U.S. FISH AND WILDLIFE SERVICE

ROCKY MOUNTAIN ARSENAL FIELD OFFICE

FISCAL YEAR 1990 ANNUAL PROGRESS REPORT

Prepared in Partial Fulfillment of the
Cooperative Agreement for Conservation and
Management of Fish and Wildlife Resources at
Rocky Mountain Arsenal, U.S. Fish and
Wildlife Service and U.S. Army.
February 15, 1990

by

The U.S. Fish and Wildlife Service
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INTRODUCTION

The Rocky Mountain Arsenal (Arsenal) is located in Adams County, Colorado, just north of Stapleton Airport and the city and county of Denver. The Arsenal was used for the production of chemical, incindiary and nerve agents by the U.S. Army (Army) beginning in 1942, and was later leased out to private companies for the production of commercial pesticides. All chemical manufacturing and storage at the Arsenal has been terminated and the area is now a Superfund site undergoing cleanup.

The Arsenal is 27 square miles in size, and is largely undeveloped, open grassland. Because large buffer zones of land surround the chemical plants on the Arsenal and these zones have remained relatively undisturbed for 40 years, wildlife populations have flourished. This, combined with the fact that the Arsenal is only a fifteen minute drive away from downtown Denver, makes the Arsenal a rare island of wildlife habitat in the midst of urbanization.

Arsenal Background

The area now known as the Rocky Mountain Arsenal was originally short-grass and sand prairie habitat, dominated by blue grama grass, western wheatgrass, sand bluestem grass, needle and thread grass, and sand sagebrush (Cooper 1988). Most native vegetation was lost through conversion of the lands to agricultural practices (Ebasco, Applied Environmental, CH2M Hill, Data Chem, Stollar 1989). Before the Arsenal's establishment in 1942, the primary land uses of the area were agricultural and rural residential. Ornamental vegetation on the facility was originally introduced around homesteads (Turner 1975). Lake Ladora and Lower Derby Lake were constructed to store irrigation water in 1919 (Ebasco 1989).

With the advent of World War II in 1942, Denver was selected as a location for a chemical munitions factory (anonymous 1980). Construction of the Rocky Mountain Arsenal began in June 1942, and production started in December 1943. Originally, the Arsenal encompassed 19,918 acres (Turner 1975), but presently is approximately 17,000 acres in size. During its World War II history, the Arsenal produced approximately 87,000 tons of chemical, intermediate, and toxic products as well as 155,000 tons of incendiary munitions.

In 1945, the Arsenal was placed on standby status and portions of it were leased to private industry for the manufacture of commercial pesticides. The Colorado Fuel and Iron Corporation was the first to lease the Arsenal for the production of DDT. The Julius Hyman Company assumed the lease in 1950 and was subsequently bought out in 1951 by the Shell Chemical Company for the continued production of pesticides.

The Arsenal was reactivated during the Korean War to produce incendiary and chemical munitions. From 1959 to 1962, the Arsenal's facilities were used to produce wheat rust (TX), a biological anti-crop agent. During this period, a hydrazine facility was also constructed for blending rocket fuels used in the Titan and Apollo projects. From 1965 to 1969, operations at the Arsenal supported warfare in Southeast Asia.

Contamination History

Production of military and commercial chemical products before 1956 resulted in considerable chemical waste by-products (Trautmann 1980). Liquid by-products were sometimes held in settling ponds in the south plants area or placed in Basin A, a natural depression centrally located within the Arsenal (Section 36). Basins B, C, D, and E were utilized to store overflow from Basin A. Solid wastes were burned or buried in pits in Sections 4, 9, 20, 30, 33, and 36. In 1955, Arsenal neighbors complained that ground water used for irrigation was contaminated. In 1956, Basin F was constructed and used to store all subsequent liquid waste disposal. Unlike the other disposal basins which were simply natural depressions, Basin F was asphalt lined.

In 1962, Basin F reached its storage capacity. As an alternative disposal method, the Army Corps of Engineers drilled a 12,045 foot injection well, and pumped 150 million gallons of liquid wastes into deep earth strata from 1962 to 1966. The well was dismantled after it was identified as the source of seismic disturbances in the Denver area in 1966. Some subsequent liquid disposal was conducted by spray evaporation, carrying aerosol droplets of hazardous liquid waste downwind from the Arsenal.

In 1965, the Shell Chemical Company entered into an agreement with the Army to pay a negotiated rate per 1,000 gallons of waste produced. The Arsenal began accepting waste for disposal from Lowry Air Force Base and Fitzsimons Army Medical Center in 1966. Solid and slurry waste were often disposed of in the most convenient manner, sometimes without regard to its hazardous nature.

In 1968, the U.S. Army Material Command requested recommendations from the National Academy of Sciences on chemical agent disposal methods. Beginning in 1975, the primary mission of the Arsenal was to demilitarize and dispose of obsolete chemical munitions. In 1980, the mission of the Arsenal was further refined to direct the disposal of chemical agents and hazardous materials, and decontamination and cleanup of the installation (Sheely 1980). In 1989, the Arsenal was decommissioned as a military installation and became a Superfund Site for contamination cleanup and land restoration.

Fish and Wildlife Resource Background

The Arsenal was designed with substantial buffer zones surrounding chemical production facilities. These lands have remained largely undisturbed. Vegetation succession, the removal of livestock grazing, and limited human access since 1942 have resulted in wildlife habitat of extraordinary diversity and area value. Surrounding urbanization and the expansion of agricultural practices have isolated the Arsenal, thereby magnifying its overall importance to local wildlife communities. Construction of the new Denver Airport, the E-470 beltway, and associated development will continue to isolate wildlife habitat within the Arsenal.

The Arsenal includes habitats that support represenatative western plains/prairie wildlife communities. Principal species include black-tailed prairie dog, cottontail rabbit, black-tailed jackrabbit, mule and whitetail deer, coyote, badger, bald eagle, golden eagle, ferruginous and red-tailed hawks, as well as a host of other native birds and mammals. Pronghorn antelope historically lived on post as well but are no present. The Arsenal contains a portion of First Creek, four lakes, a number of ponds, and several prominent canals. Wildlife dependent on Arsenal wetlands include a diversity of ducks, shorebirds, passerines, muskrat, and native fish. Major lakes on the Arsenal support a viable trophy class warm water fishery, represented predominatly by introduced northern pike and large mouth bass.

U.S. Army regulation 420-74, Natural Resources - Land, Forest, and Wildlife Management, establishes policies and procedures for the conservation, management, and restoration of lands and renewable resources on certain Army installations (U.S. Army 1986). Chapter 5 of regulation 420-74 outlines fish and wildlife protection responsibilities, and provides for the coordination and implementation of fish and wildlife management plans with appropriate Federal or State agencies. On March 23, 1989, the Army and the U. S. Fish and Wildlife Service (Service) signed and implemented the cooperative agreement, Conservation and Management of Fish and Wildlife Resources at Rocky Mountain Arsenal (Conservation Agreement). Under provisions of the Conservation Agreement, a Service Field Office was established on the Arsenal to provide centralized coordination of wildlife resource management.

The purpose of the Arsenal Service Field Office is to centrally manage wildlife resources at the Arsenal over the pre-Record of Decision period. Specific responsibilities of the Service Arsenal Office include the development of a 5-year management plan, annual management plans and budgets, annual progress reports, technical review of Arsenal programs and documents, public relations support, and law enforcement assistance (Cooperative agreement for conservation and management of fish

and wildlife resources at Rocky Mountain Arsenal, Program Manager, RMA and USFWS, 1989).
This report was prepared to report on accomplishments at the Service's Arsenal Field Office in FY1990. This report closely follows the reporting format specified in the U.S. Fish and Wildlife Service Refuge Manual (U.S. Fish and Wildlife Service, 1984).

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MANAGEMENT PLAN

The Service's 1-year and 5-year Management Plans were completed for FY90 and FY90-FY95, respectively, and are under Army review.

PUBLIC/AGENCY PARTICIPATION

NRCC Meetings

The Natural Resources Conservation Committee (NRCC) was formed to provide a mechanism for input from the state of Colorado into fish and wildlife management programs and Arsenal operations. Three meetings were held in Fiscal Year 1990 on April 17, June 12, and August 21. Bonnie Lavelle, from the Rocky Mountain Arsenal Program Managers Office, chaired the April 17 meeting. Jim Green, from RMA Facilities Maintenance, chaired the following two meetings.

Interests represented in the NRCC meetings were as follows:

Program Managers Office, RMA
U.S. Fish and Wildlife Service
Environmental Science and Engineering, Inc.
Environmental Protection Agency
Facilities Maintenance, RMA
Shell Oil Company
Ebasco
MK -- Environmental Services
Army Acumenics Division
Colorado Attorny General's Office
Colorado Department of Health
Colorado Division of Wildlife

Topics covered during the meetings involved USFWS management activities, RMA facilities maintenance, biota collections and analyses, the comprehensive monitoring program, and MKE/Shell Oil programs.

Ad Hoc Committee Meetings

The Fish and Wildlife Ad Hoc Committee was formed in September 1989. Its purpose is to inform/update non-government entities on the status of wildlife management and cleanup activities at the Arsenal and to allow opportunities for comments on these activities.

For fiscal year 1990, committee meetings were held in October, April, and July, 1990. Future meetings are planned for October, 1990 and February, 1991.

Entities represented at these meetings include the following:

U.S. Fish and Wildlife Service
Program Managers Office, Rocky Mountain Arsenal
Urban Wildlife Photo Club
Denver Audubon Society
Denver Field Ornithologist
Prairie Dog Rescue
Loveland Prairie Dog Action
Federation of Fly Fishers
Denver Museum of Natural History
National Audubon Society
Colorado Wildlife Federation
National Wildlife Federation
Colorado Wildlife Society
Urban Design Forum
Environmental Defense Fund
Sierra Club
Citizens Concerned for Wildlife
Greeley Wildlife Committee
Field Dog Trial Club

PERSONNEL

The following is a list of all personnel employed, hired, promoted, or transferred in Fiscal Year 1990.

NAME	TITLE	HIRE DATE/ PROMOTION DATE	T P	INITIAL/ CURRENT GRADE
Donald Gober	Coordinator-RMA Field Office	------- 04-08-90	P	GS-401-11 GS-401-12
James Lockhart	Fish & Wildlife Biologist	-------	P	GS-401-12
Larry Malone	Deputy Coordinator	05-14-90 (transferred)	P	GS-401-12
John Wegryzn	Toxicologist	05-06-90	P	GS-415-11
Annette Ursini	Office Assistant	07-30-89 11-05-89	P	GS-303-4 GS-303-5
Ruby Rodriguez	Clerk/Typist Office Assistant	06-17-90 10-30-90	T P	GS-303-4 GS-303-5
Patricia Stevens	Toxicologist	04-15-90	T	GS-415-9
Lisa Langelier	Park Ranger Wildlife Biol.	10-30-89 01-14-90	T P	GS-025-7 GS-486-9
Sheila Dufford	Wildlife Biol.	11-13-89	T	GS-486-5
Susan Echelberger	Clerk/Typist	07-30-90	T	GS-322-3
Jane Griess	Park Ranger	07-16-90	T	GS-025-7
Bruce Hastings	Wildlife Biol.	02-12-90	T	GS-486-9
Greg Hughes	Wildlife Biol.	09-10-89 11-14-89	T	GS-486-5 GS-486-7
Sherry James	Clerk/Typist	08-13-90	T	GS-322-3
David Jamiel	Park Ranger	02-12-90	T	GS-025-7
Greg Langer	Fishery Biol.	11-19-89	T	GS-482-9
Inita Lyon-Roberts	Clerk/Typist	11-13-89	T	GS-322-4
Daniel Matiatos	Wildlife Biol.	11-13-89	T	GS-486-5
John Miesner	Bio-technician	06-17-90	T	GS-404-5

NAME	TITLE	HIRE DATE/ PROMOTION DATE	T P	INITIAL/ CURRENT GRADE
Donna Rieckmann	Wildlife Biol.	12-03-89	T	GS-486-5
Pele Nunley	Bio-Aid	06-25-90 intermittant	T	GS-404-2
Eric Zinc	Bio-Aid	07-24-90 intermittant	T	GS-404-3
Jeff Trousil	Wildlife Biol.	10-08-89 05-10-90*	T	GS-486-5
Frank Hein	Wildlife Biol.	10-30-89	T	GS-486-7
Wendy Van Metre	Wildlife Biol.	11-05-89 05-25-90*	T	GS-486-5
Christine Lehnertz	Fisheries Biol.	11-13-89 05-31-90*	T	GS-482-7

* Date of job termination/resignation.

YOUTH PROGRAMS

The Service's Arsenal office supported one person from the Youth Conservation Corps program (YCC) in Fiscal year 1990. Kelly Ognie began work June 18 and ended his term with the Service August 10, 1990. Ninety percent of Kelly's duties were assisting clerical staff with answering phones and computer operations. Ten percent of Kelly's duties were assisting with off-Arsenal kestrel and prairie dog studies.

SAFETY

The Service Field Office has taken a very active stance on the subject of Health and Safety. The Service Field Office conducts monthly Safety Committee Meetings with representatives from each of the working groups at the Field Office. Safety issues are discussed at each Staff Meeting, and all Staff are kept up-to-date on Safety issues. The Arsenal Field Office has undergone several Health and Safety Inspections in the past year and no major violations have been discovered. In November, 1990, a potentially serious incident involving a tour group from a Denver middle school was avoided thanks to swift and effective response from Service personnel on the scene. All other Health and Safety incidents reported by the Service Field Office were minor and resulted in no lost work days, hospitalizations, or compensation pay being delivered.

TITLE: Land use, mitigation, and habitat management on the Rocky Mountain Arsenal.

PERSONNEL: Bruce Hastings, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Mike Lockhart, Fish and Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

INTRODUCTION

The Cooperative Agreement for Conservation and Management of Fish and Wildlife Resources at Rocky Mountain Arsenal defined a variety of Service responsibilities related to land use at RMA during FY 1989. The Service continued to strive to meet the obligations of this agreement during FY 1990, which included wildlife enhancement and planning (including mitigation), technical input on contaminant issues relevant to fish and wildlife management, fisheries management, public affairs relating to wildlife, and endangered species management.

The Service continued to manage the Bald Eagle Management Area (BEMA) during FY 1990. The BEMA was designated in FY 1989 to protect a critical roosting site for wintering band eagles in Colorado. Human access and vegetative manipulations were key issues.

METHODS

The Service RMA Field Office continued to develop and refine a program during FY 1990 to meet the Cooperative Agreement requirements. The staff increased to more than 20 Service employees. Appropriate individuals were designated to review documents and make recommendations related to wildlife management and land use throughout the Arsenal.

The Service continued a program specific to the BEMA. Human use was kept to a minimum during the winter months (October 15 - April 15), and the size of the BEMA was increased to encompass the lakes area. This program was approached further by (1) altering gates and signs on roads into the BEMA wherever needed, (2) requiring Service permission for BEMA entrance, (3) requiring magnetic cones to be displayed on vehicles allowed into BEMA, (4) requesting enforcement of BEMA regulations by RMA Security, and (5) recording information relevant to human use in the BEMA.

The Service, in conjunction with RMA Facilities Engineers and MK-Environmental Services (MK-ES) personnel, continued habitat manipulations at seven sites in the BEMA. Vegetation was altered to produce shortgrass prairie, tallgrass prairie, sand prairie, mixed grass prairie, and additional vegetation for lagomorph habitat. Additional areas adjacent to the seven original sites were also manipulated to produce the appropriate type of prairie.

RESULTS AND DISCUSSION

The Service provided guidance to the U.S. Army (Army) on numerous wildlife management issues including, but not limited to, contaminant issues. The Service expanded the RMA wildlife program to include the following divisions: Administration, Conservation and Mitigation, Public Use, and Contaminants.

The Service organized field dog trials for the spring and fall of 1990. This organization included establishment of protocol and selection of new sites for "obtrusive" use such as field dog trials, boy scouts, and some military training (medical, compass use, etc.). These activities were limited to Sections 3, 4, 33, 34, and the eastern strip of 9.

Mitigation plans were submitted for (1) proposed water treatment plant north of Building 111, (2) the decontamination pad, and (3) a proposed demolition of buildings at the barracks area and Rod and Gun Club. Additional plans were initiated for (1) a waterline in sections 2 and 3, (2) Ladora spillway reconstruction, (3) Lower Derby dam and spillway reconstruction, and (4) expansion of Building 111. The Service was involved in all aspects of the Army's plans for creation of wetlands in the southeastern portion of the Arsenal.

The Service developed plans for an off-road land use policy providing the Service more responsibility for minimizing unnecessary disturbance to wildlife and habitat. The Service also initiated a program of identifying sensitive wildlife areas and, wherever appropriate, eliminating use of these areas through coordination with Facilities Engineering and signs placed around the site. Most of these signs were located at raptor nests.

The Service coordinated the RMA fishing program. Plans were initiated to develop an RMA fishing club.

The BEMA access program was successful in reducing human use in the BEMA and assessing some of the degree and type of permitted use. Preliminary data analysis demonstrates that human use varied considerably by month and by contractor. The analysis also revealed that some contractors had more visits than others but may have impacted bald eagles and other wildlife less than other contractors due to spending less time on-site regardless of number of trips.

Habitat manipulations were not as successful as expected (see report by Mackey in Appendix B). Many of the problems can be attributed to Facilities Engineering's workload and high priority projects that were unrelated to this program. The Service and MK-ES may recommend that the work be contracted in the future.

ACKNOWLEDGEMENTS

The Service would like to acknowledge the significant help that was received from Col. Daniel Voss on most aspects of land use and Carl Mackey on mitigation planning and BEMA habitat manipulations. The Service would also like to thank Maj. John Fomous, Jim Green, Greg Hughes, Jim Farnham, Peter

Pauwels, Dr. Jim Fike, and Jane Griess for significant contributions to land use planning and programs.

TITLE: The potential effects of Rocky Mountain Arsenal cleanup activities and Denver metropolitan area transportation development on wintering bald eagles.

PERSONNEL: J. Michael Lockhart, Fish and Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Frank Hein, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Dan Matiatos, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Wendy Van Matre, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

In December of 1896, a winter bald eagle communal roost was discovered on First Creek along the eastern side of the Rocky Mountain Arsenal. The Arsenal roost, supporting more than fifteen bald eagles for two weeks or more, is classified as "essential habitat" for recovery of the species. Concern over the effects of various development and cleanup activities on this wintering population led to the initiation of an intensive three year study by the U.S. Fish and Wildlife Service and funded by the U.S. Army, City and County of Denver, State of Colorado (Department of Highways) and E-470 Authority.

The winter period of 1989 - 1990 represented the last year of the "Denver area cooperative bald eagle study". A total of 23 bald eagles were trapped and fitted with transmitters, of which 3 eagles were recaptures from former years of study. Bald eagles were intensively tracked throughout the wintering period to ascertain key habitat use areas and specific foraging locales.

Data obtained for the 1989 - 1990 field season is being consolidated into the final report for the project. Basically, the third year again revealed the importance of the Arsenal as a principal destination wintering ground for bald eagles in eastern Colorado. The minimum maximum daily count of bald eagles on the roost reached 38 birds in January of 1990. However, population turn over was again high, presumably due to the lack of availability of prairie dogs.

As part of the Service's bald eagle study, seasonal and annual population trends of other raptors were investigated. The findings of this aspect of the research will also be included in the final project report. As with bald eagles, winter populations of other large raptors, principally ferruginous hawks, declined precipitously with loss of up to 95 percent of the Arsenal's prairie dog population from sylvatic plague. With ongoing prairie dog restoration programs by the Service and eventual recovery of prairie dog populations, raptor numbers are also expected to rebound.

TITLE: The status and habitat use of burrowing owls on the Rocky Mountain Arsenal.

PERSONNEL: Dr. R. Scott Lutz, Assistant Professor of Wildlife Management, Texas Tech University, Lubbock, Texas.

David L. Plumpton, Graduate Student, Texas Tech University, Lubbock, Texas.

Gregory J. Langer, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Fred Krampetz, Biological Technician, USFWS, Rocky Mountain Arsenal.

This project is a cooperative research effort between the Service and Texas Tech University. A 2-year study being conducted by graduate student David L. Plumpton began in April 1990. Objectives of the study were 1) Maintain the current burrowing owl population attributes, 2) Protect critical owl burrowing habitat to the extent possible while accommodating cleanup activities, 3) Investigate burrowing owl requirements specific to Arsenal to ensure proper management and protection in the future.

The status of burrowing owls on the Arsenal is as yet undetermined. Relatively little is known of owl habitat preference, migration routes, or daily habits as well. Therefore, possible impacts to burrowing owl populations from future Arsenal cleanup operations requires further investigation. Thus, fieldwork, which ceased in September, 1990, will resume in mid-March 1991.

Information on specific methods and preliminary findings of the Arsenal burrowing owl study is provided in Appendix A.

Results at this time are inconclusive. Further data collection and analyses are planned.

TITLE: Population surveys of waterfowl species on the Rocky Mountain Arsenal.

PERSONNEL: Dan Matiatos, Wildlife Biologist, USFWS, Rocky Mounatin Arsenal.

INTRODUCTION

Surveys to monitor wintering waterfowl population trends on the Arsenal were initiated during the fall of 1988 to acquire knowledge of waterfowl as a bald eagle prey resource on the Arsenal. The surveys also provide data to assure proper mitigation for waterfowl habitats which may be impacted during Arsenal cleanup operations. The various Arsenal wetland habitats provide migration rest and wintering areas for a large diversity of waterfowl species (Table 1). The data acquired will facilitate waterfowl management to maximize public viewing potential while maintaining and protecting waterfowl habitats.

METHODS

Waterfowl were counted 2 hours after sunrise from four fixed observation points (see attached map). Observations were made from one to four times a month depending on iceover periods of water bodies and time constraints.

The waterfowl survey plan was modified during October, 1990. Twelve additional observation sites were added to more thoroughly monitor the various Arsenal wetland habitats (Figure 3). Additional data was incorporated, such as percent ice cover and percent full (surface area covered by ice or water) to monitor the effect of these variables on waterfowl numbers. This data will facilitate more effective management by determining sensitive areas requiring increased protection.

RESULTS AND DISCUSSION

Iceover periods during mid-winter and migration periods caused a decrease in available waterfowl habitat, resulting in a substantial decrease in the numbers of ducks in late fall (Figure 1). The numbers of canada geese fluctuated throughout the season (Figure 2). However, the data reveal a marked drop for geese during late December and early January probably due to an increase in the lengths of iceover periods.

The data document a need to protect small areas of wetland habitat which remain ice free during mid-winter months (i.e. December through February). This will provide winter habitat for waterfowl as well as diversify the wintering bald eagle prey base. These small ice free areas are currently utilized by a diversity of waterfowl species, and therefore provide good public viewing potential.

Table 1. Waterfowl documented on Service surveys.

Species
Canada Goose (Branta canadensis)
Greater White-fronted Goose (Anser albifrons)
Mallard (Anas platyrhynchos)
Northern Pintail (Anas acuta)
Gadwall (Anas strepera)
American Wigeon (Anas americana)
Northern Shoveler (Anas clypeata)
Blue-winged Teal (Anas discors)
Cinnamon Teal (Anas cyanoptera)
Green-winged Teal (Anas crecca)
Wood Duck (Aix sponsa)
Redhead (Aythya Americana)
Canvasback (Aythya valisineria)
Ringed-necked Duck (Aythya collaris)
Lesser Scaup (Aythya affinis)
Common Goldeneye (Bucephala clangula)
Bufflehead (Bucephala albeola)
Red-breasted Merganser (Mergus serator)
Common Merganser (Mergus merganser)
Ruddy Duck (Oxyura jamaicensis)

WATERFOWL SURVEY LOCATIONS

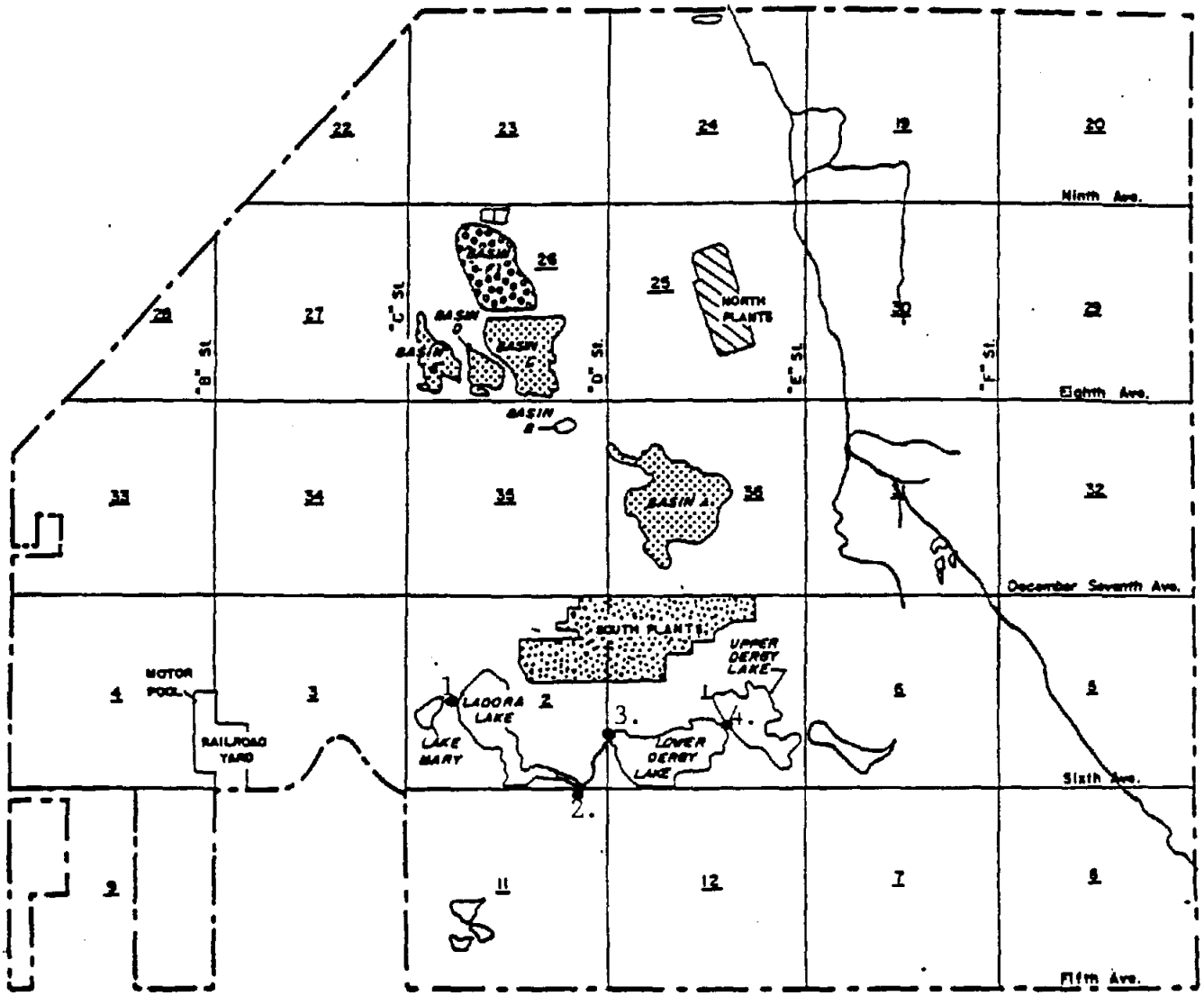
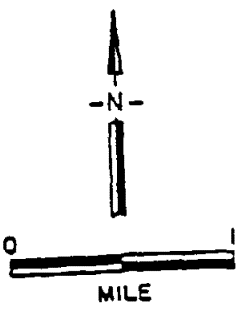
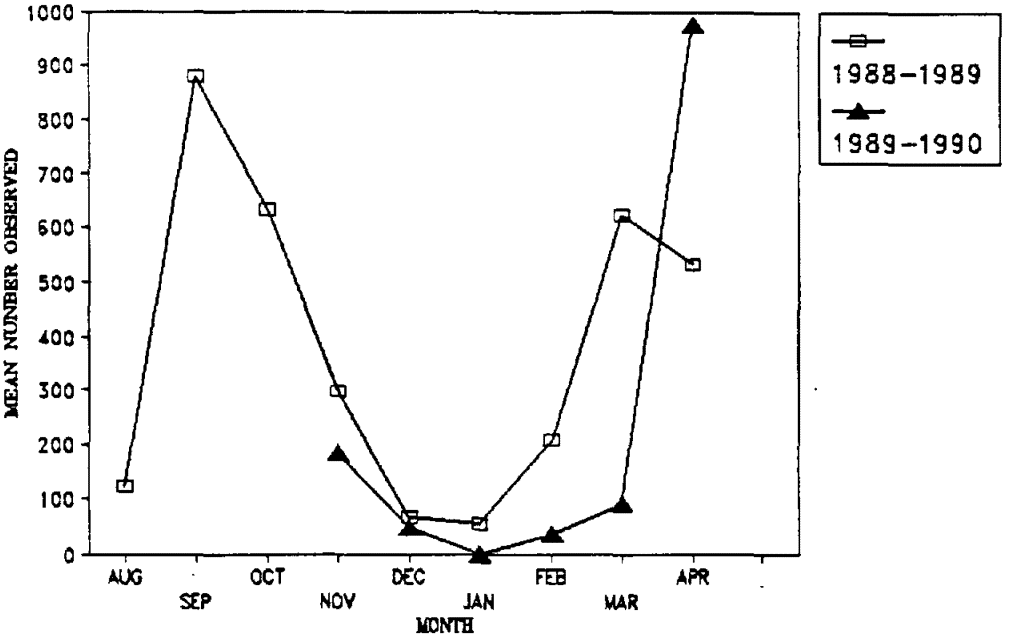


Figure 1. Waterfowl survey locations during the winters of 1988-1989 and 1989-1990.



Duck population trends on the Rocky Mountain Arsenal 1988-89 and 1989-90.



C.Goose population trends on the Rocky Mountain Arsenal 1988-89 and 1989-90.

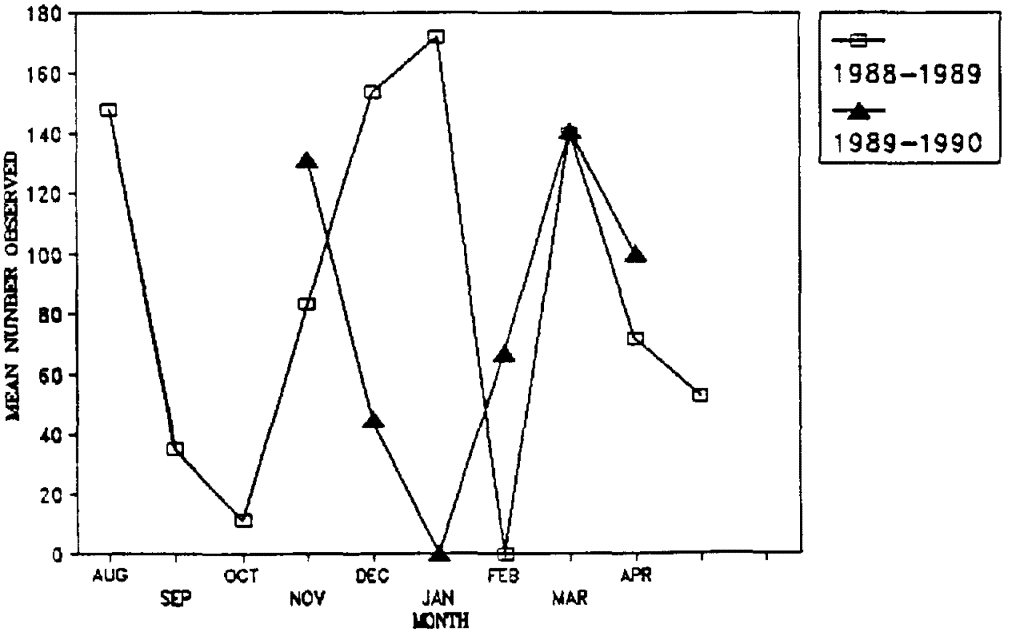
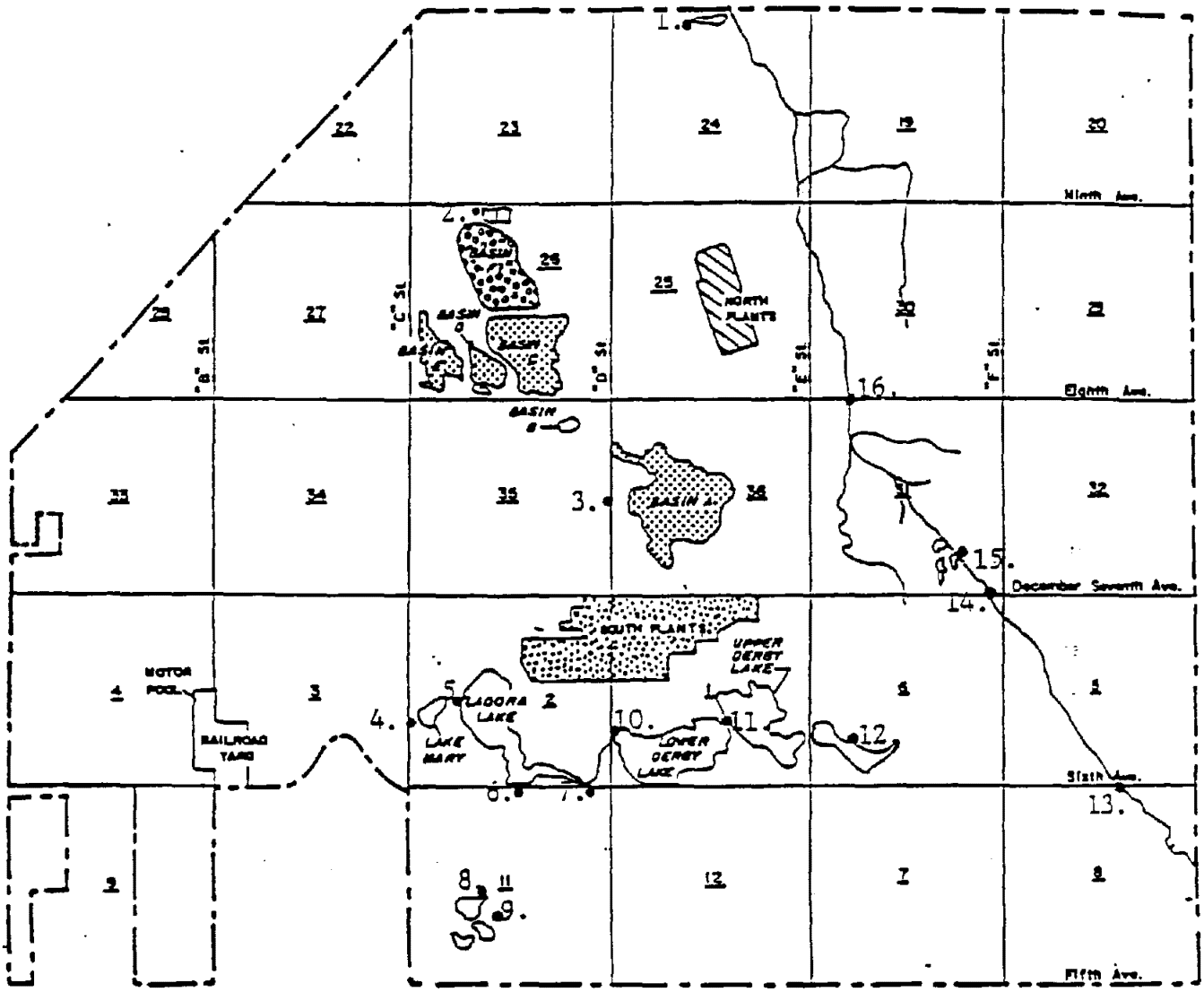


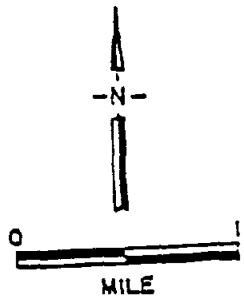
Figure 2. Duck and canada goose population trends on the RMA winters of 1988-1989 and 1989-1990.

WATERFOWL SURVEY LOCATIONS



Observation Points •

Figure 3. Waterfowl survey locations beganning in October 1990.



TITLE: Relocation and recovery of black-tailed prairie dog populations on the Rocky Mountain Arsenal.

PERSONNEL: Sheila Duffford, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Lou Hannebury, Wildlife Biologist, Fish and Wildlife Research, Fort Collins, Colorado.

Kevin Robinette, Graduate Student, Colorado State University, Fort Collins, Colorado.

Dr. William F. Andelt, Professor of Fishery and Wildlife Biology, Colorado State University, Fort Collins, Colorado.

INTRODUCTION

During the summers of 1988 and 1989, 95% of the existing black-tailed prairie dog, Cynomys ludovicianus, population on the Rocky Mountain Arsenal (Arsenal) was destroyed by sylvatic plague. In August 1989, the Fish and Wildlife Service (Service) initiated a prairie dog reintroduction project. The purpose of this project was to assist the recovery of the prairie dog colonies decimated by sylvatic plague and to develop procedures for relocating prairie dogs. During fiscal year 1990 the project was expanded to include the relocation of prairie dogs from areas on the Arsenal where they were interfering with other projects. Prairie dogs were also relocated to minimize human conflicts with Arsenal prairie dogs both on and off post. Other prairie dog projects initiated this year include a graduate field study to determine the effects of group size on the survival of relocated prairie dogs and the effectiveness of prairie dog barriers made from a variety of materials (See progress report from Kevin Robinette in Appendix A.). A vegetative barrier was also planted in Section 36 to prevent the movement of prairie dogs into and around Basin A.

