#### **ECOLOGICAL OVERVIEW**

#### APPLETON RANCH PARCEL SANTA CRUZ COUNTY, ARIZONA

Prepared for:



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# **EXECUTIVE SUMMARY**

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper Company to prepare an Ecological Overview for an approximately 357-hectare (881-acre) site in Santa Cruz County, Arizona (Appleton Ranch, or "the Property"). This evaluation of the Property was conducted to:

- Identify the types and relative condition of the biological resources found,
- Evaluate the ecological characteristics,
- Identify remarkable resources attributes, and
- Briefly assess the resource conservation values and opportunities in reference to local and regional contexts.

The Appleton Ranch is comprised of a set of three private tracts consisting of 10 parcels within the larger (3,240-hectare [8,000-acre]) Appleton-Whittell Research Ranch (Research Ranch), which is itself a set of properties owned by the US Bureau of Land Management (BLM), US Forest Service, and the Audubon Society. The Audubon Society manages the Research Ranch as a grasslands ecology study site, in part under a Memorandum of Understanding and a Memorandum of Agreement with the federal agencies. The Property considered in this Ecological Overview is not formally managed by the Audubon Society or the federal agencies, but the Research Ranch manager controls access to and assists the Property owners with the Property on an informal basis. Thus, the management practices used at the Research Ranch are the *de facto* management practices in place at the Appleton Ranch.

The Property is located in the Canelo Hills, on the western flanks of the Huachuca Mountains in southeastern Arizona. It is situated along the streambeds and adjacent upland areas of Post, Vaughn, and O'Donnell canyons (all of which flow north-northeast toward the Babocomari River, approximately 2 kilometers [km; 1.5 miles] north of the closest Property boundary). The Babocomari River is an ephemeral to perennial tributary to the perennial San Pedro River (about 32 km [20 miles] east of the Property), which flows north and northwest to join the Gila River, which flows westward across the state to the Colorado River.

The Property is largely undisturbed by human activity, but historic cattle grazing has impacted natural vegetation throughout the Property. Cattle grazing has been excluded from the Research Ranch since 1969; this exclusion has also applied to the Appleton Ranch.

Acquisition of the Property would contribute to seamless management of the surrounding ecological preserve and ensure its continued protected status. The primary values of the Appleton Ranch arise from and are contingent upon the three basic management objectives of the surrounding Research Ranch:

- to provide a wildlife sanctuary that is ungrazed by cattle,
- to conduct or promote ecological research, and
- to provide education (and dialogue) about sustainable land management.

The Research Ranch's total area of 3,240 hectares (8,000 acres) is large enough to encompass the watersheds of several tributaries of O'Donnell Canyon and includes large areas of grassland on several geomorphic surfaces. Therefore, the sanctuary offers a means of comparison with similar lands immediately off-site. Regardless of their status as protected or unprotected, grasslands are likely to differ in their growth, seed production, and composition according to their particular geomorphic surfaces (or soils). The diversity of grasslands on the Research Ranch provides a mosaic of habitats for birds and other animals. Furthermore, the fence around the Research Ranch is designed to exclude only cattle. It is otherwise a largely porous boundary. Large mammals such as pronghorn, deer, peccaries, coyotes, as well as smaller mammals, birds, reptiles, and amphibians are relatively unhindered in passing across this fence. In this regard, the Research Ranch is not an island or enclosure and the population behavior of its constituent species cannot easily be dismissed as the product of fence effects.

Research and a synthesis of the ecology of the grasslands on the Research Ranch have evolved for decades, presenting a comprehensive picture of on-site conditions. Inventories now exist for its vascular plants, mammals, birds, reptiles, and amphibians, and for select groups of insects (e.g. grasshoppers). Reference collections (herbarium, etc.) exist at the Research Ranch. A surprisingly large number of biologists have worked on the Research Ranch and they (usually) publish their findings in refereed scientific journals. On occasion, these researchers have met to give presentations of their on-going work (over 50 researchers presented papers at the Research Ranch in 2000). Permanent plots and census transects occur over much of the Research Ranch. And, the Research Ranch is still surrounded by a vast area of heavily grazed lands, which offer comparison with the ungrazed grassland found on the Research Ranch.

The Research Ranch staff provides orientation to the visiting public as to its mission and history. The staff also periodically invites ranchers to the Research Ranch to look at the vegetation changes and discuss fire ecology and grassland dynamics. The staff is involved in inter-agency and public discussions regarding broader regional concerns such as the conservation of the upper San Pedro River and its watershed. The Research Ranch staff have a unique set of management priorities and, with an awareness of research results both on the Research Ranch and on similarly studied portions of Fort Huachuca, have the potential for providing unusual perspectives to the public discussions regarding development and conservation in southeastern Arizona.

Similarly, the opportunities presented by the integration of the Appleton Ranch into the Research Ranch are directly related to the Research Ranch's mission.

#### **Opportunity #1: Seamless Addition to the Research Ranch**

One opportunity to the transfer of the Appleton Ranch in-holdings on the Research Ranch to public land would be the addition of land that has been managed since 1967 in a manner consistent with the rest of the Research Ranch. After this transfer, only one relatively small private in-holding would remain within

the boundary of the Research Ranch; the rest of the Research Ranch would belong to the Audubon Society, BLM, or National Forest. Up until now, the Appleton family with the deeded lands have been consistently cooperative in terms of the management efforts of the Research Ranch. Permanent study plots for long-term monitoring are well represented on the Appleton Ranch. Permission to do the infrequent modification or enhancement of wells or other features on the Appleton Ranch has been readily granted by the Appleton family. The Appleton Ranch, unfenced from the rest of the Research Ranch, ungrazed for as long as the rest of the Research Ranch, and included in the research and on-going management of the Research Ranch, is poised to join the Research Ranch as a seamless addition in the event that these lands are transferred to the BLM. As public lands, the Appleton Ranch would round out the Research Ranch holdings.

#### **Opportunity #2: Better Understanding of the Grassland in the Sonoita Basin**

Grassland changes on the Research Ranch since 1968 have been broadly described by Bock and Bock (1986, 1993). However, most aspects of the timing and particular demographic aspects that led to the turnover in species compositions on the Research Ranch remain poorly understood. To capture the requisite details of grass demographics, details of individual grass plant cover, species, and vegetative reproduction have been made over time at other sites in western North America. Additional work at this level of detail may yield a better understanding of the Sonoita Basin grassland and, in particular, any changes in species diversity as the Property continues to recover from the effects of grazing as well as changes resulting from the presence of introduced (invasive) species. Furthermore, coordination of Research Ranch studies with similar work conducted at grassland research sites throughout the western United States would add a new dimension to the value of the studies conducted on-site.

#### **Opportunity #3: Better Understanding of the Ecological Implications of Invasive Species**

A portion of the Research Ranch is vegetated with Lehmann lovegrass (*E. lehmanniana*), a non-native species introduced to the Research Ranch in the late 1940s by the Soil Conservation Service. This invasive species (and the similar Boer lovegrass) are now well established in grasslands throughout the southwest. This species has colonized increasing numbers of acres of the Research Ranch, and the managers have not intervened but have generally observed the spreading effect. Originally covering some 160 hectares (400 acres), the species covered approximately 800 hectares [2,000 acres] as of 2000. A large body of research and attendant literature exists pertaining to invasive and non-native plant species in the southwestern United States, including research on Lehmann lovegrass. Building on the demographic study presented as Opportunity No. 2, additional site-specific studies related to the small or larger scale employment of various active treatments at the Research Ranch may add to the knowledge associated with the ecological implications of non-natives in Arizona grasslands, and may yield strategies to slow or halt the increase of introduced lovegrass and associated decrease of other native grassland species.

# **1. INTRODUCTION AND METHODS**

#### 1.1. PURPOSE AND ORGANIZATION OF REPORT

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper Company (Resolution) to prepare an Ecological Overview for an approximately 357-hectare (881-acre) site in Santa Cruz County, Arizona (Figure 1). In this report, the site is referred to as the Property or Appleton Ranch (Figure 2).

This evaluation of the Property was conducted to:

- Identify the types and relative condition of the biological resources found,
- Evaluate the ecological characteristics,
- Identify remarkable resources attributes, and
- Briefly assess the resource conservation values and opportunities in reference to local and regional contexts.

This report is presented in seven sections:

- Section 1 Introduction and Methods (this section)
- Section 2 Regional Setting
- Section 3 Existing and Adjacent Land Uses
- Section 4 Physical Resources
- Section 5 Biological Resources
- Section 6 Conservation Values and Opportunities
- Section 7 References

# **1.2. METHODS AND APPROACH**

WestLand completed this evaluation by conducting background research of available natural history information and aerial photography of the Property and surrounding region, and through field reconnaissance to identify, map, and photograph vegetation and habitat. WestLand also interviewed the adjoining Research Ranch assistant manager to determine the natural resource and human development history of the Appleton Ranch.



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WestLand obtained and reviewed available literature pertaining to biotic communities of the southwest, riparian ecosystems, and the Canelo Hills. Primary sources of information that were reviewed include *Biotic Communities of the Southwestern United States and Northwestern Mexico* (Brown, 1994; a comprehensive reference of the desert southwest), wildlife abstracts from the U.S. Fish & Wildlife Service (USFWS), and various documents published and websites maintained by the US Forest Service (USFS), Coronado National Forest, Arizona Department of Water Resources (ADWR), Arizona Game & Fish Department (AGFD), the Audubon Society, and other agencies and conservation organizations. These references and aerial photographs were reviewed to identify potential and confirm observed vegetation communities on the Property.

WestLand biologists conducted a field reconnaissance of the Property on February 10 and March 17, 2004 to observe current site conditions, biological resources, and abiotic factors affecting biotic distribution and relative habitat value within the Property. The reconnaissance consisted of a pedestrian survey that focused on areas of interest identified during the background research phase of the evaluation. Inaccessible areas were scanned using binoculars to observe distant vegetation communities. Field observations were recorded and photographs were taken during the reconnaissance to document the various physical and biological resources present on the Property. In particular, vegetation patterns were noted and observed species were recorded. The general vegetation patterns were delineated on an aerial photograph and transcribed onto a vegetation map of the Property. Direct and indirect (tracks, scat, burrows, etc.) observation of wildlife was noted.

In order to identify special-status species that might occur on the Property, we obtained the current list of federally listed species for Santa Cruz County from the Arizona Ecological Services Field Office of the USFWS. The life history of each of these species was then studied to determine habitat requirements such as vegetation communities, elevation ranges, presence of surface water, and other landscape features. This information was used in a screening analysis to identify species potentially occurring on or near the Property for further evaluation, as well as to eliminate from consideration those that were unlikely to occur. Additional literature research was conducted and summarized for those species that have known ranges and habitat requirements close to or which have a high likelihood of occurring on the Property. We principally used the AGFD Heritage Data Management System (HDMS) for this research.

Using the list of special-status species and data collected during field reconnaissance, we conducted a screening analysis to identify those special-status species that had the potential to occur on or near the Property. Information such as the Property's elevation range, habitat type, water resources, climate, and other related data was compiled and compared to the background research information to predict the potential for occurrence of listed species in the Property area. This screening analysis resulted in a list of target species that have a reasonable potential to occur on the Property.

# 2. REGIONAL SETTING

The Appleton Ranch is comprised of a set of three private tracts consisting of 10 parcels (Figure 2) within the larger (3,240-hectare [8,000-acre]) Appleton-Whittell Research Ranch (Research Ranch), which is itself a set of properties owned by the US Bureau of Land Management (BLM), USFS, and the Audubon Society. The Audubon Society manages the Research Ranch as a grasslands ecology study facility, in part under a Memorandum of Understanding and a Memorandum of Agreement with the federal agencies. The Property considered in this Ecological Overview is not itself formally managed by the Audubon Society or the federal agencies, but the Research Ranch manager controls access to and assists the Property owners with the Property on an informal basis. Thus, the management practices used at the Research Ranch are the *de facto* management practices in place at the Appleton Ranch.

