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Dancing behavior of *Cosmopterix victor* STRINGER, a species new to the fauna of China

(Lepidoptera: Cosmopterigidae)

With 3 figures

STEVEN R. DAVIS and SERGEY YU. SINEV

Summary

A bamboo-feeding species *Cosmopterix victor* STRINGER, 1930 is mentioned from mainland Asia for the first time, with a description and illustration of its very striking dancing behavior. This behavior is regarded as a special adaptation providing the aggregation of adults on the host plants for mating and subsequent oviposition.

Keywords

Microlepidoptera, Zhejiang Province, Cosmopterigidae, *Cosmopterix victor*, dancing behavior.

Zusammenfassung

Zum ersten Mal wird ein Fund der Bambus fressenden Art *Cosmopterix victor* STRINGER, 1930 vom asiatischen Festland gemeldet. Weiterhin wird das sehr auffällige Tanzverhalten dieser Art beschrieben und abgebildet. Dabei handelt es sich um eine spezielle Anpassung, um für eine Ansammlung der adulten Schmetterlinge auf der Wirtspflanze zur Paarung und anschließenden Eiablage zu sorgen.

Introduction

The genus *Cosmopterix* is an easily recognized group, composed of approximately 185 species worldwide, and distinct from other Cosmopterigidae by its characteristic wing pattern (SINEV 2002; KOSTER and SINEV 2003; KUROKO and LIU 2005). Although many species are nearly identical in wing pattern, their genital morphology bears striking differences (HODGES 1962; SINEV 1985, 1988, 1997). The East Asian fauna of *Cosmopterix* has been reviewed mainly by SINEV and KUROKO, and the Chinese fauna is in great need of further systematic study.

In the summer of 2006 the first author spent approximately 30 minutes on Tian Mu mountain (Zhejiang Province, China) observing several specimens of *Cosmopterix* dancing on the leaves of unknown species of bamboo (Poaceae: Bambuseae).

This paper represents the identification of the moths and the first detailed documentation of dancing in the family Cosmopterigidae, including a depiction and explanation of the manner in which the dance is performed.

Materials and Methods

Specimens of *Cosmopterix* were observed dancing on foliage along the primary hiking trail ascending to the peak of Tian Mu Shan, Zhejiang Province, China. Video footage of two specimens was taken with a Nikon Coolpix 5400 digital camera. Dissections were made using a Zeiss Stemi SV11 stereomicroscope.

Results

The determination of the material made by the second author revealed that all specimens collected belong to *Cosmopterix victor* STRINGER, 1930, one of the largest species of the genus originally described and previously known only from Japan.

Cosmopterix victor STRINGER, 1930

Cosmopterix victor STRINGER, Annls & Mag. nat. Hist. (10) 6: 416 (1930).

Cosmopterix victor: KUROKO, Kontyû 25 (1): 30, pl. 2, figs. 1 and 2 (♂ genitalia), pl. 3, fig. 3 (♀ genitalia) (1957); ISSIKI, Icones Heterocerorum Japonicorum: 39, pl. 7, fig. 159 (moth) (1957); KUROKO, in ISSIKI, Early Stages of Japanese Moths in Color: 106, pl. 51, fig. 203 (moth, mine, and larva) (1969); KUROKO, in INOUE et al., Moths of Japan 1: 270; 2: pl. 11, fig. 14 (moth) (1982); SINEV, Entomol. Obozr. 76 (4): 829, fig. 24 (♂ genitalia), fig. 61 (♀ genitalia) (1997).

Material examined: China: 2 ♂, Zhejiang Province: Tian Mu Shan, 30 June 2006, 1176 m, 30° 20.634' N, 119° 26.401' E, S. DAVIS (coll. IZCAS); 1 ♀, Zhejiang Province: 'Ost Tien-mu-shan, Prov. Chekiang, 27.5.1931, H.HÖNE' (coll. ZMFK, Bonn). Japan: 1 ♂, 1 ♀, Kyushu, Hikosan (Buzen), 15.vi.1955, H.Kuroko (coll. ZIAN, St.Petersburg).

