U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Veterinary Services
Cattle Health Center

Monitoring *Haemaphysalis longicornis*, the Asian longhorned tick, populations in the United States

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Purpose

This document is a resource for VS employees and our State and local partners to guide activities related to identification of the Asian longhorned tick in a state or region. Goals for monitoring within a State or region include: 1) characterizing its distribution, habitat, and host associations; 2) detecting severe tick infestations causing morbidity or mortality in animal populations; and 3) correlating the presence of this tick with a disease pathogen that may be harmful to livestock or equine populations. Information regarding diagnosis and reporting of foreign animal diseases (FAD) possibly associated with this tick is described elsewhere and is not included here. It also serves as a document of transparency to other national agencies who may want to develop similar or parallel plans for monitoring Asian longhorned ticks in the U.S. Overall, this specific guidance on surveillance and data management will improve our ability to monitor the spread of this tick and its impact on animal health.

Etiology and Ecology

Background:

Haemaphysalis longicornis (the Asian longhorned tick, bush tick, and scrub tick), a species not native to the United States, was recently detected in at least nine states. There are currently no known epidemiological links between infestations in the different counties or states. Response to the initial finding in New Jersey in November 2017, included increased surveillance in the area to determine if the tick dispersed beyond the original site. Treatment of the areas where the tick was found was initiated to prevent any further dispersal of this tick species. The original goal was to eradicate this tick species. However, the identification of this tick species, in more than nine different states, indicates that eradication of this tick species from the United States is no longer feasible.

General Biology:

The Asian longhorned tick is a three-host tick species. Three-host tick species normally seek a new mammalian host to feed with each stage, and then return to the ground to either molt to the next stage or lay eggs. The Asian longhorned tick has a wide host range, and while earlier stages (larvae and nymph) do not seem to prefer small mammals, all three tick stages (larval, nymphal, and adult) can be found on the same medium to large host. It has been found in its native and introduced ranges, on a wide variety of species including cattle, horses, sheep, goats, hares, red deer, opossums, rats, birds, mice, dogs, and cats (Heath 2016). To date, the host list from this introduction to the United States includes dogs, cats, cows, goats, sheep, white-tailed deer, opossums, grey foxes, red foxes, red-tailed hawks, coyotes, groundhogs, raccoons, horses, striped skunks, and humans.

As a three-host tick, this tick species spends most of its time in the environment, as opposed to on biological hosts. In areas outside of the U.S. where it is established, the Asian longhorned tick adapts to a wide range of environmental conditions but invasive populations prefer mild temperatures and humid climates. To survive colder temperatures, they enter diapause (suspended development) at any stage. (Heath, 2016; Lawrence et al. 2017).

The Asian longhorned tick has a wide global distribution in temperate regions such as Japan, Korea, China, Australia, and New Zealand. This tick species exhibits multiple genetic types, including parthenogenetic and bisexual. Parthenogenesis allows for one female tick to create a population without mating and may lead to massive infestations causing morbidity and mortality in livestock in its established range. The parthenogenetic type easily invades and establishes in new areas. It is considered a livestock pest that can transmit a variety of pathogens such as *Anaplasma, Babesia, Borrelia*, *Ehrlichia*, *Rickettsia*, and *Theileria* species (Heath 2002, 2016)(Appendix C).

Identification and Classification Status

Identification:

The presence of many arthropod species transmits animal diseases. Therefore, accurate tick identification is important, particularly if the vector-borne disease of interest is not well-established in a region. Molecular testing or a reference laboratory, such as the National Veterinary Service Laboratories (NVSL) in Ames, Iowa, should confirm all taxonomic vector identifications in a new state or county. State or local laboratories specializing in tick identifications provide additional detections, if needed.

The VS Emerging Animal Disease Preparedness and Response Plan will be used to characterize and evaluate reported tick-borne pathogens associated with this tick species (EID Plan 2017). The NAHLN network can be used to aid in pathogen testing (https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/sa_lab_information_services/sa_nahln/ct_national_animal_health_laboratory_network).

Classification:

This species is currently considered to be exotic or invasive, as this tick species has not been collected in large numbers for all life stages consistently in the United States prior to November 2017. However, reevaluation of historic *Haemaphysalis* spp. tick samples indicates that *H. longicornis* has been present in the United States since at least 2010. The critical factors involved in the establishment of this tick species across the United States are climate, habitat suitability, and host availability.

