APPLETON-WHITTELL RESEARCH RANCH
COORDINATED RESOURCE MANAGEMENT PLAN

The Research Ranch was established in 1968 by the Appleton family as an ecological field station to provide a large scale exclosure by which various land uses and actions in the Southwest could be evaluated. This role, as a control or reference area, creates challenges to land management actions. Each proposed action must be judged not only on the conservation outcome but also on the potential to have adverse impact on the research values for which the field station was established. Effective management for both conservation and research is only possible if all partners are informed and involved. The Research Ranch, approximately 8,000 acres, is a complicated partnership among land owners and federal land administrative agencies: Coronado National Forest (CNF), Bureau of Land Management (BLM), Resolution Copper Mining Co. (RCM), The Research Ranch Foundation (TRRF), The Nature Conservancy (TNC), and National Audubon Society (NAS or Audubon). NAS manages the facility via contractual agreements with each entity. The Research Ranch is a Center/Sanctuary of NAS, administered through the Audubon Arizona state office in Phoenix. Audubon's strategic plan is to achieve conservation results on a broad scale by leveraging the NAS network and engaging diverse people; the Research Ranch is evaluated by NAS for its support of the following conservation concerns: Climate Change, Water, Working Lands and Bird Friendly Communities.

This Coordinated Resource Management Plan (CRMP) constitutes all ownership along with the Natural Resources Conservation Service (NRCS), Arizona Game & Fish Department (AZGF) and US Fish & Wildlife Service (USFWS). Planned practices to meet goals listed in this CRMP may not necessarily be implemented on all parcels. There is no livestock grazing on any portion of the plan, however, there are always ongoing research studies which are not addressed in this plan other than to acknowledge that all management actions must consider the impacts on past, present and future research.

This CRMP will be a living document to capture the history, baseline information, and status of resources to date and will identify areas of conservation and management concern. This plan will provide a framework to align all actions with the mission and goals of the Research Ranch:

<u>Mission:</u> *To formulate, test and demonstrate methods to safeguard and rehabilitate grasslands and related ecosystems, and to assist policy makers and other citizens in the protection and stewardship of native ecosystems, natural resources, and quality of life.*

<u>Goals:</u>

- *Conservation– to be a premier semi-arid grassland that fosters a natural diversity of native species.*
- *Research – to understand how grasslands and related ecosystems function, and to recognize the key elements that safeguard these ecosystems.*
- *Outreach and Education– to advocate for grassland ecosystems by encouraging citizens and policy makers to safeguard and rehabilitate native ecosystems throughout the region.*

Acronyms used in this CRMP

ASLD: Arizona State Trust Land Department
AWRR: Appleton-Whittell Research Ranch
AZGF: Arizona Game and Fish Department
BLM: Bureau of Land Management
CNF: Coronado National Forest
CRMP: Coordinated Resource Management Plan
FS: Forest Service
NAS: National Audubon Society
NRCS: Natural Resources Conservation Service
RCM: Resolution Copper Mining dba Swift Current Land and Cattle Co.
RR: Research Ranch
TNC: The Nature Conservancy
TRRF: The Research Ranch Foundation (formerly The Research Ranch [TRR])
USFS: U.S. Forest Service
USFWS: U.S. Fish and Wildlife Service

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History of the Research Ranch

Humans have influenced the ecology of Southwestern North America for millennia in a succession beginning with Native Americans. Several chronologies have been suggested (Bahre 1977) but in general, it is recognized that Big Game Hunters arrived approximately 10000 bce. Other groups followed such as the Cochise, Preceramic O'otam, the Formative O'otam (Pima), Hohokam, and the Sobaipuri whose occupancy overlapped arrival of Spanish explorers such as Fray Marcos de Niza and Francisco Vasuez de Coronado (1539, 1540) and Padre Eusebio Kino and Captain Juan Mateo Manje (1692). Modern Native Americans relied on gathering of native plants, hunting, and practiced some horticulture on floodplains. Apaches moved into the area near what is currently the Research Ranch in approximately 1680 ce and had largely replaced the indigenous tribes by the end of the 17th century. The warlike Apaches and their allies, plus the introduced disease, malaria, kept settlement by those of European descent at low levels until the 1870s.

Large herbivores such as camels, horses, mastodons and mammoth had largely disappeared by the time the Big Game Hunters arrived or shortly thereafter (Bahre 1977). Although bones have been found in archaeological remains that might be bison (*Bison bison*), the number of sites is small and it is generally accepted that ecological impact of these large herbivores did not extend westward much beyond the Pecos River (Bahre 1977, Truett 1996). Consequently, the grasslands of the area did not co-evolve with the pressures of large herds of large herbivores. Domestic livestock were not thought to have significant impact on the landscape under Spanish or Mexican rule. The Gadsen Purchase (1853/54) transferred ownership from Mexico to the United States, but relatively little changed in respect to land management until after the Civil War when the combined efforts of the American military and westward migration of Americans enabled development of a large livestock industry.

A combination of factors including ignorance of the climate and ecology of the region led to a series of overgrazing events in the late nineteenth and early twentieth centuries which resulted in loss of topsoil, changes in hydrology, and the realization that grasslands/prairies of the Southwest present unique challenges to ranchers. Much of the modern management of the prairies has sought to strike a balance between the economic necessities associated with ranching on a landscape that has little or no natural defense against grazing by domestic livestock.

The area now known as the Research Ranch was homesteaded by numerous individuals including T. B. Titus, Wm. Roth, James L. Finley, Juan Telles, Francis Cuthbert Fenderson, Willard T. Roath, and John D. Riggs (Collins 2008). Many of these homesteaders were already present when the federal lands were surveyed in 1912. These parcels were gradually consolidated. In the mid-20th century Frank and Ariel Appleton purchased the deeded land and grazing allotments of the Clark Ranch and the Swinging H Ranch (approximately 8,000 acres total) and created the Elgin Hereford Cattle Ranch. By the late 1960s the Appletons had determined the land they owned and leased could play a larger purpose than as a small cattle ranch, and developed a vision of an ecological

field station. In 1968 they sold their cattle and converted the ranch into a research facility to serve as a reference area and control site to evaluate large scale land uses, including but not limited to grazing by domestic livestock. The Appletons formed a non-profit organization, The Research Ranch Inc. (TRR), to manage the facility. The Forest Service (FS) and the Arizona State Trust Land Department (ASLD) agreed to suspend grazing on the allotments held by the Appletons.

By the late 1970s the Appletons sought a conservation organization to take over management of the Research Ranch to ensure its continuity into the future. Audubon had become concerned about the decrease in populations of birds that are dependent on grasslands, so accepted management of the Research Ranch in 1980 under conditions outlined in a Memorandum of Agreement between Audubon and The Research Ranch Foundation (TRRF) (previously incorporated as TRR Inc.). The Appletons donated over half of their private land to TRR/TRRF which was then transferred to Audubon. The Whittell Foundation established an endowment within Audubon, distributions from which to be used solely to support the Research Ranch. The name of the ecological field station was changed to the Appleton-Whittell Research Ranch of the National Audubon Society, Inc., (AWRR).

In 1982, Audubon entered into a Memorandum of Understanding with the FS for management of grazing allotments within the Coronado Ranger District known as Chuney #1 and 2. A portion of the FS parcel has been designated the Elgin Research Natural Area. Audubon took over the leases of the ASLD [03-1427, 00-1427, 05-86813] formerly managed by the Appletons/TRR Inc. By 1986 the Bureau of Land Management (BLM) acquired title of the ASLD property within the Research Ranch plus additional property owned by Frank Appleton and signed a Cooperative Agreement with Audubon regarding management of these parcels. Land administered by BLM that is within the boundary of the Research Ranch has been declared the Appleton-Whittell Research Area of Critical Environmental Concern and is included in the Las Cienegas Natural Conservation Area. In 2004, Audubon and The Nature Conservancy of Arizona (TNC) entered into a Memorandum of Understanding assigning management responsibilities of a parcel associated with but disjunct from TNC's Canelo Hills Cienega Preserve. Upon the passing of Ariel Appleton, the Appleton children sold all remaining parcels held with clear title to Resolution Copper Mining Co. (RCM), dba Swift Current Land and Cattle Company. Audubon and RCM developed a management agreement in 2008 regarding these properties.

A map showing current ownership of the various parcels managed by NAS as the Research Ranch can be found in Appendix A; Appendix B shows place names used at AWRR. Additional details of the land use and certain land transactions of the Research Ranch are described in Conrad Bahre's "Land-use History of the Research Ranch, Elgin, Arizona," (1977) and by Glendon Collins in "A History of the Lands in the National Audubon Society's Research Ranch near Elgin, in Santa Cruz County, Arizona," (2008). Copies of each are housed in the Research Ranch library and are available in digital form in the library at http://researchranch.audubon.org.

Geography and Physical Characteristics

Location: AWRR is in southeastern Arizona, USA, and is located in the northeastern part of Santa Cruz County (31º 35' N, 110^0 30' W) (various parcels in Township 21S, Range 18E).

Biogeographic Region: The Research Ranch is in the area often described as the Sky Islands, in which relatively discreet mountain ranges such as the Huachucas, Santa Ritas, and Mustangs jut up from surrounding grassland or deserts. This is a subsection of the Basin and Range province.

Elevation: Locations range from 1417 m (4649 ft) in O'Donnell Canyon on the northern boundary, to 1541 m (5056 ft) on Bald Hill, up to 1570 m (5151 ft) in the southernmost part of the Research Ranch. Elevation at the Headquarters is 1465 m (4761 ft).

Resource Area Designation, Soils and Ecological Sites: The Research Ranch is primarily in Major Land Resource Area 41.1 (16-20" precipitation zone). Soils and ecological sites are described in "Soil and Range Resource Inventory" by Breckenfeld and Robinett (2001), which is available on the Research Ranch website. See also Appendices F, G.

Floristic Classification: When cattle were removed in 1968 and throughout the 1980s the Ranch was considered to be primarily short-grass prairie, but that was an artifact of the cattle grazing. According to Brown (1992), grasslands of the Research Ranch are classified as Plains and Great Basin Grassland or Semidesert Grassland and the southern portion of the Research Ranch is Madrean Evergreen Woodland. More recent studies by Bock and Bock (2000) and McLaughlin et al., (2001) indicate the Research Ranch has closer floristic affinities with Mexico, and classify most grasslands of the Research Ranch as Madrean Mixed Grass Prairie.

Biota: The known biological diversity of AWRR is rich, due to geographic location, management actions, and nearly 50 years of research and monitoring efforts. See Appendix C for species lists.

Precipitation: AWRR is considered to be a semi-arid, or semi-desert ecosystem based on precipitation. The Research Ranch historically experienced a bi-modal precipitation pattern with two relatively wet seasons, July-August and Dec-Feb (60% and 40% of annual mean, respectively) separated by dry periods. Snow occurs some winters with accumulation of up to 8" but quickly melts. Long-term records show an annual mean of 17 - 17.5". Recently this pattern has shifted towards even dryer winters. The annual mean for 2002-2011 was 14.7" with an accumulated shortfall during this time period of nearly 2 feet.

Surface Water: The drainages within AWRR (Lyle, Turkey, O'Donnell, Post, Vaughn) flow ultimately into the Babacomari River; Post and Turkey drain into O'Donnell first. The Babacomari subwatershed is a major contributor to the San Pedro River (approximately 6000 af/yr) which flows northward to the Gila River. Water rights within the entire Gila River watershed are being adjudicated – a long process that began in 1974. The streams within the Research Ranch are classed as ephemeral (surface flow only after seasonal precipitation events) or intermittent (flow primarily below ground surface, with occasional surface flows due to geological patterns or to precipitation events). The only perennial, natural water are the tinajas (rocky pools) in South Post Canyon, however the upper portion of O'Donnell (TNC parcel) is usually marshy year round.

History of Land Management and Conservation Actions

Management actions must be consonant with AWRR's role as an undisturbed natural area envisioned by the founders and signatories, so activities should reduce past negative impacts that modern human actions have caused, protect resources from future degradation and also support the research values for which AWRR was established.

Fire: The historic fire return interval in these grasslands is assumed to be between 7 and 13 years (McClaran & van Devender 1995), but human activities including active fire suppression have altered the natural fire regime and reduced the frequency of natural fires to a level that is unwise for the long-term health of the grasslands. Consequently, prescribed fire may be needed as a management tool on the Research Ranch. A burn plan was developed in the late 1990s but implementation was postponed for several years due to the difficulty of compliance with prescriptions. The Ryan Wildfire of 2002 and the Canelo Wildfire of 2009 together burned virtually all of the land within AWRR (7200 ac and 2300 ac respectively); the original burn plan is no longer valid and should be re-written. Records of all known fires on AWRR (natural, accidental and prescribed) are archived. In 2006 AWRR and the Babacomari Ranch become a recognized Firewise Community, later joined by TNC's Canelo Hills Cienega Preserve and Kyle and Suzanne Wilcox. Annual reporting requirements are, at this time, completed by AWRR. The following have provided technical or financial assistance to AWRR in matters related to fire management:

- BLM
- TNC
- USFWS Partners for Fish and Wildlife Program
- University of Arizona Cooperative Extension
- USFS

Fencing: Arizona is a "fence-out" state, so fences must be constructed and maintained to exclude domestic livestock to protect the integrity of AWRR as an ungrazed control or reference area. Fences, however, do create a "fence-line impact" and present challenges to the free movement of native species. To reduce this impact, over 20 miles of unnecessary interior fences have been removed using primarily volunteer assistance. RCM removed chainlink fencing around the Appleton Bolson Tortoise paddocks in 2013. Perimeter fences have been rebuilt to wildlife friendly standards established by the AZGF wherever possible. Perimeter fence (16.75 miles) has been upgraded in stages with financial support from AWRR operating budget and the following:

- AZ Dept. of Environmental Quality Water Quality Improvement Grant 2002.
- Army Corps of Engineers Mitigation. 2003.
- RMC. 2011.
- NRCS Wildlife Habitat Improvement Program. 2003.
- USFWS Partners for Fish and Wildlife Program. 2005.

Non-native Invasive Species:

Plants: A number of non-native plants have been introduced on what is now the Research Ranch as range improvements, by accident, or in accompaniment to homestead activities.

- Several hundred upland acres, primarily in the NE, were ripped on contour in 1949. Evidence of this ripping is still evident from satellite imagery. Among the species planted in these sites were Lehmann lovegrass, Boer lovegrass and probably Wilman lovegrass. Both Lehmann and Boer have spread dramatically across the uplands.
- Coastal bermudagrass plugs were transplanted onto dams and dikes during the Appleton ranching years (1956-1965). This species has spread downstream of the original sites.
- Populations of Himalayan blackberries at the springs above Finley tank may have been planted by homesteaders.
- Johnsongrass can be found at many riparian sites and also along some roadsides.
- Hoary cress, aka Whitetop is found in O'Donnell Canyon floodplains and may have been introduced in road gravel or brought downstream from offsite.
- Yellow bluestem has been found in the northern portion of AWRR, primarily associated with roads.
- Natal grass plants have found occasionally, but no persistent stands have established.
- Blue panic has been found on dams east of the bunkhouse.
- Onionweed seed was bought in with landscape gravel and is a reoccurring problem near the research complex.

Financial support from the following assisted AWRR in treatment of the above species:

- Arizona State Forestry (pass through from USFS). Invasive Species Grant Program 2014 and Partnership Grant Program 2016.
- RCM: 2012 – present.
- BLM: Challenge Cost Share. 2004.
- University of Arizona Forest Health Program (pass through FS). 2005.
- USFWS Partners for Fish and Wildlife Program. 1999, 2002, 2005.
- NRCS WHIP. 2003.

Animals: Non-native animals have deleterious impacts on native species by direct predation, spread of disease, or degradation of habitat. AWRR takes direct action to remove bullfrogs. Others problematic species are crayfish and non-native fish, but no management actions have been taken other than opportunistic removal. No financial assistance has been received from external sources specifically to remove or control non-native animals.

<u>Water for Wildlife and Native Plants:</u> Past overgrazing had negatively impacted the hydrology of the area resulting in less open water and fewer springs that can provide water and habitat for native species. As compensation, AWRR converted water facilities developed during the ranching era into appropriate and safe wildlife waterers and

wetlands. In certain situations, new wells have been drilled. Depth-to-groundwater for all wells (including domestic) are monitored quarterly by AWRR staff.

The following have provided financial assistance to provide water for wildlife and native plants:

- RCM. 2013. Windmills at both Vaughn Canyon and Appleton Homesite.
- AZGF Conservation Stewardship. 2008. Install Solar Panels on Telles Tank well.
- NRCS WHIP. 2008. Water Harvesting Catchments*
- AGFD Conservation Stewardship. 2006. Replaced windmill head at CNF tank.
- NRCS. 2003. Drill Well at Pronghorn (aka Antelope) Tank.
- Army Corps of Engineers. 2002. Bowjon Wind Generator for Finley Tank.
- Army Corps of Engineers. 2001. Telles Tank wetland rehabilitation.
- USFWS. 2001. Telles Tank Well, solar panel.
- USFWS. 1995. Vaughn Canyon Wetland.

In addition, BLM installed solar arrays at Bald Hill and Pronghorn wells. Contributions in memory of Don and Emroy Kennedy made possible the construction of a small pond south of the Grassland Center, which is now home to endangered Desert Pupfish.

* NRCS WHIP contract allowed installation of 2 unique water harvesting catchments. Roof runoff structure was utilized with gutters that funnel into large storage tanks beside the main office building and at the barn at the headquarters of the ranch. These tanks have short pipelines that then supply water for two wildlife troughs from the barn and the small pond for Desert Pupfish south of the Grassland Center.

Native Species excluding T & E: The primary effort to protect and promote native species beyond construction of perimeter fences has been directed at rehabilitation of sacaton floodplains and earthworks dominated by non-native Coastal Bermudagrass. The following are providing/have provided financial assistance specific to this topic:

- Riester Conservation Foundation, 2008-2016. Sacaton grassland rehabilitation.
- NRCS 2008. Shrub plantings near water catchment project.
- Army Corps of Engineers. Mitigation. 2006. Sacaton grassland rehabilitation
- NRCS Wildlife Habitat Incentives Program. 2003. Sacaton grassland rehabilitation.
- Army Corps of Engineers. 2001. Greenhouse for propagation

Threatened and Endangered Species: Naturally occurring populations of Northern Mexican Gartersnakes and Yellow-billed Cuckoos are being monitored on AWRR, and the following species have been introduced or re-introduced on AWRR with the assistance of entities noted.

- Huachuca Water Umbel at Finley Tank Springs. 2003. USFWS, Desert Botanical Garden, Transplanted by John & Priscilla Titus.
- Desert Pupfish. 2011. Headquarters Pond under a Certificate of Inclusion to a Safe Harbor Agreement issued to AZGF by USFWS. 2014. Bald Hill and Pronghorn tanks. BLM, AZGF, USFWS.
- Chiricahua Leopard Frogs. Bald Hill and Pronghorn tanks (2015) BLM, AZGF, USFWS. Headquarters pond (2016) AZGF, USFWS.

Erosion control: The heavy lifting on erosion was done before Audubon became involved with the Research Ranch. Ranchers, especially the Appletons, recognized the threats of unchecked erosion and took steps to remedy the situation. Large dams and dikes were constructed in Post, O'Donnell, and Turkey Canyons to stop headcutting and small gully plugs were constructed in many smaller drainages to slow water movement. In large part those steps were successful and structures are still functioning as designed. An effort is underway to map the locations of the dozens of erosion control structures/stockponds on AWRR and reconcile with the records on file at the Arizona Department of Water Resources. Current management actions have been reactive and rather small scale – primarily sites where erosion control structures are weakening or where infrastructure such as roads are causing problems. The following are examples:

- A gabion was rebuilt near McDaniel well in 2010, after the 2009 wildfire facilitated water movement in a tributary to Turkey Creek.
- One rock dams were used to slow overland flow waterbars off Research Ranch Road.
- Small rock dams are stopping further incision of ditches on East Mesa and Post Canyon Roads.
- Tree plantings in Post Canyon were largely unsuccessful.
- The first crossing of O'Donnell Canyon by O'Donnell Road was re-positioned.

Financial Support for Other Conservation or Research Related Projects:

- Arizona Department of Commerce. 2010. Photovoltaic arrays at Headquarters and Research Complex.
- Toyota/Together Green Alliance. 2009, 2010. Reduce Carbon Emissions in Rural Communities Education Program.
- NRCS. 2006. Living Gently on the Land Education Program.
- Arizona Department of Environmental Quality. 2002. Wisconsin Mound Septic System for Swinging H Ranchhouse.
- AZGF. 2002. Research on effects of Ryan Wildfire.
- Maytag Family Foundation. 1998. Construction of Grassland Center

The following have been invited to participate in this Coordinated Plan:

Arizona Game & Fish Department

Bureau of Land Management

National Audubon Society

Natural Resources Conservation Service

Resolution Copper Mining dba Swift Current Land & Cattle

The Nature Conservancy

The Research Ranch Foundation

US Fish & Wildlife Service

US Forest Service

Land Status within the Boundary of AWRR

LAND STATUS	**ACRES***
National Audubon Society	1460.7
Bureau of Land Management	3126
Swift Current Land & Cattle Co LLC (RCM)	1000
The Nature Conservancy	70.7
The Research Ranch Foundation (Appletons)	16
U.S. Forest Service	2375
Adverse Deeded	70.6
Total	**8119**

*Note: The acreage figures shown above are approximate. The location of the adverse deeded piece is shown on the ownership map and is not under Audubon's management.

Goals and Objectives of the CRMP

GOALS

The following goals were identified during development of this Ranch Plan.

- Conduct management actions in such a manner that the research values of AWRR are not compromised.
- Maintain or improve species composition, diversity and structure for the desired (native) plant communities needed to protect the land and support the planned land uses which are
    - to provide sanctuary for native biota,
    - to provide a non-disturbed study area for ecological research.
- Enhance the diversity and abundance of native wildlife populations within the area by improvement of habitat, reduction of non-native, predatory species, and introduction of appropriate listed species.
- Enhance watershed stability, ensuring longevity of watershed health, maintaining mosaic vegetative structure in the hilly regions and productive grasslands in the lower regions, while contributing to the overall health of the riparian and cienega areas.
- Aid in soil stabilization in the lower elevations of the ranch to increase flood plain capacity within drainage channels and minimize soil transportation onto neighboring ranches.

OBJECTIVES

The management plan will support the above goals by using the best information and applications available to provide for the following objectives, which constitute the desired condition of the AWRR.

- Utilize AWRR operations and cooperative projects with researchers and partners to enhance public understanding of the positive role the AWRR plays in conserving landscapes, research locations and wildlife habitat.
- Maintain the historic fire return interval in both upland and riparian ecosystems by developing and implementation of appropriate fire planning instruments.
- Prevent encroachment of woody species in the uplands using prescribed fire to enhance herbaceous plant cover.
- Develop thresholds to judge whether woody species must be controlled by mechanical or chemical means.
- Protect selected areas from invasion by non-native, herbaceous plants.
- Create new and maintain existing improvements such as rock dams on selected channels and turn-outs on roads to minimize soil transportation.
- Install/maintain water developments as needed for wildlife.
- Install/maintain pumping plants that are dependent on renewable energy sources.

Outline of Ranch Plan

Overview

One of the primary roles of AWRR is to provide undisturbed reference/control areas by which various land use practices can be evaluated– but an equally important role is that of a sanctuary for native plants and animals. These two roles can, at times, conflict. Every proposed action to preserve or enhance habitat must be examined through the lens of the impact on active research (Appendix D) and past research which may be repeated in the future. Every proposed research project must be evaluated for possible negative impacts on habitat.

Based on the historical research function, AWRR land owning or administrative partners have chosen to keep the current non-grazing management structure with the goal of sustaining natural resources and processes while maintaining the integrity of the facility for ecological research. The partners hope to systematically implement improvements or management practices over a period of years in such a manner as to enhance, rather than to degrade research values.

Responsibility of Plan Participants

This Ranch Management Plan was developed voluntarily and as a good faith effort to implement scheduled infrastructure improvement and to document past coordination in one easily accessible location. AWRR is a non-grazing ranch and will maintain no livestock. Every improvement listed within this plan may not be installed in a specific time frame or may not be installed at all. In the event policies and laws change or funds are not available post development of this management plan, the participants are not obligated to move forward with all planned items. This plan is ***not*** a contract ***nor*** is it considered an "action" as determined by Federal Statutes. Signature of this management plan does not require AWRR or other partners to implement or install practices if they are not feasible in the future.

Benchmark Conditions

"Benchmark Conditions" refer to the existing state of ecological sites and infrastructure. A benchmark inventory of the AWRR was completed during 2000-2001 by Daniel Robinett, NRCS and Donald Breckenfeld, NRCS. The ranch was again re-inventoried in 2014-2015 by Kristen Egen, Katie Cline, Alisha Phipps, Emilio Carrillo, and Wilma Renkin of NRCS and Linda Kennedy, AWRR. James Heitholt, Ed Halloway and Steve Bluemer, USFS, assisted on the USFS land. Field assistance was also provided by Roger Cogan of AWRR, and private consultants who donated their time, Jim Koweek and Daniel Robinett. Benchmark conditions are described in Appendices E, F and G. A climate analysis can be found in Appendix H and the location of vegetation monitoring locations is shown in Appendix I.

Range Improvements

Current Range Improvements

Current range improvements consist of wells, pumping plants, wildlife watering facilities, ponds, a developed spring, fencelines, non-native vegetation management, road maintenance, and check dams for erosion control. All recent improvements have been

mapped and may or may not be of record in the BLM, USFS or other owner's files. A list of improvements can be found in Appendix E and shown on the map in Appendix J.

Proposed Improvements

Goals for improvements for the AWRR are listed here. It is understood that funding over and above the Research Ranch operating budget must be sought in order to achieve some of the following goals.

Goal: All management actions must be conducted in such a manner that the research values of AWRR are not degraded.

- AWRR and partners will collaborate and cooperate to accomplish this goal.

Goal: Maintain or improve species composition, diversity and structure for the desired (native) plant communities needed to protect the land and support the planned land uses which are: 1) to provide a sanctuary for native biota and 2) to provide non-disturbed study areas for ecological research.

- Chemically treat defined areas. Maintain as needed.
    - Target species include Lehmann Lovegrass, Boer Lovegrass, Yellow Bluestem, Whitetop, and other non-native, invasive plants.
- Develop and implement a Fire Management Plan.

Goal: Enhance the diversity and abundance of native wildlife populations within the area by improvement of habitat, reduction of non-native, predatory species and introduction of appropriate listed species. Owner or administrative entity of each site is shown in parentheses.

