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Ticks from Wild Mammals in the Kyushu District Including Okinawa Prefecture, Japan

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As a part of ecological studies on ticks, various kinds of ticks from wild mammals collected in the Kyushu district including Okinawa Prefecture, Japan were surveyed from 1982 to 1988. Nine tick species consisting of *Argas vespertilionis*, *Amblyomma testudinarium*, *Haemaphysalis flava*, *H. megaspinosa*, *H. phasianiana*, *H. longicomis*, *H. hystricis*, *Ixodes ovatus* and *I. nipponensis* (329 ticks in total), were captured from 15 species of mammals. As for the argasids, the larva of *A. vespertilionis* alone was obtained from the two Japanese house bats. The majority of the ticks were *H. flava* and *I. nipponensis*, taken from various kinds of mammals, suggesting that both tick species had a wide host range as does *I. ovatus*. Both *I. ovatus* and *I. nipponensis* showed a different host preference between the immature and the adult stages.

INTRODUCTION

Ticks feeding on vertebrate's blood are of medical and veterinary importance, because they are vectors for various diseases, not to mention the fact that they directly harm hosts by attachment. In particular, the cattle tick, *Haemaphysalis zongicornis* does much damage to animal husbandry as the vector for theileriosis caused by *Theileria sergenti*. The tick life cycle seems closely associated with wild mammals. Knowledge of life cycles and host associations of ticks is therefore essential in studying the tick-borne diseases and tick-control efforts. In Japan, there have been a few studies on their life cycles, except for *H. zongicornis* (Namba, 1958; Yoshida, 1975, 1980; Chikaki, 1976). However, several reports on host-tick relationships have been published (Saito, 1959; Yamaguti *et al.*, 1971; Kitaoka and Suzuki, 1974; Takada and Yamaguchi, 1974; Kitaoka *et al.*, 1975; Fujita *et al.*, 1981; Fujimoto *et al.*, 1986).

As a basis for ecological studies on ticks, host-tick relationships are considered important. Therefore, a survey of ticks from wild mammals collected in the Kyushu district including Okinawa Prefecture was carried out from 1982 to 1988.

MATERIALS AND METHODS

The localities of tick-infested wild mammals were shown in Fig. 1. In order to find ticks, each animal was carefully examined upon visual inspection or under a binocular microscope. Most of the ticks from medium- to large-sized mammals were obtained

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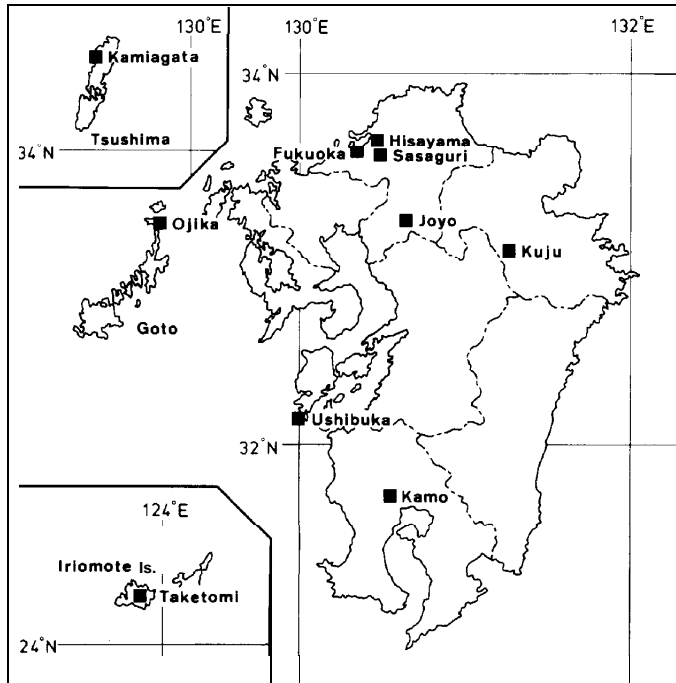


Fig. 1. Map showing the localities where host mammals were collected.

through the courtesy of other workers. Ticks were preserved in 70% ethanol and examined in a binocular microscope or a scanning electron microscope.

