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Article

# Primer registro documentado de *Neodiprion abietis* (Harris, 1841) (Hymenoptera: Diprionidae) para México

# First documented record of *Neodiprion abietis* (Harris, 1841) (Hymenoptera: Diprionidae) for Mexico

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**Resumen**

*Neodiprion abietis* es un dipriónido que tiene una distribución transcontinental en Norteamérica, y se alimenta del follaje de árboles de los géneros *Abies, Pseudotsuga* y *Pinus*. Una referencia de 1995 menciona la presencia de esta especie de insecto en México; sin embargo, carece de datos de ubicación. El objetivo del presente estudio fue determinar el taxón de un dipriónido que en 2016 se observó defoliando a *Abies concolor*, dentro del Área de Protección de Flora y Fauna Campo Verde, en Madera, Chihuahua, México. A través de exploraciones de campo realizadas en 2019, se recolectaron larvas directamente del follaje de sus hospedantes; además, de un adulto en el follaje y varios capullos en el suelo. Las larvas fueron confinadas en jaulas entomológicas y se alimentaron con follaje de sus hospedantes, hasta que tejieron sus capullos. La cría de los insectos se completó introduciendo los capullos a una cámara de crecimiento que se mantuvo a una temperatura de 26 ±2 ºC, con un fotoperiodo de 14:10 luz: oscuridad, hasta la obtención de adultos. La determinación de la especie se realizó mediante la observación de las características morfológicas externas y del ovipositor, basados en claves taxonómicas especializadas e ilustraciones de referencia de fuentes científicas. Los especímenes examinados correspondieron a *N. abietis*, lo cual confirma su presencia en el norte de México.

**Palabras clave:** *Abies concolor* (Gordon) Lindley ex Hildebr, Área Natural Protegida, defoliación por insectos, Diprionidae, mosca sierra de abeto balsámico, plagas forestales.

**Abstract**

*Neodiprion abietis* is a diprionid that has a transcontinental distribution in North America and feeds on tree foliage of the genera *Abies, Pseudotsuga,* and *Pinus*. A 1995 scientific reference mentions the presence of this insect species in Mexico; however, it lacks data of location. This study aimed to determine the species of a diprionid that, in 2016, was found defoliating *Abies concolor*, within the *Campo Verde* Plant and Wildlife Protection Area, in *Madera*, *Chihuahua*, Mexico. Through field explorations made in 2019, sawfly larvae were collected directly from host foliage. An adult was collected from the foliage and several cocoons from the ground as well. The larvae were confined within entomological cages and fed with host foliage until they spun their cocoons. Insect rearing was completed by placing the cocoons inside a growing chamber which was maintained at a temperature of 26 ±2 ºC and at 14L:10D photoperiod, until adults emerged. The species was determined through the observation of external characters as well as the form of the ovipositor, based on specialized taxonomic keys and photographic references from scientific sources. The examined specimens corresponded to *N. abietis* complex and this finding confirms the presence of this species in northern Mexico.

**Key words:** *Abies concolor* (Gordon) Lindley ex Hildebr, Natural Protected Area, insect defoliation, Diprionidae, Balsam fir sawfly, forest pests.

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# Introduction

Conifer sawflies (Diprionidae: Hymenoptera) are defoliating insects that negatively affect the growth of their hosts. In cases of severe and successive defoliation, they can also cause the death of the trees (Sánchez-Martínez and Wagner, 1999; Lyytikäinen-Saarenmaa and Tompoo, 2002).

*Neodiprion abietis* (Harris, 1841) (Hymenoptera: Diprionidae) is a conifer sawfly with a transcontinental distribution in North America (Ross, 1955). In Canada, it is found in Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario, Quebec, and Saskatchewan; while in the United States of America its presence has been documented in California, Connecticut, Maine, Minnesota, Missouri, New Hampshire, Washington and Wisconsin (Ross, 1955; EPPO, 2019). In the eastern region of North America, *N. abietis* attacks, preferentially, *Abies balsamea* (L.) Mill., and sporadically, *Picea glauca* (Moench) Voss and *Picea mariana* (Mill.) B. S. P. (Wallace and Cunningham, 1995; Johns *et al*., 2013). In the western region, it infests *Abies concolor* [Gord. and Glend.] Lindley ex Hildebr, and taxa of the *Picea*, *Pseudotsuga* and *Tsuga* genera (Ross, 1955; Knerer and Atwood, 1972; Sheehan and Dahlsten, 1985). Some pine species such as *Pinus rigida* Mill., *P. banksiana* Lamb. and *Pinus strobus* L. have also been reported to be hosts of the *N. abietis* insect species complex (Knerer and Atwood, 1972).

