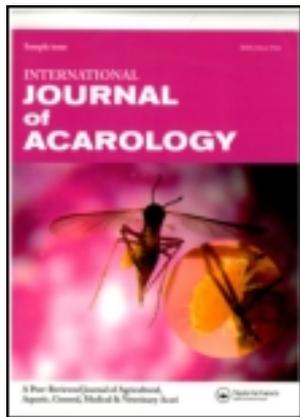


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New host and locality records for *Ixodes simplex* Neumann and *Ixodes vespertilionis* Koch (Acari: Ixodidae) from bats (Chiroptera: Hipposideridae, Rhinolophidae and Vespertilionidae) in southern China

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Between September 2004 and May 2007, 430 bats were examined for ectoparasites in southern China's Guizhou Province and Guangxi Autonomous Region. Ticks were found on 16 individuals from 6 bat species belonging to the families Hipposideridae, Rhinolophidae and Vespertilionidae. The tick *Ixodes simplex* Neumann was found on two species of vespertilionid bats, and *Ixodes vespertilionis* Koch was found on one species of hipposiderid and three species of rhinolophid bats. Five of the host records appear to be new, as are all the locality records for *I. simplex* in Guizhou Province and *I. vespertilionis* in the Guangxi Autonomous Region.

Keywords: *Ixodes simplex*; *Ixodes vespertilionis*; ectoparasite; Chiroptera; Guizhou Province; Guangxi Autonomous Region; China

Introduction

Only three ixodid ticks, all from the Old World, are known to be specific parasites of bats: *Ixodes kopsteini* (Oudemans), *Ixodes simplex* Neumann and *Ixodes vespertilionis* Koch. Because their hosts are volant and often migratory, all three species have extensive ranges in the Palearctic, Ethiopian, Oriental and Australian Zoogeographic regions (Arthur 1965; Yamaguti et al. 1971; Hoogstraal and Aeschlimann 1982). However, collections of these ticks are underrepresented in several areas, especially the subtropical interior of southern China, where, as in much of the Chinese countryside, ectoparasite studies have been few and sporadic (Chen et al. 2010). We surveyed ectoparasites of bats at several sites in southern China (Figure 1). Many different types of ectoparasites were collected including fleas (Hastriter and Bush 2010), flies (Hastriter and Bush 2006; Hastriter et al. 2009), mites (unpublished data) and ticks. Here, we report the collection of *I. simplex* from two species of bats in the family Vespertilionidae, and the collection of *I. vespertilionis* from four bat species belonging to the families Hipposideridae and Rhinolophidae in China's remote Guizhou Province and Guangxi Autonomous Region.

Materials and methods

Survey area

Bats and their ectoparasites were surveyed at the following sites:

Jing Xi County Nature Preserve – Located in Guangxi Autonomous Region, elevation 900–1400 m, 23°07'12" N, 105°57'36" E, September–October 2004. The fieldwork was conducted along a rapid stream in secondary forest

at 950 m. Old banana cultivation was evident, with less disturbed ridgetop forests of many large trees 20–30 m in height, some reaching ~50 m.

Shiwandashan National Nature Preserve – Located in Guangxi Autonomous Region, elevation 300–900 m, 21°13'48" N, 107°52'48" E, March–May 2005. Fieldwork was conducted along a winding paved road, through steep mountains of the preserve at 500 m. Secondary forests had maximum tree heights of ~25 m.

Kuan Kuoshui Nature Preserve – Located in Guizhou Province, elevation 1450–1750 m, 28°13'48" N, 107°09'36" E, March–May 2006. Fieldwork was conducted in deciduous and evergreen forests, with some trees reaching ~25 m. The valley floor and surrounding hills were cultivated. Streams drained into a small lake on the valley floor.