On August 8, Bruce Hastings gave a slide presentation on the Arsenals prairie dog relocation project at the Colorado Division of Wildlife's prairie dog workshop.

METHODS

Prairie Dog Relocation Project

During the first quarter, the Service continued to release prairie dogs in the release areas in Sections 29 and 32, and in Section 35 (Map 1). These areas continued to be the primary release areas through March when the birth of prairie dog pups postponed any additional captures until late May, when the pups

emerge from their burrows. The areas had previously been mowed and the burrows dusted for fleas to prevent the prairie dogs that were relocated from off-post from either contracting or bringing in new bouts of plague.

All prairie dogs released onto the Arsenal were sprayed with flea spray for the same purpose. The sex and age class were recorded and they were eartagged for future identification during the evaluation stage of the project. M.P. Coffeen and J.C. Pederson (1989) suggested that transplanting juvenile prairie dogs weighing under 500 g. and lactating females weighing under 750 g. resulted in poor survival in Utah prairie dogs, Cynomys parvidens. Therefore in June, the Service began weighing juvenile prairie dogs and lactating females in order to determine if the same limitations existed for black-tailed prairie dogs. In August the decision was made to weigh all prairie dogs released to determine any effects of weight on survival. The prairie dogs were then released into vacant burrows, 4-5 prairie dogs to a burrow.

The prairie dogs relocated onto the Arsenal came from two different sources. Service Personnel trapped and moved prairie dogs from other areas on the Arsenal (Map 1) and secure areas off post. Tomahawk live traps baited with sweet mix horse feed (oats, cracked corn and feed pellets, sweetened with molasses) were used to capture the prairie dogs for relocation. The traps were wired open for 2-3 days to prebait. While actually trapping, traps would be set in the morning and checked several times a day. The captured prairie dogs were then sprayed for fleas and transported to the release site in the traps.

Private relocation organizations were the other source of prairie dogs brought onto the Arsenal. There were 3 different groups relocating prairie dogs onto the Arsenal fiscal year 1990. These groups use soap and water to flush prairie dogs out of their burrows, as well as live traps to capture prairie dogs for relocation. Live traps are often borrowed from the Service for this purpose. The prairie dogs were captured in development areas and other places along the front range from Fort Collins to Castle Rock, Colorado.

Plans for a survival study in the Section 19 release area were started in September.

Prairie Dog Telemetry Study

The prairie dog telemetry study initiated by Lou Hannebury in August was continued through December. Sixty prairie dogs (29 with radio collars) were released in a study plot in Section 19 (Map 1). The study plot had been marked out, mowed and dusted for fleas. The telemetry work continued to be done twice a month. Two methods were used to locate the radio collared

prairie dogs. Triangulation techniques, using a fixed tower and a known mobile site, were used to document the prairie dogs' movements after their release. The plot was also walked with a hand held antenna to locate the burrow of an individual prairie dog. In January and February an effort was made to trap the prairie dogs out of Section 19 to determine which prairie dogs had survived and to recover as many radio collars as possible.

RESULTS AND DISCUSSION

Prairie Dog Relocation Project

A total of 2,901 prairie dogs were relocated on the Arsenal during the 1990 fiscal year. Service personnel trapped 376 prairie dogs on the Arsenal and 269 prairie dogs in other areas (Table 1). The relocation organizations brought 2,256 prairie dogs from a variety of locations along the front range. This brings the total number of prairie dogs released on the Arsenal to 3,615. The prairie dog relocation project is expected to continue through the next fiscal year.

Most of the prairie dogs (1,946) were released in Sections 19 (Table 2). The prairie dogs released for the telemetry study were trapped and moved to other areas prior to releasing these prairie dogs. In September, a Service release area was established in the NE 1/4 of Section 30 (Map 1) that may be used as an experimental plot. Only prairie dogs tapped by the Service were released in this plot.

Prairie Dog Telemetry Study

The telemetry data was collected twice a month through December. Trapping efforts in January and February resulted in the capture and relocation of 31 prairie dogs. Ten of these prairie dogs originally had radio collars, but 3 had lost their collars entirely and 2 had collars with the transmitters chewed off. To date no report of the data analysis of this study has been received from the Fish and Wildlife Research Branch.

ACKNOWLEDGEMENTS

The Service would like to Acknowledge the efforts of the following prairie dog relocation organizations and their volunteers:

Citizens Concerned for Wildlife
Loveland Prairie Dog Action
Prairie Dog Rescue

These groups have contributed significantly to the success of this project.

LITERATURE CITED

COFFEEN, M.P., AND J.C. PEDERSON. 1989. Transplant techniques for the Utah prairie dog, Cynomys parvidens. Unpublished report. 24pp.

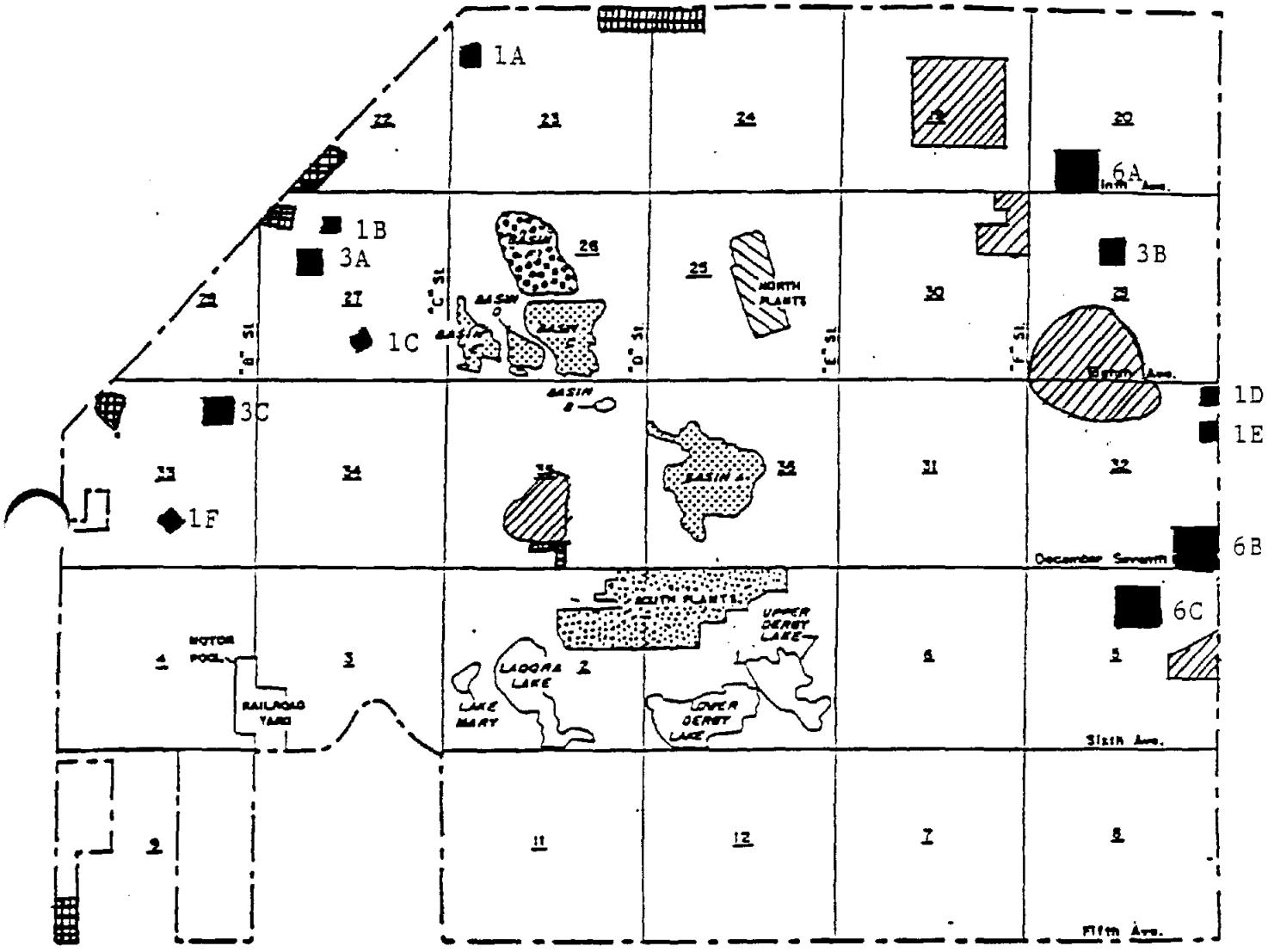
Table 1. FY-90 Monthly Prairie Dog Releases on RMA by Capture Source.

CAPTURE SOURCE	MONTH												TOTAL
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	
Rocky Mountain Arsenal						2			20		246	108	376
Buckley Air National Guard		49	38										87
Denver Water Department									9	64	46	6	125
Stapleton International Airport		39	16										55
Kevin Robinette										1	1		2
Citizens Concerned for Wildlife											51	46	97
Loveland Prairie Dog Action								15	127	62	61	84	349
Prairie Dog Rescue	150	31			140	66	3	2	263	530	246	379	1,810
TOTAL	150	119	54	0	140	68	3	17	419	657	651	623	2,901

Table 2. FY-90 Monthly Prairie Dog Releases on RMA.

RELEASE AREA	MONTH												TOTAL
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	
Sections 29 & 32	150	92	23		140	63	3						471
Section 19								12	419	531	454	530	1,946
Section 35		19	31			5		5		66			126
Section 30												20	20
Unknown		8											8
Graduate Study Plots										60	197	73	330
TOTAL	150	119	54	0	140	68	3	17	419	657	651	623	2,901

Map 1. 1990 Prairie Dog Projects

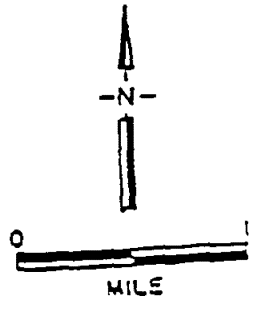


LEGEND

Prairie Dog Relocation Sites

Prairie Dog Study Plots

Prairie Dog Trapping Locations



TITLE: Habitat improvement and relocation of lagomorph species in the Rocky Mountain Arsenal.

PERSONNEL: Sheila Dufford, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Bruce Hastings, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

INTRODUCTION

In August of 1989, the decision was made diversify the prey choice of raptors on the Rocky Mountain Arsenal (Arsenal). Part of this goal included planning and executing habitat improvement projects for rabbits and relocating rabbits into these areas.

Two other lagomorph projects were initiated on the Arsenal this year. A one year study of parasites in black-tailed jackrabbits, Lepus californicus, by Metropolitan State University began in May. This was a repeat of a similar study that took place from August 1972 to July 1973. The Denver Museum of Natural History was granted a contract in September for a lagomorph study on the Arsenal.

METHODS

Habitat improvement projects included plantings of native grass and other types of vegetative cover in the Bald Eagle Management Area (BEMA) to diversify the habitat for lagomorphs and other species. Trees and shrubs cut for other project purposes were placed in brush piles along the First Creek drainage to provide cover (Map 1).

Attempts were made to trap black-tailed jackrabbits at Stapleton International Airport to release in Section 30. Large live traps baited with sweet mix were placed near shrubs and under and old airplane where jackrabbits concentrated. Cottontails, Sylvilagus sp., caught inadvertently while trapping prairie dogs were also relocated to Section 30. Both species were eartagged prior to their release.

The Service helped in the collection of jackrabbits for the parasitology study. Two jackrabbits were collected each month and taken to Metropolitan State University for analysis.

RESULTS AND DISCUSSION

Since it can take up to three years after seeding for a native grass planting to become established, it is too early to tell if the vegetation plantings were successful. Additional vegetation manipulations are being planed. The brush piles have been placed

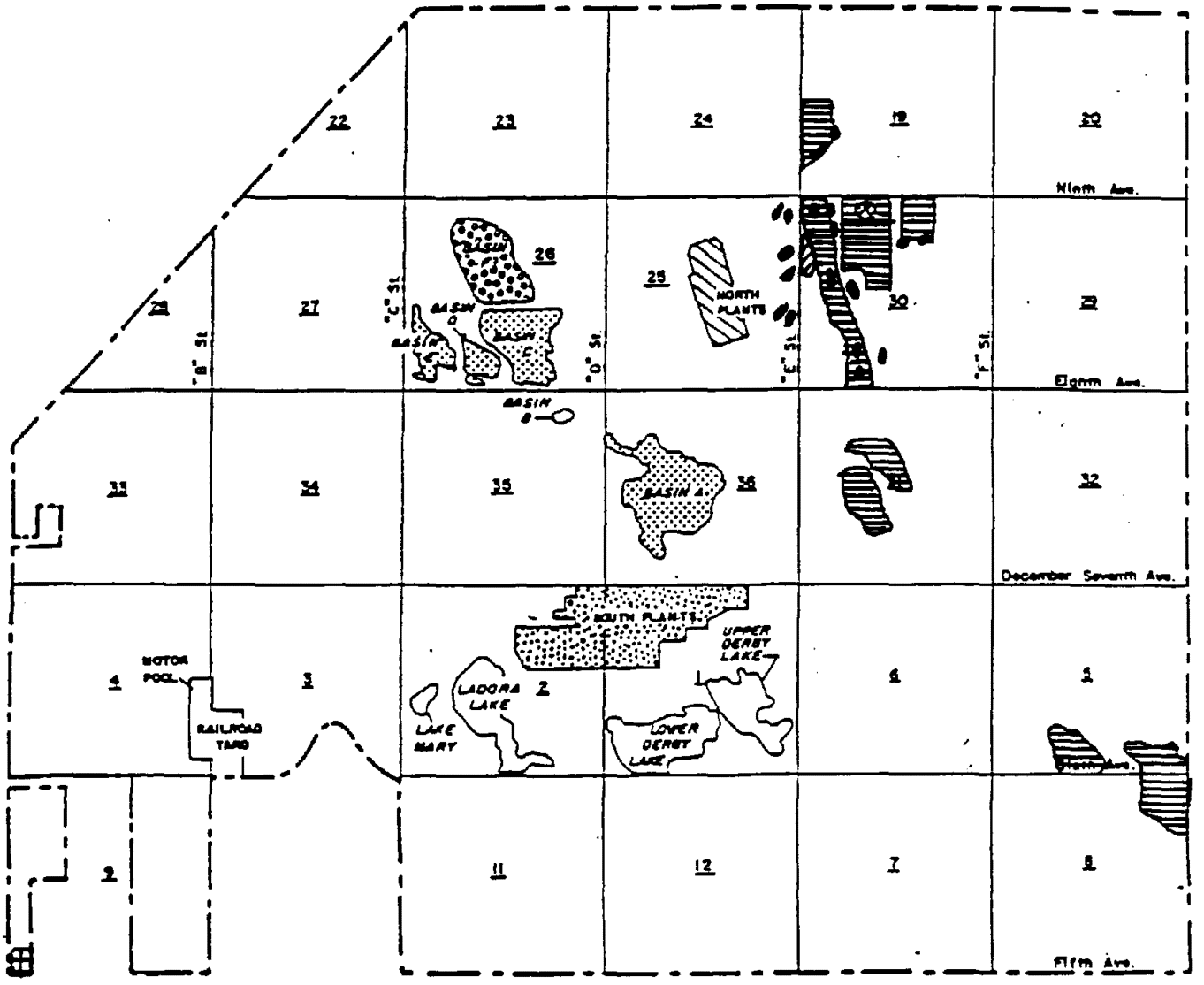
along first creek, however lagomorph populations surveys have not been initiated yet to determine any impact.

Nine cottontail rabbits were relocated to Section 30 last summer. These rabbits were incidentally captured in prairie dog traps in Section 9. Additional lagomorph relocations may be on hold until after the lagomorph study by the Denver Museum of Natural History.

The Service has collected 10 jackrabbits for the parasite study. This study is still in progress. The final collection will be in April 1991. We should receive a report of the results shortly afterwards.

The Service will be working with Denver Museum of Natural History to finalize the proposal of the contracted lagomorph study. This proposal should be finalized by January 1991.

Map 1. 1990 Lagomorph Projects



LEGEND

Rabbit Release Area

Rabbit Capture Area

BEMA Vegetation Manipulation Area

Jackrabbit Release Site

Brush Pile

N

0 1 MILE

TITLE: Non-predatory small mammal population structure and habitat use on the Rocky Mountain Arsenal.

PERSONNEL: Michelle Fink, Wildlife Technician, USFWS, Rocky Mountain Arsenal.

Bruce Hastings, Wildlife Biologist, USFWS, Rocky Mmountain Arsenal.

INTRODUCTION

The Denver Museum of Natural History had proposed a small mammal research project on the RMA in June 1990, and funding/contracting for the project was approved in October, 1990. Work on the project is scheduled to begin in the spring of 1991. No other work has been done under this category at this time; however, there are specific projects on prairie dogs and lagomorphs in progress (pages D-8 and D-15).

The Service's objectives for the small mammal project are 1) to determine species composition and density of non-predatory small mammals on the Arsenal, 2) to determine species' habitat preferences, and 3) to determine the relationship between habitat type, population density, and rate of predation.

METHODS

Capture/recapture grids will be established within representative habitat types throughout the Arsenal.

RESULTS AND DISCUSSION

Field studies have not been initiated. No results are available.

TITLE: The status, food habits, habitat use, and management of predatory mammals on the Rocky Mountain Arsenal.

PERSONNEL: Bill Andelt, Professor of Wildlife Biology, Colorado State University, Fort Collins, Colorado.

Eric Hein, Graduate Student, Colorado State University, Fort Collins, Colorado.

Bruce Hastings, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

In a cooperative agreement between the Service and Colorado State University, a field study on coyotes and badgers began in May 1990. Objectives of the study were 1) to investigate the occurrence of these predators on the Arsenal, 2) to investigate population parameters and demographic characteristics for coyotes and badgers, 3)to evaluate the importance of various prey species, 4) to investigate interactions (including competition) between predatory species, 5) to examine the influence of prairie dog communities on coyotes and badgers, 6) to monitor the presence of sylvatic plague in coyotes and badgers, and 7) to identify and protect key habitats for coyotes and badgers.

Because relative abundance of coyotes and badgers has yet to be determined, their status on the Arsenal is uncertain. However, it is assumed that both species exist in higher numbers within the Arsenal than surrounding areas because of 1) the Arsenal provides an island of good wildlife habitat in a generally urbanized and agricultural area and 2) human harassment is minimized.

Information on methods and the preliminary results of the above study is presented in Appendix A.

TITLE: The population status, habitat use, and management of mule deer and white-tailed deer on the Rocky Mountain Arsenal.

PERSONNEL: Fred Lindzey, Professor of Fish and Wildlife Biology, University of Wyoming, Laramie, Wyoming.

Don Whittaker, Graduate Student, University of Wyoming, Laramie, Wyoming.

Jon Hanna, Graduate Student, University of Wyoming, Laramie, Wyoming.

Bruce Hastings, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

A cooperative research project between the Service and the University of Wyoming on mule and white-tailed deer was initiated on January 1, 1990. The objectives of the study were 1) to obtain baseline data on seasonal habitat use and food habits for each species of deer, 2) to determine the population status and structure of each species, 3) to identify potential contamination conflicts for each species, 4) to protect and maintain, to the degree possible, important deer habitat during Arsenal cleanup, and 5) to investigate potential means of artificial population suppression as a contingency for addressing deer overpopulation.

Both white-tailed and mule deer are higher in population density within the Arsenal than in immediately surrounding areas because 1) the island of suitable habitat that the Arsenal provides in a largely urbanized/agricultural area, and 2) the prohibition of hunting on the Arsenal.

More complete statistical analyses of collected data are needed, but trends are developing which suggest that white-tailed and mule deer on the Arsenal may require species specific management strategies. Future research will focus on determining seasonal habitat preferences and inter-specific competition between the two species and what management strategies would be most beneficial for each.

Information on specific methods and preliminary findings of the Arsenal deer studies are provided in Appendix A. The Arsenal supports relatively large and healthy populations of both mule and white-tailed deer.

TITLE: Population monitoring of upland game birds on the Rocky Mountain Arsenal.

PERSONNEL: Donna Rieckmann, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Wendy Van Matre, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Dave Plumpton, Graduate Research Assistant, Texas Tech University.

INTRODUCTION

Upland birds are generally referenced as members of the family Phasianida, which are characterized as being chicken-like and non-migratory. Upland birds include partridge, grouse, turkey, pheasant, and quail. The Service also includes doves as upland birds.

The ring-necked pheasant (Phasianus colchicus) was the only upland species studied at the Arsenal, although dove and quail are known to exist, at least as migrants. Currently, pheasant populations are declining both in Colorado and nationwide. Pheasant surveys were done originally as part of the Denver Area Cooperative Bald Eagle Study, however, monitoring continued both as a graduate study and population trends after the study ended.

Objectives for the monitoring of upland birds include the following: 1) maintain, enhance, and protect the population; 2) determine habitat use seasonally; 3) access status and structure; 4) minimize loss of critical habitat; 5) monitor contaminant levels; and 6) plan for reintroduction of extirpated species.

METHODS

Pheasant road transects were conducted from 50 minutes before to 10 minutes after sunrise to coincide with highest crowing intensity. See Figure 1 for the transect route. Each survey started at different listening locations (Figure 2) to reduce bias. Every survey contained 10 stops except on 31 May when stop number 3 could not be sampled following a possible release of mustard gas near that site. Transects were discontinued after April 1990.

Auditory censuring of pheasant vocalizations associated with the breeding season were incorporated by the Service as a Crowing count following the Kimball method (Kimball 1949).

RESULTS AND DISCUSSION

Pheasant road transect were conducted 13 times from October 30, 1989 to April 10, 1990. Seventeen pheasants were observed during the count period. A summary of the survey is given on Table 1.

Pheasant studies were switched from road transects to crowing counts in April 20,1990. Vocalizing male pheasants were counted during 11 surveys from April 20, 1990 to June 05, 1990 to find the peak crowing period for RMA pheasants. Stop number 3 could not be sampled all 11 times. Counts were conducted from approximately 50 minutes before official sunrise and completed by 10 minutes after sunrise; each of the 10 listening points were visited for 2 minutes. The mean number of pheasant vocalizations was 7.2 (Tables 2 and 3).

The pheasant research project began on January 17, 1990. Five cock pheasants were captured and radio collared following intensive trapping efforts. On March 16, 1990, the project was terminated due to low pheasant densities which, coupled with uncooperative weather conditions, lead to insufficient sample size to produce statistically valid data. See Plumpton's report on the graduate study of ring-necked pheasants in Appendix A.

Pheasant populations appear to have declined sharply during 1990 prehaps due in part to low precipation.

LITERATURE CITED

Kimball, J.W. 1949. The crowing count pheasant census. J. Wildlife Management. 13:101-120.Counts started

Table 1. Pheasant Road Transect, Rocky Mountain Arsenal, 1989-1990.

Date	Rooster	Hen	Total
Oct. 30, 1989	0	0	0
Oct. 31, 1989	0	0	0
Nov. 01, 1989	2	0	2
Nov. 20, 1989	0	0	0
Dec. 04, 1989	0	0	0
Jan. 03, 1990	0	0	0
Feb. 08, 1990	0	0	0
Feb. 16, 1990	5	2	7
Feb. 28, 1990	0	1	1
Mar. 16, 1990	0	0	0
Mar. 23, 1990	1	0	1
Mar. 29, 1990	2	0	2
Apr. 10, 1990	3	1	4
Total	13	4	17
Mean	1.0	3.25	1.30

Table 2. Summary of trends in ring-necked pheasant crow counts, Rocky Mountain Arsenal, 1990.

Date	Total Calls	Total Stations	X Calls/ Station
20 April	73	10	7.3
23 April	87	10	8.7
02 May	101	10	10.1
03 May	88	10	8.8
10 May	76	10	7.6
11 May	68	10	6.8
14 May	102	10	10.2
17 May	56	10	5.6
22 May	63	10	6.3
31 May	28	9	3.1
05 June	58	10	5.8
Total	800	109	
Mean			7.2

Table 3. Summary of ring-necked pheasant crow counts by station, Rocky Mountain Arsenal, 20 April - 05 June 1990.

STOP NUMBER	REPLICATES	TOTAL CALLS	X CALLS/ STOP
1	11	108	9.82
2	11	151	13.73
3	10	245	22.40
4	11	63	5.73
5	11	71	6.45
6	11	54	4.91
7	11	0	0
8	11	0	0
9	11	50	4.55
10	11	73	6.64

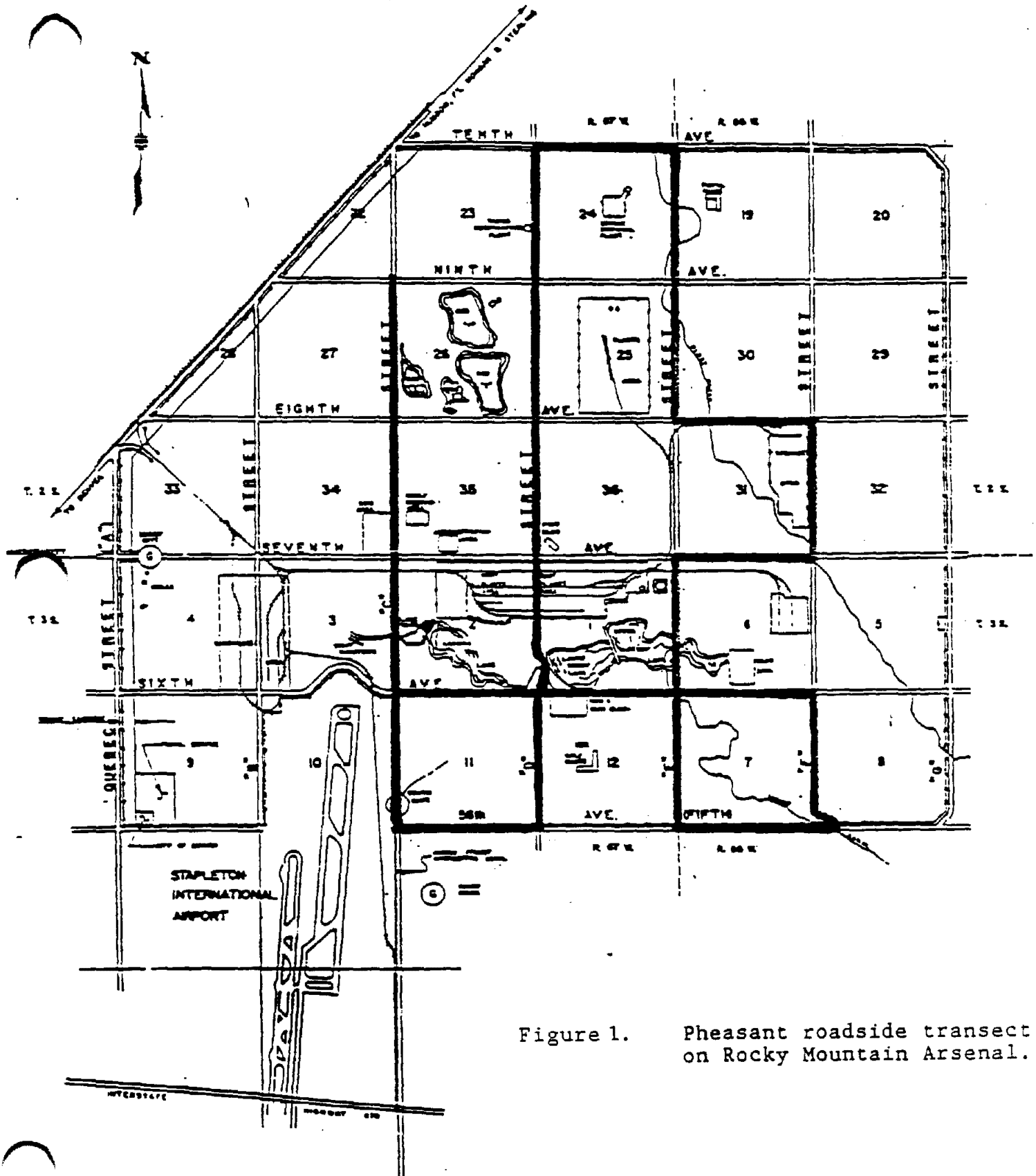
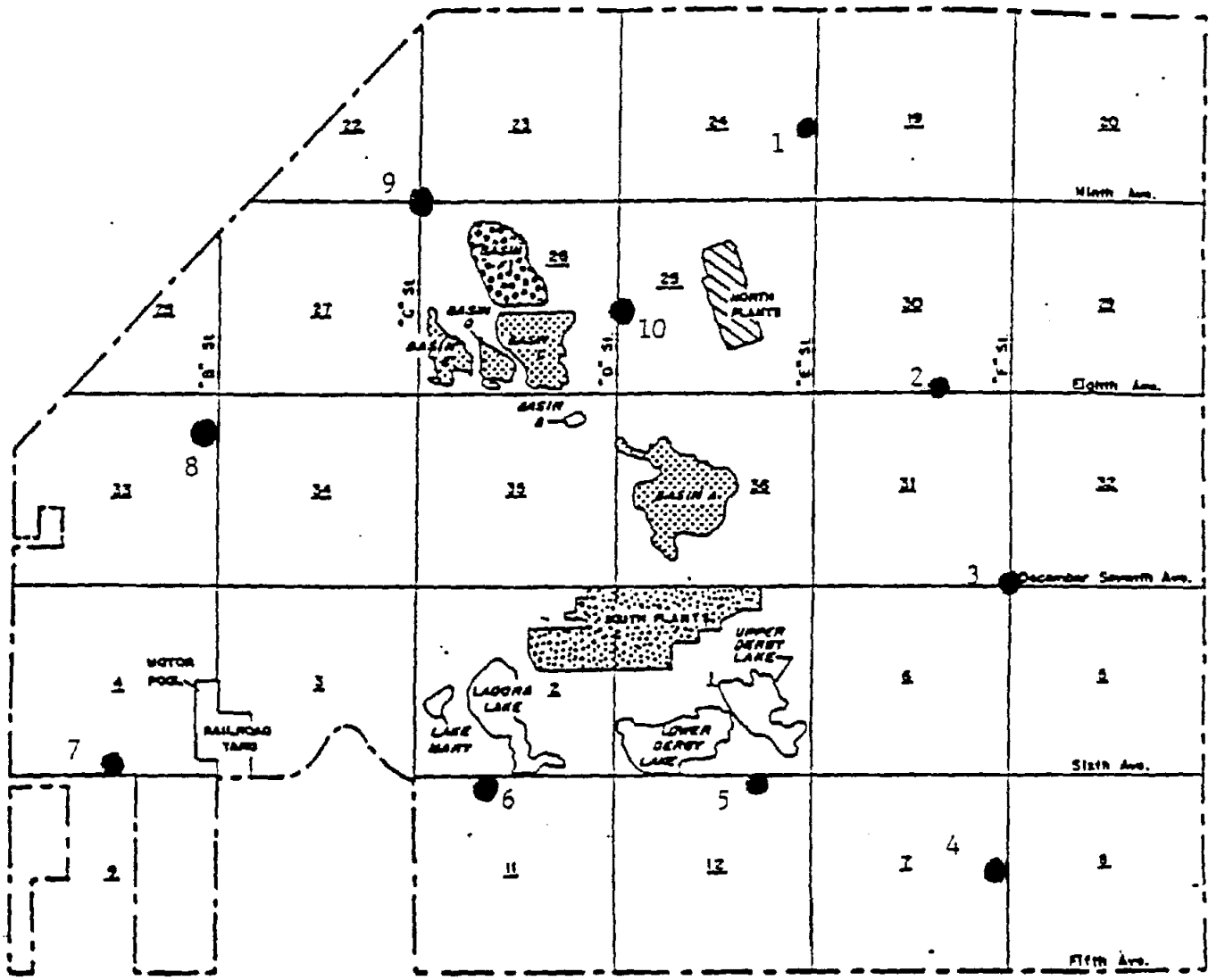
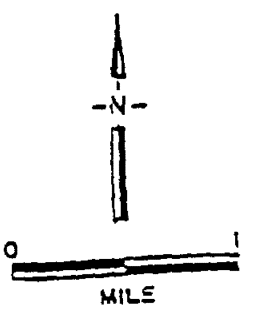


Figure 1. Pheasant roadside transect on Rocky Mountain Arsenal.



PHEASANT CROWING COUNT



TITLE: Population and habitat analysis for passerine species on the Rocky Mountain Arsenal.

PERSONNEL: Donna Rieckmann, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

INTRODUCTION

During the first half of Fiscal Year 1990, the Service had no passerine study program; consequently no information was documented other than the cooperation of the Service with Denver Field Ornithologists' (DFO) bird counts. A general survey to gather baseline enumeration of species and individuals inhabitating the trees around the Army administrative headquarters was initiated before spraying for control of tussock moths and mites. In the latter half of 1990, preliminary proposals for studies were submitted by staff and by the Denver Museum of Natural History for studies scheduled to begin Fiscal Year 1991.

In Colorado, 430 Avian species have been recorded, this includes stragglers and accidentals (Winternitz and Crumpacker 1985). The Arsenal's overall habitat diversity ranges from grassland communities interspersed with yucca, rabbit brush, sage, shrubs, wetlands, deciduous riparian woodlands and drainage areas, locust thickets and ornamental plantings. This rich habitat diversity, and the relative isolation from human disturbance on the Arsenal, results in usage by numerous species of resident and migrant passerines. However, data on population trends, species composition, or habitat affinities is incomplete.

Major management objectives for passerine include; first, implement studies that will document both species richness and diversity. Second, investigations should key diversity and richness to habitat types. And thirdly, efforts should be made to eliminate or minimize potential exposure to chemically contaminated areas for passerine species on RMA.

METHODS

Although passerine studies will not start until Fiscal Year 1991, methods for the bird survey will include the surveyor covering the study area on foot for one hour per repetition and recording all individuals seen or heard. A pair of Nikon binoculars will be used to aid in identification. Birds found dead will be recorded.

RESULTS AND DISCUSSION

The insecticides were applied June 14 and 15, 1990. Sixteen species of birds were recorded (Table 1). Number of species and number of individual birds increased following application of

pesticides. New species recorded included mourning dove, European starling, common grackle, and house finch. No avian mortality was noted.

While no mortality was observed, at least two more surveys bimonthly should have been conducted because nesting was peaking during application of the pesticides. Parental birds may have fed the poisoned insects to nestlings; the results of such feedings are unknown.

If moths are to be sprayed every year, the Service should provide Army with a plan for applying pesticides prior to the nesting season or using a biological control such as Bacillus theriengensis as a safeguard to ensure a continued diversity and density of bird species.

Table 1. Frequency of bird species observed before and after application of pesticide, Rocky Mountain Arsenal, 1990.

Before Application				After Application	
8 JUNE 1990		11 JUNE 1990		18 JUNE 1990	
Species	No.	Species	No.	Species	No.
Red-tailed Hawk	1	Mourning Dove	54	Great Blue Heron	1
Rock Dove	7	Western Kingbird	11	Mourning Dove	75
Mourning Dove	43	Black-billed Magpie	2	Common Nighthawk	1
Chimney Swift	1	American Robin	16	Western Kingbird	7
Western Kingbird	9	European Starling	7	Chimney Swift	1
Black-billed Magpie	5	Western Meadowlark	2	Black-billed Magpie	2
American Robin	19	Common Grackle	18	American Robin	29
European Starling	4	Northern Oriole	5	Brown Thrasher	1
Common Grackle	17	House Finch	21	European Starling	75
Northern Oriole	9	House Sparrow	21	Western Meadowlark	2
House Finch	31			Common Grackle	36
House Sparrow	11			Northern Oriole	4
				House Finch	43
				House Sparrow	18

TITLE: The status of reptiles and amphibians on the Rocky Mountain Arsenal.

PERSONNEL: Michelle Fink, Wildlife Technician, USFWS, Rocky Mountain Arsenal.

Bruce Hastings, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

INTRODUCTION

Records on the occurrence of reptile and amphibian species on the Arsenal were initiated in July. Objectives of Service management plans for reptiles and amphibians are to identify and maintain current population levels of amphibians and reptiles on the Arsenal.

METHODS

None.

RESULTS AND DISCUSSION

Species lists for reptiles and amphibians on the Arsenal are being maintained.

TITLE: Invertebrate communities and management on the Rocky Mountain Arsenal.

PERSONNEL: Michelle Fink, Wildlife Technician, USFWS, Rocky Mountain Arsenal.

Bruce Hastings, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

INTRODUCTION

Regular reports were begun June, 1990, in order to keep track of use and evaluation of pesticides on the Arsenal. Objectives of the Service's invertebrate management program are to maintain current population levels of both aquatic and terrestrial invertebrate communities on the Arsenal, and to evaluate potential survey or sampling programs to enumerate significant aquatic and terrestrial invertebrates.

METHODS

Fleas

All prairie dogs captured or relocated to the Arsenal as part of prairie dog population augmentation studies, were sprayed for fleas to control invertebrate plague vectors. Spraying was done individually and with hand spray pumps during initial processing of prairie dogs.

General Invertebrate Pest Control

Potential Facilities Maintenance pesticide use was evaluated on a case by case manner, with specific attention being paid to the effects on non-target lifeforms.

RESULTS AND DISCUSSION

The use of pesticides against tussock moths at Building 111 was evaluated in June and a report submitted in July, 1990. No severe negative effects were noted.

The Service is currently assisting the U.S. Army Environmental Hygiene Agency - West, Fitzsimons Army Medical Center, with development of an Arsenal pest management plan. A draft is expected to be completed by January, 1991. The Service hopes that this plan will prevent conflicts in insect control measures with wildlife management programs and goals.

TITLE: Avoidance and mitigation of actual and potential conflicts between wildlife and contaminants on the Rocky Mountain Arsenal.

PERSONNEL: Dan Matiatos, Wildlife Biologist, USFWS, Rocky Mountain Arsenal.

