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A preliminary study of the significance of ticks and tick-borne diseases in South-east Asia

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Introduction

Ticks and tick-borne diseases are of major significance both as factors directly influencing human health and also as factors reducing potential protein production in many countries where they dramatically reduce the health of domestic stock (13, 39, 47). In some areas, such as Europe, North America and Africa, the significance of ticks is well known and a great deal of effort has gone into characterizing the diseases which they transmit. This is not true for South-east Asia where comparatively little has been published on the medical and veterinary significance of tick-borne diseases (50). In this publication I hope to give some background on the tick-borne diseases of this area.

Tick Fauna of South-east Asia

South-east Asia, with about 103 species of ticks, possesses 12.5% of the world's recognized tick fauna (Tab. 1). This number is likely to change somewhat depending on taxonomic revision, reevaluation of old distribution records and the discovery of new species. Of the recognized species 96 are hard ticks (Ixodidae) and seven soft ticks (Argasidae). Very little is known about the medical or veterinary significance of any of these ticks.

The argasid ticks are rather poorly represented in South-east Asia and are of less significance than the ixodid ticks. There is also considerable variation in the potential significance of the nine ixodid genera. The genus *Aponomma,* for example, comprises only species which use reptiles as hosts and is of no significance for man. Most species of *Amblyomma* are also of little significance, being parasites of reptiles (6 species), pangolins (Manidae, *Amblyomma javanense*) or rhinoceros (Rhinocerotidae, *Amblyomma crenatum*). Moreover, some species have very limited distributions such as *Amblyomma robinsoni* which is restricted to Komodo Island in Indonesia where it infests the Komodo dragon *(Varanus komodoensis)* and *Amblyomma cyprium aetipes* which occurs in certain areas of Mindanao in the Philippine Islands. Other species, however, such as *Amblyomma testudinarium* and *Amblyomma c. cyprium* are very widely distributed and use a wide range of species as hosts, including, at least occasionally, man.

Boophilus microplus, which was probably introduced from the Indian subregion (13), is the most significant vector of *Babesia* parasites of domestic cattle and buffalos in South-east Asia. This species uses only one host for its three life history stages and does not attach to man, preferring large ungulates.

Ticks of the genus *Dermacentor* are all potential vectors of disease, although little work has been done to elucidate this (22, 23, 24, 58). HOOGSTRAAL and WASSEF (22) indicate at least four possible human diseases transmitted by *Dermacentor auratus,* none of which have been fully investigated.

Table 1:

Genera of ticks in South-east Asia and their use of humans and domestic animals as hosts.

Genus	No of species	% world total	No. of infesting man	No. of infesting domestic animals
Amblyomma*	12	11.8	4	4
Aponomma	9	39.1	0	0
Boophilus	1	20.0	0	1
Dermacentor	4	12.5	4	4
Haemaphysalis	52	35.1	17	25
Hyalomma	1	4.0	0	1
Ixodes	13	5.6	3	3
Nosomma	1	100.0	1	1
Rhipicephalus	3	4.1	2	3
SUBTOTAL	96	14.8	31	42
Argas	3	5.2	1	1
Ornithodores	4	4.0	1	0
SUBTOTAL	7	4.4	2	1
TOTAL**	103	12.5	33	43

* Do not include subspecies of *A. cyprium.*

** Total recognized world ticks for all genera see (28).

The genus *Haemaphysalis* has its center of distribution in South-east Asia (11) and comprises about half of the species found there (Tab. 1). A large number of these ticks are known to infest man. These include known and potential disease vectors. Many species range either into the Indian subregion or, less commonly, into East Asia. Some of these species, for example *Haemaphysalis (Ornithophysalis) doenitzi,* attach commonly to birds which are potentially migratory, hence increasing the possibility of transferring disease agents from one area to another (20). Other species such as *Haemaphysalis (Kaiseriana) bispinosa, Haemaphysalis (Ornithophysalis) bandicota* and *Haemaphysalis (Garnhamphysalis) rusae* have been introduced to areas outside of their natural distribution, presumably by human activity (17, 20, 21). This is particularly significant in the case of *H. (K.) bispinosa* as this species is known to harbour infectious agents in its original habitat in India.