RESULTS

A total of 329 ticks obtained, consisting of *Argas vespertilionis* (Argasidae), ***Amblyomma testudinarium***, ***Haemaphysalis flava***, ***H. megaspinosa***, ***H. phasianana***, ***H. longicornis***, ***H. hystricis***, *Ixodes ovatus* and ***I. nipponensis*** (Ixodidae), were listed according to the species (Table 1). In accordance with the host mammals (the number in parentheses), the Japanese shrew, ***Crocidura dsinezumi*** (3) (Insectivora: Soricidae); Japanese greater shrew-mole, *Urotrichus talpoides* (1) (Talpidae); Japanese house bat, *Pipistrellus abramus* (2) (Chiroptera: Vespertilionidae); Japanese (Kyushu) hare, *Lepus brachyurus brachyurus* (7); feral domestic rabbit, *Oryctolagus cuniculus domestica* (2) (Lagomorpha: Leporidae); Smith's red-backed vole, ***Eothenomys smithii*** (1); Japanese field vole, *Microtus montebelli* (1); Japanese larger field mouse, *Apodemus speciosus* (4); Japanese lesser field mouse, ***Apodemus argenteus*** (1) (Rodentia: Muridae); Tsushima yellow marten, *Martes melampus tsuensis* (6); Korean weasel, ***Mustela sibirica coreana*** (7) (Carnivora: Mustelidae); Iriomote cat, ***Mayailurus iriomotensis*** (8); leopard cat, *Felis bengalensis manchurica* (4) (Felidae); Japanese wild hog, *Sus scrofa leucomystax* (1) (Artiodactyla: Suidae) and Kyushu shika deer, *Cervus nippon nippon* (1) (Cervidae) (49 individuals of 15 species, 14 genera, 9 families belonging to 6 orders in total) were examined.

The larvae of *Argas vespertilionis* were obtained from the two Japanese house bats. The fact that the larva and/or nymph of *Ixodes* (*I. ovatus* and *I. nipponensis*) were taken mainly from small-sized mammals and the adult from medium-sized

Table 1. Ticks obtained from mammals in the Kyushu district including Okinawa Prefecture.

Tick species	Number of ticks*				Host species+	Locality	Prefecture
	L	N	♂	♀			
Argasidae							
<i>Argas vespertilionis</i>	20	0	0	0	PA (2)	Fukuoka	Fukuoka
Ixodidae							
<i>Amblyomma testudinarium</i>	0	6	1	0	MI (2)	Taketomi	Okinawa
<i>Haemaphysalis flava</i>	0	3	1	0	LB (1)	Hisayama	Fukuoka
	0	25	16	7	LB (4)	Kamo	Kagoshima
	1	0	0	0	AA (1)	Hisayama	Fukuoka
	0	1	0	0	MT (1)	Kamiagata	Nagasaki
	0	5	0	0	MS (3)	Kamiagata	Nagasaki
	0	0	1	9	SS (1)	Joyo	Fukuoka
	<i>megaspinosa</i>	0	1	0	2	CN (1)	Ojika
<i>phasiana</i>	0	0	0	3	OC (2)	Ushibuka	Kumamoto
	0	1	0	0	CN (1)	Ojika	Nagasaki
<i>longicornis</i>	0	6	0	0	LB (1)	Hisayama	Fukuoka
	0	7	1	2	LB (2)	Sasaguri	Fukuoka
	0	1	0	0	MT (1)	Kamiagata	Nagasaki
<i>hys tricis</i>	1	31	0	0	MI (8)	Taketomi	Okinawa
<i>Ixodes</i>							
<i>ovatus</i>	1	1	0	0	CD (2)	Hisayama	Fukuoka
	4	0	0	0	UT (1)	Hisayama	Fukuoka
	0	0	0	1	LB (1)	Hisayama	Fukuoka
	2	1	0	0	ES (1)	Hisayama	Fukuoka
	0	1	0	0	MM(1)	Kuju	Oita
	6	3	0	0	AS (4)	Hisayama	Fukuoka
	1	0	0	0	AA (1)	Hisayama	Fukuoka
<i>nipponensis</i>	1	1	0	0	CD (1)	Sasaguri	Fukuoka
	0	0	2	1	LB (2)	Kamo	Kagoshima
	0	2	0	0	AS (2)	Hisayama	Fukuoka
	0	1	0	0	AA (1)	Hisayama	Fukuoka
	0	0	9	21	MT (5)	Kamiagata	Nagasaki
	0	2	24	52	MS (6)	Kamiagata	Nagasaki
	0	1	16	23	FB (4)	Kamiagata	Nagasaki

