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SHORT NOTE

First report of abnormal morphology in the tick *Dermacentor dissimilis* (Acari: Ixodidae) and evidence of molt nymph-adult on hosts from Nicaragua

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ABSTRACT: A total of 10 females and 6 males of *Dermacentor dissimilis* were collected from horses and cows in Nicaragua. Four of these females presented malformations, while two nymphs were in the process of molting to adult. Further studies are necessary to find out whether this phenomenon is widespread among *D. dissimilis* specimens, and what the reasons for such malformations could be. Moreover, further research is necessary to better understand the life-cycle of *D. dissimilis*.

Keywords: *Dermacentor dissimilis*, malformations, ectromely, two-hosts tick.
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Anomalies in ticks seem to occur at low frequency in the nature, which could be of interest in taxonomic and ecological studies (Nowak-Chmura, 2012; Buczek et al., 2017). Anomalies and malformations in ticks were described over 100 years ago and among the first descriptions is the presence of a supernumerary eye in *Hyalomma* sp., absence of the left I leg in *Amblyomma* sp., and atrophy of the right IV leg in *Ixodes hexagonus* (Neumann, 1899). With the passing years, new malformations were reported and posteriorly classified as general malformations, that include gynandromorphism, and local anomalies in the idiosome and appendages (Campana-Rouget 1959a,b). Currently, malformations and anomalies have been described in the genera *Argas*, *Ornithodoros*, *Amblyomma*, *Dermacentor*, *Haemaphysalis*, *Hyalomma*, *Ixodes*, and *Rhipicephalus* (Labruna et al., 2002; Buczek et al., 2017).

The genus *Dermacentor* Koch, 1844 comprises 40 species of ticks (Yunker et al., 1986; Apanaskevich and Bermúdez, 2013; Guzmán-Cornejo et al., 2016). In this genus, malformations such as gynandromorphism have been reported in *D. andersoni*, *D. occidentalis* and *D. reticulatus* (Homsher and Yunker, 1981; Oliver and Delfin, 1967; Chitimia-Dobler and Pfeffer, 2017), and local anomalies in *D. andersoni* (Dergousoff and Chilton, 2007; Chitimia-Dobler and Pfeffer, 2017), *D. atrosignatus* (Robinson, 1920), *D. niveus*, *D. marginatus, D. reticulatus* (reported as *D. pictus*) (Campana-Rouget, 1959b). All these species are from the Nearctic and Palearctic ecozones, and there is no information about these phenomena in Neotropical species.

In Central America eight species of *Dermacentor* are known (Yunker et al., 1986; Apanaskevich and Bermúdez, 2013; Guzmán-Cornejo et al., 2016). With the exception of *D. nitens*, a one-host tick parasitizing mainly horses, little is known about the other species in this region. Among these, *D. dissimilis* was initially described in southern Mexico and subsequently reported in Guatemala, Honduras, El Salvador and Nicaragua (Yunker et al., 1986; Bermúdez et al., 2015). Along with *D. nitens*, this species was included in the former genus *Anocentor* (Camicas et al., 1998; Guglielmone et al., 2003), and some authors referred to *D. dissimilis* as having a one-host life cycle (Kohls and Dalmat, 1952).

With the objective of providing more information about *D. dissimilis*, we report for the first time morphological anomalies in this species, and also provide additional information of the nymph to adult molt on the host. This corresponds to the first finding of this phenomenon in *Dermacentor* of Centro America (Neotropical ecozone).

As part of an investigation on ticks parasitizing livestock in Central America, ticks were collected from the Departments Jinotega and Nueva Segovia, Nicaragua, during the years 2015-2019. Fifteen horses and 7 cows were examined and ticks were removed from the neck, mane and around the ears of 3 horses and 2 cows and were preserved in 80% ethanol. Ticks were collected under the supervision and permission of the animal owners and transported to the Research Department in Medical Entomology of the Gorgas Memorial Institute of Health Studies in Panama for identification. A permit was obtained from the Ministry of the Environment (SIM/A-5-19) to conduct this study. Ticks were deposited in the Ectoparasites Collection of the Zoological Collection "Dr. Eustorgio Méndez" of the Gorgas Memorial Institute of Health Studies (AE-CoZEM-ICGES).

Ticks were examined under the stereomicroscope (Leica MZ125) and photographed using the coded stereoscope microscope (Leica M205A). The specimens were identified according to the taxonomic key of Yunker et al. (1986) and confirmed by comparison with the original descriptions of *D. dissimilis* (Cooley, 1947; Kohls and Dal-

Figure 1. Dorsal view of *Dermacentor dissimilis* female with atrophy in right leg III (arrow a) and asymmetry of scutum (arrow b).

Figure 2. Ventral view of *Dermacentor dissimilis* female with atrophy in right leg III and asymmetry of scutum.

Figure 3. Dorsal view of *Dermacentor dissimilis* female with bifurcation in the posterior margin of the idiosoma.

mat, 1952). In order to categorize the anomalies, we followed the suggestion of Campana-Rouget (1959a,b).

