

Attraction of male *Lymantria schaeferi* Schintlmeister (Lepidoptera: Erebidae: Lymantriinae) to traps baited with (+)-xylylure in Jiangxi Province, China¹

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Abstract: Our objective was to investigate potential sex attractants for *Lymantria schaeferi* Schintlmeister (Lepidoptera: Erebidae: Lymantriinae). In a field trapping experiment deployed in the Wuyi Mountains near Xipaihe, Jiangxi Province, China, traps were baited with synthetic sex pheromone of congeners *L. dispar* [(+)-disparlure], *L. xylyna* [(+)-xylylure] or *L. monacha* [a blend of (+)-disparlure, (+)-monachalure and 2-methyl-Z7-octadecene]. Traps baited with (+)-xylylure captured 24 males of *L. schaeferi*, whereas traps baited with (+)-disparlure captured two males of *L. dispar asiatica*. These findings support molecular evidence that *L. schaeferi* is more closely related to *L. xylyna*, which uses (+)-xylylure for sexual communication, than it is to *L. dispar asiatica*, which uses (+)-disparlure for sexual communication. These findings also support the conclusion that *L. schaeferi* and *L. dispar asiatica* are sympatric in the Wuyi Mountains.

Key Words: Sex pheromone, small sticky traps, Wuyi Mountains, forest habitat, *Lymantria xylyna*, *Lymantria dispar asiatica*, disparlure

Little is known about the life history and behavior of *Lymantria schaeferi* Schintlmeister. This is due, in part, to its recent recognition as a new species (Schintlmeister, 2004) and earlier confusion of a moth population in China with a moth population in India identified as *Lymantria incerta* Walker (Chao, 1994; Zhao 2003). Erroneous reports (deWaard et al. 2010) that *L. xylyna* Swinhoe in China was described as *L. schaeferi* by Schintlmeister (2004) have added to this confusion.

Lymantria schaeferi (Figure 1) and *L. xylyna* (Figure 2) are not sympatric in China and males of these two species are morphologically distinct from one another. Males of *L. xylyna* are predominantly white, whereas males of *L. schaeferi* are dark brown and resemble males of *L. dispar* except that they bear pink setae on their legs, venter of the thorax, and on the pronotum behind the head. The pink coloration mentioned is common to both *L. schaeferi* and *L. xylyna*. Furthermore, genetic analysis of a single specimen of *L. schaeferi* (provided for analysis by A. Schintlmeister from the paratype series) led to the conclusion there is only 0.2% molecular sequence divergence between *L. xylyna*

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and *L. schaeferi* (deWaard et al., 2010). Here we present further evidence that these two species are closely related.



Figures 1-4. Male *Lymantria* spp. 1. *Lymantria schaeferi* captured in sticky trap (in situ), near Xipaihe, in the Wuyi Mountains (elevation 1000 – 1100 m), Jiangxi Province, China, and these traps were baited with xylinalure and deployed 22 June to 14 July 2012. Photo by Ming Jiang. 2. *Lymantria xyliua* in Kuanyin, Taiwan, 24 May 1998. 3. *Lymantria dispar asiatica* reared on laboratory diet from ova originating in Toktogal, Kyrgyz Republic, ova collected by A. Orozumbekov, reared under quarantine conditions by P. W. Schaefer, 2005. 4. *Lymantria monacha* in Morioka, Iwate Prefecture, Japan, 24 July 1997. Figures 2-4, photos by Paul Schaefer.

Based on current knowledge, *L. schaeferi* is endemic in south-central China and present in the provinces of Jiangxi (Type Locality: Xipaihe), Hubei and Guangdong (Zhao, 2003). We conclude that maple (*Acer* spp.; Aceraceae) appears to be a larval food plant (Zhao, 2003)⁶. We know nothing about the

⁶ The late lepidopterist Madam Chao maintained the Chinese population was *L. incerta* (Chao, 1994; Zhao (= Chao), 2003) and eventually listed host plants with common names that equate to the genera *Terminalia* and *Acer* (Zhao, 2003). With the recognition that the Chinese population was a misidentification and not in fact *L. incerta* (confined to the Indian sub-continent), Schintlmeister

population dynamics of this species nor whether it ever reaches outbreak populations. Our objective was to investigate potential sex attractants for male *L. schaeferi* by field testing available known sex pheromones of its congeners *L. xylina* (Figure 2), *L. dispar* L. (Figure 3), and *L. monacha* (L.) (Figure 4).

Methods

A field trapping experiment (22 June to 14 July 2012) was deployed in a subtropical, evergreen broad-leaved forest (N 27°54.24', E 117°19.66'; elevation: 1000-1100 m) in the Wuyi Mountains near Xipaihe, Jiangxi province, China (Figure 5) from where *L. schaeferi* was first described. Among the various tree species in this forest were *Castanopsis sclerophylla* (Lindl.) Schott., *C. carlesii* (Hemsl.) Hayata, *C. eyrei* (Champ.) Tutch (all Fagaceae), *Tsuga chinensis* (Franch.) (Pineaceae), *Platycrater arguta* Sieb. et. Zucc. (Hydrangeaceae), *Bretschneidera sinensis* Hemsl. (Bretschneideraceae), *Emmenopterys henryi* Oliver (Rubiaceae), *Taxus chinensis* var. *mairei* Cheng et L.K. (Taxaceae), *Machilus chekiangensis* S. K. Lee (Lauraceae), *Ormosia henryi* Prain (Leguminosae), *Torreya jackii* Chun (Taxus), and *Zelkova serrata* (Thunb.) Makino (Ulmaceae). We confirmed that *Acer pictum* subsp. *mono* (Maxim) H. Ohashi (Aceraceae) was present as a minor forest component.

