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## Turtle ectoparasites from the Pacific coastal region of Colombia

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**Abstract:** This study provides an update on the ectoparasites (ticks and leeches) associated with *Rhinoclemmys annulata* and provides new accounts on the ectoparasites associated with *R. nasuta*, *R. melanosterna* and *Kinosternon leucostomum* from the Pacific coast of Colombia. The presence of *Amblyomma sabanerae* on *R. nasuta* and *R. melanosterna* provided two new host records for the tick species. Also, the documentation of *A. sabanerae* from the Department of Valle del Cauca represents a new department record for the species in Colombia. *Placobdella ringueleti* was identified from *R. nasuta* and *K. leucostomum*, which represents a new host record for the leech species, as well as a significant extension of the known range.

**Keywords:** tick, leech, *Testudines*, *Rhinoclemmys annulata*, *Rhinoclemmys melanosterna*, *Rhinoclemmys nasuta*, *Kinosternon leucostomum*, *Amblyomma sabanerae*, *Placobdella ringueleti*.

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**Resumen:** Este estudio proporciona nueva información sobre ectoparásitos (garrapatas y sanguijuelas) encontrados en *Rhinoclemmys annulata*, y aporta nuevos registros sobre ectoparásitos asociados a *R. nasuta*, *R. melanosterna* y *Kinosternon leucostomum* en la costa pacífica de Colombia. La presencia de *Amblyomma sabanerae* en *R. nasuta* y *R. melanosterna* provee dos nuevos hospederos para esta especie de garrapata. Igualmente el reporte de *A. sabanerae* amplía el registro de esta especie en Colombia, al departamento del Valle del Cauca. *R. nasuta* y *K. leucostomum*, se constituyen en nuevos registros de hospederos para *Placobdella ringueleti*, e incrementa de manera significativa el rango de distribución geográfico conocido para esta especie de sanguijuela.

**Palabras claves:** garrapata, sanguijuela, *Testudines*, *Rhinoclemmys annulata*, *Rhinoclemmys melanosterna*, *Rhinoclemmys nasuta*, *Kinosternon leucostomum*, *Amblyomma sabanerae*, *Placobdella ringueleti*.

## Introduction

Turtles serve as hosts to a variety of blood-feeding ectoparasites, of which the most commonly encountered are ticks (Acari) and leeches (Hirudinea). In addition, ticks and leeches can serve as vectors of hemogregarine infections in reptiles (Burrige & Simmons 2003). Given that turtles have been deemed one of the most endangered groups of vertebrates (Rhodin et al. 2011) and parasitism has been suggested as one of the many possible causes for their decline (Gibbons et al. 2000), advancements have been made to identify ectoparasite species associated with turtles and document potential threats to the health of the animals. Numerous studies exist documenting ectoparasites associated with turtles in North America (e.g., Ernst 1971, Hulse & Routman 1982, Dodd 1988, Brooks et al. 1990, Graham et al. 1997, Siddall & Gaffney 2004, Ryan & Lambert 2005, McCoy et al. 2007, Read et al. 2008, Ennen & Qualls 2011), but few such studies exist for tropical turtles in South America (Fairchild et al. 1966, Guerrero 1996, Labruna et al. 2002, Robbins et al. 2003, de Campos-Brites & Rantin 2004, Voltzit 2007).

Specifically, even though the country has the second highest turtle species richness in South America, Colombia has few records of ectoparasites associated with its native turtle species. Of the 27 turtle species known to inhabit continental Colombia (Castaño-Mora 1997, Asociación... 2011), two species-rich genera that lack sufficient ectoparasite data are *Rhinoclemmys* Fitzinger 1835 (Geoemydidae Theobald 1868) and *Kinosternon* Spix 1824 (Kinosternidae Agassiz 1857). Medem (1956) first reported the tick species *Amblyomma crassum* (Robinson 1926) parasitizing a specimen of *Rhinoclemmys annulata* (Gray 1860) collected in the Department of the Chocó, Colombia, and published two more accounts of the observed parasitism between *A. crassum* and *R. annulata* (Medem 1962a, b). Ernst & Ernst (1977) recorded four species of the genus *Amblyomma* [*A. cajennense* (Fabricius 1787); *A. dissimile* Koch, 1844; *A. rotundatum* Koch, 1844 and *A. sabanerae* Stoll, 1891] as ectoparasites associated with *Rhinoclemmys* species in the Neotropics. The most commonly identified tick species, *A. sabanerae*, was collected from five species of *Rhinoclemmys*, including two specimens of *R. annulata* from Colombia. Ernst & Ernst (1977) also recovered one leech of the genus *Placobdella* from one specimen of *R. annulata* from Panama, and Ocegüera-Figueroa & Pacheco-Chaves (2012) recently reported *P. ringueleti* parasitizing *R. annulata* in Costa Rica.