- Rehabilitate wetland at Finley Tank. (RCM).
- Enhance wetland habitat at McDaniel Well. (Audubon).
- Eliminate non-native Green Sunfish from Post Canyon drainage. (BLM).
- Eliminate non-native Bullfrogs from all wetland, riparian and wildlife water sites.
- Establish breeding populations of appropriate listed species at:
    - Telles Tank (Audubon)
    - Finley Tank (RCM)
    - McDaniel Wetlands (Audubon)
    - Appleton Tank (RCM)
    - South Post Tinijas (BLM)
    - Headquarters Pond (Audubon)

Goal: Enhance watershed stability, ensure longevity of watershed health, maintain mosaic vegetative structure in the hilly regions and productive grasslands in the lower regions, while contributing to the overall health of the riparian and cienega areas.

- Cooperate in development of O'Donnell Watershed Plan.

Goal: Aid in soil stabilization in the lower elevations of the Research Ranch to increase flood plain capacity within drainage channels and minimize soil transportation onto neighboring ranches.

Timeline

AWRR is an active research facility hosting 25-40 research and monitoring projects on the ground annually (Appendix D); this must be taken into account whenever scheduling maintenance or improvement activities. Consequently, improvements or maintenance efforts might not be able to be conducted on a specific timeline. It would be optimal if at least one or two planned improvements listed in the Range Improvement section would be completed yearly. Financial assistance may be sought by Audubon to aid in installment of infrastructure through private, state and federal grants.

- Project designs for three wetland enhancements are being evaluated by USFWS and may be funded through their Partners in Fish and Wildlife program. One is a rehabilitation of the tank at Finley (RCM) and two would be at the McDaniel pond site (Audubon).
- There is a critical need for a Fire Management Plan – one grant to support this need is outstanding.
- One grant from Arizona State Forestry to treat non-native invasive plant species is ongoing (Audubon).

Fire Philosophy

Fires created an annually shifting patchwork of re-sprouting and mature grasses throughout the area before Anglo settlement. The specific impacts within any burn patch depended on soils; species present; winds; precipitation and temperatures before, during, and after burns; season and frequency of the fires; fuel accumulation; etc. Without periodic fires, southeast Arizona's grasslands might never have established, or would have succeeded to shrubland (dominated by woody plants) or other communities, centuries ago. Before Anglo settlement, most areas were naturally ignited every five to twenty years. Mesas probably burned more often, while canyons and riparian areas probably burned less often (estimates are based on the annual rings of pine trees in surrounding mountains, as the oak trees associated with these grasslands produce very indistinguishable annual rings). Under the fire suppression policies of the past 100 years, many grasslands in this area have become shrub savanna or mesquite woodlands and their grassland wildlife has been replaced by species adapted to woody habitats.

Planned fires are carried out only under a set of strict conditions, called the fire prescription, which incorporates the type of fuel, the topography of the land, the relative moisture of the air, the wind direction, wind speed, and other factors. Prescribed fires actually reduce the risk and impact of wildfire by reducing fuel loads (accumulated dry material) in problematic areas.

On AWRR, management preference for naturally occurring fires or accidental fires within the fire prescription would be to let them burn unimpeded unless they posed a risk to humans or structures. In recognition that structures are at risk due to wildfire and that the primary responsibility to protect structures lies with the landowners, AWRR and the Babacomari Cattle Ranch FireWise Community follow defensible space guidelines.

Fires on AWRR have provided data for many scientific publications. Information on timing and location of fires within AWRR is available upon request by partners.

Current Resources

Vegetation types on AWRR fall within the 41AZ Southern Arizona Basin and Range Major Land Resource Areas (MLRAs). There are two Common Resource Areas (CRAs) on the ranch; they are: 41.1AZ Mexican Oak – Pine Forest and Oak Savanna (16-20“ precipitation zone) and the 41.3AZ Chihuahuan – Sonoran Semidesert Grasslands (12-16“ precipitation zone) with most falling in the former (Appendix F). A list of plant species (Flora) can be found in Appendix C.

Descriptions of the ecological sites, MLRAs and CRAs on AWRR are found in Appendix F and G. Ecological sites that were mapped include: Shallow Hills (41.1), Loamy Hills (41.1), Limy Slopes (41.1), Loamy Bottom, swales (41.1 and 41.3), Loamy Bottom, subirrigated (41.1), Clayey Hills (41.3), Clayey Bottom (41.3), Limestone Hills (41.1), Loamy Upland (41.1) and Sandy Loam Upland (41.1). Data were collected in 2000-2001 by Daniel Robinett of NRCS during the course of a soil survey update being conducted by Don Breckenfeld of NRCS. This report included 32 sites; information from this report can be found in Appendix G. Fourteen of these sites were reassessed in 2014-2015 by NRCS and others. A summary of the sites and changes are also found are in Appendix G. Annual monitoring is conducted by AWRR. A comparison of the 2002, 2014 and monitoring data is also included in Appendix G.

Vegetation Monitoring Plan

Upland Vegetation Monitoring transects have been established on AWRR in 2003 and 2004 based in large part on the 2000-2001 inventory. There are currently 18 sites with at least 15 read annually by the AWRR staff. Summary data is available to all participants within this plan upon request. Riparian vegetation transects were established in 2008 as part of a research grant from Arizona Department of Water Resources and will serve as monitoring sites (5 yr interval). Transects to monitor mesquite encroachment on North Mesa were established in 2010 (to be read on 5 yr intervals). Appendix I is a map of the primary vegetation monitoring sites.

Methods and Responsibilities:

Monitoring data collected on transects established on AWRR include but are not limited to:

- ***Actual Use***: The AWRR will record any use data throughout the year describing any noted wildlife use and trespass cattle if applicable. This will be noted in the annual summary.
- ***Climate***: Permanent rain gauges are set and rainfall records are archived at AWRR. Precipitation at Headquarters is shared at: http://rainlog.org/usprn/html/main/maps.jsp. USDA and NOAA also maintain stations. Local climate conditions are described in Appendix H.
- ***Trend***: Trend is determined using the Pace Frequency Method for upland vegetation. Belt transects are used at some mesquite sites and riparian areas. Green Line is also used in riparian areas. Trend data will be collected by AWRR.
- ***Photographs***: Photographs are taken at each location. General views of the site may serve as the appropriate record of trend.
- ***Cover***: Pace Frequency frames are used to estimate cover at each upland vegetation transect (ex.: 200 frames X 3 points = 600 total points per transect).

Plan Approval

We, the undersigned, concur with the Appleton-Whittell Research Ranch Management Plan and will act to implement it to the best of our ability.

Signature	*Date*
Linda Kennedy	Oct 26, 2016
Appleton-Whittell Research Ranch of the National Audubon Society, Inc.	**Linda Kennedy Director**

Plan Approval

We, the undersigned, concur with the Appleton-Whittell Research Ranch Management Plan and will act to implement it to the best of our ability.

Signature	*Date*
	10/26/16
Natural Resources Conservation Service **Tucson Field Office**	**Kristen Egen** **District Conservationist**

USDA

Plan Approval

We, the undersigned, concur with the Appleton-Whittell Research Ranch Management Plan and will act to implement it to the best of our ability.

Signature	*Date*
C. Kinsey	2/7/17
Sierra Vista Ranger District **Coronado National Forest**	**Celeste Kinsey** **District Ranger**

Plan Approval

We, the undersigned, concur with the Appleton-Whittell Research Ranch Management Plan and will act to implement it to the best of our ability.

SWIFT CURRENT LAND & CATTLE LLC

Swift Current Land & Cattle LLC
An Arizona limited liability company

By: Resolution Copper Company, as Manager
and not on its own behalf.

By: _____

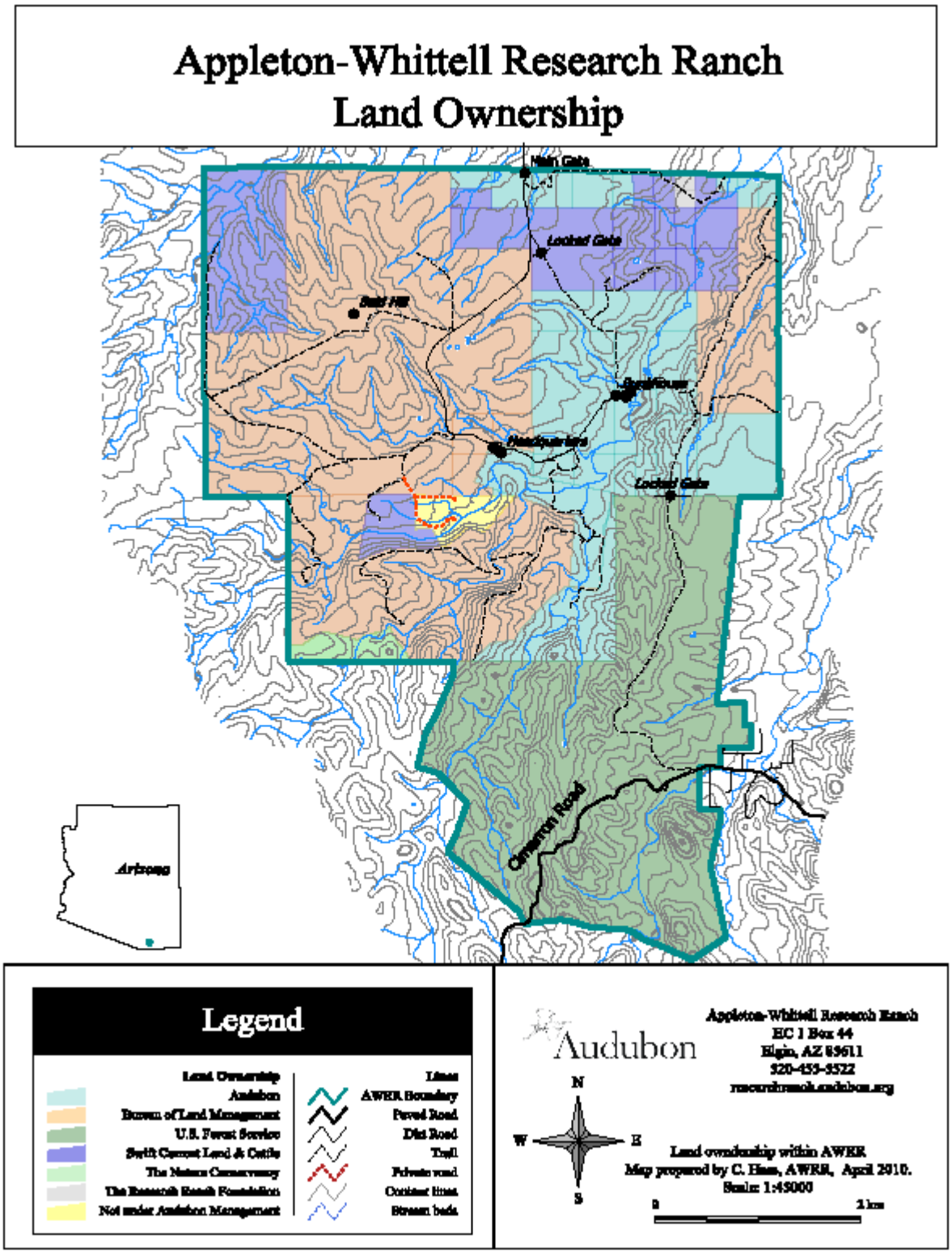
Print Name: STERLING HUNDLEY

Dated: 11/29/16

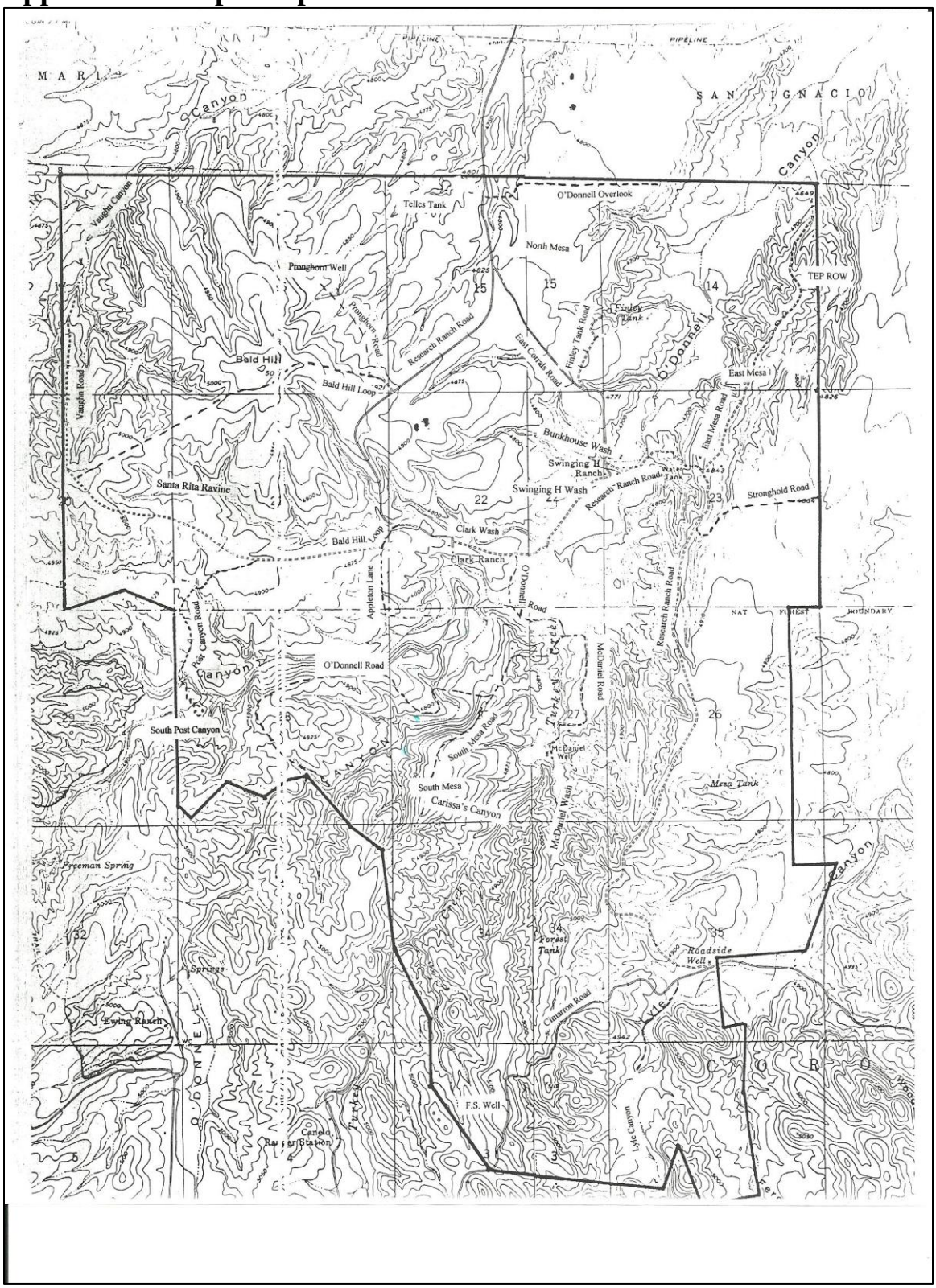
Appendices:

A: Ownership Map
B: Topo Map with Place Names
C: Biota
    Plants
    Birds
    Mammals
    Herpetofauna
        Reptiles
        Amphibians
    Fishes
    Invertebrates
        Butterflies
        Grasshoppers
D: Summary of Active Research/Baseline Projects – 2015
E: Existing Improvements and Depth-to-Groundwater Examples
F: Ecosystems and Their Components
G: Benchmark Inventory Assessments
H: Climate
I: Map of Monitoring Transects
J: Conservation Plan Map with Current Structural Improvements

Appendix A: Ownership



Appendix B: Topo Map with Place Names



Appendix C: Biota

The known biodiversity of AWRR is extensive, especially considering the rather limited variation in elevation within the sanctuary. Habitat protection and enhancement play a role, but also of tremendous importance is the depth and breadth of the research/monitoring program – there is no overriding focal area of research, thus scientists from a range of disciplines contribute their findings.

Plants: 612 species-rank vascular plants have been found on AWRR as of June 15, 2016, based on published floras (McLaughlin et al., 2001; Geiger et al., 2011), voucher records on SEINet and subsequent collections. Included is the Huachuca Water Umbel, a federally listed species which was introduced by USFWS at Finley Springs.

Birds: As of April, 2016, there have been 261 species documented on AWRR. In addition to decades of hypothesis driven research, there are three annual efforts: Christmas Bird Count, Important Bird Area transects, and Yellow-billed Cuckoo surveys. A year-round survey of the entire sanctuary has been ongoing since 2013.

Mammals: The checklist of mammals of AWRR includes 48 native species, and includes mule and white tail deer, four species of skunk, pronghorn, mountain lion, bobcat, coati, and several species of bats and rodents.

Herpetofauna:

Reptiles: To date on AWRR there have been 43 species of reptile reported: 20 species of lizard (9 genera); 21 species of snake (12 genera), including 4 rattlesnake species and the Northern Mexican Gartersnake, which is federally listed as threatened; and 2 species of turtle, both of which are species of special concern in Arizona.

Amphibians: AWRR provides habitat for 11 species of 7 genera. One of these species is non-native, the American Bullfrog, which is actively eliminated wherever found under the auspices of a Scientific Collecting License issued annually by AZGF. Arizona tree frogs were first documented on AWRR in 2015 and is under consideration for possible listing as threatened under the Endangered Species Act. Chiricahua Leopard Frogs had been extirpated from AWRR in the mid 1980s but were reintroduced in 2015.

Fishes: Seven species have been documented on AWRR, including the federally listed Rio Sonoyta Pupfish and Desert Pupfish. The Rio Sonoyta population was introduced into Finley Tank in the 1970s, into the Headquarters pond in 2002 and repatriated by AZGF into an appropriate watershed before Desert Pupfish were introduced in 2011. Non-native species include mosquitofish, large-mouthed bass (extirpated) and green sunfish.

Invertebrates: There have been 104 species of butterflies, moths and skippers and 46 grasshopper species reported on AWRR. Numerous studies on other insects have been published, but no compilation of composition has been conducted. A species new to science, *Acordulacera whittelli*, was discovered on AWRR; the specific epithet reflects the sanctuary.

Flora of the Appleton-Whittell Research Ranch

Locality: (31.572833, -110.498333)

Updated: June 19, 2016 by Linda Kennedy

Based on published floras (McLaughlin et al., 2001; Geiger et al., 2011), records from SEINET and accessions or photo-documentation since last published flora

Taxonomy and nomenclature per SEINET or USDA Plants Database

Families: 82
Genera: 322
Species: 612 (species rank)

ACANTHACEAE
Carlowrightia arizonica - Arizona wrightwort
Dyschoriste decumbens - spreading snakeherb

ADOXACEAE
Sambucus nigra - European black elder

AMARANTHACEAE
Amaranthus albus - prostrate pigweed
Amaranthus palmeri – carelessweed
Amaranthus powellii - Powell's amaranth
Amaranthus torreyi - Torrey's amaranthus
Atriplex canescens - fourwing saltbush
Atriplex elegans var. fasciculata - wheelscale saltbush
Chenopodium berlandieri - pitseed goosefoot
Chenopodium berlandieri var. sinuatum - pitseed goosefoot
Chenopodium fremontii - Fremont's goosefoot
Chenopodium graveolens - fetid goosefoot
Chenopodium neomexicanum - New Mexico goosefoot
Chenopodium neomexicanum var. neomexicanum - New Mexico goosefoot
Chenopodium neomexicanum var. palmeri
Chenopodium watsonii - Watson's goosefoot
Froelichia arizonica - Arizona snakecotton
Gomphrena caespitosa - tufted globe amaranth
Gomphrena nitida - pearly globe amaranth
Gomphrena sonorae - Sonoran globe amaranth
Guilleminea densa - small matweed
Salsola kali - Russian thistle

AMARYLLIDACEAE

Zephyranthes longifolia - copper zephyrlily

ANACARDIACEAE

Rhus aromatica - fragrant sumac
Rhus microphylla - littleleaf sumac
Rhus trilobata - skunkbush sumac
Rhus virens var. choriophylla - evergreen sumac
Toxicodendron rydbergii - western poison ivy

APIACEAE

Eryngium heterophyllum - Wright's eryngo
Lilaeopsis schaffneriana ssp. recurva – Huachuca Water Umbel
Spermolepis echinata - bristly scaleseed

APOCYNACEAE

Apocynum cannabinum - Indianhemp
Asclepias asperula - spider milkweed
Asclepias asperula subsp. asperula - spider milkweed
Asclepias asperula subsp. capricornu
Asclepias brachystephana - bract milkweed
Asclepias engelmanniana – Engelmann's milkweed
Asclepias involucrata - dwarf milkweed
Asclepias macrotis - longhood milkweed
Asclepias nummularia - tufted milkweed
Asclepias nyctaginifolia - Mojave milkweed
Asclepias quinquedentata - slimpod milkweed
Asclepias subverticillata - horsetail milkweed
Asclepias uncialis - wheel milkweed
Funastrum hirtellum – hairy milkweed
Macrosiphonia brachysiphon - Huachuca Mountain rocktrumpet
Sarcostemma crispum - climbing milkweed (generic)

ARACEAE

Lemna minor - common duckweed
Lemna minuta - least duckweed

ASPARAGACEAE

Agave palmeri - Palmer's century plant
Agave parryi var. huachucensis
Asparagus officinalis - garden asparagus
Dasylirion wheeleri - common sotol
Dichelostemma pulchellum - bluedicks
Echeandia flavescens - Torrey's craglily

Milla biflora - Mexican star
Nolina microcarpa - sacahuista
Yucca elata var. elata - soaptree yucca
Yucca schottii - Mountain Yucca

ASTERACEAE

Acourtia nana - dwarf desertpeony
Acourtia thurberi - Thurber's desertpeony
Acourtia wrightii - brownfoot
Adenophyllum porophyllum ssp. porophyllum – poreleaf dogweed
Ambrosia confertiflora - slimleaf bursage
Ambrosia psilostachya - Cuman ragweed
Artemisia campestris var. scouleriana - field sagewort
Artemisia dracunculus - tarragon
Artemisia ludoviciana subsp. albula - white sagebrush
Artemisia ludoviciana subsp. sulcata - white sagebrush
Aster falcatus var. crassulus - white prairie aster
Aster subulatus var. ligulatus - southern annual saltmarsh aster
Baccharis bigelovii - Bigelow's false willow
Baccharis neglecta - Rooseveltweed
Baccharis pteronioides - yerba de pasmo
Baccharis salicifolia - water wally
Baccharis sarothroides - desertbroom
Baccharis thesioides - Arizona baccharis
Bahia absinthifolia - hairyseed bahia
Bahia absinthifolia var. absinthifolia - hairyseed bahia
Bahia absinthifolia var. dealbata - Dealbata's bahia
Bahia dissecta - ragleaf bahia
Baileya multiradiata - desert marigold
Berlandiera lyrata - lyreleaf greeneyes
Bidens aurea - Arizona beggarticks
Bidens bigelovii - Bigelow's beggarticks
Bidens ferulifolia - Arizona beggarticks
Bidens leptocephala - fewflower beggarticks
Brickellia betonicifolia - betonyleaf brickellbush
Brickellia californica - brickell-bush
Brickellia eupatorioides var. chlorolepis - false boneset
Brickellia floribunda - Chihuahuan brickellbush
Brickellia venosa - veiny brickellbush
Carminatia tenuiflora - plumeweed
Carphochaete bigelovii - Bigelow's bristlehead
Chaetopappa ericoides - rose heath
Chrysothamnus nauseosus - rubber rabbitbrush

Cirsium arizonicum - Arizona thistle
Cirsium neomexicanum - New Mexico thistle
Cirsium ochrocentrum - yellowspine thistle
Conoclinium greggii - palmleaf thoroughwort
Conyza canadensis - Canadian horseweed
Cosmos parviflorus - southwestern cosmos
Dyssodia papposa - fetid marigold
Erigeron arisolius - arid throne fleabane
Erigeron colomexicanus - running fleabane
Erigeron divergens - spreading fleabane
Erigeron divergens var. cinereus - running fleabane
Erigeron flagellaris - trailing fleabane
Erigeron neomexicanus - New Mexico fleabane
Gaillardia pinnatifida - red dome blanketflower
Gaillardia pulchella - firewheel
Gamochaeta purpurea - spoonleaf purple everlasting
Gnaphalium canescens - Wright's cudweed
Gnaphalium chilense - cottonbatting plant
Gnaphalium leucocephalum - white cudweed
Gnaphalium luteoalbum - Jersey cudweed
Gnaphalium stramineum - cottonbatting plant
Guardiola platyphylla - Apache plant
Gutierrezia microcephala - threadleaf snakeweed
Helenium thurberi - Thurber's sneezeweed
Helianthus annuus - common sunflower
Helianthus petiolaris - prairie sunflower
Heliomeris longifolia var. annua - longleaf false goldeneye
Heliomeris multiflora - showy goldeneye
Heliopsis parvifolia - mountain oxeye
Heterosperma pinnatum - wingpetal
Heterotheca subaxillaris - camphorweed
Hymenoclea monogyra - burrobush
Hymenothrix wislizeni - Trans-Pecos thimblehead
Isocoma coronopifolia - burroweed
Isocoma tenuisecta - burroweed
Lactuca serriola - prickly lettuce
Laennecia coulteri - Coulter's horseweed
Laennecia sophiifolia - leafy marshtail
Lasianthaea podocephala - San Pedro daisy
Lygodesmia ramosissima – Pecos River skeletonplant
Machaeranthera gracilis - slender goldenweed
Machaeranthera pinnatifida subsp. pinnatifida - spiny haplopappus
Machaeranthera tagetina - mesa tansyaster

Machaeranthera tanacetifolia - tanseyleaf tansyaster
Malacothrix fendleri - Fendler's desertdandelion
Melampodium longicorne - Arizona blackfoot
Melampodium sericeum - rough blackfoot
Melampodium strigosum - shaggy blackfoot
Microseris lindleyi - silver puffs
Pectis filipes - five-bract cinchweed
Pectis filipes var. subnuda - fivebract cinchweed
Pectis imberbis - beardless cinchweed
Pectis longipes - mat cinchweed
Pectis prostrata – spreading cinchweed
Pectis rusbyi - Rusby's cinchweed
Porophyllum ruderale var. macrocephalum - yerba porosa
Pyrrhopappus multicaulis - smallflower desert-chicory
Rafinesquia neomexicana - New Mexico plumeseed
Ratibida columnifera - upright prairie coneflower
Sanvitalia abertii - Albert's creeping zinnia
Schkuhria anthemoidea var. wrightii - Wright's false threadleaf
Senecio flaccidus var. douglasii
Senecio flaccidus var. flaccidus - threadleaf ragwort
Solidago velutina - threenerve goldenrod
Sonchus asper - spiny sowthistle
Stephanomeria pauciflora - brownplume wirelettuce
Stephanomeria thurberi - Thurber's wirelettuce
Thelesperma longipes - longstalk greenthread
Thelesperma megapotamicum - Hopi tea greenthread
Thymophylla acerosa - pricklyleaf dogweed
Tragopogon dubius - yellow salsify
Verbesina encelioides - golden crownbeard
Verbesina rothrockii - Rothrock's crownbeard
Viguiera cordifolia - heartleaf goldeneye
Viguiera dentata - toothleaf goldeneye
Viguiera dentata var. dentata - toothleaf goldeneye
Xanthium strumarium var. canadense - rough cocklebur
Xanthocephalum gymnospermoides - San Pedro matchweed
Zinnia acerosa - desert zinnia
Zinnia grandiflora - Rocky Mountain zinnia
Zinnia peruviana - Peruvian zinnia