*L, larva; N, nymph; ♂, adult male; ♀, adult female. †AA, *Apodemus argenteus*; AS, *Apodemus speciosus*; CD, *Crocidura dsinezumi*; CN, *Cervus nippon nippon*; ES, *Eothenomys smithii*; FB, *Felis bengalensis manchurica*; LB, *Lepus brachyurus brachyurus*; MI, *Mayailurus iriomotensis*; MM, *Microtus montebelli*; MS, *Mustela sibirica coreana*; MT, *Martes melampus tsuensis*; OC, *Oryctolagus cuniculus domestica* (feral domestic rabbit); PA, *Pipistrellus abramus*; SS, *Sus scrofa leucomystax*; UT, *Urotrichus talpoides*. The numbers of host mammals examined are in parentheses.

mammals suggested a different tendency in host preference between the immature and the adult stages. On the contrary, *Haemaphysalis* ticks showed no such a tendency. *H. nipponensis* was so abundant that it constituted 50.5% of all ixodids collected, and was especially dominant on mammals from Tsushima (e. g. the Tsushima yellow marten, Korean weasel and leopard cat). *H. flava* had a broad host range and was next abundant, accounting for 22.3% of all ixodids captured. *H. longicornis* was obtained from three Japanese hares and one Tsushima yellow marten, but the number of that tick from the above wild mammals was much smaller than that from grazing cattle. *H. megaspinosa* and *H. phasiana* were few, both of which were taken from one Kyushu shika deer captured on Nozaki Is. of the Goto Isls., Nagasaki Pref. *H. phusiana* was collected also from feral domestic rabbits on Oshima Is. of Ushibuka City, Kumamoto Pref. *A. testudinarium* and *H. hystricis* were obtained from the Iriomote cats on Iriomote Is., Okinawa Pref.

DISCUSSION

The majority of argasids exhibit the "multihost" life cycle. The sequence requires a separate host for the larva, each nymphal instar and each adult feeding. Adult argasids with this type of life cycle feed several times. In contrast with this, the three-host ixodids utilize a separate host for each developmental stage. The host-tick relationships are discussed separately according to the two tick families as follows.

1. Argasidae

Most argasid larvae require long feeding periods (several days), but most nymphs and adults complete feeding within minutes or a few hours (Asanuma, 1965) : the habitat of a soft tick, *Argas vespertilionis* may be bats or their roosting sites. The argasid tick sometimes infests humans (Kamimura and Kondo, 1977a), and the authors also collected two adult females from two persons in a house where the Japanese house bats roosted (Kakuda, unpublished).

2. Ixodidae

It has been well known that *H. phasiana* and *H. Zongicornis* exhibit host specificity. *H. phasiana* shows a distinct preference for birds, especially for pheasants (Yamaguti et al., 1971 ; Saito et al., 1974). Engorged, one nymph and three adult females of *H. phasiana*, however, were first found from mammals, i. e. one Kyushu shika deer and two feral domestic rabbits, respectively, in the present survey.

