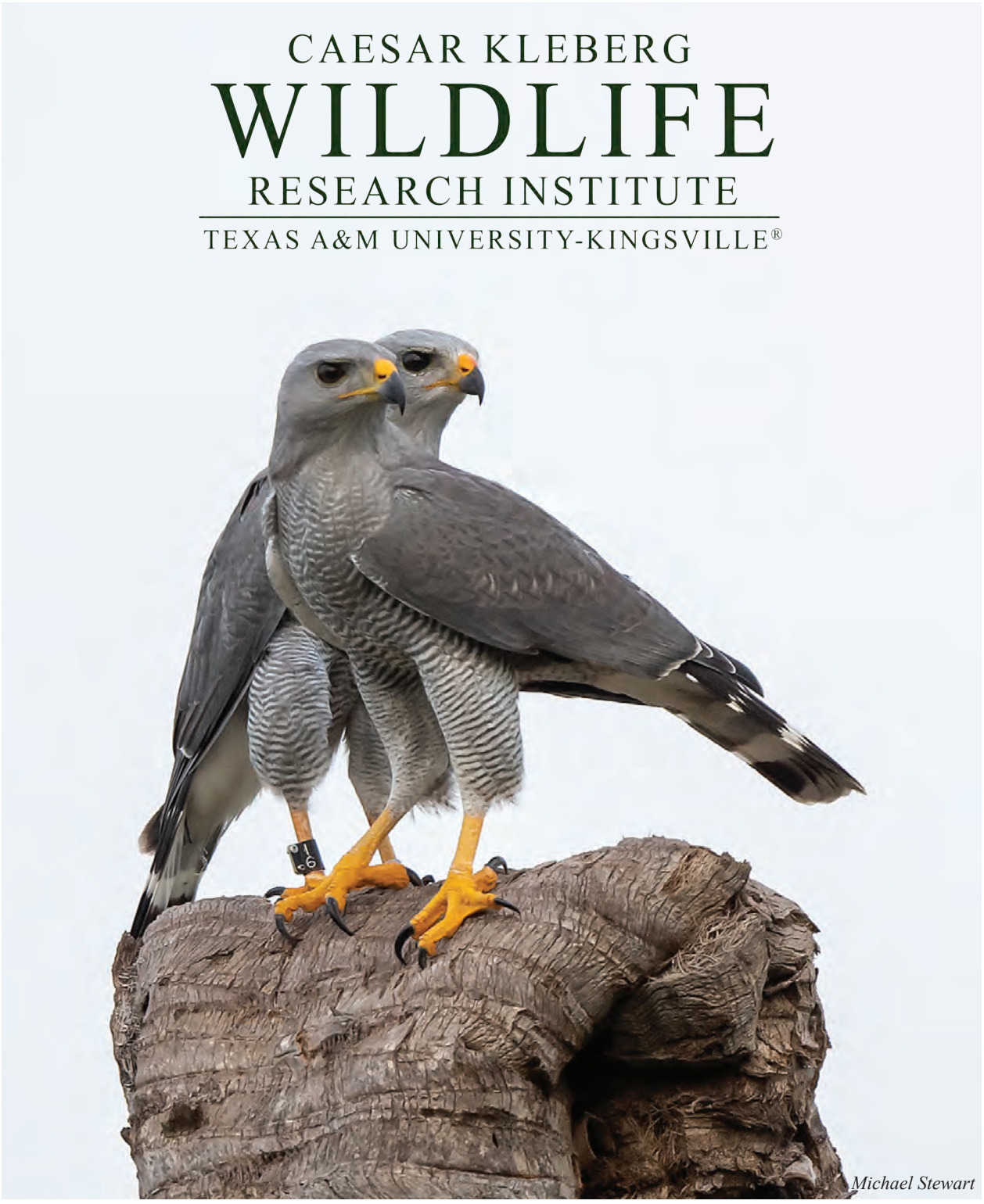
CAESAR KLEBERG

WILDLIFE

RESEARCH INSTITUTE

TEXAS A&M UNIVERSITY-KINGSVILLE®



Michael Stewart

Current Research 2021–2022

This year's cover photo is a pair of adult gray hawks (male on the left, with the leg band) in Cameron County, Texas. The photographer is Michael Stewart, a CKWRI PhD student, who is researching gray hawk home range habitat requirements and creating a distribution model for the species in South Texas. Gray hawks are a state threatened species, and there is very little known about them and their habitat needs in Texas.

Editor Sandra Rideout-Hanzak, Ph.D.

December 2022

Report of *Current Research*

September 1, 2021 to August 31, 2022

Caesar Kleberg Wildlife Research Institute

Dick and Mary Lewis Kleberg College of Agriculture and Natural Resources
Texas A&M University-Kingsville
Kingsville, Texas

Dr. Robert H. Vela, Jr.
President

Dr. Jaya Goswami
Interim Provost and Vice President for Academic

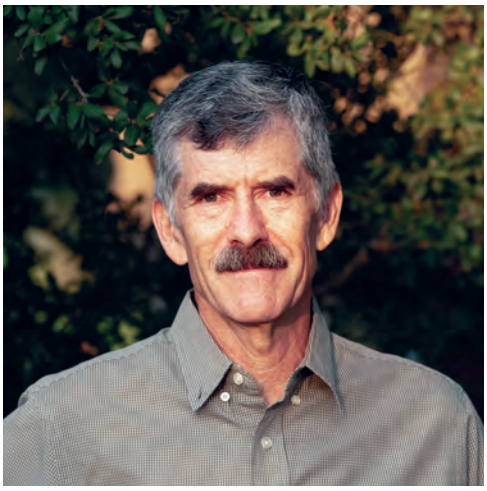
Dr. Shad D. Nelson
Dean
Dick and Mary Lewis Kleberg College of Agriculture and Natural Resources

Dr. David G. Hewitt
Leroy G. Denman, Jr. Endowed Director of Wildlife Research

A Member of the Texas A&M University System

Foreward

Dear Friends of the CKWRI,



The cover photo on this year's Current Research Report speaks volumes about Caesar Kleberg Wildlife Research Institute. The picture and the story behind it represent the wildlife we study, the techniques we employ, and the people who conduct the research.

The photo shows a pair of mature gray hawks. I bet many readers have never heard of a gray hawk, and even those who have heard the name probably know little about the species. Gray hawks are a medium-sized bird-of-prey found primarily in Mexico and Central America. They reach the northern extent of their range in extreme South Texas, the Big Bend region, southwestern New Mexico, and southeastern Arizona. Gray hawks are generalist carnivores, eating reptiles, birds, mammals, and some insects. They nest in large trees and hunt most often from perches. In South Texas, gray hawks live in urban areas and woodlands of the Lower Rio Grande Valley. They occupy the same territory year-round, have remarkably small home ranges (perhaps as small as a couple hundred acres), and may occupy the same territory in consecutive years. People come from around North America for the opportunity to see gray hawks in the Rio Grande Valley.

Gray hawks are one of the hundreds of species that make Texas a jewel in the conservation crown of the United States. South Texas has many unique plant and animal species that reach their northern extent in the Institute's backyard. East Texas has many species representative of the southeastern United States whereas the Panhandle and the Trans-Pecos support species from the Great Plains, Rocky Mountains, and southwestern deserts. Scientists and students at the Caesar Kleberg Wildlife Research Institute work in all these regions of Texas. They study endangered species and game species, plants and animals, and relationships amongst them all. Most importantly, Institute personnel conduct applied research that helps land stewards meet their management objectives.

The male gray hawk in the cover photo has a small leg band. This bird had been captured and fitted not only with the leg band but with a small GPS tracking device that sits on his back. By marking these birds with bands and transmitters, our scientists are able to follow them throughout their lives. We learn about the areas the birds choose to live in and the areas they avoid. We can determine when the hawks successfully reproduce and how long they live. All this information provides insights and knowledge that is not only interesting in its own right but helps focus conservation and management efforts. For example, the GPS tracking devices on gray hawks have shown that juveniles may make large exploratory movements before they choose a place to nest. Gray hawks from the Lower Rio Grande Valley have traveled into Central America and up the Rio Grande to Laredo. They establish their small home ranges in native brush and in highly developed urban areas. With knowledge of reproduction and survival of gray hawks in these different habitats, biologists will know what areas are good for gray hawks and thereby predict where gray hawks are likely to expand. They can also advise landowners who wish to manage for gray hawks what actions they may take to support the species.

Finally, the photo has an intriguing backstory. The picture was taken by Michael Stewart, a Ph.D. student at CKWRI. Mike is a veteran pursuing his passion for wildlife conservation after retiring from the military. He knew he wanted to help conserve a rare species and was introduced to gray hawks by a colleague. Mike identified and secured his own funding and completed a M.S. at UT Rio Grande Valley. He then came to CKWRI to work on his Ph.D. under Dr. Lenny Brennan. CKWRI is honored to have self-motivated students, who could go anywhere in the country, choose to work with us. We are especially proud to have them studying a species as unique as the South Texas environment. We hope you enjoy this edition of CKWRI's Current Research Report, and you recognize that every abstract has its own intriguing backstory.

David Hewitt
Leroy G. Denman, Jr. Endowed Director of Wildlife Research

Scholarships and Fellowships

Student Scholarships

René Barrientos Fund for Graduate Student Tuition
and
Caesar Kleberg Foundation for Wildlife Conservation Fund for Graduate Student Tuition
Every graduate student in our program financially benefits from these funds.

Houston Safari Club Dan L Duncan Scholarship Program
Cole C. Anderson, Chloe E. Bates, Aidan B. Branney, Calvin C. Ellis, Miranda L. Hopper, Lori D. Massey, Christian R.A. Moeller

Quail Coalition Scholarship in Wildlife Management Graduate Scholarships, South Texas Chapter
Cole C. Anderson, Chole E, Bates, Alejandro Bazaldua, Matti R. Bradshaw, Aidan B. Branney, Annalysa Camacho, Duston R. Duffie, Jacob L. Dykes, Georgina R. Eccles, Juan C. Elissetche. John E. Herschberger, Ashley G. Hodge, Lindsey K. Howard, Sarah K. Jacobson, Jason P. Loghry, Lori D. Massey, Zachary J. Pearson, Tara L. Rodkey, Maksim Sergeyev, Brianna M. Slothower, Thomas J. Yamashita, Rebecca R. Zerlin

Amanda Whitaker Memorial Graduate Student Scholarship in Wildlife Management, South Texas Chapter of Quail Coalition
B. Kye Johnston

Houston Livestock Show and Rodeo Graduate Scholarship
Lori D. Massey

Houston Livestock Show and Rodeo Graduate Fellow in Wildlife Research
Bryan D. Spencer

Dr. Charles Seidel Wildlife Photography Scholarship
Robert H. Dwyer, Abigail Lopez

Images for Conservation Fund Scholarship
Emily S. Anguiano-Garcia, Taylor L. Curry, Raylon L. Fumbanks, Saul Garza, Samantha J. Gerragauch, Takayla M. Hart, Jessica J. Johnston, Gabriella Ruiz, Angelica B. Sosa, Jeanette C. Velazquez

Endowed Student Scholarships

Robert and Rebecca Palmer Scholarship Fund Graduate Students
Duston R. Duffie, Georgina R. Eccles, Sarah K. Jacobson, Maksim Sergeyev, Thomas J. Yamashita

Robert and Rebecca Palmer Scholarship Fund Undergraduate Students
Michael A. Kalisek, Shaelyn T. Rainey, Evan D. Rangel, Andres N. Rosales

A. E. Leonard Undergraduate Student Scholarship in Wildlife Conservation
Jessica J. Johnston, Shaelyn T. Rainey, Andres N. Rosales

Phillip M. Plant Endowment for Graduate Scholarships in Wildlife
Alejandro Bazaldua, Annalysa Camacho, Jacob L. Dykes, Ashley G. Hodge, Brianna M. Slothower, Rebecca R. Zerlin

Alec D. Ritzell Memorial Fund for Wildlife Research and Education Scholarship
Lindsey K. Howard, B. Kye Johnston

Endowed Student Fellowships

Sam Walton Fellowship in Quail Research
Caleb M. McKinney

Alice Gertrudis King Kleberg Reynolds Endowed Fellowship in Quail Research
Zachary J. Pearson

Elliot B. and Adelle Bottom Fellowship in Quail Research
John E. Herschberger

Walter Fondren, III Fellowship in Shorebird and Wading Bird Research
Jason P. Loghry

Betty and George Coates Fellowship in Habitat Enhancement Research
Aidan B. Branney

Jess Y. Womack, II Fellowship in Wetlands and Wetland Bird Research
Search in progress

Boone and Crockett Club Fellowship in Ungulate Research
Calvin C. Ellis

Hixon Fellowship in Deer
Miranda L. Hopper

Hixon Fellowship in Quail
Lindsey K. Howard

Hixon Fellowship in Range Restoration
Katherine A. Travis

Kenneth E. Leonard Fellowship for Livestock-Wildlife Research
Rider C. Combs, J. Silverio Avila-Sanchez

Stuart W. Stedman-Faith Ranch Fellowships in Deer Research
Jesse Exum, Breanna R. Green

Mike and Mary Terry Endowed Fellowship for Habitat Research
Laura C. Beck, Dustin A. Golembiewski

Frances and Peter Swenson Fellowship in Rangeland Restoration Research
(Swenson Fellowship matched by the Estate of Nadine Arrington)
Brianna M. Slothower

We acknowledge the donors of these student scholarships and fellowships with gratitude.

In Memory and Honor

Many people choose to send unsolicited gifts in honor of cherished friends or family.
In FY2022, we have received memorials and gifts to honor...

Camila Alvarez
Bothe's Hunting Guests
*Grady Cage
*Lon and Leigh Cartwright
CKWRI's 40th Anniversary
Kate Fisher
*Helen "Helenita" Kleberg Groves
*John Harris
Steve Hanzel
*Jeff Hildebrand
*Tim Hixon
*Charlie M. Herrington
*Radcliff Killam
*Tio and Janell Kleberg
Janell Kleberg
Henry Kowalski
Duane Leach
*Meredith Long
Watt Matthews
R. Randall Grace, Jr.
Marvin Smith III
Ruth Eilene Sullivan
*David Villanueva
*C.C. "Charlie" Winn

* Also honored in previous years

New Endowments

Julianna Hawn Fellowship for Habitat Restoration

Jeff Hildebrand Fellowship for Livestock-Wildlife Research

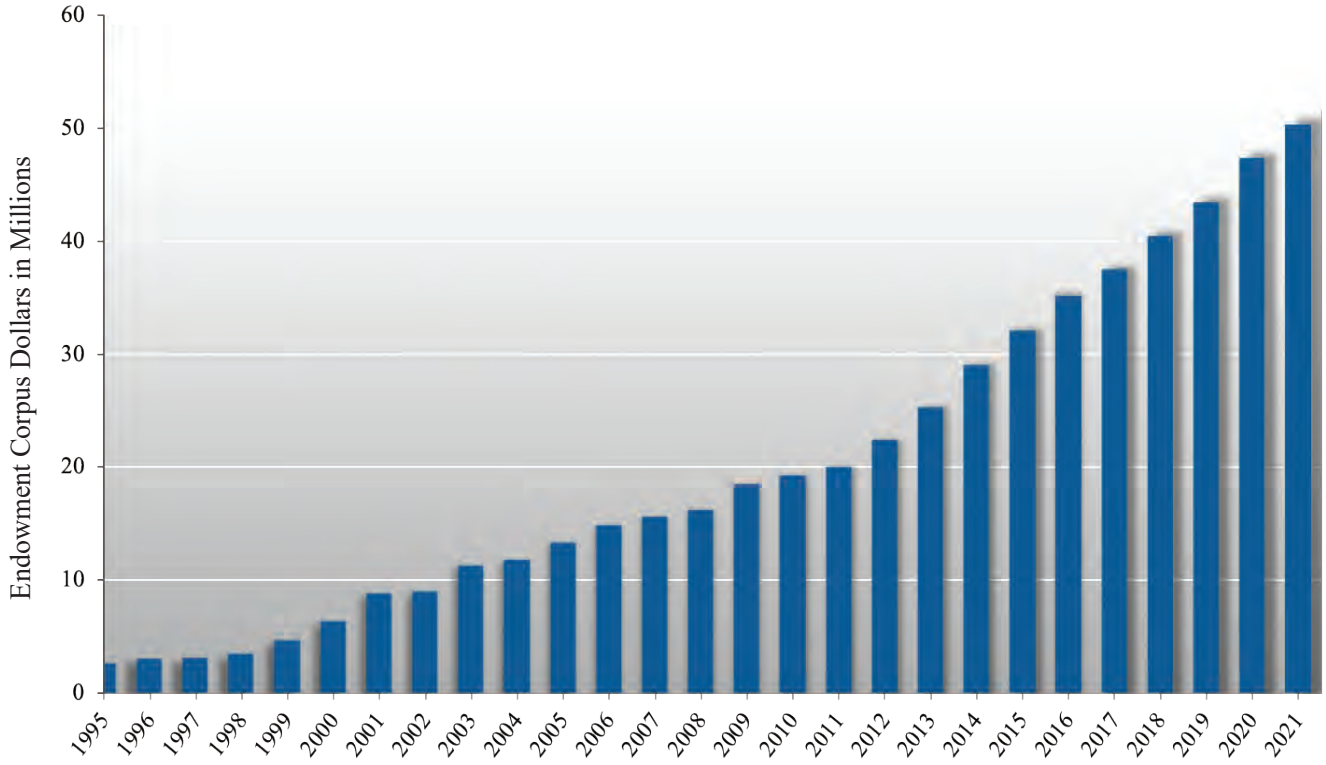
Rebecca Trant Endowment for CKWRI Staff Excellence

The Robert and Laura Underbrink Endowment for Quail Research

Patton Center for Deer Research

Endowment Financials

The Caesar Kleberg Wildlife Research Institute Endowments ended the year with a corpus value of $50.3 million and a market value of $71.4 million on December 31, 2021.

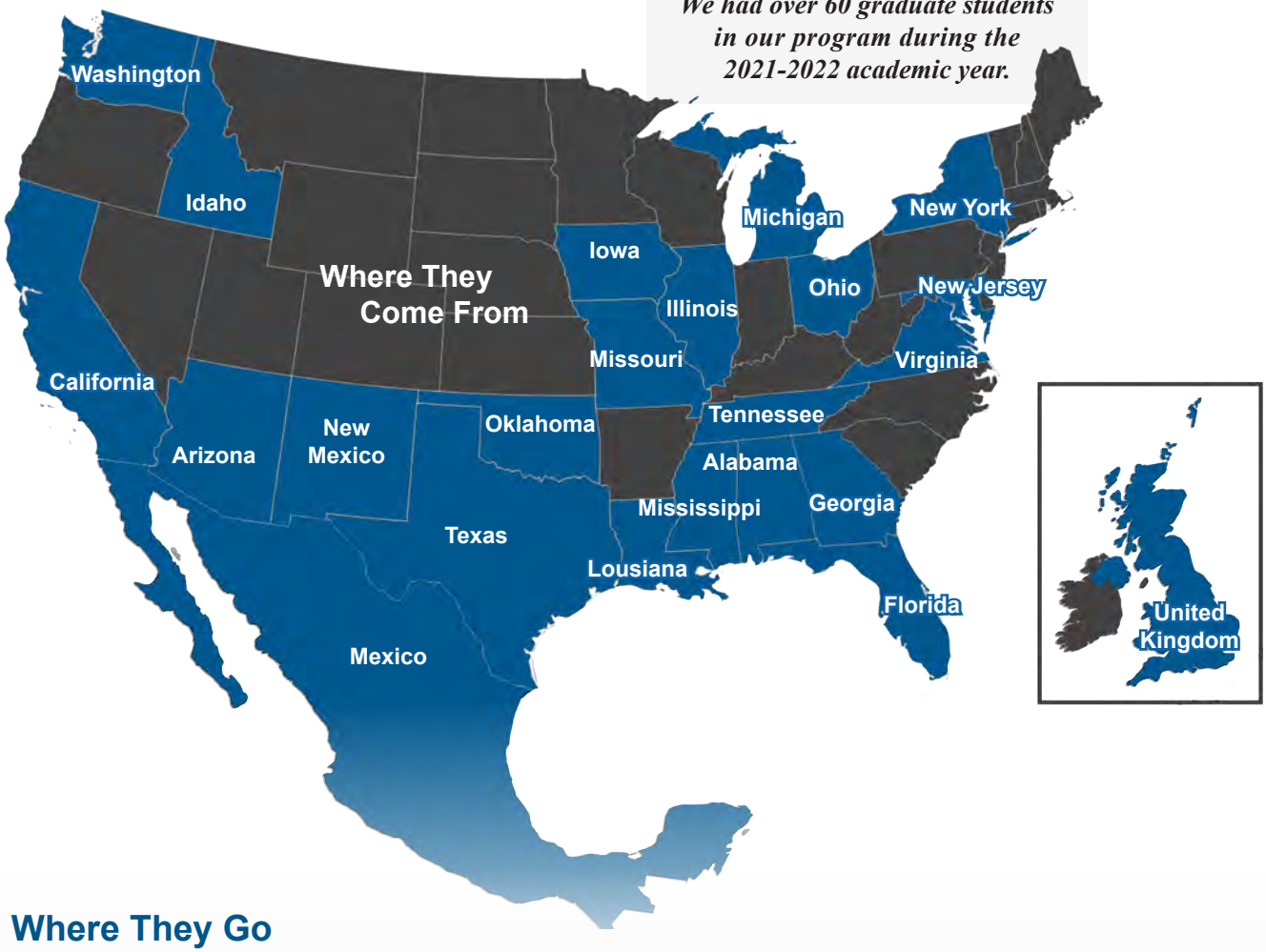


Corpus Growth Reported in December from 1995 to 2021

Our Students

The world-class program at the CKWRI attracts some of the brightest minds from all over the United States and beyond. Our program is unique in that our students have the opportunity to conduct research on private lands. Because of this, our students leave with a greater appreciation for private landowners and their stewardship values.

We had over 60 graduate students in our program during the 2021-2022 academic year.



Where They Go

Once they graduate, our students are some of the most sought after in the field of wildlife biology and habitat management. CKWRI graduates are working for:

American Bird Conservancy
The Center for Environmental Management of Military Lands
CrossTimbers Consulting, Inc.
Deseret Cattle & Timber
Ducks Unlimited
Florida Fish and Wildlife Conservation
Georgia Department of Natural Resources
Idaho Fish and Game
Kansas Wildlife Service
King Ranch, Inc.
Michigan Department of Natural Resources
Michigan State University
Mississippi Department of Wildlife, Fisheries and Parks
Montana Fish, Wildlife, and Parks
National Park Service
The Nature Conservancy
Pheasants Forever
Private Ranches
Quail Forever in Arkansas
Rocky Mountain Bird Observatory
Stephen F. Austin State University in Forest Wildlife Management
Sul Ross State University
Texas A&M International
Texas A&M University-College Station
Texas A&M University-Kingsville
Texas Parks and Wildlife Department
Texas Tech University
USDA - NRCS
U.S. Fish and Wildlife Service
U.S. Forest Service
U.S. Geological Survey, Patuxent Wildlife Research Center
U.S. Geological Survey, National Wildlife Health Center
University of Idaho
University of San Diego Department of Biology
Washington Department of Fisheries & Wildlife
Welder Wildlife Foundation
Wisconsin Department of Natural Resources

2021–2022 M.S. & PH.D. Graduates

Chloe Bates, M.S.
Thesis: Developing Rio Grande Wild Turkey Survey Methodology in Central and South Texas

Emily Bishop, M.S.
Thesis: Strategies to Restore Tall Grass Prairie Vegetation

Annalysa Camacho, M.S.
Thesis: Developing Workflows for Using Drones in Rangelands

Rider Combs, M.S.
Thesis: Understanding the Rate of Expansion of Tanglehead Grass on South Texas Rangelands

Daniel Crawford, Ph.D.
Dissertation: Effects of Predation Risk on Intraspecific Interactions of Deer

Alexandria Dimaggio, M.S.
Thesis: Prescribed Burning and Cattle Grazing of Tanglehead

Jacob Dykes, Ph.D.
Dissertation: Behavioral Responses of White-tailed Deer to Heat Stress

Jesse Exum, M.S.
Thesis: Estimating White-Tailed Deer Population Sizes Using Drones

Dustin Golembiewski, M.S.
Thesis: Restoration of Frac Ponds with Topsoil Management and Native Plants

Megan Granger, M.S.
Thesis: Population Demographics of Nilgai in South Texas

Levi Heffelfinger, Ph.D.
Dissertation: Dietary Energy Influences Growth and Antler Size of White-tailed Deer

Delanie Slifka, M.S.
Thesis: Examining Bird Populations in and on the East Foundation Ranches

Brianna Slothower, M.S.
Thesis: Native Seed Viability and Cover Crop Considerations for Rangeland Restoration

Amanda Veals, Ph.D.
Dissertation: Landscape Ecology of Ocelots in Southeastern Texas

Abe Woodard, Ph.D.
Dissertation: Aspects of Hunting on Northern Bobwhite Quail Populations - Temporal and Spatial Analysis

Our Science Team

By the Numbers:

PERSONNEL

18 FACULTY

13 RESEARCH STAFF

6 ASST. PROFESSORS OF RESEARCH

PEER REVIEWED PUBLICATIONS

53

117

PROFESSIONAL PRESENTATIONS

RESEARCH GRANTS & CONTRACTS

$3.84 Million

Awards & Achievements:

The 2021 Texas Tech Alumni Distinguished Alumni Award was given to Dr. Fred Bryant at the Texas Tech Alumni Association's Distinguished Alumni Dinner in November at the McKenzie-Merket Alumni Center. The distinguished alumni awards are presented each year to the most prestigious graduates of Texas Tech for their professional achievements, contributions to society, and support of the university.

The Wilford S. Bailey Distinguished Alumnus Award for Research and Public Policy was awarded to Dr. Clay Hilton. The award is the highest honor given by the Auburn veterinary college to recognize alumni for their professional achievements in veterinary medicine, outstanding contributions to their communities, and the overall advancement of animal and human health.

The Outstanding Achievement Award was presented to Dr. Humberto Perotto from the Society of Range Management. The award is presented for outstanding achievement to members, and other qualified individuals and groups, working with rangelands in either Research/Academia or Land Stewardship.

The Outstanding Book: Applications for Advancing Animal Ecology Award was given to Dr. Lenny Brennan at the 2022 Texas Chapter of the Wildlife Society. Book by M. L. Morrison, L. A. Brennan, B. G. Marcot, W. M. Block, and K. S. McKelvey (2021) published by Johns Hopkins University Press, Baltimore, Maryland.

TWA SAM BEASOM CONSERVATION LEADER AWARD

The **TWA Sam Beasom Conservation Leader Award** was presented to Dr. David Hewitt at the 37th annual convention of the Texas Wildlife Association. The TWA Sam Beasom Conservation Leader Award recognizes a member of the professional conservation community who has made outstanding contributions to the conservation of Texas wildlife and shares the philosophies of TWA.

Podcasts

A Talk on the Wild Side
Podcast | www.ckwri.tamuk.edu/media/talk-wild-side-podcast

A Talk on the Wild Side podcast is created by the Caesar Kleberg Wildlife Research Institute and supported by the Rotary Club of Corpus Christi Harvey Weil Sportsman Conservationist Award. Dr. Sandra Rideout-Hanzak, Andrew Lowery (Host and Editor, respectively), and various student co-hosts interview experts and enthusiasts in wildlife management, marine conservation, hunting, and fishing in Texas.

Episode List:
Pearls of Wisdom about Oyster Reefs
S1E8 (September 14, 2021)

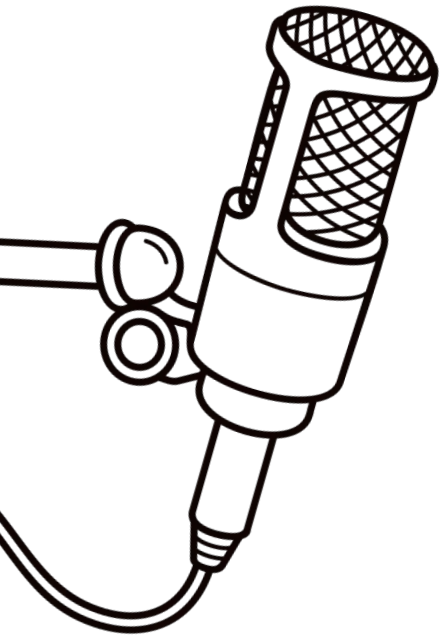
To Cull or Not to Cull;
That is the Question
S1E9 (September 28, 2021)

Snakes in a Blanket
(Not as Good as Pigs in a Blanket)!
S1E10 (October 12, 2021)

Houston, Wildlife has a SpaceX Problem! Part 1
S1E11 (October 26, 2021)

Houston, Wildlife has a SpaceX Problem! Part 2
S1E12 (October 26, 2021)

An Ocelot of Information about Wild Cats!
S1E13 (November 9, 2021)



The Native American Perspective On Wildlife Conservation --And Bears, Too!
S1E14 (November 23, 2021)

Big Science Comes in Small Organisms
S1E15 (December 7, 2021)

Kemp's Ridley Conservation --Like Turtley, Dude!
S1E16 (December 21, 2021)

Come on Baby, Light my Fire!
S1E17 (January 5, 2022)

Milking Snakes--Not as Easy as Milking Cows!
S1E18 (January 18, 2022)

Duck Detectives on the Case!
S1E19 (February 1, 2022)

Oil and Sharks Don't Mix!
S1E20 (February 15, 2022)

Little Fish, Big Impact!
S1E21 (March 1, 2022)

Celebrating Women in Natural Sciences
S1Bonus (March 8, 2022)

National Butterfly Center: Beauty and the Border
S1E22 (March 15, 2022)

What's up with all these Wildfires?
S1Bonus2 (March 25, 2022)

Alligators: Actually Not Big Toothy Lizards!
S1E23 (March 28, 2022)

Mountain Life with Desert Bighorn Sheep!
S1E24 (April 12, 2022)

Colorful Gifts of Coral Reefs!
S1E25 (April 26, 2022)

Restoration, Pipelines, and Cattle Panel
S1E26 (May 10, 2022)

Paint the Town Reddish (Egrets, that is)!
S1E27 (May 24, 2022)

Apiculture is the Bee's Knees!
S2 E1 (June 7, 2022)

Eat, Prey, Dove!
S2 E2 (June 21, 2022)

No Fowl Language. Just Turkey Talk!
S2 E3 (July 5, 2022)

Bringing Back Baffin Bay!
S2 E4 (July 19, 2022)

The Avian Rebbe!
S2 Bonus (July 26, 2022)

Oh, Quail Yes!
S2 E5 (August 2, 2022)

Alternative Fuels!
S2 Bonus2 (August 9, 2022)

When (Wild) Pigs Fly!
S2E6 (August 16, 2022)

Fastest Hooves in the West!
S2E7 (August 30, 2022)

Scan the QR code to listen on Spotify
A Talk on the Wild Side

Dr. Dale on Quail
Podcast | https://www.quailresearch.org/category/podcasts/

Dr. Scott Henke was a guest on the Rolling Plains Quail Research Foundation's *Dr. Dale on Quail* podcast. The Rolling Plains Quail Research Foundation is a nonprofit focused on one thing: understanding and managing bobwhite and scaled quail in West Texas. The episode was a fact-filled discussion on the controversy of the risks to wildlife from aflatoxins in deer corn over the past 20 years.

Episode: Is "Deer Corn" a Quail Killer - Episode 36 (April 21, 2022)

Fire University
Podcast | https://fireuniversity.libsyn.com/how-does-fire-affect-predators

Dr. Michael Cherry was a guest on the Natural Resources University's *Fire University* podcast. *Fire University* is a science-based podcast covering the latest research in fire ecology and how it relates to management of wildlife and plant communities. The episode was a discussion about how using fire as a management technique may also be used to alter the behavior of predators and can help decrease predator abundance on your land.

Episode: How Fire Affects Predators - Episode 13 (July 20, 2021)

Beast of Burden
Podcast | https://www.spreaker.com/user/13179560/ep-43-dr-michael-cherry

Dr. Michael Cherry was a guest on the *Beast of Burden* podcast. *Beast of Burden* is a podcast about land stewardship as well as enhancing the individual. The episode explored the relationship of deer, predators, and fire ecology as well as touching on the subject of being a successful researcher, despite starting to college later in life.

Episode: Dr. Michael Cherry - Episode 43 (October 11, 2021)

Television Series

WEST OF TEXAS
Television Series | Sportsman's Channel | www.ckwri.tamuk.edu/media/west-of-texas

CKWRI is the Title Sponsor for *West of Texas*, a unique hunting show distributed on the Sportsman's Channel with an audience of 2.1 million. West of Texas (2020) consists of six, thirty-minute documentaries featuring the research being conducted by CKWRI and why it is relevant to the future of wildlife and conservation. West of Texas aims to use hunting as a vector to tell the story of wildlife through the perspective of data -driven research, and those researchers who have dedicated their lives to further prevent the loss of wild habitat.

Episode List:

The Last Great Quail Country
Season 2, Episode 1 (January 1, 2022)

Anthrax Triangle
Season 2, Episode 2 (February 5, 2022)

Holding The Line
Season 2, Episode 3 (March 5, 2022)

South Texas Turkey Crawl
Season 2, Episode 4 (April 2, 2022)

Guiding With Trey Dyer
Season 2, Episode 5 (May 7, 2022)

The Land Bridge
Season 2, Episode 6 (June 4, 2022)

Patton Donates to Caesar Kleberg Wildlife Research Institute Establishing Patton Center for Deer Research

Thanks to a generous gift from Bobby and Sherri Patton, the Patton Center for Deer Research (PCDR) has been established at the Caesar Kleberg Wildlife Research Institute (CKWRI). Patton, an avid outdoorsman and dedicated conservationist created the Patton Center for Deer Research that will strengthen wildlife research and education at Texas A&M University-Kingsville through the Caesar Kleberg Wildlife Research Institute.

Robert L. "Bobby" Patton, Jr.
Commissioner

Patton has previously supported education and conservation at the University of Texas. With this gift, Patton is excited to join the Texas A&M University family by supporting CKWRI and the TAMU-Kingsville Javelinas. He said "I am passionate about supporting education and research at Universities because it is an investment in the future."

"The Patton Center for Deer Research will be transformative for wildlife science in South Texas and will establish a world-class research center equipped to conduct applied research, train the next generations of leaders in conservation, and extend the knowledge created through our studies to inform land management and policy decisions," noted Dr. Mike Cherry, the Stuart Stedman Chair for White-tailed Deer Research at CKWRI and leader of the PCDR.

