Introduction

Two species of sage-grouse occur within the western United States, the greater sage-grouse (*Centrocercus urophasianus*) and the Gunnison sage-grouse (*C. minimus*). The Gunnison sage-grouse is a candidate species for listing under the Endangered Species Act. This species occurs in a small range in southwest Colorado and southeast Utah. The greater sage-grouse occurs in a larger range throughout the western United States.

Historically sage-grouse were found in 16 U.S. states and 3 Canadian providences, but have been extirpated in Arizona, British Columbia, Kansas, Nebraska, New Mexico, and Oklahoma (Johnson and Braun 1999). Greater sage-grouse are declining throughout their historic range; breeding populations of this species have declined by 17-47% throughout much of its range (Connelly and Braun 1997). The continued regional and statewide declines have prompted some organizations to petition the US Fish and Wildlife Service (USFWS) to list the species as endangered or threatened. In December 2004, the USFWS concluded there was no need to list greater sage-grouse for protection under the Endangered Species Act at this time. The announcement encouraged state and federal agencies to continue research, and increase population size, and improve habitat quality.

The Utah Sage-grouse Conservation Plan

The Utah Division of Wildlife Resources (UDWR) reports that sage-grouse in Utah currently occupy about 50% of their historical range (Beck et al. 2003). To address these declines, the Utah Wildlife Board approved Utah's Strategic Management Plan for Sage-grouse in 2002. The plan identified regional issues and actions that needed to be implemented to reverse declining sage-grouse population in Utah (UDWR 2002). The plan provided a framework for local working groups to develop area specific management plans to aid in the recovery of sage-grouse populations. The plan outlined statewide management issues including; population management issues, habitat issues, planning issues, and others. The plan also outlines the importance of continued research to aid local working groups with decision making and planning.

West Desert Sage-grouse Status Assessment

The West Desert Adaptive Resource Management (WDARM) Local Working Group (LWG) began meeting in 2003 to develop a management plan for Utah's West Desert, a physiographic region that includes part of Tooele, and Juab counties. The area has two distinct conservation sites; the Vernon site and the Deep Creek Watershed site. Both of these areas are inhabited by greater sage-grouse.

Some local issues identified in the Utah Strategic Management Plan included expansive areas of crested wheatgrass (*Agropyron cristatum, A. desertorum*); loss of sagebrush habitat to fire, followed by cheatgrass (*Bromus tectorum*) invasion; degraded sagebrush habitat; small, isolated populations; lack of data; land ownership; and difficulty in habitat rehabilitation due to low rainfall. Some issues the WDARM LWG has identified in its

meetings include; spring grazing of cattle, Mormon cricket (*Anabrus simplex*) outbreaks and control with insecticides, recreational hunting (especially rabbit hunting), predation from mammalian predators and raptors, trespassing, and human disturbance of sage-grouse. The WDARM LWG has expressed a desire to have more and better baseline information and data. This group would like population information, lek attendance and locations, survival rates, habitat use, nest initiation dates, effects of insecticide spraying, and possible conflicts of grazing with sage-grouse recovery.

PROJECT PURPOSE

The purpose of this project is to determine factors affecting greater sage-grouse habitat use patterns and populations in the West Desert study area. This information will be used by WDARM LWG to identify and implement management actions to benefit sage-grouse and local communities.

Objectives within the West Desert study area:

1) To determine greater sage-grouse population numbers.

2) To determine greater sage-grouse breeding, brood-rearing, and wintering habitat.

3) To determine greater sage-grouse hen nesting dates and success, nest site vegetation characteristics, and mortality rates for adults and chicks.

4) To determine the relationship between spring grazing and greater sage-grouse habitat use patterns.

5) To determine the effects of insecticides (DIMILIN® 25W and Carbaryl) for Mormon cricket control on the relative abundance of invertebrate populations and the direct or indirect effects on greater sage-grouse.

6) To develop neo-tropical bird census routes and associated geographical information system database.

7) To monitor neo-tropical bird populations trends.