Distribution:

Japan (Honshu, Shikoku, Kyushu) and eastern China (Zhejiang). New to China.

Biology:

Larvae mine leaves of *Sasa japonica* MAKINO, *S. purpurascens* OHWI, *Phyllostachys bambusoides* SIEB. et ZUCC., and *Arundinaria pygmaea* MITFORD (Poaceae: Bambuseae) (KUROKO 1957).

Dancing behavior (Figs 1-3)

Movements of the moth were never linear and consisted mainly of turns in which the caudal end of the adult would swing around more rapidly than the anterior end (Figs 1, 3), demonstrating a motion much like that of the windshield wiper on an automobile. The antennae were held at an approximate 30° angle from the lateral. In between these swinging motions were variable periods of spinning (Figs 1, 2), in which two general types of rotation movements were observed. One type of spinning, referred to here as type 1 spinning, involved the moth positioning its head at one spot while the remainder of its body rotated around this central axis in a clockwise or counter-clockwise direction. The second type of spinning, type 2 spinning, was very similar to type 1, only the anterior end moved more and would not rotate around a single, fixed point. Type 2 spinning often immediately followed type 1 but did not always occur in this sequence. The number of

rotations varied tremendously, with as few as 2 to as many as 18 rotations in one direction. Movements were never restricted to any given areas of the leaf, but were sometimes slightly more concentrated in some areas, with a few locations being visited more than once where spinning previously occurred. The total duration of the dance was not witnessed, nor was the beginning or end, however dancing that was observed lasted for over 3 minutes and ended only as a result of the specimens being collected.

Discussion:

The dancing behavior observed in *C. victor* is not characteristic of this species nor of *Cosmopterix*, but rather usual for many cosmopterigid genera, i.e. *Labdia* WALK., *Vulcaniella* RIEDL, *Ressia* SIN., etc. (SINEV, 1993). In this family, many species are active before sunset, when they often dance on the leaves of shrubs and grasses making very peculiar circular passes. The similar styles of motions have been occasionally observed in several Gelechiidae (*Belthecca*), Elachistidae, Tineidae (*Dryadaula*), and Oecophoridae (ROBINSON 1988; POWELL 1999; KAWAHARA and ADAMSKI 2006; KUROKO pers. comm.; NISHIDA pers. comm.). Other types of dancing have been described in *Brenthia* (Choreutidae), which articulates its fore and hind wings as a mating display (AIELLO and BECKER 2004) and in *Nemophora* (Incurvariidae), which performs another type of mating display (OORD 1981).

The reasons and implications for this dancing behavior were only shortly discussed by the authors. As noted for *Belthecca oni* by KAWAHARA and ADAMSKI (2006), this behavior could be involved in searching for drops of water on the leaf's surface, in which once the moth happens upon a drop of water, it inserts its haustellum into the droplet and consumes it while rotating. This situation is a possible explanation, although it was unclear whether water was present on the leaf or not due to the small scale of the situation.

However, foraging alone does not seem to be an adequate explanation for the complex movements involved in this dance. It is natural for an insect to make a random search path while foraging, but the swinging motions made during the random forward movements of *Cosmopterix* seem extraneous for foraging behavior. Besides that, the observed type 2 spinning does not appear to be relevant to drinking from drops of water as the type 1 spinning could explain. So, the question remains why such elaborate, exaggerated, seemingly aimless movements are performed by these moths.

