State of Alaska Epidemiology **Bulletin** Recommendations and Reports

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Ticks as a Potential Public Health Concern in Alaska, 2010–2022

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Background

Ticks are obligate parasites that transmit a diversity of pathogens to humans, domestic animals, and wildlife while feeding on the blood of hosts.[1] Over the past several decades, the number of reported cases of tick-borne disease in the United States has increased,[2] and the geographic distribution of many tick species has expanded,[1,3] including reports from many Arctic nations.[4–6] There are several species of ticks that have historically been present in Alaska.[7] There have been no reports of locally-acquired tick-borne disease in humans in the state. Rapid ecological change in Alaska has raised concern regarding the emergence of vector-borne disease threats to public and wildlife health.[8] This report summarizes recent findings from tick surveillance; pathogen testing; habitat modeling; and survey results on veterinarians' knowledge, attitudes, and practices regarding ticks in Alaska.

Methodology

Development of the Alaska Submit-A-Tick Program

Since 2010, the Alaska Office of the State Veterinarian (OSV) and the Alaska Department of Fish and Game (ADFG) have cataloged ticks identified in the state. In 2019, in collaboration with the University of Alaska-Anchorage, these organizations established a systematic, statewide passive surveillance system to collect ticks in Alaska. Through the *Alaska Submit-A-Tick Program*, anyone can voluntarily submit ticks that they find on themselves, a family member, a pet, in the environment, or on wildlife for species identification and pathogen testing.[7] Submitters have the option to request species identification results. With each tick submission, information on the date of collection, host, probable location of tick encounter, and history of travel inside or outside of Alaska involving any pet or person living in the submitter's household within 2 weeks prior to tick submission is requested. Contact information for the submitter is voluntary. We reviewed and compiled historical tick records from the Arctos database, a literature review, and paper and electronic files from OSV and ADFG and entered these data into the Submit-A-Tick database to create a uniform tick dataset that spans from 1909 to the present. Records from 2010–2022 are presented here and summaries of earlier records can be found in a related publication.[7]

Active tick surveillance through tick drags and small mammal trapping

To supplement the passive tick surveillance program, we conducted active tick surveillance at nine recreational sites (e.g., campgrounds, off-leash dog parks, and forested areas) in Southcentral Alaska (Anchorage: Far North Bicentennial Park, University Lake Park, Ruth Arcand Park, Connors Lake Park, and Kincaid Park; Kenai Peninsula: Centennial Park in Soldotna, Hidden Lake Campground in the Kenai National Wildlife Refuge, Slidehole Campground in Anchor Point, and Jack Gist Park in Homer).[7,9] We drag sampled 1,000 m^2 in each recreational site every 2 weeks during May 24 through September 28, 2019 and June 4 through July 25, 2020 by dragging a 1-m^2 cloth made of rubber-bonded cotton fabric across the forest floor. We also conducted small mammal trapping for 3 nights in July 2020 at two of the Anchorage sites. We set 100 Sherman traps and 10 Tomahawk traps in a trapping grid.

Tick handling, identification, and pathogen testing

Ticks submitted through the Alaska Submit-A-Tick Program and those collected from drags or small mammals were morphologically identified to species and life stage at Georgia Southern University using standard guides and stored in vials of 80% to 100% ethanol at -20°C to -70°C prior to DNA extraction. Ticks were pooled by host, species, and life stage. For each tick species, we extracted records from the database where ticks were found in the environment or found on a host without reported travel outside of Alaska in the prior 2 weeks. We considered a tick species "established" in a borough if at least six ticks or two or more life stages were collected in a single borough in a single year.[10–12] Tick species were considered "non-native" if there were no historical presence records of that species having been identified in the state.[7] A sample of ticks collected in 2019 and 2020, including 185 pooled samples, representing 389 individual ticks submitted to the Alaska Submit-A-Tick Program and 18 pooled samples, representing 32 ticks collected from 55 small mammals, were processed for pathogen testing. In the sample if more than one tick was collected from a single host, ticks were pooled by species and life stage for pathogen testing because our goal was to assess pathogen presence rather than prevalence estimation.[9] We tested for genera of parasites or bacteria previously described as pathogenic in humans and spread by tick vectors, including *Borrelia* spp., *Anaplasma* spp., *Ehrlichia* spp., and *Babesia* spp.[1,13]

Projection of future tick habitat

To identify areas of suitable habitat within Alaska for *Ixodes pacificus*, a tick species that is currently present in British Columbia and is a known vector of the bacteria that causes Lyme disease (*Borrelia burgdorferi*),[14] we used model parameters from two existing sets of ensemble habitat distribution models calibrated in the contiguous United States.[15] To match the model input covariates, we calculated climatic and land cover covariates for the present (1980–2014) and future (2070–2100) climatologies in Alaska.

