Georgia Tick Surveillance, 2020

Lone Star Tick (Amblyomma americanum) Stages

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Ticks and Tick-Borne Diseases

Overview

Surveillance for ticks has been mostly lacking in Georgia, even where tick-borne diseases have been reported. Tick surveillance is intended to monitor changes in the distribution and abundance of ticks. While several short-term attached tick studies have been completed, no surveillance for presence and prevalence have been undertaken due to lack of funding.

Currently, tick surveillance at the Georgia Department of Public Health (GDPH) is only done in collaboration with the Georgia Department of Agriculture's (GDA) tick attach study. While this is an acceptable method of determining presence of tick species, it does not provide prevalence data. With sufficient funding, active surveillance using tick drags could be provided in response to detection of tick-borne diseases. It may be possible to submit ticks to the CDC for testing, allowing the determination of presence and prevalence of pathogens in ticks. Carbon dioxide traps would be used as a secondary method of determining the presence of *Amblyomma americanum* in an area.

The major tick-borne diseases in the southeastern US include Lyme disease, Rocky Mountain spotted fever, STARI, ehrlichiosis, and anaplasmosis. In addition to tick-borne diseases, a toxin can be transmitted through the salvia of a tick bite that causes progressive paralysis, a condition known as "tick paralysis." Tick feeding also may result in mild to severe allergic reactions in some individuals. Many tick-borne diseases are successfully treated if symptoms are recognized early. When the disease is not diagnosed during the early stages of infection, treatment can be difficult and chronic symptoms may develop or death may occur. It is risk of these diseases that provides a need for more active surveillance and a more tick robust program.

Current Goals:

- Obtain a better understanding of tick species found in Georgia
- Map potential tickborne disease risk
- Monitor for *Haemaphysalis longicornis* (East Asian or longhorned tick)

To date, longhorned ticks have been found in Arkansas, Connecticut, Delaware, Kentucky, Maryland, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, and West Virginia.

Background

At least two surveys of ticks attached to humans have been done in Georgia since 1990. The first, which ran from 1990-1995, was a collaboration between the Medical College of Georgia and Georgia Southern University, and is published in the Journal of Parasitology, 1996. The second study was done between April 2005 and December 2006 by the Georgia Department of Public Health (GDPH). This study was not published, but information from this study is included in a paper on *Rickettsia parkeri* published in Emerging and Infectious Diseases, 2009. Data from this second survey are included in this summary.

The Georgia Department of Agriculture (GDA) has conducted an ongoing survey on tick attached to animals since at least 2005. In 2018, the GDPH Environmental Health Section reached an agreement with the GDA to assist with the study in exchange for access to the data. The GDA shared data from 2005 to the present. Currently, DPH provides tick collection kits and mailers to local veterinarians around the state. The ticks are sent for ID and testing to the National Veterinary Services Laboratories in Iowa. Data are returned to the GDA, who send the raw data to the GDPH for analysis.

The GDA supplied a list of veterinarians in Georgia with addresses and phone numbers. Vector Surveillance Coordinators (VSCs) were tasked with calling each veterinary office in their region, discussing the attached tick study, and arranging to drop off tick kits and instructions for collecting ticks. The VSC would then pick up the vials when they were full and ship them to the lab.

Richmond County Department of Health Mosquito Control program (RCMC) has partnered with the State Entomologists for GDPH and the GDA to survey collected ticks from felines and canines in Richmond County, GA. All veterinary clinics in Richmond County were called by the regional Entomologist to request participation and explain procedure. RCMC used the same tick collection kits, containing tick forms and vials of isopropyl alcohol, along with GDA collection forms. These were disseminated to local veterinary clinics willing to participate, as well as Augusta Animal Services. Clinics were called to check for collected ticks about once every 2 months. Ticks were picked up in vials with forms and returned to the lab to be identified, followed by shipment to GDA for verification and to be included in a state-wide survey in Georgia.

Additional tick data was collected in collaboration with the Georgia Department of Natural Resources. Entomologists from DPH attended 4 quota hunts at 2 different Wildlife Management areas (Clybel and Cedar Creek) in order to check deer brought in for tagging for ticks.

Data are put into an Excel spreadsheet for analysis. Information collected include the date the tick was collected, the tick genus and species, the life stage, the number collected from the animal host, and the county where the tick was collected. Additional information (accession number, case number, and species to which the tick was attached) are preserved in an Access database but not used in analysis.

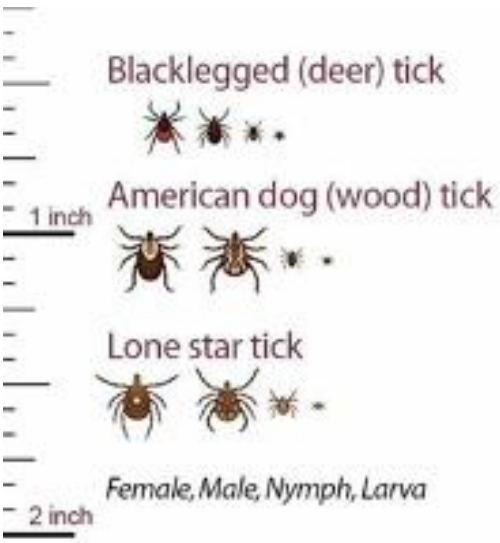
Tick Biology

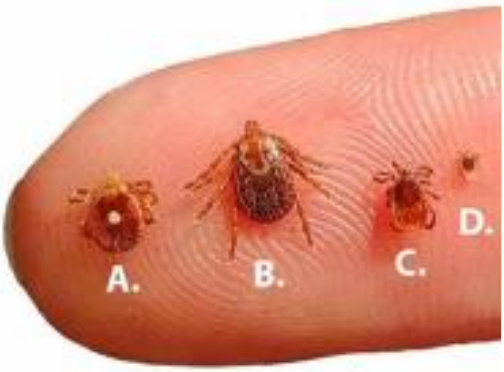
Ticks are arthropods in the Class Arachnida. Along with mites, they constitute the subclass Acari. Almost all ticks belong to one of two major families, the Ixodidae or hard ticks, and the Argasidae or soft ticks. Adults have ovoid or pear-shaped bodies, which become engorged with blood when they feed, and eight legs. In addition to having a hard shield on their dorsal surfaces, hard ticks have a proboscis at the front containing the mouthparts, whereas soft ticks have their mouthparts on the underside of their bodies. Both families locate a potential host by odor or from changes in the environment.

Ticks have four stages to their lifecycle: egg, larva, nymph, and adult. Ixodid ticks have three hosts, taking at least a year to complete their lifecycle. Argasid ticks have up to seven nymphal stages (instars), each one requiring a blood meal. Because of their habit of ingesting blood, ticks are vectors of many diseases that affect humans and other animals.

Larval ticks hatch with six legs, acquiring the other two after a blood meal and molting into the nymph stage. In the nymphal and adult stages, ticks have eight legs.

While adults are the most commonly found stage of the tick because of their size, immature stages are also important to the disease transmission cycle. Typically, the larval tick picks up a disease organism while feeding. The disease organism stays with the tick during the molt and can now be transmitted to the next host. Nymph are most implicated in disease transmission, although the disease organism does stay with the tick into the adult stage.





A. Lone star tick, female
B. American Dog tick, female
C. Blacklegged tick, female
D. Blacklegged tick, nymph

Surveillance

Vector surveillance can be defined as the monitoring of arthropod populations responsible for the transmission of pathogens. Vector surveillance can be used to:

- Better understand vector ecology, for example:
  - Vector population distribution or density
  - Vector species diversity
  - Seasonal variation and population dynamics
- Detect the presence/absence of a vector population, for example:
  - Detection of an "exotic" vector species in a region not known to be colonized
  - Evaluation of vector control programs
  - Surveillance of the presence of insecticide resistance genes in a vector population
- Assess the risk of vector-borne pathogen transmission, for example:
  - An early-alert system based on routine pathogen detection in vector populations
  - The evaluation of vector abundance

Types of Sampling

Drag/Flag Sampling

Many adult ixodid ticks can be collected while questing for hosts from the vegetation. Dragging or flagging is done with a 1 m^2 piece of white cotton flannel attached to a 1.5 m wooden dowel. Dragging is more effective in more open areas, where a greater surface area of material would contact the tick environment. Flagging, where the flannel is waved back and forth under, in, and around vegetation or leaf litter works better in heavy vegetation. These data can be used to determine tick densities.

Carbon Dioxide Trapping

To construct a CO^2 trap, simply place some dry ice in a vented, insulated container and set the container in the center of a sheet or board on the ground. If the trap will not be monitored, tape can be attached, sticky side out, on the perimeter to capture attracted ticks. A half-pound of dry ice will last about 2 hours at 80^{o}F in an insulated container.

Live Host Collection

This is a passive method of tick collection that can provide useful information on the presence and abundance of ticks. Ticks collected from hosts should only be included in assessments of county status when travel history is considered.