The Asian longhorned tick is classified as “reported” (see below) in the United States, and “established” in areas of New Jersey. New Zealand did not classify the Asian longhorned tick as established in their country until all tick stages were present consecutively for two years (Ogden et al. 2008, Heath 2015). The established designation indicates the species can survive and

thrive. It requires a minimum of one year to determine if this tick species ca[n survive and thrive throughout the various seasonal changes.

Classifications:

- Established: at least six individual ticks, or at least two of the three host-seeking life stages have been identified in a single collection period (one year)
- Reported: a single life stage (host or vegetation association) is present with no consistent collections over time and space
- Absent: no life stage collected in the area with environmental sampling and/or collection of associated small and larger mammalian hosts based on the density of mammalian hosts in the area
- No Data: no tick collections have been completed in the area

Epidemiological Investigations and Other Responses

Passive vs Active Surveillance

Data Collection:

In collaboration with state/local partners, VS is employing passive surveillance to monitor changes in the geographic distribution of this tick species in the United States. The data associated with tick collections includes recording locations where it was collected (GPS coordinates, county, state) and a description of the host. Identification of the tick in association with observed clinical illness in animals warrants additional diagnostic tests and epidemiologic investigation. Until we understand more about habitat and host preferences, it is not feasible to conduct national surveys beyond our current passive efforts.

If identification of this tick species is suspected to be linked to an outbreak of tick-associated disease in animals or humans, State agriculture and public health agencies may employ active surveillance methods to determine the risk and potential impact this tick may have on exotic or endemic disease introduction or spread in the United States. VS collaborations with these agencies include discussions on statistical-based sampling designs to ensure surveillance goals are met, recommendations for appropriate tick collection methods in different ecoregions across the United States, and protocols for data management. VS support is available by contacting a VS field office, and surveillance documents are found on the APHIS VS website.

Passive Surveillance:

- Passive surveillance involves opportunistic tick collections from vegetation and hosts (Mitcham et al. 2017, Ripoche et al. 2018).
- Passive surveillance often does not include a defined sampling protocol.

Active Surveillance:

- Active surveillance involves systematically collecting ticks from vegetation via flagging/dragging, CO_2 trapping, or collection from hosts (Mitcham et al. 2017, Ripoche et al 2018).
- Active surveillance benefits from the use of grid units to define surveillance areas with statistical-based sampling used within each sampling grid. This allows for systematic coverage of the areas. Grid units can easily be combined with spatial units (e.g., geospatial layers) relevant to ecological aspects of tick, livestock, and wildlife species surveyed, or the observed distribution of animal or human disease possibly associated with the tick. Geospatial data layers can be used for mapping.
- Active surveillance can be conducted seasonally to understand abundance fluctuations, host associations at various life stages, and monitor changes in distributional trends and patterns.

Information Management

Data Management and Reporting

The Emergency Management Response System (EMRS) will maintain premises details for data collected by VS personnel. Standardization of tick survey data from various universities, States, and other federal agencies is important for future analyses and assessments. The data management platform should provide data formatted for reporting, mapping, modeling, disease risk assessments, economic assessments, laboratory diagnosis, and easy integration into other systems. Other data management platforms used by other Federal, State, and public agencies can be integrated with EMRS data for VS assessments. The data platforms need to be described for integration.

Data for surveyed sites should include the following data (see VS Ectoparasite Submission Form (Appendix B)):

Required:

- Date of collection
- Time of collection
- Geospatial coordinates
- State name
- County name
- Name of agency or person conducting survey
- Host species examined/trapped at each of these sites
- Travel history of host and/or owner
- Method used for tick collections (trapping, flagging, dragging, CO_2)

Recommended:

- Tick life stage (Larva, Nymph, Adult (male, female)), if known. This is determined at identification.
- Estimate of the number of ticks collected
- Habitat description if ticks are collected from vegetation (e.g., shrubs, trees, pasture)
- Sex and age class of host species

Detection of the Asian Longhorned Tick

This tick species was collected from livestock, wildlife, companion animals, and humans in the United States. It was also collected from vegetation. At this time, passive surveillance is recommended to determine the geographic distribution of this tick species. It is important to assess the changes in the range of this tick species to minimize disease risk to livestock. This also involves an assessment of potential disease pathogens potentially associated with this tick species (Appendix C). The Emerging Disease Response Plan will be followed to assess any livestock and equine disease associations (EDI 2016).