In much of the southern Palearctic region, India and Africa, ticks of the genus *Hyalomma* are highly significant parasites and vectors of human and animal diseases. The single species recorded from South-east Asia, *Hyalomma hussaini,* does not fall into this category as it is confined to the drier, northern area of Burma (7, 25). Other records of *Hyalomma* ticks from South-east Asia are likely to involve incorrect identifications or brief introductions on imported livestock which have subsequently died without forming a local population.

In contrast to the haemaphysaline ticks, the genus *Ixodes,* which is the most prolific world wide, is poorly represented in South-east Asia. Most species are host specific and are not known to attach to man or his domestic animals. Two exceptions are *Ixodes granulatus* and *Ixodes ovatus,* species which are also known to harbour pathogens. Too little work has been done on this group for us to estimate their medical significance.

The monospecific genus *Nosomma,* containing *N. monstrosum,* has been poorly studied with respect to involvement in pathogen transmission although it is aggressive and not host specific. HOOGSTRAAL (13) points out that this would be a worthwhile species to study from the point of view of medical and veterinary importance.

One of the south-east asian species of the genus *Rhipicephalus, R. sanguineus,* is the only cosmopolitan tick, originating probably in Africa or the mediterranean area from whence it has been transported with its most common host, the domestic dog, all over the world (37). It and *Rhipicephalus h. haemaphysaloides* are known disease vectors in this area.

Human diseases transmitted by ticks

There is extremely little known about tick-borne diseases of man in South-east Asia. What is known is often dated and no longer taxonomically accurate. Diseases recorded from the area are listed in table 2.

Although I have placed tick-borne relapsing fever on the list, with a query, its presence in this area is questionable. The usual vector of asian relapsing fever, caused by *Borrelia persica,* is the argasid tick *Ornithodores tholozani,* which has not been recorded from this area.

Table 2:
Tick-borne diseases of man in South-east Asia.

Pathogen	Diseaese	Location in S-E Asia	Reference
Borrelia sp.	tick-borne relapsing fever?	Burma, other countries	60
Coxiella burnetti	Q-fever	Malaysia, other countries	30, 60
SFG Rickettsia	tick typhus	Malaysia, Burma, Thailand	10, 30, 43, 51, 60
RSSE group virus	viral	Thailand, Malaysia	12, 45, 46
Tick	tick paralysis	Philippines, other countries	8, 19, 60

Moreover, another recent publication (9) indicates that the disease is not known from South-east Asia. Unfortunately WILSON (60) does not record her sources.

Q-fever has a complicated epidemiology in which ticks are vectors to wild animals. In South-east Asia *Rhipicephalus haemaphysaloides, Haemaphysalis nadchatrami, Haemaphysalis semermis* and *Boophilus microplus* have been implicated as vectors (18, 30). The presence of antibodies to tick-borne encephalitis virus in the human population in Thailand (45) probably depends on a cross reaction with another member of the RSSE group virus. None of the known vectors of TBE or RSSE viruses occur in South-east Asia. However Langat virus, a member of the RSSE group, is known from *Ixodes granulatus* ticks in Malaysia. Antibodies to this virus have been found in the human population in this country (12, 46).

The presence of tick typhus has been confirmed in several studies although, again, the identity of the causative agent is open to question. Studies of this disease were carried out by MARCHETTE (30) showing the presence of a spotted fever group (SFG) rickettsia (14, 51) in wild rodent and tick populations in Malaysia. An as yet unnamed SFG rickettsia has also been identified from Thailand (43). In a recent publication TAYLOR et al. (51) found 16.5% of forest dwelling people in Sabah with antibodies to SFG rickettsiae. It is clear that more work needs to be done on the prevalence of SFG rickettsiae in South-east Asia (57).