Estimating Density of Host-Seeking Ticks

The density of host-seeking nymphal or female ticks varies spatially and temporally. To get a representative sample of the density of host-seeking nymphs or females, the sampling area should be at least 750 m of linear transects, or 50 transects of 15 m dragged with a cloth measuring 1 m wide. Distance sampled can be assessed using several methods including: (1) setting fixed sampling grids where flags, stakes or other objects are used to mark the start and end points of each measured length of the transect; (2) using a measured rope or cable and dragging or flagging its full length; or (3) measuring the collector's stride length and walking a fixed number of strides prior to checking the flag or drag. Because ticks can drop off from the drag or flag easily, inspecting the cloth at regular intervals is important, typically between 10-20 m; adults detach more readily than nymphs and therefore the drag or flag should be checked minimally every 10-15 m. Sampling should NOT be conducted when it is raining, when the vegetation is wet enough to saturate the tick drag, or when it is unseasonably cold or extremely windy.

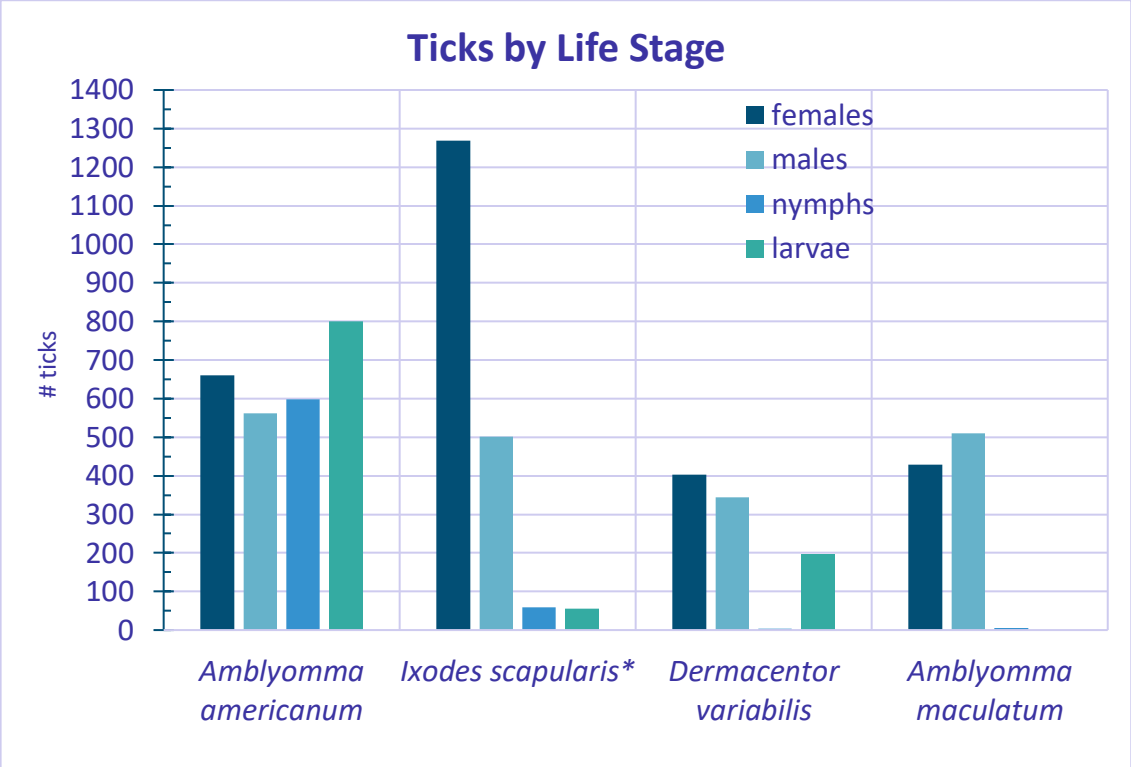
Density of host-seeking nymphs (DON) is estimated as the total number of nymphs collected per total area sampled. DON can be scaled per 100 m^2 by multiplying the total number of nymphs collected per sampling session by 100 m^2, then dividing the product by the total area sampled. Density of host-seeking females (DOF) is estimated as the total number of females collected per total area sampled. DOF can be scaled per 100 m^2 by multiplying the total number of females collected per sampling session by 100 m^2, then dividing the product by the total area sampled.