Schmidt (1947) made note that ticks were routinely discovered on the head and neck region of *Kinosternon leucostomum* (Duméril & Bibron in Duméril & Duméril 1851) specimens from Panama. Wharton (1938) reported *A. dissimile* from *K. leucostomum* in Mexico and Medem (1962a, b) recorded the tick species *A. crassum* from *K. leucostomum* in the Department of the Chocó, Colombia. Additional Neotropical reports of ectoparasites infecting *Kinosternon* include extensive parasitism by ticks on *Kinosternon scorpioides* (Linnaeus 1766) from Central and South America (Berry & Iverson 2011), and a record of *A. sabanerae* from Panama (*Kinosternon* sp.; Fairchild et al. 1966). A new leech species, *Placobdella ringueleti* López-Jiménez & Ocegüera-Figueroa, 2009, was described based on specimens from *Kinosternon leucostomum* in southern Mexico (López-Jiménez & Ocegüera-Figueroa 2009), and the same species was recently reported infecting *K. scorpioides* in Costa Rica (Ocegüera-Figueroa & Pacheco-Chaves 2012).

Five continental turtle species are known from the Department of Valle del Cauca in the central region of the Pacific coastal plain of Colombia (Corredor-Londoño et al. 2007). We present basic information on host and localities for ectoparasites associated with four of the five species. This adds to previous ectoparasite information

available for *R. annulata* and *K. leucostomum*, and contributes new host information for two other species of *Rhinoclemmys*.

## Material and Methods

Three species of *Rhinoclemmys*, *R. nasuta* (Boulenger 1902), *R. melanosterna* (Gray 1861) and *R. annulata*, and *Kinosternon leucostomum postinguinale* (Cope 1887) were examined for ectoparasites from mainland and island localities in western Colombia between April 2005 and July 2011. We examined turtles from three mainland localities in the Department of Valle del Cauca, Colombia on the Pacific coastal plain: Playa Chucheros (3.93228° N, 77.30784° W), San Pedro (3.83337° N, 77.24925° W), and San Isidro (3.44972° N, 77.16487° W). Populations of the four turtle species were also examined from the continental island known as Isla Palma (3.90019° N, 77.35597° W), which is within a few kilometers of the mainland sites Playa Chucheros and San Pedro (Figure 1).