BIGNONIACEAE
Chilopsis linearis subsp. linearis

BORAGINACEAE
Cryptantha pusilla - low cryptantha

Heliotropium fruticosum - Key West heliotrope
Lithospermum cobrense - smoothstone stoneseed
Lithospermum incisum - narrowleaf stoneseed
Phacelia arizonica - Arizona phacelia
Phacelia bombycina - Mangas Spring phacelia
Phacelia coerulea - caterpillar weed
Plagiobothrys arizonicus - Arizona popcornflower

BRASSICACEAE

Cardaria draba - globed-podded hoarycress or whitetop
Descurainia pinnata - western tansymustard
Draba cuneifolia - wedgeleaf draba
Lepidium lasiocarpum - shaggyfruit pepperweed
Lepidium thurberi - Thurber's pepperweed
Lesquerella fendleri - Fendler's bladderpod
Pennellia micrantha - mountain mock thelypody
Rorippa nasturtium-aquaticum - watercress
Schoenocrambe linearifolia - slimleaf plainsmustard
Sisymbrium irio - London rocket

CACTACEAE

Cylindropuntia spinosior - walkingstick cactus
Echinocereus fendleri - pinkflower hedgehog cactus
Echinocereus rigidissimus - rainbow hedgehog cactus
Escobaria vivipara - spinystar
Mammillaria heyderi var. macdougalii - Macdougal's nipple cactus
Opuntia chlorotica - dollarjoint pricklypear
Opuntia engelmannii - cactus apple
Opuntia laevis – tulip prickleypear
Opuntia macrocentra - purple pricklypear
Opuntia phaecantha – major pricklypear
Sclerocactus intertextus var. intertextus - white fishhook cactus

CAMPANULACEAE

Lobelia cardinalis - cardinalflower
Lobelia fenestralis - fringeleaf lobelia
Triodanis perfoliata var. perfoliata - clasping Venus' looking-glass

CANNABACEAE

Celtis laevigata var. reticulata - netleaf hackberry

CARYOPHYLLACEAE

Arenaria lanuginosa subsp. saxosa - spreading sandwort
Drymaria glandulosa - Fendler's drymary

Drymaria molluginea - slimleaf drymary
Drymaria sperguloides - slimleaf drymary
Silene antirrhina - sleepy silene

CLEOMACEAE
Polanisia dodecandra var. trachysperma - sandyseed clammyweed

COMMELINACEAE
Commelina dianthifolia - birdbill dayflower
Tradescantia pinetorum - pinewoods spiderwort

CONVOLVULACEAE
Convolvulus equitans - Texas bindweed
Dichondra brachypoda - New Mexico ponysfoot
Evolvulus arizonicus - wild dwarf morning-glory
Evolvulus nuttallianus - shaggy dwarf morning-glory
Evolvulus sericeus var. sericeus - silver dwarf morning-glory
Ipomoea capillacea - purple morning-glory
Ipomoea costellata - crestrib morning-glory
Ipomoea cristulata - Transpecos morning-glory
Ipomoea hederacea - ivyleaf morning-glory
Ipomoea longifolia – pinkthroat morning-glory
Ipomoea purpurea - tall morning-glory
Ipomoea thurberi - Thurber's morning-glory

CUCURBITACEAE
Apodanthera undulata - melon loco
Cucurbita digitata - fingerleaf gourd
Cucurbita foetidissima - Missouri gourd
Cucurbita palmata - coyote gourd

CUPRESSACEAE
Cupressus arizonica - Arizona cypress
Juniperus coahuilensis - redberry juniper
Juniperus deppeana - alligator juniper

CYPERACEAE
Bulbostylis funckii - Funck's hairsedge
Carex lanuginosa - woolly sedge
Carex praegracilis - clustered field sedge
Carex spissa - San Diego sedge
Cyperus esculentus - yellow nutsedge
Cyperus mutisii - Mutis' flatsedge
Cyperus odoratus - fragrant flatsedge
Cyperus pallidicolor - pallid flatsedge

Cyperus sphaerolepis - Rusby's flatsedge
Cyperus squarrosus - bearded flatsedge
Eleocharis montevidensis - sand spikerush
Eleocharis palustris - common spikerush
Eleocharis rostellata - beaked spikerush
Scirpus acutus - great bulrush
Scirpus maritimus - Alkali Bulrush

EPHEDRACEAE

Ephedra californica - California jointfir
Ephedra trifurca - longleaf jointfir

EQUISETACEAE

Equisetum laevigatum - smooth horsetail

ERICACEAE

Arctostaphylos pungens - pointleaf manzanita

EUPHORBIACEAE

Acalypha lindheimeri - shrubby copperleaf
Acalypha neomexicana - New Mexico copperleaf
Acalypha ostryifolia - pineland threeseed mercury
Chamaesyce albomarginata - whitemargin sandmat
Chamaesyce dioica - royal sandmat
Chamaesyce hirta - pillpod sandmat
Chamaesyce hyssopifolia - hyssopleaf sandmat
Chamaesyce revoluta - threadstem sandmat
Chamaesyce serpyllifolia - thymeleaf sandmat
Chamaesyce stictospora - slimseed sandmat
Croton pottsii - leatherweed
Croton pottsii var. pottsii - leatherweed
Euphorbia bilobata - blackseed spurge
Euphorbia exstipulata - squareseed spurge
Jatropha macrorhiza var. septemfida - ragged nettlespurge
Poinsettia dentata - toothed spurge
Poinsettia heterophylla - Mexican fireplant
Poinsettia radians - sun spurge
Tragia laciniata - Sonoita noseburn
Tragia ramosa - branched noseburn

FABACEAE

Acacia angustissima - prairie acacia
Acacia angustissima var. filicioides
Acacia constricta - whitethorn acacia

Amorpha fruticosa - desert false indigo
Astragalus allochrous - halfmoon milkvetch
Astragalus arizonicus - Arizona milkvetch
Astragalus humistratus var. sonorae - groundcover milkvetch
Astragalus mollissimus var. bigelovii - woolly locoweed
Astragalus nothoxys - sheep milkvetch
Astragalus nuttallianus var. nuttallianus
Astragalus thurberi - Thurber's milkvetch
Calliandra eriophylla - fairyduster
Calliandra humilis var. humilis - dwarf stickpea
Calliandra humilis var. reticulata - dwarf stickpea
Chamaecrista nictitans subsp. nictitans - partridge pea
Chamaecrista nictitans var. leptadenia - partridge pea
Cologania angustifolia - longleaf cologania
Coursetia caribaea var. sericea - anil falso
Crotalaria pumila - low rattlebox
Dalea albiflora - whiteflower prairie clover
Dalea brachystachya - Fort Bowie prairie clover
Dalea candida - white prairie clover
Dalea candida var. oligophylla - white prairie clover
Dalea exigua - Chihuahuan prairie clover
Dalea formosa - featherplume
Dalea grayi - Gray's prairie clover
Dalea jamesii - James' prairie clover
Dalea lachnostachys - glandleaf prairie clover
Dalea nana - dwarf prairie clover
Dalea nana var. carnescens - dwarf prairie clover
Dalea nana var. nana - dwarf prairie clover
Dalea neomexicana var. neomexicana - downy prairie clover
Dalea pogonathera - bearded prairie clover
Dalea versicolor var. sessilis - oakwoods prairie clover
Desmanthus cooleyi - Cooley's bundleflower
Desmodium batocaulon - San Pedro ticktrefoil
Desmodium cinerascens - spiked ticktrefoil
Desmodium grahamii - Graham's ticktrefoil
Desmodium neomexicanum - New Mexico ticktrefoil
Desmodium rosei - Rose's ticktrefoil
Indigofera sphaerocarpa - Sonoran indigo
Lathyrus eucosmus - bush vetchling
Lotus greenei - Greene's bird's-foot trefoil
Lotus humistratus - foothill deervetch
Lotus oroboides - New Mexico bird's-foot trefoil
Lotus wrightii - Wright's deervetch

Lupinus brevicaulis - shortstem lupine
Lupinus concinnus - bajada lupine
Macroptilium gibbosifolium - variableleaf bushbean
Marina calycosa - San Pedro false prairie-clover
Melilotus albus
Melilotus officinalis - yellow sweetclover
Mimosa aculeaticarpa var. biuncifera - catclaw mimosa
Mimosa dysocarpa - velvetpod mimosa
Mimosa grahamii var. grahamii – Graham's mimosa
Phaseolus acutifolius var. tenuifolius - tepary bean
Phaseolus ritensis - Santa Rita Mountain bean
Prosopis glandulosa var. torreyana - western honey mesquite
Prosopis juliflora
Prosopis velutina - mesquite
Psoralidium tenuiflorum - slimflower scurfpea
Rhynchosia senna var. texana - Texas snoutbean
Senna bauhinioides - twinleaf senna
Tephrosia tenella - red hoary-pea

FAGACEAE
Quercus arizonica - Arizona Oak
Quercus emoryi - Emory oak
Quercus grisea - gray oak
Quercus oblongifolia - Mexican blue oak
Quercus turbinella - Sonoran scrub oak

FOUQUIERIACEAE
Fouquieria splendens - ocotillo

GARRYACEAE
Garrya wrightii - Wright's silktassel

GENTIANACEAE
Centaurium calycosum - Arizona centaury

GERANIACEAE
Erodium cicutarium subsp. cicutarium - redstem stork's bill

GROSSULARIACEAE
Ribes aureum - golden currant

IRIDACEAE
Sisyrinchium demissum - stiff blue-eyed grass

JUGLANDACEAE
Juglans major - Arizona walnut

JUNCACEAE
Juncus balticus - Baltic rush
Juncus interior - inland rush
Juncus interior var. arizonicus - Arizona rush
Juncus mexicanus - Mexican rush
Juncus saximontanus - Rocky Mountain rush

KRAMERIACEAE
Krameria erecta - littleleaf ratany
Krameria lanceolata - trailing krameria

LAMIACEAE
Hedeoma dentata - dentate falsepennyroyal
Hedeoma drummondii - Drummond's false pennyroyal
Marrubium vulgare - horehound
Mentha canadensis - Field mint
Monarda citriodora subsp. austromontana - lemon beebalm
Salvia subincisa - sawtooth sage
Scutellaria potosina - Mexican skullcap
Scutellaria tessellata - skullcap
Stachys coccinea - scarlet hedgenettle
Tetraclea coulteri - Coulter's wrinklefruit (*Clerodendrum coulteri*)
Trichostema arizonicum - Arizona bluecurls

LILIACEAE
Calochortus ambiguus - doubting mariposa lily
Calochortus kennedyi - desert mariposa lily

LINACEAE
Linum puberulum - plains flax

LOASACEAE
Mentzelia albicaulis - whitestem blazingstar
Mentzelia isolata - isolated blazingstar
Mentzelia multiflora - Adonis blazingstar

LYTHRACEAE
Cuphea wrightii - Wright's waxweed
Lythrum californicum - California loosestrife

MALPIGHIACEAE
Aspicarpa hirtella - chaparral asphead

MALVACEAE

Anoda cristata - crested anoda
Malva parviflora - cheeseweed mallow
Malvella lepidota – scurfy mallow
Rhynchosida physocalyx - buffpetal
Sida abutifolia - spreading fanpetals
Sida neomexicana - New Mexico fanpetals
Sida spinosa - prickly fanpetals
Sphaeralcea angustifolia var. cuspidata - copper globemallow
Sphaeralcea laxa - caliche globemallow

MARTYNIACEAE

Proboscidea parviflora - doubleclaw

MOLLUGINACEAE

Mollugo verticillata - green carpetweed

MONTIACEAE

Calandrinia ciliata - fringed redmaids

MORACEAE

Morus microphylla - Texas mulberry

NYCTAGINACEAE

Allionia incarnata - trailing windmills
Boerhavia coccinea - scarlet spiderling
Boerhavia coulteri - Coulter's spiderling
Boerhavia erecta - erect spiderling
Boerhavia purpurascens - purple spiderling
Mirabilis coccinea - scarlet four o'clock
Mirabilis linearis - narrowleaf four o'clock
Mirabilis longiflora - sweet four o'clock

OLEACEAE

Fraxinus velutina - velvet ash

ONAGRACEAE

Calylophus hartwegii subsp. pubescens - Hartweg's sundrops
Calylophus lavandulifolius - lavenderleaf sundrops
Epilobium canum - hummingbird trumpet
Epilobium canum subsp. latifolium - hummingbird trumpet
Epilobium ciliatum subsp. ciliatum - fringed willowherb
Gaura coccinea - scarlet beeblossom
Gaura hexandra subsp. gracilis - harlequinbush
Gaura parviflora - velvetweed

Oenothera brachycarpa - shortfruit evening primrose
Oenothera caespitosa subsp. marginata - tufted evening primrose
Oenothera flava - yellow evening primrose
Oenothera laciniata – cutleaf evening primrose
Oenothera primiveris - large yellow desert primrose
Oenothera rosea - rose evening primrose

OROBANCHACEAE

Brachystigma wrightii - Arizona desert foxglove
Castilleja integra - wholeleaf Indian paintbrush
Castilleja sessiliflora - downy paintedcup
Orobanche fasciculata - clustered broomrape

OXALIDACEAE

Oxalis albicans subsp. albicans
Oxalis albicans subsp. pilosa - radishroot woodsorrel
Oxalis drummondii - Drummond's woodsorrel

PAPAVERACEAE

Argemone pleiacantha subsp. pleiacantha - southwestern pricklypoppy
Corydalis aurea - scrambled eggs
Eschscholzia californica subsp. mexicana - California poppy

PHRYMACEAE

Mimulus guttatus - seep monkeyflower
Mimulus rubellus - little redstem monkeyflower

PINACEAE

Pinus cembroides - Border pinyon

PLANTAGINACEAE

Maurandella antirrhiniflora - snapdragon vine
Nuttallanthus texanus - Texas toadflax
Penstemon barbatus var. barbatus – beardlip penstemon
Penstemon dasyphyllus - Cochise beardtongue
Penstemon parryi - Parry's beardtongue
Penstemon stenophyllus - Sonoran beardtongue
Plantago patagonica - woolly plantain
Plantago virginica - Virginia plantain
Schistophragma intermedia - harlequin spiralseed
Veronica anagallis-aquatica - water speedwell
Veronica peregrina - neckweed

PLATANACEAE

Platanus wrightii - Arizona sycamore

POACEAE

Agrostis stolonifera - creeping bentgrass
Aristida adscensionis - sixweeks threeawn
Aristida divaricata - poverty threeawn
Aristida havardii - Havard's threeawn
Aristida laxa
Aristida orcuttiana - Orcutt's threeawn
Aristida purpurea var. longiseta - Fendler threeawn
Aristida purpurea var. nealleyi - blue threeawn
Aristida purpurea var. parishii - Parish's threeawn
Aristida purpurea var. perplexa - purple threeawn
Aristida setifolia
Aristida ternipes - spidergrass
Aristida ternipes var. hamulosa - spidergrass
Avena fatua - wild oat
Bothriochloa barbinodis - cane bluestem
Bothriochloa ischaemum - yellow bluestem
Bothriochloa laguroides subsp. torreyana - silver beardgrass
Bothriochloa wrightii - Wright's beardgrass
Bouteloua aristidoides - needle grama
Bouteloua barbata - sixweeks grama
Bouteloua chondrosioides - sprucetop grama
Bouteloua curtipendula - sideoats grama
Bouteloua curtipendula var. curtipendula - sideoats grama
Bouteloua eludens - Santa Rita Mountain grama
Bouteloua eriopoda - black grama
Bouteloua gracilis - blue grama
Bouteloua hirsuta - hairy grama
Bouteloua hirsuta var. hirsuta - hairy grama
Bouteloua radicosa - purple grama
Bouteloua repens - slender grama
Bouteloua rothrockii - Rothrock's grama
Brachiaria arizonica - Arizona signalgrass
Bromus anomalus - nodding brome
Bromus catharticus - rescuegrass
Cenchrus carolinianus - mat sandbur
Cenchrus spinifex - coastal sandbur
Chloris virgata - feather fingergrass
Cynodon dactylon - Bermudagrass
Digitaria californica - Arizona cottontop
Digitaria cognata - Carolina cottontop
Digitaria cognata var. pubiflora - Carolina crabgrass
Digitaria sanguinalis - hairy crabgrass

Echinochloa crus-galli var. crus-galli
Elionurus barbiculmis - woolyspike balsamscale
Elymus canadensis - Canada wildrye
Elymus elymoides - squirreltail
Enneapogon desvauxii - nineawn pappusgrass
Eragrostis cilianensis - stinkgrass
Eragrostis curvula var. conferta - weeping lovegrass
Eragrostis curvula var. curvula - weeping lovegrass
Eragrostis echinochloida – African lovegrass
Eragrostis intermedia - plains lovegrass
Eragrostis lehmanniana - Lehmann lovegrass
Eragrostis pectinacea - tufted lovegrass
Eragrostis pectinacea var. miserrima - desert lovegrass
Eragrostis pectinacea var. pectinacea - tufted lovegrass
Eragrostis superba - Wilman lovegrass
Eriochloa acuminata var. minor - tapertip cupgrass
Erioneuron avenaceum - shortleaf woollygrass
Erioneuron pulchellum - low woollygrass
Festuca pratensis - meadow ryegrass
Hackelochloa granularis - pitscale grass
Heteropogon contortus - tanglehead
Heteropogon melanocarpus - sweet tanglehead
Hilaria belangeri var. belangeri - curly-mesquite
Hilaria mutica – tobosagrass (*Pleuraphis mutica*)
Hordeum arizonicum - Arizona barley
Hordeum jubatum - foxtail barley
Leptochloa dubia - green sprangletop
Leptochloa fascicularis - bearded sprangletop (*Diplachne fusca ssp. fasicularis*)
Leptochloa uninervia - Mexican sprangletop (*Diplachne fusca ssp. uninerva*)
Lycurus setosus - bristly wolfstail
Melinis repens - rose Natal grass
Muhlenbergia arenicola - sand muhly
Muhlenbergia arizonica - Arizona muhly
Muhlenbergia asperifolia - scratchgrass
Muhlenbergia emersleyi - bullgrass
Muhlenbergia fragilis - delicate muhly
Muhlenbergia repens - creeping muhly
Muhlenbergia rigens - deergrass
Muhlenbergia rigida - purple muhly
Muhlenbergia tenuifolia - mesa muhly
Panicum antidotale - blue panicum
Panicum bulbosum - bulb panicgrass
Panicum hallii - Hall's panicgrass

Panicum hirticaule - Mexican panicgrass
Panicum obtusum - vine mesquite
Paspalum dilatatum - dallisgrass
Paspalum setaceum - thin paspalum
Phalaris canariensis - annual canarygrass
Piptochaetium fimbriatum - pinyon ricegrass
Poa fendleriana - muttongrass
Poa pratensis - Kentucky bluegrass
Polypogon monspeliensis - annual rabbitsfoot grass
Polypogon viridis - beardless rabbitsfoot grass
Schizachyrium cirratum - Texas bluestem
Schizachyrium sanguineum var. hirtiflorum - crimson bluestem
Scleropogon brevifolius- burrograss
Setaria grisebachii - Grisebach's bristlegrass
Setaria leucopila - streambed bristlegrass
Sorghum halepense - Johnsongrass
Sphenopholis obtusata - prairie wedgescale
Sporobolus contractus - spike dropseed
Sporobolus cryptandrus - sand dropseed
Sporobolus wrightii - big sacaton
Stipa neomexicana - New Mexico feathergrass
Trachypogon secundus - spiked crinkleawn (*T. spicatus*)
Tridens elongatus - slim tridens
Tridens muticus var. muticus - slim tridens
Triticum aestivum - common wheat
Vulpia octoflora - sixweeks fescue

POLEMONIACEAE

Eriastrum diffusum - miniature woollystar
Gilia flavocincta subsp. australis - lesser yellowthroat gilia
Gilia mexicana - El Paso gilia
Ipomopsis macombii - Macomb's ipomopsis
Ipomopsis thurberi - El Paso skyrocket

POLYGALACEAE

Monnina wrightii - blue pygmyflower
Polygala alba - white milkwort
Polygala barbeyana - blue milkwort
Polygala hemipterocarpa - winged milkwort
Polygala obscura - velvetseed milkwort
Polygala racemosa - blue milkwort

POLYGONACEAE

Eriogonum abertianum - Abert's buckwheat
Eriogonum alatum – winged buckwheat
Eriogonum polycladon - sorrel buckwheat
Eriogonum wrightii - bastardsage
Eriogonum wrightii var. wrightii - bastardsage
Polygonum amphibium var. emersum - longroot smartweed
Polygonum pensylvanicum - Pennsylvania smartweed
Polygonum punctatum - dotted smartweed
Rumex crispus - curly dock
Rumex salicifolius var. mexicanus - Mexican dock

PORTULACACEAE

Portulaca oleracea - little hogweed
Portulaca suffrutescens - shrubby purslane
Portulaca umbraticola - wingpod purslane
Portulaca umbraticola subsp. coronata

POTAMOGETONACEAE

Potamogeton foliosus - leafy pondweed

PRIMULACEAE

Androsace occidentalis - western rockjasmine

PTERIDACEAE

Argyrochosma limitanea - southwestern false cloak fern
Astrolepis cochisensis - Cochise scaly cloakfern
Astrolepis integerrima - hybrid cloakfern
Astrolepis sinuata subsp. sinuata - wavy scaly cloakfern
Bommeria hispida - copper fern
Cheilanthes eatonii - Eaton's lipfern
Cheilanthes fendleri - Fendler's lipfern
Cheilanthes lindheimeri - fairyswords
Pellaea atropurpurea - purple cliffbrake

RANUNCULACEAE

Anemone tuberosa - tuber anemone
Clematis drummondii - Drummond's clematis
Clematis ligusticifolia - western white clematis
Delphinium wootonii - Organ Mountain larkspur
Myosurus cupulatus - Arizona mousetail
Ranunculus hydrocharoides - frogbit buttercup
Ranunculus macranthus - large buttercup

RHAMNACEAE

Ceanothus greggii - desert ceanothus
Rhamnus californica subsp. *ursina* - California buckthorn
Sageretia wrightii – Wright's mock buckthorn

ROSACEAE

Cercocarpus montanus - alderleaf mountain mahogany
Cercocarpus montanus var. *paucidentatus* - hairy mountain mahogany
Purshia stansburiana - Stansbury cliffrose
Rubus discolor - Himalayan blackberry

RUBIACEAE

Bouvardia ternifolia - firecrackerbush
Diodia teres - poorjoe
Galium wrightii - Wright's bedstraw
Houstonia rubra - red bluet
Mitracarpus breviflorus - white girdlepod

SALICACEAE

Populus fremontii - Fremont cottonwood
Salix exigua - narrowleaf willow
Salix gooddingii - Goodding's willow
Salix lasiolepis - arroyo willow
Salix taxifolia - yewleaf willow

SANTALACEAE

Phoradendron macrophyllum subsp. *macrophyllum* - mistletoe
Phoradendron villosum subsp. *coryae* - mistletoe

SAPINDACEAE

Sapindus saponaria var. *drummondii* - western soapberry

SOLANACEAE

Chamaesaracha coronopus - greenleaf five eyes
Datura ferox - Chinese thorn-apple
Datura wrightii - sacred thorn-apple
Margaranthus solanaceus - netted globecherry
Petunia parviflora - seaside petunia
Physalis hederifolia var. *fendleri* - Fendler's groundcherry
Physalis longifolia - longleaf groundcherry
Physalis philadelphica - Mexican groundcherry
Physalis philadelphica var. *immaculata* - Mexican groundcherry
Physalis pubescens - husk tomato
Solanum deflexum - sonoita nightshade
Solanum douglasii - greenspot nightshade

Solanum elaeagnifolium - silverleaf nightshade
Solanum fendleri - Fendler's horsenettle
Solanum rostratum - buffalobur nightshade

TALINACEAE

Talinum aurantiacum - orange fameflower
Talinum paniculatum - jewels of Opar

TYPHACEAE

Typha domingensis - southern cattail
Typha latifolia - broadleaf cattail

VERBENACEAE

Bouchea prismatica - prism bouchea
Glandularia bipinnatifida var. bipinnatifida - Dakota mock vervain
Phyla incisa - turkey tangle fogfruit
Verbena ambrosifolia
Verbena bracteata - bigbract verbena
Verbena gracilis - Fort Huachuca vervain
Verbena neomexicana - hillside vervain

VIOLACEAE

Hybanthus verticillatus - babyslippers

VITACEAE

Parthenocissus quinquefolia - Virginia creeper
Vitis arizonica - canyon grape

XANTHORRHOEACEAE

Asphodelus fistulosus - onionweed

ZYGOPHYLLACEAE

Kallstroemia grandiflora - Arizona poppy
Kallstroemia hirsutissima – hairy caltrop
Kallstroemia parviflora – warty caltrop

Birds Found on the Appleton-Whittell Research Ranch

Scientific names from the American Ornithologists' Union
(www.aou.org/checklist/north/full.php)
Season Code: Y: Year Round; M: Migrant; S: Summer/Breeding; W: Winter
Compiled by Tony Leonardini

Common name	Season	Genus	Species
ANSERIFORMES			
ANATADAE			
Wood Duck	M	*Aix*	*sponsa*
American Wigeon	M	*Anas*	*americana*
Mexican Mallard	Y	*Anas*	*platyrhynchos diaz*
Gadwall	W	*Anas*	*strepera*
Northern Pintail	W	*Anas*	*acuta*
Blue-winged Teal	W	*Anas*	*discors*
Cinnamon Teal	W	*Anas*	*cyanoptera*
Green-winged Teal	W	*Anas*	*crecca*
Northern Shoveler	W	*Anas*	*clypeata*
Canvasback	W	*Aythya*	*valisineria*
Redhead	W	*Aythya*	*americana*
Ring-necked Duck	W	*Aythya*	*collaris*
Lesser Scaup	W	*Aythya*	*affinis*
Ruddy Duck	W	*Oxyura*	*jamaicensis*
GALLIFORMES			
PHASIANIDAE			
Gould's Wild Turkey	Y	*Meleagris*	*gallopavo mexicana*
ODONTOPHORIDAE			
Scaled Quail	Y	*Callipepla*	*squamata*
Gambel's Quail	Y	*Callipepla*	*gambelii*
Montezuma Quail	Y	*Cyrtonyx*	*montezumae*
PODECIPEDIFORMES			
PODICIPEDIDAE			
Pied-billed Grebe	Y	*Podilymbus*	*podiceps*
PELECANIFORMES			
ARDEIDAE			
Great Egret	W	*Ardea*	*alba*
Snowy Egret	M	*Egretta*	*thula*
Cattle Egret	M	*Bubulcus*	*ibis*
Great Blue Heron	Y	*Ardea*	*herodias*