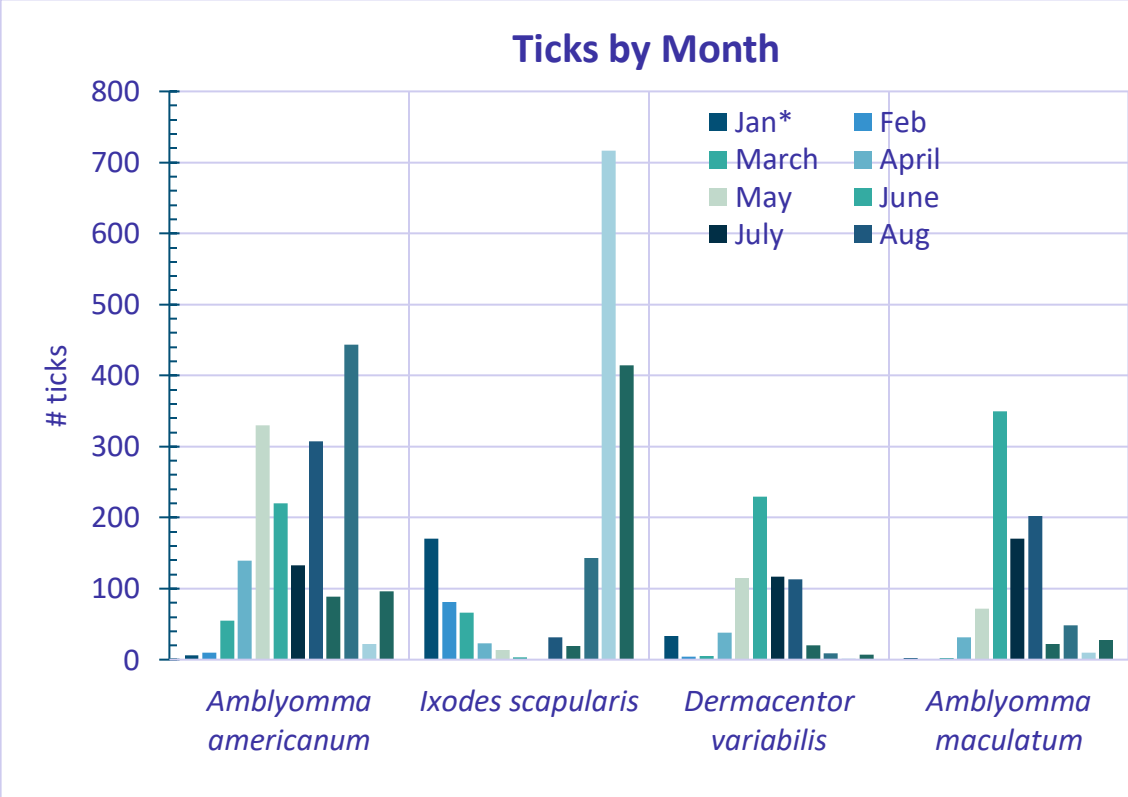
Ticks in Georgia

Tick Species Collected in Georgia 2005-2020

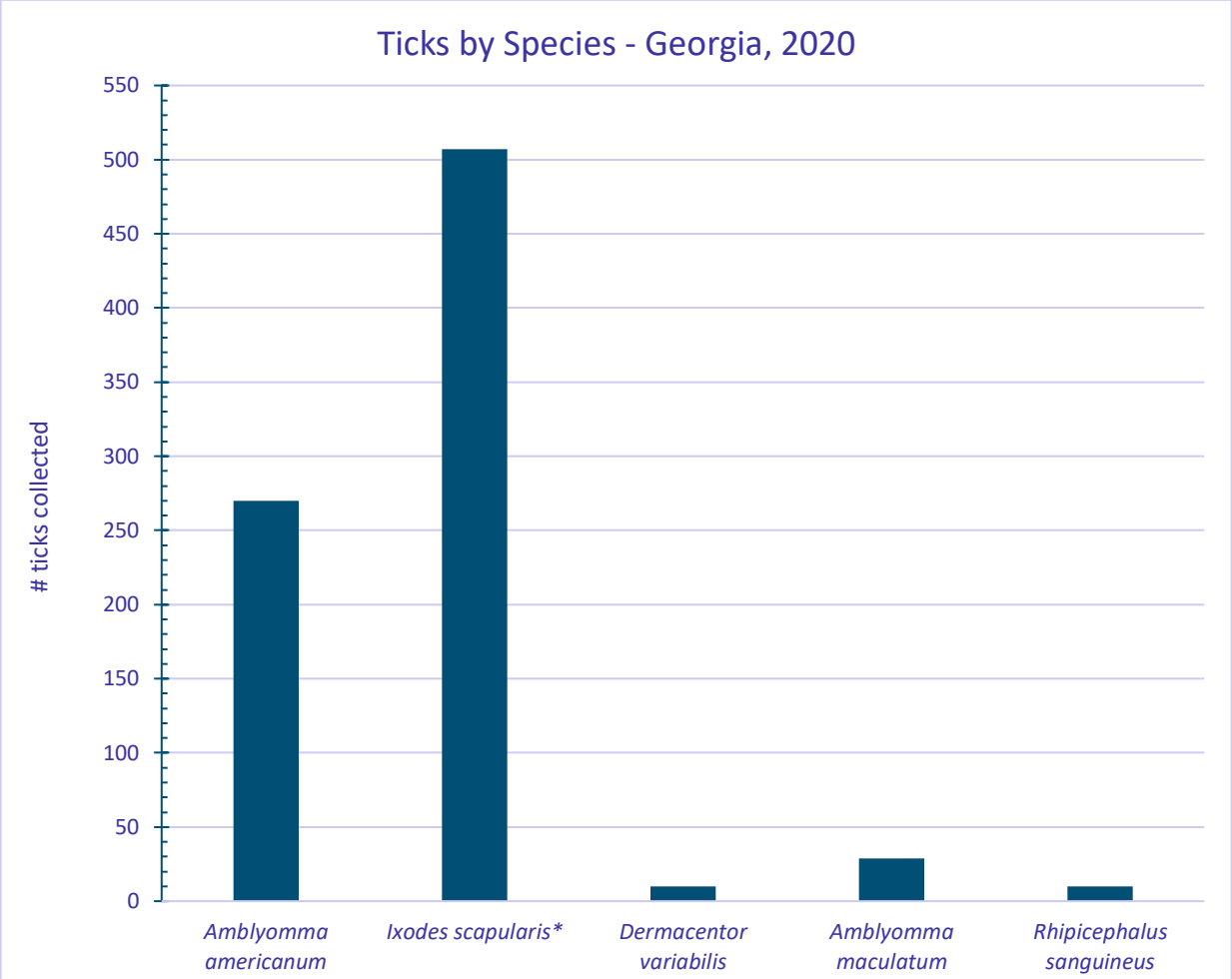
Species	**females**	**males**	**nymphs**	**larvae**	**unknown**	**Grand Total**
Amblyomma americanum	660	562	599	801		2622
*Ixodes scapularis**	1268	502	59	56		1885
Dermacentor variabilis	402	344	3	198		947
Amblyomma maculatum	429	510	6			945
Rhipicephalus sanguineus	34	30	2			66
Ixodes affinis	25	18	1	4		48
Ixodes brunneus	5		4			9
Amblyomma hebraeum	1	4				5
Dermacentor albipictus	1	4				5
Ixodes texanus			5			5
Rhipicephalus evertsi evertsi	1	3				4
Amblyomma spp.			2		1	3
Argas lahorensis			3			3
Amblyomma tuberculatum			2			2
Amblyomma variegatum			1			1
Haemaphysalis leporispalustris			1			1
Haemaphysalis parva			1			1
Ixodes cookei	1					1
Ixodes minor	1					1
Rhipicephalus simus		1				1
Rhipicephalus spp.			1			1
Grand Total	**2828**	**1978**	**690**	**1059**	**1**	**6556**

*does not include 2000 *I scapularis* larvae from one source


Ticks by Life Stage
ticks
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
females
males
nymphs
larvae
Amblyomma americanum
Ixodes scapularis*
Dermacentor variabilis
Amblyomma maculatum

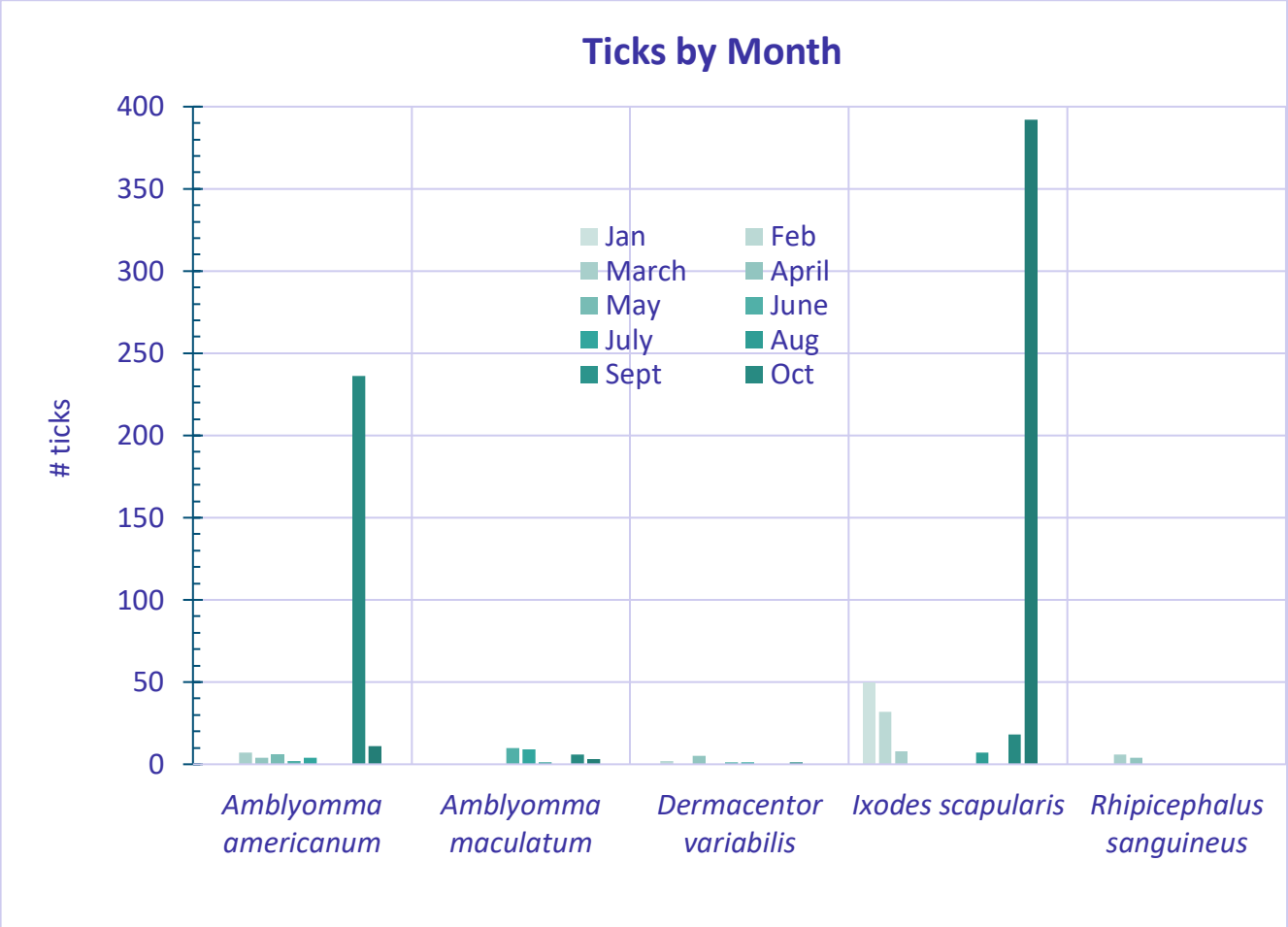

Ticks by Month
ticks
800
700
600
500
400
300
200
100
0
Jan*
Feb
March
April
May
June
July
Aug
Amblyomma americanum
Ixodes scapularis
Dermacentor variabilis
Amblyomma maculatum