Overall 10 females and 6 males of *D. dissimilis* were collected from three horses and two cows. The data collection of these specimens were: 2♀♀, 2♂♂ Nicaragua: Jinotega, San José de Las Latas. 1200m. 13°3'13"N 85°56'3"W. 13 March 2015. Ex: Horse. Col: S. Bermúdez, L. Mejía, L. Hernández. 1 N, 6♀♀, 3♂♂ NICARAGUA, Jinotega, February 28, 2019. Ex: Horse. Col: S. E. Pérez. 2♀♀, 1♂ NICARAGUA, Nueva Segovia, March 10, 2019. Ex: Cow. Col: S. E. Pérez.

Abnormalities were found in: ♀ No. 1: JINOTEGA, San José de Las Latas. 1200m. March 13, 2015. Ex: Horse. Col: S. Bermúdez, L. Mejía, L. Hernández. ♀ JINOTEGA. February 28, 2019. Ex: Horse. Col: S. E. Pérez. ♀ No. 3: JINOTEGA. March 10, 2019. Ex: Cow. Col: S. E. Pérez. ♀ No. 4: JINOTEGA. March 10, 2019. Ex: Cow. Col: S. E. Pérez.

Female 1 exhibited an atrophied right leg III and asymmetry of scutum (Figs 1, 2); female 2 showed bifurcation in the posterior margin of the idiosoma (Fig. 3); female 3 presented several abnormalities in the right side, including atrophied of leg III and ectromely in coxa III and leg IV and atrophy of the left leg IV (Figs 4, 5); female 4 showed an atrophy of the right leg IV (Fig. 6).

In addition, two nymphs were collected in the process of molting to adults. The data collection of these nymphs is: NICARAGUA, Nueva Segovia. March 10, 2019. Ex: Cow. Col: E. Pérez. NICARAGUA, Jinotega. February 28, 2019. Ex: Horse. Col: E. Pérez. In regard to these specimens, in one nymph there are evidences of female characteristics, as a short scutum, presence of porose areas and similar size in coxae (Fig. 7); while the other nymph shows characteristics of males, evidenced in the presence of a large scutum (Figs 8, 9).

This is the first report of malformation in *D. dissimilis* and complements the information of malformations in ticks from Neotropical Regions (Rivera-Paéz et al., 2017). Out of four females, three showed local anomalies and one general anomaly. Ectromely and atrophies in legs have been reported in several species of ticks (Nowak-Chmura, 2012; Kar et al., 2015). Malformations seem to be rare phenomena, since only occurring in low percentages among the population (Chitimia-Dobler et al., 2017). For example, Guglielmone et al. (1999) revised a large series of ticks (n=64,473) in Argentina, but found abnormalities in 62 (≈1%), and Muñóz-Leal et al. (2018), found gynandromorphism in one specimen out of 92 *Amblyomma parvitarsum* examined, showing that malformations are either not noticed or that these kind of observations are usually not published.

It is possible that the origin of malformations in ticks is heavily debated and could be related to physical damage and injuries, congenital mutations, interspecies hybrids or to environmental factors (Campana-Rouget, 1959a; Tovornik, 1987; Nowak-Chmura, 2012; Buczek et al., 2017; Chitimia-Dobler et al., 2017). Moreover, malformations can lead to other abnormalities on the body of ticks, e.g., loss of legs can lead to deformities of the idiosome (Nowak-Chmura, 2012; Kar et al., 2015).

Figure 4. Ventral view of *Dermacentor dissimilis* female with atrophy in right leg III and ectromely in coxa III (arrows a and b), ectromely in right leg IV (arrow c), and atrophy of the left leg IV (arrow d).

Figure 5. Dorsal view of *Dermacentor dissimilis* female with atrophy in right leg III and ectromely in coxa III, ectromely in right leg IV, and atrophy of the left leg IV.

Figure 6. Ventral view of *Dermacentor dissimilis* female with atrophy of the right leg IV.

Dermacentor dissimilis is a parasite of ungulates and is irregularly distributed in areas with temperate climate from Mexico to Nicaragua (Yunker et al., 1986; Bermúdez et al., 2015; Guzmán-Cornejo et al., 2016). The fact of extracted and preserved nymphs molting to adult directly on the host, reaffirms previous assumptions about its one-host life-cycle (Cooley, 1947; Kohls and Dalmat, 1952). However, Cooley (1947) and Kohls and Dalmat (1952) who observed nymphs and adults feeding on animals, did not reported any molting of the ticks. Thus, the present work confirms that at least the second molt occurs on the host, although it is not possible to affirm that it is a one-host tick. So far, the larva of *D. dissimilis* has not been described (Guglielmone et al., 2014).

In our study few specimens of *D. dissimilis* were observed; thus, additional studies could give more information about the biology of this scarcely studied tick. With regard to malformations, it is likely that they are more frequent than previously thought, either because they are not recognized or because they are not considered in scientific reports. Further studies are also necessary to find and describe the larval stage of this species and to find out whether *D. dissimilis* is a one-host tick.

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Figure 7. Dorsal view of a nymph of *Dermacentor dissimilis* with female characteristics in scutum (arrow).

Figure 8. Dorsal view of a nymph of *Dermacentor dissimilis* with male characteristics.

Figure 9. Ventral view of a nymph of *Dermacentor dissimilis* with male characteristics.

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