A. New Detection:

An epidemiological investigation can be initiated to determine details related to the detection of this tick species in a new State, new county, or new host. These initial detections should be confirmed at NVSL. During the investigation, the VMO or State/local partner will provide the VS Asian longhorned tick fact sheet (https://www.aphis.usda.gov/publications/animal_health/fs-longhorned-tick.pdf) to the producer. The VMO or State/local partner will discuss clinical disease signs in livestock associated with potential tick-borne diseases (Appendix C) with the producer and leaves their contact information for additional inquiries. The VMO or State/local partner will enter investigation data into EMRS after confirmation of the Asian longhorned tick by a local, State, or reference laboratory. Notifications to VS commodity specialists (equine, cattle, sheep/goats, and/or swine) will be provided after confirmation. Supporting documents may be found on the APHIS VS website or in the appendices.

If an unusual presentation of clinical signs consistent with FAD are observed in livestock, then the VMO or State/local partner should initiate FAD investigation protocols. A list of potential diseases that Asian longhorned ticks are known to vector is provided in Appendix C to aid in diagnostics.

B. Existing and Multiple Detections

After initial confirmation of Asian longhorned tick presence in a new area (host or vegetation associations), VMOs work with State agricultural and public health partners to provide educational material to producers and the public to increase awareness, and record any additional detections in the area. The EMRS is the database to enter all VS-related tick data.

Vector Control:

Tick control has many limitations due to the complexities of tick ecology and transmission of tick-borne diseases (Torres 2015). In general, single intervention tick control strategies are only as effective as the duration of the method used (Stafford et al. 2017). For example, the regrowth of vegetation will reintroduce suitable habitats for ticks, and acaricides generally have reduced efficacies as time passes or as climate changes (e.g. dilution from rainfall). Therefore, multiple tick control strategies, based on tick ecology, that are a part of an integrated pest management plan are important to consider when attempting to increase the chances of reducing tick populations and tick-host contact.

Common tick control methods include:

- Visual inspection of hosts for ticks (e.g., scratching for ticks),
- Habitat modifications,
- Acaricide treatment of hosts, vegetation, and equipment, and
- Tick vaccines

Lee et al. (2015) indicated that organophosphates, amidines, and synthetic pyrethroids may be effective in controlling this tick species in the field over a limited time period. The application of amitraz to cattle and permethrin/fipronil to dogs was effective in reducing tick numbers on the hosts (Heath 1980, Duscher et al. 2013). In addition, Heath (2016) recommended pasture management by keeping grasses short and providing low value acaricide treated stock to reduce *H. longicornis* populations. Acaricide treatments of the hosts alone may not be effective, considering the Asian longhorned tick spends majority of its time in the environment and not on a host. On August 29, 2018, the American Veterinary Medical Association issued a statement on Asian longhorned tick treatment/control warning animal health practitioners:

> There are currently no parasiticides available in the United States that contain a label claim against *Haemaphysalis longicornis.* However, several ectoparasiticides within the classes of the isoxazolines and macrocyclic lactones that are approved in the U.S. for similar ectoparasites are also approved in other countries where *Haemaphysalis longicornis* is endemic, with an indication for *Haemaphysalis longicornis*. Practitioners should remember that the use of Food and Drug Administration–approved drug products that are not labeled for this tick species would constitute extra-label use. Such extra-label use, even of approved drugs, must be under veterinary oversight and be in accordance with the Animal Medicinal Drug Use Clarification Act of 1994 and regulations on extralabel use, which pertain only to drugs and do not apply to anti-parasitic products that are pesticides.

As researchers determine Asian longhorned tick ecology in the U.S., more tools for their control and eradication will be developed. State and local animal health authorities should work within the current knowledge of successful control strategies for this tick in the U.S. to build an integrated control plan for their specific situation. VS Entomologists are available for consultation and advice on this process.