The Property is within portions of the following sections (referenced to the Gila and Salt River Meridian) of Township 21 South, Range 18 East:

- Section 14
- Section 15
- Section 17
- Section 28

The 10 parcels comprising the Property are in three groups, as shown in Figure 2:

- Parcel 1 is a rectangular tract that occupies the eastern half of Section 17. It is crossed by Vaughn Canyon and is referred to as the Vaughn Canyon Tract in this report.
- Parcel 2 is an irregularly shaped tract occupying approximately the central (east-west) third of Section 15, and adjoining Parcels 3 through 9 are a collection of smaller rectangular pieces (section fractions) occupying the northwestern half of Section 14. It is crossed by O'Donnell Canyon and is referred to as the O'Donnell Canyon Tract in this report.
- Parcel 10 is an irregularly shaped tract in the northeastern quarter of Section 28. It is crossed by Post Canyon and is referred to as the Post Canyon Tract in this report.

Access to the Property is via Research Ranch internal roads; the Research Ranch is accessed from the north via Arizona State Highway 83 from Elgin and then Research Ranch Road. The center of the Research Ranch (and the approximate midpoint between the three Appleton Ranch tracts) is approximately 17 km (10.5 miles) southeast of Sonoita, a small town of eastern Santa Cruz County. The nearest major metropolitan center is Tucson, located approximately 80 km (50 miles) northwest of the Property.



Photograph 1. Vaughn Canyon Tract



Photograph 2. O'Donnell Canyon Tract

As previously noted, the Appleton Ranch is situated along the streambeds and adjacent upland areas of Vaughn (Photograph 1), O'Donnell (Photograph 2), and Post (Photograph 3) canyons, all of which flow north-northeast toward the Babocomari River. The Babocomari River lies approximately 2 km (1.5 miles) north of the closest Property boundary, along the north side of the O'Donnell Canyon tract (Photograph 4). The Babocomari River is an ephemeral to perennial tributary to the perennial San Pedro River (about 32 km [20 miles] east of the Property).



Photograph 3. Post Canyon Tract



Photograph 4. Babocomari River Valley

The Property is located in the Canelo Hills, on the western flanks of the Huachuca Mountains in southeastern Arizona. The Canelo Hills are low and rolling (Photograph 5) and, in the immediate vicinity of the Property, range in elevation from about 1,413 to 1,540 meters (m; 4,635 to 5,051 feet [ft]) above mean sea level (amsl). Bald Hill, centrally located on the Research Ranch (and near the midpoint of the three tracts; Figure 2 and Photograph 6), represents the high point of this elevational range. The Canelo Hills reach their peak elevation at Lookout Knob (1,882 m [6,175 ft] amsl), about 11 km (7 miles) south-southeast of the Property.



Photograph 5. Canelo Hills Overview



Photograph 6. Bald Hill

# 3. PROPERTY AND ADJACENT LAND USES

The Property lies within an area that was originally part of the San Ignacia del Babocomari land grant, established in 1821 (National Audubon Society, 2004). According to a history of the Research Ranch (Bock and Bock, 2000), the Property (and portions of the surrounding lands; i.e., the Research Ranch) were purchased in a series of acquisitions by Ariel and Frank Appleton beginning in 1959 from previous ranchers, one of whom homesteaded a portion of the Property as early as 1919. The Appleton family descendants (and Bolson Holdings, LLC) currently own the Property (Ariel and Frank Appleton are both deceased) (Swift Current, 2003).

The Property is currently unoccupied. As described throughout this report, the Appleton Ranch was originally used for cattle grazing, which reportedly ceased in 1969 as a decision by the Appletons to create an ecological preserve (the Research Ranch, as described below). Improvements to the Property are limited. A few windmills (e.g., Photograph 7), wells (e.g., Photograph 8), and numerous small earthen-bermed reservoirs are present in or adjacent to the streams. Several dirt roads (e.g., Photograph 9) access these features from the Research Ranch primitive road network. One area in the Post Canyon Tract was used for residential purposes from the 1980s until 2002, when a fire consumed the residence. Only the concrete foundation (Photograph 10), underground septic system, and minimal landscaping remain. Adjacent to the former



Photograph 7. Windmill in Vaughn Canyon

house site are a set of chain link fence enclosures (Photograph 11) constructed to protect rare Bolson tortoises from predation, as a passive study area maintained by the Property owner.

Areas surrounding the Property are federal, state, and private lands managed by the USFS (as the Coronado National Forest), BLM, Arizona State Lands Department (ASLD), the National Audubon Society, and private firms or individuals. As previously mentioned, the Property is largely surrounded by the Research Ranch (Figure 2), which includes lands managed by USFS and BLM as well as those owned by the National Audubon Society. The Appletons established the Research Ranch Foundation in 1969 to manage the Research Ranch, and set aside the Research Ranch lands in a series of land exchanges with federal and state agencies. This collective property has been managed by the National Audubon Society, 2004). The Property was not part of these land exchanges; it remains privately owned but is managed similarly to the adjacent Research Ranch ecological study area.



Photograph 8. Windmill and well at Finley Tank



**Photograph 9.** Unimproved road accessing Research Ranch



Photograph 10. House foundation in Post Canyon



**Photograph 11.** Chainlink fence enclosure for Bolson tortoise in Post Canyon Tract

One other private tract is present within the Research Ranch, adjoining the eastern boundary of the Post Canyon Tract (Parcel 10) of the Property. This 32-hectare (80-acre) tract is also a portion of the former cattle grazing operation, but is now used solely for residential purposes. It should be noted that, at the time of this writing (May 2004), this additional private tract was for sale.

Outside of the Research Ranch, additional federal, state, and private land is used principally for ranching (cattle grazing) as well as dispersed recreational activities (primarily hunting, camping, off-road vehicle use, and hiking). There are several unimproved (unpaved) roads allowing public access to the surrounding areas.

# 4. PHYSICAL RESOURCES

This section describes the regional and local features of the ground surface (form, type, and age), climate (temperature and precipitation ranges), and water (surface and subsurface occurrence).

#### 4.1. LANDFORM AND TOPOGRAPHY

The Appleton Ranch is in the southeastern portion of the Sonoita basin. This basin measures approximately  $259 \text{ km}^2$  (100 square miles). The elevation of the central part of the Sonoita basin is about 1,500 m (4,921 ft) amsl. There are several mountain ranges surrounding the basin. These ranges, their cardinal directions from the town of Sonoita, and their highest elevations are (clockwise):

- Santa Rita Mountains, west, 2,881 m (9,453 ft);
- Empire Mountains, north, 1,530 m (5,020 ft);
- Whetstone Mountains, northeast, 2,350 m (7,684 ft);
- Mustang Mountains, east, 1,975 m (6,480 ft);
- Huachuca Mountains, southeast, 2,885 m (9,466 ft); and
- Canelo Hills, south, about 1,907 m (6,257 ft).

The Sonoita basin is drained to the north by Cienega Creek, to the west by Sonoita Creek, and to the southeast by Babocomari River. Cienega and Sonoita creeks discharge eventually into the Santa Cruz River, north and west (respectively) of the Property. The Babocomari River flows into the San Pedro River (near Fairbanks) east of the Property. The common source of the three drainages or watersheds is within a general area about 4.8 km (3 miles) east of the town of Sonoita, which is near the center of the basin and about 16 km (10 miles) northwest of the Property.

As shown in Figure 2, the Property is located along the streambeds and adjacent upland areas of Post, Vaughn, and O'Donnell canyons (all of which flow north-northeast toward the Babocomari River, approximately 2 km [1.5 miles] north of the closest Property boundary [O'Donnell Canyon Tract]). As previously mentioned, the Babocomari River is an ephemeral to perennial tributary to the perennial San Pedro River (about 32 km [20 miles] east of the Property), which flows north and northwest to join the Gila River, which flows westward across the state to the Colorado River and ultimately discharges to the Sea of Cortez (Gulf of California). Flow in the Gila and Colorado rivers has been altered considerably from natural conditions by the construction of dams for reservoir and flood control functions. The Gila River, in particular, is now largely ephemeral as it crosses the state.

The upland areas drained by the three on-site streams are known as the Canelo Hills, south and southwest of the Property, a rolling terrain which in the immediate vicinity of the Property ranges in elevation from about 1,413 to 1,540 m (4,635 to 5,051 ft) amsl. Bald Hill, centrally located on the Research Ranch (and near the midpoint of the three tracts; Figure 2), represents the high point of this elevational range.

# 4.2. GEOLOGY AND GEOMORPHOLOGY

The geology of the Research Ranch has not yet been mapped in detail (i.e., 1:24,000 scale or less). However, there are several mapping efforts on a larger scale that include the Research Ranch as well as the Appleton Ranch, as summarized below.

The Canelo Hills are in the southern Basin and Range physiographic province and are comprised of volcanic and sedimentary rocks (Bultman, 1999; Figure 3). These hills are cut by northwest-striking steep faults that are splays of the Sawmill Canyon-Kino Springs fault system (Bultman, 1999 quoting Drewes, 1996). A thin to moderately thick veneer of soil overlies the bedrock on the upland areas; eroded material has accumulated in canyon bottoms as alluvium. Farther north, approaching the Babocomari River, basin-fill sediment has accumulated to a degree identifiable as a geologic unit. Regionally, the "lower basin fill unit is probably lower- and middle-Miocene in age and is poorly to moderately well consolidated. In the Santa Cruz basin [in which the Property lies], this unit is the Nogales Formation. The upper basin fill unit is upper-Miocene to lower-Pleistocene and is unconsolidated to poorly consolidated. These basin fill units are overlain by Holocene surficial deposits, including alluvium of stream channels, flood plains, and terraces which are unconsolidated overall but locally well indurated" (Bultman, 1999).

# 4.2.1. Surficial Deposits

Menges and McFadden (1981) developed a generalized map of the geomorphology of the Sonoita-Patagonia area. Surficial geology on the Research Ranch (including the Appleton Ranch), as mapped by Menges and McFadden (1981), is predominantly low-level terraces and pediments with an extension of the Martinez surface and high-level pediments extending out from the Canelo Hills.

Bald Hill was not specifically analyzed by Menges and McFadden (1981) or in later geomorphological research in the area; they focused their research primarily on basin sedimentation and faulting in the western half of the Sonoita basin. However, because Bald Hill is part of a high(est) elevation strand extending to the southwest, it is very likely one of the Martinez surface remnants. It is likewise not known if the Martinez surface which may be present on Bald Hill extends into the nearby Vaughn Canyon or O'Donnell Canyon tracts. Menges and McFadden analyzed a 51-m-thick section near the top of the upper basin fill unit.



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# Explanation



Geology Features: The geologic themes shown on this map are from the Southeast Arizona Geology series of digital GIS datasets. This map is preliminary and has not been reviewed for contamity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code.

#### References

Deemes, Harold, 1980, Teotania map of southeast A rizono: U.S. Geological Survey Misochineous Investigations Series Map 1-1109, scale 1:125,000, two sheets. Drewes, Harold, 1986, Geologia Maps of the Coronado National Forest, Southeast Arizona and Southwest New Mexico: U.S. Geological Survey, Bulletin 2083 A-K, plates 2-4.

Digitel Geologic Data by Sean Kneele, Mark Bultmon, Temmy Chan, Anne Grisoleno, a Doug Hirsabherg

Hydrologia features, Roadmays, Towns, Political/Administrative Boundaries: The bacemap or background themes shown on this map are from the Astrona State Land Department-ALRIS. It is not known if these dotosets meet any aartagraphia standards. They are shown for reference purposes only.



Using Natural Remanent Magnetization determinations from samples taken from this section, they were surprised to find consistent polarity measurements from not only the finer grained silty clay samples but also from the coarser pebbly or sandy silts. The reversed polarities within the stratigraphic sequence and their proposed correlations establish a latest Miocene to late Pliocene timeframe for the upper basin fill sediments. Intact Martinez surface remnants are likely to have a 1.0-million-year-old minimum of soil formation following the last gravel deposition.

Breckenfeld and Robinett excavated a site on Bald Hill in order to make an examination of its alluvial structure (D. Breckenfeld, 2004). They described the subsurface alluvium as clayey-skeletal, meaning that the fine earth material has over 35 percent clay and the gravel fraction is also greater than 35 percent. The clay-gravel structure of Bald Hill's subsurface alluvium might be expected for a +1-million-year-old gravel deposition. The rest of the Research Ranch (including the Appleton Ranch) alluvium, in terms of geomorphological units, is likely to be a complex set of terraces deposited from mid-Pleistocene to the present.