Survey of veterinary personnel and pet owners and serosurvey for tick-borne pathogens among pets

We administered surveys to assess knowledge, attitudes, and practices of veterinary personnel and pet owners regarding ticks and tick-borne diseases in Alaska.[16] Veterinary clinics were recruited to participate in the study during December 28, 2020 and May 28, 2021 and provided information on administering the personnel survey and recruiting clients for the pet owner survey. Participant responses were categorized within each section of the survey (knowledge: low, medium, high; attitudes: low concern, neutral/undecided, high concern; practices: poor, fair, good) based on the frequency of correct answers (knowledge) or their responses on a Likert scale (attitudes and practices). Pets enrolled in the study had a standardized tick check. A sample of patients were enrolled in the serosurvey. A benchtop ELISA antibody test was performed in-clinic on whole blood or serum and screened for *Dirofilaria immitis*, *Borrelia burgdorferi*, *Ehrlichia canis*, *Ehrlichia ewingii*, *Anaplasma phagocytophilum*, and *Anaplasma platys*. Additional information about data collection protocols and methodology for these studies can be found in related publications.[7,9,15,16]

Results

Species, hosts, and seasonality of ticks submitted through the Alaska Submit-A-Tick Program

During 2010–2022, 988 tick records were identified, representing 2,207 individual ticks (Table 1). The number of tick records each year ranged from 3 (in 2010) to 231 (in 2019) (Figure 1). Non-native ticks (including *Amblyomma americanum*, *A. sabanerae*, *Dermacentor andersoni*, *D. variabilis*, *Ixodes gregsoni*, *I. pacificus*, *I. ricinus*, *I. scapularis*, *I. texanus*, and *Rhipicephalus sanguineus*) accounted for 20% (n=199) of the records (Table 1). In 2019, the first year of the Alaska Submit-A-Tick Program, we received specimens of 13 tick species. Most tick records were submitted by the public (n=463, 47%), followed by veterinarians (n=268, 27%), and biologists (n=219, 22%). Human health professionals submitted 8 records (1%); 30 records (3%) were missing submitter information.

The most common host for reported ticks was domestic animals (n=519, 53%), followed by wildlife, including small mammals and birds (n=321, 33%), and humans (n=71, 7%) (Figure 1). A small number of ticks were found off of a host in the environment (n=55, 6%) in places like on the floor in a home or office building, in a pet grooming facility, or in nesting materials of bird colonies. Fewer than 3% of records (n=22) were either missing information on the host or listed more than one potential host (e.g., human or dog).

Most ticks were submitted during May–September, with a distinct peak in June–August (Figure 2); however, ticks were submitted throughout the year. During most months, most submissions involved tick species that have historically been present in the state. During December, January, and April, most tick submissions involved non-native tick species. The peak of travel-related tick submission occurred during April–June (Figure 3); however, travel-related tick submissions occurred in all months except February and October.

Status of non-native tick species establishment in Alaska

Almost half of the records (n=91, 46%) of non-native tick species submitted to the Alaska Submit-A-Tick program from 2010–2022 were found on a host (usually a dog or a human) that had traveled outside of Alaska in the 2 weeks prior. About 16 % (n=31) of the records were missing host information. Despite the large number of travel-associated tick collections, there was a substantial number of non-native tick records where the host reportedly had not recently traveled outside the state (n=77, 39%). In 2016, an adult male *A. americanum* was found on the counter in a health clinic in Kotzebue, in 2017, another was found on a dog in Palmer. Two adult female *I. pacificus* were found on dogs in Anchorage with no recent travel history (2017 and 2019). Six adult female *I. texanus* were found on two different martens in Ketchikan (2010 and 2019), and four adult *I. gregsoni* were found on martens in 2021 near Ketchikan.

