

Migratory bird tick surveillance, including a new record of *Haemaphysalis ornithophila* Hoogstraal and Kohls 1959 (Acari: Ixodidae) from Hong-do (Hong Island), Republic of Korea

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Abstract

In 2008, tick surveillance of migratory birds was conducted on Hong-do (Hong Island), Jeollanam Province, Republic of Korea. Seventy-seven ticks representing two genera and four species—*Haemaphysalis flava* Neumann (21 ticks), *Haemaphysalis ornithophila* Hoogstraal & Kohls (2), *Ixodes nipponensis* Kitaoka & Saito (3), and *Ixodes turdus* Nakatsuji (51)—were collected from 12 species of birds belonging to nine genera. Two male *H. ornithophila*, an uncommonly collected tick, were removed from a scaly thrush, *Zoothera dauma* (Latham), on Hong-do. *Haemaphysalis ornithophila* is a Southeast Asian species that was transported to Korea during the spring migration of *Z. dauma* to its breeding grounds in Russia. This first report of *H. ornithophila* from Korea has implications for the introduction of exotic tick species and their pathogens on migratory birds.

Key words: *Haemaphysalis ornithophila*, *Ixodes*, bird ticks, migratory birds, Korea

Introduction

Haemaphysalis is the second largest tick genus in the family Ixodidae, consisting of about 170 species and subspecies (Horak *et al.* 2002). *Haemaphysalis* spp. are obligate ectoparasites on a wide range of birds and mammals and have a three-host life cycle (Hoogstraal & Kim 1985). The genus is especially well represented in Asia (Hoogstraal & Kim 1985), and although few haemaphysalids are known to be of major biomedical importance, in the forests of southwestern India *Haemaphysalis spinigera* Neumann is the principal vector of Kyasanur Forest disease, a distinctive member of the tick-borne encephalitis complex of flaviviruses (Work & Trapido 1957; Trapido *et al.* 1964).

Haemaphysalis flava Neumann is widespread in the Republic of Korea, commonly occurring in forests and, less frequently, grassy areas, especially ranches, where *Haemaphysalis longicornis* Neumann predominates (Lee *et al.* 2005).

Haemaphysalis (Ornithophysalis) ornithophila Hoogstraal & Kohls was first described in 1959 from specimens collected on the rusty-naped pitta, *Pitta oatesi oatesi* (Hume), in Thailand and on Cochin-Chinese red jungle fowl, *Gallus gallus gallus* (Linnaeus), in Burma (Hoogstraal & Kohls 1959; Hoogstraal & Wassef 1965, 1973). This tick occurs throughout much of Southeast Asia and adjoining areas, with reports from various bird species in the Philippines (Parrish 1971), Taiwan (Wilson 1970; Tseng 1978; Robbins 2005), Uttar Pradesh, northern India (Ghosh *et al.* 2007), Russia (Pospelova-Shtrom & Naumov 1965; Filippova 1984), and Thailand (Tanskul *et al.* 1983; Tanskul & Inlao 1989). It has also been collected from water buffalo in Laocai, Vietnam (Kolonin 1985, 1995), rabbits in Guiyang City, Guizhou, China (Xu & Li 1997), and ground vegetation in Thailand (Hirunkanokpun *et al.* 2003).

Ixodes spp. are commonly collected from mammals, birds and reptiles, feeding on smaller animals as larvae and on larger animals as nymphs and adults. In a recent rodent surveillance program in Korea, of more than 4,500 ticks collected seasonally from small mammals in northern Gyeonggi Province, all (except one *H. flava*) were *Ixodes nipponensis* Kitaoka & Saito, and of these >90% were larvae with no adults collected (H.C. Kim, unpublished data). Similarly, *Ixodes turdus* Nakatsuji is endemic to Korea, and in April 2007, 22 specimens were collected from tick drags on Jeju Island (Sames *et al.* 2008).

This report identifies the ticks collected from 12 migratory bird species on Hong-do (Hong Island), Jeollanam Province, southwestern Korea, including a new record for *H. ornithophila* collected from a scaly (White's) thrush, *Zoothera dauma* (Latham).

Materials and methods

Survey area

From January to December 2008, the Migratory Birds Center, National Park Research Institute, located on Hong-do, conducted banding surveys for birds that were traversing Korea to their northern summer breeding and southern wintering grounds. Hong-do is a remote island (34° 41' 07" N, 125° 11' 33" E), with a total area of 6.4 km², located in Heuksan-Myeon, Shinan-Gun, Jeollanam Province, 115 km west of Mokpo (mainland port city), and is a protected National Monument (No. 170, April 1965) (Fig. 1). Many migratory birds pass through Hong-do on their spring and autumn migrations from southern and northeastern Asia, including species from mainland Korea and Russia.

