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Subterranean Survey of Kirtland Air Force Base, New Mexico

A report on the bat survey of 58 abandoned mine features, caves, and other underground structures located on Kirtland Air Force Base, New Mexico.

A report submitted to Dustin Akins, Kirtland Air Force Base

By
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Fieldwork was conducted by our experienced team of bat surveyors including Bruce Lynn, Jim Rolf, and Anthony Smith.

Acknowledgements

This project would not have existed without the forethought and direction of senior wildlife biologist Trish Cutler of the White Sand Missile Range. Further support was offered by the Kirtland resource managers Carol Finley and Dustin Akins.

The photo documentation for this project has been a team effort and everyone deserves credit for these informative images. For this reason each image does not contain a specific photographer credit.

Project Overview

The primary mission of our work on the Kirtland Air Force Base was to locate and survey all subterranean features that could provide habitat for bats. The vast majority of these sites included abandoned mine features, but other sites surveyed included caves, shelters, buildings, bunkers, and other miscellaneous military structures. While conducting these surveys, our team produced an inventory of nearly all mine features located on the base, as well as documenting other significant biologic resources.

Fieldwork for the project began by working with Kirtland resource manager Dustin Akins, who provided a database of known abandoned mines. This dataset consisted of 22 sites, but by the end of the project, our team had surveyed 58 separate features. Fieldwork for this project consisted of conducting underground surveys of each of the sites over a one-week period.

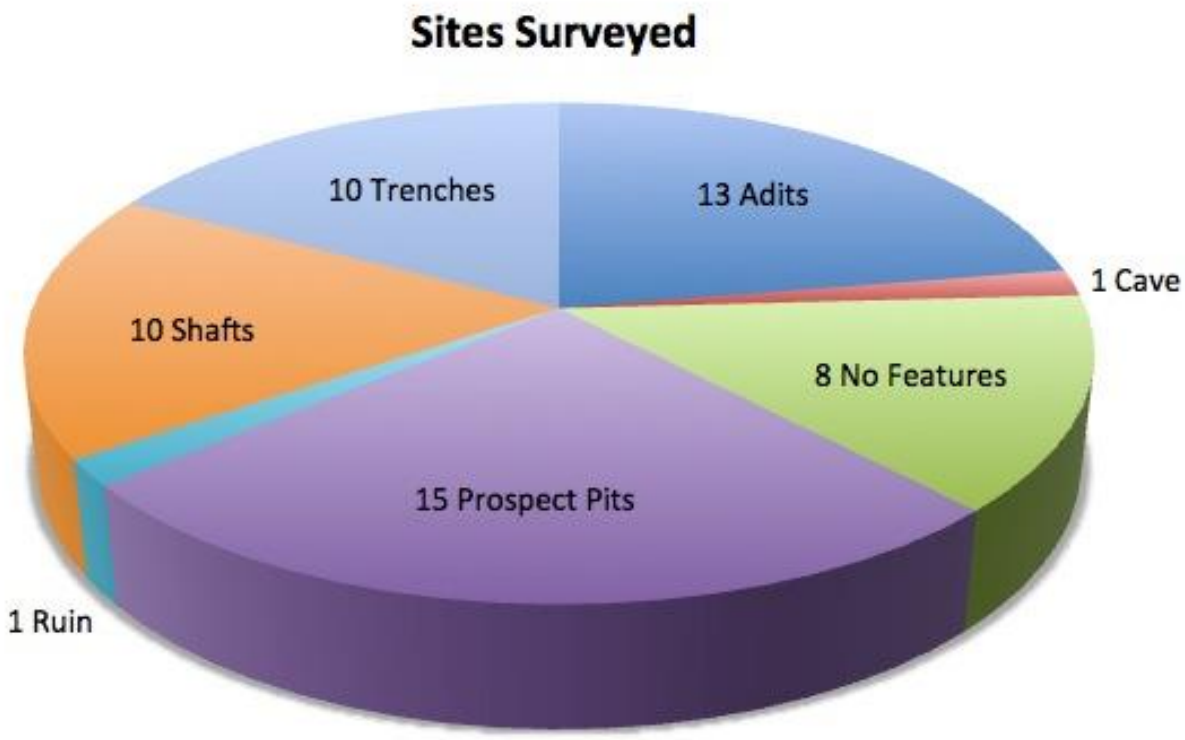
Accessing many of the sites was difficult due to a variety of challenges, including remoteness of sites, long hikes, steep terrain, non-passable mining roads, extreme temperatures (both hot and cold), area closures, secure areas, and many other factors. Our team used ATVs to travel to the general mine areas, and then hiked to each of the specific sites. Many of the sites inventoried had estimated GPS locations, but a small percentage of the target sites were not locatable. Often the unlocatable sites were sourced from the USGS dataset and consisted of mining claims that had not been worked, thus there was no mining feature to survey. These sites were recorded as “No Feature” or “NF” in our project GIS dataset, which will be useful in updating the original Kirtland GIS dataset. In some instances, an original GPS location would lead a survey team to a newly discovered group of undocumented mining features. These features were commonly found by hiking to the original GPS point, and then searching the immediate area for the telltale rock dump piles that denote other mining features.

As a survey team located each specific feature, an area safety inspection was conducted by reviewing local site risks. Once the site risks were mitigated, the team would continue the inventory and assign a unique ID in the form of a two-letter area acronym and the sequential number of the feature. All of the sites on Kirtland were denoted with the prefix of KL, and numbered from 1 to 58 This unique ID was recorded into the field GPS unit for later download into our GIS mapping software. The type of feature and optional mine name was then added to this unique ID, such as “KL36 Shaft (Blackbird Mine)”.

