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(*Niteloferus*) *californicus* (Ashmead) (Hymenoptera:
Crabronidae)**

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of *Miscophus (Niteloaterus) californicus* (Ashmead)
(Hymenoptera: Crabronidae)

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Additional observations on the nesting behavior of *Miscophus*
(*Niteloaterus*) *californicus* (Ashmead) (Hymenoptera: Crabronidae)

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Abstract. Close-up photographs of nest entry, nest closure and prey transport taken on sandy coastal back dunes in Santa Barbara County, CA by Alice J. Abela substantiate and enhance written descriptions of these nesting behavior components in *Miscophus californicus* (Ashmead) [= *M. laticeps* (Ashmead)] (Hymenoptera: Crabronidae). Dictynidae (*Dictyna* Sundevall or *Emblyna* Chamberlin) is introduced as a new host family and host spider leg amputation is revealed for the first time for this small miscophine wasp.

Key words. Nest entry, nest closure, prey transport, host spider leg amputation, Dictynidae, Lycosidae, Salticidae.

Introduction

Miscophus (*Niteloaterus*) *californicus* (Ashmead) (Hymenoptera: Crabronidae) is a small (4.5–7.0 mm) Nearctic miscophine wasp that ranges from California and Arizona north to southern Alberta and Saskatchewan (M. Buck, Royal Alberta Museum, Edmonton, AB, 2020 pers. comm.). This species is extremely common in California with larger black individuals inhabiting relict sand dunes along the Pacific Coast (Wasbauer 1978). The females excavate short shallow burrows in friable soil and hunt various tiny spiders which they immobilize with a sting in the cephalothorax. They transport the prey forward in flight or on the ground, depending on its relative size and weight, and return periodically to an open or closed nest entrance holding the spider face forward and venter to venter. They release the prey on the ground in that position, enter the burrow, pull the spider inside, and, after several spiders are deposited within and oviposition on a single prey occurs, close the burrow and entrance with loose soil.

The nesting behavior of *Miscophus californicus* [as *M. laticeps* (Ashmead)] was studied in 2010, 2011 and 2012 at Montaña de Oro State Park, San Luis Obispo County, CA by Kurczewski et al. (2012) to clarify variation in previous reports on this species. Voucher specimens from this study were collected from coastal sand dunes in San Luis Obispo and Santa Barbara counties, CA, deposited in the University of California–Davis R.M. Bohart Insect Museum, and identified as *M. laticeps* by L.S. Kimsey, University of California–Davis. This study was basically in agreement with that on *M. californicus* by Powell (1967) and in disagreement with the study of *M. laticeps* by Cazier and Mortenson (1965). *Miscophus laticeps* is a heretofore previously unpublished synonym of *M. californicus* in Joanne Slansky Wasbauer's (1978) Ph. D. Thesis from the University of California–Davis (L.S. Kimsey, University of California–Davis, Davis, CA, 2020 pers. comm.).

Materials and Methods

Eight photographs from sandy coastal back dunes, Santa Barbara County, CA were sent to Frank E. Kurczewski, a hymenopterist, by Alice J. Abela, a wildlife biologist, in 2014, 2016 and 2017 for wasp species identification. The first author, in turn, sent these photographs and spider specimens in alcohol from Montaña de Oro State Park, San Luis Obispo County, CA to Darrell Ubick, an arachnologist, for spider species identification. The excellent close-up photographs of the wasp (Fig. 1, 2) were compared with voucher specimens from a previous study on the nesting behavior of *Miscophus californicus* [as *M. laticeps*] (Kurczewski et al. 2012). Three prominent hymenopterists, Wojciech J. Pulawski, Lynn S. Kimsey and Matthias Buck, were consulted to ensure the correct species name was used. Dichotomous keys in Joanne Slansky Wasbauer's (1978) unpublished Ph. D. thesis, synonyms, species description, color and size variation, and geographic distribution ascertained that *M. californicus* was the correct species name. Realizing that Abela's eight photographs not only supported but enhanced the 2012 study on this species, the authors collaborated on written descriptions to accompany the photographs in this supplemental paper. Lukas Friedrich, a graphic design specialist from New York, NY, placed the eight photographs on a single plate in chronological order to match their position in the **Results**. The external morphology (Fig. 1, 2, 7, 8) and nesting behavior activity (Fig. 3–6) in each photograph was described in detail, including the discovery of a new host spider family for *M. californicus* (Dictynidae) and first-time observation of leg amputation in a Nearctic species of *Miscophus*.

