

# STUDENT RESEARCH

## DO THORN SHRUB PHYSICAL CHARACTERISTICS AND BROWSING AFFECT POST-FIRE SHRUB SURVIVAL?

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Many shrub species produce sprouts from stems and root crowns when above-ground tissues are destroyed. Browsing of newly-produced sprouts may reduce shrub vigor and survival. Three south Texas shrub species were observed to test the hypotheses: (1) post-fire shrub survival can be predicted by shrub physical characteristics, proximity to other shrubs, and fine fuel load and (2) survival and recovery of *Acacia smallii*, *Celtis pallida*, and *Condalia obovata* after fire are reduced by browsing. Prescribed burns were conducted on July 13 and August 25, 2001. Forty individual plants of each species were marked before the fire in 3 blocks, each consisting of 2 treatments (burned and control). For each individual, size and stem characteristics, proximity to other shrubs, and fuel loads near the plant were measured before the fire. Following the burns, survival, herbivory intensity, and size and stem characteristics of each plant were determined periodically for 1 year. Growth rates of shrubs protected from browsing following the fire were estimated using plants within wire exclosures. Mortality of *C. obovata* could be predicted in part by pre-burn distance to neighboring shrubs ( $P = 0.0037$ ). Browsing had no effect on shrub mortality ( $P = 0.903$ ) or biomass ( $P = 0.9407$ ). *A. smallii*, *C. pallida*, and *C. obovata* exhibit fire resistance and recovery strategies similar to those of shrubs in other fire prone shrublands. Regrowth of *A. smallii*, *C. pallida*, and *C. obovata* following fire exhibited compensatory growth in response to browsing rather than decreased vigor.

## WINTERING GRASSLAND BIRD RESPONSES TO SUMMER PRESCRIBED BURNING IN GRAZED AND UNGRAZED TEXAS MID-COASTAL PRAIRIES

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We examined how summer fire and rotational grazing shaped community organization and habitat associations of wintering grassland birds at 4 study areas along the Texas mid-coastal prairie: Mad Island Marsh Preserve (MIMP), Welder Wildlife Refuge (WWR), North Aransas National Wildlife Refuge (NANWR), and South Aransas National Wildlife Refuge (SANWR). Over 2 years 78 avian species and 15,199 individuals, including 17 open grassland species were recorded. We observed 15, 11, 12, and 10 open grassland species at MIMP, WWR, NANWR, and SANWR, respectively. Neither fire nor grazing influenced grassland bird richness. Despite comprising only 22% of all species, winter grassland bird abundance comprised 84, 35, 91, and 95% of the avian community at MIMP, WWR, NANWR, and SANWR, respectively. Grassland guild abundance was highest in burned units and similar among grazed and ungrazed units. Individual species did not respond similarly to management disturbances. Le Conte's sparrows (*Ammodramus leconteii*) were nearly absent from recently burned units and under burning declined by 90% in grazed and 93% in ungrazed units. Sprague's pipits (*Anthus spragueii*) were predominantly observed during the second year in recently burned units and the increases were different among grazing treatments. The increase in Sprague's pipits in recently burned, ungrazed units was more than 1000% of that in recently burned, grazed units. The differences observed between species underscores the need to manage for mosaics within large prairie parcels (>100 ha) to accommodate wintering grassland species diversity.

# STUDENT RESEARCH

## THE EFFECTS OF SUMMER PRESCRIBED FIRE ON VEGETATION, INVERTEBRATE, AND AVIAN COMMUNITIES

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The objective of this study was to determine the effects of prescribed summer burns on vegetation, invertebrate, and avian communities. Burns were conducted during summer 2001. There were 2 study sites consisting of an unburned control and a burn treatment located in south Texas. Data were collected during 2 seasons from May 2001 to July 2002. In burn units percent shrub cover and total percent cover of woody vegetation was significantly lower ( $F = 14.17$ ,  $P = 0.031$ ,  $F = 23.44$ ,  $P = 0.020$ , respectively) in 2002 compared to 2001. There were no significant differences in abundance of total invertebrates between burn and control units during the 1-year, post-fire collection periods. Within the avian community, brood parasite abundance was significantly greater ( $F = 11.72$ ,  $P = 0.021$ ) in burn units than in control units in 2002. Ground nesting species were significantly more abundant in both burn units ( $F = 23.72$ ,  $P = 0.008$ ), and control units ( $F = 4.18$ ,  $P = 0.067$ ) in 2002 compared to 2001.