There were 28 *D. variabilis* records (29 ticks) and 33 *R. sanguineus* s.l. records (73 ticks) found in Alaska either in the environment or on a host without recent reported travel history and submitted to the Alaska Submit-A-Tick program during 2010–2022. As reported previously, in 2019, *D. variabilis* did not meet the criteria for establishment;[7] this has not changed with the addition of new submissions during 2020–2022. Based on tick submissions in 2013, there is evidence to suggest that *R. sanguineus* s.l. was established in Fairbanks North Star borough, although was likely limited to a local indoor infestation rather than a locally established wild population. Additional tick submissions during 2020–2022 do not change this classification.

Species, hosts, and pathogen presence in ticks collected through tick drags and small mammal trapping

Three adult *I. angustus* were collected through drag sampling efforts (two in Anchorage and one in Hidden Lake Campground). During 660 trap nights at two sites in Anchorage, 32 ticks from 55 small mammals were collected.[9] All ticks were identified as *I. angustus*. The most commonly trapped animal was the Northern red-backed vole (*Clethrionomys rutilus*); 8 of 34 voles (2.4%) hosted ticks. Of the 17 Cinerus shrews (*Sorex cinereus*) collected, 2 (11.8%) hosted ticks. Of the three meadow voles (*Microtus pennsylvanicus*) collected, two (66.7%) hosted ticks, and the one red squirrel (*Tamiasciurus hudsonicus*) collected was parasitized by one tick.

Of the 18 *I. angustus* pools from this sample of small mammals, 72.2% (n=13) were infected with at least one species of bacteria or parasite, none of which are known to cause human disease.[9] Over half the tick samples (n=11, 61.1%) were infected with *Babesia microti-Clethrionomys*, a quarter (n=5, 27.8%) were infected with *Ba. microti-Sorex*, and four (22.0%) were infected with *candidatus* Ehrlichia. khabarensis. None of the *I. angustus* collected from small mammals trapped in Anchorage tested positive for *Borrelia* spp.

We were able to obtain a biological sample from all 55 animals collected including ear punches from 54 animals and blood samples from 21 animals.[9] No animals were positive for *Borrelia* spp. or *Anaplasma* spp. Of the 17 *C. rutilus* blood samples tested, 1 (5.9%) was infected with *candidatus* E. khabarensis, 7 (41.2%) were infected with *Ba. Microti-Clethrionomys*, and 7 (41.2%) were infected with *Ba. Microti-Sorex*. Of the three *M. pennsylvanicus* blood samples tested, one (33.3%) was infected with *Ba. Microti-Clethrionomys*. No pathogenic organisms were detected in the one *T. hudsonicus* blood sample tested.[9]

Pathogen testing in ticks collected through the Alaska Submit-A-Tick Program

One tick sample submitted through the Alaska Submit-A-Tick Program tested positive for *Borrelia* species, which was 100% identical to *B. burgdorferi* sensu stricto, *B. burgdorferi* B31. This was an *I. scapularis*, collected from a domestic dog in Eagle River, Alaska with recent travel to rural, upstate New York. No other pathogens causing human disease were detected in submitted ticks. Full testing results are available in a related publication.[9]

Occurrence of suitable habitat for Ixodes pacificus under future climate in Alaska

There were many limitations in applying a tick habitat model developed for the contiguous United States to Alaska. However, using a dual modeling approach to look for regions where the predictions of suitable habitat were most consistent, we found that much of southeast Alaska is characterized by suitable habitat for *I. pacificus.*[15] Additionally, valleys northwest of Anchorage, the northern tip of Kodiak Island, and small pockets of land in the Nulato Hills between Bethel and Nome also appear as suitable habitat, if not now, then by the end of the century. The models also agree that large portions of the Interior subregion east of Fairbanks and the region northeast of Anchorage are, and will remain, unsuitable habitat. Overall, approximately 6,000 km^2 of land area in Alaska is predicted to change from unsuitable to suitable habitat by 2100.