Ticks Collected in 2020

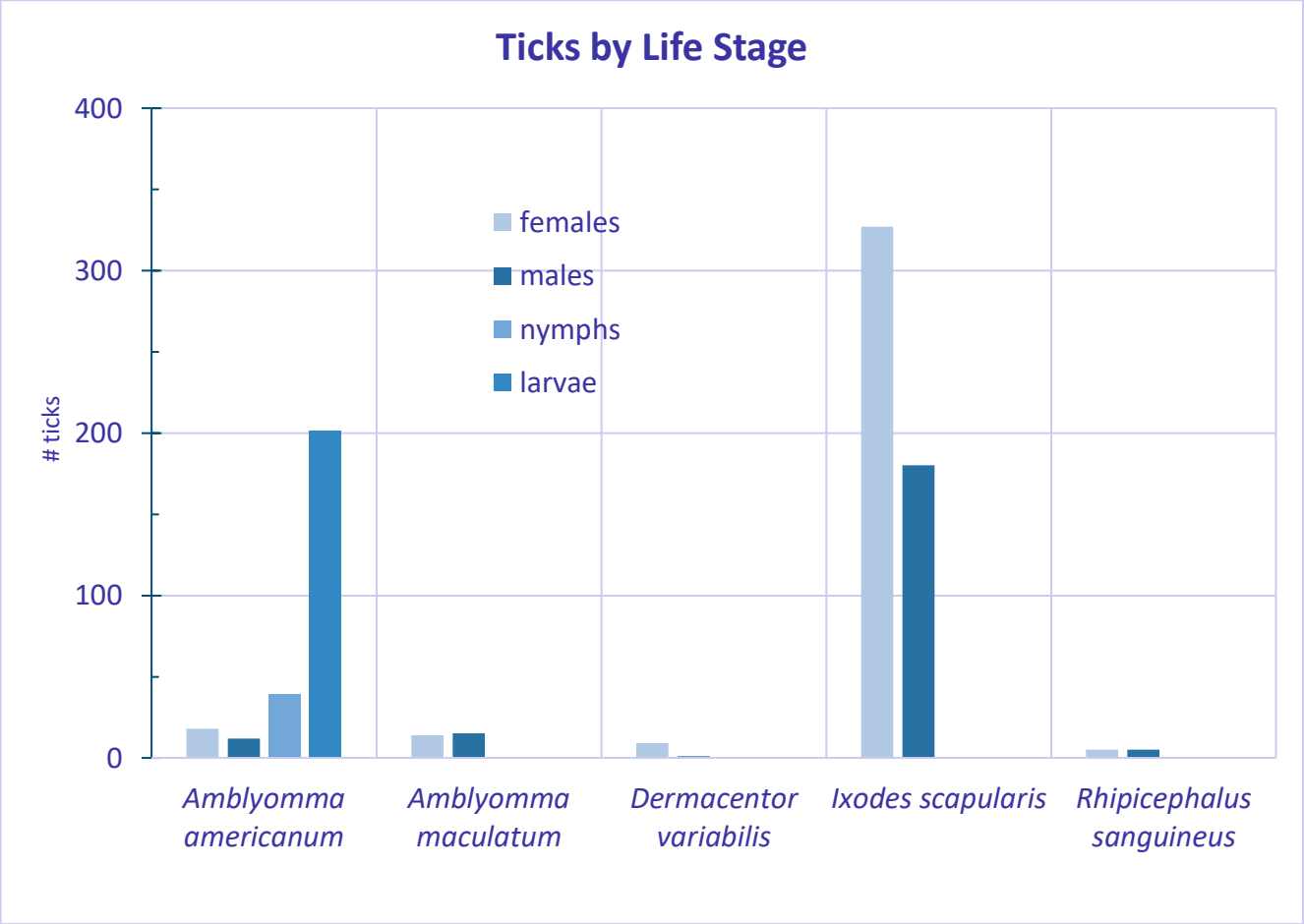


species	2005	2006	2008	2009	2010	2011	2012	2013	2014
Amblyomma americanum	451	90	184	56	596	278	117	117	37
*Ixodes scapularis**	362	4	50	1	56	204	86	82	13
Dermacentor variabilis	113	23		4	64	248	103	103	62
Amblyomma maculatum	22	24	5	3	17	45	42	122	159
Rhipicephalus sanguineus	7				29	17			

species	2015	2016	2017	2018	2019	2020^	unknown	Grand Total
Amblyomma americanum	17	18	81	32	271	270	7	1926
*Ixodes scapularis**	97	111	75	67	170	507		858
Dermacentor variabilis	12	22	56	58	69	10		720
Amblyomma maculatum	110	149	74	54	90	29		439
Rhipicephalus sanguineus				2	1	10		53



Species	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Grand Total
Amblyomma americanum			7	4	6	2	4			236	11		270
Amblyomma maculatum						10	9	1		6	3		29
Dermacentor variabilis		2		5		1	1			1			10
Ixodes scapularis	50	32	8					7		18	392		507
Rhipicephalus sanguineus			6	4									10
TOTAL	**50**	**34**	**21**	**13**	**6**	**13**	**14**	**8**		**261**	**406**		**826**



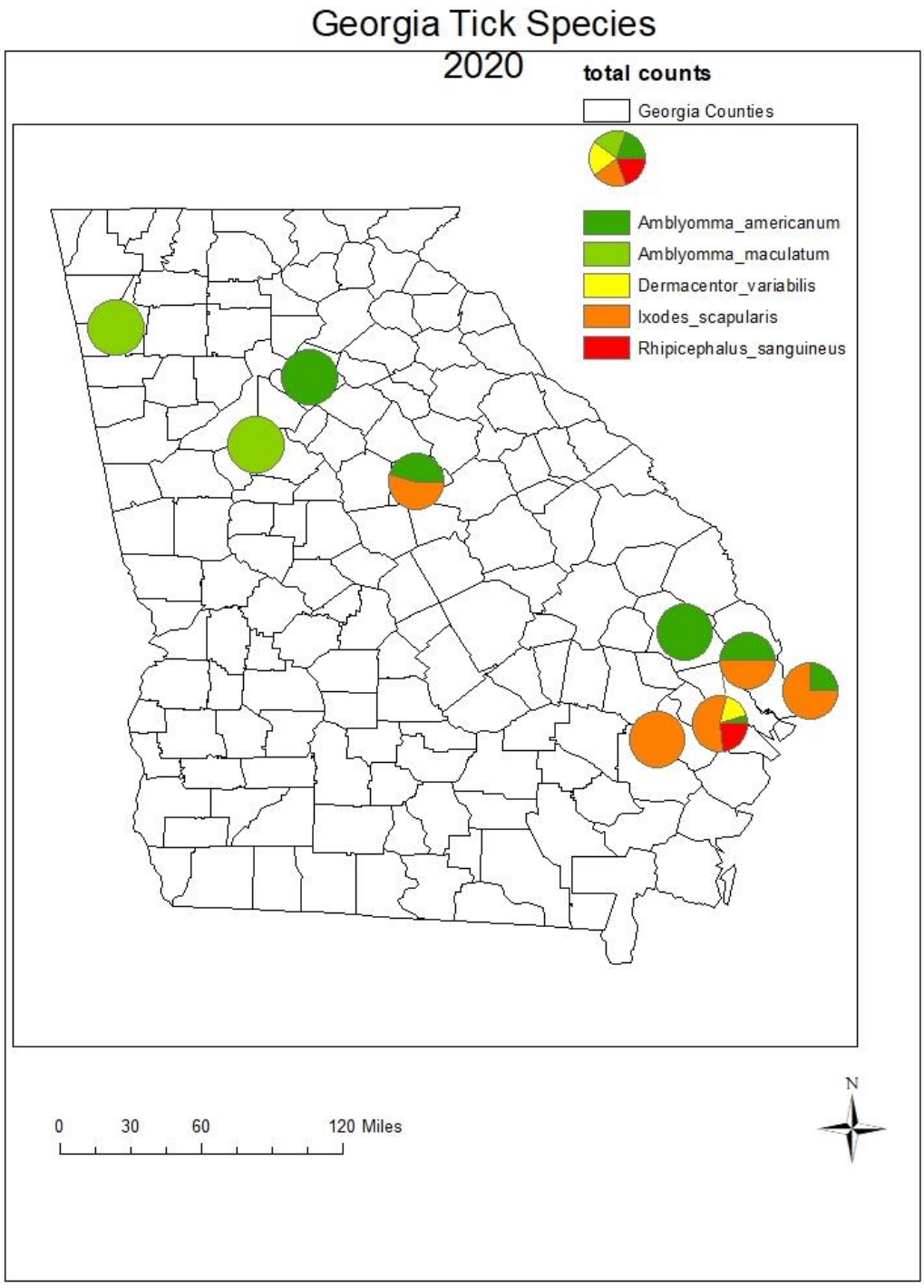
Species	females	males	nymphs	larvae	Grand Total
Amblyomma americanum	18	12	39	201	270
Amblyomma maculatum	14	15			29
Dermacentor variabilis	9	1			10
Ixodes scapularis	327	180			507
Rhipicephalus sanguineus	5	5			10
TOTAL	**373**	**213**	**39**	**201**	**826**

FEMALE AMERICAN DOG TICK

Tick Hosts, 2020

HOST	*Amblyomma americanum*	*Amblyomma maculatum*	*Dermacentor variabilis*	*Ixodes scapularis*	*Rhipicephalus sanguineus*
cat	1			46	6
dog	24	21	10	74	
goat		2			
horse		3			
human	3				
white-tail deer	242	3		406	