Few reports of tick paralysis from South-east asia are known, however at least two species of ticks occurring in this area are known to cause paralysis *(Amblyomma cyprium aetipes* [19]; *Dermacentor auratus* [8]).

Potential Human Diseases

A number of diseases are known either from the Indian subcontinent or from East Asia which could be of potential significance for South-east Asia (Tab. 3). Of these Crimean-Congo Haemorrhagic Fever and Russian Spring-Summer Encephalitis are unlikely to be of importance as their main vectors *(Hyalomma* spp. and *Ixodes persulcatus* respectively) do not occur in the area.

Kyasanur forest disease is widely distributed in India (14) and a number of known vectors also occur in South-east Asia. As the virus causing this disease has been found in bats and birds the possibility of introduction to South-east Asia must be considered.

The increasing number of SFG rickettsiae being discovered in Asia (5, 43, 52) and the fact that neither distributional limits nor significance are known, suggests that it would be worth looking for these diseases as well as new SFG associated diseases in South-east Asia.

Lyme disease, caused by *Borrelia burgdorferi,* has a very wide distribution including China (1) and Japan (27). The most common vector of the disease in East Asia is *Ixodes persulcatus* but *Ixodes ovatus* has also been reported as a vector in Japan (53). This species is known to attach to man and has been collected from Burma and Thailand (15).

Tularemia, caused by *Francisella tularensis,* is widely distributed around the world and is known to occur in Asia (60). The mode of transmission is variable but the of feral epidemiology involves ticks. The single, possible case reported from South-east Asia (Burma) requires confirmation.

Table 3:

Tick-borne diseases of humans from neighbouring asian countries, references in text.

Pathogen	Disease	Location
Arbovirus	Crimean-Congo Haemorrhagic Fever	China, India, Pakistan
Arbovirus	Kyasanur Forest Disease	India
Arbovirus	Russian Spring-summer Encephalitis	China, Japan, Korea
Borrelia burgdorferi	Lyme Disease	China, Japan, Korea
Francisella tularensis	Tularemia	China, Japan
Rickettsia japonica	Tick Typhus	Japan
Rickettsia siberica	Tick Typhus	China, Japan, Korea
Rickettsia spp.	Tick Typhus	China

Diseases of domestic animals

As in other parts of the world ticks are significant parasites of domestic animals in South-east Asia, being known to transmit a variety of diseases. A preliminary list of the most significant of these is given in table 4.

Ticks of known significance include *Boophilus microplus* which is a vector of *Babesia bigemina, Theileria orientalis* and *Anaplasma marginale* infections in cattle. *Haemaphysalis bispinosa* has been introduced to Malaysia on cattle (17) and is elsewhere also responsible for the transmission of *Babesia* to cattle, *Babesia gibsoni* to dogs and *Babesia motasi* to sheep.

Rhipicephalus sanguineus is responsible for the transmission of *Babesia canis, B. gibsoni, Ehrlichia canis* and *Hepatozoon canis* to dogs in this region as well as other parts of the world.

Dermatophilus congolensis is known from South-east Asia where it has been associated with *B. microplus*. Although not known to be trasmitted by ticks, heavy infestations of ticks can induce sufficient immunosuppression to increase the likelihood of infection with this bacteria (31, 55).

Human and animal diseases with incompletely known epidemiology

A variety of pathogenic or potentially pathogenic agents have been found in South-east Asia (Tab. 5). Most of these species involve possible or probable arboviruses (12, 26) of which only Langat virus is implicated as a pathogen of man. The significance of the other arboviruses is likely to be limited by host specificity, and the potential for the contact of humans and domestic animals with the vectors. *Argas robertsi* could be of potential significance as it is a parasite of domestic poultry and is known to feed on man (16, 34).

Ehrlichia sennetsu is a known pathogen of man, having been discovered in Japan and more recently in Malaysia (32). In Malaysia about a third of 3,000 patients admitted to hospital for fever of unknown origin were found to have antibodies to *E. sennetsu*. Although other diseases caused by *Ehrlichia* spp. are known to be transmitted by ticks to man and his domestic animals, the vector and/or mode of transmission of *E. sennetsu* are not yet known (32, 42).