Knowledge, attitudes, and practices regarding ticks and tick-borne diseases among veterinary staff in Alaska and prevalence of ticks and tick-borne pathogens among pets

Across 8 veterinary clinics recruited for this study, we sampled 31 veterinary personnel, 81 pet owners, 102 client-owned dogs, and 1 client-owned cat.[16] Most veterinary personnel survey scored in the low knowledge category (16/31, 51.6%), with only 12.9% (4/31) scoring in the high knowledge category. The majority knew about endemic tick species in Alaska and knew of the Alaska Submit-A-Tick program, but there seemed to be general confusion about where most tick-borne disease occur in the United States. Most veterinary personnel fell within the neutral/undecided range for the attitude section (29/31, 94.5%). Most felt it was important to screen dogs and cats for ticks during routine visits (24/31, 77.4%). Just under half (15/31, 48.4%) of respondents felt most dogs and cats living in Alaska would benefit from tick prevention for some or all of the year, and almost all (30/31, 98.7%) thought tick prevention could benefit dogs and cats traveling out of Alaska. Most veterinary personnel scored in the poor practice category (20/31, 64.5%). While most personnel frequently or very frequently recommend tick prevention for out-of-state travel (28/31, 90.3%), few reported engaging in tick educational activities with clients or seeking information about ticks or tick-borne disease in the past year. In contrast, owners' knowledge scores were divided, with approximately one-third in the low (27/81, 33.3%) and high (22/81, 27.2%) categories, respectively. Owners scored lower overall in the attitude section, indicating lower concern regarding ticks and tick-borne diseases in Alaska than veterinary personnel. Most owners scored in the poor (42/81, 54.5%) or fair (30/81, 39.0%) practice categories.

From the serosurvery results, one dog was positive for anaplasmosis (unknown species) antibody, and one dog with recent travel history to New York was

positive for *B. burgdorferi* antibody. No ticks were found on pets during the study.[16]

Discussion

The prevalence of ticks and the incidence of tick-borne diseases are increasing in the United States.[1,2] This evaluation revealed that several species of ticks are established in Alaska and have been found on a wide variety of hosts, including wild birds and small mammalian wildlife, domestic companion animals, and humans. The tick species that have historically been present in Alaska are thought to have limited potential as vectors for human or animal pathogens. This report also shows that several non-native tick species of medical importance have been imported into Alaska. Evidence from passive surveillance data suggests that none of these non-native tick species currently have established wild populations in the state, but ongoing tick surveillance is critical for monitoring this dynamic situation.

No known human pathogens were detected in the ticks and small mammals tested. Future studies of tick-borne microbes in Alaska should incorporate sequencing to facilitate comparison with the results presented here. Much of southeast Alaska is currently suitable for survival of *I. pacificus*. This tick is present in British Columbia where the most recent infection prevalence for *B. burgdorferi* is 0.3%.[14] Targeted surveillance activities in southeast Alaska may assist with early detection of establishment of *I. pacificus* across the Alaskan border. We found no records of *Dermacentor albipictus*, the winter tick, in Alaska. This tick has been found in western Canada[18] and has caused severe morbidity and mortality in moose in the northeast United States.[19] Continued outreach and collaboration with hunters, trappers, wildlife biologists, and the general public may facilitate early warning of newly imported tick species.

Most ticks were submitted in the summer months, but travel-related tick submissions occurred throughout the year. Tick encounters while traveling out of state to tick endemic areas continue to be a public health concern for Alaskans. Before traveling out of state, particularly if traveling with a pet, the Centers for Disease Control and Prevention (CDC) tick distribution maps should be used to see if ticks are a concern in a particular destination. Wearing long pants and DEET when spending time outdoors in the summer months in these areas is a good way to avoid tick bites. Talk with a veterinarian about putting pets on flea and tick prevention before travelling out of state, and thoroughly check for ticks on yourself, your family members, your pets, and your luggage before returning to Alaska. These prevention activities can prevent acquiring a tick-borne disease and can decrease the chances of importing a non-native tick to the state.

