

SALT LAKE CITY MOSQUITO ABATEMENT DISTRICT

Executive Director's Report

April 2026

1. Personnel:

Personnel	
Staff	Seasonal
11	18

Type of Work	2026	3 - Year Average
Adulticiding	0.00	2.33
Wetlands / Rural	292.25	158.08
Fish Culture	125.25	41.33
Catch Basins / Gutters	3.00	2.33
Tree Holes	0.00	0.33
Prison	11.00	28.67
Service Request	23.50	10.67
Traps	155.25	169.83
Aerial Operations	101.00	0.00
Laboratory	353.50	272.00
Office / Administration	691.50	836.33
Equipment Maintenance	345.50	268.17
Facility Maintenance	374.00	254.58
Training	177.25	143.42
Education	143.25	105.92
Unmanned Aerial System	116.75	57.75
CSU Grant	199.00	21.83
Other / Errands	59.00	121.83
Comp. Time Used	54.25	99.67
Vacation	135.75	162.33
Additional Hours	0.00	15.92
Holidays	0.00	0.00
Sick Leave	16.00	40.17
Total	3,377.00	2,813.49

2. Office/Lab/Shop Activities:

Ary Faraji, Executive Director

- Conducted seasonal interviews during April 2026.
- Attended and presented the keynote address at the annual joint conference of the Pacific-Southwest Center of Excellence in Vector-Borne Diseases and the Rockies and High Plains Vector-Borne Diseases Center on 8-10 April 2026 at the University of Utah. The last day of the conference was hosted at the District with over 150 attendees.
- Attended the Entomological Society of America's Pacific Branch annual meeting in Spokane, Washington from 13-15 April 2026. Executive Director Faraji was recently elected to the Board of this association.
- Attended and presented the keynote address at the New Mexico Environmental Health Association on 20-22 April 2026 in Albuquerque, NM.
- Attended multiple Owner-Architect-Consultants construction meetings during April.

Aleta Fairbanks, CFO

- 09 April 2026 – Worked with Utah Retirement Systems (URS) employees to properly set up our Advanced Utah Retirement End User System (AUREUS) account in the new URS operating system.
- 14 April 2026 – Attended PEHP Renewal Kickoff Meeting.

Chris Bibbs, Laboratory Director

Apr 1	Seasonal interviews; materials and methods writeup for vegan mosquito diet project
Apr 2	Seasonal interviews
Apr 3	Project call w/ Willenberg lab; Review for Parasites & Vectors; seasonal interviews; SRI student mentoring
Apr 6	Seasonal interviews
Apr 7	Seasonal interviews; conference visitor arrivals; Review for J Med Ent
Apr 8	Fox News visit on mosquito and drought risks for 2026; Data and methods writeup for vegan mosquito project and analysis w/ Willenberg lab; PacVec/RaHP Vec joint conference
Apr 9	Review for JAMCA; PacVec/RaHP Vec joint conference; UMNH reception and tours
Apr 10	PacVec/RaHP Vec joint conference at SLCMAD, facility tours, and airport transports
Apr 13	Iris McCulloch orientation and training; surveillance troubleshooting w/ Ada County Mosquito Abatement (w/ Desiree Keeney); Project planning and updated service quotes to Eurofins for adulticide testing; Rowland Hall internship connections and scheduling
Apr 14	Georgia Alvey orientation and training; meeting w/ Envu on Barricor efficacy
Apr 15	Route training, mosquito ID training; scheduling seasonal interviews/applicant rejection correspondence
Apr 16	Amy MS defense
Apr 20	PhD collaboration project planning meeting w/ Amy Jamison; SRI end of semester project exits
Apr 21	Presentation prep for 3i at U of U; PhD collaboration project planning meeting w/ Amy Jamison; SRI end of semester project exits

Apr 22	Heartworm surveillance methods call w/ Lee County; UMAA spring workshop planning w/ Greg White; Mosquito Anatomy Training w/ lab seasonals
Apr 23	Finalizing Tox bioassay data and sharing w/ Ilia; UMAA spring workshop planning w/ Greg
Apr 24	3i Conference at U of U
Apr 27	Larval ID training for seasonals; dragonfly ecology literature request for MAD-D; Finishing vegan colony diet experimental rearing; Planning and quotes for labor on ULV study for Central Life Sciences
Apr 28	Mosquito ecology training for seasonals; planning Culicoides trapping at Hogle Zoo (w/ Jeff Landry); pesticide license test prep w/ seasonals
Apr 29	Treehole paper edits w/ Amy; Drafting UMAA spring workshop presentations
Apr 30	Finalizing UMAA spring workshop presentations; Board meeting surveillance/research update

Michele Rehbein, Education Specialist

- Dr. Rehbein gave a virtual presentation to a second-grade class from James Leitch Elementary School on 1 April through the Skype A Scientist program.
 - Dr. Rehbein presented at the Rose Park Community Council on 1 April.
 - Dr. Rehbein presented to Yevgeny Pevzner's 6th grade class at Kearns Junior High on 2 April.
 - Dr. Rehbein published SLCMAD's biweekly newsletter on 3 April.
 - Dr. Rehbein attended a ULGT Legal Brief Series about contracts and indemnification for the Trust Integrity program on 7 April.
 - Dr. Rehbein conducted an afterschool education program at the Hartland Partnership Center on 17 April.
 - Dr. Rehbein presented to two classes (boys and girls) at the Farmington Bay Youth Center through the STEM CAP program on 21 April.
 - Dr. Rehbein presented to the Salt Lake County Health Department's Population Health Division at Murray Park on 22 April.
 - Dr. Rehbein conducted an afterschool educational program with students at the Hartland Partnership Center on 24 April.
 - Dr. Rehbein participated in a bioblitz event at the Day-Riverside Library collaborating with Jordan River Commission, Utah Public Lands, Natural History Museum of Utah for the City Nature Challenge on 27 April.
 - Dr. Rehbein participated in a STEAM Night with Q Salt and Gus Gesteland at Beehive Elementary on 29 April.
-
- Dr. Rehbein met with Dr. Tim Burton to discuss RaHP VEC social media on 3 April.
 - Dr. Rehbein participated in the PacVec + RaHP VEC joint meeting on 8-10 April.
 - Dr. Rehbein attended the UMAA Board of Director's meeting on 15 April.
 - Dr. Rehbein and Brad Sorensen tabled at the Westside Coalition's Community Celebration at Utah State Fairpark on 21 April.
 - Dr. Rehbein attended a Hartland Partnership Center partners meeting on 24 April.
 - Dr. Rehbein participated in a Partners in the Park Partners Planning meeting on 29 April.
 - Dr. Rehbein met with Jonny Gonzalez, Nayra Green, and Kara Sun from STEMCAP on 30 April, and gave them a tour of the facility.

Nate Byers, Molecular Biologist

Compiled and sent SLC trap parts list to Ivy. Also sent replacement parts with Ary after she printed the old design.

Started mosquito trapping in earnest.

Provided formal training on mosquito anatomy for new seasonal staff.

Interviewed seasonal lab staff with Dr. Bibbs.

Reviewed a manuscript for *Parasites & Vectors*.

Provided tours of the SLCMAD facilities for guest attending the RaHPVEC/PacVec meeting.

Ordered insecticide resistance testing supplies from the CDC.

Met with Dr. JR McMillan (TTU) to get his data analysis for RaHPVec aerial trial data. 6 April

Presented at the Utah Aerial Evaluation preliminary analyses at the RaHPVEC PacVec joint meeting. 8 April – 10 April

Presented the SLC CO2 trap to Dr. Victoria Ng, Dr. John Soghigian, and five other Canadian public health experts to assist in their mosquito trapping program. 16 April

Met with Dr. Ivy Hurwitz and Jessie to explain SLC CO2 trap construction. 20 April

Met with Milton Sterling to provide guidance on dog heart worm testing from mosquito samples. 22 April

Provided a tour of the SLCMAD facilities to Dr. Elizabeth Freeman. 23 April

Met with Jeff Landry at the Zoo to discuss Culicoides trapping. 29 April

Provided guidance to Dr. Neil Vickers on VectorSurv usage. 30 April

Brad Sorensen, Aerial Operations Supervisor

Brought on Tucker Visser for the season

Continued working on construction coordination and walk throughs

Flew tour flights of wetlands

Practice flights in the helicopter

Treated 30 Acres with UAS

4/1 – OAC Meeting

4/8 – OAC Meeting

4/8 – Moved Helicopter to KBTF

4/9 – First flight into SLCMAD Helipad

4/10 – PACVEC / RHAPVEC tour flights

4/10 – Returned aircraft to KOGD

4/15 – OAC Meeting (first scheduled punch walk for lab got canceled)

4/21 – Attended and tabled West Side Coalition meeting with Michele

4/21 – Moved helicopter to KSLC for maintenance inspection

4/22 – Returned helicopter to KOGD

4/22 – OAC Meeting

4/28 – Commissioning agent meeting

4/29 – OAC Meeting

Jason Hardman, Rural Field Supervisor

Prep for the season, calibration of equipment, field work, and seasonal employee training

Quentin Salt, Urban Field Supervisor

Calibrate Stihl 450 mist duster blower 4/20

Calibrate Pioneer SXS liquid skid 4/28

Collect Gambusia from Jensen Pond to get ready for season 4/17

Fish Pond Service Request 4/22

3. Field Data:**Control:****ACRES TREATED**

	Adulticide		Larvicide		Total
	Ground	Aerial	Ground	Aerial	
April's Total	0.00	0.00	58.80	0.00	58.80
April's 3 Year Avg.	0.00	0.00	105.14	189.00	294.14

Service Requests:**MOSQUITO SERVICE OPPORTUNITIES RECEIVED BY MONTH**

	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
2026	5	8								
3-Year Avg.	3.67	14.00	35.00	42.67	34.00	19.00	13.33	3.33	13.33	165.67

Inspection and Surveillance:

Larval Collections		
Species	April	5-Year Average
<i>Ae. campestris</i>	0	0.2
<i>Ae. dorsalis</i>	24	11.2
<i>Ae. fitchii</i>	0	0.2
<i>Ae. increpitus</i>	0	0.2
<i>Ae. nigromaculis</i>	0	0.0
<i>Ae. niphadopsis</i>	0	0.0
<i>Ae. sierrensis</i>	0	0.0
<i>Ae. melanimon</i>	0	0.0
<i>Ae. varipalpus</i>	0	0.0
<i>Ae. vexans</i>	1	0.0
<i>Cx. erythrothorax</i>	1	0.8

<i>Cx. pipiens</i>	6	0.4
<i>Cx. tarsalis</i>	43	9.0
<i>Cx. salinarius</i>	0	0.0
<i>Cx. impatiens</i>	0	0.0
<i>Cs. incidens</i>	7	0.0
<i>Cs. inornata</i>	38	6.0
<i>An. freeborni</i>	1	0.0
Total	121	28.0

4. Weather:

April's weather was warmer (by 0.7°) and drier (by 0.37") than normal.