## ERADICATING OLD WORLD BLUESTEMS AND RESTORING COASTAL PRAIRIE

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Texas and Louisiana coastal prairies and marshes ecosystems are one of the most endangered in North America with only about 1% of the original 3.4 million hectares remaining in native state. Much of these diverse ecosystems has been destroyed for agriculture and development, and the quality coastal prairie remnants that persist face invasion from exotic plant species. One such invasive group is the warm-season bunchgrasses known as Old World bluestems (*Bothriochloa* spp.) introduced from Europe and Asia for summer livestock forage in the early to mid-1900's. These grasses are very adaptable to the Great Plains region, and are popular among the agricultural community. However, these exotic grasses pose a serious threat to the natural plant communities of the coastal prairie. Plant communities of these coastal prairies are very similar to those of the tallgrass prairie. Notable native grass species include the big and little bluestems (*Andropogon gerardii* and *Schizachyrium scoparium*), Indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*), along with a diversity of forbs. Recently, certain herbicides have been shown to be effective at eradicating introduced grasses and aiding establishment and release of native warm-season grasses. The objective of this project is to determine the best regime of herbicides and prescribed fire to most effectively remove Old World bluestems and help restore native coastal prairie habitats. Imazapic (Plateau<sup>®</sup>), clethodim (Select<sup>®</sup>), and sulfosulfuron (Outrider<sup>®</sup>) will be used at different rates to determine the optimal usage rate. Prescribed fire will also be used with or without herbicide to determine its effects and role in restoring coastal prairies.

# STUDENT RESEARCH

## HABITAT SELECTION BY SYMPATRIC MULE AND WHITE-TAILED DEER IN TEXAS

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White-tailed deer (*Odocoileus virginianus*) and mule deer (*O. hemionus*) occur sympatrically across much of the central and western United States, including portions of west Texas. Fluctuations in populations of both species and the potential for interspecific competition have fostered a need for information to aid in management of sympatric populations. We evaluated the role of plant community structure and topography on habitat selection of sympatric deer in west-central Texas using information about deer obtained via radio-telemetry and a geographic information system (GIS). Both species selected habitat in a non-random fashion and exhibited species- and sex-specific preferences. Mule deer selected habitats with less vegetation cover and more topographic diversity, while white-tailed deer avoided higher elevations. Males of both species avoided areas with greatest vegetation cover including those areas containing permanent water sources, but females tended to use such areas particularly during summer fawning. Differences observed on the smaller core area scale were not always detected at the larger home range level, indicating that decisions about habitat selection were made at different spatial scales. Given the differential importance of open and well-concealed areas to the establishment of core areas of each sex, as well as each species, maintenance of a mosaic of open and dense cover, particularly in lower elevations and in close proximity to food and water sources, is necessary if managers wish to maintain coexistence of both species. Conversely, managers wishing to favor one species should target areas most prevalent in the smaller core areas of that species.

## RESOURCE SELECTION BY MULE DEER IN AN ARID ENVIRONMENT

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For years, wildlife managers in the deserts of North America have managed ungulates under the assumption that water is a limiting resource. Despite the widespread use of wildlife water developments (i.e., catchments) to manage habitat in deserts, few manipulative studies have attempted to establish whether water is limiting, or how presence of catchments affects distribution and resource use by ungulate populations. Given the emphasis on providing water as a habitat management tool, our goal was to determine how catchments affect range use and habitat selection by mule deer (*Odocoileus hemionus*) in the Sonoran Desert, California, USA. Our manipulation involved a 2-year period with preexisting catchments and natural water sources in the area, followed by a 2-year period with new catchments added to the periphery of the population's range. We looked for 2 responses: whether the range would expand to include new catchments, and how new catchments would affect resource use by deer. We measured weekly locations of 30 radio-collared does. Analysis of these data will involve comparison of deer locations and random locations to GIS layers containing information on vegetation characteristics, water availability, geological characteristics, and human disturbance. Studies of water, forage use, and their effects on animal distribution will continue to be a necessary part of understanding the role and importance of wildlife water developments in the management of desert ungulates.