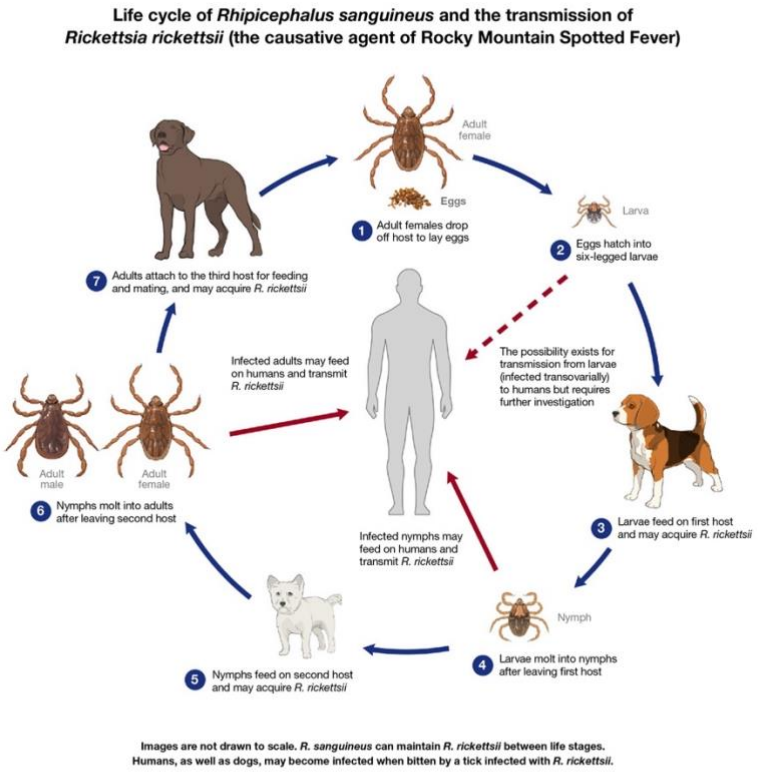
Location of Ticks Collected in 2020



Tick Distribution Status, 2020

Tick surveillance is intended to monitor changes in the distribution and abundance of ticks and to assess the presence and prevalence of tickborne pathogens to provide actionable, evidence-based information on infection risk to clinicians, the public, and policy makers (https://www.cdc.gov/ticks/index.html).

- Counties classified as “established” are those where six or more ticks of a single life stage or more than one life stage of the tick were collected in the county within a 12-month period.
- Counties classified as “reported” are those where less than six ticks of a single life stage were collected in the county within a 12-month period.
- Counties classified as “no records” should not be interpreted as the tick being absent. No records could arise either from a lack of sampling efforts, lack of tick collection during sampling efforts, or lack of reporting or publishing the results of sampling efforts.



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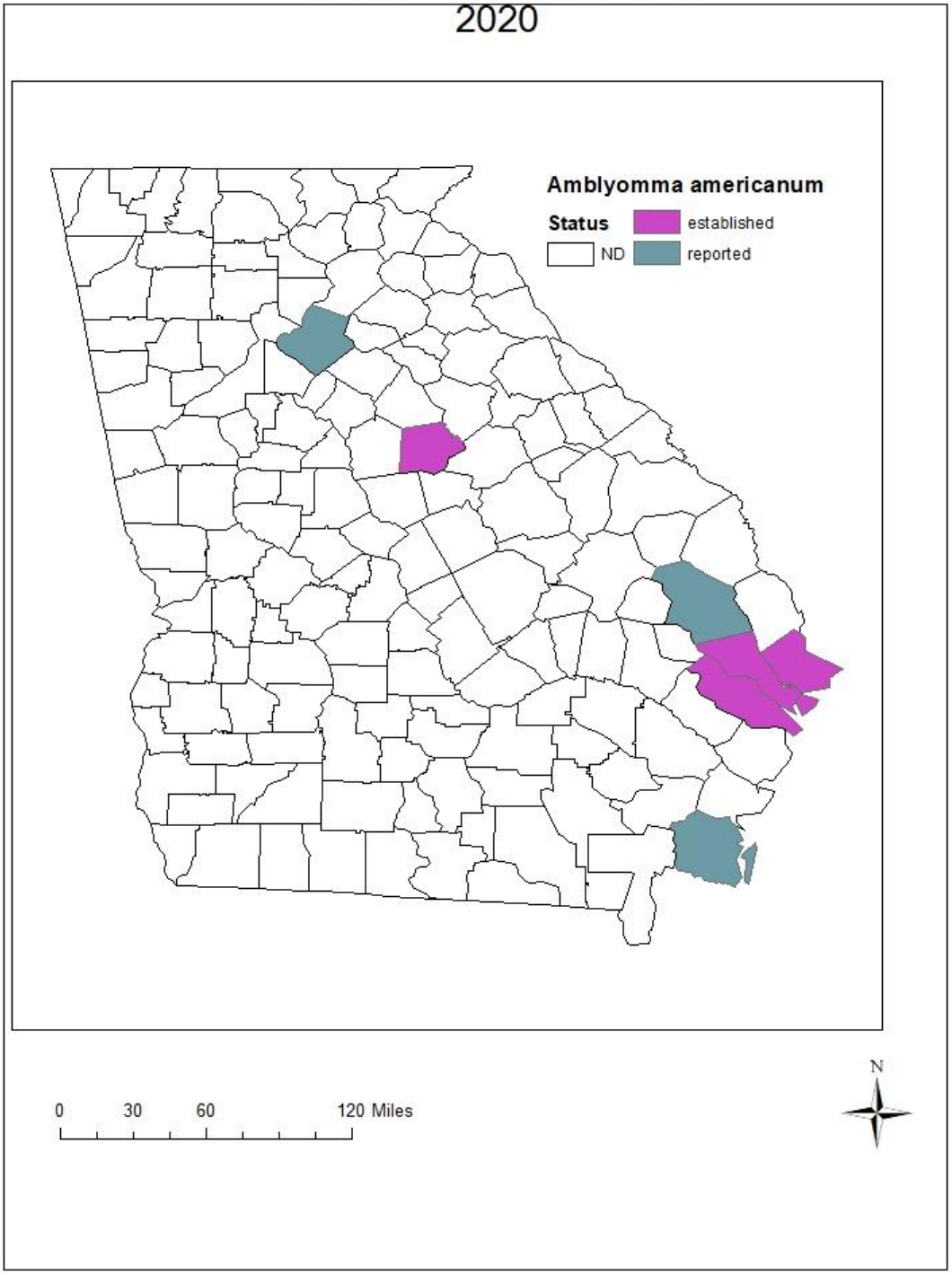
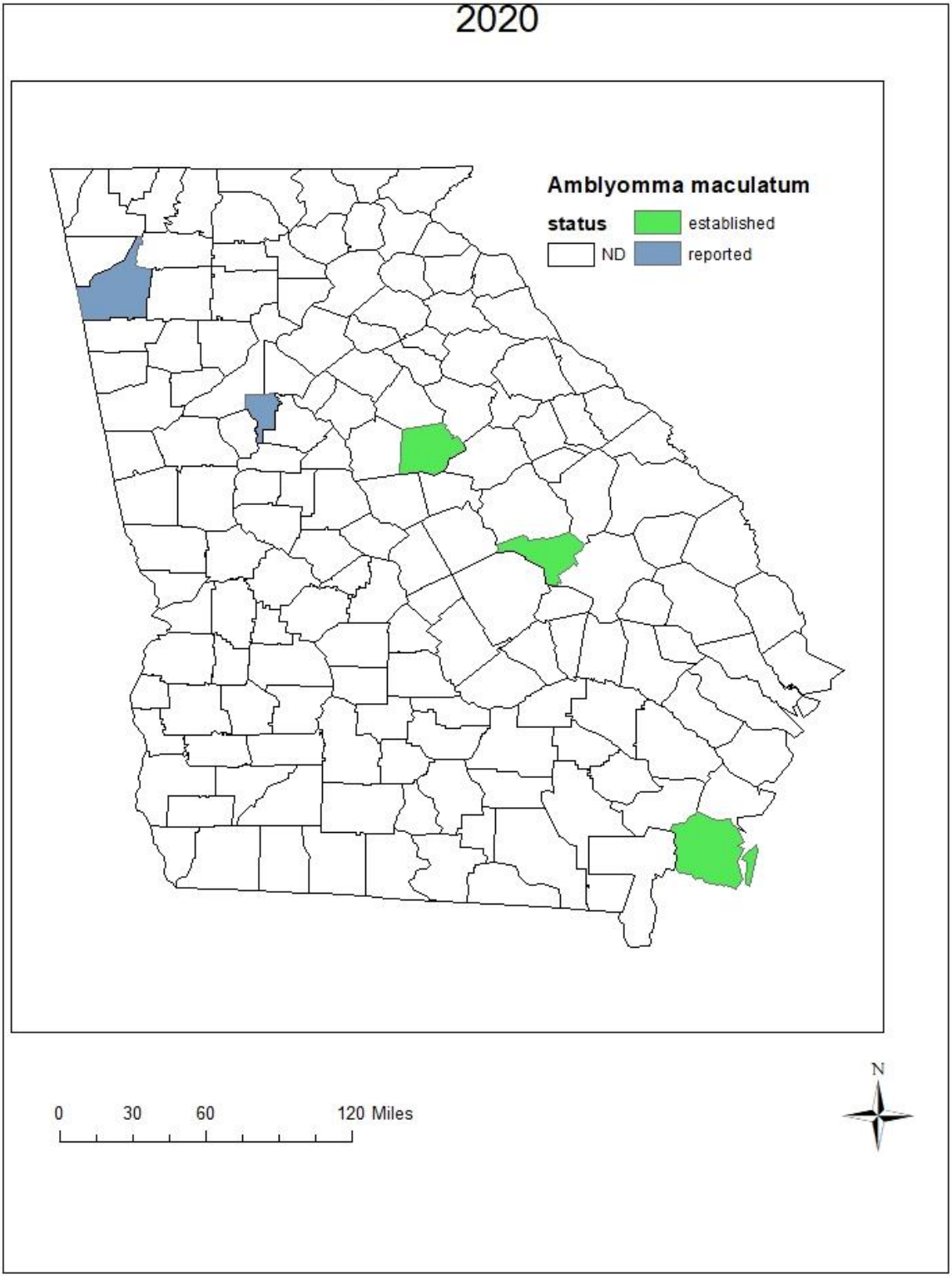
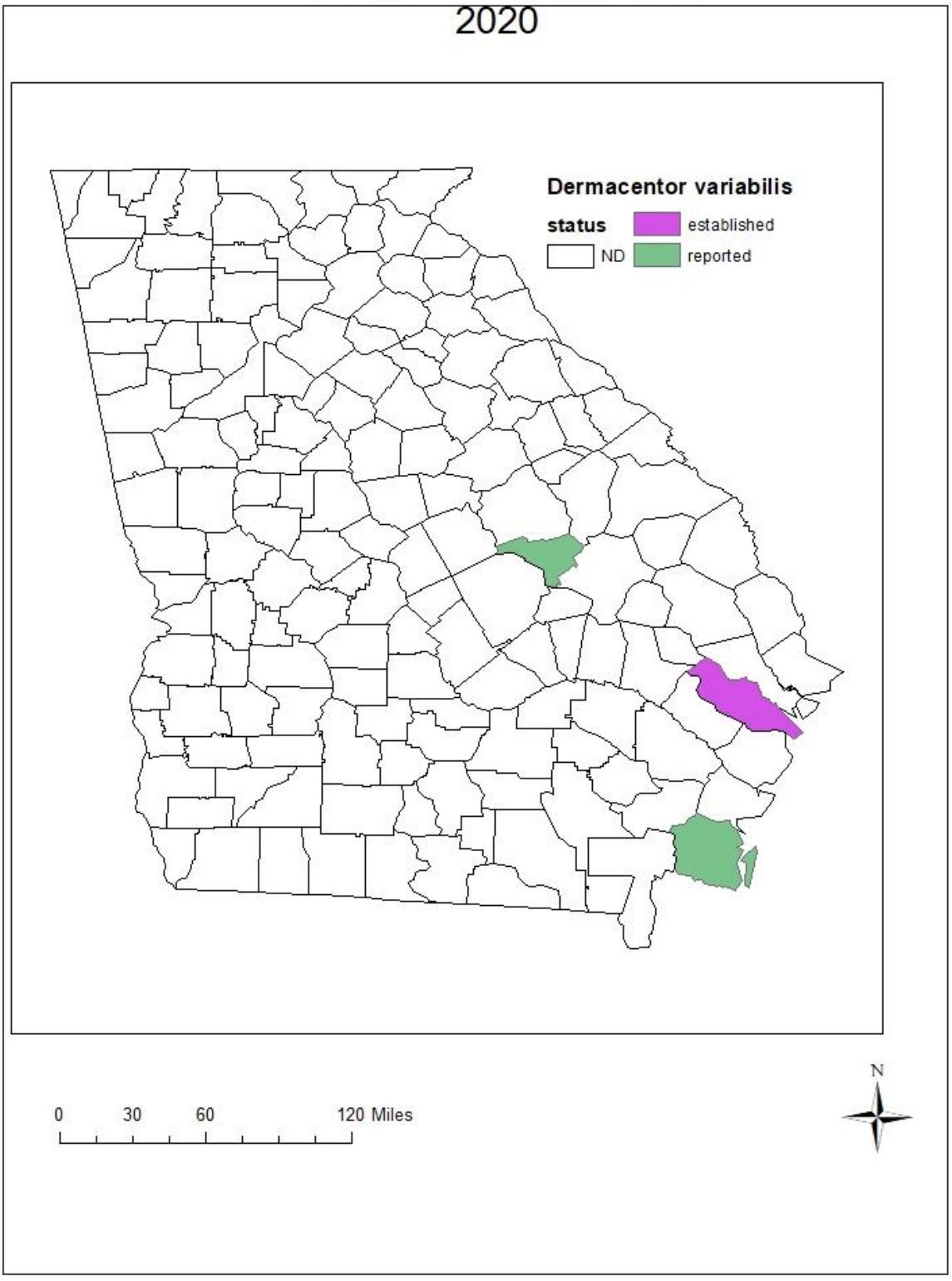
Georgia Tick Distribution
2020