It is much more likely that this dance is courtship related (SINEV, 1993, 1994). One can explain it as a kind of pre-mating behavior promoting the aggregation of individuals in the proper places. "The demonstration of presence" by peculiar movements on the leaves' surface combined with very bright coloration (contrasting black-and-white with shiny metallic stripes in *Cosmopterix*) evidently facilitates the meeting of different sexes as in the swarms of dipterans, hymenopterans and some lepidopterans (i.e. Adelidae). It is also very important that the dance of cosmopterigids takes places preferably on their host plants. The second author had an opportunity to observe this behavior for *Cosmopterix ziegelerella* (HÜBNER, [1810]) on *Humulus lupulus* L. (Canabaceae) in Ukraine, for *C. pulchrimella* CHAMBERS, 1875 on *Parietaria officinalis* L. (Urticaceae) in Transcaucasia, for *C. phyladelphella* SINEV, 1985 on *Philadelphus schrenkii* RUPR. et MAXIM. (Hydrangeaceae) and *C. schmidiella* FREY, 1856 on *Maackia amurensis* RUPR. et MAXIM. (Fabaceae) in Primorye Territory (Russian Far East), etc. In some cases, the number of dancing specimens, both males and females, on a single plant attained several tens and even hundreds (for *C. pulchrimella*). After copulation, the female usually does not abandon the territory of a group of host plants and continues dancing on the leaves, only now searching for a suitable place for oviposition. It is usually a spinning of type 2, when the female, testing the leaf surface by the tip of the ovipositor, lays eggs singularly on the under surface of the leaf along its main veins.

The above described dancing behavior of *Cosmopterix*, as well as of other Lepidoptera, can be a special adaptation of monophagous and strictly oligophagous forms providing the aggregation of adults on the host plants for mating and subsequent oviposition. It allows uniting two different life activities, the searching for a sexual partner and the searching for appropriate host plant, which leads to the economy of energy and to the success of reproduction.