8) To provide the WDARM LWG and Deep Creek Coordinated Resource Management Planning group with information to guide management actions designed to enhance habitat conditions for greater sage-grouse and neo-tropical migrants.

STUDY AREA

The study area is located in Utah's West Desert. The West Desert Study Area follows the WDARM LWG area boundaries, and has two study sites, the Deep Creek Watershed

site and the Vernon site (Figure 1). The Deep Creek Watershed site is just north and east of the Goshute Indian Reservation and near the town of Ibapah, by the Utah-Nevada border. The Vernon site is located approximately 120 kilometers east of the Deep Creek Watershed site, at the base of the Sheeprock Mountains and near the town of Vernon on Highway 36. The study sites encompass a variety of land ownerships, including: Bureau of Land Management (BLM), U.S. Forest Service, state, and private lands. The main areas of concern within the Vernon site are the Little Valley, Harker Canyon, and Horse Canyon. The main area of concern in the Deep Creek Watershed site is the Deep Creek drainage and Ibapah Valley.

METHODS

Objective 1 (Population Numbers)

Lek Surveys

Methods used to obtain sage-grouse population data follow UDWR standard protocols and those of Connelly et al. (2003). Completed counts from each lek were estimated to represent 90, 75, or 50% of the total male attendance. Using a 2:1 female to male ratio, three different populations were calculated.

We conducted lek counts once a week from the last week in March to the end of April 2005, following a combination of the techniques described by Patterson (1952), and Beck and Braun (1980). Lek counts were conducted one half hour before sunrise in reasonably good weather (i.e., light or no wind, and partly cloudy to clear skies). A location was selected near the lek that allowed for good visibility but did not disturb the birds. The time the lek count began was recorded, and then the birds were counted from right to left. We waited 10 minutes then counted the number of males on the lek from left to right; waited another 10 minutes, and then counted a third time from right to left. We recorded the highest number of males observed. This procedure was repeated at all lek sites. The areas that are suitable sage-grouse lekking areas were searched for additional unknown leks and satellite leks.

Objectives 2-4 (Habitat Use and Population Dynamics)

Capture and Radio-Telemetry

To determine current habitat use and movement patterns of greater sage-grouse hens, we proposed to trap up to 30 hens, 40 birds total, over a 2-year period between the two study sites and fit each of them with a radio-collar. The collars were programmed (mortality signal cycle: five hours off, 19 hours on) Advanced Telemetry Solutions™ necklace collars with a frequency range from 151.000-151.999 Mhz. Monitoring began in March 2005 and will continue through the life of the collars. We monitored hens to determine nest initiation rates, dates, and distance between lek and nests, nesting success rates, nest predation rates, clutch size, vegetation structure at nests, vegetation composition at brood foraging locations, and brood survival rates. Following the nesting season, we located

birds that successfully nested at least 3 times per week. Hens without broods were relocated once a week, until mid-August.

The capture methods consisted of going to the lek areas at night during lek activity. Sage-grouse could be seen with a spotlight at night while they roosted near the leks. With the aid of binoculars and rock and roll music (i.e., an amusing form of "white noise" to distract the birds) we netted grouse with a handheld net by a second person that stalked the bird while it was distracted. Several grouse can be caught each night using this technique. The radio-transmitter was then attached to the grouse (Connelly et al. 2003). In addition, the grouse were weighed and aged. We recorded a location (Universal Transverse Mercator; Dalke et al. 1963, Patterson 1952) at each capture site using a Global Positioning System (GPS). Each grouse were released after information had been recorded.

Radio-collared hens were located using Telonics™ receivers, Yagi folding antennas, and Omni antennas. The hens' general locations were located every four to five days until the nesting period commenced. During the nesting period, hens were located every two to three days to try to account for all nesting attempts. Once the nests were located and marked (flagging was only used at a distance and discreet natural materials were used when closer to the nest). We recorded a GPS reading, surrounding vegetation, slope, and aspect. The nests were frequently checked until they were depredated (we tried to identify the type of predator by the state of any present eggshells, scat, tracks, and/or hairs (Patterson 1952)), abandoned, or successfully hatched. A successfully hatched nest was determined by the presence of eggshells with loose membranes (Griner 1939). When we had a radio-collared hen mortality, we examined the remains and feathers for signs of talons, claws, or teeth and searched the surrounding area for remains, hair, feathers, tracks, and scat in an attempt to identify predators.