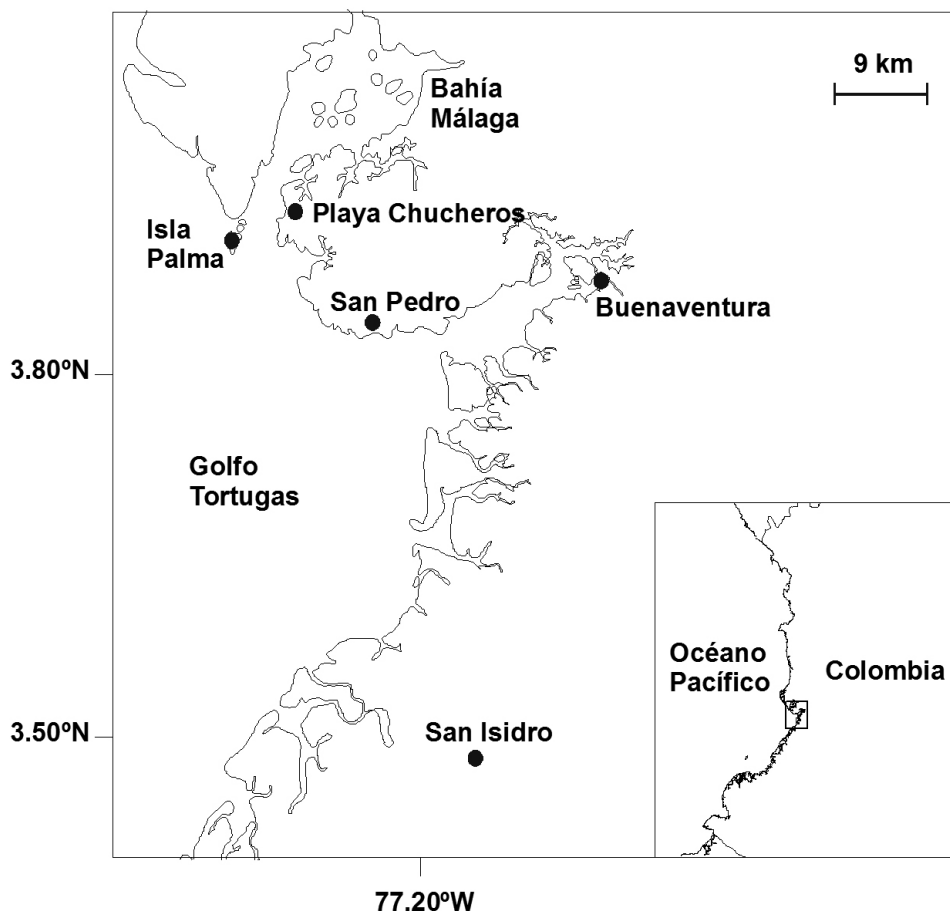
Turtles were collected by hand at night (2000 to 2400 h) from six streams on the island and eight streams on the mainland (three streams each at Playa Chucheros and San Pedro, and two streams from San Isidro). Once the turtles were collected, standard measurements of length and weight were taken, each individual was marked (Cagle 1939), sexed, and the external body surface was examined thoroughly for the presence of ectoparasites. All ectoparasites found were removed and preserved for later examination. For the two most abundant turtle species, *R. nasuta* and *K. leucostomum*, the number of specimens examined includes both original captures and recaptures as separate events. Ticks and leeches were preserved and stored in 70% ethanol (Knudsen 1966). In the last year, leeches were flattened and fixed with 10% formalin for 24 hr, we rinsed them with water before placing them in 70% ethanol for storage (Thorp & Covich 2010). Ectoparasite specimens were transported to the Animal Ecology Research Laboratory at the Universidad del Valle in Cali for sorting by life stage for ticks (i.e., nymph, larva, adult male, and adult female) and by species for the two groups. Both taxa were then identified to species using keys and primary species descriptions (Fairchild et al. 1966, Soos 1969, Jones et al. 1972, Ringuelet 1976, Ocegüera-Figueroa & Siddall 2008, López-Jiménez & Ocegüera-Figueroa 2009, Ocegüera-Figueroa & Pacheco-Chaves 2012). Parasite voucher specimens were deposited in the Teaching Collection (CD) of the Zoology Department of the Universidad del Valle (Cali) and the catalog access numbers are presented below.

## Results

A total of 639 *R. nasuta*, eight *R. melanosterna*, four *R. annulata*, and 74 *K. leucostomum* specimens were collected and subjected to thorough ectoparasite examinations from the four localities. Of the four turtle species encountered, 87 *R. nasuta*, four *R. melanosterna*, and two *R. annulata* from the island and two mainland populations (Playa Chucheros and San Pedro) possessed ticks. Leeches were not recovered from any turtles from Isla Palma; however, 59 *R. nasuta* and three *K. leucostomum* from the three mainland populations harbored leech infestations.