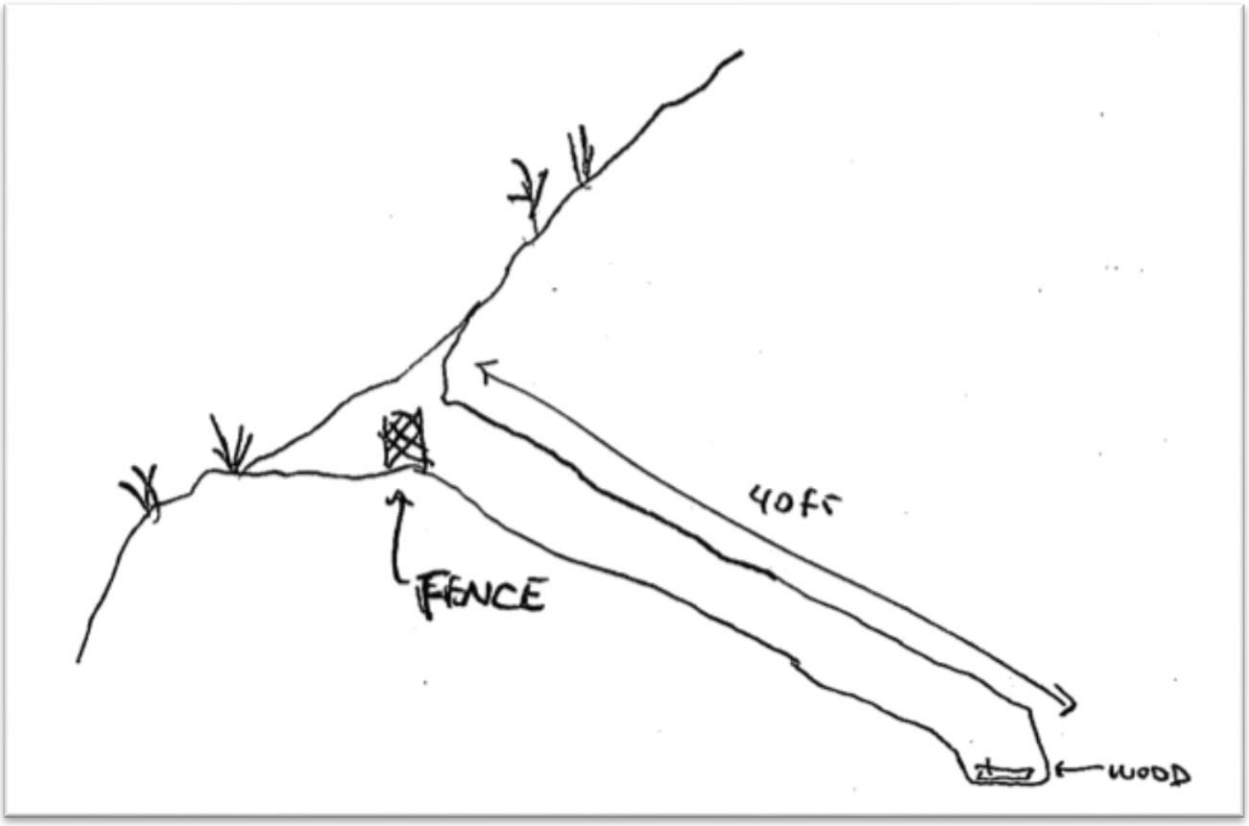
All of the surveyed features were categorized into one of the following seven designations:

Adit -	A horizontal mine passageway.
Cave -	A naturally formed void in the ground.
Ruin -	A partial or complete manmade building or structure.
NF -	No Feature; a site location that has no mining evidence, commonly an unworked mining claim.
Prospect Pit -	A mined hole in the ground that is less than six feet in depth. Often a prospect pit is a hole blasted by a single stick of dynamite.
Shaft -	A vertically oriented mine passageway that exceeds six feet in depth.
Trench -	A shallow and linear mining feature.

A breakdown of the number and types of sites surveyed is represented in the graph below. Note that Prospect Pits and Adits are the most common features, but this base also has many Shafts and Trenches. Prospect Pits and Trenches are generally not important biologic sites, but our survey team can't determine what these features are until they hike to the specific site. The "no feature" sites are generally unworked mining claims, or erroneous GIS location data.



With the location recorded, the survey team would take an entrance photo of the site. The survey team would then initiate a “quick search” for bats to see if the site was an active roost. The goal of the “quick search” was to locate and possibly photograph the bats in case they were disturbed during our full survey and moved to another roost site. Once the “quick search” process was complete, the team conducted a methodical survey of the feature looking for bats and bat sign. Temperature, humidity, site dimensions and other data was then collected and entered into the Bat Survey Form. Multiple visits to the same site would produce a new Bat Survey Form for each visit. Following is an example of a Bat Survey Form site sketch, and Bat Survey Form data sheet from KL4 Adit.



Example Profile Sketch from KL4 Adit.

Bats in Mines Internal Survey Form

Mine name (or GPS name): KL4 ADIT DECLINE (107500) Elevation: 6287 FT.

