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HYDROLOGIC CONSIDERATIONS RELATED TO INVENTORY AND EVALUATION OF WILDLIFE WATER UNITS AT WHITE SANDS MISSILE RANGE

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INTRODUCTION

Wildlife populations in the desert southwest often are thought to be limited by water availability, at least during some periods of the year. Although many native species are adapted to water limitation, populations can be increased by additional water sources (Yoakum et al. 1980). Wildlife managers continue to improve designs for wildlife watering systems (Elderkin and Morris 1989). Historically, the White Sands Missile Range (WSMR) wildlife management program has emphasized development and/or renovation of water sources for wildlife habitat enhancement. Despite this program emphasis, inventory, inspection, maintenance, and repair of water units have had relatively low priority and have been accomplished with limited personnel resources. Currently, only a few of the previously developed units provide a reliable water source for wildlife, according to WSMR natural resources staff.

Given past water unit development, the existence of a baseline wildlife water unit system at WSMR, and WSMR's desire to enhance wildlife, it would be helpful to evaluate how water units should be included economically in wildlife management planning. The evaluation must document the current status of water units, identify the actions and costs necessary to make units functional, and assess conditions and locations where wildlife will make the best use of water units. The evaluation will facilitate decisions about which wildlife species to feature in the water program; analyze budget requirements for scheduling water unit maintenance

and repair; and help determine the need for new units in context with natural water sources. Further, pre-military, rancher-established watering points not currently functional should be identified and evaluated for their role in future development or renovation planning.

PREVIOUS WORK AND PRESENT OUTLOOK

Prior to withdrawal of the WSMR area for exclusive military use, rancher-maintained water sources provided wildlife and livestock with drinking water. Once livestock were removed, normal maintenance and repair of these facilities ceased and many wildlife watering points became nonfunctional. Natural springs, seeps and intermittent surface water became the only surface water sources for wildlife. Limited water availability, especially during drought periods, likely has restricted surface water-dependent wildlife species.

The WSMR Wildlife Management Program was first staffed in 1963. Primary emphasis during the first 20 years was to enhance available wildlife habitat by renovating abandoned livestock water sources and developing new sources, especially for big game species (Anderson and Taylor 1983). A few springs also were modified to provide permanent water sources. Most springs and seeps located in mountainous areas of WSMR were not altered because of their inaccessibility. Since initiation of the WSMR Wildlife Management Program, about 100 water sources have either been renovated, enhanced, or created. Wildlife water units consist of windmills, dirt tanks, rainwater catchments, haul tanks, and spring boxes. These units contain a variety of water retrieval apparatuses, storage facilities, and piping systems. Wildlife drinkers have been installed in most of the mechanized units.

Planned research will take place throughout the entire missile range, an area of approximately 760,000 hectares in the Chihuahuan desert ecosystem of southern New Mexico. This area has a variety of surface relief, ranging from the Tularosa Basin and Jornada del Muerto plains at 1220 to 1520 meters, respectively, to the San Andres and Oscura Mountains with peaks approaching 2745 meters. The WSMR environmental office has developed and placed approximately 100 artificial wildlife watering units to aid wildlife populations. These units are located throughout WSMR, but are concentrated in the San Andres and Oscura Mountain ranges.

For clarity, the following list defines various water unit types at WSMR:

- Enhanced spring - Natural springs and seeps which have been human-altered to provide a more dependable water source for wildlife. Alterations include but are not limited to addition of spring boxes, piping, masonry dams, and hand-dug storage.
- Windmill - Wells with windmill pumping systems.
- Rainwater catchment - Inverted umbrella-style or roof-style rain collection and storage systems fabricated from metal, fiberglass, concrete, or other materials.
- Haul unit - Storage and drinker system without water collection mechanism which must be filled by water hauled from another source.
- Earthen tank - Catchment constructed from native earth to hold rainwater and run-off behind earthen berms that intercept drainage systems.
- Historic water unit - Rancher established nonfunctional water unit with potential to be made functional.

Records of varying quantity and quality have been collected through the years regarding these water units, but the records have not been compiled in an organized, readily accessible format (personal communication, P. Morrow). Thus, it is not possible to go to a single source and conveniently retrieve important data concerning site condition, location, and physical attributes, and expected wildlife use.

HYPOTHESES AND OBJECTIVES

The underlying hypothesis for this research is that artificial water sources enhance wildlife populations detectably relative to unaltered areas and that artificial water sources can be provided cost effectively relative to benefits derived. Hypothesis evaluation requires specific data regarding measurable wildlife benefits and potential costs necessary for routine maintenance and operation of various water unit designs.

Specific Research Objectives

- To compile baseline physical attributes data for about 70 wildlife water units and

identify systematic procedures needed for annual maintenance and repair to support use by big game, upland gamebirds, and other wildlife in that priority order.

- To estimate the relative suitability of current wildlife water unit placement for meeting WSMR wildlife water requirements as expressed in terms of species diversity, frequency of use, and volume of water provided versus potential wildlife populations served.
- To identify and evaluate up to 20 historic water units for their relative potential value as renovation or development sites based on cost effectiveness and anticipated wildlife use.
- To develop a working data base system using Dbase III Plus (or comparable software acceptable to WSMR staff) for organizing physical data on wildlife water units, categorizing expected wildlife use of units, and tracking maintenance and repair schedules.

PLANNED PROCEDURES

This project is organized into three major components:

- locating and evaluating the watering units
- wildlife use detection
- analysis of vegetative community structure

Location and evaluation of units will consist of finding a unit; recording its latitude, longitude, and universal transverse mercator coordinates with the aid of a global positioning system; and recording that location on USGS 1:24,000 and 1:50,000 scale topographic maps. An additional list of inspection items has also been identified, which includes, but is not exclusive to, calculated storage capacity of any and all storage tanks, surrounding vegetation association or community, and the overall condition of the unit. Watering units that have at one time or another been documented and/or maintained by WSMR as well as a minimum of 20 undocumented, nonfunctional, historic units, will be located and evaluated.