Vegetation Monitoring

There are four general reasons for assessing habitats: 1) to document current condition and trend of habitat; 2) to evaluate impacts of a land treatment; 3) to assess the success of a habitat restoration program; and 4) to evaluate the ability of habitat to support an existing or reintroduced population (Connelly et al. 2003). We attempted to determine the baseline information that will aid future management and decide which management options will best meet the desired goals and objectives of WDARM LWG.

At each nest site, we recorded vegetation measurements in four directions (every 90° starting with a randomly chosen direction). We measured shrub canopy coverage using a modified line-intercept method (Canfield 1941), and percentage of ground vegetation using 20X50 cm Daubenmire (1959) frames. The Daubenmire frame is one of the most common methods of estimating herbaceous cover in sagebrush habitats (Connelly et al. 2003). We measured visual obstruction of the sagebrush between the nest and four meters from the nest using a Robel pole (Robel et al. 1970) with painted 10 cm increments. We recorded two measurements, Robel In (a measure of predator obstruction) and Robel Out (a measure of hen's obstruction). The pole was placed in the

location of interest (i.e., nest or location four meters from nest) and the observer recorded the height on the pole, in centimeters, that the vegetation appears to covers. The Robel pole is a widespread method of measuring visual obstruction, and it is applicable for numerous species and habitats, and is generally recommended for assessing sage-grouse habitat (Connelly et al. 2003). Percent cover of shrubs and forbs was determined by using the line-intercept method (Canfield 1941) with a 15-meter tape. The amount of live shrub canopy intersecting an imaginary vertical plane on the tape was measured. Gaps in the foliage smaller than 5 cm were counted as continuous, gaps 5 cm and larger were not counted. The total amount of shrub intersecting the line was summed and divided by the length of the line to determine total shrub canopy coverage (Connelly et al. 2003). Use of the line-intercept method will allow direct comparison with data from many other studies because this is a very common method of measuring sagebrush canopy cover (Lyon 2000, Connelly et al. 2003).

At locations of collared hens with broods, a measurement of slope, aspect, number of visible chicks, as well as a GPS location were recorded. Later, the vegetation at each brood location was also measured using the Robel pole and line-intercept method, but with a 10 meter tape. For a more accurate assessment of the percent cover of the understory vegetation we placed a Daubenmire frame (20X50 cm) every 2.5 meters along the tape. These measurements were only made if the hen was suspected to still have a brood. In addition, to determine the relative quality of early season brood foraging habitat, we used pitfall traps to assess insect abundance in each plot (Morrill 1975).

Vegetation sampling was also done at random locations associated with the nest and brood sites. For each nest and brood site the random point selected was within 500 meters. The same vegetation measurements were recorded at the random sites that were measured at the nest or brood sites to allow for a direct comparison. Shrub height was measured at all locations where line-intercepts were taken; the tallest part of the shrub was recorded.

Objective 5 (Effects of Insecticides)

Insect Sampling

Insects are an important component of early brood-rearing habitat (Patterson 1952). The Utah State Department of Agriculture and Food has been aerial spraying Dimilin and ground baiting with Carbaryl to control Mormon cricket outbreaks in various locations in Utah, including the Vernon site and the Deep Creek Watershed site. Both Dimilin and Carbaryl are wide-spectrum insecticides, which are not specific to Mormon crickets. Dimilin is a chitin inhibitor, which does not allow the insect to molt from its exoskeleton. Reduced Area and Agent Treatments (RAAT) aerial spray method uses less than 50 ml of Dimilin per hectare.