Location: 13S 0368525 3868671 ☐NAD27 ☒WGS84

Township: — Range: — Section: — Mine is signed: ☒Yes ☐No

Observers: TOM GILLELAND, BRUCE LYNN

Date: 11-28-12 Time: 1140 AM Temperature (outside in shade): 61.5 °F

Human disturbance is: ☒Low ☐Moderate ☐Heavy Mine is fenced: ☒Yes ☐No

Mine is: ☐Single-level ☐multilevel ☒Simple ☐Moderate ☐Complex ☐Unknown (WITH SIGN)

Percent of mine included in survey: 100 % Air movement: ☐Yes ☒No

Number of entrances: 1 Dimensions of largest: 6 FT. H / L 4 FT. W

Mine Length is: ☒< 50 ft ☐50-100 ft ☐100-200 ft ☐200-500 ft ☐500-1000 ft

☐1000-5000 ft ☐> 5000 ft ☐Unknown ☐ Or Depth _____

Dimensions of largest passage: Length 40 FT Height 6 FT Width 4 FT.

Dimensions of largest room: Length — Height — Width —

Mine is: ☒Dry ☐Damp ☐Contains standing water ☐Flooded Bad air: ☐Yes ☒No

Mine Stability: ☐Excellent ☒Good ☐Poor ☐Bad Commodity Mined: QUARTZ / GOLD

Temperature in warmest area: 64.5 °F Temperature in coolest area: 64.5 °F

Humidity: ~ Bat Habitat: ☐Good ☒Fair ☐Poor

Bat droppings are: ☐Scattered ☐In piles ☐Splattered ☒Not present ☐Unknown

Total number of guano deposits observed: 0 Measurements of four largest guano deposits:

1. Length _____ Width _____ Depth _____
2. Length _____ Width _____ Depth _____
3. Length _____ Width _____ Depth _____
4. Length _____ Width _____ Depth _____

Number of individual bats counted: 0 or total area covered by clusters: _____

Total estimated number of bats in mine (by species if known): NONE

Comments:

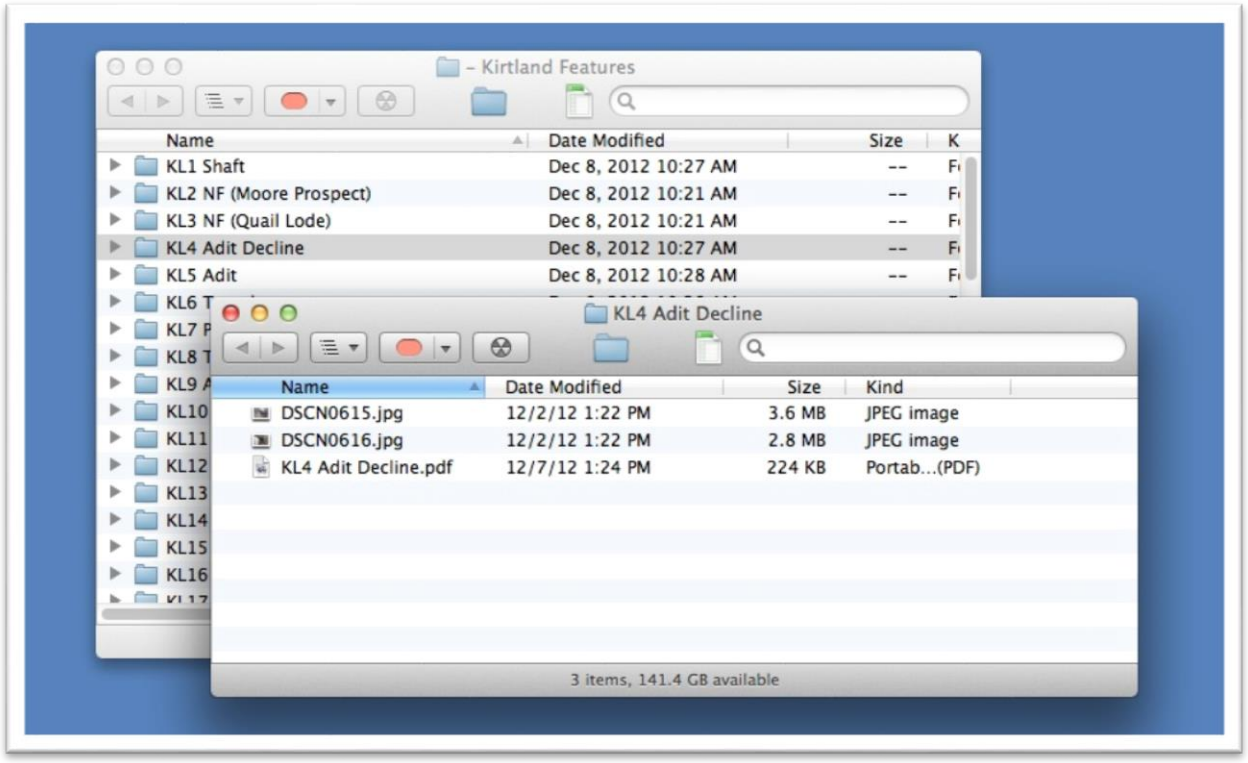
ONE STRAIGHT PASSAGE, 40 FT IN LENGTH. LOTS OF RAT SCAT. ADIT SLOPES DOWNHILL AS A DECLINE TO END. TOBACCO TIN LOCATED NEAR ENTRANCE.

Photo Numbers: 615, 616

*Map of workings on reverse ☐Scanned on _____ by _____

Example Bat Survey Form from KL4 Adit.

