ST. EDWARD'S UNIVERSITY

Wild Basin Creative Research Center



Wild Basin Wilderness Preserve
2018 Annual Report

(October 1, 2017 – September 30, 2018)

Submitted by

Wild Basin Creative Research Center and St. Edward's University

to

Travis County Commissioners Court
And Transportation and Natural Resources

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OVERVIEW OF PRESERVE MANAGEMENT AND OPERATIONS

Wild Basin Wilderness Preserve is jointly owned and managed by St. Edward's University and Travis County. Wild Basin's mission is to protect and maintain its urban wilderness, and to promote the importance of environmental education, research, conservation and preservation.

Situated at the edge of the Texas Hill Country and surrounded by commercial and residential growth in west Austin, Wild Basin is a unique conservation property for Travis County and the larger Balcones Canyonlands Preserve (BCP) system. As an urban and publicly accessible preserve, Wild Basin provides authentic environmental education and recreation experiences for the community. The preserve's location near a major urban area also brings challenges in the form of invasive species, water pollution, noise pollution, and litter. Wild Basin strives to incorporate these challenges into learning opportunities about our urban environments for students and the public.

In addition to helping implement preserve management, St. Edward's University operates the Wild Basin Creative Research Center based at the preserve, which houses a Visitors Center with environmental exhibits, staff offices, an artist in residence space, classroom, lab, and meeting space. The Research Center is a key resource for educating university level as well as K-12 students, and provides a platform for public outreach.

Wild Basin's education, art, and preserve management programs are designed to promote conservation and environmental awareness, while encouraging and demonstrating land stewardship practices. Throughout 2017 and 2018, Wild Basin hosted stewardship days for students and the public, provided training for trail guides for school group tours; organized environmental educational and interpretive events, coordinated student internships and research activities, hosted undergraduate and graduate classes, maintained public trails, managed invasive species, monitored and reported on water quality, hosted public and inter-agency meetings, workshops, and trainings, and launched an Artist in Residence Program.

Since its merger with St. Edward's University in 2009, Wild Basin remains an important resource to the local community and continues to build on its rich history of promoting conservation, research, and environmental awareness. Wild Basin

aspires to become a model for urban preserves, a hub for stewardship, creative research, and environmental education, and a gateway to the BCP.

WILD BASIN VISION

The vision of Wild Basin is to inspire conservation by connecting communities to a dynamic urban preserve. Together with our partners, we focus on the following goals for Wild Basin:

- Managing and restoring a mosaic of habitats indigenous to Wild Basin, including oak-juniper woodlands, riparian corridors, semi-open grasslands and cedar breaks;
- Protecting native biodiversity;
- Protecting habitat for the federally endangered Golden-cheeked warbler and Black-capped vireo;
- Protecting habitats to support threatened and rare plant and animal species;
- Controlling non-native and invasive species;
- Protecting soil profiles and unique geologic features;
- Monitoring water quality relative to watershed inputs, runoff, and erosion;
- Protecting prehistoric and historic cultural sites;
- Managing a trail system that presents the regional flora and fauna, while minimizing impacts to the preserve's biotic community and inherent beauty; and
- Providing stewardship opportunities, research opportunities, and educational resources for students and the community.

TRAIL MAINTENANCE, RESTORATION, AND CONSTRUCTION

Trail Maintenance and Monitoring Activities:

- Weekly trail patrols were conducted along the trail system (Appendix A) to monitor trail conditions and identify potential hazards.
- Two TrailMaster trail counters (one at each trailhead) were maintained and checked regularly to document the total number of visitors as well as temporal patterns in activity.
- Vegetation adjacent to designated trails was pruned throughout the year to maintain a visible trail for visitors. Well-maintained trails will minimize confusion about trail edges so the public can easily and efficiently hike to scenic areas. This maintenance is completed regularly to keep up with vegetative growth.
- As "social trails" (informal trails created by public or animals) were created throughout the year, signs were placed to indicate that visitors should stay on

designated trails. In addition, dead and downed material was strategically placed to deter foot traffic by humans and wild animals.

- As in recent years, staff and volunteers installed berms and swales on the trail system at strategic locations to increase sheet flow of rainwater and reduce trail erosion.
- Several large snags that were adjacent to trails and presented risks to the public were removed by Wild Basin and St. Edward's University staff and trained volunteers.

Trail Restoration Activities

- Wild Basin continued to work with trained stewardship volunteers and other volunteer groups (e.g., Boy Scouts, corporate groups, Central Texas Trail Tamers) to incorporate trail maintenance techniques that minimize erosion and lead to more sustainable trails. Wild Basin hosted two Stewardship Days where volunteers received hands-on training in sustainable trail design & maintenance practices and assisted with trail repair and cleaning activities. Approximately 43 individual volunteers participated in these events. Two stewardship days were cancelled in the fall due to heavy rains.
- Throughout the year, trail crews cleaned existing drainages and trimmed back encroaching vegetation along the entire trail system to improve functionality and allow water to drain from trails.
- A major trail restoration project was designed and implemented on and around the "Scenic Vista Overlook" trail north of the Wild Basin Visitor Center. The project was reviewed and approved by County TNR staff. Some final elements of the project remain to be implemented – the restoration of the social trail connecting the Overlook trail to Arroyo Vista Trail and building of a new trail to connect the two.
- Land management activities used primarily native juniper and native limestone when needed for trail maintenance. No old-growth junipers or other native hardwoods are cut down in the preserve for such uses. All trail maintenance and other land management activities avoid impact or disturbance to cultural and archaeological resources.

Construction & Building Maintenance Activities

- Two air conditioning units were replaced.
- A land line was added as a back-up phone line in case of the loss of internet connection (all existing phone lines are internet-based).

- The Visitor Center internet service was upgraded, doubling the speed of the connection and providing a direct connection to the St. Edward's University campus server.
- Water pipes below the Visitor Center deck were insulated with heated wires and foam barriers.
- The small building in the parking lot was renovated and sealed to prevent the entry of rodents and other pests. This work was conducted by the professional volunteer group, Austin Association of Facility and Maintenance Engineers (AAFAME). The building will now serve to house research equipment and other materials.
- Video and still surveillance cameras were installed in parking lot.
- A highly-deteriorated trash kiosk in the handicapped parking area was rebuilt by AAFAME.
- The TV/Nook Computer found in the Visitor Center lobby was hard-wired to facilitate regular software updates.
- HVAC ducts were replaced and mold was removed from the system.
- Outdoor bulletin boards replaced at the Visitor Center.

BOUNDARY MANAGEMENT

Boundary Management Activities

- Wild Basin staff monitored the preserve's perimeter at quarterly intervals to check the integrity of fencing and boundary markers.
- Perimeter checks revealed fence cuts on several occasions. Those occurrences were reported to Travis County TNR personnel, who addressed the issues directly with adjacent landowners. Fence cuts were mended by Wild Basin staff.
- Trash along Hwy 360 adjacent to Wild Basin was picked up by volunteer crews on multiple occasions throughout the year to prevent it from traveling into the preserve and Bee Creek.
- Signs discouraging holiday tree decorations were placed along Hwy 360 at the beginning of the holiday season. In addition, holiday tree decorations were removed from trees promptly to discourage further decoration.

VEGETATION MANAGEMENT

Vegetation Management Activities

- Vegetation mapping. Wild Basin staff, volunteers, and researchers are currently using the citizen science platform iNaturalist to map the distribution of plants within the preserve. iNaturalist is accessible via a smartphone app or on the web

from a computer. The app allows users to document locations, photos, and relevant notes about plant species on-site. Currently, we have two projects established in iNaturalist: one project for the public to report their observations along the trails (Wild Basin Biodiversity Project), and a second project for staff, researchers, and trained volunteers to report observations of rare plants and invasive species in off-trail locations (WBCRCMappingProject). In the case of rare or endangered species, all coordinates are obscured from the public so as not to encourage iNaturalist users to leave the trail. All iNaturalist observations can be exported and then uploaded to ArcGIS or Google Earth for mapping or further analysis. A total of 236 plant observations were added to the Wild Basin iNaturalist projects between October 2017 and September 2018.

- Rare plant species. All rare plant locations described are documented in the iNaturalist WBCRCMappingProject. Coordinates are obscured from the public when sightings are off-trail. A report from volunteer Master Naturalists monitoring rare plant species in Wild Basin can also be found in the research section of this report.
- Target rare and unusual plant species:

Primary Species of Interest

- Naked broom-rape (*Orobanche uniflora*): This species had been seen reliably for several years back in the 1980's, but the exact location has been lost. Staff and tour guides were asked to keep an eye out in March and two field excursions were made, but none were found.
- Shooting-star (*Primula meadia*, formerly *Dodecatheon meadia*): Four excursions were made during the bloom period. Both populations were found, but no blooms were observed. Herbivory was noted on the southern population and a low wire cage was placed over the plants to protect them. Both populations appear to be declining.
- Texas Madrone (*Arbutus xalapensis*): An extensive survey of all known trees was made on July 31st and August 30th. We were able to locate 19 of the 21 known trees. We found 4 new saplings less than 12" tall.

Secondary Species of Interest

- Canyon mock-orange (*Philadelphus ernestii*): Two cultivated plants were planted on the open oak-juniper slope just north of the visitor's center about 10 years ago. They are both still alive, however this is not the ideal habitat (should be mesic limestone ravine).

Tertiary Species of Interest

- Glass Mountain coral-root (*Hexalectris nitida*): No *H. nitida* were seen this year, probably due to the dry summer, that followed a wet spring.
- Crested coral-root (*Hexalectris spicata*): Surprisingly no *H. spicata* were seen this year. In 2016 and 2017, approximately 30 stems emerged 5-10 feet from the north side of the visitor's center. Current and former staff could not recall any coral roots orchids in this location in the past.
- Heller's marbleseed (*Onosmodium helleri*): An extensive survey was made in the five known locations of this species, and Heller's was located in four. There is a single plant in north hollow, a single plant on the south side of the upper Bee Creek crossing, a small cluster of plants on a cliff face above Bee Creek, and several plants on the hillside above the Bee Creek plants. The Bee Creek cliff face plants are imperiled by a cedar tree that is falling over and breaking down the cliff face. We were unable to locate the fifth population, a single plant southwest of the upper Bee Creek crossing.
- Buckley tridens (*Tridens buckleyanus*): We did not look for this species in 2018. We just learned that it was last seen by the back gate. We plan to look in early 2019.
- Louisiana broomrape (*Aphyllon ludovicianum*; *Orobanche ludoviciana*). Collected in 1919 from the hills east of Bee Creek. Current status is unknown.

Invasive species management.

Invasive plant species are regularly mapped and monitored using the iNaturalist platform. Preserve staff, student interns, and volunteers continued to map, monitor for, and remove invasive, non-native species, such as Japanese honeysuckle (Lonicera japonica), Chinese Tallow (*Triadica sebifera*), Chinaberry (Melia azedarach), firethorn (*Pyracantha coccinea*), Japanese privet (Ligustrum japonicum), Chinese privet (*Ligustrum sinense*), nandina (*Nandina domestica*), King Ranch bluestem (*Bothriochloa ischaemum*), Johnson grass (*Sorghum halepense*), chaste-tree (*Vitex agnus-castus*), bastard cabbage (*Rapistrum rugosum*), and giant cane (*Arundo donax*), among others. Most of the invasive species control measures currently used at Wild Basin involve manual removal of plants by invasive species crews (Appendix C). In addition, in collaboration with Travis County personnel, we have begun using the EZ-Ject lance with Imazapyr capsules to treat invasive stems that are too large to be removed manually with a Weed Wrench (i.e., greater than 2.5" diameter). Previous research at Wild Basin shows that this method effectively treats invasive plant species while minimizing off-target impacts of herbicide.