Wallace and Cunningham (1995) indicated that *N. abietis* is present in Mexico; however, they do not specify where it is registered, and there are no other references to support this statement. On the other hand, up to 2020, the Integral System of Forest Phytosanitary Surveillance and Control (Sivicoff, for its acronym in Spanish) of Mexico has no record of *N. abietis* in the country (Conafor, 2020). In May 2016, a group of 20 *A. concolor* saplings infested by sawfly larvae with characteristics similar to those of the *N. abietis* were registered in *Madera* municipality in the state of *Chihuahua*, Mexico, and these insects were present once more in 2019. This finding stimulated the objective of determining whether this sawfly corresponded to *N. abietis*.

# Materials and Methods

The study was conducted at the Thick-billed Parrot Sanctuary, located within the *Campo Verde* Flora and Fauna Protection Area, administered by the National Commission of Natural Protected Areas (Conanp) of Mexico (Semarnat, 2010; Conanp, 2013), which in turn, is located in the *El Largo* and *Socorro Rivera ejidos*, *Madera* municipality, *Chihuahua*, Mexico.

In the foliage of *A. concolor*, *Pinus strobiformis* Engelm. and *Pseudotsuga menziesii* (Mirb.) Franco trees, sawfly larvae (May 16$^{th}$ and June 13$^{th}$, 2019) and an adult fly (September 23$^{rd}$, 2019) with the characteristics of a Diprionidae were collected, and the ground around the crown projection area of the trees was dug in search for cocoons (August 19$^{th}$, 2017; August 29$^{th}$, 2018, and July 16$^{th}$, 2019), thereby ascertaining the insect's pupation site.

The entomological material collected was transferred to the laboratory of forest and agricultural health of the *Pabellón* Experimental Field, INIFAP for further conditioning. The larvae were confined in *bug dorm* model 1462 entomological cages (*BioQuip*); they were fed with foliage from their hosts; and once they had spun their cocoons, they were subjected to controlled conditions inside a *Binder* model 720 KBW E5.1 growth chamber, at a temperature of 26 ±2 ºC, with a photoperiod of 14:10 light: dark, until adults were obtained for examination.

The determination of the species was based on the original description of Harris (1841) under the name *Lophyrus abietis*, and on the observation of the external morphological characteristics of adult specimens (females and males), the ovipositor and the ovipositor sheath (*scopae*) of females; the taxonomic key to *Neodiprion* species of Ross (1955), as well as the description and illustrations of Sheehan and Dahlsten, were considered as references (1985).

The ovipositor was extracted after a process of maceration of the abdomen, for which purpose it was separated from the rest of the body and placed in an Eppendorf tube with 10 % KOH in a bain-marie at 80 °C for 20 minutes. At the conclusion of

maceration, the abdomen was rinsed with distilled water, dehydrated in absolute ethyl alcohol (99.9 %) for one minute, dried, and mounted on a slide. The observation was carried out using a *Motic* stereo microscope model SMZ-140 and a Labomed compound microscope model CXR3.

In addition, the appearance of adult flies was compared with images of Diprionidae published by Washington State University (WSU, n/d), the University of British Columbia (UBC, n/d) and by *BOLD Systems* (2014). The appearance of the larvae was contrasted with illustrations by Knerer and Atwood (1972).

The examined specimens (larvae and adults) were deposited in the Forest Insect Collection of the *Pabellón* Experimental Field, pertaining to Inifap in *Pabellón de Arteaga*, state of *Aguascalientes*, Mexico.