Temperature:

	Monthly Avg.	Normal	High	Low
March	53.4°	45.8°	84°	27 °
April	52.5°	51.8°	82°	30 °

<https://www.weather.gov/wrh/Climate?wfo=slc>

Precipitation:

	Total for Month	Normal	Most in 24 hours	
March	1.07"	1.75"	0.70"	on 2 nd
April	1.79"	2.16"	0.51"	on 26 th

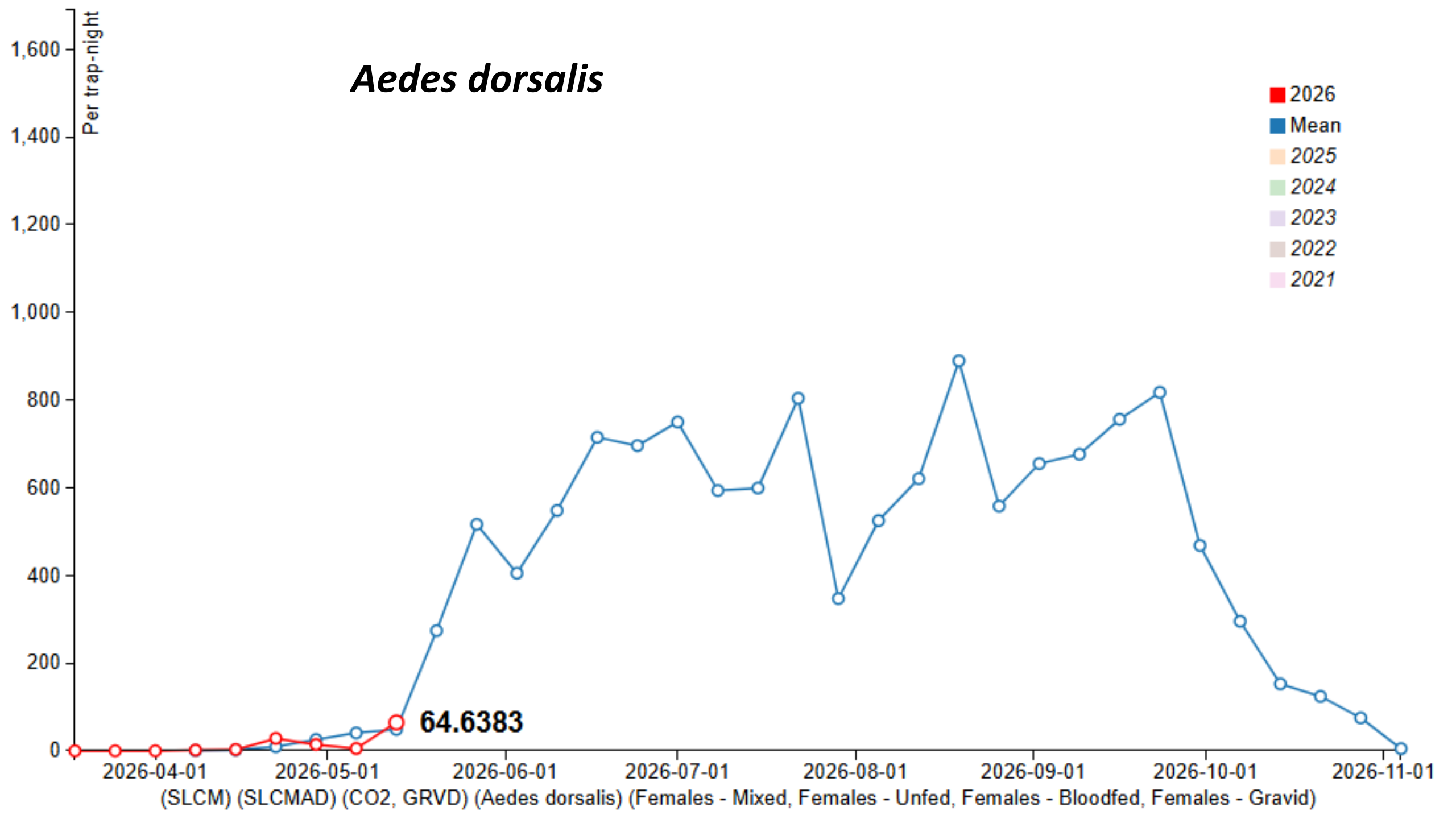
<https://www.weather.gov/wrh/Climate?wfo=slc>

Great Salt Lake (elevation in feet above sea level):

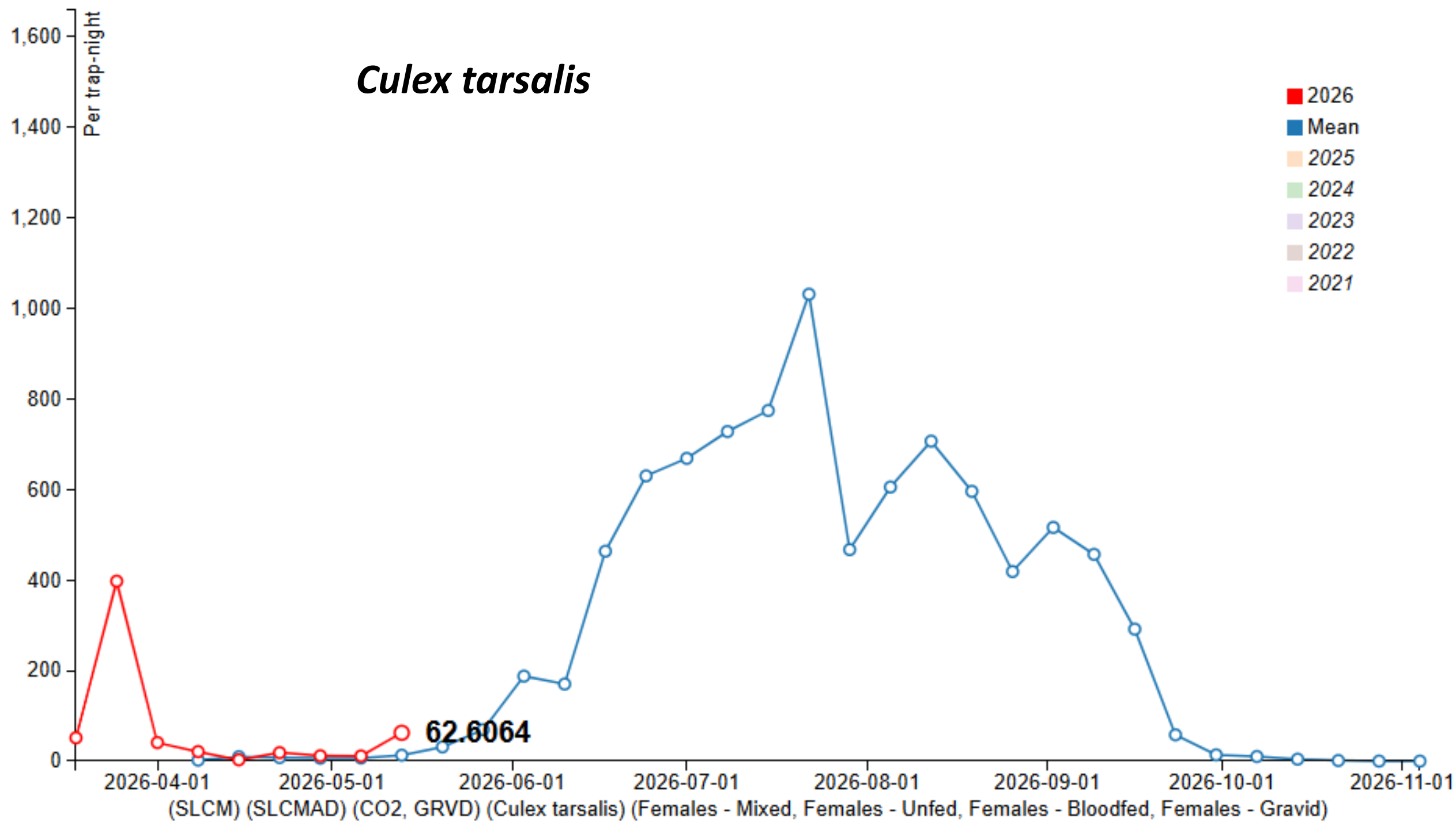
	Mar 1	Apr 1	May 1
2025	4,193.1	4,193.4	4,193.4
2026	4,192.0	4,192.3	4,192.2

<https://waterdata.usgs.gov/monitoring-location/USGS-10010000/>

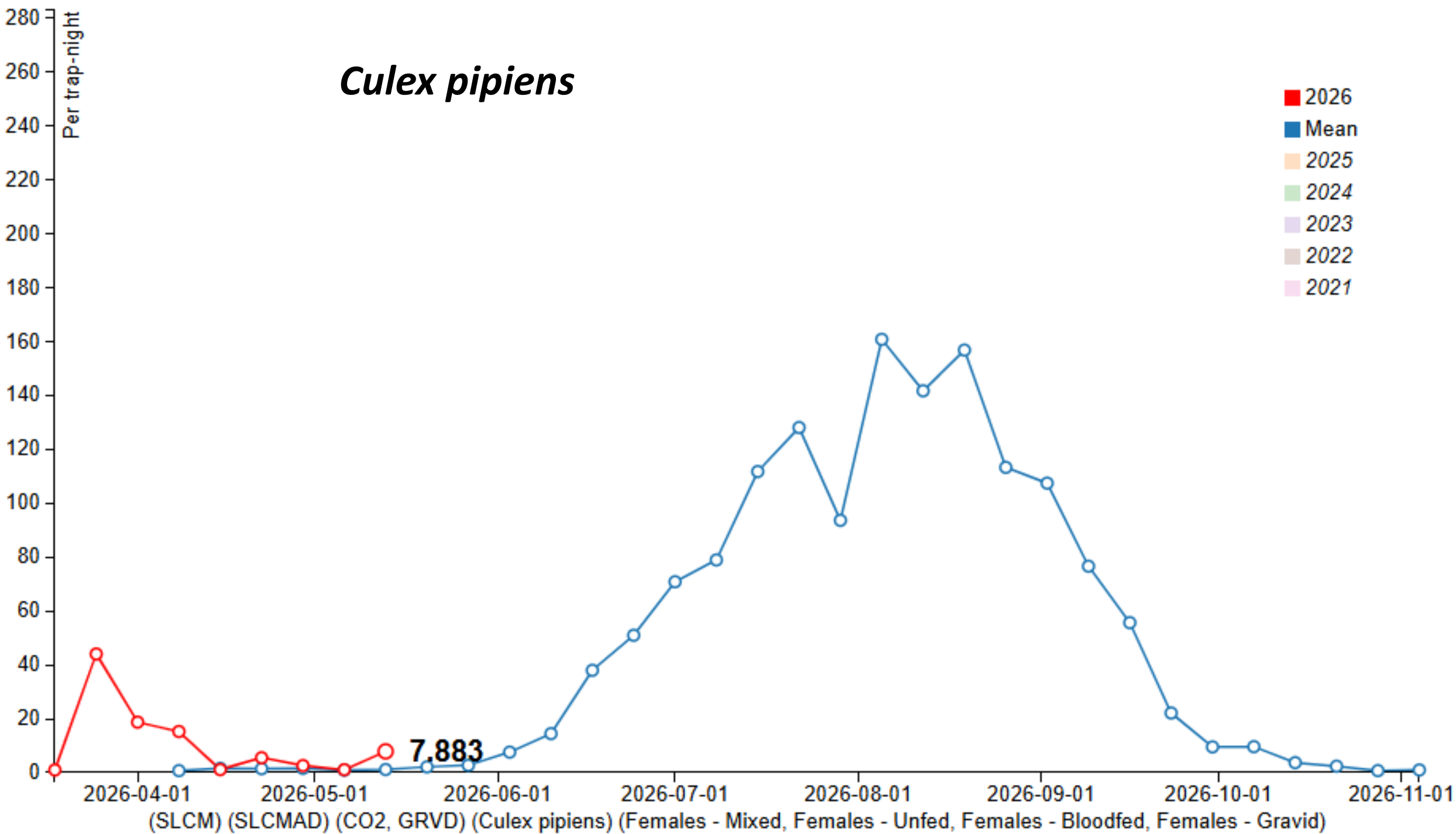
Aedes dorsalis



Culex tarsalis



Culex pipiens



Vector/Pathogen/Host Interaction, Transmission

Distribution, host records, and *Rickettsia* species associated with *Dermacentor parumapertus* (Acari: Ixodidae) in western North America

Christopher D. Paddock^{*.1, }, Maria L. Zambrano¹, Jackson H. Paddock², Bryan Ayres^{}, Ary Faraji^{3, }, Stephen Ladd-Wilson⁴, James R. Clover⁵, Andrés M. López-Pérez⁶, Lorenza Beati^{}, James W. Mertins^{8, }, Joy A. Hecht^{1, }, Michelle E.J. Allerdic^{1, }, Jerome Goddard⁹, and Sandor E. Karpthy^{1, }

¹Rickettsial Zoonoses Branch, Centers for Disease Control and Prevention, Atlanta, GA, USA

²Georgia Department of Natural Resources, State Parks and Historic Sites, Sapelo Island, GA, USA

³Salt Lake City Mosquito Abatement District, Salt Lake City, UT, USA

⁴Public Health Division, Oregon Health Authority, Portland, OR, USA

⁵Biological Consultant, Grants Pass, OR, USA

⁶Red de Biología y Conservación de Vertebrados, Instituto de Ecología, A.C, Xalapa, Veracruz, México

⁷The U.S. National Tick Collection, Georgia Southern University, Statesboro, GA, USA

⁸U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, Diagnostics and Biologics, National Veterinary Services Laboratories, Ames, IA, USA

⁹Department of Biochemistry, Molecular Biology, Entomology, and Plant Pathology, Mississippi State University, Mississippi State, MS, USA

*Corresponding author. Rickettsial Zoonoses Branch, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, GA 30329, USA (Email: cdp9@cdc.gov).