All deer-related research conducted by CKWRI will be under the banner of the newly created PCDR, which is committed to conducting research relevant to deer in Texas and northern Mexico. The research projects will increase the understanding of deer ecology and thereby increase the effectiveness of deer management. Dr. David Hewitt, CKWRI's Executive Director, indicated "The newly established Patton Center for Deer Research is a game-changer for our deer research. Resources from Mr. Patton's gift will enable our scientists and students to tackle the most critical challenges in deer management."

The Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville is the leading wildlife research organization in Texas and one of the finest in the nation. Established in 1981 by a grant from the Caesar Kleberg Foundation for Wildlife Conservation, the Institute operates as a nonprofit organization and depends financially upon private contributions and faculty grantsmanship. Its mission is to provide science-based information for enhancing the conservation and management of Texas wildlife.

The Institute has long-standing, trusted relationships with private landowners on whose land they conduct research, and through this relationship, there is a tremendous appreciation for the vital role that land stewardship plays in effective conservation. The Institute works with hunters, wildlife managers, land stewards, conservationists and policy makers to provide research for management and conservation of wildlife and its habitat.

CKWRI Personnel

Scientists and Staff

Dr. C. Jane Anderson, Research Assistant Professor
Mr. Nelson O. Avila, Research Technician II
Dr. Bart M. Ballard, Professor
Mrs. Yolanda Ballard, Director, CKWRI Administration
Mrs. Sara K. Barrera, Manager-Event Services
Dr. Jeremy A. Baumgardt, Research Assistant Professor
Mr. John R. Bow, Assistant Director, Texas Native Seeds–Central Texas
Mr. Brady K. Boykin, Research Technician I
Mr. Joshua D. Breeden, Research Technician I
Dr. Leonard A. Brennan, Professor
Dr. Fred C. Bryant, Director, CKWRI Development
Mr. Preston V. Castellon, Research Technician I
Mrs. Gina M. Cavazos, Administrative Coordinator I
Mrs. Cecilia A. Chapa, Business Coordinator III
Mr. John R. Chapa, Facilities Coordinator III
Dr. Michael J. Cherry, Assistant Professor
Mr. Marcus A. Collado, Research Technician I
Mr. Rider C. Combs, Research Associate
Mr. Seth M. Cook, Research Specialist I
Dr. Charles A. DeYoung, Research Scientist
Dr. Randy W. DeYoung, Professor
Mr. John A. Dietz, Purchasing Specialist
Mr. Tim Drake, Research Technician I
Mr. Anthony D. Falk, Program Director, Texas Native Seeds
Mrs. Sandra L. Fischer, Business Coordinator III
Dr. Aaron M. Foley, Research Assistant Professor
Mr. Colton A. Fowler, Research Technician I
Ms. Bethany A. Friesenhahn, Research Specialist I
Dr. Timothy E. Fulbright, Regents Professor Emeritus
Ms. Natalie M. Gerragauch, Administrative Associate V
Ms. Sarah A. Goodman, Research Technician I-Internship
Dr. Lon I. Grassman, Jr., Research Scientist
Mr. Tobias E. Haymes, Research Technician I
Dr. Levi J. Heffelfinger, Research Assistant Professor
Dr. Scott E. Henke, Regents Professor
Dr. Fidel Hernández, Regents Professor
Dr. David G. Hewitt, Executive Director
Mrs. Liisa L. Hewitt, Research Technician II
Dr. Clayton D. Hilton, Professor
Mrs. Nancy T. Jennings, Assistant Director-CKWRI Administration
Mr. Connor Jetton, Research Technician I
Mr. Douglas L. Jobes, Assistant Director, Texas Native Seeds–Coastal Prairies Texas
Ms. Nina S. Kappel, Research Technician I
Mrs. Edna G. Kirkpatrick, Travel Specialist I
Ms. Sarah E. Kulis, Research Technician I
Dr. William P. Kuvlesky, Jr., Professor
Mr. Brian Loflin, Adjunct Faculty
Dr. Jason V. Lombardi, Research Assistant Professor
Mr. Andrew C. Lowery, Research Associate
Mr. Samuel R. Lutfy, Assistant Director, Texas Native Seeds–Permian Basin
Mrs. Caroline McAllister, Director of Donor Relations
Mr. Hagen D. Meyer, Research Technician I
Mr. Alexander R. Meza, Research Technician I
Dr. J. Alfonso Ortega-Santos, Professor
Mrs. Celina Y. Ortiz, Purchasing Specialist
Mr. Keith A. Pawelek, Associate Director, South Texas Natives and Texas Native Seeds
Dr. Humberto L. Perotto-Baldivieso, Associate Professor
Mrs. Shyla E. Rabe, Administrative Coordinator I, Texas Natives Seeds
Dr. Sandra Rideout-Hanzak, Professor
Mr. Zachary W. Rodriguez, Business Coordinator II
Mrs. Selinda A. Rojas, Administrative Associate V
Mr. Thomas F. Rose, Administratice Associate V
Dr. Daniel G. Scognamillo, Research Associate Professor
Ms. Kimberly D. Shoback, Research Technician II
Mr. Colin S. Shackelford, Assistant Director, Texas Native Seeds–West Texas
Ms. Kathryn M. Sliwa, Research Associate
Mrs. Susan C. Smith, Administrative Coordinator
Mr. Jacob L. Sparger, Research Technician I
Dr. Evan P. Tanner, Assistant Professor
Dr. Michael E. Tewes, Regents Professor
Mrs. Rebecca S. Trant, Director, CKWRI Administration
Dr. Ashley M. Unger Tanner, Assistant Professor
Mr. Zachary M. Wardle, Research Associate
Mr. Tyler C. Wayland, Assistant Director, Texas Native Seeds–East Texas
Dr. David B. Wester, Professor

Graduate Students

Mr. Cole C. Anderson
Mr. Jose S. Avila-Sanchez
Mr. Michael R. Barrett
Ms. Chloe E. Bates
Mr. Alejandro Bazaldua
Ms. Laura C. Beck
Ms. Emily R. Bishop
Mr. Sean Blundell
Ms. Matti R. Bradshaw
Mr. Aidan B. Branney
Ms. Annalysa Camacho
Mr. Rider C. Combs
Mr. Daniel A. Crawford
Mr. Marlin M. Dart II
Mr. Dustin R. Duffie
Mr. Jacob L. Dykes
Ms. Georgina R. Eccles
Mr. Calvin C. Ellis
Mr. Juan C. Elissetche
Ms. Jesse Exum
Mr. Forrest C. Fay
Ms. Bethany A. Friesenhahn
Ms. Shanna R. Gleason
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The endangered ocelot in South Texas occurs only in a few locations where there is adequate habitat. Dense thornshrub is considered the best habitat for ocelots; however, most of this habitat has been cleared for agriculture. We are studying the ocelot-habitat relationship to answer several questions. Is dense thornshrub the only vegetation community that ocelots use? Can we predict ocelot distribution and density based on vegetation type? Do ocelots use restored dense thornshrub areas? Our study areas are on the East Foundation's El Sauz Ranch and the Yturria San Francisco Ranch.

We are using information from GPS-collared ocelots, camera traps, and satellite imagery to conduct our research. Camera trap information is revealing a high density of ocelots in woody habitat with a high canopy. GPS location data have shown that ocelots use open habitat more than was previously thought. These data also indicate there is more suitable woody cover in South Texas for ocelots than previously assumed. Although mixed and dense thornshrub remains an important habitat type for ocelots, these results show that ocelots may be more flexible.

A better understanding of the ocelot-habitat relationship will help with future conservation activities. In particular, knowing the habitat types used by ocelots should help with future translocation activities.

Cooperative funding provided by Texas Department of Transportation-Environmental Affairs Division, U.S. Fish and Wildlife Service, Tommy and Sue Arnim, the Arnim Family Foundation, Travis and Bettina Mathis, The Brown Foundation, Tim and Karen Hixon Foundation, Welder Wildlife Foundation, Las Huellas Association, and East Foundation.

Ocelot Road Ecology Studies in South Texas

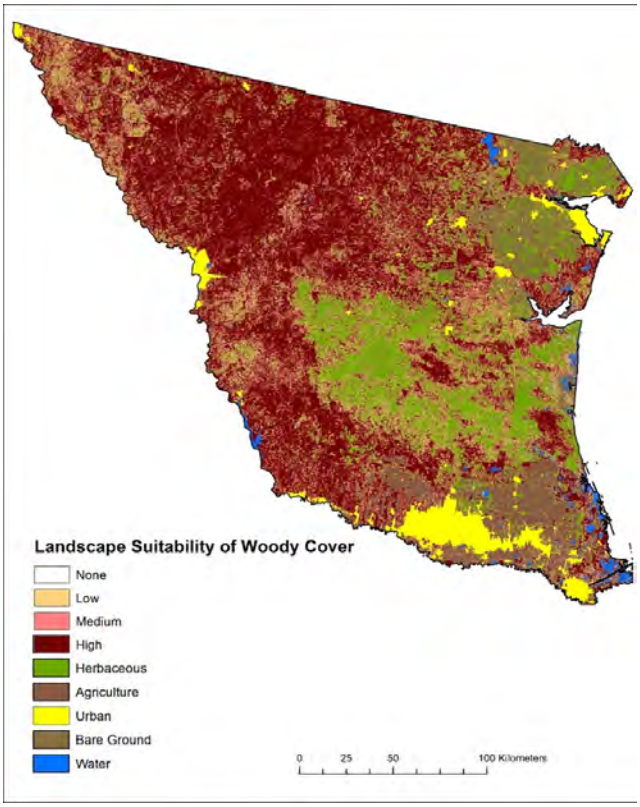
Jason V. Lombardi, Thomas J. Yamashita, Joseph D. Holbrook, David B. Wester, AnnMarie Blackburn, Zachary M. Wardle, Amanda M. Veals, Landon R. Schofield, Daniel G. Scognamillo, Ashley M. Tanner, Evan P. Tanner, Michael J. Cherry, Richard J. Kline, Randy W. DeYoung, Tyler A. Campbell, Humberto L. Perotto-Baldivieso, John H. Young, Jr., and Michael E. Tewes

Ocelot-vehicle collisions are a major cause of ocelot deaths in South Texas. It is important to understand the reasons for these road kills to reduce future deaths for this endangered species. We are studying various topics related to ocelot road ecology. What does the habitat look like where ocelots have been killed? Do ocelots use wildlife crossings under roads? How do road construction and traffic affect ocelot movements? Can bobcats and other mammals be studied to help answer these questions?

It appears that large woody patches near roads are important for ocelots to successfully cross roads. Thus, future wildlife crossing tunnels should be constructed in similar areas. We also are monitoring several wildlife crossings in Cameron County to determine ocelot use. In addition, we are monitoring certain roads to understand how construction and traffic may affect ocelot movements.

Information from these studies should help the Texas Department of Transportation plan future road construction projects, and wildlife crossing locations, to improve ocelot conservation efforts.

Cooperative funding provided by Texas Department of Transportation-Environmental Affairs Division, U.S. Fish and Wildlife Service, Welder Wildlife Foundation, and the East Foundation.



Suitable landscape structure for ocelots in South Texas.

Ocelot Reproduction Technologies in Texas

Ashley M. Reeves, Debra L. Miller, William F. Swanson, Clayton D. Hilton, Tyler A. Campbell, Landon R. Schofield, Zachary M. Wardle, Michael E. Tewes

Over the last 35 years, ocelots in the U.S. have decreased to less than 100 cats left in south Texas. These ocelots may face extinction due to low genetic diversity, limited gene flow, and no link to other ocelots. We wanted to know if assisted reproductive technologies, such as sperm freezing and artificial insemination (AI) could help increase ocelot genetic diversity.

Our goals in this study are to measure the reproductive health of current ocelot groups, store genetic materials using new methods of semen collection and freezing, and assess the use of artificial insemination with frozen-thawed semen sourced from wild Texas ocelots to produce kittens with zoo-based females.

Semen traits such as sperm abnormalities, percent movement, ability to fertilize an egg, and sperm numbers are assessed on semen samples. A post-thaw exam is then performed to compare two freezing methods. AI procedures were performed by placing the frozen-thawed sperm into the female with a quick surgical method and measuring fecal hormones to assess for pregnancy.

This information will provide a review of ocelot reproductive health, assess the best method for semen collection and long-term storage of genetic material, and explore the use of AI to create kittens. This should promote gene flow between ocelot groups and increase their genetic diversity.

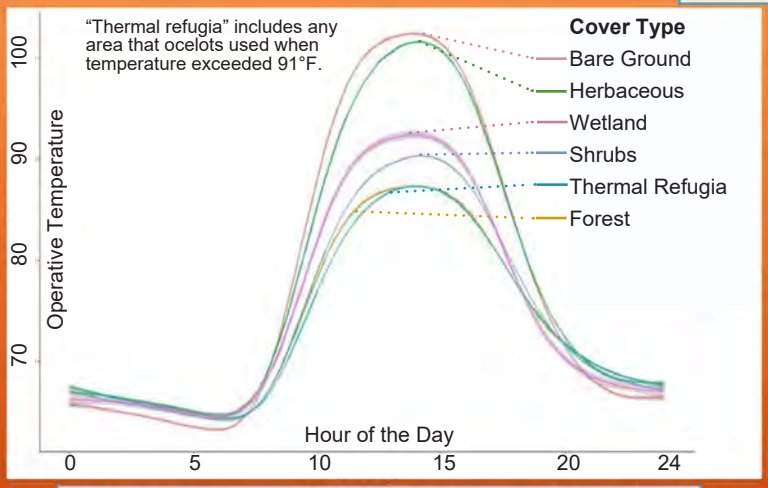
Cooperative funding provided by the East Foundation, Cincinnati Zoo, and the University of Tennessee at Knoxville.

Does Extreme Temperature Influence Habitat Selection of Ocelots, Bobcats, and Coyotes?

- As climates continue to change, understanding how extreme temperature influences species is important to conservation
- We measured seasonal temperatures in various habitats on the East Foundation's El Sauz Ranch
- Ocelot, bobcat, and coyote habitat selection is being examined using radio telemetry

Globe temperature sensors

- Ocelots, bobcats, and coyotes appear to use different thermal adaptations
- Ocelots use heavy cover during heat and cold, whereas bobcats use cover in the heat but open areas in the cold



Operative temperature in various cover types throughout the day

Coyotes show no pattern of habitat selection

Thermal refugia may mitigate the effects of extreme weather for felids

Maksim Sergeyev, Evan P. Tanner, Michael E. Tewes, and Tyler A. Campbell Cooperative funding provided by Tommy and Sue Arnim Family Foundation, Travis and Bettina Mathis, The Brown Foundation, Las Huellas Association, and the East Foundation.

Behavioral Coexistence of Ocelots, Bobcats, and Coyotes

Maksim Sergeyev, Jason V. Lombardi, Michael E. Tewes, and Tyler A. Campbell

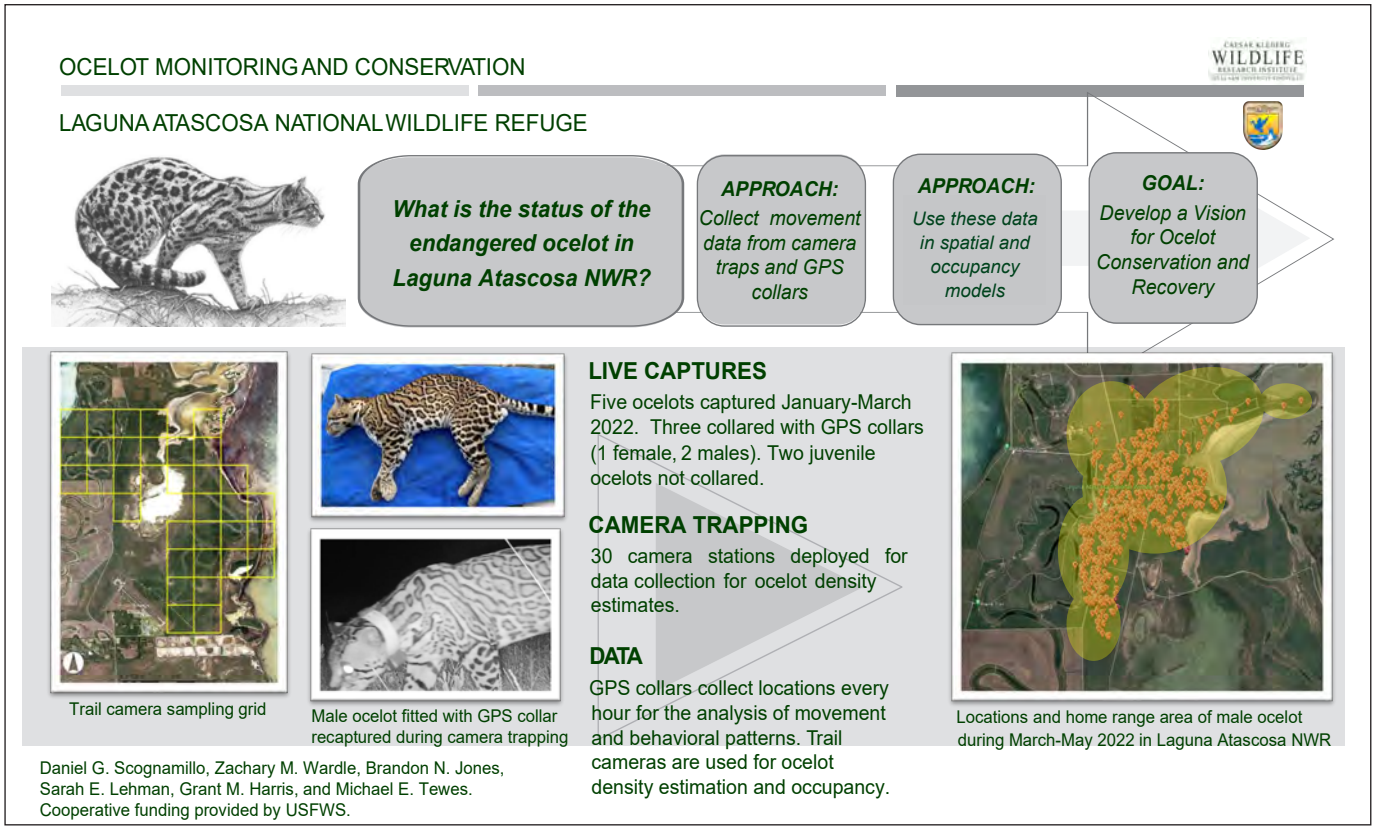
Ecological theory tells us that similar species will have a difficult time sharing an area. These species may compete for resources like food and high quality habitat. Small-scale differences in time and space use might help similar species overlap on the landscape. One less-explored form of coexistence is from behavioral differences. Species may differ in the timing and location of specific behaviors. This could allow for competing species to share their habitat. We are exploring the question: do resting, hunting, and exploring behavior permit coexistence of ocelots, bobcats, and coyotes?

We fit 12 ocelots, 19 bobcats, and 5 coyotes with a GPS collar on the East Foundation's El Sauz Ranch and the Yturria San Francisco Ranch. We are modelling the behavior of each species to compare differences in the distance and angle between locations. We are considering three behaviors: resting, hunting, and exploring. We are comparing habitat use and timing of each behavior for a single species and across all species.

To date, ocelots and bobcats appear to rest and hunt in dense woody vegetation. Both species use open areas more when exploring. Coyotes rest in open areas and hunt and explore in moderate cover. Timing of behaviors appears to differ between species, as well. Ocelots show strong nocturnal activity, whereas bobcats seem to have a similar pattern but with more daytime activity. Coyotes are active during the day and rest at night.

Our early results suggest that differences in time and space between behaviors may help these species share their landscape. These methods may also be applied to similar species that overlap in an area.

Cooperative funding provided by Travis and Bettina Mathis, The Brown Foundation, and the East Foundation.



Status and Movements of Ocelots and Bobcats in South Texas

Zachary M. Wardle, Daniel G. Scognamillo, Jason V. Lombardi, and Michael E. Tewes

The endangered ocelot is found in two isolated populations in South Texas: the Refuge Population in Cameron County, and the Ranch Population in Willacy and Kenedy Counties. Ocelots and bobcats have overlapping ranges and may compete for resources. We are exploring these questions: do ocelots and bobcats have similar activity patterns? Do they use similar resting sites? Additionally, we are surveying for ocelots on private ranches to understand the potential size and distribution of the population.

We are using camera traps and GPS radio collars to gather data for this research. Camera trapping data have shown that whereas ocelots and bobcats generally have similar activity patterns, ocelots are more active at night. Four ocelots have thus far been documented by camera traps on a private ranch in Kenedy County. GPS location information on resting site selection will be available later in the year.

Information from these studies will add to a greater understanding of ocelot distribution in South Texas, as well as ocelot and bobcat competition. These preliminary results also show the importance of private lands for ocelot conservation in South Texas.

Cooperative funding provided by the East Foundation, U.S. Fish and Wildlife Service, the Las Huellas Association, the Raul Tijerina Jr. Foundation, and Wild Cat Conservation, Inc.

A camera trap catches a bobcat resting in the April heat on a ranch in Kenedy County, Texas.

Estimating Leopard Population Size, Density, and Distribution in Botswana

Michael E. Tewes, Daniel G. Scognamillo, Christopher E. Comer, Jason V. Lombardi, and Michael J. Cherry

Leopards are a valuable game species prized by hunters from across the world. Hunters typically spend considerable amounts of money to hunt leopards. Most of this money is distributed to local rural communities that greatly benefit from these hunter resources. In addition, leopards represent an apex predator in many natural communities. The role of different harvest levels of leopards needs to be better understood so hunters can be responsible stewards of this important natural resource.

We will estimate leopard population size, density, and distribution in Botswana using camera traps. We will set up cameras in extensive grids over the next four years. The Department of Wildlife & National Parks for Botswana will provide agency guidance and direction. This support will be helpful for our project which has a broad geographic scope and technical challenges. This project has the potential to generate significant biological information for leopard management.

Cooperative funding provided by Safari Club International Foundation of Washington, D.C.

Distribution and Semi-arid Habitat Relationships of Three Wildcats in Israel

Michael E. Tewes, Ron Milgalter, Dan Malkinson, and Joseph D. Holbrook

There is little information about the occurrence or habitat use for the caracal, jungle cat, and African wildcat in the Middle East. This basic lack of information prevents development of science-based management strategies for these small cats.

Initial camera trap results have documented several African wildcats in the northern Galilee Region. In addition, other information such as distribution information was collected during Mike Tewes' recent visit to Israel. Camera traps will set up in grids to automatically photograph wild cats. These data will be used to determine species distribution and space use.

We intend to trap, and attach GPS collars to, wild cats to provide data on their movements and space requirements. This project will provide original ecological data for these rarely studied felids in Israel.

Status of the Ocelot and Jaguarundi in South Texas and Northeastern Mexico

Jason V. Lombardi, Aaron M. Haines, G. Wesley Watts III, Lonnie I. Grassman Jr., Jan E. Janečka, Arturo Caso, Sasha Carvajal, Zachary M. Wardle, Thomas J. Yamashita, W. Chad Stasey, Aidan B. Branney, Daniel G. Scognamillo, Tyler A. Campbell, John H. Young Jr, and Michael E. Tewes

Our research team has studied ocelot ecology in South Texas and northeastern Mexico for several decades. In addition, we have studied the jaguarundi in Mexico, but not in Texas. The jaguarundi is a small wild cat that was last documented in Texas in 1986. Although there have been many purported jaguarundi sightings in Texas, to date no evidence has been proven to support this cat's presence.

We wanted to know: does the jaguarundi occur in Texas? What is the status and ecology of ocelots and jaguarundis in northeastern Mexico? We used camera-traps at 16 properties in southern Texas and at 5 locations in northeastern Mexico.

- We recorded over 350,000 camera trap-nights in Texas, and did not document jaguarundi. In Mexico, we documented 126 jaguarundi photographs from 15,000 trap-nights.
- The jaguarundi likely does not occur in the United States.
- Ocelot and jaguarundi were documented on Rancho Caracol and Camatol in northeastern Mexico.
- Ocelot density was estimated at 15 individuals per 100 square miles on Rancho Caratol and Comatal.

Cooperative Funding provided by the East Foundation, Texas Parks and Wildlife Department, Tim and Karen Hixon Foundation, the Raul J. Tijerina, Jr. Foundation, U.S. Fish and Wildlife Service, Texas Department of Transportation-Environmental Affairs Division, the Brown Foundation, Caracol Ranch, Barry Putegnat, Dean Putegnat, and Wild Cat Conservation, Inc.

Jaguarundi in the Sierra Tamaulipas, Mexico.

Influences of Early-Life Conditions on Weight and Antler Size in White-Tailed Deer

Joseph A. Hediger, Matthew T. Moore, Cole C. Anderson, Charles A. DeYoung, David G. Hewitt, Stuart W. Stedman, Randall W. DeYoung, Michael J. Cherry

Variation in morphology, e.g., shape and size, of animals represents the balancing act between traits necessary for survival and traits necessary for reproduction. In an animal's early life it is programmed to place energetic reserves towards body size or secondary traits, like antlers. Research is lacking on the effects of early-life conditions as to where an animal dedicates its energy reserves.

We are evaluating the effects of early-life conditions of white-tailed deer on the relationship between antler size and body mass using a 14-year dataset containing annual antler size and body weight measurements for 471 known-age deer. These deer were born in one of two 1,100-acre, high-fenced pastures or a 6-acre pen. All deer had access to unlimited food and water. Within the smaller pen, movement was limited, predators did not occur, and sires were selected for large antler sizes. Deer born in pens were released to the pasture at approximately 4-months of age. We are evaluating antler size, body weight, and antler size to body weight ratio relative to birth site.

Our early results show offspring born into the pens were smaller bodied but had larger antlers when compared to pasture-born deer. Additionally, peak body weights and antler scores occurred at 7.5 years of age. Our preliminary results suggest early-life conditions permanently influence how an animal allocates energetic resources, either towards traits necessary for survival or traits necessary for reproduction. Preliminary findings highlight the importance of early-life conditions and their influence on body weight and antler size.

Cooperative funding provided by the Faith Ranch.

Projects from the Patton Center for Deer Research

Influences of Early-Life Conditions on Stress and Metabolism in White-Tailed Deer

Joseph A. Hediger, Matthew T. Moore, Cole C. Anderson, Charles A. DeYoung, David G. Hewitt, Stuart W. Stedman, Randall W. DeYoung, Michael J. Sheriff, Michael J. Cherry

The environment in which an individual is born and raised can have profound effects on its physical development and general health. Stress hormones like cortisol, as well as metabolic hormones such as thyroid hormone, can provide a vast array of information about the health of an individual. Mothers that experience poor nutrition or other stressors during pregnancy often produce offspring that are smaller and more likely to succumb to disease.

We are investigating whether early-life conditions influence lifelong physiology of white-tailed deer. Deer were born in either a 1,100-acre, high-fenced pasture or a 6-acre pen. All deer had access to unlimited food and water. Within the small pen, movement was limited, predators did not occur, and sires were selected for large antler sizes. Deer born in these predator-free pens were released to a larger pasture at approximately 4 months of age. Fecal samples are obtained from these individuals during annual captures. Cortisol and thyroid hormones are extracted from the samples and analyzed.

We predict that individuals born in the pens will have different stress profiles and faster metabolism than deer born in the pastures. We expect early-life conditions will have both temporary and permanent effects on an animal's physiology and performance, and that these differences will influence survival.

Cooperative funding provided by the Faith Ranch.

Doe and fawn on the Faith Ranch.

Morphometrics of White-Tailed Deer are Correlated with Soil Characteristics

Aaron M. Foley, Kory R. Gann , David G. Hewitt, Randy W. DeYoung, Alfonso Ortega-S, and Tyler A. Campbell

White-tailed deer morphometrics (body size, antler size, etc.) vary at different areas within their geographic range. Variation can be attributed to soil characteristics because soil characteristics influence forage consumed by deer. But it is unknown whether it is forage quality or forage abundance that influences morphology of deer.

We used helicopter net-gunning to capture 4,554 deer within 7 sites on East Foundation properties during autumn 2011–2018. For each deer captured, we measured body mass, body length, and antler size of males. For each capture site, we obtained percent sand and herbaceous biomass.

Despite capture sites being only 54 miles apart, preliminary results revealed that morphometrics varied by site. At the coastal capture site, male antler size was 2–10% smaller, male body mass was 10–18% smaller, male body length was 1–6% smaller, female body mass was 1–11% smaller, and female body length was 1–4% smaller than the interior capture sites. Increases in percent sand of the soil resulted in smaller morphometrics whereas herbaceous biomass had no effect, suggesting that forage quality, not forage quantity, influences deer morphology.

We will continue to search for additional correlations to determine the relationship between soil quality, forage quality and quantity, and deer morphometrics. Our information will help us understand factors limiting skeletal development of white-tailed deer.

Cooperative funding provided by the East Foundation.

Heritability of Antler Traits in White-tailed Deer

Cole C. Anderson, Randy W. DeYoung, Michael J. Cherry, Charles A. DeYoung, David G. Hewitt, Joseph A. Hediger, Matthew T. Moore, and Stuart W. Stedman

Antlers are used as both tools and targets of management in wild populations. Because antler traits are heritable, the survival and reproduction of individuals with either desirable or undesirable traits might affect the genetic potential of a population. Intensive management strategies aimed at increasing genetic potential for antler size in white-tailed deer are common in South Texas, yet have received little formal study.

We are evaluating the efficacy of deer management permit (DMP) enclosures to influence antler characteristics in an intensively managed population on the Faith Ranch, Texas. In 2007, the ranch enclosed 2 adjacent 1,100-acre pastures with game fencing. All deer were removed from one pasture while the other serves as a control. The vacated pasture was re-populated using 2 DMP enclosures. Each year, a large-antlered buck is placed with up to 15 does in each DMP enclosure; all resulting fawns are tagged and released into the enclosed pasture. The use of DMPs produced annual cohorts of fawns with known age and sires.

We re-capture tagged bucks each autumn and record antler measurements. To date, 12 bucks have produced 101 sons that survived to 5 years old or older. Preliminary results suggest that heritability of antler traits is about 30–40%, similar to previous studies of antler heritability in white-tailed deer and other species. However, sons of large-antlered sires varied greatly in antler size, suggesting that genetic quality is not always passed on. Our ongoing research will help understand how genetic and environmental factors influence antler size in managed populations of deer.

Cooperative funding provided by the Stedman West Foundation and the Faith Ranch.

Female Selection of Fawning Area and Fawn Survival

Miranda L. Hopper, Bryan D. Spencer, Randy W. DeYoung, Aaron M. Foley, J. Alfonso Ortega-Santos, Landon R. Schofield, Tyler A. Campbell, and Michael J. Cherry

Every year, female white-tailed deer are tasked with the responsibility of rearing fawns, while also needing to maintain their own health during the hot, summer months. When selecting the area where she will raise her fawn, a female must make decisions to balance her needs for adequate nutrition while still providing her fawn the best chance of survival. Lactation is the most energetically-demanding period for females. Thus, the quantity and quality of available forage are important factors in determining where a female will choose to spend her time. However, the presence of fawn predators, like coyotes and bobcats, adds another layer to the challenge of successfully raising fawns. Females must meet their energy needs, while still avoiding predators that pose a risk to their offspring.

Females may have up to three fawns in a litter, but twins are most common. Twins are shown equipped with very high frequency (VHF) collars.

Every March from 2020 until 2023, we will capture female white-tailed deer and equip them with global positioning system (GPS) collars and vaginal implant transmitters (VITs), which will allow us to track birthing events in the summer. In the same years, we will capture and collar fawns, so that we may track daily survival. We will use GPS locations and survival data to determine where females choose to raise their fawns and how that decision affects the fawns' survival. We will characterize these spaces by landcover type, forage quality, and relative predation risk. Predation risk data will by obtained from GPS-collared coyotes.

Understanding what drives females' decisions during fawning is critical in predicting population performance, particularly in limited environments with complex predator-prey dynamics.

Cooperative funding provided by the East Foundation.

White-Tailed Deer Movements Along the U.S.-Mexico Border

Ashley G. Hodge, Jeremy A. Baumgardt, Randy W. DeYoung, Michael J. Cherry, Aaron M. Foley, David G. Hewitt, John A. Goolsby, and Kimberly H. Lohmeyer

Wildlife are capable of long-distance movements, a management concern due to the potential to spread disease to livestock and humans. In South Texas, there is growing concern about the increasing presence of the cattle fever tick. This one-host tick can carry a parasite that is fatal to naïve cattle. The tick and parasite are endemic in Mexico, and the USDA and Texas Animal Health Commission maintain a permanent quarantine zone to prevent re-infestation in the U.S. Deer serve as alternative hosts for the tick, and may act as long-distance dispersers across the border or the quarantine zone.

We studied movements of deer in a high-density population surrounding Falcon Lake, near Zapata, Texas. We captured 100 deer via net gun and helicopter, and deployed GPS collars that collected hourly locations during February 2020-2021. We identified deer that crossed the border using time-based GPS tracks and estimated monthly home ranges. Several individuals made long-distance exploratory movements, though all remained within the quarantine zone. We observed 98 crossings from 41 deer from Texas to Mexico throughout the year. We are analyzing the placement of crossings and surrounding land metrics that may influence where and when deer cross. Monthly home ranges average 158 acres for females and 198 acres for males. Individual deer in this area had small home ranges, but collectively crossed at multiple different locations along the lake shore. Targeting cattle fever tick treatment or other management actions at crossing sites may help decrease the abundance of ticks in the area.

Cooperative funding provided by the USDA Agricultural Research Service and the Pinnell Family.