Reporting work for this project began with entering field data for each site into an Excel spreadsheet. All GPS locations collected in field GPS units were then downloaded into a GIS program. This program was used to create the area maps, and also export the location data into a location Excel spreadsheet appropriate for loading into the Kirtland ArcGIS program. Each of the Bat Survey Forms were scanned as pdf files and sorted into a digital folder for each feature site. Digital photos were downloaded from cameras and imported into an image management program. These images were then exported and sorted as individual files into specific site folders. An example of the digital file structure is shown below:



Inventory Form and Digital Photo file structure.

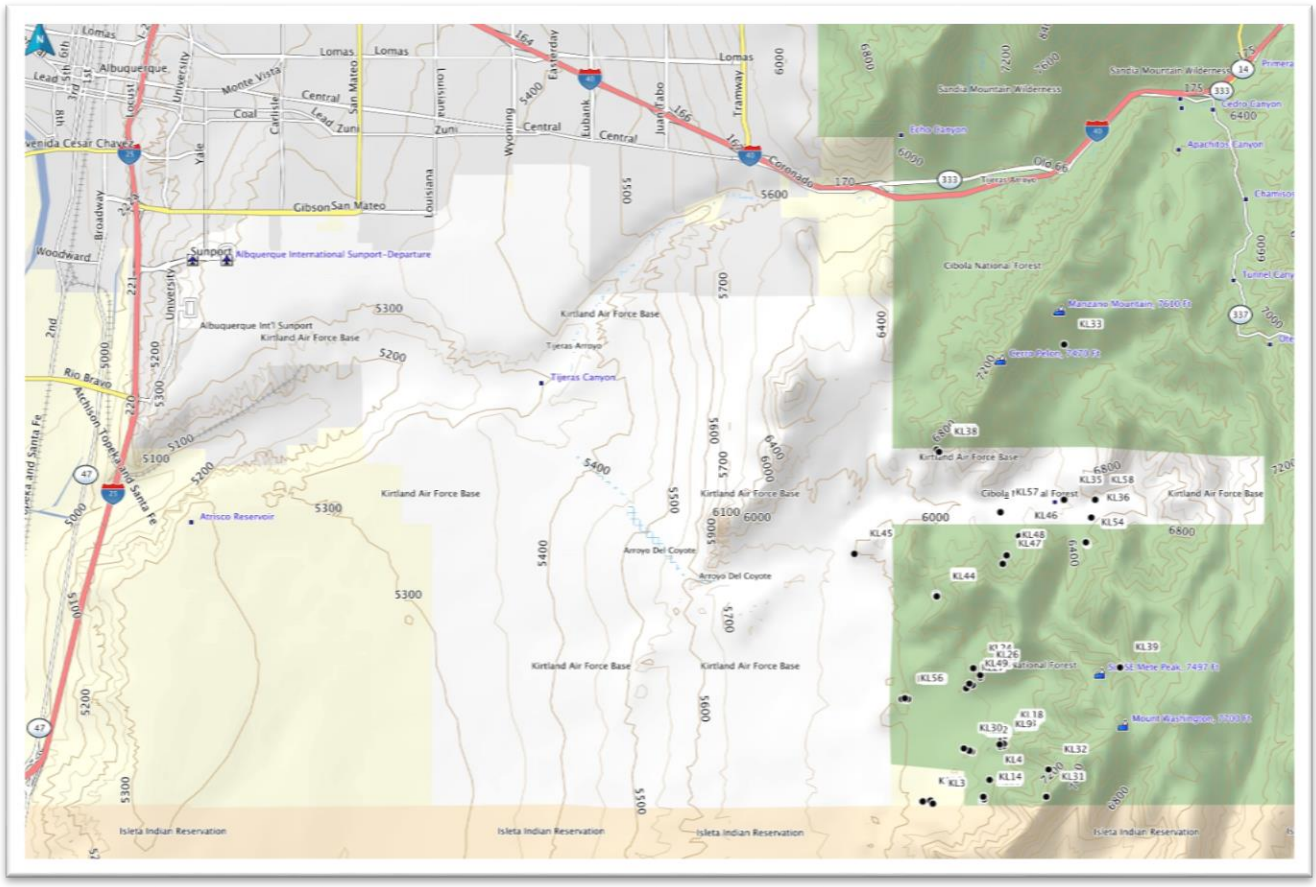
Deliverables with this report include a CD-ROM containing a mine feature database in Excel format, and 58 folders including Bat Survey Forms (pdf) and site photos (jpg).

Study Area GIS

Kirtland Air Force Base is located southeast of Albuquerque and consists of 51,558 acres situated in central New Mexico. The base is roughly bounded by the city of Albuquerque on the north, and the Isleta Indian reservation on the south. The east border consists of the hills of the Cibola Forest, and Highway 25 roughly defines the western border. Note that some of the Forest Service land on the eastern edge of the base is managed by the base, and was included in our survey project.

The landforms of Kirtland consist of typical basin and range morphology that are presented as high mountain ranges separated by low, wide, and flat valleys. Elevations in this region vary from mountain peaks of about 2350 m (7700 ft), to valley floors of about 1600 m (5300 ft). This wide elevation variance results in a large diversity of biota and environmental conditions. From dry desert scrub on the valley floor, to the pine forests of the mountaintops, there exists a wide variety of bat habitat.