- Protection from browse pressure. Wild Basin staff maintained existing deer exclosures of hog wire cages around stands of young native trees and shrubs to prohibit excessive browse by deer and other animals.
- Fuel reduction. A project was coordinated by Travis County and the City of Westlake to cut fuel breaks along the southern border of Wild Basin in areas adjacent to residential areas. In FY 2017, 0.6 acres were treated Lake Travis Fire and Rescue near the preserve's back gate. An additional 1.6 acres were treated along the southern perimeter bordering residential areas in FY2017 and FY2018.
- Firewise guidelines of clearing debris and trimming back branches continue to be followed in the area immediately surrounding the visitor's center.

WILDLIFE MANAGEMENT

Wildlife Management Activities

- Golden-cheeked Warbler (*Setophaga chrysoparia*). Thirty-six surveys were conducted at Wild Basin and Vireo Preserve between 12 March and 11 June, 2018 by Darrell Hutchinson and Jim O'Donnell for a total of 115.5 survey hours. Three color-banded male GCW returned to Wild Basin including one named "Candy" who is estimated to be at least 9 years old and the oldest known GCW in the BCP. For a full report see Appendix D.
- Feral Hogs (*Sus Scrofa*). No signs of the possible presence of feral hogs were observed within the reporting period. Wild Basin staff continue to monitor for any signs and will communicate any observations or concerns to Travis County TNR personnel.
- As part of a project to study wildlife movement across Wild Basin boundaries, between September and November of 2017, 15 motion-triggered cameras were installed along the perimeter of Wild Basin in areas bordering residential areas and the Vireo Preserve. Wildlife images from the cameras have been utilized by one University of Texas undergraduate student in an assessment of wildlife movement. The cameras continue to be maintained, data is being collected and analyzed by Wild Basin staff, interns, and research students regularly, and currently two UT undergraduate students are working to expand the scope of the study through the placement of additional cameras at key wildlife movement points along the perimeter and into neighboring areas, including at Vireo Preserve.

WATER QUALITY AND QUANTITY

Water Quality and Quantity Monitoring Activities

Water quality testing was conducted for nine of the months during the reporting period by Wild Basin staff (with assistance from student interns) using the Colorado River Watch Network water quality monitoring protocols. Several different parameters were tested, including pH, turbidity, dissolved oxygen, and specific conductance. All data from water quality testing at Wild Basin can be found online at the CRWN website (https://crwn.lcra.org/events.aspx?qrySite=72).

OUTREACH, EDUCATION, AND VOLUNTEER COORDINATION

Wild Basin actively provides environmental educational opportunities and volunteer stewardship opportunities for the community. A total of 651 volunteer hours were logged at Wild Basin on a number of outreach-related activities, including trail maintenance and stewardship (described above), environmental education, and research. The major programs held at Wild Basin from Oct 1, 2017 to Sept 30, 2018 are summarized below.

Environmental Education and interpretation Programs

- School and Group Tours – Approximately 956 school-aged children, including students from local schools and homeschool and community groups, attended education programs at Wild Basin. Group size is restricted to a maximum of approximately 40 students per visit to control for impact on the preserve and ensure volunteer guides have manageable group sizes. Approximately 14 trained volunteer guides donated an estimated 300 hours to assist with these education programs.
- Family & Public Programs – Local children and adults (approximately 911 total) attended several public programs hosted by Wild Basin or with Wild Basin representation during fiscal year 2017-18, including monthly second Saturday guided hikes, three Artist in Residence events, two specialty guided hikes, an Austin Zoo event, a public elementary school's Science Day, and five public lectures/mixer events on topics including owls, wildlife camera research, coyotes, habitat restoration, and reptiles.
- Artist in Residence - Wild Basin welcomed its second Artist in Residence in the fall of 2017. The awardee was local artist Heidi Miller Lowell. Lowell's work focuses on creating colorful watercolor mosaics that pay homage to the natural world. The artist painted at the Wild Basin weekly and extended her residency to the spring and summer of 2018. She conducted two events open to the public at

the Wild Basin Creative Research Center during her time with us. For an adult audience, Lowell presented a demonstration of her artistic process followed by a Q&A discussion. The youth event focused on artwork of Georgia O'Keefe and attendees used watercolors to paint natural scenes inspired by O'Keefe's work.

Environmental education resources for the public

- Interpretative Education Center- School groups and the general public have access to the Wild Basin visitor's center on Monday-Friday, 9am-4pm. In 2018, we continued to maintain the educational exhibits installed in the visitor's center and made use of them during group events (i.e. students used the projector microscopes to view specimens, listened to bird calls, and viewed observations on the two touch screen computers displaying Wild Basin observations on iNaturalist). Additionally, public visitors had access to the exhibits during normal business hours.
- Public visitation - We placed two trail counters at the trailheads to estimate the number of visitors using the Wild Basin trail system. We assume that each individual is counted twice by the counters (arriving and leaving), so we add the totals from both counters together and divide by two for monthly visitation estimates. Estimates from the trail counters indicate Wild Basin welcomed approximately 13,973 visitors during the 2017-18 fiscal year. Visitation rates were lowest in June (approximately 2160 visitors) and greatest in March (approximately 2910 visitors). An independent study of visitation rates in 2016 confirmed the accuracy of trail counter data have been found to be fairly accurate, although they may miss some visitors, especially when walking in large groups and, contrarily, may misfire on occasion due to extreme heat, wind disturbances, ants in the counter boxes, etc.

Citizen science

- eBird quarterly walks – Wild Basin staff and volunteers coordinated quarterly bird walks for the public to participate in the citizen science program, eBird, run by the Cornell Lab of Ornithology and National Audubon Society. Three sections of Wild Basin's trail systems are included as separate survey locations (360 Trail Segment, Bee Creek Segment, and North Hollow Segment), and all birds seen or heard during the quarterly walks were recorded in the eBird database. Thirty-two bird species and 218 total birds were recorded during the 2017-18 eBird walks, with over 11 volunteers contributing as participants.
- iNaturalist – Students, volunteer natural resource stewards, and the public are encouraged to participate in the Wild Basin Biodiversity Project, a citizen science project on the iNaturalist platform (http://www.inaturalist.org/projects/wild-basin-biodiversity-project). This project allows users to submit observations of flora and fauna, supported by photos or sound recordings, using either their mobile device or desktop computer. The community of members on iNaturalist then helps to determine or confirm the identity of the animal or plant, and it becomes a valuable data point for our natural resource management efforts as well as broader scientific research. iNaturalist also allows users to view observations uploaded by other visitors to the preserve. A total of 1,041 observations documenting 396 species have been reported by students and visitors in the Wild Basin Biodiversity Project on iNaturalist.

Volunteer stewardship

- Volunteer Stewardship Workdays- Wild Basin provides opportunities for the public to volunteer and assist with land management activities, as well as learn about the BCP and conservation issues. Collectively, land management volunteers contributed approximately 351 hours from Oct 2017-Sept 2018. This includes contributions from approximately 103 volunteers participating in Saturday workdays, corporate group stewardship events, and a dedicated small group of volunteers participating in weekly workdays. Specific stewardship events include the following:
- Wild Basin Stewardship Days – the public is invited to participate in stewardship days at Wild Basin one Saturday per quarter. During the period from Oct 2017-Sept 2018, volunteers on Saturday workdays collectively contributed over 27 hours of service.
- Thursday Volunteer Workday - A small group of dedicated Wild Basin volunteers participated in weekly land stewardship activities including trail pruning and

protection, invasive plant removal, and pond repair. Collectively, Thursday volunteers contributed 184 of land stewardship hours.

- Austin Association of Facilities and Maintenance Engineers (AAFAME) - Wild Basin has created a new relationship with a local professional volunteer organization, AAFAME. Volunteers help local non-profits by carrying out projects that require professional and technical skills in engineering. On June 7th, twenty members of AAFAME contributed 80 hours to help Wild Basin rebuild one of our trash receptacle kiosks and began refurbishing the small building in our parking lot.
- Texas Conservation Corps - Wild Basin served as a host park in the "It's My Park Day" by the Austin Parks Foundation on March 3rd. We had over 20 volunteers contribute 60 hours cleaning drains that keep water off the trails and armoring a muddy section of the trail with large stones.

Public events, meetings, workshops, and conferences

- Wild Basin co-hosted a well-attended presentation with Travis Audubon on February 13: Adaptations in Owls by Denver Holt, president of the Owl Research Institute and Ninepipes Wildlife Research Center.
- Wild Basin hosted two community mixers and presentations: Effect of Housing Development on Wildlife Movement Along Wild Basin's Boundaries by UT Capstone student, Ayu Larasati and Central Texas Reptiles by herpetologist, Bill Brooks. SEU staff/faculty/students, neighbors, volunteers, and interns were among the attendees.
- Wild Basin hosted a summer presentation on June 21, "Peacefully Co-Existing with Coyotes" by City of Austin Wildlife Officer, Sarah Whitson.
- Recreational Equipment Incorporated – REI conducted three Star Walks in 2018.
- Travis Audubon – Travis Audubon held their 2017 Master Birders Class at Wild Basin.
- Tree Folks – Tree Folks held a class at Wild Basin for their 2018 Urban Steward training.
- Meetings of local organizations – Wild Basin hosted several group meetings for entities such as Hill Country Alliance, Audubon Society, Capital Area Master Naturalist, Tree Folks and Families in Nature.
- Meetings of businesses and government entities – Wild Basin hosted several group meetings for entities such as Adlucent, Texas Health and Human Services Commission, and City of Austin – Watershed Protection Department.

- The Wild Basin Director, Dr. Barbara Dugelby, gave two invited public presentations about Wild Basin, both entitled “Wild Basin: A History of Important Research and the Preserve’s Relevance to Austin and the Hill Country”.
  - The University of Texas at Austin Osher Lifelong Learning Institute (UT OLLI); University of Texas, October 27, 2018, and
  - The Balcones Chapter of the Master Naturalist Program, Concordia University, November 7, 2018.

St. Edward’s University Events

- Staff Retreats and Meetings - Various departments and school groups from SEU scheduled their planning and staff retreats at Wild Basin including School of Behavioral and Social Sciences, School of Arts and Humanities, Campus Ministry, Academic Support, Human Resources, and the Student Entrepreneurial Club.
- SCIE 1100 Freshman Summer Research Experience - In May, four St. Edward’s University undergraduate students participated in a 1-week research experience in the field of herpetology. The students were involved in every step of the scientific method from developing a question with methods to answer it, to data collection and analysis.
- Biology 1107 - Cells, Genetics, and Organ Systems and Biology 1108 – Populations and Organisms - The introductory biology labs incorporated a course-based undergraduate research experience (CURE) that allowed students to participate in hands-on research. Approximately 108 students participated in a project to collect water samples and evaluate water quality parameters in Bee Creek.
- Biology 2420 Entomology – Insect Collection (visited 9/5/18 - Matt Steffenson)
- Biology 1305 Contemporary Biology - held Class (Judy Walther)
- HONS 2360.01 Making Sense of the World in Words: Writing about Science – Bioblitz on 4/7/18 (Lisa Goering)
- MSEM 6301 (visited 11/2/17 and 1/19/18 – Amy Concilio)
- MSEM 6311 Community Ecology (visited 2/6/18 – Amy Concilio)
- MSEM 6315 Applied Research – Graduate Course (Amy Concilio)
- ENSP 2324 Environmental Science (visited 10/9/17 - Gustavo Ochoa and 11/5/17 - Amy Concilio)
- ENSP 4349 Climate Change: Science Policy and Management (Amy Concilio)
- ENSP 4352 Research Experience (Amy Concilio)
- Education 3333 Methods and Management (visited 5/7/18 Steve Fletcher)