Subject Editor: Timothy Lysyk

Dermacentor parumapertus Neumann is an ixodid tick distributed broadly across arid and semi-arid regions of the western United States and northern Mexico. *D. parumapertus* has garnered little attention by most medical entomologists due predominantly to historical assumptions that it fed almost exclusively on lagomorphs. We summarized data from multiple sources to provide a comprehensive and current description of the distribution, host records, and *Rickettsia* species associated with this understudied species of potential medical importance. By using historical and recent scientific literature, natural history museum records, and archival collection records from the US National Tick Collection and the US Department of Agriculture (USDA)-National Veterinary Services Laboratories, we compiled county- and municipality-level locality records for *D. parumapertus* from 119 counties in 14 US states, and 12 municipalities in 10 states in Mexico. We further identified host records for nymphs and adults of *D. parumapertus* from 52 vertebrate species. From 199 field-collected adult *D. parumapertus*, we detected DNA of *Rickettsia bellii*, *Rickettsia rhipicephali*, and the potentially pathogenic *Rickettsia parkeri* Black Gap genotype in 61.3%, 4.5%, and 4.0% of the total specimens, respectively. From these data and information acquired from historical and recent scientific literature, we identified the occurrence of *R. parkeri*-infected *D. parumapertus* from 10 counties in 6 US states, and 2 municipalities in 2 states in Mexico. Collectively, these findings indicate broad distribution of *D. parumapertus* in western North America, a broader range of hosts than summarized previously, and association of this tick with a potential pathogen in several US states and municipalities of Mexico.

Keywords: rickettsiosis, Black Gap, Atlantic rainforest, black-tailed jackrabbit, rabbit dermacentor

Introduction

Dermacentor parumapertus Neumann (Fig. 1), also known as the rabbit dermacentor (Hooker et al. 1912) for its predilection for leporid hosts, is an ixodid tick distributed broadly across arid regions of the western United States and northern Mexico. The species was first described from a female specimen collected at Lakeside in San Diego County, California (Neumann 1901). Despite its recognition as a potential vector of *Rickettsia*

rickettsii, the agent of Rocky Mountain spotted fever (Maver 1911, Parker et al. 1933), Colorado tick fever virus (Eklund et al. 1955, Eads et al. 1956), and *Francisella tularensis*, the agent of tularemia (Woodbury and Parker 1954, Allred et al. 1956, Thorpe et al. 1965), *D. parumapertus* garnered relatively little attention by most medical entomologists during the first half of the 20th century, due predominantly to an assumption that it fed almost exclusively on lagomorphs (Philip 1941, Kohls 1948).

Received: 16 January 2026. Revised: 24 March 2026. Accepted: 25 March 2026

Published by Oxford University Press on behalf of Entomological Society of America 2026

This work is written by (a) US Government employee(s) and is in the public domain in the US.



Fig. 1. A) *Dermacentor parumapertus* female (left) and male (right). B, C) Adult ticks attached to the ear and lower eyelid, respectively, of parasitized black-tailed jackrabbits (*Lepus californicus*).

Scientific interest in *D. parumapertus* was invigorated during the 1950s, after a spotted fever group *Rickettsia* (SFGR) was isolated in guinea pigs and embryonated chicken eggs from pooled *D. parumapertus* specimens obtained from black-tailed jackrabbits (*Lepus californicus* Gray [Lagomorpha: Leporidae]), collected in northern Nevada and western Utah (Philip and Hughes 1953, Philip et al. 1955, Stoenner et al. 1959). When inoculated intraperitoneally into male guinea pigs, isolates of this SFGR, designated as the parumapertus strain or parumapertus agent (Philip and Hughes 1953), elicited brief fever, scrotal swelling, and mild splenomegaly. However, in contrast to guinea pigs fatally infected with *R. rickettsii*, animals infected with the parumapertus strain consistently recovered from their infections, and antigens prepared from these isolates more closely resembled an isolate identified as the “maculatum agent” (subsequently recognized as *Rickettsia parkeri* Lackman et al.) than isolates of *R. rickettsii* (Philip and Hughes 1953, Philip et al. 1955). The parumapertus strain was later characterized as a unique rickettsial serotype, similar to but distinct from classical strains of *R. parkeri* isolated from *Amblyomma maculatum* Koch in the eastern United States (Philip et al. 1978a,b). However, the original isolates of the parumapertus strain were subsequently lost to science, and this SFGR remained unstudied for the next 4 decades.

In 2017, an SFGR was isolated from *D. parumapertus* obtained from Brewster County, Texas, that elicited clinical characteristics in male guinea pigs similar to those described following infection with the parumapertus strain (Paddock et al. 2017). Multilocus sequence typing (MLST) revealed that this isolate, designated the Black Gap strain, was a unique genotype of *R. parkeri* most closely related to strains of *R. parkeri* from Argentina and Chile (Ogrzewalska et al. 2016, Allerdice et al. 2021). Whole-genome sequencing of the Black

Gap strain (Karpathy et al. 2021) revealed 99.59% nucleotide identity with the Atlantic rainforest strain of *R. parkeri* (Londoño et al. 2019), a pathogenic SFGR described from several Latin American countries that is transmitted by multiple *Amblyomma* spp. *Rickettsia parkeri* strain Atlantic rainforest causes a nonlethal rickettsiosis of humans that has been identified in Brazil (Spolidorio et al. 2010, Silva et al. 2011, Krawczak et al. 2016, Sevá et al. 2019, Martiniano et al. 2022), Colombia (Arboleda et al. 2020), and Mexico (Peniche-Lara and Lara-Perera 2022), where it causes a febrile illness accompanied by tender regional lymphadenopathy, fever, headache, myalgia, and arthralgia. The near complete genetic identity between the Black Gap and Atlantic rainforest strains of *R. parkeri* strongly suggests a potential pathogenic role for the Black Gap genotype (Paddock et al. 2017).

Despite its characterization as “... without doubt the most abundant *Dermacentor* tick distributed in the lowland regions of the Great Basin states” (Brinton et al. 1965), there are few contemporary reports describing the distribution, hosts, or rickettsial associates of *D. parumapertus* (Paddock et al. 2017, Portugal et al. 2019, Goddard et al. 2023). In this report, we summarize data from multiple sources to provide a comprehensive description of the county- and municipality-level occurrences, host records, and *Rickettsia* species associated with this understudied ixodid species of potential medical importance.

Materials and Methods

Geographical Occurrences of *D. parumapertus*

County- and municipality-level collection records for *D. parumapertus* in western North America were obtained from multiple sources. We used Google Scholar and the search terms “*Dermacentor parumapertus*” or “*Lepus californicus*” to identify historical and recent scientific literature. We obtained additional references from citations contained in the identified literature (Hooker et al. 1912, McCampbell 1926, Chamberlin 1937, Eddy 1940, Edmunds 1951, Ellis 1952, Philip and Hughes 1953, Coffey 1954, Beck 1955, Philip et al. 1955, Eads et al. 1956, Stoenner et al. 1959, Hoffmann 1962, Beck et al. 1963, Ryckman and Ryckman 1963, Hansen et al. 1965, Rodriguez 1977, Lane et al. 1981, Furman and Loomis 1984, Pfaffenberger and de Bruin 1986, Lane and Burgdorfer 1988, Pfaffenberger and Valencia 1988, Henke et al. 1990, Guzmán-Cornejo et al. 2016, Paddock et al. 2017, Sánchez-Montes et al. 2019, Backus et al. 2023, Harman et al. 2024). We also obtained data from natural history museum records (<https://arctosdb.org>, <https://www.gbif.org/>), and from archival collection records from the US National Tick Collection (USNTC) in Statesboro, Georgia, and the USDA-National Veterinary Services Laboratories (NVSL) in Ames, Iowa.

Host Records for Nymphal and Adult *D. parumapertus*

Using the search strategy described previously, we reviewed historical and current literature (Neumann 1901, Hooker et al. 1912, Boynton and Woods 1933, Chamberlin 1937, Cooley 1938, Bishopp and Trembley 1945, Ellis 1952, Coffey 1954, Beck 1955, Fremling and Gastfriend 1955, Gastfriend 1955, Eads et al. 1956, Roscoe 1956, Rosasco 1957, Egoscue 1962, Ho 1962, Beck et al. 1963, Ryckman and Ryckman 1963, Hansen et al. 1965, Strickland and Gerrish 1965, Johnson

1966, Despain 1968, Lang 1972, Rotramel et al. 1976, Furman and Loomis 1984, Lane and Burgdorfer 1988, Merten and Durden 1999, Foley et al. 2007, Guzmán-Cornejo et al. 2016, Paddock et al. 2017, López-Pérez et al. 2019, Sánchez-Montez et al. 2019, Backus et al. 2023), as well as archival data from the USNTC and NVSL to compile host records for nymphal and adult stages of *D. parumapertus*. Host records for larvae of this species were recently updated (Goddard et al. 2023).

Field Collections of *D. parumapertus* for Molecular Evaluation of *Rickettsia* spp

During 2016–2024, we obtained *D. parumapertus* from multiple locations in the southwestern United States and northern Mexico for molecular evaluations for *Rickettsia* spp. We removed ticks from carcasses of road-killed *L. californicus* or from *L. californicus* harvested by experienced hunters (CDC IACUC protocol 2824PADRABX-A2). Ticks were transferred to 70% ethanol and subsequently identified by their morphological characteristics (Cooley 1938, Brinton et al. 1965). Individual ticks were minced using sterile No. 11 scalpel blades. DNA was extracted using a QIAGEN DNeasy Blood and Tissue Kit (QIAGEN, Valencia, California) and eluted in a final volume of 100 µl of elution buffer. The DNA extracts were screened with a *Rickettsia* genus-specific assay targeting a 111-bp segment of the 23S rRNA gene (Kato et al. 2013), using 5 µl of DNA template. All reactions were run with a BioRad CFX Real-time PCR Detection System (Bio-Rad, Hercules, California) using the QuantiTect Probe PCR Kit (QIAGEN, Valencia, California). The plasmid designed for this assay (Kato et al. 2013), and molecular grade water, were used as positive and negative controls, respectively. Samples with C_t values <40 cycles were considered positive.