Greg Langer, Fishery Biologist, USFWS, Rocky Mountain Arsenal.

INTRODUCTION

U.S. Fish and Wildlife Service (Service) surveys to monitor wildlife use of areas of known or inferred contamination were implemented in May of 1990. Historically, wildlife encounters with contaminants on the Arsenal have been devastating (Environmental Science and Engineering, Inc. 1989). The surveys provide data to make effective recommendations and evaluate procedures to minimize wildlife contact with areas of possible contamination. Areas surveyed include Sections 26 and 36. Preliminary surveys revealed that a number of species (Ground squirrels, rabbits, raptors, songbirds, coyotes, deer, waterfowl, shorebirds, pheasants, etc.) were utilizing these potentially contaminated areas.

METHODS

Surveys were conducted weekly three hours after sunrise. In Section 26, wildlife observed using Ponds A and B, the liquid storage tanks area, and the Basin F waste pile were recorded. In Section 36, observations were made while slowly driving the perimeter. Wildlife observed were recorded to the nearest quarter of a Quarter section. The data were evaluated and recommendations provided to the Army.

RESULTS AND DISCUSSION

Seventeen surveys were conducted from 10 May 1990 through 10 October 1990. The results are presented in Table 1. The data were evaluated and the Service provided the Army with a number of recommendations to reduce wildlife contact with the surveyed areas. These include water level manipulations of Ponds A, B and the Emergency Spill Pond, vegetation modifications, wildlife removal, wildlife hazing devices, and wildlife barriers. Action has been taken on a number of these recommendations.

The vegetation modifications for Basin F and the hazing devices (zon guns and whistlers) around Ponds A and B have been implemented. Prairie dogs have been removed from Section 36, and the prairie dog barrier should be in place by April 1991. However, some recommendations have not been realized. Water has been allowed to accumulate in Pond B and the emergency spill pond

for moderate periods after heavy rains or snows. Trees and unnecessary power poles have not been removed from Section 26 or 36. The recommendations to reduce wildlife use of the decontamination pad in Section 36 have not been implemented.

Avian use of Ponds A and B has fluctuated by number and species. Numbers of shorebirds increased during fall migration whereas the number of ducks varied during the survey period (Table 1). The number of shorebirds increased when water levels decreased. Low water levels may allow shorebirds easier wading access to possible food items. Therefore, Pond A water levels should be maintained at the highest possible level to discourage shorebird utilization. Zon guns should be maintained and operated to discourage waterfowl use which may otherwise increase due to the high water levels.

LITERATURE CITED

Environmental Science and Engineering, Inc. 1989. Biota remedial investigation, final report. Version 3.2, Volume I. Litigation Technical Support and Services, Rocky Mounatin Arsenal, Colorado.

Table 1.0. (Continued)

Date	Liquid Storage Tanks	A Basin	Pond A	Pond B
28 June 1990		1 C-T Rabbit 1 Gadwall 3 Killdeer 25 P. Dogs NW 1/4 4 P. Dogs SE 1/4	1 Mallard 1 Pintail	1 Heron
5 July 1990		1 R-T Hawk 1 SW Hawk 30 P. Dogs NW 1/4 3 P. Dogs SE 1/4		
13 July 1990		1 UNK Hawk 30 P. Dogs NW 1/4	1 Pintail	3 Killdeer
26 July 1990		2 C-T Rabbits 33 P. Dogs NW 1/4	6 Killdeer	1 Heron
9 August 1990		1 C-T Rabbits 1 Coyote 30 p. Dogs NW 1/4 2 p. Dogs SE 1/4	65 Shorebirds	
15 August 1990		2 Mule Deer 1 SW Hawk 30 P. Dogs NW 1/4	75 Shorebirds 1 Pigeon	
30 August 1990		30 P. Dogs NW 1/4	30 Shorebirds	
6 September 1990		5 Med. Larks 1 Ground Squirrel 30 P. Dogs NW 1/4	60 Shorebirds 12 Morning Doves	

Table 1.0. Wildlife recorded during weekly surveys of sections 26 and 36.

Date	Liquid Storage Tanks	A Basin	Pond A	Pond B
10 May 1990		3 R-T Hawks 7 Mule Deer 1 C-T Rabbit 1 Kestrel 30 P. Dogs NW 1/4 5 P. Dogs SE 1/4	1 Pintail 4 Mallards	2 Mallards
17 May 1990		30 P. Dogs NW 1/4 5 P. Dogs SE 1/4 2 Killdeer		
1 June 1990		3 R-T Hawks 10 Sandpipers 28 Mule Deer 30 P. Dogs NW 1/4 5 P. Dogs SE 1/4	2 Mallards 1 Mallard	3 Mallards
8 June 1990		2 C-T Rabbits 1 R-T Hawk 1 Kestrel 30 P. Dogs NW 1/4 5 P. Dogs SE 1/4	5 Mallards	
13 June 1990		3 Gadwall 30 P. Dogs NW 1/4 3 P. Dogs SE 1/4 3 Killdeer	8 Mallards 1 Pintail	
20 June 1990		1 C-T Rabbit 1 Kestrel 1 B-W Teal 3 Killdeer 30 P. Dogs NW 1/4	2 Mallards 1 Pintail 2 Gadwalls	

Table 1.0. (Continued)

Date	Liquid Storage Tanks	A Basin	Pond A	Pond B
14 September 1990		10 Shorebirds 25 P. Dogs NW 1/4 1 Robin	50 shorebirds 10 Blackbirds	
20 September 1990		25 P. Dogs NW 1/4 3 P. Dogs SE 1/4 1 Coyote		
26 September 1990		25 P. Dogs NW 1/4 1 P. Dog SE 1/4	2 Mallards	
4 October 1990		1 R-T-Hawk		
10 October 1990	1 Ground Squirrel			

TITLE: Lake and sport fishery management in the Rocky Mountain Arsenal.

PERSONNEL: Gregory J. Langer, Fishery Biologist, USFWS, Rocky Mountain Arsenal.

INTRODUCTION

Although Arsenal Lakes are identified individually inthe U.S. Fish and Wildlife Service (Service) FY1990 Management Plan, this report will address 1990 fisheries management collectively.

The Arsenal Lakes (Ladora, Mary, and Upper and Lower Derby Lakes) successfully supported 602 angler years of fishing during 1990. Lower Derby Lake was closed for dam reconstruction leaving Lake Mary (7 acres) and Lake Ladora (78 acres) the only lakes open to fishing. It is anticipated Lower Derby Lake will be open for fishing during 1991. Fisheries management at the Arsenal has been transferred from the Fish and Wildlife Assistance Office to the Fish and Wildlife Enhancement office located on the Arsenal. Comprehensive monitoring of contaminants, fishery surveys and habitat projects were all addressed during 1990.

The objectives of the management of the four lakes are to maintain a high quality sport fishery in Lake Ladora, Lake Mary, and Lower Derby; to determine and document current fish population characteristics and establish a yearly fishery monitoring schedule the three lakes; to continue to minimize water level fluctuations which may be detrimental to the three lake's fisheries; to manage human activity to allow the most public use while minimizing wildlife and fishery habitat destruction around Lake Ladora; to functionally and aesthetically enhance Lake Mary and Lower Derby Lake areas to maximize the fishery and promote wildlife viewing opportunities; to maintain a minimum conservation pool in Upper Derby; to evaluate the fish and wildlife management potential and options to maximize fish and wildlife resources around Upper Derby Lake; and to evaluate the feasibility of establishing a self sustaining fishery to enhance other wildlife uses of Upper Derby.

General objectives for water resources on the Arsenal are 1) determine the quantity and quality of existing water resources on the Arsenal, 2) propose additional wetland development sites and protective management strategies for existing wetlands on an ongoing basis, 3) document existing fisheries populations within the Arsenal's water resources, and 4) determine sites for and construct well/guzzler locations throughout the Arsenal.

METHODS

ANGLER SURVEY

The Butler-Borgenson roving clerk creel survey method was used to estimate angler catch rates, size and species of fish caught, determine areas of use, and evaluate angler satisfaction. Additionally, an angler survey was mailed to anglers which evaluated angler type, demographics, and solicited responses to several proposed methods of future Arsenal fishery management.

FISH POPULATION ASSESSMENT

Experimental mesh, monofilament and multifiliment gillnets were set in standardized locations. Night electrofishing was conducted using a boat mounted Coffelt Mark X electrofisher and 5,000 watt generator. Hook and line, gillnets and trapnets were employed to collect fish species for the Comprehensive Monitoring Program conducted by EBASCO, Inc.

To gain data on the total number of Pike in Ladora and the number of times per year each Pike is caught, Pike were caught in trapnets (fyke) and tagged with white "cinch-up" tags. Tags were individually numbered and labelled "Please Release". Pike mouth condition was evaluated prior to the 1990 fishing season on a scale of 0 to 3 (0 = no hook marks, 1 = 1 hook mark, 2 = multiple hook marks, 3 = torn mouth parts and/or secondary infection).

VEGETATION ASSESSMENT

Standardized transects were run using a boat mounted Lowrance X-15 chart recorder to monitor Lake Ladora vegetation levels. Vegetation transects had been previously run in November by Rosenlund from 1979 through 1985.

RESULTS AND DISCUSSION

MANAGEMENT OBJECTIVES

The management objective for the Arsenal is to support approximately 650 angler years, and catch rates between 0.5 and 1.0 fish caught per hour, maintained through a naturally reproducing warmwater fishery.

PERMITS

During 1990, 602 Arsenal angler permits were issued (501 public permits, 34 Senior Citizen and Handicap permits, and 67 military personnel permits sold for $15.00, $2.00, and $5.00 respectively). Permit numbers sold were similar to the previous

three years. Permit issuing methods were modified during 1990. Anglers were issued permit application materials and given a time to return them and pick up an angler permit. This system avoids long lines waiting outside the Arsenal West Gate, and will be used during 1991 permit sales.

Nineteen Visitor Anglers were allowed entry during 1990. Visitors were allowed only one day of fishing, and must be accompanied by a permitted angler.

ANGLER USE

During 1990, 602 anglers fished an average of 2.75 hours per day for an average of 12.25 days and expended a total of 20,280 angler hours. Twenty-seven percent (5476) hours were spent on Lake Mary, while 73% (14,804) angler hours were spent on Lake Ladora.

ANGLER SUCCESS

Arsenal anglers caught an average of 0.67 warmwater fish species from Lake Ladora that averaged 11.2 inches in length. Bass represented 40% of the fish caught, with 28% of the bass exceeding 15 inches in length. Northern Pike represented 12% of the catch and Bluegill represented 41% of the catch (Table 6).

Lake Mary anglers caught an average of 2.037 fish per hour which averaged 7.2 inches in length. Bluegills represented 73% of the catch and Bass were 20% of the catch (Table 7).

ANGLER SATISFACTION AND EXPERIENCE

Angler satisfaction surveys found that 58% of the Arsenal anglers were satisfied with the number of fish caught, 59% were satisfied with the length of fish caught and 94% were satisfied with the overall Arsenal warmwater fishing program. The average Arsenal angler ranked themselves as the most experienced angler using a military fishery within Colorado, with an average angler expertise of 2.49 (1.0 = inexperienced, 2.0 = experienced, 3.0 = expert). This attribute probably stems from the rareness of warmwater catch and release fishermen in the state of Colorado.

STATUS OF RMA FISH POPULATIONS

Due to the presence of contaminants in Arsenal fish populations, all consumptive harvest of Arsenal fish ended by the late 1970's. The management of the Arsenal as a quality urban catch-and-release fisheries has resulted in waters that are dominated larger than average predator fish species.

Electrofishing population assessment was attempted in 1990. Equipment was purchased, and standardized Lake stations were established. However, due to equipment problems, limited electrofishing data was collected. Electrofishing should offer a non-lethal means of fish population structure in the future.

Gillnet population assessment was used to compare 1990 trends to previous years at standard gillnet sampling sites. Sites established in 1977 through 1985 were repeated in 1990. Results appear in Tables 1-5. In order to minimize fish mortality, gillnet sets were shortened from overnight to 3 hour sets.

LADORA

In 1970, Ladora was dominated by small bass and bluegills, with black bullhead numbers expanding during the 1970's. To control bullheads and introduce increase sport fishing opportunities, pike were introduced by the early 1970's. Under catch-and-release regulations, the populations of pike and bass in Ladora expanded and reached their maximum average size in 1982. After 1982, the number of forage fish species declined, and the average size of bass and pike declined from 2 to 11 percent. Although the average length of bass and pike (as measured by standard gill net sets), has declined, large bass and pike have dominated the fisheries since 1982, and supported the majority of the quality fish caught at the Arsenal.

YEAR	PIKE		BASS		BULLHEADS	
	Ave Ln	Kg/net H	Ave Ln	Kg/Net H	Ave Ln	Kg/Net H
1979	615	0.29	323	0.11	260	0.800
1982	793	1.77	383	0.20	273	0.31
1985	754	0.42	284	0.10	283	0.25
1990	705	1.60	361	0.54	144	<.01

Future. Continue to monitor the fish population of Ladora in relation to angler use. Total angler use could be increased, but future increases in angler use should not be expanded to where

angler use results in a decline in the current bass and pike population.

LOWER DERBY

Carp dominated Lower Derby in 1979, but aquatic vegetation was common and the water clear most of the year. Catch-and-release regulations (and the introduction of pike), resulted in an expansion of pike and a reduction of carp, by 1982.

YEAR	PIKE		BASS		CARP	
	Ave Ln	Kg/Net H	Ave Ln	Kg/Net H	Ave Ln	Kg/Net H
1979	541	0.35	347	0.27	459	2.45
1982	568	1.35	401	0.05	513	0.93
1985	703	0.97	399	0.09	378	0.66
1990	691	3.60	0	0	497	7.33

However, in 1982, the water level of Lower Derby was reduced to a minimum pool to allow repairs to the dam. Reducing the water level of Lower Derby to minimum pool reduced the rooted aquatic plant population, and combined with the presence of carp, has resulted in the reservoir being turbid since 1982. The water level of Lower Derby was severely reduced again in 1990, and resulted in additional impacts to the vegetation and fish populations.

Future. Continue to monitor the fish population of Lower Derby in relation to angler use. However, high turbidity currently limits this fisheries more than angler use. It is recommended that hay be added to Lower Derby to help reduce turbidity and allow for increased productivity. Islands of Christmas trees (if available) should be added to Lower Derby to provide cover for forage fish species. Arsenal fish permit sales could be considered if improvements in Lower Derby habitat results in increased populations of pike and bass.

LAKE MARY

Lake Mary was dredged in 1975, and the lake stocked with trout to provide a catch-and-kill fisheries. Unfortunately, trout were found to readily absorb high levels of dieldrin. The stocking of catchable trout was deleted by the direction of the Service Regional Director in 1977. Following the end of the trout stocking program, anglers introduced bass into this water. Due to a limited number of forage fish species, bass grew slowly from 1979 to 1985, and have remained relatively small (for Arsenal standards) through 1990.

YEAR	TROUT		BASS		BLUEGILLS	
	Ave Ln	Kg/Net H	Ave Ln	Kg/Net H	Ave Ln	Kg/Net H
1979	279	0.22	170	0.02	0	0
1982	0	0	219	0.13	0	0
1985	0	0	268	0.14	178	0.04
1990	0	0	321	0.07	115	0.03

Future. Lake Mary has not supported a quality sized fish population since the area was renovated in the 1970's. However, the area does support a large number of fish, that supports a high angler catchrate. It is proposed that Lake Mary be featured as the high angler use lake. Catachable trout and surplus broodstock will be stocked into Lake Mary in 1991. The objective of this stocking will be to provide an average catchrate of 1.0 fish per hour for an unlimited number of catch-and-release anglers.

NORTHERN PIKE TAGGING RESULTS

During 1990, about 150 Northern pike >400mm were tagged from 3/13/90 and to 3/31/90 in Lake Ladora. From 3/20 to 3/31 18% of the pike captured were recaptured. If 18% of the pike population was tagged, the total pike population is 833 pike >400mm in length. Average length of pike tagged was 593 mm. Although all anglers did not report the percent of tagged pike caught, reliable anglers reported from 25% to 50% of pike caught from Ladora were tagged. Therefore, it is estimated that between 18% and 50% of the pike in Lake Ladora are tagged. If 50% of the population was tagged, the total pike population is 500 pike >400mm in length. Accordingly, 20,280 angler hours x 0.08 caught per hour = 1622 pike caught per year. Pike are caught on average between (1633 ÷ 500 =) 3.244 and (1622 ÷ 833 =) 1.95 times per season.

The average Arsenal pike weighed 1250 g (2.75 lbs.) If 500 to 833 pike exist in Lake Ladora, total pounds of pike per surface acre range from 18 to 29 pounds and numbers between 6.4 to 10.7 pike per surface acre.

MOUTH CONDITION

The mouth condition of 141 Northern pike was evaluated. Eighty-eight percent (124) of the pike showed no visible impacts from the previous years fishing. It appears that hooking wounds are not severe and that pike are not hooked many times during a season and/or recovery from hooking wounds readily.

LARGEMOUTH BASS

During 1990, Arsenal anglers caught an average of 0.27 bass per hour. If Arsenal anglers expended 20,280 hours, and caught bass at a rate of 0.27 bass per hour, a total of 5,476 bass were "recycled" by anglers during the 1990 fishing year.

Although bass abundance was not estimated, an average Colorado lake carrying capacity might be 60 pounds of bass per acre. If bass average 1.5 pounds per fish, bass abundance might be 40 per acre or (78 acres x 40 per acre =) 3,120 total bass. Largemouth bass may have been caught an average of (5,476 ÷ 3,120 =) 1.75 times during the 1990 fishing season.

Future. Estimates of bass abundance will increase confidence in these estimates.

FISHERIES GRADUATE RESEARCH PROJECT

The Structural Diversity indicies Graduate Research project is ongoing. Field work will begin in Spring of 1991.

HABITAT

Lower Derby dam underwent reconstruction during 1990. Tree root systems throughout the dam caused it not to meet State Engineer standards. The newly reconstructed dam face is protected by rubble (8" - 12") and may offer a significant amount of habitat to a lake in which habitat is minimal.

Vegetation transects conducted on Lake Ladora during 1990 season showed a reduction in overall vegetation quantity from 1985. The high water levels in Lake Ladora (resulting from Lower Derby dam construction) may have influenced vegetation levels. Necessity of vegetation control was evaluated during 1990. Anglers surveyed reported mixed results, some anglers desire high density vegetation because it concentrates fish, and "reduces the number of fishermen on the lake". However, other anglers dislike dense

vegetation because of the difficulties encountered attempting to cast and retrieve lures.

FISHING DOCKS

Fishing docks were installed on Lake Mary and Lake Ladora. These docks are multiple purpose; aquatic resources education and to assist handicap fishermen access. The docks will be incorporated into the Lakes trail system and informational signs added.

COMPREHENSIVE MONITORING PROGRAM

During September of 1990, the Comprehensive Monitoring Program sampled Lakes Mary, Ladora, Lower Derby and Upper Derby. Fish, invertebrates and plankton were collected and analyzed for contamination by EBASCO, Inc.

WATER MANAGEMENT

Efforts were made during 1990 to minimize water level fluctuations typical of the Arsenal lakes. The importance of maintaining water levels was stressed to the Arsenal Facilities Maintenance Division and water levels remained fairly steady.

GENERAL WATER RESOURCES MANAGEMENT

The toxic storage yard pond in Section 31 and the Rod and Gun Club ponds in Section 12 the Arsenal were sampled in July 1990. Five guzzler sites have been selected and constructed.
The pond sampling yielded one 15" black bullhead salmon from the toxic storage yard tank; and no fish from the Rod and Gun Club pond, despite stocking in the 1970's. Consideration will be given to stocking a more surface oriented species in the storage yard pond.

ACKNOWLEDGEMENTS

The following individuals contributed greatly to the 1990 fisheries management program:

Bruce Rosenlund
Darryl Jennings
Peter Pouwels

COMMUNITY RELATIONS

This part of the report includes the Community Relations activities for Fiscal Year 1990. These activities include public use (public wildlife tours and Eagle Watch), environmental education, off-post exhibits and presentations, and volunteer activities. For information on the Arsenal's Ad Hoc and Natural Resource Conservation Committee meetings, see Public/Agency Participation, page A-1.

General

The Community Relations Section became a reality at the Rocky Mountain Arsenal when a USFWS Community Relations Coordinator was hired 30 October 1989. Prior to that time all public use programming (i.e. tours and presentations) was intermittent. Additional Community Relations personnel were hired 29 January, 12 March and 16 July, 1990. An intensive public use program was initiated beginning in March 1990. This effort included USFWS volunteer, conservation education and community outreach programs. Wildlife tours, presentations, exhibits, media releases, school presentations, and a wildlife viewing blind, visitor center, school packets, wildlife brochure and wildlife calendars were planned and completed during FY90.

Outdoor Classrooms - Students

The Community Relations section initiated an environmental education program in January 1990. This program involved developing extensive teacher contacts and planning educational programming. During FY90 approximately 55 wildlife tours were given to over 3,300 students. Approximately 73% of tours given during the school year (October - May) were given to students.

On 16 May the Community Relations section sponsored a **Take Pride in America** tree planting on the Arsenal. Over 200 6th graders from Kearney Middle School in Commerce City planted over 100 American plum shrubs. For their efforts the school was presented with a **Take Pride in America** Certificate of Appreciation.

Outdoor Classrooms - Teachers

In March 1990 the first of several teacher in-service programs was offered at the Rocky Mountain Arsenal by Service staff. Twenty-three teachers attended the in-service training which focused on using the Arsenal as an educational resource. In April over 48 environmental education packets were mailed to teachers to help them prepare their classes for field trips to the Arsenal. All available slots for school tours were filled through the first week of June.

The Arsenal Education Specialist worked closely with an Intern to develop a teacher packet for middle school teachers who plan to visit the Arsenal. She also developed a proposal for a secondary school teachers packet and prepared learning objectives for the U.S. Fish and Wildlife Service Rocky Mountain Arsenal environmental education program. Other projects included working with the U.S. Army in developing additional teacher material.

Interpretive Foot Trails

At present no interpretive foot trails have been constructed at the Rocky Mountain Arsenal. However, some effort has gone into the planning and design of interpretive trails near the Visitor Center and around the Arsenal lakes. These trails are scheduled for completion October 1991.

During April 1990 the second Arsenal Open House was held. Guided nature walks were offered for the first time. Seven walks were conducted and over 85 visitors participated on these walks.

Interpretive Tour Routes

Between 1 October 1989 and 30 September 1990, 238 wildlife tours were offered to a total of 9782 people. These tours were offered to school groups (4th grade through 12th grade), special groups (garden clubs, businesses and civic groups), and the general public. Tours were conducted so that the public would have the opportunity to view the abundant wildlife and view the on-going environmental clean-up at the Arsenal.

Interpretive Exhibits/Demonstrations

In December 1989 the Arsenal Visitor Center was renovated. Exhibits were installed in January 1990. Because the Visitor Center is located within a secured area access to the Center is limited. Therefore, only people on the tours visited the Center. Approximately 4500 people visited the Center in FY90. Numerous meetings were held at the Visitor Center during FY90 with several hundred people participating. The National Wildlife Federation held their annual March board meeting at the Arsenal Visitor Center in 1990.

Two open houses were held at the Arsenal Visitor Center during FY90. These open houses were on 3 February and 28 April. Attendance at these open houses was 1800 and 350, respectively. During these open houses the Service provided guided nature walks, wildlife bus tours, slide programs, video tapes, bald eagle, and telemetry demonstrations. Wildlife calendars and other Arsenal information brochures were distributed during these events.

A special Earth Day event was held at the Visitor Center during April. This event was held for all on-post employees (USFWS, U.S. Army and contractors). Activities included a tree and shrub planting, Earth Day games, fishing contest, exhibits and food.

The U.S. Fish and Wildlife participated in many off-post programs and events by providing interpretive exhibits. These off-post exhibits included a poster session on the Arsenal Bald Eagle study at the North American Wildlife and Natural Resources Conference, a booth and exhibit at the Northglenn Mall, an exhibit at the Denver Post Teacher's Fair, Watchable Wildlife Conference, and Superfund Conference in Washington D.C. Several other exhibits were jointly staffed by the Service and Army personnel.

Other Interpretive Programs

During FY90 a total of 20 off-post interpretive presentations were conducted by the Community Relation staff. These programs reached over 1352 people. Programs were given to school classes and special interest groups. These programs were presented so that the public could learn more about the Arsenal wildlife and clean-up activities.

During FY90 Service personnel worked cooperatively with several groups to produce two Arsenal wildlife calendars. The Service worked jointly with the U.S. Army, the National Fish and Wildlife Foundation and photographers Wendy Shattil and Bob Rozinsky to produce the 1990 calendar. Over the summer of 1990 Service personnel also worked in conjunction with Denver Audubon, Shell Chemical Company, U.S. Army, the National Fish and Wildlife Foundation, and photographers Shattil and Rozinsky to produce the 1991 calendar. These calendars were distributed to the general public.

An Arsenal wildlife brochure was developed by Service personnel during FY90. This brochure covered many of the species of wildlife often seen at the Arsenal.

Fishing

During FY90 a total of 501 fishing permits were issued to the general public at a cost of $15.00 each. Additionally, 101 special licenses (military, Arsenal employees, and handicap) were issued. It is estimated that a total of 20,280 angler hours were recorded on the Arsenal lakes.

Wildlife Observation

On 16 December 1989 the Eagle Watch Observation blind opened for the first time to the general public. This blind overlooks a bald eagle winter communal roost site. The Eagle Watch was

opened from 2:30 pm until dark every day from 16 December until 17 March 1990. During FY90 over 2200 visits were recorded at the Eagle Watch blind.

Other Wildlife Oriented Recreation

Primary wildlife viewing activities at the Arsenal include wildlife bus tours and the Eagle Watch observation blind. However, there are several coordinated wildlife activities which are sponsored by the Community Relations section. The Community Relations sections work closely with several organizations (Denver Field Ornithologists and Denver Audubon) to conduct quarterly bird counts at the Arsenal. Other interpretive tours were also provided for special groups such as photo clubs, botany classes and wetlands specialists.

Other Non-Wildlife Oriented Recreation

Historically field dog trials (primarily pointing dogs) have been held on Arsenal grounds. These trials were conducted in a similar manner as in the past. Trials were held each weekend in March, April and May, and then again in September. Trials were attended by local clubs as well as many people from around the west. Sponsoring clubs included German Short Haired Pointers, Mile High Weimeraners, Irish Setter club, Gordon Setter Club and Brittany clubs. Exact figures for attendance is not available but based on trials held during the fall of FY91 trials averaged 80 participants, and 150 dog entries.

Cooperating Associations

During FY90 the Community Relations worked cooperatively with several State, Federal and private organizations. These include the Colorado Division of Wildlife, the U.S. Army, the Denver Museum of Natural History, Denver Audubon Society, Shell Chemical Company, Colorado Wildlife Federation and Colorado Parks and Outdoor Recreation. The Service has been and continues to work closely with these groups to facilitate a smooth working relationship and to further efforts in environmental education and awareness.

Special cooperative agreements were signed with Colorado State University (CSU) and the Colorado Division of Wildlife (CDOW). The agreement with CSU is to evaluate wildlife oriented recreation potential on the Arsenal. The CDOW agreement is for analyzing the watchable wildlife opportunities and interpretation at the Arsenal.

During FY90 the following groups passed resolutions in support of maintaining the Arsenal as wildlife habitat and open space: National Wildlife Federation, Colorado Wildlife Society and Colorado Wildlife Federation.

Volunteer

The Service's Rocky Mountain Arsenal volunteer program began in October 1989 when members of the Denver Audubon Society first assisted in providing wildlife tours to the general public. In January 1990 the Service trained volunteers that the Denver Audubon Society, Colorado Wildlife Federation, and Denver Museum of Natural History had recruited through newsletters to assist at the Arsenal's Eagle Watch. Volunteers conducted daily eagle and visitor counts and answered questions about the eagles and the Arsenal.

Volunteers initially staffed the Eagle Watch and then later began conducting wildlife tours and presentations. Volunteers provided the following hours of service at the Arsenal during FY90:

January	- 72
February	- 134
March	- 67
April	- 230
May	- 83
June	- 37
July	- 42
August	- 51
Sept.	- 115
Total	- 834 Hours of service

Additionally, the Volunteer coordinator provided monthly training for all active volunteers. The following is the training provided the volunteers:

-Eagle Watch training for volunteers.
-Tour training for volunteers.
-Deer populations and studies at the Arsenal.
-Arsenal clean-up program.
-Arsenal Fisheries program.
-Burrowing owl program.
-Safety orientation for volunteers.

In July 1990 a monthly volunteer bulletin was started to keep volunteers informed of Arsenal news and up coming volunteer activities.

A special recognition ceremony was held on 28 April 1990 to recognize those individuals who assisted with the Eagle Watch activities during its first season of operation. Each volunteer was given a special eagle pin and a certificate of appreciation signed by the Regional Director.

Volunteer recruitment is conducted in a variety of ways. Primary recruitment occurs through Conservation organization newsletters

such as the Denver Audubon Society and Colorado Wildlife Federation and through community newspapers.

During FY90 the volunteer coordinator assisted Denver Audubon Society members in preparing a Challenge Grant proposal for $6300 to be submitted to the National Fish and Wildlife Foundation. The Denver Audubon Society was awarded the grant and funds are scheduled to be used to purchase binoculars, spotting scopes, reference guides and a microcomputer for the volunteers to use while working on the Arsenal.

Also during FY90 the Volunteer Coordinator, along with several of the Arsenal volunteers, were video taped by a representative of the USFWS from the volunteer office for the National volunteer program.

Media Relations

Media relations were developed during FY90. A number of television stories were produced concerning the Arsenal and its activities. The National Geographic Society produced a segment which aired on the Turner Broadcasting Network, the program 48 Hours produced a story, as well as CNN. Several special local programs were produced concerning the Arsenal. These included the program Colorado Getaways, and a video produced by the League of Women Voters.Many local television stations also produced shorter Arsenal related segments. A number of national newspapers and magazines also wrote articles concerning the Arsenal. These included the New York Times, National Wildlife, and Buzzworm.

COMMUNICATION SYSTEMS

The Clerical Section was formed July 1990 when two additional clerk-typists were hired, bringing the clerical support staff to three. The Clerical Section answers all incoming calls, including calls arranging for tours, and is responsible for the check-out of field radios.

The following radios and related equipment were purchased in July, 1990:

QT	Equipment	Price
20	LPV 4141A-02 Portable Radios with ACC	$11592.00
12	Radio Batteries	$415.80
20	LAA325 1hr Desk Top Chargers	$882.00
02	LAA380 5 capacity 1hr chargers	$497.70
20	LAA0200 Microphones	$756.00
10	LAA0220 Earphones	$ 94.50
20	LAB436 Carry Cases	$585.80
20	LAA0411 Full Radio Covers	$100.80
20	LAA701 Program Plugs	$252.00
	Total	$15176.60

Four Motorola portable radios were transferred to the RMA Field Office from the Colorado Field Office in July, 1990. The LPV radios purchased were found to be inefficient for field use on the Arsenal. A base station will be purchased in FY91 in order to increase the power of the field radios.

All telephones used by the Service on the Arsenal are the property of the U.S. Army.

COMPUTER SYSTEMS

Computers are used for virtually all memo and report writing, as well as for storage and analysis of project data by all staff. Standard computer training to all employees includes WordPerfect 5.1, DOS, and dBASE IV training. Special training, such as for GIS, is arranged for specific employees on a need basis.

The following computers and related equipment were purchased in FY90:

QT	Equipment	Price
1	Compaq LTE286 Laptop Computer	$3549.00
1	Compaq Model 40 Laptop Computer	$4478.00
2	Easy Data ED216HI Computers	$3472.00
1	Dauphin Lappro 386SX Laptop Comp.	$3280.00
1	Compuadd Computer	$3144.99

2	Dell Computers	$11677.00
2	Epson LQ1050 Printers	$1440.00
1	Hewlett Packard Series II Printer	$2043.00
2	Fujitsu DL4400 Printers	$1496.00
1	Hewlett Packard Laserjet II	$1821.00
1	Buffalo Peripheral Device, Buffer Switch	$ 520.00
2	Auto Switches	$ 136.00
	Total	$37056.99

This list does not include the software purchased with each computer system. Computer systems and software are upgraded annually.

LIST OF APPENDICES

APPENDIX A

ROCKY MOUNTAIN ARSENAL DEER PROJECT

PART I

By

Jonathan D. Hanna

and

Frederick G. Lindzey

FY 1990 Progress Report

ROCKY MOUNTAIN ARSENAL DEER PROJECT

PROGRESS REPORT

PART I

1 January 1990 to 1 May 1990

Prepared by:

Jonathan D. Hanna

and

Frederick G. Lindzey

Wyoming Cooperative Fishery and Wildlife Research Unit

University of Wyoming

Larimie, Wyoming 82071

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Abstract: Initial work was begun on the Rocky Mountain Arsenal in December 1989 to document characteristics of the mule deer (Odocoileus hemionus) and white-tailed deer (virginianus) populations prior to completion of the perimeter fence. Maximum number of mule and white-tailed deer counted (minimum population estimates) was 230 and 70 respectively. Proportion of bucks in both populations was high, apparently reflecting their non-hunted status. Proportion of fawns in both populations entering the winter was moderate to low with white-tailed deer consistently evidencing lower fawn:doe ratios than mule deer. Mule deer tended to occupy most of the Arsenal while white-tailed deer appeared restricted to the southeast quadrant and the riparian communities associated with First Creek. Winter and spring efforts were designed primarily to document composition, size, and dispersion by the two species on the Arsenal. We expected resultant data to be the best representation available of characteristics of the two populations before the fence enclosed them. These data will also characterize the two populations and provide the basis for identifying changes that occur after the fence is complete.

ACKNOWLEDGMENTS

A special thanks to those individuals assisting in trapping operations.

Angela Brummond, Marcie DeBock, Sheila Dufford, Russ Hardesty, Bruce Hastings, Frank Hein, Grag Huges, Lisa Langelier, Greg Langer, Vic Langer, Chris Lehnertz, Fred Lindzey, Dan Matiatos, Greg McDanials, Dave Plumpton, Annette Ursini, Donna Rieckmann, Bob Rozinski, Wendy Shattil, Mark Sjobakken, Liz Stoller, Wendy Wan Matre, Don Whittaker.

INTRODUCTION

The Rocky Mountain Arsenal (RMA) mule deer/white-tailed deer study is a U. S. Fish and Wildlife Service (U.S.F.W.S.) project conducted in cooperation with the Wyoming Cooperative Fishery and Wildlife Research Unit at the University of Wyoming. Prior to this project limited information was available on the status of deer at the RMA. Current clean-up operations at the RMA and the construction of an eight foot chain link fence along the RMA perimeter will likely influence RMA deer populations. The purpose of this phase of the project is to provide baseline information on the dispersion, composition, habitat use, and interactions of the two deer species. This documentation will assist U.S.F.W.S. in management decisions to prevent or mitigate

possible impacts that could be detrimental to the RMA deer population and in future management of these two species.

OBJECTIVES

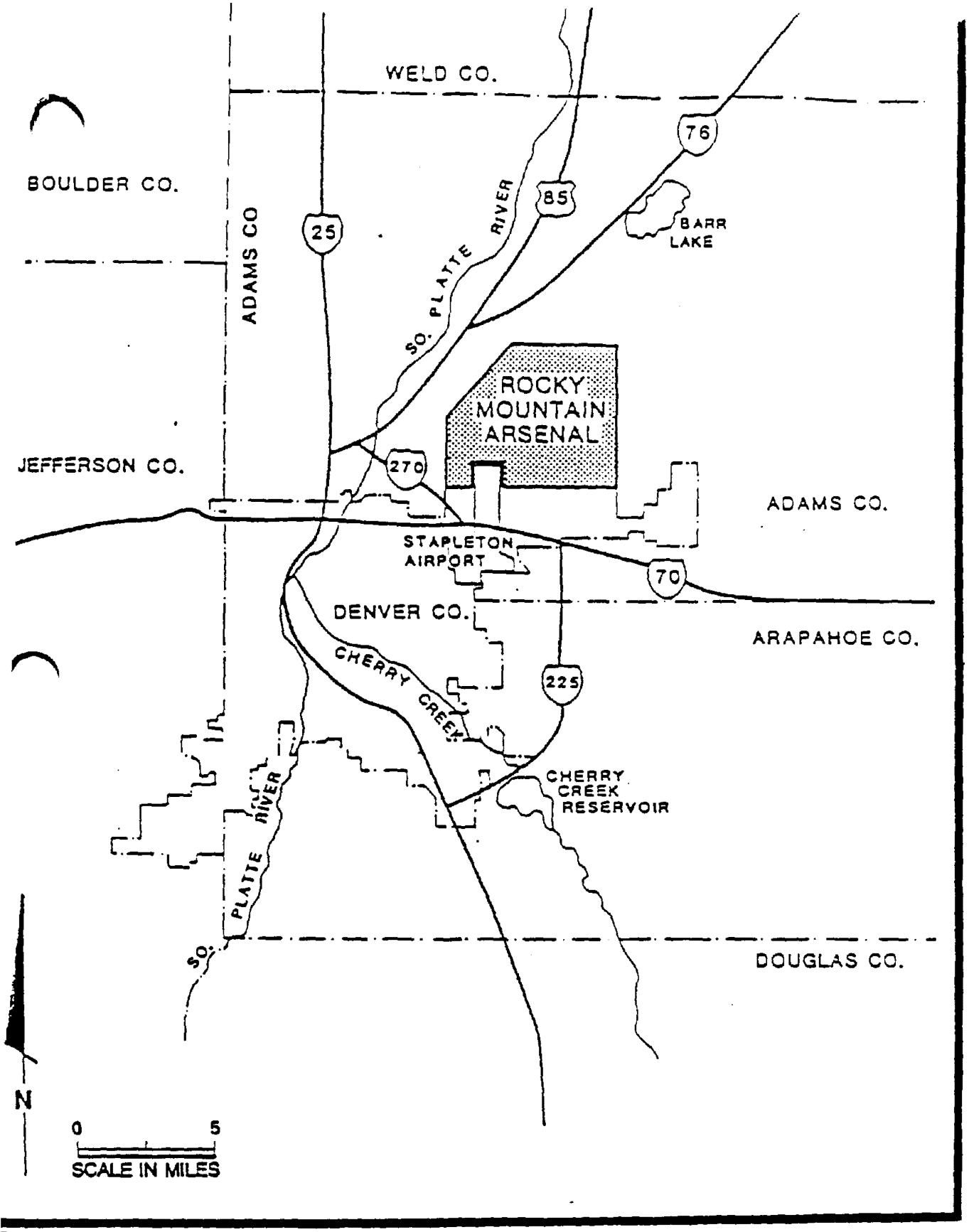
1) Map distribution of mule and white-tailed deer on the RMA.