### 1. Ixodidae Murray, 1877; *Amblyomma* Koch, 1844; *Amblyomma sabanerae* Stoll, 1891

A total of 509 tick specimens were collected from the three *Rhinoclemmys* species, but none were found on *K. leucostomum*. The only tick species recovered was *A. sabanerae*, consisting of 385 larvae, 65 nymphs, 44 adult males, and 15 adult females (Table 1). Voucher specimens of *A. sabanerae* from each turtle species are as follows: *R. annulata*, CD 2737-2741, CD 2770; *R. melanosterna*, CD 2767-2769; and *R. nasuta*, CD 2614, CD 2663-2727, CD 2742-



**Figure 1.** Map of the four collecting localities from coastal areas of the Department of Valle del Cauca, Colombia.

**Table 1.** Number of ectoparasite specimens for each turtle species.

Species	<i>Amblyomma sabanerae</i>				<i>Placobdella ringueleti</i>
	Male	Female	Nymphs	Larvae	
<i>Rhinoclemmys nasuta</i>	34	11	61	175	463
<i>Rhinoclemmys annulata</i>	8	3	3	210	0
<i>Rhinoclemmys melanosterna</i>	2	1	1	0	0
<i>Kinosternon leucostomum</i>	0	0	0	0	102

2766. The immature stages (i.e., larvae and nymphs) have not been described for *A. sabanerae* (Guglielmone et al. 2003); therefore we followed the practice of “identifying” the preimaginal stages by their association with adult ticks present in the turtle population (Robbins et al. 2001). Robbins et al. (2001) described the hypostomal dentition of nymph specimens associated with adult *A. sabanerae* from *R. areolata* (Duméril & Bibron in Duméril & Duméril 1851) in Belize, and documented a 2/2 hypostomal dentition for the nymphs, as opposed to the 3/3 dental formula they attributed to *A. dissimile*, which is also known to parasitize *Rhinoclemmys* species (Ernst & Ernst 1977). The nymphal dentition we observed varied between 2/2 and 3/3. The 2/2 dental formula was observed in 65.5% of the nymphs recovered and the other 34.5% were 3/3. The different dental formulae observed were not only among nymphs on different individual turtle

hosts, but also between nymphs on the same turtle. The adult dental formula for *A. sabanerae* is 4/4.

*Rhinoclemmys nasuta* and *R. melanosterna* represent new host records for *A. sabanerae*, adding another two species to the previously recorded five species of *Rhinoclemmys* [*R. annulata*, *R. areolata*, *R. funerea* (Cope 1876), *R. pulcherrima* (Gray 1856), *R. punctularia* (Daudin 1801)], parasitized by this tick (Ernst & Ernst 1977, Burridge 2001, Robbins et al. 2001). Also, the presence of *A. sabanerae* in Valle del Cauca represents a new department record, south of the nearest reported locality where it was recovered from a *R. annulata* specimen in the Department of the Chocó (Ernst & Ernst 1977). Osorno-Mesa (1940) previously reported *A. sabanerae* from Colombia based on Schulze (1937); however, there was no mention of the host or a specific locality.

2. *Glossiphoniidae* Vaillant, 1890; *Placobdella* Blanchard, 1893; *Placobdella ringueleti* López-Jiménez & Ocegüera-Figueroa, 2009

A total of 565 leech specimens (including both adults and juveniles) were recovered over the course of this study, and *Placobdella ringueleti* was the only leech species identified from *R. nasuta* and *K. leucostomum* (Table 1). Voucher specimens of *P. ringueleti* from each turtle species are as follows: *R. nasuta*, CD 2606-2662, CD 2729-2736, and *K. leucostomum*, CD 2613, CD 2638-2639. This record of *R. nasuta* represents a new host for this leech, which is now recorded for two species of *Rhinoclemmys*. Ocegüera-Figueroa & Pacheco-Chaves (2012) reported *P. ringueleti* from *R. annulata* in Costa Rica. This record of *P. ringueleti* in Colombia represents a new locality record and substantial range extension compared to the previously reported localities in Chiapas, Mexico (López-Jiménez & Ocegüera-Figueroa 2009), and Costa Rica (Ocegüera-Figueroa & Pacheco-Chaves, 2012). *Kinosternon leucostomum* is the host species from which the type material of *P. ringueleti* was obtained, and it has also been recorded from three other turtle species, *Staurotypus triporcatus* (Wiegmann 1828), *Dermatemys mawii* (Gray 1847) (López-Jiménez & Ocegüera-Figueroa 2009), and *K. scorpioides* (Ocegüera-Figueroa & Pacheco-Chaves 2012). The turtle taxon in southern Mexico corresponds with the nominal subspecies, *K. l. leucostomum*, and our specimens from western Colombia correspond with the subspecies *K. l. postinguinale*.