Ants and beetles are often the most important groups of insects for young sage-grouse chicks (Johnson and Boyce 1990), and their abundance can be assessed using pitfall traps. Sampling of invertebrates via pitfall traps was conducted at nest sites and brood

sites in untreated areas and treated areas. We will not sample between swaths of the sprayer due to drift of insecticide. Sampling of untreated areas would have occurred in areas with no application within 500 meters. We placed pitfall traps so they were flush with the ground in a grid arrangement (Nelle 1998). Ten meter transects were established at brood and nest locations and random locations. Eight pitfall traps were placed at each random, nest, and brood location to capture ground-dwelling insects. One trap was placed at five and 10 meters from center on each transect. All nest sites had insects collected. Three randomly chosen brood sites and three random sites associated with the brood sites were sampled each week for 7 weeks following hatching. Traps were opened for a maximum of 48 hours and insects were collected and preserved at the end of that time. Four pan traps were placed in the center of each of four quadrants, five meters from the center point. The pan traps had 5-10 cm of water to aid in the capture of jumping insects. Pan traps have been shown to capture jumping insects such as crickets and grasshoppers (Evans and Bailey 1993). Insects were placed in separate containers for preservation. Insects will be preserved in a 70% ethylene glycol solution (Pedigo and Buntin 1993) or frozen for future quantification and identification. Insects will be quantified for each taxa to determine relative abundance for each at different locations from May to June (Connelly et al. 2003). Invertebrates will be classified to order and families.

Objectives 6-7 (Neo-tropical Migrants)

Data on neo-tropical migrant use will be collected in 2006 using two different techniques as employed by the UDWR and Federal bird monitoring programs. These include a 24.5-mile "Breeding Bird Survey" route, and ten "Partners in Flight" point count stations on each of the study sites.

RESULTS

Objective 1. Population Status

<u>Vernon site</u>

Lek attendance for males began in late February; lek counts began March 3, 2005. Peak male attendance was the first week in April, peak female attendance was second and third week in April. There were two known active leks in Vernon: McIntyre and Little Valley. A third strutting area, Benmore, was found April 2, 2005 by the researchers; the area will be deemed an active lek if 2 or more males strut there for 2 or more years in the next five (UDWR). The season high male lek attendance for the McIntyre lek was 87 males on April 6, 2005. The season high male lek attendance for the Little Valley lek was 32 males on March 15, 2005. The season high male lek attendance for the Benmore strutting area was 24 males on April 2, 2005. Lek counts concluded on May 1, 2005; but some males continued to strut until the second week in May.

Deep Creek Watershed site

Lek attendance for males began in mid-March; lek counts began April 1, 2005. Peak male attendance was the third week in April. Peak female attendance was the third week in April. There was one known active lek in the Ibapah Valley. Two additional strutting areas were discovered by the researchers on April 20, 2005. Both strutting areas were west of the known active lek, the two strutting areas are possible satellite leks. The season high male lek attendance for the known active lek (East lek) was 20 males on April 12, 2005. The season high male lek attendance for the two found strutting areas, West and North strutting areas, were 15 and 24 males, respectively, on April 20, 2005. Lek counts concluded on May 1, 2005.

Additional leks are suspected to exist in both study areas. The Goshute tribal lands have had historical lek sites, but access to land has been restricted, causing difficulties in monitoring the lek sites. Many of the collared birds used the tribal lands during lekking times. Sage-grouse have been observed during lekking times in the Vernon site by us and local people in areas with no known leks.

Objectives 2-4 (Population Ecology and Habitat Use)

Capturing

Thirty-five birds were captured and collared. Captures started on April 1, 2005 and ended on May 14, 2005. Three males were captured and collared in Vernon from each of the 3 lek areas. Twenty-one females were captured and collared in Vernon. Four females were captured on the Benmore flats, 5 females in Little Valley, and 12 females on the McIntyre lek. Three males were captured and collared in Deep Creek Watershed near each of the lek areas. Eight females were captured and collared in the Deep Creek Watershed. Two females were captured east of the highway, and 6 were captured west of the highway near the leks.