Green Heron	S	*Butorides*	*virescens*
Black-crowned Night Heron	Y	*Nycticorax*	*nycticorax*
THRESKIORNITHIDAE			
White-faced Ibis	M	*Plegadis*	*chihi*
FALCONIFORMES			
CATHARTIDAE			
Black Vulture	S	*Coragyps*	*atratus*
Turkey Vulture	S	*Cathartes*	*aura*
PANDIONIDAE			
Osprey	M	*Pandion*	*haliaetus*
ACCIPITRIDAE			
Bald Eagle	W	*Haliaeetus*	*leucocephalus*
Golden Eagle	Y	*Aquila*	*chrysaetos*
White-tailed Kite	Y	*Elanus*	*leucurus*
Northern Goshawk	W	*Accipiter*	*gentilis*
Sharp-shinned Hawk	Y	*Accipiter*	*striatus*
Cooper's Hawk	Y	*Accipiter*	*cooperii*
Gray Hawk	S	*Asturina*	*nitidus*
Harris's Hawk	W	*Parabuteo*	*unicinctus*
Zone-tailed Hawk	S	*Buteo*	*albonotatus*
Swainson's Hawk	Y	*Buteo*	*swainsoni*
Red-tailed Hawk	Y	*Buteo*	*jamaicensis*
Ferruginous Hawk	W	*Buteo*	*regalis*
Rough-legged Hawk	W	*Buteo*	*lagopus*
Northern Harrier	W	*Circus*	*cyaneus*
FALCONIFORMES			
FALCONIDAE			
Crested Caracara	M	*Caracara*	*cheriway*
American Kestrel	Y	*Falco*	*sparverius*
Merlin	Y	*Falco*	*columbarius*
Peregrine Falcon	S	*Falco*	*peregrinus*
Prairie Falcon	S	*Falco*	*mexicanus*
GRUIFORMES			
RALLIDAE			
Virginia Rail	W	*Rallus*	*limicola*
Sora	W	*Porzana*	*carolina*
American Coot	W	*Fulica*	*americana*

CHARADRIIFORMES			
CHARADRIIDAE			
Killdeer	Y	*Charadrius*	*vociferus*
Mountain Plover	W	*Charadrius*	*montanus*
RECURVIROSTRIDAE			
Black-necked Stilt	M	*Himantopus*	*mexicanus*
American Avocet	S	*Recurvirostra*	*americana*
SCOLOPACIDAE			
Greater Yellowlegs	W	*Tringa*	*melanoleuca*
Lesser Yellowlegs	W	*Tringa*	*flavipes*
Solitary Sandpiper	M	*Tringa*	*solitaria*
Willet	M	*Tringa*	*semipalmata*
Spotted Sandpiper	Y	*Actitis*	*macularius*
Long-billed Curlew	W	*Numenius*	*americanus*
Western Sandpiper	M	*Calidris*	*mauri*
Least Sandpiper	W	*Calidris*	*minutilla*
Long-billed Dowitcher	W	*Limnodromus*	*scolopaceus*
Wilson's Snipe	W	*Gallinago*	*delicata*
Wilson's Phalarope	M	*Phalaropus*	*tricolor*
LARIDAE			
Black Tern	M	*Chlidonias*	*niger*
COLUMBIFORMES			
COLUMBIDAE			
Band-tailed Pigeon	Y	*Patagioenas*	*fasciata*
Eurasian Collared Dove	S	*Streptopelia*	*decaocto*
White-winged Dove	S	*Zenaida*	*asiatica*
Mourning Dove	Y	*Zenaida*	*macroura*
Inca Dove	Y	*Columbina*	*inca*
Common Ground Dove	Y	*Columbina*	*passerina*
CUCULIFORMES			
CUCULIDAE			
Yellow-billed Cuckoo	S	*Coccyzus*	*americanus*
Greater Roadrunner	Y	*Geococcyx*	*californianus*
STRIGIFORMES			
TYTONIDAE			
Barn Owl	Y	*Tyto*	*alba*
STRIGIDAE			
Whiskered Screech Owl	Y	*Megascops*	*trichopsis*

Western Screech Owl	Y	*Megascops*	*kennicottii*
Great Horned Owl	Y	*Bubo*	*virginianus*
Northern Pygmy Owl	S	*Glaucidium*	*gnoma*
Elf Owl	S	*Micrathene*	*whitneyi*
Burrowing Owl	Y	*Athene*	*cunicularia*
Long-eared Owl	W	*Asio*	*otus*
Short-eared Owl	W	*Asio*	*flammeus*

CAPRIMULGIFORMES

CAPRIMULGIDAE			
Lesser Nighthawk	S	*Chordeiles*	*acutipennis*
Common Nighthawk	S	*Chordeiles*	*minor*
Common Poorwill	Y	*Phalaenoptilus*	*nuttallii*

APODIFORMES

APODIDAE			
Vaux's Swift	M	*Chaetura*	*vauxi*
White-throated Swift	Y	*Aeronautes*	*saxatalis*
TROCHILIDAE			
Broad-billed Hummingbird	Y	*Cynanthus*	*latirostris*
Blue-throated Hummingbird	M	*Lampornis*	*clemenciae*
Magnificant Hummingbird	M	*Eugenes*	*fulgens*
Black-chinned Hummingbird	Y	*Archilochus*	*alexandri*
Anna's Hummingbird	Y	*Calypte*	*anna*
Costa's Hummingbird	M	*Calypte*	*costae*
Calliope Hummingbird	S	*Stellula*	*calliope*
Broad-tailed Hummingbird	S	*Selasphorus*	*platycercus*
Rufous Hummingbird	M	*Selasphorus*	*rufus*
Allen's Hummingbird	M	*Selasphorus*	*sasin*

CORACIIFORMES

ALCEDINIDAE			
Belted Kingfisher	W	*Megaceryle*	*alcyon*

PICIFORMES

PICIDAE			
Lewis's Woodpecker	W	*Melanerpes*	*lewis*
Acorn Woodpecker	Y	*Melanerpes*	*formicivorus*

Gila Woodpecker	Y	*Melanerpes*	*uropygialis*
Red-naped Sapsucker	W	*Sphyrapicus*	*nuchalis*
Red-breasted Sapsucker	M	*Sphyrapicus*	*ruber*
Williamson's Sapsucker	W	*Sphyrapicus*	*thyroideus*
Ladder-backed Woodpecker	Y	*Picoides*	*scalaris*
Hairy Woodpecker	Y	*Picoides*	*villosus*
Arizona Woodpecker	Y	*Picoides*	*arizonae*
Northern Flicker	Y	*Colaptes*	*auratus*

PASSERIFORMES

TYRANNIDAE			
Northern Beardless-Tyrannulet	S	*Camptostoma*	*imberbe*
Olive-sided Flycatcher	M	*Contopus*	*cooperi*
Western Wood-Pewee	S	*Contopus*	*sordidulus*
Greater Pewee	S	*Contopus*	*pertinax*
Willow Flycatcher	M	*Empidonax*	*traillii*
Hammond's Flycatcher	W	*Empidonax*	*hammondii*
Gray Flycatcher	W	*Empidonax*	*wrightii*
Dusky Flycatcher	W	*Empidonax*	*oberholseri*
Cordilleran Flycatcher	S	*Empidonax*	*occidentalis*
Black Phoebe	Y	*Sayornis*	*nigricans*
Say's Phoebe	Y	*Sayornis*	*saya*
Vermilion Flycatcher	S	*Pyrocephalus*	*rubinus*
Dusky-capped Flycatcher	S	*Myiarchus*	*tuberculifer*
Ash-throated Flycatcher	S	*Myiarchus*	*cinerascens*
Brown-crested Flycatcher	S	*Myiarchus*	*tyrannulus*
Sulphur-bellied Flycatcher	S	*Myiodynastes*	*luteiventris*
Tropical Kingbird	S	*Tyrannus*	*melancholicus*
Cassin's Kingbird	S	*Tyrannus*	*vociferans*
Western Kingbird	S	*Tyrannus*	*verticalis*
LANIIIDAE			
Northern Shrike	W	*Lanius*	*excubitor*
Loggerhead Shrike	Y	*Lanius*	*ludovicianus*
VIREONIDAE			
Bell's Vireo	S	*Vireo*	*bellii*

Gray Vireo	S	*Vireo*	*vicinior*
Plumbeous Vireo	S	*Vireo*	*plumbeus*
Cassin's Vireo	S	*Vireo*	*cassinii*
Hutton's Vireo	Y	*Vireo*	*huttoni*
Warbling Vireo	S	*Vireo*	*gilvus*
Red-eyed Vireo	S	*Vireo*	*olivaceus*
CORVIDAE			
Western-scrub Jay	Y	*Aphelocoma*	*californica*
Mexican Jay	Y	*Aphelocoma*	*ultramarina*
Clark's Nutcracker	W	*Nucifraga*	*columbiana*
Chihuahuan Raven	Y	*Corvus*	*cryptoleucus*
Common Raven	Y	*Corvus*	*corax*
ALAUDIDAE			
Horned Lark	Y	*Eremophila*	*alpestris*
HIRUNDINADAE			
Purple Martin	S	*Progne*	*subis*
Tree Swallow	S	*Tachycineta*	*bicolor*
Violet-green Swallow	S	*Tachycineta*	*thalassina*
N. Rough-winged Swallow	S	*Stelgidopteryx*	*serripennis*
Bank Swallow	S	*Riparia*	*riparia*
Cliff Swallow	S	*Petrochelidon*	*pyrrhonota*
Barn Swallow	S	*Hirundo*	*rustica*
PARIDAE			
Bridled Titmouse	Y	*Baeolophus*	*wollweberi*
REMIZIDAE			
Verdin	Y	*Auriparus*	*flaviceps*
AEGITHALIDAE			
Bushtit	Y	*Psaltriparus*	*minimus*
SITTIDAE			
Red-breasted Nuthatch	Y	*Sitta*	*canadensis*
White-breasted Nuthatch	Y	*Sitta*	*carolinensis*
CERTHIIDAE			
Brown Creeper	Y	*Certhia*	*americana*
TROGLODYTIDAE			
Cactus Wren	Y	*Campylorhynchus*	*brunneicapillus*
Rock Wren	Y	*Salpinctes*	*obsoletus*
Canyon Wren	Y	*Catherpes*	*mexicanus*
Bewick's Wren	Y	*Thryomanes*	*bewickii*
House Wren	W	*Troglodytes*	*aedon*
Marsh Wren	W	*Cistothorus*	*palustris*

REGULIDAE			
Golden-crowned Kinglet	W	*Regulus*	*satrapa*
Ruby-crowned Kinglet	W	*Regulus*	*calendula*
POLIOPTILIDAE			
Blue-gray Gnatcatcher	Y	*Polioptila*	*caerulea*
TURDIDAE			
Eastern Bluebird	Y	*Sialia*	*sialis*
Western Bluebird	Y	*Sialia*	*mexicana*
Mountain Bluebird	W	*Sialia*	*currucoides*
Townsend's Solitaire	W	*Myadestes*	*townsendi*
Hermit Thrush	Y	*Catharus*	*guttatus*
Swainson's Thrush	M	*Catharus*	*ustulatus*
American Robin	Y	*Turdus*	*migratorius*
MIMIDAE			
Northern Mockingbird	Y	*Mimus*	*polyglottos*
Sage Thrasher	W	*Oreoscoptes*	*montanus*
Brown Thrasher	W	*Toxostoma*	*rufum*
Curve-billed Thrasher	Y	*Toxostoma*	*curvirostre*
Crissal Thrasher	Y	*Toxostoma*	*crissale*
STURNIDAE			
European Starling	Y	*Sturnus*	*vulgaris*
MOTACILLIDAE			
American Pipit	W	*Anthus*	*rubescens*
Sprague's Pipit	W	*Anthus*	*spragueii*
BOMBYCILLIDAE			
Cedar Waxwing	W	*Bombycilla*	*cedrorum*
PTILOGONATIDAE			
Phainopepla	Y	*Phainopepla*	*nitens*
PARULIDAE			
Orange-crowned Warbler	W	*Oreothlypis*	*celata*
Nashville Warbler	M	*Oreothlypis*	*ruficapilla*
Virginia's Warbler	S	*Oreothlypis*	*virginiae*
Lucy's Warbler	S	*Oreothlypis*	*luciae*
Black-throated Blue Warbler	M	*Setophaga*	*caerulescens*
Yellow Warbler	S	*Dendroica*	*petechia*
Yellow-rumped Warbler	Y	*Dendroica*	*coronata*
Black-throated Gray Warbler	S	*Dendroica*	*nigrescens*
Townsend's Warbler	M	*Dendroica*	*townsendi*

Hermit Warbler	M	*Dendroica*	*occidentalis*
Palm Warbler	S	*Dendroica*	*palmarum*
American Redstart	S	*Setophaga*	*ruticilla*
Northern Waterthrush	M	*Parkesia*	*noveboracensis*
MacGillivray's Warbler	M	*Oporornis*	*tolmiei*
Common Yellowthroat	S	*Geothlypis*	*trichas*
Hooded Warbler	S	*Setophaga*	*citrina*
Wilson's Warbler	S	*Wilsonia*	*pusilla*
Painted Redstart	S	*Myioborus*	*pictus*
Yellow-breasted Chat	S	*Icteria*	*virens*
CARDINALIDAE			
Summer Tanager	S	*Piranga*	*rubra*
Hepatic Tanager	M	*Piranga*	*flava*
Western Tanager	S	*Piranga*	*ludoviciana*
EMBERIDIDAE			
Green-tailed Towhee	Y	*Pipilo*	*chlorurus*
Spotted Towhee	Y	*Pipilo*	*maculatus*
Canyon Towhee	Y	*Melozone*	*fuscus*
Abert's Towhee	Y	*Melozone*	*aberti*
Rufous-winged Sparrow	Y	*Peucaea*	*carpalis*
Cassin's Sparrow	Y	*Peucaea*	*cassinii*
Botteri's Sparrow	Y	*Peucaea*	*botterii*
Rufous-crowned Sparrow	Y	*Aimophila*	*ruficeps*
Chipping Sparrow	Y	*Spizella*	*passerina*
Clay-colored Sparrow	W	*Spizella*	*pallida*
Brewer's Sparrow	W	*Spizella*	*breweri*
Black-chinned Sparrow	Y	*Spizella*	*atrogularis*
Vesper Sparrow	W	*Pooecetes*	*gramineus*
Lark Sparrow	Y	*Chondestes*	*grammacus*
Sage Sparrow	W	*Amphispiza*	*belli*
Black-throated Sparrow	Y	*Amphispiza*	*bilineata*
Grasshopper Sparrow	Y	*Ammodramus*	*savannarum*
Lark Bunting	W	*Calamospiza*	*melanocorys*
Savannah Sparrow	W	*Passerculus*	*sandwichensis*
Baird's Sparrow	W	*Ammodramus*	*bairdii*
Lincoln's Sparrow	W	*Melospiza*	*lincolnii*
Song Sparrow	Y	*Melospiza*	*melodia*
White-throated Sparrow	W	*Zonotrichia*	*albicollis*

White-crowned Sparrow	W	*Zonotrichia*	*leucophrys*
Dark-eyed Junco	W	*Junco*	*hyemalis*
Yellow-eyed Junco	Y	*Junco*	*phaeonotus*
McCown's Longspur	W	*Rhynchophanes*	*mccownii*
Chestnut-collared Longspur	W	*Calcarius*	*ornatus*
CARDINALIDAE			
Northern Cardinal	Y	*Cardinalis*	*cardinalis*
Pyrrhuloxia	Y	*Cardinalis*	*sinuatus*
Black-headed Grosbeak	S	*Pheucticus*	*melanocephalus*
Blue Grosbeak	S	*Guiraca*	*caerulea*
Lazuli Bunting	S	*Passerina*	*amoena*
Indigo Bunting	S	*Passerina*	*cyanea*
Painted Bunting	S	Passerina	ciris
Varied Bunting	S	Passerina	versicolor
Dickcissel	S	*Spiza*	*americana*
ICTERIDAE			
Red-winged Blackbird	Y	*Agelaius*	*phoeniceus*
Yellow-headed Blackbird	W	*Xantho cephalus*	*xanthocephalus*
Western Meadowlark	Y	*Sturnella*	*neglecta*
Eastern Meadowlark	Y	*Sturnella*	*magna*
Brewer's Blackbird	W	*Euphagus*	*cyanocephalus*
Great-tailed Grackle	S	*Quiscalus*	*mexicanus*
Brown-headed Cowbird	S	*Molothrus*	*ater*
Bronzed Cowbird	S	*Molothrus*	*aeneus*
Hooded Oriole	S	*Icterus*	*cucullatus*
Scott's Oriole	S	*Icterus*	*parisorum*
Bullock's Oriole	S	*Icterus*	*bullockii*
FRINGILLIDAE			
House Finch	Y	*Carpodacus*	*mexicanus*
Purple Finch	W	*Carpodacus*	*purpureus*
Cassin's Finch	W	*Carpodacus*	*cassinii*
Lesser Goldfinch	Y	*Spinus*	*psaltria*
Lawrence's Goldfinch	W	*Spinus*	*lawrencei*
American Goldfinch	W	*Spinus*	*tristis*
Pine Siskin	W	*Spinus*	*pinus*
PASSERIDAE			
House Sparrow	Y	*Passer*	*domesticus*

Mammals of the Research Ranch

Compiled by C. Hass, Ph.D., 2007

Taxonomy after Wilson, D.E. and D.M. Reeder, 2005. Mammal Species of the World.

LAGOMORPHA		
LEPORIDAE	*Lepus californicus*	Black-tailed jackrabbit
	Sylvilagus floridanus	Eastern cottontail
RODENTIA		
SCIURIDAE	*Spermophilus spilosoma*	Spotted ground squirrel
	Spermophilus variegatus	Rock squirrel
HETEROMYIDAE	*Chaetodipus baileyi*	Bailey's pocket mouse
	Chaetodipus hispidus	Hispid pocket mouse
	Chaetodipus intermedius	Rock pocket mouse
	Chaetodipus penicillatus	Desert pocket mouse
	Perognathus flavus	Silky pocket mouse
	Dipodomys merriami	Merriam's kangaroo rat
	Dipodomys ordii	Ord's kangaroo rat
MURIDAE	*Baiomys taylori*	Northern pygmy mouse
	Neotoma albigula	White-throated woodrat
	Onychomys torridus	Southern grasshopper mouse
	Peromyscus boylii	Brush deermouse
	Peromyscus eremicus	Cactus deermouse
	Peromyscus leucopus	White-footed deermouse
	Peromyscus maniculatus	North American deermouse
	Reithrodontomys fulvescens	Fulvous harvest mouse
	Reithrodontomys megalotis	Western harvest mouse
	Reithrodontomys montanus	Plains harvest mouse
	Sigmodon fulviventer	Tawny-bellied cotton rat
	Sigmodon ochrognathus	Yellow-nosed cotton rat
	Sigmodon arizonae	Arizona cotton rat
ERETHIZONTIDAE	*Erethizon dorsatum*	North American porcupine
CARNIVORA		
CANIDAE	*Canis latrans*	Coyote
	Urocyon cinereoargenteus	Gray fox
URSIDAE	*Ursus americanus*	Black bear
PROCYONIDAE	*Bassariscus astutus*	Ringtail
	Nasua narica	White-nosed coati
	Procyon lotor	Northern raccoon
MEPHITIDAE	*Conepatus leuconotus*	American hog-nosed skunk
	Mephitis macroura	Hooded skunk
	Mephitis mephitis	Striped skunk
	Spilogale gracilis	Western spotted skunk
MUSTELIDAE	*Taxidea taxus*	American badger

FELIDAE	*Lynx rufus*	Bobcat
	Puma concolor	Mountain lion

ARTERIODACTYLA

TAYASSUIDAE	*Pecari tajacu*	Javelina
CERVIDAE	*Odocoileus hemionus*	Mule deer
	Odocoileus virginianus	White-tailed deer (Coues)
ANTILOCAPRIDAE	*Antilocapra Americana*	Pronghorn

CHIROPTERA

VESPERITILIONIDAE		
	Eptesicus fuscus	Big brown bat
	Myotis californicus	California myotis
	Myotis thysanodes	Fringed myotis
	Myotis auriculus	Southwestern myotis

MARSUPIALIA

DIDELPHIDAE	*Didelphis virginiana*	Sonora opossum

INSECTIVORA

SORICIDAE	*Notiosorex* sp.	Shrew

Herpetofauna of AWRR

Cogan, R.C. http://researchranch.audubon.org/PDFs/Herp%20pdf%202015.pdf

Nomenclature applied is from Society for the Study of Amphibians and Reptiles, Herpetological Circular No. 39, Seventh edition, 2012

Reptiles

SQUAMATA

Arizona Striped Whiptail	*Aspidoscelis arizonae*
Canyon Spotted Whiptail	*Aspidoscelis stictogrammus*
Chihuahuan Spotted Whiptail	*Aspidoscelis exsangui*
Gila Spotted Whiptail	*Aspidoscelis flagellicaudus*
Sonoran Spotted Whiptail	*Aspidoscelis sonorae*
Sonoran Tiger Whiptail	*Aspidoscelis tigris punctilineatus*
Desert Grassland Whiptail	*Aspidoscelis uniparens*
Eastern Collared Lizard	*Crotaphytus collaris*
Madrean Alligator lizard	*Elgaria kingii*
Mountain Skink	*Plestiodon callicephalus*
Great Plains Skink	*Plestiodon obsoletus*
Gila Monster	*Heloderma suspectum*
Chihuahuan Earless Lizard	*Holbrookia maculata flavilenta*
Greater Short-horned Lizard	*Phrynosoma hernandesi*
Round-tailed Horned Lizard	*Phrynosoma modestum*
Regal Horned Lizard	*Phrynosoma solare*
Clark's Spiny Lizard	*Sceloporus clarkii*
Slevin's Bunchgrass Lizard	*Sceloporus slevini*
Southwestern Fence Lizard	*Sceloporus cowles*
Ornate Tree Lizard	*Urosaurus ornatus*
Western Diamondback Rattlesnake	*Crotalus atrox*
Mohave Rattlesnake	*Crotalus scutulatus*
Banded Rock Rattlesnake	*Crotalus lepidus klauberi*
Black-tailed Rattlesnake	*Crotalus molossu*
Regal Ringneck snake	*Diadophis punctatus regali*
Chihuahuan Hook-nosed Snake	*Gyalopion canum*
Mexican Hognose Snake	*Heterodon kennerlyi*
Spotted Nightsnake	*Hypsiglena chlorophaea*
Western Black Kingsnake	*Lampropeltis nigrita*
Desert Kingsnake	*Lampropeltis splendida*
Arizona Mountain Kingsnake	*Lampropeltis pyromelan)*
Sonoran Whipsnake	*Coluber bilineatus*
Sonoran Coachwhip	*Coluber flagellum*
Sonoran Coral Snake	*Micruroides euryxanthus*
Sonoran Gopher snake	*Pituophis catenifer affinis*
Western Patchnose Snake	*Salvadora deserticola*
Eastern Patchnose Snake	*Salvadora grahamiae*
Western Groundsnake	*Sonora semiannulata*

Western Black-necked Gartersnake	*Thamnophis cyrtopsis*
Northern Mexican Gartersnake	*Thamnophis eques*
Checkered Gartersnake	*Thamnophis marcianus*

TESTUDINES

Sonoran Mud Turtle	*Kinosternon sonoriense*
Desert Box Turtle	*Terrapene ornata luteola*

Amphibians

ANURA

Red-spotted Toad	*Anaxyrus punctatus*
Woodhouse Toad	*Anaxyrus woodhousii*
Sonoran Desert Toad	*Incilius alvarius*
Couch's Spadefoot Toad	*Scaphiopus couchii*
Chihuahua Spadefoot Toad	*Spea multiplicata stagnalis*
Canyon Treefrog	*Hyla arenicolor*
Arizona Treefrog	*Hyla wrightorum*
Chiricahua Leopard Frog	*Lithobates chiricahuensis (*repatriated May 2015)
Lowland leopard Frog	*Lithobates yavapaiensis* (extirpated)
American Bullfrog	*Lithobates catesbeiana (*Non-native, invasive)

CAUDATA

Tiger Salamander	*Ambystoma mavortium*

Fish Species Documented on AWRR

Common Name	Scientific Name	Status
Rio Sonoyta (Quitobaquito)	*Cyprinodon eremus*	Population removed by AZGF
Desert Pupfish	*Cyprinodon macularis*	Introduced by AZGF, USFWS, BLM
Mosquitofish	*Gambusia affinis*	Present in O'Donnell, South Post
Gila Chub	*Gila intermedia*	Probably extirpated
Green Sunfish	*Lepomis cyanellus*	South Post
Largemouth bass	*Micropterus salmoides*	Extirpated
Gila Topminnow	*Poeciliopsis occidentalis*	Probably extirpated

Butterflies of the Appleton-Whittell Research Ranch

From Bailowitz, 1985

Family	Common design.	Scientific Name	Common Name
HESPERIIDAE	Common Skippers	*Achalarus casica*	Desert Cloudywing
		Adopaeoides prittwitzi	Sunrise Skipper
		Amblyscirtes aenus	Bronze Roadside-Skipper
		Amblyscirtes eos	Dotted Roadside-Skipper
		Amblyscirtes exoteria	Large Roadside-Skipper
		Amblyscirtes nereus	Slaty Roadside-Skipper
		Amblyscirtes nysa	Nysa Roadside-Skipper
		Amblyscirtes oslari	Oslar's Roadside-Skipper
		Amblyscirtes simius	Simius Roadside-Skipper
		Amblyscirtes texanae	Texas Roadside-Skipper
		Atalopedes campestris	Sachem
		Atrytonopsis lunus	Moon-marked Skipper
		Atrytonopsis ovinia edwardsi	Ovinia Skipper
		Atrytonopsis pittacus	White-barred Skipper
		Cogia caicus moschus	Gold-costa Skipper
		Cogia hippalus	Acacia Skipper
		Copaeodes aurantiaca	Orange Skipperling
		Erynnis brizo burgessi	Sleepy Duskywing
		Erynnis funeralis	Funereal Duskywing
		Erynnis juvenalis clitus	Juvenal's Duskywing
		Erynnis tristis tatius	Mournful Duskywing
		Hesperia pahaska williamsi	Pahaska Skipper
		Hesperia uncas lasus	Uncas Skipper
		Hesperia viridis	Green Skipper
		Hylephila phyleus	Fiery Skipper
		Lerodea eufala	Eufala Skipper
		Pholisora catullus	Common Sootywing
		Piruna aea mexicana	Many-spotted Skipperling
		Polygonus leo	Hammock Skipper
		Pyrgus albescens	White Checkered-Skipper
		Pyrgus philetas	Desert Checkered-Skipper
		Pyrrhopyge araxes arizonae	Dull Firetip Skipper
		Staphylus ceos	Golden-headed Scallopwing
		Thorybes drusius	Drusius Cloudywing
		Thorybes pylades	Northern Cloudywing
		Urbanus dorantes dorantes	Dorantes Longtail
		Yvretta carus	Carus Skipper