Heritability Using Deer as Sentinels to Predict Distribution of Cattle Fever Ticks

Ashley G. Hodge, Jeremy A. Baumgardt, Randy W. DeYoung, Michael J. Cherry, Aaron M. Foley, David G. Hewitt, John A. Goolsby, and Kimberly H. Lohmeyer

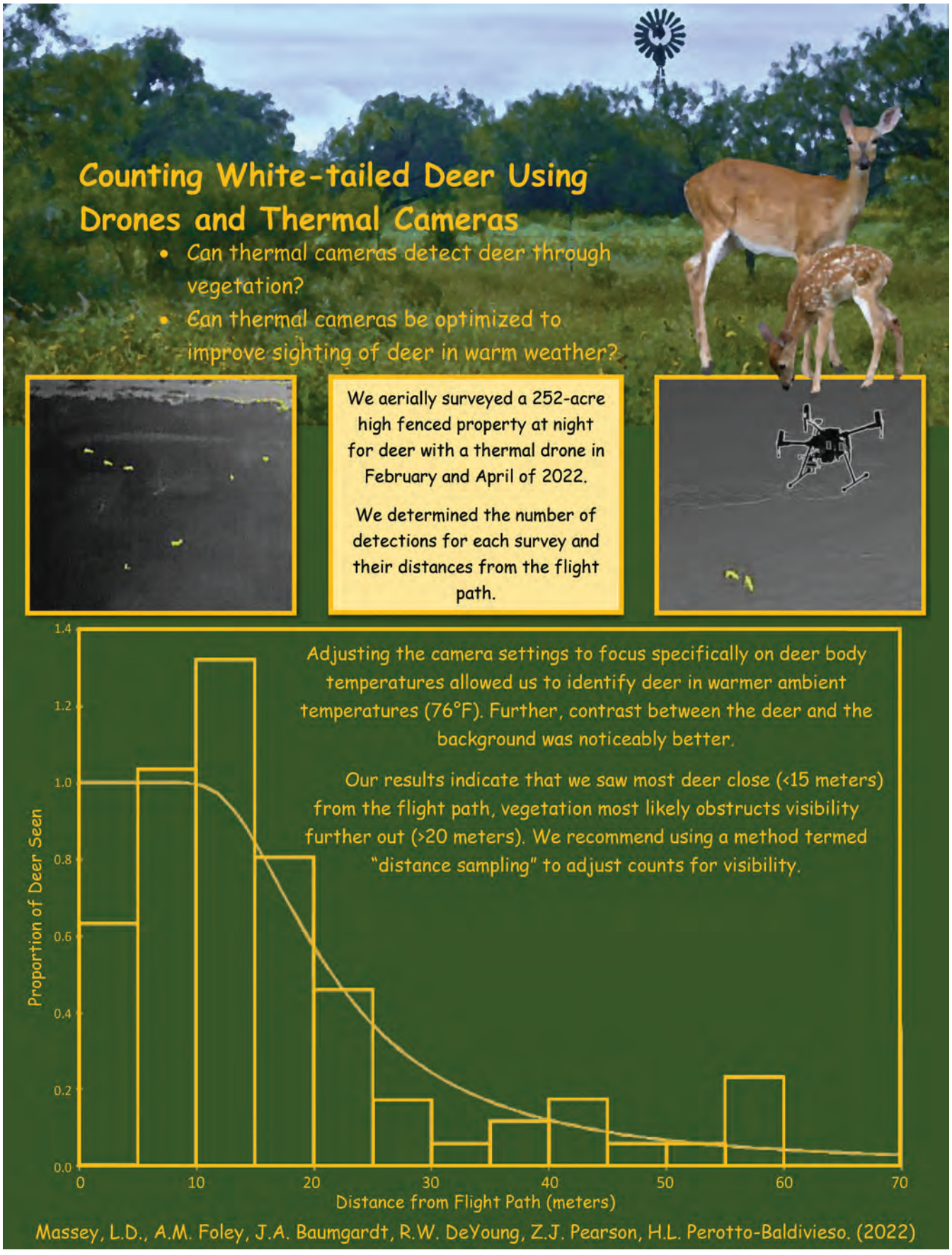
Cattle fever ticks were introduced into the Americas in the early 1500's by Spanish settlers. The ticks quickly spread throughout both North and South America. These one-host ticks can carry a deadly parasite that can be fatal in up to 90% of naïve cattle and also cause reductions in meat and milk production, weight loss, and abortion. Fever ticks were eradicated from the U.S. in the 1940's, but remain endemic in Mexico. Although the fever tick prefers a cattle host, they can use several alternative wildlife hosts, including white-tailed deer.

We captured deer in a high-density population surrounding Falcon Lake near Zapata, Texas. The site is located along the U.S.-Mexico border, inside a permanent quarantine zone established to prevent re-emergence of the tick in the U.S. We fitted 100 deer with GPS collars that collected hourly fixes and removed 298 females from the area to reduce density of host animals; we recorded capture locations and tick loads from all deer.

We are using ecological niche models to understand how local site characteristics are associated with abundance of ticks. Home ranges of infested deer will serve as occurrence data, and covariates will include landscape metrics such as ecological site description, land cover, precipitation, distance to Ivermectin feeders maintained to treat deer, and pasture treatments for cattle. The outputs will further inform us on environmental variables important to ticks at a macro scale and highlight areas that may be impacted by future northward range expansions of the tick.

Cooperative funding provided by the USDA Agricultural Research Service and the Pinnell Family.

Collecting ticks from a buck in Zapata County, Texas.


Counting White-tailed Deer Using Drones and Thermal Cameras
• Can thermal cameras detect deer through vegetation?
• Can thermal cameras be optimized to improve sighting of deer in warm weather?
We aerially surveyed a 252-acre high fenced property at night for deer with a thermal drone in February and April of 2022.
We determined the number of detections for each survey and their distances from the flight path.
Adjusting the camera settings to focus specifically on deer body temperatures allowed us to identify deer in warmer ambient temperatures (76°F). Further, contrast between the deer and the background was noticeably better.
Our results indicate that we saw most deer close (<15 meters) from the flight path, vegetation most likely obstructs visibility further out (>20 meters). We recommend using a method termed "distance sampling" to adjust counts for visibility.
Proportion of Deer Seen
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
0
10
20
30
40
50
60
70
Distance from Flight Path (meters)
Massey, L.D., A.M. Foley, J.A. Baumgardt, R.W. DeYoung, Z.J. Pearson, H.L. Perotto-Baldivieso. (2022)

Long-Term Study of Deer Captures on East Foundation Lands

Aaron M. Foley, David. G. Hewitt, Mike J. Cherry, Randy W. DeYoung, Timothy E. Fulbright, J. Alfonso Ortega-Santos, Kory R. Gann, Michaela F. Rice, Seth T. Rankins, Bryan D. Spencer, Miranda L. Hopper, Landon R. Schofield, and Tyler A. Campbell.

Conducting long-term studies is critical to fully understand the impact of the environment on wildlife. Quite often, conducting studies for 2-3 years is of insufficient length because of the variable environment, especially in South Texas where one year may be a drought and the next year may be a wet year. Additionally, long-term studies are beneficial for studying long-lived species such as white-tailed deer, which can live up to ~16 years old in the wild.

The East Foundation is in its 10th year of sponsoring a large-scale white-tailed deer capture on 4 of its ranches in South Texas. Numerous student volunteers from Louisiana State University, Southwest Texas Junior College, Stephen F. Austin State University, Sul Ross State University, Tarleton State University, Texas A&M University, Texas A&M University-Kingsville, Texas State University, and Texas Tech University have assisted with collecting blood and ear tissue samples, collecting morphometrics, and learning more about why such data are collected.

During the decade of deer captures, 4,303 unique individuals have been captured, which includes 1,488 records of known-age deer. Approximately 39% of the deer have been recaptured at least once. The oldest known-age deer is a 11.5-year-old female. This large dataset will be used to improve our understanding of deer ecology in semi-arid environments and provide ancillary data to use with sister studies evaluating stress physiology, nutrition, fawn recruitment, antler development, age-related growth patterns, and landscape genetics.

Cooperative funding provided by the East Foundation.

Dietary Requirements of Reproductive Females

Miranda L. Hopper, Breanna R. Green, Joseph A. Hediger, David G. Hewitt, Clayton D. Hilton, Michael J. Cherry

The final trimester of gestation and the early phases of lactation are the most energetically-demanding periods for female white-tailed deer. Females have energy requirements, but they also need enough protein for growth and maintenance. Healthier, heavier females tend to be more successful in raising fawns. Access to quality foods is important to ensure females can provide adequate nutrition to their developing fawns, while also allowing them to recover before breeding again. Therefore, determining diet preferences during gestation and lactation is critical for understanding the needs of females during these times.

Nutritional requirements likely differ between pregnant and non-pregnant females. Additionally, dietary preference may change throughout gestation. Our objectives are to (1) determine the relative importance of protein and energy in diet selection during gestation and lactation, and (2) identify differences in preference according to reproductive status. We will offer pregnant and non-pregnant females 2 dietary options: a feed that is high energy and low protein and another that is low energy and high protein. We will measure daily food consumption of both diets during

Access to quality nutrition is crucial for reproductive females. A pregnant female is shown bedded down at the Albert and Margaret Alkek Ungulate Research Facility.

Rainfall Timing Affects Size of Juvenile Deer

Miranda L. Hopper, Bryan D. Spencer, Randy W. DeYoung, Aaron M. Foley, J. Alfonso Ortega-Santos, Landon R. Schofield, Tyler A. Campbell, and Michael J. Cherry

In semi-arid environments, rainfall is highly variable among years and can have drastic consequences for wildlife populations. Changes in rainfall patterns may negatively affect wildlife by affecting available forage. This could have implications for survival, and other physical characteristics, such as size. In years with more rainfall, we would expect increased vegetation growth, resulting in improved nutrition. Alternatively, drier years may limit vegetation, and thus nutrition available for wildlife. Availability of nutrition directly affects body size and condition of wildlife. Juveniles are particularly susceptible to variability in resources during early growth stages.

Our objective is to determine which pattern of rainfall has the strongest effect on body size of juvenile white-tailed deer. Over 10 years, we captured a total of 480 fawns and 571 1.5-year-olds at 4 sites in the South Texas Plains. We measured body size at time of capture. We then determined cumulative rainfall that each deer experienced during several biological seasons: Early Growing Season, Late Growing Season, Spring, Early Summer, Late Summer, and Fall. Our results suggest rainfall during the early growing season, particularly during the month of April, is the most important in determining body size of fawns and 1.5-year-olds in semi-arid environments.

Previous research has shown that larger individuals tend to have a higher chance of survival. Understanding the effects of rainfall timing on juvenile size will enable managers to predict population outcomes under variable rainfall patterns.

Cooperative funding provided by the East Foundation.

A student restrains a white-tailed deer buck during a research capture.

Free Choice of Water Based on Salinity

Austin K. Killam, Clayton D. Hilton, David G. Hewitt, Aaron M. Foley, and Natasha L. Bell

Frequent droughts in the southwestern United States can impact the availability of surface water and its quality. The quality of artificially pumped water and rapidly evaporating pools of water can vary and change drastically, influencing salinity and the dissolved solids. Developed water sources are abundant in the southwestern United States for cattle operations and improvement of wildlife habitat. Water developments are installed where water is limited to expand wildlife distribution, increase productivity, reduce mortality, and increase fitness.

Game cameras are being used to monitor water troughs of varying salinities across the East Foundation's San Antonio Viejo Ranch. White-tailed deer, other wildlife, and livestock visitations are recorded for each water trough. The number of individuals, sexes, and age groups (adult/fawn) are also recorded. Visitations are recorded as "actively drinking" if the animal is ≤ 8 feet, or "visiting" if the animal is > 8 feet from the water trough. Game cameras have a 1-minute delay to record all visiting individuals.

Water site visitations have been studied before, but none have included the effects of water quality. Water sources can vary in quality among locations and days depending on water source, soil type, water depth, mineral concentration, and evaporation. Using a YSI water meter to test the water trough salinity levels, our project will provide a range of water salinity that is acceptable to white-tailed deer and other wildlife. These findings will help managers determine which water sources can meet wildlife's needs and which are unacceptable because of high salinity.

Cattle Grazing Influences on White-Tailed Deer Recruitment and Productivity

Bryan D. Spencer, Miranda L. Hopper, Randy W. DeYoung, Aaron M. Foley, David G. Hewitt, J. Alfonso Ortega-S., Landon R. Schofield, Tyler A. Campbell, and Michael J. Cherry

In the last 25 years, Texas has experienced a shift in land use trends from solely agricultural to multi-use incorporating wildlife management. Multi-use approaches require an understanding of how objectives influence other objectives to optimize the returns of the landscape.

In South Texas, cattle production and white-tailed deer hunting are two of the most economically and socially important activities, and managers often strive to maximize their returns from both. However, management strategies to optimize production of one of these can counter the other. Therefore, we will determine (1) the effect of cattle grazing on productivity of white-tailed deer, and (2) what environmental factors buffer these effects.

To accomplish this, we have collected 5,771 observations from aerial captures of white-tailed deer across 4 ranches in South Texas since 2011. During these captures we collect data such as age, weight, antler measurements, and lactation status. These data will be linked to stocking and grazing practices of these ranches, the landscape structure, and the climatic conditions. This will allow us to provide informative management recommendations on how cattle grazing can influence white-tailed deer productivity and what management actions can be taken to buffer these influences.

Cooperative funding provided by the East Foundation.

White-tailed deer buck being released after processing.

A pregnant white-tailed deer at the Alkek Ungulate Research Facility. An implant sensor collects her internal temperature, while a thermal black globe in the foreground collects environmental temperature.

Thermal Ecology of White-Tailed Deer in South Texas

Breanna R. Green, Evan P. Tanner, and Michael J. Cherry

An important aspect of wildlife ecology is how wildlife change their behavior to cope with periods of high heat while still meeting their daily needs. Equally important is how heat and life-history stages affect the internal temperatures of wildlife. In South Texas, where heat stress is common, increases in temperatures related to climate change could reduce the ability of white-tailed deer to function on rangelands. As deer are an important resource, understanding the heat stress experienced by individuals and how they change their behavior to deal with it will highlight difficulties they may have adapting to changing conditions.

With a captive deer herd at the Alkek Ungulate Research Facility, we measured the internal temperatures of pregnant and non-pregnant deer throughout spring and summer 2022. In addition, we simulated activity to determine how their temperatures changed between rest and activity periods, and how the changes relate to weather, age, weight, and pregnancy status. We also collected trail camera data from cameras placed at deer feeders. These feeders were either under full shade or full sun. The purpose is to determine temperatures at which does chose to forage under the shade rather than in full sun. Additionally, we will determine the temperature at which deer alter the time of day they come to feed, and how pregnancy affects that change. Results of this research will provide new insight into white-tailed deer behavior and adaptability to rising temperatures in South Texas.

Cooperative funding provided by Albert and Margaret Alkek Foundation.

A GPS-collared female mule deer in the Texas Panhandle being chased by a young buck.

Fine-Scale Resource Selection of Mule Deer in Agricultural Fields

Calvin C. Ellis, Michael J. Cherry, Randy DeYoung, Shawn S. Gray, David G. Hewitt, Levi J. Heffelfinger

Texas is a highly-productive agricultural state, leading the nation in cotton production and in the top 10% for several other crops. Cropland is widespread and increasing across the Panhandle region, and multiple species of wildlife have been documented using crop fields. Recent research showed mule deer selected wheat fields near their home ranges. Although several wheat fields were near each other, deer were observed using certain fields while avoiding others, resulting in the question of what factors influence crop field selection.

We will use a 5-year dataset of 146 GPS-collared adult mule deer across 4 sites in the Texas Panhandle to determine landscape attributes of agricultural fields that may be influencing selection. These sites vary in proportions of agriculture, energy development, and urban infrastructure. Other factors that could be influencing selection of crop fields by mule deer include proximity to roads and rangelands, the size and shape of the field, and irrigation type.

Our results will identify factors influencing crop field selection by mule deer and allow managers to predict which fields are likely to congregate deer. Understanding landscape factors influencing selection has important implications for management of habitats, disease, and harvest. With increasing fragmentation, understanding animal space use in these landscapes is a high priority for wildlife conservation.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Juvenile Mule Deer Movement in a Chronic Wasting Disease Zone

Calvin C. Ellis, Michael J. Cherry, Shawn S. Gray, David G. Hewitt, Levi J. Heffelfinger

Chronic Wasting Disease (CWD) is a neurological disease affecting deer species. In Texas, CWD has been detected in 358 captive or free-ranging deer, and the Panhandle region has 3 CWD-positive counties, Dallam, Hartley, and Lubbock. The Canadian River passes into this region of Texas from New Mexico, where there is limited information on CWD. Many counties in this region have not yet detected CWD, however, the river could be a movement corridor between CWD regions.

Fine-scale movement data are generally lacking for juveniles of most mammals. Also, drivers of movement in unfamiliar landscapes are rarely known. To further understand this, we GPS-collared 30 juvenile mule deer in Oldham County, along the Canadian River. We studied their movement and examined habitat selection as these deer move away from their natal range.

Preliminary results show that 20 of 30 GPS-collared deer made movements outside of their natal range. These 20 individuals combined for a total of 121 irregular movements, consisting of 114 exploratory trips and 7 dispersals. All dispersals were made by males and peaked during fawning and rut. Females accounted for 60% of the exploratory movements and made the two longest treks (41 miles in a straight line; and totals of 356 and 383 miles). Generally, all deer selected higher elevations and greater shrub cover than surrounding areas; however, during excursions deer selected areas closer to the river supporting our prediction that the river is a movement corridor. These early results indicate juvenile mule deer are prone to exploratory movement, and that the Canadian River is facilitating movement. These results will inform CWD management.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Site Fidelity of Mule Deer in a Fragmented Landscape

Calvin C. Ellis, Levi J. Heffelfinger, Randy W. DeYoung, Shawn S. Gray, David G. Hewitt, Michael J. Cherry

Site fidelity, the tendency of an individual to return to a site, has been linked to familiarity of resources, increased fitness, or minimizing predation risk. Mobile animals, particularly migratory species, exhibit strong site fidelity to seasonal ranges and migration corridors. While it has been linked to many benefits, recent studies suggest that high site fidelity can negatively affect species in a heavily human-influenced landscape.

Site fidelity has been examined in mule deer, primarily in association with migration. Texas mule deer, however, are not known to migrate. It is unknown whether their fidelity may differ compared to migratory herds. In the Texas Panhandle, mule deer are exposed to fragmentation, energy development, and row-crop farming. Texas is one of the top cotton and wheat producing states and continues to be very productive in oil and natural gas development.

To examine site fidelity in response to human-influences and landscape fragmentation, we will use a 5-year GPS dataset of movement of 146 adult mule deer in the Texas Panhandle. This dataset was collected across 4 sites with varying proportions of agriculture and energy development. Site fidelity is crucial to many species' fitness and is at risk due to expanding landscape fragmentation and human influence. These results will reveal how mule deer site fidelity is influenced by fragmentation, which could aid in population monitoring and management plans.

Cooperative funding provided by the Texas Parks and Wildlife Department.

Habitat Overlap of Three Cattle Fever Tick Hosts

Jeremy A. Baumgardt, Randy W. DeYoung, Michael J. Cherry, Aaron M. Foley, Clayton D. Hilton, Greta L. Schuster, J. Alfonso Ortega-S., David G. Hewitt, and Kimberly H. Lohmeyer

Cattle fever ticks were introduced to North America by European colonists in the 1500's. This one-host tick can carry a parasite that is lethal to naïve cattle and thus poses a serious threat to the livestock industry. The ticks were eradicated from the US in the 1940's but remain endemic in Mexico.

Historically, cattle were treated for ticks using spray-on or injectable medication, but the easiest method was to remove cattle–the host species– for 8-9 months. Lacking a host, the local tick population would perish. All treatment methods worked well until recent years, when wildlife populations increased. White-tailed deer and nilgai antelope can serve as alternative hosts for the ticks. Treating wildlife is challenging; there are few viable methods and wild animals use the landscape at scales larger than individual properties. Therefore, even if cattle are treated in a given pasture, deer and nilgai may maintain ticks that can seed a new outbreak.

We deployed over 80 GPS collars on deer, nilgai, and cattle on private and public lands in Cameron and Willacy Counties, Texas. We plan to collect hourly locations for each collared animal for a year, and will use the information to understand how wildlife movements may carry ticks into and out of treated areas. Additionally, we will identify habitats where treated cattle do not overlap with deer and nilgai, which may act as reservoirs for ticks. Understanding how these three species interact and use the landscape will inform management strategies and monitoring efforts for cattle fever ticks in South Texas.

Cooperative funding provided by the USDA Agricultural Research Service, the Pinnell Family, and the East Foundation.

Reaction of Nilgai to Motion-Activated Sprayers for Cattle Fever Tick Management

Akari Katsuta, Kathryn M. Sliwa, Jeremy A. Baumgardt, Randy W. DeYoung, J. Alfonso Ortega-Santos, David G. Hewitt, John A. Goolsby, Kimberly H. Lohmeyer

Domestic livestock are often exposed to pathogens and diseases by wildlife. Nilgai antelope are an exotic, free-ranging ungulate in South Texas. Nilgai are a competent host of cattle fever ticks that can carry the parasite that causes bovine babesiosis, a serious threat to the U.S. livestock industry. There are no viable methods to treat free-ranging nilgai for cattle fever ticks.

The USDA created a motion-activated sprayer system to spray nilgai with a solution containing live nematodes that can kill the ticks. The sprayer systems were set up at fence crossing locations, as nilgai use gaps in fences to move throughout South Texas. The goals of this study were to determine if nilgai react to the presence of sprayers, and if the presence of sprayers affected how fast a nilgai crossed the fence. The sprayers were deployed in February 2019 and removed from the field in October 2019. We used trail cameras to record the frequency of nilgai at fence crossings with and without the sprayers. We also calculated how long nilgai spent around the sprayers prior to crossing.

Preliminary results suggest that nilgai appeared at fence crossings more often when there was no sprayer present. Factors that might influence crossing behavior are the frequency of human activity at the sprayer sites and time of the year. Nilgai appear to be extremely wary of novel items in their environment. Sprayer systems may require time for nilgai to become accustomed to their presence to be an effective treatment for cattle fever ticks on nilgai.

Cooperative funding provided by the USDA Agricultural Research Service and the Pinnell Family.

Nilgai are captured by a game camera while moving across the South Texas landscape.

Treating Cattle for Ticks Benefits White-Tailed Deer

Jeremy A. Baumgardt, Ashley G. Hodge, Randy W. DeYoung, J. Alfonso Ortega-S., David G. Hewitt, John A. Goolsby, and Kimberly H. Lohmeyer

Cattle fever ticks carry the disease cattle fever, which can have devastating effects on naïve herds of cattle. Wildlife, such as white-tailed deer, can also carry the ticks, and may be the source of recent tick outbreaks near the Texas–Mexico border. Sprays and injectable medication are available to treat cattle for ticks. These treatments are not feasible for deer, but deer are fed corn treated with Ivermectin to reduce tick loads. Ivermectin-treated feed must be removed 60 days prior to the hunting season to ensure venison is safe for human consumption. Therefore, deer treatments are unavailable for about six months of the year. Because the ticks prefer cattle, the presence of treated cattle combined with Ivermectin-treated corn may result in lower tick loads for all animals in the treated area.

To test this idea, we captured white-tailed deer near Falcon Reservoir, Zapata, TX, during February 2020 and outfitted them with GPS collars. We recaptured 13 deer in November and recorded number and species of ticks present.

- We used the 9 months of GPS locations for each deer to quantify how many medicated corn feeders and pastures with treated cattle were within each deer's home range.

A collared white-tailed deer in the South Texas brush country.

- We found that a deer's tick loads were strongly impacted by the amount of area shared with treated cattle, as well as the number of medicated-corn feeders that were near the center of their range.
- Our results suggest that treating cattle for ticks may effectively reduce the tick population in the pastures, which benefits wildlife that also live there.

Cooperative funding provided by the USDA Agricultural Research Service.

Ecological Tug-of-War: Competition Between White-Tailed Deer and Cattle

Bryan D. Spencer, Randy W. DeYoung, Aaron M. Foley, J. Alfonso Ortega-S., Landon R. Schofield, Tyler A. Campbell, and Michael J. Cherry

Competition takes many forms and is an important species interaction. Yet, it can be difficult to separate the mechanisms of competition. This complicates development of management aimed at reducing competition and optimizing multiple land uses.

To better understand competition between cattle and white-tailed deer, cattle were stocked across 10 pastures containing female deer equipped with GPS collars on a ranch in South Texas. Pastures were stocked at rates that varied between 0-39 animal units per mi^2 per year. We evaluated the influences of cattle competition on white-tailed deer for a 1-month period before and after the stocking event. Competition often affects resource availability. We assessed this using deer home range size relative to cattle stocking. Competition also influences resource accessibility and behavior.

- We evaluated interaction through changes in deer resource selection and movement.
- After cattle stocking, home range size did not differ.
- Deer decreased movement and increased use of sandier and brushier sites with increasing stocking rate indicating that cattle did not immediately impact resource availability, but interactions altered deer movement and selection.
- Management actions should be targeted to limit encounters between these 2 species or offer deer areas to avoid cattle.

Cooperative funding provided by the East Foundation.

Habitat Management Alters Space Use of White-Tailed Deer

Jacob L. Dykes, Levi J. Heffelfinger, Randy W. DeYoung, Timothy E. Fulbright, J. Alfonso Ortega-S., Dean W. Wiemers

Southwestern rangelands were once dominated by grasslands. Recent brush encroachment has decreased productivity, and increased wind and water erosion. Brush management is a crucial tool for rangeland conservation. Root-plowing in a strip-motte pattern is a common technique thought to benefit wildlife. However, the creation of mottes is time-consuming and complicates follow-up treatments. Understanding wildlife responses to brush management and the cost-benefit of the techniques is important. We monitored GPS-collared deer during and the year following brush management within 1,668 acres of dense regrowth mesquite. Brush outside the treated area was undisturbed. We used the GPS locations to evaluate changes in deer home-range size and placement. We also measured deer use of brush strips, root-plowed strips, and mottes within the management areas.

- Post-management landcover was 33% brush strips, 54% root-plowed strips, and 13% mottes.
- Deer home range size and placement did not change in response to brush treatment. Deer remained in the treated area, but used the different landcover types at different times of the day.
- Within the brush management areas, proportional use of brush by male deer was 39%, root-plowed 35%, and mottes 27%. During midday deer selected root-plowed strips over brush but showed no preference for mottes. Deer selected mottes over brush and the root-plowed strips at night, early morning and evening.
- Land managers must balance objectives and cost when manipulating the landscape. Deer used mottes, and thus root-plowing in a strip motte pattern may serve its intended purpose, justifying the additional cost and time.

Cooperative funding provided by the USDA Natural Resources Conservation Service, the Jack R. and Loris J. Welhausen Experimental Station, and the ExxonMobil Corporation.

Treatment area after root-plowing a strip motte pattern.

Thermal Ecology of White-Tailed Deer and Cattle in South Texas

Jacob L. Dykes, Randy W. DeYoung, Timothy E. Fulbright, David G. Hewitt, Charles A. DeYoung, J. Alfonso Ortega Santos, Aaron M. Foley, Landon R. Schofield, and Tyler A. Campbell

Summer heat in South Texas can be brutal for animals to cope with, and corresponds with stressful life events such as growth and reproduction. Seeking shade helps alleviate heat stress, but may lead to competition with other species if shade is sparse. We deployed GPS collars on deer and cattle on the East Foundation's El Sauz Ranch in South Texas during spring 2019 to determine if deer and cattle compete for shade. Collars recorded animal locations every 30 minutes. We compared how deer and cattle used woody and open areas throughout the day and deployed 100 thermometers throughout the site to determine the effect of temperature on animal use.

- During the hottest part of the day, deer selected woody cover while cattle selected grasslands. At night, early morning, and evening, male deer and cattle selected grasslands while female deer selected woody cover or showed no preference.
- Deer and cattle selected greater canopy cover midday, and cattle selected greater vegetation density midday. Greater canopy cover produced lower temperatures during midday, while temperature increased with vegetation density.
- Mean distance between deer and cattle within woody cover during June – September was > 5,900 feet and ranged from 2,578 feet – 12,273 feet, indicating that the species rarely interacted. Deer and cattle remained separated throughout summer.

- Woody cover is important to deer during hotter periods and is used by both deer and cattle but at different times. Managers should promote areas offering adequate woody canopy cover and consider wildlife and livestock interactions when managing the landscape.

Cooperative funding provided by the Zachry Foundation

Experimental pen with shade cloth treatments.

Shade Quality Matters to Deer During Summer Heat

Jacob L. Dykes, Austin K. Killam, Randy W. DeYoung, Evan P. Tanner, Michael J. Cherry, and Clayton D. Hilton

South Texas summers produce extreme heat, which can stress wildlife. Seeking shade is a common behavior to cool down, reducing radiant heat gain by 30%. However, all shade isn't equal, as natural vegetation often produces dappled shade. We offered captive white-tailed deer varying qualities of shade in South Texas during summers 2020 and 2021 to understand when deer select for shade. The only shade available at midday was created by mesh cloth arranged in panels that blocked 30, 60, or 90% of sunlight. We conducted 14 trials with different combinations of deer. We recorded the ambient temperature as well as the operative temperature, which accounts for heat gain or loss from all sources, including sunlight and wind. We tallied deer preference for shade during the hottest part of the day using time-lapse cameras.

- Average ambient temperature was 96° F, and average operative temperature in the open was 117° F. Operative temperature decreased with greater shade quality, where temperature in 30, 60, and 90% shade averaged 112, 106, and 101° F.
- Deer preferred denser shade as ambient temperature increased, but showed no preference until ambient temperature exceeded about 84° F.
- Our results emphasize the importance of shade resources for deer, as denser shade was up to 11° F cooler than partial shade and 16° F cooler than in the open.
- Land managers should consider thermal cover when designing management plans and retain woody cover capable of producing dense, high-quality shade.

Cooperative funding provided by the Zachry Foundation

Shade is a coveted resource by both deer and cattle.

Evaluating the Use of Drones for Daytime Surveys of White-Tailed Deer

Jesse Exum, Aaron M. Foley, Randy W. DeYoung, David G. Hewitt, Jeremy A. Baumgardt, Humberto L. Perotto-Baldivieso, and Michael T. Page.

Estimates of white-tailed deer population sizes can be generated via a variety of methods including aerial, spotlight, and trail camera surveys. It is unknown whether drones can be used as an alternative method to estimate population sizes of white-tailed deer. We used a drone with a thermal camera to conduct repeated fixed-width transect surveys during the mornings in February – April 2020 on 5 sites in South Texas; sites had different vegetation and terrain characteristics.

Deer were missed on all 5 sites. We detected 50–64% of deer in the 3 sites comprised of flat brush country, but only detected 48% of deer in the hilly site. Detection probability in the grassland could not be generated because there was low contrast between the heat signature of deer and the grassland.

- Drone-based population estimates from the 3 brush country sites were comparable with helicopter, spotlight, and trail camera population estimates whereas the drone estimate from the hilly site was ~60% lower than the helicopter estimate.
- Our results indicate that thermal-based drone surveys during the morning hours can be used to generate comparable population estimates.
- However, drone surveys were affected by vegetation and terrain which suggest that use of drones may be limited to certain habitat types.
- Additionally, thermal contrast between the deer and the background became difficult when ambient temperatures were >70° F which may limit opportunities for conducting daytime surveys in South Texas.

Cooperative funding by Dallas Safari Club, Arroyo, Sweden, GMD, Dolores-Needmore, and Zacatosa ranches.

Precision of Ratio Data from Helicopter Surveys of White-Tailed Deer

Aaron M. Foley, Randy W. DeYoung, and David G. Hewitt

Aerial surveys are frequently conducted to estimate population sizes and sex ratios of white-tailed deer. Surveys are often designed to ensure population estimates are precise, but little attention is placed on whether sex ratios are precise or not. We evaluated 180 helicopter surveys of white-tailed deer across 5 years from 37 wildlife management units in South Texas to assess whether sex ratios are precise enough for a monitoring survey (moderate precision) or for a survey appropriate for an intensively managed population (high precision). Surveys were flown at 25 or 50% coverage during September.

- Precision was largely appropriate for monitoring surveys, not for surveying intensively managed populations. Most buck to doe (96%) and fawn to doe ratios (92%) had precision appropriate for monitoring surveys. Mature to immature buck ratios had the lowest precision (72%).
- Precision appropriate for intensive management required ~200 ratio-specific detections (buck+doe or fawn+doe) whereas ~50 ratio-specific detections were needed for monitoring surveys.
- Our results show that ratio data from helicopter surveys are likely not precise enough to detect significant changes between years. Thus, management actions should be based on trends from multiple years particularly for mature to immature buck ratios. The relatively imprecise mature to immature buck ratios have implications for understanding impacts of male harvest and changes in male age structure due to chronic wasting disease.
- There is a trade-off in terms of precision vs survey costs. Survey coverage could be increased to increase precision, but that increases costs and possibly double-counting. Managers should design helicopter surveys based on population demographics of interest.

Cooperative funding provided by King Ranch, Inc., and East Foundation.

Mature South Texas white-tailed deer buck.

Accuracies and Biases of Ageing White-Tailed Deer in Semiarid Environments

Aaron M. Foley, John S. Lewis, Oscar Cortez , Jr., Mickey W. Hellickson, David G. Hewitt, Randy W. DeYoung, Charles A. DeYoung and Matthew J. Schnupp

Variation in estimated ages of white-tailed deer via tooth wear and replacement (TRW) has often been attributed to environmental conditions or visual bias but has never been quantified. Additionally, accuracy of ageing via TRW and cementum annuli (CA) has not been evaluated. We used differences between TRW and CA estimates from 5,117 harvested males to evaluate the environmental effects on tooth wear. We also quantified accuracy of TRW and CA age estimates from 134 known-age deer and developed a modified TRW ageing method that minimized errors.

- Estimated ages based on TRW had high variation, and effects of drought, supplemental feed, and soil sandiness did not alter estimated TRW ages by ≥1 year. Deer with abnormally small or large antlers and body size affected estimated TRW ages but such instances were rare. Most variation in tooth wear was individualistic; each deer had its own unique tooth wear pattern.
- Evaluation of known-age deer mandibles revealed that CA was more accurate than TRW, especially for older deer (≥5.5 years old). Accuracy ranged from 18–79% for TRW and 45–69% for CA. CA and TRW were ±1 year of true age 93% and 87% of the time, respectively.

Research volunteers prepare to release a deer after capture via aerial net gunning.

- Wear on the first molar was most correlated with known age. A modified TRW ageing method that placed deer into 2, 3–5, and ≥ 6.5 years of age classes using characteristics of only the first molar improved accuracy to 68–73%.

Cooperative funding provided by A. R. Sanchez, Jr., Carl Rush, Carlos Y. Benavides II, International Bank of Commerce, Joe Finley, King Ranch, Inc., and Texas Parks and Wildlife Department.

Salinity Effects on Water and Dry Matter Intake

Austin K. Killam, Clayton D. Hilton, David G. Hewitt, Aaron M. Foley, and Natasha L. Bell

Surface water in the southwestern United States is often limited due to drought. Large mammals in this environment are forced to rely on pumped ground water or rapidly evaporating pools of poor-quality water that may contain high (≥7,000 ppm) levels of salt and dissolved solids. White-tailed deer consume 2-3% of their body weight in dry matter, but volumes of water consumption are unknown. To evaluate the impact of water salinity on water and dry matter intake of male white-tailed deer we offered water and feed ad libitum at varying (1,000, 2,500, 4,000, 6,000, and 7,500 ppm) salinity levels during 10-day trials in spring, summer, and autumn.