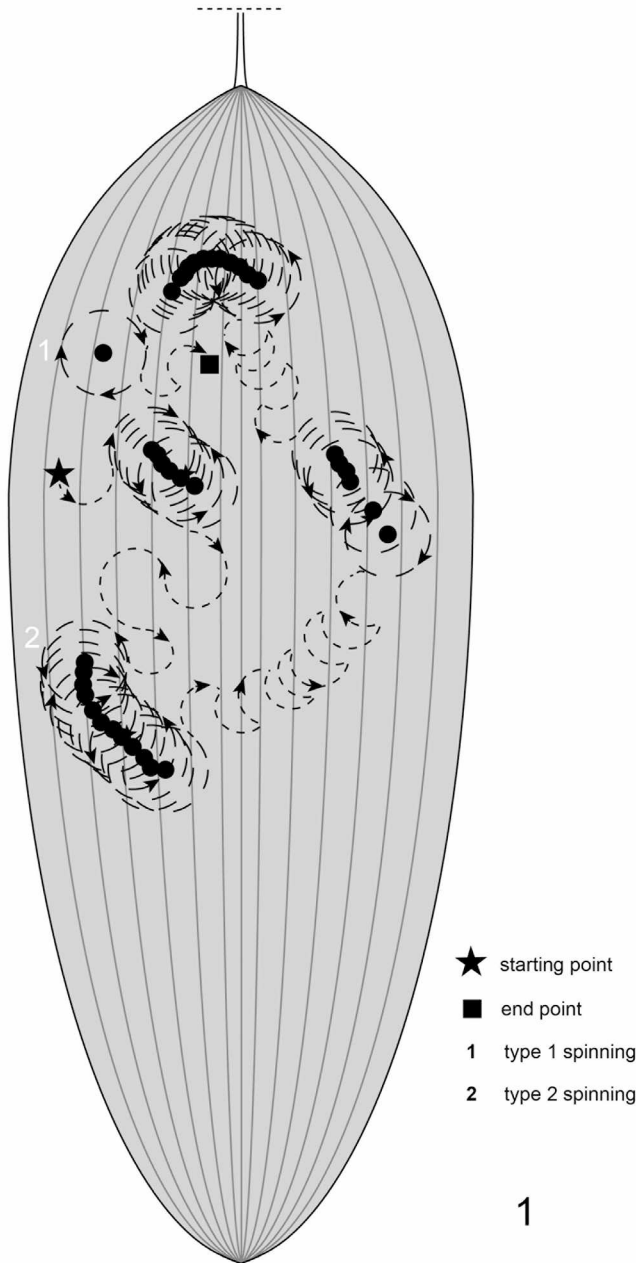
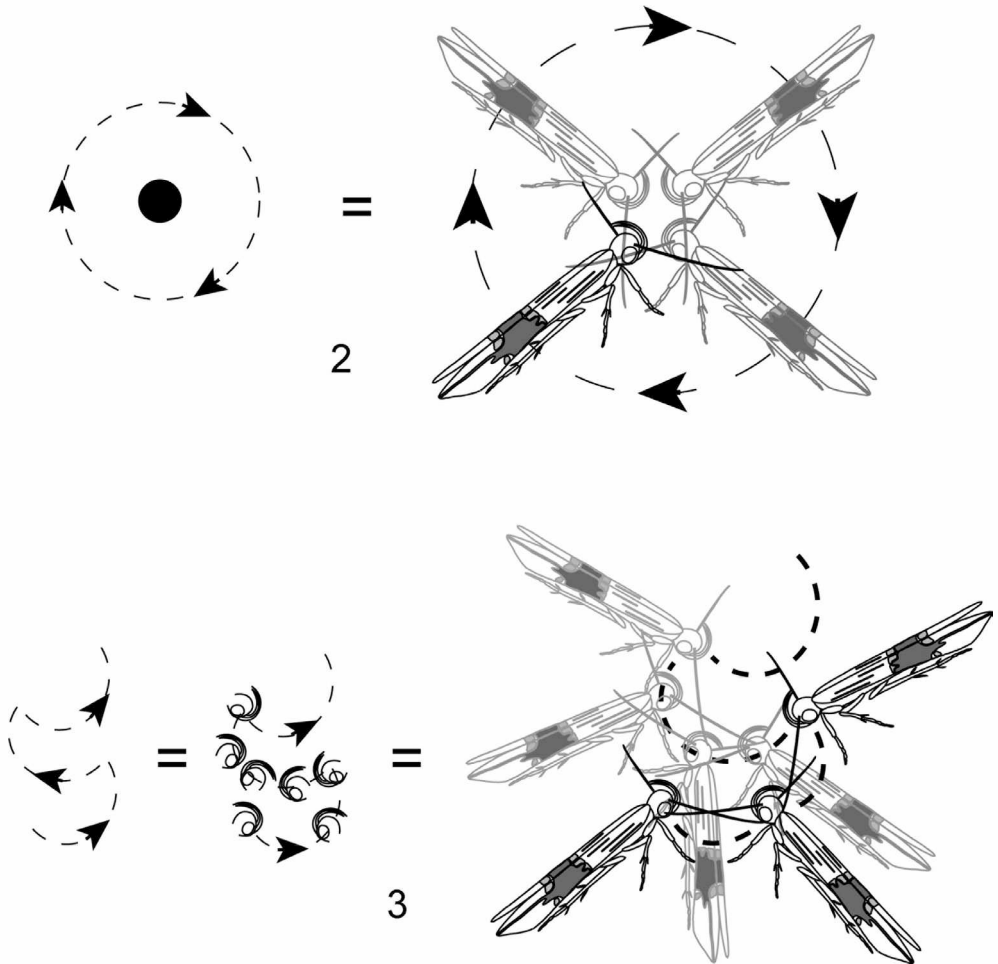


Fig. 1: Diagram of dance path on a leaf. Figure represents only a fragment of the entire dance.



Figs 2-3: Depiction of body orientation during dance. 2, body orientation during spinning; 3, body orientation during swinging motion.

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Authors' addresses:

STEVEN R. DAVIS
Division of Entomology
Natural History Museum, and
Dep. of Ecology & Evolutionary Biol.
1501 Crestline Drive – Suite #140
University of Kansas
Lawrence, Kansas 66049-2811, USA
steved@ku.edu

Subject editor:

SERGEY YU. SINEV
Laboratory of Insects Taxonomy
Zoological Institute of the
Russian Academy of Sciences
Universitetskaya nab. 1
199034 St.Petersburg
Russia
sinev@zin.ru

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