Results

On 12 June 2014 a female of *M. californicus*, 6 mm long, was photographed in series by Alice J. Abela on sandy coastal back dunes, Santa Barbara County, CA (Fig. 1, 2). Her close-up photographs match in every detail the voucher specimens from Kurczewski et al.'s (2012) study as well as keys, species description, figures and geographic distribution maps in Wasbauer's (1978) Ph. D. Thesis. Females of *M. californicus* can be separated from other species of western *Miscophus* by their larger size, all-black color, silvery/golden head and thoracic pubescence, reduced wing venation, fuscous apical half of forewing, well developed foretarsal rake and coastal California geographic distribution (Bohart and Menke 1976; Wasbauer 1978).

On 6 April 2016 Alice J. Abela took a series of close-up photographs of *M. californicus* from the sandy coastal back dunes that elucidate important components of the wasp's nesting behavior. Figure 3 shows the wasp releasing the immobilized spider on the sand, face forward and ventral side upward, and removing the temporary sand closure from her entrance using her forelegs in unison. Figure 4 shows the spider lying motionless on the sand as the wasp has entered and is inside her burrow. Figure 5 shows the wasp exiting her burrow headfirst after placing the spider inside and remaking the temporary sand closure of the entrance using her forelegs in unison. Abela's photographs also disclose a new family (Dictynidae) and genus (*Dictyna* Sundevall or *Emblyna* Chamberlin), adult female (det. D. Ubick), of host spider. The discovery of Dictynidae as a new host family for *M. californicus* brings to seven the number of host spider families now captured by this small polyphagous miscophine wasp if Cazier and Mortenson's (1965) *M. laticeps* observations refer to this species: Pholcidae, Oecobiidae, Araneidae, Theridiidae, Lycosidae, Dictynidae, and Salticidae (Cazier and Mortenson 1965, Powell 1967, Kurczewski et al. 2012).

A third female of *M. californicus* was photographed by Alice J. Abela on the sandy coastal back dunes on 19 July 2017 transporting an immobilized *Habronattus* sp., juvenile (det. D. Ubick) forward on the ground, face first and ventral side upward, grasping its left foreleg midway from the end with her mandibles (Fig. 6). During ground transport, the wasp rhythmically bobbed her abdomen up and down and periodically flicked her wings. The spider had its right hindleg and second left leg missing beyond the coxa-trochanter joint (Fig. 7, 8). Amputation of the host spider's legs was not mentioned in previous studies on Nearctic species of *Miscophus* (*Niteloapterus*) (Cazier and Mortenson 1965; Powell 1967; Kurczewski 1969, 1981; Kurczewski et al. 2012).

Two other observations of *M. californicus* (Montaña de Oro State Park, San Luis Obispo County, CA; 20 August 2014; F. E. Kurczewski) confirm previous host records for this species: *Pardosa ?californica*

Keyserling (Lycosidae), penultimate male (det. D. Ubick), 4.5 mm; *Habronattus* sp., either *californicus* (Banks) or *peckhami* (Banks) (Salticidae), penultimate male (det. D. Ubick), 5.5 mm (wasp, 7.0 mm).