- Student research symposiums – student researchers presented their work on Wild Basin-related research projects at the following symposiums:
  - “Testing effort efficiency for surveying herpetofauna at Wild Basin Wilderness Preserve” by Christopher Walker, Jamie Malone, Julianna Rosales, Anna Qualls and Aaron Haynes, Lucian Symposium, St. Edward’s University, September 28, 2018.
  - “Fitness response of Asclepias asperula, antelope horns milkweed, with the inoculation of arbuscular mycorrhizal fungi” by Rebecca Woodard, Texas Society of Ecological Restoration Annual Meeting, November 10, 2018.
  - “Changes in plant and animal diversity and movement in response to shaded fuel break fire mitigation” by Jonathon Brooks, Michael Gembarowski, Conlon McOsker, and Madison Tumicki, Texas Society of Ecological Restoration Annual Meeting, November 10, 2018.
  - "Travis County stream assessment: macroinvertebrate indices in response to urbanization" by Patrick Kelleher, 2018 MSEM Graduate Student Research Symposium, St. Edward’s University, December 6, 2018.
  - "Fitness response of Asclepias asperula, antelope horns milkweed, to the inoculation of arbuscular mycorrhizal fungi in the Balcones Canyonlands Preserve, Austin, TX" by Rebecca Woodward, 2018 MSEM Graduate Student Research Symposium, St. Edward’s University, December 6, 2018.
  - "Evaluation of ecosystem function of a 30-year old dump site at Wild Basin Preserve in Austin, TX” by Adriana Lee, 2018 MSEM Graduate Student Research Symposium, St. Edward’s University, December 6, 2018.
  - Justin Stewart and Teresa Bilinski. 2018. The role of edaphic factors in the structuring of microbial carbon substrate utilization and community composition in an urban preserve, Symposium for Undergraduate Research and Creative Expression (SOURCE), St. Edward's University, Austin, TX (oral presentation).
  - Kizil Yusoof and Teresa Bilinski. 2018. Environmental Drivers Affecting Soil Microbial Activity in the Riparian Zone, Symposium for Undergraduate Research and Creative Expression (SOURCE), St. Edward's University, Austin, TX (oral presentation).
  - “Supplemental mechanical removal methods are effective in inhibiting regrowth of Privet (Ligustrum spp.) at Wild Basin Wilderness Preserve” by Savannah Bryson and C. Eric Johnson, Texas Society for Ecological Restoration Annual Conference, Denton TX. Nov. 11, 2017.

- Wild Basin Internship program – Wild Basin provided internships for 11 students. This includes internships in Environmental Management, Sustainability, Environmental Education, and Outreach/Social Media. Projects included water quality testing, invasive species removal, trail maintenance, monitoring animal behavior with wildlife acoustics and camera systems, butterfly garden research and implementation, and trail patrol.
- St. Edward's University events – Wild Basin staff provided resources and community outreach at several SEU events on campus such as Earth Day, Sustainability Fair, and Student Involvement Fair
- Courses – A list of undergraduate and graduate courses that incorporated Wild Basin into their curricula in Fall 2017 and Spring 2018 is included in Table 1. Approximately 189 university students visited Wild Basin as part of their course work in 2017.

Table 1. Undergraduate & graduate classes taught at Wild Basin in 2017-2018.

Course #	Title	# of Students	Semester
BIOL 1305	Contemporary Biology	17	Spring 2018
BIOL 1107	Cells, Genetics, and Organ Systems Lab	48	Fall 2017
BIOL 1108	Populations and Organisms	60	Spring 2018
MSEM 6301	Population Ecology	7	Fall 2017
MSEM 6311	Community Ecology	7	Spring 2018
ENSP 2324	Environmental Science	27	Fall 2017
ENSP 4349	Climate Change: Science Policy and Management	7	Spring 2018
SCIE 1100	Freshman Summer Research Experience	4	Summer 2018
EDUC 3333	Methods and Management	8	Spring 2018
HONS 2360.01	Making Sense of the World in Words: Writing about Science	4	Spring 2018
	TOTAL	189 students	10 classes

Publications

- Wild Basin staff and interns reported on Wild Basin news, events, and volunteers in three email newsletters, as well as updates in regular blog posts and social media outlets.
- Wild Basin was selected “Best of Austin 2018” by Austin Chronicle staff for best field research.
- As part of a series, an article titled “Wild Basin Director Leads Documentation of Preserve’s History” was published in the Austin American Statesman in June 2018.
- As part of a series, an article titled “Golden-cheeked Warbler Named Candy calls Wild Basin Preserve Home” was published in the Austin American Statesman in June 2018.
- An article titled “Tracking Austin’s Wildlife” was published in the St. Edward’s University Magazine, Fall 2017 Issue.
- A blog post titled “Historic Project at Wild Basin” was published in the Travis Audubon’s Signal Smoke Newsletter in Fall 2017.
- An article titled “It's So Obvious Why These Are Airbnb Plus’s Most Wish listed Plus Properties” was published on Brides.com in June 2018 and credited Wild Basin’s views and access to nature for the Airbnb property’s inclusion in the list.
- An article titled “Why an Austin Wilderness Preserve is Trashing a Christmas Tradition” was published and aired on CBS Austin News in December 2017, educating the public about the impact of Christmas decorations on wildlife in the preserve.

SCIENTIFIC RESEARCH

Ten research projects received Scientific Research Permits and 6 academic courses received education permits from Travis County and completed work at Wild Basin in 2017-2018. Short summaries of all permitted projects are included below.

(1) Belair, A., Haynes, A., Dugelby, B. Documenting Spatial and Temporal Patterns in Wildlife Distribution Across Wild Basin

Summary: 15 cameras were installed along the northern and southern perimeter of the preserve and images obtained from the cameras over a 6-month period were used to assess the impacts of residential housing, fences, and other structures on movement of native wildlife species in and out of the preserve. An abstract of the final report is presented below and the full report can be found in Appendix E.

Abstract: As populations increase, urban sprawl has gradually encroached on the wildlands, affecting the behavior of wildlife, particularly patterns of hunting, foraging, and movement. Increase in edge habitat, especially in areas where wildlands are immediately bordered by urban and suburban development, has been linked to potential increases in invasive species and human-wildlife altercations (Marks and Duncan 2009). In this research, motion-triggered camera traps were used to photograph wildlife moving along and through the boundaries of Wild Basin Wilderness Preserve, a 227-acre urban preserve in Austin, Texas, from September 2017 to April 2018. Camera placements were identified based on the condition of their location (boundaries with housing and fencing structures, boundaries with only fencing structure, and boundaries with no fencing and no housing structure serving as a control). Analysis show that boundaries with housing and fencing structures saw a larger instance of boundary-crossing (46.9%) compared to boundaries with only fencing structure (35.75%). Boundaries with housing and fencing structures saw a larger number of coyotes (n = 281) compared to boundaries with only fencing (n = 103). However, when comparing composition of deer and coyotes between the three areas, coyotes were shown to favor areas with only fencing structures. These findings indicate that the presence of urban development has had an effect on movement patterns of animals. This information can be utilized by the preserve in developing their management plans and for residential safety in areas surrounding the preserve.

Progress Report: Data continue to be collected from the 13 cameras as well as an additional 4 cameras installed on the perimeter and at key wildlife movement points (e.g., culverts). Currently, two UT Environmental Science students are planning their capstone research projects utilizing the camera network.

(2) Bilnski, T., M. Rodriguez, A. Ontai, S. Kramer, B. Shults, and J. Salinas. Effects of urbanization on ecosystem services at Wild Basin

Update: Data continues to be collected for this research during the year. However, the data have not been analyzed and no new results are available to be presented.

(3) Bilinski, T. Course-based Undergraduate Research Experience (CURE) for Ecology Students

No work was conducted on this project during the reporting period.

(4) Beck, P. Research Experience in Environmental Science and Policy Class: Conservation and Management of Wild Basin

Twelve St. Edward's University students learned research techniques and designed and conducted research projects during Fall Term 2017. 4 of the projects were conducted at Wild Basin. Three of the research projects involved going off trail. Instructors and students were careful to minimize the number of times they went off trail and the impact of their activities was limited to non-destructive vegetation sampling. All projects were coordinated and approved by Wild Basin staff in advance to minimize potential off-trail impacts on habitat.

(5) Haynes, A. Freshman Accelerated Research Methods workshop (FARM)

Summary: Thirteen freshmen from St. Edward's University participated in the annual Freshman Accelerated Research Methods workshop (FARM). During the workshop the students were required to downloaded iNaturalist onto their smart devices and used iNaturalist to conduct a "Bioblitz" on the preserve. The students split into five groups based on the organism type; mammals, insects, reptiles/amphibians, birds, and plants. Each group was given a field guide to help identify organisms within their designated groups. They conducted the Bioblitz for roughly three hours. Upon completion, they were shown how to download CSV data to an Excel spreadsheet for statistical analysis. Due to extreme heat conditions wildlife observations were relatively low with a total of roughly 25 observations made. The majority of observations were of plants.

(6) Kelleher, P. Travis County Stream Assessment: Macroinvertebrate Indices and Water Composition Comparison

Project Description: This study aimed to determine stream bed stability of five different streams in Travis County including Bee Creek at Wild Basin. This research will measure biotic indices which will be used to classify the degree of pollution in the aquatic systems based on the tolerance or sensitivity of different groups of invertebrates to pollution. Only the researcher will be going off trail and collecting water and 100 macroinvertebrate specimens at Wild Basin. Off trail activities will be guided by Wild Basin staff.

Progress Report: Water samples were collected at Bee Creek in Wild Basin Preserve and are being analyzed.

(7) Gold, D. Comparing Biological Diversity in Gregarines from Wild-Isolated and Grain Beetles through Genomic Sequencing

Progress Report: Over the past several months, our priority has been to establish a colony of Mealworm beetles (*Tenebrio molitor*) that is wholly infected by gregarine parasites. After obtaining beetles from domestic suppliers we allowed the organisms to carry out their life cycle, with the hopes that any gregarine infection would spread throughout the beetle population. We then hope to compare wild-caught beetles to the domestically sourced organisms to determine the selective effect that environment has on parasite diversity and infection burden. Further, we have worked to refine methods for isolating parasites from the hosts, and then extracting genetic material from parasites. We have also conducted research to determine the most effective way to identify which parasites are infecting the hosts. With funding from the Hook Fellowship, we have successfully confirmed that our host organisms are indeed infected with eukaryotic organisms (specifically gregarines) that our research team is interested in.

(8) Grove, E. Documenting spatial and temporal patterns in wildlife distribution across Wild Basin

Project Description: Permittee will use 5 motion-triggered wildlife cameras to document wildlife species and their activity patterns across the Wild Basin landscape. SD cards from the cameras will be collected every 4-6 weeks, and cameras will be left in place through the end of 2018. Off-trail travel is required. Data from this project will be combined with similar data collected during the past summer during analysis

Progress Report: Images from 2 cameras installed (by Wild Basin staff) in Wild Basin and 3 cameras in other greenspaces in Austin are being analyzed.