- During spring, summer, and autumn trials, we observed no differences in dry matter intake among water salinity treatments. Our results confirmed previous research that white-tailed deer consume between 2-3% of their body weight in dry matter.
- During spring and summer, white-tailed deer consumed ≥ 2% more of the higher salinity water than lower salinity water. We saw a similar trend during the autumn trial, but the increase was ≤ 1%.
- In spring and summer trials, white-tailed deer water intake was 8-12% of body weight. Water intake during autumn was lower (6-10% of body weight).
- We observed no negative health consequences of deer consuming water with salinity up to 7,500 ppm.
- Our results show that white-tailed deer have a wide tolerance for salinity in drinking water, and that water sources with up to 7,500 ppm salinity will support deer's needs.

Cooperative funding provided by the Albert and Margaret Alkek Foundation.

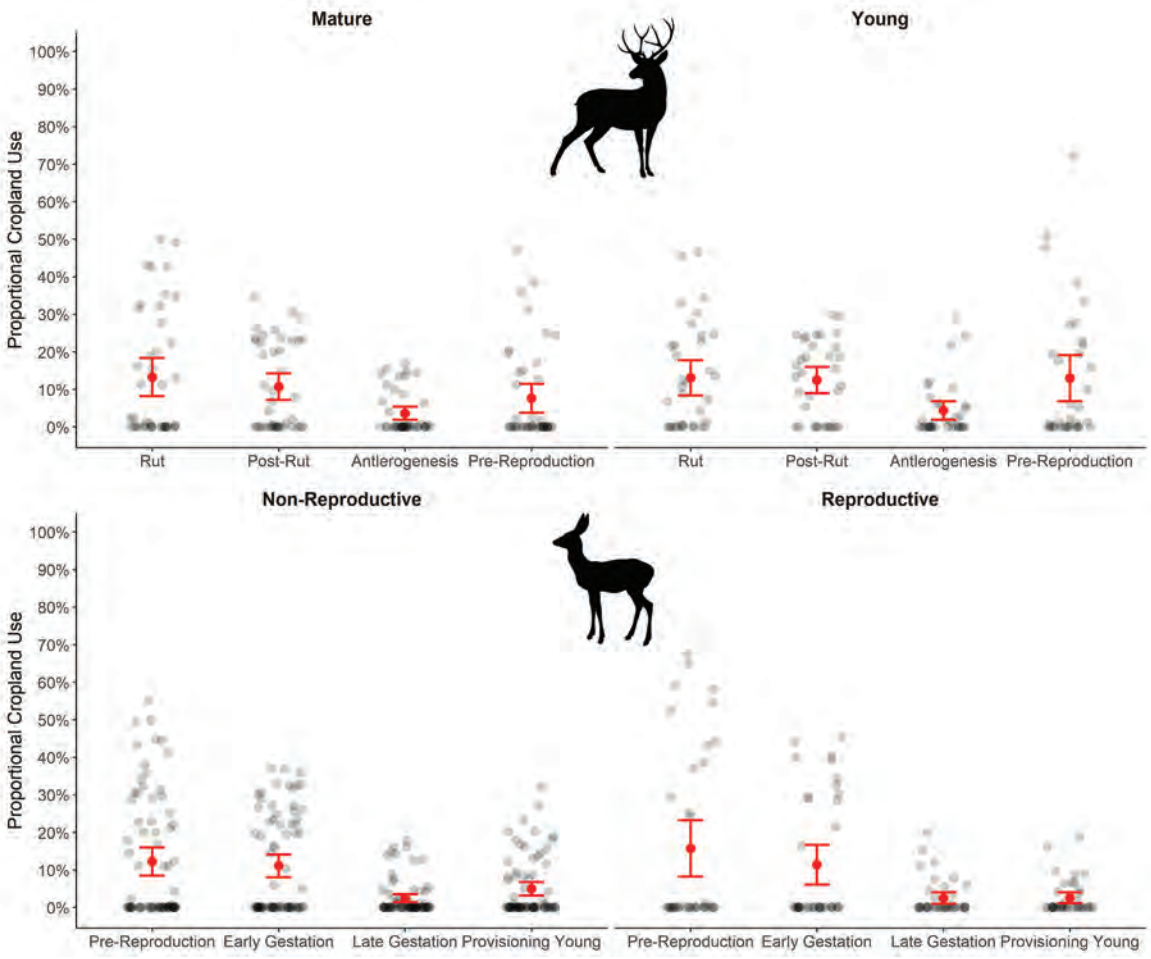
Cropland Influences on Mule Deer Size and Population Performance

Levi J. Heffelfinger, David G. Hewitt, Warren C. Conway, Timothy E. Fulbright, Randy W. DeYoung, Aaron M. Foley, Louis A. Harveson, and Shawn S. Gray

The Southern Great Plains is an area of extensive crop production. Crops may be a source of high-quality forage for mule deer that live in these areas, but crops are not always available. Additionally, the human population is only growing, so if cropland replaces other native forage sources, then this landscape alteration may be detrimental to mule deer populations. We placed GPS collars on 146 adult mule deer and took various body size and nutritional indicator measurements annually. We evaluated the ways in which cropland use by mule deer influenced body size metrics, survival, and reproduction.

- Males that had access to croplands had greater body condition (2.5% more body fat) than those that did not.
- Of males that accessed cropland, young males (2 to 3-year-olds) weighed more and had larger antlers with increasing use of cropland immediately after the rut.
- Cropland use had no influence on size of adult females.
- Cropland use during pre-pregnancy and early pregnancy increased the probability of a female successfully producing fawns.
- Cropland did not seem to limit mule deer size or population performance in the Texas Panhandle; in fact, it may act as a nutritional buffer or enhancement during years of reduced native forage such as drought or harsh winters.

Cooperative funding provided by Texas Parks and Wildlife Department, Boone and Crockett Club, and the Mule Deer Foundation.



Average proportional use of cropland during varying life stages of mature and young males (top) and non-reproductive and reproductive females (bottom). Red estimates are population averages and gray dots represent individual deer.

Mule Deer Movement Relative to Agriculture in the Texas Panhandle

Levi J. Heffelfinger, David G. Hewitt, Warren C. Conway, Timothy E. Fulbright, Randy W. DeYoung, Aaron M. Foley, Louis A. Harveson, and Shawn S. Gray,

Native rangeland conversion to row-crop farming is a large form of habitat fragmentation in the United States. Mule deer populations have been stable, but have increased in the Texas Panhandle, an area of extensive row-crop production. Our objectives were to evaluate how presence of agriculture influenced mule deer home ranges and habitat use. We placed GPS collars on 69 male and 77 female adult mule deer across 4 sites of varying cropland densities.

- Male home range size averaged 10,090 acres and females averaged 2,652 acres. Home ranges rarely occurred in areas where >40% of the landscape was agriculture.
- Cropland was preferred during the months of January-March and July-August and avoided the rest of the year. Even during the preferred months for cropland, mule deer only averaged 3-14% of their time in crop fields.
- 25-30% of the population preferred winter wheat and alfalfa; whereas, milo, corn, peanuts, and cotton were minimally used. The remainder of the population showed no preference for specific crop types.
- Less than 10% of the population made long distance movements toward croplands and they were all males during the rut.
- Understanding the influence of human-induced changes on the landscape will enhance knowledge towards human-wildlife interactions and aid in management planning for mule deer in the Great Plains.

Mule deer during fall in the Texas panhandle.

Cooperative funding provided by the Texas Parks and Wildlife Department, Boone and Crockett Club, and the Mule Deer Foundation.

Mule deer in the Texas Panhandle where croplands may act as nutritional buffers to reduced forage availability brought about by a changing climate.

Nilgai Inventory at Palo Alto Battlefield National Historical Park

Jeremy A. Baumgardt, Allison H. Hendryx, Connie L. McCune, Dessa J. Dale, and David G. Hewitt

The Palo Alto Battlefield National Historical Park is the site of the first major battle of the U.S.-Mexican War, which occurred on May 8, 1846. Located on 3,400 acres near Brownsville, TX, the area is managed and operated by the National Park Service, with the goal of maintaining the site in historic condition. This goal is complicated by changes in land use and management in the region. Much of South Texas, including the Battlefield, has been impacted by nonnative species of plants and animals, including exotic grasses, wild pigs, and nilgai antelope. To guide restoration efforts, the Park Service needs a way to estimate abundance of exotic plants and animals. Aerial or spotlight surveys are useful, but only index the population at a given time period. Game cameras offer a means to estimate populations over time.

- We evaluated population estimation methods for nilgai antelope that can be applied to a site the size of the Battlefield, where the total land area may be smaller than the home range of an individual nilgai.
- In February 2021, we began a year-long project where we used game cameras spread across the park to record photos of wildlife. We collected over 22,000 photos of nilgai, which we used to estimate a density of 1 nilgai per ~23 acres.
- Nilgai were more commonly observed in mixed-brush areas where exotic grasses were common than in open areas dominated by native gulf cordgrass. This camera-based method appears to be a feasible method for monitoring populations of nilgai on similar-sized properties.

Cooperative funding by the National Park Service.

Multiscale Habitat Selection of Nilgai Antelope

Kathryn M. Sliwa, Jeremy A. Baumgardt, Randy W. DeYoung, J. Alfonso Ortega-Santos, David G. Hewitt, John A. Goolsby, and Kimberly H. Lohmeyer

Foraging activities and resource availability can influence the home range size and movement of animals. Understanding how a species selects habitat features across a landscape can provide managers information for management. Nilgai antelope are an exotic ungulate species that has naturalized in South Texas. Nilgai are suitable hosts for cattle fever ticks, which can transmit bovine babesiosis, a deadly disease in cattle and a major concern for livestock producers. Nilgai are a large animal that consumes both grass and browse, a diet that may overlap with both native white-tailed deer and cattle, depending on the time of year and range condition. Although nilgai have been in Texas for almost a century, there is very little information on nilgai ecology and habitat selection.

- We used GPS radio collars to monitor 28 adult nilgai during 2019–2020. The collars collected a location every hour for 1 year. We compared the GPS locations to a map of vegetation types to assess nilgai preference and avoidance.
- Nilgai selected for woody, herbaceous, and mixed cover at the landscape level and within their home ranges. Areas with greater brush cover are commonly used by nilgai and also are suitable habitat for the cattle fever tick.
- Eradication efforts include use of treated cattle to remove ticks from the landscape. However, areas where wildlife hosts and cattle do not overlap can act as a source of re-infestation.
- Understanding how nilgai use the landscape can aid in the creation of a better cattle fever tick eradication plan for South Texas.

Cooperative funding provided by the USDA Agricultural Research Service and the Pinnell Family.

Can Remote Cameras Be Used to Assess Tick Loads on Nilgai Antelope?

Nadia N. Castanon, Kathryn M. Sliwa, Jeremy A. Baumgardt, Randy W. DeYoung, J. Alfonso Ortega-S, David G. Hewitt, John A. Goolsby, and Kimberly H. Lohmeyer

Nilgai antelope are a free-ranging exotic species that were introduced to South Texas in the 1920's–1930's. Nilgai are a popular game animal but are also a suitable host for cattle fever ticks, which can carry a parasite that poses a major threat to the U.S. livestock industry. The ticks prefer cattle, but wildlife such as white-tailed deer and nilgai can serve as alternative hosts. Managers can monitor and treat cattle, but surveillance and treatment of wildlife is difficult at best. Nilgai have larger home ranges and movements than white-tailed deer and pose the greatest potential

to disperse ticks from infested areas. The goal of this study was to determine if remote cameras can be used as a tool to assess tick loads on nilgai.

- Between February 2019 and September 2020, we captured 140 nilgai during 5 capture events held on 3 private ranches located in Cameron County, Texas. We collected ticks from all captured individuals.
- Nilgai prefer to cross under livestock fences rather than jump over, which presents an opportunity to monitor their movements using remote game cameras. We monitored 140 fence-crossing sites with remote cameras during this period.
- We evaluated photos based on how much of the body was clearly visible and whether ticks were present. We compared prevalence of ticks on captured nilgai to camera data. We found at least some ticks on 83-98% of captured individuals. However, camera counts were much lower than physical counts due poor image quality and inconsistent view of vital areas.
- Capturing wildlife is not always an option, so use of remote cameras to monitor wildlife health could prove to be a useful tool if image quality and coverage is improved.

Cooperative funding provided by the USDA Agricultural Research Service and the Pinnell Family.

Social Interactions of Nilgai Antelope

Kathryn M. Sliwa, Randy W. DeYoung, Jeremy A. Baumgardt, J. Alfonso Ortega-Santos, David G. Hewitt, John A. Goolsby, and Kimberly H. Lohmeyer

Nilgai antelope are an exotic species that were introduced into South Texas in the 1920's. Populations have since expanded and there are currently over 30,000 free-ranging individuals in South Texas. Although nilgai have been present in Texas for almost a century, there is little known about their movements, behaviors, and social interactions. Recently, there has been increased interest in nilgai behavior due to their ability to carry and spread cattle fever ticks, which pose a threat to the livestock industry. The goal of this study is to better understand the nilgai social system, or how the sexes and different age classes interact throughout the year.

We captured 40 nilgai during 2019 and 2020 and fitted them with satellite GPS collars that collected a location every hour. We then used the GPS information to define nilgai home ranges and monitor interactions between individuals. We also extracted DNA from tissue samples collected from the collared nilgai and used genetic markers to calculate relatedness among individuals.

- We found 64 pairs of nilgai whose home ranges overlapped by at least 10% and therefore had the opportunity to interact.
- Some pairs of adult nilgai interacted closely for several days to weeks, followed by a multi-day or week separation, then resumed interactions.
- Genetic analysis revealed that pairs of adult females in the area were unrelated. Pairs of adult males were generally more related regardless of their degree of home range overlap.
- Our results suggest that nilgai have a loose social structure that changes throughout the year. The social interactions of nilgai can aid in the understanding of population dynamics and space use, and provide insight for disease management strategies.

Cooperative funding provided by the USDA Agricultural Research Service and the Pinnell Family.

A nilgai is released after being fitted with a GPs collar to track its movements.

Forecasting Bobwhite Abundance in South Texas Using Roadside Surveys

Alejandro Bazaldua, Fidel Hernández, Aaron M. Foley, Andrea Montalvo

Over the past 30 years, northern bobwhite populations have been declining throughout the U.S. Texas is one of the last remaining strongholds for bobwhites, and they are an important gamebird in the state. Developing reliable measures of population abundance therefore is important for landowners to appropriately plan bobwhite harvest.

Currently, landowners use anecdotal observations or regional trends to forecast the upcoming quail-hunting season. This approach is limited because it either is subjective or lacks fine-scale resolution. The goal of our research is to develop a more precise and finer-scale estimate of bobwhite abundance for South Texas. Our objectives are to quantify the relationships between bobwhite relative abundance, landscape characteristics (e.g., % cover of rangeland, urban, or water) and rainfall to build a spatial map of bobwhite abundance across South Texas.

We will conduct roadside surveys along established routes in 15–20 ranches in South Texas. Surveys will be conducted every 15 days during August–September 2022–2023 to estimate relative abundance (no. quail/mile). Using GIS, we will quantify the landscape composition and rainfall occurring within a 15-mile buffer surrounding each route. We will use these data to quantify the relationship between bobwhite relative abundance and landscape characteristics and rainfall. We will use this relationship to build a spatial map predicting bobwhite relative abundance across South Texas.

Developing an annual map of the spatial abundance of bobwhites will provide landowners a tool to better forecast and plan harvest for the upcoming quail-hunting season.

Cooperative funding provided by the Harvey Weil Sportsman Conservationist Award, Quail Associates Program, Charity Quail Weekend, Inc., and the South Texas Chapter of Texas Quail Coalition.

Projects from the Richard M. Kleberg, Jr. Center for Quail Research

Bobwhite quail can sometimes be found in a tree, such as this one posing for a photo, but they typically stick to the ground. Roadside surveys have a long history of use to estimate bobwhite abundance in Texas. Researchers are using roadside surveys to develop a spatial map of bobwhite abundance in South Texas that can help forecast the season.

Cattle Grazing and Northern Bobwhites

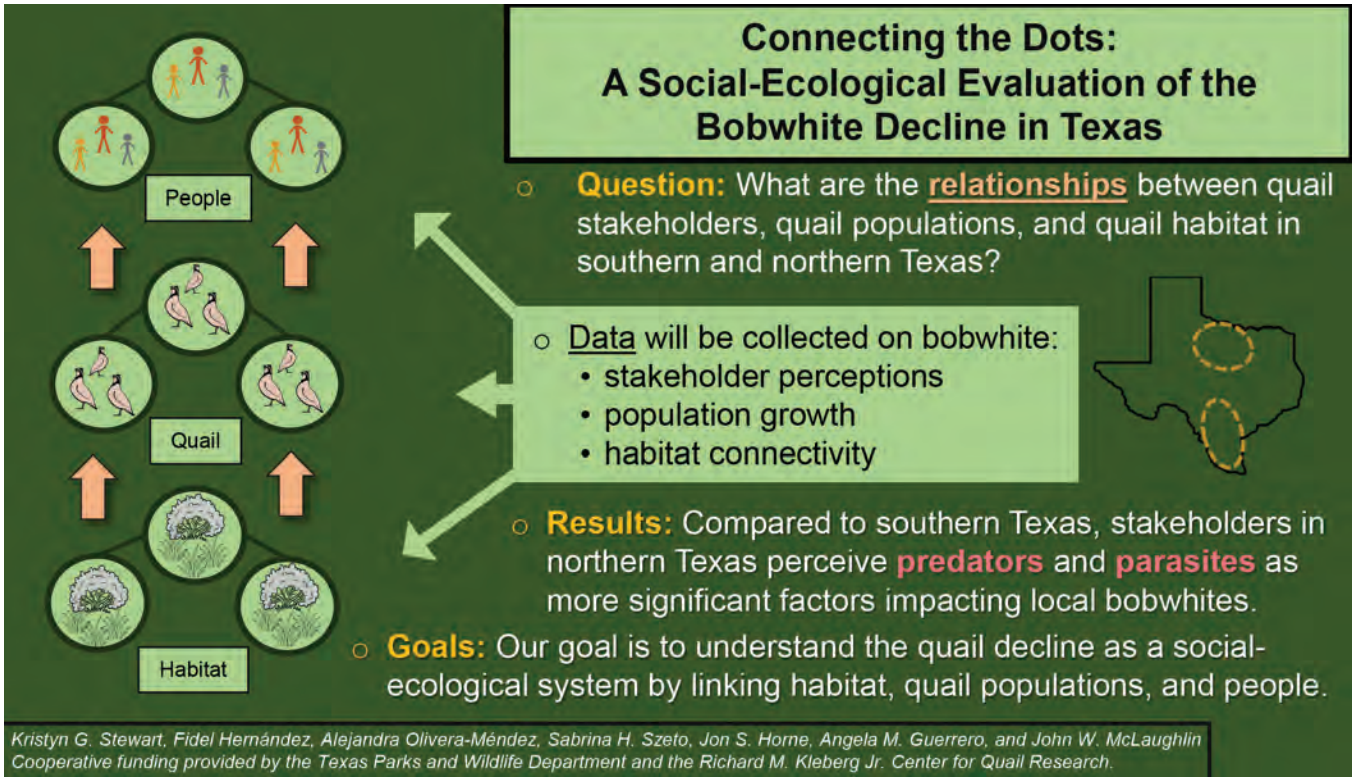
J. Silverio Avila-Sanchez, Bradley K. Johnston, Humberto L. Perotto-Baldivieso, J. Alfonso Ortega-S., Leonard A. Brennan, Fidel Hernández, and Jason W. Karl

Northern bobwhites (hereafter 'bobwhites') are declining due to habitat loss, fragmentation and unfavorable management impacts to habitat. Cattle grazing and trampling can improve bobwhite habitat because they open up the grass canopy and reduce bunchgrass height for nesting. However, when stocking rates are too low or too high they not improve bobwhites' habitat. Therefore, we will study the spatial and temporal interactions between bobwhites and cattle in South Texas rangelands.

We will calculate stocking rates to manage grazing utilization and meet the optimal forage height to benefit bobwhites for nesting and movement. We will deploy 15 GPS collars on cattle to quantify the spatial and temporal distribution of cattle in the pasture. We will also monitor quail activity with radio collar transmitters. We will evaluate vegetation in areas where quail and cattle locations have been recorded. We have vegetation transects and exclosures randomly located across 2 pastures of 2,500 acres each to estimate utilization. We will compare the 2 pastures, where one pasture is grazed and one pasture is not grazed. We will monitor grass and forb cover and structure, and forage production and utilization. We will relate cattle and bobwhite locations with vegetation data.

This information will help us understand how a grazing regime can help modify vegetation structure to improve bobwhite habitat. This research will provide data on interactions between bobwhites and cattle. This has direct implications for the development of cattle-bobwhite habitat management strategies in South Texas.

Cooperative funding provided by Sweden Ranch, CONACYT, The Ken Leonard Fund for Livestock Interactions Research, and The Rotary Club of Corpus Christi Harvey Weil Sportsman Conservationist Award.



Female northern bobwhite with a VHF radio collar.

Rainfall Effects on Bobwhite Reproduction

Lindsey K. Howard, Fidel Hernández, Clayton D. Hilton, and David G. Hewitt

Northern bobwhite populations display "boom and bust" dynamics, with population sizes drastically changing from year to year. It is widely accepted that these fluctuations are related to rainfall, but the exact cause of this relationship is unknown.

Birds use 2 categories of information to time reproduction: long-term predictive cues (such as daylength) and short-term environmental cues (such as weather). Short-term cues adjust breeding to local conditions, and rainfall itself or changes in landscape appearance, such as the change in vegetation color that occurs from brown to green after rainfall, may be acting as environmental cues that trigger quail breeding. Our objective is to test this hypothesis and evaluate if rainfall events and vegetation color serve as reproductive cues for bobwhite in semi-arid environments.

To investigate vegetation color (summer 2022), 20 bobwhite hens were housed in aviary cages with 1 of 4 color treatments: a brown treatment with dry vegetation, a green treatment with lush vegetation, a switch treatment in which vegetation color will change from brown to green, and a control. The birds' reproductive hormone levels and egg-laying rate will be monitored throughout the study. To investigate rainfall events (summer 2023), bobwhite hens will be exposed to natural rainfall and the same variables will be monitored.

Our results will give a better understanding of what connects the "boom and bust" dynamics of quail to rainfall, as well as increase general knowledge about bird reproduction in semi-arid environments. This information will inform management in areas of unpredictable rainfall and will help predict the results climate change may have on desert birds.

Funding for this project is provided by the South Texas Chapter of Quail Coalition and the South Texas Charity Weekend, Inc.

Dry, brown vegetation dominates the landscape during drought conditions, which may serve as environmental cues that inhibit reproduction. Photo taken in Kleberg County, Texas.

Helicopter conducting an aerial survey for bobwhite quail in South Texas.

Winter Aerial Distance Sampling Surveys for Bobwhite Quail

Zachary J. Pearson, Leonard A. Brennan, Andrea Montalvo, Humberto L. Perotto-Baldivieso, Fidel Hernández

Distance sampling is a survey and analysis method which allows biologists to estimate population abundance. In 2008, King Ranch began incorporating helicopter-based distance sampling surveys for bobwhites to establish spatially explicit harvest quotas. Over this period researchers have worked to refine the survey protocols and data collection systems used to conduct these surveys to increase the precision of abundance estimates. In this study we summarized survey effort by year, estimated bobwhite abundance using distance sampling, and compared abundance estimates using the designated transect line and the actual flight path as a baseline for observation.

Winter quail surveys conducted from 2010 to 2021 accounted for 7,090 miles of transects and 7,545 bobwhite covey observations with an average covey size of 8.8 birds. Pasture level estimates of abundance fluctuated annually from 0.3 to 5.5 quail per acre. Abundance estimates had similar levels of precision when using the designed transect line or the flight path. This information helps guide the use of distance sampling analysis for long-term population monitoring.

Cooperative funding provided by the Alice Gertrudis King Kleberg Reynolds Endowed Fellowship in Quail Research, King Ranch, Inc., South Texas Quail Coalition, and the Hill Country Quail Coalition.

Testing for Drought-Legacy Effects in Northern Bobwhite in Texas

John E. Herschberger, Fidel Hernández, John T. Edwards, and David B. Wester

Northern bobwhite are known to fluctuate in response to rainfall. However, population responses often are less than expected given the amount of rainfall in a particular year. We are investigating whether this occurrence may be resulting from drought-legacy effects. Drought-legacy effects occur when the influence of drought persists on a system well after the drought has subsided, a phenomenon known to occur in grasslands. The objectives of our study are to quantify the relationship between bobwhite abundance and current-year and prior-years' rainfall to evaluate the existence of drought-legacy effects.

Our study will focus on both southern and northern Texas. We will use a long-term dataset (1978–present) of bobwhite relative abundance collected by Texas Parks and Wildlife Department and annual rainfall data from PRISM to analyze the influence of current- and prior-years' rainfall on bobwhite abundance in each ecoregion.

We predict that the relationship between quail and rainfall will be stronger when both current-year and prior-year rainfall are considered than when only current-year rainfall is considered. Such a finding would provide support for the possible existence of drought-legacy effects in bobwhite populations and allow ecologists to better predict the possible impacts of climate change.

Cooperative funding provided by the Elliot B. & Adelle Bottom Fellowship in Quail Research, and the South Texas Chapter of Texas Quail Coalition.

The amount of biomass produced in grasslands is influenced not only by current-year rainfall but also prior-year rainfall, a phenomenon known as drought-legacy effects.

Range-Wide Assessment of Chestnut-bellied Scaled Quail in South Texas

Caleb M. McKinney, Evan P. Tanner, Leonard A. Brennan, Ashley M Tanner, Humberto L. Perotto-Baldivieso, and Fidel Hernández

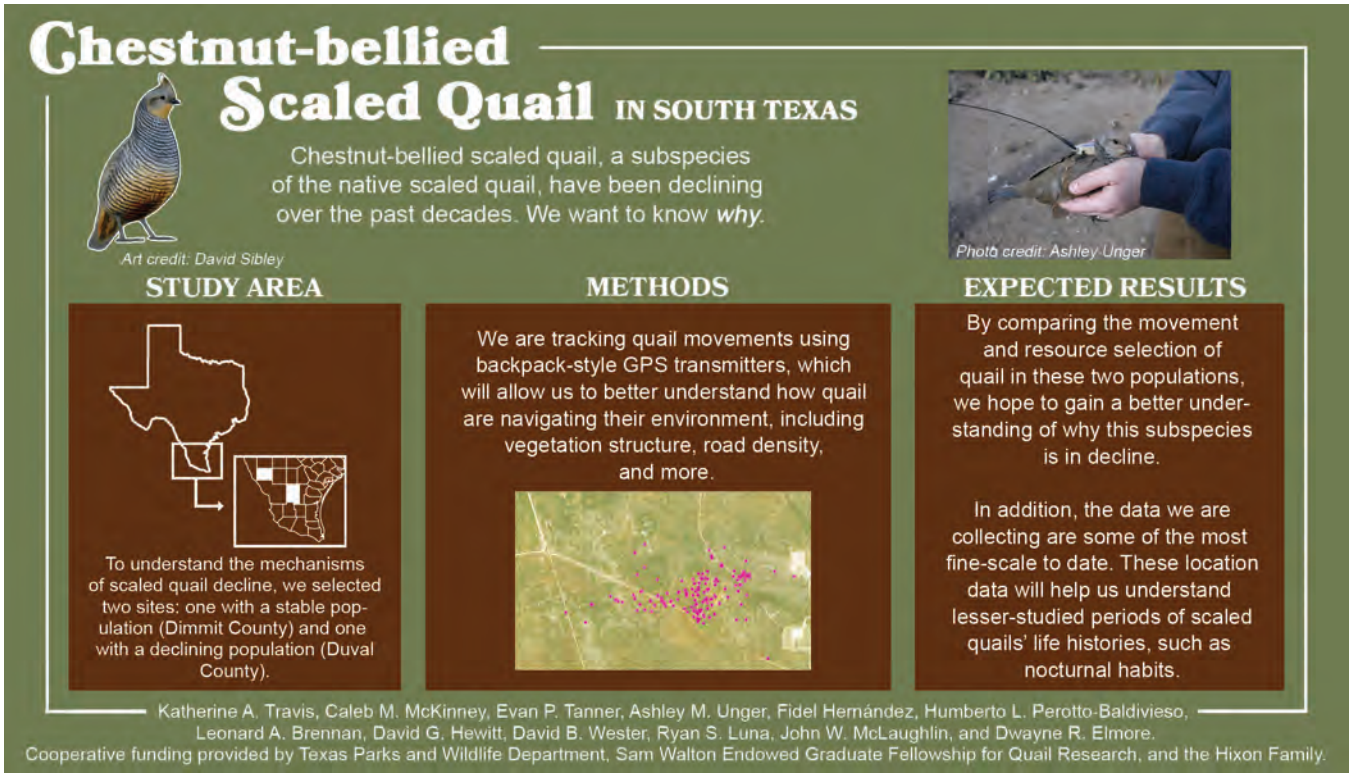
Chestnut-bellied scaled quail are a subspecies of scaled quail native to South Texas, and they have experienced significant range-wide population declines in recent decades. Habitat loss and fragmentation have been suggested as primary factors behind scaled quail declines, but more research is needed to understand the scale at which habitat fragmentation affects scaled quail populations.

We began our research in January 2022 at two field sites located on private ranches in Duval and Dimmit Counties, Texas. We attached backpack-style GPS transmitters to chestnut-bellied scaled quail, becoming the first research project to do so. Transmitters will provide us the opportunity to study scaled quail movement and habitat use with frequency and accuracy that was impossible with previous technology. We are also performing 5-minute point count surveys to detect scaled quail occupancy at 170 random locations on each ranch.

We will use results from our occupancy surveys and GPS monitoring to help create models to predict how scaled quail populations change. The models will be useful over longer timeframes and larger areas than we are able to study on our sites. Models will also use long-running citizen science data along with data collected by other researchers and Texas Parks and Wildlife Department.

Our results will help identify factors on the landscape that influence scaled quail occupancy and dispersal, and drive population trends. This will help inform management decisions for an important game species that is experiencing range-wide population declines.

Cooperative funding provided by the Texas Parks and Wildlife Department, the Sam Walton Endowed Graduate Fellowship for Quail Research, and the Hixon Family.



Genetic Analysis of Wild Turkey Across Oklahoma

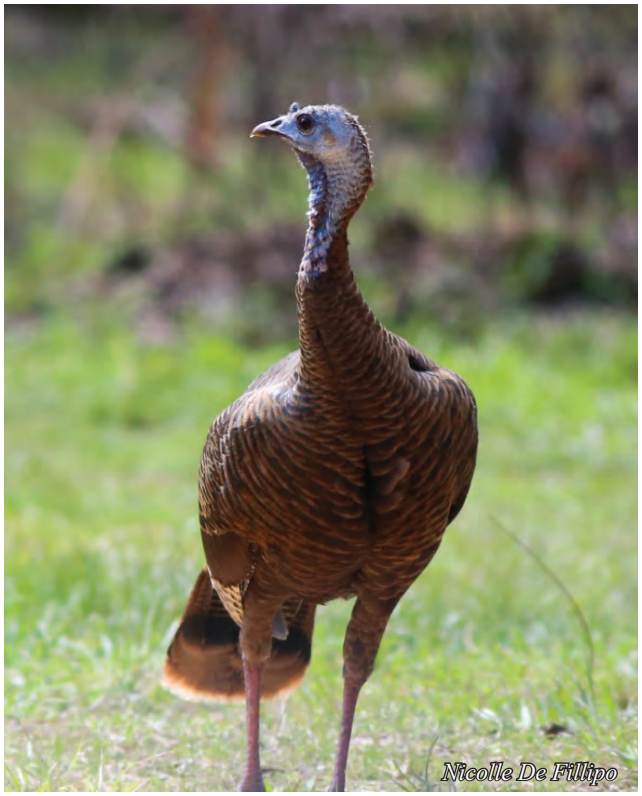
Michael R. Barrett, Evan P. Tanner, and Randy W. DeYoung

Wild turkeys are a well-known conservation success story within the United States. However, population declines have prompted wildlife agencies to become concerned with the future of these valuable game birds. Oklahoma Department of Wildlife Conservation (ODWC) has documented a declining number of turkeys across their range. Considering this decline, we will use genetic techniques to better understand spatial patterns and potential barriers to genetic diversity of wild turkeys across Oklahoma.

Beginning in the Spring 2022 harvest season, we coordinated with ODWC, the National Wild Turkey Federation, the Oklahoma Tribal Nations, and private citizen scientists to collect tissue samples from hunter-harvested birds. Genetic sample numbers ranged from 1 to 12 samples per county. A total of 117 samples were collected across 41 Oklahoma counties. In the coming year, these samples will be used to determine genetic diversity, gene flow and connectivity between populations. This research should also indicate the amount of hybridization between subspecies of turkey within the state.

Sample collection will continue during the next three years. We seek to increase both number of samples collected and coverage across the state. By collecting a greater number of samples across a wide range, we can improve our understanding of the current genetic makeup of wild turkey populations. Increased understanding of genetic health will allow ODWC to determine conservation and management priorities and identify specific areas to promote recovery of turkey populations within Oklahoma.

Cooperative funding provided by the Oklahoma Department of Wildlife Conservation.



Wild Turkey at Oklahoma State University research station in Southeastern Oklahoma.

Monitoring Turkeys in Burned and Non-Burned Areas

Kaylee L. Lovejoy, Humberto L. Perotto-Baldivieso, William P. Kuvlesky, and Jason V. Lombardi

The Rio Grande wild turkey ('wild turkeys') is a key game bird species in the Texas wildlife community. They have an important ecological role with insect and native seed consumption and as part of the native food chain. Wild turkeys are of aesthetic and economic value to private landowners, and they are one of the most popular gamebirds in the United States.

In March 2022, a large wildfire spread across Kleberg County and burned 51,566 acres. This was one of the largest fires in South Texas. We will be looking at the changes in wild turkey numbers in both burned and non-burned sites in Kleberg County, Texas. We will set up trail cameras in transects that go from burned to non-burned areas. We will collect photos for a period of 4 months every year for 2 years and we will use these photos to analyze occupancy estimates. We will compare these estimates between burned and non-burned sites for wild turkeys.