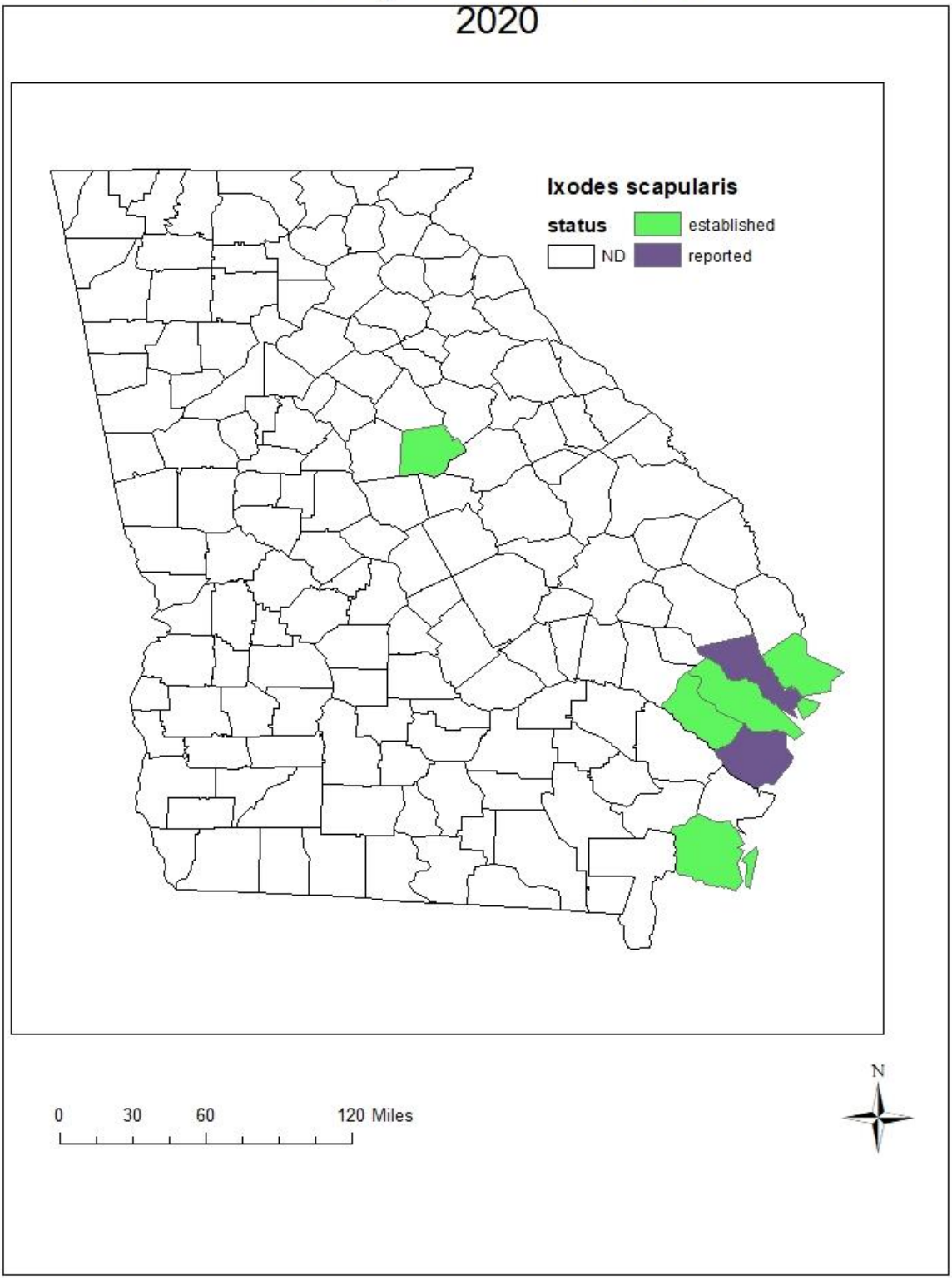
Georgia Tick Distribution 2020



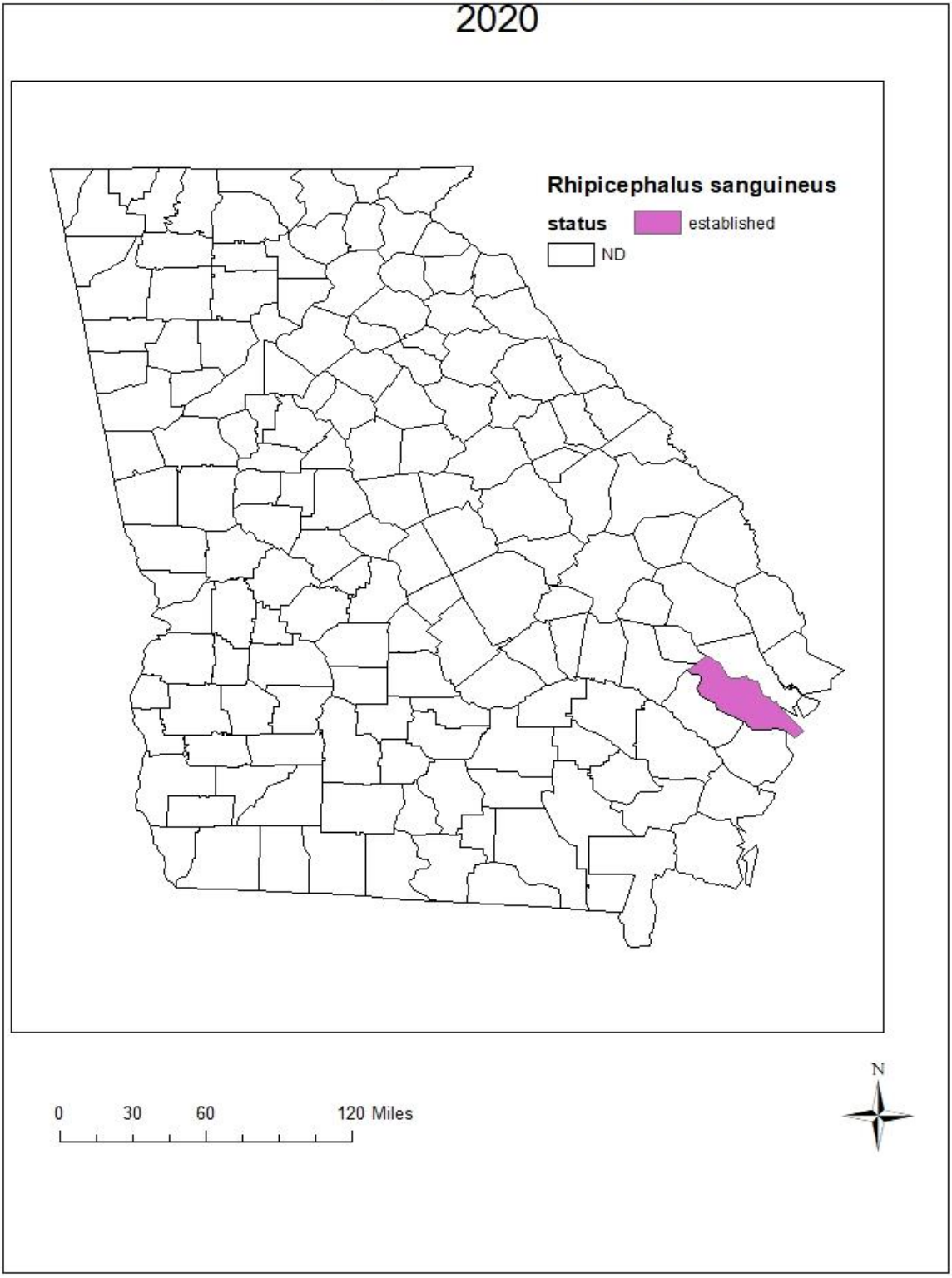
Georgia Tick Distribution 2020



Georgia Tick Distribution 2020



Georgia Tick Distribution 2020



Tickborne Diseases

Ticks collected in Georgia during this period of surveillance are known transmitters of disease to humans and animals. Common tick-borne diseases in Georgia include Lyme disease, Rocky Mountain spotted fever, anaplasmosis, ehrlichiosis, and Southern tick-associated rash illness. Infected ticks spread disease once they've bitten a host, allowing the pathogens in their saliva and mouth get into the host's skin and blood. Tick bites are typically painless, but the site of the bite may later itch, burn, turn red, and feel painful. Individuals allergic to tick bites may develop a rash, swelling, shortness of breath, numbness, or paralysis. Tick bite treatment involves cleaning the area with soap and water and monitoring the site of the bite.

Anaplasmosis is a disease caused by the bacterium *Anaplasma phagocytophilum*. These bacteria are spread to people by tick bites primarily from the blacklegged tick (*Ixodes scapularis*) in Georgia. People with anaplasmosis will often have fever, headache, chills, and muscle aches. Doxycycline is the drug of choice for adults and children of all ages with anaplasmosis.

Ehrlichiosis is the general name used to describe diseases caused by the bacteria *Ehrlichia chaffeensis*, *E. ewingii*, or *E. muris eauclairensis* in the United States. These bacteria are spread to people primarily through the bite of infected ticks including the lone star tick (*Amblyomma americanum*) and the blacklegged tick (*Ixodes scapularis*). People with ehrlichiosis will often have fever, chills, headache, muscle aches, and sometimes upset stomach. Doxycycline is the treatment of choice for adults and children of all ages with ehrlichiosis.