(9) Haynes, A. A comprehensive diversity survey of Herpetofauna at Wild Basin Wilderness Preserve

Wild Basin was divided into four sections to standardize sampling efforts, using creeks as a boundary to separate the sections. Five researchers conducted biodiversity surveys in each section for 2.5 hours. Sampling periods occurred at various times of day to gain an understanding of the prominent times herpetofauna may appear. The species identified include: blotched water snake, Leopard Frog, Cricket Frog, Six-lined racerunner, Whiptail Lizards, Western Rat Snake, Three-toed Box Turtle, Texas Spiny Lizard, Texas Patch-nosed Snake, Texas Cooter, Strecker's

Chorus Frog, Red-eared Slider, Pond Slider, North American Toads, Mediterranean House Gecko, Little Brown Skink, Gulf Coast Toad, Green Anole, Flat-headed Snake, Common Spotted Whiptail, Common Snapping Turtle, Colubrid Snakes, Black-necked Garter Snake and American Water Frogs. Citizen science data through iNaturalist species reports were compared with the findings of the 1-week project. The research suggests the best time to search for herpetofauna was at night; however, the data from iNaturalist indicated that the best time were afternoons. This could possibly be because of sampling bias because iNaturalist observers are most active during afternoon hours and not allowed in the preserve at night. Thus, iNaturalist gives a strong indication of the variation of species present over time, but not the abundance of individual species in Wild Basin. More efficient methods for sampling the preserve's herpetofaunal diversity may include drift fences with pitfall traps, plywood coverboards and funnel traps. This would decrease the need for temporal standardization of sampling efforts and be less energetically costly to the observers.

(10) Concilio, A. Impacts of fuel mitigation treatments on plant and animal diversity and abundance

Project Description: The permittee will supervise students conducting a research project that will measure vegetation and mammal diversity and abundance in response to fuel mitigation treatments anticipated to occur along the fenced boundary of the Wild Basin Wilderness Preserve in October 2018. During the fall semester of 2018, students will go off trail 6-8 times to conduct non-destructive vegetation and mammal sampling at 2 main sites adjacent to the WBNP fenced boundary (sites = area to be cleared, control area). For vegetation, we will sample the herbaceous and shrub understory community using point-intercept quadrats at 6 subplots per site (12 sites total). At the same sites, we will place camera traps along the fence boundary to sample the mammal community. Plots will be marked with flagging and GPS points so they can be easily found and re-sampled. Plot markers will not be visible from the trail, and will be removed at the conclusion of the study. Students will gain ecological research skills collecting and analyzing these data.

Summary of Results (Abstract from Scientific Presentation): Residents living in the Wildland-Urban Interface (WUI) deal with an increased risk of wildfire, as fuel loads are often high due to fire suppression. Land managers have employed a number of mitigation tactics aimed at minimizing the risk of fire spreading from residential neighborhoods into preserved wilderness and vice-versa. Shaded fuel breaks are

used to reduce the understory fuel load and raise the base height of the canopy to prevent ground fires from leaping up into the canopy. Although this technique is commonly employed, little is known about its non-target effects. We took advantage of an existing fire mitigation treatment along the border of Wild Basin Wilderness Preserve in Austin, TX, to measure the impacts on plant and mammal diversity and abundance using a before-after-control-impact design. To measure changes in mammal movements, abundance, and diversity we set up 8 game cameras (4 in control, 4 in mitigated areas), all of which are along the fenced border of Wild Basin. We surveyed overstory vegetation (DBH, species composition) using fixed area plots ($225m^2$), canopy cover (3 points per plot), and understory shrub cover (3 circular 5-m diameter subplots) at each of the 8 sites. Fuels treatments will begin in Oct 2018, and we will measure post-treatment vegetation and mammal movement afterward. We anticipate that invasive species may become problematic based on their presence in pre-treatment plots, and that animal movement will change in response to canopy openings. These results should be of broad interest to environmental managers working in central Texas.

(11) Woodward, B. Identification and analysis of microbial communities associated with antelope horns, *Asclepias asperula*, success in the Balcones Canyonlands Preserve

Summary: The role the microbial community plays in providing milkweed with the nutrients it needs for survival and recruitment will be examined using DNA sequencing methodology to isolate the 16S rRNA gene. Study sites will be at Wild Basin Wilderness Preserve, Vireo Nature Preserve, and Commons Ford park where antelope horn, *Asclepias asperula*, is growing. There will be 3, $1m^2$ plots at each of the three sites and 3 X 100 mL soil samples will be taken in each plot around *A. asperula*. The 3 soil samples from each plot will be mixed and 150 mg will be used to isolate the DNA with DNeasy PowerSoil Kit Quick Start Protocol (Qiagen, Carlsbad, USA). The isolated 16S rRNA region will be sent to Mr. DNA Laboratory (Shallowater, Texas) to be sequenced and the sequences will be classified into operational taxonomic units (OTUs). The microbes associated with *A. asperula* can potentially be included in inoculation mixes to create better soil conditions to support its growth. Characterizing the microbial community that increases milkweed recruitment can speed up habitat restoration for the rapidly declining monarch butterfly populations who depend on these plants for reproduction.

Progress: Two prairie grassland sites within the Balcones Canyonlands Preserve where Texas milkweed, *Asclepias texana*, has successfully and unsuccessfully grown have been identified and are currently being examined: Commons Ford and Wild Basin. These sites are directly within the migratory path of the monarch butterfly and *Asclepias texana* occurs at each. Though there are over 30 milkweeds native to Texas, our research will focus on Texas milkweed, *Asclepias texana*. At each site, we have established five 1m2 paired plots: one surrounding a Texas milkweed individual that has been successfully established after planting, and one surrounding a dead milkweed plant that did not survive transplanting from the greenhouse. Paired plots were selected based on their proximity to one another and their occupation of the same general habitat to minimize any other differences aside from whether the milkweed survived or not.

To characterize the plots, we have collected soils for pH (to be measured in the lab with soils samples at the site), measure soil moisture and temperature in the field with probes (soil moisture probe), and measure vegetative composition (using Daubenmire cover classes) at the same time that soil samples are taken for microbial analysis. For soil pH, temperature, and moisture, three samples have been randomly be taken within the 1m2 quadrat, and vegetation will be evaluated within the full quadrat.

The next phase of the project will be to collect soil samples for DNA analysis. At each site, 5 soil samples will be collected from soil that milkweed have successfully been grown and 5 soil samples will be collected from areas milkweed were unsuccessfully grown, for a total of 20 samples. The ability to isolate fungal and bacterial DNA from soil will be verified by PCR amplification using ITS or 16S primers respectively. These sequences are used because they are highly conserved and an accurate way to identify species (Chakravorty et al. 2007). DNA quantification and purity will be assessed spectrophotometrically using A260/A280 ratio. Amplicon DNA sequencing will be carried out at Mr. DNA Lab. These sequences will undergo quality control trimming prior to analysis using the Quantitative Insights Into Microbial Ecology (QIIME) and Phyloseq suite of tools. Although 99% of environmental microorganisms are not culturable in the lab (Sharma et al. 2005), culturing does provide adequate genus level identification for some microorganisms and provides valuable information. The concentration of microbes in each sample will be determined using plating techniques through the College Tryptic Soy Agar Media Kit. Single colony forming units (CFUs), colonies

originating from a single cell, can be identified through sufficiently diluting samples and used to identify the microorganism present. Then, the abundance, diversity, and distribution of communities at each sample site will be calculated from the microorganisms identified.

(12) Birch, K. Fluoride Toxicity in Freshwater Systems.

Project Description: The main objective of the study is to discover alternate means to measure toxicity in the water other than measuring, for example, pesticide or oxygen levels. This research area has not been extensively explored. This should be a cause for concern: factors such as ion concentrations (fluoride and chloride measured in the experiment) could play a definitive role in stream and organism health. Other factors such as Total Dissolved Solids (TDS), habitat quality and diversity index will be measured in order to get a more holistic view of other variables that may impact water quality. Discovering the relationships between chloride, fluoride, TDS, and acidity and comparing it to macroinvertebrate diversity and habitat quality can alert scientists what aquatic environment is detrimental to the macroinvertebrates inhabiting the area.

Update and Summary of Data Trends: Data analysis is currently in progress. Water samples may be taken in order to observe if E. coli presence has any relation to observed trends. Some water quality parameters are better indicators for macroinvertebrate abundance and diversity than others. Parameters that seem to be the best indicators for freshwater stream health are average tolerance values of macroinvertebrates, pH, habitat quality, and macroinvertebrate diversity. pH is heavily related to macroinvertebrate diversity. Precipitation seems to be a factor highly related to stream health, but does not seem to significantly influence macroinvertebrate diversity. The relationship between chloride levels and pH levels follow literature trends. There were large differences between the habitat quality for both upstream and downstream sites. The downstream sample site had a lower habitat quality and was more variable in terms of water chemistry and macroinvertebrate diversity (total habitat assessment scores 149.5 vs 122 for upstream and downstream sites respectively). This corresponds with the tolerance levels of the downstream and upstream sites, as the downstream sites had greater tolerance levels than in the upstream site, as well as lower diversity index. Fluoride and TDS levels are highly correlated with macroinvertebrate diversity in the upstream sites only; the implications of TDS and fluoride on macroinvertebrate diversity and habitat quality with further sampling. More subsequent trials examining

the effects of fluoride on stream quality will be needed in order to determine its significance. Longer and more frequent sample periods would be a beneficial follow up study in order to determine the significance of these trends over a longer period of time.

(13) Lee, A. Evaluation of ecosystem function of a 30-year old dumpsite in Wild Basin Wilderness Preserve

Project Description: Permittee will use flags to designate the 6 transect locations along 3 different arroyos in Wild Basin for a total of 18 test sites. At each site permittee will use a soil moisture probe to test soil temperature, pH, and moisture. Permittee will lay out 15X15cm wire mesh (2mm fiberglass screen mesh) litterfall packets to determine decomposition and biomass. The litterbags will be out in the field for one month and anchored into the soil using 3 inch garden staples. Permittee will determine percent coverage and species richness by visual analysis. To determine Above Ground Net Primary Productivity permittee will clip all flora (to the soil) in a 20X20 cm^2 area to the north of each flagged plot. All flags and other materials will be removed at the end of the study.

Progress Report: Data on soil, litterfall, and vegetation have been collected at all 6 transect locations are and currently being analyzed.

(14) Schwarz Taylor, E. Course based undergraduate research experience within an introductory biology course (BIOL 1107) at St. Edward's University

Summary:

Sampling structure: During the Spring 2018 semester, the course BIOL 1108 at St. Edward's University had approximately 72 students conducting research at Wild Basin. Three different sections of BIOL1108, each with approximately 24 students, completed sampling at 3 different sites of Bee Creek: 1) upstream of the waterfall, the closest point at Bee Creek to the Highway 360 Bridge while staying on trail, 2) midstream near the intersection of Creek Trail and the path to the Scenic View, and 3) downstream where Creek Trail intersects the creek at the furthest distance south and east. Students quantified periphyton biomass, macroinvertebrate diversity, and coliform concentration. This data was made available to all of the students enrolled in BIOL 1108, so that they could compare sites across Austin to obtain a better understanding of how land use and other factors may affect stream quality.

Coliform sampling: The data for the coliforms were not conclusive as the students faced the issue of contamination and inconsistent colony counting technique.

Macroinvertebrate sampling: Students collected macroinvertebrates using the kick and sweep method which utilizes a kick screen to collect individuals. The students brought the samples back to the lab and anesthetized and preserved the animals in 70% ethanol and then identified the individuals. Students were required to identify the organisms to family and then calculate % EPT, which is the percent of families identified that belong to the orders: Ephemeroptera, Plecoptera, and Trichoptera. These organisms are more sensitive to pollution so serve as bio-indicators. Over two weeks of collection, the results suggest that the midstream site had 1.7 times more EPT% (52.6%) compared to the downstream and upstream sites sample sites (30%) within Wild Basin. Due to inconsistent data reporting by students (some groups clumped replicates), statistical analysis is unable to be completed at this time. A higher %EPT suggests that there may be better water quality midstream. This is interesting considering it contradicts data from Spring 2017. However, this could be due to differences in reporting and ability to complete proper summary statistics.

Periphyton sampling: The periphyton data was less conclusive and there was not a statistical significance between the three Wild Basin sites (Table 2; $p=0.65317$, $\alpha=0.05$). The students had difficulty measuring the surface area of the rocks they scraped and some would collect excess sediment which created inconsistencies between mass measurements. We hope to collect same data parameters in Spring 2019.