		Zestusa dorus	Short-tailed Skipper
MEGATHYMIDAE	Giant Skippers	*Agathymus aryxna*	Arizona Giant Skipper
PAPILIONIDAE	Butterflies	*Battus philenor philenor*	Pipevine Swallowtail
		Papilio astyalus pallas	Broad-banded Swallowtail
		Papilio cresphontes	Giant Swallowtail
		Papilio multicaudata	Two-tailed Swallowtail
		Papilio polyxenes asterius	Black Swallowtail
PIERIDAE	Whites, Sulfurs, and Orange Tips	*Anteos clorinde nivifera*	White Angled-Sulphur
		Colias cesonia	Southern Dogface
		Colias eurytheme	Orange Sulphur
		Colias philodice	Clouded Sulphur
		Euchloe hyantis lotta	Pearly Marble
		Eurema boisduvaliana	Boisduval's Yellow
		Eurema mexicana	Mexican Yellow
		Eurema nicippe	Sleepy Orange
		Eurema proterpia	Tailed Orange
		Kricogonia lyside	Lyside Sulphur
		Nathalis iole	Dainty Sulphur
		Phoebis agarithe agarithe	Large Orange Sulphur
		Phoebis sennae marcellina	Cloudless Sulphur
		Pieris pontia (P. protodice)	Checkered White
		Pieris rapae	Cabbage White
LYCAENIDAE	Gossamer-winged Butterflies	*Atlides halesus estesi*	Great Purple Hairstreak
		Brephidium exillis	Western Pygmy-Blue
		Celestrina ladon cinerea	Spring Azure
		Everes comyntas comyntas	Eastern Tailed-Blue
		Hemiargus cyaunus gyas	Cyaunus Blue
		Hemiargus isola alce	Reakirt's Blue
		Icaricia acmon texana	Acmon Blue
		Leptotes marina	Marine Bllue
		Ministrymon leda	Leda Ministreak
		Mitoura siva siva	Siva Hairstreak
		Strymon melinus franki	Gray Hairstreak
RIODINIDAE	Metalmarks	*Apodemia mormo mejicanus*	Mormon Metalmark
		Calephelis arizonensis	Arizona Metalmark
		Calephelis nemesis nemesis	Fatal Metalmark
		Emesis ares	Ares Metalmark
		Emesis zela cleis	Zela Metalmark

HELICONIIDAE	Heliconians & Fritillaries	*Agraulis vanillae incarnata*	Gulf Fritillary
LIBYTHEIDAE	Snout Butterflies	*Libytheana bachmanii larvata*	American Snout
NYMPHALIDAE	Brush-footed Butterflies	*Adelpha bredowii eulalia*	California Sister
		Anthanassa texana texana	Texan Crescentspot
		Chlosyne lacinia crocale	Bordered Patch
		Dymasia dymas chara	Tiny Checkerspot
		Euptoieta claudia	Variagated Frittilary
		Euptoieta hegesia hoffmanni	Mexican Fritillary
		Junonia coenia	Common Buckeye
		Junonia nigrosuffusa	Tropical Buckeye
		Limenitis archippus obsoleta	Viceroy
		Limenitis arthemis arizonensis	Red-spotted Admiral
		Marpesia petreus	Ruddy Daggerwing
		Nymphalis antiopa	Mourning Cloak
		Phyciodes picta canace	Painted Crescent
		Phyciodes tharos distincta	Pearn Crescent
		Poladryas arachne gilensis	Arachne Checkerspot
		Texola elada perse	Elada Checkerspot
		Thessalia theona thekla	Theona Checkerspot
		Vanessa annabella	West Coast Lady
		Vanessa atalanta rubria	Red Admiral
		Vanessa cardui	Painted Lady
		Vanessa virginiensis	American Lady
SATYRIDAE	Nymphs, Satyrs, and Arctics	*Cyllopsis henshawi*	Henshaw's Satyr
		Cyllopsis pyracmon nabokovi	Nabokov's Satyr
		Megisto rubricate cheneyorum	Red Satyr
DANAIDAE	Milkweed Butterflies	*Danaus plexippus*	Monarch
		Danaus gilippus strigosus	Queen

Grasshoppers (Orthoptera) Documented on the Research Ranch

Nomenclature as per http://animaldiversity.org http://inaturalist.org From Reifel, Jepson

ORTHOPTERA

ACRIDIDAE	*Achurum sumichrasti*	Sumichrast Toothpick Grasshopper
	Ageneotettix deorum	White-whiskered Grasshopper
	Amphitornus coloradus	Striped Grasshopper
	Arphia conspersa	Speckle-winged Rangeland Grasshopper
	Arphia pseudonietana	Red-winged Grasshopper
	Aulocara femoratum	White Cross Grasshopper
	Barytettix humphreysii	Humphrey's Grasshopper
	Boopedon flaviventris	Yellow-bellied Boopie
	Boopedon nubilum	Ebony Grasshopper
	Conalcea humphreysii	
	Conozoa carinata	Ridged Grasshopper
	Cordillacris crenulata	Crenulated Grasshopper
	Dactylotum bicolor variegatum	Rainbow Grasshopper
	Eritettix simplex	Velvet-striped Grasshopper
	Hadrotettix trifasciatus	Threebanded Grasshopper
	Heliaula rufa	Rufous Grasshopper
	Hesperotettix viridis	Meadow Purple-striped Grasshopper
	Leprus robustus	
	Leprus wheelerii	Blue-winged Grasshopper
	Melanoplus arizonae	Arizona Spur-throat Grasshopper
	Melanoplus desultorius	Red Whiskers Grasshopper
	Melanoplus differentialis	Differential Grasshopper
	Melanoplus femurrubrum	Red-legged Grasshopper
	Melanoplus gladstoni	Gladstone Grasshopper
	Melanoplus lakinus	Lakin Grasshopper
	Melanoplus mexicanus	Migratory Grasshopper
	Melanoplus regalis	Regal Grasshopper
	Melanoplus thomasi	Two-striped Grasshopper
	Mermiria bivittata	Two-striped Slantfaced Grasshopper
	Mermiria picta	Lively Merimiria Grasshopper
	Opeia obscura	Obsure Grasshopper
	Paropomala wyomingensis	Wyoming Toothpick Grasshopper
	Phoetaliotes nebrascensis	Large-headed Grasshopper
	Poecilotettix pantherinus	Panther-spotted Grasshopper
	Psoloessa delicatula	Brown-spotted Range Grasshopper
	Psoloessa texana	Texas Spotted Range Grasshopper
	Spharagemon collare	Mottled Sand Grasshopper
	Syrbula montezuma	Montezuma's Grasshopper
	Tomonotus ferruginosus	Oak Leaf Grasshopper
	Trachyrhachis mexicana	
	Trimerotropis latifasciata	Broad-banded Grasshopper
	Trimerotropis melanoptera	
	Trimerotropis pallidipennis	Pallidwinged Grasshopper
	Xanthippus corallipes	Red-shanked Grasshopper
ROMALEIDAE	*Brachystola magna*	Lubber Grasshopper
	Phrynotettix tshivavensis	Toad Lubber
	Taeniopoda eques	Horse Lubber

Appendix D: Summary of Active Research/Baseline Projects - 2015

Active: One or more of following: Proposal approved but project not commenced; Field work/research within past two years; Publication received within past two years; Publications pending; Publications in demand within past two years; Projects with return intervals >1 year; Repeated, long term efforts.

Investigating the effect of livestock on the physical properties of soil in an arid grassland
Allington, Ginger. Michigan Univ. and Thomas J. Valone; Saint Louis University.
Subject: Collect water infiltration and soil compaction data on grazed and ungrazed land
Application: Evidence of impacts of livestock on physical properties may assist restoration efforts at desertified sites.

Effect of mesquite cover on avian diversity, density and reproductive success in desert grasslands
Andersen, Erik and Dr. Robert Steidl. SNRE, University of Arizona.
Subject: Sites on Research Ranch to be used as control/reference compared to grazed grasslands
Application: Better understanding of ecological processes driving grassland ecosystems and aid development of sound management practices.

Chiricahua Leopard Frog Recovery
Arizona Game & Fish Dept.: Hunter McCall (2015), Cody Mosley (2014)
Subject: Establish and support populations
Application: Enhance long-range stability of federally threatened species.

Springsnail Survey
Arizona Game & Fish Dept.: Jeff Sorensen (2015).
Subject: Determine presence/absence of snail species in Finley Tank
Application: Baseline population information.

Northern Mexican Gartersnake Management
Arizona Game & Fish Dept.: Tom Jones (2014), Taylor Cotton. Roger Cogan & Linda Kennedy, Volunteers, covered under AZGF Section 6 authority to manage federally threatened species.
Subject: Capture, mark, process and release Mexican Gartersnakes
Application: Document recruitment and recaptures of federally threatened species.

Desert Pupfish
Arizona Game & Fish Dept.: Ross Timmons (2010).
Subject: Monitor and protect population of pupfish introduced into ranch stockponds and wildlife waters
Application: Conserve native species

Survey of Gould's Turkeys near Huachuca Mountains
Arizona Game and Fish Dept. John Millican (ret); 555 North Greasewood; Tucson, AZ 85745
Project: Estimate populations
Application: Track success of re-introduction effort

Avian Monitoring for Research Ranch IBA
Audubon staff: Tice Supplee, L Kennedy,
Project: Monitor bird species on AWRR
Application: Support IBA nomination (see also Wonkka), examine longterm trends

Bullfrogs: Monitoring and removal on the Research Ranch
Audubon Staff: L. Kennedy, R. Cogan
Subject: Discover and eradicate individuals within boundary of ARR
Application: Protect native fish, reptiles and amphibians from predatory, non-native species

Christmas Bird Count – Appleton Whittell Circle
Audubon staff. Suzanne Wilcox, Compiler (Audubon) and Tony Leonardini, volunteer
Subject: Conduct bird count as per Audubon standards.
Application: Pooled data yield important information re avian populations, movement and trends.

Depth to groundwater on Research Ranch
Audubon Staff & Volunteers
Project: Monitor the depth to groundwater of the wells on Research Ranch.
Application: This study helps establish a water consumption baseline for the Sonoita Valley.

Upland Vegetation (Ecological Site) Monitoring (ESM)

Audubon Staff– Linda Kennedy

Project: Establish permanent points to monitor vegetation change. Based on Ecological Site Map (Robinett & Breckenfeld)

Application: Identify trends in vegetation change

Precipitation at Ecological Sites

Audubon Staff – Linda Kennedy

Project: Establish range gages to correspond with ESM. Based on Ecological Site Map (Robinett & Breckenfeld)

Application: Correlate precipitation with changes in vegetation.

Wild Turkeys on the Research Ranch

Audubon Staff; Linda Kennedy, Assistant Director

Project: Record sightings of wild turkeys.

Application: Document spread of sub-species reintroduced in Huachuca Mtsn.

Effects of fire and climate change on mesquite

Audubon Staff: Kennedy, Linda

Project: Monitor the effects of fire and climate change on mesquite.

Effects of fire and climate change on cacti

Audubon Staff: Kennedy Linda,

Project: Monitor the effects fire and climate change on native cacti

Application: Baseline information for future research

Small mammal populations on the Appleton-Whittell Research Ranch

Audubon Staff: Linda Kennedy

Project: Develop long-term monitoring program based on Jones, Bock and Kennedy

Applicability: Indicate trends in small mammal populations

Survivorship of Riparian Trees in the Southwest

Bock, Carl & Jane Bock. University of Colorado (retired)

Project: Resurvey the riparian trees tagged in the 1980s.

Application: Determine the survivorship of native trees after fires, flood and drought

Agave Site Monitoring

BLM (Tucson Field office) and University of Arizona (Cochise Co. Extension). Kristen Duarte (BLM), Kim McReynolds (U of A)

Project: Establish permanent transects to monitor agave numbers, class and herbivory.

Application: Ungrazed land to function as control.

Assessing condition of O'Donnell Creek

BLM. Simms, Jeffrey, BLM Fish Biologist, Tucson Field Office, Nate Dietrich, BLM Hydrologist.

Project: Use Proper Functioning Condition Standards to evaluate the condition of a portion of O'Donnell Creek

Application: Environmental Assessment

Minimizing the effects of Green Sunfish (*Lepomis cyanellus*) on native competition.

Carter, Sean. Colorado College.

Project: Remove predatory, non-native sunfish from South Post Canyon pools

Application: Study changes in behavior of Sonora mud turtle when experiencing levels of competitive release.

Population dynamics and habitat characteristics of Montezuma (Mearn's) Quail in southeastern Arizona

Chavarria, Pedro Mazier, Ph.D., Northern New Mexico College and Louis Harveston, Ph.D., Sul Ross State University

Subject: Monitoring life history of Montezuma quail.

Application: Fill knowledge gaps about life history and determine how behavior and genetic viability is affected in areas where hunting is, and is not, allowed.

Annotated Bibliography of Lehmann Lovegrass

Chasey, Richard Adam. San Francisco State University

Project: Gather all known publications associated with non-native, invasive *Eragrostis Lehmanniana*

Application: Aid to research and management

Arizona Tree Frog documentation

Cogan, Roger C., Conservation Program Manager, AWRR.
Project: Discovered amphibian species new to AWRR. Document all sightings.
Application: Species is candidate for federal listing. May inform critical habitat designation.

Survey of herpetofauna (reptiles and amphibians) including den sites of Crotalids on the Research Ranch

Cogan, Roger C., Conservation Program Manager, AWRR.
Project: Document sightings of herps and monitor winter den sites
Application: Determine whether new species are on AWRR and if species earlier recorded are extant, plus document sites of critical importance to rattlesnake survival.

Use of Cover Boards to Locate and Monitor Reptile Species

Cogan, Roger C., Conservation Program Manager, AWRR.
Project: Distribute coverboards in specific locations across AWRR
Application: Evaluate technique to further baseline knowledge about reptiles.

A History of the Lands in the National Audubon Society's Research Ranch near Elgin, in Santa Cruz County, Arizona

Collins, Glendon E, Bureau of Land Management (retired), Arizona State Trust Lands (retired). Phoenix.
Subject: Compile and document history of land transactions involving federal and state lands.
Application: Background

Honeybee communication and the ecological context

Donaldson-Matasci, Matina. Assistant Professor. Harvey Mudd College
Project: Explore relationship between resource distribution and value of communication.
Application: Basic science on species

Current Distribution and Status of Slevin's Bunchgrass Lizard, Sceloporus slevini, in southeastern Arizona

d'Orgeix, Christian, Ph.D. Virginia State University;
Project: Survey for bunchgrass lizard.
Application: foundation for determining genetic relatedness of different populations and effects of bottlenecks on populations

Survey of Appleton-Whittell Research Ranch Drainages and Ponds for the Mexican Garter Snake

d'Orgeix, Christian, Ph.D., Virginia State University
Project: Survey for presence of Mexican garter snakes (Telles tank, O'Donnell Canyon, Post Canyon), and conduct long-term study of population at Finley tank.
Application: Management implications for Threatened species

Annotated bibliography of selected reports, publications and theses

Dyson Ruth E, Mason, Mi.
Project: Prepare annotated list/bibliography of publications of particular interest to ARR.
Application: Facilitate information exchange and document publications

Genetic approach for using pollen to determine plant resources used by nectarivorous bats.

Ferguson, George, University of Arizona, Tucson Arizona
Project: Collect tissue samples from Agave *parryii* v *huachucaensis*
Application: Determine usage of this species by Lesser Long Nosed Bats (Endangered Species)

Using soil moisture to assess ecosystem function following exotic lovegrass invasion in semiarid grasslands of southeastern Arizona

Fernald, Alexander G. (Sam), Ph.D., New Mexico State University
Project: Measure soil moisture under Plains lovegrass (*Eragrostis intermedia*), a native species, and Lehmann lovegrass (*E. lehmanniana*), an exotic species.
Application: Determine whether a semiarid grassland retains its functional integrity following the invasion of an introduced, exotic grass.

Merging functional ecology and phylogenetics to predict the response of grasslands to global change

Forrestel, Elisabeth, Melinda Smith, Ph.D., Yale University.
Project: Compare natural grassland sites across broad precipitation gradients in North America, Australia and South Africa.
Application: Provide evolutionary history and functional biology of ecologically and economically important grass species here.

Ecological and evolutionary responses of lizards to resource limitation

Gilbert, Anthony. Ohio University

Project: Quantify how resource limitation impacts lizard performance, fitness and social dominance.

Application: Furthering knowledge of how lizards may respond to anthropogenic disturbances such as climate change

Research Ranch boundary surveying and mapping

Greene, Dale and Kristen L. Greene. TerraData AZ. LLC.

Project: Survey and map Audubon property boundary and certain water catchments.

Application: 1) The exact perimeters of property owned by Audubon will be determined with up-to-date equipment and marked for posterity. 2) Location and physical characteristics of artificial water catchments will be determined and compared to existing records.

Survey of high desert grasslands Hymenoptera

Grissell, Eric, Sonoita, AZ

Project: Study insect diversity in southwest

Application: Significant contribution to state of knowledge

Introduction of Species Diversity into Boer Lovegrass Monocultures

Hershdorfer, Mary, formerly with USDA-NRCS Plant Materials Center.

Project: Determine effectiveness of various methods to increase native biodiversity into monoculture created by non-native lovegrass.

Application: Protect native grasslands

Linking individual behavior, microhabitat use, and spatial population structure with fitness

Jaworski, Kortney. John Carrol University

Project: Study behavior of adult male mountain spiny lizards (Sceloporus jarrovii)

Application: Insight onto the relationship between individual traits and population spatial structure and influence upon fitness.

Camera-trap Network

Joder, Greg, Tucson, AZ

Project: Collect photographic or video for archival purposes.

Application: Augmentation of research, ecosystem conservation and education/outreach goals of AWRR.

Photo-herbarium for the Research Ranch

Kennedy Linda, Director, Research Ranch

Project: Document life stages of plant species found on the Research Ranch.

Application: Baseline information for future research; Aids identification.

Sacaton Rehabilitation

Kennedy Linda, Ph.D. Research Ranch

Project: Re-establish *Sporobolus wrightii* in appropriate degraded sites.

Application: Improve wildlife habitat, bioremediation of sites dominated by exotic, invasive Bermudagrass.

Oak (*Quercus*) water use strategies in Sky Island Systems

Lackey, Russell, Dylan Schwilk. Texas Tech University,

Project: Determine physiological drought tolerance of native oak species

Application: Explain current patterns in community composition and distribution in relation to water balance.

Modeling impacts of habitat alterations on habitat use and diet selection of desert reptile communities

Lattanzio, Matthew S. Christopher Newport University, Newport News, VA.

Project: Determine how management practices and climatic variability affect resource availability and use by grassland reptiles

Application: Management practices may be altered to enhance habitat and use

Avian Survey/Monitoring on the Research Ranch

Leonardini, Tony. Volunteer, Appleton-Whittell Research Ranch

Project: Document avian species composition and population size.

Application: Baseline information and trends. Develop database to track and archive data.

Evaluating Avian Use of Restored Desert Grasslands

Levandoski, Greg. Rocky Mountain Bird Observatory

Project: Determine wintering abundance, distribution and habitat needs of grassland birds.
Application: Enable conservation of grassland birds by establishing baseline (control) response to restoration.

Flora of the Appleton-Whittell Research Ranch

McLaughlin Steven P., Ph.D., University of Arizona, (Ret.) Tucson AZ, Erika L. Geiger; USGS ; Janice E. Bowers; U.S. Geological Survey (Ret) Tucson AZ
Project: Compile a flora –a complete list of all flowering plants, ferns, and conifers on the Research Ranch.

Flora of Upper O'Donnell Canyon

Miller, Kathryn. Patagonia Union High School
Project: Collect plant specimens at TNC's Canelo Hills Cienega Preserve
Application: Creation of flora and herbarium for CHCP will establish baseline presence via voucher specimens. Duplicate specimens will be lodged at AWRR herbarium. Information will be available to researchers via SEINET.

Long-term meteorological, evaporation and carbon flux measurements

National Oceanic & Atmospheric Administration (NOAA); Tilden P. Meyers, Ph.D. Meterologist; NOAA, Oceanic and Atmospheric Research, Oak Ridge, TN; John Hughes, NOAA, National Data Climatic Center, U.S. Climate Reference Network, Ashville, NC
Subject: Climate Reference Network site – to characterize the water and carbon balance for typical ecosystem for arid southwest grasslands.
Application: Data will be used to improve the current land use models for climate change

The Effects of Fire and Grazing on Grassland Bird Diversity and Abundance in an Arizona Oak-Savanna

Nichols, Clay. Eastern New Mexico University, Portales, New Mexico
Project: Re-survey bird diversity on oak transects established by Bock & Bishop after Ryan fire.
Application: Provide information, long-term, on effect of wildfire on avian diversity and abundance

Impacts of grazing, fire and precipitation variability on woody plant cover in Chihuahuan Desert grasslands, USA

O'Neal, Kelley. Department of Geography, University of Maryland,
Project: Quantify changes in woody plant cover, map occurrence of grazing, fire and precipitation using (in part) Landsat and MODIS satellite data
Application: Identify trends, develop methodology

The Babacomari Restoration Project

H. Ron Pulliam. Borderlands Restoration, L3C
Subject: Re-establish avian plots from 1970s & 1980s to serve as control/reference areas.
Applicability: Evaluate effectiveness of rehabilitation efforts on Babacomari Cattle Ranch.

Babocomari River Protection

Robinett, Daniel G., Robinett Rangeland Resources, Elgin, AZ;, Coronado RD & D., Inc. Willcox.
Project: Establish transects and monitor streamside conditions of Babocomari River, O'Donnell and Turkey Creek for 5 years.
Application: Results will enable sound management decisions to maintain and/or improve vegetation conditions on Babocomari watershed. Will have application to other desert rivers.

Effects of the Ryan Wildfire (April 2002) on Wintering Grassland Birds in the Sonoita Valley, Arizona

Ruth, Janet M. Ph.D., (Ret.) USGS Arid Lands Field Station, Fort Collins Science Center, Department of Biology, University of New Mexico, Albuquerque, NM
Project: Compare pre-fire data collected on the Audubon Appleton-Whittell Research Ranch in 1999-2001 with post-fire data collected on the same transects and plots.
Application: Evaluate the effect of wild fire on wintering avian abundance/densities and vegetation structure/composition in desert grassland habitats.

Wintering habitat use by priority grassland birds

Ruth, Janet M. Ph.D., USGS (Ret). Arid Lands Field Station, University of New Mexico, Albuquerque, NM
Project: How do high priority grassland birds use habitats during the winter season? How is winter habitat use affected by land use practices such as grazing?

Distribution and abundance of breeding Arizona Grasshopper Sparrow (*Ammodramus savannarum ammolegus*), and associated priority grassland species, throughout its known range in the Southwest U.S.

Ruth, Janet M. Ph.D., (Ret.) USGS Arid Lands Field Station, University of New Mexico, Albuquerque, NM

Project: Document current distribution and abundance of Arizona Grasshopper Sparrows and associated priority grassland bird species. Test methodologies.

Application: Understanding status and distribution, population trends, ecology and habitat relationships is essential for conservation of avian species of concern.

Continuously Monitor Groundwater Levels

Salywon, Andrew, Ph.D., and R.J. Tiller, Ph.D., Desert Botanical Garden, Phoenix, AZ 85008

Project: Install pressure transducers in wells and piezometers to expand research program begun on northern portion of Las Cienegas NCA.

Application: Enhance ability to record temperature and water depth and data sharing capability.

Locate Native *Pectis imberbis*

Schmalzel, Robert (Bob). Sonoran BioQuest, LLC. Tucson, AZ

Project: Relocate historic sites of rare plant. Document habitat.

Application: Information may be used in support of or against federal listing.

Biomass of grassland in proximity to Thomas study plots and inspection of dead cactus carcasses for evidence of insect

Schmalzel, Robert (Bob). Sonoran BioQuest, LLC.

Project: Determine above-ground biomass and examine cacti for weevils

Application: comparison of biomass associated with Thomas study plots to Altar Valley grasslands

Evolution of Hummingbird Visual Traits

Simpson, Richard (Rick). Arizona State University, Tempe, AZ

Project: Film male hummingbird courtship displays and measure plumage coloration

Application: Understand the mechanisms by which multiple ornaments evolved

Population and habitat assessment of *Spiranthes delitescens*

Stromberg, Juliet, Ph.D., and Dustin Wolkis. Arizona State University, Tempe, AZ. Kimberlie McCue, Ph.D., and Steve Blackwell, Desert Botanical Garden

Project: Survey for and assess population size of *Spiranthes delitescens* (Canelo hills ladies tresses) and the wetland habitat.

Application: Information necessary for development of recovery plan for this federally Endangered species.

Wet-Dry Mapping

The Nature Conservancy. Miller, J.B., Canelo Hills Cienega Preserve

Project: Map extent of open water in O'Donnell Canyon

Application: Track the health of the San Pedro River by monitoring surface water during driest time of year.

Research and reintroduction effort for Huachuca Water Umbel

Titus, Jonathan H., Ph.D., SUNY-Fredonia, Fredonia, NY; Priscilla Titus, Fredonia NY

Project: Transplant plugs and monitor success

Application: Protect listed species, aid in development of recovery plan for species Meteorological Station

USDA-ARS. Keefer Tim, Hydrologist; Southwest Watershed Research Center; Tucson, AZ

Project: Station jointly owned by ARR & USDA

Application: Baseline information on climate available to researchers and land managers of region

Pre-monsoon post-fire sediment survey

USDA-ARS. Nichols Mary, Ph.D. Hydraulic Engineer, Tucson, AZ

Subject: Survey several stock tanks on ARR to determine level of sediment movement after monsoon. Ground cover lost due to Ryan Wildfire.

Application: Predict one factor in rangeland health post fires.

Conservation Effects Assessment Project on the Cienega Creek Watershed

USDA-ARS. Goodrich, David C. and Haiyan Wei. Southwest Watershed Research Center, Tucson, AZ

Project: Use data from the Research Ranch as a control to judge vegetation cover and condition for a non-grazed condition for a number of years.

Application: Quantify the benefits of conservation management and practices.

Soil inventory update

USDA-NRCS. Breckenfeld, Donald J., Daniel Robinett; Tucson, AZ

Project: A soil inventory update that coincides with soil surveys that have been done elsewhere in southern Arizona – updating the old soil survey to the new soil series and map units used in MLRA 41-1.