Soils on the Property have been described and mapped by the Natural Resource Conservation Service (NRCS) of the US Department of Agriculture, first by Richardson et al. (1979) and more recently by Breckenfeld and Robinett (unpublished special NRCS report for the Audubon Society). A copy of this surface soil map was obtained from the Research Ranch and is provided as Figure 4. As would be expected given the topographic range across the Property and corresponding time ranges in depositional weathering history, there is significant variability in soil types.

#### 4.2.2. Bedrock

As mentioned previously, the geology of the Research Ranch has not been mapped in detail. However, at least two narrow outcrops of limestone are recognized as occurring on the Research Ranch. One is on the west side of Turkey Creek in the southern part of the Research Ranch (McLaughlin et al. 2001) (i.e., not within the Property); the other is immediately south of Post Canyon and the former Appleton ranch house within the Post Canyon Tract.

# 4.3. CLIMATE

Average annual temperatures in the area (based on data from Canelo, about 5 km [3 miles] south of the Property, for a period of record from 1910 to 2003) range from 4.9 to 23.4 degrees Celsius (40.8 to 74.1 degrees Fahrenheit) with average precipitation at approximately 45 centimeters (cm; 18 inches [in]) per year (Western Regional Climate Center, 2004).



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McLaughlin et al. (2001) reviewed precipitation records provided by Sellers et al. (1985) for four weather stations in eastern Santa Cruz County and northwestern Cochise County close to the Research Ranch and at comparable elevations:

- Elgin (1,494 m [4.902 ft]),
- Canelo (1,528 m [5,013 ft]),
- Fort Huachuca (1,422 m [4,666 ft]), and
- San Rafael Ranch (1,490 m [4,889 ft]).

Monthly precipitation data from the Research Ranch for 1968 to 1997 are available on the Research Ranch's website (<u>www.audubon.org/local/sanctuary/appleton/</u>). McLaughlin et al.'s (2001) monthly precipitation data and the annual track of mean maximum and mean minimum monthly temperatures indicate that all five stations have very similar climatic regimes. However, mean annual precipitation is 40 to 50 millimeters (mm; 1.6 to 2.0 inches [in]) greater at the Research Ranch Headquarters (433 mm [17.0 in]), San Rafael Ranch (441 mm [17.4 in]), and Canelo (453 mm [17.8 in]) compared to Fort Huachuca (391 mm [15.4 in]) and Elgin (381 mm [15.0 in]); this pattern suggests the southern, higher elevation portion of the Research Ranch receives annually more precipitation than the northern, lower portion. Accordingly, it may be assumed that the northeastern and northwestern tracts (Vaughn Canyon and O'Donnell Canyon) of the Appleton Ranch receive slightly more precipitation than the southern tract (Post Canyon).

Similarly, mean monthly temperatures are about 15°C (5°F) higher at Fort Huachuca than at Canelo, suggesting a gradient of decreasing temperature with increasing elevation across the Research Ranch. We are unaware of any weather stations on or near the Research Ranch that provide a comparison between climate within large drainages compared to adjacent upland sites, but experience on similar lands in southern Arizona suggests that the large drainages are likely to have significantly lower night and early morning temperatures due to cold air drainage from higher elevations.

Precipitation, as for much of southeastern Arizona, is strongly bimodal, with a monsoon season in July and August, a winter rainy season from December through February, and a pronounced dry season from April through June. The spring dry season receives on average less than 10 percent of the annual precipitation. The winter rainy season has about one-fourth to one-third of the rainfall received during the summer rainy season. Probability calculations indicate that there is a 50 percent probability of a storm event at the Canelo station on any given day during the monsoon season (Western Regional Climate Center, 2004). Thunderstorms are intense but brief. The maximum annual rainfall recorded for the Canelo station was 78.5 cm (30.9 in) in 1914; the lowest was 25.5 cm (10.1 in) in 1996 (Western Regional Climate Center, 2004). (Several years recorded low values in the single digits, but were missing some days of data.) For the period of record from 1961 through 1990, the maximum monthly rainfall (19.4 cm; 7.7 in) was recorded in July 1964; the lowest (0.00) has occurred frequently, recorded in 8 months (all months except January, and July through September) in several years, most commonly in the 1980s.

#### 4.4. WATER RESOURCES

#### 4.4.1. Surface Water Resources

There are no stream gauges along any of the on-site drainages. The closest stream gauge is on the Babocomari River, near Huachuca City some 11 km (7 miles) downstream of the Property (O'Donnell Canyon Tract). The period of record for this gauge is relatively short (August 2000 through September 2002), but allows for an indication of annual (to a limited extent) and seasonal variability in stream flow for the area. Despite the short period of record, the data collected from Upper Babocomari River gauge (U.S. Geological Survey [USGS] Gauge No. 09471380) shows high seasonal variability based on monthly mean stream flow (1.91 [June] to 33.4 [October] cubic feet per second [cfs]). These data suggest changes in stream flows are delayed by approximately 2 to 3 months from precipitation events, which usually peak in July. The extreme variability in monthly mean flows exhibited in the Babocomari watershed are likely reflected in the three smaller on-site watersheds.



Photograph 12. Post Canyon

During our visits on February 10 and March 17, 2004, we found none of the on-site channels flowing in Post (Photograph 12), Vaughn (Photograph 13), or O'Donnell (Photograph 14) canyons. The channel of O'Donnell Canyon east of Finley Spring consists of a series of scoured pool areas separated by shallow, vegetation-lined meandering channels. During our March 16, 2004 visit, we saw evidence that these pools and channels had flowed within the last year.



Photograph 13. Vaughn Canyon



Photograph 14. O'Donnell Canyon

The map of perennial streams in Arizona compiled by Brown et al. (1978) indicates an approximately 2km (1.2-mile) stretch of perennial flow (less than 10 cfs base flow) in O'Donnell Canyon within the Research Ranch area. (It should be noted that the scale of this map [1 inch = 25 km] does not permit precise location of small segments.) It is not possible to determine if the perennial flow segment depicted in this 1978 map includes a portion of the Appleton Ranch. However, a segment of heavier perennial base flow (10 to 50 cfs) is indicated in Turkey Creek (a tributary to O'Donnell Canyon) farther upstream, near Canelo, consistent with other reports. Segments of this stream, upstream and downstream of the Research Ranch perennial flow section, are depicted on the map as ephemeral or intermittent. Additionally, a short segment of an unnamed stream immediately west of the Turkey Creek segment near Canelo is depicted with 10 to 50 cfs perennial baseflow. Although depicted as isolated (i.e., not connected to any other waterway via even ephemeral flow), this unnamed stream is likely the upper reach of O'Donnell Canyon. Furthermore, as discussed later in Section 5.4, native fish have been collected in the perennial reaches of O'Donnell Canyon upstream of the Research Ranch.

Comparing our observations to the 1978 map, it is likely that the segment of O'Donnell Canyon on the Research Ranch varies from ephemeral to intermittent to perennial flow based on long-term precipitation patterns. Although the stream may have been perennial in 1978 (and preceding years), the lack of flow during our visit (and during a known drought period in Arizona) indicates that the on-site segment of the streams have, at least temporarily, reverted to ephemeral flow. Currently, these streams are likely ephemeral, flowing only in response to storm events. Protracted wet seasons or years may temporarily elevate the streams to intermittent status, while droughts and/or excessive groundwater pumping may change perennial streams to intermittent or ephemeral flow.

As described in the groundwater resources section below, several on-site wells are fitted with windpowered pumps, and are located adjacent to stock tanks (earthen-bermed impoundments). Three such tanks are present within the Property: Finley Tank (Photograph 15) and Telles Tank (Photograph 16) in the O'Donnell Canyon Tract, and Vaughn Tank (Photograph 17) in the Vaughn Canyon Tract.



Photograph 15. Finley Tank



Photograph 16. Telles Tank



Each of these tanks is relatively small (less than  $\frac{1}{2}$ hectare [1 acre]) and shallow (less than 3 m [10 ft] deep). The tanks contain water year-round from the wells, and the groundwater supply is periodically supplemented with storm water runoff during significant precipitation events. Since the Property is no longer used for stock grazing, the stock tanks now function as permanent surface water bodies, providing a localized riparian habitat and wildlife watering location at each tank.

Photograph 17. Vaughn Tank

One metal-sided aboveground tank is also located on the Property, in the Post Canyon Tract. This tank is not considered a significant surface water resource from an ecological standpoint because it is inaccessible to most terrestrial wildlife and plants.

#### 4.4.2. Ground Water Resources

Detailed hydrogeologic studies of the Appleton Ranch or Research Ranch are not known to us. Available information is limited to water supply well data, as summarized in the following paragraphs.

Four on-site groundwater wells are present on the Research Ranch (i.e., on or near the Appleton Ranch), originally used to provide water for livestock, using shallow impoundments for storage (stock tanks) as described above. The pumps in these wells are all powered by windmills. The ADWR was contacted in reference to their Well Registry database. ADWR well information is summarized in Table 1.

Table 1. Registered Wells					
Record #	Location (on or near)	Original Registered Owner	Well Depth (meters [m]; feet [ft])	Water Level (year)	Use
648930	Vaughn Canyon tract	Appleton	30.5 m (100 ft)	NR	Stock
566294	O'Donnell Canyon tract	Research Ranch	79.2 m (260 ft)	21.3 m (70 ft) (NR)	Production
805300	O'Donnell Canyon tract	Appleton Trust	NR	NR	Stock
650978	Post Canyon tract	Appleton	51.8 m (170 ft)	22.6 m (74 ft) (NR)	Domestic, Stock

NR = not reported

These data indicate that groundwater is present on or near the Property at relatively shallow depths (i.e., generally less than 30.5 m [100 ft]) and was used principally for stock watering purposes.

Additionally, Research Ranch depth-to-groundwater data was obtained from the National Audubon Society for 10 wells monitored on or near the Research Ranch, including the four wells on or near the Property. These data indicate that groundwater is present on the Property generally between 8 and 53 m (25 and 175 ft) below ground surface.

# 5. BIOLOGICAL RESOURCES

Given the ecological preserve status of the Research Ranch, extensive studies of the biological resources of this land have been conducted since 1969. Much of the descriptive work that has been conducted is directly applicable to the Appleton Ranch land. This section summarizes the relevant research that has been completed, and applies those descriptions as appropriate, to the Appleton Ranch.

# 5.1. VEGETATION AND HABITAT DESCRIPTION

The vegetation of the Research Ranch is primarily grassland in the northern part and Madrean evergreen

oak woodlands in the higher elevations of the southern part, north-facing slopes, and canyon bottoms. This characterization translates to the Appleton Ranch in that the Vaughn Canyon and O'Donnell Canyon tracts are predominantly grassland while the Post Canyon Tract is predominantly Madrean evergreen oak woodland. Grasslands are much more extensive on the Research Ranch (including the Appleton Ranch) than are the oak woodlands. The limited extent of the oak woodlands is clearly seen in Figures 5a and 5b (aerial photographs from 1976 and 1992, respectively). The grassland



Photograph 18. Short-grass stand

varies markedly in species composition, density, and structure in the northern part of the Appleton Ranch, with short-grass grasslands (Photograph 18) found on south-facing slopes, medium sized grass stands (Photograph 19) in swales and north-facing ridges, and tall-grass stands (Photograph 20) of sacaton (*Sporobolous wrightii*) in the broader floodplains along several of the washes on the Appleton Ranch.



Photograph 19. Medium-grass stand



Photograph 20. Tall-grass stand



PROPERTY BOUNDARY

T.21S., R18E., Portions of Sections 14, 15, 17 & 28. Santa Cruz County, Arizona O'Donnell Canyon & Pyeatt Ranch 1:24000 USGS Quadrangles

Photo Source: Cooper Aerial Surveys, Co. Three Unrectified Images, 1976.



WestLand Resources Inc. Engineering and Environmental Consultants 2343 E. Broadway Bivd. Suite 202 Tuseon, Az 85719 (520) 206-9595







# APPLETON RANCH

Aerial Photograph (1976) Figure 5A



PROPERTY BOUNDARY

T.21S., R18E., Portions of Sections 14, 15, 17 & 28. Santa Cruz County, Arizona O'Donnell Canyon & Pyeatt Ranch 1:24000 USGS Quadrangles

Photo Source: Cooper Aerial Surveys, Co. Three Unrectified Images, 1976.