2) Determine monthly composition of mule and white-tailed deer on RMA.

3) Document movement and activity patterns of mule deer and white-tailed deer on the RMA.

STUDY AREA

The RMA is located in Adams County, Colorado, 10 miles northeast of downtown Denver with Stapleton International Airport adjacent to its southwest border (Figure 1). The RMA occupies approximately 43 km^2 (27 mi^2) mainly consisting of open plains habitat but interspersed with lakes, ponds, riparian areas and woodlands. Elevation ranges from 1545 m. (5150 ft.) to 1597 m. (5323 ft.). Surrounding areas are intensively farmed and/or developed for housing or industry.



Harding Lawson Associates
Engineers and Geoscientists

Figure 1. Location of Rocky Mountain Arsenal.

METHODS

Trapping and Marking

Trapping sites were selected to representatively sample the mule deer and white-tailed deer populations (Figure 2). Legal descriptions of trap sites are in Appendix A. Sites were identified during initial composition surveys. Deer were trapped using clover traps (Clover 1956). Areas to be trapped were pre-baited with third-cutting alfalfa. Traps were then set in areas where deer were feeding on the alfalfa. Apple mash and salt blocks were later used for bait. Traps were checked, reset if needed, and rebaited each morning and late afternoon. Captured deer were restrained by one person while a second person blindfolded and processed the deer. Physical condition of each deer was subjectively evaluated and age determined from tooth wear and replacement. Morphometric measurements were recorded (e.g. ear, tail, and metatarsal length). Color patterns which have been identified as characteristic of mule deer/white-tailed deer hybrids (Oceanak 1977) were noted. All deer were tagged with a standard Colorado Fish and Game metal eartag in both ears. Female deer, 2 1/2 years of age or older, were instrumented with radio-transmitter-collars (Telonics, Mesa, Arizona).

A Coda-Netgun (Coda Enterprises, Mesa, Arizona) and Cap-Chur gun (Palmer Chemical & Equipment Co., Douglasville, Georgia) were also used to capture deer. Mule deer were approached by vehicle to within 9 m. (10 yds.) for effective range of the Coda-

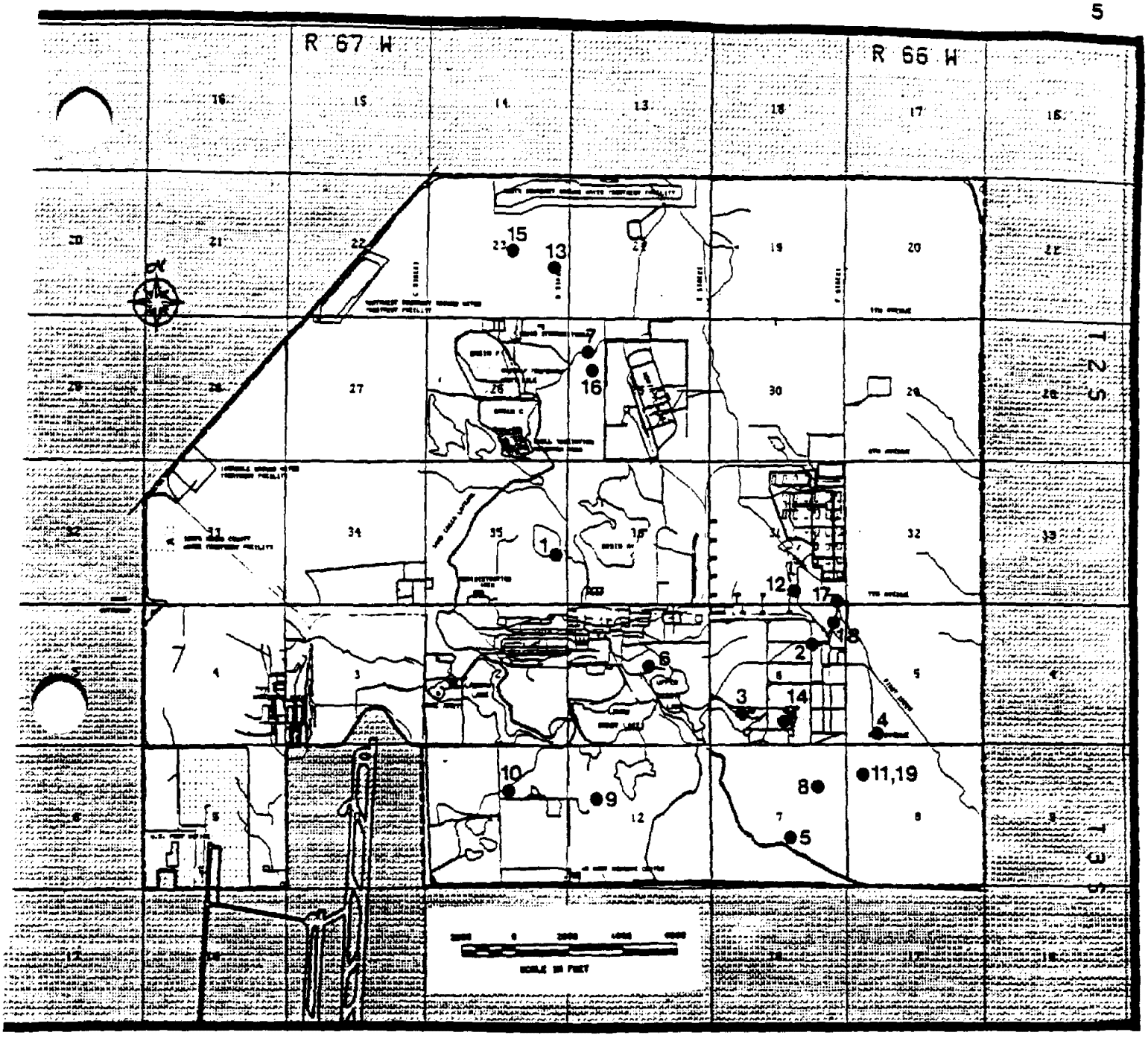


Figure 2. Deer trap site locations during the 1990 trapping period at the Rocky Mountain Arsenal. Trap sites are numbered.

Netgun and within 23 m. (25 yds.) for the Cap-Chur gun. A 12 foot square net with seven inch mesh was used with the Coda-Netgun. Three cc syringes containing 6.0 mg - 7.4 mg of succinylcholine chloride (Surcostrin) were used with the Cap-Chur gun.

Composition survey

Because of the extensive primary and secondary road system on the RMA a vehicle can be used to adequately cover the entire RMA during the ground composition surveys. An aerial photo was used to map the survey route as it was driven. Deer numbers and locations were plotted on an aerial photo. Composition of observed deer groups was recorded on a separate sheet. Time, miles driven, and weather conditions were recorded for each composition survey. An entire mi^2 (section) was covered before moving into the next section. Transects started in the southwest corner of the RMA and progressed section by section in a west to east, east to west direction until the entire arsenal was covered.

Aerial surveys were flown in a Bell Jet Ranger III helicopter (Orion Helicopters, Fort Collins, CO). One quarter mile transects were flown, starting at the southeast corner of the RMA and progressing in an east to west then west to east direction until the entire RMA was covered (Figure 3). Deer groups were circled until counted before continuing the transect. Major drainages adjacent to the RMA were also flown to document

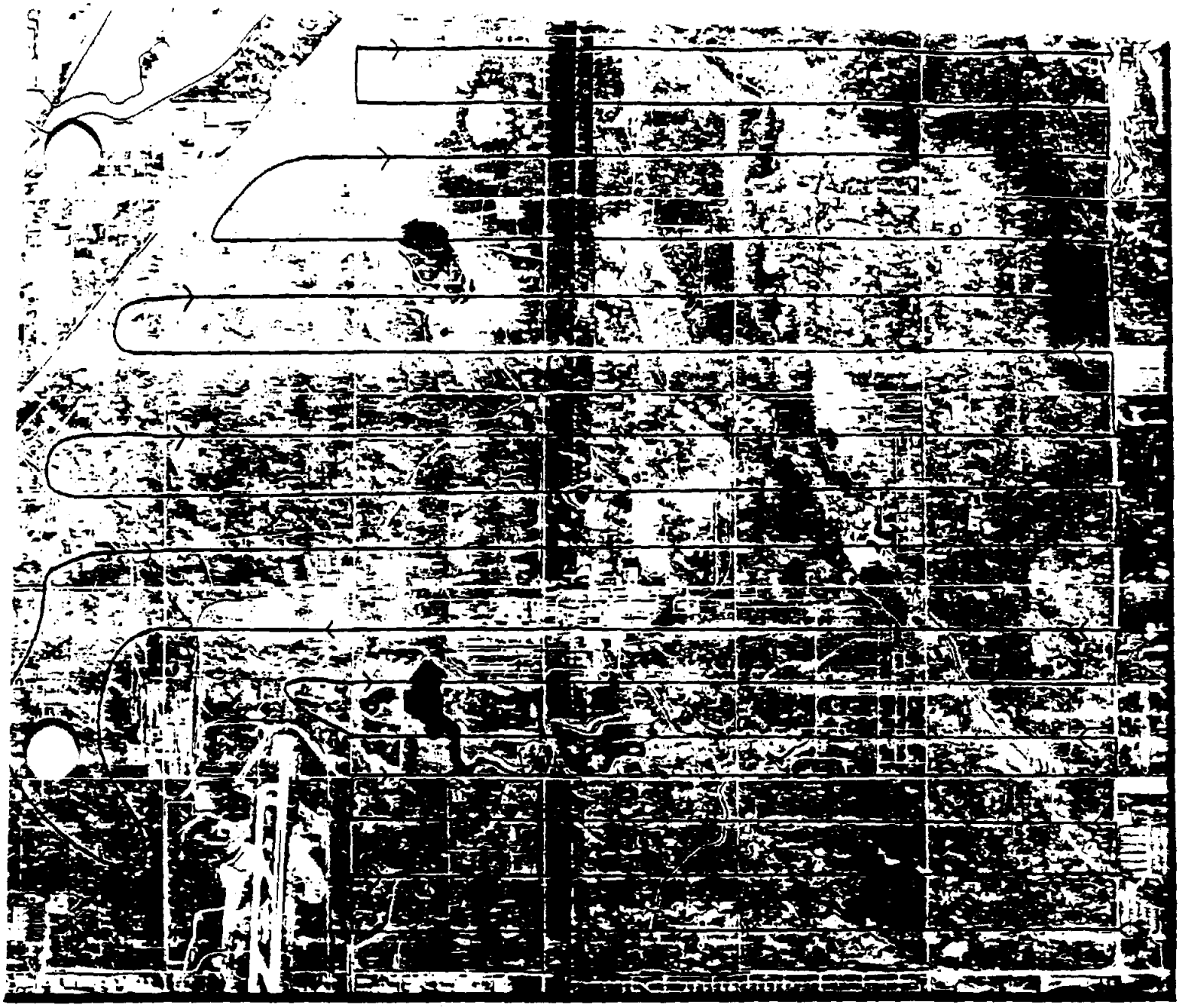


Figure [illegible] Transect route of Marion [illegible] aerial survey over the Rocky Mountain [illegible]

occurrence of deer. Average flight speed was 56 kpm (35 mph) and average altitude was 39 m. (130 ft.). Ground composition surveys were conducted after aerial surveys to allow comparison of the two survey techniques.

Monitoring

Ground locations were made from truck or on foot. A roof mounted antenna was used to obtain a general location of radio-collared deer from the vehicle. After a strong signal was located from the truck, a hand-held directional H-antenna was used to locate deer by triangulation (Heezen and Tester 1967) or to obtain a visual location. Relocation protocol required sampling from four diel periods (Dawn = sunrise + 4 hours, Dusk = sunset - 4 hours, Diurnal = Dawn to Dusk, Nocturnal = Dusk to Dawn). Order of location for deer within each species was randomly chosen and an individual deer was searched for until located. No deer were located more than once within a 24-hour period however, and no deer were excluded from more than three consecutive location bouts. Relocations of each radio-collared deer were plotted on separate aerial photos and recorded using legal descriptions and the Universal Transverse Mercator System (UTM system, U.S. Dept. of the Army 1958). Records of observations of marked deer included animal number, date, time, location, group size and composition, activity, habitat type, mule deer/white-tailed deer distance, and visible distance.

Movement corridors of mule deer and white-tailed deer before the perimeter fence was in place were documented from track counts in the snow. One to three days after new snowfall the perimeter of the RMA was driven to locate tracks of deer moving on and off the RMA.

Food habits

Deer pellets were collected to examine food habits. A minimum of five pellet samples per species were collected each month. Samples were collected after visual observation of defecation or from areas where deer were bedded and collected after deer left the area.

RESULTS

Trapping and marking

One-hundred deer were captured from 17 January, 1990 to 6 April, 1990. Thirteen mule deer does and seven white-tailed does were radio-collared. There were four double captures, 23 recaptures and four trap mortalities. All mortalities were fawns. Capture and tagging records are in Appendix B. Composition of trapped deer are represented in Table 1. Two mule deer does were captured with a Coda-Net gun and four mule deer does were captured with a Cap-Chur gun. There were no

mortalities from darting or netting. Figure 4 shows the locations where radio-collars were attached. Appendix C gives legal descriptions of radio-collar attachment.

Table 1. Composition of mule deer and white-tailed deer trapped at the RMA from 17 January, 1990 through 6 April, 1990.

	MATURE FEMALE	MATURE MALE	YEARLING FEMALE	YEARLING MALE	FAWN FEMALE	FAWN MALE
Mule deer	12	19	1	3	3	12
White-tailed	10	22	2	0	3	8

Morphometric measurements of captured mule deer and white-tailed deer are presented in Tables 2 and 3. No mule deer or white-tailed deer exhibited characteristics of hybrids.

Composition survey

Five ground and two aerial surveys were completed (Table 4). Fawn:doe and buck:doe ratios of mule deer and white-tailed deer are presented in Table 5. The greatest number of mule deer and white-tailed deer observed was 230 and 73, respectively. The number for mule deer was obtained from a ground survey and that for white-tailed deer from an aerial survey. The fewest deer observed were 161 mule deer during an aerial survey and 41 white-

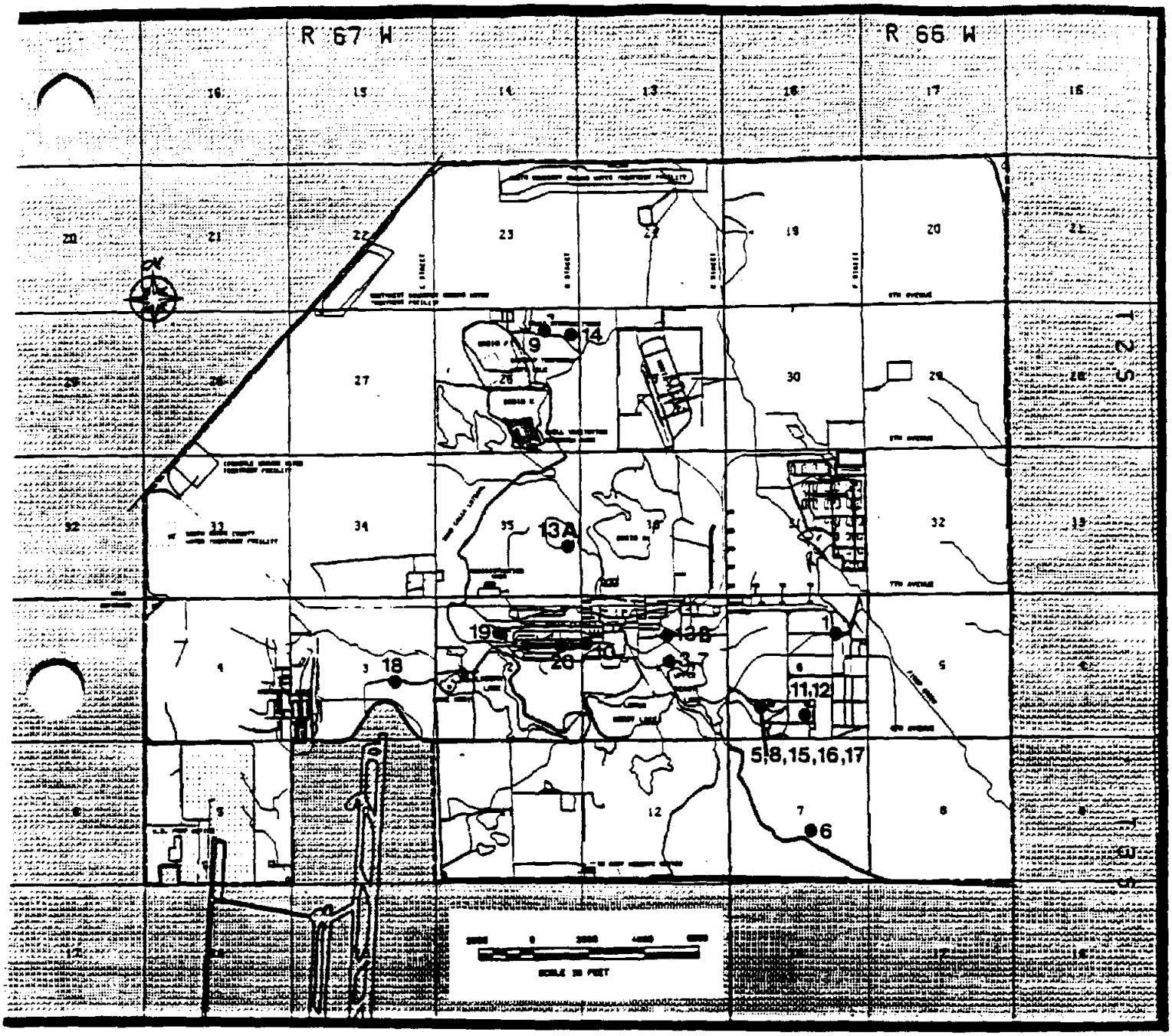


Figure 4. Locations of radio-collar attachment during the 1984 trapping period at the Rocky Mountain Arsenal. Numbers represent radio-collar number.

Table 2. Mean morphometric measurements (mm) of mule deer captured at the RMA (January - March 1990).

Mule deer	Metatarsal (min.-max)	Tail (min.-max)	Ear (min.-max)
Adult female (N=15)	132.7 (115 - 157)	258.2 (221 - 295)	219.5 (200 - 289)
Adult male (N=5)	134 (126 - 140)	273 (263 - 289)	227.2 (220 - 240)
Yearling female (N=1)	119	280	219
Yearling male (N=3)	111.6 (95 - 126)	262 (250 - 285)	220.3 (218 - 225)
Fawn female (N=2)	120.5 (115 - 126)	224 (208 - 240)	212 (211 - 213)
Fawn male (N=10)	109.0 (82 - 126)	232.5 (199 - 270)	212.8 (200 - 230)

Table 3. Mean morphometric measurements (mm) of white-tailed deer captured at the RMA (January - March 1990).

White-tailed deer	Metatarsal (min.-max)	Tail (min.-max)	Ear (min.-max)
Adult female (N=7)	28.2 (22 - 36)	320.7 (297 - 349)	150.2 (141 - 170)
Adult male (N=5)	27.5 (21 - 32)	349.7 (314 - 364)	167.2 (161 - 182)
Yearling female (N=1)	24	308	158
Yearling male (N=0)			
Fawn female (N=3)	20.1 (19 - 20)	295.3 (280 - 306)	143.3 (131 - 158)
Fawn male (N=6)	20.3 (16 - 29)	325 (289 - 358)	155.8 (145 - 175)

Table 4. Composition and population totals from ground and aerial population composition surveys of the mule deer and white-tailed deer on the RMA from 16 November, 1989 to 01 May, 1990.

Dates	Survey type	Species[a]	Doe	Fawn	Buck	Unc.[b]	Total
11-16 & 17-89	Flight	MD	45	29	48	80	202
		WT	15	4	20	17	56
12-28 & 29-89	Ground	MD	97	63	52	3	215
		WT	30	12	25	2	69
01-02 & 03-90	Ground	MD	103	53	53	21	230
		WT	24	6	20	8	58
03-09-90	Flight	MD	-	-	-	161	161
		WT	-	-	-	73	73
03-20 & 22-90	Ground	MD	4	49	25	129	182
		WT	2	6	2	28	41
04-25 & 26-90	Ground	MD	90	58	57	10	215
		WT	30	11	22	9	72
05-01 & 02-90	Ground	MD	85	41	59	15	200
		WT	39	14	14	2	69

[a] MD = mule deer, WT = white-tailed deer

[b] Unc. = unclassified

tailed deer during a ground survey. A reliable composition could not be obtained during the 9 March, 1990 flight because bucks had shed their antlers and fawns were hard to distinguish. During this flight 30% (3 of 10) of the radio-collared mule deer and 60% (3 of 5) of radio-collared white-tailed deer were observed.

Distribution of mule deer and white-tailed deer were recorded during composition surveys. Figure 5 depicts the distribution of mule deer and Figure 6 white-tailed deer distribution. Overlap of the distributions of mule deer and white-tailed deer is shown in Figure 7. Major concentrations of mule deer (Figure 8) and white-tailed deer (Figure 9) are plotted on preliminary vegetation maps (ESE, 1986).

Table 5. Fawn:doe and buck:doe ratios of mule deer and white-tailed deer from ground composition surveys at the RMA.

Survey dates	Species[a]	Fawn:doe ratios	Actual values	Buck:doe ratios	Actual values	Un-classified
12-28 & 29-89	MD	65:100	63:97	54:100	52:97	3
	WT	40:100	12:30	83:100	25:30	2
01-02 & 03-90	MD	51:100	53:103	51:10	53:103	21
	WT	25:100	06:24	83:100	20:24	8
04-25 & 26-90	MD	64:100	58:90	63:100	57:90	10
	WT	37:100	11:30	73:100	22:30	9
05-01 & 02-90	MD	48:100	41:85	69:100	59:85	15
	WT	36:100	14:39	36:100	14:39	2

[a] MD = mule deer, WT = white-tailed deer

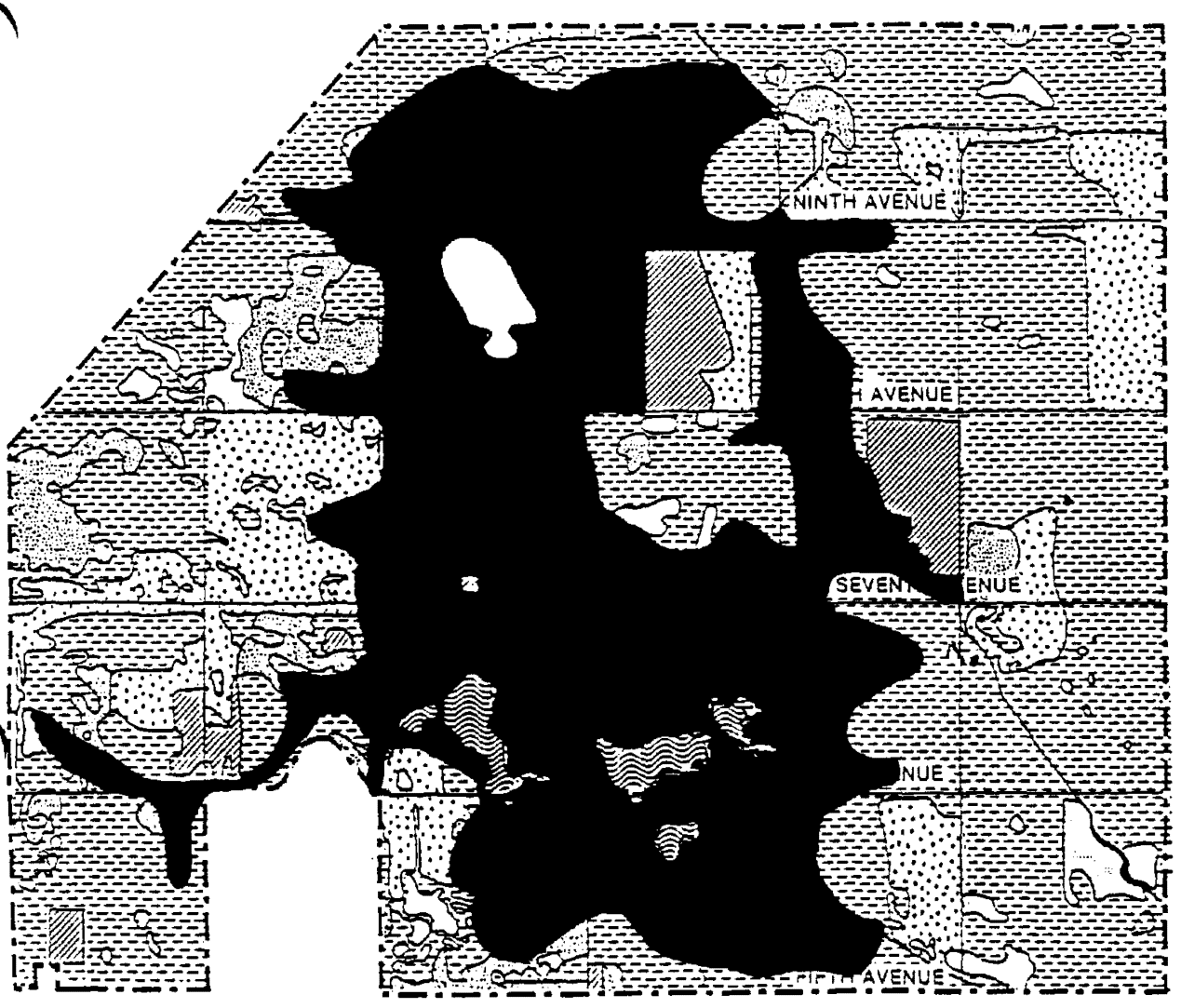


Figure 1. Shaded area represents mule deer distribution in general vegetation types on the Rocky Mountain Arsenal from January 1990 through [illegible]

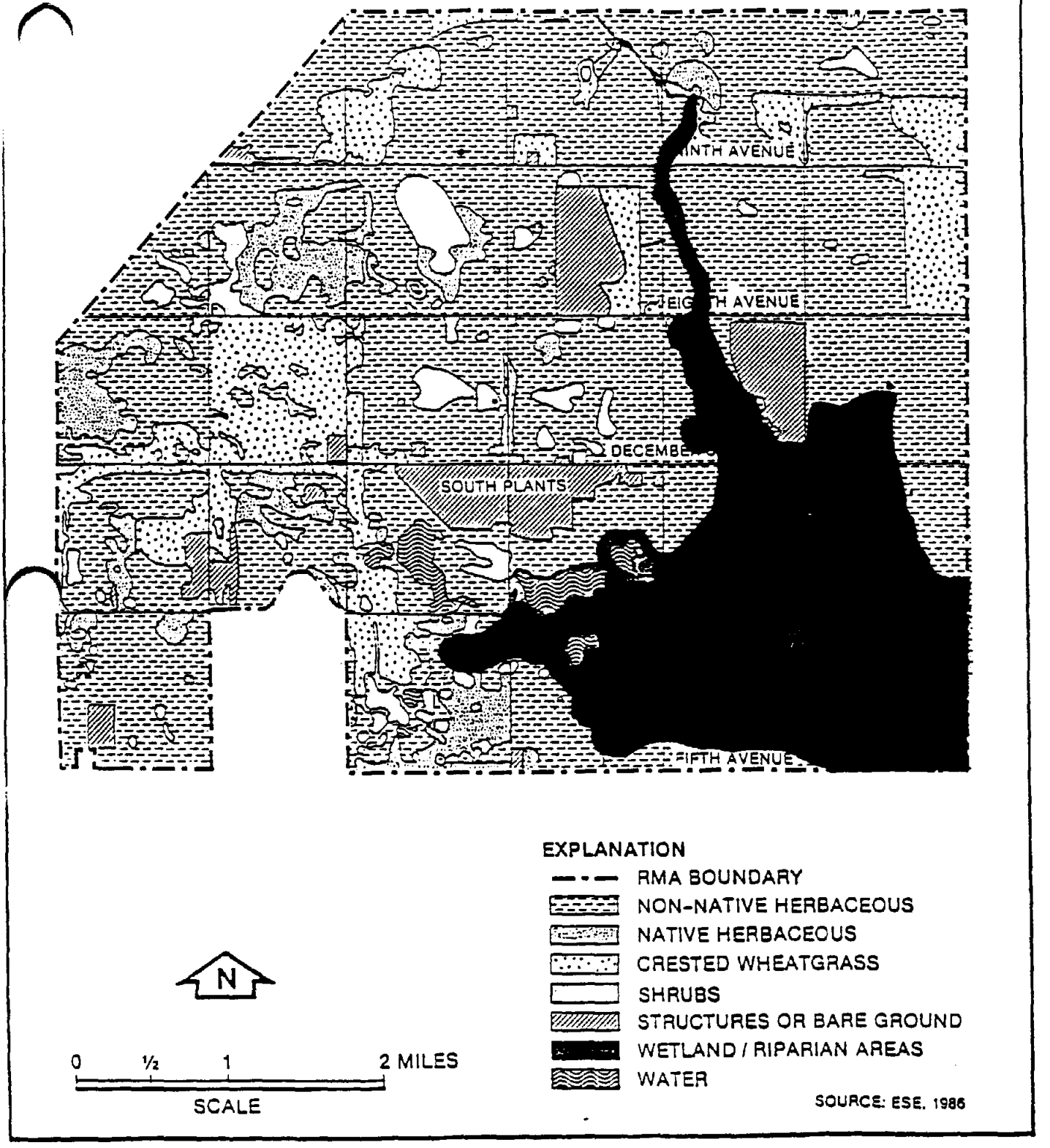


Figure 5. Shaded area represents white-tailed deer distribution in general vegetation types on the Rocky Mountain Arsenal from January 1990 through April 1990.

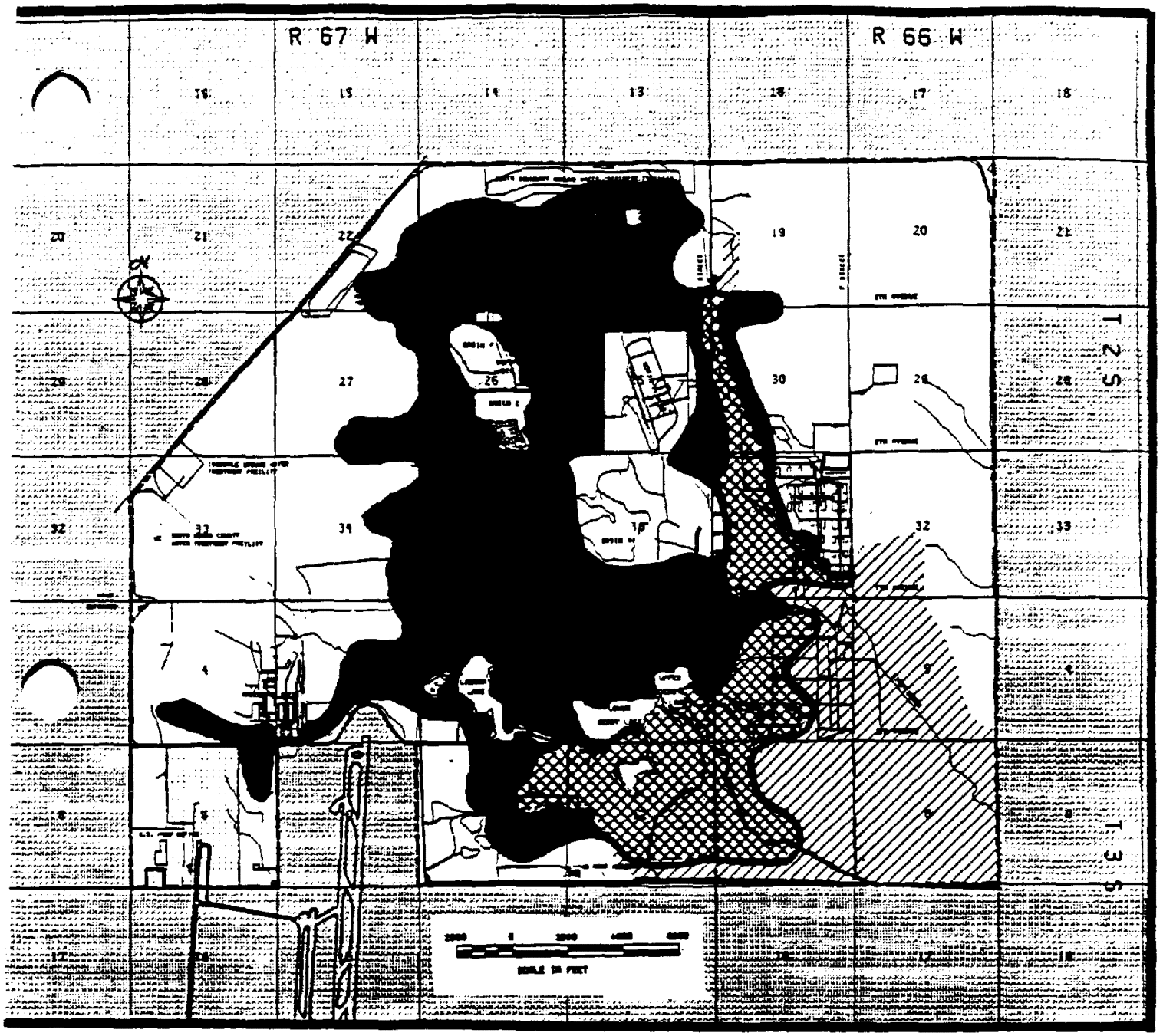


Figure 7. Mule deer and white-tailed distribution on the Rock Mountain Arsenal from January 1990 through April 1990.

