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Species richness of noctuid moths (Lepidoptera: Noctuidae) from the State of Guanajuato, Mexico

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The greatest diversity of lepidopterans is found in the Neotropical region. Within this order, the family Noctuidae are striking for their dominance and great species richness with 35,000 species worldwide, of which 8,539 have been recorded in the Neotropics (Quimbayo et al. 2010). Dodd et al. (2011) found that noctuid species could reach up to 40% of the lepidopteran species richness, in both forests and fragmented landscapes, many with generalist feeding habits (Sánchez-Ramos et al. 1999). Gómez y Gómez & Beutelspacher (1999) indicated that Mexico has a wide diversity of lepidopterans, but the biological and taxonomic information is not enough. Of the studies from Mexico, MacGregor & Gutiérrez (1983), Pacheco-Mendivil (1985), and Beutelspacher & Balcázar-Lara (1999) reported 22, 20, and 19 species, respectively, of noctuid pests, which are widely distributed on many types of Mexican crops. *Spodoptera exigua* Hübner and *Helicoverpa zeae* Boddie are among the most common. More research on the taxonomy of Lepidoptera is necessary, particularly on the Noctuidae (Lorente-Bousquets et al. 2014) because of the family’s great species richness and the negative impact by some species on the agriculture of Mexico.

Guanajuato, located between the arid north of the country and the luxuriant south, is one of the most agriculturally productive states of Mexico. Likewise, Guanajuato is the most transformed by intensive agricultural activity, which makes it important to know what species are currently present in the region in order to identify potential crop pests. Faunistic lists and scientific collections are useful for recording faunal change, for understanding how disturbing events have caused changes, and for predicting future trends. In addition, the study of lepidopterans can be used as a bioindicator of environmental change and for prioritizing sites for the conservation of natural areas (Kir’yanov & Balcázar-Lara 2007). Due to the lack of information on species richness of Noctuidae moths, the aim of this research was to record the species of noctuids from agricultural sites from the state of Guanajuato, Mexico, and to provide information about their distribution and their biogeographic affinities.

Collections of specimens were made at the experimental agricultural field of the Universidad de Guanajuato, Campus Irapuato-Salamanca (20°44’36”N, 101°19’35”W; 1,739 m asl) in Irapuato, Guanajuato, and at the experimental field of Universidad de La Salle Bajío (21°3’15”N, 101°36’42”W; 1,812 m) in León, Guanajuato. A 15 W blacklight trap 50 cm long (Cantelo 1990) was placed once a year in the middle of the fields during 2012. In addition, specimens from the entomological collection “Leopoldo Tinoco Corona” of Universidad de Guanajuato were examined. In total, 680 individual moths were subjected to morphological analysis of the front and hind wings. The species taxonomic determination was performed according to keys of Chapman & Lienk (1981), Covell (1984), Kitching (1987), Mitchell & Zim (1994), Lafontaine & Poole (2010), and MEM (2012). All specimens identified at species level are in the “Leopoldo Tinoco Corona” collection. Biogeographic affinities of species that are consequence of taxonomic history and ecological adaptations (Rzedowski 1993; Halfter et al. 2008) were determined using distribution data from the systematic literature and online sources of MEM (2012), Nearctica (2013), and GBIF (2014). We also used the concept of Megamexico as a complete biogeographic region according to Rzedowski (1993).