Tick collections

Birds were captured using 36 mm nylon mist nets (12 m in length, 2.5 m high) placed at ground level. The trapped birds were identified to species, their sexes and ages determined, and banded with a unique identification number. Prior to release, banded birds were closely examined for ticks, particularly around the head and neck. Observed ticks were carefully removed with forceps to prevent injury to the bird and placed individually in cryovials containing 70% ethanol. Each cryovial was labeled with a unique identification number that corresponded to the migratory bird collection data. Ticks were microscopically examined using taxonomic identification keys to determine species and developmental stages (Hoogstraal & Kohls 1959; Yamaguti *et al.* 1971; Tanskul & Inlao 1989). A field data sheet that included the unique bird identification number, species, sex, and other pertinent information was archived.

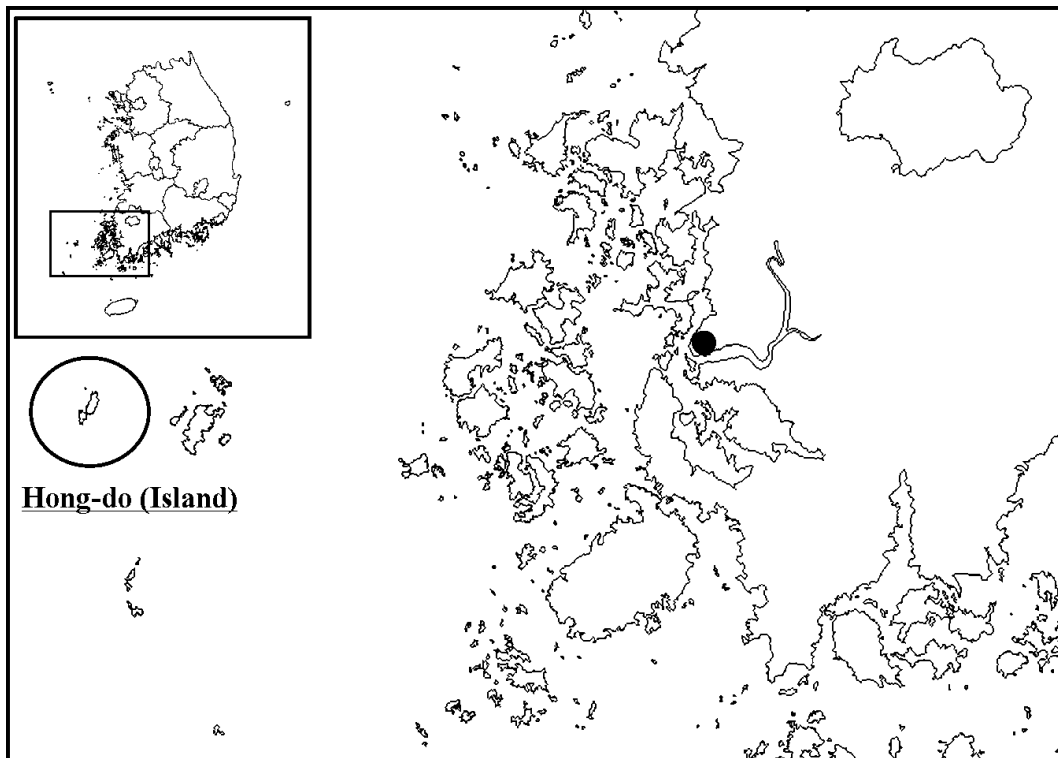


FIGURE 1. Location of Mokpo (●) and Hong-do, collection site of ticks removed from migratory birds, Jeollanam Province, Korea.

