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Ticks (Acari: Ixodidae) from Wild Mammals in Fragmented Environments in the South of Yucatán Peninsula, México

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Ticks are in the class Acari, subclass Arachnida. Biologically, ticks are hematophagous ectoparasites commonly found on terrestrial vertebrates, with potential for vectoring bacteria, parasites, and viruses (Randolph 2011). Ticks are distributed worldwide. Recent taxonomic studies found approximately 80% of ticks of the world are ixodid (hard) and the remaining are argasid (soft) ticks. There are 241 species of ixodid ticks in seven genera: *Amblyomma*, *Boophilus, Dermacentor*, *Haemaphysalis*, *Hyalomma*, *Ixodes*, and *Rhipicephalus* (Jongejan and Uilenberg 2004).

In Latin America, sylvatic areas are used for ranching and food production, annually destroying large amounts of vegetation and leaving patches of forest for harvesting wood and hunting (Dirzo and Raven 2003). Habitat is lost through fragmentation that also results in loss of biodiversity and species richness while altering species interactions (Taylor and Merriam 1995). Fragmentation increases the rate of contact between domestic and wild animals, exponentially augmenting pathogen exchange among species inhabiting such areas (Daszak et al. 2000). For example, human activities increase the occurrence of Lyme disease in the northeastern United States (Levi et al. 2012). The objectives of this study were to determine tick species on wild mammals collected in fragmented habitats of a tropical forest in southern Yucatán Peninsula and to briefly review the medical importance of tick species encountered.

From September 2012 to May 2013, ticks were collected from wild mammals ranging freely at Ejido Caoba (18° 26´43.89" N, 89° 06´15.43" W) and Ejido Laguna Om (18° 27´ 32.89" N, 88° 55´48.14" W) in the south of Quintana Roo State. The area was approximately 1,000 ha, with fragmented areas because of farming. The most abundant introduced vertebrate species at both sites were cattle (*Bos taurus indicus* L.), sheep (*Ovis orientalis* L.), and goats (*Capra aegagrus hircus* L.), for extensive farming because most of the area had been deforested and most fragments covered by grassland.

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Wild animals were captured and identified to species by standard techniques (Reid 1997). The entire body of each animal was inspected. Ticks were collected and placed into sterile microtubes containing 75% pure ethanol (Sigma, St Louis, MO) for preservation and taken for identification to the Laboratory of Arbovilorogía of Centro de Investigaciones Regionales "Dr. Hideyo Noguchi" Universidad Autónoma de Yucatán. Ticks were identified with the aid of a stereoscope (Olympus 5Z30, Japan) and morphological keys (Brinton and Beck 1963, Guzmán-Cornejo and Robbins 2010). They were classified by genus, species, life stage, and host from which they had been collected (Table 1).

Nine wild mammals of seven species were trapped. Ticks were found mainly on ungulates, rodents, and carnivores. Thirty-five specimens of hard ticks (Ixodes) collected were *Amblyomma inornatum* Banks (18), followed by *Amblyomma ovale* Koch (seven), *Amblyomma imitator* Kohls (three), *Haemaphysalis juxtakochi* Cooley (two), *Amblyomma auricularium* Conil (one), *Amblyomma maculatum* Koch (one), and *Amblyomma cajennense* Fabricius (one). When separated by life stage, nymphs (20), adults (15), but no larvae, were found. Females (29) were more abundant than males (six). Twenty females were engorged, but no male had fed.