# STUDENT RESEARCH

## DENSITY-DEPENDENT EFFECTS ON PHYSICAL CONDITION AND REPRODUCTION IN NORTH AMERICAN ELK: AN EXPERIMENTAL TEST

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Density dependence plays a key role in life-history characteristics and population ecology of large herbivores. We tested hypotheses relating effects of density dependent mechanisms on physical condition and fecundity of North American elk (*Cervus elaphus*) by creating low and high density populations. We hypothesized that if density dependent effects were manifested principally through intraspecific competition, female body condition and fecundity would be lower in areas of high versus low population densities. We collected data on physical condition, indexed by rumpfat depth, and pregnancy rates in each population. Our experiment indicated that density dependent feedbacks affected adult female physical condition and reproduction. Age-specific pregnancy rates were lower in the high-density area, although there were no differences in pregnancy of yearlings or age at peak reproduction between areas. Age-specific rates of pregnancy began to diverge at 2 years and peaked at 6 years of age. Body condition and mass most affected pregnancy rates, although successful reproduction the previous year also reduced pregnancy rates during the current year. While holding effects of winter constant, density dependent mechanisms had a greater effect on physical condition and fecundity than density independent factors (e.g., precipitation and temperature). Moreover, our results demonstrated effects of differing nutrition resulting from population density during summer on body condition and reproduction. Thus, summer is a critical period for accumulation of body stores to buffer animals against winter. More emphasis should be placed on the role of spring and summer nutrition on population regulation in large, northern herbivores.

## WHITE-TAILED DEER POPULATION MODELS FOR TWO ECOLOGICAL REGIONS IN TEXAS

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Texas Parks and Wildlife Department (TPWD) devotes a significant effort to managing white-tailed deer (*Odocoileus virginianus*) populations, an important game species in the state. Computer simulation models can be used to evaluate different management practices and their potential impacts on wildlife populations. We developed a sex- and stage-structured population model for 2 ecological regions (South Texas Plains and Edwards Plateau) that incorporates population trend data and harvest strategies to aid TPWD biologists and landowners in managing white-tailed deer populations in the state. Our model is unique in that no specialized software is needed, only Internet access. Model users can predict changes in population numbers and sex- and age-structure ratios under different harvest levels. Model output can be used in developing management plans for white-tailed deer in the state. Currently, model parameters are being estimated and evaluated with existing harvest data in these 2 ecological regions.

# STUDENT RESEARCH

## MOVEMENTS AND RESOURCE SELECTION OF RECOLONIZING BIGHORN SHEEP

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Three herds of Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) recently colonized unoccupied habitat in western Montana. Natural recolonization by bighorn sheep has been rare and the movements and resource selection of these sheep have implications for future bighorn conservation. Radio-telemetry was used to monitor ewes and rams from each herd, asking 2 primary questions: (1) how do movements of recolonized populations relate to neighboring bighorn and domestic sheep with regards to population connectivity and disease transmission and (2) do bighorn sheep in naturally recolonized habitats exhibit consistent patterns of resource selection? Ewes remained in local home ranges at each site, suggesting that herds were new and were independent populations rather than range expansions of source populations. However, long (>30 km) extra-home range movements by rams were detected in all 3 herds and connectivity with neighboring bighorn and domestic sheep in some cases. Logistic regression in a GIS framework was used to generate predictive resource selection models for ewes in each herd. Initial evaluation of models by resubstituting data revealed excellent fit and predictive accuracy ( $P = 0.002$ ). However, testing models across sites with independent testing data gave mixed results and in many cases poor fit ( $0.001 \leq P \leq 0.960$ ). Increasing slopes and decreasing distances to escape terrain were important in most models, but there appeared to be much site-specific variation in resource selection among these 3 herds.