Dashahe Nature Preserve – Located in Guizhou Province, elevation 1350–1650 m, 29°10'12" N, 107°34'12" E, March–May 2006. Fieldwork was conducted in heavily disturbed natural vegetation at 1350 m. Maximum height of trees was ~15 m. Secondary growth surrounded the valley, much of which consisted of agricultural plots of tobacco and other crops. Secondary vegetation surrounded the valley and some native vegetation lined a small river running through the steep karst landscape.

Shuipu – Located near Maolan National Nature Preserve, Guizhou Province, elevation 635–850 m, 25°29'05" N, 107°52'54" E, March–May 2007. Fieldwork was conducted in and around Shuipu village in a gently sloping cultivated valley approximately 500 m wide and several kilometres long. The valley was surrounded by steep, rugged, karst formations. Perennial streams flowing into the valley were diverted to agricultural fields.



Figure 1. Map of field sites in southern China.

Mist nets and harp traps were set within the forest and at caves to capture bats (Hastriter and Bush 2010). Bats were removed live from nets and traps, placed individually in cloth bags and euthanized according to the guidelines of the American Society of Mammalogists (Gannon et al. 2007). Each bat was subjected to a thorough post-mortem visual examination: the face and ears were carefully searched and parasites were removed with forceps. In addition, the fur was systematically searched with the aid of a fine-toothed metal comb (LiceMeister®, National Pediculosis Association, Needham, MA, USA). All ectoparasites removed during examination were preserved in 70% ethanol for later identification in the laboratory. All associated hosts were prepared as museum specimens and were deposited in the Royal Ontario Museum, Toronto, Canada, except for a subsample of specimens that remained in regional collections in China. Ticks were assigned accession (Yale Peabody Museum; YPM) numbers and deposited in the Division of Entomology, Peabody Museum of Natural History, Yale University, New Haven, CT, USA.

Results

A total of 430 bats representing 17 genera and 44 species were examined (Table 1). Ticks were found on 16 individu-

als of 6 bat species and were identified to species on 15 of the 16 hosts.

Ixodes simplex

One adult female, 3 nymphs and 69 larvae were recovered from *Myotis ricketti* (one host individual, YPM 300756, 20 April 2006, Kuan Kuoshui, Figure 2). One nymph was recovered from *Ia io* (one host individual, YPM 300757, 15 April 2007, Shuipu); it is likely that three larvae from another *I. io* (YPM 300758, 24 April 2006, Kuan Kuoshui) are also *I. simplex*.

Ixodes vespertilionis

Two larvae were recovered from *Hipposideros larvatus* (two host individuals, YPM 300759 and YPM 300760, 10 and 12 April 2007, Shuipu). Ten larvae and two nymphs were recovered from *Rhinolophus affinis* (eight host individuals, YPM 300761–300768, 20 and 27 September, 3 October 2004, Jing Xi; 18 and 26 April 2005, Shiwandashan). Two larvae were recovered from *Rhinolophus pearsonii* (one host individual, YPM 300769, 5 May 2006, Dashahe). One larva and one nymph were recovered from *Rhinolophus rouxii* (two host individuals,

Table 1. Bats examined for ectoparasites in southern China.