Our study demonstrated that fragmented areas are zones where wild and introduced animals interact. Fragmentation supports a wide range of tick species, many of which bite humans and/or vector pathogens affecting humans or domestic animals. The most common genus in the fragmented forest was *Amblyomma* of which several species were identified. *Amblyomma* has been reported to be one of the most abundant species on wild and domesticated animals and is less common on humans (Beldomenico et al. 2003, Tokarz et al. 2014). Ticks transmit several pathogens including *Babesia* spp., *Rickettsias*, and viruses (Tokarz et al. 2014). For example, *A. maculatum* ticks are linked to transmission of *Rickettsia parkeri* (Parker 1939), from the spotted fever group (Oliveira et al. 2003, Sumner et al. 2007). *Rickettsia prowazekii* (Da Rocha-Lima 1916), was detected and isolated in *Amblyomma* ticks at Nuevo León, México (Medina-Sanchez et al. 2005). *R. prowazekii* is an intracellular bacillus that causes epidemic typhus in humans. During identification of ticks, the presence of *H. juxtacochi* was surprising, because is not a common pest on the American continent, although this particular specie has been linked to rickettsial infection to birds in Brazil (Ogrzewalska et al. 2010). The ticks and their pathogens might be spread to new ecosystems by migratory birds or trading animals (Burridge 2001). Most tick activity occurs during months that coincide with the dry season in the tropical area of Southeast Mexico, when animals move more to locate resources such as water and food (Crawshaw and Quigley 1991, Madsen and Shine 1996) and consequently spread ticks among foraging areas. The presence of ticks in fragmented landscapes, their introduction, and their role in transmission of pathogens remains unclear. The role of ticks as a bridge for pathogens between wild or domestic animals and humans, needs to be determined, as does the effect of ticks on health and productive status of wild and domesticated animals in fragmented environments.

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Table 1. Mammal Species and Ticks Collected in Fragmented Areas of Quintana Roo State, Mexico

Mammal host common name (*scientific name*)	Tick species	Stage	Sex	Trophic stage	Total ticks collected
Collared peccary (*Pecari tajacu*)	*Amblyomma inornatum*	Nymph	Female	Not engorged	3
		Nymph	Female	Not engorged	
		Adult	Female	Engorged	
White-tailed deer (*Odocoileus virginianus*)	*Amblyomma imitator*	Adult	Male	Not engorged	3
	Amblyomma inornatum	Nymph	Female	Engorged	
	Amblyomma inornatum	Adult	Female	Engorged	
Lowland paca (*Cuniculus paca*)	*Amblyomma maculatum*	Nymph	Female	Engorged	3
	Amblyomma inornatum	Nymph	Female	Not engorged	
	Amblyomma auricularium	Nymph	Female	Not engorged	
Central American agouti (*Dasyprocta punctata*)	*Amblyomma inornatum*	Nymph	Female	Engorged	3
Central American red brocket (*Mazama temama*)	*Amblyomma inornatum*	Nymph	Female	Engorged	8
	Amblyomma inornatum	Nymph	Female	Engorged	
	Amblyomma inornatum	Nymph	Female	Engorged	
	Amblyomma inornatum	Nymph	Female	Engorged	
	Amblyomma inornatum	Nymph	Female	Engorged	
	Amblyomma cajennense	Nymph	Male	Not engorged	
	Haemaphysalis juxtakochi	Adult	Female	Not engorged	
	Haemaphysalis juxtakoch	Adult	Female	Not engorged	
Gray fox (*Urocyon cinereoargenteus*)	*Amblyomma inornatum*	Nymph	Female	Not engorged	2
	Amblyomma inornatum	Adult	Female	Not engorged	
Jaguar (*Panthera onca*)	*Amblyomma ovale*	Adult	Male	Not engorged	13
	Amblyomma ovale	Adult	Male	Not engorged	
	Amblyomma ovale	Adult	Male	Not engorged	
	Amblyomma ovale	Adult	Male	Not engorged	
	Amblyomma ovale	Adult	Female	Engorged	
	Amblyomma ovale	Adult	Female	Engorged	
	Amblyomma ovale	Adult	Female	Engorged	
	Amblyomma inornatum	Nymph	Female	Engorged	
	Amblyomma inornatum	Nymph	Female	Engorged	
	Amblyomma inornatum	Nymph	Female	Engorged	
	Amblyomma inornatum	Nymph	Female	Engorged	
	Amblyomma imitator	Adult	Female	Not engorged	
	Amblyomma imitator	Adult	Female	Engorged	

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