Nesting

Nests were initiated by 10 of the remaining 19 hens still alive in the Vernon site. Of the 10 nests initiated, two were predated, one nest was predated while hatching, seven hatched successfully. It is extremely difficult to determine the type of predator that predated the nests; we suspect one of the predation events was mammalian due to buried egg shells. Four of eight hens initiated nests in Deep Creek Watershed; all four of the nests hatched successfully. No re-nesting attempts were documented in either site.

Average clutch size for all nests in both sites was 6.5 eggs per nest, (range = 4-9). Average nest initiation date was May 7 (range = April 22- May 23). A total of 76 eggs were observed, of those five did not hatch and were at various stages of development. Average hatch date was June 9 (range = May 30- June 25).

For both sites combined, average shrub density for all nests was 31.7%, average forb density was 25.5%, and the average grass density was 31.8%. Eleven of 14 nests were within 3 kilometers of a lek, for both sites combined. In the Vernon site the mean distance a hen traveled from a lek to nest was 2002 meters (range = 435 ─ 4310 meters).

Broods

Two of 7 broods were considered successful, 1 or more chicks living to at least 50 days, in the Vernon site, with 4 and 3 juveniles per hen. Two of 4 broods were considered successful in Deep Creek Watershed site with 3 juveniles per hen. There were 13 chicks for 27 total collared hens that we know reached an age of 50 days, which is a ratio of 0.48 juveniles per collared hen. We were unable to determine the fates of the chicks in unsuccessful broods due to them leaving the collared hen. Broods were previously considered unsuccessful if a hen had no chicks; this was thought to be due to mortality of the chicks. However, current research (David Dahlgren, Utah State University, 2005, personal communication) suggests that lost broods may be due to brood-hopping. Brood-hopping occurs when chicks from one brood leave their birth mother and join the brood of another hen. We suspected brood-hopping might be occurring in the West Desert study area even before the findings of Dahlgren. If this is the case, our successful brood estimates may be lower than the actual number of chicks that survived. Anecdotal evidence observed by us in the field suggests that more chicks may have survived than reported, many un-collared hens with chicks were observed in the study area. As reported, these populations of sage-grouse do not meet the guidelines of 2.25 juveniles per hen (Connelly et al. 2003).

The major areas we consider good brood-rearing habitat based on the movements of our collared birds include the Horse Valley, Little Valley, Benmore Flats, Cherry Creek, and most of the Ibapah Valley within 5 kilometers of a lek site.

Population Ecology

Mortality has occurred for seven of the 35 collared grouse, as of December 12, 2005. At the time this report was prepared, December 2005, 28 West Desert LWG study area males and females were alive. The extremely high survival rates are likely a cause of chance and lower sample sizes. Also, the winter months sometimes have higher mortality rates and the survival rates are not yet one full year.

The survival rate for Vernon females is 67%, calculated from April 2005-December 2005. Two mortality birds were juvenile females and two were adult females from the McIntyre lek; the cause of mortality was undetermined, but a golden eagle (*Aquila chrysaetos*) is suspected in two of the cases. Three birds were adult females from Little Valley, again the cause of mortality was hard to determine. We suspect either a red fox (*Vulpes vulpes*) or coyote (*Canis latrans*) for two of the Little Valley birds. Red fox, coyote, badger (*Taxidea taxus*), weasels (*Mustelidea spp*), and eagles have all been observed by the researchers in the sage-grouse areas. Two birds died in April, one bird in

May, one bird in August, one in October, and two in November. No male or female mortalities have occurred in Deep Creek Watershed.

No grouse mortalities have occurred from human structures, including fences. Several un-collared grouse were found dead, but had been heavily scavenged and cause of mortality could not be determined. Unlawful hunting of sage-grouse in the West Desert may be a contributing factor to mortalities. The researchers met many sportsmen that were unaware that hunting of sage-grouse in the West Desert is illegal. All were informed it was unlawful. No people were actually observed unlawfully harvesting sage-grouse, but the threat is there. Due to the concern, the topic was brought to the attention of the WDARM LWG; in response "No Hunting" signs were posted throughout the West Desert study area in hopes of informing hunters and poachers.