## ASSESSING PUBLIC KNOWLEDGE AND BELIEFS REGARDING MOUNTAIN LION ECOLOGY AND MANAGEMENT IN TEXAS

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Various states have utilized human dimension studies to understand public sentiment toward mountain lion (*Puma concolor*) management. Currently, information about knowledge, attitudes, and beliefs of Texans regarding mountain lions is inadequate. This study was designed to evaluate these attributes using data collected by a self-administered questionnaire distributed to randomly selected individuals from rural and urban areas of Texas. To assess public education needs, respondents were asked questions regarding mountain lion ecology and current and future management practices. Results showed mean knowledge score of respondents to be 8.92 of a possible 19 ( $SD = 4.0$ ). Knowledge about mountain lions differed within gender ( $F = 33.83$ ,  $df = 1$ ,  $P < 0.001$ ), ethnicity ( $F = 9.68$ ,  $df = 1$ ,  $P = 0.002$ ), and education ( $F = 5.48$ ,  $df = 4$ ,  $P < 0.001$ ). Eighty-four percent of respondents believed mountain lions are an essential part of nature. Forty-two percent of respondents believed mountain lions were rare and 44% believed mountain lions were covered by some type of legal protection in Texas. The greatest percentage of all respondents, regardless of their rural or urban designation or landownership status, believed there should be a game season on mountain lions. Results suggest that respondent beliefs concerning mountain lion management differ from current regulations set by the Texas Parks and Wildlife Department.

# STUDENT RESEARCH

## CHANGES IN VOLUNTEER KNOWLEDGE AND ATTITUDES AS A RESULT OF TEXAS MASTER NATURALIST™ TRAINING

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The Texas Master Naturalist program, initiated statewide in 1998, has trained over 2,000 volunteers in natural resource ecology, management, and interpretation. Participants' (1) changes in knowledge and attitudes about ecology, resource management, and consumptive uses of wildlife; (2) reasons for involvement in the program; (3) demographics; and (4) activities completed after training were evaluated. Beginning fall 2001, a survey of Master Naturalist volunteers was conducted ( $n = 228$ ) using a quasi-experimental pre- and post-test design. Participants received a pre-test and post-test, and were mailed a second post-test 8 months after completion of training. A non-equivalent comparison group of Texas Master Gardener volunteers ( $n = 80$ ) received the pre-test and first post-test at approximately the same time. Master Naturalist knowledge scores (percent correct) increased from 57.4 on the pre-test to 72.6 on the first post-test ( $P < 0.001$ ) and 73.7 on the second post-test. Comparison group knowledge scores did not differ significantly from pre- to first post-test ( $P < 0.05$ ). Attitudes about natural resource management and consumptive uses of wildlife became more pro-management on 14 out of 26 attitude statements from pre-test to first post-test ( $P < 0.05$ ). Eighty-two percent of respondents ( $n = 125$ ) to the second post-test stated that they had participated in natural resource-based volunteer activities since completion of training. These results and survey instruments will serve as baseline information for future Master Naturalist program evaluation.

## CHANGING PATTERNS OF RANGELAND USE: ECONOMICS OF TEXAS FEE HUNTING

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Ranching communities in Texas have long recognized fee hunting as a natural resource with the potential of directly affecting agricultural incomes. Hunting as an industry today appears to be developing into an economic substitute for Texas ranchers who are accustomed to the variable nature of agricultural markets. To determine the economic impact of this market relative to its functional utilization by landowners, this research investigated a large group of landowners in central and south Texas. Information was collected through personal interviews of about 150 landowners relative to their specific fee hunting operations and the economics (cost versus benefits) resulting from their enterprises. Response data were tabulated and examined through use of bivariate and multivariate methods. Output yielded basic demographic information along with landowner opinion and attitude on ensuing constraints and values of enterprise operations. Additionally, costs and returns to operations were summarized and budget information derived. Analysis showed that landowners possess strong feelings about their 'love of the land' and shared parallel ideals relative to their properties as an entitlement and privilege to be passed along to their heirs. However, these Texas ranchers are well aware of the economic pressures under which they must operate, and their commitment to sound land management practices increasingly includes wildlife management. This is due much in part to the dramatic increase in revenues generated by fee hunting enterprises over the past decade.