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# APPLETON RANCH

Aerial Photograph (1976) Figure 5A Robinett and Breckenfeld (unpublished) recognized and mapped seven vegetation types on the Research Ranch (Figure 6). The seven vegetation types are:

- Encinal Mixed Oak
- Interior Riparian/Cottonwood-Willow Forests
- Interior Riparian/Mixed Riparian Scrub
- Semidesert Mixed Grass-Mesquite
- Semidesert Mixed Grass-Mixed Scrub
- Semidesert Mixed Grass-Yucca-Agave
- Sonoran Riparian/Mixed Broadleaf Forest

Of these seven types, Semidesert Mixed Grass-Mixed Scrub is the most extensive on the Research Ranch and occurs primarily on the younger terraces and alluvial remnants. The second most extensive vegetation type is the Semidesert Mixed Grass-Yucca-Agave. It is interesting to see that this association is mapped on the oldest geomorphic surfaces, which are clay-rich. Yucca and agave are considered to be succulents and are likely to have a competitive advantage on clay-rich soils during drought phases (Burgess, 1995). In addition, these older surfaces may be less productive and have a lower density of grasses than younger geomorphic surfaces. Lower density, less productive grassland may be more favorable conditions for the survival of these two succulents than elsewhere on the Research Ranch.

At least three of these vegetation types are mapped within the three Appleton Ranch tracts:



Photograph 21. Semidesert Mixed Grass-Mixed Scrub



- Semidesert Mixed Grass-Mesquite (Photograph 22), and
- Semidesert Mixed Grass-Yucca-Agave (Photograph 23).



Photograph 22. Semidesert Mixed Grass-Mesquite



Photograph 23. Semidesert Mixed Grass-Yucca-Agave



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Brown and Lowe (1994), in their 1:1,000,000 scale mapping of the biotic communities of southwestern United States and northwestern Mexico, recognized three biotic communities as occurring on or near the Research Ranch:

- Semidesert grassland,
- Plains and Great Basin grassland, and
- Madrean evergreen woodland.

By including portions of the Sonoita basin as part of the Plains and/or Great Basin grasslands, Brown and Lowe (1994) were suggesting that the grassland of the Research Ranch had a greater floristic affinity with grasslands to the north or northeast in North America. Bock and Bock (2000), after 30 years of research on the Research Ranch and adjacent lands, considered the grassland to be Madrean mixed-grass prairie. Bock and Bock (2000) suggested that the floristic affinity of the Research Ranch was closer to the flora of northern Mexico.

The question of floristic affinity was resolved by McLaughlin et al. (2001) by comparing the floristic inventory they had compiled for the Research Ranch with 40 other local floras from the western United States, 32 local floras from Mexico, and 40 floras from the central United States. Figure 7, reproduced from McLaughlin et al. (2001), shows isoclines of floristic similarity for the flora of the Research Ranch with other local (small-area) floras within the United States and Mexico. McLaughlin et al. (2001) found that nearly 80 percent of the native species on the Research Ranch belong to floristic elements characteristic of the American Southwest. "The largest elements in the flora are the widespread Madrean and Apachian elements. The former includes species found from western Texas through southern New Mexico and southern Arizona, whereas the latter are more narrowly distributed in southeastern Arizona and southwestern New Mexico" (McLaughlin et al., 2001).

The flora of the Research Ranch as described by McLaughlin et al. (2001) is worth summarizing here. Based on plant collections made from all habitats on the Research Ranch from September 1997 to October 1999 and an additional set of collections made by other researchers to the Research Ranch, McLaughlin compiled a flora of 81 families, 290 genera, 473 native species, and 38 exotic species. The largest families are the composites (Asteraceae, 94 species), grasses (Poaceae, 84 species), and legumes (Fabaceae, 53 species); the combined number of species of these three largest families represents nearly half (45.7 percent) of the total flora. Fifty-one plant families (63 percent of the families) have no more than three species on the Ranch.

In terms of life forms, the flora of the Research Ranch is – as might be expected for a grassland - predominantly composed of herbaceous perennials (253 species, 54 percent of the flora), followed by annuals (137 species, 29 percent of the flora), shrubs (49 species, 10 percent), and relatively few species of trees (21 species, 4 percent) and succulents (13 species, 3 percent).



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Finley Spring (actually two closely spaced springs and the only perennial [and supplemented] springs on the Research Ranch) includes several plant species that occur nowhere else on the Research Ranch. These are wetland species and include:

- Carex lanuginosa
- Scirpus maritimus
- Sisyrinchium demissum
- Juncus interior
- Lobelia cardinalis



Photograph 24. Huachuca water umbel

Cyperaceae Cyperaceae Iridaceae Juncaceae Campanulaceae Woolly sedge Alkali bulrush Greene stiff blue-eyed grass Inland rush (family) Cardinal flower

One additional plant, *Lilaeopsis schaffneriana* var. *recurva* (Apiaceae; Huachuca water umbel), a federally listed endangered species, was introduced to Finley Spring in late 2003 as several vegetative "plugs" near the base of the seep face (Photograph 24). These plugs had not yet begun to extend creeping stems when we observed them on February 10, 2004. If these establish successfully, they will form dense, low (2 to 4 cm [1 to 2 in]) bright green mats on the wet soil of Finley Spring.

As described earlier in this report, there are two rainy

seasons on the Research Ranch, the major one in the summer (July and August) and a second one in the winter (December through February). The winter rainfall is only about one-fourth to one-third that of summer rainfall. Most of the herbaceous perennials and annuals are responsive to the summer rains, accomplishing their growth, flowering, and seed production during and immediately after the summer rains. Trees, shrubs, and succulents respond to both summer and winter rains. Arizona white oak (*Quercus arizonica*) and Emory oak (*Quercus emoryi*) both flower in late March to early April and drop their acorns at the beginning of the summer rains (late July through August). Mesquite (Prosopis *velutina*), flowering in late April to early May, also sets mature pods just prior to the onset of the summer rains. We estimate that, in terms of summed above-ground productivity on the Research Ranch, the greatest mass of leaves is produced by herbaceous and annual plants in response to summer rains, and the greatest mass of seeds is also produced by herbaceous and annual plants after the summer rains. The oaks and some of the woody shrubs (like *Rhus trilobata*) produce new leaves in late winter and, sporadically between years, large crops of seeds. Perhaps the only two significant producers during the winter are junipers (Juniperus coahuilensis and J. deppeana) and manzanita (Arctostaphylos pungens); both "flower" in February and March, both require most of the summer to mature their "berries" and, during wet years, have significant amounts of mature berries by early winter.

These schedules of leaf and seed productivity affect the animals that consume leaves and seeds on the Research Ranch and, by association, the Appleton Ranch. Grasshoppers, which eat the leaves of herbaceous plants, are most abundant during and immediately after the summer rains. Acorn woodpeckers and mammals (including javelina, bear, deer, coyotes, foxes, and rodents) will utilize, often to an extraordinary degree, the acorns and mesquite pods produced just prior to the onset of the summer rains. In a year of significant acorn production and good mesquite pod production, late June through August is the greatest period of resource (seed) availability for the larger mammals, a feast that exceeds by orders of magnitude what is available during the rest of the year. Grassland birds, particularly sparrows, are expected to move into the area as the grasses and other herbaceous plants finish their reproduction in late summer.

Lima and Valone (1991) found that structure of vegetation (open grassland versus grassland with shrubs or, as an experimental manipulation, piles of brush) had a notable effect on the composition of sparrows in the grassland. In open grasslands, they found horned larks and grasshopper sparrows to predominate. When mesquite shrub piles were added to this open grassland, both of these birds left and vesper sparrows became the most common birds.

# 5.2. HUMAN ALTERED ASPECTS OF VEGETATION ON APPLETON RANCH

Bahre has researched the land-use history of the Research Ranch specifically (Bahre, 1977) and of the Arizona borderlands generally (Bahre, 1991). Bahre has assembled a number of historically significant accounts and photographs of the Babocomari area and the adjacent portion of the San Pedro River valley. In his review of the land-use history of the Research Ranch, he addresses the probable minor effects of the Sobaipuri Native American community in the area during early Spanish contact as well as the extensive effects of ranching (ca 1700 - 1850) in the area. Ranching and mining are likely to have had the most obvious effects on the Ranch and the Sonoita valley. Bahre (1977, p. 16) writes:

"Probably no single human activity in the entire history of the upper San Pedro has had such a devastating impact on the ecology of the region or has led to greater changes in the wild landscape in short period than the livestock industry. An examination of the pictures in *Views of the Monuments and Characteristic Scenes Along the Boundary between the United States and Mexico West of the Rio Grande 1892-1895* (International Boundary Commission, 1899) and the pictures in the George Roskruge Collection give one a deep appreciation of the combined effects of droughts and overstocking on the ranges of the upper San Pedro in the 1880's and '90's. In these pictures hundreds of square miles of rangelands are desolated and denuded of their cover. The grasses, even the sacaton in the river bottoms, are grazed to the ground; the hills are covered with cattle trails; and the oaks have browse lines. After the summer rains of 1893, the rangelands were covered with weeds, and for the first time the invasion and /or increase of woody xerophytic shrubs in the rangelands was noted (*Report of the Governor of Arizona to the Secretary of the Interior*, 1893, p. 23).

The continuous overstocking and overgrazing of the ranges, which began in the 1880s and lasted into the 1930s, has had an enormous impact upon the wild lands of upper San Pedro as well as upon the lands contained within the Research Ranch. Overgrazing has led to vast changes in the diversity and composition of the grass and shrub communities, the invasion of weedy plants, and the compaction of the soils, and has upset the balance between infiltration and runoff in favor of the latter."

At the time Bahre (1977) described the vegetation of the Research Ranch, cattle had been removed for less than 10 years. Jane Bock had assembled a provisional flora of the Ranch in the early 1970s; included in her list were 45 weedy species (Bahre, 1977). It is likely that these weedy species, such as mustard (*Brassica* spp.), groundsel (*Senecio* sp.), Russian thistle (*Salsola kali*), and Johnson grass (*Sorghum halepense*), abundant during most of the 1900s, have declined markedly in the last two to three decades since cattle were removed; however, we are unaware of any published reports that document or quantify this decline on the Research Ranch. Even at the time Bahre made his descriptions of the Research Ranch, the grassland appeared to be a short-grass grassland. Today, medium and tall grasses are much more abundant (Photographs 25 and 26, respectively). The short endemic grass, curley mesquite (*Hilaria berlangeri*) was probably the most numerically abundant grass on the Research Ranch at the time grazing ceased (and continues to be one of the dominant grasses on the adjacent grazed rangelands); today it is no longer the dominant grass in many portions of the uplands on the Research Ranch. Grazing by cattle has had a significant effect both in the increase of weedy species and the relative composition of native species on the Research Ranch.



Photograph 25. Medium height grassland



Photograph 26. Tall grassland

There are several other human-altered aspects of the Research Ranch and, by association, the Appleton Ranch:

• Large areas near Finley Spring and on East Mesa were contour plowed in 1953-54 and about 1940, respectively. After plowing, these areas were seeded with two African grasses, Lehmann lovegrass (*Eragrostis lehmannii*; Photograph 27) and Boer lovegrass (*E. chlorometas*; Photograph 28). The populations that established at the time of seeding persist and continue to spread today.



Photograph 27. Lehman lovegrass



Photograph 28. Boer lovegrass

Boer lovegrass, although occupying less of the grassland on the Research Ranch than Lehmann lovegrass, is more troublesome because it has displaced native grasses to form a nearly continuous monotypic stand of grass. Conversely, Lehmann lovegrass on the Research Ranch is usually part of a heterogeneous community of native forbs and grasses.

- There are impoundments that were constructed in many areas of the Research Ranch that are still present to day. These stock water ponds decrease overall stream flow and allow for greater localized infiltration of retained storm water to groundwater.
- Robinett and Breckenfeld (NRCS), after a close inspection and mapping of soils and vegetation on the Research Ranch, have concluded that a significant portion of the upper soil horizon(s) was lost during the last 200 years of sustained over-grazing (L. Kennedy, pers. comm.). At least one pedicel of soil on the Research Ranch, isolated from grazing by cattle, has a significant upper organic layer of soil that suggests to these soil scientists what the original soil condition may have been.
- There are very few sycamores and cottonwoods left on the northern portion of the Research Ranch; all of the trees we saw on our visits were mature (i.e., little recruitment is occurring). Bock and Bock (2000) described the loss of lone sycamores along O'Donnell Canyon. A grove of mature cottonwoods we observed north of the Research Ranch appeared to have been largely killed by a recent fire (Photograph 29). Bahre (1977) suggests that woodcutting for nearby mine stamp mills in the late 1800s may have resulted in the loss of many of these riparian trees, at least from the Babocomari River generally. Repeat photographs in the San Pedro River valley near Fairbank and Contention (Bahre, 1991) indicate that cottonwoods have increased along the river since the late 1800s.