Movements

Movements of grouse in the Vernon site are much less pronounced than the Deep Creek Watershed birds. Birds in the Vernon site have moved very little from the areas of capture, with the exception of a couple of birds. Hens with broods moved very little; hens without broods moved more, but still remained close to the areas of capture (lek areas). Males in Vernon move more than females and travel from one lek area to others during the course of the year, but not during lekking times. Thus, the Vernon population of grouse does not appear to be migratory, but further winter information is needed.

Hens with broods in Deep Creek Watershed move more that brood hens in the Vernon site. Brood-less hens and males in Deep Creek Watershed also move much more than hens in the Vernon site. Sage-grouse in Deep Creek Watershed may be migratory; however additional information is still being collected.

Objective 5. Mormon Cricket Spraying

The Utah State Department of Agriculture and Food did not apply insecticides (Dimilin and Carbayl) to control Mormon crickets in 2005. No Mormon crickets were observed in the Vernon site in 2005, and a small band of Mormon crickets was seen once in Deep Creek Watershed, but did not require control. If spraying is initiated in 2006 we will implement the procedures discussed in the methods.

Objectives 6-7. Neo-tropical Birds Surveys

Because of contract delays this work was not initiated in 2005. This work will be initiated in 2006 and coordinated with the UDWR.

Objective 8. Management Recommendations

The management recommendations will be developed upon completion of the project in 2007.

PLAN FOR 2006

Winter movements of the collared grouse will be collected throughout winter 2006. Information regarding habitat use, areas most often used, and determining if each of the populations are truly migratory or non-migratory will also be collected. We will begin using aerial telemetry rather than ground radio telemetry to find birds as access becomes more restricted due to weather.

In early spring we will focus heavily on locating additional leks and possible satellite leks. We suspect that several leks exist that are not known. Leks are suspected to exist on the Goshute Tribal Lands, another west of Vernon near Lookout Pass, and a third south of Eureka, Utah. Accurate lek information is very critical when preparing a conservation plan. Lek attendances are often used for population estimates. Most female grouse in the West Desert study site nest within 3 kilometers of a lek. Most brood-rearing takes place near leks, and leks serve as the focal point for sage-grouse activities. If additional leks are located, we may be able to identify additional areas of good nesting and brood-rearing habitat. Having more and accurate information regarding leks will provide the best information to aid in the recoveries of the populations of sage-grouse in the West Desert study area.

Using the methods previously described we will capture additional grouse during lekking activities (April-May) to maintain a useful sample size and utilize the collars of grouse that have suffered mortality. We will continue to collect data on movements throughout the year. The same information will be collected regarding nest success, chicks per hen, nest initiation dates, nest and brood vegetation data, and survival rates. The information collected in 2005 will be compared to information collected in 2006. The effects of insecticide use to control Mormon crickets will be monitored and analyzed if insecticides are used in 2006.

A fuels reduction treatment was conducted in November/December 2005 in the Deep Creek Watershed on BLM lands. The treatment is in a major movement corridor for grouse traveling to and from the known lek sites. The effects of the treatment on movements, nesting, brood-rearing, and roosting of sage-grouse will be monitored throughout the year. We will be able to compare pre-treatment and post-treatment data. The treatment is being conducted in a manner we believe will facilitate the movements of grouse and not impede them, based on observations and suggestions made to the treating agencies.

In addition, a lek improvement project may be in the works in the Vernon site. The lek is the largest lek in the West Desert study area and is becoming increasingly overgrown with sagebrush. It is feared that if the area becomes too overgrown the grouse will cease to strut at the lek site. The lek is located on private lands. The landowner is very cooperative and relations are being made to possibly conduct the treatment in the near future. We believe the treatment will be beneficial to sage-grouse in the area.

