. As for *N. lowii*'s foodplant, during a June 1995 stopover in Malaysia, I visited the butterfly house on Penang and learned that *N. lowii* uses three kinds of bamboo inside this enclosed exhibit.

About one week prior to pupation, a resting *Z. musides* larva in its final stadium measured 55mm from the tip of its forward-pointed cephalic "horn" (actually two contiguous ones) to the end of its bowed tails. Both caterpillars pupated at the terminus of their last-occupied resting perches, which were pendent slivers of *A. pygmaea* blade that their above-described feeding manner formed. The chrysalises (Fig. 4) had a pair of 6mm head projections, which were parallel on one but crossed on the other, with the same individual whose length as a larva is noted above measuring 38mm from tip to tip. Again, the pupae are very similar in form and habit to those of *P. formosanum* (Fig. 7) and *N. lowii* (Fig. 8).

Thus, the larval stage for these two reared *Z. musides* lasted 56 and 58 days, and their pupal stage both lasted 11 days. Two males resulted, eclosing on 10 and 12 October 1994, and are being kept as unpinned voucher specimens (Fig. 3). The length of

which is considerably smaller than the mean of 45mm obtained from the four wild-collected Negros males examined by Vane-Wright and Smiles (1975). The empty head capsules and chrysalid shells are in the author's possession and, along with the voucher adults, will be bequeathed to the California Academy of Sciences, San Francisco, California, at some time in the future.

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LITERATURE CITED

- Ackery, P. R.**
1988. Hostplants and classification: a review of nymphalid butterflies. *Biol. J. Linn. Soc.* (London), 33:95-203.
- Chang, B.-S.**
1973. The life-history of *Penthema formosanum* Rothschild in Formosa (Lepidoptera: Satyridae). *Tyô to Ga* (Osaka), 24:81-83. (In Japanese)
- D'Abrera, B.**
1984. *Butterflies of the Oriental Region. Part II. Nymphalidae, Satyridae & Amathusiidae*. Melbourne: Hill House. 290pp.
- Fukuda, H.**
1974. *Life Histories of Butterflies*. Tokyo: Seibundoshinkosha. 272 pp. (In Japanese)
1975. Record of the adult and larva of *Penthema formosnum*. In *Report of Investigation on the Butterflies of Lanyu, Taiwan*, 114-123. Kagoshima: Kagoshimadaigaku Seibutsukenkyukai. (In Japanese)
- Igarashi, S., and H. Fukuda**
(in prep.). Life-histories of Asian Butterflies.
- Lee, J.-Y., and Y.-C. Chang**
1988. *Illustrations of Butterflies in Taiwan (1)*. Taipei: Taiwan Mus. 142pp. (In Chinese)
- Li, C. L., and B. Y. Zhu**
1992. *Atlas of Chinese Butterflies*. Shanghai: Shanghai Yuandong. 238pp. (In Chinese)
- Tsukada, E.** (ed.)
1982. *Butterflies of the South East Asian Islands. III. Satyridae, Libytheidae*. Tokyo: Plapac. 500pp. (In Japanese)
- Unno, K.**
1994. *Great History of Insects: Tropical-Jungle Part*. Tokyo: Detahausu. 263pp. (In Japanese)
- Vane-Wright, R. I., and R. L. Smiles**
1975. The species of the genus *Zethera* Felder (Lepidoptera: Nymphalidae, Satyrinae). *J. Ent.* (London), (B. Taxon. Syst.) 44: 81-100.