Lyme disease is the most common vector-borne disease in the United States. Lyme disease is caused by the bacterium *Borrelia burgdorferi* and rarely, *Borrelia mayonii*. It is transmitted to humans through the bite of infected blacklegged ticks. Typical symptoms include fever, headache, fatigue, and a characteristic skin rash called erythema migrans. If left untreated, infection can spread to joints, the heart, and the nervous system.

Spotted fever rickettsioses are a group of tickborne infections caused by some members of the genus *Rickettsia*. Rocky Mountain spotted fever (RMSF) is an illness caused by *Rickettsia rickettsii*, a bacterial pathogen transmitted to humans through contact with ticks. *Dermacentor* species of ticks are most commonly associated with infection, including *Dermacentor variabilis* (the American dog tick), *Dermacentor andersoni* (the Rocky Mountain wood tick), and more recently *Rhipicephalus sanguineus* (the brown dog tick). Symptoms include acute onset of fever, headache, and a macular or maculopapular rash, often present on the palms and soles. In addition to RMSF, human illness associated with other spotted fever group *Rickettsia* species, including infection with *Rickettsia parkeri* (associated with *Amblyomma maculatum* ticks), has also been reported.

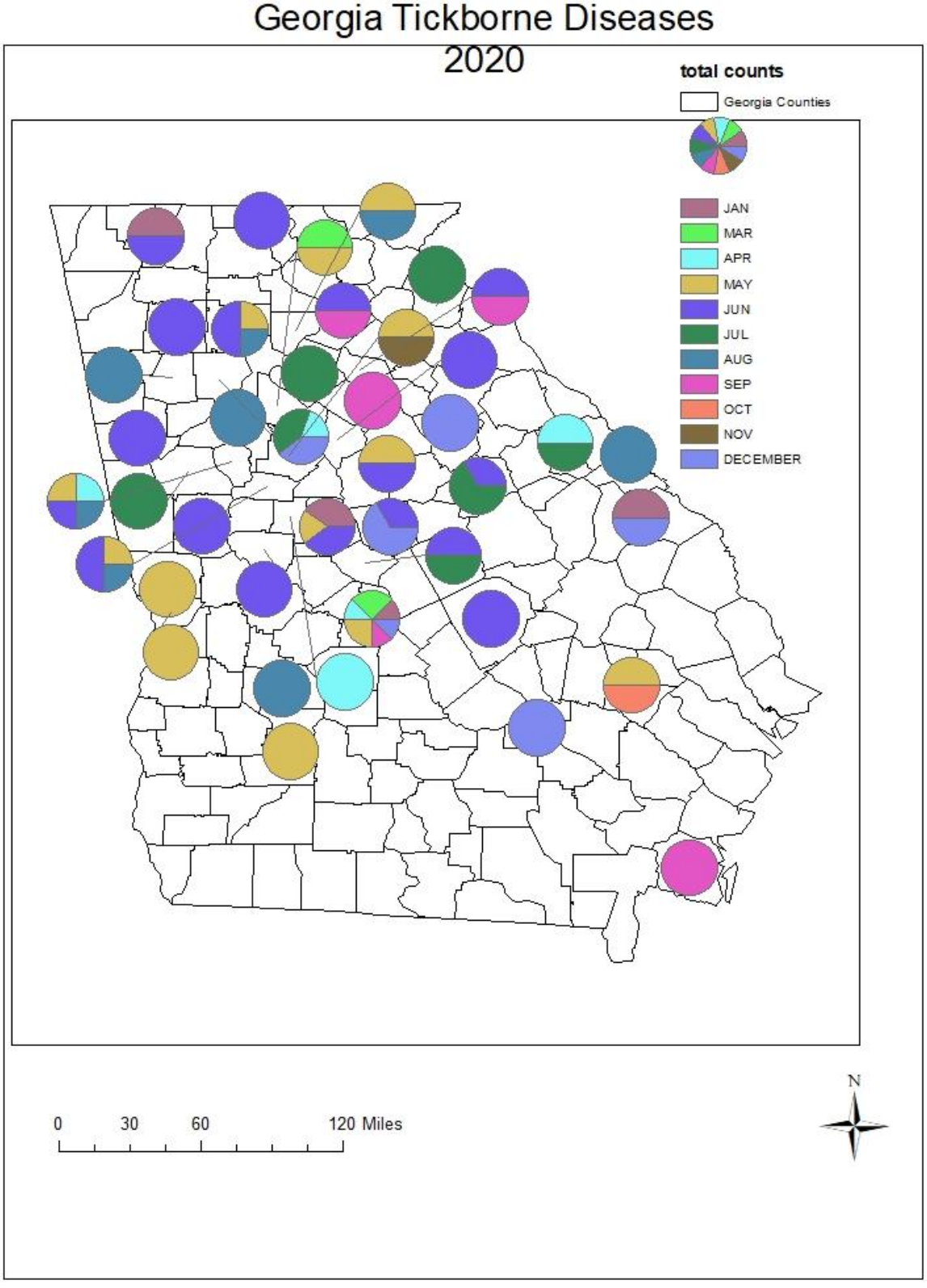
Tick paralysis, or toxicosis, is an acute, ascending, flaccid motor paralysis that can be confused with Guillain-Barre syndrome, botulism, and myasthenia gravis. In the US, tick paralysis is associated with *Dermacentor andersoni* (Rocky Mountain wood tick), *D variabilis* (American dog tick), *Amblyomma americanum* (Lone Star tick), *A maculatum* (Gulf Coast tick), *Ixodes scapularis* (black-legged tick), and *I pacificus* (western black-legged tick). Onset of symptoms usually occurs after a tick has fed for several days. If unrecognized, tick paralysis can progress to respiratory failure and may be fatal in approximately 10% of cases. Prompt removal of the feeding tick usually is followed by complete recovery.