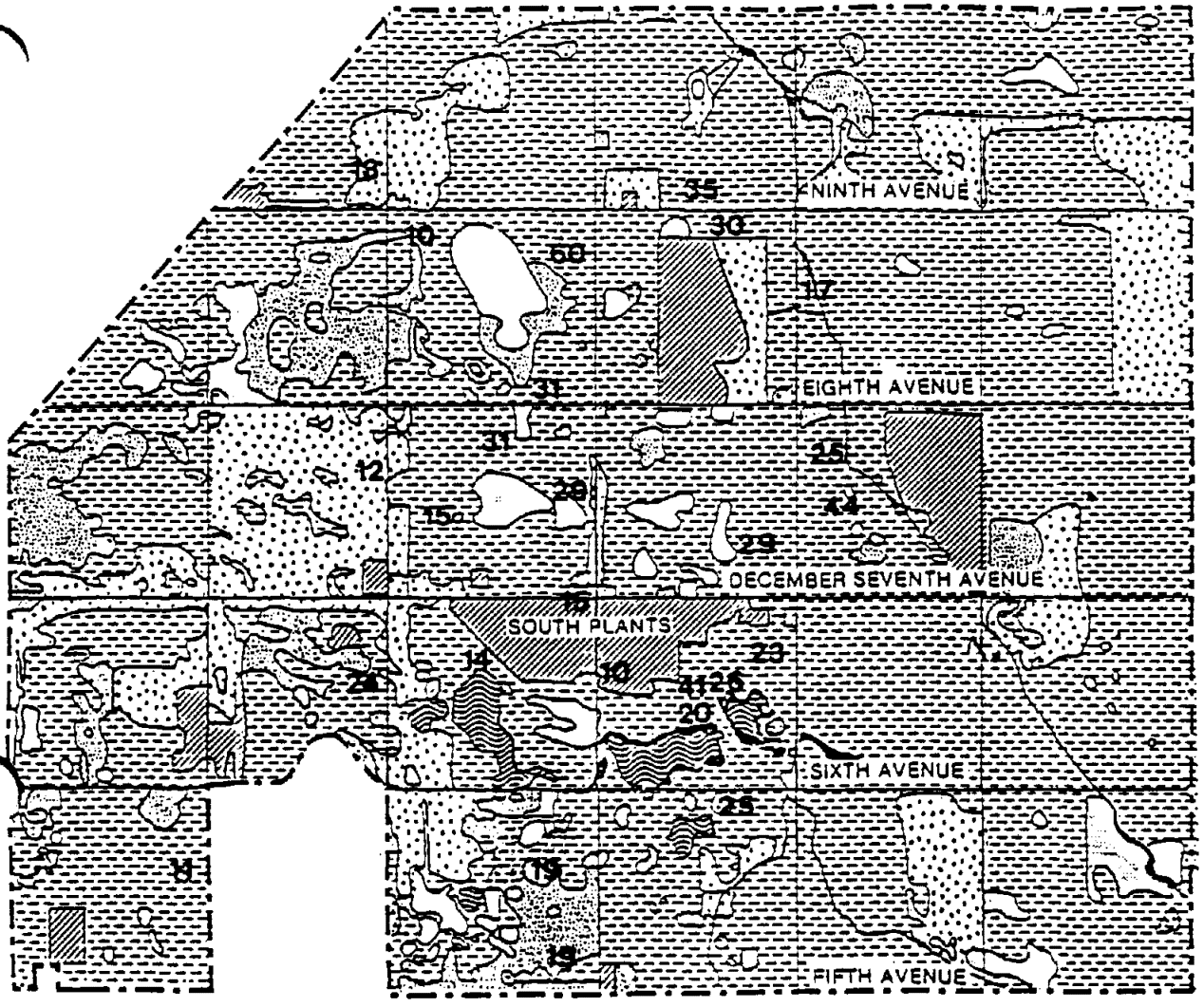
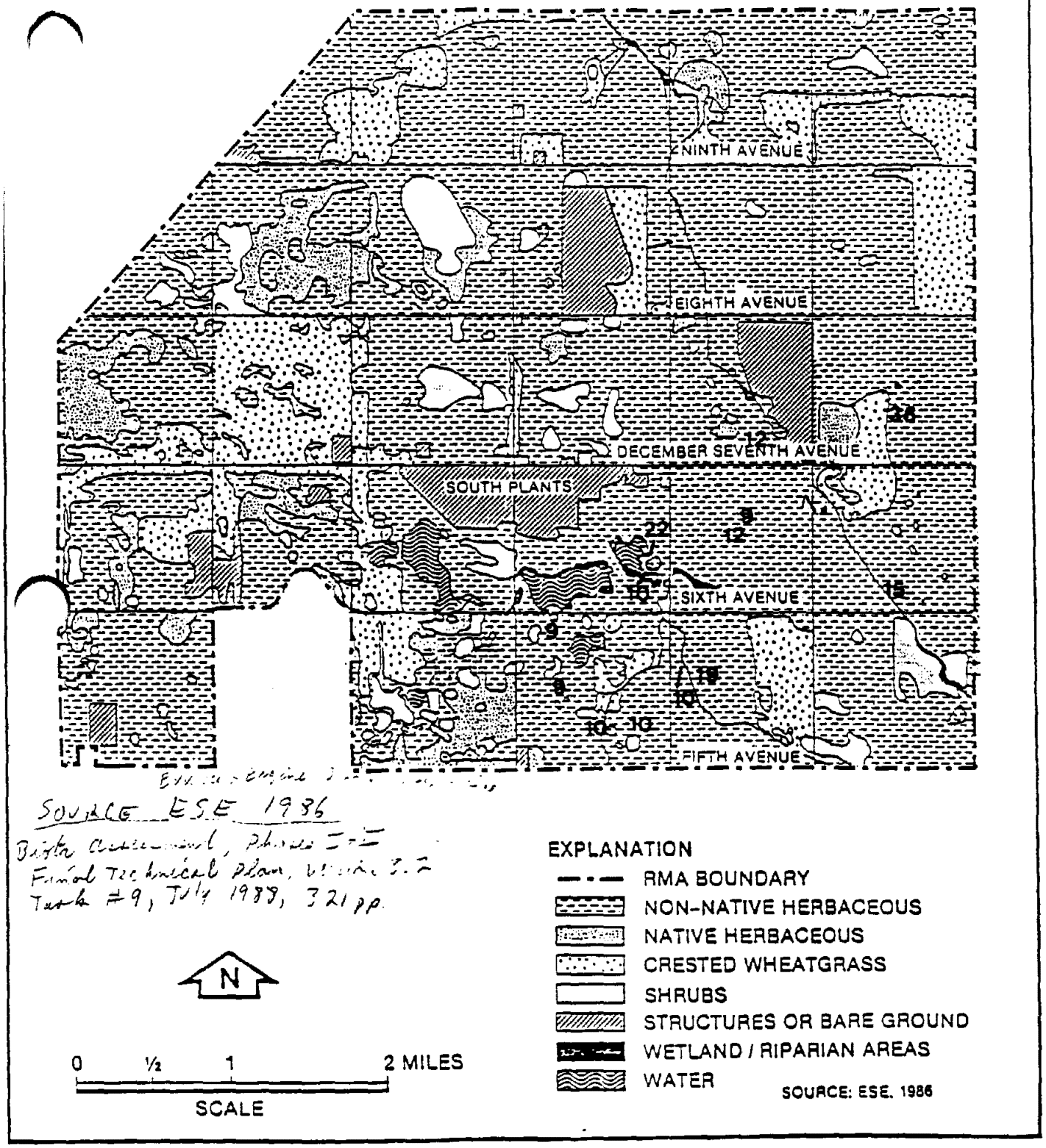


Figure 6. Major concentrations of mule deer on the Rocky Mountain Arsenal from January 1986 through April 1986. Numbers represent group size



SOURCE ESE 1986

Figure 4. Major concentrations of white-tailed deer on the Rocky Mountain Arsenal from January 1986 through April 1986. Numbers represent group size.

Monitoring

Relocations of radio-collared deer are in Appendix D. The longest distance moved by a radio-collared mule deer (#14) was 5.8 km (3.6 mi.) (Figure 10). One radio-collared mule deer (#11) left the RMA. This deer has remained within 0.5 km (0.3 mi.) of the RMA and is in a group with 23 other mule deer. Radio-collared mule deer #13-A died during the week of 12 March. She was in poor condition when trapped and estimated to be ten-years-old.

The longest distance moved by a radio-collared white-tailed deer (#8) was 4.5 km (2.8 mi., Figure 11). No white-tailed deer were observed off the RMA since the completion of the perimeter fence.

Prior to fence construction individual deer and groups of eight or more were documented moving on and off the RMA along the southern, eastern, and northern boundaries (Figure 12). Some mule deer were still moving on and off the RMA (as of 1 May) via a drainage canal at the west gate entrance. Up to 14 mule deer have been reported using this corridor by security guards at the west gate.

Food habits

Twenty pellet groups have been collected for each deer species. At this time, pellet samples have not been analyzed to determine food habits.

Figure 10. Movements of radio-tagged mule deer # 4 from [illegible] at the Rocky Mountain Arsenal

Figure 11. Movements of radio-collared white-tailed deer #3 from 01-29-90 to 04-27-90 at the Rocky Mountain Arsenal.

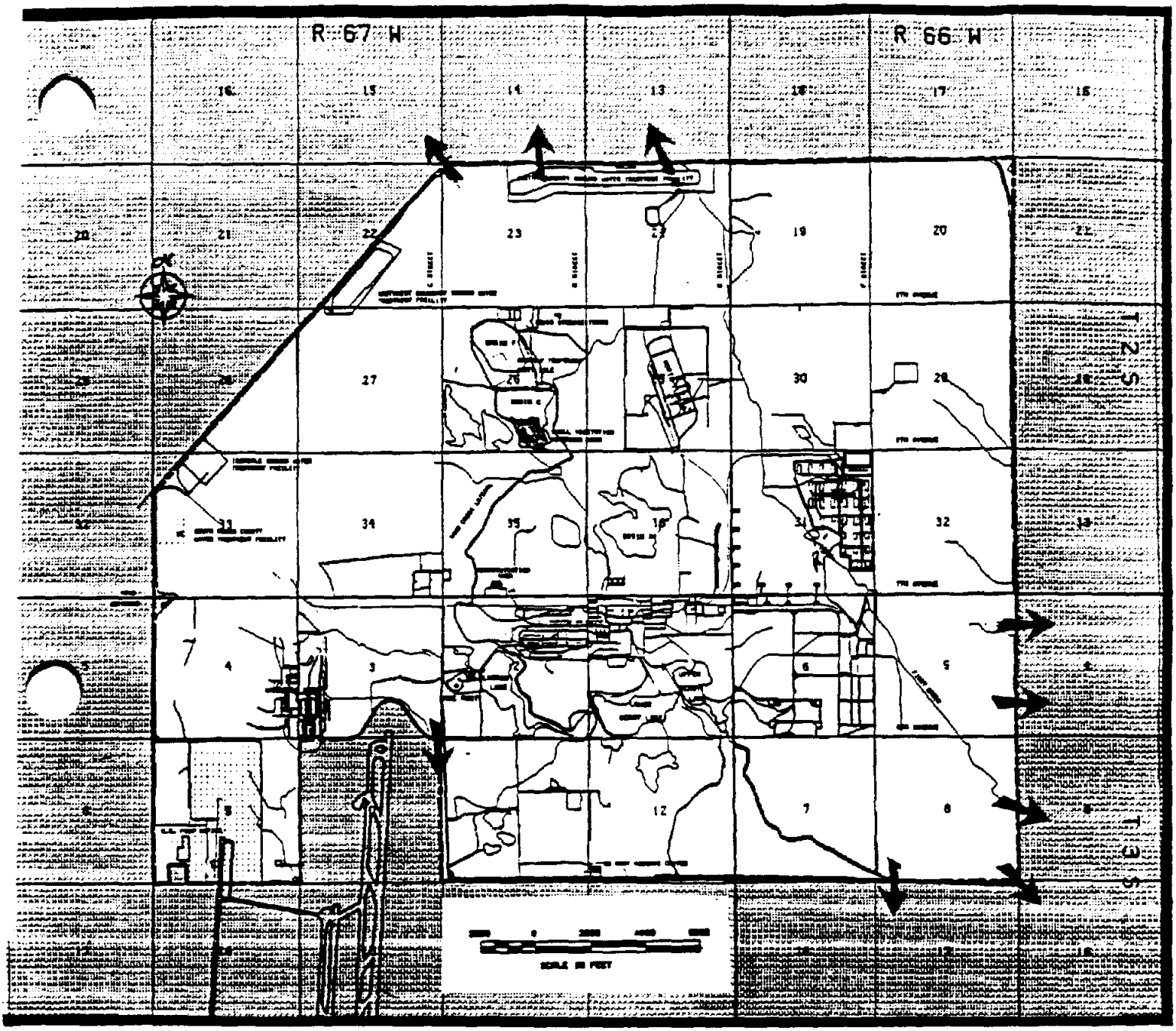


Figure 12. Major movement corridors of deer on and off the Rocky Mountain Arsenal during January and February, 1990, prior to perimeter fence completion.

DISCUSSION

Mild weather and abundant natural forage undoubtably contributed to our poor trapping success. Locations of captured deer appear to adequately reflect distribution of the two species on the Arsenal. While we were unable to capture ten white-tailed does as planned, white-tailed deer were proportionally over represented in the sample.

White-tailed deer range on the RMA was restricted primarily to the southeast quadrant and northward along the riparian corridor of First Creek. Mule deer ranged more generally over the RMA and the two species overlapped considerably in the south-central portion. Mule deer and white-tailed deer were commonly seen in close association, particularly in the riparian areas.

The relatively high buck:doe ratios observed in both species are typical of non- to lightly hunted populations. Fawn:doe ratios were higher in the mule deer population entering the winter and remained higher than white-tailed deer through spring. While identifying bucks in the spring is tenuous at best, fawn:adult ratios showed the same trends.

Completion of the perimeter fence created a captive deer herd. The areas where ingress and egress is still possible under the fence should be blocked. Monitoring of the populations will continue to document demographic changes in the two species as they adjust to being constrained to the RMA.

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U.S. Department of the Army. 1958. Universal transverse mercator grid. Tech. Manual TM5-241-8. U.S. Government Printing Office. 1969-390-947/404. 66pp.

APPENDIX A

LEGAL DESCRIPTION OF TRAP SITE LOCATIONS DURING THE 1990 TRAPPING PERIOD.

Trapsite Number	UTM Coordinates X	Y	Legal 1/4-1/4	Section	Township (North)	Range (West)
1	513.07	4408.91	NESE	35	3	67
2	516.08	4407.69	SENE	6	3	66
3	515.13	4407.12	SESW	6	3	66
4	516.68	4406.83	SWSW	5	3	66
5	515.57	4405.69	NWSW	7	3	66
6	514.05	4407.73	SWNE	1	3	67
7	513.31	4411.19	NWNW	25	2	67
8	516.09	4406.49	NENE	7	3	66
9	513.67	4406.12	SESW	12	3	67
10	512.42	4406.22	SWNE	11	3	67
11	516.51	4406.56	NWNW	8	3	66
12	515.71	4408.52	SWSE	31	2	66
13	513.03	4412.21	NESE	23	2	67
14	515.63	4406.99	SWSE	6	3	66
15	512.63	4412.46	SWNE	23	2	67
16	513.36	4410.93	SWNW	25	2	67
17	516.20	4408.40	SESE	31	2	66
18	516.20	4408.12	NENE	6	3	66
19	516.51	4406.56	NWNW	8	3	66

APPENDIX B

CAPTURE AND TAGGING RECORDS FOR THE 1990 TRAPPING PERIOD.

MD = mule deer WT = white-tailed deer B = buck D = doe Y = yearling F = fawn
RC = radio-collar NEE = letters on each eartag T = tpwmship R = range

* Recapture.
** Double capture.
*** Mortality.

Date 1990	Trap#	MD WT B D Y F	RC#\ Freq. 165.	Eartag# NEE	UTM X	UTM Y	Legal 1/4 sec.	sec.	T	R	Est. age
01-17	1	WT D	\010	403	513.07	4408.91	NESW	35	3	67	3+
01-18	4	WT B		404	516.68	4406.83	SWSW	5	3	66	
01-18	5	WT B		405	515.57	4405.69	NWSW	7	3	66	
01-18**	9	MD DY		406	513.67	4406.12	SESW	12	3	67	
01-18	9	MD D	\020	407	513.67	4406.12	SESW	12	3	67	2.5
01-18	6	MD D	\030	408	514.05	4407.73	SWNE	1	3	67	2.5
01-18	1	WT B		410	513.07	4408.91	NESW	35	3	67	2.5
01-19	7	MD BY		409	513.31	4411.19	NWNW	25	2	67	
01-19	1	MD BF		411	513.07	4408.91	NESW	35	3	67	
01-19	3	WT B		412	515.13	4407.12	SESW	6	3	66	
01-19	9	MD D	\040	413	513.67	4406.12	SESW	12	3	67	2.5
01-20	2	WT B		414	516.08	4407.69	SESE	6	3	66	
01-20	3	WT D	\050	415	515.13	4407.12	SESW	6	3	66	4+
01-20	4	WT B		416	516.68	4406.83	SWSW	5	3	66	
01-20	11	WT B		417	516.51	4406.56	NWNW	8	3	66	3+
01-20	6	MD BF		418	514.05	4407.73	SWNE	1	3	67	3+
01-20	1	MD B		419	513.07	4408.91	NESW	35	3	67	6+
01-20	13	MD B		420	513.03	4412.21	NESE	23	2	67	6+
01-21	3	WT BF		421	515.13	4407.12	SESW	6	3	66	
01-21	7	MD B		419*	513.31	4411.19	NWNW	25	2	67	6+
01-22	13	MD B		422	513.03	4412.21	NESE	23	2	67	
01-22	11	WT B		423	516.51	4406.56	NWNW	8	3	66	
01-23	3	WT B		404*	515.13	4407.12	SESW	6	3	66	
01-23	5	MD D	6\060	424	515.57	4405.69	NWSW	7	3	66	3+
01-23	6	MD BF		411*	514.05	4407.73	SWNE	1	3	67	
01-23	6	MD B		426	514.05	4407.73	SWNE	1	3	67	
01-24	1	MD B		409*	513.07	4408.91	NESW	35	3	67	
01-24	3	MD BF		425	515.13	4407.12	SESW	6	3	66	
01-24	14	WT BF		427	515.63	4406.99	SWSE	6	3	66	
01-24	11	WT B		412*	516.51	4406.56	NWNW	8	3	66	
01-25	13	MD B		420*	513.03	4412.21	NESE	23	2	67	6+
01-25	13	MD B		428	513.03	4412.21	NESE	23	2	67	2.5
01-26**	6	MD D		429	514.05	4407.73	SWNE	1	3	67	4+
01-26	6	MD D	7\070	430	514.05	4407.73	SWNE	1	3	67	3+
01-26	3	WT B		431	515.13	4407.12	SESW	6	3	66	
01-26	14	WT BF		432	515.63	4406.99	SWSE	6	3	66	
01-27	7	MD B		433	513.31	4411.19	NWNW	25	2	67	2.5

Date 1990	Trap#	MD WT B D Y F	RC#\ Freq. 165.	Eartag# NEE	UTM X	UTM Y	Legal 1/4 sec.	sec.	T	R	Est. age
01-27	7	MD B		435	513.31	4411.19	NWNW	25	2	67	2.5
01-29	13	MD B		422*	513.03	4412.21	NESE	23	2	67	
01-29	1	MD BF		436	513.07	4408.91	NESW	35	3	67	
01-29	3	WT D	8\080	437	515.13	4407.12	SESW	6	3	66	2.5
01-29	4	WT B		404*	516.68	4406.83	SWSW	5	3	66	
01-30**	1	MD DF***		438	513.07	4408.91	NESW	35	3	67	
01-30	1	MD BF		439	513.07	4408.91	NESW	35	3	67	
01-30	3	WT B		416*	515.13	4407.12	SESW	6	3	66	
01-30	14	WT BF		440	515.63	4406.99	SWSE	6	3	66	
01-30	Coda	MD D	9\090	441	512.70	4411.30	NWNE	26	2	67	3+
01-30	Coda	MD D	10\100	442	513.20	4407.88	SWNW	1	3	67	2.5
01-31	7	MD B		420*	513.31	4411.19	NWNW	25	2	67	6+
01-31	14	MD D	11\110	443	515.63	4406.99	SWSE	6	3	66	2.5
01-31	1	MD BF		444	513.07	4408.91	NESW	35	3	67	
01-31	7	MD BF		445	513.31	4411.19	NWNW	25	2	67	
02-01	14	MD BY		446	515.63	4406.99	SWSE	6	3	66	
02-01	4	WT BF		421*	516.68	4406.83	SWSW	5	3	66	
02-02	13	MD B		447	513.03	4412.21	NESE	23	2	67	
02-04	14	WT D	12\210	448	515.63	4406.99	SWSE	6	3	66	2.5
02-05	3	WT BF***			515.13	4407.12	SESW	6	3	66	
02-06	7	MD BF***			513.31	4411.19	NWNW	25	2	67	
02-06	16	MD B		420	513.36	4410.93	SWNW	25	2	67	6+
02-07	7	MD B		450	513.31	4411.19	NWNW	25	2	67	
02-07	1	MD BY		451	513.07	4408.91	NESW	35	3	67	
02-09	16	WT B		454	513.36	4410.93	SWNW	25	2	67	2.5
02-09	4	WT B		453	516.68	4406.83	SWSW	5	3	66	2.5
02-11	3	MD D	11\110	443*	515.13	4407.12	SESW	6	3	66	2.5
02-11	1	MD BF		456	513.07	4408.91	NESW	35	3	67	
02-12	1	MD B		450	513.07	4408.91	NESW	35	3	67	
02-12	3	WT BF		455	515.13	4407.12	SESW	6	3	66	
02-13	1	MD D	13\130	---	513.07	4408.91	NESW	35	3	67	6+
02-15	1	MD D	13\130	---*	513.07	4408.91	NESW	35	3	67	6+
02-16	13	MD B		422*	513.03	4412.21	NESE	23	2	67	
02-21	3	MD DF		457	515.13	4407.12	SESW	6	3	66	
02-22	Dart	MD D	14\140	458	513.03	4411.28	NENE	26	2	67	2.5
02-26	18	WT B		412*	516.20	4408.12	NENE	6	3	66	
02-27	17	WT B		412*	516.20	4408.40	SESE	31	2	66	
03-02	14	MD BF		452	515.63	4406.99	SWSE	6	3	66	
03-02	4	WT B		423*	516.68	4406.83	SWSW	5	3	66	
03-03	18	WT B		423*	516.20	4408.12	NENE	6	3	66	
03-05	18	WT BF***		---	516.20	4408.12	NENE	6	3	66	
03-06	18	WT DF		459	516.20	4408.12	NENE	6	3	66	
03-06	3	WT D	15\150	461	515.13	4407.12	SESW	6	3	66	2.5
03-07	8	WT DY		462	516.09	4406.49	NENE	7	3	66	
03-08	18	WT B		412*	516.20	4408.12	NENE	6	3	66	
03-09	3	MD BF		463	515.13	4407.12	SESW	6	3	66	
03-13	18	WT B		476	516.20	4408.12	NENE	6	3	66	2.5
03-14	14	MD B		465	515.63	4406.99	SWSE	6	3	66	
03-19	18	WT DF		478	516.20	4408.12	NENE	6	3	66	
03-20	3	WT D	16\160	479	515.13	4407.12	SESW	6	3	66	7+

L 1990	Trap#	MD WT B D Y F	RC#\ Freq. 165.	Eartag# NEE	UTM X	UTM Y	Legal 1/4 sec.	sec.	T	R	Est. age
03-21	3	WT D	17\170	480	515.13	4407.12	SESW	6	3	66	2.5
03-23	4	WT D	15\150	461*	516.68	4406.83	SWSW	5	3	66	2.5
03-24**	19	WT D	17\170	480*	516.51	4406.56	NWNW	8	3	66	2.5
03-24	19	WT DY		462	516.51	4406.56	NWNW	8	3	66	
03-28	19	WT DF		481	516.51	4406.56	NWNW	8	3	66	
03-28	3	MD DF		457	515.13	4407.12	SESW	6	3	66	
03-28	18	WT B		431*	516.20	4408.12	NENE	6	3	66	
03-29	4	WT D	17\170	480*	516.68	4406.83	SWSW	5	3	66	2.5
03-30	17	MD B		466	516.20	4408.40	SESE	31	2	66	
04-03	Dart	MD D	13B\130	468	513.05	4407.96	SWSW	1	3	67	3+
04-03	Dart	MD D	18\180	470	511.34	4407.49	NWSE	3	3	67	4+
04-06	Dart	MD D	19\190	482	512.34	4408.00	SENW	2	3	67	2.5
04-06	Dart	MD D	20\200	483	513.03	4407.94	NESE	2	3	67	2.5

APPENDIX C

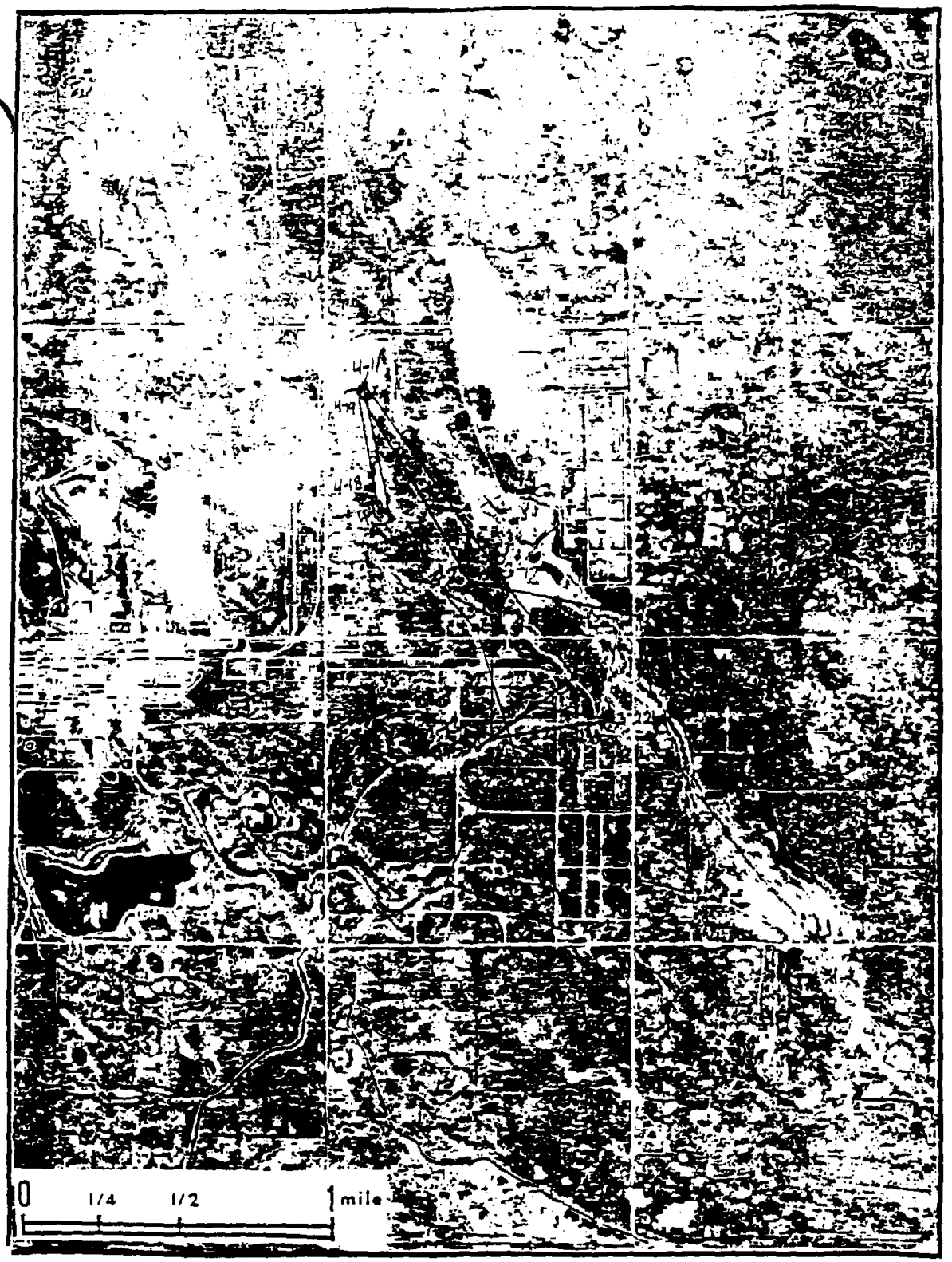
LEGAL DESCRIPTION OF RADIO-COLLAR ATTACHMENT DURING THE 1990 TRAPPING PERIOD.

RADIO-COLLAR #\ MD*, WT* - Date 1990	METHOD	UTM Coordinates X	UTM Coordinates Y	Legal 1/4-1/4	Section	Township (North)	Range (West)
01\WT-01-17	Trap #2	516.08	4407.69	SENE	6	3	66
02\MD-01-18	Trap #9	513.67	4406.12	SESW	12	3	67
03\MD-01-18	Trap #6	514.05	4407.73	SWNE	1	3	67
04\MD-01-19	Trap #9	513.67	4406.12	SESW	12	3	67
05\WT-01-20	Trap #3	515.13	4407.12	SESW	6	3	66
06\MD-01-23	Trap #5	515.57	4405.69	NWSW	7	3	66
07\MD-01-26	Trap #6	514.05	4407.73	SWNE	1	3	67
WT-01-29	Trap #3	515.13	4407.12	SESW	6	3	66
09\MD-01-30	Coda-Net	512.70	4411.30	NWNE	26	2	67
10\MD-01-30	Coda-Net	513.20	4407.88	SWNW	1	3	67
11\MD-01-31	Trap #14	515.63	4406.99	SWSE	6	3	66
12\WT-02-04	Trap #14	515.63	4406.99	SWSE	6	3	66
13(A)\MD-02-13	Trap #1	513.07	4408.91	NESE	35	3	67
13(B)\MD-04-03	Cap-Chur	513.05	4407.96	SWSW	1	3	67
14\MD-02-22	Cap-Chur	513.03	4407.28	NENE	26	2	67
15\WT-03-06	Trap #3	515.13	4407.12	SESW	6	3	66
16\WT-03-20	Trap #3	515.13	4407.12	SESW	6	3	66
17\WT-03-21	Trap #3	515.13	4407.12	SESW	6	3	66
18\MD-04-03	Cap-Chur	511.07	4407.49	NWSE	3	3	67
19\MD-04-06	Cap-Chur	512.34	4408.00	SENW	2	3	67
20\MD-04-08	Cap-Chur	513.03	4407.94	NESE	2	3	67

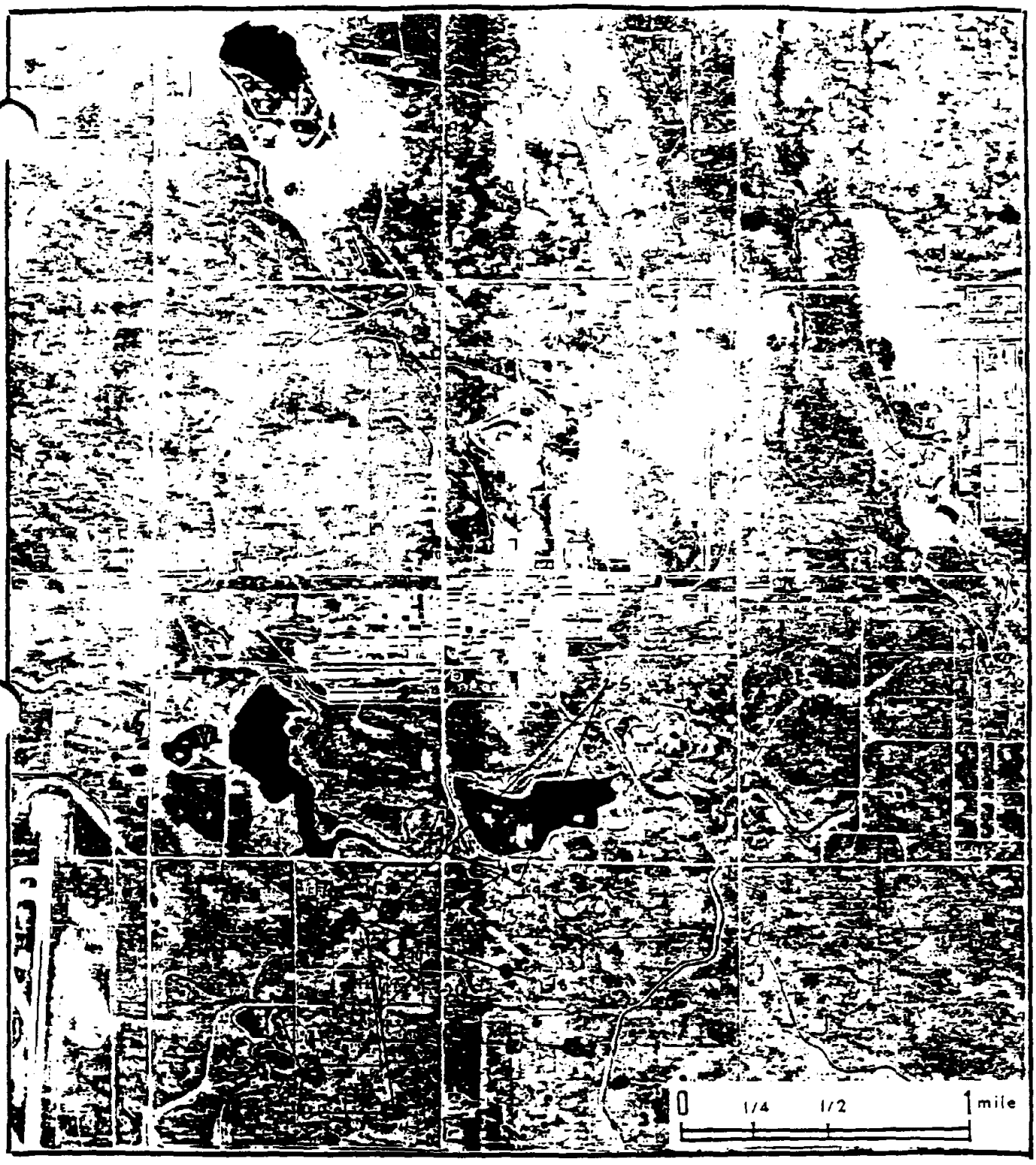
*MD = mule deer, WT = white-tailed deer

APPENDIX D

RELOCATIONS OF RADIO-COLLARED DEER



Movements of radio-collared white-tailed deer #1 from 01-17-90 t
04-27-90 at the Rocky Mountain Arsenal.



Movements of radio-collared mule deer #2 from 01-18-90 to 04-26-90 at the Rocky Mountain Arsenal.

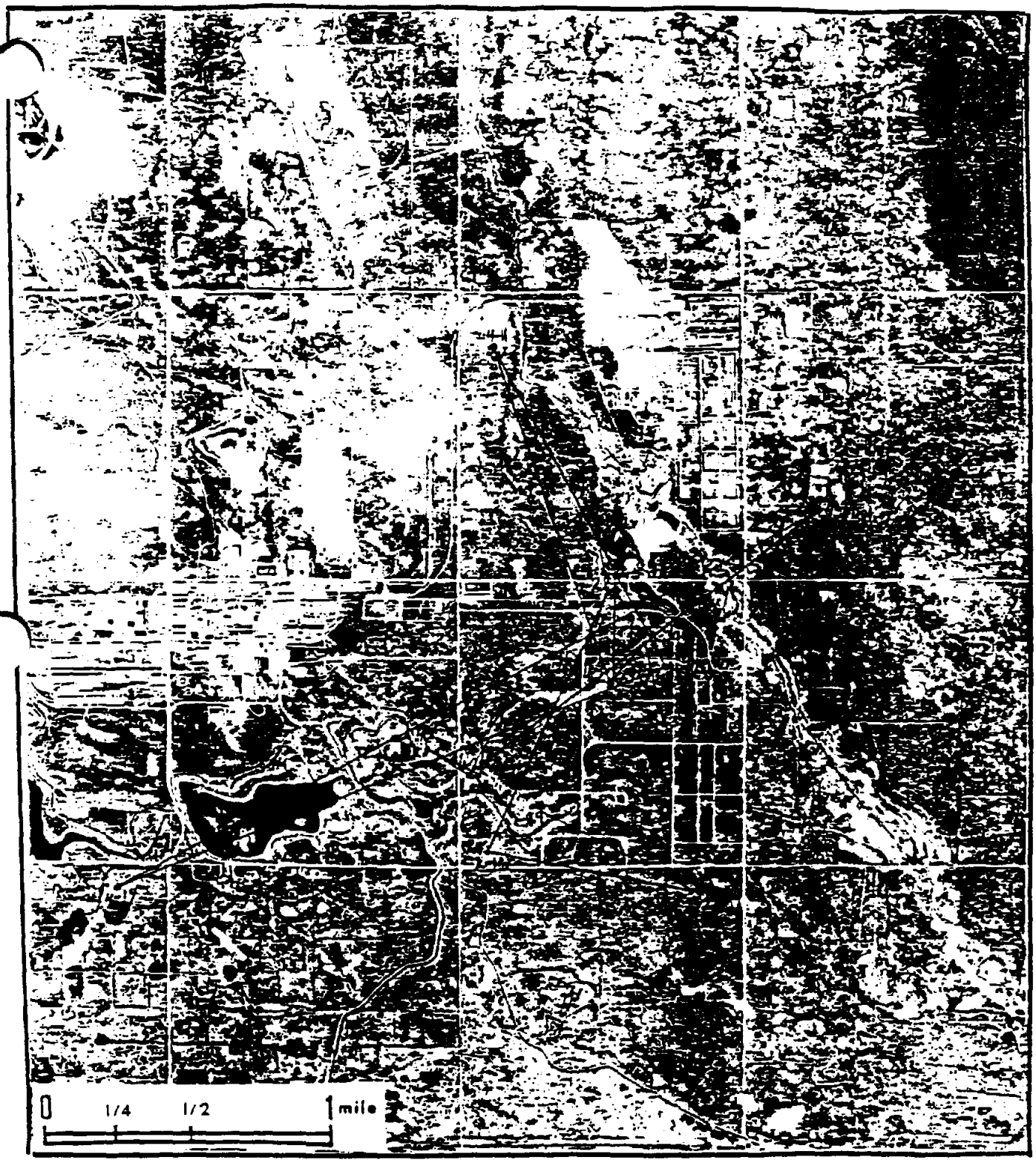
Movements of radio-collared mule deer #3 from 01-18-90 to 04-20-90 at the Rocky Mountain Arsenal.

Movements of radio-collared mule deer #4 from 01-19-90 to 01-25-90 at the Rocky Mountain Arsenal.

Movements of radio-collared white-tailed deer #3 from 01-20-3[illegible] 04-25-80 at the Rocky Mountain Arsenal.