# STUDENT RESEARCH

## EFFECTS OF REDHEAD GRAZING ON SHOALGRASS RESOURCES IN THE LAGUNA MADRE OF TEXAS

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Approximately 80% of all redhead ducks (*Aythya americana*) winter in the Laguna Madre where their diet is comprised almost exclusively of shoalgrass (*Halodule wrightii*) rhizomes. Although redhead reliance on a single food source within a narrow geographical range simplifies management strategies, it also predisposes the continental redhead population to serious consequences should shoalgrass beds be depleted or degraded. Unfortunately, shoalgrass distribution and abundance in the Texas Laguna Madre has declined significantly during the past 4 decades. Intracoastal Waterway dredging, salinity reductions, and brown tide (*Aureococcus anophagefferens*) have been implicated in the decline. However, large numbers of wintering redheads may also significantly impact shoalgrass. Research objectives were to (1) determine the reduction of shoalgrass rhizomes attributable to redhead grazing in the Texas Laguna Madre, (2) determine spatial and temporal distributions and abundance of redheads throughout the Texas Laguna Madre, and (3) determine the ability of shoalgrass resources in the Laguna Madre to sustain redhead populations. During the winters of 2000 – 2003, weekly aerial surveys were conducted to estimate redhead abundance throughout the Texas Laguna Madre from their arrival in mid-October to departure in mid-March. Shoalgrass rhizome biomass was estimated monthly by sampling benthic cores ( $n = 11,620$ ). Rhizome biomass was reduced ( $P < 0.05$ ) from foraging by redheads in portions of the Texas Laguna Madre each year. While increasing wintering populations of redheads in the Laguna Madre may stress available shoalgrass resources, shoalgrass response to herbivory appears resilient enough to sustain the current estimates of redheads using the system.

## EFFECTS OF LONG-TERM LAND USE CHANGES ON RIO GRANDE TURKEYS IN THE SOUTHERN COASTAL PLAIN OF TEXAS

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Rio Grande turkeys (*Meleagris gallopavo intermedia*) occur from Kansas through Oklahoma, Texas, and south into central Mexico. During the past 30 years populations have declined in some areas, while remaining stable in others. Concurrently, land use practices have reduced the use of fire to control undesirable shrubs resulting in the establishment of dense underbrush that may limit turkey movements. Additional habitat loss has occurred from shifts in traditional cattle ranching to crop farming. Research goals were to document land use changes over time and relate current turkey habitat selection to these changes in an effort to explain long-term population declines on the Texas southern coastal plain. This study was conducted on the Welder Wildlife Refuge (WWR) and adjacent Rooke Ranch (Rooke). Both sites have similar vegetation and soils, but differ in management, land use, and hunting regimes. Available turkey habitat was assessed from aerial photography. Radio-telemetry was used to assess habitat use by female Rio Grande turkeys during January to December 2002. Annual survival (23.5%) was determined from 29 radio-tagged turkeys. Turkeys selected against brushy habitats and for riparian habitats. All successful nests were in riparian areas. Aerial photographs from 1969, 1975, 1982, 1989, and 1995 were analyzed using ERDAS<sup>®</sup> Imagine Software 8.3 and ARC/INFO to determine proportional changes in 6 vegetation types. Between 1969 and 1995 brushy vegetation increased by 32% on WWR and 2% on Rooke; riparian and grassland areas declined on Rooke by 16% and 14%, respectively and on WWR by 32% each; and Rooke converted 28% of available land to agricultural cropland, whereas no similar conversion took place on WWR.

# STUDENT RESEARCH

## ECOLOGICAL EFFECTS OF PRESCRIBED FIRE ON TEXAS HORNED LIZARDS

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The Texas horned lizard (*Phrynosoma cornutum*) has experienced apparent large-scale declines throughout its range, particularly in Texas. The effect of prescribed burning, a common habitat management practice, on the ecology of the Texas horned lizard was studied in a thornscrub savannah. Home range size, woody vegetation selection, and survival rates of horned lizards was assessed in 4 treatments. Home ranges in the summer-burned-grazed treatment were smaller than those in other treatments (winter-burned-grazed, unburned-grazed, and unburned-ungrazed). Survival rates in burned sites were higher than in unburned sites. Survival functions also differed between burning treatments, with survival declining in early summer in unburned areas and in late summer in burned areas. Lizards selected for whitebrush (*Aloysia gratissima*) and avoided Texas persimmon (*Diospyros texana*) consistently across treatments. Selection or avoidance of other woody species was not consistent among treatments. Structural changes of individual species in response to fire may alter thermal and escape cover at the lizard level, leading to predictable patterns of selection. Prior research found higher ant activity on burned sites on the study area. Therefore, more food, or better food-cover interspersions, may explain higher survival in burned areas and smaller home ranges in summer-burned areas. Prescribed burning in a thornscrub savannah provided favorable ecological conditions for Texas horned lizards in this study.