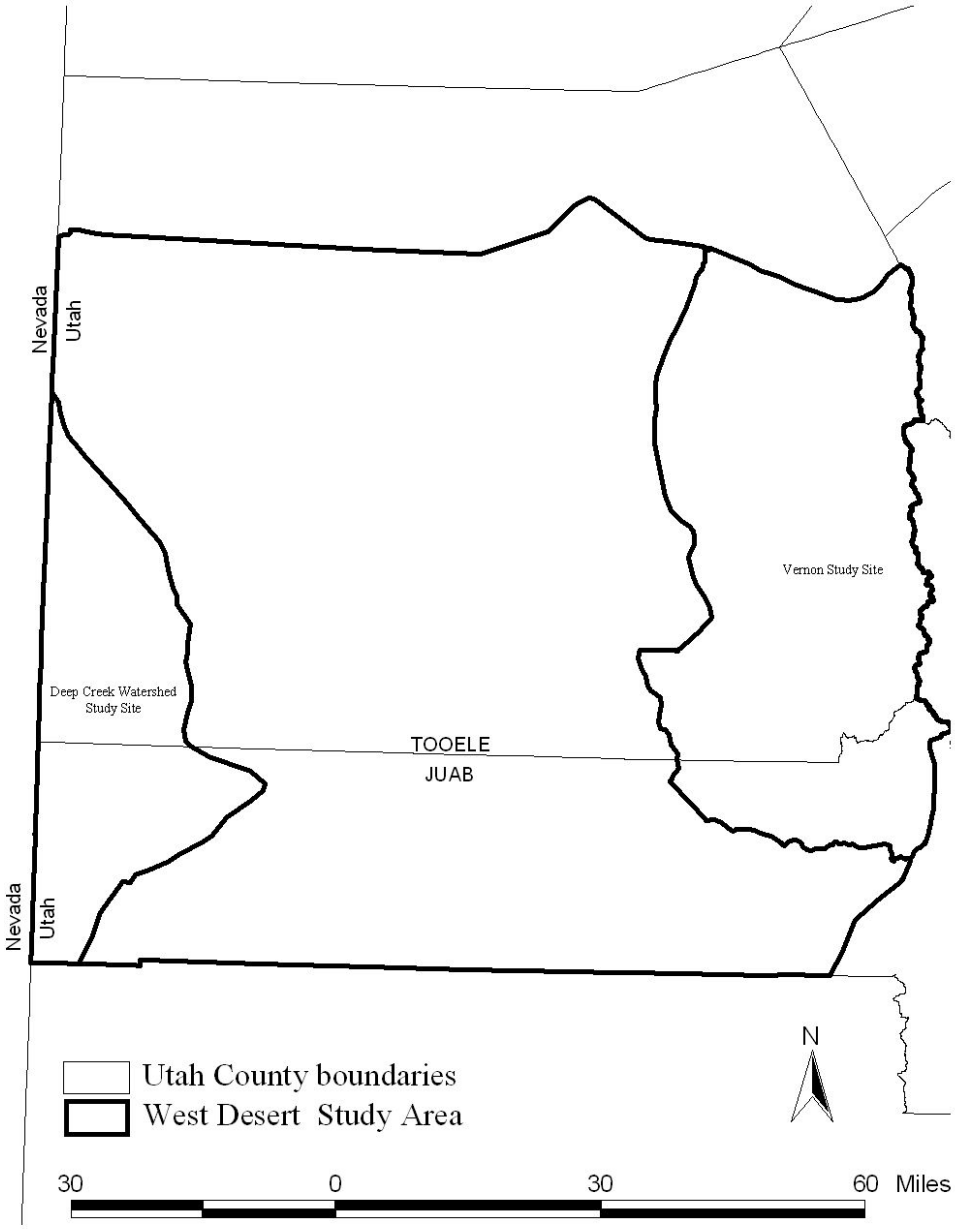

Figure 1. The two study sites, Vernon and Deep Creek Watershed, are shown within the West Desert Study Area.

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