We hypothesize that burned areas will likely have more turkeys than non-burned areas. This information will provide clues on how a large fire can affect wild turkeys and their distribution across pastures.

Cooperative funding provided by the South Texas Charity Weekend, Inc., the Kenedy Ranch, the Bass Ranches, the Las Huellas Association, the George and Mary Josephine Hamman Foundation, and the Rachel and Ben Vaughan Foundation.

Bobwhite Response to Cattle Grazing in South Texas

Bradley K. Johnston, J Alfonso Ortega-S., Leonard A. Brennan, Humberto L. Perotto-Baldivieso, Fidel Hernández

Management practices to sculpt brush vegetation, in combination with low cattle stocking rates to improve herbaceous vegetation for bobwhites, lead to dense stands of dominant grasses, such as four-flower trichloris. These monocultures of four-flower trichloris can become too dense for bobwhite quail while also reducing the diversity of plant species.

We have been grazing cattle to maintain a stubble height of 12 to 16 inches in a pasture dominated by four-flower trichloris in Duval County, Texas, and we also used an adjacent pasture with similar characteristics as a control with no cattle grazing.

Forage standing crop and utilization surveys were completed every 45 days while cattle were present in the pasture. Additionally, percent cover of plant species, bare ground, and litter were recorded for the grazed and the control pastures. We also completed aerial surveys of the study area.

- Percent cover of four-flower trichloris was lower in the grazed area.
- Bare ground and litter were higher in the grazed area.
- Quail density in the grazed pasture was 35% higher compared to the non-grazed across both years.
- These results show how cattle grazing can be used as a management tool to improve habitat for bobwhites in South Texas.

Cooperative funding provided by the Sweden Ranch.

Population and Habitat Assessment of the California Quail in California's Changing Landscape

Sarah K. Jacobson, Leonard A. Brennan, Humberto L. Perotto-Baldivieso, Evan P. Tanner, and Katherine S. Miller

The California quail is the most widespread of the three quail species in California. During the past half century, California has seen extensive land use changes, leading to potential habitat loss for the species due to impacts of urban development, large-scale agriculture, and changes in forest and rangeland management. For this project we determined the long-term population trend for the California quail in California and quantified how changes in land use and land cover impacted localized changes in population. We used data from the North American Breeding Bird Survey to create relative abundance maps and established random points to calculate the average number of birds detected per route from 1970 to 2017. We then identified areas with decreasing, stable, and increasing abundances and compared road density, human population density, land use, and land cover between them.

- We found that California quail had not experienced a range-wide decline in population over the past 50 years.
- The population cycled with peaks in relative abundance in the early 1980s, mid-1990s, and late 2000s.
- Areas with decreasing abundances of California quail were associated with higher human population and road density and lower percentages of litter and bare ground than areas with stable or increasing abundance.
- Our results support previous evidence that California quail is sensitive to high rates of urbanization. In certain parts of its range, periodic disturbance may be needed to create habitat for quail.
- Currently we are investigating the effects of land use for the other two quail species: the mountain and the Gambel's quail.

Cooperative funding provided by Tall Timbers Foundation and California Department of Fish and Wildlife.

Male California quail with chicks along an urban-wildland interface in Folsom, California.

Analysis of Survey Methods for Rio Grande Turkey

Chloe E. Bates, Humberto L. Perotto-Baldivieso, William P. Kuvlesky, Jr., Alfonso Ortega-Santos, Leonard A. Brennan, Jason V. Lombardi, Thomas J. Yamashita, Daniel J. Ramirez, Joshua D. Allison, Meghan E. Anderson, Michael T. Page, and Willis P. Sontheimer

Many researchers have developed, tested, and refined methods of surveying for wild turkey. Despite the knowledge gained from previous studies, Texas wildlife biologists still do not have a consistent and precise method to survey wild turkey populations in the Post Oak Savannah and Cross Timbers ecoregions of Texas. The aim of this study is to determine the most consistent and precise method to estimate Rio Grande wild turkey abundance on our study sites. We used road surveys, roost surveys and camera-traps between December and April.

On Camp Swift, 32 turkeys were detected during road surveys and 21 turkeys were detected during roost surveys. On Camp Bowie, 11 turkeys were detected during road surveys and no turkeys were detected during roost surveys. The road and roost survey methods were found to be similar on both sites. The majority of detections on camera traps was during the early breeding months of March-May. Twenty-four turkeys were detected on Camp Swift and 18 turkeys were detected on Camp Bowie during camera-trap surveys. All survey methods yielded low detections of Rio Grande wild turkeys.

- The winter non-breeding season is considered the most efficient time to survey for wild turkeys. However, the majority of camera-trap detections on both sites occurred during the breeding season.
- This indicates that for both Camps Swift and Bowie the most efficient survey method is camera-traps as they can easily be used to survey for long time periods.
- This method would allow the Texas Military Department to simultaneously reduce staff hours and expand the survey to the wintering and breeding season.

Cooperative funding provided by Texas Military Department, the Kenedy Ranch, the Bass Ranches, the Las Huellas Association, the George and Mary Josephine Hamman Foundation, and the Rachel and Ben Vaughan Foundation.

Male Rio Grande wild turkey captured by camera-trap on Camp Swift, Bastrop, Texas.

Habitat Suitability Models for Rio Grande Turkey

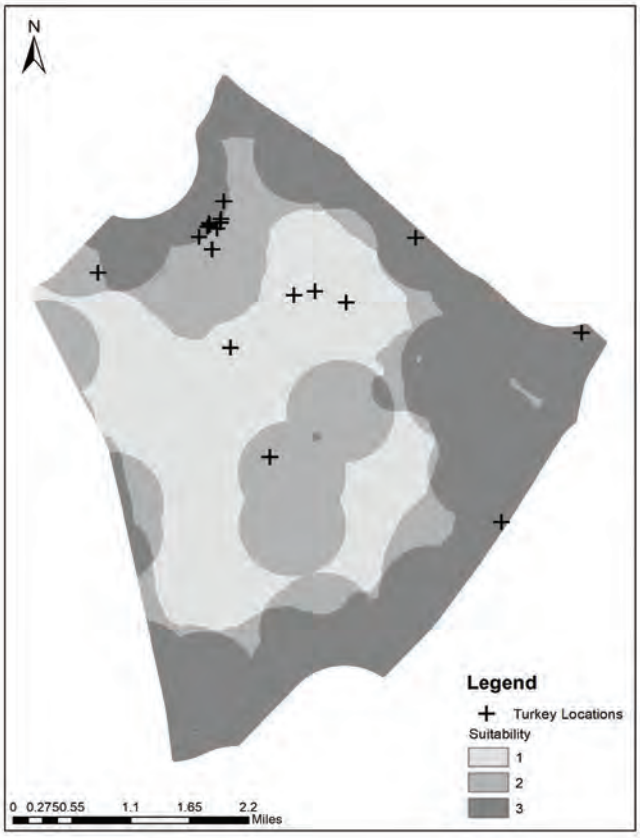
Chloe E. Bates, Humberto L. Perotto-Baldivieso, William P. Kuvlesky Jr., Alfonso Ortega-Santos, Leonard A. Brennan, Michael T. Page, and Willis P. Sontheimer

Habitat suitability models are important tools for habitat conservation and wildlife management. Our objective was to develop habitat suitability models and identify the areas most likely to harbor Rio Grande wild turkeys on Camps Swift and Bowie.

Wild turkeys select for different habitat during different seasons. With this in mind, we developed breeding season (March-August) and non-breeding season (December-February) habitat suitability models for wild turkeys. The breeding habitat suitability model showed Camp Swift habitat has 38% low suitability and 62% high suitability for Rio Grande wild turkeys. The non-breeding model showed Camp Swift habitat has 20% low suitability, 55% medium, and 25% high. The breeding model showed Camp Bowie has 5% low and 95% medium suitability for Rio Grande wild turkeys. The non-breeding model showed Camp Bowie has 17% low suitability, 77% medium, and 6% high.

- We found that the majority of habitat on Camp Swift had areas with medium suitability for breeding wild turkeys. Camp Swift non-breeding habitat was a mix of suitable and non-suitable habitat.
- We also found that the majority of habitat on Camp Bowie is only moderately suitable for both breeding and non-breeding Rio Grande wild turkeys.
- We recommend the Texas Military Department focus on habitat management for both the breeding and non-breeding season of Rio Grande wild turkey for Camps Swift and Bowie.

Cooperative funding provided by Texas Military Department, the Kenedy Ranch, the Bass Ranches, the Las Huellas Association, the George and Mary Josephine Hamman Foundation, and the Rachel and Ben Vaughan Foundation.



Habitat suitability map for breeding Rio Grande wild turkey on Camp Swift. The crosshairs represent observed turkey locations and the values represent a suitability index (1: low; 2: medium; 3: high)

Spring Migration Strategies in Northern Pintails

Georgina R. Eccles, Bart M. Ballard, Kevin J. Kraai, Daniel P. Collins, J. Dale James, Mitch D. Weegman, and Clayton D. Hilton

Migration is the seasonal movement of animals from one area to another. Birds following available resources, such as food, is thought to be the main driving force in the evolution of migration. Migration strategies broadly fall into energy-saving or time-saving strategies. Not all animals make the same choices when migrating. These differences in animal decisions on migration affect an individual's success in reproduction and survival.

Northern pintails are a species of dabbling duck that have experienced declines since the 1970's. There is evidence suggesting female decisions on spring migration influences breeding effort (e.g., likelihood to nest, number of eggs laid, number of renesting attempts, etc.). The aim of this research is to investigate the influence of spring migration behavior on breeding effort in female northern pintails.

Females were captured throughout the southwest portion of the United States and released with tracking devices. To date, we have complete spring migration data from 199 females. We will calculate several migration metrics including numbers of stopovers used, length of time spent in stopovers, total migration time, and several other metrics. We will compare migration characteristics with breeding effort, which we can infer from movement information on breeding areas. These findings will increase our knowledge about the role spring migration plays in northern pintail population dynamics.

Cooperative funding provided by Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, Ducks Unlimited, Inc., U.S. Geological Survey, Louisiana Department of Wildlife and Fisheries, Canadian Wildlife Service.

Crucial Stopovers of Spring Migrating Northern Pintails

Georgina R. Eccles, Bart M. Ballard, Kevin J. Kraai, Daniel P. Collins, J. Dale James, Mitch D. Weegman, and Clayton D. Hilton

The ecology of migratory birds during stopovers is one of the least understood aspects of bird migration. Stopover sites are where birds stop during migration to rest and feed to fuel their migratory journey. Because birds cannot make the entire migratory journey in a single flight, these sites are critical for their successful migration. Our goal is to identify characteristics of important stopover sites of female northern pintails.

We have captured female northern pintails during winter and attached tracking devices to them. These devices provide accurate locations of each marked female every hour and automatically upload information to a data portal via the cell phone network. Thus, we will be able to identify stopover sites using location data from tracking devices deployed on female pintails. We will use several geospatial datasets to help classify habitat types within each stopover site. Also, we are able to infer nesting success from location data on breeding areas based on the habitat and movement rates of females during the nesting period. With this information, we will be able to relate several characteristics of stopover sites used by female pintails with their nesting success. Thus, we hope to be able to link nesting success with aspects of migratory stopover site use. This will allow us to understand those characteristics of stopover sites that enable female pintails to reproduce successfully.

These findings will help identify important areas for spring migrating females. Further, these results could explain some of the drivers impacting northern pintail population dynamics.

Cooperative funding provided by Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, Ducks Unlimited, Inc., U.S. Geological Survey, Louisiana Department of Wildlife and Fisheries, Canadian Wildlife Service.

Spring migration tracks of female northern pintails captured on wintering areas and released with tracking devices. Inset: Northern pintail females with GPS devices.

Winter Landscape Effects on Northern Pintail Energetics

Georgina R. Eccles, Bart M. Ballard, Kevin J. Kraai, Daniel P. Collins, J. Dale James, Mitch D. Weegman, and Clayton D. Hilton

Animals spend time and energy finding food. The habitat animals live in affects where animals move to and how long they search for food and mates. Late winter is an important time for waterfowl that migrate as this is the time they prepare for migration. This includes finding enough food to fuel migration as well as pairing with mates. Understanding how the habitat composition of the landscape influences animal movement and energy can help habitat managers plan future projects for their target species.

The aim of this research is to identify the spatial design of landscape features that influence female northern pintail movements and energy in winter. Females were captured and fitted with tracking devices throughout the southwest portion of the United States. We will use several geospatial datasets to help classify land-cover types within wintering landscapes of each marked female. Several landscape metrics will be determined including the area and distribution of land-cover types. Within wintering landscapes, we will also calculate several movement metrics from each female including energy expenditure.

We will investigate how the land-cover composition of the landscape influences movement and energy expenditure by female pintails. Our results will help to better understand female winter ecology and how to prioritize habitat management on wintering grounds to optimize energy balance of wintering waterfowl.

Cooperative funding provided by Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, Ducks Unlimited, Inc., Louisiana Department of Fish and Game, and Canadian Wildlife Service.

Habitat Selection of Female Northern Pintails During the Breeding Season

Matti R. Bradshaw, James H. Devries, Jay A. VonBank, Kevin J. Kraai, J. Dale James., and Bart M. Ballard

The northern pintail is a species of waterfowl whose population is of concern for wildlife managers. This species nests in the Prairie Pothole Region of the U.S. and Canada. The northern pintail population in North America has shown a long-term decline, which is of concern to resource managers. Much of the decline is thought to come from changes in land-use practices throughout its breeding range. The goals of this project are to (1) identify habitats used by northern pintails during nesting, and (2) estimate breeding success.

We attached tracking devices to female northern pintails during winters 2020, 2021, and 2022 throughout much of the southwestern portion of the U.S. These females were allowed to migrate north to the Prairie Pothole Region where the majority of the population breeds. To date, we have had 105 females that settled in the Prairie Pothole Region during the breeding period. These areas of use will be investigated in regard to the habitat types available as well as other landscape features that may influence nesting success. Nest success can be estimated based on the specific habitats used as well as the amount of movement (i.e., if nesting females remain on the nest for most of the day). With this information we can relate the specific habitat characteristics of the nesting area to nesting success.

The results from this project will allow managers to supply resources to waterfowl breeding in the Prairie Pothole Region. Understanding the habitat needs of northern pintails during nesting appears to be one of the most important pieces of information to guide future conservation plans.

Cooperative funding provided by Texas Parks and Wildlife Department, U.S. Fish and Wildlife Service, Ducks Unlimited, Inc., Louisiana Department of Wildlife and Fisheries, and Canadian Wildlife Service.

Identifying Key Stopovers for Black-Bellied Plovers Migrating Through the North American Mid-Continent

Jason P. Loghry, Sarah J. Clements, David J. Newstead, Mitch D. Weegman, and Bart M. Ballard

During spring migration, birds manage time and energy to arrive at breeding areas in their best condition. Along the way, they stop to rest and refuel for the next leg of their journey. The areas where they stop are called stopover sites. The placement and quality of stopover sites are important aspects for a successful migration. A clear understanding of what makes a stopover site high quality is needed for effective conservation.

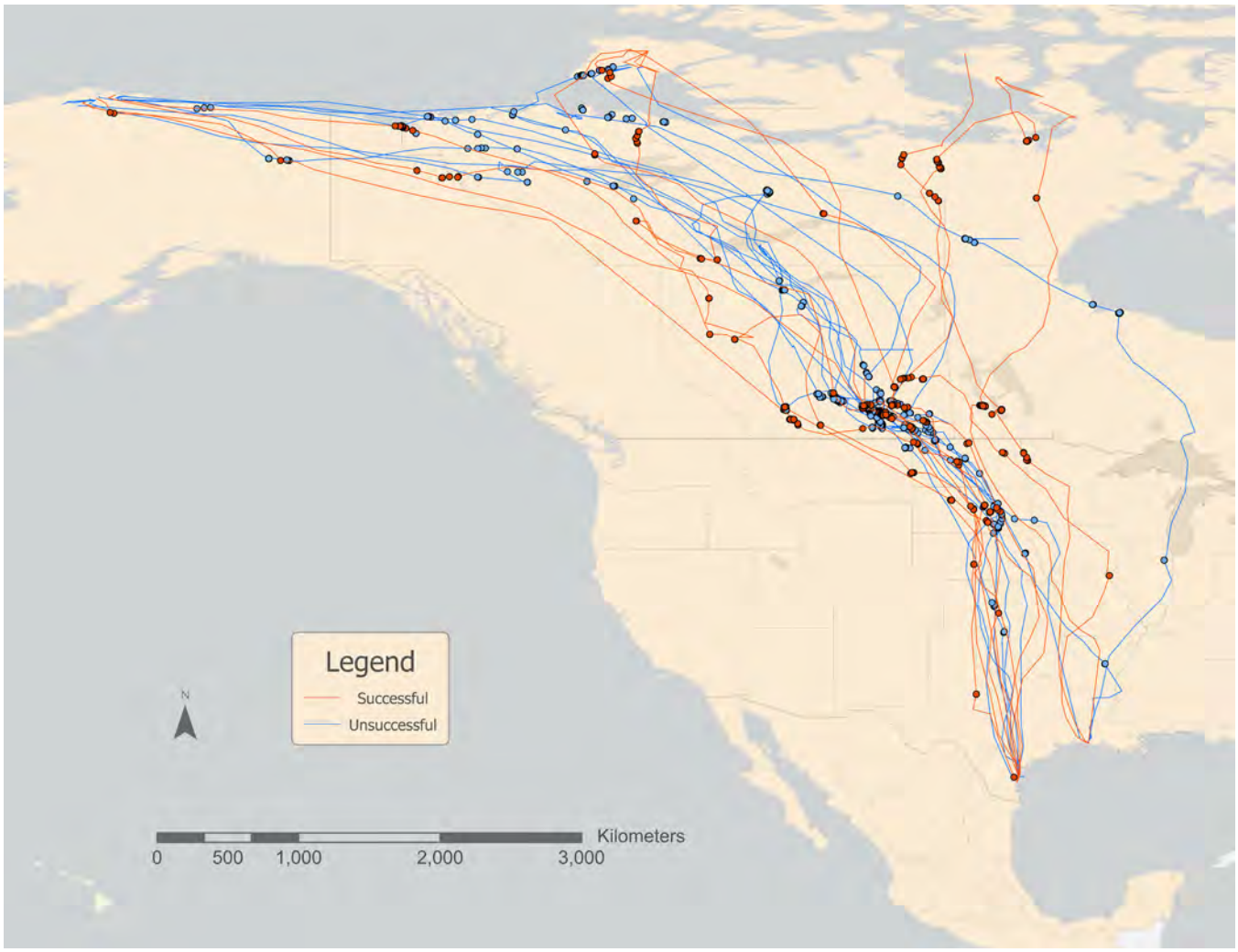
With this project, we are assessing how the black-bellied plover uses stopover sites during its spring migration. The black-bellied plover migrates through

the Texas and Louisiana coasts on its way to breeding areas in the high Arctic. We captured 24 black-bellied plovers at areas along the Texas and Louisiana coasts during early spring. We tracked their migrations to identify stopover sites throughout the mid-continent region and to identify their breeding areas in the Arctic. Almost all plovers used stopover sites in southern Saskatchewan, which appears to be a critical area to stop prior to their jump to the Arctic.

We are now looking at how the types of habitat they use might relate to breeding success. The stopoversites we have identified and subsequent links between stopover site and reproductive success will be useful to regional habitat management planners. We hope to contribute to reversing declines seen in many species of shorebirds in North America.

Cooperative funding provided by the Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation.

Black-bellied plover caught during spring on Padre Island National Seashore.



Spring 2019-2021 migration routes and stopover sites of black-bellied plovers.

Buff-Breasted Sandpiper Habitat Selection During Stopover in the Texas Gulf Coastal Plain

Tara L. Rodkey, Richard B. Lanctot, and Bart M. Ballard

Agricultural intensification has been identified as one of the largest drivers of habitat loss and global bird declines. The central North American grasslands are particularly threatened, with over 80% of these grasslands converted to agriculture and other land uses, and grassland-associated birds experiencing declines of almost equal proportion in the past half-century. The buff-breasted sandpiper is a species of shorebird that depends on grasslands to forage. It is a long-distance migrant that travels from the high Arctic to South America each year. The buff-breasted sandpiper is a species of global conservation concern due to these persistent threats of habitat loss along its migratory pathway.

The Texas Gulf Coastal Plain is the most important stop for this species along its journey. Sandpipers rest and replenish their fat stores in this region during both their spring and fall migrations. Conservation measures targeted at protecting habitat for this species are expected to also benefit many other grassland birds. Thus, an understanding of how they use habitat in this important migratory passage point is imperative to designing and implementing effective conservation plans.

We are evaluating the habitat use by buff-breasted sandpipers while they travel through the Gulf Coastal Plain in Texas. We captured over 50 birds in fall and spring 2021 and equipped them with GPS transmitters to discover what types of habitat they use, and we are aiming to equip another 50 this year. From these location data, we will build models to identify and predict high-use areas. These models will then be used to work with Texas private landowners, agencies, and conservation non-profits towards the conservation of buff-breasted sandpipers and other grassland shorebirds.

Cooperative funding provided by the Knobloch Family Foundation, U.S. Fish and Wildlife Service, Neotropical Migratory Bird Conservation Act, National Fish and Wildlife Foundation, Asociación Calidris and Polar Knowledge Canada.

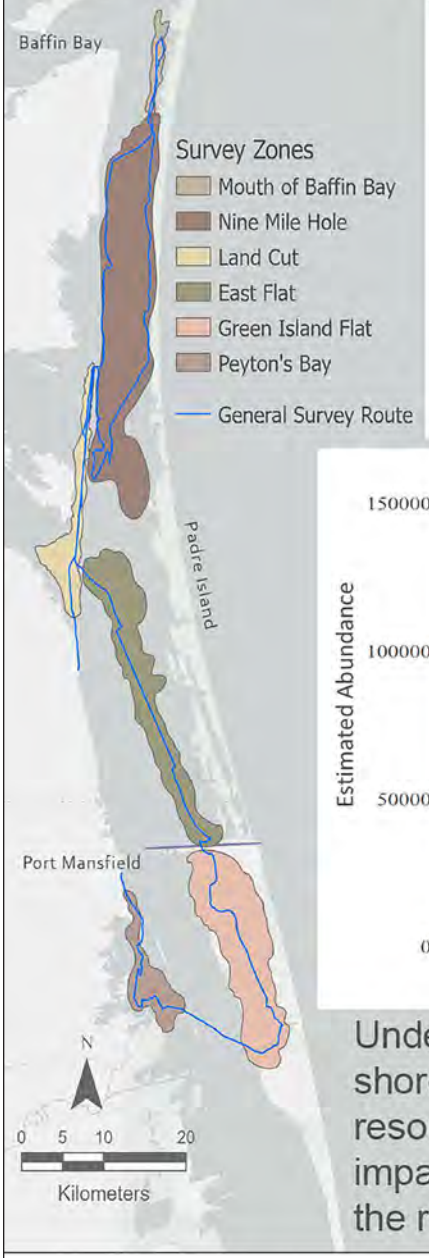
Male buff-breasted sandpiper in courtship display during a spring migratory stopover along the Texas Coast.

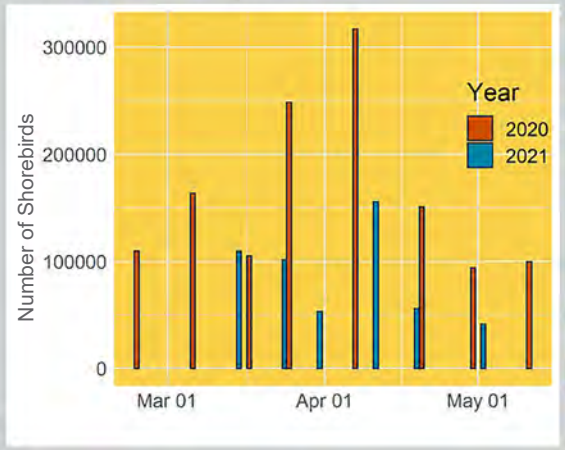
Community Dynamics of Migratory Shorebirds in the Laguna Madre of Texas

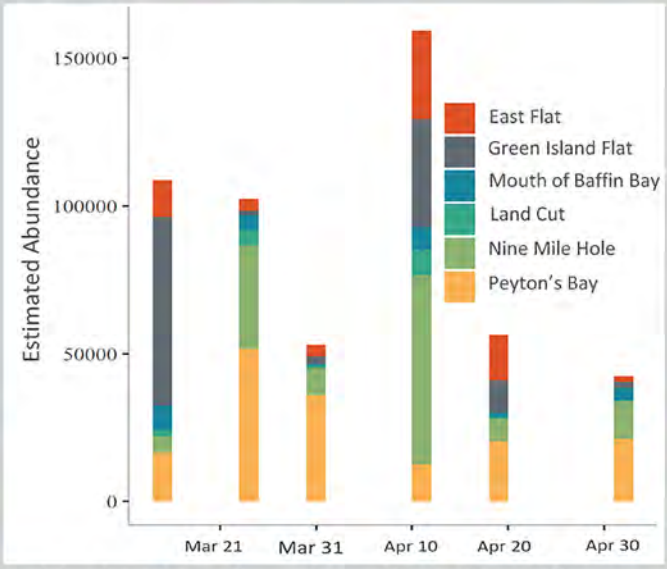
Jason P. Loghry and Bart M. Ballard

We conducted biweekly surveys in spring 2020 and 2021 to estimate number of shorebirds, and estimated species composition of flocks.

The Laguna Madre is one of the most important areas for migrating shorebirds in the western Hemisphere.







Understanding the migration of shorebirds will be important to resource managers to limit the impacts of increased development in the region.

Cooperative funding provided by the Robert J. Kleberg, Jr. and Helen C. Kleberg Foundation.

Assessing Grassland Restoration Techniques in the Edwards Plateau

Molly E. O'Brien, Evan P. Tanner, David B. Wester, Anthony D. Falk, and Sandra Rideout-Hanzak

Grasslands are the most widespread ecosystem in the world and account for 20-40% of the world's land area. With the increase in human-caused changes to the land, grasslands across the globe have been lost to many causes, including agricultural practices. In Texas, about 60% of our native grasslands are now degraded, and a large percent of rangelands in Central Texas have been impacted by human activities, resulting in a loss of historic native grasslands in this region. Globally, research has been conducted with the goal of transforming altered grasslands back to their native state. Though such restoration research has been done in some regions of Texas, there is a lack of knowledge on appropriate techniques in Central Texas.

In the same way that a medical doctor would not prescribe the same medication to treat every medical condition, damaged lands need site-specific restoration methods that address their unique conditions. Some of the most commonly used treatment options for restoring grasslands are disking, the application of herbicide, and seeding. In this research, different combinations of these techniques will be applied to retired agricultural fields in Central Texas with the goal of determining which combination of methods works best. Moreover, locally-adapted seed sources will be used to attempt to enhance restoration success, which is particularly important under challenging environmental conditions such as prolonged drought. This research will help guide stakeholders in planning restoration projects and help provide recommendations for more successful and cost-effective restoration efforts.

Cooperative funding provided by AEG Dos Ranches, LLC, in partnership with Texas Ecological Laboratory (Eco Lab).

Grassland Restoration in the Permian Basin

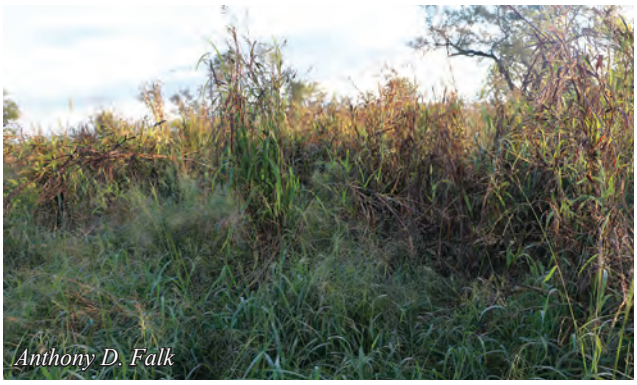
Rider C. Combs, Anthony D. Falk, Colin S. Shackelford, and Matthew T. Kapelewski

Unpredictable environmental conditions, as well as land management history in the Permian Basin, have often lead to an unhealthy plant community, an abundance of bare ground, and little biomass. Building on current restoration practices, we aim to document the amount of above-ground biomass in a growing season and how it is affected by the establishment of different herbaceous plant communities in the Permian Basin.

Monitoring of the existing plant community began during spring 2022 on a 4-acre undeveloped site in southern Midland County, Texas. Pre-seeding data collection of the existing vegetation was conducted 2 weeks prior to seeding. The site was prepared using a bulldozer to blade and remove the existing brush. This is a common land-clearing practice used in the Permian Basin and it provides an open area for a tractor to navigate. The site was then seeded with 4 different seed mixes: a locally-adapted native; a locally-adapted native plus cover crop; switchgrass; and Permian Germplasm whiplash pappusgrass. A third of the planted sections will be irrigated for the remainder of the study. Site monitoring will occur at the end of the summer and fall 2022 growing seasons. We will survey plant density and collect biomass clippings and soil samples. This project will provide insight on how restoration efforts impact above-ground biomass and the development of different plant communities in the Permian Basin.

Cooperative funding provided by Exxonmobil Energy, Inc.

Degraded rangeland in the Permian Basin prior to brush removal and reseeding.



Hay grazer still alive and growing 2 years after seeding.

Using Cover Crops and Native Seed to Control Guineagrass

Anthony D. Falk, Colin S. Shackelford, Jimmy C. Rutledge, C. Bart DuPont, and Eric D. Grahmann

Guineagrass is a highly competitive non-native species capable of forming dense single-species stands and is capable of reaching heights of 12 feet, climbing high into dense brush. It is also well known for taking advantage of disturbances such as brush clearing, increasing in density in those areas and limiting usable habitat for native wildlife such as bobwhite quail.

Texas Native Seeds (TNS) partnered with La Paloma Ranch to evaluate the use of cover crops and seeding locally-adapted native species following brush removal to combat this aggressive species. During summer 2020 La Paloma Ranch completed an extensive brush removal project. Following this, research plots were seeded with two commonly used summer cover crops; browntop millet and hay grazer. These cover crops were seeded individually and also in combination with native seed mix. Additional treatments included half rates of the cover crops with the native seed mixes. During spring 2021, the same native seed mix was planted into the plots that previously only received the cover crops.

While a significant amount of change is expected to happen in these research plots in the future, we have learned a great deal already as seeded cover crops are not aiding the establishment of permanent native grassland species. Also, seeding the cover crop to compete with guineagrass followed by a delayed native seed mix has resulted in reduced cover of permanent native species. Results from this project will guide future use of cover crops in grassland restoration.

Cooperative funding provided by the Lee and Ramona Bass Foundation.

Plants growing in seeded vs. nonseeded plots on a solar development in Bee County, Texas.

Grassland Restoration – South Texas' New Solar Developments

Micayla E. Pearson, Anthony D. Falk, David B. Wester

Green energy development and the use of solar energy has steadily increased over the last 10 years. Little research has been done to determine ways to counteract ecological damage caused by the removal of native vegetation that large-scale developments have on surrounding areas. To remedy this, we are attempting to restore native grassland within a 20-acre site that has been developed for solar energy in Bee County, Texas.

There are many things to be tested when restoring a new solar development because very little research has been conducted so far. For this project we chose to study 2 planting dates (pre- and post-construction); 4 seed mixes (that vary in species diversity and plant height); and 2 planting techniques (drill seeding and hydromulching). We are collecting plant cover at different heights above the soil surface to evaluate restoration success on a micro-habitat scale where local disturbance can be significant.

Microhabitat data were collected in February and March 2022 when 56% of the data collection points had experienced some form of disturbance. The average rating of disturbance for the disturbed areas was a 4.5 out of 5 (severe). Vegetation data collected in May 2022 recorded 61 species across planted plots. The final planting will take place before the end of 2022. Findings from this project will, hopefully, allow us to create healthy rangelands under solar developments making green energy even more green.

Cooperative funding provided by Orsted Energy Company.

Native Pollinator Habitat at Goldsmith Solar Farm

Colin S. Shackelford, Veronica G. Rapp, and Rhett K. Kerby

Large-scale solar energy facilities for both industrial and public consumers are expanding rapidly in the Permian Basin and Panhandle regions of Texas. In 2019, Texas Native Seeds (TNS) was asked to assist with revegetating a recently-developed 200-acre solar farm in Goldsmith, TX. The project goals were to restore suitable habitat for pollinators and wildlife, while also reducing soil erosion to benefit the functionality of the panels.

Initial site preparation included caliche removal and compacted soil disking. This was followed by drill seeding of winter wheat as a nurse crop. Erosion-prone areas were then hydroseeded with a cotton by-product and a nutrient amendment to reduce erosion, retain soil moisture, and facilitate optimal plant establishment. In spring 2020, a mix of native grasses and forbs was no-till drilled into the winter wheat and native wildflowers that had previously started growing. However, due to summer drought conditions germination of the drilled mix was poor; thus, in 2021 the seeding was repeated. Abundant rainfall throughout the 2021 growing season helped establish the seeded native perennial grasses and forbs.

This project will serve as an example of the possible benefits of restoration projects alongside solar energy development. Results will contribute to a broader understanding of solar site restoration across Texas.

Cooperative funding provided by Occidental Petroleum Company, KerTech, LLC, and donors to the Permian Basin-Panhandle Native Seed Project.

Seeded wildflowers at the Goldsmith Solar Farm in West Texas.

Riverby Ranch Evaluation and Restoration Research

Tyler C. Wayland, Nelson O. Avila, Jacob S. Sparger, Keith P. Pawelek, David B. Wester, and Anthony D. Falk

The lack of regionally-adapted native seeds for restoration in Northeast Texas forces land managers to use seed sources from distant regions. Performance of many of these available seed sources has been untested in East Texas. Texas Native Seeds (TNS) has been partnering with RES, LLC to conduct a native seed variety adaptation trial on former cropland on the Riverby Ranch, a mitigation project for the newly constructed Bois D'Arc Lake in Fannin County, Texas. The results of this trial will help steer the restoration of over 3,000 acres of native grassland on the site.

We planted replicated plots of 30 commercially-available native seed varieties in a combination of single species stands and seed mixtures. The fall portion of this project was planted in October 2019, and the spring portion was completed in June 2020. We have been collecting data to record vegetation establishment and performance over 3 growing seasons. Further long-term monitoring will take place to document establishment dynamics and evaluate future success.

This project will aid in finding suitable seed varieties for the mitigation project at Riverby Ranch, as well as help guide future seed source development efforts in the East Texas region.

Cooperative funding provided by RES Texas Mitigation, LLC, and the North Texas Municipal Water District.