## FERAL AFRICANIZED HONEY BEE ECOLOGY IN A COASTAL PRAIRIE LANDSCAPE

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Honey bees (*Apis mellifera*) play an important role in many ecosystems, pollinating a wide variety of native, agricultural, and exotic plants. The recent decline in numbers of feral and managed honey bee colonies in North America, as well as the arrival of Africanized honey bees, have caused concern about adequate pollination for agricultural crops and native plant communities. However, little is known about feral colonies and the feral population is the source for Africanized honey bees as they spread and infiltrate managed populations. Thus, the goal of this study was to examine the ecology of feral honey bee colonies, adding the spatial context necessary to understand population ecology and patterns of resource use by feral honey bees on the Welder Wildlife Refuge. The refuge supported a high density of feral colonies, and the dense live oak (*Quercus virginiana*) habitat provided the best overall source for cavities, nectar, and pollen. Nectar and pollen were abundant throughout the year, with the exception of December and January when a large number of honey bees searched for resources. Cavities did not appear to vary in suitability for feral colonies based on measured structural and environmental attributes. However, indices of cavity quality varied between cavities, suggesting some cavities were more suitable for feral honey bees than others. Colonies were aggregated within the study area, probably as a result of the distribution of resources. Africanized honey bee invasion appeared to fragment the existing European population, with Africanized colonies spatially aggregated in distribution and European colonies randomly distributed.

# STUDENT RESEARCH

## SPATIAL DISTRIBUTION AND ABUNDANCE OF RED IMPORTED FIRE ANTS RELATIVE TO DISTURBANCE

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Red imported fire ant (*Solenopsis invicta*) abundance and their distribution across the landscape following disturbance were evaluated using a gradient of landscape-level disturbances. This disturbance gradient included a control and 3 treatments: 2-track roads, mowed roadsides, and overgrazed pastures ( $n = 40$ ). The hypothesis was that fire ant abundance would increase as intensity of disturbance increased, but would be unaffected by soil type. Foraging and mound surveys were used to test this hypothesis. Foraging surveys were conducted in 2002 on the Welder Wildlife Refuge (WWR). Mound surveys took place during 2003 on the WWR and adjacent properties. Data were collected on soil moisture, soil temperature, mound dimensions, and distance to nearest edge. Mound abundance did not fluctuate with disturbance, but was affected by soil type. Indices suggested that fire ants were more abundant in sandy soils in 2002 and clay soils in 2003, possibly a result of twice the normal level of precipitation between field seasons. Results from analysis of foraging dependence, using variogram models and Kriging, demonstrated that fire ant foraging behavior did not differ based on distance from a disturbance corridor. Using spatial point pattern analysis, it was found that fire ant mound distribution followed complete spatial randomness regardless of soil type or disturbance intensity. Additional research into the effects of disturbance and environmental conditions associated with fire ant abundance and distribution is essential to learning more about potential pathways of invasion. Specifically, it may be important to focus on micro-scale disturbances instead of large anthropogenic disturbances when considering the success of red imported fire ants.