WSMR provides an extensive and unique laboratory for assessing wildlife use of artificial water sources, which is the second research component. A distinct opportunity exists for determining competitive interactions between native and exotic ungulates in arid environments. Following identification, location, and evaluation of all specified watering units, functional units will be selected at random to represent rain catchment, windmill, human-altered spring, earthen tank, and haul style categories. These sites will be examined for relative wildlife use among different styles of functioning watering units. For our research, wildlife benefit will be assessed as differences in measurable wildlife presence between water unit sites and comparable sites of natural vegetation and relief. The purpose of the wildlife data collection will be to ascertain measurable differences in wildlife activity in areas containing artificial watering units versus areas devoid of artificial units. Specific priority will be given to mule deer, pronghorn antelope, bighorn sheep, oryx, barbary sheep, feral horses, and upland game birds. Additional field work will employ a wide variety of techniques (observation, sign detection, fecal counts, capture, etc.) to measure use and presence by all wildlife categories.

Vegetation analysis will be the project's third major component. It has been suggested that ungulates have a significant detrimental impact on vegetation surrounding watering units as expressed in an increase in unpalatable plants, a decrease in palatable plants, or overall change in vegetative structure important to native animal species (Tembo 1990). Vegetation sampling will be done using a combination of quadrats and transects established in concentric belts centered on sample units. Each evaluation unit will be stratified into three concentric circles, and each circle will be further stratified into three sections. Each section will then have a line transect chosen perpendicular to the center of the unit. Finally, each line within each section will be divided into equal sections in which herbaceous and woody plants will be recorded as to species, number, height, and basal or canopy diameter.

Regarding procedures, it is important to illustrate one key point, notably access control. WSMR is first and foremost a high technology, high security military installation. Because of this security, the project has several conditions or restraints. Special and highly controlled permitting is required to take photographs on WSMR. Additionally, we must call the base a week in advance, check on any planned missions, and put our visits on the mission planning board. The day before scheduled field work, we must call the base and check on roadblocks. We must call the day of the planned work and inform

Range Control where we will be, and must call back when we are out of the area. Each of these conditions may result in postponement, rearrangement, or rescheduling of field work—starting the entire process all over again. These are significant planning constraints.

PROGRESS

As of November 1991, the project has proceeded to the watering unit location stage. All units will have been located and cataloged by the middle of January 1992. The first wildlife and vegetation study period will begin in March 1992 and go through May 1992, while the second, and final, study period will be June through August 1992. The final study report and a working data base comprised of a watering unit maintenance and repair schedule is due on or before September 30, 1992.

IMPLICATIONS TO NEW MEXICO WATER RESOURCES

Watering habits and water requirements of exotic ungulates has particular significance to New Mexico hydrology. According to a May 1991 aerial survey, there are approximately 1200 $\pm$ 100 feral horses on WSMR. Resource personnel feel that such a large herd may negatively impact on riparian areas. As a rule of thumb, horses require 4.2 liters of water per 100 kilograms of horse per day (J.B. Armstrong, personal communication). An average horse weighing 500 kilograms requires about 21 liters of water per day. To sustain a herd at WSMR at its current level, the horses would consume an estimated 25,200 liters of water per day, 176,400 liters of water per week, and almost 9.2 million liters of water per year. This amount of water removal coupled with trampling and compaction of surrounding vegetation and soils can be a significant resource consideration, especially in sites such as Malpais Springs where the state endangered White Sands pupfish (Cyprinodon tularosa) occurs. Further, it is possible that exotic ungulates can negatively impact native ungulates through potential introduction of diseases during common use of water sources.

Research results are expected to add to knowledge regarding the types of hydrologic settings where artificial watering sources may provide most benefit to wildlife in Chihuahuan desert and adjacent mountainous ecosystems. This added insight should reduce future placement of watering structures in surface water features where little good accrues to wildlife but impacts on other hydrologic considerations exist.

COOPERATION

This project is being conducted by the New Mexico Cooperative Fish and Wildlife Research Unit, based in the Fishery and Wildlife Sciences Department of New Mexico State University. Principal project investigators are the coauthors of this report. Project cooperators include Dr. J.B. Armstrong, NMSU Department of Animal Science; Dr. Rex Pieper, NMSU Department of Range Science; Dr. Manual Cardenas, NMSU Department of Experimental Statistics; the New Mexico Department of Game and Fish, the U. S. Fish and Wildlife Service, and the U.S. Department of Agriculture Jornada Experimental Range. Financial support for the research is provided by U.S. Army White Sands Missile Range.

REFERENCES

Anderson, W.D. and D.E. Taylor. 1983. Natural resources management plan - White Sands Missile Range, New Mexico. Department of the Army, White Sands Missle Range, NM.

Elderkin, Jr., R.L. and J. Morris. 1989. Design for a durable and inexpensive guzzler. *Wildlife Society Bulletin.* 17:192-194.

Morrow, P. 1991. U.S. Army White Sands Missle Range, STEWS-ES-E, White Sands Missle Range, NM.

Tembo, A. 1990. *Influence of watering points on range condition of vegetation of the Chihuahuan desert.* Doctoral dissertation. Department of Animal and Range Sciences, New Mexico State University, Las Cruces, New Mexico.

Yoakum, J., W.P. Dasmann, H.R. Sanderson, C.M. Dixon, and H.S. Crawford. 1980. Habitat improvement techniques. In *Wildlife management techniques manual.* Edited by S.D. Schemnitz. The Wildlife Society, Washington, D.C. pp. 329-404.