Application: Baseline information needed by other research projects.

Inventory of ecological sites, their present day condition, trend and rangeland health

USDA-NRCS: Robinett Dan, Don Breckenfeld, Tucson, AZ

Project: Mapped the ecological sites on ARR and compared present day plant communities to what our site guides show as potential for MLRA 41.

Application: Baseline information for future research and land management. Control area for comparison by ranch managers.

Natural Resources Inventory – Primary Site Unit

USDA-NRCS. Tucson, AZ. Emilio Carrillo (2004), Kristen Egen (1992), Steve Barker (1982)

Project: Repeated measures: vegetation and soil. Transects established in 1982, to be resampled on approximately decadal basis.

Application: Identification of trends – reference area for MLRa-41

Rangeland Health Reference Areas

USDA-NRCS (Natural Resources Conservation Service). Wilma Renken (2014), Ecological Site Inventory Specialist. Tucson Soil Survey Office. Tucson, AZ

Project: Determine reference areas for Ecological Sites Descriptions in MLRA-41 (high functioning rangelands with minimal human and livestock impacts)

Application: Reference areas to support rangeland health descriptions in 2-3 mil acres of SW.

National Soil Health & Sustainability

USDA-NRCS Dial, Heather. Tucson Plant Materials Center.

Project: Haney Soil Test on loamy upland, sacaton bottom, Boer monoculture

Application: Reference for comparison through time and against other land uses.

Agave Monitoring on the Coronado National Forest

US Forest Service. Biedenbender, Sharon, Ph.D. (Ret), James Heitholt

Project: Monitor impacts of livestock grazing on florivory of agave

Application: Management of food source for lesser long-nosed bat

Pectis imberbis surveys

USFWS. Julie Crawford. Tucson, AZ.

Project: Survey reported sites

Application: Information on species that may become federally listed.

Examining long-term effects of drought and fire on vegetation using high-resolution satellite phenometrics

Villarreal, Miquel. U.S.G.S. Tucson, AZ

Project: Field truth satellite imagery.

Application: Estimate changes on cover and phenology related to climate and fire

Chiricahua Leopard Frog reintroduction to the Research Ranch, a conservation strategy

Volentine, Sandy. Prescott College, Prescott AZ

Project: Explore opportunities and suitability for reintroduction effort of *Lithobates [Rana] chiricahuensis* to historic habitat

Application: Protect federally listed species

Inventory of native plant-feeding insects Arizona

Wheeler, Alfred G., Department of Entomology, Clemson University, Clemson, SC

Project: Collect insects that feed on Eragrostis spp. and other plants to identify species, and compare species composition with collections from NM, OK and TX.

Application: Baseline information on species occurrence and host plants

Ground Beetle (Coleoptera: Carabidae) assemblage responses to fire in southern Arizona.

Wright, Corynne A., Dept. of Organismal and Environmental Biology, Christopher Newport University, Newport News. Virginia

Project: Study Carabid diversity at four sites with varying fire histories.

Application: Contribute to understanding of how ground beetle assemblages respond to fire and habitat succession.

Comparison of the soil ecology and nutrient cycling in adjacent viticulture and native grassland habitats

Wyant, Karl. Arizona State University, Tempe, AZ

Project: Compare soil characteristics and fauna between ungrazed grassland and vineyards

Application: Elucidate the detrital food web associated with desert grasslands and adjacent viticulture operations.

Pollination without a keel: an investigation of floral form change in the genus *Dalea* (Fabaceae)

Zweck, Justin. Saint Louis Univ. St. Louis MO

Project: Compare pollination biology of *Dalea* species with "closed" and "open" floral forms

Application: May encourage planting of specific *Dalea* species to serve as host plants for pollinators that are important for legume crops.

Appendix E

Existing Improvements

Listed below are improvements which currently exist on the ranch. Some of the improvements may or may not be in working order or reflect what is listed on the AWRR leases/operating agreements. Following the list of improvements are examples of records of depth-to-groundwater available.

	Existing Fence	Ownership	Description	Condition
1	N-S center Sec 17 & 20; S edge Sec 20; W edge Sect 28; S ½ Sec 28; W edge Sec 34; T22S R18E	RCM BLM TNC	West Boundary	Functional
2	W ½ Sec 3; T21S R18E	USFS	West Boundary	Functional
3	S ½ Sec 2 & 3; T22S R18E	USFS	South Boundary	Functional
4	E 1/2 Sec 2; T22S R18E	USFS	East Boundary	Functional
5	E ½ Sec 35; E ¼ Sec 26; E edge Sec 23; E edge Sec 14; T21S R18E	Audubon BLM, USFS	East Boundary	Functional, lacks ¼ mi wildlife friendly*
6	N edge Sec 14; Sec 15; Sec 16; N ½ Sec 17; T21E R18S	Audubon RCM BLM	North Boundary	Functional
7	N edge Sec 26, Sec 34, E edge Sec 27; T22S R18E	Audubon/USFS	Pasture Division	Functional

*adjacent to Westgate (wildcat community), wildlife friendly fence would be irrelevant

	Existing Wells**	Ownership	Description	Condition
1	NE¼ Sec 16; T21S R18E	BLM	Pronghorn (Antelope) Well	Functioning
2	SW¼ Sec 22; T21S R18E	Audubon	Headquarters Well (2)	Functioning
3	NW¼ Sec 23; T21S R18E	Audubon	Bunkhouse Well	Functioning
4	SE¼ Sec 27; T21S R18E	Audubon	McDaniel Well	Functioning
5	SW¼ Sec 35; T21S R18E	USFS	Roadside Well	Not Functional
6	NW¼ Sec 3; T22S R18E	USFS	F.S. Well	Functioning
7	NW1/4 Sec 15; T21S R18E	RCM	Telles Well	Functioning
8	SW1/4 Sec 14; T21S R18E	RCM	Finley Well	Functioning

	Existing Storage	Ownership	Description	Condition
1	SW¼ Sec 22; T21S R18E	Audubon	Headquarters Storage	Functioning
2	NW¼ Sec 23; T21S R18E	Audubon	Bunkhouse Storage	Functioning

3	NW ¼ Sec 3; T22s R18E	USFS	Forest Service Storage	Functioning
4	NE ¼ Sec 28 T21S R18E	RCM	Appleton Storage	Functioning

Existing Troughs		**Ownership**	**Description**	**Condition**
1	SW¼ Sec 22; T21S R18E	Audubon	Barn Trough (2)	Functioning
2	NE¼ Sec 16; T21S R18E	BLM	Pronghorn (Antelope) Trough	Functioning
3	SE¼ Sec 27; T21S R18E	Audubon	McDaniel Trough	Bypassed
4	NE ¼ Sec 28 T21S R18E	RCM	Appleton Trough	Functioning
5	SE 1/4 Sec 16; T21S R18E	BLM	Bald Hill Trough	Functioning
6	NE ¼ Sec 17; T21S R18E	RCM	Vaughn Canyon Trough	Functioning
7	SW1/4 Sec 14; T21S R18E	RCM	Finley Trough	Functioning
8	NE ¼ Sec 22: T21S R18E	Audubon	Swinging H Drinker	Functioning
9	NW ¼ Sec 3; T22s R18E	USFS	Forest Service Well (2)	Functioning

Existing Dirt Tank		**Ownership**	**Description**	**Condition**
1	NW¼ Sec 15; T21S R18E	Audubon	Telles Tank	Functioning/Well fed
2	SW¼ Sec 14; T21S R18E	RCM	Finley Tank	Leaking/Well fed
3	SW¼ Sec 22; T21S R18E	Audubon	HQ Pond Tank	Endgrd Spp Pond Pipeline Fed
4	SE¼ Sec 26; T21S R18E	USFS	Mesa Tank	Unknown
5	SE¼ Sec 34; T21S R18E	USFS	Forest Tank	Unknown
6	NE ¼ Sec 17; T21S R18E	RCM	Vaughn Tank	Reliable/Well Fed
7	SE¼ Sec 27; T21S R18E	Audubon	McDaniel Tank	Reliable/Well Fed

Existing Developed Springs		**Ownership**	**Description**	**Condition**
1	NW1/4 Sec 15; T21S R18E	Audubon	Telles	Functioning

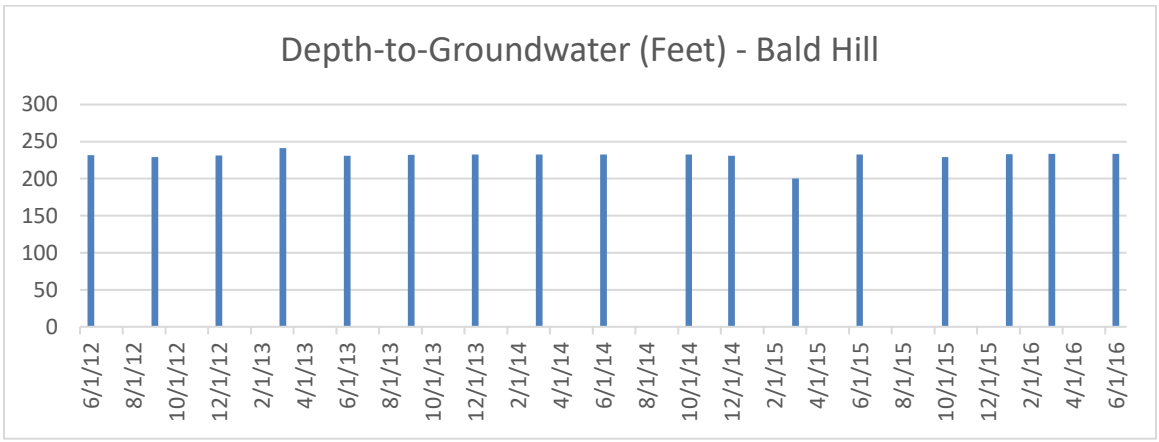
Existing Undeveloped Springs		**Ownership**	**Description**	**Condition**
1	SW¼ Sect 14; T21S R18E	RCM	Finley (2)	Functioning

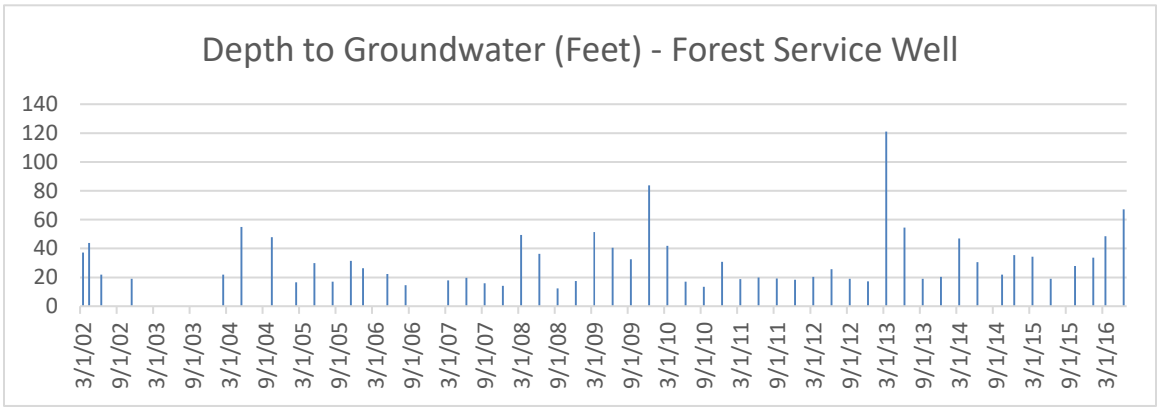
Existing Concrete Dams		**Ownership**	**Description**	**Condition**
1	SW ¼ Sec 28; T21S R18E	BLM	South Post Canyon	Functioning
2	SW ¼ Sec 28; T21S R18E	BLM	South Post Canyon	Functioning
3	SE ¼ Sec 28; T21S R18E	BLM	O'Donnell Canyon	Functioning
4	SE ¼ Sec 28; T21S R18E	BLM	O'Donnell Canyon	Functioning

Existing Pipeline		**Ownership**	**Description**	**Condition**
1	SE¼ Sec 16, NW ¼ Sec 21, NW ¼ Sec 22; T21S R18E	BLM	Bald Hill Pipeline	Not functioning

	Existing Erosion Control Structures	Ownership	Description	Condition
1	On File w/Arizona Dept of Water Resources. Audubon is gathering GPS locations.	Various		Most in good condition

**Wells are monitored quarterly by AWRR staff. Below are examples of results. Bald Hill is on land administered by BLM, Forest Service Well by CNF.





Appendix F – Ecosystems and Their Components

Major Land Resource Areas (MLRAs): Broad geographical areas that are characterized by a particular pattern of physiographic features. Soils, climate, vegetative, water resources, and land use are used to delineate the different land resource areas throughout the state. In accordance with NRCS guidelines, AWRR falls within the 41AZ Southern Arizona Basin and Range MLRA.

Land Resource Areas/Common Resource Area: A Land Resource Area (LRU) is the basic unit from which MLRAs are determined. They are also the basic mapping units for State Land Resource Maps and have been more historically used in the southwestern portion of the United States. Common Resource Areas (CRA), much like LRUs, are mapping units that are created by subdividing MLRAs by resource concerns, soil taxonomy and groups, hydrologic units, resource use, topography, other landscape features, human considerations affecting land use and land treatment needs. CRAs are a more specific description of local land sites and are named as a subunit under the MLRA symbol followed by a dot numeric code (e.g. 40.1AZ). CRAs are not State specific; they cross State boundaries as described by their geographic areas and physical characteristics. CRAs are more widely accepted across the nation for land unit descriptions and will be used for the ecological site descriptions in this management plan although LRUs may commonly be used in written descriptions. Ecological sites are described in accordance with the CRA descriptions local to the AWRR within this plan. CRAs mapped within the 41AZ are the: 41.1 AZ Mexican Oak-Pine Forest and Oak Savannah and the 41.3AZ Semidesert Grassland CRA. Ecological sites were mapped in accordance with these CRAs.

Ecological Sites: The ecological concept of plant succession and historic climax plant community is the foundation by which universities, the NRCS, federal and state land management agencies, and other landowners and managers categorize and evaluate rangelands. The concept of plant succession is based upon the process of vegetation community development through time where an area is successively occupied by different plants of higher ecological order and greater species diversity. The climax plant community refers to the highest ecological development of plant community on a given site as determined by climate, soil and soil parent material, and by topographic, vegetative, fire and animal factors. Some species have greater genetic amplitude than others and may occur throughout the different plant successional stages. Sometimes reaching the climax plant community is an impractical objective, such as where a naturalized plant community of non-native species becomes established and dominant or where historic soil erosion has removed most of the soil surface (A horizon).

The ecological site is the basic mapping unit used in this rangeland inventory. An ecological site is a distinctive kind of rangeland that has the potential to support a native community typified by an association of species different from that of other sites. Ecological site descriptions have been developed within each MLRA. For this ranch, each ecological site was mapped in accordance with these guidelines. Non-native species are not included in the typical ecological site descriptions.

Appendix G - Benchmark Inventory Assessments: An ecological site and similarity survey for AWRR was conducted in the years 2000 and repeated in 2014-15 by Audubon and NRCS. Annual plant production was included in these surveys. The inventories were conducted using the Range Inventory and Condition (AZ-SCS-Range 1) format and the Double Sampling method with the old Ecological Site Descriptions (Range Site Guides).

Dan Robinett of the Tucson Resource Support Team Office of the Natural Resources Conservation Service (NRCS) completed an inventory of ecological sites on AWRR with the assistance of Linda Kennedy. This inventory was completed during the course of the soil survey update being done by Don Breckenfeld, also of NRCS. Others participating in this effort include Phil Heilman of the Southwest Watershed Research Center of Agricultural Research Service, Joan Scott of the Arizona Game and Fish Department, Dana Backer of the Nature Conservancy and Emilio Carrillo of the NRCS. The work was done from October 16 through 20 and November 14 and 15, 2000 and February 8, 2001. Thirty-two sites were evaluated using NRCS methods for rangeland inventory (see NRCS Nat. Range and Pastureland Handbook, Sept. 1997). Arizona NRCS ecological site descriptions for MLRA 41-3 and 41-1 were used to compare existing plant communities to potentials (see NRCS Site Descriptions for 41-3, 1988 and 41-1 1992). This part of the rangeland condition classification is called the "Similarity Index" and refers to the similarity of the existing plant community to the potential plant community. In addition, each site was assessed as to the "Trend" of the plant community towards or away from the site potential and finally each site was assessed a rangeland health. This is a technique developed by the USDA Agricultural Research Service (ARS), NRCS and the Bureau of Land Management (BLM) which evaluates 17 indicators of ecosystem function relating to the condition of the site to; soil and site stability, biotic integrity and hydrologic function (see BLM and NRCS Tech. Ref 1734-6, Ver. 4, Interpreting Indicators of Rangeland Health).
Eleven different ecological sites were identified and mapped on the Research Ranch. Four were assessed using the Ecological Site Descriptions for MLRA 41-3; the others were assessed using the descriptions for MLRA 41-1. Some inclusions of other ecological sites occur within each of the larger sites but were too minute to exclude from the larger units.

Thirteen of locations were revisited in November of 2014 by NRCS and others. A new site was added on USFS in November of 2015. Current years' growth was clipped at each of these locations to estimate annual production of all species using the Double-Sampling method. Changes since the initial inventory 14 years ago are described briefly under each site assessed. In addition, a table is included comparing Similarity Index and Rangeland Health at the end of this section.

The names of certain ecological sites have been changed; the original name is in brackets.

Clayey Swales [Clayey Bottom] 41-3 (12-16pz)
2000-2001: This site occurs in one area as a small floodplain in the northwest end of O'Donnell canyon. Soils are deep and clayey and have high shrink-swell potentials.

Slopes are less than one percent. The site receives extra water in the form of runon from adjacent uplands. The present day and potential plant communities are similar being dominated by tobosa (*Hilaria mutica [Pleuraphis mutica*]) and vine mesquite (*Panicum obtusum*) grasses. Similarity index is high and the site is healthy.
2014: This site was not revisited.

Loamy Bottom [Loamy Bottom, subirrigated] 41-3 (12-16pz)
2000-2001: This site occurs as the major floodplains of O'Donnell, Post and Turkey Creek canyons. Soils are deep and silty-clayloam in texture. Slopes are less than one percent. The soils benefit from extra water received as both, flooding of the stream channels and high water tables (1 to 10 meters). The present day and potential plant communities are similar both being dominated by giant sacaton (*Sporobolus wrightii).* One area of this site was assessed and had a very high similarity index and was healthy.
2014: A site similar to this was examned. It continues to have very high similarity index and remains dominated by sacaton. Range Health showed all attributes were stable.

Loamy Swales [Loamy Bottom, swales] 41-3 (12-16pz)
2000-2001: This site occurs as small floodplains of the tributaries of major streams throughout the area. Soils are deep and range in texture from sandyloam to clayloams. Slopes are from one to two percent. They benefit from extra water received as runon from adjacent uplands. The present day and potential plant communities are similar and the two areas of this site that were assessed both had high similarity indices and were healthy. Historic severe gully erosion dating from the 1920's and 1930's has healed extremely well in all of these bottoms. Native grasses like blue and sideoats gramas (*Bouteloua gracilis, B. curtipendula*), cane beardgrass (*Bothriochloa barbinodis),* vine mesquite (*Panicum obtusum*), and Arizona cottontop *(Digitaria californica)* dominate the plant community.
2014: These sites were found to have increases in sideoats grama (*Boutuloua curtipendula*), mesa threeawn (*Aristida ternipes v. hamulosa*) and shrubby buckwheat (*Eriogonum wrightii).* Burmudagrass (*Cynodon dactylon)* has now come into some of these areas as well so the biotic integrity is at risk. Production is very similar to 2000.

Clayey Slopes [Clayey Hills] 41-3 (12-16pz)
2000-2001: This site occurs as small areas of steep hillslopes in the breaks along the north end of O'Donnell canyon. Soils are deep and clayey and developed in lacustrine (lakebed) deposits. They have high amounts of gypsum causing them to be highly erodible. Slopes are from 15 to 45 percent. The present day and potential plant communities are both dominated by tobosa grass (*Hilaria mutica [Pleuraphis mutica*]) but historic accelerated erosion caused by cattle trails have put areas of this site in an "unhealthy" classification. This erosion is probably proceeding at geologic rates at present and should not be cause for alarm.
2014: This site was not reassessed.

Sandy Loam Upland 41-1 (16-20pz)
2000-2001: This site occurs as fan terraces and inset fans alongside the bottomlands of Post Canyon. Soils are deep, reddish colored and loamy. Slopes are from one to five

percent. The surface soil is sandy loam six to twelve inches thick over clayey subsoils. Soils are neutral to slightly acid pH. The thick, coarse textured surface takes summer rainfall very well and lets it slowly infiltrate the heavy textured subsoils. Native grasses dominate the plant community including blue, black and sideoats gramas (*Bouteloua gracilis, B. eriopoda, B. curtipendula*), cane beardgrass (*Bothriochloa barbinodis*), Arizona cottontop (*Digitaria californica*), plains lovegrass (*Eragrostis intermedia*), fall witchgrass (*Digitaria cognata*), and threeawns (*Aristida* spp.).
2014: This location is included in the area Audubon staff treats annually to control exotic grass species. This site was first sampled on October 19, 2000. The data from that inventory show a native plant community with low production (700 lbs./ac.) the summer after a spring prescribed burn. The similarity index was 82 but that was calculated using the older 1996 NRCS site guides and not adjusting for production. The year 2000, through time of inventory, had slightly below average precipitation. In October 10.5 inches of rain occurred but did not influence production of grasses. When we adjusted the 2000 similarity index of 82 for production the score came down to 42. The site was resampled for condition and production by NRCS in November 2014. The similarity index calculated from this inventory used the 2005 NRCS site guides and was adjusted for average year production (1645 lbs./ac). The NRCS score in 2014 was 40. Precipitation in 2014 was very close to the historic average. The trend monitoring data shows a nearly static trend in the plant community. Production is still low on this site but fires have occurred in 2000, 2002 and 2009 perhaps having an impact on the survival and recruitment of native mid-grass species need to improve annual production and increase the condition score.

Loamy Upland 41-1 (16-20pz)
2000-2001: This site is the most common upland ecological site on the Research Ranch. It occurs as fan terraces and mesa tops. Soils are deep, reddish colored and loamy textured. Slopes are from one to ten percent. Soils are neutral to slightly acid pH. Soils surfaces are very gravelly sandy loams one to three inches thick over a clay loam horizon about six inches thick. Dense, red, clayey subsoils underlie this surface. The thin coarse textured surfaces do not take summer rainfall very well and when the native grass cover is depleted this site can easily produce runoff and erosion at accelerated rates. Eight areas of this site were evaluated. Three of these areas were either dominated by non-native lovegrasses or are being invaded by them and were rated as "at risk" with low similarity indices. One area had historic heavy soil erosion and may not have enough soil surface left to ever recover to the sites potential. It also rated as "at risk" and other areas between Post Canyon and O'Donnell Canyon appeared to be in the same condition. Five areas had high similarity indices and rated as "healthy". Native grasses dominate this plant community and include blue, sideoats and sprucetop gramas (*Bouteloua gracilis, B. curtipendula, B. chondrosioides),* cane beardgrass (*Bothriochloa barbinodis*), plains lovegrass (*Eragrostis intermedia*), wolftail (*Lycurus setusus*), and threeawns (*Aristida* spp.). Herbaceous production on one inventory point was determined to yield 1,500 lbs./acre of annual production (dry weight) by clipping current year growth.
2014: Three original transects and an additional three on this ecological site were examined. In general, the sites continue to show increases in Lehmann lovegrass, having over 50% of the production. Annual production varied from 1500 to 2500 lbs per acre due

to this Lehmann increase which also caused biotic integrity to be at risk on most sites. Similarity Indices are much lower due to this increase as well. There are still native grasses at each site, but, in much lower amounts than 14 years ago.

Limy Slopes 41-1 (16-20pz)

2000-2001: This site occurs on moderate to steep slopes in the canyons around Bald Hill and the breaks into O'Donnell, Turkey and Post canyons. Soils are deep, gravelly and/or cobbly, and very calcareous. Soil textures range from very gravelly sandy loams to loams. The surface six to ten inches is dark colored over light colored subsoils. Soil reaction is alkaline with pH of about 8.

Slopes are from 10 to 45 percent. Seven areas of this site were evaluated. The present day and potential plant communities are very similar with indices of 72 to 95 and all sites rated as "healthy". Native grasses dominate the plant community including black and sideoats gramas *(Bouteloua eriopoda, B. curtipendula*), slim (slender) tridens (*Tridens muticus*), wooly bunchgrass (*Elionurus barbiculmis*), crinkleawn (*Trachypogon secundus*), blue threeawn (*Aristida purpurea v. nealleyi*) and New Mexico feathergrass (*Stipa neomexicana*) . Numerous perennial forbs are unique to these calcareous soils. The dominant shrubs are beargrass (Nolina microcarpa), sotol (*Dasylirion wheeleri*), spreading ratany *(Krameria lanceolata*), false mesquite (*Calliandra eriopoda*) and mimosa species. On some north aspects this site has an overstory of Emory and Arizona white oaks (*Quercus emoryii, Q. arizonica*) resembling the same site in a higher precipitation zone that is oak woodland.

2014: This ecological site was not revisited.

Loamy Slopes [Loamy Hills] 41-1 (16-20pz)

2000-2001: This site occurs in complex with the Limy Slopes described above. Soils are deep and gravelly to cobbly loams to clay loams. Soil reaction is neutral to slightly acid pH. Slopes are from 10 to 45 percent. The soil surface is typically a very dark colored cobbly and/or gravelly loam two to eight inches thick over reddish clay subsoils. Seven areas of this ecological site were evaluated. Similarity indices ranged from 56 to 90. In two areas non-native lovegrasses are increasing resulting in low indices and "at risk" ratings for range health. In three other areas the present day and potential plant communities were very similar and the sites were "healthy". Native grasses dominate the plant community. On southern aspects the main species are sideoats grama (*Bouteloua curtipendula*), cane beardgrass (*Bothriochloa barbinodis*), tanglehead (*Heteropogon contortus*), plains lovegrass (*Eragrostis intermedia*), and green sprangletop (*Leptochloa dubia*). On northern aspects the dominant grasses include these plus bullgrass (Muhlenbergia emersleyi), Texas bluestem (*Schizachryium cirratum*) and threeawn (*Aristida* sp.). Important native shrubs on this site are wait-a-bit and velvet-pod mimosas (*Mimosa aculeaticarpa v. binucifera, M. dysocarpa*), false mesquite (*Calliandra eriopoda*), Palmers agave (*Agave palmeri*), yerba-de-pasmo (*Baccharis pternioides*), and rainbow cactus (*Echinocereus rigidissimus*). This site appears to be the most important site for Palmer agave within its range in southern Arizona. Two areas (#14 and 25) of this ecological site were inventoried on steep north aspects where the plant communities are more characteristic of the same site in a higher precipitation zone. These areas had an oak woodland community dominated by Emory and Arizona white oak (*Quercus emoryii, Q.*

arizonica). The canopy cover at both sites was from 20 to 25 percent and understory production was about 1000 pounds per acre per year, which is normal for the site. These two areas had very high similarity indices and rated as "healthy".
2014: These sites were not revisited.