H. longicornis is most dominant in Japanese pastures and selectively parasitises grazing cattle (Kitaoka, 1975 ; Kitaoka et al., 1975). This tick has been sometimes obtained from humans (Yamaguti, 1977 ; Yamaguti and Suzuki, 1981; Yamaguti and Takada, 1981) and the following various kinds of mammals : the Japanese (Kyushu) hare (this study), Japanese (Tohoku) hare, *L. b. angustidens* (Saito et al., 1965), Japanese black bear, *Selenarctos thibetanus japonicus* (Fujita and Takada, 1977 ; Takada and Fujita, 1978), dogs (Saito, 1978 ; To et al., 1980 ; Fujita et al., 1981), the Japanese raccoon dog, *Nyctereutes procyonoides viverrinus* (Saito et al., 1965), Tsu-

shima yellow marten (this study), Japanese badger, *Meles meles anakuma* (Saito et al., 1965), Japanese wild hog (Saito, 1978 ; Kakuda, unpublished) and Honshu shika deer, *C. n. centralis* (Yamaguti et al., 1971). That is, *H. Zongicornis* has a broad host range, and the above wild mammals are regarded as the important temporary or substitute hosts filling the blank of cattle in completing the tick life cycle during the non-grazing period, suggesting epizootically the possible transmission of *Theileria sergenti* to such wild mammals. Correspondence of timing between the active season of *H. Zongicornis* and the grazing period may cause serious damage to cattle.

All the ticks collected, except for the two above-mentioned ticks, exhibit a wide host range. Both *A. testudinarium* and *H. hystrix* are common species in the Ryukyu Islands, and feed on the Ryukyu rabbit, *Pentalagus furnessi*, Ryukyu wild hog, *S. s. riukiuanus*, dogs (Kitaoka and Suzuki, 1974 ; Yamaguti et al., 1971) and the Iriomote cat (Hasegawa and Iwatsuki, 1986 ; this study). *A. testudinarium* frequently attaches to humans (Yamaguti et al., 1971; Yamamoto et al., 1976 ; Kamimura and Kondo, 1977b ; Yamaguti, 1977 ; Yamaguti and Takada, 1981; Kakuda, unpublished),

H. flava, which has been regarded as a vector for tularemia (Asanuma et al., 1956 ; Asanuma and Sakurai, 1958 ; Fujita et al., 1985), is widely distributed in Japan (Kitaoka, 1975), and has a very broad host range, including birds. In this study, however, only one larva of *H. flava* was collected from small-sized mammals (the Japanese lesser field mouse), suggesting that small-sized mammals are not important hosts for this tick (Fujita et al., 1981).

H. megaspinosa has been taken from the Yeso brown bear, *Ursus arctos yesoensis*, Japanese black bear (Kitaoka et al., 1975), Japanese wild hog (Yamaguti et al., 1971), Kyushu shika deer (Yamaguti et al., 1971 ; this study), Honshu shika deer and Japanese serow, *Capricornis crispus crispus* (Yamaguti et al., 1971). These large-sized mammals seem to be important hosts for this tick.

I. ovatus and *I. nipponensis* display a difference in host preference between the developmental stages, i. e. the immature and adult parasitise small- and medium-sized mammals, respectively. All the immatures of *I. ovatus* were obtained from small-sized fossorial mammals, supporting the assumption that the immature attaches to hosts in their tunnels (Asanuma, 1965). The immature of *I. nipponensis* commonly attacks the kanahebi lizard, *Takydromus tachydromoides*, which is a small-sized terrestrial reptile (Fujita and Takada, 1978; Yoneda, 1981; Fujimoto et al., 1986). On the other hand, the adults of both *Ixodes* species were taken from medium-sized mammals. In contrast to the adult, the immatures of these two species appear not to ascend vegetation. Judging from the above, it is revealed that such a difference in host preference between the immature and the adult stages may be due to the disparity in ascending behaviour.

Both the Tsushima yellow marten and the leopard cat are rare species. Accordingly, to our knowledge, this is the first record on ticks found from such mammals in Japan. Much of the host-tick relationships has remained unsolved. It is thus essential that further investigations of ticks from various wild animals are carried out in order to elucidate the relationship.

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