Reflection: Some inconsistencies will be inherent in the Course-based Undergraduate Research Experience layout. However, there are some things that could be improved upon such as communicating expectations with the students and checking their work more thoroughly before allowing them to submit their numbers to all the sections.

Table 2. One-way ANOVA results comparing three weeks of periphyton biomass collection for each of three sample sites at Wild Basin Preserve.

SUMMARY				
Groups	*Count*	*Sum*	*Average*	*Variance*
Upstream	3	0.01004589	0.00334863	2.3138E-06

Midstream	3	0.01944269	0.0064809	4.2089E-05
Downstream	3	0.01352228	0.00450743	4.9227E-06

(15) Walther, J. Field Biology Class for New College, St. Edward's University

Summary: The spring 2018 Contemporary Biology class had a total of twenty students, fifteen New College students and five traditional students. The class topics included topographic maps, geology, plant identification, habitat restoration, riparian habitat and endangered species. During the three-hour hikes, students worked on field handouts to map locations, find and identify fossils and rock types, used a dichotomous key for plant identification, collect and identify aquatic insects, mapped the Bee Creek drainage basin, and observed and listened to the golden-cheeked warbler and its habitat. Students wrote essays about each hike's topic, wrote wondering questions generated from their reading assignments and took short quizzes. Their last assignment was to hike alone and answer questions during their solo hikes. Students expressed positive reactions to their hikes and what they learned. For many of the students this class represents a first true nature study opportunity. Course evaluations and final papers indicate that many of the students believe the course will have a lasting impact on their outlook for and appreciation of wild nature.

(16) Steffenson, M. Entomology Student Insect Survey.

Investigators: Matt Steffenson, Addie Broussard, Katrina Bush, Jade Darwish, Alexandria De La Cruz, Ana Flores, Breda Hogan, Lilia Houser, Mario Hernandez, Chukwufumnanya Ofuokwu, Rachel Vargas, David Weier, Dylan Wichman, and Mikaela Wilson.

Project Description: Students enrolled in Entomology (BIOL 2420) at St. Edward's University during the Fall 2018 semester are required to create an insect collection as part of their grade. The insect collection serves to help student learn how to preserve insects according to museum standards, as well as how to correctly use a specialist-level taxonomic key.

Project Progress: Sampling was conducted for approximately three hours on Wednesday, September 12th, 2018. Students sampled by rock flipping, sweep netting, and aerial netting. Identification of samples is ongoing, but the following larger taxonomic groups were present in the specimens collected:

- Subphylum Chelicerata
    - Class Arachnida
        - Order Araneae
            - Suborder Araneomorphae
            - Suborder Mygalomorphae
        - Order Opiliones
        - Order Scorpiones
- Subphylum Hexapoda
    - Class Insecta
        - Order Blattodea
        - Order Coleoptera
        - Order Diptera
        - Order Hemiptera
        - Order Hymenoptera
        - Order Lepidoptera
        - Order Odonata
            - Suborder Anisoptera
            - Suborder Zygoptera
        - Order Orthoptera
        - Order Zygentoma
- Subphylum Myriapoda
    - Class Chilopoda
    - Class Diplopoda

Samples will continue to be processed and after student collections have been graded, specimens of appropriate quality will be transferred to the St. Edward's University insect collection.

Number of Participants: 14 (September 2018)

FACILITIES AND SIGNS

Facilities

- The driveway paved with "Road Base" is being maintained by Wild Basin Land Management staff and volunteers. Potholes are filled with excess road base.

- Previous exhibits are still in place including two touch screen monitors, a large mural of native animals, and a bird song exhibit that requires people use binoculars to identify a bird and its song.
- The building's security system is currently monitored by ADT.
- We have been actively working on rodent control in the building. Land Management Staff are using baited snapping rat traps.
- Compost toilets are being maintained with wood shavings. St. Edward's University replaced two ventilation fans on the Clivus composting toilets.

Signs and maps

- Currently, we have two versions of digital maps available on the website homepage (www.wildbasin.org) for visitors to access on their smartphones, including a Google Earth file for the trail system and a PDF copy of the trail map. We also have other resources available on the website, including interpretive information and resources for specific age groups. Paper maps are still available inside the visitors' center, and a weather-resistant map of the trail system is mounted at each trailhead.

SECURITY, ACCESS AND SAFETY

Emergency Preparedness

Wild Basin staff worked with St. Edward's University Campus Safety personnel to develop an Emergency Response Plan. The Wild Basin Wilderness Preserve (Wild Basin) Emergency Response Plan (ERP) describes how staff, student interns, and volunteers will respond to emergencies, addresses various types of hazards and establishes policies, responsibilities and operations designed to effectively and efficiently address an incident.

Wild Basin personnel developed this ERP in collaboration with the Director of Campus Resilience. This plan outlines the roles and responsibilities of identified parties and as well as the training and exercises that will be conducted on a regular basis.

All staff and volunteers who work at Wild Basin will have access to an electronic copy of the ERP. It is located in the "Wild Basin Share" directory of the SEU online file hosting service "Box", filed under "***Safety Resources and Emergency Response Plan.***" Additionally, a hard copy of this ERP is stored in a labeled binder

located under the hutch on the front desk of the Wild Basin Creative Research Center.

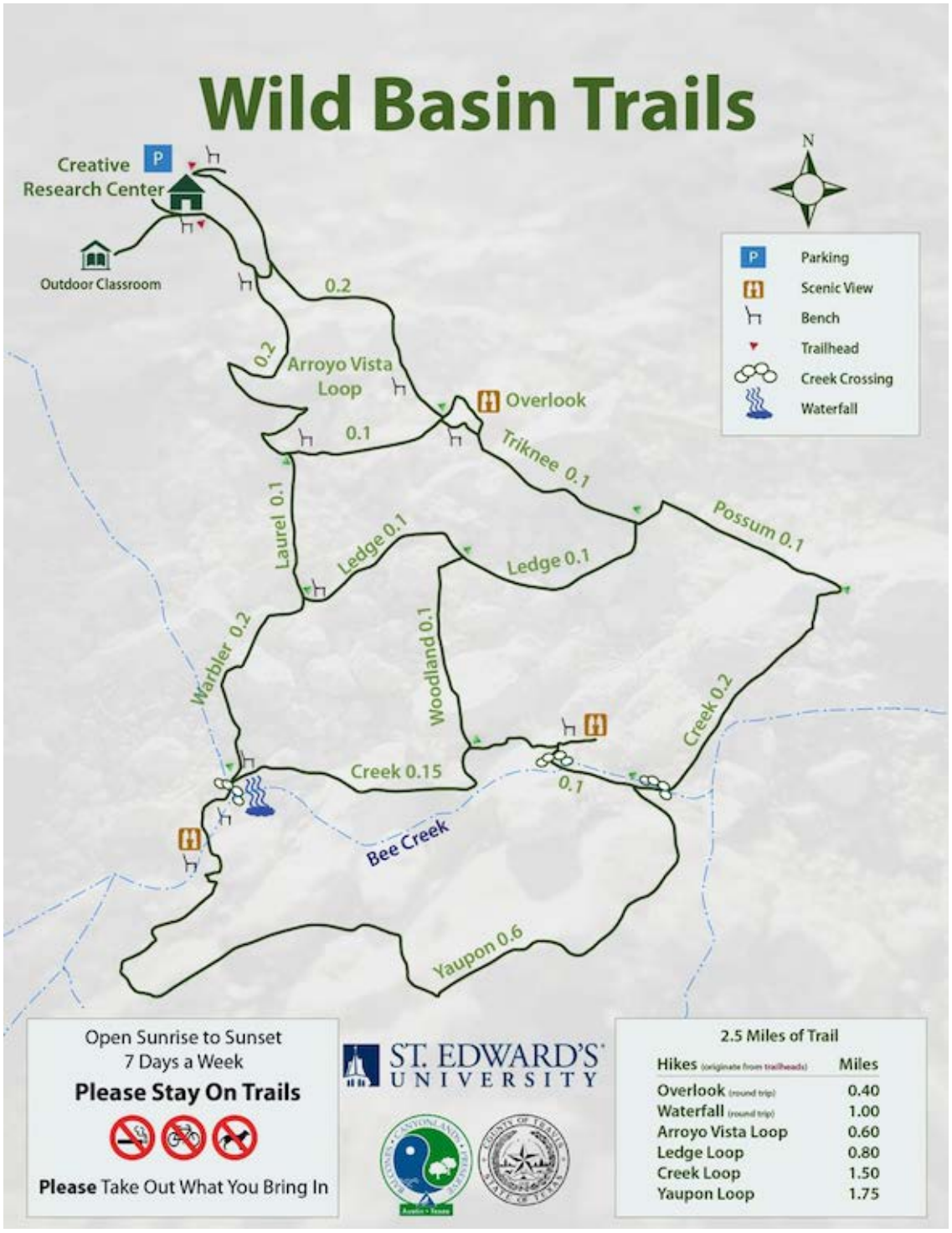
Fire Safety and Preparedness

In August, 2018, Wild Basin and St. Edward's University Campus Safety personnel met with personnel from the Westlake Fire Department and Travis County to discuss wildfire preparedness and response strategies. WFD personnel gave an overview of the potential for wildfire and explained their potential response time and approaches to different wildfire scenarios. At the meeting, Travis County and Wild Basin personnel agreed to share GPS coordinates of key trails and points of interest at Wild Basin for rescue personnel to use in the future in responding to 911 calls.

- The company Care Specialty currently monitors for fire in the building.
- Westlake Fire Department inspected the visitors' center and it passed inspection.

APPENDICES

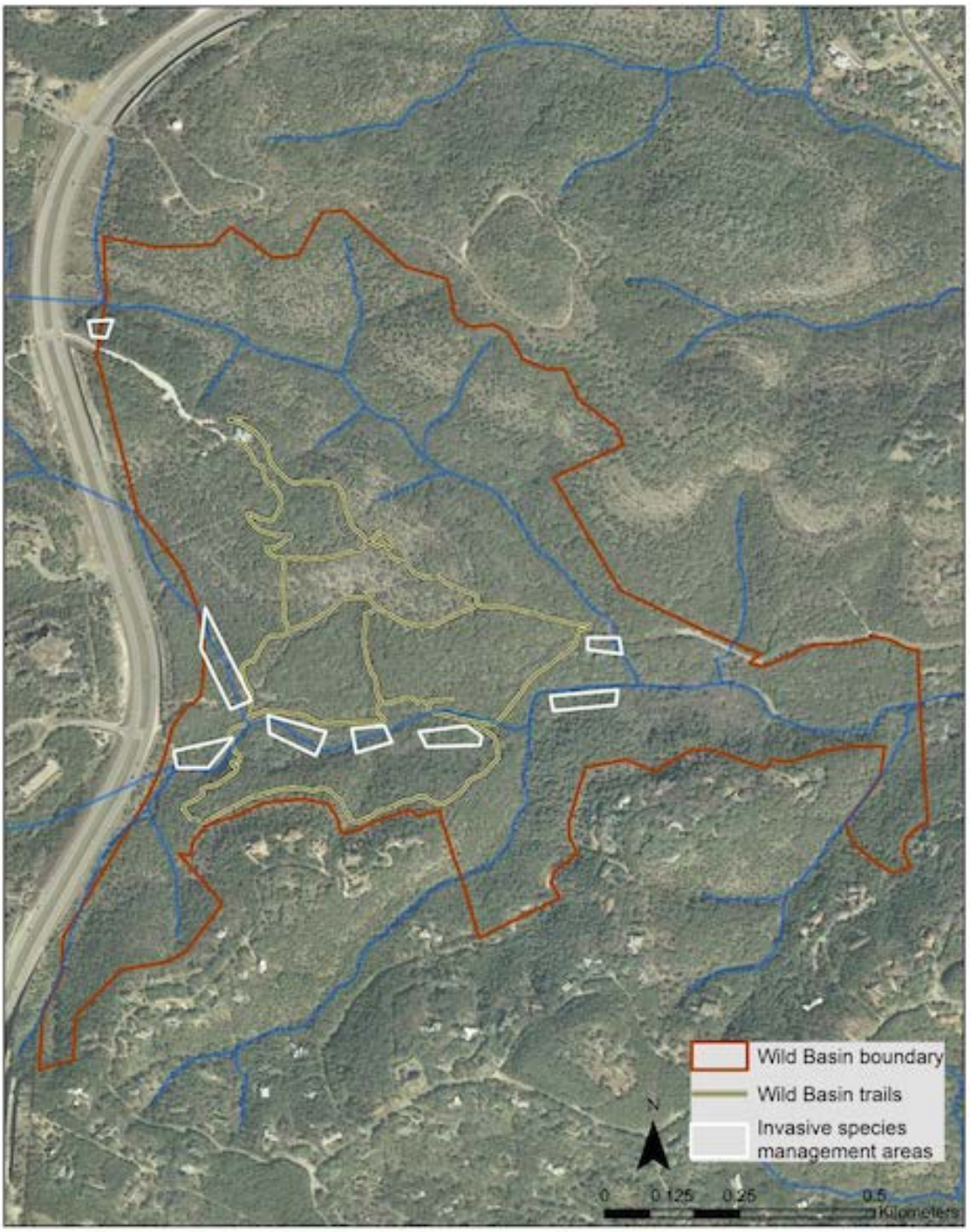
APPENDIX A: Map of Wild Basin Wilderness Preserve Trail System