Communication/Outreach

Public education will play a major role in the surveillance effort along with increasing awareness about this tick species and the potential diseases it may transmit. Materials can be provided to practicing veterinarians, producers, and pet owners through press releases, visits to veterinary clinics, farm visits, information booths at meetings, etc. Fact sheets, distribution maps, story map, tick collection method descriptions, VS Ectoparasite Submission Form (Appendix B), VS entomologists contact information, and situational reports on the Asian longhorned tick will be provided on an APHIS VS website.

Training in CO_2 trapping, flagging, and tick collection/shipping is being developed and offered to VS and State field personnel.

Appendices A-C

Appendix A: References

Dennis, D. T., T. S. Nekomoto, J. C. Victor, W. S. Paul, and J. Piesman. 1998. Reported distribution of *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae) in the United States. J. Med. Entomol. 35: 629-38.

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Eisen, R.J., Eisen, L. and and C. Beard 2016. County-Scale Distribution of *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae) in the Continental United States. J Med Entomol. 2016 March ; 53(2): 349–386.

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Heath AGG. 2016. Biology, ecology, and distribution of the tick, *Haemaphysalis longicornis*, Neumann (Acari: Ixodidae) in New Zealand. New Zealand Veterinary Journal 64: 10-20.

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Ogden DH, Lindsay LR, Morshed PN, Sockett PN, Artsob H. 2008. The rising challenge of Lyme borreliosis in Canada. Canadian Communicable Disease Report 34, 1–19.

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Journal of Medical Entomology. 55(4): 1016-1026

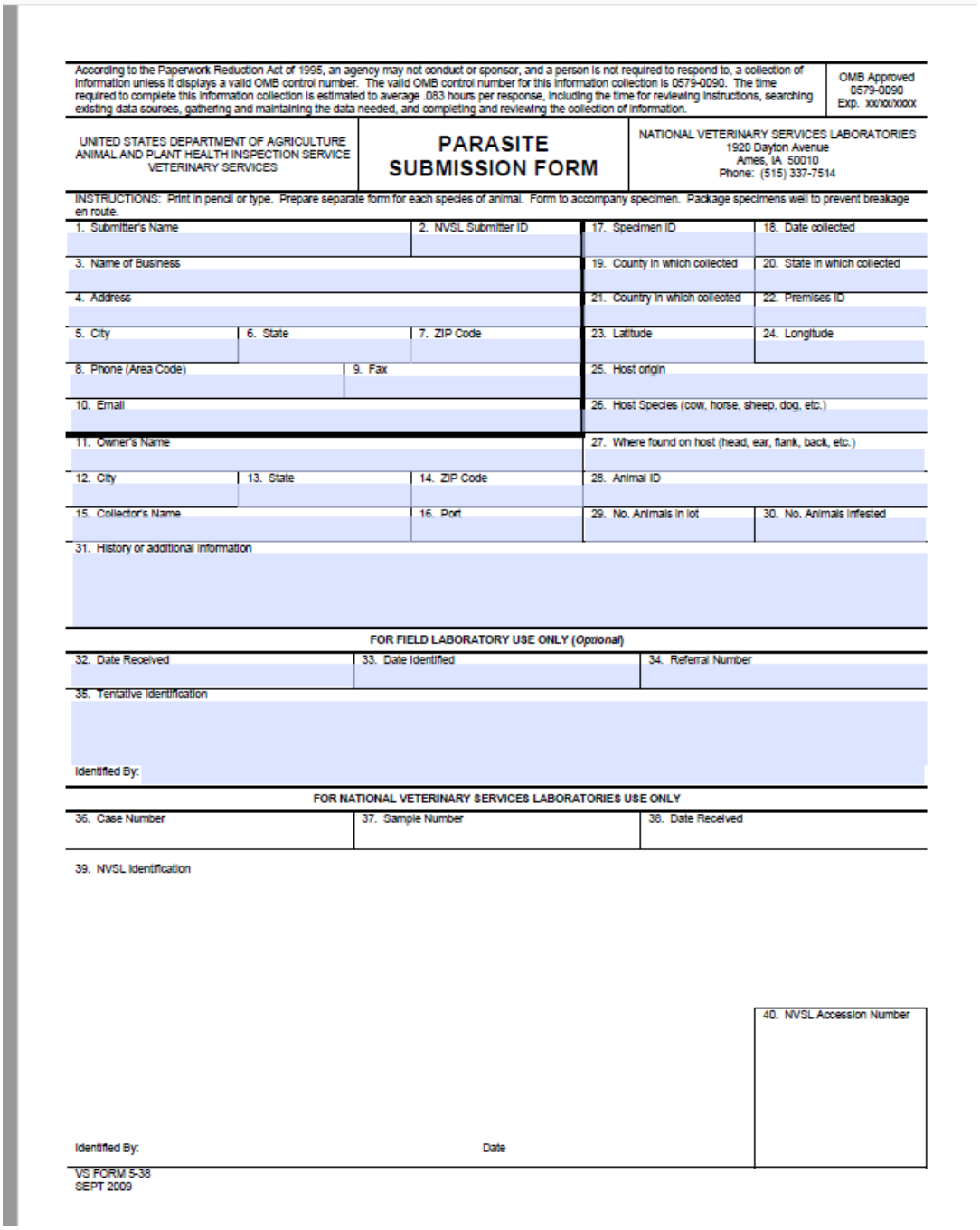
Stafford KC, Williams SC, and Molaei G. 2017. Integrated Pest Management in Controlling Ticks and Tick-Associated Diseases. Journal of Integrated Pest Management 8: 1–7.