Fall planting of a native seed mixture at the Riverby Ranch Native Seed Adaptation Trials site in Fannin County, Texas.

Tallgrass Prairie Restoration in Northeast Texas

Emily R. Bishop, Tyler A. Wayland, Keith Pawelek, Sandra Rideout-Hanzak, and David B. Wester

Tallgrass prairies provide important ecosystem services that should be preserved through enhanced restoration of this threatened ecosystem. The first step in ecosystem restoration is the selection of locally-adapted seed sources. This information is lacking in northeast Texas. We have completed a 2-year assessment of tallgrass prairie restoration by evaluating 30 varieties of native grasses and 4 mixes of native grasses and forbs. We monitored plant establishment in 500 research plots on a 250-acre study area on a retired ranch in Fannin County.

- Coastal Plains Germplasm little bluestem and Lavaca Germplasm Canada wildrye established stands 2 years post-seeding at densities high enough (> 1.7 plants per square yard) to warrant recommendation.
- Most grass varieties performed equally or better when seeded in a mixture than when seeded alone.
- The seed bank was larger and more variable in the area disturbed by a plow than the area below plow disturbance.

Coastal Plains little bluestem (left) and Lavaca Canada wildrye (right) were successfully established two years after restoration in northeast Texas.

- The historic seed bank below the disturbed plow layer supported 223 seedlings per square yard; a nearby non-disturbed tallgrass site had only 6.7 seedlings per square yard.
- Although long-term restoration success usually requires at least 10 years of vegetation monitoring, our results have identified potentially successful grass varieties that can enhance future restoration success.

Cooperative funding provided by RES Texas Mitigation, LLC and North Texas Municipal Water District.

Restoring Frac Ponds—A Four-Year Summary

Dustin A. Golembiewski, Sandra Rideout-Hanzak, and David B. Wester

Soil disturbances that accompany energy extraction can damage local habitats. Stock-piling topsoil is commonly recommended to promote restoration of disturbed areas. We have completed a 4-year study of fracking pond restoration. We evaluated plant density, community composition, and seed banks on frac pond surfaces that were created from 3 depths within a stockpile. Each surface was reseeded with native grasses (with or without a cover crop). Controls in this study represented non-amended surfaces that were not reseeded.

- Stockpile depth did not affect restoration success over time.
- Restoration with native seeds initially enhanced grass density and richness. However, by the 4th year of monitoring, plant density in non-seeded areas equaled density in seeded areas.
- Inclusion of a cover crop did not enhance restoration success.
- Frac pond surfaces that were not amended with stock-piled topsoil had higher grass density, greater species richness, and a larger seed bank than stock-piled surfaces.
- Results indicate that stockpiling topsoil at this site was not necessary and although seeding (without a cover crop) is recommended, it may not be necessary to reach long term restoration goals.

Cooperative funding provided by Alston and Holly Beinhorn.

Vegetation on a frac pond four years after restoration includes the native grass, bristlegrass, and a variety of forbs.

Native Seed Burial and Cover Crop Considerations for Rangeland Restoration

Brianna M. Slothower, Anthony Falk, Sandra Rideout-Hanzak, Terry Blankenship, and David B. Wester

Accessing energy resources provided by rangelands can have long-lasting effects. One of most challenging negative impacts of disturbance is the introduction and dominance of invasive plants. One strategy to combat the introduction of invasive grasses is to seed a cover crop. We have completed a 2-year assessment of pipeline restoration involving the use of native grasses and cover crops. We also documented effects of burial on native seed germination and viability.

Native grass density was higher when grasses were seeded sooner after disturbance than when seeding was delayed. Use of cover crops did not affect this trend.

- Two years of monitoring following summer seeding indicated that invasive grass cover and density increased from the first to the second year. Native grass density did not change during this period.
- Buried seeds generally lost their viability within a year.
- If grazers are present, the use of a cover crop can enhance native grass success.
- Restoration success is enhanced when disturbed areas are seeded as soon possible. If native grass density goals are not met by the first year after seeding, we recommend reseeding.

Cooperative funding provided by the Swenson Fellowship and L.H and P. M. Stumberg

Restoration of pipeline rights-of-way can be enhanced when native grasses are seeded as soon as possible after pipeline closure.

Biology, Ecology, and Management

Wild Pig Movements in Response to Aerial Shooting

Bethany A. Friesenhahn, Randy W. DeYoung, Michael J. Cherry, Justin W. Fischer, Kurt C. VerCauteren, and Nathan P. Snow

Wild pigs are a destructive and invasive species, and their populations continue to increase. The U.S. government spends about $30.5 million annually to control the wild pig problem and has established local and state efforts for research and management to address the wild pig issue, including the National Feral Swine Damage Management Program. The increase in research on wild pigs has aided in the effectiveness of both lethal and non-lethal control efforts, but there is still a need for further information. Our objective for this study is to analyze movement behaviors of wild pigs in response to aerial gunning efforts.

In January and February 2020, we trapped and GPS-collared 29 adult wild pigs in Delta County, Texas, which collected hourly locations. Texas Wildlife Services conducted aerial gunning efforts throughout our study area to eradicate wild pigs on February 17–27th and March 25th and 26th. We divided the hourly GPS locations into three separate time periods: two weeks before, during, and two weeks after aerial gunning. We calculated and compared distance between successive GPS locations, home range size, and movement behaviors for each time period to determine how wild pigs responded to interactions with aerial gunning.

With this research, we hope to provide a better understanding of the impact that aerial gunning has on surviving wild pigs and its implications for management. It is important to use management strategies that reduce wild pig populations, yet also do not cause surviving individuals to disperse to new areas, which would increase risks of disease transmission and human-wild pig interactions.

Cooperative funding provided by USDA APHIS Wildlife Services National Feral Swine Damage Management Program.

Drone Estimates of Wild Pig Damage to Different Crop Types

Bethany A. Friesenhahn, Randy W. DeYoung, Justin W. Fischer , Nathan P. Snow, Kurt C. VerCauteren, Humberto L. Perotto-Baldivieso

Presently, there are an estimated 6.9 million wild pigs in the U.S., which cause over a billion dollars in damage to agriculture, environmental impacts, and control costs. There is a need for standardized monitoring of wild pig damage and a method to accurately determine the magnitude of damage and estimate the economic costs of direct wild pig damage to agriculture. Wild pig damage to agricultural resources is most commonly estimated by producer surveys or direct ground-based assessments which can be costly, needing extensive time and labor, and over-or-under-estimating damage.

Our objectives for this study are to (1) assess the accuracy of wild pig crop damage estimates from ground assessments, drones, and daily satellite imagery, and (2) assess deep learning methods to estimate damage in different crops. We will carry out drone flights to collect imagery for analyses and ground surveys in a total of 9 agricultural fields: 3 corn, 3 sorghum, 3 cotton. The 9 fields are privately owned and located throughout San Patricio and Nueces Counties in South Texas. Flights and ground surveys will occur approximately 2-3 times per field, in June-September 2022. Daily satellite imagery will be downloaded for damage estimate comparisons.

Drone technologies are advancing quickly and becoming a more common practice in the wildlife and agricultural industry. With this research, there is a potential for drones to become a tool for landowners and producers to accurately estimate wild pig damage and to receive compensation for their lost income.

Cooperative funding provided by the USDA APHIS Wildlife Services National Feral Swine Damage Management Program.

Habitat Use of Gray Hawks in the Lower Rio Grande Valley of Texas

Michael T. Stewart, Leonard A. Brennan, Bart M. Ballard, Humberto L. Perotto-Baldivieso, and Brian A. Millsap

Gray hawks are an uncommon species with a limited range in Texas where they are state listed as threatened. Despite their status, very little is known about their populations within the state. Identifying gray hawk habitat is especially important for conservation efforts in the Lower Rio Grande Valley where much of the native vegetation has been lost.

We began research in our study area of Cameron and Hidalgo Counties, Texas, in January 2022. In our approach, we use GPS data to identify where gray hawks occur. This is accomplished by attaching GPS transmitters using backpack-type harnesses; these transmitters use the cellular network to transmit the data they collect. All hawks captured also receive coded aluminum color bands so individual birds may be visually identified.

Information collected will also be used to study population demographics, determining parameters such as survival rates, nesting productivity, and the population growth rate. Data from the transmitters along with surveys to resight the color-banded individuals will be analyzed over the next four years, and predictive modelling will allow us to identify other potential areas gray hawks may use.

In our initial research we will identify areas used by gray hawks and compare these to other available areas so we may understand what habitat type they are selecting. With these data we can better inform management decisions for this Species of Greatest Conservation Need.

Gray hawk chicks in Cameron County, Texas.

Assessment of Contaminants in Avian Scavengers

Michael A. Kalisek, Ashley M. Unger, Evan P. Tanner, Clayton D. Hilton, Christine Hoskinson, Richard L. Sramek, Michael J. Bodenchuk, and Katherine Garwood.

Avian scavengers such as turkey vultures and black vultures can be indicators of contaminants present in the environment. This is primarily due to their dietary role and migratory behavior, which may promote exposure to diseases and environmental toxins. This behavior and exposure is important when considering disease ecology.

We have been studying contaminants present in both species of vulture in Kleberg County, Texas, since 2021. Vultures were trapped in March and November 2021, and cloacal swabs and blood samples were taken from individuals to monitor fungal and bacterial organisms, antibiotic resistance, and lead levels in birds, respectively.

Many bacteria that can potentially cause disease were found in high frequencies of the vultures. *E. coli* was present in over 50% of black vultures and over 40% of turkey vultures captured, while *Salmonella* bacteria were found in 60% of the black vultures captured in March. The bacteria that causes chlamydia was found in 36% of birds tested in November, while a dangerous fungus (*Trichosporon asahii)* was also found in two black vultures from the same capture. Analysis of antibiotic resistance indicated that the *Salmonella* strain and *E. coli* present were resistant to many of the tested antibiotics. Blood lead levels varied from almost 0.034 parts per million to 0.65 parts per million.

We will continue to monitor the contaminants found in these birds. Given that these species may be indicators of contaminants that other wildlife encounter, we can utilize continued research to determine disease-related impacts and management recommendations.

Dr. Clayton Hilton take a cloacal swab sample from a captured black vulture.

Can We Use 'Old School' Methods to Determine Movement Patterns of Texas Tortoises?

Saren L. Perales, Christin A. Moeller, E. Drake Rangel, Juan C. Elissetche, Jacob M. Reyes, Preston W. Richardson, Scott E. Henke, Cord B. Eversole, Sandra Rideout-Hanzak, Jeremy Webb, and Paul S. Crump

Telemetry is a common method to determine animal movements. Animals are outfitted with a transmitter or receiver, and animal locations are monitored by a person or satellite, respectively. Researchers or satellites typically locate animals hourly or daily, but animal movements between such locations are unknown and assumed to be linear.

Our objective is to test this theory of linearity between locations by obtaining hourly locations of Texas tortoises via VHF telemetry and comparing it to the old school method of outfitting tortoises with a spool of thread. With this method, the end of the thread is tied to a stake at the initial location of the tortoise. As the tortoise moves through its daily routine, the thread is released and caught on the vegetation that it passes; thus, providing the exact path of movements. Movement patterns recorded by both methods then will be compared to determine the similarity of the methods. Our research will highlight whether 'old school' technology could return and be used for movement patterns of species like the Texas tortoise.

Cooperative funding was provided by the Welder Wildlife Foundation, NextDecade LNG, and Texas Parks and Wildlife Department.

Is Translocation a Viable Management Option for Texas Tortoises?

Christin A. Moeller, E. Drake Rangel, Juan C. Elissetche, Saren L. Perales, Jacob M. Reyes, Preston W. Richardson, Scott E. Henke, Cord B. Eversole, Sandra Rideout-Hanzak, Jeremy Webb, and Paul S. Crump

Historically, Texas tortoises ranged southward from a line going from Del Rio to San Antonio and Victoria with densities estimated as high as 8 tortoises/acre. However today, their abundance has declined to < 0.5 tortoise/acre and their distribution within their historical range has become sporadic. Urbanization, agriculture, and habitat fragmentation are considered major issues that Texas tortoises face. Today, Texas tortoises are listed as state-threatened.

Development by liquefied natural gas (LNG) companies in the Lower Rio Grande Valley has converted large areas of native thornscrub and coastal grasslands into energy infrastructure land use. As part of the Environmental Impact Statements for these LNG terminals, the companies committed to translocation of Texas tortoises from the project development sites. However, translocation of Texas tortoises has not been evaluated to determine if it is a feasible management option. Therefore, our objectives are to (1) determine if translocation of Texas tortoises is a feasible method to mitigate habitat alterations, (2) compare movement patterns of translocated Texas tortoises to non-translocated tortoises, and (3) compare survival of translocated Texas tortoises to non-translocated tortoises. The goal of our research is to develop a restoration plan to recover this threatened species.

Cooperative funding provided by Welder Wildlife Foundation, NextDecade LNG, and Texas Parks and Wildlife Department.

Prevalence of Selected Diseases of Texas Tortoises

Christin A. Moeller, E. Drake Rangel, Juan C. Elissetche, Saren L. Perales, Jacob M. Reyes, Preston W. Richardson, Tom deMaar, Scott E. Henke, Cord B. Eversole, Sandra Rideout-Hanzak, Jeremy Webb, and Paul S. Crump

The Texas tortoise is a threatened species in Texas. Two diseases of concern have been noted in Texas tortoises; necrotizing scute disease and upper respiratory tract disease. Necrotizing scute disease is caused by a fungus, which appears as white discolored patches on the upper shell (i.e., carapace) of the tortoise.

Mycoplasma is a contagious respiratory disease of Texas tortoises.

Tortoises in the Lower Rio Grande Valley have a much higher prevalence than tortoises from more northern populations. Upper respiratory tract disease (URTD) is caused by bacterial species of the genus *Mycoplasma*. The disease causes a range of symptoms including nasal discharge, swollen eyelids, lethargy, and a general failure to thrive. Recent research suggests that these bacteria have a commensal relationship with their tortoise hosts but that additional stress on tortoises could alter their immune system, which can lead to infection.

Our objective is to collect serum samples from Texas tortoises located in the Rio Grande Valley and in coastal Texas to determine the prevalence of these diseases. It is important to determine disease prevalence prior to translocation efforts of a companion study because it is undesirable to introduce a disease to a novel area.

Cooperative funding provided by Welder Wildlife Foundation, NextDecade LNG, and Texas Parks and Wildlife Department.

Assessing Number of Texas Tortoises by Counting Their Scat

Christin A. Moeller, Juan C. Elissetche, Saren L. Perales, Jacob M. Reyes, Jeremy Webb, Sandra Rideout-Hanzak, Cord B. Eversole, Paul S. Crump, and Scott E. Henke

Texas tortoises were once numerous throughout southern Texas but their populations have greatly declined and their distribution has become patchy. Today they are a Texas state-threatened species. Because of their status, wildlife agencies want to know how many tortoises remain. This seems to be an easy request, after all, how difficult can it be to count slow-moving animals? As it turns out, the true answer is: quite difficult. Texas tortoises easily camouflage themselves within their surroundings, spend much of their time hiding under thick vegetation, and using the burrows of other animals as shelters. Thus, counting Texas tortoises is not an easy task. However, Texas tortoises tend to use open areas as bathroom spots; thus, making their dung easy to find.

Therefore, our objective is to determine if a relationship exists between the number of Texas tortoises in an area and the number of their dung found within a month. We plan to use lomas of southern Texas because (1) they appear to be preferred habitat of Texas tortoises, and (2) they are 'islands' of clay-soil mounds of specific size within a 'sea' of sand dunes. If successful, this research will assist wildlife agencies and tortoise enthusiasts with a method to know how many Texas tortoises are in an area so that population trends (increasing, decreasing, or stable) can be known.

Cooperative funding provided by the Welder Wildlife Foundation, NextDecade LNG, and Texas Parks and Wildlife Department.

Can Eating Dung Cause Health Problems for Texas Tortoises (Besides Bad Breath)?

Christin A. Moeller, Juan C. Elissetche, Saren L. Perales, Jacob M. Reyes, Jeremy Webb, Sandra Rideout-Hanzak, Cord B. Eversole, Paul S. Crump, and Scott E. Henke

Texas tortoises are mainly vegetarians, but have a unique habit of eating dung, an activity known as coprophagy. Such a habit may have developed because vegetation can be difficult to break down, so eating dung provides the stomach a second chance for greater processing. Rabbits are another species that practice coprophagy, but rabbits only eat their own 'first-time through' feces. Texas tortoises do not appear to be picky when it comes to eating dung and will eat the dung of other animals, which can cause them problems. Raccoons can have an intestinal roundworm that sheds its eggs in the feces of raccoons. If raccoon feces is infected with roundworm eggs and is eaten by an animal, the eggs hatch in the animal and the larvae enter its brain, causing many physical issues and even death. Such an outcome could happen to Texas tortoises if they eat infected raccoon feces.

Therefore, our objectives are to determine (1) how often Texas tortoises eat dung, and (2) if tortoises have a preference of dung from certain species. Texas tortoises will be placed in a captive setting and provided natural growing vegetation, vegetable produce from grocery stores, and dung from tortoises, coyotes, bobcats, and raccoons. These species were selected because they represent the most common species associated with Texas tortoises. This research will provide data to determine the potential risk of raccoon roundworm as a mortality factor for Texas tortoises.

Cooperative funding provided by the Welder Wildlife Foundation, NextDecade LNG, and Texas Parks and Wildlife Department.

Taste is like beauty; it's in the eye of the beholder. Texas tortoises like to eat dung.

Summer prescribed fires produce a lot of smoke because of moisture in the fine fuels.

Effects of Prescribed Burning on Texas Tortoises

Camryn M. Kiel, Forrest C. Fay, Sandra Rideout-Hanzak, David B. Wester, Evan P. Tanner, Ashley M. Tanner, Tyler A. Campbell, and Michael L. Morrison

Prescribed fire is commonly used to increase plant diversity, palatability, and nutritional quality in grasslands. It has other known benefits as well, such as improving overall habitat quality for many wildlife species. However, fire effects on many species of wildlife have not been studied formally and are not well understood. Texas tortoises is one of those species.

We are studying the effects of fire in summer and winter on Texas tortoises in the Gulf Coast Prairies and Marshes ecoregion of Texas. We are burning plots that are at least 500 acres in size and are dominated by native perennial grasses where gulf cordgrass and seacoast bluestem dominate, with scattered oak mottes. We are attaching GPS trackers and temperature dataloggers to Texas tortoises so we can track where they are when we conduct our prescribed fires, and re-locate them after the fires to see if they survived. The dataloggers will allow to see what temperatures they are exposed to by prescribed fire and what temperatures they can withstand. The Texas tortoise is a state threatened species, and our study will provide a better understanding of how suitable this land management tool is for managing its habitat.

Cooperative funding provided by the East Foundation.

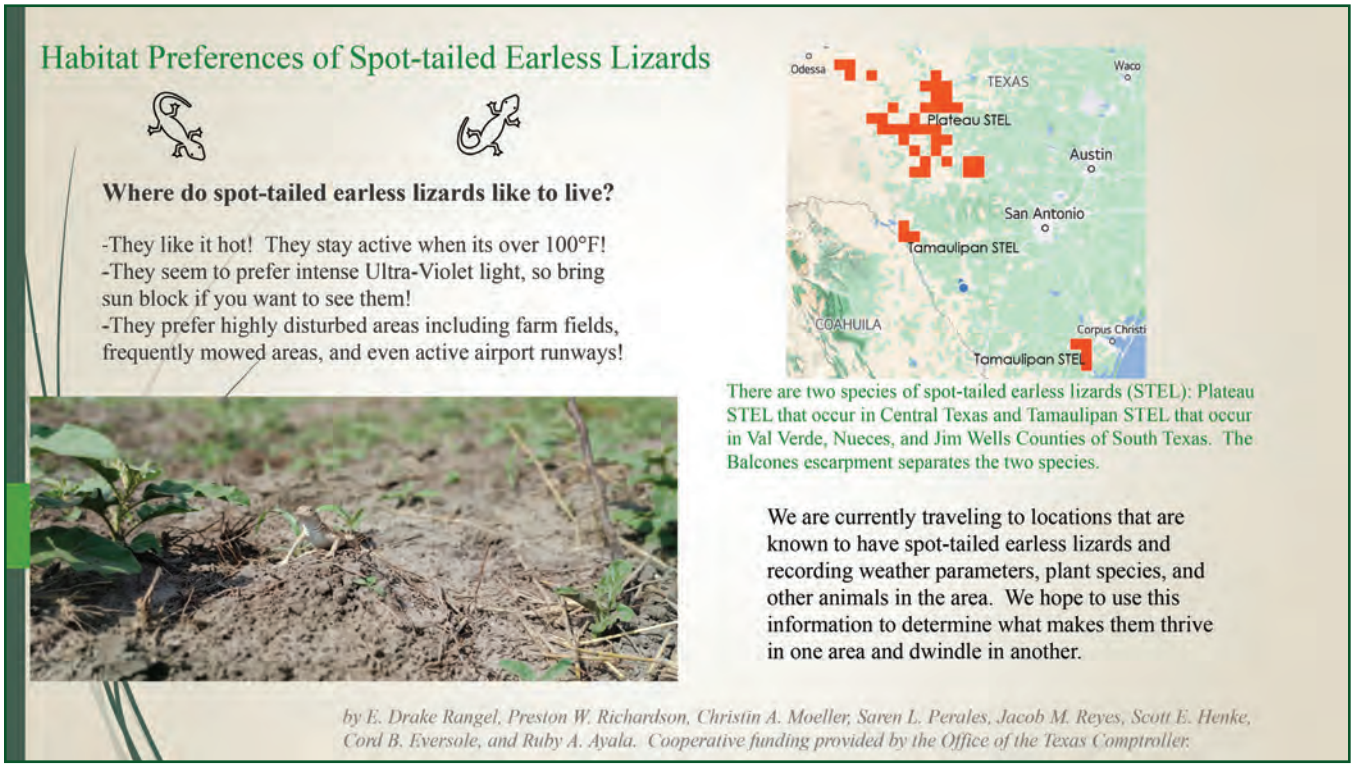
How Does Prescribed Burning Affect Neighboring Plant Relationships?

Forrest C. Faye, Juan C. Elissetche, David B. Wester, Tyler A. Campbell, and Sandra Rideout-Hanzak

It has been well-documented in recent decades that plants form relationships with each other, either underground through roots and fungi, or aboveground, or in ways that are not yet known. But, the effects of disturbances such as fire on these relationships has not been studied. We are investigating whether the presence of prescribed burning affects the plant "neighborhood" in the South Texas Gulf Marshes and Prairies ecoregion, and if so, does the season of burning or the length of time between burning matter?

We are applying winter burning or summer burning to plots that are at least 500 acres and comparing the effects of burning against control plots that are not burned. Additionally, the winter and summer burn plots are treated with either a short return interval (every 3 years) or a long return interval (every 5 years). We are recording the herbaceous plants that are present in these plots and their nearest neighbor, and we will analyze the relationships between the plants to determine whether these relationships are related to the presence of fire, its season, or its return interval. Our results will be important to land managers in South Texas that wish to use prescribed fire to create certain desired vegetation communities.

Cooperative funding provided by the East Foundation.



Onset of Breeding Colors in Spot-Tailed Earless Lizards

E. Drake Rangel, Christin A. Moeller, Alexander R. Meza, Saren L. Perales, Jacob M. Reyes, Preston W. Richardson, Brian K. Loflin, Scott E. Henke, Cord B. Eversole, and Ruby A. Ayala

In the Animal Kingdom typically males display elaborate colors to attract mates. Male birds have brightly-colored feathers and male green anoles have red dewlaps that they expand under their chin. However, in spot-tailed earless lizards (STEL) it is the female that displays iridescent colors to attract a mate. Typically, Plateau and Tamaulipan STEL are caramel tan and slate gray colors, respectively, but with the onset of summer, females begin to display a fluorescent light green color that lasts until the end of breeding.

Our objectives are to (1) document the color change, (2) determine if the trigger for the change is environmental or physiological, and (3) quantify the change in color and its return to normal via the RGB color method. Knowing the triggers for this color change and its return to normal will help biologists better understand the STEL reproductive cycle, and may inform future efforts to increase population sizes of these rare species.

Female spot-tailed earless lizard just beginning to display her breeding colors to attract a mate.

Cooperative funding provided by the Office of the Texas Comptroller.

Does Presence of Researchers Alter Spot-Tailed Earless Lizard Home Ranges?

E. Drake Rangel, Christin A. Moeller, Jacob M. Reyes, Saren L. Perales, Preston W. Richardson, Scott E. Henke, Cord B. Eversole, and Ruby A. Ayala

Spot-tailed earless lizards (Plateau and Tamaulipan; STEL) are Species of Concern and are both being considered for federal listing as a threatened species by the United States Fish and Wildlife Service. Because of this consideration, the ecology of STEL needs to be assessed. Previous studies found their home range sizes to be quite large compared to similarly-sized insectivorous lizards. However, in our captive studies with STEL, we found their area of use to be localized, but that STEL would flee if we approached too close. Their area of use would again become localized, but in a new area of the enclosure. This type of movement could give the appearance of a large home range.

Our objective is to determine home ranges of harassed and non-harassed STEL. This research is designed to determine if researchers cause the appearance of larger home range sizes in these species during the course of their study.

Cooperative funding provided by the Office of the Texas Comptroller.

Can Cricket Attractants Entice Lizards for Collecting eDNA?

Jacob M. Reyes, E. Drake Rangel, Christin A. Moeller, Saren L. Perales, Preston W. Richardson, Scott E. Henke, Cord B. Eversole, and Ruby A. Ayala

Spot-tailed earless lizards (STEL) are a Species of Concern and are being considered for federal threatened status by the United States Fish and Wildlife Service. These species are elusive and our research has determined that lizards spend much time underground, making them even more difficult to locate. Environmental DNA (eDNA) has been considered as a possible method to determine if STEL are present in an area; however, warm temperatures and humidity cause eDNA to deteriorate quickly. Also, if a soil sample is collected near a lizard resting spot but not in the actual spot, the eDNA sample will register as negative for STEL presence. Therefore, STEL need to be enticed to a specific location so eDNA can determine their presence. Because STEL have a preference for crickets as a diet item, our objective is to determine various cricket attractants that will ultimately entice STEL to specific locations for positive eDNA results. If successful, this method can be used to identify areas where STEL still exist.

Cooperative funding was provided by the Office of the Texas Comptroller.

Using Dummies with Breeding Colors to Attract Male Spot-Tailed Earless Lizards

E. Drake Rangel, Christin A. Moeller, Jacob M. Reyes, Saren L. Perales, Preston W. Richardson, Scott E. Henke, Cord B. Eversole, and Ruby A. Ayala

Spot-tailed earless lizards (STEL) are unique reptiles in that it is the female that displays bright colors during breeding season to attract mates. Females will change from their typical caramel tan (Plateau STEL) or slate gray (Tamaulipan STEL) color to a bright fluorescent green color. We used this aspect of their natural history to determine if males are solely attracted to the color, lizard shape, movement, or combination of these factors. We purchased plastic lizards, fluorescent green paint, and fluorescent green reflective tape. Half of the toy lizards were painted; then lizards and reflective tape were either mounted on sticks or springs. Each was randomly placed along with a motion-activated remote camera in known STEL habitat. Data will be collected throughout the breeding season and analyzed to determine if male STEL will respond to these stimuli. If successful, this can be a potential method to determine the presence of STEL within an area.

Cooperative funding provided by the Office of the Texas Comptroller.

A bright green plastic lizard is used to attract a male spot-tailed earless lizard.

Vegetation and Soil Characteristics of Clay Lomas on the South Texas Coast

Juan C. Elissetche, David B. Wester, Scott E. Henke, Evan P. Tanner, Humberto L. Perotto-Baldivieso, I-Kaui Hung, Cord B. Eversole, and Sandra Rideout-Hanzak

Forming thousands of years ago when wind-blown soil particles accumulated on vegetation, clay lomas make up a complex coastal ecosystem of unique vegetation and soils. For this reason, it is important for us to understand what resources lomas can contribute to wildlife and how they differ from their surrounding environment.

We are currently working on both public and private lands conducting research on lomas in Willacy, Cameron, and Kenedy Counties, Texas. We are recording plant species and plant density on lomas to characterize the vegetation communities. We are also collecting elevation and soils data. Samples from the top 6 inches of soil are being collected both inside and outside lomas. Samples are analyzed for soil type, texture and pH to determine differences between lomas and surrounding areas. Our data will be used in a model to predict where other lomas may occur on the landscape based on elevation and soils data.

Our study will provide the descriptive characteristics of clay lomas, as well as information about the location of unknown lomas, and information that may guide further conservation of lomas as a resource for the wildlife that depend on them.

Funding provided by Texas Parks and Wildlife Dapertment.

Ecology and Management of Whitebrush in Texas

Katie J. Pennartz, Evan P. Tanner, Megan K. Clayton, Anthony D. Falk, Humberto L. Perotto-Baldivieso

Whitebrush is a shrub species found throughout many Texas rangelands. It is increasingly the target of management to reduce its coverage and promote growth of plants more desirable for wildlife and livestock. Dense shrubs reduce the presence of grasses and forbs that serve as important wildlife food resources. Traditional treatments used in shrub management, such as roller chopping and recommended herbicides, have had limited effectiveness. New herbicides have been developed for whitebrush control, though research in field settings is needed to better understand what promotes application success. Furthermore, there is limited knowledge on the basics of whitebrush ecology such as seed production and growth habit.

A whitebrush monoculture in Frio County is the site of targeted herbicide treatments.

To gain information on basic reproductive ecology and effective management strategies, we are trialing herbicides and collecting seed for greenhouse trials at sites in Frio and Webb Counties, Texas. We have established plots where whitebrush was treated with 1 of 4 herbicides, including a recently developed product, at varying application rates during the dormant season. Additionally, growing season treatments were established with 1 new herbicide. One year post-treatment, all treatments had an 89% success rate or better, though 2 years of data is necessary to determine control. Greenhouse trials will focus on observing germination rates and indirect herbicide effects on seedling growth. Preliminary laboratory testing showed a wide range of germination potential from 5 – 49%.

Results from this research will give us a better understanding of whitebrush ecology to help guide management decisions in Texas rangelands.

Cooperative funding provided by the Houston Livestock Show and Rodeo, Bayer, Corteva Agriscience, and Texas A&M AgriLife Extension Service.

Microbiomes of Little Bluestems and Old World Bluestems

John R. Bow, Jeff A. Brady, Kelly Carroll, James P. Muir, and Anthony D. Falk

Old World bluestems taking over native grasslands is a major concern for land managers in Texas. Old World bluestems regularly form single-species stands

that sustain few animal species and negatively impact native pollinators.

Microscopic bacteria and fungi that live in plants and soil can have both positive and negative impacts on plants based on the local environment and conditions. The goal of this project is to characterize the natural microbiomes of native little bluestem and Old World bluestems that could be crucial for uncovering means to control Old World bluestem invasion into native grasslands.

Since June 2021, 734 samples of Old World bluestems and little bluestem have been collected across 35 counties in Texas. Microbial DNA was extracted from all of these samples and sent to the Texas A&M AgriLife Genomics Core facility in College Station to be sequenced. In addition, 100 strains of microbes that were collected from little bluestem and Old World bluestems have been cultured. Two of these strains showed some promise in inoculation studies conducted in growth chambers testing germination.

Future analyses will include comparing the microbiomes of little bluestem growing in a native plant-dominated ecosystem versus those growing around Old World bluestem. These comparisons will help us to determine the importance of microscopic bacteria and fungi. It may also potentially reveal bacteria and fungi found in little bluestem that provide resistance to Old World bluestem invasion.

Cooperative funding provided by the Native Plant Society of Texas, Chalk Mountain Wildlife Management Area, Tarleton State University, USDA-NLGCA and USDA-NIFA.

Effects of Vegetation on Temperature and Sound Transmission

Laura C. Beck, Evan P. Tanner, Ashley M. Tanner, Darren S. Proppe, Samuel D. Fuhlendorf

One of the main factors driving grassland decline in the Great Plains is woody plant encroachment. Direct impacts of woody plant encroachment are well understood, while indirect impacts like changes in temperature and the alteration of sound travel, due to the changes in vegetation structure, are not. Sound and temperature are intrinsically linked; changes in temperature modify how sounds travel. Warming conditions could lead to sound transmission being enhanced or degraded. As most animals rely on auditory cues to communicate, this could have large impacts on the biological community. Additionally, the enhancement of human-made noises could mask natural sounds used for communication.

For this study, we will measure how changes in vegetation patterns from woody to grassland areas impact temperature and sound propagation by using a combination of temperature and sound measuring devices. We will quantify different sound types across the landscape, which include: tones (2, 5, 8 kHz), broadband noise, and animal vocalizations (i.e., leopard frog, cicada, golden-cheeked warbler). This study is being conducted at the Wild Basin Creative Research Center, in Austin, Texas. Wild Basin is representative of a natural area which provides key habitat for wildlife in urban areas, recreational opportunities, and may also serve as a buffer for "heat island effects."

Our hope is to not only understand the links between temperature and sounds in the landscape, but also help guide the City of Austin in managing these urban-centered native vegetation communities for conservation of critical wildlife species.

Cooperative funding provided by Oklahoma State University and St. Edwards University.

Sound and temperature study area at the Wild Basin Creative Research Center in Austin, Texas.

Mapping Thornscrub Communities in South Texas

Lori D. Massey, Humberto L. Perotto-Baldivieso, J. Silverio Avila-S., Evan P. Tanner, J. Alfonso Ortega-S.

Tamaulipan thornscrub is an important brush community home to several wildlife species in southern Texas and northern Mexico. There has been very little information gathered on these brush communities over the last 20 years. Most of the research has been conducted in Mexico, leaving large data gaps in the South Texas region. Thus, we will focus our research in 4 counties in South Texas: Dimmit, Duval, Maverick, and Webb Counties. We will study brush species diversity using multispectral imagery acquired from drones. Multispectral cameras capture visible data as well as bands not visible to the naked eye and give us a unique look at brush species.

We are flying drones on four study sites located on two private ranches in South Texas during Spring, Summer, Fall, and Winter. For each site, we are identifying brush species and marking them with a GPS. These points will be used to obtain data from the imagery and will help us identify thornscrub species across the landscape.

With this new information, we will select the best time to use multispectral cameras for thornscrub species identification. Our data will be used to start mapping thornscrub communities using drone and satellite imagery. This is the first step towards assessing their diversity and potential distribution in South Texas.