## *BAYLISASCARIS PROCYONIS* IN RACCOONS: CHARACTERISTICS, DISTRIBUTION, AND ZOONOTIC POTENTIAL IN TEXAS

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*Baylisascaris procyonis* is a nematode with zoonotic potential found in the small intestine of raccoons (*Procyon lotor*). Larval stages of this roundworm can cause neurological disorders in many mammals including humans by entering the central nervous system. Objectives of the study include determining prevalence and intensity of *B. procyonis* and other nematode parasites in Texas raccoons and examining relationships between raccoon infection and environmental variables. We documented 20 different gastrointestinal helminth species in 590 raccoons collected from across Texas. *B. procyonis* was documented in 32 raccoons with its prevalence of infection being highest in raccoons from Austin, Houston and Kingsville (27.6%, 15.0%, and 15.0%, respectively). Prevalence and intensity of *B. procyonis* was higher among adult raccoons than juveniles indicating a raccoon population naïve to this parasite. *B. procyonis* intensity (number of parasites per infected raccoon) was highest in Bryan-College Station ( $34.33 \pm 17.30$ ), Corpus Christi ( $8.50 \pm 7.50$ ), and San Antonio ( $7.89 \pm 3.13$ ). Logistic regression identified soil texture and raccoon age as the best predictors of *B. procyonis* presence. A higher number of positive raccoons was found on clay soils. Older raccoons were more likely to be infected. Soil texture may influence egg mortality and transmission rate potential by preventing eggs from desiccating quickly and allowing eggs to remain on the surface. Results provide a complete inventory of gastrointestinal nematodes in Texas raccoons and help determine the areas most at risk for potential impacts of *B. procyonis* on humans and domestic animals.

# STUDENT RESEARCH

## USING AUTOMATICALLY TRIGGERED CAMERAS TO MONITOR AND ESTIMATE BOBCAT ABUNDANCE

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Advances in automatically triggered photography provide wildlife professionals with an opportunity to develop innovative applications that might be more useful than traditional methods involving scent stations and physical capture. This study evaluated whether bobcats (*Lynx rufus*) could be surveyed using automatically triggered cameras. The assumptions were tested that bobcats were individually identifiable by their natural markings and information obtained from camera surveys can contribute to abundance estimates from capture-recapture calculations. On the Welder Wildlife Foundation Refuge 8 individual bobcats were captured and monitored. Sixty-five bobcat photographs were obtained consisting of 15 individuals, 41 recaptures, and 9 unusable photographs. The ability to identify individuals in automatic photographs was influenced by the position in which the bobcat was photographed. Bobcats were most often photographed perpendicular to and facing the camera, which enhanced the observer's ability to identify unique pelt and facial markings. Individual bobcats were successfully identified using these natural markings. Scent stations and physical capture combined with radio telemetry were unable to monitor changes in abundance or provide abundance estimates, whereas automatically triggered camera surveys provided reasonable and reliable abundance estimates. Residence status of some individuals was determined by frequency and timing of photographic captures. Though further research to refine the technique for bobcats is encouraged, camera surveys provided a reliable framework to conduct capture-recapture surveys.

## MALE-BIASED DISPERSAL AND SOCIAL STRUCTURE OF BOBCATS INFERRED FROM MICROSATELLITES

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Dispersal and social structure strategies in populations have evolved to reduce resource competition and inbreeding. We examined dispersal and social structure in a south Texas bobcat population using 8 microsatellites by estimating relatedness and kinship within the population and comparing to radio-telemetry data from a previous study. Among 4 groups of siblings only 2 females and 1 male became residents suggesting high dispersal rates. Relatedness among females ( $r = 0.050 \pm 0.042$  95% CI) was significantly higher than among males ( $r = -0.075 \pm 0.031$ ). Pair-wise relatedness distribution for females was skewed towards first and second degree relatives. In contrast, pair-wise relatedness distribution for males was not significantly different from the expected random distribution. This provided the first genetic evidence for male-biased dispersal in bobcats and is consistent with both field data and dispersal trends in mammals. Three parent-offspring groups and 4 sibling groups were identified. All parents identified by genetic analysis had established home ranges. Individuals with no distinct home ranges were not genetically observed to have offspring. Of 2 identified male offspring and 3 identified female offspring, only 2 female offspring were philopatric. These females became a part of the breeding population in their natal area. Two unrelated female offspring established home ranges within the home ranges of the parents. This led to at least 1 observed incestuous mating. This suggests that establishing a home range may be necessary for bobcats to breed and that daughters may establish home ranges near their mother.

