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New records and updated distribution of *Myopa metallica* Camras 1992 (Diptera: Conopidae: Myopinae) in Chile by using integrative collection methods

Nuevos registros y distribución actualizada de *Myopa metallica* Camras 1992 (Diptera: Conopidae: Myopinae) en Chile usando métodos de colecta integrativa

Rodrigo M. Barahona-Segovia[1,2,3*], Laura Pañinao-Monsálvez[2,4] & Matías Barceló[2,5]

[1]Laboratorio de Ecología de Ambientes Fragmentados (LEAF), Departamento de Ciencias Biológicas Animales, Facultad de Ciencias Veterinarias y Pecuarias, Universidad de Chile, Santiago, Chile.
[2]Citizen Science program "Moscas Florícolas de Chile", Chile.
[3]Centro de Estudios en Ecología Espacial y Medio Ambiente – Ecogeografía, Santiago, Chile.
[4]Facultad de Ciencias Forestales, Universidad de Concepción, Concepción, Chile.
[5]Laboratorio de Conservación Biológica, Departamento de Ciencias Ecológicas, Facultad de Ciencias, Universidad de Chile, Santiago, Chile.
*E-mail: rbarahona13@gmail.com

ABSTRACT

Myopa metallica Camras1992 is a parasitic fly, endemic to Chile, whose distribution was unknown. In this study, four new localities are reported between the Atacama and Metropolitan regions using citizen science. Our work breaks down the methodological barriers, providing a distribution for a rare and conspicuous thick-headed fly.

RESÚMEN

Myopa metallica Camras, 1992 es una mosca parásita, endémica de Chile, cuya distribución era desconocida. En este estudio se reportan cuatro nuevas localidades entre la región de Atacama y Metropolitana usando ciencia ciudadana. Nuestro trabajo rompe las barreras metodológicas, proporcionando una distriución para una especie de mosca conspicua y rara.

Thick-headed flies (Diptera: Conopidae) are represented by 863 species distributed worldwide except for both Antarctica and Pacific Islands (see Freeman 1996, Marshall 2012, Gibson & Skevington 2013, Stuke 2017). These species are considered endoparasitoids, principally bees and aculeate wasps, although also cockroaches and crickets for the genus *Stylogaster* Macquart (see Lopes, 1937, Woodley & Judd, 1998 and Skevington *et al*. 2010); using flowers as watch sites for oviposition, showing an in-flight attack system (Freeman 1996, Marshall 2012, Stuke 2017). In addition, adults are nectarivorous, pollinators and show a hilltop mating behavior (Kendall & Solomon 1973, Skevington *et al.* 2010, Marshall 2012). However, in many parts of the world, this group of flies is barely known, particularly in the Neotropics, a region where the knowledge about natural history and ecology in all species of thick-headed flies is deficient.

Neotropical thick-headed flies are represented by more than 220 species in 14 genera such as *Zodion*, *Physocephala*, *Physoconops* or *Stylogaster* (Skevington *et al.* 2010, Stuke 2017). The principal investigation on Neotropical Conopidae has been in taxonomy (Camras 1955, 1957, 1992, 1996, Pearson & Camras 1978), host-parasite relationships (Melo *et al.* 2008, Stuke *et al.* 2011, Stuke and Cardoso 2013) or checklist (Stuke & Skevington 2007, Rocha & Mello-Patiu 2016). In this sense, native and endemic thick-headed flies in Chile are poorly known, represented by nine species, including the genus *Mallochoconops* Malloch 1933, *Physocephala* Schiner 1861, *Zodion* Latreille 1796 and *Myopa* Fabricius 1775. This last genus has one single species that can be found in South America, only in Chile, where it is endemic: *Myopa metallica* Camras 1992. Recently, this species was rediscovered in Northern Chile, by using the citizen science method, after 46 years of absence of occurrences (Barahona-Segovia *et al.* 2017). This new record that was located to 1,352 km from the type locality, opens the question if the new record could really be a cryptic new species related to *M. metallica* or if the

absence of distributional information is due to the lack of systematic collections between both records (Barahona-Segovia *et al.* 2017). This conspicuous fly is recognized by its shiny red head, antennal segments, eyes, and halters, as well as its evident metallic blue color in the thorax and in a part of the abdominal segments (Barahona-Segovia *et al.* 2017; Fig. 1).