Funding provided by the Houston Livestock Show and Rodeo, Dallas Safari Club, and USDA Natural Resources Conservation Service.

Drone sitting on a ranch road surrounded by Tamaulipan Thornscrub.

Effects of Introduced Vegetation on Medium and Large Mammals

Duston R. Duffie, Andrew J. Mullaney, Cord B. Eversole, Scott E. Henke, and Terry L. Blankenship

Plants introduced into the United States are a conservation threat to native ecosystems. A variety of animals and plants is needed to maintain stable ecosystems. Negative consequences of introduced plants have been demonstrated throughout the world, often resulting in a decline in habitat quality. For example, introduced plants often take over a habitat and become the only plant species in an area, which reduces the variety of animals within the area also.

Our project will investigate how native animal species use habitats with no, moderate levels, and high levels of introduced plants. Our overall goal is to determine if the presence of native and introduced plants causes differences in abundance, diversity, occupancy, and overall habitat associations of medium-sized (e.g., raccoons, skunks) and large-sized (e.g., white-tailed deer, feral pigs) mammal communities across a South Texas landscape. We established 24 remote camera stations across Welder Wildlife Refuge in San Patricio County, Texas, in July 2021. As of May 2022, we have observed 12 medium and large mammal species, including the plains spotted skunk, a species of conservation concern. Few studies have gathered community-level data to document the impact of introduced plants, and this is especially true in South Texas.

Funding provided by the Welder Wildlife Foundation

Effects of Introduced Vegetation on Small Vertebrates

Duston R. Duffie, Andrew J. Mullaney, Cord B. Eversole, Scott E. Henke, and Terry L. Blankenship

In South Texas, historically open rangelands have been invaded by introduced grasses and native woody shrubs. The invasion of introduced plants can lead to reduced animal species diversity, which may alter how ecosystems work. Small vertebrates, such as rodents and reptiles, are vital to ecosystems as they are prey and also predators of smaller vertebrates and insects. However, little is known of how small vertebrates respond to introduced plants.

Our study objective is to determine how rodent and reptile abundances and diversities are affected

Western diamondback rattlesnake captured at a site with native vegetation at Welder Wildlife Refuge in Sinton, TX.

across habitats of no, moderate, and high levels of introduced plants. We began conducting rodent and reptile surveys at the Welder Wildlife Refuge in San Patricio County, Texas, in December 2019. Preliminary results from the first two years showed that small vertebrate species diversity and community structure did not differ between the three levels of introduced plants. However, abundance of 2 rodent, 9 reptile, and 6 amphibian species differed between habitat types. Our early results show that habitat specialists are more likely to be negatively affected by introduced plants; whereas, generalist species are either unaffected or increased in abundance at sites with high levels of introduced plants. We plan to continue this study for two more years to better understand the effects of introduced plants on rodent and reptile communities in South Texas.

Funding provided by the Welder Wildlife Foundation.

Monarch Habitat Roadside Sampling for TxDOT CCAA

Hagen D. Meyer, Rider C. Combs, Samuel J. Glinsky, Travis J. Jez, Anthony D. Falk, and John R. Bow

In 2020, the Texas Department of Transportation (TxDOT) joined the nationwide Monarch Candidate Conservation Agreement with Assurances (CCAA) program. The agreement was formed in response to the monarch butterfly's possible listing as an endangered species, with a recent decision to list them as Endangered in 2022. TxDOT enrolled about 450,000 of 800,000 acres of possible monarch butterfly habitat. The goal of the agreement is to inform the development and conservation of monarch habitat along TxDOT rights-of-way properties.

Texas Native Seed (TNS) has partnered with TxDOT to document the condition of monarch butterfly habitat along Texas rights-of-way. TxDOT randomized roadside sampling plots across enrolled right-of-way lands to collect data typical of monarch habitat across Texas. A total of 109 plots were surveyed during April to May 2022 from as far west as Pecos and east to Paris, and as far north as Bovina and south to Brownsville. TNS surveyed each plot and recorded wildflower cover percentages, number of milkweed stems, presence of monarchs or other pollinators, and presence of added habitat resources. To date TNS staff has identified over 285 different plant species and recorded an average of 75% cover of forbs in the rights-of-way. TxDOT will use the data to inform current and future vegetation management practices to improve monarch butterfly habitat.

Funding provided by the Texas Department of Transportation

Milkweeds are a vital part of monarch habitat, as their leaves supply food for the caterpillar.

Future Water Storage of the Ogallala Aquifer in Texas

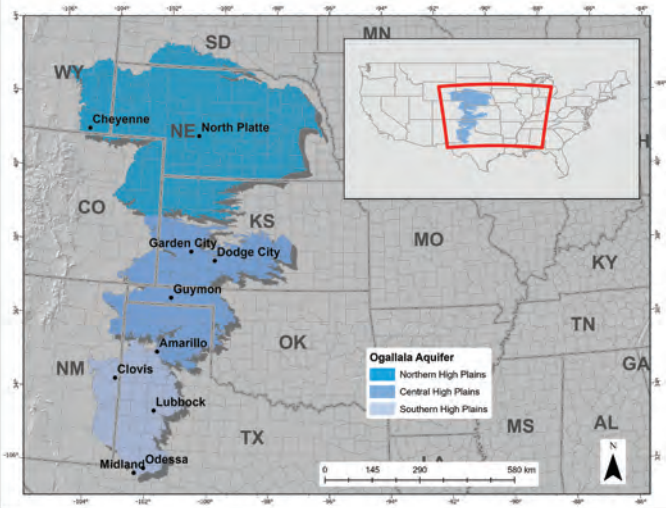
Edward C. Rhodes, Humberto L. Perotto-Baldivieso, Evan P. Tanner, Jay P. Angerer, and William E. Fox

Once considered by early explorers as the "Great American Desert," the United States High Plains have been transformed into the "Breadbasket of the World" through irrigation from the Ogallala aquifer. This aquifer spans eight US states: Texas, Oklahoma, New Mexico, Kansas, Nebraska, Colorado, Wyoming, and South Dakota.

The Ogallala is critical to the economic success of the region. It supports a $20 billion economy and is the drinking water source for 82% of those living there. However, the Texas portion is at risk of depletion over the next eighty years. Many of these areas have already faced serious drops in water output with impacts on crop production.

Water within the Ogallala aquifer is often called "fossil water," as recharge in this region is minimal. Therefore, conservation remains a high priority. It is assumed that in the future much of the irrigated area will shift to dryland farming or to grazing lands. We will use advanced groundwater modeling software and projected future land use and population data to estimate the status of the aquifer under low and high usage through the year 2100. We expect to identify potential areas of deficit or surplus water within the region, and to direct future research to address these issues.

Cooperative funding provided by the USDA Agricultural Research Service.



The Ogallala aquifer spans parts of 8 states.

Developing Virtual Fences for Large Areas in South Texas

Daniel J. Ramirez, Humberto L. Perotto-Baldivieso, Jeremy A. Baumgardt, J. Alfonso Ortega-S., Jason W. Karl

Farmers and ranchers use a variety of tools to move large farm animals across different areas. A new way of managing cattle has been through virtual fencing, drawing boundaries with electronics rather than posts and wire. Traditional fencing can cause harm to wildlife and disrupt habitat connectivity. Physical fences can also be costly to build and maintain.

Our objective with this project is to provide a prototype of low-cost virtual fencing that is easy to create and performs better than current virtual fencing technologies. We plan to test the virtual fence prototype using 30-40 cattle over a large pasture. Current virtual fence technologies have been used in small areas. We will also monitor cattle with GPS collars to assess their movement and behavior.

With the information gathered from this study, we will learn how cows adapt to the virtual fences and how they affect the vegetation in the area. We hope our data will help ranchers and farmers manage cattle in large pastures with new methods and reduced costs.

Cooperative funding provided by the Sweden Ranch.

Drones and Hay Production

Lori D. Massey, Humberto L. Perotto-Baldivieso, J. Silverio Avila-S., Evan P. Tanner, J. Alfonso Ortega-S.

Hay production plays a vital role in the ranching industry. It provides ranchers with food reserves for those harsh winter months and dry years. Drones have been used to estimate forage mass production in rangelands, but what we want to know is how well they can do it.

We will be flying a hay field with a drone and taking on-the-ground vegetation measurements and weights. These measurements will be used to calibrate the drone data. We will estimate the total forage produced using the drone information data and the ground measurements combined. Once we have collected field data and drone imagery the hay field will be cut and baled for hay. We will take the bales to a weigh station and obtain their weights. We will compare these weights to the estimates obtained from the drone.

This study could ultimately provide ranchers with a hay production estimate before they consider cut-

ting a field for hay. The methodology developed in this study could also be used to determine the correct stocking rate for their fields or pastures.

Cooperative funding provided by the Houston Livestock Show and Rodeo, Dallas Safari Club, The Rotary Club of Corpus Christi Harvey Weil Sportsman Conservationist Award, and USDA Natural Resources Conservation Service.

Drones to Evaluate Grazing Intensity for Wildlife

J. Silverio Avila-S., Bradley K. Johnston, Humberto L. Perotto-Baldivieso, J. Alfonso Ortega-S., Leonard A. Brennan, and Fidel Hernández

The ability of drones and their use to monitor rangelands has increased in the last decade. Drones can capture data from large areas with very high resolution imagery (less than inches per pixel). Recent rangeland studies with drones include biomass and crude protein estimation, as well as multispectral imagery for identifying grass species. Additionally, drones have been used for wildlife studies to quantify thermal refugia and fine-scale resource selection for northern bobwhites (hereafter 'bobwhites'). Our objectives are to determine vegetation changes from grazing and impacts of grazing on bobwhite habitat by using drone imagery.

We will use drones to compare vegetation differences between two pastures, one grazed and one non-grazed. We will collect drone imagery from six 20-acre plots in each pasture at a height of 164 feet above ground level. We will study density and height of vegetation between pastures by comparing 3D vegetation models derived from the drone imagery. We will compare those results to data collected in the field.

This project will provide information on herbaceous vegetation changes that take place as grazing occurs in a livestock operation. It will enhance our understanding of how these changes can improve bobwhite habitat, while improving efficiency of drones. Our results have direct impacts for rangeland management that include both livestock and wildlife.

Cooperative funding provided by the Sweden Ranch, CONACYT, the Ken Leonard Fund for Livestock Interactions Research, and The Rotary Club of Corpus Christi Harvey Weil Sportsman Conservationist Award.

DJI Phantom 4 RTK drone used to collect imagery of vegetation in Duval County, Texas.

Texas Native Seeds

Anthony D. Falk, Shyla E. Rabe, Colin S. Shackelford, John R. Bow, Tyler C. Wayland, and Douglas L. Jobes

It has been an exciting year for Texas Native Seeds (TNS). TNS and its partners have made significant strides in improving the number and availability of commercially-produced and locally-adapted native seed sources. During the past year, TNS staff and partners have completed seed releases of 4 additional species including (1) Cibolo Germplasm little barley, (2) Loma Germplasm purple threeawn, (3) Fuego Germplasm Indian blanket, and (4) Burnett Germplasm hooded windmillgrass. TNS has also begun new evaluations on 4 species in the Coastal Prairies, East, Central, West, and Permian Basin-Panhandle regions. Additionally, there has also been great progress made in our seed increase capabilities with the establishment of 2 new seed increase sites and an expansion of a third site. These new sites will now allow for the rapid production of native seed sources across the state.

TNS has recently added 5 new employees to assist with program growth and meet native seed needs. We've added 3 new staff members in Kingsville, Stephenville, and Edna to aid seed increase efforts and improve regional operations. In Kingsville, we've also hired a research associate to help CKWRI graduate students further our knowledge of native grassland restoration, as well as an additional office staff member to assist with added travel, purchasing and grant submissions.

The additional staff members and the improvements to our seed increase efforts will make TNS more efficient and effective in impacting the availability of locally-adapted native seed sources across Texas.

Cooperative funding provided by numerous generous supports of Texas Native Seeds.

Commercial seed production of recently released Fuego Germplasm Indian blanket.

Effects of Seeding Rates on Plant Establishment

Anthony D. Falk, Keith A. Pawelek, C. Bart Dupont, Jimmy C. Rutledge, and Eric D. Grahmann

During the last few decades there have been great strides made in our knowledge of native grassland restoration. However, the question of "how much seed do I need to plant?" continually is asked. The standard planting rate according to the USDA NRCS is 20 pure live seeds (PLS) per ft²; however, it is human nature to think that more is better.

To test the effects of seeding rates on plant establishment Texas Native Seeds (TNS) and La Paloma Ranch began a grassland restoration project that included extensive brush control followed by seeding several different rates of a number of competitive native species. Species of interest in this project included: Dilley Germplasm slender grama, Maverick Germplasm pink pappusgrass, Hidalgo Germplasm multi-flowered false Rhodesgrass, and Mariah Germplasm hooded windmillgrass. Treatments for this project included: a standard seed mix seeded at 20 PLS per ft²; additional treatments were each of the species above seeded at 20 PLS per ft² plus the standard mix seeded at 20 PLS per ft² for a total of 40 PLS per ft², and a final treatment included a mix with all of the above listed species at the standard rate resulting in a rate 4 times the recommended amount of just 4 species.

One year post-planting we can see that there is an early advantage to seeding at 40 PLS per ft² or twice the standard rate, but that there is no additional benefit seen when seeding at 80 PLS per ft². These early results can be used to help inform landowners and managers of the benefits of correct seeding rates such as cost savings and stand establishment, as well as the negatives of over-seeding.

Cooperative funding provided by the Lee and Ramona Bass Foundation.

South Texas Natives Project Update

Rider C. Combs, Anthony D. Falk, and Keith A. Pawelek

Throughout the last year the South Texas Natives (STN) project of Texas Native Seeds (TNS) has continued its standard of success. Last year STN and its partners, the USDA Natural Resources Conservation Service Plant Materials Centers in Knox City and Kingsville, released 3 new plant varieties for use in South Texas. Along with the 3 new releases we have distributed 170 pounds of seed to commercial growers, allowing for additional production of seed.

STN staff was able to expand seed production by planting 12 new species in our seed increase fields in Kingsville. Pollinator habitat has become such an important part of STN restoration efforts that this year we started new fields of Indian blanket, awnless bush sunflower, zizotes milkweed, scarlet sage, and Gregg's mistflower. Additional grasses that were installed include red lovegrass, little bluestem, Texas grama, hairy grama, pink pappusgrass, southern witchgrass, and purple threeawn. Along with seed production, restoration research continues to be an interest of STN staff, serving on 3 graduate student committees and starting 3 new research projects in the region.

Despite our busy nature, the STN staff specifically seek to maintain the excellent relationships with our current partners, develop new relationships with organizations, and provide guidance to land owners that choose our program. As we look forward to restoring many acres of native rangelands in the future, we are grateful for the abundant growth and collaborations STN has seen this year.

Funding provided by the many generous donors to South Texas Natives.

Texas Native Seeds Plant Material Center Partnership

Anthony D. Falk, Keith A. Pawelek, Shelly D. Maher, Robert A. Shadow, C. Brandon Carr, Colin S. Shackelford, Tyler C. Wayland, Douglas L. Jobes, Samuel R. Lutfy, and John R. Bow

The Texas Native Seeds Program (TNS) and the USDA NRCS Plant Materials Centers (PMC) in Kingsville, Nacogdoches, and Knox City, TX are continuing their partnership through a series of Cooperative Ecosystem Studies Unit projects supported by Texas NRCS. These projects are focusing on increasing commercial availability of past releases of native germplasms and developing new seed sources that will benefit pollinators. In addition to seed source development, these projects are also looking to improve restoration success through research plantings.

During the last year TNS and PMC staff have installed new evaluations of 4 different species throughout the state. These evaluations include 2 new flowering species to provide feeding habitat for pollinators: a fast-establishing species for use in East Texas and the Coastal Prairies region; and a large bunchgrass for use in the Panhandle and Central Texas.

Seed increase efforts were continued and expanded for 36 previously-released or soon-to-be-released native plants. This included the installation of 6 new forb species and 12 new grass species. In addition, 4 new research plantings were established across Texas in an effort to examine seed source performance as well as examine planting and establishment methods. This partnership will positively influence native plant restoration across the state.

Cooperative funding provided by the USDA NRCS Texas Cooperative Ecosystem Studies Unit.

New research planting being seeded in West Texas.

TxDOT and Texas Native Seeds Program Collaboration

Anthony D. Falk, Shyla E. Rabe, Colin S. Shackelford, Samuel R. Lutfy, John R. Bow, Douglas L. Jobes, Tyler C. Wayland, and Travis J. Jez

Texas Native Seeds (TNS) and the Texas Department of Transportation (TxDOT) have a long-standing partnership focused on developing native seed varieties for use in rights-of-way. A major accomplishment of this partnership has been the changes TXDOT has made to their rural revegetation specifications. Through this partnership TNS has made enough native plant material available for TxDOT to move towards using all native species in their rural seed mixes across the entire state.

This past year TNS completed 5 new native plant releases for use throughout the state. These releases include 4 grasses and 1 flowering pollinator species. Along with releases, TNS has installed and maintains over 25 seed increase fields at various locations throughout the state. Additionally, TNS has started evaluating 2 new flowering species to provide food sources for pollinators. We have also installed evaluations of 2 new grass species that are low growing and quick to establish.

Through this collaboration there are now over 75 native grass varieties commercially available that are adapted for use across the state. There are also over 20 perennial native forbs commercially available and adapted for use throughout the state. While these are impressive numbers there is still a significant amount of work to be done in many regions of the state.

Cooperative funding provided by the Texas Department of Transportation

Commercial production of the recently released Cibolo Germplasm little barley.

Restored native grasses and forbs at a Safety Rest Area in Central Texas.

Most Effective Seed Mixtures for Safety Rest Areas

Anthony D. Falk, Travis J. Jez, Colin S. Shackelford, Douglas L. Jobes, Rider C. Combs, Samuel R. Lutfy, Keith A. Pawelek

Safety Rest Areas (SRAs) are large areas maintained by the Texas Department of Transportation (TxDOT) that include restrooms, ample parking, and park areas for travelers to enjoy. Traditionally, SRAs were seeded with non-native Bermudagrass and mowed to maintain a short and uniform stand. However, recent changes in policy and an interest in saving money through reduced mowing has prompted TxDOT to explore seeding the outer edges of SRAs to native grasslands with a focus on providing habitat for pollinators.

To fill this need TxDOT has partnered with Texas Native Seeds to develop 5 different seed mixes made up of commercially-available and locally-adapted native species to seed at SRAs throughout the state. This project was conducted at 5 different SRAs spread throughout the state. Each SRA had 5 specific seed mixes developed for the exact site of the planting based on the soils and climate. Following seeding, data were collected to determine the most effective seed mix for each site.

Each of the SRAs had very different results. One of them was removed from the study shortly after planting because of a change in construction plans. Two of the SRAs have been very slow to develop due to prolonged drought, while the last two are performing fairly well. Despite less than ideal growing conditions, all of the plantings not affected by construction have seen an increase in the number of flowering plants that will provide habitat for pollinators.

Cooperative funding provided by the Texas Department of Transportation.

Central Texas Native Seed Project

John R. Bow, Anthony D. Falk, Colin S. Shackelford, Hagen C. Meyer, and James P. Muir

The Central Texas Native Seed Project (Central Texas NSP) of Texas Native Seeds develops native seed sources to restore plant communities throughout Central Texas. The Central Texas NSP collects native seed from plant populations in 67 counties in Central Texas to evaluate, select, and make native seed releases. New plant populations are tested in field sites at the Texas A&M AgriLife Research Center in Stephenville, the USDA NRCS James E. "Bud" Smith Plant Materials Center in Knox City, and the Sandbrock Ranch in Aubrey.

This year a new evaluation of Arizona cottontop was installed in the region. This evaluation consisted of 43 native plant populations each transplanted at 2 sites. Data collected from these plots include growth measurements, plant characteristic rankings, and seed quality. Along with these new evaluations data collection continues at each location for existing state-wide evaluations of Canada wildrye, which is in its second year. New wild seed collections were focused on pollinator plants.

Past plant population selections of yellow Indiangrass, little bluestem, meadow dropseed, silver bluestem, hairy grama, tall grama, sideoats grama, and seep muhly are being grown in field plots at the Stephenville location for seed increase. Seed from these selected populations will be harvested and made available to commercial seed producers. Results from this project include commercially-available seed sources for reclamation and restoration in Central Texas.

Cooperative funding provided by Texas Department of Transportation.

Native Bunchgrasses for Bioenergy Production

James P. Muir, John R. Bow, Anthony D. Falk, and Jamie L. Foster

Our goal is to identify native seed sources that can be used to restore abandoned croplands, degraded rangelands, and failing pastures to create bioenergy products. The idea is to gradually introduce land managers to grasslands that can be used for bioenergy production in the future. Diverse native grasslands will provide diverse income sources for independent farmers in the Southern Great Plains and surrounding ecoregions. The diverse income sources will help reduce operation risks and promote resilience and sustainability to the environment.

Our objective is to replace current plants with native plants in current ranching, wildlife management, and ecosystems services lands. These lands are ideal for conversion to natives because native grassland species will be a more competitive and sustainable bioenergy source when compared to low-input introduced plant systems.

We have identified ideal perennial native grass populations collected from the Southern Great Plains and tested their abilities to grow in field studies at five locations. These locations were selected to capture the differences in rainfall, temperatures, and soils in the region. In addition to monitoring plants in monocultures, grassland mixtures were also tested in field trials with low inputs.

This project will set the groundwork for selecting regionally-adapted native seed mixes to help promote profitable use on the grasslands of the South-Central region.

Cooperative funding provided by SUN grant.

Plots of locally-adapted native plants monitored for regional biomass differences.

Update on the West Texas Native Seed Project

Colin S. Shackelford, Louis A. Harveson, and Anthony D. Falk

The development of locally-adapted native species for West Texas is ongoing with significant new accomplishments for 2022. Currently, we are evaluating Canada wildrye, Arizona cottontop, and hairy grama in West Texas. New evaluation plantings of sand bluestem and narrow-leaf coneflower were installed in June 2022. Data will be collected on these plantings through 2023 before populations are selected for seed production and commercial release. Twenty-seven native plant species have been or are presently undergoing evaluation in West Texas.

Thirteen species are currently planted in seed increase fields to provide seed for commercial release. These include 9 grasses (black grama, blue grama, Hall's panicum, hooded windmill grass, sand dropseed, sideoats grama, silver bluestem, tobosagrass, and whiplash pappusgrass) and 4 forb or shrub species (cowpen daisy, Gregg's mistflower, skeletonleaf goldeneye, and Tahoka daisy).

Three seed releases have been completed and are currently in commercial production: Brewster Germplasm sideoats grama, Permian Germplasm whiplash pappusgrass, and Santiago Germplasm silver bluestem. Plans are in place for the additional releases of sand dropseed and cowpen daisy in 2021. Seed collections for West Texas are continuing to support future seed selections for the region. Presently, over 1,600 native seed collections have been made for West Texas.

Seven grassland restoration research plantings have been completed near the project headquarters in Alpine, Texas. West Texas staff has also provided technical guidance on multiple restoration seedings conducted by our partners at the Borderlands Research Institute at Sul Ross State University as well as multiple private landowners.

Cooperative funding provided by the Texas Department of Transportation, the USDA Natural Resources Conservation Service, Caesar Kleberg Foundation for Wildlife Conservation, ConocoPhillips, National Fish and Wildlife Foundation, A. S. Gage Foundation, Faye L. and William A. Cowden Foundation, Shield Ayres Foundation, Stan Smith, and the Railway Ranch.

Seed increase planting of cowpen daisy in Alpine, Texas.

Midland Native Plant Demonstration Garden

Colin S. Shackelford and Jesse S. Wood

ConocoPhillips has partnered with the Permian Basin-Panhandle Native Seed Project (Permian Basin-Panhandle NSP) of Texas Native Seeds (TNS) to develop a native plant demonstration garden in downtown Midland. The garden is intended to showcase regional native plant species that can be used for grassland restoration projects in the Permian Basin. The garden is made up of commercially-available species as well as species nearing commercial release by TNS.

This garden was established in spring 2018 with a mix of 8 native wildflowers and 21 native grass species. A small area adjacent to the garden was drill seeded with native short grass species to create a lawn border. Each species is displayed in a 10 foot x 10 foot square with 5-foot wide walking rows in between. This garden gives people an idea of the plant's growth habits and the aesthetic benefits of restoration.

Interpretive signs were posted in summer 2019 that explain the benefits of native grassland restoration, give a brief introduction to each plant species, and provide program information about TNS. The garden is an easy-to-access tool to introduce industry professionals and public organizations to the benefits of grassland habitat restoration in the heart of downtown Midland. The garden will continue to expand as TNS develops new plant materials for the region.

Cooperative funding provided by Concho Resources, Inc.

The Permian Basin-Panhandle Native Seed Project

Colin S. Shackelford and Anthony D. Falk

The Permian Basin-Panhandle Native Seed Project (Permian Basin-Panhandle NSP) of Texas Native Seeds (TNS) began in 2017 working to develop commercially-available native seed sources for the Permian Basin and Panhandle regions. To date, 535 grass and wildflower seed collections have been made from private and public lands. Collections are catalogued and stored at the James E. "Bud" Smith Plant Materials Center in Knox City, TX. Plant evaluations and selections are conducted at 3 different sites across the region: the Railway Ranch near Odessa; the USDA Natural Resources Conservation Service's Knox City Plant Materials Center; and Texas Tech University's Quaker Avenue Research Farm in Lubbock. Over 30 plant species are currently being evaluated for potential use in the region. Additionally, new evaluations of sand bluestem and narrow-leaf purple coneflower were planted in June 2022.

Other objectives include educational and community outreach and developing partnerships with the energy industry and landowners in the Permian Basin. ConocoPhillips has partnered with Permian Basin-Panhandle NSP in research plantings, developing a demonstration garden in Midland, as well as restoration planting trials at their ranches. The Railway Ranch is another important research partner. Three different research plantings have been installed on the ranch since 2018 examining planting methodology and the use of cover crops. We have also had the opportunity to provide native plant seed mix specifications to various oil and gas, renewable energy, and pipeline companies that have impacted thousands of acres in the region.

Cooperative funding provided by ConocoPhillips, the National Fish and Wildlife Foundation, and the USDA Natural Resources Conservation Service.

National Fish and Wildlife Foundation West Texas Native Seed Project Research

Colin S. Shackelford, Louis A. Harveson, and Anthony D. Falk

A new two-year project supporting both the West Texas Native Seed Project (West Texas NSP) and the Permian Basin-Panhandle Native Seed Project (Permian Basin-Panhandle NSP) of Texas Native Seeds (TNS) was recently funded by the National Fish and Wildlife Foundation (NFWF). The project is part of NFWF's Pecos Watershed Conservation Initiative, a partnership between NFWF, 6 major oil and gas producers in West Texas, the USDA Natural Resources Conservation Service, and the US Fish and Wildlife Service.

This new round of funding will expand on the partnership between NFWF and the West Texas NSP and Permian Basin-Panhandle NSP that began in 2019. Ongoing efforts of the partnership include the development of new seed sources for habitat restoration across West Texas. New seed source research made possible by the project includes sand bluestem and narrow-leaf purple coneflower. Funding will also support farm operations for seed production of new plant releases. Additionally, 20 acres of new grassland restoration research plantings in West Texas and Southeast New Mexico will be part of the project. Results from these plantings will be used in the development of best practices for grassland restoration in West Texas.

This funding will provide partial support for 2 assistant director positions and a full-time technician employed through project partner Sul Ross State University in Alpine, TX. This ongoing partnership will bring new regionally-adapted native seed sources to commercial markets across West Texas and the Panhandle helping to make successful grassland habitat restoration a reality.

Cooperative funding provided by the National Fish and Wildlife Foundation, ConocoPhillips, Caesar Kleberg Foundation for Wildlife Conservation, Stan Smith, and the Railway Ranch.

Commercial production of Brewster Germplasm sideoats grama, an ecotypic seed release developed by the West Texas Native Seed Project.

Native Seed for Harris County Flood Control District

Douglas L. Jobes, Tyler C. Wayland, Anthony D. Falk, and Jeffery Jowell

The flood control infrastructure of Harris County, Texas, consists of various waterways that include drainages, ponds, and water channels totaling nearly 2,500 miles. Managing these waterways to maintain function, while still being ecologically beneficial to the region, is a priority for Harris County Flood Control District (HCFCD). An important part of that management includes establishing vegetation through seeding or reseeding after construction or maintenance activities. However, the use of native seed sources is limited due to the lack of availability and limited testing.

We are implementing a study using native species at 2 locations in Harris County. The plots are in typical soil types found in the adjacent drainages and basins. Maintenance and monitoring of research plots will occur throughout the 2020 growing season. Plots at each location are 100 ft² and include several species that are currently commercially-available. The 5 yet-to-be-released species that have potential include herbaceous mimosa, velvet dicanthelium, Florida paspalum, eastern gamagrass, and knotroot bristlegrass. Collections are also underway to increase evaluations of other candidate species.

Results from this study will play an important role in providing reliable seed sources for use within the drainages and waterways of HCFCD. This will also help to encourage the use of native seeds for restoration and reclamation by other groups, agencies, and landowners of the region.

Cooperative funding provided by the Harris County Flood Control District.

Purpletop tridens evaluation near Cat Springs, Texas.

Coastal Prairies Native Seed Project

Douglas L. Jobes, Anthony D. Falk, Aaron D. Tjelmeland, Garry S. Stephens, Jim Willis, and Sonia Najera

Wildlife in the Coastal Prairies and Marshes ecoregion of Texas is threatened by habitat loss caused by urban growth and rural land development. These activities destroy native habitat on which wildlife depend. With few intact coastal prairies remaining it will become more important to offset habitat loss. Developing native seed sources for restoration will be a vital part of future conservation in the region. Currently there is a lack of commercially-available native seed sources adapted for the Coastal Prairies. Texas Native Seeds (TNS) and the Coastal Prairies Native Seed Project (Coastal Prairies NSP) are working to develop adapted native seed that will allow for large-scale restoration in the region.

We are collecting seeds within an 18-county area and storing them in the USDA Natural Resources Conservation Service (NRCS) E. "Kika" de la Garza Plant Materials Center in Kingsville, Texas. Seed from these collections are used to evaluate native plant populations from the coastal prairies for seed source development. To date we have evaluated little bluestem, knotroot bristlegrass, yellow Indiangrass, silver bluestem, purpletop tridens, rattlesnake master, beebalm, longspike tridens, and round-leaf boneset. The top performing populations of knotroot bristlegrass and silver bluestem are currently being produced to provide seed to commercial growers.

In addition to native plant seed source development, Coastal Prairies NSP is also working to provide guidance to landowners and managers across the region and to educate the public on the importance of native plants in wildlife conservation.

Cooperative funding provided by the Texas Department of Transportation, USDA Natural Resources Conservation Service, Henderson-Wessendorf Foundation, Chiltepin Charitable Fund, Trull Foundation, and the Willard and Ruth Johnson Charitable Foundation.

Update on the East Texas Natives Project

Tyler C. Wayland, Nelson O. Avila, Keith A. Pawelek, and Anthony D. Falk

East Texas Natives (ETN) is a collaborative initiative within the statewide Texas Native Seeds Program (TNS). Our focus is on increasing the quality and quantity of native seed sources available for native plant restoration on private and public lands in East Texas. The goal is to make available the needed seed to enable large-scale restoration across the region.

This project is now entering its 5th year of operation. We are collecting, evaluating, and selecting populations of common native plant species that are best suited for an agronomic production setting. Selected populations are farmed for seed which are then released to commercial seed producers for large-scale production.

To date, we have made 675 native seed collections representing 71 different species from 59 counties in East Texas. East Texas Natives is operating native plant evaluation sites in the Pineywoods, Blackland Prairie, and Oak Woods and Prairies ecoregions. We currently have 6 species under evaluation, and our project's first release, silver bluestem, is in seed increase. Species under evaluation include Indiangrass, purpletop tridens, rattlesnake master, spotted beebalm, longspike tridens, and roundleaf thoroughwort.

The regionally-adapted seed sources developed by ETN and project partners will help to increase the number of acres restored to quality habitat throughout East Texas.

Cooperative funding provided by Ellen Temple, Rufus Duncan, Amanda Haralson and Thomas Livesay, Jeff Austin III, RES Texas Mitigation, the Texas Department of Transportation, USDA Natural Resources Conservation Service, and the U.S. Forest Service.

Native Seed Development for East Texas Understory

Tyler C. Wayland, Jacob L. Sparger, Nelson O. Avila, Thomas C. Philipps, Robert A. Shadow, Keith P. Pawelek, and Anthony D. Falk

A diverse native plant understory is an important indicator of a healthy open pine forest ecosystem. Increases in disturbances due to infrastructure development and land conversion have highlighted a need for a supply of locally-adapted native seeds to restore these disturbed sites. We are working with the US Forest Service and the NRCS East Texas Plant Materials Center (ETPMC) to develop locally-adapted native seed sources needed to support successful restoration projects across East Texas.

This project involves collecting, evaluating, and selecting top-performing populations of native plant species to release for large-scale production by commercial seed producers. We are currently evaluating 6 native species. Along with these evaluations, we are also working to produce enough seed of existing ETPMC seed releases to assist producers in establishing commercial-scale fields. This project also focuses on public outreach to highlight the importance of habitat restoration on a large scale. Last year we gave 15 presentations engaging with private landowners, land managers, and partner agencies. In addition, we have installed several demonstration plantings to show the benefits of locally-adapted native species.

This increase in available seed and conservation education outreach will help support federal, state, and private native plant restoration efforts across the region.

Cooperative Funding Provided by the U.S. Forest Service, the USDA Natural Resources Conservation Service, and the numerous private donors of the East Texas Natives Project.

Seed increase field of USFS pinehill bluestem being harvested at the East Texas Plant Materials Center in Nacogdoches, Texas.

Restoration of Horned Lizard Habitat

Anthony D. Falk, Colin S. Shackelford, and Jo Ann Ortiz

Texas horned lizards are a state threatened species that require open native grassland with some brush for overhead cover. Toyota Motor Manufacturing in San Antonio has partnered with the San Antonio Zoo and Texas Native Seeds (TNS) to create useable habitat for Texas horned lizards. Hopefully these changes will allow for Texas horned lizards on their property.

The process for reintroduction had to begin with eliminating the current vegetation, which was non-native Bermudagrass, and establishing native grassland vegetation. TNS staff began spraying herbicide aggressively on 20 acres of the project during spring 2020. The spraying was done with 4 herbicide applications sprayed monthly from June through September. After spraying, a seed mix of 15 native grass species and 12 native forb species was seeded in late September. Then during spring 2021, staff from Toyota Motor Manufacturing transplanted a number of brush species into the restoration area to complete the restoration efforts.