APPENDIX B: Aerial Map of Wild Basin and Residential Neighbors



APPENDIX C: Locations of invasive species removal at Wild Basin from Oct 2017-Sept 2018



APPENDIX D: **Summary of 2018 Golden-cheeked Warbler Surveys at Wild Basin Wilderness Preserve**

Darrell Hutchinson

A total of thirty-six surveys were conducted at Wild Basin and Vireo Preserve between 12 March and 11 June by Darrell Hutchinson and Jim O'Donnell for a total of 115.5 survey hours.

The 2018 GCWA breeding season at Vireo Preserve/Wild Basin had similar territory occupancy and increased breeding success compared to 2017. Compared to previous years, the location of the territories at Wild Basin shifted eastward away from Hwy #360 and upper Bee Creek towards the interior portion of the Preserve around lower North Hollow Creek and the back gate at Wild Basin Ledge. Between the two plots, four males established territories. Three males paired and bred successfully. One male failed to find a mate and departed the plot in mid-May.

Two color-banded males returned to occupy territories inside Wild Basin and across the boundary with Vireo Preserve (see Figure 1. 2018 VPWB Territory Polygons). Both color-banded males were returns from previous years. NB/WH:MV/SI was banded at Vireo Preserve in 2011 aged after-second-year and returned for the seventh year in a row. "Candy" is, at least, 9 years old and the oldest known bird on the Balcones Canyonlands Preserve. OR/YE:NB/SI was banded at Vireo Preserve in 2014, and returned for the fourth year in a row.

We first detected NB/WH:MV/SI on 13 March. NB/WH:MV/SI was observed singing in his former territory along lower North Hollow Creek, but the pair nested further west between Possum and Woodland Trails. On 30 April, we found the nest on the day of fledging, where the female was observed feeding minimum two fledglings. Interestingly, neither the female nor any of the fledglings were ever re-sighted again. The male was re-sighted only one time on 14 May.

We first detected OR/YE:NB/SI on 13 March. His territory was located in the same area as years previous. We did not find the nest, but the female was observed feeding one 2-day old fledgling near the pond on 29 April. On 1 June, the male was observed feeding two older fledglings.

Second-year male RD/SI:MV/RD was banded on 26 March in Vireo Preserve. We detected him regularly throughout April and early May in Vireo Preserve, but we never observed breeding behaviors. On 14 May, we detected him along Creek Trail in Wild Basin accompanying a female and her fledgling. He was not observed feeding the fledgling and, based on the location and the age of the fledgling, we presume the female was paired with one of the Wild Basin males and he was seeking her attention. On 21 May, he was observed northwest across the Colorado River in Emma Long Park. We assume RD/SI:MV/RD failed to attract a mate at Vireo Preserve and began roaming in May.

An unbanded male, labeled UBWB1, remained undetected throughout the early breeding season. He was first detected in Vireo Preserve on 27 April along the back fence line bordering Wild Basin Ledge. We believe his territory straddled the fence lines between Vireo Preserve and the in-holding property at Wild Basin. No nest was found, but we observed him feeding one ~ 4-day fledgling on 30 April and two older fledglings on 14 May.

Surveys were funded by City of Austin Wildlands Conservation Division and conducted according to City of Austin's Balcones Canyonlands Preserve GCWA Demographic Study protocols.

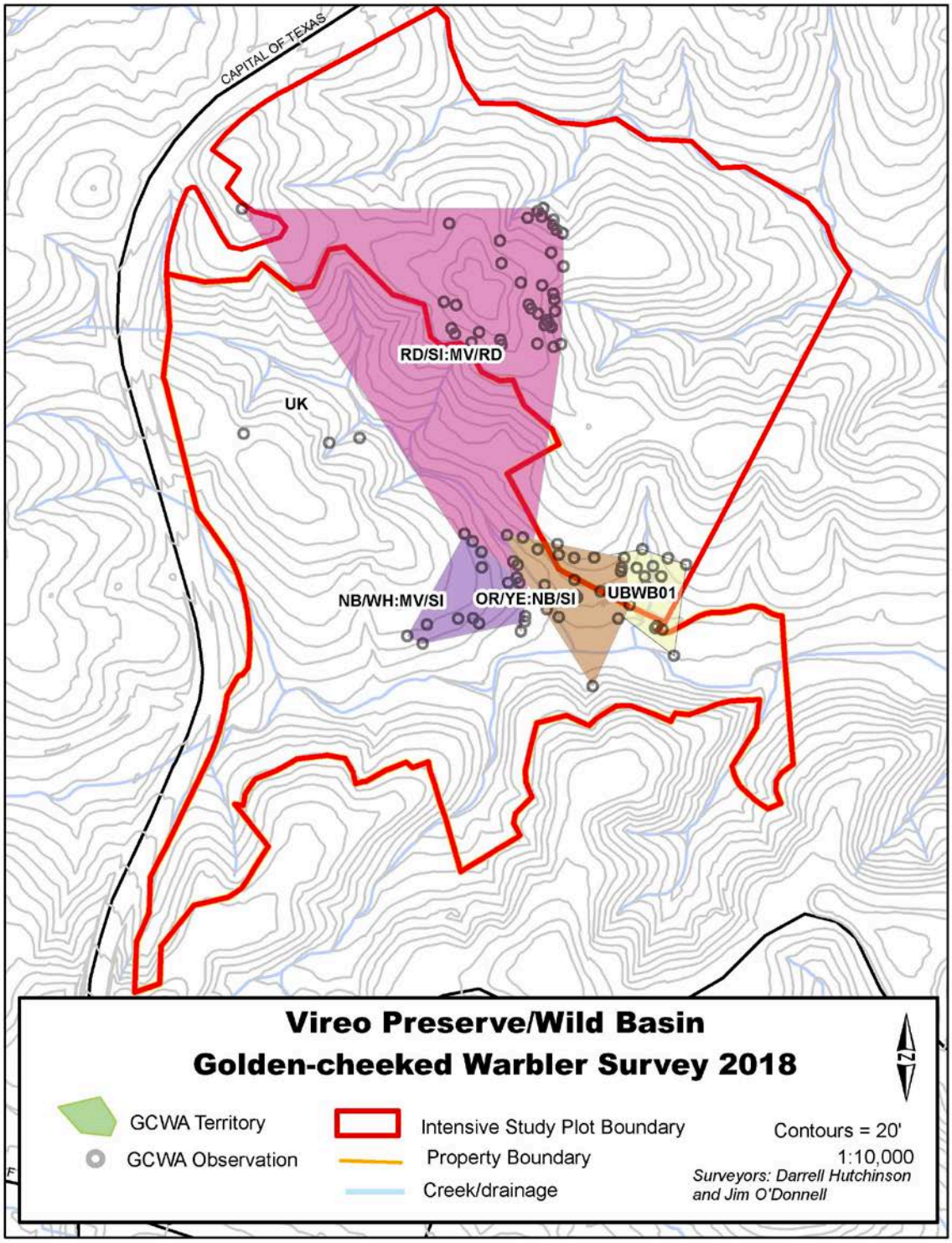


Figure 1. 2018 VPWB Territory Polygons

Appendix E: Capstone Research Final Report: Effect of Housing Development on Wildlife Movement Along and Through Wild Basin Wilderness Preserve Boundaries

Ayu Larasati, Environmental Science Institute, The University of Texas at Austin,
Wild Basin Wilderness Preserve, 10 May 2018

Abstract

As populations increase, urban sprawl has gradually encroached on the wildlands, affecting the behavior of wildlife, particularly patterns of hunting, foraging, and movement. Increase in edge habitat, especially in areas where wildlands are immediately bordered by urban and suburban development, has been linked to potential increases in invasive species and human-wildlife altercations (Marks and Duncan 2009). In this research, motion-triggered camera traps were used to photograph wildlife moving along and through the boundaries of Wild Basin Wilderness Preserve, a 227 urban preserve in Austin, Texas, from September 2017 to April 2018. Camera placements were identified based on the condition of their location (boundaries with housing and fencing structures, boundaries with only fencing structure, and boundaries with no fencing and no housing structure serving as a control). Analysis show that boundaries with housing and fencing structures saw a larger instance of boundary-crossing (46.9%) compared to boundaries with only fencing structure (35.75%). Boundaries with housing and fencing structures saw a larger number of coyotes (n = 281) compared to boundaries with only fencing (n = 103). However, when comparing composition of deer and coyotes between the three areas, coyotes were shown to favor areas with only fencing structures. These findings indicate that the presence of urban development has had an effect on movement patterns of animals. This information can be utilized by the preserve in developing their management plans and for residential safety in areas surrounding the preserve.

Introduction

As population density increases in urbanized areas, anthropogenic development tend to spread out into beyond the city into the suburban areas, bringing with them various aspects of development like housing and business practices. In certain cases, undisturbed natural areas beyond the urban center have a high appeal for future homeowners for various reasons like seclusion from hectic city centers and an opportunity to be surrounded by nature. As these developments continue to increase into wildlands, natural environments continuously face anthropogenic threats and the

negative implications these threats may bring. Development in these areas, typically addressed as wildland-urban interfaces, have been observed to disrupt and damage wildlands. Aside from the increased risk of wildfires that can be difficult to contain (Stewart et al. 2007), urban development in these areas have been associated with disturbance in wildlife biodiversity, community structure (Wood et al. 2014), and can lead to habitat degradation, fragmentation, and loss (Radeloff et al. 2005).

In some areas, these urban developments have gradually crawled towards wildlands surrounding protected areas, which typically serve as buffer zones between the perimeters of the protected area and the wildlands beyond. These “wildland” areas--and the protected areas themselves--are known to be beneficial for species diversity and richness, and research has shown that these areas facilitate in species conservation, recovery, and range expansion (Brooks et al. 2004; Thomas et al. 2012). The negative impacts of human development and settlement around protected areas occur in many different ways beyond just habitat alterations; encroachment into natural areas introduce various other foreign species into the interface such as pets and exotic and often non-native plants that could potentially increase competition for resources, introduce new diseases (Bar-massada et al. 2014), and exacerbate problems within the protected area associated with pre-existing non-native and/or invasive species (Spear et al. 2013). Moreover, presence of housing development around protected areas could limit and potentially decrease conservation value and reduce effectiveness of conservation efforts by cutting off or even isolating protected areas from other protected areas or the wildlands beyond the perimeters (Radeloff et al. 2010).