Results

A total of 1,561 birds representing 92 species were banded and examined for ticks from January to December 2008, with peak tick collection dates corresponding to the spring and autumn migration periods (Fig. 2). Seventy-seven ticks were removed from 22 birds belonging to 12 species and nine genera: scaly thrush (*Zoothera dauma* (Latham)) (5 birds), yellow-throated bunting (*Emberiza elegans* Temminck) (4), pale thrush (*Turdus pallidus* Gmelin) (3), olive-backed pipit (*Anthus hodgsoni* Richmond) (2), Siberian thrush (*Zoothera sibirica* (Pallas)) (1), Eurasian siskin (*Carduelis spinus* (Linnaeus)) (1), Tristram's bunting (*Emberiza tristrami* Swinhoe) (1), yellow-browed bunting (*Emberiza chrysophrys* Pallas) (1), brambling (*Fringilla montifringilla* Linnaeus) (1), thick-billed shrike (*Lanius tigrinus* Drapiez) (1), Styan's grasshopper warbler (*Locustella pleskei* Taczanowski) (1), and Japanese white-eye (*Zosterops japonicus* Temminck & Schlegel) (1) (Table 1). Larval, nymphal and adult ticks removed from these birds, representing two genera and four species, were *Haemaphysalis flava* (21 ticks, 27.3% of total collected), *H. ornithophila* (2, 2.6%), *Ixodes nipponensis* (3, 3.9%), and *I. turdus* (51, 66.2%) (Table 1). All ticks were attached to the anterior part of the body, around the eyes, crown and front of the head, and nape of the neck (Fig. 3). *Ixodes turdus* was the most commonly collected tick, with a total of 31 larvae, 14 nymphs, and 6 females recorded from six of the 12 bird species: *Z. dauma*, *T. pallidus*, *E. elegans*, *E. tristrami*, *E. chrysophrys*, and *F. montifringilla* (Table 1). Similarly, *H. flava* larvae (1) and nymphs (20) were collected from six of the 12 species of birds found with ticks (Table 1). *Ixodes nipponensis*,

TABLE 1. Ticks collected from migratory birds during 2008 on Hong-do (Hong Island), Jeollanam Province, Korea.

Host species	Number of birds captured	Number of birds with ticks	<i>Ixodes turdus</i> 40 (30L, 7N, 3F)	<i>Ixodes nipponensis</i>	<i>Haemaphysalis flava</i>	<i>Haemaphysalis ornithophila</i> *
Scaly thrush	20	5		0	10 (10N)	2 (2M)
Siberian thrush	6	1	0	1 (1N)	0	0
Pale thrush	126	3	3 (1N, 2F)	0	0	0
Yellow-throated bunting	178	4	1 (1F)	0	5 (1L, 4N)	0
Tristram's bunting	93	1	2 (1L, 1N)	0	0	0
Yellow-browed bunting	24	1	4 (4N)	0	0	0
Eurasian siskin	5	1	0	0	1 (1N)	0
Brambling	148	1	1 (1N)	0	0	0
Thick-billed shrike	2	1	0	0	2 (2N)	0
Styan's grasshopper warbler	11	1	0	2 (2N)	0	0
Japanese white-eye	262	1	0	0	1 (1N)	0
Olive-backed pipit	39	2	0	0	2 (2N)	0
TOTAL	914	22	51	3	21	2

* First report from Korea
L (Larva), N (Nymph), F (Female), M (Male)

commonly collected from a wide range of mammals and birds elsewhere, was less frequently collected on Hong-do, with only three nymphs removed from two of the 12 species of birds.

Two males of *H. ornithophila*, an uncommonly collected species and a new record for Korea, were recovered on 22 April 2008 from a single *Z. dauma*, a common spring visitor that breeds in Russia and parts of Korea. Males of *H. ornithophila* are easily distinguished by their strongly developed ventral spurs on palpal segment 3, coxa I and trochanter I. This tick is known to occur throughout much of Southeast Asia and China but has not previously been reported from Korea.

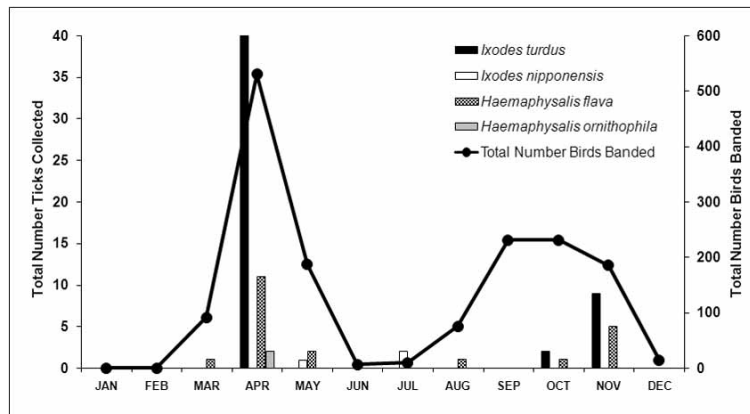


FIGURE 2. Monthly changes in total number of banded migratory birds, and ticks collected from them, on Hong-do, Jeollanam Province, Korea.