Development of a Real-Time Assay Specific for the Black Gap Genotype of *R. parkeri*

We used a previously described primer set (Rpa129F and Rpa224R) to amplify a 96-bp segment of the *ompB* gene of *R. parkeri* (Wright et al. 2011) and designed a novel probe (5'-CalRed 610- CGC GAA ATC AAT ACC CTT ATG AAC ACC AGT CGC G- BHQ2-3') that binds specifically to the Black Gap genotype of *R. parkeri*. The reaction mixture included 700 nM of each primer, 400 nM of probe, 12.5 µl QuantiTect Probe PCR Master Mix (QIAGEN, Valencia, California), 2 µl sample DNA, and mixile, PCR-grade water to adjust the final volume to 25 µl. Reactions were performed with an initial incubation at 95°C for 15 min, followed by 45 cycles of 95°C for 60 s, and 60°C for 60 s. Sensitivity testing was performed using a synthetic plasmid containing an *ompB* sequence specific to the Black Gap genotype of *R. parkeri* (Blue Heron Biotech, Bothell, Washington). A standard curve was generated to determine the limit of detection of the assay using plasmid concentrations of 10^1 to 10^8 copies per reaction. We determined the PCR efficiency and the R^2 value using the standard curve. The specificity of the assay was evaluated using a panel of DNA samples extracted from 37 isolates of *R. parkeri* representing 7 genotypic clades (Allerdice et al. 2021), including 35 isolates of *R. parkeri* sensu stricto and 1 strain each of *R. parkeri* Atlantic rainforest and *R. parkeri* NOD (Supplementary Table S1). The exclusivity of the assay was also evaluated for 26 other *Rickettsia* species and subspecies, 5 species and subspecies of Anaplasmataceae, and *Orientia tsutsugamushi* (Supplementary Table S2). All reactions were run with a BioRad CFX Real-time

PCR Detection System using the QuantiTect Probe PCR Kit. The plasmid designed for this assay and molecular grade water were used as positive and negative controls, respectively. Samples with C_t values <40 cycles were considered positive.

Molecular Evaluation for Other *Rickettsia* spp

Samples that tested positive by the *Rickettsia*-genus assay, but negative by the real-time assay specific for the Black Gap genotype of *R. parkeri*, were subsequently tested using a semi-nested PCR assay targeting a 532-bp segment of the *Rickettsia sca0 (ompA)* gene with primers Rr190.70p, Rr190.602n, and Rr190.701 (Regnery et al. 1991, Roux et al. 1996). The PCR reactions included 2 µl of DNA template in the primary reaction and 1 µl in the semi-nested reaction, each primer at a final concentration of 1 µM, and 12.5 µl of QIAGEN Taq PCR Master Mix, in a final reaction volume of 20 µl. Genomic DNA extracted from a Vero E6 cell culture infected with *Rickettsia slovaca*, and molecular grade water, were used as positive and negative controls, respectively. Amplicons generated with the *sca0* assay were visualized on a 1.5% agarose gel and purified using the Promega Wizard SV Gel and PCR Clean-up System (Promega, Madison, Wisconsin). Purified amplicons were sequenced bidirectionally using a BigDye Terminator v3.1 kit and an ABI 3500 Genetic Analyzer (ThermoFisher Scientific, Waltham, Massachusetts). We assembled the sequences using Geneious Prime 2023.2.1. (www.geneious.com) and compared these to GenBank data using BLASTn analysis. Amplified *sca0* sequences of *Rhipicephalus rhipicephali* were assigned genotypes as described by Wikswow et al. (2008).

All DNA extracts positive by the *Rickettsia* genus-specific assay were additionally tested by using a *Rickettsia bellii*-specific real-time assay (Hecht et al. 2016) with 5 µl of DNA template. Reactions were run with a BioRad CFX Real-time PCR Detection System using the QuantiTect Multiplex PCR Kit (QIAGEN, Valencia, California). Genomic DNA extracted from a Vero E6 cell culture infected with *R. bellii* and molecular grade water were used as positive and negative controls, respectively. Samples with C_t values <40 cycles were considered positive.

Results

Geographical Occurrences for *D. parumapertus*

From our review of scientific literature, and unpublished archival data from natural history museums, USNTC, and NVSL, we identified collection records of *D. parumapertus* from 119 US counties in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, and Wyoming, with the greatest concentration of records comprising locations in the Great Basin, Southern California, Arizona, New Mexico, and West Texas (Fig. 2). Records of occurrence of *D. parumapertus* were additionally documented from 12 municipalities of Baja California, Baja California Sur, Chiapas, Chihuahua, Ciudad de México, Coahuila, Durango, Hidalgo, San Luis Potosí, and Sonora, Mexico (Fig. 3).

Host Records for Nymphal and Adult *D. parumapertus*

Using data from scientific literature and archival USNTC and NVSL data, we identified host records for nymphs and adults of *D. parumapertus* from 52 vertebrate species, comprising 31

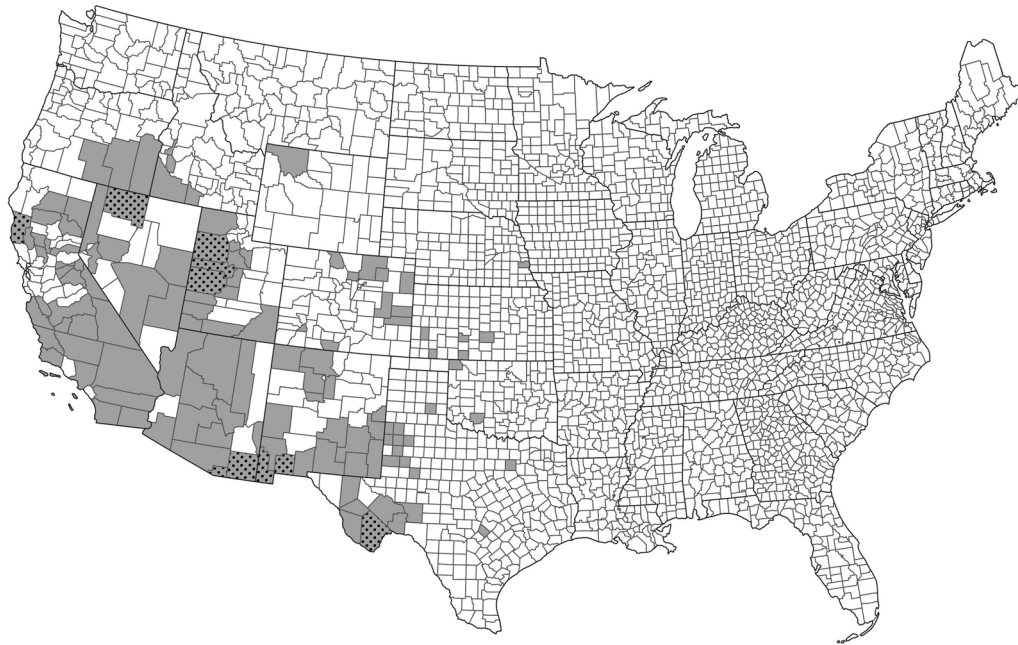


Fig. 2. County-level occurrence of *Dermacentor parumapertus* (gray), and *Rickettsia parkeri* isolated from or detected in *D. parumapertus* (stippling), in the continental United States, 1938–2025. See text for data sources.



Fig. 3. Municipality-level occurrence of *Dermacentor parumapertus* (gray) and *Rickettsia parkeri* (stippling) in Mexico, 1962–2024. See text for data sources.

genera and 13 families (Table 1). Excluding lagomorphs, we identified collection records for adult ticks from 43 other species of small, medium, and large mammals, 1 avian species, and 1 reptilian species.

Field Collections of *D. parumapertus* for Molecular Evaluation of *Rickettsia* spp

During 2016–2024, we obtained a total of 202 adult *D. parumapertus*, comprising 158 males and 44 females, from 22

black-tailed jackrabbits collected in 7 counties in Arizona, New Mexico, Oregon, Texas, and Utah, and from 1 municipality in Chihuahua, Mexico. No larvae or nymphs were obtained. Specimens obtained from Tooele County, Utah, in 2016 (1M/1F), and Hidalgo County, New Mexico, in 2018 (1M), were deposited as vouchers with the USNTC. Of the remaining 199 specimens (Table 2), 131 (65.8%) tested positive by the *Rickettsia* genus-specific assay and were evaluated further to determine the infecting bacterial species.

Table 1. Host records for nymphs and adults of *Dermacentor parumapertus*^a

Host	Common name	Feeding stage		Reference(s)
		Nymph	Adult	
<i>Ammospermophilus leucurus</i>	White-tailed antelope squirrel	X	X	Gastfriend 1955, Johnson 1966, Beck et al. 1963
<i>Aquila chrysaetos</i>	Golden eagle		X	Beck et al. 1963
<i>Aspidoscelis gularis</i>	Texas spotted whiptail		X	USNTC ^b 1974
<i>Bos taurus</i>	Cattle	X	X	Bishopp and Trembley 1945, Strickland and Gerrish 1965, USDA-NVSL ^c 1962, 1964–1969, 1972, 1978, 1980, 1982–1984, 1987, 1998, USNTC 1908, 1951
<i>Brachylagus idahoensis</i>	Pygmy rabbit	X	X	USNTC 1931, 1932, Bishopp and Trembley 1945
<i>Callospermophilus lateralis</i>	Golden-mantled ground squirrel	X		Furman and Loomis 1984
<i>Canis familiaris</i>	Domestic dog		X	USNTC 1940
<i>Canis latrans</i>	Coyote	X	X	Cooley 1938, Ho 1962, Johnson 1966, Rotramel et al. 1976, López-Pérez et al. 2019
<i>Capra hircus</i>	Domestic goat		X	USNTC 1933
<i>Chaetodipus formosus</i>	Long-tailed pocket mouse	X		Gastfriend 1955, Johnson 1966
<i>Cynomys ludovicianus</i>	Arizona black-tailed prairie dog	X		Eads et al. 1956
<i>Dipodomys agilis</i>	Agile kangaroo rat	X		Furman and Loomis 1984
<i>Dipodomys heermanni</i>	Heermann's kangaroo rat	X	X	USNTC (date not recorded), Furman and Loomis 1984
<i>Dipodomys merriami</i>	Merriam's kangaroo rat	X	X	Coffey 1954, Beck et al. 1963, USNTC 1932, 1941, 1950, 1951, 1968, 1984, 1985, 1987, Furman and Loomis 1984, Gastfriend 1955, Beck et al. 1963, USNTC 1985
<i>Dipodomys microps</i>	Chisel-toothed kangaroo rat	X	X	USNTC (date not recorded)
<i>Dipodomys nitratooides</i>	San Joaquin kangaroo rat		X	USNTC 1940, 1951, 1970, Coffey 1954, Gastfriend 1955, Beck 1955, Eads et al. 1956, Beck et al. 1963, Furman and Loomis 1984
<i>Dipodomys panamintinus</i>	Panamint kangaroo rat	X		Furman and Loomis 1984
<i>Felis catus</i>	Domestic cat		X	Johnson 1966
<i>Glaucomys sabrinus</i>	Northern flying squirrel	X		Foley et al. 2007
<i>Homo sapiens</i>	Human	X	X	Neumann 1901, USNTC 1932, 1934, Cooley 1938, Roscoe 1956, Johnson 1966, Furman and Loomis 1984, Merten and Durden 1999
<i>Ictidomys tridecemlineatus</i>	Thirteen-lined ground squirrel	X		Eads et al. 1956
<i>Lepus alleni</i>	Antelope jackrabbit	X	X	USNTC 1919, 1927, 1933, 1963, Bishopp and Trembley 1945, USDA-NVSL 1993
<i>Lepus californicus</i>	Black-tailed jackrabbit	X	X	USNTC 1909–1995, Cooley 1938, Bishopp and Trembley 1945, Coffey 1954, Fremling and Gastfriend 1955, Beck 1955, Eads et al. 1956, Rosasco 1957, Ho 1962, Beck et al. 1963, Ryckman and Ryckman 1963, Thorpe et al. 1965, Rotramel et al. 1976, Furman and Loomis 1984, Sánchez-Montes et al. 2019, Guzmán-Cornejo et al. 2016, Paddock et al. 2017,