Jambana disease affects cattle on Java and has been suspected of being tick-borne (48) although this is doubtful (49).

Conclusions

In 1972 HOOGSTRAAL et al. (18) published a paper on ticks collected on an expedition to Gunong Benom on the Malayan peninsula. Of the 18 species collected information on tick-borne diseases was available for only one. The authors commented on the lack of information in this respect for 15 of the other species. In the 20 years that have passed since the publication of this paper, very little new information on the medical and veterinary significance of ticks has been published. Given the increasing interest tick-borne diseases are receiving in other parts of the world and the recognition of their growing importance (2, 38) it is time that more work is done in this area in South-east Asia.

Table 4:

Tick-borne diseases of domestic animals known from South-east Asia.
This is a preliminary list subject to change.

Pathogen	Host	Location	Reference
Aegyptianella pullorum	poultry	trop., subtrop. Asia	44
Anaplasma marginale	cattle, buffalo	Indonesia, Thailand, Philippines	33, 36, 59
Babesia argentina	cattle	Malaysia	41
Babesia bigemina	cattle, buffalo	Cambodia, Indonesia, Malaysia, Vietnam	33, 36
Babesia caballi	horses, donkeys	throughout Asia	40
Babesia canis	dogs	Malaysia	29
Babesia gibsoni	dogs	Malaysia	40
Babesia motasi	sheep, goats	S-E Asia	40
Borrelia anserina	poultry	worldwide?	6
Coxiella burnetii	cattle, sheep, goats	Malaysia	30
Dermatophilus congolensis	cattle	Malaysia	61
Ehrlichia canis	dogs	Thailand	4
Hepatozoon canis	dogs	Philippines	3, 35
Theileria orientalis*	cattle, buffalo	Indonesia	36, 54

* Theileria sergenti (56)

Table 5:

Diseases with incompletely known epidemiology (12, 26, 48)

Pathogen/Disease	Host	Vector	Location
Ehrlichia sennetsu	man	unknown	Malaysia
Jambana Disease	cattle	unknown	Java
Kao Shuan virus**	unknown	Argas robertsi	Indonesia
Keterah virus*	man?	Argas pusillus	Malaysia
Langat virus	man	Ixodes granulatus and others	Malaysia
Lanjan virus**	unknown	Dermacentor spp.	Malaysia
Nyamanini virus*	unknown	Argas robertsi	Thailand
Pathum Than virus**	unknown	Argas robertsi	Thailand
Seletar virus**	cattle, pigs	Boophilus microplus	Malaysia, Singapore

* probable arbovirus
** possible arbovirus

Summary Although ticks and tick-borne diseases are of major significance for human and animal health in many parts of the world there is a paucity of information from South-east Asia. This publication is a preliminary review aimed at summarizing the information available from this area. After a discussion on ticks occurring in South-east Asia diseases of humans and domestic animal which are transmitted by ticks are listed and potential diseases considered.

Key words Ticks, Ixodoidea, South-east Asia, medical significance.

Zusammenfassung

Die Bedeutung von Zecken und zeckenübertragenen Krankheiten: Eine vorläufige Übersicht

Obwohl Zecken und die von ihnen übertragenen Krankheiten in vielen Teilen der Welt von großer human- und veterinärmedizinischer Bedeutung sind, existieren nur sehr wenige Informationen über die Situation in Südostasien. Ziel des vorliegenden Artikels ist es, den gegenwärtigen Kenntnisstand für diese Region zusammenfassend zu referieren. Nach Diskussionen der südostasiatischen Zeckenfauna wird eine Auflistung der zeckenübertragenen Erkrankungen des Menschen und der Tiere — unter Einbeziehung potentiell übertragbarer Krankheiten — vorgelegt.

Schlüsselwörter Zecken, Ixodoidea, Südostasien, medizinische Bedeutung.

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