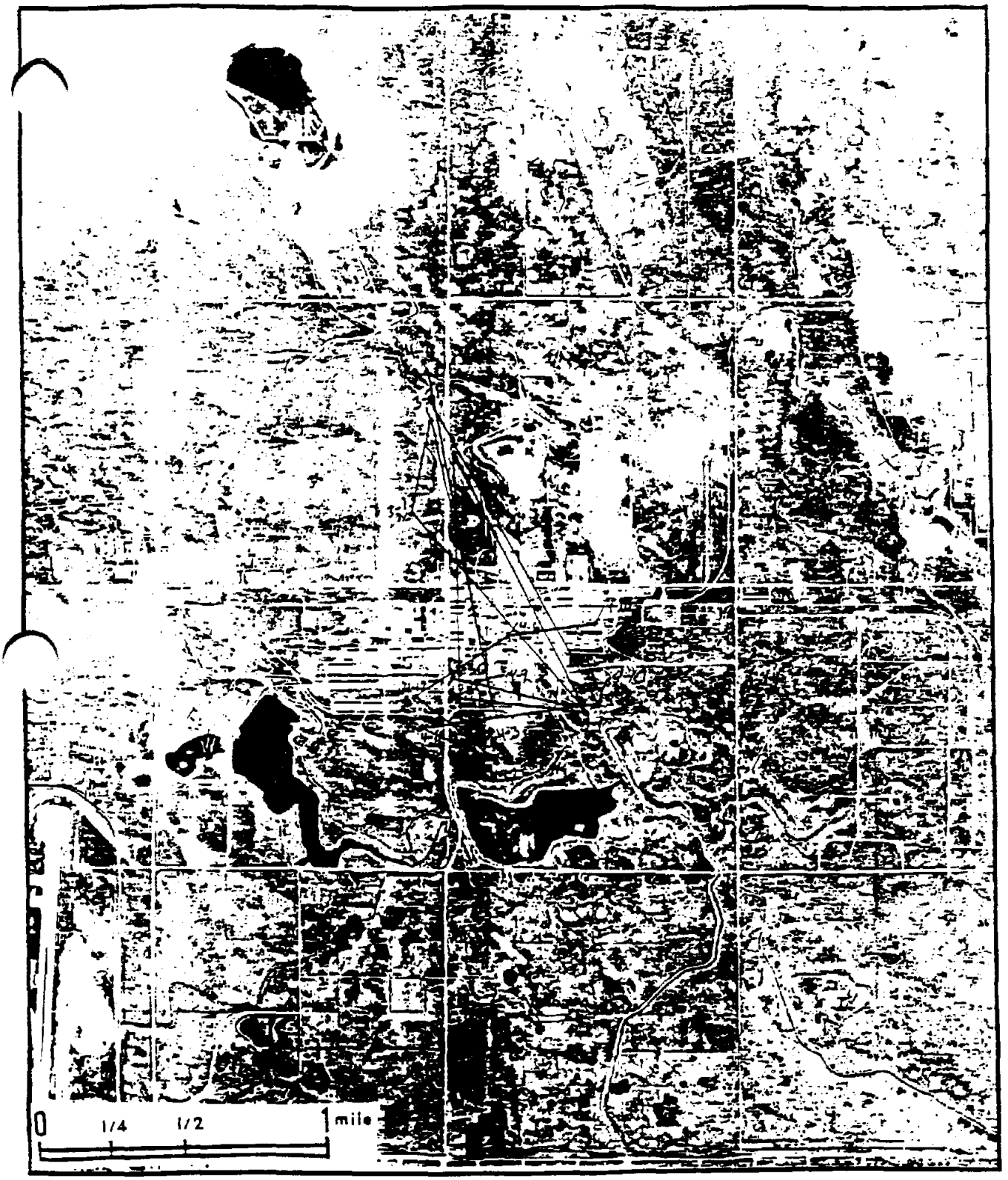
Movements of radio-collared mule deer #6 from 01-23-90 to 01-26-90 at the Rocky Mountain Arsenal.

Movements of radio-collared mule deer #7 from 01-26-90 to 04-26-90 at the Rocky Mountain Arsenal.

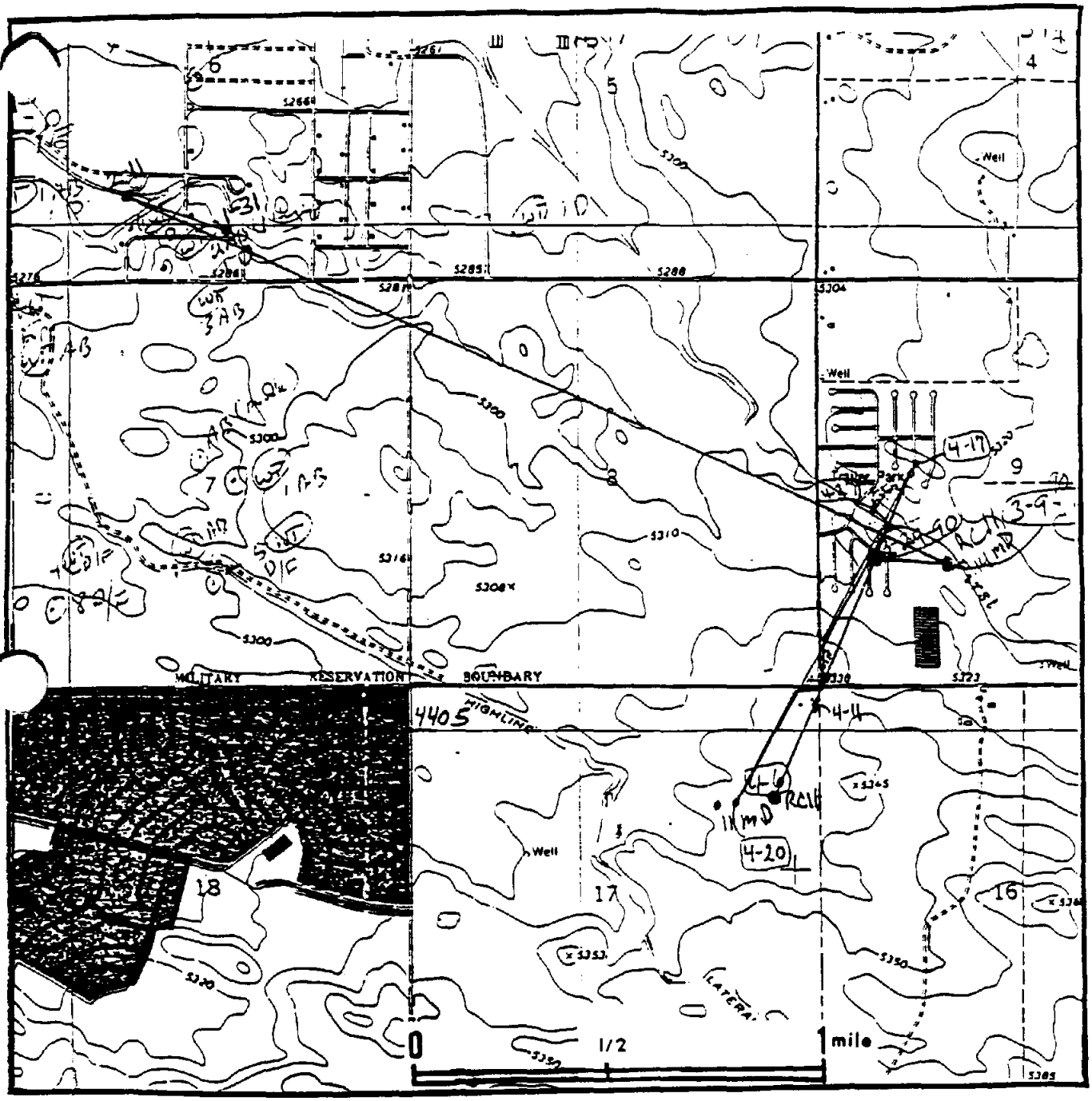


Movements of radio-collared white-tailed deer #8 from 11-23-90 to 04-27-90 at the Rocky Mountain Arsenal.

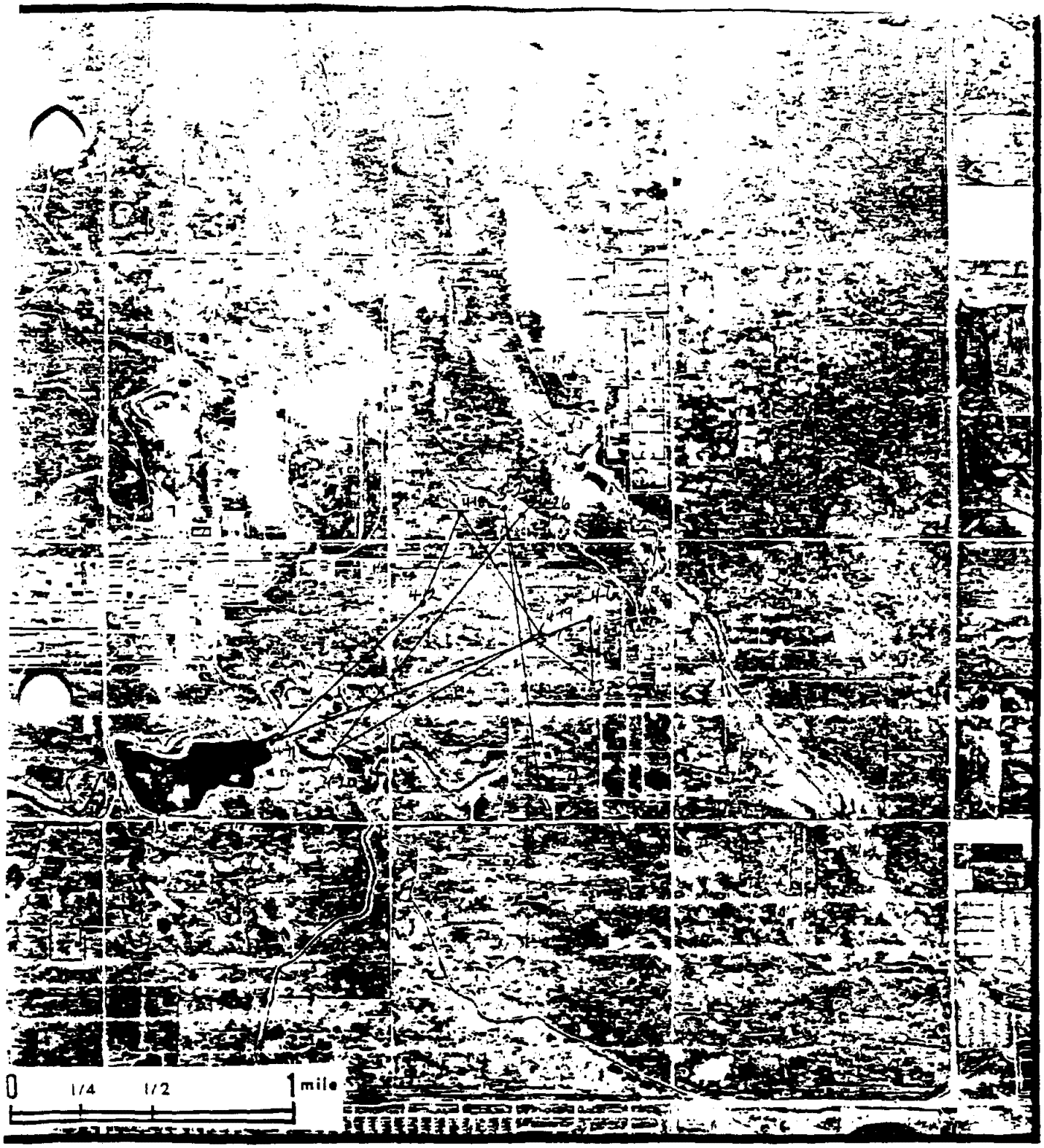
Movements of radio-collared [illegible] deer #9 from 01-30-90 to 04-26-90 at the Rocky Mountain Arsenal.



Movements of radio collared mule deer #10 from 01-30-90 to 04-20-90 at the Rocky Mountain Arsenal.

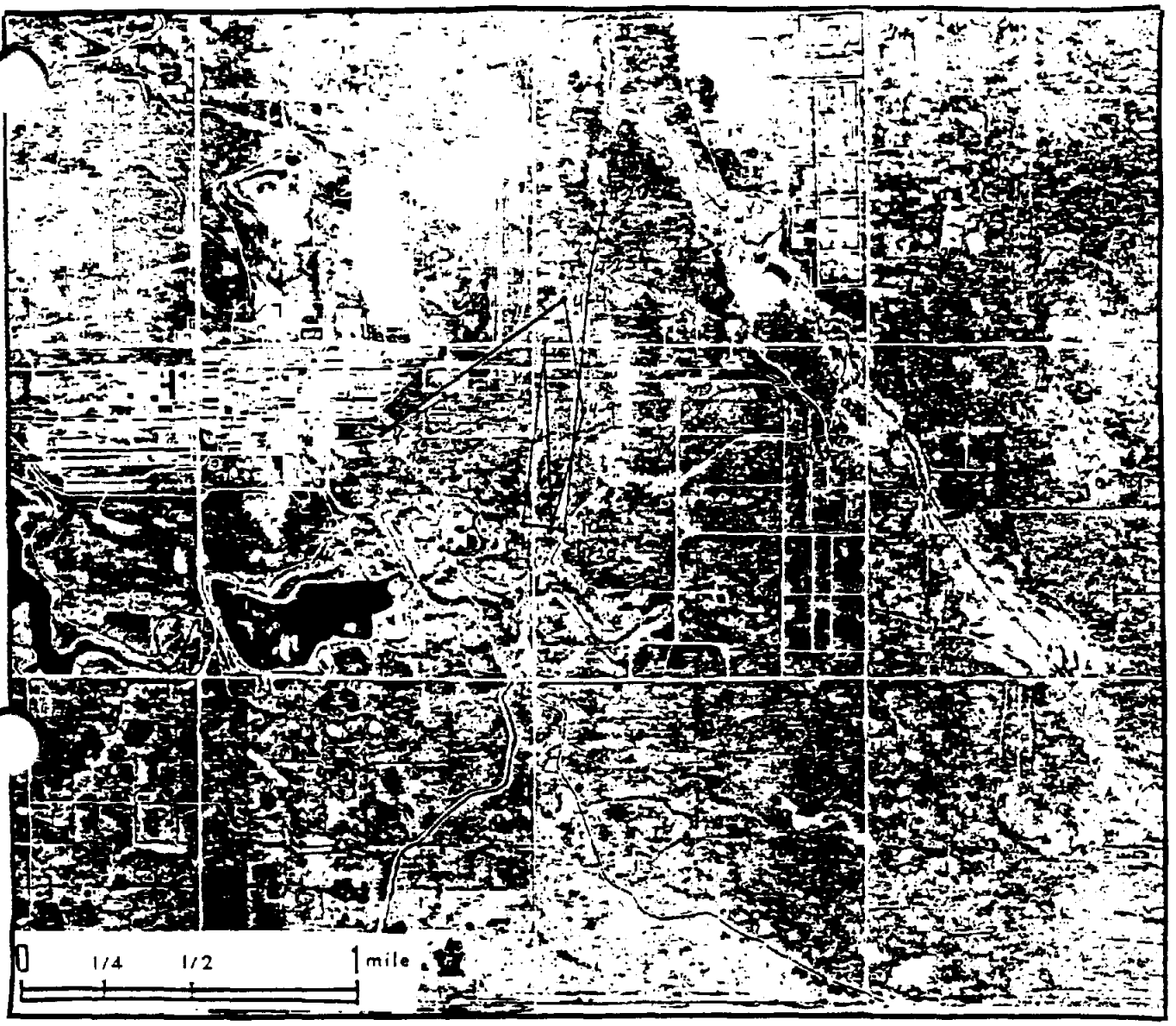


Movements of radio-collared mule deer #11 from 01-31-90 to 04-27-90 at the Rocky Mountain Arsenal.



Movements of radio-collared white-tailed deer #12 from 02-04-90 to 04-26-90 at the Rocky Mountain Arsenal.

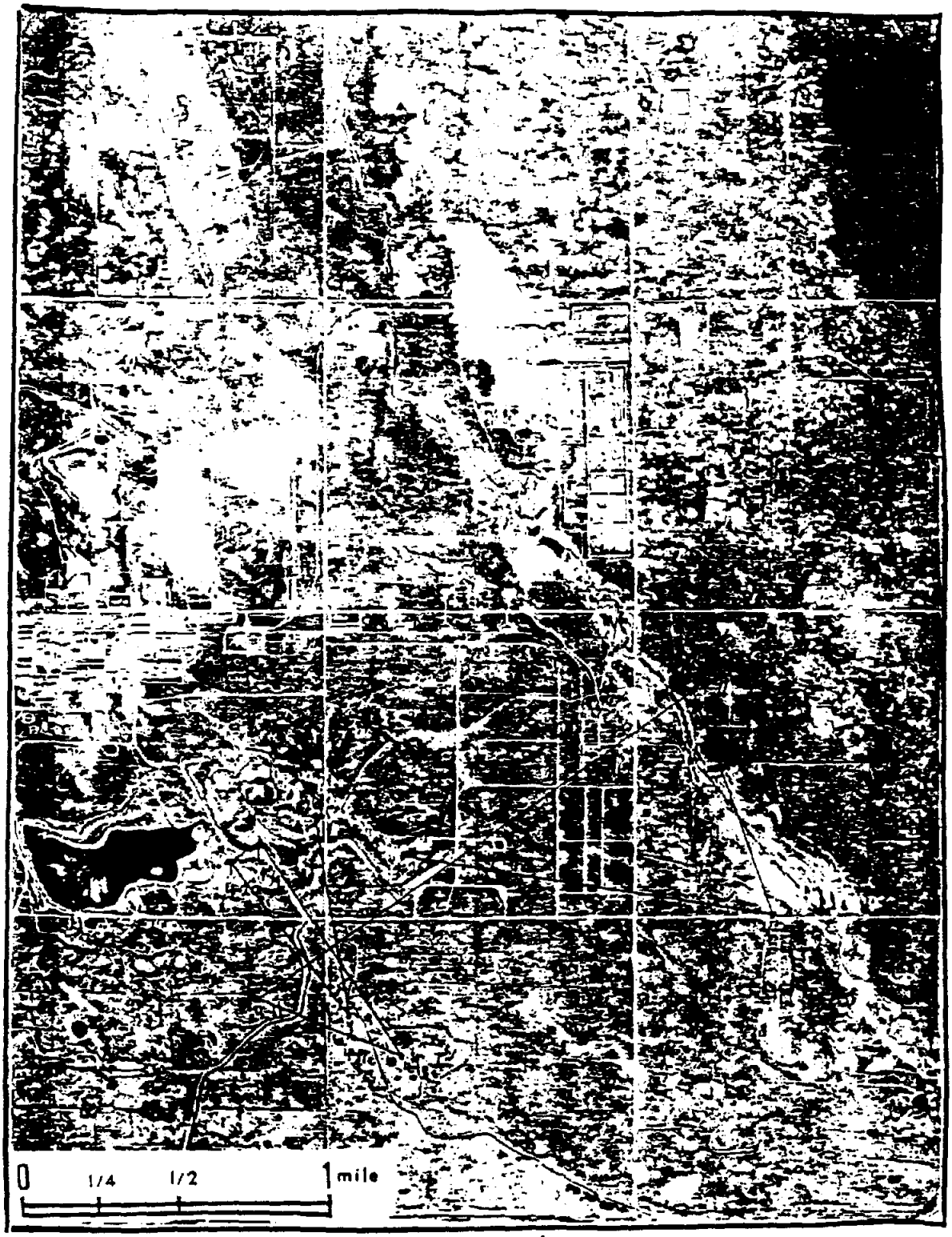
Movements of radio-collared mule deer #13-A from 02-13-90 to 03-20-90 at the Rocky Mountain Arsenal.



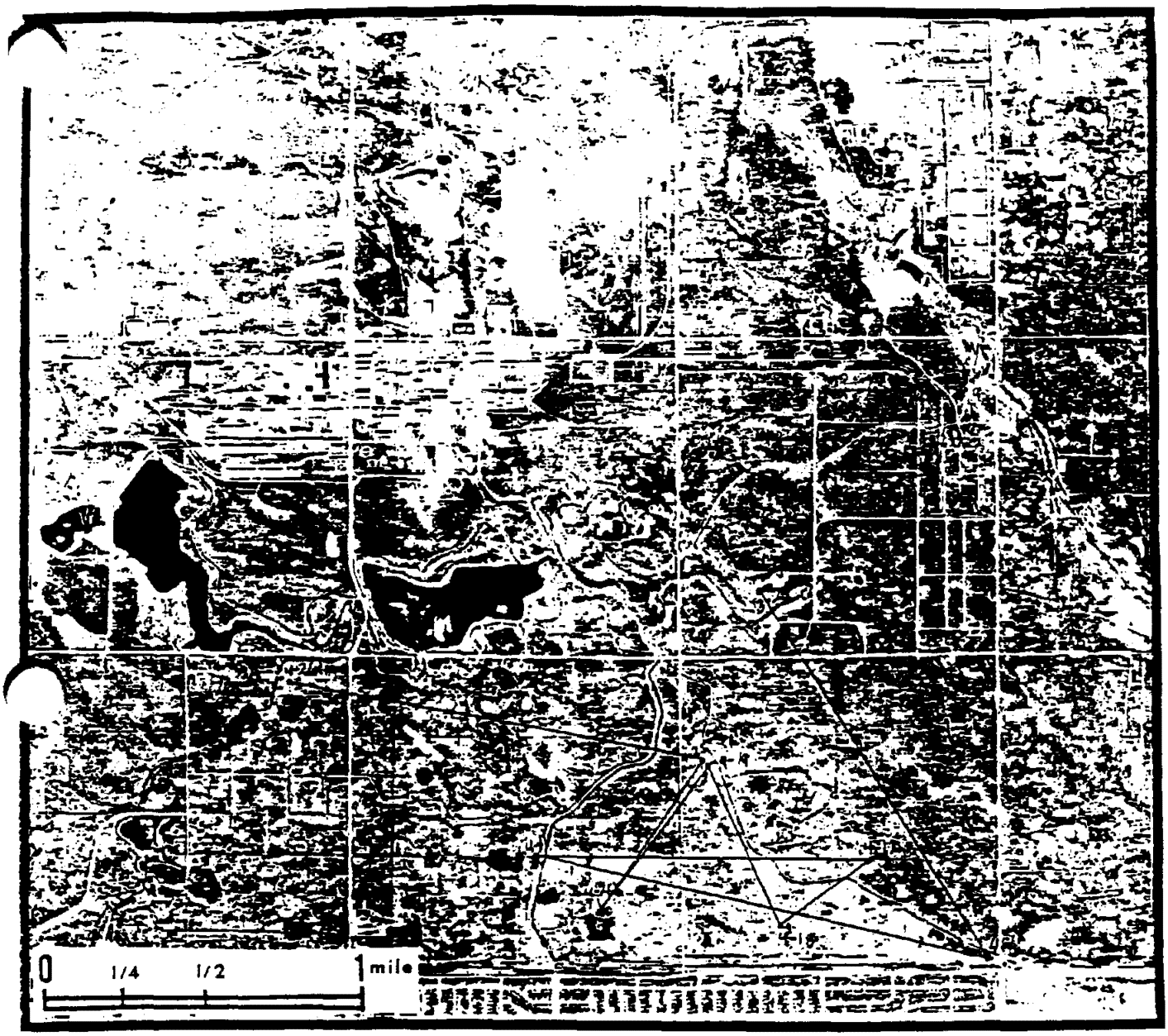
Movements of radio-collared mule deer #13-B from 04-03-90 to 04-16-90 at the Rocky Mountain Arsenal.

Movements of radio-[illegible] mule deer #14 from 02-22-90 to 04-26-90 at the Rocky Mountain Arsenal.

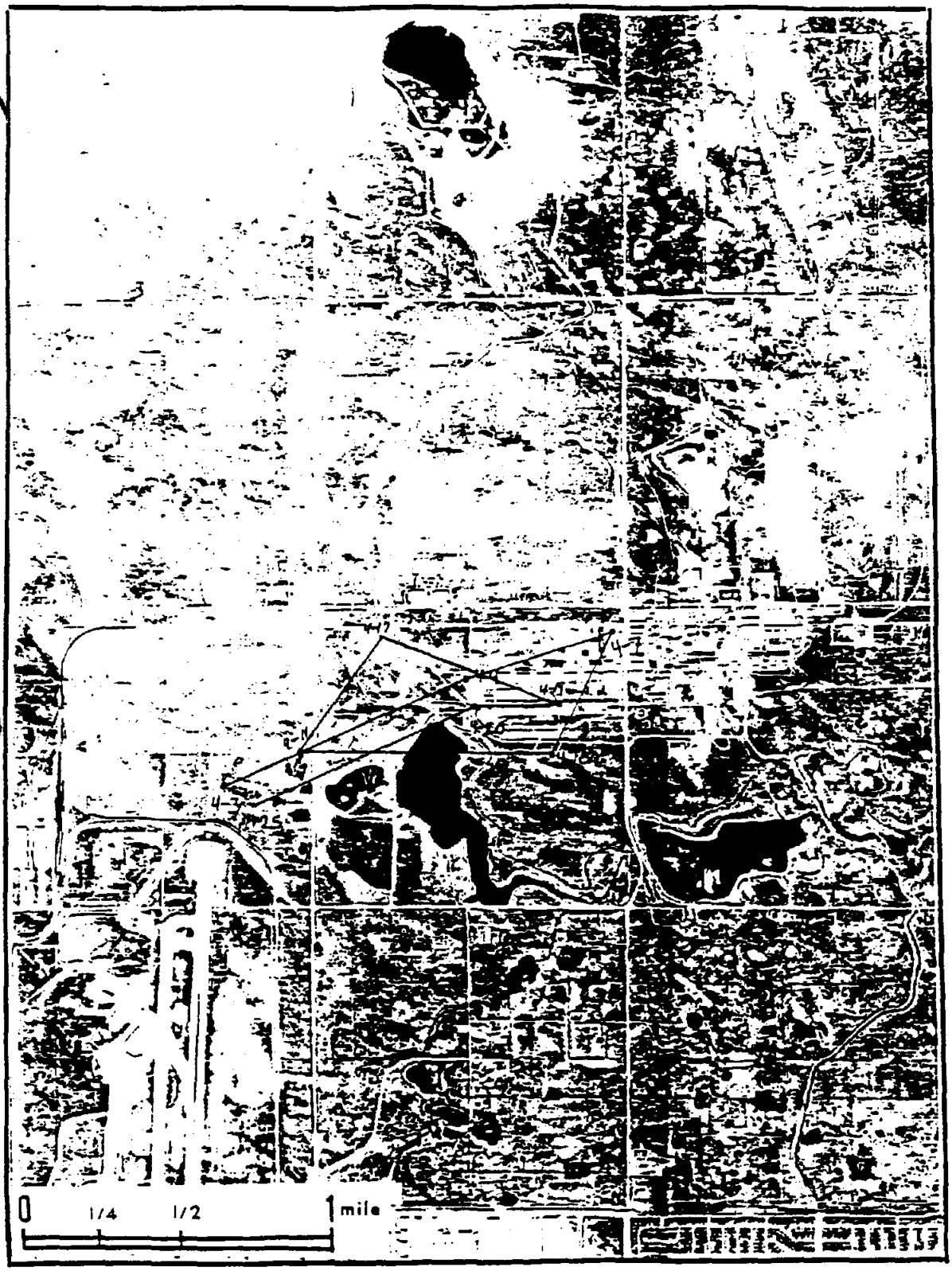
Movements of radio-collared white-tailed deer #15 from 03-06-90 to 03-25-90 at the Rocky Mountain Arsenal.



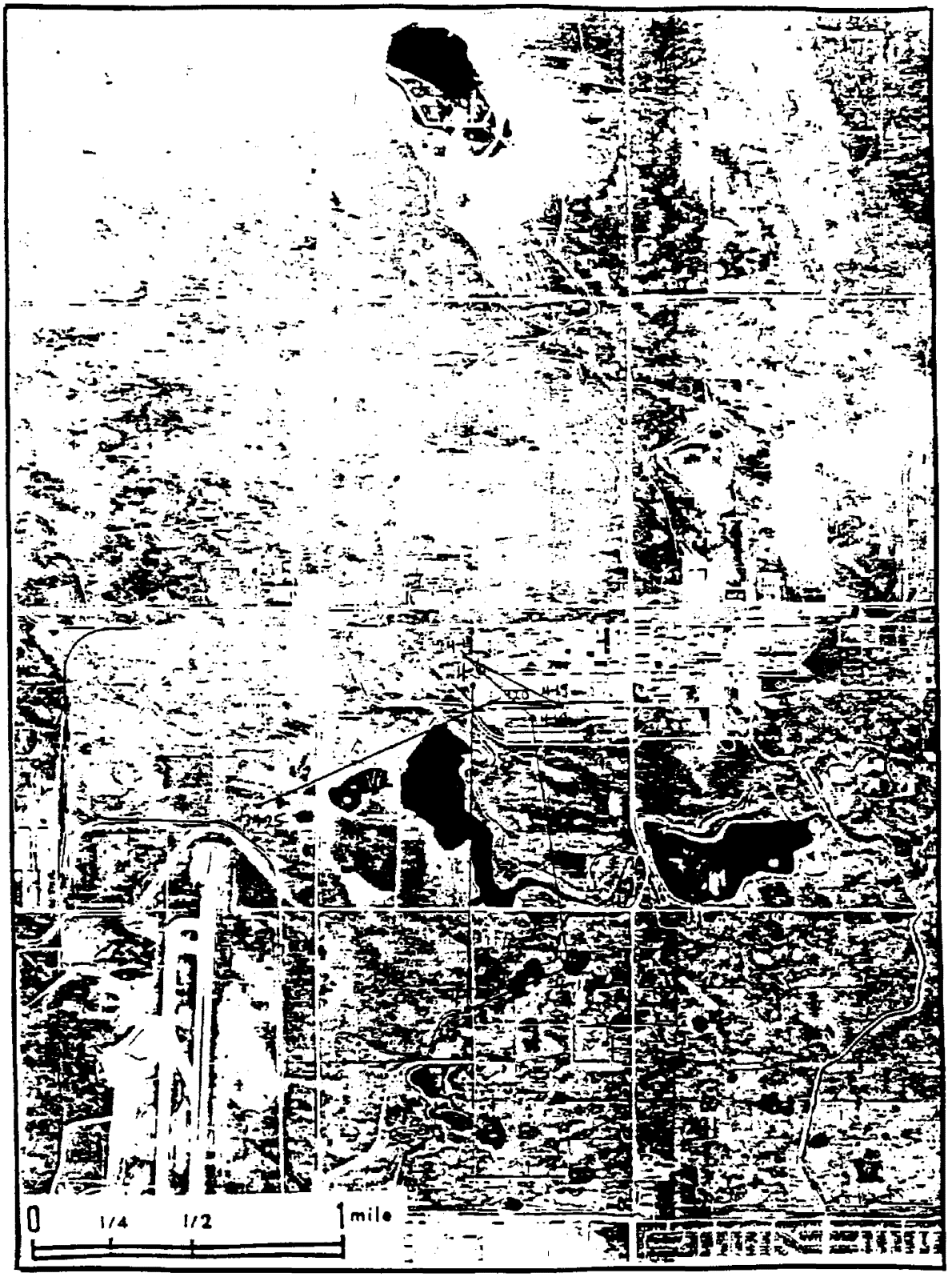
Movements of radio-collared white-tailed deer #16 from 03-20-9
to 04-26-90 at the Rocky Mountain Arsenal.



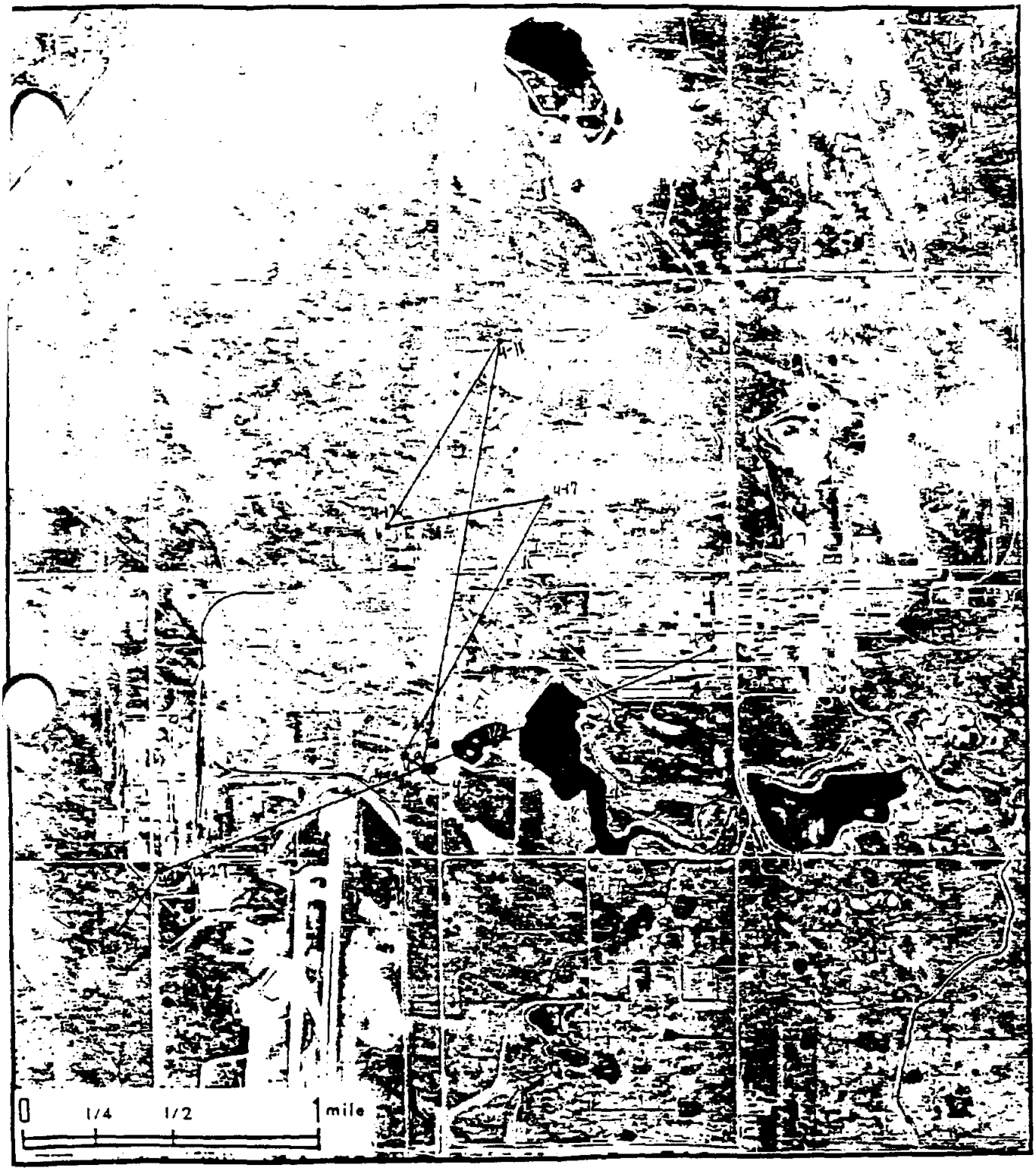
Movements of radio-collared white-tailed deer #17 from 03-21-90 to 04-28-90 at the Rocky Mountain Arsenal.



Movements of radio-collared mule deer #18 from 04-03-90 to 04-25-90 at the Rocky Mountain Arsenal.



Movements of radio-collared mule deer #10 from 04-06-90 to 04-25-90 at the Rocky Mountain Arsenal.



Movements of radio-collared mule deer #20 from 04-06-90 to 04-27-90 at the Rocky Mountain Arsenal.

ROCKY MOUNTAIN ARSENAL DEER PROJECT

PART II

By

Donald G. Whittaker

FY 1990 Progress Report

ROCKY MOUNTAIN ARSENAL DEER PROJECT

PROGRESS REPORT

PART II

2 May 1990 to 31 December 1990

Prepared by:

Donald G. Whittaker

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INTRODUCTION

The Rocky Mountain Arsenal (RMA) Deer Project is a cooperative research project between the U.S. Fish and Wildlife Service and the University of Wyoming. The purpose of the project is to document the demographics and interactions of mule (*Odocoileus hemionus*) and white-tailed (*O. virginianus*) deer on RMA. An additional purpose of the project is to fulfill the research requirements for a Ph.D. with the University of Wyoming Graduate School.

Initial work began on 1 January 1990 and was conducted by Jonathan D. Hanna until 1 May 1990. Work conducted after 15 May 1990 has been completed by Donald G. Whittaker. A description of the study area and methods, as well as results of work conducted during this time period can be found in Part I (Hanna and Lindzey 1990) of the progress report. The purpose of part II is to document the progress and results of work conducted from 15 May 1990 to 31 December 1990.

RESULTS

Dietary Comparisons

Thirteen composite fecal samples were sent to the CSU Diet Composition Analysis Laboratory for analysis. A total of 33 plant species or parts (7 grasses, 2 shrubs, 2 trees, and 22 forbs) were identified in mule and white-tailed deer diets between February and August 1990 (Table 1). Results of chemical analyses indicate no difference in dietary protein ($P = 0.47$) and nitrogen ($P = 0.47$) (Table 2).

Table 1. List of plant species or parts identified in the diets of mule and white-tailed deer on Rocky Mountain Arsenal between February and August 1990.

Plant	Growth Form
Agropyron sp.	Grass
Bromus sp.	Grass
Carex sp.	Grass Like
Grass seeds/glumes	Grass
Poa sp.	Grass
Sporobolus sp.	Grass
Zea sp.	Grass
Artemesia sp.	Shrub
Salix sp.	Shrub
Eleagnus sp.	Tree
Pinus sp.	Tree
Composite (Family)	Forb
Convovulvus sp.	Forb
Descurania sp.	Forb
Erigeron sp.	Forb
Helianthus sp.	Forb
Hymenopappus sp.	Forb
Kochia sp.	Forb
Lesquerella sp.	Forb
Lupinus sp.	Forb
Melelotus sp.	Forb
Mentzelia sp.	Forb
Oenothera sp.	Forb
Plantago sp.	Forb
Potentilla sp.	Forb
Sphaeralcea sp.	Forb
Verbascum sp.	Forb
Legumes	Forb
Seeds	Forb
Spines	Forb
Unknown (2 sp.)	Forb

Table 2. Mean and standard error percent dietary nitrogen and protein found in mule and white-tailed deer fecal samples collected at Rocky Mountain Arsenal from February to August, 1990.

	% Protein			% Nitrogen		
Species	N	Mean	SE	N	Mean	SE
Mule Deer	6	14.55	1.74	6	2.33	0.28
WT Deer	7	16.05	1.13	7	2.57	0.18

Radio Tracking

Over 1,300 location estimates have been obtained on 11 mule deer and 7 white-tailed deer since 1 January 1990. Mean convex polygon home ranges (Mohr 1947) for the period between January and August were 3991 ± 1831 ha and 4286 ± 3187 ha for white-tailed and mule deer respectively (Table 3). Plots of all location estimates for each species indicates a high degree of overlap in areas used (Figures 1 and 2). However, when location estimates from only does with at least 1 fawn during the period 1 June - 30 August 1990 are plotted, there appears to be segregation between the species (Figures 3 and 4).