Wild Basin Wilderness Preserve is a protected area located just outside of Austin. Co-owned by Travis County and St. Edward’s University, Wild Basin is part of a larger system of protected areas known as the Balcones Canyonlands Preserve. Wild Basin provides nesting and breeding habitat for the federally-endangered Golden-Cheeked Warbler (*Setophaga chrysoparia)*. The area surrounding Wild Basin has gradually become more urbanized as residents move out from the City central to the Hill Country, and could potentially affect the wildlife residing in the area. Expansion in urban development has made the area increasingly fragmented and could potentially expose nesting warblers to exposed forest edges which could negatively affect their population (Peak 2007). Greater habitat fragmentation due to anthropogenic influences such as roads and houses have been linked to negative

effects on the quality of protected area and its inhabitants (Wade and Theobald 2010).

The main goal of this study was to investigate the effects of housing development and fencing structures on wildlife movement through and along the boundaries of Wild Basin Wilderness Preserve over a specified time period using motion-detecting cameras. It was hypothesized that zones with both fencing and housing structure would observe the most boundary-crossing event and that the highest frequency of coyote observation would occur along these zones, as well has the possibility of observations of domesticated animals. As part of the main goal of this study, wildlife composition would also be studied based on the gathered data to further understand how wildlife responds to the spatial variance of the study site.

Methods

To select camera placement locations, the boundaries of the preserve were hiked, looking for indications of wildlife movement, including fence breaks, game trails, etc. Where wildlife movement indications were located, images were taken of the indication and the location was georeferenced for further analysis and possible camera placement. After the hike was completed, the boundary of the preserve was divided into three major zones: (1) The “Fence/Housing” zone refers to areas along the southern boundary of the preserve in which a fencing structure is present alongside housing development, (2) The “Fence” zone refers to areas along the southeastern boundary of the preserve where there is only fencing structure present, and (3) The “Natural” zone refers to areas along the northeastern boundary of the preserve where there was neither fencing structure nor housing development and served as a control for the study. An additional section of the preserve boundary bordering a 4-lane divided highway (“Highway” zone) was not included in this study.

Five camera placement points were selected for each zone. Along the “Fence/Housing” and “Fence” zones, cameras were located at selected fence gaps, with the camera shutter facing the gap. Along the “Natural” zone, as there was no physical structure that demarcated the boundary separating Wild Basin Wilderness Preserve and the neighboring City of Austin Vireo Preserve, cameras were placed approximately equidistant from each other and were positioned to face a possible game trail in order to increase the chances of wildlife detection if they happen to move along the area. Cameras were set to record three images at 60-second intervals upon movement detection. These settings were chosen in order to confirm whether or not the wildlife detected crossed the boundary or was simply moving

along the boundary. Each camera was equipped with SD cards to store images, and they were swapped out in January 2018 in order to conduct preliminary analysis and to ensure that the camera would not run out of storage for the images captured. The SD cards were swapped out again at the end of the sampling period in April 2018. The cameras were kept in their positions to continue gather images after the study was concluded.

Once extracted, images were examined and only images containing wildlife were recorded on a Google Form created for this study regardless of whether or not the wildlife was observed to cross the boundary. On the Google Form, the following information was noted: camera name, image file name, date and time of captured image, wildlife type, number of individuals, whether or not the individual was crossing the boundary ("crossing event"), and any outstanding notes regarding the image. Because the camera was programmed to capture three images upon detection, information regarding image file, date, and time were recorded based on the first of the set. In categorizing crossing events where fencing structure was present, wildlife was considered to cross the boundary if any of the images of the captured set show that the wildlife was visibly moving through or under the preserve boundary. For every different wildlife observed, a new recording was made using the form. If the same type of wildlife appeared in two or more consecutive sets, the wildlife was only recorded once as long as these sets were captured within 10 minutes of each other. If the same type of wildlife appeared in two or more sets but more than 10 minutes have lapsed between each set, a new recording was made.

Of the 15 cameras, images were collected from 11 cameras indicated on Figure 1. After all images were appropriately recorded, crossing events were counted and compared to non-crossing events between the different zones. Deer and coyote detection were also counted and compared between each other and between the three different zone categories. The final results were also compared to the results obtained during preliminary analysis to better understand how sample size affected the differences in results. Although all images of wildlife were recorded, those with coyote and deer were in particular interest as these wildlife types were predicted to have a more visible impact towards one of the purposes of this study.

Results



Figure 1. Wild Basin Wilderness Preserve boundary and camera locations. Preserve boundary was marked with white line. Camera location is marked by colored dot. Blue dot indicates camera used in analysis; red dot indicates camera not used in analysis. Camera zones are marked as “N” for Natural, “F” for Fence, and “FH” for Fence/House.

A preliminary analysis was conducted based on the data gathered up to January 2018 in the same manner as the final data analysis. In the preliminary analysis, a total of 741 images were analyzed and 127 crossing and non-crossing events were detected. Of this, an overall 29.13% of these events were categorized as a crossing event whereas 70.87% were not (Figure 2). This information was further broken down to analyze differences in crossing events per zone. Results showed that Fence/Housing zones have a higher degree of crossing events compared to Fence zones. When comparing composition percentage of deer and coyote, preliminary results showed that Fence zones detected more coyote activity compared to Fence/House zones (Figure 4). No bobcats were detected in any of the

three zones during preliminary analysis which prevents an analysis on composition percentage of bobcat and coyote across the different zones.

Final analysis was conducted based on data gathered until April 2018. Although 15 cameras were put in place for this study, the analysis could only be completed

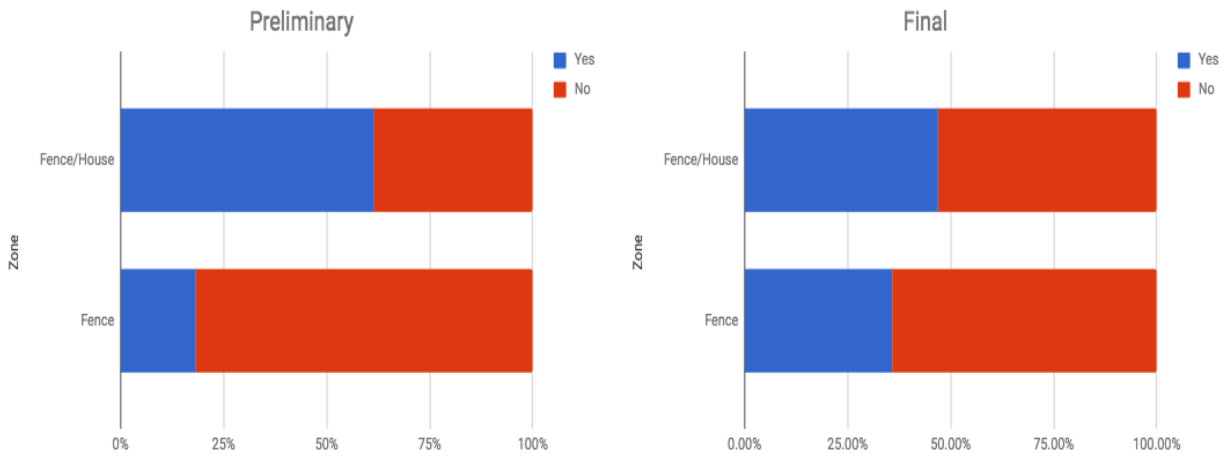


Figure 2. Preliminary and final analysis of crossing events. Preliminary analysis was conducted based on data collected by January 2018. Final analysis was conducted based on data collected by April 2018.

based on data gathered from 11 cameras as one could not be located while the other three were not retrieved due to the time constraints of this study. A total of 10,221 images were analyzed for this study, which generated a total event count of 1,060 both crossing and non-crossing. Of this number, a total of 34.87% of the events detected indicate wildlife crossing and 65.13% events detected non-crossing. A further breakdown as shown in Figure 2 show that there were more crossing events detected in Fence/House zones compared to Fence zones.

Based on the total events detected, wildlife composition count was broken down for each zone (Table 1). From Figure 5, the Fence/House zone wildlife composition was shown to be predominantly deer (54.6%) and coyote (20%). Based on overall composition, coyote was detected to a lesser degree along the Fence zone (9.5%) compared to Fence/House zone and was not detected at all along the Natural zone. However, a comparison between coyotes and deer indicate that more coyotes were detected along Fence zones at 34% compared to Fence/House zones at 27% (Figure 4). For bobcats and coyotes, both wildlife species showed a decrease in detection count in Fence zones compared to Fence/House zones. However, compositional percentage of just the two species indicate that more bobcats were detected along Fence zones at 11% compared to Fence/House zones at 7% (Figure 3).

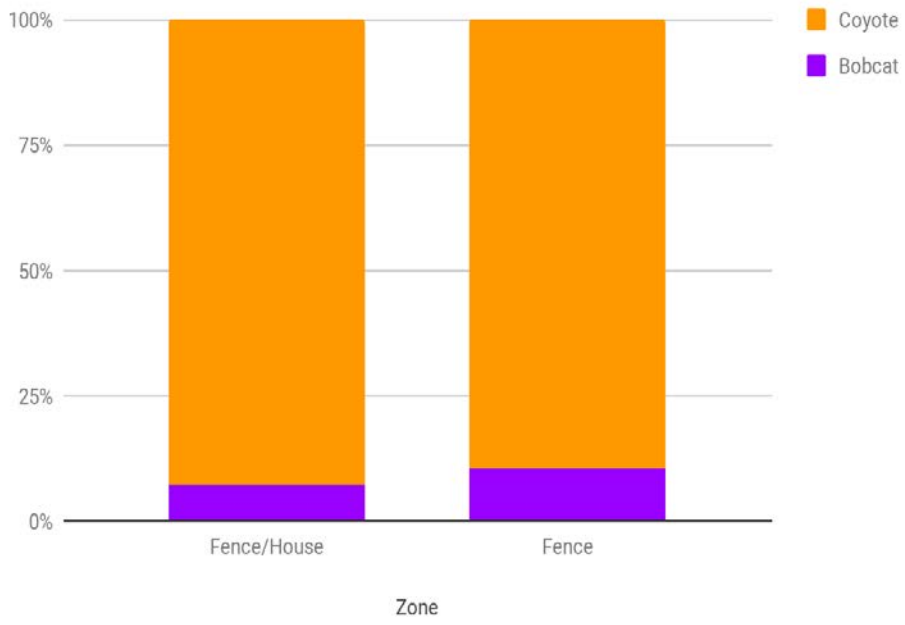


Figure 3. Final analysis on proportion of bobcat and coyote. Neither coyotes nor bobcats were detected in Natural zones. No preliminary analysis was conducted due to the absence of bobcat and coyote detection.