In this natural history note, we remark the necessity of generating new collections due to a large amount of territory without occurrences and the presence of different ecosystems in these geographical gaps, which could be complemented by other methods such as reviewing entomological collections or using citizen science program. According to this communication, we reported new records and updated distribution of the poorly known species *M. metallica* based on i) the active collection between The Atacama Province and Sclerophyllous matorral in central Chile (Morrone 2014), ii) the review of entomological collections and iii) the use of the citizen science program *Moscas Florícolas de Chile* (www.facebook.com/groups/774986852548819/) as external dataset.

Between September and November 2017, Chile presented the phenomenon of flowering desert, which manifest after winter rains and follow by a marked increase in the number and richness of endemic plants (i.e. 19 mm; Vidiella *et al.* 1999). In this time period, spring temperatures increase over 22-24ºC and entomological fauna is active between Atacama and Maule province for mating. Therefore, we carried out three systematic collections using the biogeographical realms (BR) proposed by Morrone (2006, 2014). In each BR, we realized transects of 100 meters each and they were separated by a minimum of 500 meters. The BR surveyed were: i) Atacama province (i.e. from Caldera to Vallenar in the flowering desert bloom (n=19)), ii), Coquimbo province (i.e. from Huentelauquen to La Ligua (n = 12)) and iii) Santiago province in Andean region (i.e. from El Arrayán to El Manzano in Santiago Metropolitan Region (n=7)). Insects were captured by active collection and entomological net by using 10 hand-net points moving in zigzag. All BR present different priority sites for conservation (Muñoz *et al.* 1997) as well as different ecosystems. On the other hand, during January 2016 to December 2017, we carried out a comprehensive revision of native flies in entomological collections (i.e. MNHNC, IEUMCE, MEUC, MZUC, UACH and SAG; see in acknowledgments). In addition, the citizen science program that started in 2015 has +3100 volunteers, including several worldwide recognized dipterologists. Photographic records from this source were identified by authority in the family: both Jens-Hermann Stuke and by the first author.

Our results showed that the combination of all methods generated four new records between Caldera and Santiago Metropolitan Region: i) Carrizal Bajo (by active collection), 18.vii.2017, Leg. R. Barahona-Segovia (Deposited in MEUC); ii) Llanos de Challe National Park (by citizen science), 13.viii.2017, Leg. Gabriela Germain; electronical

Figure 1. General lateral habitus of *Myopa metallica* Camras 1992 with characteristic blue-reddish metallic color. Bar represents 1mm scale. / Vista lateral general de *Myopa metallica* Camras 1992 con su característico color metálico azul-rojizo. Barra representa escala de 1mm.

voucher in our citizen science program (https://www.facebook.com/photo.php?fbid=10213742742547874&set=pcb.1382875211759977&type=3&theater&ifg=1); iii) Las Breas, Río Hurtado, Leg. L. E. Peña (by revision of entomological collection and deposited in MEUC) and iv) Farellones, 31.xii.1997, Leg. Francisco Ramírez (by active collection, deposited in the private collection of the collector and then showed in citizen science; https://www.facebook.com/photo.php?fbid=10209698349567864&set=gm.1458199044227593&type=3&theater&ifg=1) (Figs. 2a, 2b).

Our results suggest that integrative methods could be an alternative method to know about the distribution of rare species. The use of the citizen science method to gather occurrence data and modelling the potential distribution – even for potential insect invasion – is recognized worldwide by many conspicuous insect species such as bumblebees (Montalva *et al.* 2017, Suzuki-Ohno *et al.* 2017) or ladybugs (Grez *et al.* 2016). However, in conspicuous flies, it could be a unique opportunity to offset the high Wallacean shortfall in this insect group (Barahona-Segovia *et al.* 2017). One example of this positive interaction is the use of social media and open access cooperative information of taxonomist, which can help to increase the known distribution of water beetles (Suprayitno *et al.* 2017). With further information about this species expanded by social media, is highly probable that new records can appear and thus, new collection and data about their habitat and ecology can be carried out.