Demographics

Four monthly surveys have been conducted since May 1990. Number of total deer seen has varied from 102 in July to 298 in December (Table 4). Roughly 70% of the collared animals were seen in the December survey indicating that a high percentage of the total population was seen. Entering the number of collars seen (12 of 15 mule deer, 6 of 8 white-tailed deer) and the total number of each species seen in the December survey into a Lincoln-Petersen formula yields a simple population estimate of 274 mule deer and 105 white-tailed deer on RMA. Doe:Fawn and Buck:Doe ratios were consistently lower for white-tailed deer than mule deer (Table 4).

Table 3. Convex polygon home range areas for 17 mule and white-tailed deer radio-tracked between January and August 1990 on Rocky Mountain Arsenal, Colorado.

ID	Species	Hectares	Acres
1	White-tail	7282	17993
2	Mule Deer	2742	6775
3	Mule Deer	9654	23855
5	White-tail	5106	12617
6	Mule Deer	2962	7319
7	Mule Deer	5547	13706
8	White-tail	3517	8692
9	Mule Deer	3578	8841
10	Mule Deer	3067	7578
12	White-tail	1993	4922
13	Mule Deer	1969	4865
14	Mule Deer	10111	24984
15	White-tail	2652	6553
16	White-tail	4657	11507
17	White-tail	2726	6738
18	Mule Deer	858	2120
20	Mule Deer	2316	5725

Figure 1. Distribution of re-locations for female mule deer on Rocky Mountain Arsenal, 1 January 1990 - 30 August 1990.

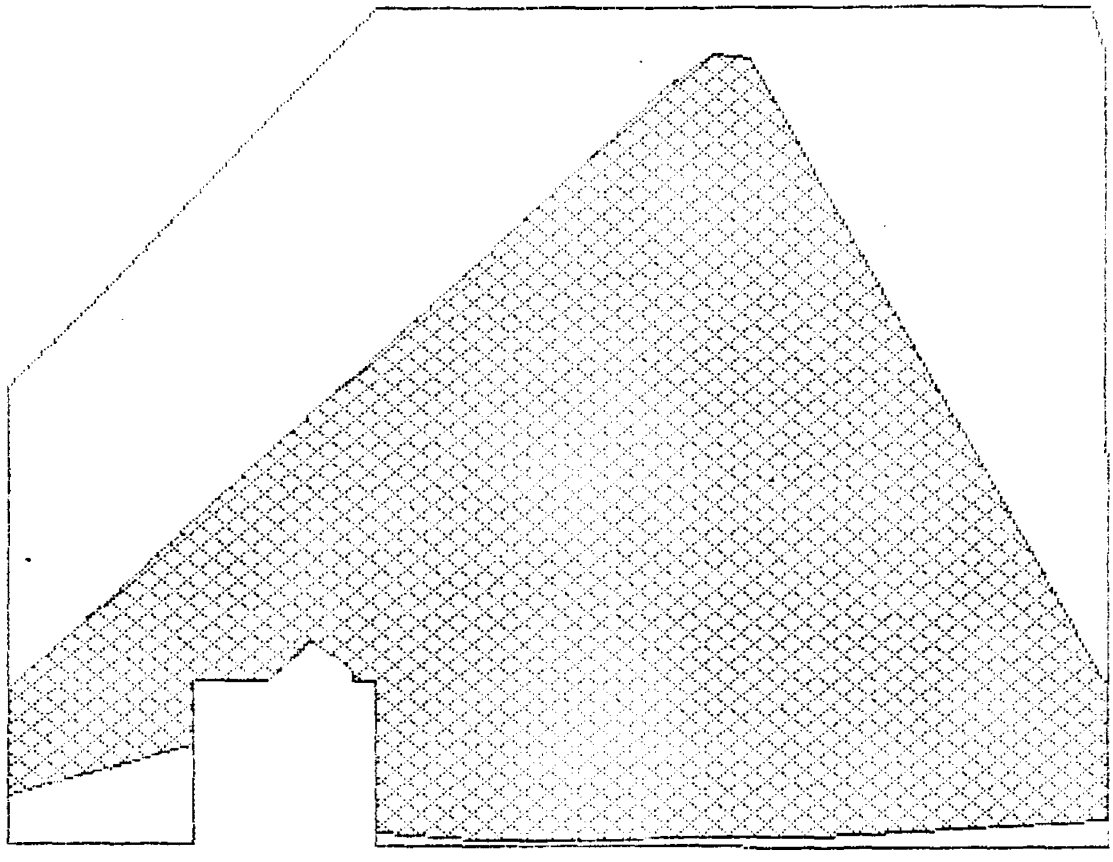

Figure 2. Distribution of re-locations for female white-tailed deer on Rocky Mountain Arsenal, 1 January 1990 - 30 August 1990.

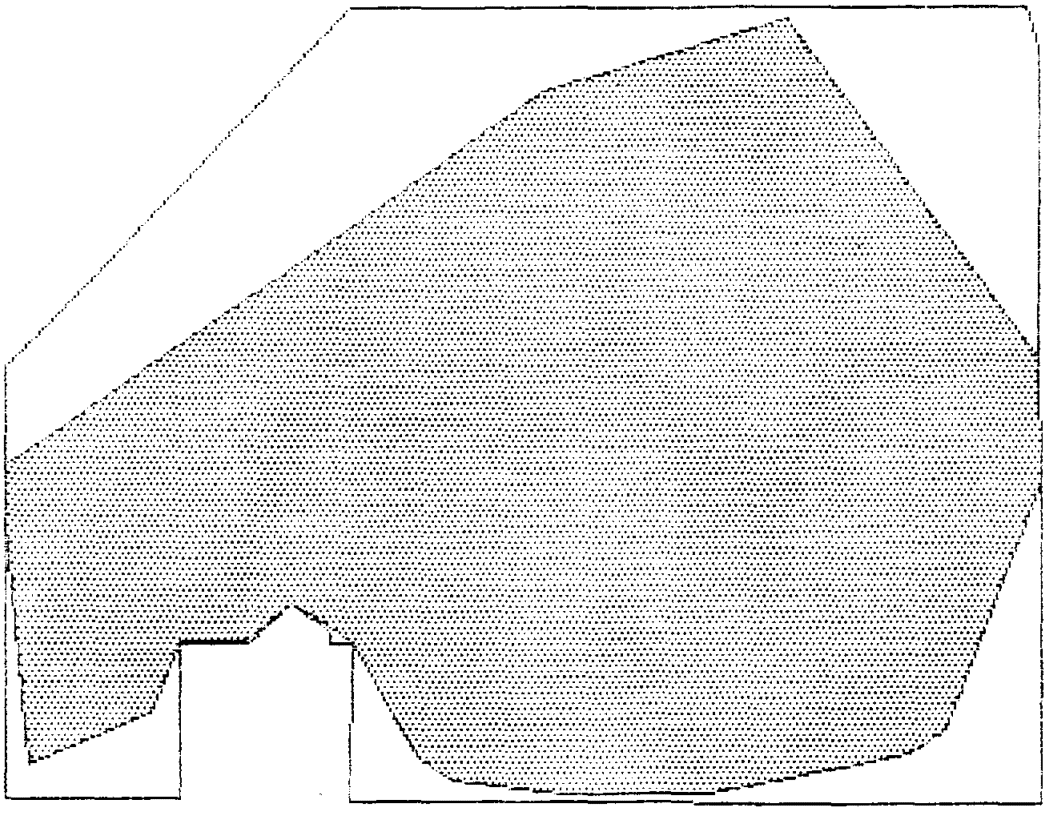

Figure 3. Distribution of re-locations for female mule deer with fawns on Rocky Mountain Arsenal, 1 June 1990 - 30 August 1990.

Figure 4. Distribution of re-locations for female white-tailed deer with fawns on Rocky Mountain Arsenal, 1 June 1990 - 30 August 1990.

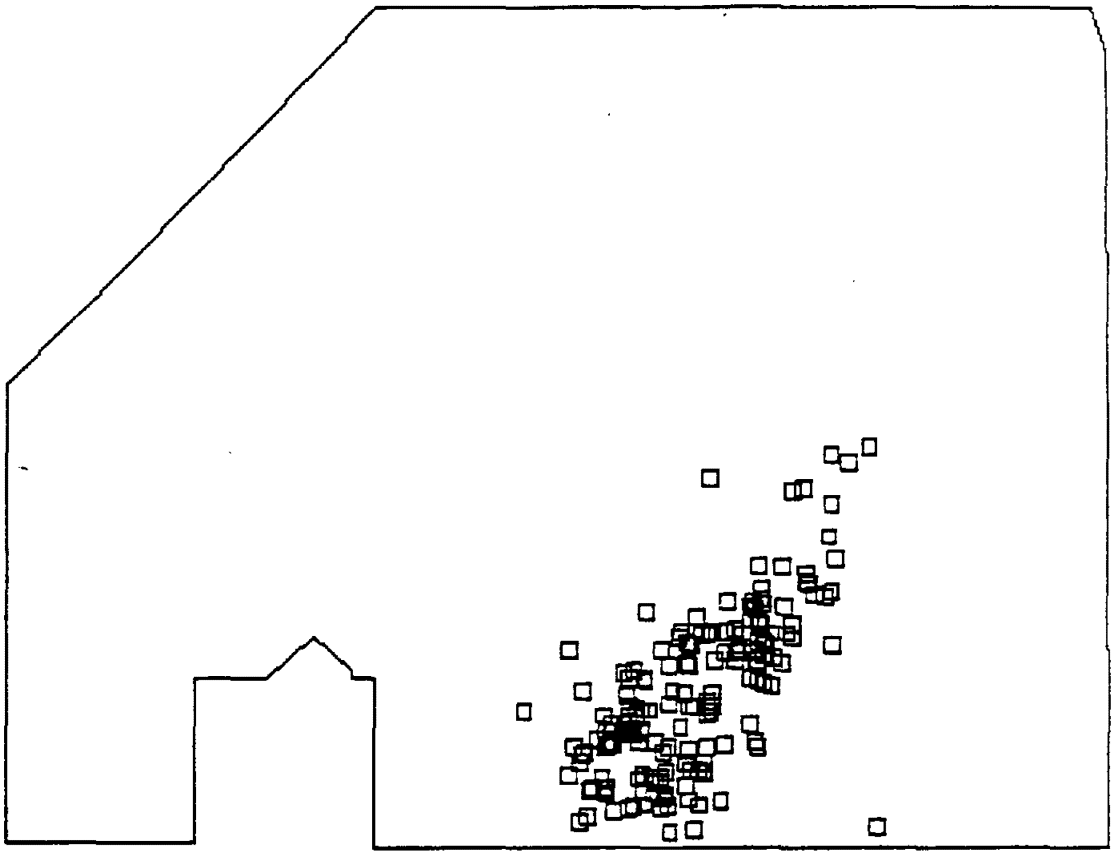

Table 4. Results of composition surveys conducted between July and December 1990 on Rocky Mountain Arsenal, Colorado.

Date	Species	Number Seen			Number/100 does		
		Bucks	Does	Fawns	Bucks	Does	Fawns
1 July	Mule Deer	35	32	7	109	100	22
1 July	White-tail	11	15	2	73	100	14
17 Oct.	Mule Deer	35	68	56	51	100	82
17 Oct.	White-tail	15	30	22	50	100	73
18 Nov.	Mule Deer	73	112	50	65	100	45
18 Nov.	White-tail	11	21	5	52	100	24
30 Dec.	Mule Deer	60	84	70	71	100	83
30 Dec.	White-tail	17	39	20	43	100	51

CONCLUSION

Although rigorous statistics have not yet been applied to the data, apparent trends for different fawning and fawn rearing areas and differences in demographics on RMA indicates that mule and white-tailed deer may require species specific management strategies on RMA. Using preliminary results of the first year as a guideline, future data collection and analysis will be directed at determining specific differences between mule and white-tailed deer, and what management strategies will be most beneficial for Rocky Mountain Arsenal deer.

LITERATURE CITED

Hanna, J. D, and F. G. Lindzey. 1990. Rocky Mountain Arsenal Deer Project, Progress Report, Part I. Wyo. Coop. Fish and Wildl. Res. Unit. Larimie, Wyo. 52 pp.

Mohr, C. O. 1947. Table of equivalent populations of North American small mammals. Am. Midl. Nat. 37:223-249.

PRAIRIE DOG ABUNDANCE AND EVALUATION OF PRAIRIE DOG TRANSLOCATIONS ON THE ROCKY MOUNTAIN ARSEANAL

By

Kevin W. Robinette

and

Dr. William F. Andelt

FY 1990 Annual Progress Report

COMBINED PROGRESS REPORT

Research Work Orders 21 and 24

For the period 1 May to 30 November 1990

on the study of

PRAIRIE DOG ABUNDANCE ON THE ROCKY MOUNTAIN ARSENAL

and

EVALUATION OF PRAIRIE DOG TRANSLOCATIONS ON THE ROCKY MOUNTAIN ARSENAL

Prepared by:

Kevin W. Robinette

and Dr. William F. Andelt

Department of Fishery and Wildlife Biology

Colorado State University

1 December 1990

The results presented in this report are preliminary and may not be cited or otherwise published without the written consent of the authors.

Abstract: Black-tailed prairie dogs (Cynomys ludovicianus) were relocated into 12 experimental release sites on the Rocky Mountain Arsenal (RMA) from 30 July through 3 October 1990. Relocation plots 1, 3, and 6 hectares in size received 10, 30, and 60 animals, respectively. The animals in each plot were recaptured from 25 September to 16 October 1990 to determine survival in relation to group size. The percentage of residents recaptured averaged 26.7, 41.1, and 40.3 for the 1-ha, 3-ha, and 6-ha plots, respectively.

Several materials were evaluated to determine their effectiveness as prairie dog barriers on the RMA. Barriers constructed from electrified wire and/or irrigation ditch lining were the most successful.

J. Wildl. Manage. 00(0):000-000

Black-tailed prairie dogs (prairie dogs) are an important prey source for wintering raptors on the RMA. Sylvatic plague decimated the prairie dog population on the RMA in the Fall of 1988 (Ebasco Services, Inc. 1989). United States Fish and Wildlife Service (USFWS) personnel began relocating prairie dogs to abandoned prairie dog colonies on the RMA in the Fall of 1989 in order to increase the rate of population recovery in these colonies (U. S. Fish and Wildlife Service, 1989). Although these prairie dogs were individually ear-tagged by USFWS personnel, the animals were released over non-descriminant periods of time and into non-descriminant areas with limited subsequent monitoring of survival. In May of 1990, we began a study to evaluate the effect of group size on survival of black-tailed prairie dog relocated to the RMA.

In addition to the relocation study, we attempted to develop barriers to keep prairie dogs out of areas where they are not desired. This has management implications for landowners and government agencies who wish to control prairie dog colony expansion. On the RMA, barriers can be used to keep prairie dogs out of contaminated areas, out of areas which are involved in clean up operations, and/or from migrating off the RMA and into urban areas.

We thank Prairie Dog Rescue, Loveland Prairie Dog Action, Citizens Concerned for Wildlife, and the Boulder Humane Society for providing prairie dogs used in the relocation experiment.

METHODS

Relocation

Twelve sites were selected as experimental relocation plots in prairie dog colonies extirpated by plague on the RMA (Figure 1). These plots included 3 sites 6 ha in size, 3 sites 3 ha in size, and 6 sites 1 ha in size. Plots were demarcated with t-posts and signs. RMA's facilities engineers mowed all relocation plots and dusted the prairie dog burrows with a synthetic pyrethrin, Pyraperm™ (Fairfield American Corporation, Rutherford, N.J.). These precautions were taken before releasing any animals in an effort to increase the attractiveness of the release sites and to kill any fleas which might remain in the burrows and carry plague.

Prairie dogs were released in densities of 10 animals per ha, sex ratios of 2 females to 1 male, and age ratios of 3 juveniles per 2 adults to reflect natural ratios and to satisfy concerns we had about

animals leaving the plots. We sprayed each prairie dog with Sectrol™ pet spray (3M Animal Care Products, St. Paul, Minn.) and ear-tagged them in both ears with Monel no. 1 fingerling fish tags (National Band and Tag Co.. Newport, Ky.). Each prairie dog was distinctly marked with Nyanzol-D fur dye (Belmar Inc., North Andover, Mass.) in relation to sex and age. Adult males were marked on the right shoulder, juvenile males were marked on the right flank, adult females were marked on the left shoulder, and juvenile females were marked on the left flank. Prairie dogs were then released into burrows near the center of each plot.

Prairie dogs were relocated to the experimental plots in a series of 3 repetitions. Each repetition included 4 plots; 1 plot 6 ha in size, 1 plot 3 ha in size, and 2 plots 1 ha in size. Two repetitions were filled with prairie dogs which were flushed from their burrows with soapy water. These "flushed" prairie dogs were brought to the RMA by prairie dog relocators from sites around Denver, Boulder, and Loveland, Colorado. The remaining repetition was filled with prairie dogs that were live-trapped on other parts of the RMA.

Recapture of Relocated Animals

In September, we began recapture trapping of the relocation plots. One repetition was trapped per trapping session. Each repetition was trapped for 4 days after prebaiting for 3 days. Tomahawk model 202 live traps (Tomahawk Live Trap Company, Tomahawk, Wis.) were placed on active burrow mounds at densities of 1.5 traps per prairie dog released.

During recapture sessions, fur dye was reapplied and replacement eartags were attached if either of the original tags were lost. We

recorded if recaptured animals were initially relocated at the plot (resident) or had moved in from elsewhere (immigrant).

Barrier Prototypes

Small barrier prototypes were evaluated on the RMA from June through August 1990 using prairie dogs captured on site. We constructed the prototypes as 4-m square enclosures. Wooden posts were permanently set at the corners of each enclosure to facilitate construction and removal of barrier material and/or electric fence wire. We evaluated irrigation ditch lining material at different heights, aluminum flashing material, various configurations of electric fence wire, combination electric fence and irrigation ditch lining material, and an electrified net product.

Prairie dogs were live-trapped from burrows surrounding the enclosure site and released into the enclosures. The first prairie dogs released into the enclosures immediately traversed the barriers after release. We determined that this might be due to increased motivation to flee from observers, so we constructed a wooden box from which we could release the prairie dogs remotely. This release box was used throughout the evaluation. Success of the barrier prototypes was determined by the amount of time animals were kept within the enclosure.

RESULTS

Recapture of Relocated Animals

The percentage of residents recaptured in the relocation plots averaged 26.7%, 41.1%, and 40.3% for the 1-ha, 3-ha, and 6-ha plots

respectively (Table 1).

Barrier Prototypes

Barriers constructed from irrigation ditch lining and electric fence wire were the most successful. Irrigation ditch lining material was more successful at a height of 66 cm than at a height of 46 cm. Electric wire configurations were most successful at heights of 30 cm. Wires worked best when alternately charged and grounded with a maximum of 4 cm spacing between the wires. A set of charged wires offset from an electric fence design or irrigation ditch lining material improved the success of both types of barriers. Aluminum flashing material was unsuccessful as prairie dogs responded to it by digging under. This might be a behavioral response to the animals viewing a reflection and not a opaque barrier like the irrigation ditch lining material. Electrified netting was unsuccessful due to the large spaces between the wires inherent in the manufacturers design. Slanting the electric wire and electric net designs did not improve their success.

From our initial work with barrier materials, we have decided to further evaluate 4 designs, including:

1. A visual barrier constructed from agricultural irrigation ditch lining material attached to wire strung between t-posts.
2. A visual barrier like (1) with 3 strands of electric wire spaced 3-4 cm apart run parallel and about 10 cm from the visual barrier.
3. An electric fence barrier constructed with 9 strands of electric wire spaced 3-4 cm apart.
4. An electric fence barrier like (3) with 3 offset electric wires

spaced 10 cm parallel to the original 9.

DISCUSSION

Recapture of Relocated Animals

The number of animals trapped may be a function of what trapping method was used to capture the animals for relocation i.e. trapped animals may be more easily trapped than flushed animals. However, the trapped animals were evenly distributed throughout the repetitions and if there is a trapping effect, it should have an equal effect throughout the different sized plots.

The number of residents recaptured during the trapping session are rough estimates of animals remaining in the plots after about 1 month (avg. = 39.33 days, S.D. = 11.8) and may be thought of as even rougher estimates of survival. Very small plots had lower average survival than the medium and large plots. Survival was not different between medium and large plots.

OTHER ACTIVITIES THIS PERIOD

1. Finalized research proposal.
2. Selected Buckley Air National Guard Base after looking at numerous private and public areas throughout the Denver and Boulder metropolitan areas.
3. The status of prairie dog colonies recovering from plague on the RMA was determined by mapping.

PLANS FOR NEXT PERIOD

1. Construct and evaluate 4 barrier designs as 0.5 ha exclosures on Buckley Air National Guard Base.
2. Attend classes at Colorado State University.
3. Continue capture-recapture trapping of relocation plots.

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Figure 1. Location of relocation plots on the Rocky Mountain Arsenal.

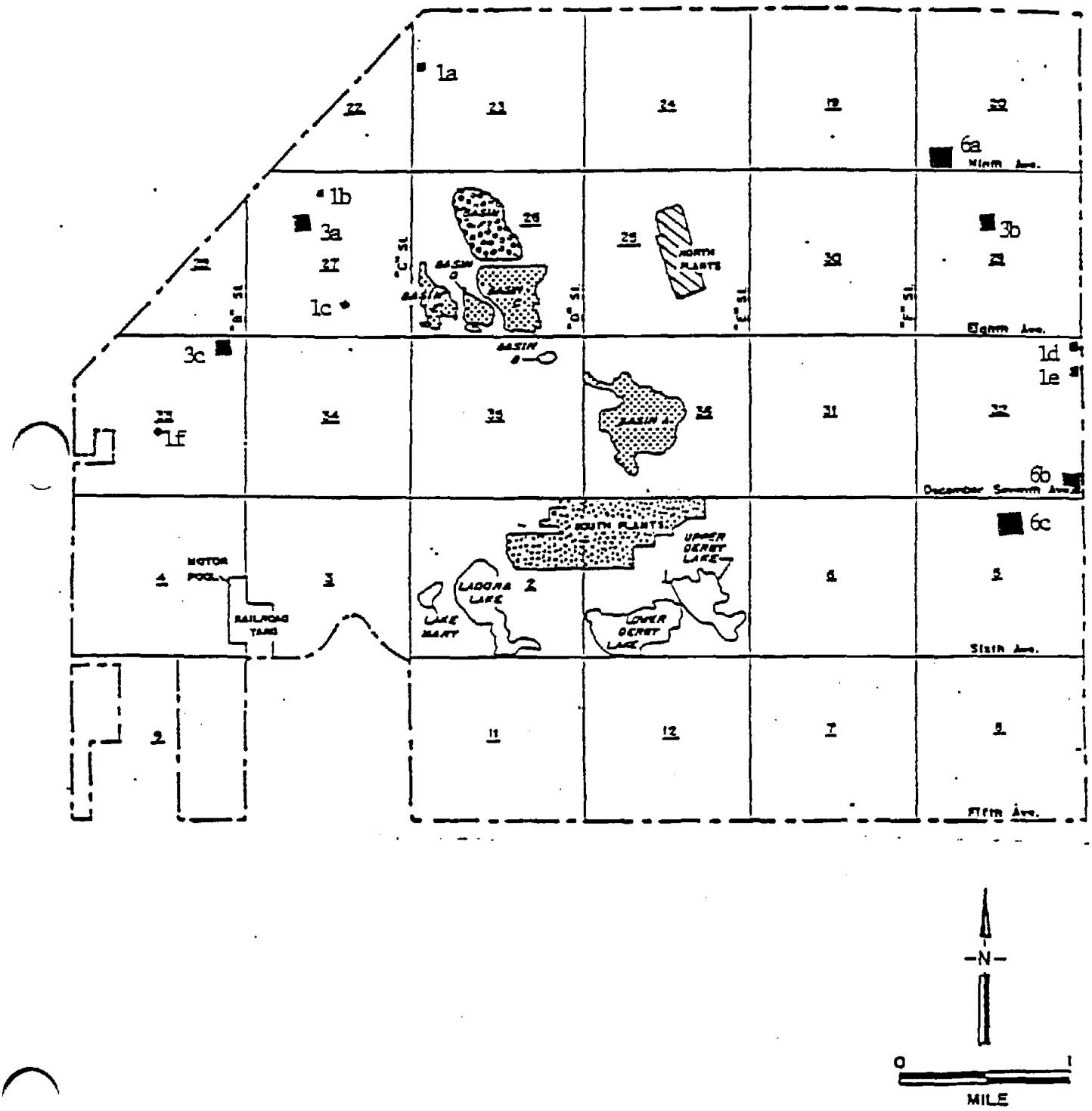

Table 1. Prairie dogs recaptured at relocation plots.

	Animals Released	Recaptures			Percent Residents Trapped
		Res.	Imm.	Total	
1a	10	1	0	1	10.0
1b	10	9	0	9	90.0
1c	10	0	0	0	0.0
1d	10	5	2	7	50.0
1e	10	1	0	1	10.0
1f	11	0	0	0	0.0
Average for 1-ha plots					26.7
3a	30	18	1	19	60.0
3b	30	7	1	8	23.3
3c	30	12	0	12	40.0
Average for 3-ha plots					41.1
6a	60	27	5	32	45.0
6b	59	29	0	29	49.2
6c	60	16	7	23	26.7
Average for 6-ha plots					40.3

ECOLOGY OF COYOTES AND BADGERS ON THE ROCKY MOUNTAIN ARSENAL

By

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and

Dr. William F. Andelt

FY 1990 Annual Progress Report

The results presented in this report are preliminary and may not be cited or otherwise published without the written consent of the authors.

Abstract: The effectiveness of an oral bait delivery device, coyote lure operative device (CLOD), was evaluated for coyotes (Canis latrans) on the Rocky Mountain Arsenal (RMA). Coyotes and badgers (Taxidea taxus) were captured using Woodstream Softcatch® traps and radio transmitters placed on all coyotes and selected badgers. Both species will be monitored to develop home range estimates. Two permanent radiotelemetry towers located on the RMA and a vehicle-mounted antenna system were field tested to provide information on accuracy and precision of location estimates. We will investigate the effect of deer carcass bait stations on coyote activity during December 1990, and January and February 1991. A protocol was established for coyote surveys which will be completed during the winter, to develop an estimate on coyote density on the RMA.

In a cooperative agreement between United States Fish and Wildlife Service and Colorado State University, a field study began in May 1990 studying coyotes and badgers on the RMA. Remediation efforts on the RMA might destroy significant areas of habitat. These clean-up operations might include mitigation efforts for specific species. Therefore, it is important to test several procedures to demonstrate their utility in

coyote management on the RMA. An oral-bait delivery device (Coyote Lure Operative Device, CLODs), and the effect of deer carrion bait stations on coyote activity will be evaluated. Furthermore, badgers and coyotes will be monitored to determine activity patterns and develop home range estimates in order to establish baseline information for future management decisions. This report summarizes the field work conducted on the RMA from May through November 1990. During this time we tested field tested CLODs, captured coyotes and badgers, evaluated the accuracy and precision of radiotelemetry equipment and antenna systems, began radiotelemetry locations of instrumented animals, developed an experimental design for investigating the effect of deer carcass bait stations on coyote movements, and finalized a protocol for coyote surveys on the RMA.

I am grateful to Drs. Richard C. Cambre and David E. Kenny for their support and efforts with surgical implanting of radio transmitters in badgers, and to the staff at the Denver Zoological Foundation Animal Care Clinic.

METHODS

Study Site

The RMA is an area of 27 square miles that is inhabited by a large abundance and diversity of wildlife. It is located at the northeast corner of Denver, Colorado, at the northern boundary of Stapleton International Airport.

Coyote Lure Operative Device

The effectiveness of Coyote Lure Operative Devices (CLODs) for delivering ingestible substances to coyotes was tested by using a solution of corn syrup/powdered sugar (Marsh et al. 1982) and biological markers, iophenoxic acid (alpha-ethyl-3-hydroxy-2,4,6-triiodobenzenepropanoic acid) (10 mg) (Larson et al. 1981, Knowlton et al. 1987) and tetracycline hydrochloride (100 mg) (Johnston et al. 1987) in CLODs. Iophenoxic acid produces a distinguishable lasting mark in coyotes, that is detectable in blood serum analysis (Larson et al. 1981, Knowlton et al. 1987) and tetracycline hydrochloride should produce a distinguishable mark detectable by ultra-violet microscopy of cross-sectioned lower premolar (Johnston pers. comm.). Iophenoxic acid was used near deer carcasses whereas a mixture of iophenoxic acid and tetracycline hydrochloride was used away from carcasses. CLODs were placed in a modified survey scent station design (Stolzenburg and Howard 1989) $\leq$ 20 m and $\geq$ 500 m from deer carcasses to determine the effect of carcasses on coyote activation and visitation rates. Three CLODs were placed at each location at equal distances from the carcass. Selection of CLOD locations was determined a priori and randomly assigned to one of the 2-week sessions. CLOD locations were spaced uniformly throughout the RMA, and carcasses placed at every other station following a random assignment for the first station. CLODs were scented with 0.3cc of lure

(Carman's Distant Canine Call, W-U lure, and Fatty Acid Scent), and lure placement was randomized.

Capture and Marking

Woodstream Softcatch® traps (Linhart et al. 1986) with attached tranquilizer tabs (Balser 1965) were used to capture badgers and coyotes. Snares designed for live capture of coyotes also were utilized (Nellis 1968). Badgers received an injection of Ketamine hydrochloride before handling. Data recorded on captured animals included sex, age (determined from tooth wear and extraction of a premolar) (Linhart and Knowlton 1967, Crowe and Strickland 1975), weight, and a description of general condition. Coyotes were fitted with ear tags and transmitters attached to colored collars to permit visual identification. Males were equipped with orange collars and red ear-tags and females with yellow collars and yellow ear-tags. Selected badgers received an abdominal radio transmitter implant. All badgers were fitted with an ear tag to permit future identification. The ear tag was attached to the right ear of males and the left ear of females.

Radiotelemetry Testing

The accuracy and precision of the radiotelemetry system (Table 1) was determined by replicating bearings on radio transmitters placed at surveyed points on the RMA. Programs from White and Garrott (1990) were

used in generating these data. A stacked four-element (vehicle) and ten-element (towers) dual-Yagi antenna array using the null system was used. Precision is reported as the standard deviation of bearing errors and confidence ellipses (Lenth 1981) in relation to straight-line distances from permanent towers, for a short-range (mean 0.8 km) and long range (mean 2.6 km) vehicle-mounted antenna system. Bearing error, and confidence ellipses were calculated to determine system accuracy. Bearing errors > 10° was classified as signal bounce and excluded from calculations (Lee et al. 1985). Transmitters were placed on the ground in an upright position in a variety of habitat types, terrain, and at varying distances from the receiver. Bearings were recorded to the nearest 0.5 degree. Towers utilized known azimuths to beacons to calibrate the compass rosette. Bearings from the vehicle-mounted system were estimated by sighting down one of the antenna arrays with a hand-held Suunto compass. Only one eye was used to read the bearing from the compass to eliminate parallax. Replicate bearings were taken on each transmitter with independence assured by turning the antenna before relocating the transmitter, and by covering the compass rosette before locating the transmitters.

Coyote Activity In Relation To Deer Carcass Placement

Coyote activity in relation to deer carcass placement will be investigated by monitoring collared individuals. There will be a total

of 4 monitoring sessions each consisting of a 3-week tracking schedule. During session 1 (pre-pre-treatment), home ranges, activity patterns, and locations for future carcass placements will be established. Session 2 (pre-treatment) will establish baseline use of carcass sites by coyotes before carcasses are placed. Session 3 (treatment) will determine use of carcass sites by coyotes. Session 4 (post-treatment) will determine use of carcass sites by coyotes after removal of carcasses. Home range estimates for coyotes on the RMA calculated during session 1 will determine the location for the placement of the deer carrion station. Additionally, determining activity patterns during session 1 will focus monitoring during times of peak coyote activity. Activity will be determined by comparing average straight line distances moved between sequential hourly locations obtained during tracking sessions (Andelt 1985). Nine weeks of monitoring, 3 weeks pre-treatment, session 2; 3 weeks treatment, session 3; and 3 weeks post-treatment, session 4; will determine the effect of deer carrion on coyote movements.

A circular area with a 150 meter radius which contains little or no coyote locations, but within the estimated home range, will be chosen for the carcass site. Coyotes located within 150 meters of the deer carcass will be considered a visit to the carcass. By choosing an area of low activity, we anticipate coyotes will increase the proportion of locations within 150 meters of the carcass site. Coyote visitation at carcass sites will be determined using a remote radiotelemetry data logger with an

attached receiver stationed at a carcass site, and moved at 3 day intervals to other carcass locations. Additionally, the researcher will simultaneously monitor 1 carcass site to record coyote visits using the vehicle-mounted antenna system. Monitoring of carcass stations will be randomized with an equal number of remote and man-operated data recorder nights at carcass locations, which will allow nightly monitoring of 2 carcass sites for visitations from collared animals. Road-killed deer will be used to determine the effect of deer carcasses on coyote movements. A carcass will be added to the site when approximately one half of the carcass remains. Daily visual inspection of the carcasses with a spotting scope will detect consumption of carcasses, without disturbing the area. Deer remains will be collected from the station at the conclusion of the 3 week carcass (session 3) monitoring period. Fidelity exhibited by coyotes to areas associated with deer carcasses will be determined by comparing pre-treatment (session 2), treatment (session 3), and post-treatment (session 4) data. Placement of carcasses will be influenced by distribution of radio collared coyotes, topography, and radiotelemetry shortfalls.

Density Estimation

Coyote densities will be estimated from visual observations of collared and uncollared coyotes (Lincoln-Petersen Index/Mark-Resight). The researcher will systematically survey the RMA during 2 to 3 hour

periods following sunrise. Surveys will be attempted on 12 to 15 snow-covered mornings, to aid sightings. Section roads will be followed starting in the southeast corner of the RMA and traveling northwards. Routes will be alternated from north-south to east-west routes during surveys on different days and driving speeds will be similar. Marked and unmarked coyotes will be identified by using a spotting scope and/or binoculars. Number of coyotes and direction of travel will be noted to help avoid recounts. Sightability will be field tested a priori to determine accuracy in assessing marked individuals. Field testing will consist of identifying marked and unmarked coyotes with a spotting scope and/or binoculars, and verifying with a scanning radiotelemetry receiver. Closure will be ensured using radiotelemetry equipment, immediately following the survey, to assess the number of animals contained in the study area, and subject to resighting. These data can be used in program NOREMARK (White pers. comm.) to estimate the number of coyotes on the RMA.

Badgers

Badgers also will be monitored to develop activity patterns and home range estimates for baseline information. Implanted animals will be monitored in relation to deer carcasses following the methods described above for coyotes if time permits.

RESULTS

Coyote Lure Operative Device

The CLOD experiment was run for 14 nights, with 7 nights per session and 30 sites for CLOD placement (15 carcass, 15 non-carcass) each session. Locations were moved after the first week, for a total of 60 different sites over a 2 week period during the month of June. The experiment had a total of 1260 CLOD nights, with only 3 CLOD activations. The number of activations were not sufficient to employ serum analysis of blood and U-V microscopy of lower premolars from captured coyotes to determine the proportion of coyotes ingesting CLOD solutions.

The modified survey scent station technique, used with CLOD placement, allowed detection of prints to differentiate visitations by species. Coyote visitation rates will be analyzed for differences between lures and to determine if visitation rates near and away from carcass stations differ. Data points will involve comparing 60 lure nights of each lure by summing across the 7 nights per session to generate 1 data point per station per week per lure.

Capture and Marking

A total of 3417 trap nights were run between 7 July and 30 November. Fourteen coyotes and 19 badgers were captured with padded leghold traps. Two badgers were captured using live snares. All coyotes were equipped with radio transmitter collars and 10 badgers received

abdominal radio transmitter implants. One coyote and 1 implanted badger were killed by vehicles off the study site. Additionally, 1 implanted badger died on the study site. The badger was probably killed by coyotes.

DISCUSSION

The number of CLOD activations by coyotes on the RMA suggests this device is an inefficient vector for delivering oral baits to coyotes during the interval tested. The low number of activations did not permit analysis on the affect of deer carcasses on activation rates. However, future analysis of coyote visitation rates will determine if coyotes are attracted to deer carcasses.

We chose to utilize the vehicle-mounted antenna system to monitor animals on the RMA due to accuracy achieved during field testing (Table 1). This system will allow the home range estimates, activity patterns, and deer carcass monitoring objectives to be achieved.

OTHER ACTIVITIES THIS PERIOD

1. Finalized research proposal.
2. Adjusted and prepared traps for trapping.
3. Assembled tranquilizer tabs.
4. Assembled CLODs.

PLANS FOR NEXT PERIOD

1. Analyze CLOD data for visitation rates.
2. Develop home range and activity patterns for coyotes and badgers.
3. Monitor coyotes in relation to deer carcass bait stations.
4. Determine coyote density on the RMA.

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Table 1. Results of radiotelemetry testing on the Rocky Mountain Arsenal, Colorado.