Photograph 29. Cottonwoods killed by fire

One other observation made during our visits was the number of young cottonwoods establishing in a relatively small arroyo about 3 km (2 miles) west of the Research Ranch immediately south of State Highway 83. It is not known what the ecological and human factors are that have encouraged populations of sycamore and cottonwood in some off-property areas while deterring their establishment on the Research Ranch and in the washes of other nearby ranches.

#### 5.3 VEGETATION AND FIRE



Photograph 30. Burned sacaton stand

On the grazed grasslands immediately beyond the boundary fences of the Research Ranch, fire is infrequent except in the sacaton (*Sporobolus wrightii*) stands along the washes. Because of cattle grazing, there is generally very little standing fuel on the offsite uplands to support a fire and little immediate gain for ranchers to perform prescribed burns. However, sacaton stands, even when grazed, do have enough fuel to support a fire. Ranchers in the Sonoita area burn the sacaton in March or early April in order to remove the coarse dead grass stems so that cattle can easily forage on the new growth (Bock and Bock, 2000). For example, Photograph 30 depicts a stand of sacaton in Hay Canyon about two miles north of the Research Ranch that was burned March 6, 2004 (Kennedy, 2004), 10 days before the photograph was taken.

Bock and Bock (2000) describe the results of their research on some of the observed effects of sacaton burns that occurred

midyear (June) on the Research Ranch. Some of their observations of post-burn sacaton stands include:

- Immediate decline in cotton rats (which are usually the most common rodent in unburned sacaton);
- Reduced growth of sacaton during the first postfire growing season and a concomitant increase in other native grasses and wildflowers;
- An increase in rodent species, especially Merriam's kangaroo rat (*Dipodomys merriami*) and hispid pocket mouse (*Perognathus hispidus*) that are characteristic of more open habitats; and
- An increase in the use of the burned sacaton by birds such as American kestrel, harrier, mourning dove, eastern meadowlark, Savannah sparrow, vesper sparrow, Cassin's sparrow and white-crowned sparrow.

The Bocks note that the effect of fire on sacaton stands is relatively short-lived. Most of the grasses, including sacaton, were not killed by the fires but resprouted and, within about 1.5 years after a burn, the sacaton stands had returned to "preburn dominance, and the pulse of postfire plants and animals had begun to wane" (Bock and Bock, 2000).

Upland fires now occur on the Research Ranch with some frequency. There have been 18 documented fires since grazing stopped in 1968. The mean area burned in these 18 fires is 260 hectares (643 acres); however, 11 of the fires were less than 40 hectares (100 acres) in size. The most recent extensive fire on the Research Ranch was the Ryan Fire, which was ignited off-property by a human on April 29, 2002 and burned approximately 2,900 hectares (7,200 acres) of the 3,240-hectare (8,000-acre) Research Ranch. Within the Appleton Ranch, the Vaughn Canyon and O'Donnell Canyon tracts were burned during this fire, but the Post Canyon Tract at the southern extreme of the Research Ranch apparently did not burn. A previous extensive fire was Big Fire, ignited by lightning on July 16, 1987, and burned nearly 1,000 hectares (2,500 acres) in lower Turkey Creek and East Mesa of the Research Ranch. This fire appears to have burned a portion of the O'Donnell Canyon Tract.

After the Big Fire, the upland grasslands had reduced perennial grass cover for two growing seasons but perennial grass cover returned to its preburn level during the third summer. Bock and Bock (2000) found that wolftail (*Lycurus setosus*), plains lovegrass (*Eragrostis intermedia*), and bluestems recovered more quickly than threeawn (*Aristida* spp.) and grama (*Bouteloua* spp.) grasses. They also found that seed-eating sparrows increased ten-fold on the burned areas (compared to unburned areas) in the fall after the Big Fire. Nesting sparrows declined for at least 2 years on the burned areas until the grass recovered to former levels. Research is underway to describe the effects and duration of the Ryan Fire on the vegetation, animals, and soil movement on the Research Ranch.

# 5.4. WILDLIFE

As described above, the biotic communities (as identified by Brown, 1994) on, and immediately adjacent to, the Appleton Ranch are:

- Semidesert grassland,
- Plains and Great Basin grassland, and
- Madrean evergreen woodland

Common reptile and amphibian species that have been recorded in these biotic communities on or adjacent to the Property include black-tailed rattlesnake (*Crotalus molossus*), rock rattlesnake (*C. lepidus*), Arizona mountain kingsnake (*Lampropeltis pyromelana pyromelana*), black-necked garter snake (*Thamnophis cyrtopsis*), Mexican garter snake (*T. eques megalops*), whiptail lizards (*Cnemidophorus spp.*), Clark's spiny lizard (*Sceloporus clarkii*), red-spotted toad (*Bufo punctatus*), canyon tree frog (*Hyla arenicolor*), desert box turtle (*Terepene ornate luteola*), and Sonoran mud turtle (*Kinosternon sonoriense*)

(Smith and Chiszar, undated). Common bird species expected to occur on or adjacent to the Property include red-tailed hawk (*Buteo jamaicensis*), goshawk (*Accipiter gentillis*), great-horned owl (*Bufo virginianus*), mourning dove (*Zenaida macroura*), Chihuahuan raven (*Corvus cryptoleucus*), common raven (*C. corax*), meadowlark (*Sturnella* ssp), Mearn's quail (*Cyrtonyx montezumae*), American robin (*Turdus migratorius*), Scott's oriole (*Ictarus parisorum*), Lucy's warbler (*Vermivora luciae*), blue grosbeak (*Passerina caerulea*), and Gould's turkey (*Meleagris gallopavo mexicana*) (Audubon Society, 2003; National Geographic, 2002). Common mammals expected to occur on the Property include whitefooted mice (*Peromyscus* spp.), pack rat (*Neotoma* spp.), cottontail rabbit (*Sylvilagus* spp.), Coues whitetailed deer (*Odocoileus virginianus couesi*), mule deer (*O. hemionus*), pronghorn antelope (*Antelocapra americana*), javelina (*Tayassu tajacu*), bobcat (*Felis rufus*), mountain lion (*Felis concolor*), raccoon (*Procyon lotor*), coati (*Nasua nasua*), and coyote (*Canis latrans*) (Hoffmeister, 1986).

The portions of the Vaughn Canyon, O'Donnell Canyon, and Post Canyon drainages that pass through the Appleton Ranch apparently flow ephemerally and were dry at the time of WestLand's visits. However, the flows at the headwaters of these drainages are perennial. These perennial flows begin a short distance (3 to 5 km [2 to 3 miles]) upstream of the Research Ranch (Brown et al., 1978; Kennedy, 2004). Three species of native fish have been recorded in these headwater creeks. These species are Sonoran sucker (*Catastomous insignis*), long-finned dace (*Agosia chrysogaster*), and Gila chub (*Gila intermedia*). Nonnative green sunfish (*Lepomis cyanellus*) were first observed in O'Donnell Creek in 1990 and are thought to have contributed to the recent decline in the native fish species, especially the Gila chub (USFWS, 2001a). During periods of sustained intermittent flows, we would expect all four of these species to be found on the portions of the drainages that pass through the Property. These intermittent streams may also serve as important avenues for fish dispersal between perennial reaches upstream and downstream of the Property.

Wildlife species observed<sup>1</sup> by WestLand on the Property include whitetail deer, mule deer, pronghorn antelope, javalina, coyote, mountain lion<sup>2</sup>, skunk (*Mephitis* spp.), feral goldfish (*Carassius auratus*)<sup>3</sup>, desert pupfish, guilded flicker, Mexican jay (*Aphelocoma ultramarina*), meadowlark, mourning dove, raven, Cassin's sparrow (*Aimophila cassinii*), and white-crowned sparrow (*Zonotrichia atricapilla*).

# 5.5. SPECIAL-STATUS SPECIES

The following special-status species list (Table 2) was provided by the USFWS and contains all federally listed threatened, endangered, proposed, and candidate species for Santa Cruz County, Arizona. The table includes the species' common and scientific name, federal listing status, and WestLand's evaluation of the likelihood of occurrence on or near the Property.

<sup>&</sup>lt;sup>1</sup>Wildlife observations included direct visual observation and the observation of tracks and scat.

<sup>&</sup>lt;sup>2</sup> Mountain lion tracks were observed by WestLand personnel in the bottom of Post Canyon on March 17, 2004.

<sup>&</sup>lt;sup>3</sup> WestLand personnel observed numerous feral goldfish in a tank above Post Canyon.

Species	Status	Potential Occurrence at Project Site and Basis for Potential Occurrence Determination
Canelo Hills ladies'-tresses (Spiranthes delitescens)	Endangered	Possible: this species is known to occur approximately 3 to 5 km (2-3 miles) upstream of the Property along O'Donnell Creek. During wet years, it is possible that this species may establish itself along the portions of O'Donnell and Post Creeks that flow through the Property.
Pima pineapple cactus (Coryphantha scheeri var. robustispina)	Endangered	None: the Property is located outside of the species' documented range.
Huachuca water umbel (Lilaeopsis schaffneriana ssp. recurva)	Endangered	Present: there is an introduced population of this species on the Property at Finley Springs. In addition, there are known populations of Huachuca water umbel approximately 3 to 5 km (2-3 miles) upstream of the Property along O'Donnell Creek (AGFD, 2003a). During wet years, it is possible that this species may establish itself along the portions of O'Donnell and Post Creeks that flow through the Property.
Sonora chub (Gila ditaenia)	Threatened	None: this species' range in Arizona is restricted to the Sycamore Creek drainage west of Nogales, AZ (USFWS, 1992), some 70 km (45 miles) southwest of the Property.
Gila chub (Gila intermedia)	Proposed Endangered	Possible: this species is known to occur approximately 3 to 5 km (2-3 miles) upstream of the Property in the perennial portion of O'Donnell Creek and recently extirpated from upstream portions of Post Creek. It is possible that the portions of O'Donnell and Post Creeks that flow through the Property may be occupied by this species during periods of intermittent flow.
Gila topminnow (Poeciliopsis occidentalis occidentalis)	Endangered	Possible: this species is known to occur approximately 3 to 5 km (2-3 miles) upstream of the Property in the perennial portion of O'Donnell Creek and recently extirpated from upstream portions of Post Creek. It is possible that the portions of O'Donnell and Post Creeks that flow through the Property may be occupied by this species during periods of intermittent flow.
Desert pupfish ( <i>Cyprinodon macularius</i> )	Endangered	Present: there is an introduced population of this species on the Property at Finley Springs.
Chiricahua leopard frog ( <i>Rana chiricahuensis</i> )	Threatened	Possible: this species has been reported in Post Canyon, O'Donnell Creek, and the Babocomari River in the Property vicinity. According to Linda Kennedy of the Research Ranch, a population of Chiricahua leopard frogs in Finley Springs was recently extirpated due to predation by introduced bullfrogs ( <i>Rana catesbeiana</i> ). Bullfrogs have subsequently been removed from Finley Springs and it is hoped that the Chiricahua leopard frog may become reestablished there.
Sonora tiger salamander (Ambystoma tigrinum stebbinsi)	Endangered	None: this species' range is restricted to the San Rafael Valley and the foothills of the Huachuca Mountains (25 km [16 miles] south of the Property) (USFWS, 2002a).