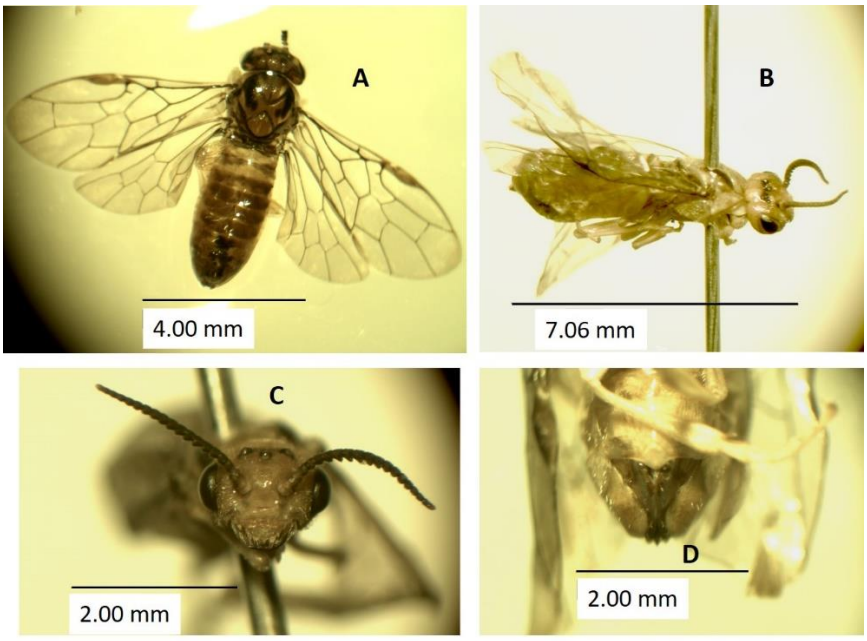
## Results and Discussion

The species of sawfly that defoliates *A. concolor*, *P. menziesii* and *P. strobiformis* in *Madera, Chihuahua*, was confirmed to be *Neodiprion abietis* (Harris, 1841).

Data on material examined: Mexico, *Chihuahua, Madera* municipality, *El Largo ejido,* Thick-billed Parrot Sanctuary, *Cinco Millas* sites (29°19'23.8" N, 108°12'40.3" W; 2 620 masl) and *Las Cebadillas* (29°19´38.4" N, 108°12´4.5" O; 2 498 masl). Three ♀ and 1 ♂ reared from larvae collected from the foliage of *A. concolor*; 17-X-2019; col. E. González G.; 2 ♀ and 1 ♂ reared from larvae collected from the foliage of *Pinus strobiformis,* 17-X-2019; coll. E. González G.; 2 ♀ and 1 ♂ reared from larvae collected from the foliage of *Pseudotsuga menziesii*, and 1 ♀ collected from the foliage of *P. menziesii*; 23-IX-2019; coll. K. V. de Lira R.

The female (Figure 1) is 0.6 to 0.75 cm long. It has a yellowish head, transparent ocelli surrounded by dark spots; serrate antennae with 16 to 18 dark flagellomeres; brown scapus and pedicel. The thorax in dorsal view is yellowish; with two dark longitudinal spots on the anterior part of the median lobe of the *mesoscutum* (sometimes faint or absent) and the lateral lobes, each with two spots, one of which

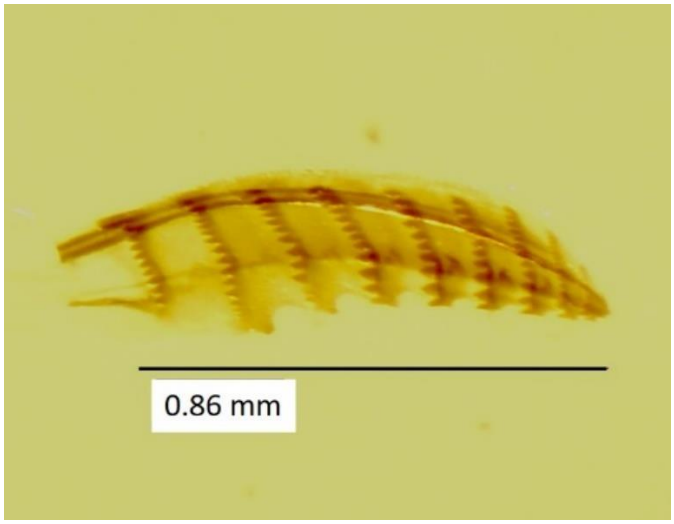
is large, longitudinal, and well-defined, on the outer margin, and the other, smaller and semicircular, on the inner basal part, and, finally, a yellowish, smooth *Mesoscutellum* with dark margins; yellowish-brown wings, with dark brown veins and stigma, and short, evenly distributed hairs. It has yellow legs of an even hue. The abdomen in dorsal view has yellowish-brown tergites; in ventral view, yellow sternites, except the part near the thorax which is slightly grayish. It also has a lancet with nine parallel and equidistant rings; the first one smaller than the second and third ones (Figure 2). The ventral lobe of the second annulus is small and only slightly larger than the ventral lobe of the third annulus. The projection of the ventral lobe of the second ring is slight in relation to the ventral margin. The lancet sheath (*scopae*) is of medium oblique shape, not as sharply oblique as the illustration of *N. abietis* by Ross (1955).




Photographs taken at 2X (A and B) and 4X (C and D).

A) Dorsal view, B) Lateral view, C) Appearance of the head and D) Last abdominal segment.