System	N	Minimum	Maximum	Mean	SD
Distance from transmitter to receiver (m).					
long-range	20	501.68	4934.83	2642.29	1379.54
short-range	24	161.76	1623.54	808.03	392.20
tower	138	1,166.95	7,092.87	3,667.88	1,381.47
Difference between true and estimated bearing (degrees).					
long-range	57	-9.36°	4.45°	-0.75°	3.18°
short-range	120	-4.17°	2.61°	-0.91°	1.15°
tower 35	60	-3.84°	6.18°	-0.11°	1.91°
tower 7	50	-8.80°	3.45°	-0.94°	3.88°
Size of confidence ellipse surrounding location estimate (m^2).					
long-range	15	51,119.14	440,518.59	194,085.50	130147.07
short-range	30	647.05	3,329.63	1,578.65	876.99
tower	59	264,012.55	1,532,083.42	662,657.43	356,837.43

ASPECTS OF NEST SITE SELECTION AND HABITAT USE BY BURROWING OWLS AT THE ROCKY MOUNTAIN ARSENAL, COLORADO

By

David L. Plumpton

FY 1990 Annual Progress Report

REPORT SUMMARY

Fieldwork began in April, 1990, on a 2-year study of burrowing owl use of the Rocky Mountain Arsenal (RMA). The objectives were:

1) To determine burrowing owl abundance on the RMA.
2) To locate areas on the RMA used by burrowing owls, and to quantify habitat variables in occupied and non-occupied habitats.
3) To determine the behaviors, productivity, growth rates, and food habits of burrowing owls at the RMA.
4) To determine differences in behavior, productivity, and density between burrowing owl populations subjected to various management treatments.

OBJECTIVE 1:

Through 1990, 31 burrows were occupied, 25 by mated pairs. All activity occurred north of 7th Avenue. Marked burrows will be used to examine breeding pair and burrow fidelity, as well as pioneering to natal site in 1991 by 1990 young. Burrowing owls occupied the RMA from 2 April to 27 November in 1990.

OBJECTIVE 2:

Physiographic and vegetative habitat variables were measured in areas occupied by burrowing owls, and tested for significance against "potential" habitat, to identify specific habitat requirements. Owls tended to select burrows in greater forb cover, shorter grass height, and greater burrow availability.

OBJECTIVE 3:

Behavioral data were collected from 19 pairs of adult burrowing owls in part to understand the potential effect of human disturbance to nesting burrowing owls. A total of 249 behavioral observation periods, totaling over 62 hours, were conducted. Twenty pairs fledged 109 young. Food habits were studied to determine the species preyed upon at the RMA.

OBJECTIVE 4:

An understanding of the potential effect of local disturbances on nesting burrowing owls was monitored by a combination of behavioral, dietary, habitat, and reproductive studies. Baseline data were collected which will aid in identifying post-cleanup changes in burrowing owl use of the RMA.

PROGRESS REPORT

FOR

ASPECTS OF NEST SITE SELECTION AND HABITAT USE BY BURROWING OWLS AT THE ROCKY MOUNTAIN ARSENAL, COLORADO

submitted by:

David L. Plumpton

December, 1990

Introduction

In April, 1990, work was begun on a study of the habits of the burrowing owl (*Athene cunicularia*) at the Rocky Mountain Arsenal (RMA). The following report summarizes field data collected from 1 April to 20 August, 1990, in the first season of a 2-year study. The objectives of the study were:

1) To determine burrowing owl abundance on the RMA.

2) To locate areas on the RMA used by burrowing owls, and quantify habitat variables in occupied and non-occupied habitats.

3) To determine the behaviors, productivity, growth rates, and food habits of burrowing owls breeding on the RMA.

4) To determine differences in behavior, productivity and density between burrowing owl populations subjected to various management treatments.

To summarize field work and data analyses completed to date, each objective will be addressed by presenting field results, preliminary analysis of data, and any changes intended for the second year of data collection.

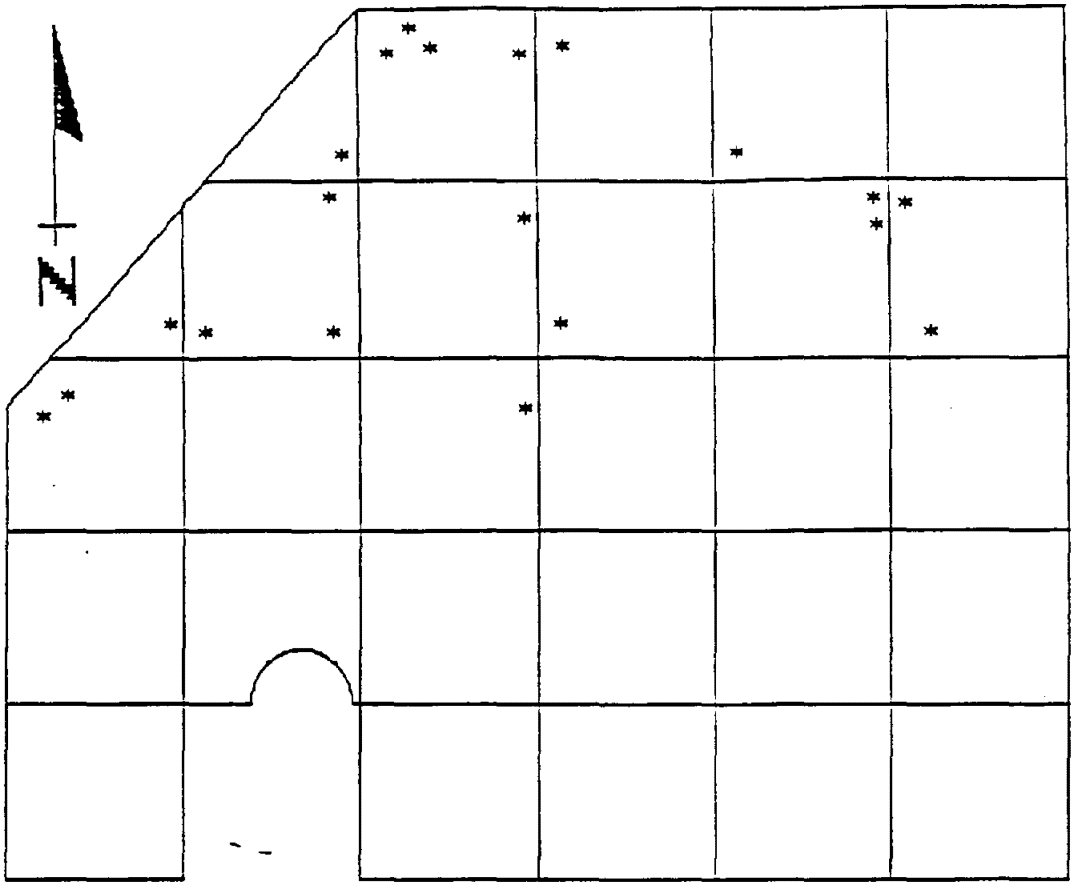
OBJECTIVE 1

In 1990, burrowing owls were first spotted at the RMA on 2 April. Following this time, repeated searches by vehicle were made to identify and mark burrows occupied by owls. Searches were also conducted on foot to locate prairie dog towns within each section. Each burrow was then inspected for signs of use by owls.

Thirty-one occupied burrows were found; 25 were used by mated pairs of owls. Twenty burrows housed reproductively successful pairs (Figure 1.1).

In 1991, prior to the owls' migration to the RMA, I plan to inspect all burrows used in 1990. Since burrowing owls often reuse burrows in successive years, this will provide information on burrow selection based on presence or absence of prairie dogs at the time the birds arrive. Information on pair and burrow

Figure 1.1. Location of burrowing owl activity on the RMA, Colorado, 1990.



* Pair successfully fledged young

fidelity will be gained from recoveries of birds banded in 1990. Data on natal site reuse by burrowing owls will aid in future habitat-alteration decisions. Burrowing owls occupied the RMA from 1 April through 27 November, 1990. This period of residency exceeds the historic record for the species.

OBJECTIVE 2

Vegetation and physiographic data from occupied burrows were compared using paired t-tests with data from burrows unoccupied by burrowing owls within active prairie dog towns (Table 2.1).

Overall, burrowing owls were non-selective of microhabitat features within the habitat defined by prairie dogs. However, burrowing owls tended to occupy burrows in areas with greater ($P < 0.05$) burrow density and percent forb cover, and shorter ($P < 0.001$) grass height than unoccupied burrows. This suggests that burrowing owls select early successional habitats, and would likely respond favorably to habitat disturbances that maintain disclimax, and which do not eradicate prairie dogs or destroy burrows. For example, burrowing owls occupied areas on the RMA where prairie dog burrows existed, and vegetation levels were artificially maintained by mowing.

Table 2.1. Vegetative and physiographic differences in burrows occupied by burrowing owls and randomly selected, non-occupied control burrows at the RMA, Colorado, 1990.

Measurement	Occupied (Mean +- SE)		Control (Mean +- SE)	
Bearing	175	22	212	21
Burrow Density	27.2	1.9[a]	21.7	1.5[a]
Distance to Perch (m)	12.8	2.1	8.2	1.3
Tunnel Convolution (cm)	80.4	5.2	77.2	4.7
Forb Cover (%)	2.6	0.09[a]	2.2	0.08[a]
Grass Cover (%)	1.1	0.1	1.2	0.09
Bare Ground (%)	6.3	0.1	6.5	0.1
Grass Height (cm)	6.9	0.5[b]	9.4	0.4[b]
Forb Height (cm)	6.8	0.3	6.8	0.2

[a] Significant at $P < 0.05$.
[b] Significant at $P < 0.0005$.

OBJECTIVE 3

Behavioral data were collected from adult owls marked at the RMA. Instantaneous behavior sampling was used, and behaviors were recorded as feeding, locomotion, resting, comfort, courtship, alert, agonistic, and out-of-sight. When compared using t-tests, burrowing owls show no differences in behavior based on sex (Table 3.1). Owls equipped with radio telemetry packages had significant ($P < 0.005$) differences in 2 of 8 behaviors. Burrowing owls equipped with telemetry packages spent less time alert, and a greater amount of time out of sight of the burrow. Although not statistically significant, radio-equipped owls also spent less time feeding, in locomotion, and resting, and greater amounts of time engaged in comfort activities. It is possible that the increased expression of any one behavior sacrifices time spent in other required behaviors. These behavior modifications may be made to the detriment of the individual.

Table 3.1. Mean percentage of instantaneous behavioral events of burrowing owls (n=19 pairs) by sex and radio instrumentation at the RMA, Colorado, 1990.

	Sex		Transmitter	
Behavior	Male	Female	Collared	Non-Collared
Feeding	.099	.231	.102	.201
Locomotion	.576	.950	.512	.902
Resting	4.56	3.04	2.32	4.51
Comfort	1.47	2.17	2.17	1.66
Courtship	0.00	0.00	0.00	0.00
Alert	35.0	39.4	26.9[a]	42.5[a]
Agonistic	.045	.115	.038	.103
Out Of Sight	58.2	54.0	67.8[a]	50.0[a]

[a] Significant at ($P < 0.005$).

The effect of radio transmitters on productivity and survival of young was tested using paired t-tests. Mean brood size was significantly ($P < 0.005$) smaller for radio instrumented owls (mean=4.3) than non-equipped owls (mean=5.3).

In 1991, behavioral sampling will begin when sufficient pairs have been marked to provide an adequate sample size. In 1990, equipment delays forced a delay in trapping and marking adult owls, and behavioral data collection began after courtship behaviors were no longer exhibited. In 1991, trapping will begin with the owls' arrival to the RMA.

Productivity estimates were made from data gathered during behavioral observations. Twenty-two known pairs attempted nesting, and 20 pairs successfully fledged young. In 1990, 109 owlets fledged, and the average brood size was 4.9 (range: 3-11). Productivity estimates will be compared to published data.

Repeated captures of adults and juveniles were used to collect data on changes in body condition and growth rates, respectively. Growth rates from RMA juveniles will be compared to growth data from a theoretically contamination-free population of burrowing owls. Adult wings, tails, and tarsi were measured, and body weights were taken to distinguish any sexual size dimorphism; only tarsometatarsus length was significantly different ($P < 0.05$) (Table 3.2.). Males had longer tarsometatarsi than females ($P = 0.0007$).

Table 3.2. Morphological measurements of adult burrowing owls at the RMA, Colorado, 1990.

Measurement	Male			Female		
	N	Mean	SE	N	Mean	SE
Weight (g)	21	144	2.8	20	145	5.6
Tail (mm)	21	80.2	0.8	20	77	1.5
Wing (mm)	21	161	1.8	20	158	1.9
Tarso. (mm)	21	53.6	0.6[a]	19	50.7	0.4[a]

[a] Significant at $P < 0.001$.

Food habits were studied by collection and analysis of regurgitated castings, recording of prey remains found at the burrow (Table 3.3), visual observation of prey deliveries to the burrow, and from stomach contents of burrowing owls killed on roads or collected at the RMA. To determine whether owls were selecting specific arthropods or were consuming them on the basis of availability, relative abundances of ground-dwelling arthropods were studied in the area of occupied owl burrows. These relative abundance data were then contrasted to insect fragments found in castings or as prey remains to determine degree of selection exhibited by foraging burrowing owls. To date, casting analysis is 40% completed. Reference collections of mammalian skeletons and arthropods common in burrowing owl diets have been assembled. The total number of prey individuals, the number of prey species taken, and the estimated percent composition in castings will be derived via casting analysis. Casting analysis will be completed by March, 1991.

Table 3.3. Food habits of burrowing owls based on analysis of prey remains found during biweekly searches 14 June-9 August, 1990, at the RMA, Colorado, 1990.

Prey Item	N	%N
Vertebrates		
Rodentia		
Peromyscus maniculatus	40	75
Spermophilus tridecemlineatus	1	1.9
Cynomys ludovicianus	1	1.9
Passeriformes		
Sturnella spp.	2	3.8
Salientia		
Scaphiopus spp.	1	1.9
subtotal	45	84.5
Invertebrates		
Coleoptera		
Tenebrionidae	2	3.8
Silphidae	2	3.8
Orthoptera		
Acrididae	1	1.9
Lepidoptera		
Miller's moth Saturniidae (*Antheraea polyphemus*)	1	1.9
subtotal	8	15.2
Total:	53	100

OBJECTIVE 4

This objective was included to address the unforeseeable habitat alterations that could potentially occur within burrowing owl habitats on the RMA. Two habitat disturbances in 1990 occurred near or on occupied owl burrows. Early in the reproductive season, a clay borrow pit was established in the SW corner of section 27. The area was within 50 m of an occupied

owl burrow. The pair fledged 3 young. In the NE corner of section 30, an area was soil-saved and seeded. An occupied owl burrow within this area remained active, and the pair successfully fledged 5 young.

Although limited to these 2 instances, it would seem that habitat disturbances which do not destroy or fill burrows do not severely impact burrowing owls. However, road grading activities in 1989 were known to fill in several burrows used by breeding owl pairs, which were not reclaimed by prairie dogs. These formerly used areas went unused by burrowing owls in 1990. This demonstrates the importance of maintaining areas historically used by breeding burrowing owls.

MOVEMENTS, COVER SELECTION, AND NESTING OF RING-NECKED PHEASANTS AT THE ROCKY MOUNTAIN ARSENAL

By

David Plumpton

Progress Report, 1 January to 31 March, 1990

QUARTERLY REPORT

For work done from 1 January to 31 March, 1990

on the study:

Movements, Cover Selection, and Nesting

of Ring-Necked Pheasants

at the Rocky Mountain Arsenal, Colorado

Submitted by:

Dave Plumpton

The Rocky Mountain Arsenal (RMA) is currently undergoing extensive environmental cleanup. The potential impacts from this cleanup may cause significant modification to the existing habitat at the RMA, and these habitat alterations will affect the wildlife inhabiting the area. This report is intended summarize fieldwork and efforts in the attempted first phase of this project until its termination in March, 1990.

In January, 1990, a study was begun of the general ecology of the ring-necked pheasant on the RMA. The primary objectives of this study were:

1) To determine cover types and home ranges used by hen ring-necked pheasants during nesting, brood rearing, and winter seasons.

2) To monitor the response of pheasants to cover-type alterations that result from Rocky Mountain Arsenal cleanup activities.

3) To estimate pheasant numbers on the Arsenal.

STUDY AREA

The RMA is located in southcentral Adams County, Colorado, 16 km northeast of downtown Denver. The land encompasses 6,900 ha, and is administered by the United States Army.

METHODS

Sixty pheasants were to be captured and equipped with radio transmitters to study movement and habitat use on the RMA. Initial capture attempts were made with baited walk-in traps (W. Snyder, Colorado Division of Wildlife, pers. comm.), and by night-lighting (Drewien et al. 1967, Labisky 1968). Due to the inefficiency of these trapping methods, the attempt was made to capture pheasants using a Coda net gun over trained pointing dogs, drive traps, baited rocket nets, mist nets, noose carpets, and net-gunning from stands.

RESULTS

One hen pheasant was captured by hand-netting with a trained pointing dog, but this bird died when bitten by the dog. Five cocks were captured in bait traps. All were radio instrumented and released. Shortly after release, rooster number 5 was eaten by a coyote. No birds were captured by any other trapping method.

DISCUSSION

The mild climate during the winter of 1989/1990 contributed to the inefficiency of the bait traps (W. Snyder, pers. comm.), and extremely low pheasant numbers across the RMA made trapping by any other means extremely inefficient. The decision to terminate this project was reached in March 1990, as sample size

was insufficient to produce a valid research product.

PLANS FOR NEXT QUARTER

The months of April through June will be spent proposing, planning, funding, and initiating a study of burrowing owl ecology on the RMA. Funds remaining from the pheasant study will be requested for the burrowing owl study.

RESEARCH BUDGET

COSTS:	1989 9/1-12/31	1990 1/1-12/31	1991 1/1-9/1
PERSONNEL:			
research assistant	1,912.00	7,650.00	5,737.00
secretarial	550.00		500.00
secretarial (Wright)	1,000.00		1,000.00
secretarial benefits	300.00		300.00
technician		3,600.00	3,600.00
TELEMETRY:			
Lockhart telemetry	4,300.00		
receiver	1,475.00		
transmitters	15,372.90		
antenna	95.00		
headset	145.00		
computer	2,700.89		
owl transmitters		7,960.00	
SUPPLIES			
motorcycle helmet	20.00		
backpack frame	85.95		
generator	375.00		
power transformer	32.00		
lighter adapter	7.06		
computer case	94.60		
lining for case	19.84		
spotlights	119.90		
replacement bulbs	99.95		
net handles	38.38		
ben meadows supplies	529.20		
herculite	25.90		
netting	33.02		
disks	25.62		
zenith disks	67.51		
net hoops	18.72		
postage & copying	20.00		
UPS charges	75.00		
drive netting	63.00		
film	200.00		
radio refurbishment	500.00		
fax charges	25.00		
truck mileage 1/90	175.56		
truck mileage 2/90	238.48		
truck mileage 3/90	167.42		
VID legpands		1,400.00	
spotting scope		139.95	
scope eyepiece		85.00	
window mount		20.46	
binoculars		79.95	
lit. searches		35.22	
TRAVEL			

rfare to Lubbock		293.00	
TOTAL COSTS:	30.907.80	13.613.59	11.137.00
TOTAL BUDGET:	37.500.00	45.000.00	0.00
PREVIOUS YEAR EXCESS:	0.00	6,592.20	37,978.61
OPERATING EXCESS:	6.592.20	37,978.61	26.841.61

APPENDIX B

DRAFT

IMPLEMENTATION OF THE VEGETATION MANAGEMENT PLAN FOR THE BALD EAGLE MANAGEMENT AREA OF ROCKY MOUNTAIN ARSENAL: EVALUATION OF RESULTS OF 1990

Prepared for:

U.S. Fish and Wildlife Service

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January 23, 1991

EXECUTIVE SUMMARY

In 1989, the U.S. Fish and Wildlife Service (FWS) initiated a vegetation management program at Rocky Mountain Arsenal (RMA) after receiving Army approval. The overall goal of this program is to diversify habitat and the prey base for bald eagles and other predators of the RMA ecosystem. This objective is to be achieved by restoring weedy land to a variety of prairie grassland types, restoring other areas to shrublands, and manipulating vegetation in other areas to provide structural diversity appropriate for prey species. Work is conducted under the direction of the Facilities Engineer. Standard reclamation and agricultural techniques are employed.

Although much has been learned during the two years of this program, limited success has been attained at this point. Of 14 areas at 7 major sites, goals have been achieved at only 4 areas. Success at these areas is defined by the control of weedy species, the establishment of seeded or planted species, or the modification of vegetation structure by mowing to provide appropriate habitat. Ten areas where manipulations have occurred are still dominated by weedy species which must be controlled before native prairie species can be established.

Early in each year of this program, FWS has provided a plan which includes a scope of work. This plan has incorporated the best approaches as developed by the agricultural, academic and scientific communities. Although most of the work specified was eventually completed, very few operations were conducted at the time specified. Army personnel have the expertise and most of the equipment to perform the specified tasks, however, their work load and assignments in other areas do not allow for the tasks specified to be completed at the time scheduled. The result has

been partial or no control of weedy vegetation and failed seeding. Success can be achieved only when proper methods are applied at the appropriate time.

INTRODUCTION

A vegetation management program was initiated in 1989 at Rocky Mountain Arsenal in order to diversify habitat and the prey base for bald eagles and other raptors. Design of the management plan was instigated and approved by the U.S. Fish and Wildlife Service Rocky Mountain Arsenal Field Office and submitted to the Army for approval. Work was conducted by Army grounds and maintenance personnel under the direction of the Facilities Engineer. Methods utilized to accomplish this goal included mowing vegetation, discing and other soil manipulation operations, applying herbicides, burning, seeding native species and cover crops, mulching, and planting cottonwood poles (Cooper 1988, Cooper and Mackey 1990). Manipulations occurred at seven major locations along First Creek in the Bald Eagle Management Area. These major sites were divided into sub-sites based upon the year in which operations began or location.

This report is to evaluate work which was specified for the 1990 calendar year (for details see Cooper and Mackey 1990). The results section of this report is organized by site. For each site (1 through 7) the objectives, scope of work for 1990, work actually conducted, and status is reported. The discussion section concludes the body of this report. A location map is provided as Figure 1. Appendix A provides work plans for 1989 and 1990, and the evaluation of 1989 work conducted.

It should be noted that dates reported for work conducted are approximate because Army personnel did not always communicate to FWS when work was initiated or completed. However, dates specified are based upon FWS personnel observations and do not deviate from the true date by more than a few days. It should

also be noted that there is generally a wide discrepancy between the scope of work and the actual work conducted in 1990. These differences are due to the inability of Army personnel to meet the schedule set forth in the scope of work. Although most, but not all, changes in the scope of work were discussed with FWS, the work as conducted has not achieved many of the goals.

RESULTS

SITE 1.

Objectives: The overall goal at this site is to establish sand prairie grasses, shrubs, and forbs in an area that is dominated by weedy vegetation. A secondary goal, which is essential to achieving the primary objective, is control of weedy vegetation. This site was divided into areas 1A and 1B. Area 1A was initiated in 1989, 1B in 1990.

Scope of work for area 1A: Spray Roundup herbicide in early May. Inter-seed specified seed mix with carrier into standing sorghum cover crop with grass drill equipped with coulters about May 10. Mow sorghum at a height of 8"-12" after seeding to provide mulch.

Work conducted at area 1A: Coulter implements were not obtained for the seed drill, therefore, to facilitate seeding the area was mowed close to the ground in mid-April.

The area was sprayed with a mixture of Roundup and Surflan herbicides about May 15. The rate of application was not reported to FWS. Use of Surflan, a pre-emergent herbicide that affects the ability of seeded species to germinate, was not approved by FWS. The spray pattern was very erratic and resulted

in approximately 45% of the area being missed. Weeds in areas that did not receive herbicide were mowed about May 23.

Seeding of the site began about May 24, but was not completed because the fluffy seed mix would not flow efficiently out of the seed boxes without adjustments to the drill and use of a carrier. After this initial attempt at seeding, the operator was assigned to other tasks until about June 22. Seed remained in the drill seed boxes during this time, and the seed drill was stored outside. This may have resulted in a loss of seed viability if excessive temperatures developed in the seed box. Around June 22 seeding of site 1A was again attempted and completed although similar problems were encountered in the operation. Seeding was completed only after going over the area numerous times. An additional problem with seeding occurred as a result of surface material from mowing causing the drill to ride over this material resulting in seed being deposited on the surface of the soil. Equipping the seed drill with coulters would have prevented this problem. In addition, the air temperature at this time was very hot and soil moisture was very low at the seeding depth so that seed viability may have been affected.

Status: Very few individuals of seeded species are established. Weeds, especially cheatgrass and bindweed, still dominant after two years of effort.

Scope of work for area 1B: Burn the area prior to April 1. Chisel plow the area for weed control about May 21. Shallow till (soil save, harrow, shallow disc, etc.) for weed control prior to seeding sorghum. Seed hybrid sorghum about June 20. Treat the area with herbicide in mid-August if needed.

Work conducted at area 1B: Burning was attempted around April 22, but the area was too wet at this time and the burn was not successful. The area was chiseled in mid-May. Roundup herbicide was applied around June 20. Sorghum was seeded about June 26.

Status: An excellent cover crop of sorghum was established, but weeds, especially cheatgrass, bindweed, and Canada thistle remain prevalent and a major impediment to establishment of sand prairie species. Also note that the sorghum hybrid lodged early in the fall and did not provide as good cover for wildlife as the variety of sorghum seeded the previous year in area 1A.

SITE 2.

Objectives: Modify habitat to create features attractive to jackrabbit.

Scope of work for site 2: Mow the site about April 10 and June 26. Apply wood chip mulch to shrub gardens planted in 1989. Remove protective fencing around shrubs planted in 1989.

Work conducted at site 2: The area was mowed once in mid-May.

Status: Mowed areas are providing open areas for jackrabbit foraging. Aggressive perennial grasses are competing with planted shrubs. Shrubs are growing out of protective fencing. Of the total number of shrubs planted, a high number (78%) have survived. This includes:

Species	% Survival	# Planted	# Surviving
Hawthorn	100	49	49
Chokecherry	54	50	27
Snowberry	70	68	48
Sumac	90	60	54
Total	78	227	178

SITE 3.

Objectives: Modify habitat to create features attractive to jackrabbit.

Scope of work for site 3: Evaluate area for establishment of seeded rubber rabbitbrush shrubs. Collect and plant rubber rabbitbrush seed produced by mature shrubs on site.

Work conducted at site 3: The area seeded with rubber rabbitbrush in the spring of 1989 was surveyed for shrub establishment on October 27.

Status: No rubber rabbitbrush seedlings were observed during the survey in the fall of 1990. A literature survey has been initiated to determine a strategy for successful establishment of rubber rabbitbrush at RMA.

SITE 4.

Objectives: Control of weedy vegetation and establishment of tall grass prairie species. Area 4A was initiated in 1989, area 4B in 1990.

Scope of work for site 4A: Apply Roundup herbicide about April 27 to insure that the cereal rye cover crop is killed and does not produce viable seed. Inter-seed specified seed mix without soil preparation via seed drill equipped with coulters around May 7. Mulch seeded area with tall grass prairie hay.

Work conducted at site 4A: Area 4A was mowed April 24 to prevent seed production by cereal rye. Herbicide (2,4-D) was applied in late June or early July. The area was tilled and seeded about

September 20. (Note: 50 lbs of 20-5-5-5 fertilizer was used as a carrier for the fluffy seed mix.) Mulch was applied in early November.

Status: Excellent weed control has been achieved at this site and provides an excellent potential for establishment of seeded species. No germination of seeded species was evident as of the November mulching date. Germination is expected in spring 1991.

The fluffy seed mix was a problem at this site, as at site 1A. None of the adjustments to the seed drill or use of fertilizer granules as a carrier was effective in getting seed to flow out of the drill boxes efficiently. The seeding operation was only completed after numerous passes over the area. Seed establishment will probably not be affected. However, this inefficiency is inexcusable. Seeding contractors have been seeding these types of seed mixes for decades, and do not have these efficiency problems.

Scope of work for site 4B: Burn the area in late winter or early spring. Apply Roundup in mid-May. Prepare soil for seeding in early June. Seed cereal rye cover crop in mid-June. Apply 2,4-D in mid-October if required.

Work conducted at site 4B: Burning was attempted in mid-spring, but was not successful. The area was mowed June 19. Application of Roundup was attempted about June 20, but the sprayer tank broke and the herbicide spilled over limited strips of vegetation. 2,4-D was applied on August 7. Soil at this area was prepared and seeding of a barley cover crop occurred in September.

Status: In the fall of 1990, vegetation at this area consisted of weedy species, especially cheatgrass. Some barley was emerging, but was sparse.

Although the seeded cover crop was not established at this area, cheatgrass is providing a similar function. However, absolute control of this noxious weed is essential early in the 1991 growing season to facilitate establishment of native grasses. Cheatgrass is prevalent at this site because Roundup was not applied at the correct growth stage or at the proper rate; nor were soil preparation activities conducted at the appropriate time for best weed control.

SITE 5.

Objectives: Weed control and establishment of shortgrass prairie vegetation. This site has been divided into areas 5A, 5B, and 5C based on treatments established in 1989 and 1990.

Scope of work for area 5A: Apply 2,4-D herbicide in early June and again in early October if needed.

Work conducted at area 5A: 2,4-D was applied in April.

Status: An excellent stand of native grasses including western wheatgrass, blue grama grass, and slender wheatgrass has been established in area 5A. The area is dominated by slender wheatgrass due to a mistaken seeding operation in 1989. Canada wildrye is also a component of this area although it was not included in the seed mix. Canada thistle persists as a minor component of the vegetation of the area even after many applications of herbicide.

The persistence of Canada thistle in this area even after numerous herbicide applications is a result of applying herbicides at inappropriate growth stages. Even though the occurrence of this noxious weed has been much reduced at this area, healthy, reproducing populations still exist and will again exert dominance of the area if not completely controlled.

Scope of work for area 5B: Apply Roundup in mid-April. Apply 2,4-D herbicide in mid-May if needed. Inter-seed specified seed mix with no soil preparation mid-May. Apply 2,4-D herbicide in mid-October if needed.

Work conducted at area 5B: 2,4-D was applied in late April. Soil was prepared for seeding from May 16 through May 19 and again on June 5. Seeding of the specified seed mix took place in early June.

Status: Poor establishment of seeded species, weedy vegetation dominant, considerable bare soil.

Scope of work for area 5C: Apply Roundup in mid-April. Prepare soil and seed cereal rye cover crop in mid-June. Apply 2,4-D in mid-October if needed.

Work conducted at area 5C: 2,4-D applied in late April. Area chiseled in mid-May. Soil preparation continued and the area was seeded with buckwheat as a cover crop in early June. Note: the eastern strip of this area may have been left fallow.

Status: Weedy vegetation still dominates this area. Buckwheat did not prove to be a successful cover crop. Emergence and growth was very limited and its broadleaf status precluded the

use of broadleaf herbicides to control broadleaf weeds such as Canada thistle and bindweed.

SITE 6.

Objective: Establishment of western wheatgrass. This site was divided into two areas based upon location. Area 6W is on the western side of the site, 6E on the eastern side.

Scope of work for area 6E: Limited weed control as needed.

Work conducted at area 6E: The area was mowed about May 28.

Status: An excellent stand of western wheatgrass has been established at this area, although some bare, weedy areas do remain. A considerable amount of seed was produced by established plants. In the fall, a pattern was evident in the stand, i.e., there were rectangular areas with lush vegetation. These may be the result of past land use or variation in topography that provides increased moisture.

Scope of work for area 6W: Shallow till 20 acres and seed western wheatgrass in mid-March. Apply 2,4-D mid-June.

Work conducted at area 6W: The area was mowed during the week of May 23.

Status: No western wheatgrass has been established at this site by seeding. Weeds are still dominant. Mowing may have been too short in some areas so that existing western wheatgrass was negatively impacted. Mowed western wheatgrass appeared "burned" during the hot weather that followed mowing.

SITE 7.

Objectives: Weed control and establishment of mixed-grass species. This site was divided into areas 7A and 7B based upon year of seeding. One hundred cottonwood poles were also planted at this site.

Scope of work for area 7A: Apply 2,4-D June 1 and again October 15. Replace cottonwood pole cuttings that were killed by deer.

Work conducted at area 7A: 2,4-D applied mid-May.

Status: Vegetation at this area is mostly dominated by native grasses with a few weedy types interspersed. However, there are some patchy areas dominated by weedy vegetation. Two cottonwood pole cuttings of 100 planted have survived and appear to be growing. Survival was affected by wind moving the poles thus causing damaged to below ground portions and by deer rubbing and damaging above ground portions of the poles.

Scope of work for area 7B: Apply Roundup April 18 to control cheatgrass. Prepare soil, seed native seed mix, and apply mulch prior to May 1.

Work conducted at area 7B: 2,4-D applied in late April. The area was seeded with the specified mix on May 18. Soil preparation was not conducted. Weedy vegetation may have been mowed around May 23.

Status: Poor establishment of seeded species, although there is considerable establishment of sand dropseed which is a native species that occurred on the area prior to manipulation. Cheatgrass is still a major weed problem at the area.

DISCUSSION

The goals of weed control and establishment of prairie vegetation at these sites have not been accomplished, even after two years of work at some areas. Although most of the work specified for this site was eventually completed, very few operations were conducted at the time specified. Army personnel have the expertise and most of the equipment to perform the specified tasks, however they do not have the flexibility to accomplish tasks in a timely manner. In addition, the personnel assigned to these tasks have assignments in other areas which very often are given priority and cause delays in the operations for the Bald Eagle Management Area.

It is not effective to apply herbicides when the time is available. Weed control can only be achieved if the proper herbicide is used and herbicide application coincides with the appropriate vegetation growth stage. Similar comments apply to seeding. Success for dry land seeding can be expected only when seeding is conducted at the appropriate time, with the correctly adjusted equipment. Seeding only when time is available has resulted in failure, waste of time and money, and missed opportunity.

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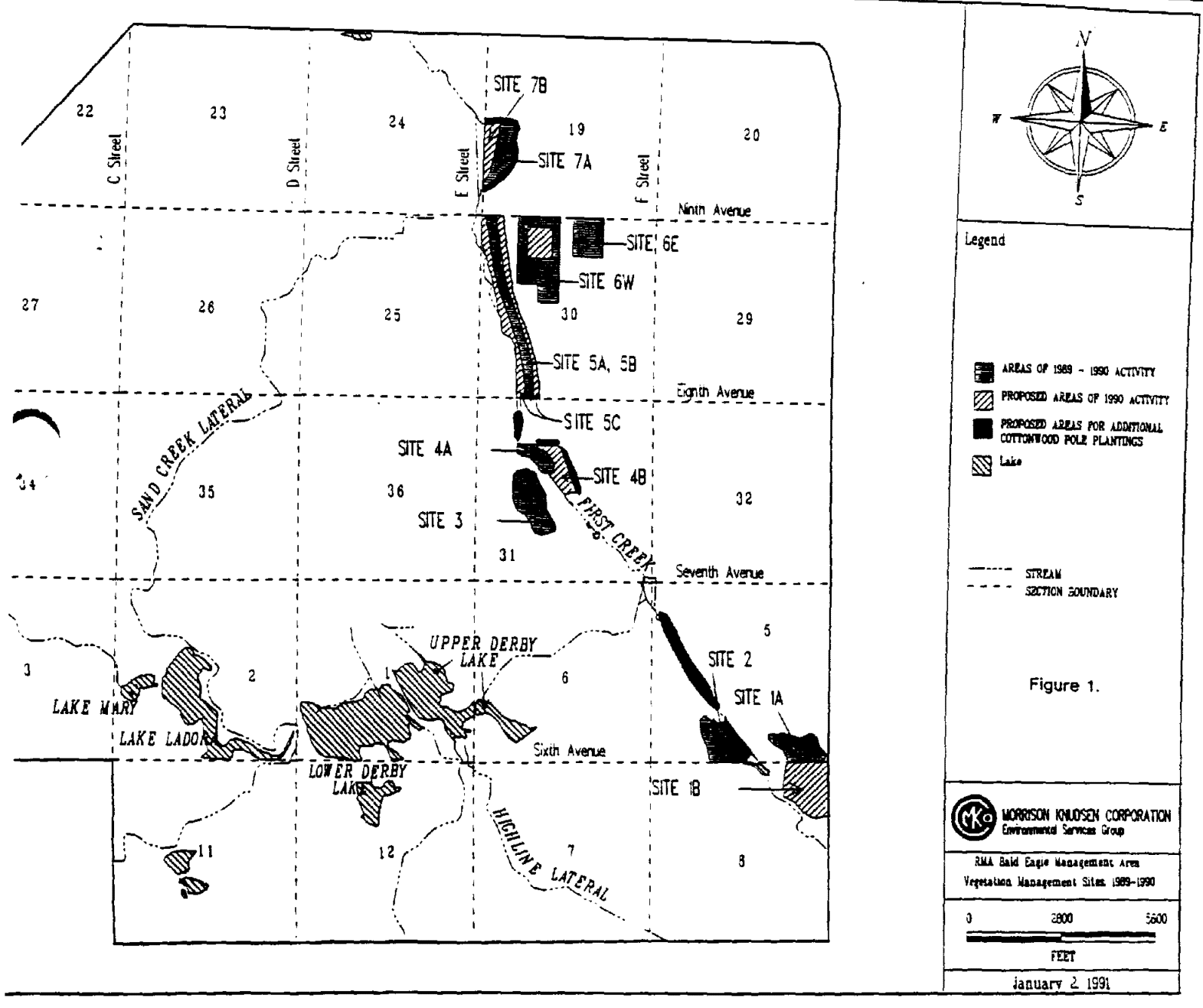

N
W
E
S

Legend

- AREAS OF 1989 - 1990 ACTIVITY
- PROPOSED AREAS OF 1990 ACTIVITY
- PROPOSED AREAS FOR ADDITIONAL COTTONWOOD POLE PLANTINGS
- Lake
- STREAM
- SECTION BOUNDARY

Figure 1.

MORRISON KNUDSEN CORPORATION
Environmental Services Group

RMA Bald Eagle Management Area
Vegetation Management Sites 1989-1990

0 2800 5600
FEET

January 2 1991