(Continued)

Table 1. Continued

Host	Common name	Feeding stage		Reference(s)
		Nymph	Adult	
<i>Lepus townsendii</i>	White-tailed jackrabbit	X	X	Backus et al. 2023, USDA-NVSL 1963, 1964, 1992, 1993, 2001, 2008, 2021 USNTC 1926, 1933, 1977, Bishopp and Trembley 1945, Coffey 1954, Beck 1955
<i>Microdipodops megacephalus</i>	Dark kangaroo mouse	X		Gastfriend 1955, Johnson 1966
<i>Neotoma cinerea</i>	Bushy-tailed woodrat	X		USNTC 1951
<i>Neotoma lepida</i>	Desert woodrat	X		Gastfriend, 1955, Johnson 1966
<i>Odocoileus hemionus</i>	Mule deer		X	Boynton and Woods 1933, Cooley 1938, Rotramel et al. 1976
<i>Onychomys leucogaster</i>	Northern grasshopper mouse	X		Johnson 1966
<i>Onychomys torridus</i>	Southern grasshopper mouse	X		Beck et al. 1963
<i>Peromyscus boylii</i>	Brush deer mouse		X	USNTC 1986
<i>Peromyscus californicus</i>	California deer mouse		X	Furman and Loomis 1984
<i>Peromyscus crinitus</i>	Canyon deer mouse		X	USNTC 1985
<i>Peromyscus maniculatus</i>	North American deer mouse	X	X	USNTC 1932, 1987, Coffey 1954, Beck 1955, Gastfriend 1955, Johnson 1966, Despaigne 1968
<i>Peromyscus truei</i>	Piñon mouse	X		Gastfriend 1955, Johnson 1966
<i>Perognathus longimembris</i>	Little pocket mouse	X	X	Gastfriend 1955, Beck et al. 1963, Johnson 1966, USNTC 1985, Furman and Loomis 1984
<i>Perognathus parvus</i>	Great Basin pocket mouse	X	X	Coffey 1954, Beck 1955, Gastfriend 1955, Furman and Loomis 1984
<i>Reithrodontomys megalotis</i>	Western harvest mouse	X		Gastfriend 1955, Johnson 1966
<i>Rattus norvegicus</i>	Norway rat	X		Eads et al. 1956
<i>Sigmodon hispidus</i>	Hispid cotton rat	X		USNTC 1941
<i>Sylvilagus audubonii</i>	Desert cottontail	X	X	USNTC 1922, 1938, 1939, 1948, 1967, Bishopp and Trembley 1945, Eads et al. 1956, Beck et al. 1963, Johnson 1966, Despaigne 1968, Furman and Loomis 1984, USDA-NVSL 1993, 1996, Backus et al. 2023
<i>Sylvilagus bachmani</i>	Brush rabbit	X	X	USNTC 1934, Furman and Loomis 1984
<i>Sylvilagus nuttallii</i>	Nuttall's cottontail	X	X	USNTC 1938, 1941, Beck 1955, Johnson 1966
<i>Tamias dorsalis</i>	Cliff chipmunk		X	Johnson 1966
<i>Tamias minimus</i>	Least chipmunk	X		Johnson 1966
<i>Tamiasciurus douglasii</i>	Douglas's squirrel	X	X	USNTC 1936
<i>Taxidea taxus</i>	American badger		X	USNTC 1937
<i>Urocyon v. beldingi</i>	Belding's ground squirrel	X		Furman and Loomis 1984
<i>Vulpes macrotis</i>	Kit fox	X	X	Egoscue 1962, Ho 1962, Johnson 1966, USNTC (date not specified)
<i>Xerospermophilus spilosoma</i>	Spotted ground squirrel	X		USNTC 1941, 1948
<i>Xerospermophilus tereticaudus</i>	Round-tailed ground squirrel	X		USNTC 1938, Lang 1972

Scientific and common names of hosts from original publications have been updated to conform with the Integrative Taxonomic Information System (www.itis.gov).

*Host records for larvae compiled in [Goddard et al. \(2023\)](#).

^bUSNTC, U.S. National Tick Collection, archived records.

^cUSDA-NVSL, U.S. Department of Agriculture-National Veterinary Services Laboratories, archived records.

Development of a Real-Time Assay Specific for the Black Gap Genotype of *R. parkeri*

We determined the sensitivity of the real-time PCR assay for the Black Gap genotype of *R. parkeri* to be <10 genomic copies per reaction. Its efficiency was 99% and R^2 for the standard

curve of the dilution series was 0.996. The assay identified specifically the Black Gap genotype of *R. parkeri* and did not amplify any other *R. parkeri* genotype or *Rickettsia*, *Ehrlichia*, *Anaplasma*, or *Orientia* species. Using this assay, we detected DNA of the Black Gap genotype of *R. parkeri* in specimens of

Table 2. *Rickettsia* spp. identified in adult *Dermacentor parumapertus* ticks obtained from black-tailed jackrabbits (*Lepus californicus*) in western North America, 2016–2024

State	County or municipality	Coordinates	Date of collection	No. of ticks evaluated	<i>Rickettsia</i> spp. identified by PCR		
					<i>R. parkeri</i>	<i>R. rhipicephali</i>	<i>R. bellii</i>
United States							
Arizona	Pima	31.8130, −110.9105	12 Jul 2017	42 (29M/13F) ^a	0	0	27
		32.2524, −110.6763	08 Jul 2017	7 (7M)	0	0	2
New Mexico	Cochise	31.7521, −110.3478	08 Aug 2018	14 (12M/2F)	2 ^b	0	12
	Gila	33.3560, −110.6490	23 May 2022	7 (7M)	0	0	4
		31.9678, −108.6546	11 Aug 2018	6 (5M/1F)	1	0	1
		31.9612, −108.6859	11 Aug 2018 ^c	14 (10M/4F)	3	0	3
		32.3171, −108.6167	13 Aug 2018	8 (3M/5F)	0	0	3
Oregon	Harney	42.7756, −118.4367	11 Jul 2024	5 (3M/2F)	0	0	2
Texas	Brewster	30.4271, −103.6984	13 Aug 2019	17 (16M/1F)	2	0	8
		30.4271, −103.6984	15 Aug 2019	11 (10M/1F)	0	0	8
		29.8396, −103.5768	16 Aug 2019	1 (1F)	0	0	0
Utah	Tooele	40.1758, −112.4439	08 Jul 2016 ^c	37 (34M/3F)	0	5 ^c	29
		39.9602, −113.7556	14 Aug 2019	5 (2M/3F)	0	0	5
		40.8245, −112.4920	21 Aug 2019	6 (5M/1F)	0	1 ^b	4
		40.8245, −112.4920	18 Sep 2019	14 (9M/5F)	0	2 ^b	13
Mexico							
Chihuahua	Janos	30.8659, −108.4456	29 Jul 2020	5 (4M/1F)	0	1 ^b	1
Total				199 (156M/43F)	8	9	122

^aM, male; F, female.^bEach co-infected with *R. bellii*.^cThree coinfecting with *R. bellii*.

adult *D. parumapertus*, obtained from Cochise County, Arizona, Hidalgo County, New Mexico, and Brewster County, Texas (Table 2). These represented 4.0% (8/199) of the total specimens tested for this agent during the period of evaluation. Our review of historical literature identified additional records of *R. parkeri* or the *parumapertus* agent detected in or isolated from *D. parumapertus* from Santa Cruz County, Arizona (Paddock et al. 2017), Mendocino County, California (Lane et al. 1981), Humboldt County, Nevada (Philip et al. 1978a), Luna County, New Mexico (Harman et al. 2024), and Juab, Millard, and Tooele counties, Utah (Stoenner et al. 1959) (Fig. 2), in addition to reports from the municipalities of Janos, Chihuahua, and Naco, Sonora, in Mexico (Sánchez-Montes et al. 2018) (Fig. 3).

Molecular Evaluation for Other *Rickettsia* spp

We detected DNA of *R. rhipicephali* in 4.5% (9/199) of the tested specimens (Table 2). Positive ticks originated from Utah, United States, and Chihuahua, Mexico, and all contained a previously unreported *sca0* genotype that differed from the corresponding *sca0* sequence of the *R. rhipicephali* reference strain Burgdorfer 3-7-♀-6^T by a single point mutation (393T → C). DNA of *R. bellii* was detected in 61.3% (122/199) of the tested specimens and occurred as a coinfecting species in 25.0% (2/8) of the ticks infected with *R. parkeri*, and in 66.7% (6/9) of the specimens infected with *R. rhipicephali* (Table 2).

Discussion

Our investigation corroborates historical assessments that situate *D. parumapertus* in semi-arid foothill or desert habitats of western North America that overlap much of the

distribution of *L. californicus* (Cooley 1938, Bishopp and Trembley 1945, Beck 1955, Johnson 1966, Despain 1968, Guzmán-Cornejo et al. 2016). However, the range of *L. californicus* also encompasses the lowlands of the Central Valley and Coastal Range of California, as well as the Great Plains region of eastern Colorado and New Mexico, central Texas, and western Oklahoma and Kansas (Best 1996), and *D. parumapertus* has been collected from *L. californicus* in these same areas (McC Campbell 1926, Ellis 1952, Eads et al. 1956, Hansen et al. 1965, Rotramel et al. 1976, Rodriguez 1977, Furman and Loomis 1984). Collectively, these observations characterize *L. californicus* as a keystone host for *D. parumapertus* (Bishopp and Trembley 1945, Beck 1955, Fremling and Gastfriend 1955, Beck et al. 1963, Johnson 1966). Data from longitudinal studies that describe the phenology of *D. parumapertus* in the Great Basin reveal that adult ticks are most abundant on *L. californicus* during May through August and that males are characteristically more numerous than females during this period. Immatures are found more frequently on heteromyid rodents, but when collected from *L. californicus*, these are most abundant during April and May and largely disappear from this host by mid-June to early July (Beck 1955, Fremling and Gastfriend 1955, Rosasco 1957, Beck et al. 1963).

The last distribution maps of *D. parumapertus* in the United States were generated more than 80 yr ago from collection data archived at the Rocky Mountain Laboratory in Hamilton, Montana (Cooley 1938) and the Bureau of Entomology and Plant Quarantine in Bethesda, Maryland (Bishopp and Trembley 1945). We compiled data from multiple and diverse sources to produce a contemporary, county-level occurrence map for an ixodid species that has received relatively little scientific attention for several decades. Despite a more granular

representation of occurrences, our map largely approximates the previously described distributions for *D. parumapertus*. However, we identified a few occurrence records beyond historically documented boundaries, including counties in central Kansas, and eastern Texas and Nebraska that are included within the recognized range of *L. californicus* (Best 1996). Extensive range expansions have been identified recently for several ixodid species in the United States (Eisen and Paddock 2021), to suggest that intensified surveillance for *D. parumapertus*, particularly on host species in the Great Plains region, could reveal a more eastern and northern distribution of *D. parumapertus*.