#### Table 2. Special-Status Species: Known or Suspected to Occur in Santa Cruz County, Arizona.

Species	Status	Potential Occurrence at Project Site and Basis for Potential Occurrence Determination
Bald eagle ( <i>Haliaeetus leucocephalus</i> )	Threatened	Possible: no potential for breeding. Bald eagles spend most of their time along major waterways. The nearest occupied breeding habitats are located along the Salt, Verde, and Gila Rivers in Central Arizona and along the Rio Yaqui in Sonora, Mexico. Wintering bald eagles can be found throughout Arizona. There are unconfirmed reports of bald eagles on the Research Ranch. It is possible that this species may be an infrequent visitor to the Property (Hunt et al., 1992).
Cactus ferruginous pygmy-owl (Glaucidium brasilianum cactorum)	Endangered	None: the Property is located outside of the documented range for this owl and is located above the upper elevational limit occupied by this species (USFWS, 2003).
California brown pelican (Pelecanus occidentalis californicus)	Endangered	None: occurrence of this species is Arizona is limited to larger lakes and rivers, none of which are present on the Property.
Mexican spotted owl ( <i>Strix occidentalis lucida</i> )	Threatened	Possible: no suitable breeding habitat occurs on the Property (Ganey, 1998). However, there are occupied breeding sites of this species nearby (within 11 km [7 miles]) in the higher elevations of the Huachuca Mountains. Some Mexican spotted owls remain in their breeding territories year round while others migrate, generally to more open habitats at lower elevations, in winter (USFWS, 1995a). Therefore it is possible that the Property may be utilized by Mexican spotted owls in winter.
Southwestern willow flycatcher (Empidonax traillii extimus)	Endangered	None: the Property lacks riparian habitat containing significant stands of willow, cottonwoods, or tamarisk required by this species.
Yellow-billed cuckoo (Coccyzus americanus)	Candidate	Possible: this bird has been recorded in the immediate vicinity of the Property.
Northern aplomado falcon (Falco femoralis septentrionalis)	Endangered	Unlikely: the Property contains potentially suitable habitat for the species and there are historical records of nesting aplomado falcons from nearby Fort Huachuca in the 1800s (Keddy- Hector, 1998). There are no recent records of this species in the Property vicinity. The rarity of this species in Arizona makes it very unlikely that it would occur on or near the Property.
Lesser long-nosed bat (Leptonycteris curasoae yerbabuenae)	Endangered	Present: there are two known day roost sites for the lesser long- nosed bat within 8 km (5 miles) of the Property. At night, this species is known to forage widely upon nectar and pollen of agaves, saguaros, and other columnar cacti. The lesser long- nosed bat forages over long distances, possibly 50 to 100 km (30 to 60 miles) from their day roost (Wilson, 1985). The Property contains suitable foraging habitat and is very close to known roosting areas. Therefore we have determined that this species is present on the Property.

#### Table 2. Special-Status Species: Known or Suspected to Occur in Santa Cruz County, Arizona.

Species	Status	Potential Occurrence at Project Site and Basis for Potential Occurrence Determination
Ocelot (Felis pardalis)	Endangered	Possible: several ocelots have been documented in Arizona. Two of these documented occurrences were in the vicinity of the Property (Brown and López González, 2001). Unconfirmed reports of ocelots continue to be received from throughout southern Arizona (USFWS, 1990), including the Research Ranch (Kennedy, 2004).
Jaguar (Panthera onca)	Endangered	Possible: this cat has been well documented as occurring in southern Arizona in the 1900s and within the last five years. The nearest known breeding population of jaguars is located approximately 250 km (150) miles south of the Property in Sonora, Mexico. Jaguars recently documented in southern Arizona are thought to be young dispersing males. There is evidence that at least one of these dispersers has established a territory in the Coronado National Forest east of the Property. Persistent reports of jaguar sightings throughout southeastern Arizona continue to this day (Brown and Lopez, 2001). It is possible that jaguars may occasionally utilize the Property.
Mexican gray wolf ( <i>Canis lupus baileyi</i> )	Endangered	None: wolves historically occurred in the area as recently as 1950, when an adult male was taken at the headwaters of Turkey Creek (Hoffmeister, 1986) south of the Property. Currently, there no known natural wild populations of gray wolves remaining in Arizona. A reintroduced population now exists in the White Mountains of Arizona and New Mexico. The Property is approximately about 225 km (140 miles) southwest from these reintroduction areas. The low numbers of wolves currently in Arizona and the distance between the reintroduction site and the Property makes their potential presence very low.
Stephen's riffle beetle ( <i>Heterelmis stephani</i> )	Candidate	None: the entire range of this species is confined to Madera Canyon, approximately 32 km (20 miles) northwest of the Property (USFWS, 2004).
Huachuca springsnail (Pyrgulopsis thompsoni)	Candidate	Possible: this species is known to occur approximately 3 to 5 km (2 to 3 miles) upstream of the Property in the perennial portion of O'Donnell Creek. It is possible that the portions of O'Donnell and Post Creeks that pass through the Property may be occupied by this species during periods of intermittent flow.

#### Table 2. Special-Status Species: Known or Suspected to Occur in Santa Cruz County, Arizona.

The screening analysis conducted by WestLand indicates that at least three federally listed threatened, endangered, proposed, or candidate species for Santa Cruz County, Arizona occur on the Appleton Ranch. These species are the Huachuca water umbel, desert pupfish, and lesser long-nosed bat. Ten additional threatened, endangered, proposed, or candidate species have the potential to occur on the Property. These species are the Canelo Hills ladies'-tresses, Gila chub, Gila topminnow, Chiricahua leopard frog, bald eagle, Mexican spotted owl, yellow-billed cuckoo, ocelot, jaguar, and Huachuca springsnail. These species are discussed in the following sections.

#### 5.5.1. Huachuca Water Umbel

#### Life History

The Huachuca water umbel (*Lilaeopsis schaffneriana* var. *recurva*) is a small, herbaceous semi-aquatic perennial plant in the parsley family with slender erect leaves that grow from the nodes of creeping rhizomes (AGFD, 2003a). This plant occurs in cienegas and among associated vegetation within Sonoran desertscrub, grassland, oak woodland, and coniferous forests between 1,210 to 1,979 m (4,000 to 6,500 ft) in elevation. This plant seems to require an intermediate level of flood frequency to keep competition with other plants manageable. However, populations of this plant can be destroyed if flooding is too frequent and intense. They require perennial water, gentle stream gradients, small to medium sized drainages, and (apparently) mild winters. The Huachuca water umbel is usually found in water depths of 5 to 15 cm (2 to 6 in) (USFWS, 2001b).

The Huachuca water umbel was listed as an endangered species by the USFWS in 1997 (USFWS, 1997a). Critical habitat for this species was designated in 1999 (USFWS, 1999).

#### Potential for Occurrence on the Property

There is an introduced population of Huachuca water umbel on the Property at Finley Spring. This population was established by the USFWS in the fall of 2003. In addition, there are known populations of Huachuca water umbel approximately 3 to 5 km (2 to 3 miles) upstream of the Property along O'Donnell Creek. During wet years, it is possible that this species may establish itself along the portions of O'Donnell and Post Creeks that flow through the Property.

#### 5.5.2. Desert Pupfish

#### Life History

The desert pupfish (*Cyprinodon macularius, macularius*) is a small fish (5 cm [2 in] long) with a smoothly rounded body shape and narrow, dark vertical bars on the sides (AGFD, 2001a). Breeding males are blue on the top and sides, and have yellow fins. Females and juveniles have tan to olive colored backs and silvery sides. The desert pupfish is found in shallow water of desert springs, marshes, backwaters, and tributaries below 1,515 m (5,000 ft) elevation. They tolerate great extremes of environmental conditions under desert climatic regimes, and therefore have attracted considerable scientific attention. This species was once common in the Rio Sonoyta, San Pedro, Santa Cruz, lower Gila, and lower Colorado River drainages in Arizona, California, and Mexico. This species has declined markedly in recent years due to competition with introduced fishes, water impoundments and diversion, water pollution, stream channelization, and habitat modification. Its range is now restricted to three natural populations in California and one natural population in Arizona at Quitobaquito Springs in western Pima County. Desert pupfish are also known to occupy restricted locations in Sonora and Baja California,

Mexico. Various reintroduced populations occur in Pima, Pinal, Maricopa, Graham, Cochise, La Paz, Yavapai, and Santa Cruz counties, Arizona. New reintroductions continue (USFWS, 2000a).

The desert pupfish was listed as an endangered species by the USFWS in 1986 with critical habitat (USFWS, 1986).

#### Potential for Occurrence on the Property

Natural populations of desert pupfish have been extirpated from the Property vicinity. In 1980, desert pupfish were introduced into Finley Springs (Kennedy, 2004) and persist to this day. This species was observed at Finley Springs by WestLand personnel.

#### 5.5.3. Lesser Long-Nosed Bat

#### Life History

The lesser long-nosed bat (Leptonycteris curasoae verbabuenae) is a leaf-nosed bat characterized by an elongate muzzle, small leaf nose, and long tongue (AGFD, 2003b). Coloration is yellowish brown or gray above and cinnamon below. The tail is minute and appears to be lacking. The species habitat in Arizona includes areas below 1,830 m (6,000 ft) in elevation in Cochise, Pima, Maricopa, Pinal, Graham, and Santa Cruz counties. In Arizona, the species is migratory. Pregnant females arrive in late April and early May and occupy maternity roosts located in caves and abandoned mines. At night, they disperse to feed upon nectar and pollen of saguaros and other columnar cacti (Wilson, 1985). In late July and early August, the adult males arrive to join the females and young as they disperse to forage upon the nectar and pollen of agave flowers. This dispersal extends farther east and north into plant communities occurring at elevations higher than those used earlier in the season (Cockrum and Petryszyn, 1991). By late September, the majority of the bats have left Arizona and returned to their winter range in Mexico. The closest known roost site is located approximately 80 km (50 miles) to the northwest of the Property. The lesser long-nosed bat is known to fly 80 to 100 km (50 to 60 miles) per night while foraging (USFWS, 1997b). According to the species' Recovery Plan, numerous studies documenting long-distance commutes between day roost sites and foraging areas, that the bats forage over long distances, possibly 50 to 100 km (30 to 60 miles) from their day roost (USFWS, 1997b and 2001c).

The lesser long-nosed bat is federally listed as endangered by the USFWS (1988).

#### Potential for Occurrence on the Property

There are two known day roost sites for the lesser long-nosed bat within 8 km (5 miles) of the Property. The Property contains suitable foraging habitat and is very close to known roosting areas. Therefore we have determined that this species is present on the Property.

#### 5.5.4. Canelo Hills ladies'-tresses

#### Life History

The Canelo Hills ladies'-tresses (*Spiranthes delitescans*) is a slender, erect member of the orchid family (AGFD, 2000a). It is also known as the Madrean ladies'-tresses. The flower stalk is approximately 50 cm (20 in) tall. The flower stalk may contain up to 40 white flowers borne in a spiral on the stem. This plant occupies habitat with finely grained, highly organic, saturated soils of cienegas. Plants occur intermixed with tall grasses and sedges at approximately 1,524 m (5,000 ft) elevation. This plant is only known from five sites in the San Pedro River watershed in Santa Cruz and Cochise counties, in Arizona. The small number of known sites, rare and declining habitat, and small population size makes this species vulnerable to extinction. Threats include livestock overgrazing, improper fire management, competition with non-native plants, and water diversions (USFWS, 2001d).

The Canelo Hills ladies'-tresses was listed as an endangered species by the USFWS in 1997 without critical habitat (USFWS, 1997a).

#### Potential for Occurrence on the Property

This species is known to occur approximately 3 to 5 km (2 to 3 miles) upstream of the Property along O'Donnell Canyon. During wet years, it is possible that this species may establish itself along the portions of O'Donnell Creek and Post Canyon that flow through the Property.

#### 5.5.5. Gila Chub

#### Life History

The Gila chub (*Gila intermedia*) is a small-finned, deep bodied, "chubby" member of the minnow family (AGFD, 2002a). It is dark colored with diffuse lateral bands rarely present. Adult males average 150 mm (6 in) in length; females are somewhat larger and can exceed 200 mm (8 in). Gila chubs inhabit pools in smaller streams, cienegas, and artificial impoundments at elevations ranging from 600 to 1,000 m (2,000 to 3,500 ft). Gila chubs are highly secretive, preferring quiet, deeper waters, especially pools, or remaining near cover such as terrestrial vegetation, boulders, and fallen logs. Historically, this fish inhabited suitable habitat throughout the entire Gila River basin. Factors potentially related to habitat destruction, overgrazing, and competition and predation by introduced non-native fishes has reduced its distribution to 29 extant populations, 28 of which are small, isolated, and threatened. The portions of Turkey Creek, O'Donnell Canyon, and Post Canyon that flow near or through the Property have been proposed as critical habitat for the Gila chub.