Nearly a third of ticks submitted during 2010–2022 were submitted by veterinarians. Veterinarians and clinical care providers are important contributors to the tick surveillance program because they are often the first point of contact for people who find a tick on their self, a family member, or a pet.[17] Our study on the knowledge, attitudes, and practices of veterinary personnel regarding ticks and tick-borne diseases highlighted significant knowledge gaps, suggesting that continuing education to veterinarians on this topic might help to assure that pet owners are getting up-to-date information.16.[16]

While the risk of tick exposure and related tick-borne disease in Alaska is currently low, rapidly changing climactic factors might result in habitats more suitable for ticks that are capable of transmitting infections to humans in the years ahead. Monitoring tick distributions through the Alaska Submit-A-Tick Program is a resource-effective method for collecting and disseminating up-to-date information to clinicians, veterinarians, and the public. A primary limitation of this approach is that the trend in tick records is related to public awareness of ticks. For example, the increase in tick records in 2019 was likely due to outreach about the newly established surveillance program. Long-term surveillance to detect newly introduced tick species and to assess which tick species and microbes are locally established are critical for developing clinical, public health, and veterinary guidelines for tick-borne disease prevention in Alaska.

Public Health Recommendations:

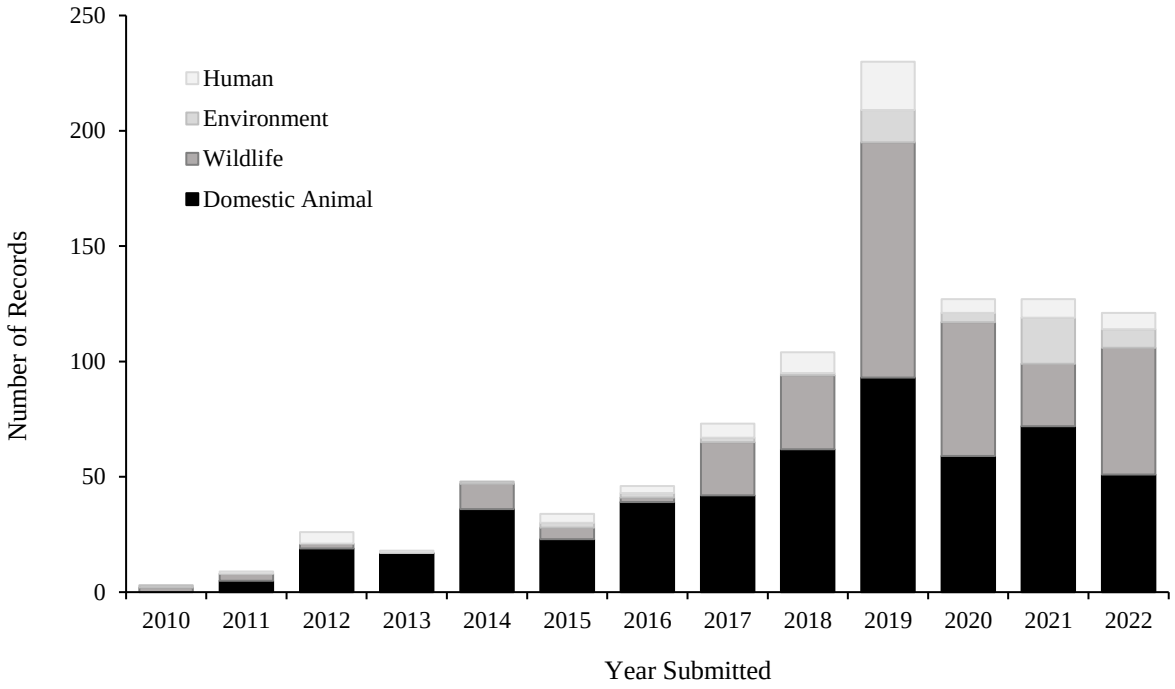
- If you find a tick, submit it to the Alaska Submit-A-Tick Program.
- If traveling to a tick endemic region, wear long pants and DEET when in wooded areas, tall grasses, or other tick habitat. Talk to your veterinarian about putting your pet on tick preventative if they are traveling. Check for ticks on yourself, your family members, your pets, and your luggage before returning to Alaska.
- Clinicians and veterinarians should be familiar with common tick-borne disease symptoms and obtain a travel history on patients/pets with clinically-compatible symptoms.
- More information about preventing tick bites can be found on the CDC website.
- More information on ticks in Alaska is available on the Alaska Department of Environmental Conservation's *Information on Ticks* website.