Although the taxonomic description of *P. ringueleti* was relatively recent (López-Jiménez & Ocegüera-Figueroa 2009), the key of Ocegüera-Figueroa & Pacheco-Chaves (2012) and several morphological characteristics helped us to identify the specimens. Externally, the leech specimens exhibit an ovate-lanceolate body shape, are brownish in color, and possess a single confluent dorsal stripe. The external feature that was diagnostic for this species identification was the presence of papillae on the dorsal surface of the posterior sucker (López-Jiménez & Ocegüera-Figueroa 2009). Internally, the leech specimens have two pairs of compact salivary glands and a pair of mycetomes (López-Jiménez & Ocegüera-Figueroa 2009).

## Discussion

The biogeographic affinities of the two ectoparasite species identified here coincide with those of the turtles. Turtles of the Chocóan biogeographic region have a strong relationship with the fauna of lower Central America, a relationship between the *trans*-Andean forest herpetofauna of Colombia and Ecuador and the Central American herpetofauna that has long been recognized (Savage 1966, Duellman 1979). The difference in distribution among sites for the two ectoparasite species is also of biogeographic interest in that the leech is absent from the island locality. Although it might be thought the intolerance of *Placobdella* for seawater could account for this distributional difference, there is no evidence that the turtles colonized the island from the mainland across the seawater barrier – more than likely given that the maximum depths of the area around the island at the entrance to Bahía Málaga are <50 m (Cantera et al. 1998, Guevara-Fletcher et al. 2011), the island would have been connected to the mainland within the last 18,000 years during the last glacial period (Martínez 1993).

The geographic range and host distribution of both ectoparasite species have been expanded with our observations. The tick *Amblyomma sabanerae* is now reported from seven of nine *Rhinoclemmys* species (Ernst & Ernst 1977), with a distribution extending from western (Fairchild et al. 1966) and southern Mexico

(Paredes-León et al. 2008) at least as far south as Valle del Cauca in *trans*-Andean Colombia along the Pacific coast. The only record of the species from east of the Andes in South America is that of Ernst & Ernst (1977) based on a nymph found on a specimen of *R. punctularia* in Suriname. Our new record of the leech *Placobdella ringueleti* extends the known range from Costa Rica to western Colombia (approximately 1000 km), again a distributional pattern coinciding with the distribution of the host species, *K. leucostomum*, distributed from Mexico to South America. The species is now also recorded from two species of *Rhinoclemmys*, *R. annulata* in Costa Rica (Ocegüera-Figueroa & Pacheco-Chaves 2012) and *R. nasuta* in Colombia. Although there has been some question about whether or not there were species of *Placobdella* distributed in South America (Siddall et al. 2005, López-Jiménez & Ocegüera-Figueroa 2009), there are four species of *Placobdella* listed from *cis*-Andean South America (Christoffersen 2007, 2009), but this appears to be the first reported from the *trans*-Andean region. Both ectoparasite species recorded here have an apparently broad host tolerance among turtle species in lowland Neotropical localities.

The observed decline of turtles throughout the world has amplified the need for research that stands to clarify all possible reasons for their demise. The presence of ectoparasites on turtles is not novel; however, studies have shown that heavy sanguivore infestations could produce anemia and significantly limit the aerobic capacity and behavior of the host (Ernst & Ernst 1977, Burridge 2005), thus reducing its viability in a population (Jacobson 1994). In addition, ticks and leeches are known vectors of hemogregarine infections in different kinds of reptiles, which could reduce hemoglobin concentrations (Burridge & Simmons 2003, Ryan & Lambert 2005, McCoy et al. 2007, Read et al. 2008), and the lesions they create may serve as sites of pathogen entry and infection (Ernst & Ernst 1977). The first step in monitoring the potential threats of ectoparasite associations with a host species is to identify the ectoparasite species involved.

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