Bat family	Scientific name	Individuals examined	Infested individuals
Hipposideridae	<i>Aselliscus stoliczkanus</i>	3	—
	<i>Hipposideros armiger</i>	9	—
	<i>Hipposideros larvatus</i>	30	2 ^a
	<i>Hipposideros pomona</i>	5	—
Megadermatidae	<i>Megaderma lyra</i>	6	—
Pteropodidae	<i>Cynopterus sphinx</i>	27	—
	<i>Rousettus leschenaultii</i>	16	—
Rhinolophidae	<i>Sphaerias blanfordi</i>	19	—
	<i>Rhinolophus affinis</i>	45	8 ^a
	<i>Rhinolophus lepidus</i>	2	—
	<i>Rhinolophus luctus</i>	2	—
	<i>Rhinolophus macrotis</i>	7	—
	<i>Rhinolophus paradoxolophus</i>	12	—
	<i>Rhinolophus pearsonii</i>	35	1 ^a
	<i>Rhinolophus pusillus</i>	14	—
	<i>Rhinolophus rouxii</i>	41	2 ^a
	<i>Rhinolophus yunnanensis</i>	11	—
	<i>Rhinolophus sp. nov.</i>	1	—
Vespertilionidae	<i>Eptesicus serotinus</i>	1	—
	<i>Harpiocephalus harpia</i>	6	—
	<i>Ia io</i>	3	1 ^b
	<i>Kerivoula hardwickii</i>	4	—
	<i>Miniopterus magnater</i>	3	—
	<i>Murina aenea</i>	1	—
	<i>Murina aurata</i>	9	—
	<i>Murina cyclotis</i>	48	—
	<i>Murina leucogaster</i>	13	—
	<i>Murina tubinaris</i>	9	—
	<i>Murina sp.</i>	1	—
	<i>Myotis altarium</i>	1	—
	<i>Myotis daubentonii</i>	3	—
	<i>Myotis montivagus</i>	6	—
	<i>Myotis muricola</i>	7	—
	<i>Myotis mystacinus</i>	8	—
	<i>Myotis ricketti</i>	3	1 ^b
	<i>Myotis siligorensis</i>	4	—
	<i>Pipistrellus cadornae</i>	1	—
	<i>Pipistrellus ceylonicus</i>	1	—
	<i>Pipistrellus coromandra</i>	1	—
	<i>Pipistrellus paterculus</i>	3	—
	<i>Pipistrellus pulveratus</i>	1	—
	<i>Pipistrellus sp.</i>	1	—
	<i>Scotomanes ornatus</i>	4	—
	<i>Vespertilio sinensis</i>	3	—
	Total species	44	6
Total individuals	430	15	

^aBats infested by *Ixodes vespertilionis*.

^bBats infested by *Ixodes simplex*; a second individual of *Ia io* was infested with larval ticks and it is likely that these are also *Ixodes simplex*.

YPM 300770 and 300771, 20 April 2005, Shiwandashan; 11 April 2007, Shuipu).

Discussion

Previous Chinese collections of *I. simplex* have all been made in the coastal provinces of Fujian and Jiangsu (Chen et al. 2010) or in Taiwan (Wilson 1970; Robbins 2005). Our collections of this tick from *I. io* and *M. ricketti* in Guizhou Province are apparently the first records from the

Chinese interior and suggest that *I. simplex* is widespread, albeit uncommon, in south-eastern Asia. This argument is bolstered by the recent discovery of *I. simplex* in Hà Tĩnh Province, north-central Vietnam (Kolonin 2003), and by a few earlier records from Malaysia, summarized by Petney and Keirans (1994).

Ixodes vespertilionis is also thought to be uncommon in south-eastern Asia (Petney and Keirans 1994), but this tick occurs widely in China, with reports from the northern provinces of Jiangsu, Liaoning and Shanxi, the northern



Figure 2. *Myotis ricketti* infested with *Ixodes simplex*.

autonomous region of Nei Mongol (Inner Mongolia), the central province of Hubei, the south-western province of Sichuan and the southern provinces of Fujian, Guizhou and Yunnan (Chen et al. 2010); it also occurs in Taiwan (Wilson 1970; Robbins 2005). Significantly, the only South East Asian records of this species are from Thailand, where *I. vespertilionis* has been collected in the eastern and northern provinces of Chanthaburi and Chiang Mai (Tanskul et al. 1983).

Of our host records, all but one – *I. vespertilionis* from *R. affinis* – appear to be new. Our collections of *I. vespertilionis* from Guangxi Autonomous Region, like those of *I. simplex* from Guizhou Province, represent new locality records for China (Chen et al. 2010). For both tick species, we expect that additional collections from bats in China will yield records for most, if not all, of that country's administrative divisions.

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