Torres-Dantes F. 2015. Climate change, biodiversity, ticks and tick-borne diseases: The butterfly effect. International Journal of Parasitology Parasites and Wildlife 4: 452-461.

USDA VS Emerging Animal Disease Preparedness and Response plan: https://www.aphis.usda.gov/animal_health/downloads/emerging-dis-framework-plan.pdf

Appendix B: NVSL Submission Instructions and Form

Specimens should be submitted fresh (if possible) in vials with a leak-proof closure. Glass or plastic vials may be used, and red top vacutainer tubes work well. At least 70% ethanol (preferred) or isopropyl alcohol should be used in the vial. A ratio of 1:10 specimen to alcohol volume or 1 ml per specimen should be used so that the specimens are completely submerged. Wrap the vial(s) in an absorbent sheet and place in a sealed plastic bag (Ziploc). The online fillable form is found here: https://www.aphis.usda.gov/library/forms/pdf/VS_Form5_38.pdf.



According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0579-0090. The time required to complete this information collection is estimated to average .083 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

OMB Approved 0579-0090 Exp. xx/xx/xxxx

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
VETERINARY SERVICES

PARASITE SUBMISSION FORM

NATIONAL VETERINARY SERVICES LABORATORIES
1920 Dayton Avenue
Ames, IA 50010
Phone: (515) 337-7514

INSTRUCTIONS: Print in pencil or type. Prepare separate form for each species of animal. Form to accompany specimen. Package specimens well to prevent breakage en route.

1. Submitter's Name		2. NVSL Submitter ID		17. Specimen ID	18. Date collected
3. Name of Business				19. County in which collected	20. State in which collected
4. Address				21. Country in which collected	22. Premises ID
5. City	6. State	7. ZIP Code		23. Latitude	24. Longitude
8. Phone (Area Code)		9. Fax		25. Host origin	
10. Email				26. Host Species (cow, horse, sheep, dog, etc.)	
11. Owner's Name				27. Where found on host (head, ear, flank, back, etc.)	
12. City	13. State	14. ZIP Code		28. Animal ID	
15. Collector's Name		16. Port		29. No. Animals in lot	30. No. Animals infested

31. History or additional information

FOR FIELD LABORATORY USE ONLY (*Optional*)

32. Date Received	33. Date Identified	34. Referral Number

35. Tentative Identification

Identified By:

FOR NATIONAL VETERINARY SERVICES LABORATORIES USE ONLY

36. Case Number	37. Sample Number	38. Date Received

39. NVSL Identification

40. NVSL Accession Number

Identified By: Date

VS FORM 5-38
SEPT 2009

GUIDELINES AND EXPLANATORY DETAILS FOR VS FORM 5-38: PARASITE SUBMISSION FORM
USDA, APHIS, VS, NATIONAL VETERINARY SERVICES LABORATORIES
AMES, IA

INSTRUCTIONS: Print in pencil or type. Form must accompany specimen. Package specimens to prevent leakage en route. Despite best efforts, specimen vials may break or leak alcohol in transit; when that happens, accompanying forms that were completed in ink may become illegible.