## SOCIAL AND SPATIAL ECOLOGY OF THE SWIFT FOX

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Little is known of the mating system, social group structure, or population structure of the swift fox (*Vulpes velox*). In a 4-year study of 188 foxes (167 of which were genotyped using 11 microsatellite loci) in southeastern Colorado, genetic analyses were used in conjunction with spatial observations to investigate these issues. Mating strategies employed by swift foxes were diverse with extra-pair paternity common. Occasional mate switching also occurred. At the social group level, during initial stages of pair formation, mated foxes were in closer proximity and shared dens more frequently than during the remainder of their pair bond. There was a gender difference in response to the death or disappearance of a mate. All females maintained their territory in the event of mate death or disappearance, but 50% of males emigrated from their range after mate loss. The influence of relatedness between individuals on their social and spatial ecology was assessed. Close kin appeared to cluster geographically within the population. This evidence of kin clustering was useful in explaining findings that neighbors exhibited considerable range overlap, did not spatially avoid each other, and the more closely related neighbors were, the more home range overlap they tolerated. Relatedness also influenced the likelihood an individual would inherit a newly vacated home range. Thus, genetic structure of the population and interactions between kin were interrelated to space use patterns and social ecology of the swift fox.

## COYOTE-MEDIATED INTERACTIONS AMONG SNOWSHOE HARES AND DALL SHEEP

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Foraging behavior and population dynamics of coyotes (*Canis latrans*) were studied in the Alaska Range during the peak and decline of a snowshoe hare (*Lepus americanus*) population cycle from 1999 to 2002. It was predicted that snowshoe hare abundance would indirectly affect alternative prey populations via shared coyote predation. Hypotheses were (1) coyotes would respond numerically to the hare decline, (2) coyotes would switch from hares to Dall sheep (*Ovis dalli*) during the decline, and (3) certain coyotes would specialize in killing sheep. Coyotes had a weak numerical response to the hare decline, with a 1-year time lag. Coyote survival during the hare peak and early decline was positively related to snowshoe hare abundance ( $R^2 = 0.92$ ). Coyotes that ate more hares and voles had higher survival than coyotes that ate more porcupine (*Erethizon dorsatum*) and carrion. In general, coyotes switched to porcupine rather than Dall sheep when hares declined, but 1 adult pair preferred sheep to porcupine. This pair consumed more than 4 times more Dall sheep than other groups, indicating that certain coyotes did specialize in sheep. Coyote predation on lambs was highest during peak hare and coyote years and failed coyote reproduction during low hare years resulted in less coyote predation and high lamb survival. Thus, there was an inverse relationship between lamb survival and snowshoe hare abundance. This information can be used to predict years when hunters should expect to find fewer legal rams, because high lamb predation during peak hare years can lead to "missing" age cohorts.

# STUDENT RESEARCH

## LONG-TERM SPATIAL STABILITY OF COYOTES AT THE WELDER WILDLIFE REFUGE

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Although short-term spatial stability in coyote (*Canis latrans*) populations is well documented, little information is available regarding long-term patterns. The main objective of this study was to compare historical and current spatial and social structures of coyote home-ranges at the Welder Wildlife Refuge. The following questions were addressed: (1) do home-range boundaries and space-use exhibit long-term patterns, (2) do age and social structures of a population remain stable between generations, and (3) do ecological factors (e.g., prey availability) influence coyote spatial patterns? In 2003, 17 coyotes from 8 home-ranges were radio-tracked to obtain information on their space-use and to make direct comparisons with 48 coyotes from 7 home-ranges radio-tracked in 1979. More than 1,000 coyote scats were also analyzed for each time period to compare diet. Home-ranges were the same size and showed a high percent of overlap between the 2 time periods. Home-ranges observed in 2003 had a mean percent overlap with 1979 of 71.73% ( $\pm 6.79\%$ ). The 30% core areas showed little overlap, however, and the distribution of locations within home-ranges was different between years. Coyotes exhibited similar diurnal activity patterns, with peaks near sunrise and sunset. Diet was also similar between the 2 studies, but there were some differences in type of mammalian prey. There was long-term stability in overall spacing, activity, and diet of coyotes, but changes occurred in use of space within home-ranges and type of prey items eaten. Small-scale changes within a system characterized by long-term site fidelity likely reflect the ability of coyotes to adapt to ecological changes in the local environment.