This first 20-acre project has been largely successful, with almost complete elimination of the non-native Bermudagrass and establishment of many native flowering species, with mixed grasses and shrubs. The success of this first project has led to an extension of this partnership and the conversion of an additional 40 acres. Work on the new acreage will begin during summer 2022 and follow a similar plan as the initial 20 acres, with an expected planting date of fall 2022.

Cooperative funding provided by Toyota Motor Manufacturing

Restored native vegetation with lots of forbs at Toyota Motor Manufacturing.

Comparison of Texas County Laws Pertaining to Dangerous Animals

Harry Rakosky and Scott E. Henke

Members of the public often desire dangerous exotic animals, such as lions, tigers, bears, and wolves, as pets. However, the possibility of owning such a pet depends upon where the person lives. Nineteen states ban the private ownership of exotic animals, 26 states require the owner of an exotic animal to obtain a license first, and 5 states have no regulations about the ownership of dangerous wild animals.

In Texas, each individual county via its commissioners' court can choose how it will regulate the ownership of dangerous wild animals within its jurisdiction. If such ownership is allowed, then the state can apply any conditions (e.g., state registration, liability insurance) that apply. Some Texas counties ban the ownership of all dangerous animals, while other counties require licenses to maintain exotic pets, and still other counties ban certain species of animals while requiring a license to own others. Such a mixture of possibilities can create confusion among Texans who may reside in one county, yet hear stories involving exotic pet ownership in other counties. In addition, in counties with multiple statutes and regulating agencies, confusion can creep into law enforcement agencies about who has enforcement power, thereby weakening the protective measures that have been passed.

Our objective is to survey the counties in Texas to determine: (1) what statutes or ordinances govern the private ownership of dangerous wild animals, (2) which species, if any, are banned, (3) which species require licenses or permits to be maintained as pets, and (4) what agencies enforce the regulations related to exotic pet ownership. Our goal is to provide a complete, single source of information that will assist Texans in finding the regulations governing private ownership of dangerous wild animals within each county.

Texans' Attitudes Pertaining to Ownership of Dangerous Animals

Harry M. Rakosky and Scott E. Henke

The newness and thrill of owning an exotic animal often entices people to get one. Texas pet law states that exotic animals can be privately owned if the owner has a certificate of registration for the animal issued by the Texas Department of State Health Services.

A privately-owned tiger lounges behind a chain-link fence.

This includes animals considered dangerous, such as lions, tigers, wolves, bears, and non-human primates.

However, some Texans believe that certain exotic animals are too dangerous to be allowed as pets. This belief was supported in 2021 when a Bengal tiger escaped from its owner and roamed freely throughout a neighborhood in Houston, Texas. After the incident, the public was divided concerning the logic of the exotic pet ownership law. Some people argued that wild animals belong only in their natural habitats and should never be allowed as pets. Others argued for individual property rights and believed that if a person wanted a dangerous animal as a pet, then he or she should be allowed to own one. Yet another group agreed with the individual rights argument, but didn't want a dangerous wild animal in their neighborhood.

The main goal of our study will be to assess the attitudes of Texans concerning the right to maintain dangerous wild animals as pets. Our objectives will include determining: (1) whether Texans believe that dangerous wild animals should be kept as pets, (2) what species of exotic animals Texans currently maintain as pets, (3) the level of comfort that Texans have concerning various species of dangerous animals, and (4) the level of comfort of Texans have concerning ownership of dangerous animals within various distances of their own home. Our study will provide Texas lawmakers with information that can be used to better serve the public concerning exotic pet ownership.

Podcast and Chill

Andrew C. Lowery, Gabriella D. Olivas, Paul C. (Tre') Kendall, Rebecca R. Zerlin, Brianna M. Slothower, Georgina R. Eccles, Sandra Rideout-Hanzak

This year our podcast, A Talk on the Wild Side (ATOTWS), marked its first anniversary and began Season 2. Billing itself as, "Your Bi-weekly Tour of All Things Wild in Texas," ATOTWS has gotten off to a successful start with over 15,000 downloads. In our first year on the air we published 27 regular episodes and 3 bonus episodes. We've covered fun subjects such as wildlife photography, and tackled some difficult subjects such as Chronic Wasting Disease in deer. The podcast has given us the opportunity to shine a light on our own research, as well as other research, wildlife species, and conservation issues from all over the state.

In the podcast world, success is often measured in your outreach; ATOTWS has had listeners in 47 states and 40 foreign countries. Additionally, we have consistently ranked in the top 100, and reached as high as 27, in the Nature category rankings in the U.S. We have also earned 17 reviews, all with 5-star ratings. If you're a podcast listener, look for us on any podcast app you use—Spotify, Castbox, Apple Podcasts, etc. If you aren't a podcast listener now, we hope to be your introduction to this vast arena of information and entertainment. Be sure to subscribe to ATOTWS so you don't miss an episode.

Cooperative funding provided by the Rotary Club of Corpus Christi Harvey Weil Sportsman Conservationist Award.

A Talk on the Wild Side podcast covers a variety of topics about anything wild in Texas from coral reefs to deer to bees. Original artwork by Gabriella D. Olivas.

Using Drones and Real-Time Harvest Yield Maps to Quantify Wild Pig Damage

Bethany A. Friesenhahn, Lori D. Massey, Randy W. DeYoung, Michael J. Cherry, Justin W. Fischer, Nathan P. Snow, Kurt C. VerCauteren, and Humberto L. Perotto-Baldivieso

One of the most successful invasive species is frequently implicated in wildlife-agriculture conflicts: the wild pig. Wild pig damage to agriculture costs millions of US dollars annually, resulting in lost revenue for agricultural producers. Generally, producer and ground surveys may over- or under-estimate lost income. As such, standardized and accurate methods of monitoring wild pig damage to agriculture to estimate the economic losses is needed. The goal of this study was to combine drone imagery and corn harvest data to quantify wild pig damage in corn fields.

- We used a drone to monitor corn fields at different growth stages in an agricultural matrix in Delta County, Texas, during 2019–2020. We conducted 36 flights and identified wild pig damage in the resulting aerial photos. We compared estimates of damage from the drone to those derived from physically walking through the fields. Finally, we compared damaged areas of fields using real-time yield monitors during harvest to estimate loss due to pig damage.
- Drone imagery identified damage to corn fields caused by wild pigs and confirmed that most damage occurred during the late growth stages, when corn is most abundant and nutritious.
- Real time-time harvest yield mapping combined with drone imagery also allowed us to estimate an average total yield loss of 51 bushels per acre, at a cost to the producer of $72 per acre.

Wild pigs cause damage to rangelands and farm crops.

- Imagery collected from drone, real-time yield monitors, and machine-learning algorithms can be powerful tools for monitoring and quantifying wild pig damage in crops.

Cooperative funding provided by USDA APHIS Wildlife Services National Feral Swine Damage Management Program.

Movements and Resource Selection of Wild Pigs in Relation to Corn Growth Stages

Bethany A. Friesenhahn, Randy W. DeYoung, Michael J. Cherry, Humberto L. Perotto-Baldivieso, Nathan P. Snow, and Kurt C. VerCauteren

Wild pigs are one of the most successful invasive species globally and are often a common cause of agricultural damage. Crop damage is expected to increase as ranges of wild pigs expand, impacting the human food supply and increasing costs of food production. Our objective was to evaluate how wild pigs used the landscape relative to corn growth stages in an agriculture-dominated landscape, with a goal of informing management practices for reducing damage to corn. We monitored hourly movements of adult wild pigs relative to corn crops using GPS collars during the 2019 and 2020 growing seasons (Feb–Sept) in Delta County, Texas. We monitored pig movements, home ranges, and use of corn from planting to mature growth stages.

- We found that space-use and resource selection by wild pigs was dependent on corn growth stages and landscape composition. Pigs displayed more use and home range overlap as corn matured, with increased damage in fields closer to wooded areas.
- Most of the pigs were categorized as residents, who remained near corn fields throughout the growing season, yet some did make long-distance movements to access corn. Our results suggest that protecting corn is most important during the later stages of growth.
- If lethal control is not effective, managers should consider non-lethal methods, such as fencing, to account for wild pigs that travel from afar, especially if corn fields are located near forests or woody vegetation.

Cooperative funding provided by USDA APHIS Wildlife Services National Feral Swine Damage Management Program.

Detector dogs reduced the time required to find Texas tortoises in thick vegetation.

Playing 'Hide and Seek' with Texas Tortoises: Value of Detector Dogs

Christin A. Moeller, E. Drake Rangel, Barry Moeller, Scott E. Henke, Cord B. Eversole, and Sandra Rideout-Hanzak

Texas tortoises were once abundant throughout South Texas, as many as 8 tortoises per acre. Today, estimates are 1 tortoise per 10 acres, a decline of ~98%. Combined with their elusive behavior this makes them difficult to find. We demonstrated the value of using a detector dog to save time locating Texas tortoises. We glued VHF radio transmitters on 9 adult tortoises and released them in a 10-acre, plowed and short-grass pasture that contained mesquite mottes. We calculated Detectability Index (DI), which is represents the time it takes to find a percent of tortoises from the known population within 60 minutes. We compared DI's via telemetry, detector dog, and 'cold' (no equipment or knowledge of location) searches. We used the time required to find all tortoises when the searcher had prior knowledge of locations as the baseline.

- Our baseline DI was 0.78, followed by telemetry (0.109) and detector dogs (0.106), while 'cold' searches was 0.03.
- Using prior knowledge of tortoise locations was 8 times, 11 times, and nearly 60 times faster than using telemetry, detector dog, and cold searches, respectively.
- The combination of a detector dog and telemetry resulted in a 25% time savings. Telemetry was useful in locating an area with a tortoise, but a detector dog was 2 times faster locating the tortoise once the area was identified.
- We recommend using detector dogs to save time when conducting research on Texas tortoises.

Cooperative funding provided by Welder Wildlife Foundation and NextDecade LNG.

Land Bird Population Trends on East Foundation Ranches: A 10-Year Study

Delanie E. Slifka, April A.T. Conkey, Leonard A. Brennan, Humberto L. Perotto-Baldivieso, Fidel Hernández and Tyler A. Campbell

Many private land owners understand the value of documenting and managing for non-game birds on their property; however, few long-term bird studies have been conducted on the ranchlands of South Texas. Long-term data sets can reveal the lows, highs, and in-betweens of the trends of a population through time. We conducted surveys for 10 years on 3 ranches owned by the East Foundation: San Antonio Viejo, El Sauz, and Santa Rosa. There were 223 species documented throughout the study period. Of those, 52 were sufficiently abundant to establish populations trends. Most resident bird species appeared to have stable populations.

- On El Sauz, the populations of 7 species increased (field sparrow, lark sparrow, olive sparrow, killdeer, green jay, blue-gray gnatcatcher, and crested caracara); the brown-crested flycatcher population decreased, and 42 other species remained stable.
- On San Antonio Viejo, 44 species remained stable and 7 species experienced a significant increasing trend (eastern phoebe, golden-fronted woodpecker, lark sparrow, Lincoln's sparrow, northern cardinal, green jay, and Harris's hawk).
- On Santa Rosa, 36 species remained stable, 15 experienced a significant increasing trend (black-bellied whistling-duck, Cassin's sparrow, grasshopper sparrow, lark sparrow, long-billed thrasher, northern cardinal, northern mockingbird, olive sparrow, pyrrhuloxia, wild turkey, blue-gray gnatcatcher, house wren, American kestrel, red-tailed hawk, and crested caracara); and brown-crested flycatchers decreased.
- The data from these surveys show that a well-managed cattle ranch can support a wide diversity of bird species and continued monitoring can be used to detect significant population changes.

Cooperative funding provided by the East Foundation.

Differences in Spot-Tailed Earless Lizards Justify Separation as Different Species

E. Drake Rangel, Christin A. Moeller, Preston W. Richardson, Saren L. Perales, Jacob M. Reyes, Scott E. Henke, Cord B. Eversole, Ruby A. Ayala, and Brian K. Loflin

Spot-tailed earless lizard (STEL) originally was a single species that was separated into 2 subspecies, the Plateau and the Tamaulipan subspecies. Today, the lizards are considered two distinct species because of genetic differences, with the Balcones Escarpment fault line separating the northern (Plateau) species from the southern (Tamaulipan) species. However, we offer additional evidence to maintain the 2 species of STEL as distinct species.

- Tamaulipan STEL were larger by snout-vent length (SVL) and weight in both males and females. Tamaulipan STEL are ~4 inches in SVL and 2.5 ounces in weight, compared to Plateau STEL that were 3 inches in SVL and 2.0 ounces in weight.
- Within species, sexes were similar in size.
- Tamaulipan STEL were gray in color compared to a tan to brown color of Plateau STEL. The Red/Green/Blue quantification for Tamaulipan STEL was greater than for Plateau STEL.
- The two species behaved differently in our study also. Tamaulipan STEL appeared faster, ran further, and behaved more skittishly than Plateau STEL.
- Our evidence warrants maintaining the separation of these species.

Cooperative funding provided by the Office of the Texas Comptroller.

Daily Emergence Behavior of Captive Spot-Tailed Earless Lizards

E. Drake Rangel, Christin A. Moeller, Scott E. Henke, Cord B. Eversole, and Ruby A. Ayala

Spot-tailed earless lizards (STEL) are elusive species that spend most of their 24-hr daily cycles underground, which makes them even more difficult to locate. In conducting surveys for STEL, we noted that they emerge during daytime after cloud cover clears, temperature increases, and ultraviolent light (UV) and light intensity are near peak levels. Therefore, we tested this theory by controlling each of the above factors in laboratory experiments. Fifteen STEL were wild-caught and individually housed in 10-gallon aquaria in which they were provided unlimited crickets and water. Aquaria received either heat lamp, UV light, LED light, darkness, or a combination of UV and LED light for 3 days. Lights were turned on at 7:30 a.m. In a second experiment, STEL were provided both UV and LED light, but the onset of light began at either 8:00 a.m., 10:00 a.m., or noon. Time of emergence was recorded.

- STEL immediately emerged with a combination of UV and LED lights, followed by delayed emergence with either UV light or LED light only, while emergent behavior became sporadic if provided heat or darkness.
- STEL emerged upon lights turning on irrespective of time. STEL emerged upon lights turning on 81% of time, within 30 minutes 11% of time, within 1 hour 6% of time, and after 1 hour only 2% of the time.
- STEL react to and became active aboveground with higher light intensity and UV index.

Cooperative funding provided by the Office of the Texas Comptroller.

Spot-tailed earless lizards blend well with their background making them difficult to find.

Detectability of Spot-Tailed Earless Lizards by Various Methods

E. Drake Rangel, Christin A. Moeller, Scott E. Henke, Cord B. Eversole, and Ruby A. Ayala

Spot-tailed earless lizards (STEL) are elusive and potentially rare species, which are currently being

considered for threatened status by the United States Fish & Wildlife Service. To assist with federal listing, we investigated the best methods to detect STEL when present in an area. Also, we determined if a specific density of STEL was needed to reach a threshold for detectability. We wild-caught 20 Plateau and 20 Tamaulipan STEL and released them within a 2.5-acre outdoor enclosure, which was subdivided into 100 quadrats. We randomly selected 45 quadrats and constructed one treatment (i.e., camera traps, light traps, rock piles, cover boards, pitfall array, funnel traps, detector dog, visual search, and road cruising) per quadrat with 5 replications. We placed 5, 10, 20, 30, and 40 STEL into the enclosure and conducted 3 searches per lizard density.

- STEL's were observed during road cruising and visual searches.
- STEL's were not observed in funnel traps, camera traps, rock piles, cover boards, lights, or by detector dog.
- Only one STEL was captured in a pitfall trap, but was killed by fire ants.
- STEL detectability increased with increasing STEL density but not in a proportional manner.
- STEL above-ground activity increased as daily UV index increased.
- About 42% of STEL were above ground during the daily peak of UV index; however, only 25% were potentially detectable at a given point in time.
- A searcher of STEL must look within appropriate habitat and during the correct time to find STEL.

Cooperative funding provided by the Office of the Texas Comptroller.

Soil Texture and Compaction Preferences of Spot-Tailed Earless Lizards

E. Drake Rangel, Christin A. Moeller, Scott E. Henke, Cord B. Eversole, and Ruby A. Ayala

Plateau and Tamaulipan spot-tailed earless lizards (STEL) are seemingly rare species that are being considered for federally threatened status. Little is known about the habitat preferences for these two species. Past research indicated the species' used compacted clay soils; however, recent iNaturalist accounts locate the species in sandier soils. Therefore, our objective was to experimentally test soil texture and soil compaction preferences of both the Plateau and Tamaulipan STEL. We captured 10 Plateau STEL and 10 Tamaulipan STEL from San Angelo and Bishop, Texas, respectively, and maintained them in captivity at CKWRI Wildlife Research Park. We constructed 3 interconnected 1.5 x 3 x 1.5-ft plastic boxes, which each contained 6 inches of either sand, clay, or silt loam soils. Three experiments were conducted. In the first, each soil texture was ground into a fine, loose powder. In the second, soils were exposed to the environment for 2 weeks and allowed to naturally compact, and in the third each soil was compacted into a hard pan using a 120 lb iron weight. Individual STEL were randomly placed into 1 of the 3 interconnected boxes and allowed 24 hours to acclimate to their environment, after which the quantity of time spent on each soil was recorded on video.

- With loose, powdery soils STEL's spent more time in the silt loam soils.
- When soils were compacted either naturally or mechanically, STEL's preferred sandy soil texture.
- Compacted clay or loam soils were only used if cracks formed within the soil in which STEL's could hide.
- STEL were capable of adapting to various soil types and compactions.

Cooperative funding was provided by the Office of the Texas Comptroller.

Spot-tailed lizards, given a choice of sand, clay, or loam soils, selected loam soils before soil was hardened over time, and then sandy soils after soils were compacted.

Diet Preferences of Captive Spot-Tailed Earless Lizards

Ruby A. Ayala, E. Drake Rangel, Christin A. Moeller, Scott E. Henke, Cord B. Eversole

Conservation knowledge about rare species is difficult because of the lack of information about their ecology and natural history, which is the case with Plateau and Tamaulipan spot-tailed earless lizards (STEL). Because STEL are in the same family as Texas horned lizards, it has been assumed that they would have similar diets. We tested this hypothesis by capturing 12 Plateau and 13 Tamaulipan STEL and provided each lizard with a self-feeder, cafeteria-style choice of 5 crickets, 5 termites, 5 harvester ants, 5 flightless fruit flies, and 5 roaches, and monitored their daily consumption during a 5-day period.

- No difference in diet selection was observed between Plateau and Tamaulipan STEL.
- STEL overwhelmingly selected for crickets and avoided harvester ants.
- Termites were the second choice food for STEL, followed equally by flies and roaches.
- Although STEL and Texas horned lizards have overlapping distributional ranges, the two species avoid competition by selecting different diets.

Cooperative funding provided by the Office of the Texas Comptroller.

Prevalence and Severity of Sarcoptic Mange on South Texas Coyotes

Krystal A. Ruiz, Kathryn M. Sliwa, Jeremy A. Baumgardt, Randy W. DeYoung, J. Alfonso Ortega-Santos, David G. Hewitt, John A. Goolsby, Kimberly H. Lohmeyer

Sarcoptic mange is a skin disease caused by tiny mites that affects over 100 species of domestic and wild animals. The mites are transmitted through either direct or indirect contact with an infected animal. A female mite will burrow into the skin of the host and lay eggs inside the skin, causing itchiness. Clinical signs of mange include hair loss, thickening of skin, skin lesions, and infections. Coyotes are highly susceptible to sarcoptic mange infections and may act as reservoirs to transmit mites to other species.

- We assessed the prevalence and severity of sarcoptic mange in coyotes on 3 ranches in Cameron County, Texas from January 2019 to October 2020. We examined photos of coyotes taken by 140 remote cameras set up at fence crossings, areas where wildlife cross underneath livestock fences.
- We obtained 9,418 photos of coyotes for analysis. We ranked all coyote photos from 0 to 3 according to severity of mange. A "0" showed no signs of infection, hair loss or scabs; "1" indicated early signs of infection with hair loss around the tail; "2" was moderate hair loss or scabbing, covering 30-50% of the animal's surface area; and "3" indicated severe signs of infection, including 51-100% of hair loss, emaciation, and severe scabbing.
- Five to 12% of coyotes had mild to moderate cases of mange; fewer than 2% had severe mange. Assessing the prevalence of sarcoptic mange is important, as the disease may spill over and impact other wildlife and even livestock.
- Remote cameras appear to be a promising way to monitor mange outbreaks and severity in affected areas.

Cooperative funding provided by the USDA Agricultural Research Service.

A coyote in the South Texas sunshine.

Prescribed Fire and Butterflies in Coastal South Texas

Rebecca R. Zerlin, Sandra Rideout-Hanzak, David B. Wester, Richard J.W. Patrock, Tyler A. Campbell

The majority of flowering plants worldwide, including major agricultural crops, rely on insects for pollination. With major declines seen in insect populations in the past three decades, pollinator conservation is becoming more important. Prescribed fire can be a useful tool in rangelands for reducing dead plant matter, recycling nutrients, and promoting new plant growth. We investigated effects of prescribed fire on butterfly populations in coastal South Texas. We burned sixteen plots in either winter or summer, and compared them to control plots. Plots ranged from 500 to 1,200 acres and were located in areas dominated by either gulf cordgrass or seacoast bluestem. We conducted butterfly surveys monthly to see how their populations responded to fire.

- There were only a few months in which either butterfly abundance or diversity was different in the plots that were burned, and differences often showed no clear effects of either summer or winter burns.
- Butterfly numbers were sometimes lower immediately following burning, particularly summer burning, but rebounded within two to three months.
- While we found that season of burning made no noticeable differences, providing burned and non-burned areas may offer ideal habitat for butterflies by maintaining a variety of both host and nectaring plants at various growth stages.

Cooperative funding provided by the East Foundation.

Extreme Weather and Butterflies—There's Snow Way!

Rebecca R. Zerlin, Sandra Rideout-Hanzak, David B. Wester, Richard J.W. Patrock, Tyler A. Campbell

Extreme temperatures and weather events caused by climate change may be unsustainable for many species. While studying effects of prescribed burning on butterfly populations, our field site in Willacy and Kenedy Counties, Texas, was impacted by two extreme weather events: a Category 1 hurricane and an unprecedented winter storm. Hurricane Hanna made landfall 11 miles north of our field site in July 2020 bringing sustained winds of 90 mph and over 14 inches of rain. Winter Storm Uri caused record low temperatures sustained over multiple days in February 2021, including a low of 20° F. We compared butterfly populations in July (pre-) and August (post-hurricane) 2020 to determine the impacts of Hurricane Hanna. We also compared March-May 2020 (no winter storm) to March-May 2021 (after Winter Storm Uri).

- We saw no effect of Hurricane Hanna on butterfly abundance. Hanna was a Category 1 hurricane, and more severe hurricanes may have adverse effects.
- Winter Storm Uri did affect butterfly abundance. There were significantly fewer butterflies in the three months immediately following Winter Storm Uri than there were in the same months the previous year.
- Butterflies are unable to maintain their own body temperatures, and sustained cold temperatures may be fatal for them. This was apparently the case with Winter Storm Uri in 2021.
- Studying extreme weather effects on pollinators can help us understand their future needs and potential problems in a world with a changing climate.

Cooperative funding provided by the East Foundation.

Zebra longwing butterfly nectaring on lantana.

Water, Fire, and Drones: What Can We Learn from Spectral Signatures?

Annalysa M. Camacho, Humberto L. Perotto-Baldivieso, J. Alfonso Ortega-S., Evan P. Tanner, Anthony D. Falk, Shad D. Nelson, Amanda L. Montemayor, Walter E. Gless, Michael T. Page, Melaine A. Ramirez, W. Dwain Daniels, Tony Kimmet

Multispectral data have been used to identify plants in the past, with a focus on woody plants or dominant grass species. Spectral signatures can be highly variable due to water and chlorophyll content, plant structure, maturity, growth, or environmental stresses. Analyzing the variability of spectral signatures in grassland species is an important first step to identify vegetation communities using remote sensing approaches. Our objectives were to determine how the spectral signature of Gulf cordgrass was affected after a prescribed burn and determine how spectral signatures of 14 native grasses were affected by an irrigation event. We used a drone-mounted multispectral camera to capture spectral signatures of these grasses before and after irrigation and burning.

- Spectral signatures of burned and non-burned Gulf cordgrass 1 to 4 months after the burn were different.
- After 8 months, only 4 band s were different between the burned and non-burned Gulf cordgrass.
- Before the irrigation event, only 3 grasses (sand dropseed, silver bluestem, Texas grama) could be identified using their spectral signature, but no grasses were identifiable after the irrigation.

Cooperative funding provided by USDA Natural Resources Conservation Service, National Science Foundation, and the Rotary Club of Corpus Christi Harvey Weil Sportsman Conservationist Award.

Soil Health Gradients and Relationships in Semi-Arid Grazinglands

Douglas J. Goodwin, Stephen L. Webb, Kundan Dhakal, J. Alfonso Ortega-S., Humberto L. Perotto-Baldivieso, Douglas R. Tolleson, William E. Fox

Soil health has received attention lately largely due to its importance to many ecosystem functions. The ability of the soil to function is dependent on its physical, chemical, and biological components. These components allow the soil to conduct ecosystem functions, such as water infiltration, and affect the soil's capacity to hold moisture.

To understand the relationships among soil health metrics across ecological landscapes better, 19 properties in Oklahoma and Texas were sampled in 2019. On selected ranches, 110 variables (both soil and non-soil) were measured on 519 sites. We analyzed 32 soil variables.

- Soil organic matter had a positive relationship with soil available water holding capacity. However the strength of the relationship was not universal, it is mediated across soil texture classes.
- In rangelands strong relationships were identified among fine to medium textured soils, reduced bare ground, and robust soil biological biomass. Conversely, croplands and, to a lesser extent, pasture sites tended to be more closely associated with coarse textured soils. They also had more bare ground (on croplands) and decreased biological biomass.
- Ultimately, total microbial biomass and its components, along with soil organic matter, provided the greatest contributions to explaining the relationships and were most closely associated with rangelands.

Cooperative funding provided by the Noble Research Institute, LLC.

Understanding the relationships among soil health metrics across soil types and land use gradients can provide actionable information for management decision making.

Prescribed fire and cattle grazing can effectively control the spread of tanglehead.

Tanglehead Response to Prescribed Burning and Cattle Grazing

Rider C. Combs, J. Alfonso Ortega-S., Humberto L. Perotto-Baldivieso, Sandra Rideout-Hanzak, and David B. Wester

Native grasses such as tanglehead can become invasive, and this has occurred across the South Texas Sand Sheet ecoregion. The earliest report of expansion was from a rancher in the late 1990s in Jim Hogg County, Texas. Prescribed fire is a common management practice used to improve wildlife habitat and increase the forage palatability and nutritive value of mature stands of tanglehead for grazing cattle.

We monitored the rate of expansion of tanglehead under four different combinations of cattle grazing and prescribed fire: burning and grazing; burning; grazing; and control (no burning, no grazing). On a 236-acre pasture in Jim Hogg County, Texas, three 10-acre prescribed patch burns were implemented in February 2019. Over the course of two years, cattle were stocked at rate of 0.04 cows per acre per year. Every 30-40 days following the prescribed fire, tanglehead basal circumference and foliar cover, seed head counts, and seedling establishment, as well as ground cover and other plant species foliar cover were measured, and the data were analyzed.

- Basal circumference of tanglehead did not increase in the burning and grazing treatment.
- In the control, the grazing, and the burning treatments basal circumference of tanglehead increased during the two years of the study.
- Tanglehead cover was lower in the burning and grazing treatment compared to the other treatments.
- Bare ground was higher in the burning and grazing treatment.
- Prescribed fire and cattle grazing may be used as tools to control the expansion of tanglehead.

Cooperative funding provided by the Jones Ranch, Ken Leonard Fund for Livestock Interactions Research.

Estimating Crude Protein in Tanglehead Using Drones

Rider C. Combs, Humberto L. Perotto-Baldivieso, J. Alfonso Ortega-S., Sandra Rideout-Hanzak, David B. Wester, Douglas R. Tolleson, Michael T. Page, and Annalysa M. Camacho

Tanglehead grass has been forming large monocultures on south Texas ranches. As tanglehead matures the percent crude protein often decreases to less than 7%. This can be problematic for ranchers to meet cattle nutritional requirements.

We determined the relationship between high resolution drone imagery and the percent crude protein in tanglehead on private ranch in Jim Hogg County, Texas. In a 10-acre area, ten different circular patches of tanglehead were mowed. After 35 days, this provided with a sufficient variation in percent crude protein for five growth stages to be sampled. Two overlapping drone flights were conducted at an altitude of 150 ft above ground level to collect imagery. Once the flights were completed, all plants were clipped, bagged and mailed to a forage laboratory for to determine the percent crude protein. The imagery collected with the drone and the values of crude protein were used to develop prediction equations to estimate crude protein.

- The imagery collected with the drone is related to the percent crude protein of tanglehead.
- Drone imagery has the potential to be used to estimate the percent crude protein rangelands.
- Range managers may use detailed information on crude protein percentage in tanglehead to develop supplementation programs for cattle to fulfill animal nutrition requierments.

Cooperative funding provided by the Jones Ranch and the Ken Leonard Fund for Livestock Interactions Research.

Test plots of native bunchgrasses compared to commonly used non-native ornamental bunchgrasses.

Water Use of Ornamental Native Texas Plants

James P. Muir, Ambika Chandra, Benjamin G. Wherley, Chrissie A. Segars, Jorge L. Alvarado, and John R. Bow

Ornamental landscaping uses large amounts of water in urban areas. With this in mind, the goal of this project was to identify which Texas Native Seed (TNS) native bunchgrass could do well in urban landscape settings in Northcentral Texas. We also tested the native species against the currently used introduced species to see which used less water. To complete this work TNS teamed up with Texas A&M AgriLife researchers at Stephenville and Dallas.

Initial trials of these native plants with landscape appeal took place in greenhouses testing performance under different watering treatments and soil types. Promising plant populations were then tested in field conditions under city water restriction stages 1 through 4 at both the Stephenville and Dallas Texas A&M Research Centers.

- Drought-tolerant TNS germplasms are widely adapted throughout the state's varied soils, climates, and ecoregions which potentially allows for a reduction in municipal water consumption in urban Texas
- Little bluestem and sideoats grama are aesthetically pleasing native species that, grow year around, require low maintenance, and may reduce homeowner and city water use.
- Additional benefits include providing habitat and feed for native insects, birds, and mammals while reducing potential exotic weed introduction risks.

Cooperative funding provided by the Texas Water Research Institute, Texas A&M AgriLife Research.

Genomic Analysis of Common Texas Native Grasses

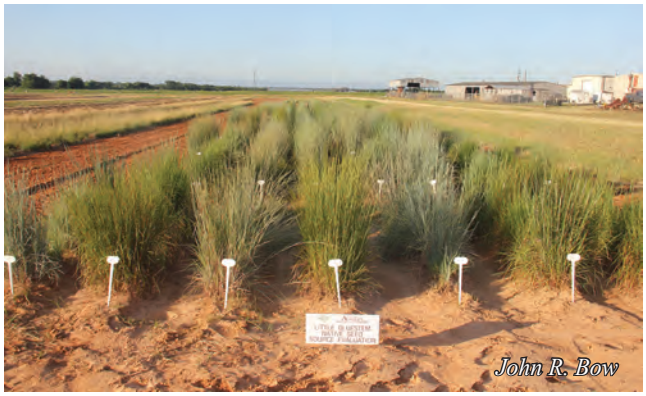
John R. Bow, Jeff A. Brady, James P. Muir, and Anthony D. Falk

Texas Native Seeds (TNS) collects and evaluates native plant material for the purpose of releasing seed sources of native plants that are adapted to particular regions of Texas. Plant differences are clear during the evaluation portion of our field research, but the relationship of seed origin to these differences is poorly understood. Our objective was to compare native plant populations of little bluestem, silver bluestem, and blue grama to plants already commercially available by looking at differences in their gene sequences. The genetic sequence is simply the order of the chemical bases that eventually create a gene.

We have conducted genetic sequencing on 53 little bluestem, 12 silver bluestem, and 6 blue grama plants. The project produced 508 million sequences for an average of 5.6 million sequences per plant. Sequence analysis was conducted in Greg Sword's laboratory at Texas A&M University.

- Data collected will be used to identify plant population structures that will help guide geographic decisions for future plant releases.
- Data collected from genetic sequences will also be used to conduct a study of the effects of individual plant genetics on the genetics of surrounding plants and soils.
- Sequenced genetic information is also being used to add to larger genetic sequence libraries used by researchers around the country.

Cooperative funding provided by donors to the Texas Native Seeds Program



Native little bluestem plots containing different plant populations tested for genetic sequences.

New Coastal Prairies Native Seed Project Site

Douglas L. Jobes, Anthony D. Falk, Patrick Brzozowski

Isolated seed increase is an important part of the seed development process that occurs after evaluations are completed. Within the seed increase facility top-performing populations are grown in a larger setting to increase the number of seeds available to be released for commercial production. Currently, the seed increase for Coastal Prairie NSP occurs at the South Texas Natives (STN) farm in Kingsville, Texas, but a region-specific location will serve and benefit the local project.

- The Coastal Prairie NSP, in cooperation with Lavaca Navidad River Authority (LNRA), has established a 10-year agreement on a 40-acre production facility. The facility, located in Jackson County, will serve as a base of operations and seed increase site for the regional project.
- We have developed an irrigation system that can provide suitable water for 8 separate locations within the facility, and an 8-foot game-proof fence along its perimeter decreases damage from native wildlife and feral hogs.
- A covered area has been constructed and serves as a storage and work zone, and a small parking area for visitors and staff has also been completed. Plans have also begun for adding additional structures for secured, weather-proof storage.
- This site will serve as potential demonstration area and study site for future projects, and can be used for field days and tours.

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New sign at the Coastal Prairies Native Seed Project

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Parting Shots

We hope you enjoy these parting shots taken by CKWRI scientists and graduate students.

Gregg's mistflower provides nectar for this tawny emperor butterfly. Photo by Rebecca Zerlin.

A white-tailed deer buck surveys an autumn grassland. Photo by Randy DeYoung.

A female bobwhite quail forages for seeds in South Texas. Photo by Randy DeYoung.

The sun sets on a mule deer doe in the Permian Basin. Photo by Levi Heffelfinger.

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