Similar to historical host associations reported for larvae (Goddard et al. 2023), our summary of scientific literature and archival collection data revealed a surprisingly broad range of host records for nymphs and adults of *D. parumapertus*, comprising >50 species of vertebrates. The cumulative data indicate that *D. parumapertus* has a more extensive host range than generally appreciated and will parasitize available hosts other than lagomorphs. We identified multiple records of nymphs, adults, or both attached to cattle in the southwestern United States and northern Mexico (Bishopp and Trembley 1945, Strickland and Gerrish 1965, USNTC, NVSL). Attachments to other livestock species, including horses (Hoffmann 1962) and goats (USNTC) are also recognized. Records of attachments to humans are uncommon (USNTC, Roscoe 1956, Johnson 1966, Furman and Loomis 1984, Merten and Durden 1999); nonetheless, the scarcity of documented attachments could reflect the predominantly remote and arid habitats occupied by *D. parumapertus* but less so by humans. Rarer still are off-host collection records (USNTC, Hoffmann 1962, Furman and Loomis 1984, Lang 1999), to suggest nidicolous or semi-nidicolous behavior by this tick. In support of this hypothesis, immatures have been collected from nests of desert and bushy-tailed woodrats (Beck et al. 1953, Ho 1962), and from the den of a kit fox (Howell 1960).

Rickettsia bellii was the most frequently identified rickettsial species in adult *D. parumapertus* and was detected in more than half of the ticks tested in this study. These findings are consistent with other studies that showed levels of *R. bellii* infection from 77% to 89% of *D. parumapertus* obtained from southern Arizona, northwestern Utah, and northern Baja California (Paddock et al. 2017, Backus et al. 2023). *Rickettsia bellii* has also been isolated from *D. parumapertus* obtained in Arizona, California, Texas, and Utah (Philip et al. 1983, Hecht et al. 2016, Paddock et al. 2017). We identified *R. rhipicephali* as a frequent coinfecting species with *R. bellii*, consistent with previous observations (Paddock et al. 2017) on the frequency of coinfection of these 2 *Rickettsia* species in host-associated *D. parumapertus*. We also identified coinfection with *R. bellii* in 25% of the *R. parkeri*-infected ticks. Each of the *D. parumapertus* evaluated in this study was host-associated, and cofeeding may have influenced the relatively high numbers of observed coinfections with the predominant rickettsial species (ie *R. bellii*). Further studies evaluating rickettsial infection rates in host-seeking *D. parumapertus* could provide important data to reconcile these observations.

Several decades ago, investigators demonstrated that isolates of *R. parkeri* cultivated from *D. parumapertus* obtained from the western United States represented a serotype distinct from isolates cultivated from *A. maculatum* obtained from the eastern United States (Philip et al. 1978a,b, Lane et al. 1981). Subsequent phylogenetic evaluations using MLST revealed that

a contemporary isolate of *R. parkeri* (strain Black Gap) obtained from *D. parumapertus* formed a unique clade and grouped most closely with strains of *R. parkeri* isolated from *Amblyomma* spp. ticks in several countries of South America. The Black Gap genotype of *R. parkeri* is most closely related to the Parvitarsum genotype of *R. parkeri* (Nieri-Bastos et al. 2018, Allerdice et al. 2021), an SFGR thus far detected only in *Amblyomma parvitarsum* Neumann from Argentina, Bolivia, Chile, and Peru (Muñoz-Leal et al. 2016, Ogrzewalska et al. 2016).

The Black Gap strain of *R. parkeri* also shares close genetic identity with the Atlantic rainforest strain of *R. parkeri* (Londoño et al. 2019, Karpathy et al. 2021), a pathogenic SFGR detected predominantly in *Amblyomma ovale* Koch from several regions of Latin America, including the Brazilian states of Bahia (Nieri-Bastos et al. 2016, de Oliveira et al. 2019), Ceará (Moerbeek et al. 2016), Espírito Santo (Faccini-Martínez et al. 2020), Mato Grosso, Paraná (Nieri-Bastos et al. 2016), Rio de Janeiro (Martiniano et al. 2022), Santa Catarina (Medeiros et al. 2011, Voizzoni et al. 2016), and São Paulo (Sabatini et al. 2010, Szabó et al. 2013, Luz et al. 2016), as well as from Argentina (Lamattina et al. 2018), Colombia (Londoño et al. 2014), Belize (Lopes et al. 2016, Nelson et al. 2022), El Salvador (Romero et al. 2023), Nicaragua (Vogel et al. 2018), and Mexico (Sánchez-Montes et al. 2019).

The evolutionary associations between the Black Gap genotype of *R. parkeri* and the Atlantic rainforest and Parvitarsum genotypes of *R. parkeri* are particularly enigmatic in the context of the disparate geographical distributions and bionomics of the associated vector species. The Black Gap genotype of *R. parkeri* has thus far been detected exclusively in *D. parumapertus* (Paddock et al. 2017, Sánchez-Montes et al. 2018, data herein), and its occurrence is restricted to western North America, overlapping the distributions of heteromyid rodents and *L. californicus*, the most frequently identified hosts for immature and adult *D. parumapertus*, respectively (Gastfriend 1955, Beck et al. 1963, Johnson 1966, Goddard et al. 2023). By contrast, all other genotypes of *R. parkeri* across the Americas, including the Atlantic rainforest and Parvitarsum genotypes, are associated with Nearctic or Neotropical *Amblyomma* spp. ticks (Nieri-Bastos et al. 2018, Allerdice et al. 2021). Cricetid rodents and carnivores serve as the primary hosts for the immatures and adults of *A. ovale*, respectively (Guglielmone et al. 2003, Szabó et al. 2013), whereas lizards of the genus *Liolaemus* and wild and domesticated camelids are the usual hosts of the immatures and adults of *A. parvitarsum*, respectively (Muñoz-Leal et al. 2016, Castillo et al. 2019).

Data from this investigation and others have identified *R. parkeri* in *D. parumapertus* from 10 counties, collectively, in Arizona, California, New Mexico, Nevada, Texas, and Utah (Philip et al. 1955, Stoenner et al. 1959, Lane et al. 1981, Paddock et al. 2017, Harman et al. 2024, data herein), and also in 2 municipalities in the states of Sonora and Chihuahua in Mexico (Sánchez-Montes et al. 2018). However, the true geographic distribution of *R. parkeri* in western North America is probably far more extensive than we know (Fig. 2). For example, archival collection records document the presence of *D. parumapertus* in Kearny County, Kansas, where complement-fixing antibodies against SFGR were detected in the sera of 26 (4.8%) of 549 black-tailed jackrabbits collected during 1957–1960 (Pagan et al. 1961). Similarly, in Lubbock County, Texas, 21 (27.6%) of 76 black-tailed jackrabbits

captured during 1987–1988 had antibodies reactive with SFGR when tested by using an indirect immunofluorescence antibody assay (Henke et al. 1990).

In some areas of the Great Basin, the seroprevalence of SFGR among jackrabbits can be considerable: approximately 20% to 40% of 3,969 black-tailed jackrabbits evaluated in Tooele County, Utah, during 1965–1972, demonstrated SFG-reactive antibodies (Eberhardt and Van Voris 1986). In this context, black-tailed jackrabbits, and possibly several rodent species, could serve as amplifying hosts for *R. parkeri*, as suggested when macerates of pooled lung, liver, spleen, and kidney from *L. californicus*, antelope ground squirrels, Ord's kangaroo rats, chisel-toothed kangaroo rats, North American deer mice, and desert woodrats produced antibodies reactive with SFGR in guinea pigs when inoculated peritoneally (Stoenner et al. 1959, Vest et al. 1959).

Despite its demonstrated pathogenicity in guinea pigs (Philip and Hughes 1953, Paddock et al. 2017), there are no confirmed infections of human hosts with the Black Gap genotype of *R. parkeri*. The most suggestive is a patient, described by Cumming (1917), who developed a nonlethal, febrile illness associated with rash that began with an initial pustular lesion on his chest several days after being exposed to ticks while clearing sagebrush near his property in Elko County, Nevada. It is possible that *D. parumapertus*, an otherwise obscure and infrequently studied ixodid tick species, will be confirmed eventually as a vector of pathogens to humans, similar to the gradual recognition of several other tick species as disease vectors in North America during the 21st century (Childs and Paddock 2003, Paddock and Goddard 2015, Paddock et al. 2025).

Acknowledgements

We thank Blaine Oakeson, Quinten Salt, and Keith Lawson, of the Salt Lake City Mosquito Abatement District (Salt Lake City, Utah); David Ganskopp (retired, Eastern Oregon Research Center, Burns, Oregon); Scott Bradshaw (Tooele Valley Mosquito Abatement District, Lake Point, Utah); Emily Braswell (Baker Valley Vector Control, Baker City, Oregon); and Johanna Salzer (Rickettsial Zoonoses Branch, CDC, Atlanta, Georgia) for their assistance in collecting *D. parumapertus* ticks. We also thank Dianna Krejsa (Collection Manager of Mammals, Kansas University Biodiversity Institute, Lawrence, Kansas) for directing us to various natural history collections in the western United States. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the US Department of Agriculture.

Author Contributions

Christopher Paddock (Conceptualization [lead], Data curation [lead], Formal analysis [lead], Investigation [lead], Methodology [equal], Project administration [lead], Supervision [equal], Writing—original draft [lead], Writing—review & editing [equal]), Maria Zambrano (Methodology [supporting], Writing—review & editing [supporting]), Jackson Paddock (Investigation [equal], Writing—review & editing [equal]), Bryan N. Ayres (Methodology [equal], Writing—review & editing [supporting]), Ary Faraji (Investigation [supporting], Resources [supporting], Writing—review & editing [supporting]), Stephen

Ladd-Wilson (Investigation [equal], Resources [equal], Writing—review & editing [supporting]), James R. Clover (Investigation [supporting], Resources [equal], Writing—review & editing [supporting]), Andres Lopez-Perez (Investigation [supporting], Resources [supporting], Writing—review & editing [supporting]), Lorenza Beati (Data curation [equal], Resources [equal], Writing—review & editing [supporting]), James W. Mertins (Investigation [supporting], Resources [supporting], Writing—review & editing [equal]), Joy Hecht (Investigation [supporting], Methodology [supporting], Writing—review & editing [supporting]), Michelle E.J. Allerdice (Investigation [supporting], Methodology [supporting], Writing—review & editing [supporting]), Jermone Goddard (Investigation [supporting], Resources [supporting], Writing—review & editing [supporting]), and Sandor E. Karpthy (Investigation [supporting], Methodology [supporting], Writing—review & editing [supporting])

Supplementary Material

Supplementary material is available at *Journal of Medical Entomology* online.

Funding

None declared.

Conflicts of Interest

None declared.