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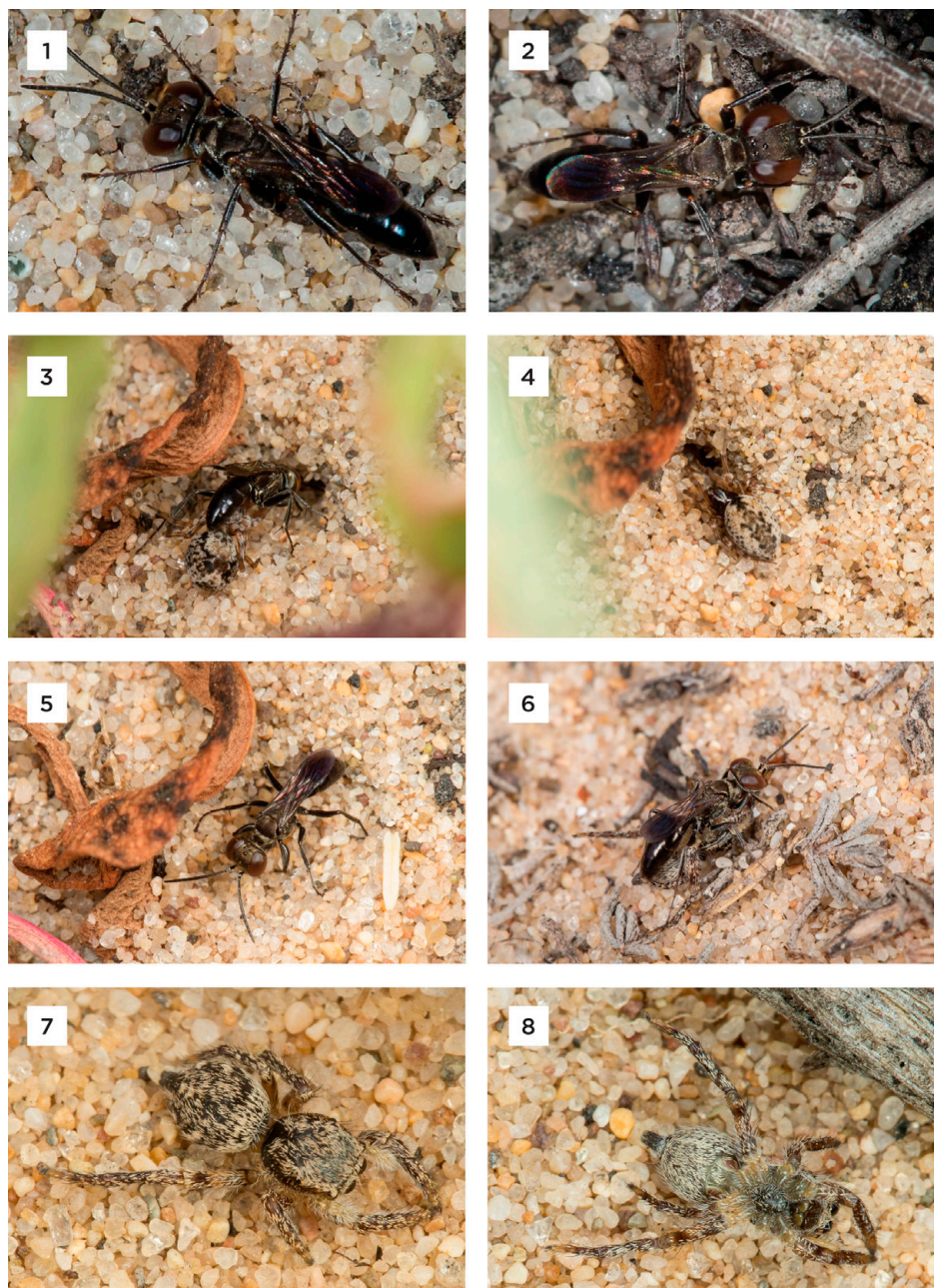
We thank Matthias Buck, Royal Alberta Museum, Edmonton, AB, and Kevin Williams, California Department of Food and Agriculture, Sacramento, CA for reviewing the manuscript. Wojciech J. Pulawski, California Academy of Sciences, and Matthias Buck aided in the identification of *M. californicus*. Matthias Buck provided information on the northern geographic distribution extent of *M. californicus*. Lynn S. Kimsey, University of California–Davis, Davis, CA, aided in the identification and synonymies of *M. californicus* using voucher specimens and Joanne Slansky Wasbauer's unpublished Ph. D. (1978) thesis. Lukas Friedrich, Luna Design Inc., New York, NY reconfigured Figures 1–8 of *M. californicus* as a single plate.

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Figures 1–8. *Miscophus californicus*. **1)** Dorsal view of female on sandy coastal back dunes, Santa Barbara County, CA, 12 June 2014 showing primary taxonomic characteristics as described above. Photograph © Alice J. Abela. **2)** Frontodorsal view of female on sandy coastal back dunes, Santa Barbara County, CA, 12 June 2014 showing primary taxonomic characteristics as described above. Photograph © Alice J. Abela. **3)** Female wasp has released an immobilized adult female of *Dictyna* or *Emblyna* sp. (Dictynidae) on the sand surface, face forward and ventral side upward, and begins to remove her temporary sand closure using her forelegs in unison. Photograph © Alice J. Abela. **4)** Immobilized spider lies motionless on the sand surface in front of the wasp's open entrance. The wasp has entered and is inside her burrow. Photograph © Alice J. Abela. **5)** Female wasp exits her burrow headfirst, after placing the immobilized spider inside, and remakes her temporary sand closure of the entrance using her forelegs in unison. Photograph © Alice J. Abela. **6)** Female transporting *Habronattus* sp. (Salticidae), juvenile, forward on the ground, face first and venter to venter, grasping its left foreleg midway from the end with her mandibles. Photograph © Alice J. Abela. **7)** Immobilized *Habronattus* sp., dorsal side upward. Note missing right hindleg and second left leg. Photograph © Alice J. Abela. **8)** Immobilized *Habronattus* sp., ventral side upward. Note missing right hindleg and second left leg. Photograph © Alice J. Abela.