During field work, 51 genera and 77 species of noctuids grouped into 10 subfamilies were identified. The subfamily with the most genera was Catocalinae (*n* = 10), followed by Amphipyrinae (*n* = 11), Hadeniinae (*n* = 6), Accontiinae (*n* = 5), Noctuinae (*n* = 5), Plusiinae (*n* = 5), Cucullinae (*n* = 4), Heliothinae (*n* = 2), Acontioidea (*n* = 1), and Promniinae (*n* = 1). The greatest numbers of species were found in the genera *Melipotis* (*n* = 9), *Tarache* (*n* = 5), *Spodoptera* (*n* = 4), *Lacinipolia* (*n* = 4), *Leucania* (*n* = 4) and *Heliotris* (*n* = 3) (Table 1). Of the total species identified, 36.3% had a Megamexico I affinity, 33.7% Nearctic affinity, 16.8% were cosmopolitan, 11.6% corresponded to Megamexico III, and 1 species had a Megamexico II distribution. Due to Guanajuato’s geographic position at the southern limit of the Chihuahuan Desert, these results suggest that the noctuid fauna of Guanajuato has greater affinity with the southern USA and northern Mexico than central or southern Mexico. The presence of species within Megamexico I and II might be a consequence of mountain ranges such as the Sierra Madre Oriental, the Sierra Madre Occidental, and the Transmexican Volcanic Belt, which are regions of relatively great endemism. Guanajuato can be considered to be a transition province between the Nearctic and the Neotropical biogeographic regions (Escalante et al. 2005). Also, 16.8% of the 13 cosmopolitan species were found in the Transmexican Volcanic Belt; their presence is probably due to the intense agricultural activity and transport of products into and out of the region for international trade. Our results present 30 new species records for Mexico together with data about their biogeographic affinity based on distribution data reported in the literature.

Four well-known noctuid pest species were recorded: *Peridroma saucia* Hübner, *Helicoverpa zeae* Boddie, *Mythimna unipuncta*

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### Table 1. List of noctuid species collected from Guanajuato, with (*) indicating new records for Mexico, and distribution according to MEM (2012) and Nearctica (2013).