Table 1. Number of Records and Ticks Submitted Through the Alaska Submit-A-Tick Program — Alaska, 2010–2022

Species	# of Records	# of Ticks
Native tick species		
Haemaphysalis leporispalustris	40	499
Ixodes angustus	638	903
Ixodes auritulus	9	9
Ixodes signatus	22	75
Ixodes uriae	80	381
Non-native tick species		
Amblyomma americanum	26	42
Amblyomma sabanerae	1	1
Dermacentor andersoni	9	9
Dermacentor variabilis	73	81
Ixodes gregsoni	3	4
Ixodes pacificus	4	4
Ixodes ricinus	4	4
Ixodes scapularis	15	19
Ixodes texanus	2	6
Rhipicephalus sanguineus[a]	54	97
Species only identified to genus		
Haemaphysalis spp.	2	45
Ixodes spp.	6	28
TOTAL*	988	2207

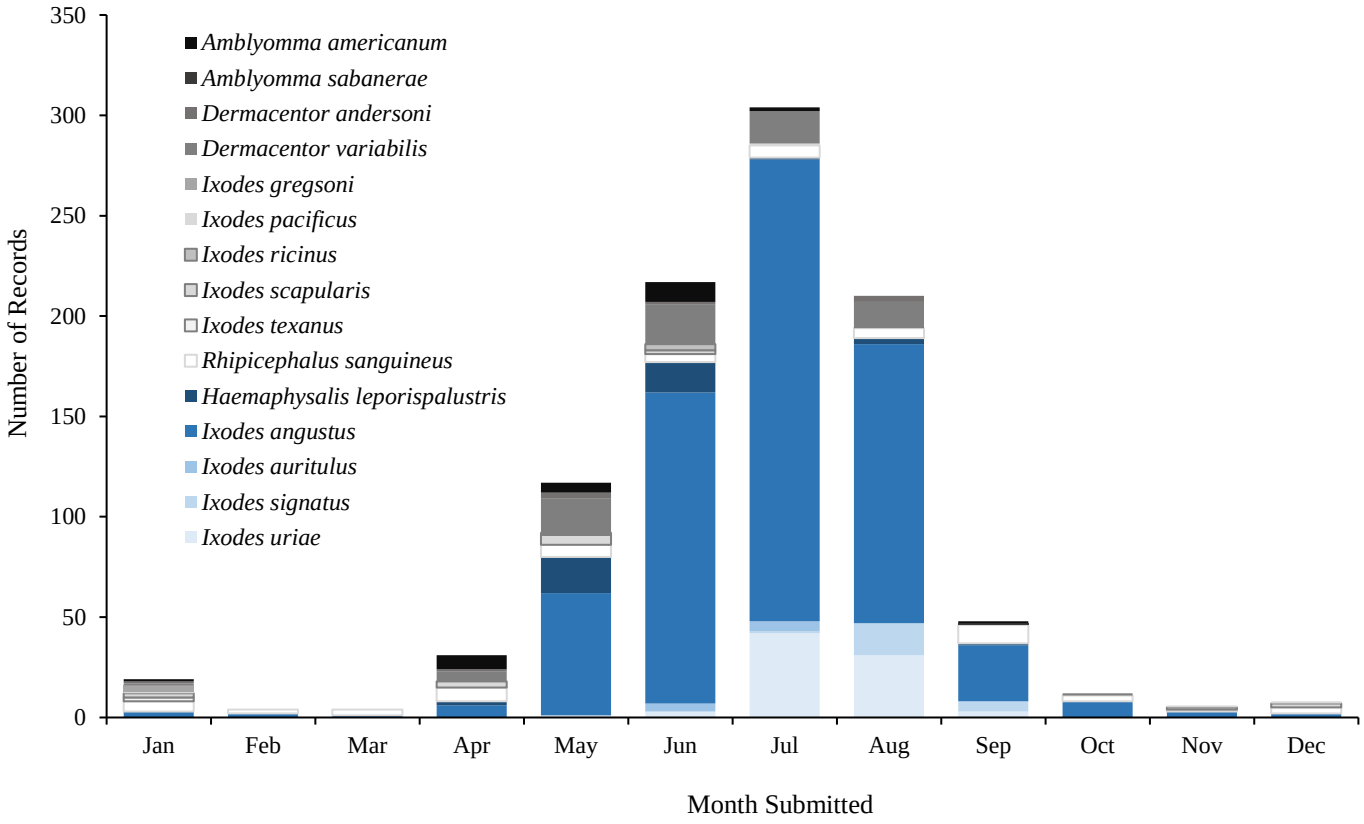
**Two records (representing 1 tick each) were identified as Rhipicephalus sanguineus tropical lineage.*