Future work must be directed to know the potential host and habitat preferences of this fly. Barahona-Segovia *et al.* (2017) suggest that this species could attack *Megachile* bee species in Northern Chile due to the fact it is the most abundant species in the area. On the other hand, the potential bee host could be high due to the high diversity of bees in Chile (Montalva & Ruz 2010). Habitat preferences or phenology could also be proportionated by a citizen volunteer by using social media (see an example in Suprayitno *et al.* 2017; Fig. 2c). With this information, it could be possible to combine some biotic or abiotic variables to know the most important environmental conditions or habitat requirements for *M. metallica* or even modelling the distribution by using scarce occurrence data (Miličić *et al.* 2017). In conclusion, our work breaks down barriers between classic methods and existing technology to provide an updated distribution of an endemic, conspicuous and rare thick-headed fly.

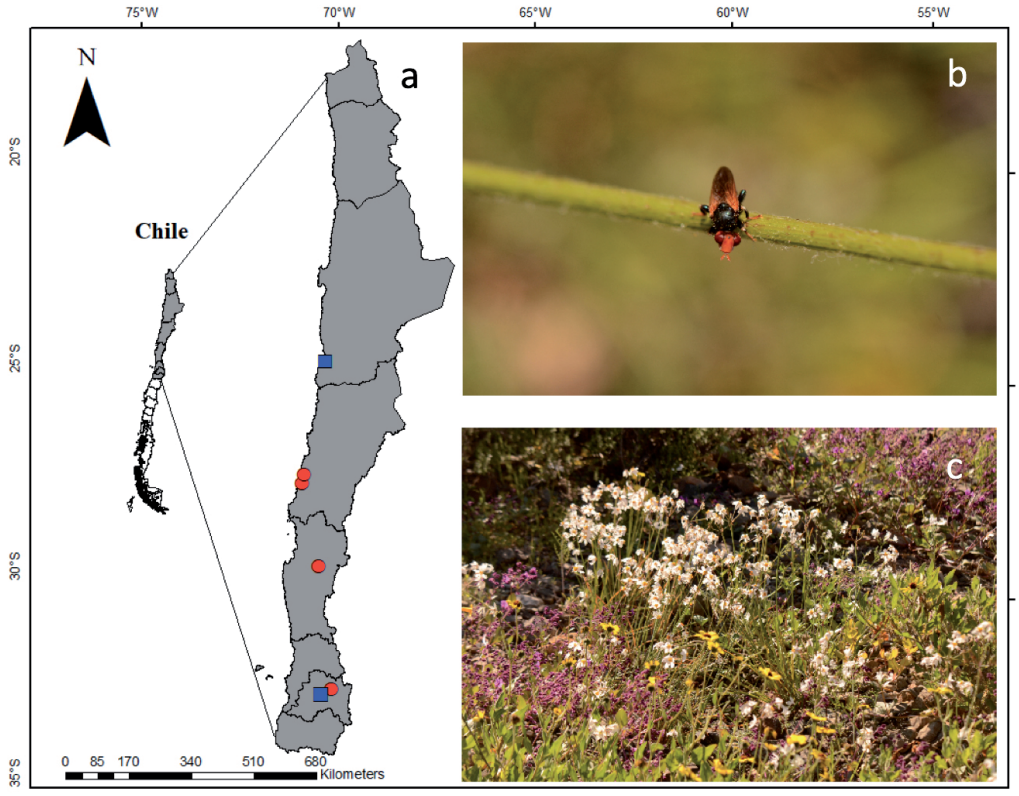

Figure 2. Distributional map of *Myopa metallica* Camras 1992: a) new records; blue squares represent data shown in Barahona-Segovia *et al.* (2017) and red circles, new records by different methods of collect; b) *in situ M. metallica* (photo courtesy of Gabriela Germain Fonck) and c) flowering desert in the habitat of *M. metallica* and occupied as attack sites. / Mapa de distribución de *Myopa metallica* Camras 1992: a) nuevos registros; cuadrados azules representan datos mostrados por Barahona-Segovia *et al.* (2017) y círculos rojos, nuevos registros por diferentes métodos de colecta; b) *M. metallica* en vivo (fotografía cortesía de Gabriela Germain Fonck) y c) desierto florido en el hábitat de *M. metallica* y ocupados como sitios de ataque.

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