References

- Allerdice MEJ, Paddock CD, Hecht JA, et al. 2021. Phylogenetic differentiation of *Rickettsia parkeri* reveals broad dispersal and distinct clustering within North American strains. *Microbiol. Spectr.* 9:e014717-21.
- Allred DN, Stagg GN, Lavender JF. 1956. Experimental transmission of *Pasteurella tularensis* by the tick, *Dermacentor parumapertus*. *J. Infect. Dis.* 99:143–145.
- Arboleda M, Acevedo-Gutiérrez LY, Ávila A, et al. 2020. Human rickettsiosis caused by *Rickettsia parkeri* strain Atlantic Rainforest, Urabá, Colombia. *Emerg. Infect. Dis.* 26:3048–3050.
- Backus LH, López-Pérez AM, Marcek J, et al. 2023. Rickettsial antibodies and *Rickettsia bellii* detection in lagomorphs and their ectoparasites in Northern Baja California, Mexico. *J. Med. Entomol.* 60:1073–1080.
- Beck DE. 1955. Distributional studies of parasitic arthropods in Utah, determined as actual and potential vectors of Rocky Mountain spotted fever and plague, with notes on vector-host relationships. *Brigham Young Univ. Sci. Bull. Biol. Ser.* 1:1–71.
- Beck DE, Allred DM, Brinton EP. 1963. Ticks of the Nevada Test Site. *Brigham Young Univ. Sci. Bull. Biol. Ser.* 4:1–12.
- Beck DE, Barnum AH, Moore L. 1953. Arthropod consorts found in the nests of *Neotoma cinerea acraia* (Ord) and *Neotoma lepida lepida* Thomas. *Proc. Utah Acad. Sci. Arts Lett.* 30:43–52.
- Best TL. 1996. *Lepus californicus*. *Mamm. Species* 530:1–10.
- Bishopp FC, Trembley HL. 1945. Distribution and hosts of certain North American ticks. *J. Parasitol.* 31:1–54.
- Boynton WH, Woods GM. 1933. Deer as carriers of anaplasmosis. *Science* 78:559–560.
- Brinton EP, Beck DE, Allred DM. 1965. Identification of the adults, nymphs, and larvae of ticks of the genus *Dermacentor* Koch (Ixodidae) in the western United States. *Brigham Young Univ. Sci. Bull. Biol. Ser.* 5:1–44.

- Castillo GN, Acosta JC, Rodríguez-Muñoz M, et al. 2019. New association between *Amblyomma parvitarsum* (Acari: Ixodidae) and the endemic lizard *Liolaemus eleodori* (Iguania: Liolaemidae) in Argentina. *Ann. Parasitol.* 65:27–33.
- Chamberlin WJ. 1937. The ticks of Oregon. *Oregon State Coll. Agric. Exp. Stn. Bull.* 349:1–36.
- Childs JE, Paddock CD. 2003. The ascendancy of *Amblyomma americanum* as a vector of pathogens of humans in the United States. *Annu. Rev. Entomol.* 48:307–337.
- Coffey MD. 1954. A study of some Rocky Mountain spotted fever vectors and their hosts in Utah. *Great Basin Nat.* 14:31–37.
- Cooley RA. 1938. The genera *Dermacentor* and *Otocentor* (Ixodidae) in the United States, with studies in variation. *Natl. Inst. Health Bull.* 171:49–54.
- Cumming JG. 1917. Rocky Mountain spotted fever in California. *J. Infect. Dis.* 21:509–514.
- de Oliveira PB, Harvey TV, Fehlberg HF, et al. 2019. Serologic and molecular survey of *Rickettsia* spp. in dogs, horses and ticks from the Atlantic rainforest of the state of Bahia, Brazil. *Exp. Appl. Acarol.* 78:431–442.
- Despain WJ. 1968. Elevational occurrence of the ticks *Dermacentor andersoni* and *Dermacentor parumapertus* in Utah County, Utah [master's thesis]. Brigham Young University. <https://scholarsarchive.byu.edu/etd/7672>
- Eads RB, Menzies GC, Hightower BG. 1956. The ticks of Texas, with notes on their medical significance. *Texas J. Sci.* 8:7–24.
- Eberhardt LE, Van Voris P. 1986. Historical wildlife dynamics on Dugway Proving Ground: population and disease trends in jack rabbits over two decades. *Pacific Northwest Natl. Lab. Rep.* PNL 5967:1–56.
- Eddy GW. 1940. The ticks of Oklahoma [master's thesis]. Okla. Agric. Mech. College.
- Edmunds LR. 1951. A checklist of the ticks of Utah. *Pan-Pacific Entomol.* 27:23–26.
- Egoscue HJ. 1962. Ecology and life history of the kit fox in Tooele County, Utah. *Ecology* 43:481–497.
- Eisen RJ, Paddock CD. 2021. Tick and tickborne pathogen surveillance as a public health tool in the United States. *J. Med. Entomol.* 58:1490–1502.
- Eklund CM, Kohls GM, Brennan JM. 1955. Distribution of Colorado tick fever and virus-carrying ticks. *J. Am. Med. Assoc.* 157:335–337.
- Ellis, LL Jr. 1952. A tentative key to the mammalian ectoparasites of the Wichita Mountains Wildlife Refuge. *Proc. Okla. Acad. Sci.* 33:111–115.
- Faccini-Martínez AA, Muñoz-Leal S, Krawczak FS, et al. 2020. Epidemiological aspects of *Rickettsia parkeri* in the Atlantic forest biome of Espírito Santo state, Brazil. *Ticks Tick Borne Dis.* 11:e101319.
- Foley JE, Nieto NC, Clueit SB, et al. 2007. Survey for zoonotic rickettsial pathogens in northern flying squirrels, *Glaucomys sabrinus*, in California. *J. Wildl. Dis.* 43:684–689.
- Fremling CR, Gastfriend A. 1955. Seasonal abundance of the tick, *Dermacentor parumapertus*. *Ecology* 36:162–163.
- Furman DP, Loomis EC. 1984. The ticks of California. *Bull. Calif. Insect Surv.* 25:37–40.
- Gastfriend A. 1955. New host records for the immature stages of *Dermacentor parumapertus*. *J. Parasitol.* 41:63–65.
- Goddard J, Baker GT, Paddock CD, et al. 2023. Redescription of the larval stage of *Dermacentor parumapertus* Neumann (Acari: Ixodidae), with notes on hosts. *Syst. Appl. Acarol.* 28:1297–1304.
- Guglielmone AA, Estrada-Peña A, Mangold AJ, et al. 2003. *Amblyomma aureolatum* (Pallas, 1772) and *Amblyomma ovale* Koch, 1844 (Acari: Ixodidae): hosts, distribution and 16S rDNA sequences. *Vet. Parasitol.* 113:273–288.
- Guzmán-Cornejo C, Robbins RG, Guglielmone AA, et al. 2016. The *Dermacentor* (Acari, Ixodida, Ixodidae) of Mexico: hosts, geographical distribution, and new records. *Zookeys* 569:1–22.
- Hansen MF, Bartel MH, Lyon ET, et al. 1965. Part II. Helminth and arthropod parasites. In: CP Wilson, editor. *The black-tailed jack rabbit in Kansas*. Kansas Agric. Exp. Sta. Tech. Bull. 140. Kansas State Univ. Agric. Appl. Sci. p. 41–64.
- Harman PR, Mendell NL, Harman MM, et al. 2024. Science abhors a surveillance vacuum: detection of ticks and tick-borne pathogens in southern New Mexico through passive surveillance. *PLoS One* 19:e0292573.
- Hecht JA, Allerdice MEJ, Krawczak FS, et al. 2016. Development of a *Rickettsia bellii*-specific TaqMan assay targeting the citrate synthase gene. *J. Med. Entomol.* 53:1492–1495.
- Henke SE, Pence DB, Demarais S, et al. 1990. Serologic survey of selected zoonotic disease agents in black-tailed jack rabbits from western Texas. *J. Wildl. Dis.* 26:107–111.
- Ho BC. 1962. Ectoparasite-host associations in three areas of Utah and Wyoming [Ph.D. dissertation]. University of Utah.
- Hoffmann A. 1962. Monografía de los Ixodoidea de México. I Parte. *Rev. Soc. Mex. Hist. Nat.* 23:191–307.
- Hooker WA, Bishopp FC, Wood HP. 1912. The life histories and bionomics of some North American ticks. *U.S. Dept. Agric. Bur. Entomol. Bull.* 106:1–239.
- Howell JF. 1960. Arthropod consortes of a kit fox den. *Great Basin Nat.* 20:71–77.
- Johnson DE. 1966. Ticks of Dugway Proving Ground and vicinity and their host associations. *Proc. Utah Acad. Sci. Arts Lett.* 43:49–66.
- Karpathy SE, Paddock CD, Grizzard SL, et al. 2021. Complete genome sequence of *Rickettsia parkeri* strain Black Gap. *Microbiol. Resour. Announc.* 10:e00623-21.
- Kato CY, Chung IH, Robinson LK, et al. 2013. Assessment of real-time PCR assay for detection of *Rickettsia* spp. and *Rickettsia rickettsii* in banked clinical samples. *J. Clin. Microbiol.* 51:314–317.
- Kohls GM. 1948. Vectors of rickettsial diseases. In: Mouton FR, editor. *Rickettsial diseases of man: a A.A.A.S. symposium on the rickettsial diseases of man*. Am. Assoc. Advanc. Sci. p. 83–96.
- Krawczak FS, Muñoz-Leal S, Guztzaky AC, et al. 2016. Case report: *Rickettsia* sp. strain Atlantic rainforest infection in a patient from a spotted fever-endemic area in southern Brazil. *Am. J. Trop. Med. Hyg.* 95:551–553.
- Lamattina D, Tarragona EL, Nava S. 2018. Molecular detection of the human pathogen *Rickettsia parkeri* strain Atlantic rainforest in *Amblyomma ovale* ticks in Argentina. *Ticks Tick Borne Dis.* 9:1261–1263.
- Lane RS, Burgdorfer W. 1988. Spirochetes in mammals and ticks (Acari: Ixodidae) from a focus of Lyme borreliosis in California. *J. Wildl. Dis.* 24:1–9.
- Lane RS, Philip RN, Casper EA. 1981. Ecology of tick-borne agents in California. II. Further observations on rickettsiae. In: W Burgdorfer, RL Anacker, editors. *Rickettsiae and rickettsial diseases*. Academic Press. p. 575–583.
- Lang JD. 1972. Ectoparasites found on the round-tailed ground squirrel near Tucson, Arizona. *J. Ariz. Acad. Sci.* 7:99–100.
- Lang JD. 1999. Ixodid ticks (Acari: Ixodidae) found in San Diego County, California. *J. Vector Ecol.* 24:61–69.
- Londoño AF, Díaz FJ, Valbuena GA, et al. 2014. Infection of *Amblyomma ovale* by *Rickettsia* sp. strain Atlantic rainforest, Colombia. *Ticks Tick Borne Dis.* 5:672–675.
- Londoño AF, Mendell NL, Valbuena GA, et al. 2019. Whole-genome sequence of *Rickettsia parkeri* strain Atlantic Rainforest, isolated from a Colombian tick. *Microbiol. Resour. Announc.* 8:e00684-19.
- Lopes MG, Junior JM, Foster RJ, et al. 2016. Ticks and rickettsiae from wildlife in Belize, Central America. *Parasit. Vectors* 9:e62.
- López-Pérez AM, Sánchez-Montez S, Foley J, et al. 2019. Molecular evidence of *Borrelia burgdorferi* sensu stricto and *Rickettsia massiliae* in ticks collected from a domestic-wild carnivore interface in Chihuahua, Mexico. *Ticks Tick Borne Dis.* 10:1118–1123.
- Luz HR, McIntosh D, Furusawa GP, et al. 2016. Infection of *Amblyomma ovale* with *Rickettsia* species Atlantic rainforest in Serra do Mar, São Paulo state, Brazil. *Ticks Tick Borne Dis.* 7:1265–1267.