Limestone Hills 41-1 (16-20pz)
2000-2001: A few small areas of this site occur on steep slopes in Post and O'Donnell Canyons. Soils are shallow to calcareous conglomerate parent materials. Slopes are from 15 to 60 percent. Soil reaction is alkaline with pH of about 8. Soil textures are very gravelly loams to clayloams and light colored or pinkish. One area of this site was evaluated and the present day and potential plant communities are very similar except that shrubby species have thickened in the absence of natural fires. Historic erosion has put this site in an "at risk" classification and present day erosion is probably occurring at geologic rates. Dominant plants of this site are shrubs including desert ceanothus (*Ceanothus greggii*), mountain mahogany (*Cercocarpus montanus*), cliffrose (*Purshia stansburiana*), silktassle (*Garrya wrightii*), sotol (*Dasylirion wheeleri)*, beargrass (*Nolina microcarpa*), and skunkbush sumac (*Rhus trilobata*). Common grasses are black, purple and sideoats gramas (*Bouteloua eriopoda, B. radicosa, B. curtipendula*), purple muhly (*Muhlenbergia rigida*), bullgrass (*Muhlenbergia emersleyi*), New Mexico feathergrass (*Stipa neomexicana*), woolly bunchgrass (*Elionurus barbiculmis*), and crinkleawn (*Trachypogon secundus*). Alligator juniper (*Juniperus deppeana*) , Mexican pinyon (*Pinus cembroides*), Emory and Arizona white oaks (*Quercus emoryii, Q. arizonica)* dominate on cool north aspects.
2014: These sites were not revisited.

Sandy Wash [Sandy Bottom, subirrigated] 41-1 (16-20pz)
2000-2001: This site occurs along stream channels and on low stream terraces. It is the sandy bottoms of Turkey Creek and Post and O'Donnell Canyons. Soils are deep and sandy and gravelly. Slopes are less than one percent. This site benefits both from extra water received as flooding of stream channels and periodic high water tables. One area of this site was evaluated in Post Canyon and the present day and potential plant communities are very similar. This is a woodland site and the dominant tree species include cottonwood (*Populus fremontii*), willow (*Salix gooddingii*), Arizona ash (*Fraxinus velutina*), Arizona black walnut (*Juglans major*), and desert willow (*Chilopsis linearis*). The main shrubs and vines are canyon grape (*Vitus arizonica*), coyote willow (*Salix exigua*), batamote (*Baccharis salicifolia*) and rabbitbrush (*Ericameria nausosus*). Deergrass (*Muhlenbergia rigens*), sedges (*Carex, Cyperus* spp), rushes (*Eleocharis, Scirpus* spp.) and horsetail (*Equisetum laevigatum*) dominate the grasslike component of the understory.
2014: This site was not revisited.

Granitic Hills [Shallow Hills] 41-1 (20-23pz) This site name is listed as Granitic Hills but is likely going back to the name of Shallow Hills in the future.
2000-2001: This site occurs as moderate to steep slopes in the upper drainages of Post and O'Donnell Canyons. Slopes are from 15 to 55 percent. Soils are shallow very gravelly loams to clay loams over parent materials of granite, rhyolite, quartzite and other

metamorphic rocks. Soil reaction is slightly acidic. Two areas of this site were evaluated and the present day and potential plant communities are similar with indices of 60 and both were assessed as "healthy". Shrubby species have thickened on this site in the absence of historic fires and reduces the similarity indices. The plant community is open woodland of Emory and Arizona White oaks (*Quercus emoryii, Q. arizonica*) with lesser amounts of Mexican pinyon (*Pinus cembroides*) and alligator juniper (*Juniperus deppeana*). Canopy cover averages 15 to 25 percent. Common understory grasses are sideoats, purple and hairy gramas (*Bouteloa curtipendula, B. radicosa, B. hirsuta*), bullgrass (*Muhlenbergia emersleyi*), plains lovegrass (*Eragrostis intermedia*), Texas bluestem (*Schizachrium cirratum*), cane beardgrass (*Bothriochloa barbinodis*), and threeawns (*Aristida*). Common shrubs include the mimosas (*Mimosa aculeaticarpa v. binucifera, M. dysocarpa)*, agave (Ag*ave palmeri*), Schott yucca (*Yucca schottii*), sotol (*Dasylirion wheeleri*), beargrass (*Nolina microcarpa*), manzanita (*Arctostaphylos pungens*), skunkbush sumac (*Rhus trilobata*), yerba-de-pasmo (*Baccharis pteronioides*), shrubby buckwheat (*Erigonum wrightii*) and cane cholla (*Cylindropuntia spinosior*). Forbs are primarily shade tolerant species like herbaceous sage (*Artemesia ludoviciana*), ferns, and daisy (*Erigeron* spp.).

2014-2015:

One location (TNC parcel) was not revisited, but has been monitored annually (beginning 2003) by Audubon staff using the Pace Frequency method. This transect (#666) burned in the 2002 Ryan Wildfire, but appears to be stable or trending upward. Cane beardgrass has increased in frequency from 7% to 28%; Sideoats grama from 22% to 50%. Transect #772 is on USFS and has been monitored by Audubon beginning in 2004. Frequency of Yerba de pasmo decreased from 19% to 1% in 2013, but has rebounded to 7% in 2015. Spidergrass has increased greatly, from 2% to 35%. Cane beardgrass has increased from 2% to 10%. Sprucetop grama has dropped from 60% down to 38%, however sideoats has increased from 36% to 53%. Plains lovegrass has shown a dramatic decrease from 29% to 4%, as has curley mesquite (44% to 26%). A new transect was established in 2015 on USFS, #1351. Similarity Index is 63 here mainly due to the low amounts of mid-grasses (plains lovegrass, Cane beargrass, green sprangletop).

2000 and 2014 Comparison of Ecological Sites on AWRR: Ecological Sites are a distinctive kind of land with specific physical characteristics that differs from other kinds of land in its ability to produce a distinctive kind and amount of vegetation, and its ability to respond to management actions and natural disturbances. In essence, Ecological Sites are a way to divide landscapes into basic units of study, evaluation and management.

The potential plant communities found on an ecological site are naturally variable. Composition and production will vary with yearly conditions, location, aspect, and the natural variability of the soils. The Climax Plant Community represents the natural potential plant communities found on relict or relatively undisturbed sites. NRCS uses a Similarity Index to compare existing plant communities to the plant communities described in an Ecological Site Description. Similarity index is determined by comparing the annual production and composition of a plant community to the annual production of a plant community described in the Ecological Site Description. To determine Similarity Index, comparison of the production (air dry weight) of each species to that shown in the plant community description.

Thirty-two locations were inventoried in 2000. Fourteen locations were inventoried in 2014 and 2015. Some sites were the same and some sites were added that are currently monitored by AWRR staff.

From the total species composition data, we are able to derive similarity indices by comparing current annual weights of individual plant species to that of the sites potential weights. These comparisons convey a sites likeness to that of the desired plant community on a scale range from 1 to 100; one indicating low or no similarity, 100 being the potential plant community. The similarity index can be used as an assessment of the current plant community in relationship to the desired or climax plant community. Indices that are collected over time can depict the trend or direction of change the current plant communities are heading in relationship to the desired plant community. Management practices are directly affected and may have to be adjusted or implemented to maintain or improve a declining state of a site in order to meet management goals.

Production was estimated based on clipping data and ocular estimates gathered from the AZ-SCS-Range 1 and 417 which summarized data gathered using the Comparative Yield methods on individual ecological sites. Total annual production includes all trees, shrubs, perennials grasses, perennial forbs, annual grasses and forbs and cacti species. In 2000-2001 most were estimated while in 2014-15 all sites were clipped and weighed utilizing a Double Sampling technique.

The table on the next page illustrates the differences found.

SITE #	ECOLOGICAL SITE	Similarity Index 2000	Similarity Index 2014	Range Health 2000	Range Health 2014	Production 2000	Production 2014
5	Loamy Bottom Swales	70	62	All Stable	Biotic Integrity At Risk	2000*	2448
8	Loamy Upland	52	45	Biotic Integrity At Risk	Biotic Integrity At Risk	1000*	2567
15	Loamy Slopes	56	80	Watershed Function At Risk	All Stable	500*	2083
20	Sandy Loam Upland	82	40	All Stable	All Stable	700*	842
23	Loamy Upland	90	30	All Stable	Biotic Integrity At Risk	1516	1653
24	Loamy Slopes	67	29	Biotic Integrity At Risk	Biotic Integrity At Risk	1000*	1953
29	Granitic Hills	60	53	All Stable	All Stable	900*	713
30	Loamy Upland	79	26	All Stable	Biotic Integrity At Risk	1000*	1483
650	Loamy Upland		43		Biotic Integrity At Risk		1569
706	Loamy Upland		36		Biotic Integrity At Risk		1309
TRR1	Loamy Bottom		49		All Stable		1632
C1	Loamy Upland		57		All Stable		1558
C2	Granitic Hills		102, 93		All Stable		4256
ARR 1351	Granitic Hills		63		Biotic Integrity At Risk		786
						*Estimate	

Field Notes on Each Site Inventoried

Site 5 – Loamy Bottom Swales - Change in 2014 is sideoats increase, mesa 3-awn now present, bermudagrass now present. Shrubby buckwheat increase, forbs similar. Production similar. Biotic Integrity at departed now.

Site 8 – Loamy Upland – Change in 2014 is Boers is gone but Lehmann is 1467 lbs of 2567 lbs production. It was estimated at just 1000 lbs in 2000. Hairy, sprucetop gone. Forbs similar. Mesquite slight increase. Biotic Integrity at risk both surveys.

Site 15 – Loamy Slopes - Change in 2014 – sideoats and cane beardgrass increased. Lehmann and blue grama on site in small amounts. Forbs are down. Yerba-de-pasmo is up a little. Watershed function now stabilized. Production went from 500 estimated to 2085 clipped in 2014. Similarity Index way up.

Site 20 – Sandy Loam Upland – Change in 2014 is loss or decrease in midgrasses, perhaps because site burned in 2000, 2002 and 2009. Yerba-de-pasmo increase by 5% also. Range Health Assessment (RHA) is stable.

Site 23 – Loamy Upland – Change in 2014 is huge Lehmann increase – 2/3 of all production now. Most other grass still there, but, lower amounts. Yerba-de-pasmo increased as well. Forbs similar. Similarity Index from 90 to 30 due to Lehmann and Biotic Integrity now at risk.

Site 24 – Loamy Slopes – Lehmann huge increase with 60% of all production now. Boers on site now as well. Sideoats lower, missing: Plains lovegrass, falls witchgrass, sprangletop, cottontop, most shrubs. Goldeneye is on site now. Biotic Integrity was and is at risk. Production is doubled but it is Lehmann. Similarity Index: 67 to 29.

Site 29 – Granitic Hills – Change in 2014 is loss of plains lovegrass and hairy grama. Other grasses similar and no introduced on site. Forbs increase fourfold and shrubs similar. Similarity Index similar 60 to 53. Site still stable.

Site 30 – Loamy Upland – Change in 2014 is no Lehmann's before, now it is 2/3 of production. Native grasses still here but in low amounts – plains lovegrass, blue grama, sideoats, cane beardgrass and cottontop. Forbs and shrubs similar. Similarity Index from 79 to 26, Biotic Integrity at risk.

General observations – Loamy Upland and slopes mostly seeing Lehmann lovegrass increase and natives down. Loamy Slopes – one increased in SI and one decreased due to Lehmann. Sandy Loam Uplands losing natives, Granitic Hills similar and Loamy Bottom similar but gaining Bermudagrass. All watershed functions are stable now, just many at risk on Biotic Integrity.

Sites only done in 2014 Summary:

650 – Loamy Upland -Sideoats, blue grama, plains lovegrass and sprucetop are here but in much lower amounts than ecological site guide. Lehmann lovegrass is on this site for about 20% of production. Yerba-de-pasmo is higher than should be. Similarity Index just 43 and Biotic Integrity at risk. Production ok but not correct species composition. Sprucetop has slowly declined since 2003 Frequency monitoring set up. Sideoats, Blue and Hairy hanging in. Lehmann has increased steadily. Yerba-de-pasmo shows steady increase. Species richness is about the same now as first monitoring.

706 – Loamy Upland - Natives are here but much lower than should be for the site. Cane beardgrass is much higher than expected. Some Lehmann's but not much as once was. Goldeneye is very high for site and so is mesquite. Similarity Index is only 36 due to this. Forbs are ok. Production ok but not correct spp. Frequency set up in 1997 here. Shrubby buckwheat decreased. Cane beard increased starting 2011. Steady decline in curly mesquite, wolftail, and Plains lovegrass. Forbs up and down through years.

C-1 –Loamy Upland - Cane beardgrass and some other native grasses low. Forbs and shrubs less than expected for site. Production a little higher than guide, mainly due to high blue grama and sprucetop grama and some Lehmann's. Similarity Index 49. Frequency transect set up in 2004 shows 90% hits on Blue grama, rest of grasses low. Similar on forbs and shrubs – ragweed was 20%. Sprucetop increases in 2005 and has remained steady around 40% hit.

C-2- Granitic Hills – Native grasses in high amounts but missing several midgrass. Lehmann's on site but not much. Forbs ok, shrubs a little low. Similarity Index is 57. Production a little higher than guide. Frequency started in 2004. Shrubs steady decline, Sprucetop and sideoats up and down. Plains down through years, Curley about ½ from start now. Forbs up and down too.

TRR1 – Loamy Bottom – Mainly sacaton, no shrubs. Perfect site. Using normal production got Similarity Index of 102. When using precipitation at its highest potential, this number became more realistic with a 93.

ARR 1351 – Granitic Hills – The site has high diversity of grass species with sideoats grama, vine mesquite and spidergrass in high amounts. It is missing sprangletop and plains lovegrass as main component, they are there but small amounts. Some Lehmann and velvet pod as invaders. Arizona white oak was very high production but probably from hitting a large tree in transect. Production was much higher than reference due to this.

Soils: A soil survey by SCS and published in 1979 (Soil Survey of Santa Cruz and Parts of Cochise and Pima Counties, AZ) provided base nomenclature and mapping units. The table, below, crosswalks this soil survey and the survey conducted by Breckenfeld & Robinett (NRCS) in 2001 (available on the AWRR website).

SITE #	ECOLOGICAL SITE	SOIL FROM 1979 SURVEY	SOIL FROM 2001 SURVEY
5	Loamy Bottom Swales	BhD	90
8	Loamy Upland	WgC	110
15	Loamy Slopes	BhD	10
20	Sandy Loam Upland	WgC	100
23	Loamy Upland	WgC	10
24	Loamy Slopes	WgC	110
29	Granitic Hills	FrE	10
30	Loamy Upland	FrE	120
650	Loamy Upland	WgC	110
706	Loamy Upland	Haf	10
TRR1	Loamy Bottom	Pima	40
C1	Loamy Upland	WgC	110
C2	Granitic Hills	FrE	10
ARR 1351	Granitic Hills	FrE	10

Rangeland Health: The Rangeland Health assessment evaluates how well ecological processes on a given site are functioning. Ecological processes include the water cycle (the capture, storage and safe release of precipitation), energy flow (conversion of sunlight to plant and then animal matter), and nutrient cycle (the cycle of nutrients through the physical and biotic components of the environment). The product of this qualitative assessment is not a single rating of rangeland health, but an assessment of 3 components called attributes. These attributes are; Soil/Site Stability, Hydrologic Function, and Biotic Integrity. Each of the attributes relate to the ecological processes described above. There are 17 indicators used for the evaluation of the 3 attributes. A rangeland health assessment provides information in the functioning of ecological processes relative to the reference state for the ecological site or other functionally similar unit for that land area.

Range Health was assessed on each ecological site during the inventory period. Attributes including Soil/Site Stability, Hydrologic Function and Biotic Integrity are evaluated and given a rating depicting the site's departure from a reference state. Reference states are a depiction of the proper functioning condition of a site. Each ecological site has a specific reference state and desired states should help guide management goals and objectives. Management practices have an effect on the health of a site and should be adjusted according to the management goals. There are 17 indicators used for the evaluation and when combined give a qualitative assessment of the entire site.

Trend

Rangeland trend is defined as the direction of change in an existing plant community relative to the climax plant community as described in the ecological site descriptions or the desired plant community as described by the client's goals. Trend is also measured on long term monitoring transects by comparing frequency fluctuations. It can be determined as apparent trend or measured trend. Apparent trend is a point in time determination of the direction of change. Measured trend requires measurements of the trend indicators over a period of time. Rangeland trend is monitored on all rangelands ecological sites and is described as: *Toward or upward* - Moving towards the historic climax plant community. *Not apparent or stable* - No change detectable. *Away from or downward* - Moving away from the climax plant community.

Overall trend of each is depicted in the frequency data collected by the AWRR. Data sheets from the 2014/2015 inventory are available upon request by partners.

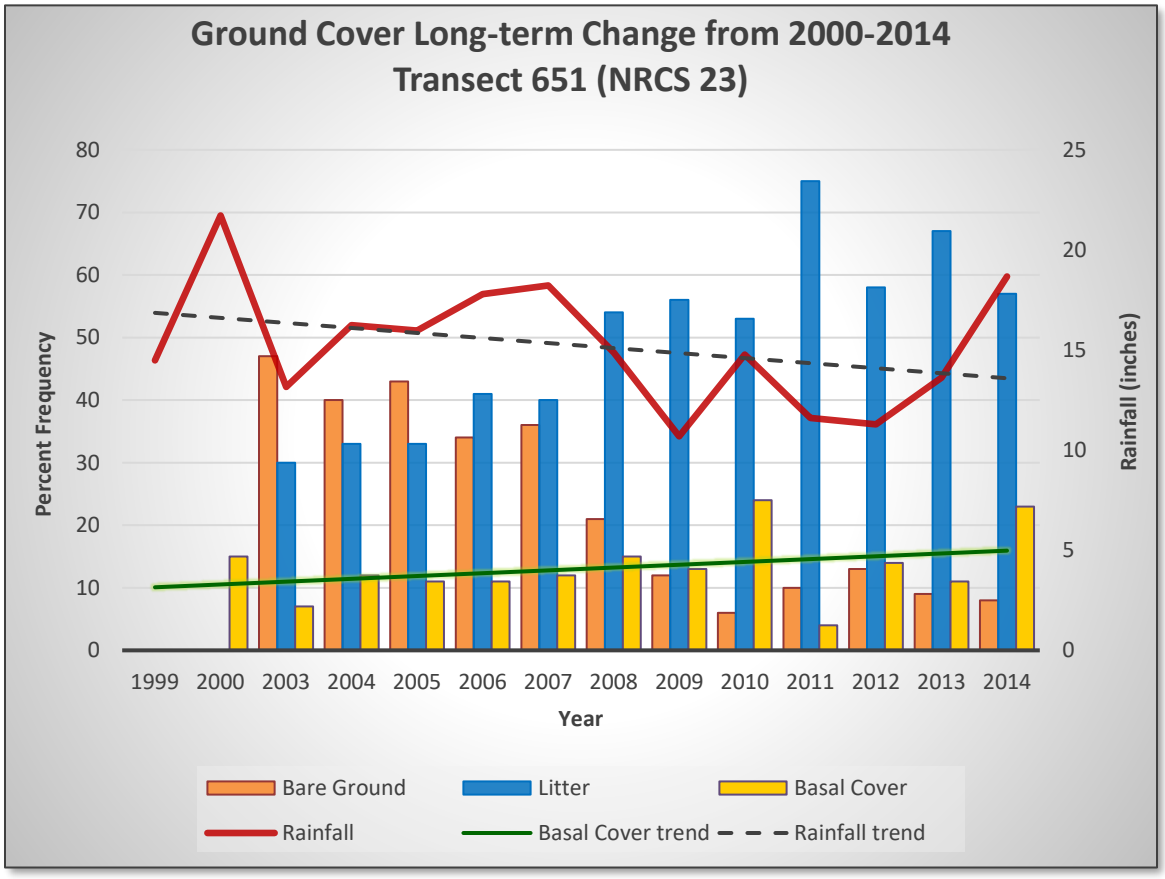


Figure 1. Ground cover data of transect 651 from 2000 through 2014.

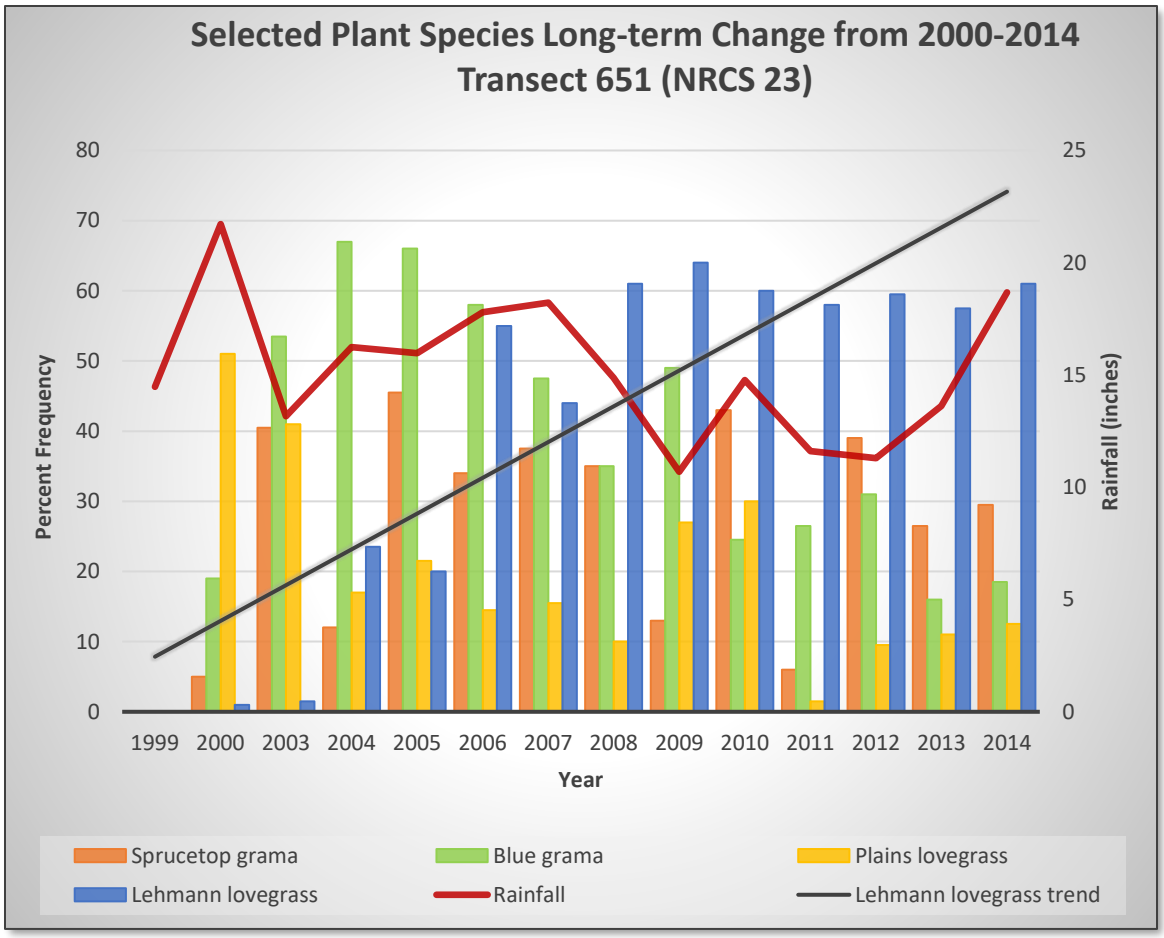


Figure 2. Pace frequency data of transect 651 from 2000 through 2014.

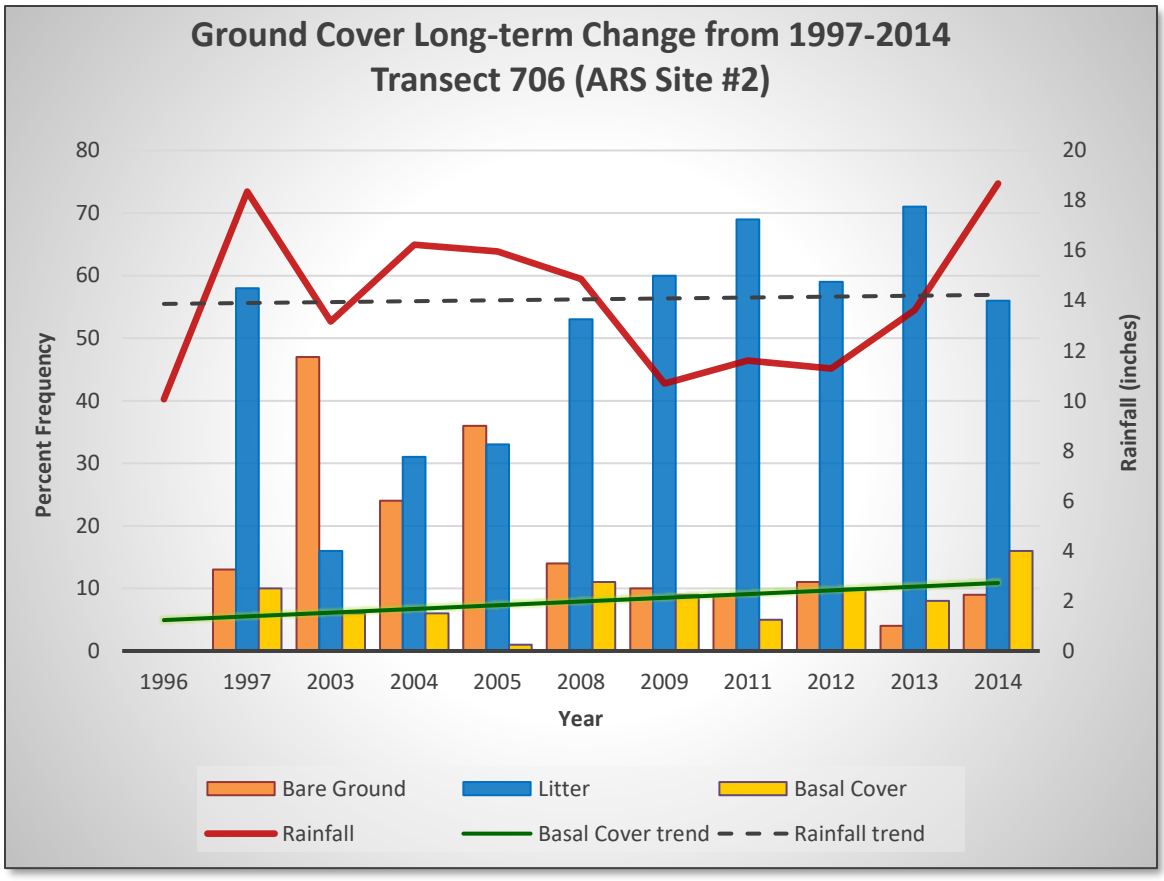


Figure 3. Ground cover data of transect 706 from 1997 through 2014.