| Taxa                        | Locality of collection | Distribution                                      |
|-----------------------------|------------------------|---------------------------------------------------|
| Acontiinae                  | Irapuato               |                                                   |
| Acontiella chea Druce (*)    | Irapuato               | southern Arizona, Texas (Megamexico I)            |
| Bagisara laevina (Druce) (*) | Irapuato               | Arizona (Megamexico I)                            |
| Lithacodia synochitidis Grote & Robinson (*) | Irapuato | northeastern USA to Texas (Nearctic) |
| Tarache aprica (Hübner)      | Irapuato               | northeastern USA to Texas and California (Nearctic) |
| Tarache areli Strecker       | Irapuato, Dolores Hidalgo, León | California, Arizona, Nuevo Mexico, Peninsula of California (Megamexico I) |
| Tarache blimeki (Felder & Rogenhofer) | Irapuato | southern California, Arizona, Texas, northern Baja California (Megamexico I) |
| Tarache quadriplaga Smith    | Irapuato               | southern Arizona, New Mexico, Texas, Tamaulipas (Megamexico I) |
| Tarache tenuicola (Morrison) (*) | Irapuato | central and southern Texas (Megamexico I) |
| Tarachidida semiflava Guenée | Irapuato, León         | Amazona, New Mexico, states of the Gulf of Mexico (Megamexico I) |
| Acronictinae                | Irapuato               |                                                   |
| Acronicta interrupta Guenée (*) | Irapuato | southern Canada to Nebraska and California (Nearctic) |
| Simyra insularis (Henrich-Schaffer) (*) | Irapuato | widely distributed in USA (Nearctic) |
| Amphipyrinae                | Irapuato               |                                                   |
| Amphipoea americana Speyer (*) | Irapuato | both coasts and central USA, southern Canada (Nearctic) |
| Callistege diagonalis Dyar   | Irapuato               | southern Arizona, New Mexico (Megamexico I)       |
| Chalocasta howardi H. Edwards | Irapuato, León        | southern Arizona, New Mexico, Texas (Megamexico I) |
| Cirrhapopus dyari Cockerell  | Irapuato               | southern Arizona, Texas (Megamexico I)            |
| Cirrhapopus pretiosus Morrison (*) | Irapuato | Texas (Megamexico I) |
| Conidica mobilis Walker (*)  | Irapuato               | southern Arizona, New Mexico, Texas, Atlantic coast of USA, Guatemala, the Antilles (Nearctic) |
| Eulithispa papago Barnes (*) | Irapuato               | southern USA (Megamexico I)                       |
| Magusa divaricata (Grote)    | Irapuato               | from Canada to South America (Nearctic)           |
| Osalaria viridifera Grote    | Irapuato               | southern Arizona, New Mexico, Texas (Megamexico I) |
| Papiopema marginidens Guenée (*) | Irapuato | northeastern USA to Louisiana (Nearctic) |
| Spodoptera exigua Hübner     | Irapuato, Abasolo, Cortazar, Juventino Rosas, Yuriria, Manuel Dobrado, León | Cosmopolitan |
| Spodoptera frugiperda Smith & Abbot | León, Irapuato | from southern USA to South America (Megamexico III) |
| Spodoptera latifascia Walker (*) | Irapuato | California, Texas, Florida, the Antilles, Guatemala (Megamexico III) |
| Spodoptera ornithogalli Guenée | Irapuato, León, Juventino Rosas | Cosmopolitan |
| Stria intermixta Dyar        | Irapuato               | from Arizona to Morelos (Mexico) (Megamexico I)   |
| Catocalinae                  | Irapuato               |                                                   |
| Alabama argillacea (Hübner)  | Irapuato               | Cosmopolitan                                      |
| Anticarsia gemmatalis Hübner | Irapuato, León         | USA, Mexico (Nearctic)                            |
| Ascaltaphoda odorata L.      | Irapuato               | Canada, USA, Yucatan, Antilles (Megamexico III)   |
| Bulia deducta Morrison       | Irapuato               | Canada, USA, Mexico (Megamexico I)                |
| Bulia similis Richards       | Irapuato, León         | southern USA, Mexico (Megamexico I)               |
| Dipthera festiva F.          | Irapuato               | east coast and southern USA, Sinaloa, Veracruz, Chiapas, Yucatan, Guatemala (Megamexico I) |
| Gonodonta pyro Cramer        | Guanajuato, Irapuato, León | southern USA, Yucatan, Guatemala (Megamexico III) |
| Heteranassa mima (Harvey) (*) | Irapuato               | southern California, Arizona, New Mexico, Texas (Megamexico I) |
| Melipotis acontioides Guenée | Irapuato, León         | from Canada to South America and the Antilles (Megamexico I) |
| Melipotis agratooides Walker | Irapuato, León         | southern California, Arizona, New Mexico, the Antilles, Baja California, Guatemala (Megamexico III) |
| Melipotis cellaris Guenée    | Irapuato               | southern New Mexico, Texas, Florida, Brazil (Megamexico I) |
| Melipotis contorta Guenée    | Irapuato               | Florida, the Antilles (Megamexico III)            |
| Melipotis indomita Walker    | Irapuato, León, Pueblo Nuevo | Florida, southern USA (Megamexico I) |
| Melipotis januaris Guenée    | Irapuato               | Florida, the Antilles (Megamexico III)            |
| Melipotis jucunda Hübner     | Irapuato, Silao, Salamanca, León | Canada, USA (Nearctic) |
| Melipotis novanda Guenée     | Irapuato               | southern California, Arizona, New Mexico, Texas, Estado de México (Megamexico I) |
| Melipotis perpendicularis Guenée | Irapuato, León, Silao, Salamanca, León | Península de Baja California, southern California, Arizona, New Mexico, Texas, Florida, the Antilles; Nuevo León (Megamexico I) |
| Metria bilineata (Smith) (*) | Irapuato               | southern Texas and Florida to Central America (Megamexico III) |
| Zale lunata Drury (*)        | Irapuato               | east and west coasts and southern USA, the Antilles (Nearctic) |
| Cucullinae                   | Irapuato               |                                                   |
| Copitarsia incommoda Walker  | Abasolo, Irapuato, Salamanca, León | Mexico, Central America (Megamexico II) |
| Cucullia similars Smith (*)  | Irapuato               | western USA (Nearctic)                            |
Table 1. (Continued) List of noctuid species collected from Guanajuato, with (*) indicating new records for Mexico, and distribution according to MEM (2012) and Nearctica (2013).