The Gila chub has been proposed as an endangered species with critical habitat (USFWS, 2002b).

#### Potential for Occurrence on the Property

This species is known to occur approximately 3 to 5 km (2 to 3 miles) upstream of the Property in the perennial portion of O'Donnell Creek where recent restoration efforts have been undertaken to aid in its conservation (Kennedy, 2004). This restoration effort, carried out by the USFWS, was aimed at removing introduced green sunfish, which have been known to limit populations of Gila chubs. Gila chubs currently persist in the perennial reaches of O'Donnell Creek just upstream from the Property. It is possible that the portions of O'Donnell Creek and Post Canyon may be occupied by this species during periods of intermittent flow.

#### 5.5.6. Gila Topminnow

#### Life History

The Gila topminnow (*Poeciliopsis occidentalis occidentalis*) is a small (2.5 to 5 cm [1 to 2 inches] long) guppy-like live bearing fish (AGFD, 2001b). It occurs in small streams, springs, and cienegas below 1,350 m (4,500 ft) elevation, primarily in shallow waters with aquatic vegetation and debris for cover. Historically, this fish was one of the most common and widespread species in the Gila River drainage in Arizona, New Mexico, and Mexico. This species has declined due to habitat destruction and the impacts of the introduction and spread of non-indigenous predatory and competitive fishes. The species persists in suitable habitats in Mexico and Arizona. Over 100 artificial populations are being maintained in order to provide stock for the reestablishment of Gila topminnows into numerous sites in Arizona. To date, Gila topminnows have been introduced to over 20 sites (USFWS, 2001e).

The Gila topminnow was listed as an endangered species without critical habitat in 1967 (32 FR 4001, March 11, 1967).

#### Potential for Occurrence on the Property

This species is known to occur approximately 3 to 5 km (2 to 3 miles) upstream of the Property in the perennial portion of O'Donnell Creek. It is possible that the portions of O'Donnell Creek and Post Canyon may be occupied by this species during periods of intermittent flow.

#### 5.5.7. Chiricahua Leopard Frog

#### Life History

The Chiricahua leopard frog (*Rana chiricahuensis*) is a medium sized, stout bodied frog with greenbrown skin, many spots on its back, and pale yellow to white skin below (AGFD, 2001c). Adults are distinguished from other leopard frogs by their unique "salt and pepper" thigh pattern. Historical distribution of the Chiricahua leopard frog includes elevation ranges from 1,000 to 2,700 m (3,281 to 8,890 ft) in central and southeastern Arizona, including Santa Cruz County. The Chiricahua leopard frog requires permanent or nearly permanent water sources, including streams, rivers, backwaters, ponds, and stock tanks that are free from introduced fish, crayfish, and bullfrogs (*Rana catesbeiana*). Habitat destruction, predation and displacement by non-native species, and disease are suspected contributing factors to the species decline (USFWS, 2002c).

The Chiricahua leopard frog is designated as a threatened species throughout its range (USFWS, 2002c). Critical habitat has not been designated at this time and a recovery plan for this species has not yet been drafted. According to the listing summary, this species is absent from more than 75 percent of its known historical sites and former range.

#### Potential for Occurrence on the Property

This species has been reported in Post Canyon, O'Donnell Creek, and the Bobocamari River in the Property vicinity. According to Linda Kennedy of the Research Ranch, a population of Chiricahua leopard frogs within Finley Springs was recently extirpated due to predation by introduced bullfrogs. Bullfrogs have subsequently been removed from Finley Springs and it is hoped that the Chiricahua leopard frog may become reestablished there.

#### 5.5.8. Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is a large bird of prey up to 1 m (3 ft) long and with a wingspan of about 2 m (6 to 7 ft) (AGFD, 2002b). Adults have a characteristic white head and tail with a brown body. Immature bald eagles are mostly dark and lack the white head and tail found in adult birds. Nesting populations are increasing throughout the United States. Arizona supports a small, widely dispersed resident population of approximately 40 pairs that breed along the Salt, Verde, Gila, Bill Williams, Agua Fria, and San Francisco rivers and associated reservoirs, and also Tonto and Canyon creeks. Arizona also hosts a number of wintering eagles, with at least 200 to 300 wintering birds documented each year. Bald eagles in Arizona prey upon fish, waterfowl, small mammals, and carrion (USFWS, 2002d).

Terrestrial habitats are also utilized during certain periods of the year, especially by non-breeding and wintering birds. Cattle (as carrion) may become important as a food item both episodically (during prolonged droughts) and periodically during the calving season (such as early spring) when placentas, stillborn calves, and cows that die while calving become available to scavengers. Terrestrial habitats also supply elk<sup>4</sup> and deer carrion, rabbits, and other mammals of appropriate size, upland birds, and reptiles (Hunt et. al., 1992).

<sup>&</sup>lt;sup>19</sup> Elk sign is common on the site and Westland biologists documented the skeletal remains of a female elk calf on the Property.

The bald eagle was down-listed from endangered to threatened status in 1995 (USFWS, 1995b).

#### Potential for Occurrence on the Property

There is a potential for the Property to be utilized for foraging by wintering bald eagles. O'Donnell Creek and its tributaries provide potential foraging habitat for wintering bald eagles. Sonoran suckers are an important prey species for bald eagles in Arizona and are known to occur adjacent to the Property. There are unconfirmed reports of bald eagles on the Property. It is possible that this species may be an infrequent visitor to the Appleton Ranch.

#### 5.5.9. Mexican Spotted Owl

#### Life History

The Mexican spotted owl (*Strix occidentalis lucida*) is a brown bird about 40 to 50 cm (16 to 19 in) long and with a wingspan of approximately 105 to 135 cm (42 to 54 in) (AGFD, 2001d). The Mexican spotted owl's lack of ear tufts gives its head a large round appearance. The head and back are covered with white spots, hence the common name. Mexican spotted owls are reportedly quite tame and will tolerate close range observations if the observer is quiet. The Mexican spotted owl inhabits steep canyon and montane forest habitats in a range extending from southern Utah and Colorado through Arizona, New Mexico, west Texas, and Mexico. In the northern portion of its range (Utah, Colorado, northern Arizona, and New Mexico), the species primarily occurs in steep walled rocky canyons with mixed conifers. Below the Mogollon Rim of Central Arizona and New Mexico, the Mexican spotted owl occupied a much more diverse array of habitat types. In this region, breeding Mexican spotted owls occupy canyons containing mixed conifers, Madrean pine-oak and or ponderosa pine forests, encinal oak woodlands, and riparian forests. Some Mexican spotted owls remain in their breeding territories year round, while others migrate, generally to lower elevations, in winter. The Mexican spotted owl, described as a "perch and pounce" predator, primarily consumes small to medium-sized rodents such as pack rats, mice (*Peromyscus* spp.), and voles (*Microtus* spp.). It also preys upon bats, birds, reptiles, and arthropods (USFWS, 2002e).

In 1993 the Mexican spotted owl was designated as a threatened species throughout its range by the USFWS (1993). Portions of this species' range are designated as critical habitat, but not Santa Cruz County.

#### Potential for Occurrence on the Property

No suitable breeding habitat occurs on the Property. However, there are occupied breeding sites of this species nearby (within 11 km [7 miles]) in the higher elevations of the Huachuca Mountains. Some Mexican spotted owls remain in their breeding territories year round, while others migrate, generally to more open habitats at lower elevations, in winter. Therefore, it is possible that the Property may be utilized by Mexican spotted owls in winter.

#### 5.5.10. Yellow-billed Cuckoo

#### Life History

The western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) is a long and slender bird with relatively short, dark legs (AGFD, 2002c). The plumage is grayish-brown on top and white below. The primary feathers on the wings are rufous (orange-brown) in color, and there is a bold, black and white pattern under the tail. The lower mandible on the bill is yellow. Juveniles, which hold their plumage well into the fall, have a much paler pattern on the tail; and the bill may show little to no yellow. The yellow-billed cuckoo is a seasonal migrant to the western United States, including Arizona. The species winters in Central and South America, arriving in Arizona in late May and early June for the breeding season (AGFD, 1999 and USFWS, 2001f). The species has been documented in Arizona as late as September.

The western population of yellow-billed cuckoo is considered an obligate riparian species requiring large tracts of undisturbed riparian forest (AGFD, 1999). An obligate broadleaf species at lower elevations, the yellow-billed cuckoo is able to use mesquite and salt cedar (*Tamarisk* spp.) communities at higher elevations. Optimal breeding habitat is comprised of tall cottonwoods and mid-successional stage willows, with dense foliage below 10 m (30 ft), high relative humidity, and relatively close proximity to water. Less optimal habitat may be used as resting and feeding stops during migration. Breeding for this species in Arizona is presumed to occur along several major river drainages and their tributaries, including the Bill Williams, Colorado, Verde, Gila, Santa Cruz, San Pedro, San Francisco, and the Santa Maria and Big Sandy Rivers (AGFD, 1999). Breeding populations have also been documented on the Tonto Creek inflow to Roosevelt Lake, and Sonoita, Cienega and Arivaca Creeks. The highest populations of breeding birds is believed to occur at Cienega Creek (Pima County), Sonoita Creek (Santa Cruz County), and the San Pedro River (Cochise County).

This species was added to the USFWS candidate species list in 2001 (USFWS, 2001f). Due to budgetary constraints, higher priority taxa are currently being addressed by USFWS.

#### Potential for Occurrence on the Property

The Property lacks the optimal breeding habitat described above. Suitable breeding habitat exists just upstream of the Research Ranch along the perennial reaches of O'Donnell and Turkey Creeks. As described above, less optimal habitat may be used as resting and feeding stops during migration. There are confirmed records of this species from the immediate vicinity of the Property. Therefore, we have concluded that there is potential for migrating or dispersing yellow-billed cuckoos to occur on the Property.

#### 5.5.11. Ocelot

#### Life History

The ocelot (*Leopardus pardalis*) is a small spotted cat (76 to 104 cm [30 to 41 inches] long) weighing 7 to 19 kg (15 to 40 lbs). The upper surface (back) is grayish to cinnamon colored and paler on the sides (AGFD, 2004a). The underparts are whitish. Dark markings form streaks on the sides and each cheek has two black stripes (USFWS, 2002f).

Historically, the ocelot ranged over much of Texas, Mexico, Central and South America, and in Arizona as far north as Camp Verde. Currently this cat's range is thought to include south Texas, Mexico, Central and South America, and possibly Arizona. Prey includes rabbits, small rodents, and birds. The ocelot is known to occur in northern Sonora, Mexico. Over 60 percent of documented (i.e., killed) ocelots in Sonora were taken in Sinaloan thornscrub habitat. An additional 20 percent were taken in Madrean evergreen woodland. This habitat type occurs on and adjacent to the Property.

This neotropical cat is listed as endangered (USFWS, 1972a, 1982) without critical habitat.

#### Potential for Occurrence on the Property

Several ocelots have been documented in Arizona. Two of these documented occurrences were in the vicinity of the Property in the Huachuca and Dragoon mountain ranges. Many additional reports of ocelots in Arizona are not documentable. According to the USFWS, the protected status imposed in 1979 may prevent people from reporting ocelots. At least four ocelots may have been inadvertently trapped in Arizona since 1980, including two reportedly taken from the San Pedro Valley at Dudleyville. One of these individuals was reportedly a lactating female, indicating a reproducing population. It is notable that these two unconfirmed reports, as well as the confirmed specimens taken in the Huachuca and Dragoon mountains, are located within the San Pedro watershed, which also includes the Property. Confirmed reports of ocelots killed in adjacent Sonora continue to this day. These confirmed reports include specimens taken in Madrean evergreen woodlands just south of the border, with the most recent being taken approximately 95 km (60 miles) from the Property near Agua Prieta, Sonora in 2000. Unconfirmed reports of ocelots continue to be received from throughout southern Arizona, including the Property. Therefore the occurrence of ocelots on the Property is remotely possible.