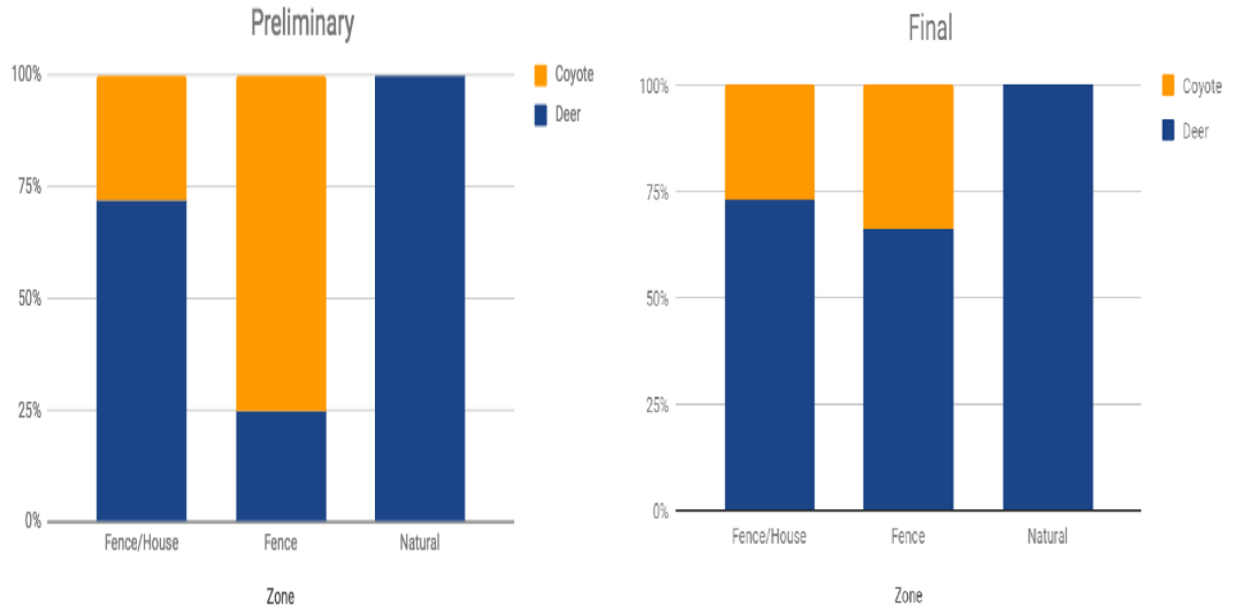


Figure 4. Preliminary and final analysis of proportion of deer and coyote. Preliminary analysis was conducted based on data collected by January 2018. Final analysis was conducted based on data collected by April 2018.

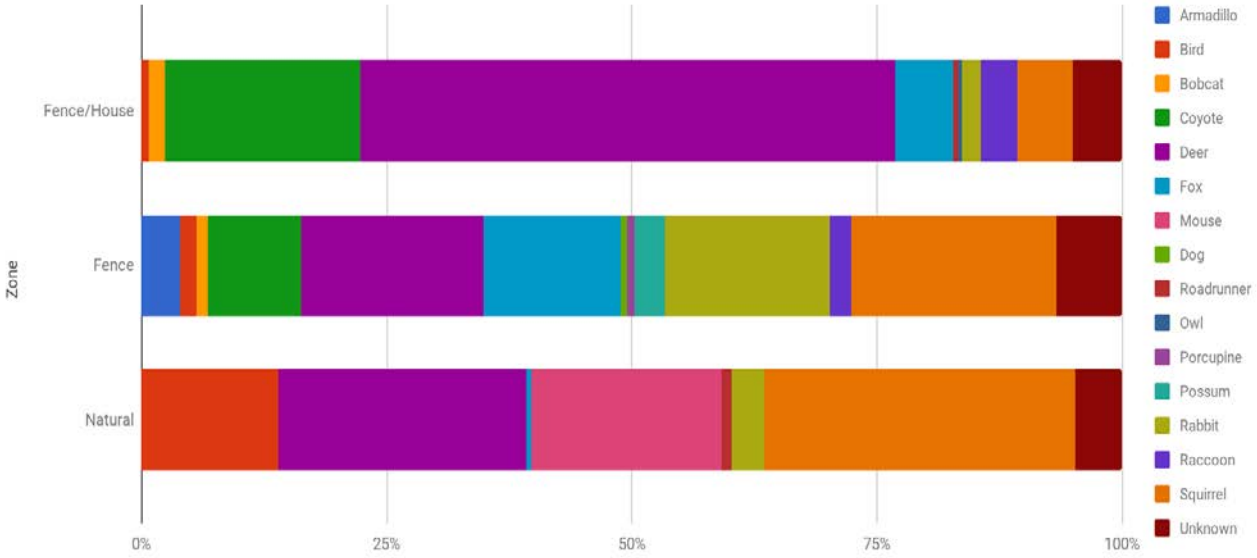


Figure 5. Wildlife composition per studied zone based on data collected by April

Species	Overall Count	Fence/House Count	Fence Count	Natural Count
Armadillo	14	0	14	0
Bird	36	4	6	26
Bobcat	13	8	4	0
Coyote	137	103	34	0
Deer	395	281	67	47
Fox	81	30	50	1
Mouse	36	0	0	36
Dog	2	0	2	0
Roadrunner	5	3	0	2
Owl	2	2	0	0
Porcupine	3	0	3	0
Possum	11	0	11	0
Rabbit	76	10	60	6
Raccoon	27	19	8	0
Squirrel	163	29	75	59
Unknown	59	26	24	9
Total	**1060**	**515**	**358**	**186**

Table 1. Breakdown of wildlife detected per zone and as an overall study site. “Unknown” indicates that wildlife were not clearly identifiable.

Discussion

Overall, the results of this study indicated that boundary crossing events occur more frequently in areas where both housing development and fencing structures were present as shown in both the preliminary and final data analysis. This could be due to a number of reasons, but they all relate to anthropogenic influence. The fence

along the preserve border with the housing development had numerous man-made fence cuts. Some of these fence cuts have been mended, but most have not or have been re-opened, serving as access points for wildlife to freely enter and exit the preserve. Moreover, the presence of private property could also be the cause of increase wildlife traffic along these areas. Urban coyotes and raccoons are known to be able to forage through waste materials for food, and property owners often have no second thoughts regarding leaving food out for deer (Poessel et al. 2017). The readily available supply of food source could be the reason these areas see higher wildlife traffic compared to other study areas.

This study indicated that between coyotes and deer, coyotes prefer to stay along areas where only fencing structure exists, whereas deer favor areas where housing development exists along with fence structures. This could be due to a number of reasons, but perhaps the most probable is due to the coyote's reclusive behavior towards human presence and their tendency to stay within the forest interior during daylight (Wang et al. 2015). Most observations of coyote activity in this study occurred during the night, dawn, or dusk, and the greater availability of tree and shrub cover that the fence areas have provided coyotes with better cover compared to the relatively uncovered perimeter that the fence/house zones had. In contrast, deer are known to live at edge habitats and prefer areas with less canopy cover and more smaller shrubs and grasses to forage (Potapov et al. 2014). This habitat is precisely what the fence/house zones are; in these zones, the fence line usually has a buffer of several meters before more dense forest canopy starts. Coupled with readily available food that property owners would occasionally leave out for deer, the fence/house zones evolved into the ideal foraging grounds for the deer.

Although there was a small difference in bobcat presence as part of the overall wildlife composition between the different zones in this study, the analysis between bobcat and coyote proportions was completed in order to observe the relationship between the two predator species. Comparing the composition percentage of just bobcat and coyote revealed that bobcats seemed to favor areas with only fencing structure. However, it is very important to note that there were more occurrences of bobcats in the Fence/House zones (n = 8) compared to the Fence zone (n = 4) based on the data used for the final analysis. The contrasting results and small bobcat sample size makes it difficult to discern the bobcat's actual zone preference and whether or not this preference is impacted by the presence of coyotes. Interestingly, compared to the coyote observations which tended to occur during the

night, dusk, or dawn, the 12 bobcat observations occurred throughout the day. This could potentially indicate that the bobcats have no temporal preference in regards to its activities compared to the coyotes, but the small sample size prevents a definitive conclusion on whether or not a preference exists for bobcats. However, if the assumption that the bobcat has no temporal preference compared to the nocturnal coyote was taken, then it could be inferred that the presence of one does not directly affect the other and that their zonal preference could be due to their fundamental niche and not specifically related to resource competition (Nealel and Sacks 2001, Tigas et al. 2002).

An important decision was made during data analysis in regards to categorizing crossing events in the Natural zones and why it was eventually not included in the analysis of crossing and non-crossing events. For both the preliminary and final analysis, natural areas were initially calculated to have no crossing events. This decision was made based on the assumption that, unlike the funneling effect that a fence could have on wildlife movement, natural areas would allow in free movement range as it had no distinctive anthropogenic demarcation of where the boundary actually stands. Because there was no way to positively indicate that wildlife crossed the boundary of the preserve, all detected animals were considered simply moving along the boundary and images were subsequently categorized as a non-crossing event and was excluded from the overall analysis and results of the study in regards to crossing events. However, Natural zones were included in the analysis of wildlife composition. Along the Natural zones, smaller prey animals (mouse, squirrels) were also detected more frequently compared to other areas. This could be due to a number of reasons, including camera positioning. Some of the cameras in the fence/house and fence areas were installed on tree trunks some distance away from ground level, so smaller prey would not be detected unless they managed to get into very close proximity to the camera sensors. However, almost all cameras installed in the natural areas were placed closer to the ground, thus allowing better detection of smaller prey animals.

Overall, the results of this study proved the hypothesis presented at the beginning that higher frequency of boundary crossing occurred along the preserve boundary bordered by housing development. The coyote's observed preference for the fence areas did not support the proposed expected outcome of the study, but it does provide a better understanding of where and why the coyotes prefer the area. Surprisingly, there were only two domesticated animals detected: two dogs in two

different occasions but at the same zone. It is worth noting that the dogs did not actually cross through the boundary of the preserve, and the image captured show the dogs coming close to the boundary before leaving soon after, presumably after being called by its owners.

Conclusion

At the time of the writing of this report, this study was the first of its kind conducted at Wild Basin Wilderness Preserve. The data gathered during this study will be kept as records at the preserve as it provides information regarding to the wildlife that potentially resides within the preserve and a way to monitor their activities along the boundaries. This information could also inform preserve authorities concerning future management policies, especially regarding to fence rules and maintenance. Along with the preserve, surrounding residents could also benefit from the knowledge of the organisms passing through their property and could allow them to make informed decisions regarding the conditions of their backyard. By a stretch, the City of Austin could also benefit from this study as the data gathered could provide essential information regarding city planning and controlling the urban sprawl.

There are improvements that could be made if this study were to be duplicated in a different location. Although the directional angle of the camera positioning was recorded during the setup process, this study did not take into account the game camera's degree of detection--that is, the extent to which the camera detects movement with its sensors. Knowledge of this information could inform decisions regarding to distance between camera placements in order to reduce the margin of error in detecting an organism. It is also important to take not that, in this study, the probability of a wildlife crossing the boundary of the preserve at a point between any two adjacent cameras was high. As stated in the methods section, camera placement and positioning was determined after a thorough hike to survey all possible camera locations, and cameras were placed in areas with the highest predicted chance of wildlife crossing. This study also did not consider the degree of urbanization and/or population density of the area surrounding the preserve which could be easily calculated based on residential population survey over a predetermined area around the preserve or urbanized area calculation over a predetermined area around the preserve. This information, coupled with the data gathered from the study, could serve as a benchmark in regards to how population changes and urban sprawl affects wildlife movement.

There are many possible aspects and ways to continue to develop and further the results of this study in order to provide a better picture of wildlife movement in the face of urban sprawl. Select wildlife individuals could be tagged and tracked via GPS units in order to observe their roaming behaviors inside and outside of the preserve boundaries in order to give a more robust understanding to reasons why wildlife enter and leave the preserve. Continuing this camera study in the future is also highly recommended in order to monitor the status of wildlife presence and provide continuous data as time progresses. The number of cameras used could also be increased to reduce the margin of error from wildlife crossing in between two adjacent cameras. The data gathered from this study could be utilized in analyzing the temporal aspects of wildlife movement to further understand wildlife behavior. Additionally, this study could serve as a starting point for a further study regarding monitoring wildlife biodiversity, composition, and population within the preserve.

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