The following page contains a map of the study area with black dots marking each of the 58 surveyed abandoned mine and other features. Note that this map is scaled to a view that results in many of the location dots overlapping on the map. As is clearly presented on the image, most of the mining sites were located in the mountain range. The reason for this is that the near surface mineralization areas are located in the geologically active zone of uplifting mountains, and that the basin is filled with alluvium material which deeply buries potential mining sites. We also found that most mine sites were located at places where the miners would have access, or be able to build roads to their specific mine. If they located valuable ore, they would need to be able to transport this ore from the mine to smelters or other processing sites. The oldest mines might only have mule access along trails, but later or larger mines would need roads to transport their ore. Note that all of the mine features that we were able to survey were located in the eastern hills of the Cibola National Forest.

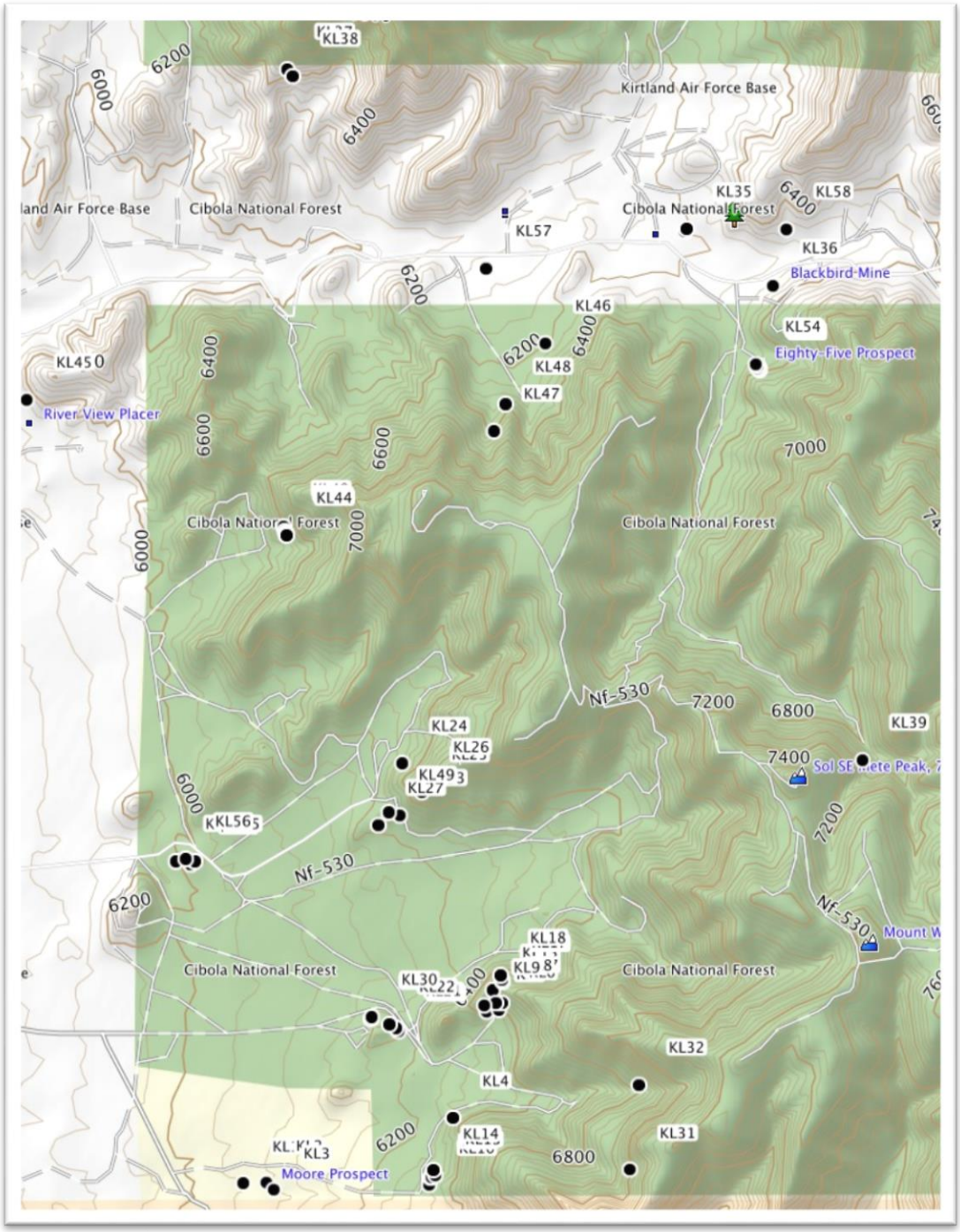


Overview map of the study area.

Mine & Cave Resources with Bat Roosts

Cibola National Forest Area

During our survey, we located 4 sites that contained roosting bats, or had sign of previous bat roosts. The roost sites were located at KL24, KL26, KL31, and KL47. Three (3) other sites that we visited may also be roost sites, but our team was not able to enter the sites due to gating or unsafe conditions. These sites are KL5, KL9, and KL31.



KL24 Adit

Date: 11.28.12
Bat Count: 1

This horizontal adit extends 30 feet into the hillside following a pink quartz vein. The site is a winter bat hibernaculum, and only contained a single Townsend's big-eared bat (*Corynorhinus townsendii)*. The floor of the mine did not contain any guano or other bat sign commonly found in summer roost sites.