#### 5.5.12. Jaguar

#### Life History

The jaguar (*Panthera onca*) is the largest species of cat native to the western hemisphere. The cat is muscular, with short, massive limbs, and a deep-chested body (AGFD, 2004b). The coloration is cinnamon-buff with black spots. These cats weigh between 40 to 135 kg (90 to 300 lbs) and can measure

up to 2.4 m (7.8 ft) in length. Prey species include deer, peccaries, livestock, fish, and reptiles. Historically, the jaguar ranged over much of Mexico, Central and South America, Texas, Louisiana, New Mexico, California, and in Arizona as far north as the Grand Canyon. In Arizona, jaguars have been reported in habitats ranging form Sonoran desertscrub up through sub-alpine coniferous forests, with the majority of reports from Madrean evergreen woodlands. Currently this cat's range is thought to include Central and South America, Mexico, and southeastern Arizona. The primary reasons for its decline is loss and modification of habitat, shooting, and predator control activities (USFWS, 2000b).

The United States population of this cat was listed as endangered, without critical habitat, in 1997 (USFWS, 1997d). The non-U.S. population of jaguars was listed as endangered in 1972 (USFWS, 1972b).

#### Potential for Occurrence on the Property

This cat has been well documented as occurring in southern Arizona in the 1900s and within the last 5 years. The nearest known breeding population of jaguars is located approximately 250 km (150 miles) south of the Property in Sonora, Mexico. Jaguars recently documented in southern Arizona are thought to be young dispersing males. There is evidence that at least one of these dispersers has established a territory in the Coronado National Forest. Persistent reports of jaguar sightings throughout southeastern Arizona continue to this day. Jaguars have been documented within 26 km (16 miles) of the Property (HDMS). It is possible that jaguars may rarely utilize the Property.

#### 5.5.13. Huachuca Springsnail

#### Life History

The Huachuca springsnail is a small (1.7 to 3.2 mm [0.05 to 0.13 inch] tall) aquatic snail with three to five convex whorls on its shell (USFWS, 2001g). Positive identification of this species requires the verification of reproductive organ characteristics. This species inhabits springs and cienegas at an elevation of 1,370 to 2,195 m (4,500 to 7,200 ft) in southeastern Arizona and adjacent Sonora, Mexico. Springs and cienegas inhabited by this snail are typically marshy areas characterized by various aquatic and emergent plant species that occur within grasslands, oak-pine woodlands, and coniferous forest communities. The species is most common in shallower areas of springs or cienegas, often in rocky seeps at the spring source.

This species is vulnerable due to loss or degradation of spring and cienega habitat due to overgrazing, timber harvest, altered fire regimes, drought, mining, water developments, recreation, and catastrophic fire. The localized nature of individual Huachuca springsnail populations makes them vulnerable to local extirpations resulting from stochastic events. Once isolated populations are extirpated, re-colonization is unlikely without human intervention.

The Huachuca springsnail was first identified as a candidate species in 1989 (USFWS, 1989).

#### Potential for Occurrence on the Property

This species is known to occur approximately 3 to 5 km (2 to 3 miles) upstream of the Property along O'Donnell Canyon. During wet years, it is possible that this species may establish itself along the portions of O'Donnell Creek and Post Canyon that flow through the Property.

# 6. CONSERVATION VALUES AND OPPORTUNITIES

The Appleton Ranch is a set of three private in-holdings within the Appleton-Whittell Research Ranch. Acquisition of the Property would contribute to seamless management of the surrounding ecological preserve and ensure its continued protected status. The following paragraphs summarize the unique conservation values and opportunities presented by the Property.

# 6.1. VALUES

The primary values of the Appleton Ranch arise from and are contingent upon the three basic management objectives of the surrounding Research Ranch:

- to provide a wildlife sanctuary that is ungrazed by cattle,
- to conduct or promote ecological research, and
- to provide education (and dialogue) about sustainable land management.

The following sections summarize these objectives in regard to the value of the Appleton Ranch.

#### 6.1.1. Value as Wildlife Sanctuary

The Research Ranch's total area of 3,240 hectares (8,000 acres) is large enough to encompass the watersheds of several tributaries of O'Donnell Canyon and includes large areas of grassland on several geomorphic surfaces. The sanctuary offers a means of comparison with similar lands immediately off-site.

Regardless of their status as protected or unprotected, grasslands are likely to differ in their growth, seed production and composition according to their particular geomorphic surfaces (or soils). This variability is present on the Research Ranch and the protected status allows study of the recovering environment. The diversity of grasslands on the Research Ranch provides a mosaic of habitats for birds and other animals. For example, Bock and Bock (2000) note that Botteri's sparrow in the 1970s and early 1980s used almost exclusively sacaton stands in the floodplains for nesting and foraging. In the mid-1980s, they began finding Botteri's sparrows nesting in the ungrazed upland grasslands. This species of sparrow was apparently common in the grasslands of the southwest until overgrazing by cattle in the late 1800s drastically reduced or eliminated tall stands of upland grasses. Bock and Bock (2000) consider it possible that their 1970s and 1980s observations of this bird's reliance on sacaton stands for nesting may be an historic artifact. Sacaton stands may not be preferred by the sparrow, but instead may be all that was available – until the recovery of upland stands of grasses on the Research Ranch after about 20 years of exclusion of cattle grazing. This kind of observation could only be made on a sufficiently large, heterogeneous, and ungrazed grassland.

The fence around the Research Ranch is designed to exclude only cattle. It is otherwise a largely porous boundary. Large mammals such as pronghorn, deer, peccaries, coyotes, as well as smaller mammals, birds, reptiles, and amphibians are relatively unhindered in passing across this fence. In this regard, the Research Ranch is not an island or enclosure and the population behavior of its constituent species cannot easily be dismissed as the product of 'fence effects' (*sensu* Otsfeld, 1994; Krebbs, 1996).

#### 6.1.2. Value as a Research Station

Ecologists and environmental scientists often do research on lands where little or no previous biological research has taken place. With such rudimentary information on a site, research is often side-tracked or slowed by the need to make preliminary species inventories and landscape descriptions. Without long-term observations, the researcher can begin and end his/her studies unaware of whether the year in which their work is completed is typical or extraordinary. The researcher is also often unaware of the timing, or even the occurrence, of episodic events (hurricanes, landslides, range fires, floods, freezes, droughts) which occur outside of the study timeframe. Any one of these or similar events can create a mosaic of attributes within the landscape that the researcher is likely to be unaware of as he/she sets up her experimental design. This historic mosaic, if unrecognized, may confound the interpretation of the research results.

In contrast, there are a number of research stations across the world where ecologists have worked now for decades. Research and a synthesis of the ecology of the grasslands on the Research Ranch have evolved in a similar manner. Inventories now exist for its vascular plants, mammals, birds, reptiles, and amphibians, and for select groups of insects (e.g. grasshoppers). Reference collections (herbarium, etc.) exist at the Research Ranch. Weather stations are in place. Funding will enable the construction of at least one gauging station by the end of 2004 (L. Kennedy, pers. comm.). A surprisingly large number of biologists have worked on the Research Ranch and they (usually) publish their findings in refereed scientific journals. On occasion, these researchers have met to give presentations of their on-going work (over 50 researchers presented papers at the Research Ranch in 2000). Permanent plots and census transects occur over much of the Research Ranch. And, the Research Ranch is still surrounded by a vast area of heavily grazed lands, which offer comparison with the ungrazed grassland found on the Research Ranch.

Finally, long-term observations are identifying important events that might otherwise be missed. The shift in landscape utilization by nesting Botteri's Sparrow (described above) is one example. Another is the observation of the utilization of the Research Ranch by fawning pronghorn. Although the terrain on the Research Ranch is not favored for browsing by pronghorn, in the spring of 2003 pronghorn does used the Research Ranch to successfully conceal their fawns for the first six weeks of life, a critical time in the survival of fawns when they cannot run away from predators such as coyotes. This observation of high fawn survivorship in the grassland on the Research Ranch is a valuable fact about this small population (< 50 animals) of pronghorn in the Sonoita basin; it is also a valuable idea about how landscapes in Arizona might be better managed so that populations of pronghorn can increase again. Pronghorn populations in

Arizona have not been reproducing anywhere in Arizona at a rate that provides replacement of the herd; they are everywhere in decline. So, the observed successful fawning in a grassland ungrazed for 35 years becomes a stimulating idea. Perhaps fawn survival on Anderson Mesa in central Arizona and within areas of the Altar Valley could be enhanced if potentially valuable sites for fawn concealment could be identified and fenced to exclude cattle such as has occurred at the Research Ranch.

#### 6.1.3 Value for Education

The Research Ranch staff provides orientation to the visiting public as to its mission and history. The staff also periodically invites ranchers to the Research Ranch to look at the vegetation changes and discuss fire ecology and grassland dynamics. The staff is involved in inter-agency and public discussions regarding broader regional concerns such as the conservation of the upper San Pedro River and its watershed. The Research Ranch staff have a unique set of management priorities and, with an awareness of research results both on the Research Ranch and on similarly studied portions of Fort Huachuca, have the potential for providing unusual perspectives to the public discussions regarding development and conservation in southeastern Arizona.

# 6.2. **OPPORTUNITIES**

Similarly, the opportunities presented by the integration of the Appleton Ranch into the Research Ranch are directly related to the Research Ranch's mission.

#### 6.2.1. Seamless Addition to the Research Ranch

One opportunity to the transfer of the Appleton Ranch in-holdings on the Research Ranch to public land would be the addition of land that has been managed since 1967 in a manner consistent with the rest of the Research Ranch. After this transfer, only one relatively small private in-holding would remain within the boundary of the Research Ranch; the rest of the Research Ranch would belong to the Audubon Society, BLM, or National Forest. Up until now, the Appleton family with the deeded lands have been consistently cooperative in terms of the management efforts of the Research Ranch. Permanent study plots for long-term monitoring are well-represented on the Appleton Ranch. Permission to do the infrequent modification or enhancement of wells or other features on the Appleton Ranch has been readily granted by the Appleton family. The Appleton Ranch, unfenced from the rest of the Research Ranch, ungrazed for as long as the rest of the Research Ranch, and included in the research and on-going management of the Research Ranch, is poised to join the Research Ranch as a seamless addition in the event that these lands are transferred to the public ownership. As public lands, the Appleton Ranch would round out the Research Ranch holdings.

#### 6.2.2. Opportunity to Better Understand the Grassland in the Sonoita Basin

What has been the behavior of the grass and forb populations on the Research Ranch and on the surrounding grazed grasslands since 1968, when cattle were removed from the Research Ranch? Grassland changes on the Research Ranch since 1968 have been broadly described by Bock and Bock (1986, 1993). However, most aspects of the timing and particular demographic aspects that led to the turnover in species compositions on the Research Ranch remain poorly understood. To capture the requisite details of grass demographics, details of individual grass plant cover, species, and vegetative reproduction have been made over time at other sites in western North America. For each site, typically there were large numbers of 1-square-meter quadrats established and annually monitored. Studies analyzing individual grass plants within quadrats have determined mean life-span, maximum life-span, vegetative reproductive rates, and seed production for the common grass species. Additional work at this level of detail may yield a better understanding of the Sonoita Basin grassland, and in particular, any changes in species diversity as the Property continues to recover from the effects of grazing as well as changes resulting from the presence of introduced (invasive) species. Furthermore, coordination of Research Ranch studies with similar work conducted at grassland research sites throughout the western United States would add a new dimension to the value of the studies conducted on-site.

#### 6.2.3. Opportunity to Better Understand the Ecological Implications of Invasive Species

A portion of the Research Ranch is vegetated with Lehmann lovegrass (*E. lehmanniana*), a non-native species introduced to the Research Ranch in the late 1940s by the Soil Conservation Service. This invasive species (and the similar Boer lovegrass) are now well established in grasslands throughout the southwest. This species has colonized increasing numbers of acres of the Research Ranch (Linda Kennedy, Sky Island Conference, May 2004), and the managers have not intervened but have generally observed the spreading effect. Originally covering some 160 hectares (400 acres), the species covered approximately 800 hectares [2,000 acres] as of 2000. A large body of research and attendant literature exists pertaining to invasive and non-native plant species in the southwestern United States, including research on Lehmann lovegrass. Building on the demographic study presented as Opportunity No. 2 (above), additional site-specific studies related to the small or larger scale employment of various active treatments at the Research Ranch may add to the knowledge associated with the ecological implications of non-natives in Arizona grasslands, and may yield strategies to slow or halt the increase of introduced lovegrass and associated decrease of other native grassland species.

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