| Taxa                                      | Locality of collection | Distribution                                      |
|-------------------------------------------|------------------------|---------------------------------------------------|
| **Rivulinae**                             |                        |                                                   |
| *Rivula propinqualis* Guenée (*)          | Irapuato, León         | Canada, eastern USA, Texas (Nearctic)             |
| **Plusiinae**                             |                        |                                                   |
| *Autographa ampla* Walker (*)             | Irapuato               | wide distribution in USA (Nearctic)               |
| *Chrysodeixis includens* Walker           | Irapuato, Juventino Rosas | Cosmopolitan                                     |
| *Megaglossa biloba* (Stephens)            | Irapuato               | Cosmopolitan                                     |
| *Rachiplusia ou Guenée*                   | Irapuato, Huanimaro, León | Cosmopolitan                                     |
| **Rivulinae**                             |                        |                                                   |
| *Rivula propinqualis* Guenée (*)          | Irapuato, León         | Canada, eastern USA, Texas (Nearctic)             |

(Haworth), and Spodoptera frugiperda Smith & Abbot (Table 1). In addition, other potentially important economic species were recorded, which included Chrysodeixis includens Walker, whose larvae were seen feeding on tomato under greenhouse conditions in Irapuato; Anticarsia gemmatalis Hübner, pest of many crops, whose larval stage was observed feeding on alfalfa; Autographa ampla Walker, a defoliator of various species of trees and shrubs in Canada and the USA (Chapman & Lienk 1981), which has been observed feeding on lettuce in Guanajuato (personal observation of the first author M. D. S. A.), and Striacosta albicosta Smith, which was reported to feed on transgenic Bt maize crop in the northern USA (Tooher & Fleischer 2010). In contrast, Dargida proculata Grote was caught on "alpistillo" or reed canarygrass (Phalaris arundinacea L.; Poales: Poaceae), an important weed in Guanajuato; this interaction could be interesting for a study of this noctuid’s potential as a biological control of reed canarygrass.

Although the numbers of individuals of the various taxa caught during sampling were not recorded systematically, the most abundant species were clearly *S. frugiperda*, *H. zea*, and *M. unipuncta*, likely because of the great expanse of sorghum and maize crops grown in the region. Similar to the findings of Sei-Woong & Jeog-Seop (2013), the pattern of species richness of Noctuidae was one in which the majority of species were represented only by a few individuals. Nevertheless, more precise determinations of abundance patterns and total species richness of noctuids in Guanajuato are required, and more rigorous statistical and systematic field sampling is needed.

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**Summary**

The Noctuidae are a family with many species worldwide, but in Mexico, there is little information about their species richness despite noctuids being very important pests in agriculture. With data obtained from fieldwork and specimens from the Entomological Collection of Universidad de Guanajuato, a list of species found in Guanajuato was made, taking into account distribution and biogeographic affinity data.
The results showed 77 species, of which 36.3% had a distribution of Megamexico I affinity, 33.7% had Nearctic affinity, and 16.8% were cosmopolitan, whereas the rest of the species had distributions that corresponded to Megamexico II and III. The high percentage of northern species suggests that the biogeographic affinity of the noctuids from Guanajuato is closer to the southern USA and northern Mexico. This research reports 30 new species records for Mexico, and 1 species may be a potential agent for the biological control of reed canarygrass, a major weed species.

Key Words: richness; biogeography; biological control; reed canarygrass; Megamexico

Sumario

Noctuidae es una familia de palomillas con muchas especies reconocidas alrededor del mundo, pero en México hay poca información disponible sobre su riqueza a pesar de que los noctuidos se consideran plagas en la agricultura. Con datos obtenidos en campo y de la revisión de ejemplares de la Colección Entomológica de la Universidad de Guanajuato, se elaboró un listado de especies tomando en cuenta la distribución y la afinidad biogeográfica. Se encontraron 77 especies, 36.3% de afinidad Megamexico I, 33.7% de afinidad Neártica y 16.8% cosmopolitanas, el resto de las especies tienen distribución que corresponde a Megamexico II y III. El alto porcentaje de especies norteñas sugiere que Guanajuato es más parecido al sur de Estados Unidos y Norte de México. En esta investigación se reportan 30 nuevos registros de especies para México, una con el potencial de usarse como control biológico de malezas en cultivos.

Palabras Clave: riqueza; biogeografía; control biológico; malezas en cultivos; Megamexico

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