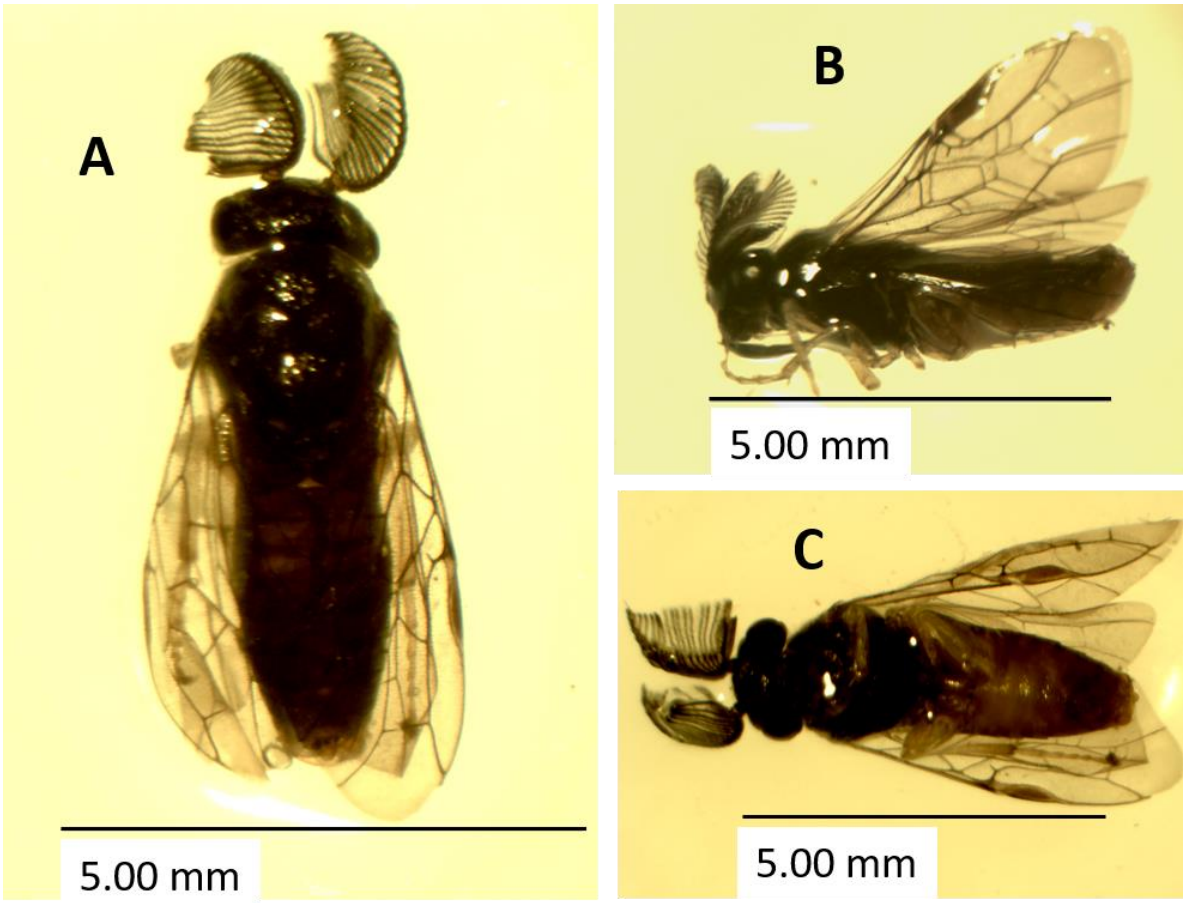
**Figure 1.** Female *Neodiprion abietis* (Harris, 1841).




Photomicrograph taken at 10X.

**Figure 2.** *Neodiprion abietis* (Harris, 1841) ovopositor.

The male is smaller than the female, 0.5 to 0.6 cm long (Figure 3). Its head is black; its antennae, bipectinate with 20 segments. Segments with long setae. The *rami* (plural of Latin *ramus* = branches) of segments 3-20 are shortened towards the distal part. Ocelli of amber hue. The thorax in dorsal view is uniformly black. The wings are transparent, slightly iridescent, with brownish tones. The legs are yellow, except for the femurs, which are slightly dark in the part closest to the coxa. The abdomen in dorsal view is brown; in ventral view, it is brown, slightly dark in the terminal part.