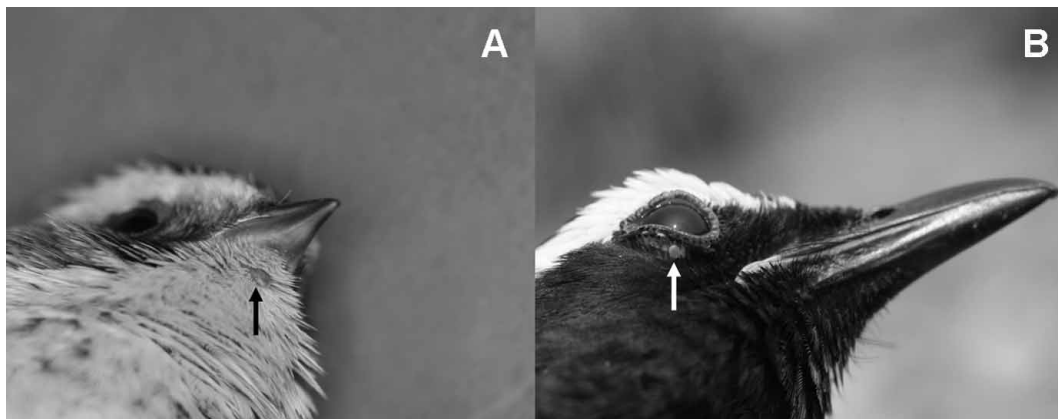


FIGURE 3. Tick-infested birds on Hong-do. (A) *Emberiza elegans* with *Haemaphysalis flava* attached at neck; (B) *Zosterops sibirica* with *Ixodes nipponensis* attached below eye.

Discussion

The bird population of Korea is augmented by millions of migrants during April-May and September-November, with >100 species recorded on spring migrations to the northeastern Palearctic region, including Russia, eastern China and Manchuria, and autumn migrations to Southeast Asia and Australia (Lee *et al.* 2000). Over the past several years, studies have focused on migratory birds and their role in annually reintroducing highly pathogenic avian influenza to Korea. This program has recently been expanded to include tick surveillance, evaluation of the potential for

introducing new tick species and non-endemic tick-borne pathogens, and collection of baseline information for species and stages of bird ticks transported to Korea during the spring and autumn migratory seasons.

While *H. flava* has a broad host range that includes mammals and birds (Asanuma *et al.* 1955; Yamaguti *et al.* 1971; Yamauchi & Takeno 2000; Yamauchi 2001), only one of >3,000 ticks was collected from small mammals captured throughout northern Gyeonggi Province, even though it was commonly collected with tick drags in forested areas (H.C. Kim, unpublished data). As in a migratory bird tick survey in central Japan (1995–1997), where *H. flava* was the most frequently collected tick (94.4%) (Ishiguro *et al.* 2000), one larva and 20 nymphs were recorded from six species of birds on Hong-do.

Two male *H. ornithophila*, a tick previously unreported in Korea and an uncommonly collected species throughout its range, were removed from a scaly thrush, *Z. dauma*. *Haemaphysalis ornithophila* is widespread in Southeast Asia and China, and individuals of *Z. dauma* may carry this tick with them when migrating to their summer breeding grounds in Korea and Russia. One of our specimens (accession number YPM 300689) has been deposited in the Division of Entomology, Peabody Museum of Natural History, Yale University, New Haven, CT, USA.

Ixodes nipponensis is commonly collected from a wide range of mammals and birds, and during this survey three nymphs were collected from two species of birds. During surveys from 2004 to 2008, *Ixodes nipponensis* was the predominant parasite of small mammals in Korea, accounting for >98% of the ticks collected from wild rodents (H.C. Kim, unpublished data). *Ixodes nipponensis* is also the most commonly reported tick on humans in Korea (Lee *et al.* 1989; Cho *et al.* 1994; Ko *et al.* 2002).

Ixodes turdus is chiefly a bird parasite (Yamauchi 2001) and was the most frequently collected tick (66.2 % of all specimens) during this study, having been found on six of the 12 bird species from which ticks were removed. These results are similar to those from migratory bird surveys in eastern Shimane Prefecture, Japan, where *I. turdus* accounted for 79.0% of all ticks collected from birds (Yamauchi & Mori 2004).

All of the ticks collected during this study were attached to the anterior part of their hosts' bodies, around the eyes, crown and front of the head, and nape of the neck, a pattern that was also reported by Miyamoto *et al.* (1993).

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