- Martiniano NODM, Sato TP, Vizzoni VF, et al. 2022. A new focus of spotted fever caused by *Rickettsia parkeri* in Brazil. *Rev. Inst. Med. Trop. São Paulo* 64:e22.
- Maver MB. 1911. Transmission of spotted fever by other than Montana and Idaho ticks. *J. Infect. Dis.* 8:322–326.
- McC Campbell SC. 1926. Notes on some parasites of the jack rabbits of eastern Colorado. *Colo. State Entomol. Circ.* 52:9–12.
- Medeiros AP, Souza AP, Moura AB, et al. 2011. Spotted fever group *Rickettsia* infecting ticks (Acari: Ixodidae) in the state of Santa Catarina, Brazil. *Mem. Inst. Oswaldo Cruz* 106:926–930.
- Merten HA, Durden LA. 1999. A state-by-state survey of ticks recorded from humans in the United States. *J. Vector Ecol.* 25:102–113.
- Moerbeck L, Vizzoni VF, Machado-Ferreira E, et al. 2016. *Rickettsia* (Rickettsiales: Rickettsiaceae) vector biodiversity in high altitude Atlantic rainforest fragments within a semiarid climate: a new endemic area of spotted fever in Brazil. *J. Med. Entomol.* 53:1458–1466.
- Muñoz-Leal S, Tarragona EL, Martins TF, et al. 2016. *Liolaemus* lizards (Squamata: Liolaemidae) as hosts for the nymph of *Amblyomma parvitarsum* (Acari: Ixodidae), with notes on *Rickettsia* infection. *Exp. Appl. Acarol.* 70:253–259.
- Nelson SP, Bourke BP, Badr R, et al. 2022. Ticks (Acari: Ixodidae) and associated pathogens collected from domestic animals and vegetation in Stann Creek District, southeastern Belize, Central America. *J. Med. Entomol.* 59:1749–1755.
- Neumann FG. 1901. Revision de la famille des Ixodidés (4e mémoire). *Mém. Soc. Zool. Fr.* 14:267–268.
- Nieri-Bastos FA, Horta MC, Barros-Battesti DM, et al. 2016. Isolation of the pathogen *Rickettsia* sp. strain Atlantic rainforest from its presumed tick vector, *Amblyomma ovale* (Acari: Ixodidae), from two areas of Brazil. *J. Med. Entomol.* 53:977–981.
- Nieri-Bastos FA, Marcili A, De Sousa R, et al. 2018. Phylogenetic evidence for the existence of multiple strains of *Rickettsia parkeri* in the New World. *Appl. Environ. Microbiol.* 84:e02872-17.
- Ogrzewalska M, Nieri-Bastos FA, Marcili A, et al. 2016. A novel spotted fever group *Rickettsia* infecting *Amblyomma parvitarsum* (Acari: Ixodidae) in the highlands of Argentina and Chile. *Ticks Tick Borne Dis.* 7:439–442.
- Paddock CD, Allerdice MEJ, Karpathy SE, et al. 2017. Unique strain of *Rickettsia parkeri* associated with the hard tick *Dermacentor parumapertus* Neumann in the western United States. *Appl. Environ. Microbiol.* 83:e03463-16.
- Paddock CD, Goddard J. 2015. The evolving medical and veterinary importance of the Gulf Coast tick (Acari: Ixodidae). *J. Med. Entomol.* 52:230–252.
- Paddock CD, Harris A, Clark TR, et al. 2025. *Rickettsia lanei*, sp. nov. (Rickettsiales: Rickettsiaceae), a newly recognized pathogen of humans associated with the rabbit tick, *Haemaphysalis leporispalustris* (Acari: Ixodidae). *Am. J. Trop. Med. Hyg.* 113:957–965.
- Pagan EF, McMahon KJ, Bowen RE. 1961. Complement-fixing antibodies for *R. rickettsii* in serums of black-tailed jack rabbits. *Public Health Rep.* 76:1120–1122.
- Parker RR, Philip CB, Jellison WL. 1933. Rocky Mountain spotted fever. Potentialities of tick transmission in relation to geographical occurrence in the United States. *Am. J. Trop. Med.* 13:341–379.
- Peniche-Lara G, Lara-Perera V. 2022. Rickettsiosis caused by *Rickettsia parkeri*, Mexico. *Emerg. Infect. Dis.* 28:478–479.
- Pfaffenberger GS, de Bruin D. 1986. Ectoparasitic overlap between sympatric *Dipodomys ordii* and *Onychomys leucogaster* (Rodentia) in eastern New Mexico, USA. *J. Med. Entomol.* 23:201–207.
- Pfaffenberger GS, Valencia VB. 1988. Ectoparasites of sympatric cottontails (*Sylvilagus audubonii* Nelson) and jack rabbits (*Lepus californicus* Mearns) from the high plains of eastern New Mexico. *J. Parasitol.* 74:842–846.
- Philip CB. 1941. Rocky Mountain spotted fever: known and potential tick vectors in the United States. In: Proceedings of the Sixth Pacific Science Congress, Jul 24–Aug 12, 1939; Berkeley, CA. University of California Press.
- Philip CB, Bell JF, Larson CL. 1955. Evidence of infectious diseases and parasites in a peak population of black-tailed jack rabbits in Nevada. *J. Wildl. Manag.* 19:225–233.
- Philip CB, Hughes LE. 1953. Disease agents found in the rabbit tick, *Dermacentor parumapertus*, in the southwestern United States. In: *Atti Del VI Congresso Internazionale di Microbiologia*, Sept 6–12, 1953, Rome, Italy. L'istituto Sieroterapico Milanese, Vol. 5. p. 541–548.
- Philip RN, Casper EA, Anacker RL, et al. 1983. *Rickettsia bellii* sp. nov.: a tick-borne *Rickettsia*, widely distributed in the United States, that is distinct from the spotted fever and typhus biogroups. *Int. J. Syst. Bacteriol.* 33:94–106.
- Philip RN, Casper EA, Burgdorfer W. 1978a. Current knowledge of the distribution of serotypes of spotted fever-group rickettsiae in the United States as determined by microimmunofluorescence. In: *VII International Conference on Infectious and Parasitic Diseases*, Oct. 3–6, 1978, Varna, Bulgaria. International Society for the Study of Infectious and Parasitic Diseases, Vol. 1. p. 500–509.
- Philip RN, Casper EA, Burgdorfer W, et al. 1978b. Serologic typing of rickettsiae of the spotted fever group by microimmunofluorescence. *J. Immunol.* 121:1961–1968.
- Portugal J, JSIII, Allerdice M, Moraru GM, et al. 2019. Molecular phylogeny of *Dermacentor parumapertus* (Acari: Ixodidae) from two locations within its geographical range. *J. Med. Entomol.* 56:979–983.
- Regnery RL, Spruill CL, Plikaytis BD. 1991. Genotypic identification of rickettsiae and estimation of intraspecies sequence divergence for portions of two rickettsial genes. *J. Bacteriol.* 173:1576–1589.
- Rodriguez PH. 1977. A survey of ectoparasites of hares and rabbits in Grant County. *New Mexico. Texas J. Sci.* 28:358.
- Romero LE, Binder LC, Marcili A, et al. 2023. Ticks and tick-borne rickettsiae from dogs in El Salvador, with report of the human pathogen *Rickettsia parkeri*. *Ticks Tick Borne Dis.* 14:e102206.
- Rosasco ME. 1957. Seasonal abundance of the tick *Dermacentor parumapertus* on the black-tailed jack rabbit, with notes on other ectoparasites. *J. Mammol.* 38:485–490.
- Roscoe EJ. 1956. A rabbit tick, *Dermacentor parumapertus*, attached to man. *J. Parasitol.* 42:527.
- Rotramel GL, Schwan TG, Doty RE. 1976. Distribution of suspected tick vectors and reported cases of Rocky Mountain spotted fever in California. *Am. J. Epidemiol.* 104:287–293.
- Roux V, Fournier PE, Raoult D. 1996. Differentiation of spotted fever group rickettsiae by sequencing and analysis of restriction fragment length polymorphism of PCR-amplified DNA of the gene encoding the protein rOmpA. *J. Clin. Microbiol.* 34:2058–2065.
- Ryckman RE, Ryckman AE. 1963. Loma Linda University's 1962 expedition to Baja California: medical entomology and parasitology. *Med. Arts Sci.* 17:65–75.
- Sabatini GS, Pinter A, Nieri-Bastos FA, et al. 2010. Survey of ticks (Acari: Ixodidae) and their *Rickettsia* in an Atlantic rain forest reserve in the state of São Paulo, Brazil. *J. Med. Entomol.* 47:913–916.
- Sánchez-Montes S, Ballados-González GG, Hernández-Velasco A, et al. 2019. Molecular confirmation of *Rickettsia parkeri* in *Amblyomma ovale* ticks, Veracruz, Mexico. *Emerg. Infect. Dis.* 25:2315–2317.
- Sánchez-Montes S, López-Pérez AM, Guzmán-Cornejo C, et al. 2018. *Rickettsia parkeri* in *Dermacentor parumapertus* ticks, Mexico. *Emerg. Infect. Dis.* 24:1108–1111.
- Sev AP, Martins TF, Muñoz-Leal S, et al. 2019. A human case of spotted fever caused by *Rickettsia parkeri* strain Atlantic rainforest and its association to the tick *Amblyomma ovale*. *Parasit. Vectors* 12:e471.
- Silva N, Ereemeeva ME, Rozental T, et al. 2011. Eschar-associated spotted fever rickettsiosis, Bahia, Brazil. *Emerg. Infect. Dis.* 17:275–278.
- Spolidorio MG, Labruna MB, Mantovani E, et al. 2010. Novel spotted fever group rickettsiosis, Brazil. *Emerg. Infect. Dis.* 16:521–523.
- Stoener HG, Holdenried R, Lackman D, et al. 1959. The occurrence of *Coxiella burnetii*, *Brucella*, and other pathogens among fauna of the Great Salt Lake Desert in Utah. *Am. J. Trop. Med. Hyg.* 8:590–596.
- Strickland RK, Gerrish RR. 1965. Collections of *Dermacentor parumapertus* from cattle. *J. Parasitol.* 51:1000.

- Szabó MPJ, Nieri-Bastos FA, Spolidorio MG, et al. 2013. *In vitro* isolation from *Amblyomma ovale* (Acari: Ixodidae) and ecological aspects of the Atlantic rainforest *Rickettsia*, the causative agent of a novel spotted fever rickettsiosis in Brazil. *Parasitology* 140:719–728.
- Thorpe BD, Sidwell RW, Johnson DE, et al. 1965. Tularemia in the wildlife and livestock of the Great Salt Lake Desert region, 1951 through 1964. *Am. J. Trop. Med. Hyg.* 14:622–637.
- Vest ED, Bachtold JG, Gardner FT, et al. 1959. Epizootological survey of certain endemic diseases in the southern part of the Great Salt Lake Desert. Report for 5 Sept 57- 31 Dec 58. *Ecol. Epizootol. Ser. Univ. Utah* 42:1–18.
- Vogel H, Foley J, Fiorello CV. 2018. *Rickettsia africae* and novel rickettsial strain in *Amblyomma* spp. ticks, Nicaragua, 2013. *Emerg. Infect. Dis.* 24:385–387.
- Voizzoni VF, Silva AB, Cardoso KM, et al. 2016. Genetic identification of *Rickettsia* sp. strain Atlantic rainforest in an endemic area of a mild spotted fever in Rio Grande do Sul state, Southern Brazil. *Acta Trop.* 162:142–145.
- Wikswa ME, Hu R, Dasch GA, et al. 2008. Detection and identification of spotted fever group rickettsiae in *Dermacentor* species from southern California. *J. Med. Entomol.* 45:509–516.
- Woodbury AM, Parker DD. 1954. Ecology of the Great Salt Lake Desert. Studies of tularemia, *Pasteurella tularensis*. Special Report No. 2 to the U. S. Army Chemical Corps, Dugway Proving Ground, Dugway, Utah. June, 1953.
- Wright CL, Nadolny RM, Jiang J, et al. 2011. *Rickettsia parkeri* in Gulf Coast ticks, southeastern Virginia, USA. *Emerg. Infect. Dis.* 17:896–898.