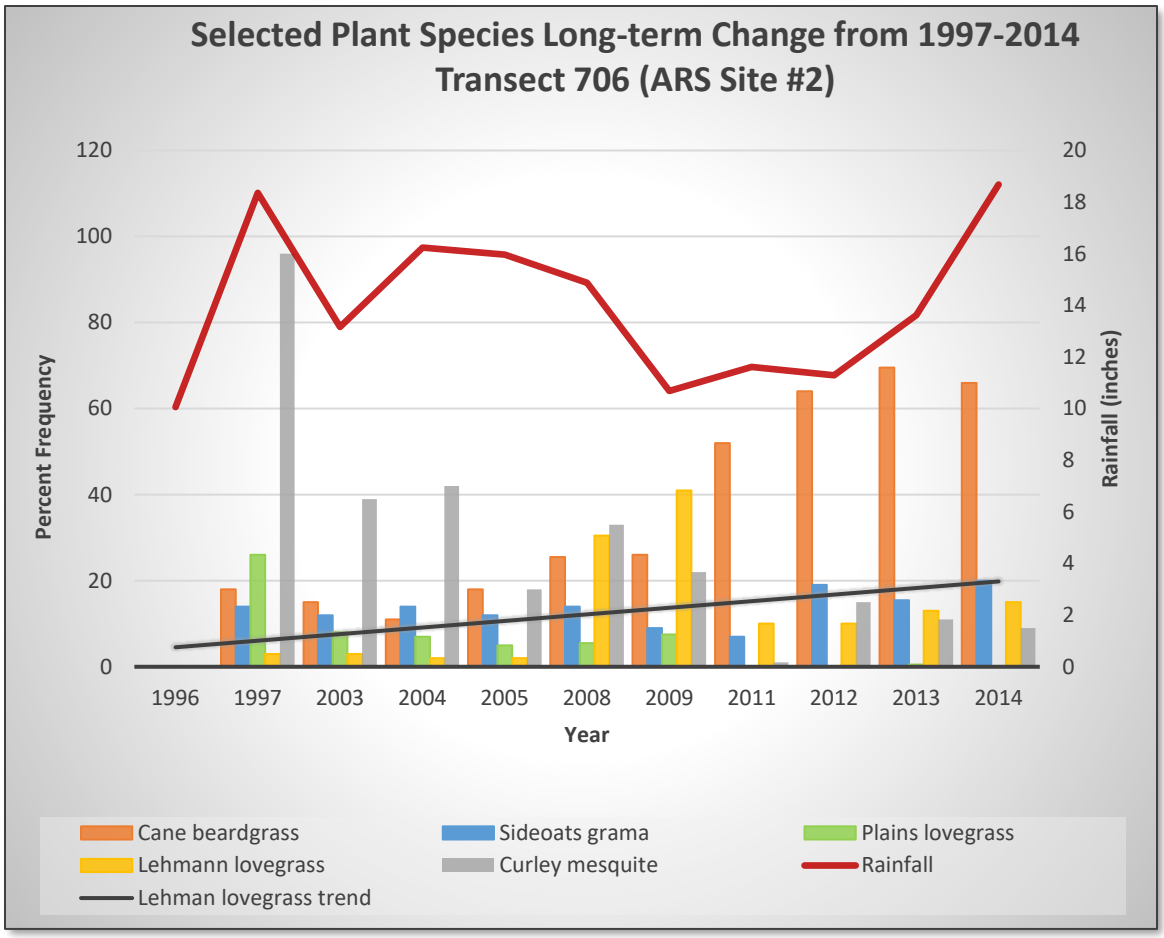


Figure 4. Pace frequency data of transect 706 from 1997 through 2014.

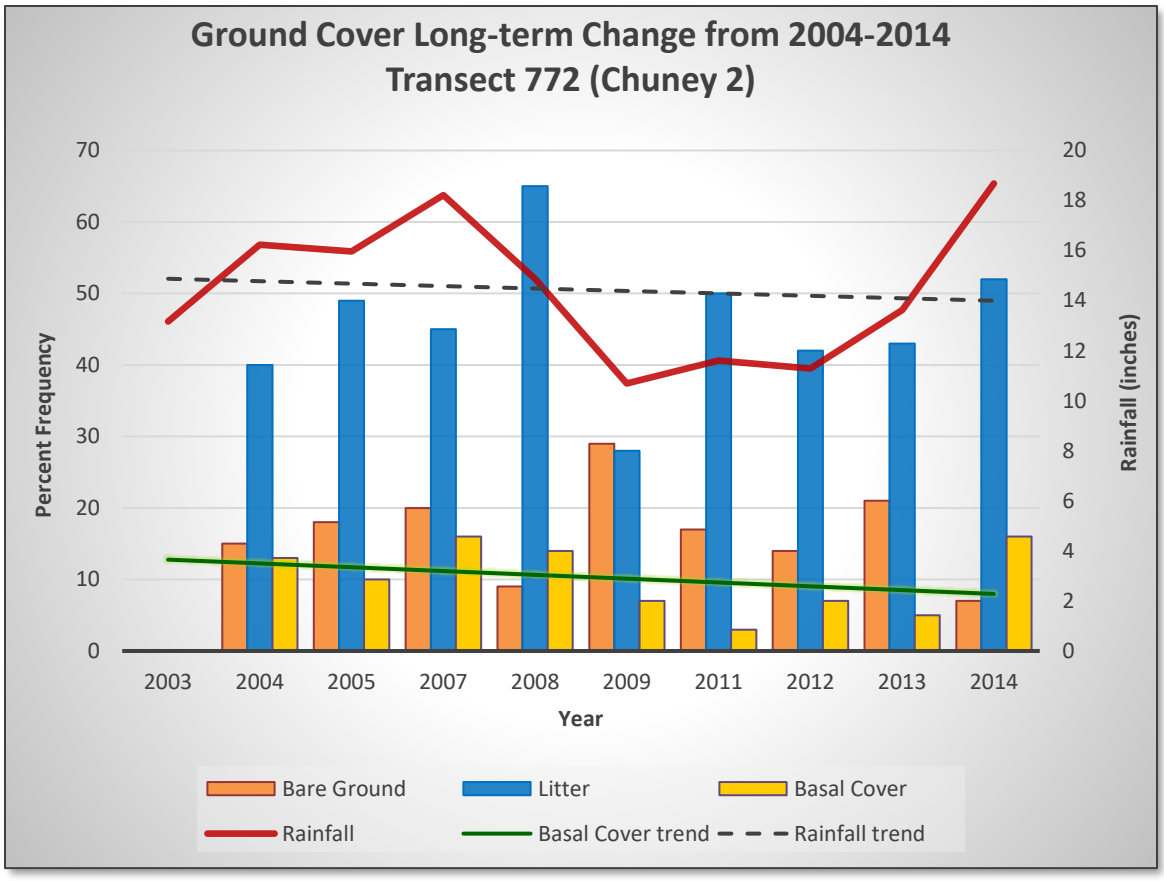


Figure 5. Ground cover data of transect 772 from 2004 through 2014.

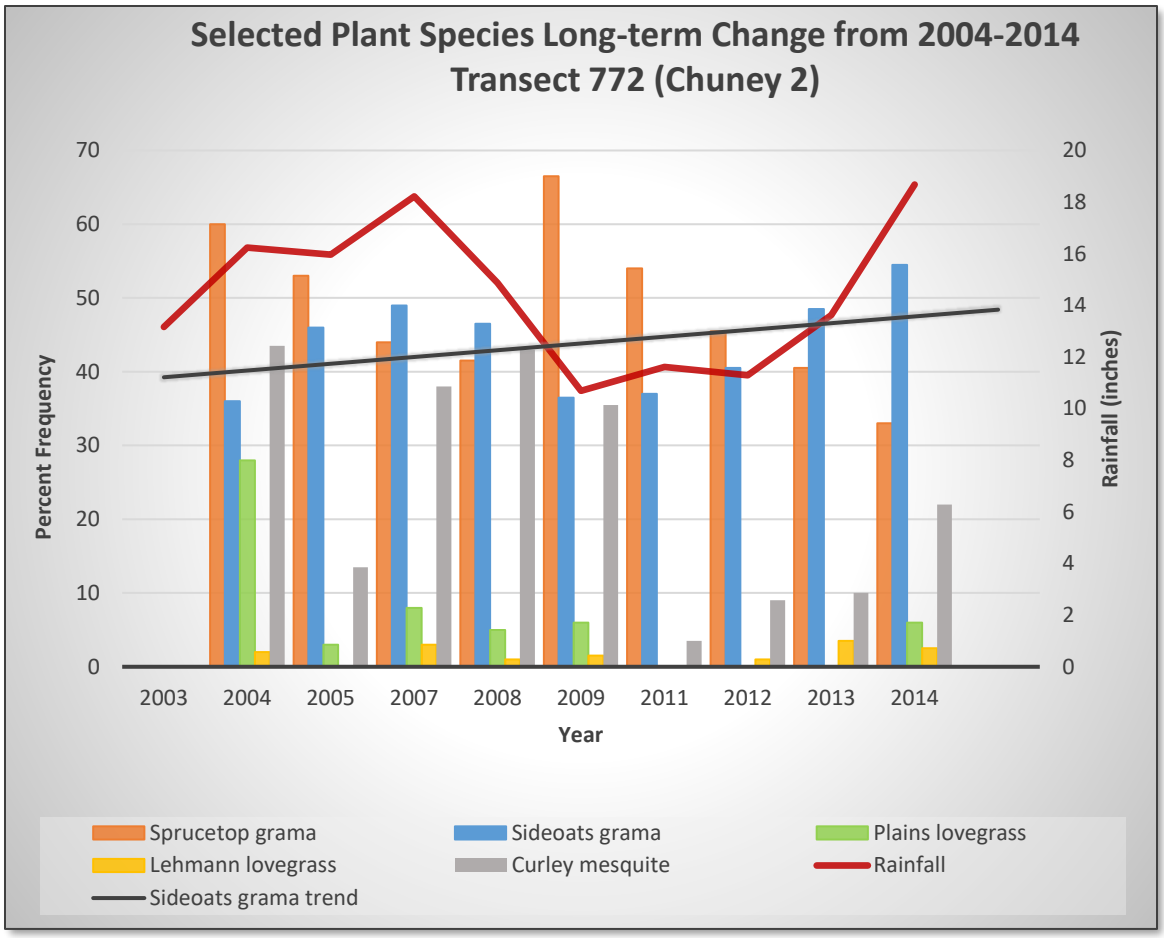


Figure 6. Pace frequency data of transect 772 from 2004 through 2014.

Appendix H

Climate

The WWDT and NOAA weather station at the headquarters show the average maximum temperature for the area is 76 degrees Fahrenheit and the average minimum temperature is 45 degrees Fahrenheit. Below are charts of the yearly average and monthly mean temperatures of the AWRR climate station located at the headquarters.

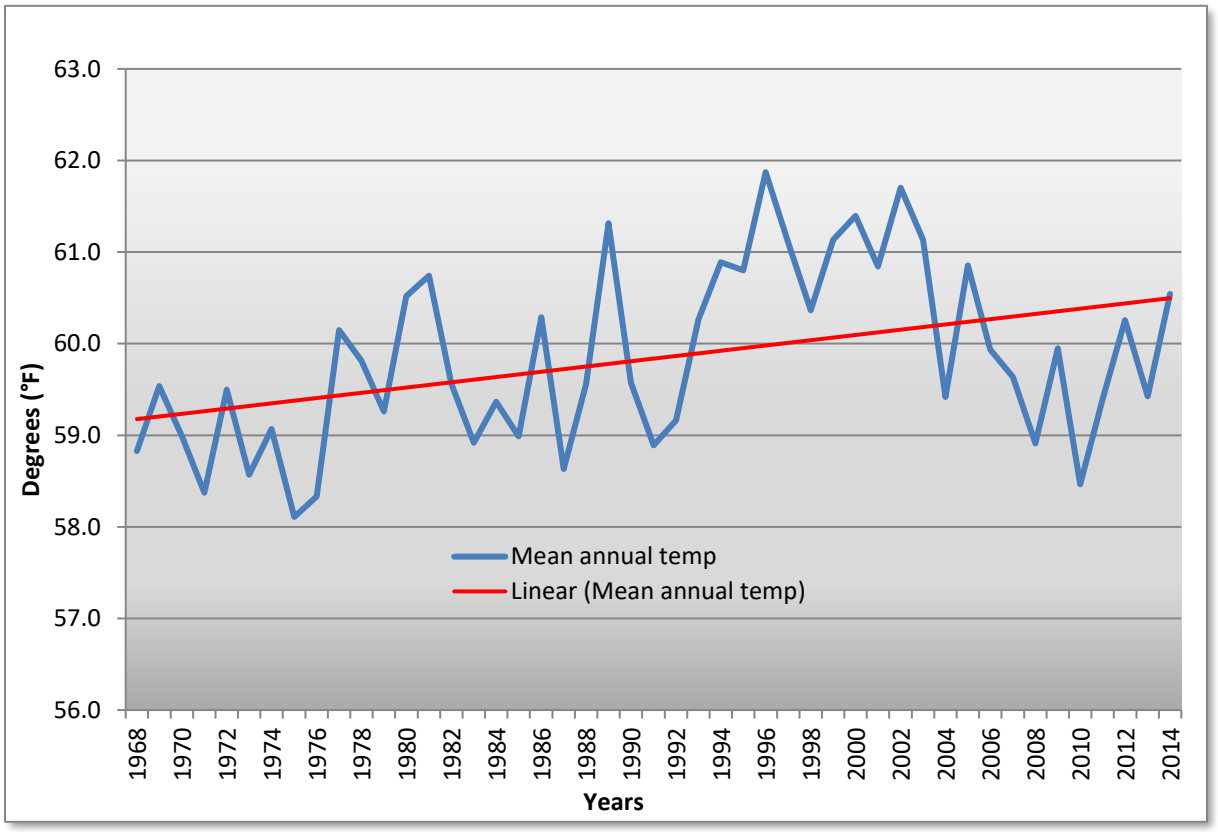


Figure 1. Average yearly temperatures for the AWRR climate station over a 46 year period (1968 through 2014).

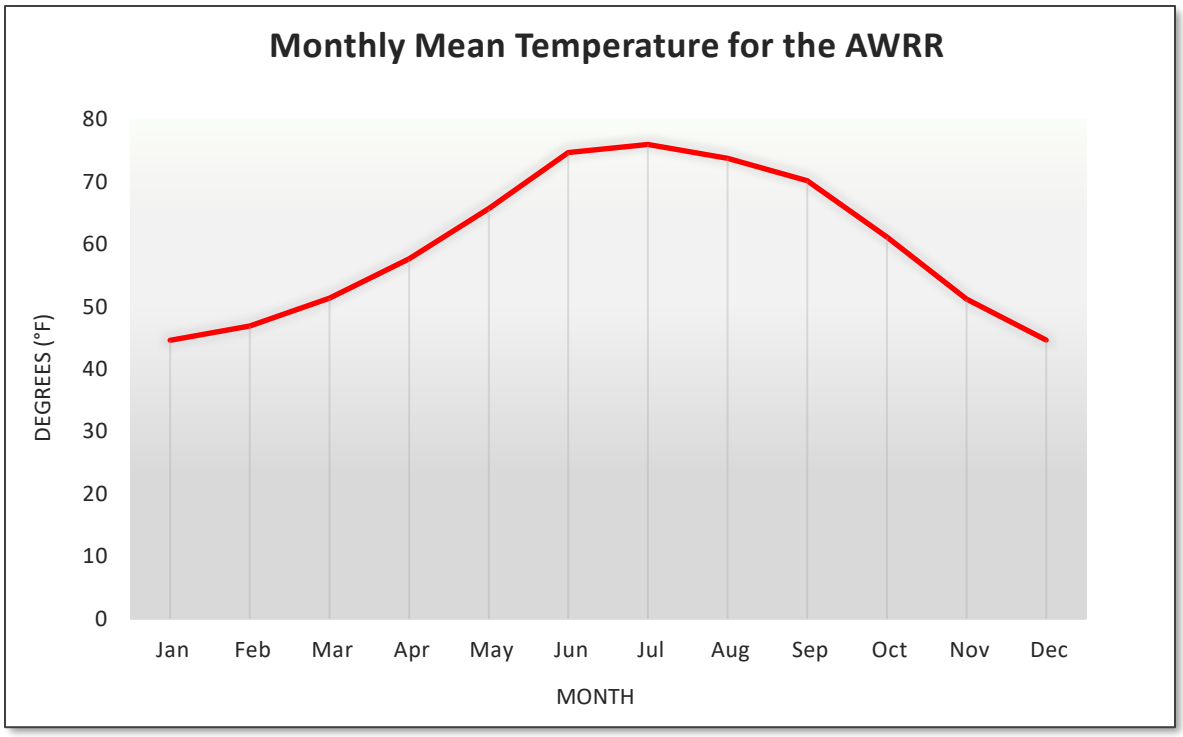


Figure 2. Average monthly temperatures for the AWRR climate station over the last 46 year period (1968 through 2014).

Monthly average data for the AWRR climate station indicate temperatures are between 1 and 3 degrees cooler over the last 20 year period compared to the 71 year average.

Precipitation Averages

Precipitation ranges between 12 to 16 inches in the lower elevations and 16 to 20 inches in the upper elevations annually. Rainfall fluctuations are common; some years post 1982 have received well over 20 inches in precipitation annually and as low as 8 inches annually. Approximately 30% of the areas precipitation falls in the cool season months between November and April, while 70% normally falls in the warm season months between May and October. Following are charts depicting precipitation records from the AWRR Ranch for years from 1968 to 2014. Seasonal precipitation totals provided by the AWRR was used to develop these charts.

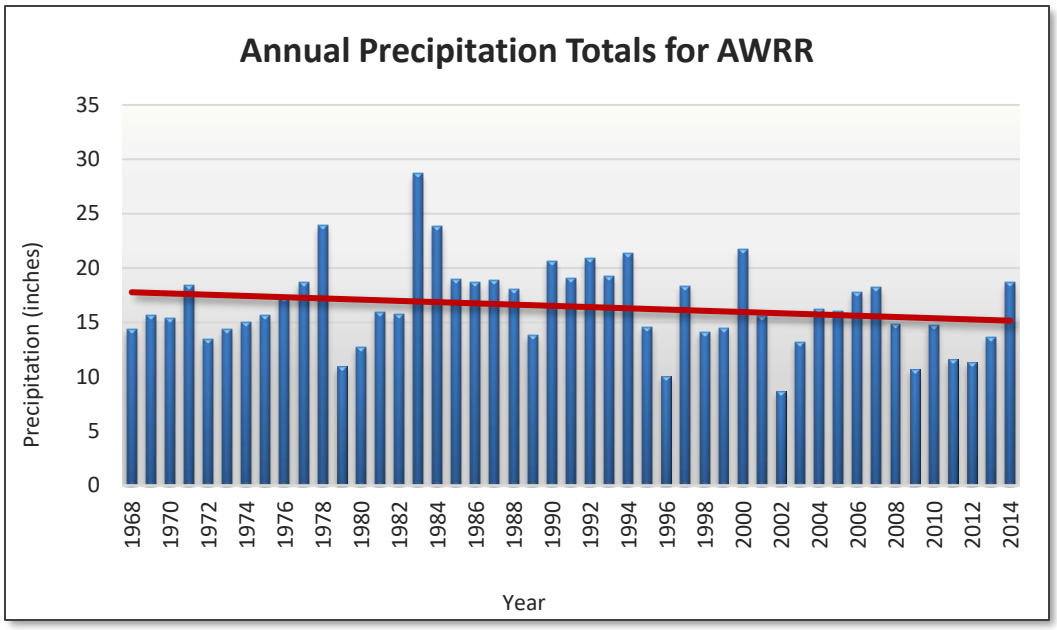


Figure 3. Annual precipitation totals for the AWRR from 1968 to 2014.

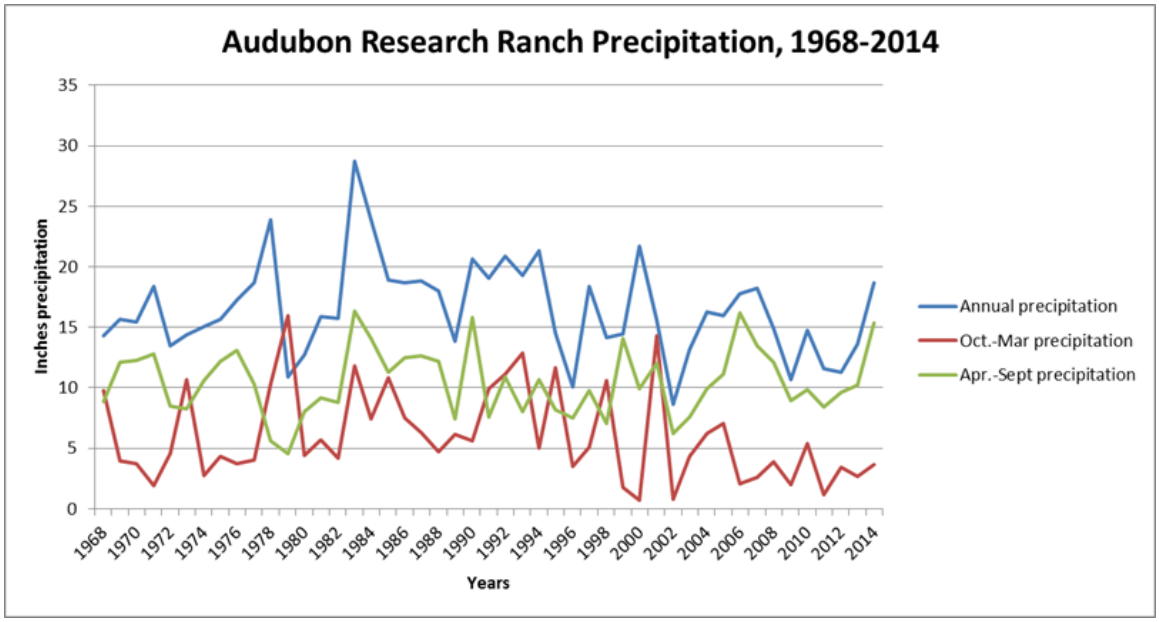
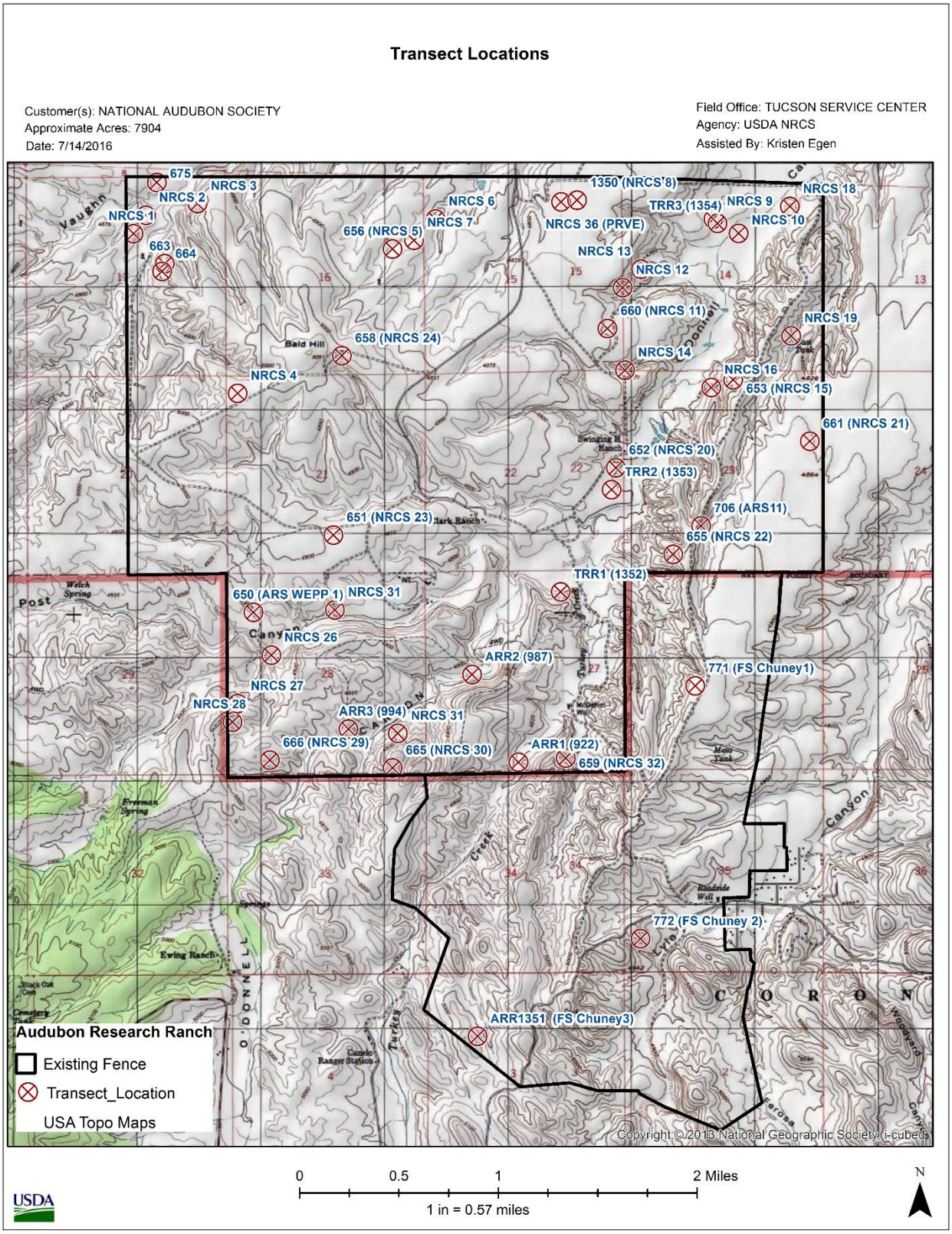


Figure 4. Cool season verses warm season precipitation averages for the AWRR for the years 1968 through 2014. Months considered winter or cool season months are October to March. Summer or warm season months are April through September. Annual precipitation reflects the total rainfall for the water-year, October through September.

Plant vigor and productivity have been affected by the prolonged drought. On certain sites, many of the plant species have been severely affected. Many species that are expected on sites have reduced their production, or they have dropped out completely. Introduced species have a drastic effect on many sites as well.

Appendix I: Map of Monitoring Transects



Appendix J: Conservation Plan Map with Current Structural Improvements and Names