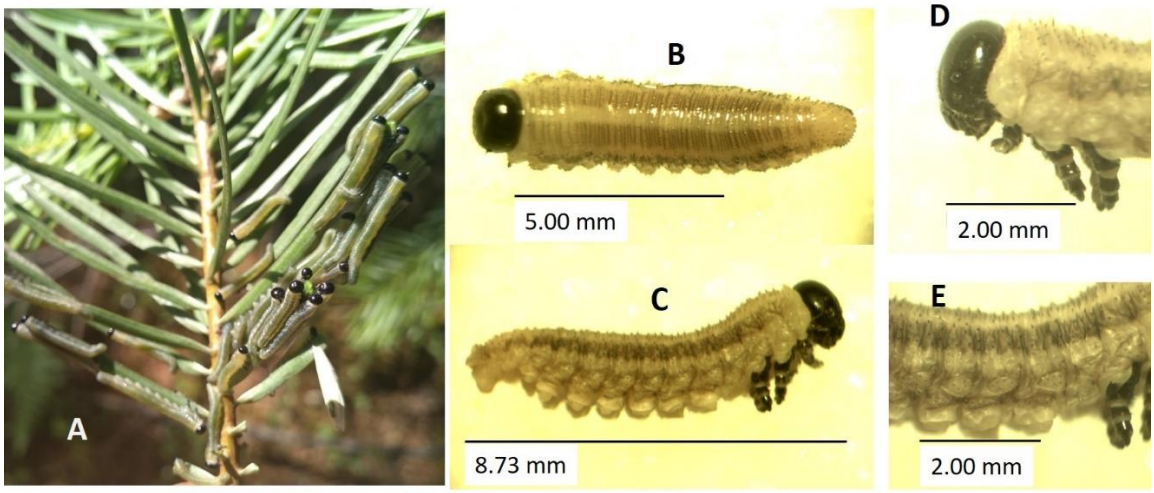



Photographs taken at 2.6X

A) Dorsal view, B) Lateral view and C) Ventral view.

**Figure 3.** Male *Neodiprion abietis* (Harris, 1841).

The appearance of the observed adult specimens matches the *N. abietis* photographs illustrated by *BOLD Systems* (2014), with the numbers BIOUG10340-C06 (♀), CNCHYM02459 (♂), and the appearance of the larvae (Figure 4) is consistent with the white fir strain of *N. abietis* that feeds on *A. concolor* in California, United States of America (Knerer and Atwood, 1972) and with the *N. abietis* shown in *BOLD Systems* (2014) with the number BIOUG09981-D12.




Photomicrographs taken at 1.2X (B y C) and 4X (D and E).

A) On a branch, B) Dorsal view, C) Lateral view, D) Thoracic segments in lateral view, E) Lateral aspect of the third abdominal segment. Staining of B, C, D and E with the effect of preservation in ethyl alcohol at 70 %.

**Figure 4.** *Neodiprion abietis* (Harris, 1841) larvae.

The specimens of *N. abietis* obtained in this study showed a different behavior from that of the *N. abietis* which attacks *A. concolor* in California, United States of America, as the former spend the pupal stage on the foliage of the host (Knerer and Atwood, 1972*),* whereas the population studied in *Chihuahua* does so underground, like most *Neodiprion* species. This situation can be interpreted as an adaptation of the taxon to local environmental characteristics. As pointed out by several authors, the *N. abietis* complex groups several "strains", forms, or even morphologically similar species (Ross, 1955; Knerer and Atwood, 1972, Wallace and Cunningham, 1995).

In the study area, the adult stage was observed during August and September, when oviposition occurs. The presence of larvae occurred during May, June, and July. Pre-pupae started forming cocoons for pupation in August. Adults were detected from August to September. These preliminary observations indicate the presence of one generation per year, and are consistent with the observations of Wallace and Cunningham (1995) and Johns *et al*. (2013) in terms of the biology of *N. abietis*.

# Conclusions

Given the transcontinental distribution of *Neodiprion abietis* in North America, and that the plant communities where it was found in *Chihuahua* are relatively isolated and with controlled access, we conclude that the presence of this species in northern Mexico is natural and that its endemic population does not represent a phytosanitary problem at present. However, if the population were to grow to the level of an epidemic outbreak, as has been the case in Canada, it could affect the populations of *A. concolor* and *P. menziesii*, and consequently the habitat of the Thick-billed parrot, an endangered species.

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## Conflict of interests

The authors declare no conflict of interests.

## Contribution by author

Ernesto González Gaona: field explorations, collection of biological material, taking of photographs, and drafting of the manuscript; Alejandro Gómez Nísino: first detection of the insect in field explorations, collection of biological material, and review of the manuscript; Karla Vanessa De Lira Ramos and Juan Antonio Olivo Martínez: collection of biological material and review of the manuscript; Yahaira Elizabeth Rodríguez Cruz: collection of biological material and insect rearing in the laboratory; Ana Adeliz Rascón-Mendoza: field guide and collection of biological material; Guillermo Sánchez Martínez: examination of specimens, determination of the species, and drafting of the manuscript.

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