Figure 1. Number of Tick Records Submitted Through the Alaska Submit-A-Tick Program, by Host* — Alaska, 2010–2022



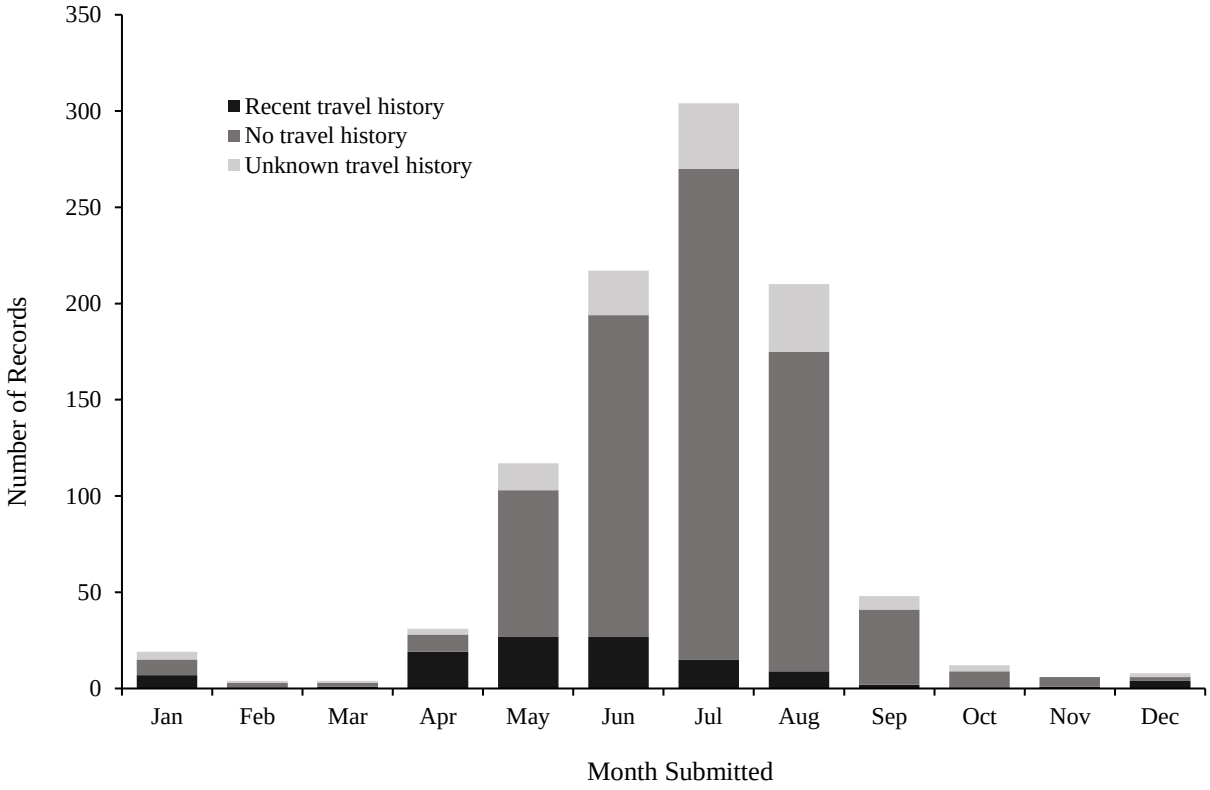
**22 records without host information are missing from this figur*e.

Figure 2. Seasonality of Tick Records Submitted Through the Alaska Submit-A-Tick Program — Alaska, 2010–2022*



** Tick species that are non-native to Alaska are shown in grey-scale, and tick species that have historically been present in the state are shown in blue-scale.*

Figure 3. Seasonality of Travel-Related Tick Records Submitted to the Alaska Submit-A-Tick Program, by Travel History of Host — Alaska, 2010–2022



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