KL26 Adit

Date: 11.29.12
Bat Count: 0

This small adit only extends underground for 13 feet. The entrance has a dangerous rock barely wedged over the portal. Ceiling staining and small amounts of scattered guano confirm this site as a summer roost. No bats were present during our winter survey.

KL31 Adit

Date: 11.29.12
Bat Count: 1

This linear adit extends 730 feet underneath a thick layer of horizontally bedded limestone. This site is a winter bat hibernaculum, and only contained a single Townsend's big-eared bat (*Corynorhinus townsendii)*. The floor of the mine is very level and contains the remnants of a mine cart rail and ties. Our survey did not observe any guano or other bat sign commonly found in summer roost sites.

KL47 Adit

Date: 11.30.12
Bat Count: 1

This horizontal adit extends 30 feet into the hillside following a pink quartz vein. The site is a winter bat hibernaculum, and only contained a single Townsend's big-eared bat (*Corynorhinus townsendii)*. The floor of the mine did not contain any guano or other bat sign commonly found in summer roost sites. Odd mining tools are at the adit end.

Subterranean Biological Resources

During this project, our team inventoried 58 Kirtland mine features, including 4 sites with bat usage. Three (3) of these sites containing bats during specific site surveys. Following is a list of the positive bat usage sites:

Site	Feature Name	Elevation	Roost Type	Bats Count	Species Count	Date
Kirtland	KL24 Adit	6359 ft	Winter Hibernaculum	1	1 *Corynorhinus townsendii*	11/28/12
Kirtland	KL26 Adit	6537 ft	Summer Roost	0	?	11/29/12
Kirtland	KL31 Adit	7117 ft	Winter Hibernaculum	1	1 *Corynorhinus townsendii*	11/29/12
Kirtland	KL47 Adit	6389 ft	Winter Hibernaculum	1	1 *Corynorhinus townsendii*	11/30/12

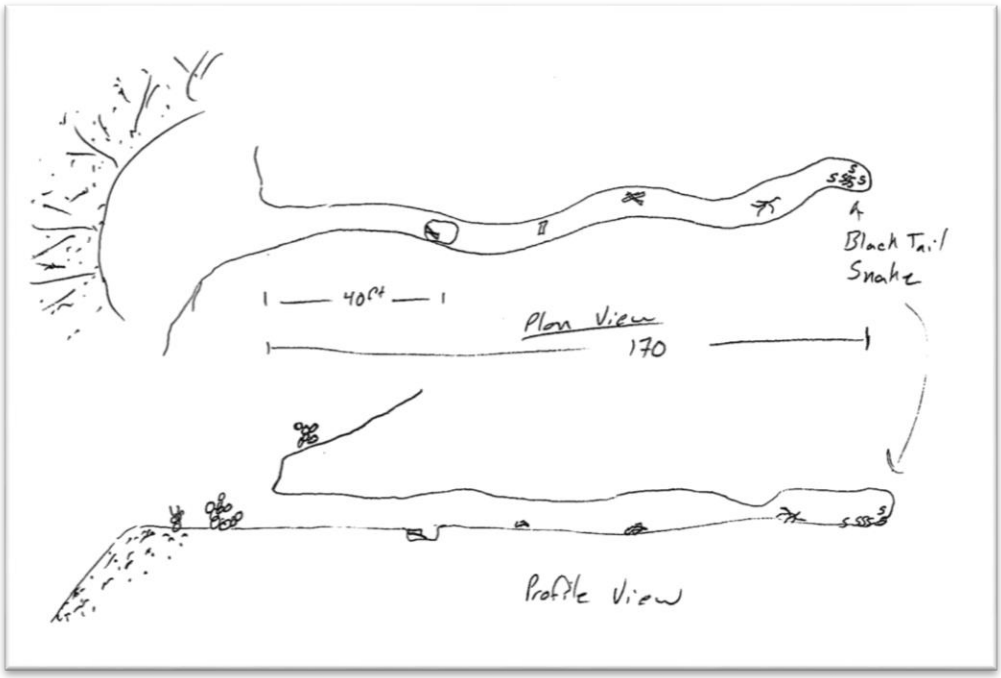
Note that all sites that have bat usage were horizontal adits. The only species we noted was the Townsend's big-eared bat (*Corynorhinus townsendii*). This species of bat is commonly found roosting in the mines and caves of the desert southwest. It is common to find this species roosting singly, often with a single bat per mine feature. A cluster of *Corynorhinus townsendii* is normally associated with a maternity colony, but no such occurrence of this was noted during our survey. The elevation of the roost sites are all located at expected elevations common to *Corynorhinus townsendii.*

Townsends Big-eared Bat (*Corynorhinus townsendii*

KL37 Adit

Date: 11.30.12
Snake Count: 6+

This horizontal adit was biologically interesting as it is a rare winter rattlesnake hibernaculum. At least six Black-tailed Rattlesnakes (*Crotalus molossus*) were noted at a point 170 from the entrance, at the back of the mine.


Black Tail Snake
40ft
Plan View
170
Profile View

Other Vertebrate Species

While conducting field surveys of the mines and other subterranean features, our team encountered a variety of animals or animal sign using these sites. Following is a list of the most common non-bat vertebrates that we directly observed, or noticed sign of in the caves and mines.

Barn Owl (*Tyto alba*)

Often vertical shafts would contain Barn Owl roosts, and our team found many instances of owl eggs at the very bottom of these shafts. Bats are rarely found in sites with Barn Owls as owl predation clearly influences bat roost site selection.