1-10. Submitter Information: If the submitter has an ID assigned previously by the NVSL, give the name of the submitter and that ID. For new submitters, or if the ID is not known, please also give the name of the business, mailing address, email address, and telephone and FAX numbers, to whom the identification report will be sent. Specify if there is a preferred method of report delivery; email will be used if no preference is stated. If fax or email is not available, test reports can be mailed but this will delay delivery of your results. Repeat submitters are encouraged to be consistent with the submitter contact information that they provide, as the NVSL keeps a master record. If the test report for an individual submission needs to be routed to a non-standard destination, include special instructions in Block 31 (History or additional information).

11-14. Owner Information: Give the name, city, Sate, and ZIP Code of the owner of the host animal.

15. Collector's name: For multiple collectors, additional names may be given in History or additional information (Field 31).

16. Port: Enter the port of entry, if applicable.

17. Specimen ID: The collector may indicate an identifier for a sample, usually denoting samples taken in series (1, 2, 3, etc.). Please also put that number or other identifier on or in the associated sample container. See also instructions for Referral number (Field 34).

18. Date collected: Enter the calendar date on which the sample was collected from the host animal.

19-21. County, State, and country in which (specimens) **collected:** Specify country only for non-USA collection locales.

22-24. Premises ID, Latitude, and Longitude: Give the NAIS Premises ID and/or geographical coordinates (if known). List coordinates as decimal degrees when possible (e.g., N27.087821 and W92.021484).

25. Host origin: Indicate the county, state, and country (if not the USA) of origin of the host animal.

26. Host species (Cow, horse, sheep, dog, etc.): State the host species from which the parasites were collected. Give only one species, be as specific as possible, and avoid generic terms like "equine", "avian", "reptile", "canine", "feline", etc. Use a separate parasite submission form for each host species. If using "deer", list the kind of deer (white-tailed, mule, etc.). For convenience, names used as examples may be encircled or underlined.

27. Where found on host (head, ear, flank, back, etc.): Indicate one or more anatomical sites where the specimen(s) was or were found. Names used as examples may be encircled or underlined.

28. Animal ID: Give ear/back tag numbers, animal name, or other information that identifies the host animal.

29. No. (Number of) **animals in lot:** Give a count or estimate of the number of individual animals in the group from which the collection was made.
30. No. (Number of) **animals infested:** Give a count or estimate of the number of individual animals in the lot that were infested with parasites; this count will be less than or equal to the number in the lot.
31. History or additional information: This field is open-ended, and may be used to include any additional information pertinent to the collection (e.g., locale, history, quarantine status, additional collectors, etc), observations on host animal condition, or additional details. This field also may be used for notes or requests to the NVSL.
Fields 32-35 are for tentative identifications made at a field laboratory.
34. Referral number: Give submitter's unique identification number assigned to the sample (e.g., foreign animal disease [FAD] investigation number).
Fields 36-40 are for NVSL use only

Appendix C. Pathogens associated with the Asian longhorned tick worldwide

Susceptible Species	Etiological Agent
Bovine	
	Anaplasma bovis
	*Anaplasma phagocytophilum**
	Babesia ovata[1]
	Babesia major
	Theileria spp.[2]
Canine	
	Babesia gibsoni
	Hepatozoon canis
Equine	
	Babesia (Theileria) equi
Human/Primate	
	Borrelia spp.*
	*Ehrlichia chafeensis**
	Rickettsia japonica[1]
	Powassan virus
	Khasan virus[1]
	Thogoto virus[1]
	Tick-borne encephalitis virus
	Russian Spring-Summer Encephalitis Virus[1]
	Severe Fever with Thrombocytopenia syndrome[1]
	Huaiyangshan virus hemorrhagic fever[1]
	Kyasanur Forest disease[1]

*Multiple species affected

[1] Indicates a pathogen exotic to the United States of America

[2] Some species are exotic to the United States of America