Delta-like traps were wired to vegetation (Figure 6) approximately 2 m above ground in non-randomized blocks (3 treatments in repeating sequence, 10 replicates each) in a trap line with 15-20 m between traps and blocks. Traps (7 x 18 cm) were made from Elopak™ or Pure-Pak™ 473 ml juice cartons (ELOPAK, Oslo, Norway). The outer surface was painted green with a water-based latex paint to minimize contrast with vegetation. Two panels only of the inner surface were covered with a thin layer of Stikem Special™ (Michel & Pelton, Co., Emeryville, California, USA) as a trapping adhesive.

Traps were baited with a grey rubber sleeve stopper (Item #10600275, West Pharmaceutical Services Co., Lionville, Pennsylvania, USA) impregnated with synthetic sex pheromone of *L. dispar* (Bierl et al. 1970) [(+)-disparlure: (7*R*,8*S*)-*cis*-7,8-epoxy-2-methyloctadecane (100 µg)], *L. xylina* (Gries, et al. 1999) [(+)-xylinalure: (7*R*,8*S*)-*cis*-7,8-epoxy-2-methyleicosane] or *L. monacha* (Gries et al. 1996) [a blend of (+)-disparlure (100 µg), (+)-monachalure (100 µg) ((7*R*,8*S*)-*cis*-7,8-epoxy-octadecane) and 2-methyl-Z7-octadecene (10 µg)] in HPLC-grade hexane (Figures 2-4 show expected species). Captured male moths were identified to species using digital imagery of each specimen and comparing them to the expected species.

(2004) renamed the Chinese population *L. schaeferi*. An earlier listing of the food plants of *L. incerta* listed *Terminalia* but not *Acer* (Maxwell-Lefroy and Howlett, 1971). We are left with the belief that the listing of *Acer* by Zhao (2003) is a valid host record in China. We know nothing further about the basis of this record. We recommend that *Acer* be verified as a host whenever larval stages of *L. schaeferi* become available.



Figures 5-6. Location of the study. 5. Partial map of China highlighting Jiangxi Province with “X” marking the Wuyi Mountains and approximate study area location. Map modified from <http://gochina.about.com/od/maps/ig/Province-Maps/Jiangxi-Province-Map.htm> (visited on April 27, 2013). 6. Wuyi Mountain forest habitat showing one sticky trap wired in position. Photo by Ming Jiang.

Results and Discussion

Traps baited with (+)-xylinalure captured 24 males of *L. schaeferi* (Figure 1), whereas traps baited with (+)-disparlure captured two males of *L. dispar asiatica* similar to the central Asian specimen shown in Figure 3. Two additional small male moths were captured in traps baited with the *L. monacha* pheromone blend but one was submerged in trap adhesive and the other had missing body parts (likely removed by birds) and thus neither could be identified. These two specimens likely represent a third responding species.

Our finding that males of *L. schaeferi* were attracted to (+)-xylinalure, but not to (+)-disparlure, supports molecular evidence (deWaard et al. 2010) that *L. schaeferi* is more closely related to *L. xyliana*, which uses (+)-xylinalure for sexual communication (Gries et al. 1999) than it is to *L. dispar*, which uses (+)-disparlure for sexual communication (Bierl et al. 1970). However, we have yet to analyze the sex pheromone of female *L. schaeferi* and to confirm that they produce (+)-xylinalure. If so, the distinctively different communication systems of *L. schaeferi* and *L. dispar asiatica* could be expected as the geographic distribution of *L. schaeferi* and *L. xyliana* [distributed in southern Japanese Islands, including Okinawa, Taiwan and coastal south China (Li et al., 1981; Pogue and Schaefer, 2007)] almost overlap in southern China and also appear to be separated by differences in elevation.

Our collection of male *L. schaeferi* in the Wuyi Mountain forest helps establish the habitat of this moth species as a subtropical evergreen broad-leaved forest (Figure 6). Among the many tree species is an occasional *Acer pictum* subsp. *mono* which may serve as one larval host plant based on the listing by Zhao (2003). Our collection of two male *L. dispar asiatica* in traps baited with

(+)-disparlure confirms the presence of *L. dispar asiatica* also in the Wuyi Mountains in an area close to its southern distribution limits in China (Schaefer et al., 1984).

Following export of trap-captured specimens, additional genetic analyses (deWaard et al. 2010) and placement of voucher specimens will be completed. (+)-xylinalure as a trap lure may now prove useful for further studies into the behavior of *L. schaeferi*.

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