Turkey Vulture (*Cathartes aura*)

These large birds often nest in caves and mines and our team would often find the large speckled eggs of this species. The adult birds will normally fly away on approaching a mine feature. Note that this species will vomit as a defense mechanism, so field surveyors should give these birds a wide berth.

Mountain Lion (*Felis concolor*)

Mountain lion track and scat are often found in the caves and mines of the SW. Our survey team has encountered mountain lions at subterranean features on two separate occasions.

Mule Deer (*Odocoileus hemionus*)

Mule deer remains are often found in cave and mine sites normally as kill remains from mountain lions, but sometimes as victims of falling down mine shafts.

Black-tailed Rattlesnake (*Crotalus mollosus*)

This species is fairly common to many caves mines of the southwest. If the mine is cool and the snake is given a wide berth, this species will not even rattle its tail as you pass the snake.

Ringtail Cat (*Bassariscus astutus*)

Many of the caves and mine features at Kirtland contain Ringtail scat, but it is rare to see this animal due to their elusive behavior.

Pack Rat (*Neotoma species?*)

Pack Rats or Wood Rats are very common in the mines, but they are rarely seen. Their fur nests can be found in most mines, as well as their stick middens, urine trails, and extensive amounts of scat.

Mouse (Peromyscus species?)

Mice are also very common in mines, but also rarely seen. Their scat is very similar in size to bat guano, but can easily be tested via the “crush test”. Squeeze a small pellet between your fingers and if it does not crush it is probably mouse scat. If it crushes easily and sparkles of insect parts, it is bat guano.

A variety of other vertebrates certainly use the mines as is evident from their sign (scat, hair, nests, etc.), but were not physically identified during our survey. Peccary or Javalina (*Pecari tajacu*), Grey Fox (*Urocyon cinereoagenteus*), and Bobcat (*Lynx rufus*) sign were all noted at Kirtland mines and caves.

Management Recommendations

Bat Habitat Protection

Many caves and mines offer important biologic habitat to bats, as well as owls, vultures, javelina and a variety of other wildlife. Choosing the correct management plan for these unique sites should be undertaken from a broad wildlife usage perspective. During our survey we located only 4 mines that had confirmed bat usage. These sites were fairly remote and one of the mines was further protected by its inaccessible location high on a hillside. All sites had small quantities of bats and no evidence of being a sensitive bat habitat site such as a maternity colony, or large winter hibernaculum. It is our opinion that these sites do not justify additional protections beyond than those that are already in place.

Other Vertebrate Species Habitat Protection

The snake winter hibernaculum at KL37 Adit is a rare habitat site and should be protected. A large cluster of Black-tailed rattlesnakes (*Crotalus molossus*) also offers significant risk to the unwary human visitor and further supports protecting of this unique site. At a minimum, basic fencing and signage would be appropriate for a remote site such as this. If the area becomes more heavily traveled, or it is decided that the site should be further protected, then we would suggest installing a bat and snake-friendly steel adit gate.

Safety Closures

During the course of this survey project our team located many mine features that would be appropriate for closure. Shafts are the most common feature to close due to fall hazard. Some horizontal adits are also appropriate for closure, especially in the case of collapsing country rock, or rotten timbering and shoring. Many shallow features such as prospect pits and trenches can be left alone as they generally self-reclaim over time. There are many methods of abandoned mine closures, so it is important to choose the appropriate solution for each site.

Feature location also plays an important role in selecting the type of closure, or prioritizing which sites should have this work done. Some remote sites offer technical challenges that in most cases would not be worth the effort and expense to do the closure. Our team located multiple sites in very remote canyons that would require helicopter support to even build a simple closure. If a mine site is easy to get to, or is easily viewed from well-traveled roads, it should be prioritized for closure.

As a general guideline we recommend that nearly all vertical shafts should minimally have a fence around the site. Note that a person can be killed falling down a 20 ft. shaft, or a 200 ft. shaft so all of these features should be approached with caution. Safety signs on these fences offer good and bad results. For informational and liability reasons these signs are good to install. The drawback of these signs is that they attract curious people to these dangerous sites, and since the signs are interesting looking they are often stolen from the site. A possible solution would be to mount the signs just inside the feature so that they are not visible from afar, but still readable when the feature is approached.

Future Site Monitoring

The limited access of Kirtland, and the remote locations of the few bat roosts provide strong habitat protection. Though the bat resources are small, the sites are interesting enough to warrant on-going monitoring. A main focus of this project was to locate all bats roosts and to establish baseline data for these important wildlife resource sites. During our survey of 58 sites on Kirtland, our team located 4 sites that had sign of bat usage, and 3 sites that had bats present. Future monitoring of these 4 sites during winter and summer periods would provide useful data in roost usage. A more detailed study of these roost sites would include long-term studies of summer and winter usage patterns.

White-nose syndrome (WNS) is a fungal infection that has killed upwards of 6.7 million bats in the eastern states. This fungus (*Pseudogymnoascus destructans*) is the cause of WNS and has been spreading westward through winter hibernaculum bat roost sites. Fortunately, WNS has only spread westward as far as Missouri. With the western migration of WNS it would be prudent to monitor the higher elevation winter bat hibernation sites that fall into the favored temperature ranges of the fungus.