A recently discovered reaction to the bite from the Lone Star tick is that it can cause people to develop an allergy to red meat, including beef and pork. This specific allergy is related to a carbohydrate called alpha-gal and is best diagnosed with a blood test. Although reactions to foods typically occur immediately, in the instance of allergic reactions to alpha-gal, symptoms often take several hours to develop. Owing to the significant delay between eating red meat and the appearance of an allergic reaction, it can be a challenge to connect the culprit foods to symptoms. Therefore, an expert evaluation from an allergist familiar with the condition is recommended. The Lone Star tick has been implicated in initiating the red meat allergy in the US, and this tick is found predominantly in the Southeast, from Texas to Iowa and into New England.

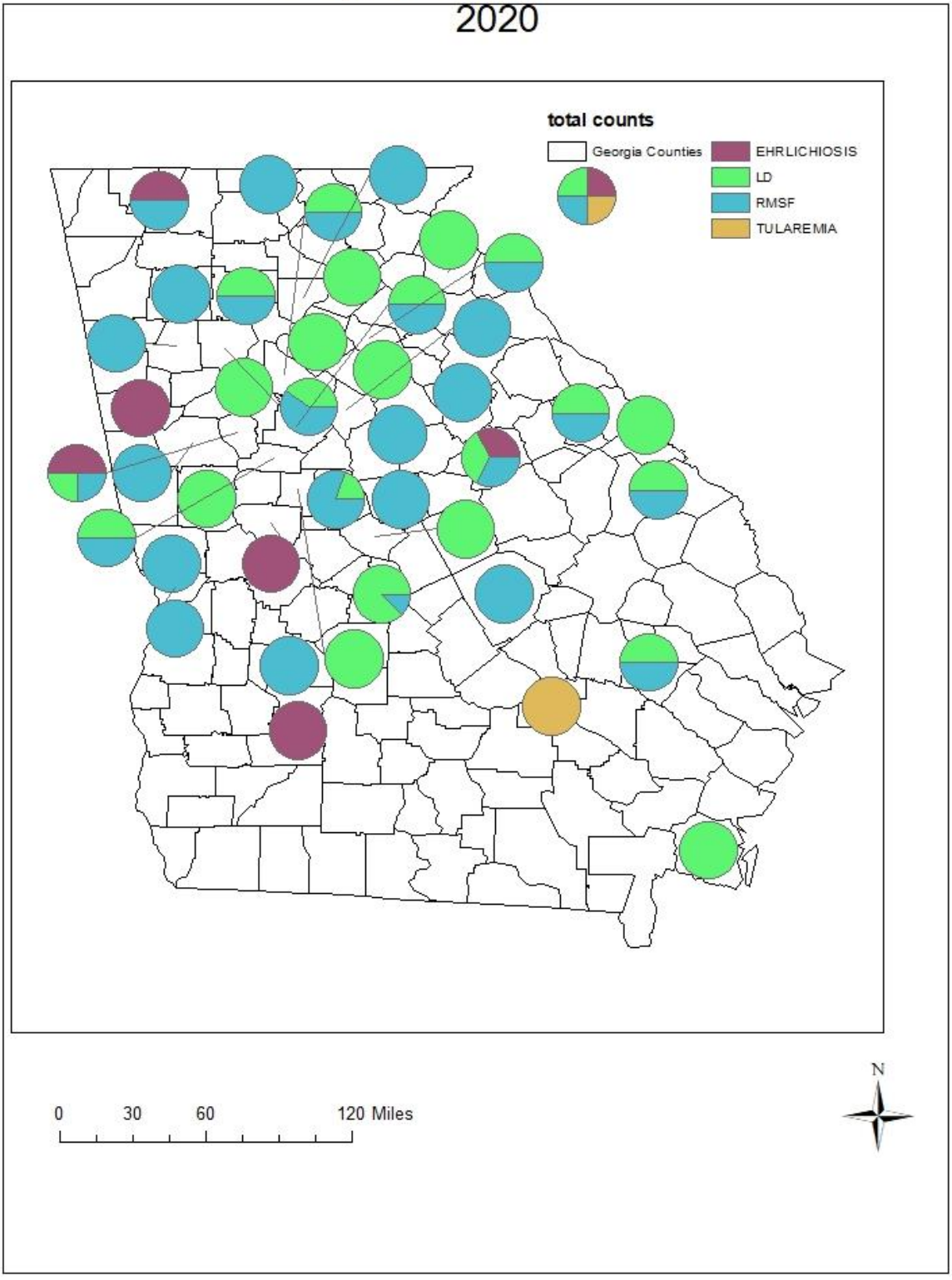
Patients with delayed anaphylaxis to red meat whose serum contained IgE antibodies to alpha-gal

Commins S. et.al. J Allergy Clin Immunol 2011;127:1286-93

DISEASE, 2020	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
EHRLICHIOSIS				1	1	5	1						8
LYME DISEASE	1		3	3	4	6	4	5	5		1	2	34
ROCKY MOUNTAIN SPOTTED FEVER	4			1	10	11	4	3		1		5	39
TULAREMIA												1	1
Grand Total	**5**		**3**	**5**	**15**	**22**	**9**	**8**	**5**	**1**	**1**	**8**	**82**


Georgia Tickborne Diseases
2020
total counts
Georgia Counties
JAN
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DECEMBER
0
30
60
120 Miles
N

Georgia Tickborne Diseases 2020



Asian Longhorned Tick

Asian longhorned ticks were not normally found in the Western Hemisphere but were reported for the first time in the United States in 2017. Asian longhorned ticks have been found on pets, livestock, wildlife, and people. One reason this tick is so successful is that the female ticks can lay eggs and reproduce without mating. Compared with well-known native ticks (such as the blacklegged tick, lone star tick and American dog tick), the Asian longhorned tick appears to be less attracted to human skin. However, in countries where this tick is normally found, they have been found to transmit disease to both people and animals. One recent experimental study found that this tick is not likely to contribute to the spread of Lyme disease bacteria in the United States.

Research is ongoing.

NYMPH AND ADULT FEMALE

Resources

https://dph.georgia.gov/tick-borne-diseases

https://www.slideshare.net/AllergyChula/alpha-gal-allergy-red-meat-allergy

https://www.cdc.gov/ticks/longhorned-tick/index.html

https://www.cdc.gov/ticks/pdfs/Tick_surveillance-P.pdf

https://www.cdc.gov/ticks/resources/TickSurveillance_Iscapularis-P.pdf

https://www.contagionlive.com/news/rutgers-investigators-create-pictorial-key-for-accurate-identification-of-asian-longhorned-tick

https://zookeys.pensoft.net/article/30448/

https://www.cdc.gov/mmwr/preview/mmwrhtml/00040975.htm

Pictorial Key to the Adults of Hard Ticks, Family Ixodidae (Ixodida: Ixodoidea), East of the Mississippi River. JAMES E. KEIRANS AND TAINA R. LITWAK. J. Med. Entomol. 26(5): 435-448 (1989)

Ticks Parasitizing Humans in Georgia and South Carolina, Michael W. Felz, Lance A. Durden, James H. Oliver and Jr. The Journal of Parasitology, Vol. 82, No. 3 (June 1996), pp. 505-508

Carl Vinson Institute of Government
University of Georgia

District Map