Site Access Safety

All abandoned mines should be approached as being unsafe, and most federal and state agencies manage these features as being closed to entry. The common signage on many sites states, “Stay Out, Stay Alive!,” but with proper training, equipment, and experience we feel that some abandoned mines can be entered safely. Our team has completed extensive underground training classes and specialized certifications, and we have safely conducted subterranean surveys of thousands of mines and caves. During our survey at Kirtland we noted some site-specific risks that are outlined below. Note that this list is not inclusive of all Abandoned Mine Lands (AML) safety issues, and anyone visiting these sites should also review the AML Safety Protocols that were submitted at the beginning of this project, as well as other mine safety sources.

Physical Risks

1. Is the mine site clear of unexploded ordnance (EOD)?
   The fact that Kirtland is a military site that has been active for over 50 years has resulted in unexploded ordnance spread throughout the entire site. Many of the AML sites are in very remote locations that have not been cleared of possible unexploded ordnance. Survey teams must stay vigil when traveling to these remote sites, and view any unknown manmade object as a potential bomb instead of some odd mining artifact.

2. Is the mine shoring and timbering strong enough make the mine safe to enter?
   Note that most of the mines at Kirtland are from 70 to 120 years old. This means that most of the wooden shoring, timbering, and collar are of rotten wood that has little if any structural strength. If a miner installed shoring 80 years ago when they built the mine, this is a sign that they had ground control issues at that time. Current conditions should be assumed to be worse.

3. If a mine has no wooden shoring and is dug in hard rock, will it be safe to enter?
   Many mines at Kirtland are dug in hard rock and may be stable for entry. If a mine has no spalling and the floor is clear from rockfall after 80 years, this mine is more stable for access than the mine with wooden timbering.

4. Does the mine have bad air?
   During our survey at Kirtland we did not encounter any sites with bad air. It is very important that any team entering a mine have a working gas detector to measure at minimum oxygen, carbon monoxide, and hydrogen sulfide. Our team used a MSA Altair 4X Multigas Detector for our surveys. Also note that a gas detector does not identify every dangerous gas, so the survey team should also be aware of their own physiology and be ready to retreat from a site if they notice any problems.

5. Is the mine site safe from weather events?
   Many of the Kirtland mine sites are located in steep and remote canyons. During one of our site surveys our team endured a flash flood that had traveled many miles through a steep canyon. This rain deluge had happened out of view on the other side of the mountain range, therefore our team did not notice the storm until we heard the boom of the rushing stream.

Biologic Risks

1. Did the site have a killer bee nest at the entrance?
   By quietly approaching a site, a surveyor can look for bees flying in and out of the site. Normally beehives will be in cracks along vertical cliff faces, but our team has also observed hives a short distance into vertical shafts. The hives will be within daylight, but shelter under the dripline to protect from rain. Bees defending a hive will fly into surveyors and bump them before stinging ensues. Once a surveyor has been stung they now carry the pheromone that will draw other stinging bees from the hive.

2. Are rattlesnakes present at the site?
   Rattlesnakes are common at abandoned mines and are usually found within 100 feet of a mine entrance, but often very near to the entrance. Rattlesnakes have a keen sense to vibrations, so stomping on the ground near an entrance will often trigger the telltale rattle of these snakes.

3. Are mountain lions present at the site?
   Lion tracks, scat and deer kills are evidence of periodic usage of mines by mountain lions. Some mines contain flooded passages that offer an ideal water source for these large predators and other animals. Our team has had two encounters with mountain lions at caves and mines.

4. Are other large mammals present at the site?
   Other animal encounters to be wary of are javelina, bears, and vultures. Note that the turkey vulture species will vomit on the survey team as a defense mechanism.

Bibliography

Adams, Rick A., 2003, Bats of the Rocky Mountain West, Natural History, Ecology, and Conservation, 289 pgs.

Burkett, Douglas W., 2008, Amphibians and Reptiles of White Sands Missile Range Field Guide 2008, 65 pgs.

Cosgrove, C.B., 1947, Caves of the Upper Gila and Hueco Areas in New Mexico and Texas

Duran, Meliha S., 1997, Jewels of the Desert, Collections from the First Dump at White Sands Proving Ground, 98 pgs.

Eidenbach, Peter L., 1994, Home on the Range, Oral Recollections of Early Ranch Life on The U.S. Army White Sands Missile Range, New Mexico, 111 pgs.

Eidenbach, Peter L., 1997, School Days, Education During the Ranching Era on The U.S. Army White Sands Missile Range, New Mexico, 87 pgs.

Gilleland, Thomas O., Corbett, Jason, 2012, Subterranean Bat Hiberacula Sites of Southeastern Arizona, 89 pgs.

Gilleland, Thomas O., Corbett, Jason, 2013, Subterranean Survey of Fort Bliss, New Mexico and Texas, 24 pgs.

Gilleland, Thomas O., Corbett, Jason, 2013, Subterranean Survey of White Sands Missile Range, New Mexico, 103 pgs.

Kingsley, Charles Dunham, 1935, The Geology of the Organ Mountains, 272 pgs.

Merlan, Thomas, 1997, The Trinity Experiments, 101 pgs.

Sagstetter, Bill, 1998, The Mining Camps Speak: A New Way to Explore the Ghost Towns of the American West

Sherwin, Richard E., Altenbach, J. Scott, Waldien, David L., 2009, Managing Abandoned Mines for Bats, 103 pgs.

Snow, Tim, Pictorial Key to the Bats of Arizona, 48 pgs.

Twitty, Eric, 2009, Blown to Bits in the Mine, A History of Mining & Explosives in the United States, 208 pgs.